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PREFACE

Persistent organic pollutants (POPs) are a group of chemicals that are widely used in agricultural and industrial practices, as well as unintentionally released from many anthropogenic activities around the globe. POPs are characterized by persistence – the ability to resist degradation in various media (air, water, sediments, and organisms) for months and even decades; bio-accumulation - the ability to accumulate in living tissues at levels higher than those in the surrounding environment; and potential for long range transport – the potential to travel great distances from the source of release through various media (air, water, and migratory species). Specific effects of POPs can include cancer, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders, and disruption of the immune system. Some POPs are also considered to be endocrine disrupters, which, by altering the hormonal system, can damage the reproductive and immune systems of exposed individuals as well as their offspring. The ability of these toxic compounds to be transported to isolated areas of the globe, such as the Arctic, and bioaccumulate in food webs has raised concerns for the health of humans and the environment, particularly for indigenous people that rely on traditional diets of marine mammals and fish. The transboundary transport of the compounds and the international scope of their manufacture, use and unintentional releases, and the long distances to impacted populations have led to the adoption of the Stockholm Convention on Persistent Organic Pollutants in May 2001 to "protect human health and the environment from persistent organic pollutants by reducing or eliminating releases to the environment". Substances presently being addressed under the Convention are aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, PCBs PCDDs/PCDFs and toxaphene. The Convention includes a procedure to add further substances to it.

The Convention calls for the reduction or elimination of releases of persistent organic pollutants, which should translate into reduced environment levels over time. Article 16 of the Stockholm Convention stipulates that the Conference of the Parties shall evaluate the effectiveness of the Convention four years after its date of entry into force. The effectiveness of the Convention shall be evaluated on the basis of available scientific, environmental, technical and economic information, including:

Reports on monitoring of environmental levels
National reports submitted pursuant to Article 15
Non-compliance information provided pursuant to Article 17

An important component of effectiveness evaluation is the development of a global monitoring plan providing a harmonized organizational framework for the collection of comparable monitoring data or information on the presence of the persistent organic pollutants from all regions, in order to identify changes in levels over time, as well as to provide information on their regional and global environmental transport. The first report for the effectiveness evaluation will be presented at the fourth meeting of the Conference of the Parties in May 2009 and will serve as baseline for further evaluations.

The global monitoring plan is being implemented in all five United Nations Regions. This regional monitoring report is presenting the findings and describing the baseline levels in the Central and Eastern European Region including the countries of Central Asia.

ABBREVIATIONS AND ACRONYMS

ACP	Arctic Contamination Potential
ADI	Acceptable Daily Intake
ALRT	Atmospheric Long Range Transport
AMAP	Arctic Monitoring and Assessment Programme
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
APEs	Alkylphenol Ethoxylates
APOPSBAL	EU 5th Framework project "Assessment of the selected POPs in the atmosphere and water ecosystems from the waste generated by warfare in the area of former Yugoslavia"
BACCON	Baltic Chemicals Programme (BAltic States Regional Co-operation programme on Chemicals CONtrol)
BCF	Bioconcentration Factor
BHC	Benzenehexachloride
CA	Central Asia
CACs	Central Asian countries
CEE	Central and Eastern Europe
CEECs	Central and Eastern European Countries
CEP	Caspian Environment Programme
CRM	Certified Reference Material
CIS	Commonwealth of Independent States
COP	Conference of the Parties
CRLTAP	UN ECE Convention on Long-range Transboundary Air Pollution
CTD	Characteristic Travel Distance
CV	Coefficient of Variation
DANCEE	Danish Cooperation for Environment in Eastern Europe initiative
DDD /DDE	Metabolites of DDT
DDT	Dichlorodiphenyltrichloroethane
DLPCBs	Dioxin-like PCBs
EDCs	Endocrine Disrupting Chemicals
EMAN	Ecological Monitoring and Assessment Network
EMEP	European Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants
EPER	European Pollutant Emission Register
ERL	Effects Range Low
ERM	Effects Range Median
EROD	7-ethoxyresorufin-O-deethylase
EUSES	European Union System for the Evaluation of Substances
FAO	Food and Agriculture Organisation of the United Nations
FERTIMEX	Fertilizantes Mexicianos, S.A.
GAPS	Global Atmospheric Passive Sampling Survey
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GLBTS	Great Lakes Bi-national Toxics Strategy
GMP	Global Monitoring Plan
HCB	Hexachlorobenzene
HELCOM	Helsinki Commission/The Baltic Marine Environment Protection Commission
HCHs	Hexachlorocyclohexanes
HIPS	High Impact Polystyrene

HPLC	High Performance Liquid Chromatography
HRGC	High Resolution Gas Chromatography (capillary column)
HRMS	High Resolution Mass Spectrometer
HxBB	Hexabromobiphenyl
IADN	Integrated Atmospheric Deposition Network
IARC	International Agency for Research on Cancer
ICES	International Council for the Exploration of the Sea
IFCS	Intergovernmental Forum on Chemical Safety
IMO	International Maritime Organisation
INSPQ	Centre de Toxicologie du Québec
INFOCAP	Information Exchange Network on Capacity Building for the Sound Management of Chemicals
IPPC	Integrated Pollution Prevention and Control
I-TEQ	International Toxicity Equivalence
K_{AW}	Air-Water Partition Coefficient
K_{OA}	Octanol-Air Partition Coefficient
Kow	Octanol-Water Partition Coefficient
LC_{50}	Median Lethal Concentration
LD_{50}	Median Lethal Dose
LOAEL	Lowest Observable Adverse Effect Level
LOD	Limit of Detection
LOQ	Limit of Quantification
LRT	Long Range Transport
LRTAP	Long Range Transport of Air Pollutants
LRTP	Long Range Transport Potential
MDL	Minimum Detectable Level
MEDPOL	Mediterranean Pollution Monitoring and Research Programme
MEA	Multi Lateral Environmental Agreements
MONARPOP	MONitoring of POPs in Alpine region
MONET	RECETOX MOnitoring NETwork for determination of POPs in ambient air using the polyurethane foam passive sampler
MRL	Maximum Residue Limit
MSCE-East	EMEP Meteorological Synthesizing Centre-East
NAFTA	North American Free Trade Agreement
NARAPs	North American Regional Action Plans
ND	Not detected
NGOs	Non-Governmental Organisations
NHATS	National Human Adipose Tissue Survey
NIS	Newly Independent States
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observable Adverse Effect Level
NOEL	No Observable Effect Level
NWT	Northwest Territories
OCs	Organochlorines
OCPs	Organochlorine Pesticides
OECD	Organisation for Economic Co-operation and Development
OPs	Organophosphates
OSPAR	Commission for the Protection of the Marine Environment of the North-East Atlantic
PAHs	Polycyclic aromatic hydrocarbons
PAS	Passive sampler
PBDEs	Polybrominated diphenyl ethers

PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzo- *p*-dioxins
PCDFs	Polychlorinated dibenzofurans
PeCP	Pentachlorophenol
PeCB	Pentachlorobenzene
PFOS	Perfluorooctane sulfonate
PIC	Prior Informed Consent
POPs	Persistent Organic Pollutants (group of twelve as defined in the Stockholm Convention 2001)
PRTRs	Pollutant Release and Transfer Registers
PTS	Persistent Toxic Substances
PUF	Polyurethane Foam
PVC	Polyvinylchloride
QA/QC	Quality Assurance and Quality Control Regimes
REACH	Registration, Evaluation and Authorisation of Chemicals
RECETOX	Research Centre for Environmental Chemistry and Ecotoxicology, Masaryk University, Brno, Czech Republic
RENPAP	Regional Network on Pesticide Production in Asia and Pacific
ROGs	Regional Organization Groups for the Global Monitoring Plan
ROPME	Regional Organisation for the Protection of the Marine Environment
ROWA	Regional Organisation of West Asia
SAICM	Strategic Approach to International Chemicals Management
SCCPs	Short-chain chlorinated paraffins
SOP	Standard Operating Procedure
SPM	Suspended particulate matter
SPREP	South Pacific Regional Environment Programme
TBBPA	Tetrabromobisphenol A
TCDD	Tetrachlorodibenzo-p-dioxin
TEL	Tetraethyllead
TEQ	Toxicity Equivalents
TOMPS	Toxic Organic Micropollutants Survey
TPT	Triphenyltin
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
WFD	Water Framework Directive
WHO	World Health Organisation
WMO	World Meteorological Organization
XAD	Styrene/divinylbenzene-co-polymer Resin

GLOSSARY OF TERMS

Activity	Any program or other activity or project that generates data or information on the levels of POPs in the environment or in humans that can contribute to the effectiveness evaluation under Article 16 of the Stockholm Convention Core matrices These are the matrices identified by the Conference of the Parties to the Stockholm Convention at its second meeting as core for the first evaluation: A = ambient air; M = (human) mother's milk and / or B = human blood
CTD	The characteristic travel distance – defined as the "half-distance" for a substance present in a mobile phase
IL-1	Instrumentation level 1 capable to analyze PCDD/PCDF and dioxin-like PCB at ultra-trace concentrations: must be a high-resolution mass spectrometer in combination with a capillary column
IL-2	Instrumentation level capable to analyze all POPs: (capillary column and a mass-selective detector)
I L-3	Instrumentation level capable to analyze all POPs without PCDD/PCDF and dioxin like PCB (capillary column and an electron capture detector)
I L-4	Instrumentation level not capable to do congener-specific PCB analysis (no capillary column, no electron capture detector or mass selective detector)
Intercomparisons	Participation in national and international intercalibration activities such as ring-tests, laboratory performance testing schemes, etc.
LOD	Limit of detection. Definition: The lowest concentration at which a compound can be detected; it is defined as that corresponding to a signal three times the noise.
<LOD	Result below the of limit detection
LOQ	Limit of quantification. Definition: The lowest concentration that can quantitatively be determined, it is three times higher than LOD.
<LOQ	Result below limit of quantification. Compounds found at levels between LOD and LOQ can be reported as present, or possibly as being present at an estimated concentration, but in the latter case the result has to be clearly marked as being below LOQ.
MDL	Method detection limit. The MDL considers the whole method including sampling, sample treatment and instrumental analysis. It is determined by the background amounts on field blanks.
Phase I	Activities to support the Article 16 effectiveness evaluation that will be conducted by the Conference of the Parties at its fourth meeting, information collected between 2000 and 2007 (also termed as first evaluation).

EXECUTIVE SUMMARY

Based on the Decision SC-3/19, **a regional organization group for CEEC** composed of six members was established. The main objectives of the regional organization group were to define and implement the regional strategy for gathering of information, building of capacity and establishment of strategic partnerships in order to fill the identified data gaps, and to prepare the regional monitoring report as a contribution to the first effectiveness evaluation report, to be presented at the 4th Conference of the Parties in May, 2009.

According to the UN structure, the region of **Central and Eastern Europe** consists of **23 countries.** For the purpose of the first evaluation, **5 countries of the Central Asia** (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) were added to the CEE regional report.

There is **no current production** of POPs in the CEEC region. The main sources of POP pollution are obsolete and unused pesticides (including the ones with POPs properties) in agriculture, POPs-containing equipment, use of industrial technologies resulting in unintentional releases of dioxins and furans and formation of dioxins and furans in the open combustion.

Information on **pesticide production**, use, import and export in the past is incomplete in many countries of the CEE region. Although some dangerous pesticides are not used anymore, old stocks still remain in the countries. Since 1990, programs have been carried out in all countries to identify these pesticides, re-pack them and store them under safe conditions. The current amount of accumulated old stocks is still a subject of the national inventories and evaluations. Recent data are collected under National Implementation Plans of the Stockholm Convention on POPs.

Some countries of the region produced **technical mixtures of PCBs** (former Czechoslovakia, Poland, and former Soviet Union). Former industrial application of PCBs is responsible for current PCB emissions. The major sources of atmospheric contamination are evaporation from old open systems (paint and wood protecting layers, softeners), from dumping sites and waste incinerators, and from operational or dumped transformers, condensers, hydraulic systems and other PCB containing devices.

There is a **general lack of information on the levels** of POPs in the countries of Central and Eastern Europe (UNEP, 2002a). A better situation is in the Czech Republic, Slovakia, Poland, and Slovenia; satisfactory information only on the pesticide levels exists in some others, like Hungary, Bulgaria and Croatia. In the rest of the CEE countries, data available on POPs sources and levels is very limited, and there is no systematic monitoring of POPs in the environment or humans in the countries of former Yugoslavia (UNEP, 2002b) and the countries of former Soviet Union.

There is a particular **deficit in the area of dioxin measurements** (PCDDs/Fs) and human exposure studies in most countries. Available monitoring programs are mainly focused on OCPs, PCBs, in some cases also on PAHs. Monitoring of PCDDs/Fs is a rather rare (human milk in the Czech Republic); in other countries it has an episodic or research form (Croatia, Estonia, Montenegro, Poland, Russian Federation, Slovenia, Slovakia). The highest level of environmental monitoring and research activities in Central and Eastern Europe has been established in the Czech Republic with the countrywide monitoring of various environmental compartments. Lot of research related to the human exposure has been also performed in the Slovak Republic, Poland, Croatia, Hungary, Slovenia and Estonia. Some other countries have restricted their activities to specific compartments, and some of them have only started the real monitoring activities in frames of the GEF funded projects for the development of national implementation plans under the Stockholm Convention.

In conclusion, data on the **POP contamination of ambient air** in the Central and Eastern European Region is **insufficient**, and the lack of regular monitoring is a priority problem. Based on the evaluation of the

technical and financial capabilities of available local laboratories it has been concluded that they are capable of providing OCP and PCB analyses of environmental and food samples. These laboratories, however, require both financial and human resources to obtain or replace equipment, and to attract and train the skilled personnel.

The only **long-term monitoring program** focused on POPs in ambient air performed in the CEE region is the integrated monitoring program at Košetice observatory in the Czech Republic which is also a part of EMEP background monitoring. Atmospheric POPs have been measured using a **high volume active sampler** since 1988, sampling and analytical methods have been consistent since 1996. Twelve years of monitoring data from the Košetice observatory was used for an assessment of the long-term trends of POPs in ambient air at the Central European continental background. Presented results demonstrated that the long-term background monitoring is not only an excellent way to study the regional levels and trends but also a powerful tool for evaluation of the impact of various local and regional events – from industrial accidents to natural disasters. As such, this approach has a potential to play a crucial role in the implementation of regional and global measures and conventions on persistent toxic substances.

Majority of information on the POP levels in ambient air in CEEC is derived from the **passive air monitoring projects**. Model passive air monitoring network (MONET-CZ) has been developed in the Czech Republic since 2003 as a contribution to the ongoing national POPs inventory in the Czech Republic. It currently consists of 37 sampling sites, including 15 backgrounds (industrial, urban, rural, mountain) and variety of sites influenced by primary and secondary POP sources. Based on the results from this network, various aspects of the POP contamination can be addressed, from an impact of the point sources or the old burdens, through spatial or seasonal variability, to the long term trends in the background areas.

The Czech Republic is the first from the signatory countries of the Stockholm convention that offers **fully developed and functional tool** capable of providing information on the **Central European levels of POPs** and the **long-term trends** in those levels. The major advantage is availability of consistent high volume POPs monitoring data from Košetice EMEP station. This dataset with established time trends for the last twelve years can itself serve the evaluation of the future trends in the atmospheric concentration of POPs. Parallel PAS monitoring in Košetice in the last five years gives another unique calibration dataset and at the same time, a centerpiece of the PAS network in the Czech Republic.

There are other **key aspects of the MONET-CZ network**. Such well characterized region in Central Europe with the dense monitoring network provides the core element for the **spin-off projects** in other countries of Central, Southern and Eastern Europe. Since many of these countries lack not only data on the POP levels in the atmosphere but also appropriate monitoring and laboratory capacities, this aspect is very valuable.

Based on the experience from the Czech monitoring network, **MONET-CEEC project** was initiated in 2006 with the goal of building the monitoring capacity in this region. **Network of partner institutions** was established and they cooperated in designing the pilot screening study in the CEE region in 2006-2008. Transfer of know-how, educational and training activities were an important part of the MONET-CEEC project.

Sampling sites for three phases of the MONET-CEEC Project have been selected in cooperation with the local partners in all participating countries. A **background site** was included in most countries as a potential candidate of background monitoring for the effectiveness evaluation of the Stockholm Convention. Whenever possible, **gradient of other sites** (rural, urban, and industrial) was developed also to address a range of contamination, possible sources and spatial variations. Soil samples were collected from the air sampling sites as a part of the study.

The results revealed **great differences between the POP levels in the individual countries**. While the highest median levels of studied POPs were found in Southern Europe and Russia, the lowest values were measured in Central Europe and the Baltic countries.

Median **PCB concentrations** in the air samples were highest in Bosnia and Herzegovina, Romania, Serbia, Montenegro and Russia. Generally, the sites in Central Europe (the Czech Republic, Poland and Hungary) demonstrated significantly lower concentrations (20-50%) than those in Southern and Eastern Europe. Wastes, storages of used equipment, contaminated buildings and soils must be responsible for high ambient air levels in this region.
When looking at background sites, higher PCB concentrations were measured in Serbia, Croatia, Montenegro, Bosnia and Herzegovina which is the area of the was damage. Elevated PCB level was also found in Russia where it is connected to the industrial contamination. All EMEP stations had very low contamination.

Air samples from the industrial sites in Romania and Russia had extremely high **levels of HCHs**. Median level in this set of samples was one order of magnitude higher than those in other countries. Air samples from Serbia, Macedonia, the Czech Republic or Moldova also varied widely in HCH concentrations.
Elevated median levels of HCHs at the background sites were observed in Romania, Moldova, Serbia, Hungary and Montenegro. They were probably connected to the old burdens from production and improper storage of pesticides in these countries. Lowest concentrations were determined in Estonia, Poland, Croatia and Slovenia.

Median **atmospheric concentration of DDTs** was highest in Romania and Moldova while it was an order of magnitude lower in the Montenegro or Croatia and 5 times lower in the Czech Republic, Slovenia or Poland.
DDT levels at background sites were also highest in Moldova and Romania, but in Bulgaria, Hungary or the Czech Republic they were elevated as well.

Atmospheric levels of HCB were found to be quite uniform in the Central and Eastern European region with the exception of Russia. Extremely high HCB concentration was found at some hot spots in the Czech Republic, all the other maxima varied within the factor of two.
Bosnia and Herzegovina, but also the EMEP station Košetice had higher HCB concentrations than all the others backgrounds.

Air samples from Romania, Montenegro, Russia, and Bosnia and Herzegovina had the highest median **concentrations of PAHs**, possibly due to the selection of industrial sites.
Romania and Montenegro had both very high PAH concentrations also for the backgrounds. On the contrary, all EMEP stations had low and comparable median PAH levels.

Although these results are, of course, not representative for all countries, they give a very **good starting point for establishment of continuous and coordinated background POP monitoring in the CEE region**. We can conclude that passive sampling technique is fully applicable in the long term monitoring projects and capable to fulfill the tasks of determination of levels of POPs in the ambient air, evaluation of the spatial and temporal trends in distribution of POPs, impact evaluation of point and diffusive sources, and assessment of the short- and long-range transport of POPs. All of these are important in the process of establishment of relevant arrangements for the effectiveness evaluation of the international conventions and fulfilling the international obligations of the Czech Republic.

Out of **28 countries** of to the Central and Eastern European Region, certain amount of data on the **POPs levels in human milk or blood** collected in the period of 1998 – 2008 are available from **11 countries**:

Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Ukraine, and Uzbekistan.

Countries such as Bulgaria, Croatia, Czech Republic, Hungary, Romania, Russia, Slovakia, and Ukraine participated in the 3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk. Within this study, organochlorine pesticides (chlordane, DDT, dieldrin, endrin, heptachlor, HCB, and toxaphene) were also determined in human milk samples from Bulgaria, Czech Republic, Russia, and Ukraine. The Czech Republic, Hungary and Slovakia participated also in the 4th round. Although only several tens of human milk samples had been collected in each participating country and the samples were pooled to several samples, the results of these studies are often the only comparable data on POPs levels in the region.

Except for the Czech Republic, **no systematic and regular human biomonitoring** of POPs has been performed in the Central and Eastern European countries since 1998. With regards to dioxins, dl-PCBs and marker PCBs, the 3rd and 4th round of WHO-coordinated exposure studies have given the most reliable results because, in spite of a small number of milk samples, the samples were collected, stored and shipped according to a WHO protocol and pooled samples were analyzed by the same laboratory meeting the strict QA/QC criteria. The highest marker PCB levels were found in milk samples collected from the Czech Republic and Slovakia both in the 3rd round and the 4th one. Surprisingly, the highest dioxin-like PCBs expressed as WHO_{98} TEQ were found in milk samples from Ukraine although marker PCB levels were several times lower than those in samples from the Czech Republic and Slovakia

Other CEE countries such as Azerbaijan, Georgia, Lithuania, Moldova and Tajikistan are participating in the UNEP/WHO human milk survey being performed in the second half of 2008. Results are expected in autumn of 2009. Thus, no data on the POPs levels in human milk or maternal blood have been available for the purpose of this report from 12 out of 28 countries of the CEE region (Albania, Armenia, Belarus, Bosna-Herzegovina, Estonia, Kazakhstan, Kyrgyzstan, Macedonia, Montenegro, Serbia, Slovenia, and Turkmenistan).

To conclude, the **background station in Košetice**, Czech Republic with fully developed system of the integrated monitoring and established trends of the atmospheric POPs in the last decade should serve as a regional air **monitoring superstation** using both, the active and passive sampling.

Košetice is the only station worldwide which serves the purpose of the **three major air monitoring programs generating POPs data for the GMP**: EMEP, MONET and GAPS. The high volume samplers from the EMEP program have been employed side by side with the PUF passive samplers from the MONET project as well as both (PUF and XAD) PAS samplers from the GAPS project since 2005. The fact that it can serve as an intercalibration site for all three large-scale monitoring projects makes Košetice station quite unique and very valuable.

Having the Košetice station as a superstation in the center of the region, **greater spatial and temporal resolution of data** can be achieved by deployment of passive samplers and establishment of the **PAS monitoring network in CEE region**. This network must be based on the results of three phases of the MONET-CEEC project.

Based on this report, one **background site** suitable for the continuous POP monitoring **should be selected** in each country in cooperation with local authorities. **CEE regional background monitoring network** consisting of selected sites can be **initialized in January, 2009**, supported from the budget of the Central and Eastern European POPs Centre, RECETOX and national sources. All local partners participating in the pilot phases are encouraged to continue this cooperation and take the necessary responsibility in the long-term project. They are also encouraged to use this opportunity to establish their **national monitoring**

studies as a spin-off activity. MONET-CEEC background network can serve as a backbone to which the national PAS monitoring projects can be attached. This way, it will also serve the purpose of the **capacity building** in the CEE region. The local laboratories can collect and analyze duplicate samples from the MONET-CEEC sites to ensure the **comparability of their results**. **Intercalibration study** can be organized by RECETOX if needed. Capacities of the RECETOX laboratories are available for the **training courses and the transfer of knowledge**.
RECETOX **Summer School in Environmental Chemistry and Ecotoxicology** is another platform that can be exploited for this purpose.

1 OBJECTIVES OF THE REPORT

1.1 Introduction

The **Stockholm Convention on Persistent Organic Pollutants** (POPs) (UNEP, 2001) entered into force on the May 17, 2004, and has currently 156 signatory parties (July 29, 2008). The main objective of the Stockholm Convention (SC) is to protect human health and the environment from persistent organic pollutants by reducing or eliminating their releases into the environment.

Parties to the Stockholm Convention are required to develop **National Implementation Plans** to demonstrate their implementation of the Convention obligations including arrangements necessary for effectiveness evaluation of adopted measures. It was agreed that mechanism providing Parties with comparable monitoring data is needed for evaluation whether the objective of SC is being reached. Although a number of regional and global monitoring programs have been established to report on the presence of POPs in the environment, there is very little previous experience with POPs monitoring designed to help to evaluate the effectiveness of a legally binding international agreement. According to Article 16 of the Convention, its **effectiveness shall be evaluated** starting four years after the date of its entry into force, and periodically thereafter at intervals to be decided by the Conference of the Parties (COP). Each effectiveness evaluation should consist of reports and environmental monitoring information pursuant to paragraph 2 of Article 16, and national reports pursuant to Article 15 (reports on the measures taken by the Parties, and the effectiveness of those measures). For the first of these elements, the Guidance of Global monitoring was prepared and its main goal is development and implementation of the arrangements to provide comparable monitoring information on the presence of the chemicals listed in Annexes A, B and C of the Convention, as well as their regional and global environmental transport.

The objectives of the POPs **Global Monitoring Plan** are to evaluate whether the POPs actually were reduced or eliminated as requested in Articles 3 and 5 of the Convention which means that information on environmental levels of the chemicals listed in the annexes should enable detection of trends over time. Therefore focus is upon monitoring of background levels of POPs at locations not influenced by local sources. Reliable identification of trends will require that statistical evaluation is carried out on the design of each national monitoring program contributing to the Global Monitoring Plan, to ensure that it is powerful enough to detect trends in time. In order to meet the objectives of the Global Monitoring Plan (support the preparation of regional reports of comparable information on environmental background levels), the guidance must be provided on how information is to be collected, analyzed, statistically treated, and reported.

The Global Monitoring Plan should outline a strategic and cost effective approach built on existing monitoring programs to the extent possible. It has to be simple, practical, feasible and sustainable. Design has to go beyond the first monitoring report and address long-term needs for attaining appropriate representative data in all regions to achieve global coverage. Clarity of design should be promoted for the sampling activities; of expectations for standards of analytical performance and of arrangements for quality assurance/quality control (QA/QC).

Substantial geographic differences currently exist in the availability of monitoring capacity to contribute comparable data and information for the purpose of an effectiveness evaluation of the Stockholm Convention. Differences in capacity within and between regions provide opportunities for regional capacity building focused on enhancement of capability to detect the regional trends. In order to put the GMP into regional reality, capacity building and sustainability must be crucial aspects for implementation. Comprehensive regional inventory of capacities should be developed and maintained and a corresponding needs assessment conducted by the Secretariat with contributions from national Stockholm Convention focal points. Relevant regional centers could play a role in coordination efforts, and in development and maintenance of the network of databases containing monitoring information.

1.2 Definition of monitoring

A risk of irreversible changes in the terrestrial and aquatic ecosystems as well as a danger of the global climate change caused by environmental pollution was first recognized in the early 1960s. However, detection of such changes in the natural environment at regional and global levels requires **a coordinated monitoring effort** based on broad international cooperation. First international monitoring programs were introduced in the 1960s and 1970s by the international institutions (WMO, ECE, UNEP), and they focused on various environmental aspects including effects of human activities on climate change, trans-boundary transport of pollutants and exchange of chemicals between environmental compartments. **Persistent organic pollutants (POPs)**, as the substances prone to the long-range atmospheric transport and deposition in the distant regions (Wallack et al., 1998; UN ECE, 1998), are the compounds of such concern. Their global impact has been apparent since the members of this group were detected in polar regions at the levels posing risks to both wildlife (Barrie et al., 1992) and humans (Mulvad et al., 1996).

In 1992, a newly established initiative of United Nations Economic Commission for Europe (UN-ECE) had prepared a Protocol on POPs (UN ECE, 1998) with the goal to control, reduce or eliminate their discharge, emission and release. A similar program of United Nations Environment Program was introduced in cooperation with the International Forum for Chemical Safety (UNEP/IFCS) (UNEP, 2001). It has been recognized that an important step in establishment of effective control measures is the inventory of current POP concentrations in various environmental compartments, and assessment of their time trends. Determination of POP concentrations in the atmosphere, wet and dry deposition, surface water, sediment, soil, and vegetation is desirable under various geographic and climatic conditions. Such information improves our understanding of the pathways and potential effects of chemical substances, and defines specific parameters for exposure assessment. At the same time, new data sets valuable for validation of regional and global models of atmospheric transport and environmental fate are generated. A number of the sites where POPs are continuously monitored over extended time periods in several environmental compartments is, however, very limited.

1.3 Global and Regional monitoring reports objectives

1.3.1 Global Monitoring Plan of the Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants (POPs) (UNEP, 2001) entered into force on May 17, 2004. As of July 28, 2008 the Convention had 156 Parties.

The objective of the Stockholm Convention on POPs can be stated as to:

> Protect human health and the environment from persistent organic pollutants by reducing or eliminating releases to the environment.

Parties have agreed that they need a mechanism to measure whether this objective is reached. According to **Article 16 of the Convention**, its **effectiveness** shall be evaluated starting four years after the date of entry into force of the Convention and periodically thereafter at intervals to be decided by the **Conference of the Parties (COP)**. Each **effectiveness evaluation** will consist of three elements; reports and other environmental monitoring information pursuant to **paragraph 2 of Article 16**; national reports submitted pursuant to **Article 15** (i.e., reports by Parties on the measures they have taken and the effectiveness of those measure); and, non-compliance information submitted pursuant to **Article 17**. The revised Guidance Document is concerned only with the first of these elements, that is the development and implementation of arrangements to provide comparable monitoring information on the presence of the chemicals listed in **Annexes A, B and C of the Convention**, as well as their regional and global environmental transport.

The COP has decided (**Decision SC-2/13**) to complete the first effectiveness evaluation at its fourth meeting in 2009, and has agreed upon the essential modalities for the environmental monitoring component of the first evaluation. The decision included agreement to implement the elements of a global monitoring plan as proposed in an annex to that decision. It was also agreed to establish a provisional ad hoc technical working group (TWG) consisting of 15 Parties of the five United Nations regions to coordinate and oversee implementation of the plan. At that time the COP also decided upon the essential features of the GMP and requested the TWG to coordinate and oversee its implementation. One of the tasks specified by the COP was to develop guidance for data comparability taking into account the available guidance produced by UNEP Chemicals (i.e., the aforementioned 2004 edition of the "Guidance Document").

The use of the words **"reduce" or "eliminate" POPs** in **Articles 3 and 5 of the Convention** states that information on environmental levels of the chemicals listed in the annexes is intended to enable the detection of trends over time. As a result the focus is upon background levels of POPs at locations not influenced by local sources. It should, however, be noted that the word **"trend"** is used here to indicate the use of appropriate statistical methods, but does not imply the use of any particular method.

The objective of the POPs global monitoring plan can therefore be described as to:

> Provide a harmonized organizational framework for the collection of comparable monitoring data on the presence of the POPs listed in Annexes A, B and C of the Convention in order to identify trends in levels over time as well as to provide information on their regional and global environmental transport

Reports on these activities will form one of the components of information to be compiled by the Secretariat to enable periodic effectiveness evaluations of the Convention by the COP.

1.3.2 Global Monitoring Plan for the first evaluation

This is a stepwise process that begins with a **review of programs and activities at a global, regional and national level and their potential capacities** to contribute core comparable information and data (UNEP, 2007)**.** Potential programs and data are examined according to agreed criteria to ensure that data used is of a quality that would allow the comparability required by Article 16 of the Convention. The output from this work can then be examined from a geographic perspective in order to consider priorities for capacity enhancement aiming to obtain core data from all regions;

The minimum requirements for the first evaluation are that:

a) The first monitoring report will provide baselines for further evaluations;

b) Air monitoring and human exposure through human breast milk or blood would be used as core data;
c) Such comparable and representative core data should be obtained from all five regions;
d) Guidance should be provided on standardization;
e) Strategic arrangements and partnerships shall be established, including with the health sector; and
f) Reports are prepared for the Conference of the Parties summarizing and presenting the data on a regional basis.

Air monitoring and human exposure through breast milk or blood serum will be used as core media data, and comparable and representative core data should be obtained from all regions.

Data will be derived from:

a) Existing international and regional programs and activities;
b) Existing national programs and activities; and
c) National or regional arrangements and activities enhanced or initiated as a function of capacity building to address regional data gaps.

1.3.3 The objectives of the Guidance Document

In order to meet the objectives of the **GMP**, (i.e., support the preparation of reports of comparable information on environmental background levels), the monitoring program must provide guidance on, for example, how information is to be collected, analyzed, statistically treated, and reported. This guidance must also, in some cases, accommodate using existing programs and in other cases the establishment of new activities. It must also describe a harmonized regime for the preparation of monitoring reports to support the periodic evaluations of effectiveness to be undertaken by the COP. The information to be included in the first monitoring report will be heavily dependant on existing programs and here the opportunities for the **Guidance Document** to change procedures may be limited.

The objective of the Guidance Document is therefore to:

> Provide a uniform activity framework for all tasks associated with collection, assessment and reporting of environmental background levels of the POPs listed in annexes A, B, and C of the Convention in order to provide comparable information for the COP as required in paragraph 2 of Article 16.

The framework will assist programs initiated specifically for the purposes of **Article 16** and existing programs that may wish to contribute to the **Article 16** monitoring reports. In addition, the document will also be a key source of information for the comprehensive regional inventories of capacities together with the corresponding needs assessment, and the step by step capacity enhancement plan, that are to be prepared by the Secretariat at the request of the COP (**SC-2/13**). It will also help laboratories identified through the inventory building process in developing their capacity and in preparing targeted proposals for support from their government or from other donors.

The Guidance Document should be viewed as one part of a continuum of documents that inform the reader about environmental information gathering and reporting methodologies to support effectiveness evaluation. In terms of increasing complexity, this continuum includes the following: Article 16 of the Convention; decisions of the COP, including decision SC-2/13; the **Global Monitoring Plan and its Implementation Plan for the First Evaluation; the Guidance Document,** and media specific protocols on methodology.

This second edition of the Guidance Document is focused upon the requirements of preparing for the **first effectiveness evaluation in 2009**. However, the **first monitoring report** will provide information that will in the future help to indicate whether changes in environmental levels of the listed POPs can be detected. Therefore the document also looks to the future. It is intended to be a living framework, that is, one that may evolve and be elaborated over time to reflect further direction from the COP, experience gained, and emerging specific needs. The present edition draws heavily on the Global Monitoring Plan and Implementation Plan for the Global Monitoring Plan for the First Evaluation" prepared by the TWG. The most recent versions of these documents are available at:
http://www.pops.int/documents/meetings/gmptwg/default.htm

1.3.4 General principles

The framework developed by the TWG for the **GMP** closely follows the direction given in COP Decision SC2/13. This decision provides the general elements that the COP has requested should form the basis of the GMP, and from this it is possible to identify the following underlying principles.

It states that the **GMP should:**

a) Outline a strategic and cost-effective approach and build on, but not be limited to, existing and scientifically sound human health and environmental monitoring programs to the extent possible, with the aim of providing appropriate and sufficient comparable data for the effectiveness evaluation of the Convention;
b) Be practical, feasible and sustainable;
c) Be inclusive, achieve global coverage and contain at least core representative data from all regions;
d) Be designed to go beyond the first monitoring report and address long-term needs for attaining appropriate representative data in all regions;
e) Provide for supplementing data, where necessary taking into account the differences between regions and their capabilities to implement monitoring activities. Such progressive enhancement should be planned at the outset;
f) Enable phased enhancement of the ability of parties to participate in regional arrangements for producing comparable data.

Substantial geographic differences currently exist in the availability of present monitoring capacity to contribute comparable data and information for the purpose of an effectiveness evaluation of the Stockholm Convention. Therefore COP decision SC-2/13 has specified a number of tasks to identify needs and opportunities to increase participation. These generic tasks include the following:

a) That a comprehensive regional inventory of capacities should be developed and maintained and a corresponding needs assessment conducted by the Secretariat with contributions from national Stockholm Convention focal points;
b) That capacity-building for the purpose of implementing Article 16 should be guided by a plan for step-by-step capacity enhancement for Parties on a regional basis;
c) That relevant regional centers could play a role in coordination efforts;
d) That a network of databases containing monitoring information should be developed and maintained.

The needs and opportunities for capacity-building to increase participation in the global monitoring plan are to be taken into account during the implementation of **COP decision SC-2/9** on technical assistance.

In addition to the **general principles of the GMP**, a number of attributes of a **cost effective monitoring framework** focused upon the needs of **Article 16** and **decision SC-2/13** have been identified as requiring particular emphasis. They are presented here because of their potential to assist in **decision making in the regional and global context** as the program becomes operational:

- The program should strive for simplicity and, to the extent possible, build on existing programs to meet present and future needs. It should encourage plasticity, which is the ability to evolve over time in order to respond to the needs of the Convention while maintaining comparability. Plasticity is enhanced by simplicity of the original design.
- Clarity of design should be promoted for the sampling activities; of expectations for standards of analytical performance; and of arrangements for QA/QC.
- Differences in capacity within and between regions provide opportunities for regional capacity building focused to ensure a capability to detect regional trends. In order to put the GMP into regional reality, capacity building and sustainability will be a crucial aspect for implementation. Sustainability is strongly linked to both simplicity and effectiveness.
- Only the substances contained in Annexes A, B and C of the Convention are considered in the context of Article 16.
- It is essential to ensure inclusiveness and transparency in all aspects of the GMP design, conduct and reporting process without which there is a risk of lack of confidence and interest in the final reports.
- Monitoring for effectiveness evaluation (Article 16, paragraph 2) will not address: issues of compliance; preparation of dossiers for substances that may be proposed for addition to the Annexes of the Convention; hot spot detection and evaluation; or, specific issues of scientific understanding.

1.3.5 Other information sources

The basis for the Global Monitoring Program are: Article 16 of the Convention, COP Decision SC-2/13; and the Global Monitoring Plan and the Implementation Plan for the First Evaluation" prepared under the guidance of the TWG. The later two documents will evolve over time and the reader can access the most recent versions at:
http://www.pops.int/documents/meetings/gmptwg/default.htm.

In order to obtain an overview of laboratory capacity for POPs analysis worldwide, UNEP Chemicals maintains an inventory of POPs laboratories, which provides information on the technical and analytical capabilities of each laboratory so that potential partners for a POPs GMP may be identified. The title of the project is "Assessment of Existing Capacity and Capacity Building Needs to Analyze POPs in Developing Countries" and further information is available at:
http://www.chem.unep.ch/databank/Home/Welcome.aspx
and at: http://www.chem.unep.ch/pops/laboratory/default.htm

During the assessment process, the assessment teams should be able to use information derived from sources external to the GMP, providing that quality standards are not compromised. To assess the capacity of existing monitoring programs, the interim Secretariat has opened discussions with organizations such as the World Health Organization, and other data producers and providers regarding access to information. When appropriate, memoranda of agreement with such organizations have or can be developed.

Article 11 of the Convention is concerned with the conduct of research and monitoring aimed to improve the basic understanding of such characteristics as the sources, movement, fate, behavior and toxicity of POPs in the environment. Those activities which can be conducted at any level of organization (e.g. national, regional

or global) and are not restricted to the substances listed in the Convention are not formally linked to effectiveness evaluation. However it is possible that information resulting from such activity could be of assistance in the preparation of the Article 16 environmental reporting.

Article 16 does not specifically exclude non-parties from contributing information. Non-parties would be encouraged to contribute information and work that conforms to the framework described in this document, but would not be able to take part in decision making.

1.3.6 Evaluated substances

The attention of the first evaluation was focused on the substances listed in the Annexes of the Stockholm Convention (Table 1) while gathering also available information on some new POPs (hexachlorocyclohexanes, pentachlorobenzene) and on regionally very relevant pollutants such as polycyclic aromatic hydrocarbons (PAHs) which are also on the list of pollutants of the UN ECE Convention on Long-Range Transboundary Air Pollution (CRLTAP).

Table 1: Substances used for the first evaluation in the CEE region

Chemical	Parent POPs	Transformation products
Old POPs		
Aldrin	Aldrin	-
Chlordane	*cis* – *trans* chlordane	Cis- and *trans* – nonachlor, oxychlordane
DDT	4,4'-DDT; 2,4'-DDT	DDE, DDD
Dieldrin	Dieldrin	-
Endrin	Endrin	-
HCB (hexachlorobenzene)	HCB	-
Heptachlor	Heptachlor	heptachlorepoxide
Mirex	Mirex	-
Polychlorinated biphenyls (PCBs)	ΣPCB_7 (7 congeners 28, 52, 101, 118, 138, 153 and 180); PCB with TEFs (12 congeners: 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189)	-
Polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)	2,3,7,8 – substituted PCDDs/PCDFs (17 congeners)	-
Toxaphene	Congeners P26, P50, P62	-
New POPs		
Hexachlorocyclohexanes	α, β, γ, δ-isomers	
Pentachlorobenzene	Pentachlorobenzene	
Additional regionally relevant chemicals		
Polycyclic aromatic hydrocarbons	16 US EPA	

Table 2: Units to be used for reporting concentration data in all reports.

Compounds	Air/active sampling	Air/passive sampling	Human Milk and Blood	Tissues and organs of other biota
All POPs except PCDDs/PCDFs	ng m^{-3}; pg m^{-3}	ng m^{-3}; ng $filter^{-1}$	ng g^{-1} lipid	ng g^{-1} lipid
PCDDs/PCDFs	pg m^{-3}; fg m^{-3}	pg m^{-3}; pg $filter^{-1}$	pg g^{-1} lipid	pg g^{-1} lipid

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http://www.chem.unep.ch/pops/laboratory/default.htm
GMP website http://www.chem.unep.ch/gmn/default.htm
GMP workshop, 2003 http://www.chem.unep.ch/gmn/Files/popsmonprg_proc.pdf
GEF/UNEP, 2000/3 http://www.chem.unep.ch/pts/gr/Global_Report.pdf
UNEP/POPs/INC.7/20 http://www.pops.int/documents/meetings/inc7/en/7_20.pdf
UNEP/POPS/INC.7/INF/15 http://www.pops.int/documents/meetings/inc7/en/7_15.pdf
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2 PERSISTENT ORGANIC POLLUTANTS IN THE CENTRAL AND EASTERN EUROPEAN AND CENTRAL ASIAN COUNTRIES

2.1 Introduction

The evaluated region of the Central and Eastern Europe based on the UN structure includes 23 countries which are presented in the Table 3. For the first evaluation, 5 countries of the Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) were also added to the regional report.

Table 3: Countries of Central and Eastern Europe and Central Asia included to this evaluation

Central and Eastern European States			
1. Albania *	7. Croatia *	13. Lithuania *	20. Slovakia *
2. Armenia *	8. Czech Republic *	14. Montenegro	21. Slovenia *
3. Azerbaijan *	9. Estonia	15. Poland	22. The former Yugoslav Republic of Macedonia*
4. Belarus *	10. Georgia	16. Republic of Moldova *	
5. Bosnia and Herzegovina	11. Hungary *	17. Romania *	
6. Bulgaria *	12. Latvia *	18. Russian Federation	23. Ukraine *
		19. Serbia	
Central Asia			
Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan
Uzbekistan			

* Parties to the Stockholm Convention as of 29 July 2008.

2.2 Geographical characteristics

The region under examination occupies **area** of almost 23 500 000 km² which **is inhabited** by 402 800 000 people. Politically it is a territory of 28 countries. The boarders of the territory are defined by 12 °E (Czech Republic), Chukhotka (170 °W), North land (82 °N) and Tajikistan (35 °N).

2.2.1 Population density

Average density of population for the whole region is 17 inhabitants on 1 km² (low value is caused mainly by the Asian part of the region). However, the population is distributed very unevenly. In the part of Central and Eastern Europe (without Russia) as well as in the Caucasian region, the average population density is 85 inhabitants on 1 km², whereas in Central Asia it is only 14 inhabitants on 1 km². There, the major part of people is concentrated in the Fergana Valley with very high population density. For the single Russia fall 8 inhabitants on 1 km², which is naturally influenced by extraordinary large area of Siberian region with very low population (majority of it is concentrated in the south-western part and along the great Siberian rivers).

2.2.2 Relief

Wide lowlands as well as highlands and mountains can be found within the studied region. In the western part of the region, the Carpathians and mountains of the Balkan Peninsula are the most important mountain systems. Farther to the east, spacious East-European Plain is situated, which is by the north-to-south range of the Ural Mountains separated from equally wide West Siberian Plain extending up to the Yenisei River. Farther to the east, between Yenisei and Lena Rivers, the Central Siberian Plateau is spreading out. Eastern part of Siberia is mostly mountainous with several mountain ranges (e.g. Verkhoyansk Range) and some active volcanoes in the Kamchatka Peninsula (e.g. Klyuchevskaya Sopka). Major part of Central Asia is occupied by the Kazakh Steppe (or Kazakh Plain) and the Kara Kum and Kyzyl Kum Deserts. In the southern part of the region, the highest mountain systems of Caucasus (Mt. Elbrus 5 642 m asl), Pamir Mountains (Ismoil Somoni Peak 7 495 m asl), Tian Shan (Jengish Chokusu 7 439 m asl), Altai Mountains, Sayan Mountains and other mountain ranges in southern part of Siberia are situated.

2.2.3 Hydrology

Western part of the studied region belongs to Atlantic Ocean drainage area with these main rivers: Danube and Dnieper Rivers flowing to the Mediterranean or Black Sea and Elbe, Oder and Vistula Rivers drifting towards the German Ocean or Baltic Sea. Great part of the region is drained away to the Arctic Ocean – major part of Siberia, where the south-to-north flow direction is typical (with large streams of Lena, Yenisei and Ob-Irtysh), and northern part of European Russia. Eastern part of the region belongs to drainage area of the Pacific Ocean (particularly Amur River). Important part of the studied region has no drainage to any ocean, concerning especially area drained away by Volga River to the Caspian Sea and Central Asia from where water is led away by Amu Darya and Syr Darya Rivers to the Aral Sea (its drying-out is great ecological problem in this area with significant economical consequences) and by some other rivers to the Lake Balkhash and Lake Yssyk Köl. In addition to already mentioned lakes, Lake Baikal – the world's deepest, purest and most capacious freshwater lake (it contains over one fifth of the world's fresh surface water) is very important. From great European lakes especially Lake Lagoda and Lake Onega are to be mentioned. From the economic point of view, there are great water reservoirs of major importance in the studied region, mainly the dam system on Volga and Kama Rivers and Dnieper River and on upper streams of Siberian rivers.

2.2.4 Climate

From climatic point of view, the studied region belongs to following climatic zones: arctic (the northernmost part along the Arctic Ocean), sub arctic (reaching c. 60 °N in European part and c. 55 °N at Lake Baikal), temperate and in the southernmost part rarely also subtropical (Mediterranean coast of the Balkan Peninsula, south of Caucasus and south of Central Asia). Along eastern Asian coast, subarctic zone stretches more to the south due to cooling effect of the cold Oyashio Current. Southern part of East-Asian coast (round about Amur River and Sakhalin Island) is under influence of monsoon of temperate zone, which is expressed especially in winter season as a dry airflow from land to ocean and is linked to the semi-permanent Siberian High. Concerning precipitation, most part of studied region is semi-humid to dry (the driest are Central Asia and Central and Eastern Siberia), only the westernmost part of temperate zone could be classified as prevalent humid. Due to great surface extent of Eurasian continent, for large part of the studied region continental character of climate with the wide annual temperature range (very cold winter and hot summer) and unbalanced annual course of precipitation with remarkable summer maximum is typical.

2.2.5 Soils

In the northernmost part alongshore the Arctic Ocean and in major part of the Kamchatka Peninsula, a range of arctic and tundra type soils (lithosols) is situated. More southwards, a zone with prevailing occurrence of podzolic character soils is spreading out to large areas – whole Central and Eastern Siberia, only to Amur River territory stretches belt of cambisols. Eastward from upper stream of Yenisei River, podzolic soils verge into a compact zone of chernozems which is stretching to east as far as to lower stream of Dnieper River and to Caucasus region and chernozems also can be found along Danube River (up to Hungary). In Central Asia and in Europe southwards from c. 50°N, cambisols and kastanozems are prevailing. In European part north from the Arctic Circle, in Western Siberia more southwards (c. to 65–60°N) and in whole Central and Eastern Siberia, deep permafrost is extended (in the coldest region of Yana River basin, permafrost reaches 1,493 m deep).

2.2.6 Vegetation (natural)

From the point of view of natural vegetation (not affected by human activity), the studied region can be classified as follows: the northernmost parts are occupied by tundra which occurs also in the highest parts of Siberian and central-Asian mountain ranges (so-called mountain tundra). Major part of the studied region is occupied by a wide zone of taiga (boreal coniferous forest), whereas so-called mountain taiga could be found also in the highest locations of the Carpathian Mountains. In southern part of Western and Central Siberia, taiga verge into a belt of forest-steppe and steppe spreading westwards (southwestwards) up to the Caucasus and along northern coast of the Black Sea. In Central Asia and along the Caspian Sea, semi-deserts and especially in Aral Sea drainage basin spacious deserts (Kara Kum and Kyzyl Kum) are situated. Only around lower stream of Amur River (under influence of monsoon) alternately-moist leafy forests reach. In Europe, taiga verge directly into a belt of leafy forests of temperate zone. Alongshore the Mediterranean Sea and at the Black Sea in Caucasian area, subtropical forests and shrubbery represent natural vegetation.

2.3 POPs in the CEECs region

2.3.1 Introduction

Persistent organic pollutants (POPs) is a generic term, encompassing several classes of organic contaminants including **polycyclic aromatic hydrocarbons** (PAHs), **polychlorinated dibenzo-*p*-dioxins and furans** (PCDDs/Fs), **polychlorinated biphenyls** (PCBs), **organochlorine pesticides** (OCPs), and other **industrial and agricultural** chemicals. Due to their **wide distribution**, their **ability to accumulate** in abiotic matrices **and to bioaccumulate** in the biotic tissues, and their **potential harmful effects** such are immunotoxicity, neurotoxicity, developmental toxicity, carcinogenicity, mutagenicity, and endocrine disruption potentials, POPs have remained in the centre of scientific attention for the last decades.

There is **no production of POPs** in the whole region. **The main sources** of POPs pollution are **obsolete and unused pesticides** (including the ones with POPs properties) in agriculture; **POPs-containing equipment**; use of industrial technologies resulting in **unintentional releases** of dioxins and furans; formation of dioxins and furans in the **process of open combustion**.

There is a **general lack of information on the levels** of POPs in countries of the Central and Eastern Europe (CEE) (UNEP, 2002a). A better situation is in the Czech Republic, Slovakia, Poland, and Slovenia; satisfactory information about the pesticides only exists in some others, like Hungary, Bulgaria and Croatia. In the rest of the CEE countries, data available on POPs sources and levels is very limited, and there is no systematic monitoring of POPs in the environment or humans in the countries of former Yugoslavia (UNEP, 2002b) and the countries of the former Soviet Union.

It has to be taken into consideration that data collected in frames of ongoing GEF funded projects (**development of the National implementations plans**) are still mostly unavailable, current database is small, and many issues are missing completely for the majority of countries. Even available data from various measurements are difficult to compare because a number of samples is often so small that the results are not representative. Besides, they differ in the year of collection, season, sampling and analytical techniques, selected analytes, standards, and other important parameters.

Based on limited available information it seems that the **POP contamination levels** in many CEE countries do not exceed the levels in the old EU member states. According to collected data, they might be even significantly lower in some countries (Hungary and Bulgaria). Also similarly to the old member states, some studies showed a strong decline of POP contamination in the CEE region over the last decade. This may, however, not apply to specific "hot spots". Such sites with extremely heavy PCB and OCP contamination can

be found in particular in the Central European Countries with strong industrial background, and they require urgent remediation measures to prevent further dissemination and exposure of the local population. Elevated PCB levels, for instance, have been reported in various environmental compartments and human tissues in the Czech Republic, Slovakia and - to some extent - also Slovenia. There is some evidence of the local problems in Poland, Latvia and Lithuania as well but available data do not allow any conclusions.

Situation in this region is further complicated by **recent war conflicts**. A burning or damaging of industrial and military targets in **former Republic of Yugoslavia** during the Balkan wars and the "Allied Force" operation in the spring of 1999 resulted in the release of large amounts of various persistent organic pollutants (including polychlorinated biphenyls, flame-retardants, and explosives) into the environment (APOPSBAL, 2005; Kerekes et al., 2001; Melas et al, 2000; Picer et Holoubek, 2002; Picer et Picer, 2003; Picer et al., 2004; Vojinovic-Miloradov et al., 1996). Determination of possible environmental and human risks connected to these events was the main objective of the **EU project APOPSBAL** ("Assessment of the selected POPs in the atmosphere and water ecosystems from the waste generated by warfare in the area of former Yugoslavia") (APOPSBAL, 2005).

Damaged military facilities present a problem of its own since no information about their status is available to the public. Moreover, many of the **PCB filled capacitors** remained in the service and they pose further risks since some of them are not in a good condition. Even though operation of some damaged capacitors was discontinued, there is apparently no systematic solution of this problem since many of these **devices** are **stored without proper management** (Firestation Tuzla). There is a poor evidence of stored capacitors, their PCB contents and conditions, and several facilities were found where the Pyralene leaking from the stored equipment is causing very significant ecological damage.

Similar situation is in the **Caucasian region** based on the conflict between Armenia and Azerbaijan, recently in Georgia and some conflicts in the Russian Federation (Chechnya). In comparison with the former Yugoslavia, there is **no information** on the environmental contamination as a result of these military conflicts.

The Russian Federation occupies the large territory situated in both, Europe and Asia including the large areas in the Arctic zone. Arctic is the most vulnerable to transboundary POPs contamination. About two third of the territory of the Russian Federation has not been touched by economic operations and preserves undisturbed environment, natural bioreproduction and biodiversity. Such areas are mainly situated in Siberia, The Far East, arctic and sub arctic regions.

The territory of Russia is a subject to accumulation of pollutants from its own sources as well as from the trans-boundary transport from the countries of Europe, Northern Africa, Middle East and Asia. Reduction of the POP emissions in these countries would also lead to the decline of the trans-boundary pollution transport to natural environments in Russia (AMAP 2000).

2.3.2 Organochlorine pesticides (OCPs)

Information on pesticide production, use, import and export in the past is incomplete in many countries of the CEE region. Although some dangerous pesticides are not used anymore, **old stocks** still remain in the countries. Since 1990, programs have been carried out in all countries to identify these pesticides, re-pack them and store them under safe conditions. Estimation of **current amount of accumulated old stocks** is still a subject of the national inventories and evaluations. **Recent data** are collected under National Implementation Plans of the Stockholm Convention on POPs. Present state of ratification of the SC in the CEE region is presented in Table I-1 (Annex I).

Several POPs pesticides (DDT, HCH, lindane) were produced in the territory of **former Czechoslovakia**. Other pesticides were never produced but they were imported to the **Czech Republic and Slovakia**, and used to formulate plant protection preparations. Nowadays both, a production and use of organochlorine pesticides is banned or severely restricted in these countries; obsolete stockpiles, however, remain a particular problem.

Among the substances covered by the Stockholm Convention, only DDT and toxaphene were produced in **Poland** while the others were imported. DDT was used as an active substance by the Polish chemical industry for the production of pesticides until the 1970s. DDT was used in Poland mainly for the protection against various species of pests causing damage to field crops, forests, fruit trees and gardens, as well as human and animal insects (within the framework of sanitary actions) and insects found in buildings. Since 1972, DDT-containing preparations have been gradually withdrawn from use in line with the plant protection law in force. The process of phasing out has been finalized in 1975.

Dieldrin, hexachlorobenzene and toxaphene were also used for production of pesticide preparations in **Poland** in the past. Apart from the above mentioned substances, aldrin, endrin and heptachlor preparations were imported and used in agriculture. Preparations containing substances listed in Annexes A and B of the Stockholm Convention are currently neither manufactured or used nor imported or exported. For the last 30 years only substances that do not contain POPs have been used for the production of pesticides.

Only very limited information is available on POPs in some countries of **former Yugoslavia (Serbia, Montenegro)** and practically none in the case of **Bosnia and Herzegovina**. National POPs Inventory and National Implementation Plan are currently under development in Serbia, Montenegro, Bosnia and Herzegovina. **Serbia** produced and used organochlorine pesticides, the amounts of applied or obsolete pesticides are, however, not known.

No POP pesticides have been produced in the **Republic of Macedonia**. The import and use of DDT has been banned since 1982, the last application was in 1976 for plant protection of forests areas. However, there are unofficial reports for illegal import and application of DDT for plant protection in the agricultural regions bordering Albania and Greece. There are no POP pesticides currently in trade or in use in agricultural or veterinary practice, as to their applications in the public hygiene, additional analyses of the present situation is needed. For malaria eradication, DDT had been used most frequently between 1947-1959.

The OCPs problem is considered as one of the most stringent environmental problems in many countries of the region due to the lack of adequate infrastructure for collection and storage of these chemicals. A proper management of both, household and hazardous wastes is missing as well. Due to unselective waste depositing in the past in many countries, a lack of the waste documentation and a variety of applied remediation methods, full identification and quantitative assessment of POP historical deposits in landfills owned by chemical plants is not possible.

Obsolete plant protection products deposited in pesticide landfills scattered all over the country constitute the most serious environmental hazard caused by persistent organic pollutants **in Poland and many other CEE countries.** In Poland (at 2000), were over 112 obsolete pesticide landfills throughout the country intended for elimination with an estimated amount of waste almost 3 248 t. All these pesticide landfills need to be eliminated as contamination of the environment caused by releases of hazardous substances has been observed in their vicinity. Contamination is found mainly in the topsoil and sometimes in deeper layers due to POPs migration with penetrating water.

We have only very limited information on OCPs in **the Russian Federation.** National POPs Inventory and National Implementation Plan are currently under development and they are not officially available. Former Soviet Union produced and used organochlorine pesticides but the application inventory or the amount of

obsolete pesticides is not available. DDT was used in the period of 1946 – 1986. Based on available information, aldrin, dieldrin, endrin, chlordane, heptachlor, mirex, and toxaphene have never been registered and applied in the Russian Federation. Some of these pesticides were, however, used in the former Soviet Union. Toxaphene, for instance, was applied in the **Kazakhstan** for protection of the cotton fields. HCB has not been banned yet.

The Institute of EcoHygiene and Toxicology named by L. Medved (at present under the Ministry of Health of Ukraine) was the leading institution in the former USSR for the issues related to pesticides, including OCPs. The most of POPs-pesticides under the SC were regulated by the Soviet legislation. The use of DDT, aldrin, endrin, heptachlor, toxaphene and their various preparations was banned before 1987. Definitely only mirex was never registered. It means that it could not be imported, produced and used anywhere in the country.

In **Ukraine**, the list of the banned OCPs (since 1997) includes aldrin, chlordane, dieldrin, endrin, heptachlor and its mixtures, HCB, toxaphene, DDT and its preparations, DDD, DDE and HCH. The complex inventory of sites for storage and disposal of the agro-chemicals, which are considered as obsolete or banned for use, was initiated by the so-called Order of Three Ministers (2001) and the Decree of the Cabinet of Ministers of Ukraine "On developing the infrastructure for elimination of the banned and obsolete pesticides" (2002). The initial data obtained by regional bodies of the Ministry of Agrarian Policy, the Ministry of Environmental Protection and the Ministry of Health in 2003 were renewed within some recent international projects and the latest search and analysis of the available information was carried out within the NIP project (GEF/UNEP). The overall results dated by 2006 reveal that about 22 thousand tons of obsolete pesticides are stored in about 5000 store-houses in agricultural facilities of all types of property. This total OP amount includes: about 18 thousand tons of unidentified obsolete pesticides and the rest – POPs-pesticides, such as DDT, heptachlor, HCB and HCH. During the recent years a certain amount of these OPs has been already disposed and the actual figures are not specified yet.

2.3.3 Polychlorinated biphenyls (PCBs)

Some countries of the region **produced technical mixtures of PCBs** (the former Czechoslovakia, Poland, and former Soviet Union). Former and present industrial application of PCBs is responsible for current PCB emissions. The major sources of atmospheric contamination are due to evaporation from the old open systems (paint and wood protecting layers, softeners etc.), from dumping sites and waste incinerators, and from operational or dumped transformers, condensers, hydraulic systems and other PCB containing devices.

In the **former Czechoslovakia**, both polychlorinated biphenyls and organochlorine pesticides were produced until 1993. **PCBs** were manufactured between 1959 and 1984 in Chemko Strážské (Eastern Slovakia) and 21 482 tons of PCB containing products sold during this period represents **2% of the estimated world PCB production.** 9 869 tons (46 %) from this total amount were exported, mainly to former East Germany. It was also broadly used mainly for production of capacitors, paints and varnishes (UNDP, 2004). Generally concerning to new states existing now on the territory of the former Czechoslovakia, PCBs were produced **on the territory of the Slovakia** and mainly used in various technological applications **on the territory of the Czech Republic.** Results of these historical production and usages are reflected in the massive contamination of environmental matrices and human in both part of the former Czechoslovakia.

Based on extensive inventories carried out in 2000 and 2002, there is currently 3 500 tons of PCBs in the territory of **Slovakia** (1 000 tons of production wastes, 1 000 tons in closed systems and 1500 tons of various PCBs containing wastes). The total amount of identified PCBs wastes will probably increase when the new waste management legislation will come in force.

PCBs were produced at two sites in **the former USSR (both in Russia)** (AMAP, 2000). The largest facility was the Orgsteklo Ltd. Production Amalgamation located in Dzerzhinsk in Nizhni Novgorod region, approximately 300 km east of Moscow. Second was the Orgsintez Ltd. Production Amalgamation in Novomoskovsk in Tula region, about 200 km south of Moscow. PCBs were produced under three brand-names: Sovol (mixture of tetra- and pentachlorinated PCBs used as a plasticiser in paints and varnishes), Sovtol (mixture of Sovol with 1,2,4 trichlorobenzene; mixture with the ratio of 9:1 named Sovtol-10 was used in transformers); and Trichlorobiphenyl – TCB (mixture of trichlorobiphenyls used in capacitors). Minor production of special mixtures took place during the early days of PCB production. Nitrosovol, for instance, was a mixture of Sovol and a–nitronaphthalene, a mixture of PCBs with paraffin and cenerezin was used to impregnate paper capacitors, and there was also a limited production of Hexol, a mixture of pentachlorobiphenyls with hexachlorobutadiene.

Sovol and Sovtol production at the Orgsteklo (Dzerzhinsk) facility began in 1939, and TCB in 1968. Sovtol-10 production was shut-down in 1987, TCB and Sovol production in 1990. At the Orgsintez (Novomoskovsk) facility, Sovol and Sovtol production was launched in 1971, and full-size operation started in 1972. Orgsintez Ltd. stopped production of Sovtol in 1990, and production of Sovol in 1993. There was no production of TCB at Orgsintez. Retrospective analysis of production figures shows that two factories produced a total amount of 180 000 metric tons of the main PCB mixtures during the period between 1939 and 1993, comprising of 53 000 metric tons of Sovol, 57 000 tons of Sovtol and 70 000 tons of TCB. According to data from enterprises manufacturing PCB containing equipment, approximately 60% of the production was destined for Russia, corresponding to 32 000 tons of Sovol in the form of paints, varnishes and lubricants, 34 000 tons of Sovtol in transformers, and 24 000 tons of TCB in capacitors. According to available information, the only exporter of PCBs (Sovtol-10) was Orgsintez Ltd. (Novomoskovsk), which exported 39.5 tons to Cuba, Vietnam or Pakistan during the period from 1981 to 1989. Import figures are not available.

Between 1990 and 1993, production of PCBs at these facilities ceased entirely, equipment has been dismantled and no PCBs are stored at the sites. The amount of PCBs in the PCB contaminated wastes in industrial facilities is estimated to be 565.1 tons, including 318.6 tons of PCBs in the electrical equipment (transformers and capacitors) which has been taken out of operation, and 246.5 tons of liquid PCBs emptied from transformers. Within the fuel and energy sector, there are some 296.3 tons of PCBs in PCB contaminated wastes. According to the data of the territorial environmental protection authorities of the Russian Federation, there is a further 378.4 tons of PCB in PCB contaminated wastes. The total amount of PCBs in electrical equipment (transformers and capacitors) taken out of operation, and separately stored as PCB fluids is, therefore, 1 240 tons. (Information was obtained from the Ministry of Natural Resources of the Russian Federation, Russian Service of Technical and Atomic Control, Federal Hydrometereology and Environmental Monitoring Service, the UNEP-Chemicals, Eco-Accord, and other sources).

15 countries of the CEE region were the parts of former Soviet Union until 1990, and majority of PCB containing equipment present in this region today originates from the Soviet period. A multilateral project carried out in the **Russian Federation** in 1988-1989 brought useful information on PCBs in the former Soviet Union. Generally in many of these countries, there is a lack of information regarding the presence of PCBs in environmental matrices, except for the special evaluations and studies which where usually covered from the foreign sources (EC, 2001).

Being based on the general data on PCBs obtained in the RF, a rather different methodological approach to development of the PCBs inventory was elaborated in **Ukraine** within the UNEP Chemicals Project under the financial support provided by Canadian POPs Trust Fund (2002-2004) (Sukhorebra, 2005). The amounts and locations of the PCBs-containing equipment and synthetic liquids, which were available at the largest enterprises of transport, industrial, agrarian, energy and defense complexes of Ukraine were determined. Collected data in the format of an administrative report became a part of the informational and analytical

system which was created to perform a comprehensive evaluation of types, number and location of the exposed equipment and materials containing PCBs. The inventory covered more than 3500 enterprises of all types and served as the base to advance for the further NIP development.

The current database on PCBs in **Ukraine** reflects the situation in 2003-2004 and reveals the availability and location of about 250 tons of pure PCBs liquids (sovtol, TCB, ascarel, hexol, delor, clophene, pyranol) and electrical equipment of Soviet and foreign production - about 1 000 PCBs transformers, about 100 thousand units of PCBs capacitors, still in use or phased out. Part of it is also unidentified electrical equipment, mainly imported from the former CEE countries.

Polychlorinated biphenyls (PCBs) have been produced only in small quantities in **Poland**. There was, however, considerable import of PCB-containing electrical equipment and oils used in this equipment. The first PCB inventory was carried out in 2002 identifying the actual stocks of equipment and oils containing this group of substances. According to it, 3 000 t of oil was contaminated with PCBs and around 1 400 capacitors and over 5 600 transformers contained PCBs. Estimation of the amount of PCB-containing equipment was extremely difficult, because former producers did not label their products with information on PCB content. Most of them were produced in the 1960s and 1970s, and a lot of the equipment containing PCBs is still in use. Some can be found in storehouses, abandoned factories, in scrap yards, waste landfills, and similar places hard to define.

PCBs have never been produced in **the former Yugoslavia,** but the equipment (transformers and capacitors) containing PCBs was manufactured. For this purpose, the liquid PCBs were imported. Transformers and capacitors were produced using mostly PCBs of the French origin (Pyralene mixtures). Along with pyralene, the most commonly used PCB mixture was Askarel, a mixture of tetrachlorobenzene with 60-80% of PCB content.

Capacitors and transformers were produced in the **Slovenian** manufacturer ISKRA and **Serbian** companies MINEL and AVALA before 1991. Some quantities were also imported from the former USSR and DDR to some countries, for example to **Croatia.** Since the equipment purchased in **Slovenia and Serbia (as parts of former Yugoslavia)** was not recorded as imported, determination of exact quantities in the former Yugoslavia was not possible. In addition, there is no information available on the equipment imported after 1991.

The use of PCBs in **Slovenia** increased after 1960, when ISKRA condenser factory was built in Semic, Bela Krajina (about 80 km south-east from Ljubljana capitol city) (Polis and Leskovcek, 1996). PCBs were introduced into the production process in 1962 (Clophen A-50 and A-30 was supplied by Bayer, FRG until 1970, and Pyralen 1500 was supplied by Prodelec, France between 1970 and 1985). A consumption of PCBs totaled 3 700 tons in the period between 1962 and 1985, with a PCB waste rate of 8-9 % in the form of waste impregnates or condensers. By 1974, 130 tons of waste containing around 70 tons of pure PCBs were dumped at various waste sites within five kilometers from the factory. After 1975, the waste impregnates were collected and sent to France for a treatment (170 t), whereas the smaller waste condensers were still disposed of at the local waste site. Measurements in 1982 showed very high concentration of PCBs in the environmental compartments (air, water, sediments), as well as in food, and animal and human tissues. Slovenia has similarly as all other EU member states an action plan for PCBs disposal until 2010.

An import of PCBs is still allowed in **Croatia,** as well as their use in the closed and semi-closed systems. In present time, Croatia has a sufficient control of an import of PCBs and equipment containing PCBs. Country has also own capacity for collection and management of the POP or other hazardous wastes, but there is no capacity for destruction and collected wastes are sending for the incineration outside the country similarly as in many other countries of the CEE region. Other problem in many countries of the region still is that most of the installed equipment is old and no reliable information on PCB quantities is available. There is also no

reliable information in many countries on leakage accidents and PCB releases to the environment during last decades, their content in the environment, PCB-contaminated sites and related risks or on the exposure of the population to PCBs or other negative impacts of PCBs.

Many countries have a preliminary estimation of PCBs in currently used devices as a part of their NIPs, but for majority of them, data are not available yet. Sufficient capacities for PCB destruction and decontamination of the PCB-containing equipment currently exist in the **Czech Republic** and they are being developed in **Poland and Slovakia**. Overview of the production of OCPs and PCBs in all countries of the region is presented in Table II-1, Annex II.

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3 POPS MONITORING IN THE CEE REGION

3.1 Monitoring programs and responsible institutions

Environmental monitoring data from CEE region are scarce, and there are particular deficits in the area of dioxin measurements (PCDDs/Fs) and human exposure studies in most countries. The highest level of environmental monitoring and research activities in the Central and Eastern Europe has been established in **the Czech Republic** with the countrywide monitoring of various environmental compartments. Lot of research related to the human exposure has been also performed in the **Slovak Republic, Poland, Croatia, Hungary, Slovenia and Estonia** (Bipro, 2004). Some other countries have restricted their activities to

specific compartments, and some of them have only started the real monitoring activities in frames of the GEF funded projects for the development of national implementation plans under the Stockholm Convention.

Monitoring effort has been coordinated on the **international** (UN ECE/EMEP; Nordic Environment Research Programmes; Swedish Baltic Programme), **national** (Czech Republic in all environmental matrices and human tissues for more than 20 years), and **local bases** (City of Gdansk; Krakow) and carried out by the individual research institutions and governmental authorities according to their competence. These are often Hydrometeorological or Environmental institutes responsible also for reporting, including the international reporting.

Regular monitoring of ambient air is not common in the CEE region. With the exception of above mentioned countries, there are no relevant atmospheric data in any other countries. Air monitoring is mentioned in the National Implementation Plans of the Baltic countries or Romania but presently there are no sufficient sampling capacities for the regular programs. Data on the ambient air levels of PCBs, for instance, has been only reported from eight countries (Czech Republic, Croatia, Estonia, Latvia, Lithuania, Poland, Slovakia, Slovenia), and even some of these campaigns have only been episodic, or carried out on the local level.

Amount of information on environmental contamination in **the Czech Republic** is, however, comparable with many member countries of the EU. Government institutions as the State Health Institute or the Czech Hydrometeorological Institute operate systems of the long term monitoring of the atmospheric pollution but from the group of POPs only polyaromatic hydrocarbons are determined in the air samples on the regular basis. There is no legislation requirements for those institutions to monitor chlorinated compounds mentioned in the Stockholm Convention or in the POPs Protocol of the UN ECE CRLTAP (Holoubek et al., 2007). The only site where chlorinated persistent organic pollutants are monitored on the regular basis is the **background station of the Czech Hydrometeorological Institute in Košetice.** This observatory is a part of the **EMEP (Environmental Monitoring and Assessment Programme) background monitoring program**, and at the same time, it is the only one EMEP station in the Central, Southern and Eastern Europe measuring persistent organics. From all 15 EMEP stations where POPs are determined, there were only 6 sites reporting POPs in both, air and deposition, in 2004. Košetice observatory in the Czech Republic is the only site where POPs are also determined in other environmental matrices, such as surface waters, sediments, soils, mosses, and needles. **POPs integrated monitoring program** was established in Košetice in 1988, and the high volume air samples are collected once a week for 24 hours. Polychlorinated biphenyls, organochlorine pesticides and polyaromatic hydrocarbons are determined in all samples in the laboratories of the **RECETOX** (Research Centre for Environmental Chemistry and Ecotoxicology), Masaryk University, Brno. This provides **most complete data on POPs contamination of the background atmosphere** in the Central and Eastern European region.

Besides the regular monitoring programs, there have been a lot of **short term projects** in the Czech Republic supported by various ministries (Ministry of Environment, Ministry of Health, Ministry of Agriculture, and Ministry of Education) and grant agencies focused on various aspects of the POP pollution. Aggregating all this data into the joint database on POPs contamination of the Czech environment would be a major achievement and it should be one of the important objectives of the National Implementation Plan. It would provide very unique dataset for a distribution, fate and transport modeling as well as for an environmental and health risk analysis.

In conclusion, **data on the POP contamination of ambient air** in the Central and Eastern European Region is insufficient, and the lack of regular monitoring is a priority problem. Based on the evaluation of the technical and financial capabilities of available local laboratories it has been concluded that they are capable of providing OCP and PCB analyses of environmental and food samples. These laboratories, however, require both financial and human resources to obtain or replace equipment, and to attract and train the skilled

personnel. It cannot be done without the methodological coordination of the individual monitoring programs to achieve higher effectiveness of data collection.

Answering those needs (providing **the passive air samplers** as reasonably cheap tools for the ambient air monitoring, coordination of the local institutions in their efforts, and transferring know-how) was a main reason for the initiation of the **MONET_CEECs Project** and establishment of the partner network (Klanova et al., 2007a, b).

Similar situation exists in the case of **human matrices.** Except for **the Czech Republic**, no country from the Central and Eastern European region has been conducting regular national human biomonitoring of at least some Stockholm Convention POPs. Fortunately, some countries such as Bulgaria, Croatia, Hungary, Slovakia as well as the Czech Republic participated in last two **WHO-coordinated surveys of human milk for POPs** that involved the analysis of pooled human milk samples collected in 2001 and 2006. **No data** (meeting certain QA/QC criteria) on POPs levels in human milk or maternal blood is publicly available in the following countries from the region: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Lithuania, Macedonia, Moldova, Montenegro, Serbia, Slovenia, Tajikistan, and Turkmenistan. Further countries such as Bulgaria, Hungary, Latvia, Ukraine, and Uzbekistan have available only very limited information acquired either from participation in one or two WHO-coordinated surveys of human milk for POPs or from a short-term national survey. POPs levels in milk and blood collected in northern parts of **the Russian federation** were measured within the **AMAP** (Arctic Monitoring and Assessment Programme). Most data on POPs levels in maternal blood from Slovakia comes from research projects focused on a PCB-contaminated area and adjacent control area.

Monitoring programs which are focused on **other environmental matrices** than the core matrices from the first evaluation, exist in many CEE countries and some are being developed (see Table III-1 and III-2 in Annex III). For example, the competent authorities for monitoring of air, water, soil, food, and human milk were defined in Bulgaria. Soil is being monitored in Bulgaria, Czech Republic, Moldova, Montenegro, Poland, and Slovakia. Similarly, in many countries of the region, POPs are monitored in surface waters and sediments of the main water bodies (lakes, reservoirs, rivers), in Bulgaria and the Czech Republic also in ground water, some countries monitor POPs in precipitation (Czech Republic, Moldova). There are, however, the countries with no monitoring data on POPs in the environmental matrices (Albania, Bosnia and Herzegovina, Macedonia, Kyrgyzstan, and Tajikistan).

These monitoring programs are mainly focused on OCPs, PCBs, in some cases also on PAHs. Monitoring of PCDDs/Fs is a relatively scare (human milk in the Czech Republic), and mostly has an episodic or research form (Czech Republic, Croatia, Estonia, Montenegro, Poland, Russian Federation, Slovenia, Slovakia).

Rapid development of the monitoring programs can, however, be observed in recent years. Many countries are working on the new concept of environmental monitoring including POPs (for example Bulgaria, Moldova, Montenegro, Poland, Russian Federation, Ukraine). In the Czech Republic, the complex conception with the respect to the international conventions exists, and is being upgraded now.

For example in Ukraine, the State Hydrometeorological Service of Ukraine is responsible for carrying out the regular monitoring studies of two OCPs belonging to the POPs group: DDT (including p,p'-DDE, p,p'-DDT, and p,p'-DDD) and HCB in surface water, and DDT in soils, on the territory of whole Ukraine. Aggregated data are available until 2005.

The State Sanitary and Epidemiological Service of Ukraine is in charge for the net of laboratories which provide, (unfortunately not systematically), data on DDT and its derivatives, HCH isomers, heptachlor, aldrin, dieldrin, HCB and PAHs (benzo(a)pyrene) in foodstuff, plants, water, and soils.

A significant part of POPs monitoring data in various media is available thanks to the research projects, but only few institutes within the National Academy of Sciences carry out the long-term studies. Institute of Occupational Health of the Academy of Medical Sciences of Ukraine is the leading facility for the long-term DDT, HCH and HCB measurements in humans.

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National Implementation Plans of the Stockholm Convention on Persistent Organic Pollutants in the Central and Eastern European countries.

3.2 Organization of the regional implementation

The CEE regional organization group inception workshop for the Central and Eastern European region was held at the Pyramida hotel, in Prague, Czech Republic from 15-17 October 2007.

The aim of the workshop was to present and discuss the main elements of the regional monitoring plan and to obtain commitments for their implementation. **The main objectives of the workshop** were to:

- Establish a regional organization group strategy, work plan and timetable;
- Agree on arrangements to receive readily available data;
- Establish strategic partnerships to produce supplementary data and to provide enabling capacity strengthening;
- Identify necessary enabling capacity-strengthening to Group 2 programs;
- Establish arrangements for regional cooperation;
- Establish arrangements to draft the regional monitoring report.

The meeting was attended by the following **nominated regional organization group members:** Ms. Anahit Alexandryan (Armenia), Ms. Tsvetanka Dimcheva (Bulgaria), Mr. Ivan Holoubek (Czech Republic), Ms. Anna Cumanova (Moldova) and Ms. Jana Matejovicová (Slovakia). Mr. Trajce Stafilov (The Former Yugoslav Republic of Macedonia) was unable to attend.

The meeting was also attended by the following non-members, **national experts**: Ms. Nermina Skejovic-Huric (Bosnia and Herzegovina), Ms. Blanka Krauthacker (Croatia), Mr. Otto Roots (Estonia), Ms. Cholpon Alibakieva (Kyrgyz Republic), Ms. Marina Frolova (Latvia), Ms. Nijole Striupkuviene (Lithuania), Mr. Adam Grochowalski (Poland), Mr. Mihai Lesnic (Romania), Mr. Alexey Konoplev (Russian Federation), Mr. Valery

Chashchin (Russian Federation), Mr. Ivan Grzetic (Serbia), Mr. Anton Kocan (Slovakia) and Mr. Rok Brinc (Slovenia).

The meeting was also attended by the following **invited experts and representatives of international and regional bodies:** Mr. Lars-Otto Reiersen, Arctic Monitoring and Assessment Programme (AMAP), Mr. Seongsoo Park, World Health Organization (WHO), Mr. Knut Breivik, Co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe (EMEP) Chemical Coordinating Centre, Norwegian Institute for Air Research (NILU), Mr. Sergey Dutchak, Co-operative program for monitoring and evaluation of the long-range transmissions of air pollutants in Europe, Meteorological Synthesizing Centre-East; Mr. Peter Weiss, Monitoring network in the alpine region for persistent organic pollutants (MONARP), Mr. Pavel Čupr and Ms. Jana Klánová, Research Centre for Environmental Chemistry and Ecotoxicology (RECETOX).

The meeting was also attended by a representative of the following **non-governmental organization:** Mr. Jindřich Petrlík and Ms. Saška Petrova, Arnika Association (Czech Republic).

During the presentations the following issues were highlighted. **A common problem** in the region was poor waste, chemical and environmental management. There were many hotspots of contamination, aggravated in areas of conflict. The importance of maintaining age-related biomonitoring to ensure comparability of human data in future monitoring was emphasized. While human data was mostly taken from highly exposed populations, general population data taken for reference purposes could serve as background data for human samples. It was also understood that interpretation of monitoring data from different sources and generated for different purposes must be performed with caution. Monitoring data on dioxins was scare particularly due to the high cost of analysis. The workshop acknowledged the usefulness of modeling data to understand long-range transport and evaluate trends. Slovakia offered to serve as a specimen bank.

WHO announced the countries which were involved in the previous rounds of the human milk biomonitoring program (see chapter 4.4.5.1). WHO stressed out an importance of consistency in selecting donors and analyzing samples. WHO also recommended that the uncertainty of the result related to human milk should be evaluated by the experts before finalizing.

With regard to data gaps the workshop agreed that sufficient data was available on air monitoring through the activities carried out by **RECETOX** in the Czech Republic and the CEE region, as well as **AMAP** and **EMEP** activities. Additional funding was necessary, however, to ensure the sustainability of these programs. The workshop further agreed that in several sub-regions, sufficient data was available on human milk and human blood data. It was noted, however, that human biomonitoring data were lacking in two sub-regions, the Baltic States and the trans-Caucasus region. In addition, human data in the Balkan region were relatively limited.

The workshop agreed that upon the interest expressed by the countries of **Central Asia** (Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan), data from these countries could be included in the regional report from the Central and Eastern European region.

The representative of the Secretariat outlined the Stockholm Convention capacity strengthening policy and Secretariat activities in support of implementation of the Global monitoring plan.

In the subsequent discussion, it was stressed out that several countries might be able to organize monitoring but several obstacles hindered achievements: resources for analyses were lacking; limited capacity was available in the region for the analysis, in particular of dioxins and furans; and the high cost of replacing out of date equipment.

Several opportunities for the **strategic partnerships** were suggested: RECETOX: air monitoring in 16 countries can be extended to 21 countries; Russian Federation: AMAP for air and human data (with Canadian funding); Russian Federation: countries of former Soviet Union (support for and training in analysis: 5 labs accredited for dioxin analysis and others for other POPs); Poland: 5 labs and possible analytical partnerships; Czech Republic and Slovak Republic: support for analysis; Moldova: support for non-dioxin POPs analysis; WHO: 4th round human milk biomonitoring program (Czech Republic, Hungary, Slovakia). RECETOX passive sampling will be extended further in the framework of the ongoing project supported by the Secretariat; EMEP model assessment at regional level (data, assessment, etc.); EMEP support for guidance on monitoring and training for laboratory analysis; Possible AMAP project in cooperation with the Stockholm Convention Secretariat funded from Canada POPs Fund.

While emphasizing there was a limited funding, the workshop participants were encouraged to join the WHO program conducted in cooperation with UNEP on biomonitoring of human milk for persistent organic pollutants, by expressing their interest. The representative of WHO informed the workshop of the program for proficiency testing of national laboratories which would also be undertaken providing funds were available. Interested countries were encouraged to contact WHO to join the program.

The workshop prepared a summary of capacities, gaps and needs (see Annex III of this report).

Turning to possible arrangements to receive readily available data and to identify the data gaps and possible strategies to fill those gaps, the workshop agreed that all relevant national data should be **submitted to and stored at RECETOX.** The regional organization group would review provided data and consequently prepare the regional report for the Central and Eastern European region for submission to the Coordination Group for their consideration. The workshop noted that national data should be obtained through the national focal points and that particular data sources should be indicated to the focal points to facilitate that process**.** The workshop also agreed that regional organization group members should be in a position to consult primary data where necessary.

The workshop agreed that RECETOX in cooperation with consultants would develop a format for gathering available/existing data. The workshop agreed that each regional organization group member would have responsibility for facilitating compilation of data from the specific number of countries. The regional organization group would collect data and submit them to RECETOX. RECETOX in cooperation with Slovak experts and consultants would develop a draft of the regional report. A draft regional report will be reviewed by the regional organization group members and then circulated to countries of the region for the comments. The workshop noted a need to finalize a method for data handling and time lines for actions as well as a need to distribute responsibility for the countries to various regional organization group members.

Milestones and timetable for development of the CEE Regional monitoring report

1.	Establishment of the CEECs ROG	October 2007	✓
2.	Collection of available data and information and their first compilation, establishment of the drafting team	February 2008	April 2008
3.	Preparation of the first draft	April 2008	10 April 2008
4.	Drafting meeting of the CEECs ROG, Brno, CR	18 – 19, April 2008	✓
5.	Drafting workshop for all regions takes place in Geneva	19-23 May 2008	✓
6.	The 2nd Draft of the Regional report	15 July, 2008	13 August 2008
7.	Review of the 2nd Draft by ROG members	31 July, 2008	08 September 2008
8.	Regional review of the 2nd Draft	31 August, 2008	08 September 2008

9.	Revision of the reviewed 2nd Draft by the ROG members and drafters	30, September 2008	30, September 2008
10.	**Final Regional monitoring report will be submitted to the Secretariat**	**15 October, 2008**	**15 October, 2008**

When starting its activities in order to obtain available monitoring information, **the CEECs ROG** took careful note of two concepts outlined in Article 16 of the Convention. First, it is stated that Parties shall make arrangements to obtain comparable monitoring data. The operational procedure to achieve comparability is the application of the criteria for program selection outlined in the Implementation Plan for the first evaluation and the measures listed in the "Guidance Document". Second, Article 16 further states that the arrangements to gather data should be implemented using existing program and mechanisms to the extent possible.

The ROG members reviewed **available information on existing programs** based upon survey responses obtained by the Secretariat and own questionnaires, which were sent to the National Focal points of the Stockholm Convention. Unfortunately, the responses from many countries were insufficient or none (see Table 4). The countries of Central Asia declared their interest to be included to the CEECs region evaluation, but nobody reacted to the ROG contacts and no information was send to the ROG (or very limited in case of Kazakhstan).

ROG selected the candidate programs capable of providing the basis for the first evaluation report (see Table 5). A monitoring design, sampling and analytical procedures and quality control measures of each program were carefully examined to make sure that data can be used by the COP now and in the future for an assessments of the trends in the POPs levels.

Table 4: Overview of the CEEC activities and approaches

Countries which have responded to the ROG and contributed to the Regional Report
Armenia, Azerbaijan, Bulgaria, Czech Republic, Hungary, Macedonia, Moldova, Poland, Romania, Slovakia, Slovenia, Kazakhstan
Countries which have responded to the ROG and have not contributed to the Regional Report
Russian Federation
Countries which have not responded to the ROG, but some national experts have contributed to the Regional Report
Belarus, Croatia, Estonia, Kyrgyzstan, Latvia, Lithuania, Russian Federation, Ukraine
Countries which have not responded to the ROG and have not contributed to the Regional Report
Albania, Bosnia and Herzegovina, Georgia, Montenegro, Serbia, Tajikistan, Turkmenistan, Uzbekistan

The fact that results of EMEP and MONET programs both generated in the RECETOX laboratories, represent the only available air monitoring data from the CEE region, means an advantage concerning the **internal comparability**. In the case of mother milk, a major part of available information is based on the WHO study. Regular monitoring of human tissue exists only in the Czech Republic and all data are produced in the National POPs reference laboratory of the Institute of Public Health in Ostrava.

It has been decided that all available information on POPs in ambient air will be included to the Regional Report, including information on the **new types of POPs** (HCHs, PeCB) or **PAHs** (as a relevant marker of air pollution in the region).

ROG selected and confirmed the **regional drafting group** which was responsible for the first draft development and latter corrections. The drafting group had five members – Ivan Holoubek, Jana Klánová, Pavel Čupr (RECETOX MU, Brno, Czech Republic), Anton Kočan (Medical University, Bratislava, Slovakia), Alexey Dudarev (Northwest Public Health Research Centre, St. Petersburg, Russian Federation).

Drafting group carefully evaluated all available information and prepared **the first draft** for the 2nd Meeting of ROG in Brno, Czech Republic on April 18-19, 2008. After discussion, additional available information from the CEE region was collected and evaluated. 2nd draft of the Regional Report was completed on August 13, 2008 and it was sent to the ROG members, countries and national experts for a final review. Evaluation of resent data coming from the second phase of the MONET-CEECs in 2007 and newest data on human milk caused a short delay.

4 METHODS FOR SAMPLING, ANALYSIS AND DATA HANDLING

4.1 Programs/activities related to the air monitoring

Assessing the POPs trends in the region, the **Global monitoring plan** (GMP) (UNEP, 2007) should istrive for at least:

- **Three to five stations** with **active** high-volume sampling devices;
- A **network of 10 to 15 passive air sampling stations** arranged in a grid with spacing of approximately 20° x 20° for an enhancement of the geographical resolution. Passive samplers should be co-located with the high volume sites for the calibration purposes.

These sites may be located **centrally** in order to obtain information on the **time trends of regional sources.** They need to be sufficiently remote from the urban centers and industrial and other sources of POPs to provide concentrations typical for the large area around the site (at least 100 km radius). Requirement for such a site includes an access to the meteorological observations and station personnel available for training in the sampling techniques. Geographical considerations may also be taken into account for the final decision on selection of the regional sampling sites.

In summary, **two types of measurements** of a full range of POPs are envisioned in each region:

- **Cumulative air sampling** of a few sites in each region (1-2 days per week, or continuously over the periods of 1- 2 weeks) using an active high volume sampling device (~0.5-1 m^3/min. flow rate). Gas and particle phases have to be sampled and analyzed separately.
- **Continuous passive sampling** for integration periods of 3 months to 1 year using a passive sampling technique deployed at a large number of sites, including the high volume sampling sites.

A combination of the small number of active sampling sites supplemented **by the large number of passive sampling sites** will result in a cost-effective program with flexibility to address a variety of issues. **Availability of the regional laboratories** as well as an assessment of the sources and the air transport pathways will determine the spatial configuration and density of the network.

Positioning and installation of samplers should follow standard operating procedures for air sampling programs. More general criteria are given here:

- Regional representativeness: A location free of the local POP sources and other pollution sources so that the air sample is representative for larger region around the site.
- Minimal meso-scale meteorological circulation influences: Free of strong systematic diurnal variations in local circulation imposed by topography (e.g. upslope/ down slope mountain winds; coastal land breeze/lake breeze circulation).
- Long term stability: In many aspects including infrastructure, institutional commitment, land development in the surrounding area.
- Ancillary measurements: For the super-sites, more detailed atmospheric measurements are needed including wind speed, temperature, humidity and a measure of boundary layer stability. For the passive sites, wind speed, temperature and humidity.
- Appropriate infrastructure and utilities: Electrical power, accessibility, buildings, platforms, towers and roads.

Ambient air is an important matrix because it has a very short response time to changes in atmospheric emissions. This well-mixed environmental medium is also an entry point into food chains and a global transport medium. Air data are required to validate atmospheric POPs transport models.

Existing sampling networks. As mentioned above, active and passive samplers can be combined, offering an opportunity to create a cost-effective program. There are existing programs built on both techniques in the CEEC region.

4.2 Existing international monitoring programs covering CEECs

The overview of existing programs and activities related to the air monitoring and contributing to current report is presented in Table 5.

Table 5: List of monitoring programs which contributed to the assessment of POP levels in ambient air (12 priority substances) in the CEE region

Monitoring program	Abbreviation	Region of interest	No. of POP monitoring sites	Monitoring period	Monitored compounds (Stockholm Convention POPs)
Arctic monitoring and Assessment Programme	AMAP	Arctic	2	1993 - present	PCBs, DDTs, HCB chlordanes
European Monitoring and Evaluation Programme	UNECE-EMEP	Europe	1	1988 - present	PCBs, DDTs, HCB, PeCB, HCHs, PAHs
Global Atmospheric Passive Sampling network	GAPS	Global	3	2004 - present	PCBs, chlordanes, HCB
Passive sampling MOnitoring NETwork	MONET	CEECs	$37^{+}/100^{++}$	2005 - present	PCBs, DDTs, HCB, PeCB, HCHs, PAHs

[+] permanent sampling sites in the CR (MONET-CZ)
[++] in 21 CEECs and CAS during the pilot phase of MOMET-CEECs

4.3 Atmospheric programs - active high volume sampling

4.3.1 EMEP

4.3.1.1 Introduction

One of the programs coordinating a monitoring effort on multiple sites is the European Monitoring and Evaluation Programme (EMEP). It was established with the main goal of providing the governments and subsidiary bodies under the Convention on Long Range Trans-boundary Air Pollution with qualified scientific information supporting development and evaluation of the international protocols. The EMEP program was initially focused on the trans-boundary transport of acidification and eutrophication. Later its scope broadened to address a formation of surface ozone, and more recently it also covers the volatile organic compounds, persistent organic pollutants, and heavy metals. Map of the EMEP stations (including analyzed matrices) is presented in Figure 1 (Aas and Breivik, 2006).

Heavy metals and **persistent organic pollutants (POPs)** were included in EMEP's monitoring program in 1999. However, earlier data has been available and collected, and the EMEP database thus also includes older data, even back to 1988 for a few sites. A number of countries have been reporting heavy metals and POPs within the EMEP area in connection with different national and international programs such as HELCOM, AMAP and OSPARCOM.

The strategic long-term plan on POPs (EB.AIR/GE.1/1997/8) recommended to take a stepwise approach and include following compounds or groups of compounds in the first step of evaluation: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), HCB, chlordane, lindane, α-HCH, DDT/DDE. These recommendations are implemented in the EMEP monitoring strategy and measurement program for 2004–2009 (EB.AIR/GE.1/2004/5).

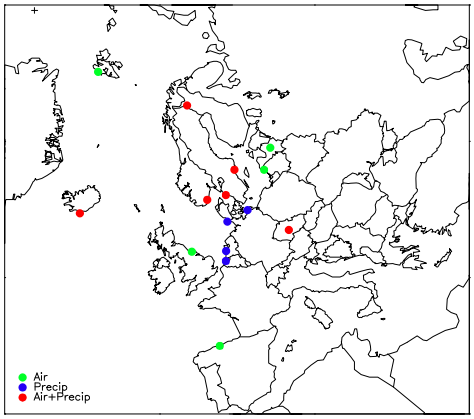

Figure 1: Only six (out of fifteen) EMEP sites reported POPs in both, air and wet deposition, in 2004

So far, ten reports (EMEP/CCC-Reports 8/96, 9/97, 7/98, 7/99, 2/2000, 9/2001, 9/2002, 1/2003, 7/2004, 9/2005, 7/2006) presenting data on heavy metals and POPs from national and international measurement programs have been published for the period 1987 to 2004. All these data are also available from the EMEP's homepage, http://www.nilu.no/projects/ccc/emepdata.html.

Distribution of the POP measuring sites is insufficient; only one observatory from this network is located in the **CEE region – Košetice observatory in the Czech Republic.** EUs daughter directive on PAHs and the Stockholm Convention on POPs may have a positive effect on the number of EMEP .

Košetice observatory (last to the right) was the only site where POPs have been also determined in other environmental matrices. Košetice observatory of the Czech Hydrometeorological Institute is located in the southern Czech Republic (N49°35´; E15°05´). The climatic classification of the region is moderately warm and moderately humid upland zone with a mean annual temperature of 7.1 °C, mean annual total precipitation of 621 mm, between 60 and 100 days with snow-cover per year, 1800 hours of sunshine per year, and prevailing westerly winds. Observatory was established as a regional station of an integrated background monitoring network in the late 1970s (Holoubek et al., 2007a,b).

All measurements assigned to EMEP stations (including VOCs, POPs and heavy metals) are currently implemented in Košetice (Holoubek, 1993; Holoubek et al., 1990, 1992, 1996a, b, 2000, 2001), and monitoring design is based on the EMEP POP monitoring strategy EMEP, 1998). Samples of the ambient air, wet deposition, surface water, sediment, soil and biota, as the key components of the environmental system, are collected. The ecosystem indicators are further applied to determine the current state, anthropogenic impacts and influences, and to predict the future changes of terrestrial and freshwater ecosystems in a long-term perspective (EMEP, 1998). A dataset generated in **RECETOX,** (Masaryk University, Brno, Czech Republic) in ten years of **integrated monitoring in Košetice** was used to assess the **Central European trends in background levels of persistent organic pollutants**.

4.3.1.2 Selection of compounds

16 US EPA polycyclic aromatic hydrocarbons (PAHs), 7 indicator polychlorinated biphenyls (PCBs: IUPAC congeners number 28, 52, 101, 118, 153, 138, 180), organochlorine pesticides (OCPs) - *p,p'*-DDT, *p,p'*-DDD, and *p,p'*-DDE, α-, β-, γ-, δ-hexachlorocyclohexane (HCH), hexachlorobenzene (HCB) and pentachlorobenzene are being analyzed on the regular bases.

Ambient air sampling has been carried out in Košetice since September 1988 which makes it a unique achievement of 18 years of continuous monitoring. One sample per three months was the sampling frequency between 1988 and 1993. Since 1994, the air samples have been collected once a week (every Wednesday, from 08:00 h to Thursday, 08:00 h) resulting in 52 samples per year (Holoubek et al., 2007a).

4.3.1.3 Sampling techniques

High volume ambient air samplers PS-1 (Graseby-Andersen, USA, flow: 12-18 m^3 h^{-1}, volume: 250-400 m^3 per 24 h) and two types of adsorbents were used: a Whatmann quartz filter (QF) (fraction d_{ae} < 50 μm) for collection of particles, and a polyurethane foam (PUF) filter (Gumotex Břeclav, density 0.03 g cm^{-3}) for collection of the gaseous phase. PUF filters were cleaned before the campaign by extraction with acetone and dichloromethane in a Soxtec extractor. The duration of sampling was 24 hours; quartz filter field blanks and PUF field blanks were collected each month (Holoubek et al., 2007a).

4.3.1.4 Chemical analysis

Quartz filters and polyurethane foam filters were extracted and analyzed separately in order to determine the gas-particle partitioning of compounds of interest. All filters were extracted with dichloromethane in a Büchi System B-811 automatic extractor. Surrogate recovery standards (d8-naphthalene, d10-phenantrene, d12-perylene for PAH analysis; PCB 30 and PCB 185 for PCB analysis) were spiked on each sample prior to extraction. Terphenyl and PCB 121 were used as internal standards for PAH and PCB analyses, respectively. The volume was reduced after the extraction under a gentle nitrogen stream at ambient temperature, and fractionation was achieved on a silica gel column; a sulfuric acid modified silica gel column was used for

PCB/OCP samples. Samples were analyzed using a GC-ECD (HP 5890) supplied with a Quadrex fused silica column 5% Ph, and a GC-MS (HP 6890 - HP 5975) with a J&W Scientific fused silica column DB-5MS for PCBs and OCPs. 16 US EPA polycyclic aromatic hydrocarbons were determined in all samples using a GC-MS instrument (HP 6890 - HP 5972 and 5973) supplied with a J&W Scientific fused silica column DB-5MS (Holoubek et al., 2007a).

4.3.1.5 Quality assurance, quality control

Recoveries were determined for all samples by spiking with the surrogate standards prior to extraction. Amounts were similar to detected quantities of analytes in the samples. Recoveries were higher than 75 % and 70 % for all air samples for PCBs and PAHs, respectively. Recovery factors were not applied to any of the data. Recovery of native analytes measured for the reference material varied from 88 to 100 % for PCBs, from 75 to 98 % for OCPs, from 72 to 102 % for PAHs. Field blanks were extracted and analyzed in the same way as the samples, and the levels in field blanks never exceeded 1 % of the quantities detected in samples for PCBs, 1% for OCPs, 3% for PAHs, indicating a minimal contamination during the transport, storage and analysis. Laboratory blanks were always lower than 1% of the amount found in the samples (Holoubek et al., 2007a).

4.3.2 AMAP

Measurements of POPs in Arctic air have continued on a weekly basis at locations in Canada, Iceland, Norway, Finland, and Russia, building on the datasets discussed in the first assessment (AMAP, 2004). In addition, over the past five years, a number of ship-based studies have also measured air concentrations of POPs over shorter time periods to address air–water exchange.

These two sites covered the North of Russian Federation:
Dunai:
1. 74°60'N, 124°30'E
2. Sea level
3. Remote, treeless, Lena River Delta near Arctic Ocean
4. 1993. No longer operating
5. Chlorinated pesticides, PCBs, and PAHs
6. Weekly

Amderma
1. 69°43'N, 61°37'E
2. Sea level
3. Forested, near military bases and Pechora Sea
4. 1999-2000. Possible future operations
5. Chlorinated pesticides, PCBs, and PAHs
6. Weekly

Unfortunately, this part of AMAP activities was stopped in 2000, and new sampling sites for a follow-up project are still under discussion.

4.3.3 Existing national monitoring and international and national research programs and projects

There are **no other ongoing long-term monitoring programs** focused on POPs in ambient air in the CEE region with the **exception of the Czech Republic** (see Table 6, Annex III).

The only available data from some regions came from the research projects. **Persistent organic pollutants (POPs)** spilled into the environment as a result of damaged industrial and military targets, natural resources, and infrastructure during the Balkan wars still pose a problem several years later. The aim of **APOPSBAL** project was to investigate an extent to which the residents of former Yugoslavia are exposed to elevated levels of POPs as a consequence of the wars. The atmospheric as well as the soil levels of PCBs, OCPs and PAHs were determined in Croatia, Serbia, Bosnia and Herzegovina during five high volume air sampling campaigns in 2003 and 2004. A considerable contamination of several sites was detected (PCB concentrations in the atmosphere ranged between 67 pg m^{-3} and 40 ng m^{-3} for the sum of 7 indicator congeners) and the levels are reported in this article

An objective of the **APOPSBAL project** ("Assessment of the selected POPs in the atmosphere and water ecosystems from the waste generated by warfare in the area of former Yugoslavia") was to investigate levels of POPs (with the special attention to PCBs) in various environmental matrices, their atmospheric and hydrogeological fate, a human intake, and ecotoxicological consequences of the exposure of living organisms to POPs for the regions of Croatia, Serbia and Montenegro, Bosnia and Herzegovina, and Kosovo affected by the war (APOPSBAL, 2005). Identification of the hot spots, laboratory and field biotransformation studies as well as suggestions for remediation of contaminated sites were among the main goals. As a part of this project, the high volume ambient air sampling was performed at the industrial, residential, rural, and background sites in Croatia, Serbia, Bosnia and Herzegovina and the levels of polychlorinated biphenyls, organochlorinated pesticides and polyaromatic hydrocarbons were determined. In addition, the top layer soil samples were collected from all sampling sites to assess the source of the air pollution. 24 sampling sites were selected in Croatia, Serbia, Bosnia and Herzegovina and five high volume sampling campaigns (5–10 days each) were used.

4.4 Passive sampling

4.4.1 Introduction

As the **air pollution** became an issue of great public health concern and the new regulations introduced their demands, a pressing need to obtain more **POPs data** in a **cost-effective way** appeared. Global Monitoring Network has been designed for the purpose of the Stockholm Convention with the objective of establishing **baseline trends at global background sites** (Harner et al., 2006a). When signatory parties are to conduct source inventories, identify ongoing sources, and provide environmental monitoring evidence that ambient levels of POPs are declining (UNEP, 2004; Harner et al., 2006b), developing countries in particular require cost-effective and simple approaches. Moreover, as most of the primary sources have been controlled, national environmental agencies increasingly need a simple tool to identify less obvious diffusive sources of POPs as they seek to further reduce emissions (Harner et al., 2006b). Attention is focused also on occupational and indoor exposure to airborne POPs as an important source of risks.

Since **the high volume air samplers** as expensive devices requiring reliable power supply as well as trained operators are not widely available, the air monitoring of POPs has only been conducted at limited number of sites. In the last years, however, new demands resulted in development of the range of **passive air samplers (PAS)** as new tools for the air quality monitoring (Tremolada et al., 1996; Sharir and Holsen, 1999; Peters et al., 2000; Weinrich et al., 2002; Harner et al., 2003; Bartkow et al., 2004). **PAS** offer a cheap and versatile alternative to the conventional high volume air sampling and they have been currently recommended as one of the methods suitable for the purpose of new long-term monitoring projects. They are capable of being deployed in many locations at the same time, which offers a new option for the large scale monitoring. As it provides information about long-term contamination of selected site, passive air sampling can be used as a

screening method for semi-quantitative comparison of different sites with the advantage of low sensitivity to accidental short-time changes in concentration of pollutants.

It was demonstrated that **passive air samplers using polyurethane foam (PUF) filters** are suitable to study vapor-phase air concentrations of POPs, particularly of more volatile compounds (Harner et al., 2004; Jaward et al., 2004a, b), and they were successfully applied as a tool for POPs monitoring on the global (Harner et al., 2006a) and regional (Klanova et al., 2007) levels. Studies have been conducted to demonstrate the feasibility of employing PAS across large areas on national or continental scale (Jaward et al., 2004a, b, c; Shen et al., 2004; Farrar et al., 2006). PAS provide site- and source-specific fingerprints and they can be used to conduct screening surveys to help to identify the sources (Klanova et al., 2006; Cupr et al., 2006). They are often the only way of taking air samples for POP analysis from the remote regions (high mountains, arctic sites) and they can serve as tools in scientific investigations, like recording compositional changes PCBs undergo between the tropical and Arctic atmosphere (Shen et al., 2006) or evaluating the model-based predictions of their long range transport potential (Shen et al., 2005). As PAS tend to provide information on the long term average conditions in the atmosphere and ignore variability on a shorter time scale data, they are particularly suited to complement the high volume air measurements and serve in the evaluation of multimedia fate and transport models. Based on their unquestionable advantages, passive samplers were recommended by the Preliminary Ad-hoc Technical Working Group for the Global Monitoring Plan as a suitable tool for the global monitoring of POPs in ambient air.

On the other hand, due to the sensitivity of PAS to local effects, **sampling site selection** seems to be crucial for the success of such projects since small-scale variability in each region can exceed the continental variability**. To develop a monitoring network,** the local conditions must be evaluated very carefully since only detail characterization of potential local effects for every sampling site can assure the successful selection of sites for larger (regional or global) scale monitoring. Performing more detailed local screening studies before designing the final network is advisable.

4.4.2 MONET

4.4.2.1 Introduction

Passive air sampling network of the Czech Republic (MONET-CZ) has been developed since 2003. It consist of the background monitoring station in Košetice serving as an intercalibration site with high volume air sampling performed in frames of the EMEP project, and a number of additional sites. Those include the set of 15 other background sites ranging from mountain to urban backgrounds, as well as rural, urban and industrial sites. Facilities mentioned in the Stockholm Convention as potential sources of POPs (chemical and cement factories, incinerators of various kinds, local combustion systems, remediation sites) are included also. The network is re-evaluated every year and optimized accordingly: redundant sites were omitted and some new sources added. It is still flexible and allows further improvements. At the same time, the backbone of the network (37 sites) allows performance and advanced interpretation of the short term spin-off case studies. In 2006, those included monitoring of an impact of certain industrial technologies (municipal waste incinerator Termizo Liberec, medical waste incinerator Olomouc, cement factory Mokra), impact of advanced decontamination and remediation technologies (Spolana Neratovice), local studies of the air contamination of residential areas including toxicological assessments (Zlin and Brno region) or monitoring of the occupational environment.

MONET-CZ sampling sites

New design of the **MONET-CZ sampling network** was introduced and initiated in January, **2006** (see Figure 2) (Klanova et al, 2007b). In 2007, the number of sites was reduced from 50 to 37 freeing a capacity to perform detailed screening studies in 14 regions of the Czech Republic (see Figure 3) (Klanova et al., 2008a). Thirteen 28-days samples were collected from each of 37 sampling sites. Detailed information concerning to the MONET-CZ sampling sites from the years 2006 and 2007 are presented in Annex IV, Tables IV-1 and IV-2.

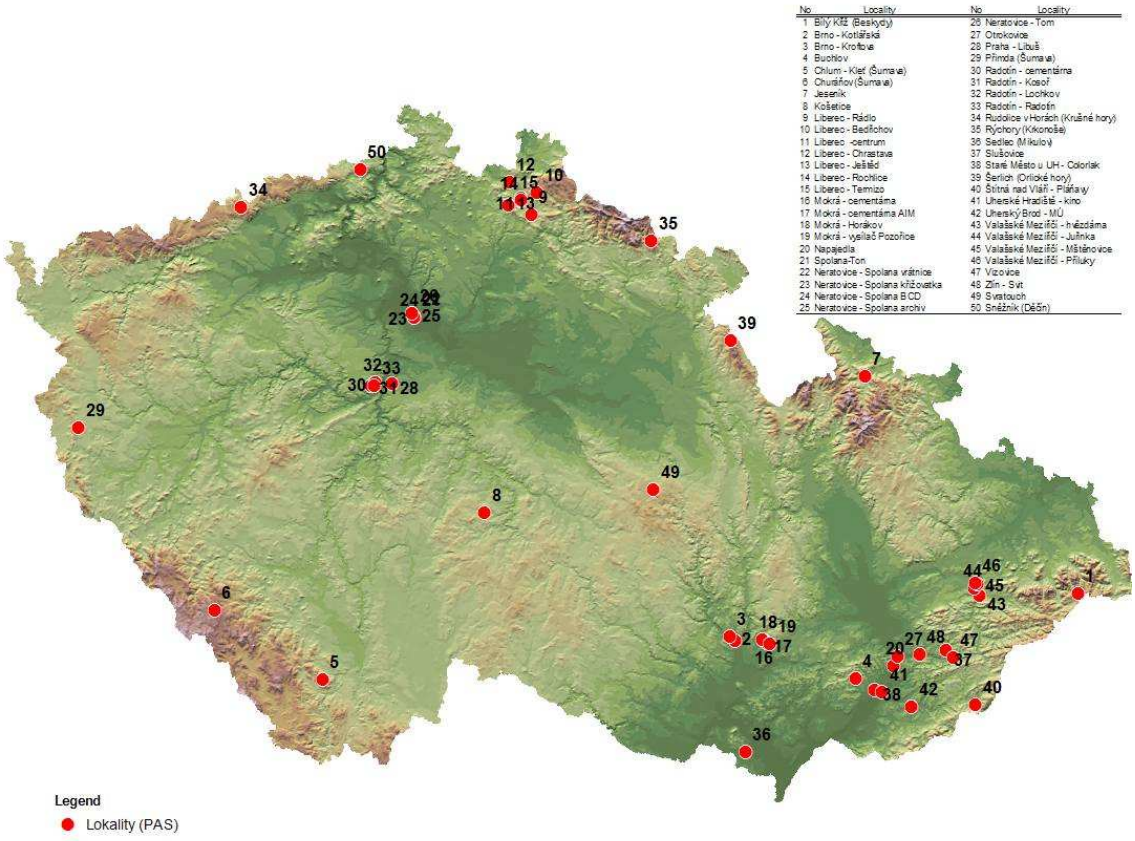

Figure 2: Sampling sites in the Czech Republic, 2006

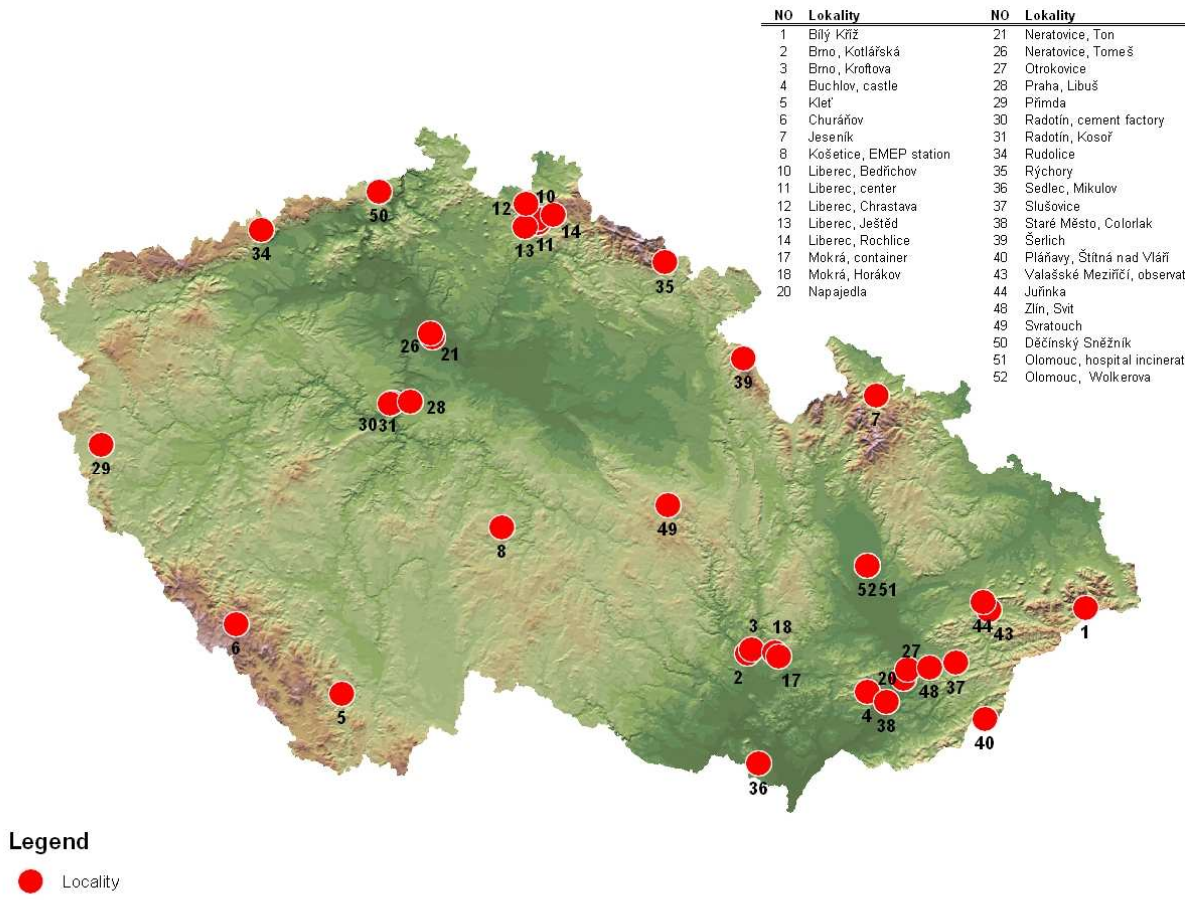

Figure 3: Sampling sites in the Czech Republic, 2007

4.4.2.2 MONET-CEECs sampling sites

Feasibility of the long-term application of passive air samplers for evaluation of the POP levels in the atmosphere was tested in frames of the **APOPSBAL project** (Klanova et al, 2007a). PUF based passive samplers were employed at 34 sampling sites for 5 consecutive periods of 28 days between July and December of 2004. The sampling design of previous high volume campaigns (Klanova et al., 2007a) was extended to cover a central part of Croatia (Zagreb) and Western Slavonia, the industrial, residential, and rural areas were included. Two sites in Kosovo were added to the network where an active air sampling proved to be difficult to organize as well as new background site in Serbia to learn more about the transport (Fruska Gora). Additional eighteen sites in the Czech Republic – including the background monitoring station in Kosetice serving as an EMEP observatory (Holoubek et al., 2001) – were sampled accordingly and they served as a reference region.

In 2006, the first phase of the MONET-CEEC project as an extension of MONET-CZ was initiated in eight countries from the CEE region. Sampling sites for the first phase have been selected in cooperation with the local partners in all participating countries. A background site was included in most countries as a potential candidate of background monitoring for the effectiveness evaluation of the Stockholm Convention. Whenever possible, gradient of other sites (rural, urban, and industrial) was developed also to address the range of contamination, possible sources and spatial variations. Soil samples were collected from the air sampling sites as a part of the study. A design of the study was synchronized with the Czech passive air monitoring network (MONET-CZ) which provides continuous data.

Sampling sites from **the first** (2006: Figure 4) **and second** (2007: Figure 5) **phases** of the project are presented in following Figures and Tables in Annex. Summary information on the sampling sites from the first phase (2006) is given in Table V-1 (Annex V), from the second phase (2007) in Table V-2 (Annex V) and from ongoing third phase (2008) in Table V-3 (Annex V).

Figure 4: MONET-CEECs, phase I, sampling sites in Central, Eastern and Southern Europe, 2006

Figure 5: MONET-CEECs, phase II, sampling sites in Central, Eastern and Southern Europe, 2007

4.4.2.3 Sampling procedure

Passive air sampling device consists of two stainless steel bowls attached to the common axes to form a protective chamber for the polyurethane foam filter. The filter is attached to the same rod and it is sheltered against the wet and dry atmospheric deposition, wind and UV light (Shoeib and Harner, 2002). Exposure times between four and twelve weeks enable determination of many compounds from the POP group. Average sampling rate was estimated to be 3.5 m^3 day^{-1}, which roughly corresponds to 100 m^3 of the air sampled during four weeks of deployment.

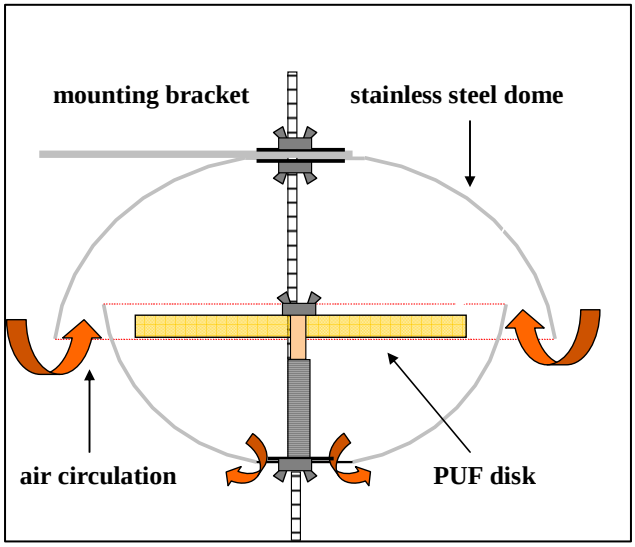

Figure 6: Scheme of the passive air sampling device

Previous **RECETOX studies** (Cupr et al., 2006, Klanova et al., 2006, 2007a) confirmed that PAS are sensitive enough to mirror even small-scale differences, which makes them capable of monitoring of spatial, seasonal and temporal variations. Passive samplers can be used for point sources evaluation in the scale of several square kilometers or even less - from the local plants to diffusive emissions from transportations or household incinerators - as well as for evaluation of diffusive emissions from secondary sources. While not being sensitive to short time accidental releases passive air samplers are suitable for measurements of long-term average concentrations at various levels.

Passive air samplers consisting of the polyurethane foam disks (15 cm diameter, 1.5 cm thick, density 0.030 g cm^{-3}, type N 3038; Gumotex Breclav, Czech Republic) housed in the protective chambers were employed in this study. Theory of passive sampling using similar devices was described elsewhere (Harner et al., 2004; Shoeib and Harner, 2002). Sampling chambers were pre-washed and solvent-rinsed with acetone prior to installation. All filters were pre-washed, cleaned (8 hours extraction in acetone and 8 hours in dichloromethane), wrapped in two layers of aluminum foil, placed into zip-lock polyethylene bags and kept in the freezer prior to deployment. Exposed filters were wrapped in two layers of aluminum foil, labeled, placed into zip-lock polyethylene bags and transported in cooler at 5 °C to the laboratory where they were kept in the freezer at –18 °C until the analysis. Field blanks were obtained by installing and removing the PUF disks at all sampling sites.

4.4.2.4 Sample analysis

All samples were extracted with dichloromethane in a Büchi System B-811 automatic extractor. One laboratory blank and one reference material were analyzed with each set of ten samples. Surrogate recovery standards (*d8*-naphthalene, *d10*-phenanthrene, *d12*-perylene for PAHs analysis, PCB 30 and PCB 185 for PCBs analysis) were spiked on each filter prior to extraction. Terphenyl and PCB 121 were used as internal standards for polyaromatic hydrocarbon (PAH) and polychlorinated biphenyl (PCB)/ organochlorine pesticide (OCP) analyses, respectively. Volume was reduced after extraction under a gentle nitrogen stream at ambient temperature, and fractionation achieved on a silica gel column; a sulphuric acid modified silica gel column was used for PCB/OCP samples. Samples were analyzed using GC-ECD (HP 5890) supplied with a Quadrex fused silica column 5% Ph for PCBs: PCB 28, PCB 52, PCB 101, PCB 118, PCB 153, PCB 138, PCB 180, and OCPs: α-hexachlorocyclohexane (HCH), β-HCH, γ-HCH, δ-HCH, 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene (*p,p´*-DDE), 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethan (*p,p´*-DDD), 1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethan (*p,p´*-DDT), *o,p´*-DDE, *o,p´*-DDD, *o,p´*-DDE, hexachlorobenzene (HCB), and pentachlorobenzene (PeCB). 16 US EPA polycyclic aromatic hydrocarbons were determined in all samples using GC-MS instrument (HP 6890 - HP 5972) supplied with a J&W Scientific fused silica column DB-5MS (Klanova et al., 2006xx).

4.4.2.5 Quality Assurance / Quality Control

Recoveries were determined for all samples by spiking with the surrogate standards prior to extraction. Amounts were similar to detected quantities of analytes in the samples. Recoveries were higher than 76 % and 71 % for all samples for PCBs and PAHs, respectively. Recovery factors were not applied to any of the data. Recovery of native analytes measured for the reference material varied from 88 to 103 % for PCBs, from 75 to 98 % for OCPs, from 72 to 102 % for PAHs. Laboratory blanks were under the detection limits for selected compounds. Field blanks consisted of pre-extracted PUF disks and they were taken on each sampling site. They were extracted and analyzed in the same way as the samples, and the levels in field blanks never exceeded 3% of quantities detected in samples for PCBs, 1% for OCPs, 3% for PAHs, indicating minimal contamination during the transport, storage and analysis (Klanova et al., 2007b).

4.4.3 Global Atmospheric Passive Sampling (GAPS) Network

4.4.3.1 Introduction

The GAPS Network is a key program producing comparable global-scale data for POPs. This program was initiated in December 2004 as a two-year pilot study covered by the Environment Canada before evolving into a network consisting currently of more than 60 sites on seven continents. Its objectives are to i) demonstrate the feasibility of passive air samplers (PAS) for the POPs monitoring; ii) determine spatial and temporal trends of POPs in air; and iii) contribute useful data for assessing regional and global long-range atmospheric transport of POPs. Deployment of PAS worldwide over the period of several years will allow an assessment of temporal trends and thus, the effectiveness evaluation of the POPs control measures.

4.4.3.2 Sampling sites

The first year results (January–December 2005) from the Global Atmospheric Passive Sampling (GAPS) Network provide baselines of air concentrations for persistent organic pollutants (POPs) at three sampling sites in the Eastern Europe region.
The GAPS Network has been active at three sites in Eastern Europe since 2005 – see Figure 7 and Table 6.

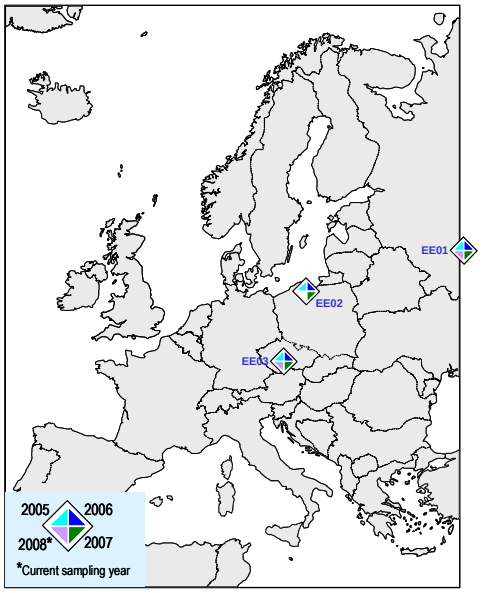

Figure 7: GAPS sampling sites and years in Eastern Europe

Table 6: Detailed information on the GAPS sampling sites in Eastern Europe (PO = polar; BA = background; RU = rural; AG = agricultural and UR = urban)

Site ID	Location	Country	Site Type	Latitude	Longitude	Elevation (m a.s.l.)
EE01	Danki	Russia	RU	54° 54' 00" N	37° 48' 00" E	180
EE02	Pomlewo (near Gdańsk)	Poland	RU	54° 12' 55 N	18° 22' 29 E	
EE03	Kosetice	Czech Republic	BA	49° 35' N	15° 05' E	534

4.4.3.3 Sampling procedures

Two types of PAS (Figure 8) have been used at the GAPS sampling sites. The **PUF-disk sampler** is deployed for three-month periods to capture seasonal differences and the **XAD sampler** is exposed for a full year.

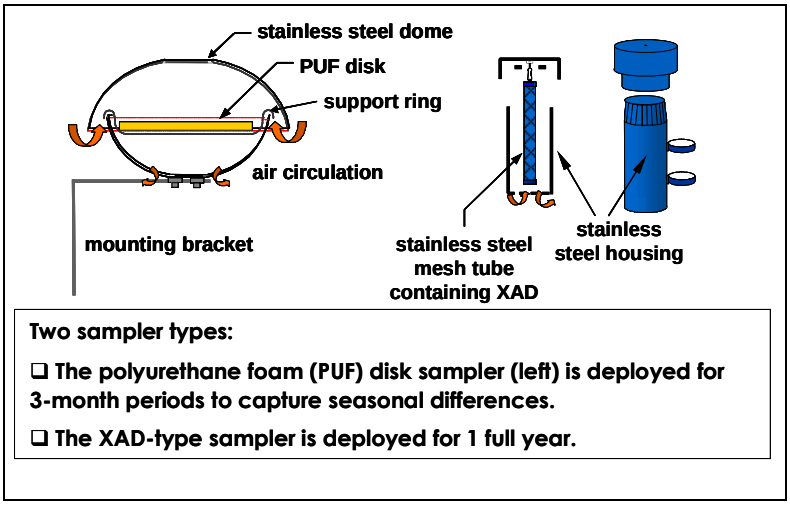

Figure 8: Schematic diagrams of two passive air samplers

The PUF-disk sampler is described in Shoeib and Harner (2002) and Pozo et al. (2006) and the **XAD sampler** in Wania et al. (2003). Both types of PAS are installed outdoors far away from potential sources of contamination to the site (e.g., exhaust vents, electronics, and sources of combustion or human activities). They are mounted approximately two meters above the ground in an open area with unobstructed airflow.

4.4.3.3.1 PUF Disk PAS

Details for the extraction and analysis of the PUF-disk samples and field blanks are given in Pozo et al. (2006). The following QA/QC procedures were employed for the PUF-disk sampler:

- Field blanks – A PUF disk field blank was collected once a year from each site to assess possible contamination caused by shipping, handling and storage.
- Method blanks – A solvent blank was extracted with every set of eight samples to assess possible contamination during the laboratory analysis (i.e., from sample preparation to instrumental analysis). One sample from each batch was also extracted and checked for purity during the PUF disk clean-up for deployment
- Instrument blanks – A solvent blank was analyzed with every set of twelve field samples to assess any instrument contamination.
- Surrogate spikes – Prior to extraction, PUF-disk samples were spiked with a method recovery standard consisting of 13C-PCB-105, d6-α-HCH, and d8-*p,p'*-DDT to confirm analytical integrity.
- Matrix spikes – Analytical (method) recoveries were determined by spiking clean PUF disks with known quantities of the target chemicals and treating them as samples to assess matrix effects on extraction efficiencies.
- Field collocated samples – Duplicate samples were collected at several sites in the GAPS Network to assess overall precision of both sampling and laboratory methods.
- Mirex was added as an internal standard to correct for volume differences in sample extracts.

All samples and field blanks were quantified for target compounds including organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs). OCPs, PCBs, and PBDEs were analyzed on a Hewlett-Packard 6890 gas chromatograph-5973 mass spectrometer (GC-MS)

using electron impact (EI) for PCBs and negative chemical ionization (NCI) for OCPs and PBDEs in the selected ion monitoring mode.

4.4.3.3.2 XAD PAS

Cleaning of XAD-2 resin, and packing of XAD PAS samples were carried out as described previously by Wania et al. (2003).

The XAD-2 resin was Soxhlet extracted with dichloromethane for 20 hours. Prior to extraction, the resin was spiked with standards consisting d6-α-HCH, 13C10-HEPX, 13C10-TN, 13C12-dieldrin, d8-*p,p'*-DDT and 13C12-PCB-32, 13C12-PCB-77, 13C12-PCB-118 and 13C12-PCB-126 to test for the loss of the compounds during the extraction and clean-up procedures. The extracts were volume reduced using a rotary evaporator and concentrated to around 1 ml using a gentle stream of nitrogen. The extracts from the first year samples were cleaned using alumina columns, but not those from the second year. After reducing samples to 3 ml using a rotary evaporator, the extracts from second year samples were passed through sodium sulfate (baked at 450 °C overnight) columns to remove any water present in sample. The extracts from the first year air samples were cleaned on a column with 1 g of 6% deactivated alumina (baked at 450 °C overnight) and 0.5 cm of sodium sulfate. The samples were eluted with 20 ml of DCM: PE (5:95; v/v). The extracts were concentrated to 1 ml using a stream of nitrogen and then the extracts were solvent-exchanged to isooctane. The final volume of the extracts was 1 ml, and 100 ng of mirex was added to the sample as an internal standard for correcting volume differences in the sample.

4.4.3.4 Analytical procedures

The sample and blank (field and laboratory) extracts were analyzed for the Stockholm Convention POPs as well as pesticides not classified under Stockholm Convention using an Agilent 6890 gas chromatograph (GC) coupled to a 5973 mass selective detector (MSD) with a negative chemical ionization source for organochlorine pesticides (OCPs) in selected ion mode. The analyzed non-Stockholm Convention pesticides in air samples were: α-HCH, γ-HCH, α-endosulfan, β-endosulfan, endosulfan sulfate, dacthal, chlorothalonil, pendimethalin and trifluralin.

4.4.3.5 QA/QC procedures

Quality assurance and control measures were used to monitor all analytical procedures. Field blanks were collected to determine the levels of contaminants introduced by handling, shipping and storage and one laboratory blank was analyzed for every set of sample extractions to determine the levels of contaminants introduced during extraction and clean-up. The laboratory blanks and field blanks were processed in the same way as the samples. Air samples were not spiked with surrogates for the pesticides that are not classified under the Stockholm Convention POPs, such as chlorothalonil, dacthal, metribuzin, pendimethalin, and trifluralin. To test for the loss of these compounds during the extraction and clean-up procedure, six samples of 20 g of XAD-2 were spiked with the pesticides, then extracted and cleaned in the same way as the samples.

All PUF-disk samples were prepared and analyzed in the same laboratory (Hazardous Air Pollutants (HAPs), Environment Canada in Toronto) to ensure that the data can be compared spatially and temporally. The HAPs laboratory participates in international intercalibration studies for POPs and performs well in these exercises.

4.4.3.6 Data storage

Sample extracts were capped tightly in GC vials and stored in a freezer at a temperature of about -20°C. Air concentration results and relevant sample information (e.g. sample ID, site ID, location name, sample duration, meteorological conditions etc.) are recorded in Excel spreadsheets.

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4.4.5 Monitoring of Human Milk for Persistent Organic Pollutants in the framework of the WHO survey

4.4.5.1 Background

Since the mid-seventies, **WHO in collaboration with UNEP** has implemented the food component of the Global Environment Monitoring System (GMES/Food) that collects, collates and evaluates data on the levels and trends of contaminants in food and human milk. These contaminants include the organochlorine pesticides, which were the initial focus of attention. Starting in the 1980s WHO coordinated several surveys

on the levels of dioxin-like polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). These surveys were carried out in collaboration with other international organizations and national institutions. They aimed to prevent and control an exposure to these chemicals through food and concentrated particularly on the health risk of infants exposed to contaminated human-milk.

More recently, the **WHO protocol** has been revised to include the objective of providing accessible, reliable and comparable data on levels of POPs in human milk for purposes of the Stockholm Convention. The latest protocol (used for the ongoing 4th survey) is different from the early protocols because it: a.) emphasizes the protection, promotion and support of breastfeeding; b.) specifies a minimum of 50 donors for one pooled sample, and; c.) includes the analysis of all 12 POPs currently covered by the Convention. The latest version of WHO Guidelines (1 October 2007) is currently available at: http://www.who.int/foodsafety/chem/POPprotocol.pdf.

WHO noted that the following CEE countries were involved in the 4th round human milk biomonitoring program: Czech Republic, Hungary and Slovak Republic. While previously the program covered only dioxins, furans and dioxin-like PCBs, the 4th round covers all 12 POPs under the Stockholm Convention. 3rd round data (Bulgaria, Croatia, Czech Republic, Hungary, Romania, Russian Federation, Slovakia and Ukraine) are currently available and 4th round data should be available in 2008.

4.4.5.2 Sampling

In order to promote reliability and comparability, participating countries are encouraged to adhere as closely to WHO protocol as possible. However, it has been also recognized that the situation in countries varies considerably and some flexibility is necessary. Guidance has been provided to assist countries in developing their national protocols, including:

Number of donors: A minimum of 50 individual donors should each provide 50 ml of human milk for the pooled sample. One additional participant per each million of population over 50 million is recommended for the large countries. In some cases, more than one pooled sample may be needed. On the other hand, a lower number of samples may be necessary for the small countries.

Strategies for selecting donors: Interviewing of potential donors can take place at pre- or post-natal or well-baby clinics. The stratification of donors should represent a presumed national exposure profile of each country. This would include consideration of diet, occupational exposure, rural and urban residence and proximity to potential POPs releasing activities such as industries and waste sites.

Biosafety: In general, the handling of any milk sample should comply with the biosafety rules to protect workers who handle the samples. The laboratory has to know whether known HIV-positive donors are included and whether the precautionary measures (decontamination by heating) have already been taken.

One of the criteria for selecting women as potential donors is that both the mother and infant should be apparently healthy with a normal pregnancy. The reason for this criterion is to avoid extra demands on a mother who is already experiencing difficulties and to minimize results that may be caused by medical conditions (for example, sudden loss of weight may alter the body burden of POPs and levels in human milk). Consequently, donors with previously diagnosed clinical hepatitis, malaria, AIDS and other such diseases should be excluded from the study. In many countries, pregnant women are screened for a number of infectious diseases so that their health status can be evaluated.

In countries which have established HIV screening of pregnant women, the National Coordinator should decide whether HIV-positive donors should be excluded from the study. In this regard, potential weight loss of donors could be an issue as well as the biosafety of the samples. In some countries, discrimination based on HIV status is not allowed legally and in certain countries, a person's HIV status is considered confidential. While the infectivity of human milk from HIV-positive mothers is considered low when ingested by infants, for the purpose of this study, such milk should be considered infectious unless it is decontaminated. Therefore, any milk sample known or suspected to be contaminated with HIV should be decontaminated by heating at 62.5 °C for 30 minutes. Similarly for countries with HIV morbidity and no HIV screening, human milk samples should be considered contaminated and heat-treated as above.

Consequently, the sampling protocol will vary among countries and therefore, comparison of results between countries should be approached with caution. However, once the national protocol is established, it should be applied in subsequent rounds so that changes/trends can be identified. In these cases, observation of temporal trends should be scientifically valid provided information on distribution of levels in the individual samples is available.

4.4.5.3 Sample analytical procedures

4.4.5.3.1 PCDDs, PCDFs and PCBs

Three groups of compounds (PCDDs/PCDFs, dioxin-like PCBs and marker PCBs) were determined by high resolution mass spectrometry (HRMS) methods. Dioxin-like PCBs comprise non-ortho PCBs (77, 81, 126 and 169) and mono-ortho PCBs (105, 114, 118, 123, 156, 157, 167 and 189); marker PCBs (also called "Indicator PCB") are PCB 28, 52, 101, 138, 153 and 180. Some countries also include PCB 118 (which otherwise is a dioxin-like PCB) in these marker PCBs

After freeze-drying of the whole sample, fat and contaminants of interest are extracted in a hot extraction device ("Twisselmann extractor") with ethanol/toluene (70/30) for 8 hrs. After evaporation of the solvent, the crude extract contains polar co-extractives which are removed by solving the residue in butyl methyl ether. This gives the purified fat after evaporation. An aliquot of the purified fat is spiked with 13C-labeled internal standards - all 17 PCDD/Fs with 2,3,7,8-chlorine substitution, 5 non-ortho PCBs (37, 77, 81, 126, 169), 10 mono-ortho PCBs (28, 60, 105, 114, 118, 123, 156, 157, 167 and 189) and 10 di-ortho PCBs (52, 101, 138, 141, 153, 170, 180, 194, 206 and 209). Gel permeation chromatography on Bio Beads S-X3 removes fat. A silica column impregnated with sulfuric acid removes remaining oxidizable substances. A florisil column separates PCDDs/Fs from PCBs. The PCDDs/Fs purification on a Carbopack B column (Gilson Clean up System) is fully automated or it is performed manually on a Carbopack C-column.

After addition of 1,2,3,4-13C12-TCDD, PCDD/F determination is performed using a HRGC/HRMS (Fisons Autospec; resolution 10,000; DB5-MS). PCBs separation on a Carbopack B-column (Gilson Clean up System) into three fractions of di-ortho PCBs (elution with hexane), then mono-ortho PCBs (elution with hexane/toluene; 92.5/7.5) and finally non-ortho PCBs (reversed elution with toluene) is fully automated. After addition of 13C12-PCB 80, various PCB groups are determined using a HRGC/HRMS (Fisons Autospec; resolution 10,000; DB5-MS) in three separate runs.

4.4.5.3.2 POP pesticides

The milk samples were analyzed for the **POP pesticides** including aldrin, dieldrin, sum of chordane, sum of DDT, sum of endrin, sum of heptachlor, hexachlorobenzene (HCB), mirex, and toxaphene (Parlar congeners).

Fat and POPs of interest were extracted from freeze-dried human milk samples as described above for PCDDs, PCDFs and PCBs. Up to 0.5 g of the fat extract was re-dissolved in cyclohexane/ethyl acetate and the internal standards (2,4,5-Trichlorobiphenyl and Mirex), solved in cyclohexane, were added.

The applied clean up-parts of the analytical method followed the principles of the European standardized methods for the pesticide residue analysis "Fatty food – Determination of pesticides and PCBs", EN 1528 part 1-4, 1996-10 (confirmed 2001). To remove the fat, gel permeation chromatography was performed on a chromatography column using Bio-Beads S-X3 with cyclohexane/ethyl acetate as eluting solvent. After concentration and transfer into iso-octane, chromatography on a small column of partially deactivated silica gel was used as a final clean up step with toluene as eluent.

Determination was performed with GC/ECD using a GC (Fisons Mega 2) with two parallel columns of different polarity (fused silica no. 1: 30 m PS-088 [97.5% Dimethyl-2.5% diphenyl siloxane copolymer], 0.32 mm i.d., 0.32 µm film thickness, fused silica no. 2: 30m OV-1701-OH, 0.32 mm i.d., 0.25 µm film thickness, both columns custom-made). Results were confirmed by GC-LRMS (GC: HP 6890 / MS: HP 5973; 30 m HP5-MS, 0.25 mm i.d., 0.25 µm film thickness + 2.5 m pre-column; detection mode: MSD-EI). The limit of quantification (LOQ) was 0.5 ng g^{-1} fat.

4.4.5.4 Data comparability

To ensure reliability of exposure data and to improve comparability of analytical results from different laboratories, WHO has coordinated a number of inter-laboratory quality assessment studies. A study on levels of PCBs, PCDDs and PCDFs in human milk was conducted between February 1996 and April 1997, with the objective of identifying laboratories, whose results could be accepted by WHO for exposure assessment studies (Malisch et al., 2000; WHO, 2000). Only the State Institute for Chemical and Veterinary Analysis of Food (CVUA, Chemisches und Veterinäruntersuchungsamt) in Freiburg, Germany, met all the pre-set criteria for analyses of PCDDs, PCDFs, dioxin-like PCBs, marker PCBs and fat in human milk and was thus selected as the WHO Reference Laboratory for the third and fourth round of the WHO human milk studies. This institute was selected also as the Community Reference Laboratory (CRL) for the European Union for determination of dioxins and PCBs in feed and food and for determination of pesticides in food of animal origin and commodities with high fat content (Commission Regulation (EC) No. 776/2006 of 23 May 2006 amending Annex VII to Regulation (EC) No 882/2004 of the European Parliament and of the Council as regards Community reference laboratories; Official Journal of the European Union of 24.5.2006, L 136/3-8).

As noted above, the protocol for collection of samples may vary from country to country and therefore, data comparison between the countries is not advised without a review of the national protocols. However, temporal trends should be possible based on the use of a consistent protocol for collection and handling of samples and on stringent criteria to assure that analytical quality assurance and control over the long periods of time.

It should also be noted that calculation of levels of PCDDs, PCDFs and dioxin-like PCBs may be slightly different in earlier surveys, which used international toxic equivalence factors (I-TEQs) when compared to more recent surveys using the WHO toxic equivalence factors (WHO-TEQs). The limited sampling plan of older studies is yet another reason why the levels reported earlier should only be considered as indicative of exposures.

4.4.5.5 Data storage

Data are stored at the GEMS/Food database located at WHO in Geneva, Switzerland and is password-accessible through the WHO Summary Information and Global Health Trends (http://SIGHT) portal.

5 RESULTS

5.1 Ambient air

5.1.1 Active sampling

5.1.1.1 EMEP - results

Although the ambient air and wet deposition measurements have been carried out **since 1988 at Košetice observatory**, only POP data from the **last twelve years (1996-2007)** were used for the evaluation of the long-term trends mainly due to the comparability of the sampling and analytical techniques (Holoubek et al., 2007).

The ranges of measured air concentrations for all POP groups, their means, medians, minima, and maxima in the period of ten years are presented in Table 7. The maximum **PAH** air concentrations reached as high as hundreds of nanograms per cubic meter for the sum of 16 PAHs in each, gas and particulate phase (median 8 ng m^{-3}, and 2 ng m^{-3} for a gas, and a particulate phase, respectively). On the contrary, all groups of chlorinated compounds stayed at the maximum levels of hundreds of picograms per cubic meter. While a significant portion (up to 50 %) of PAHs was associated with the particles and captured on the quartz filter, almost entire amount of chlorinated compounds was present in the gas phase.

We are, however, aware that particle phase constituents can be slightly under estimated due to the common high volume sampling artifact. Regarding the individual compounds, phenanthrene (median: 4 ng m^{-3}, maximum: 31 ng m^{-3}) and fluorene (median: 2 ng m^{-3}, maximum: 23 ng m^{-3}), were found to be the most abundant PAHs in the gas phase, fluoranthene (median: 0.5 ng m^{-3}, maximum: 19 ng m^{-3}), pyrene (median: 0.5 ng m^{-3}, maximum: 13 ng m^{-3}), and phenanthrene (median: 0.3 ng m^{-3}, maximum: 15 ng m^{-3}) reached the highest levels on the particles. There was no significant predominance of any **PCB congener** in the air; the measured concentrations of **γ-HCHs** were approximately two times higher than those of **α-HCH**, and the ***p,p'*-DDE** levels where almost a half order of the magnitude higher than those of ***p,p'*-DDT.** Prevalence of **DDT metabolites** in the ambient air (observed also in the samples of other environmental matrices) (Holoubek et al. 1998a, b; 2000a, b, c; 2001; 2005) suggests that old burdens rather than a long-range transport are responsible for the levels of DDT compounds in air.

A typical seasonality in the atmospheric POP concentrations can be seen in Figures 9-13. The PAH levels show a characteristic pattern (Figure 9) prompted by higher occurrence of these compounds in the cold seasons when they are produced by various combustion processes.

Highest atmospheric **PAH** levels found in January and February were as much as three orders of magnitude higher than the lowest ones measured in July and August. January monthly means varied between 22 and 86 ng m^{-3}, while those of July stayed between 1 and 4 ng m^{-3}.

PCB and OCP concentrations displayed a very different profile (Figures 10-13). Most of these compounds were banned in Europe and their maxima are not connected to their production or seasonal

application. They are present in the atmosphere due to their volatilization from the old deposits (soils, sediments, wastes) or possibly due to a long-range atmospheric transport from regions where they are still applied. In agreement with this hypothesis, elevated levels of chlorinated compounds can be observed during the summer when increasing temperatures enhance the evaporation of these chemicals from the old burdens. Even though this seasonality is not as well pronounced as it is in the case of PAHs, it can still be detected for PCBs in Figure 8, and for pesticides in Figures 10 and 11.

Table 7: POP concentration, Košetice observatory, 1996-2007

Matrix (Media) Unit	Species	Mean	Median	Min	Max
Air (PUF) ng.m^{-3}	Σ PAHs	11.9	7.6	0.178	208.9
	Σ PCBs	0.071	0.061	BQL	0.390
	Σ HCHs	0.063	0.043	BQL	0.771
	Σ DDTs	0.033	0.027	0.001	0.207
	HCB	0.121	0.097	BQl	0.831
Air (QF) ng m^{-3}	Σ PAHs	5.3	2.0	0.029	358.8
	Σ PCBs	0.028	0.019	BQL	0.215
	Σ HCHs	0.008	0.003	BQL	0.104
	Σ DDTs	0.004	0.002	BQL	0.050
	HCB	0.003	0.002	0.001	0.134

BQL = bellow quantification limit. Quantification limit is 1 pg.m^{-3} for the individual compounds in ambient air.

The annual median concentrations were calculated for all POP subgroups (PAHs, PCBs, DDTs, HCHs and HCB) in the air, and resulting ten annual values for the period of 1996-2007 were compared to evaluate the long-term trends for each group of compounds (Figure 14). The analysis revealed time related changes in the amounts of chemical species. An interesting time development can be seen for the sum of 16 PAHs in the atmospheric gas phase (Figure 9): very pronounced decrease between 1996 and 2000 was followed by an increase in 2001-2002. This effect probably reflects the local economic situation in the Czech Republic where growing prices of gas in 2001 brought back the coal and wood combustion in local heating systems. Similar trend can be identified for the particulate phase as well as the wet deposition.

The annual medians of PCBs also indicate a general decreasing trend interrupted by two periods of higher concentrations (Figures 10, 14): 1997-1998 and 2000-2001. As can be seen from Figure 10, there are significantly elevated summer maxima of PCB concentrations in 1997 and 1998 (maxima 390 pg m^{-3} and 337 pg m^{-3} for the sum of 7 PCB congeners in 1997 and 1998, respectively). In contrast, summer maxima between 2000 and 2001 were lower (167 pg m^{-3} and 246 pg m^{-3}) but due to the higher winter minima (52 pg m^{-3} - same as in 1998), the annual medians remained quite high. Interestingly, in the 2000-2001 periods there was also significant fraction of particle associated PCBs (Figure 10). On the contrary, high summer maxima were observed in 2002 and 2003 (366 pg m^{-3} for the sum of 7 congeners) but due to the low winter levels, it was not reflected in the annual medians.

Figure 9: Σ PAHs in ambient air, Košetice observatory, 1996-2007

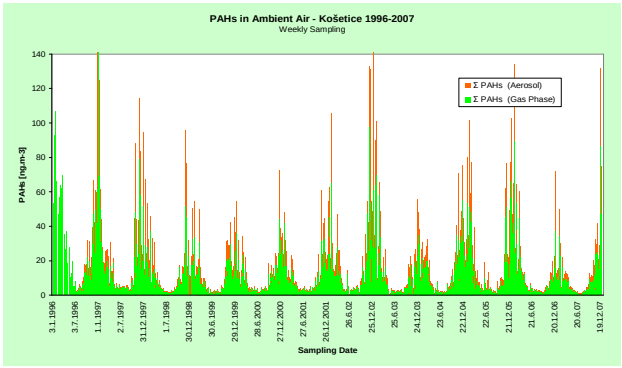


Figure 10: Σ PCBs in ambient air, Košetice observatory, 1996-2007

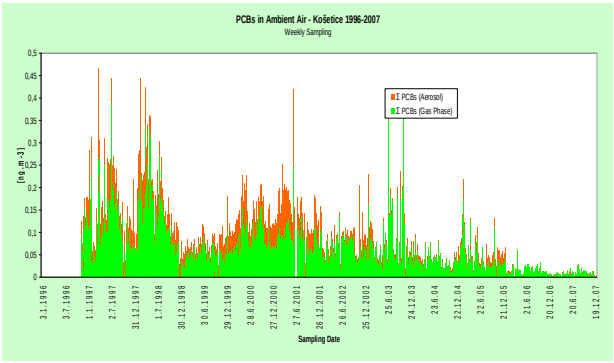


Figure 11: Σ DDTs in ambient air, Košetice observatory, 1996-2007

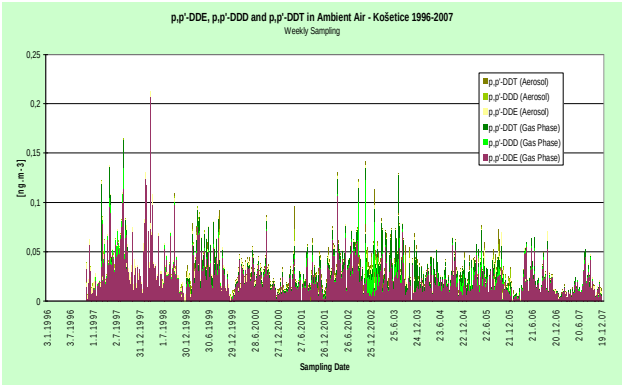


Figure 12: Σ HCHs in ambient air, Košetice observatory, 1996-2007

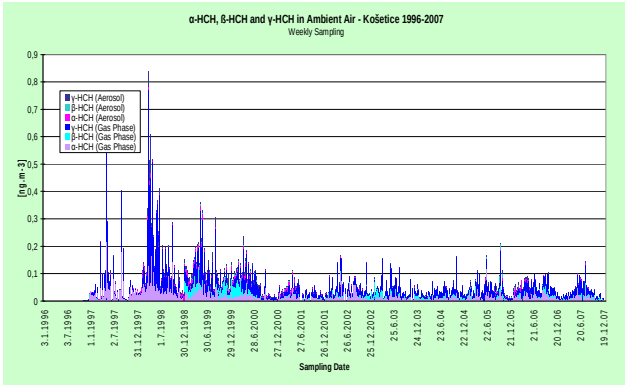
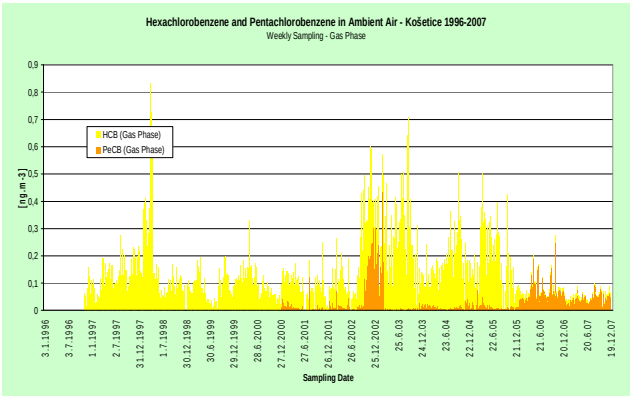


Figure 13: HCB and PeCB in ambient air, Košetice observatory, 1996-2007



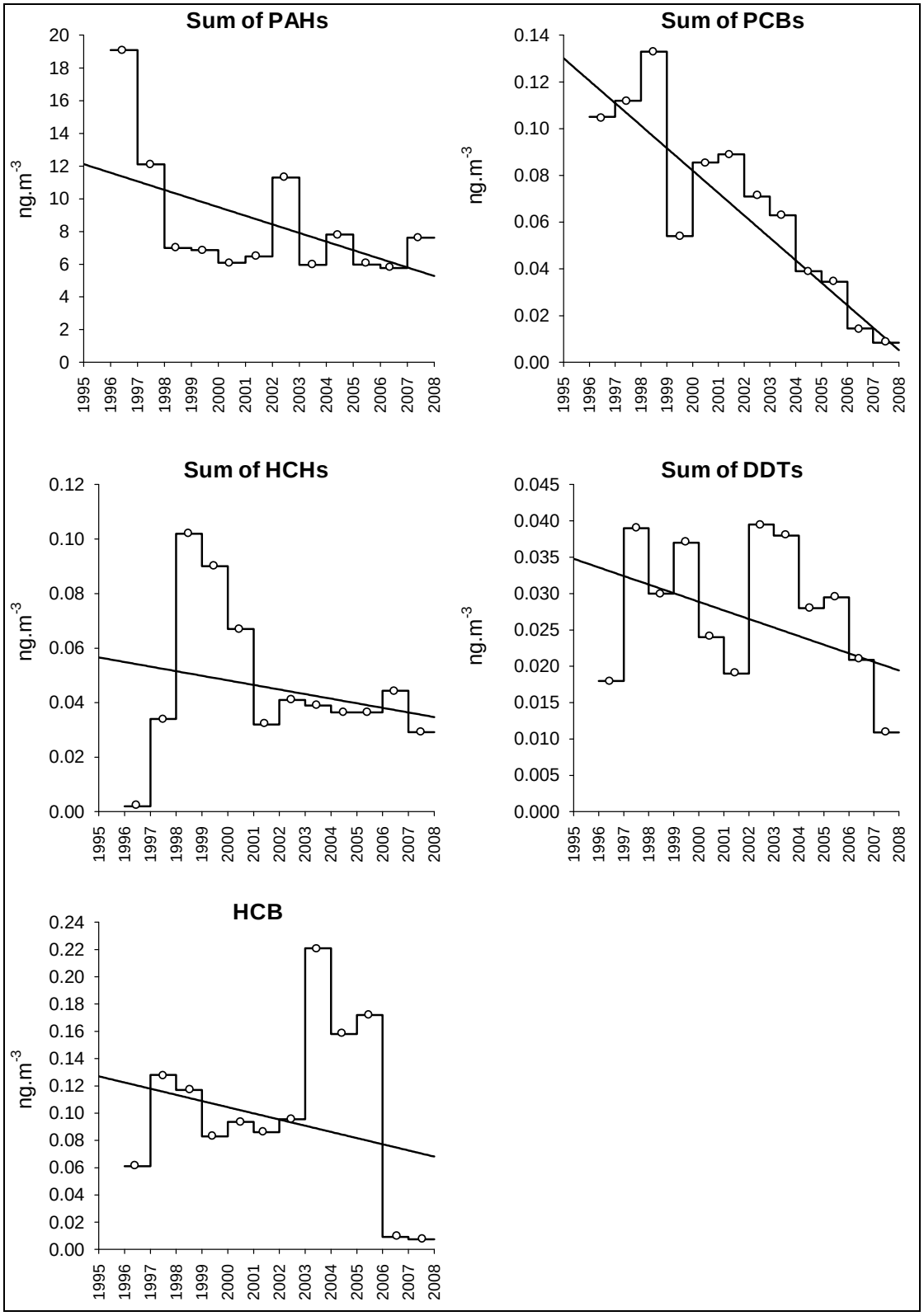


Figure 14: Temporal trends of POPs in air, the gas phase. The line represents a linear trend estimate.

These fluctuations in the annual medians of PCBs may reflect the major flood events in the Czech Republic in 1997 and 2002. A large area of central and southern Moravia (to the east from Kosetice) was flooded in 1997, including the industrial and agricultural facilities where various chemicals were stored. The floods were followed by extremely hot summer therefore those chemicals could evaporate from impacted areas and be a subject of the atmospheric transport. Similarly, the central part of Bohemia (to the west from Kosetice, Prague included) was flooded in 2002. Several large chemical enterprises located to the north of Prague were severely damaged and variety of chemicals escaped to the surface waters and was distributed with the flood. According to the results of our previous research which focused on the impact of these flood events on aquatic and terrestrial environments (Hilscherova et al., 2007), one of the effects of floods is a re-distribution of the old burdens from the river sediments to the surface layers of the soils that were flooded.

Semi-volatile persistent organic compounds can easily re-evaporate from these top soil levels during the warm season. This is probably the source of elevated atmospheric concentration of chlorinated POPs in the years following these disasters. The reason why the floods in 1997 so significantly affected the background levels of PCBs, and the flood events in 2002 had much smaller impact, can be a character of the flooded regions. In 1997, the region with highest PCB levels in the environmental matrices (including the mother milk) in the Czech Republic was impacted. A paint factory located in this area (Colorlak) was the major consumer of PCB mixtures produced in former Czechoslovakia (Chemko Strazske) (Tanyiasu et al., 2004) under the commercial name Delor, and PCB-containing paints were heavily used in this region.

The same reasoning can be applied to explain the elevated levels of organochlorine pesticides over the same periods (Figures 11 and 12). **HCHs** exhibited extremely high levels in the summer of 1998, and gradually decreased in 1999 and 2000 (Figures 11 and 14). An elevated fraction of β-HCH was observed in 1999 and 2000 (Figure 11) suggesting that some old deposits of HCH technical mixtures or ballast HCH congeners were newly exposed. The levels have been stabilizing since 2001, showing only a typical seasonal variability.

DDTs followed the same pattern with very high summer maxima in 1997 and 1998 and the gradual decrease until 2001 (Figures 12 and 14). However, since the second increase in 2002-2003, the concentrations of DDT and its metabolites have stabilized at elevated levels. This is probably again connected to the flood events in 2002 when the chemical factories which earlier produced pesticides, agricultural enterprises, and pesticide storage facilities were affected and large amounts of pesticides escaped to the environment. However the influence of the local sources (evaporation from the soils or ponds) cannot be excluded. A new DDT fingerprint is typical with a less pronounced seasonal variability and the enhanced fraction of *p,p'*-DDD.

HCB is the only analyte which shows a statistically significant increasing trend in its air concentrations. We can still detect high summer air concentrations of HCB following the floods in 1997 but – similarly to DDT – floods in 2002 seem to have more lasting impact. The very high concentrations from 2002 and 2003 have only declined very slowly in the next few years. Thus, what seems to be an increasing trend in the statistical analysis of annual medians is most probably only a very slow recovery of the ecosystem from the severe impact of the natural disaster. At the same time, an extreme level of pentachlorobenzene as a degradation product of HCB was detected in 2002.

Between 1987 and 2004, there have been ten reports published by **EMEP** presenting data on POPs and heavy metals from national and international monitoring programs (Aas and Breivik, 2004, 2005, 2006). POPs were included in the EMEP's monitoring program in 1999; however, data for POPs have been reported only from countries around the North and Baltic Seas, in the Arctic and from the Czech Republic. In general, the concentrations decreased from the south to north, except for α-HCH where the

highest concentration was measured in 2004 in Svalbard, Norway (Zeppelin, 17 pg m^{-3}) and Finland (Pallas, 18 pg m^{-3}), followed by lower concentration in Sweden (Råö, 13 pg m^{-3}), Czech Republic (Košetice, 12 pg m^{-3}) and Iceland (Storhovdi, 5 pg m^{-3}) (Aas and Breivik, 2005). A presence of HCHs in the environments far away from sources can be attributed to long-range atmospheric transport. Preferential deposition and accumulation in the polar latitudes is to be expected according to the hypothesis on the global fractionation and cold condensation (Wania nd Mackay, 1996). Iceland, on the other hand, is influenced by westerly air masses, which may explain the lower concentrations. Similar monitoring study performed in the Great Lakes area (Integrated Atmospheric Deposition Network - IADN) (IADN, 2006) found the α-HCH concentration in Chicago area (Lake Michigan, 45 pg m^{-3}) lower than the one in Eagle Harbor (Lake Superior, 52 pg m^{-3}).

Concentrations of other POPs are much higher in the Czech Republic than those observed in the Nordic. For PCBs it is explained by the high historical usage in central Europe (Breivik et al., 2002) and production of PCBs in former Czechoslovakia in significant amounts until 1984 (Taniyasu et al., 2004). Concentration of, for instance, PCB 101 in Košetice was 7 pg m^{-3} in 2004, while it is only 1-2 pg m^{-3} in all the other stations. In the Great Lakes area, for comparison, concentration of 33 pg m^{-3} was measured for PCB 101 in Chicago while it was only 2 pg m^{-3} in Eagle Harbor (IADN, 2006).

Similar situation was observed for DDTs. DDE concentration as high as 21 pg m^{-3} was observed in Košetice while it was only 3 pg m^{-3} in Sweden, 1 pg m^{-3} in Finland or Svalbard, and bellow detection limit in Iceland. IADN program reported 20 pg m^{-3} of DDE in Chicago and 1 pg m^{-3} in Eagle Harbor (IADN, 2006).

Determination of PAHs in the air samples showed the levels of 5.9 ng m^{-3} for phenanthrene and 279 pg m^{-3} for benzo(a)pyrene in Košetice, 1.1 ng m^{-3} and 29 pg m^{-3} in Sweden, 470 pg m^{-3} and 33 pg m^{-3} in Finland, and 7 pg m^{-3} and 3 pg m^{-3} in Svalbard. At the Great Lakes, a concentration of 27.8 ng m^{-3} was measured for phenanthrene and 230 pg m^{-3} for benzo(a)pyrene in Chicago while it was only 480 pg m^{-3} and less than 1 pg m^{-3} in Eagle Harbor (IADN, 2006).

A significant effort connected to the long-term ambient air monitoring program in the Košetice observatory is also focused on source identification. Due to the prevailing western wind direction and the main sector of incoming air masses between 220° and 320°, major industrial and urban centers in the Czech Republic, i.e. Prague, Plzen, and Ceske Budejovice may act as source areas for Kosetice observatory. These sources, of course, only contributed towards the end of air parcels' traveling to the site. A detailed analysis of the wind trajectories and the origin of air masses is needed in order to identify other, more remote sources, and the main contributors to the atmospheric pollution at the background station. Those tasks are currently being addressed (Holoubek et al., 2007).

5.1.1.2 EMEP - Conclusions

Košetice observatory with more than a decade of consistent air monitoring data on POPs in the atmosphere represents an ideal Central European background station for the purpose of GMP. Data from twelve years of integrated monitoring at Košetice observatory were applied for an assessment of the long-term trends of POPs in ambient air in the European continental background. Most of the selected compounds exhibited decreasing trends in the last decade. This is consistent with data reported from other European sites (Aas and Breivik, 2006).

The results of this study demonstrated that the **long-term background monitoring** is not only an excellent way to study the regional levels and trends but also a **powerful tool** for evaluation of the impact of various local and regional events – from industrial accidents to natural disasters. As such, this

approach has the potential to play a crucial role in the implementation of regional and global measures and conventions on persistent toxic substances.

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5.1.1.4 AMAP

There are no available data from the AMAP program reporting on POPs in ambient air in the the CEE region.

5.1.1.5 National monitoring programs and international and national research projects

There are no available data from the national monitoring programs focused on POPs in ambient air the CEE region and suitable for the evaluation of the long-term trends with the exception of **the Czech Republic.** But some research projects produced or produce some long-term relevant information on POPs in ambient air.

In Slovakia, the initial measurements of PCDDs, PCDFs and PCBs in ambient air were realised in October 1996 – July 1997 within the Phare Project EU/93/AIR/22 (Stenhouse et al., 1998). The additional measurements of the Slovakia's ambient air concentration of PCDDs, PCDFs and dioxin-like PCBs (dl-PCBs) were performed in 2007 and data were compared to those of 10 years earlier.

In total, 20 ambient air samples were collected during two campaigns in March (mild winter) and June (summer) 2007 at five selected areas in Slovakia – Košice area – SW rural vicinity of Košice city (iron ore sintering in a metallurgical plant; municipal waste incinerator); Krompachy area (metallurgical plant processing copper scrap); Nemecká area (hazardous waste incinerator in a petrochemical plant); Šaľa area (hazardous waste incinerator in a chemical plant); Starina area (eastern Slovakia's background area around the Starina lake serving for drinking water production) – 2 sampling sites in each area. Air samplers were deployed in the back gardens of family houses.

An overview of concentrations of PCDDs, PCDFs and dl-PCBs expressed as WHO_{98}TEQs and summed 2,3,7,8-substituted PCDD and PCDF congeners determined in 10 air samples collected in March and 10 ones in June 2007 can be seen in Table 8 (the arithmetic mean, geometric mean and minimum and maximum values). Some of these parameters are also reported for air concentrations measured in 1997; 11 samples collected in winter and summer at sites similar to those in 2007 were selected. Although the 1997 samples were collected identically and analyzed also by HRGC/HRMS analytical sensitivity and selectivity was lower and much more individual PCDD/PCDF congeners findings were below the limit of detection. Nevertheless, after 10 years a certain drop in both TEQ and summed levels can be seen.

It is known that combustion of fossil fuels such as coal as well as wood or other biomass increases PCDD/PCDF emissions into air (Quass et al., 2004; UNEP, 2005). One of the important dioxin sources is residential heating because of its large scale, none or limited combustion control and no chimney gas cleaning. It is anticipated that in many countries the residential heating based on fossil fuels particularly in rural areas may be a dominant source of PCDD/PCDF emissions. Since the residential heating combusting natural gas has become the most expensive heating in Slovakia, the vast majority of family houses in rural areas have again begun to use dioxin-generating fossil fuels. Although an open burning (which is another important dioxin source) (Wewers et al., 2004) and combustion of garden and household waste has recently been banned in Slovakia, this regulation is often being broken.

Table 8: Basic statistical data on TEQ and summed congener concentrations measured in ambient air samples in Slovakia

	WHO_{98}TEQ (fg/m³)				**Sum (pg/m³)**			
	PCDDs	**PCDFs**	**PCDDs+Fs**	**dl-PCBs**	**2,3,7,8-substituted congeners**			**dl-PCBs**
					PCDDs	**PCDFs**	**PCDDs+Fs**	
2007								
Arith. mean	11.7	39.6	51.3	7.8	0.27	0.51	0.78	8.2
Geom. mean	6.9	19.9	27.0	6.2	0.14	0.22	0.37	6.4
Minimum	1.3	3.2	4.7	2.4	0.010	0.029	0.038	2.1
Maximum	72.0	257.5	329.4	26.5	1.06	4.48	5.54	25.3
1997								
Arith. mean			78.8				0.99	
Geom. mean			56.9				0.67	

Differences between $TEQ_{PCDDs/PCDFs}$ levels in the Slovak air samples taken in winter and summer are evident and confirm findings published previously (Grass and Mueller, 2004). In spite of atypically mild winter of 2006/2007, an influence of emissions from household heating systems is unambiguous. On average, winter $TEQ_{PCDDs/PCDFs}$ concentrations were 3- to 21-times higher than summer ones. Unlike PCDDs/Fs, summer summed dl-PCBs levels were 2- to 6-times higher (except one site) than winter ones. That corresponds with the fact that air-borne PCBs come from the environment rather than emissions. With several exceptions, the contribution of dl-PCBs to the total TEQs was lower than that of PCDDs/Fs. PCDF contribution to $TEQ_{PCDDs/PCDFs}$ was 2- to 6-times higher than that of PCDDs. Total solid particulate (TSP) concentrations (geom. mean: 33 μg m^{-3}; range: 14 – 86 μg m^{-3}) were higher in the air samples collected in winter at 8 sites out of 10 sampling sites. TSP concentrations measured at 11 sampling sites in 1997 were 50 μg m^{-3} (geom. mean), i.e. higher than those in 2007 likewise PCDDs/Fs (see Table 8). However, there is a low correlation (~ 0.4) between TSP concentrations and summed PCDDs/PCDFs or $TEQs_{PCDDs/PCDFs}$.

Mean $WHO_{98}TEQ_{PCDDs/Fs}$ and $WHO_{98}TEQ_{dl\text{-}PCBs}$ measured in 2002/2003 at 10 sample collection sites across Australia[5] ranged from 1.05 to 17.17 fg m^{-3} (min. 0.11 fg m^{-3} – max. 121.6 fg m^{-3}) and from 0.11 to 7.04 fg m^{-3} (0.02 – 12.34 fg m^{-3}), respectively, which is substantially less than found in Slovakia (see Table 8). Dioxin-like PCBs were determined in 11 air samples collected in 2002/2003 in Japan (Yokohama city) (Kim and Masunaga, 2005). Arithmetic mean, geometric mean, and minimum – maximum range were 4.6, 3.9, and 1.4 – 9.7 fg WHO_{98} $TEQ_{dl\text{-}PCBs}$ m^{-3} respectively. These values are about half of those measured in Slovakia. PCDD, PCDF and dl-PCB monitoring in California (Californian EPA) in 2002 – 2005 provided this range of mean annual values: 23 – 26 fg $WHO_{98}TEQ_{PCDDs/Fs}$ and 3.7 – 6.2 fg $WHO_{98}TEQ_{dl\text{-}PCBs}$ which are concentrations slightly lower than the Slovak values. Mean I-TEQ concentration calculated from monthly values within four-year monitoring (2004-2007) of PCDDs/PCDFs in Hong Kong (EPD Hong Kong) ambient air was 65 fg m^{-3}.

As for the additional measurements in the Czech Republic, several research studies in various regions of the country have led to establishment of a national air monitoring system, initiate in 1993 (Holoubek et al. 2003). A spatial distribution of the annual mean of PCDDs/Fs levels from 1996–2001 is demonstrated in (Holoubek et al. 2003). Annual means in the Czech Republic are quite constant over the last 5 years, they, however, differ significantly between 35 sampling sites included in the national monitoring.

Data for Bohemia (number of sites=20) show the range of contamination over the period of one year. Data from East Bohemia/Moravia represent variability between mean summer and mean winter levels of the PCDDs/Fs contamination at 17 sites over the period of the last 3 years. Background data reported from the Košetice observatory (number of sites =7) present mean and min-max levels of sampling campaigns in spring and summer 1995-2000. Data reported for the Zlin region show autumn means for 2001 and 2002 and a summer mean for 2003 (Holoubek et al., 2003).

In Poland, measurements of PCDDs/Fs concentrations in ambient air have been performed at 4 different sites in the surrounding of Krakow in southern Poland (Grochowalski et al. 1995, 1997). While contamination levels in the winter season (January-March) ranged between 950-12 000 fg I-TEQ m^{-3}, they decreased in 1995 to 2 580-5 740 fg I-TEQ m^{-3} in 1996. A control measurement in the summer season (June 1996) showed the levels up to 2 orders of magnitude lower (60-120 fg I-TEQ m^{-3}).

There are more data available on the air contamination with PCBs and OCPs than for PCDD/Fs. Majority of existing information is related to indicator PCBs in CEECs. Information on the air contamination is available for the Czech Republic, Slovakia, Poland, Latvia, Estonia, Lithuania and Slovenia.

In the Czech Republic, a research monitoring system consisting of 35 sites has been established, capable of providing information on the spatial distribution of contamination levels throughout the country. Annual means have ranged from 196 to 9 700 pg m^{-3} (Σ 6 PCBs) over the last five years. Local monitoring program

running in the city of Prague in 1994-95 showed distinct contamination differences between the sampling sites (79.5-3 018 pg m^{-3}).

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5.1.2 Passive sampling

5.1.2.1 MONET-CZ

5.1.2.1.1 Results and discussion

Results from the first two years (13 sampling periods, 28 days each) of the Czech passive air monitoring network project for 50 sampling sites in 2006 and 37 sampling sites un 2007 are presented in Annex VI (Tables VI-1 – VI-11). There were about 20 additional sites sampled in each year as a part of the specific local studies but they are not included in this report unless important for this study.

Annex VI gives detailed data on measured concentrations of PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 153, PCB 138, and PCB 180), OCPs (α- HCH, β-HCH, γ-HCH, δ-HCH, *p,p´*-and *o,p´*-DDE, DDD, and DDT, HCB, and PeCB), and polyaromatic hydrocarbons (16 US EPA) at each sampling site including their variations over 13 months. An overview of temporal and spatial fluctuations in the geographic information system maps is presented in Figures 15-28. It can be seen from figures that passive air sampling provides very good information on the spatial distribution of the POP contamination of ambient air.

For **PCBs**, elevated levels were found in the vicinity of Colorlak enterprise in Uherské Hradiště -Staré Město where PCBs were used in the large amounts in the paint production. Amounts of PCBs (7 congeners) sequestered in PAS filter varied between 12 and 76 ng per filter (since the passive sampler of this design samples about 100 cubic meters per 28 days, those values roughly correspond to 120 and 760 pg m^{-3}) (Figure

15, Table VI-1 for year 2006 and Figure 16 and Table VI-2 for year 2007). Levels were also higher (between 9 and 132 ng per filter) in Spolana Neratovice chemical factory where the soil is known to be contaminated with PCBs, and other industrial sites. On the other hand, the levels never exceeded 10 ng per filter significantly (100 pg m^{-3}) at most of the rural and mountain sites.

As to the **PCB congener distribution in ambient air**, PCB 153 was most abundant in all samples from Spolana and vicinity, followed by PCB 101 and PCB 138. Very similar situation was in the Colorlak paint factory and in Radotin. At other industrial sites (incinerators in Liberec or Olomouc, for instance), the volatile and non-volatile congeners had similar concentrations indicating the mixed sources, and PCB 28 dominated at most of the urban sites (Brno, Kotlářská, Brno, Kamenice, Zlín). Most volatile PCBs (PCB 28 and PCB 52) prevailed also in rural and mountain background samples.

Both, figures and tables demonstrate **the seasonal variability of the POP atmospheric concentrations.** PCBs reached their maxima in the warmer season due to the enhanced evaporation, however, their seasonality was not well pronounced at all sampling sites partially due to very low levels of organochlorines. This trend can be easily detected at industrial and urban sites (Spolana, Colorlak, Brno - Kotlářská) where the PCB levels increase 2-5 times in the summer when compared to the winter levels but they are not so significant at the mountain background sites distant to the sources of PCB evaporation.

Variabilities of the PCB concentrations can be seen in Tables VI-1 and VI-2, where the minima, maxima, mean and median values from all sites and all campaigns in 2006 and 2007, respectively, were summarized.

Organochlorine pesticides were found in high concentrations particularly in Spolana (Figures 17-19, Tables VI-3-VI-9), where pure chemicals (HCH) as well as their formulations (mixtures with DDT) were produced. HCH levels (sum of α-, β-, γ-, and δ-HCH) varied from 256 ng to 7.9 μg per filter (corresponds to 2.5 and 79 ng m^{-3}), DDTs (sum of *p,p´*-and *o,p´*-DDE, DDD, and DDT) from 28 ng to 1.5 μg per filter (280 pg and 15 ng m^{-3}), and HCB from 84 ng to 4.4 μg per filter (840 pg and 44 ng m^{-3}). Those concentrations, measured directly inside the chemical plant cannot, however, be compared to any other sampling site. For all organochlorine pesticides, the maxima here were two orders of magnitude higher than any other site in the Czech Republic. It must be taken into consideration, that there have been intensive remediation activities performed at the factory grounds during all sampling periods. Passive sampling during these activities had very specific goals: to evaluate an impact of the contaminated soil-air exchange on the air pollution, to study an impact of remediation on the quality of atmosphere especially in surrounding residential areas, and to assess an improvement of situation after those activities are terminated.

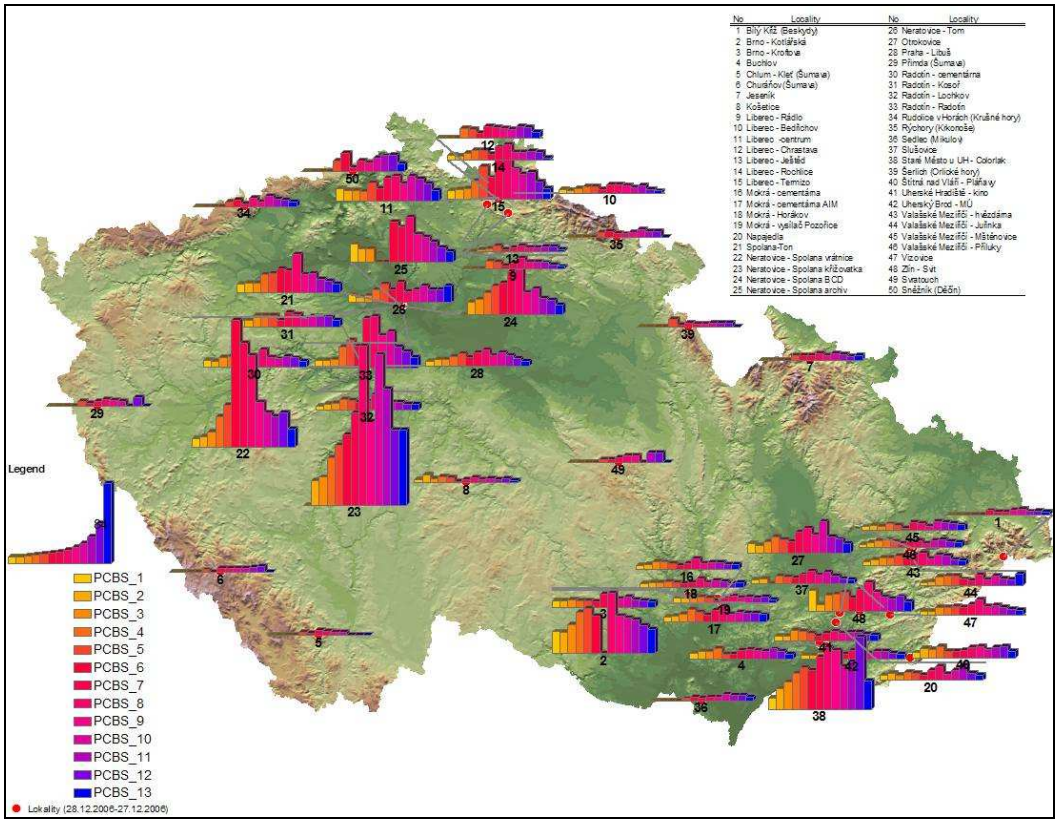

Figure 15: PCB levels (7 indicators) in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2006

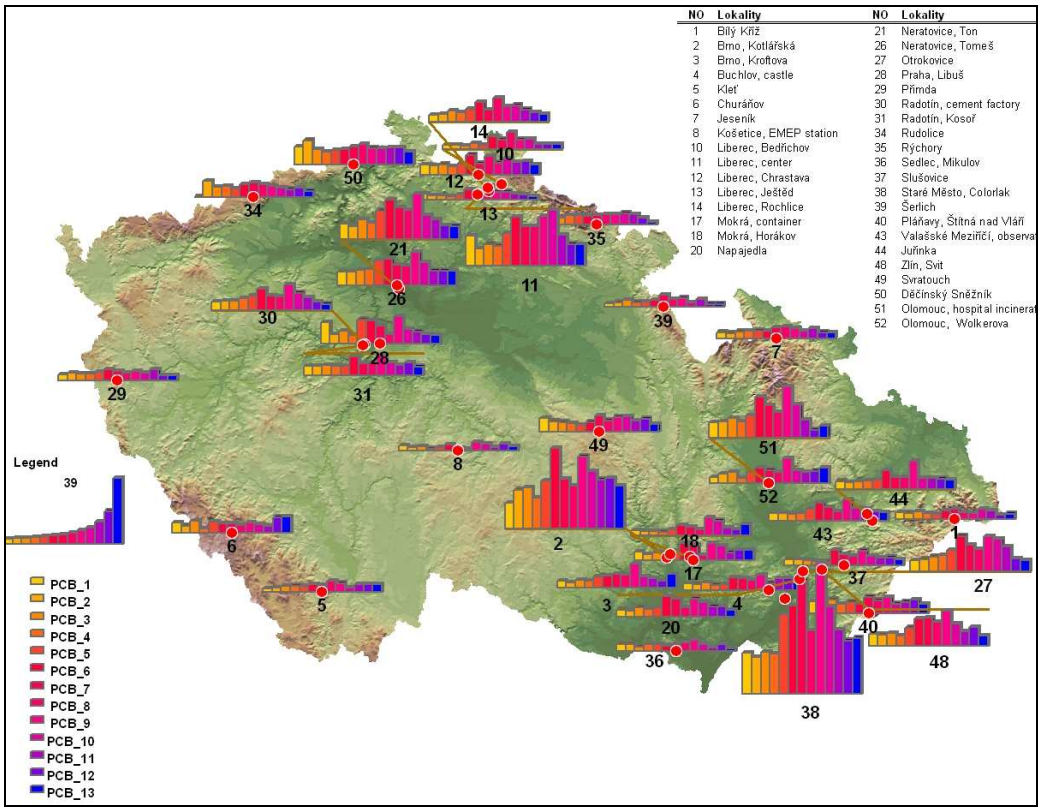

Figure 16: PCB levels (7 indicators) in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

Apart from Spolana sites, **HCH** congeners are almost uniformly distributed in the area of the Czech Republic (Figure 17) ranging between units and tens of ng per filter (tens to hundreds of pg m^{-3}). There is not much difference between the industrial, urban, and rural sites; surprisingly some mountain backgrounds seem to have levels slightly higher than the sites inland. Seasonal fluctuations (factor of 2-10) were more obvious on highly contaminated sites again; maxima were achieved in the warm season, however, they seemed to be shifted towards late summer and fall. At some sites, second maxima can be detected in the spring. Seasonality was hardly detectable at many mountain background sites possibly due to the low concentrations, lack of sources, high volatility and efficient mixing of air.

Distribution of the individual congeners reflects the history of production and use of those chemicals in the Czech Republic. Between 1952 and 1975 Spolana was one of two largest producers of pesticides in former Czechoslovakia. Pesticides containing DDT were produced between 1958 and 1969 and technical HCH since 1961. When technical HCH was banned, Spolana continued to manufacture lindane preparations until 1975 and the ballast congeners were dumped at factory grounds and close vicinity for several years. This mishandling of chemicals caused heavy soil contamination of the area. At those sampling sites, β-HCH was the most abundant congener (90%) in the soil due to its high persistence, low biodegradability and low volatility. Since β congener is also most water soluble, this fact poses a risk for the ground waters. This applies to the vicinity of the factory as well. On the other hand, due to its highest volatility, α- HCH prevailed in the air samples (50-80%) followed by β-HCH and γ-HCH.

Variability of the OCP concentrations is presented in the following tables (HCHs: Table VI-3–VI-4, DDTs: Table VI-5–VI-6, HCB: Table VI-7–VI-8) where the minima, maxima, mean and median values from all sites and all campaigns were summarized.

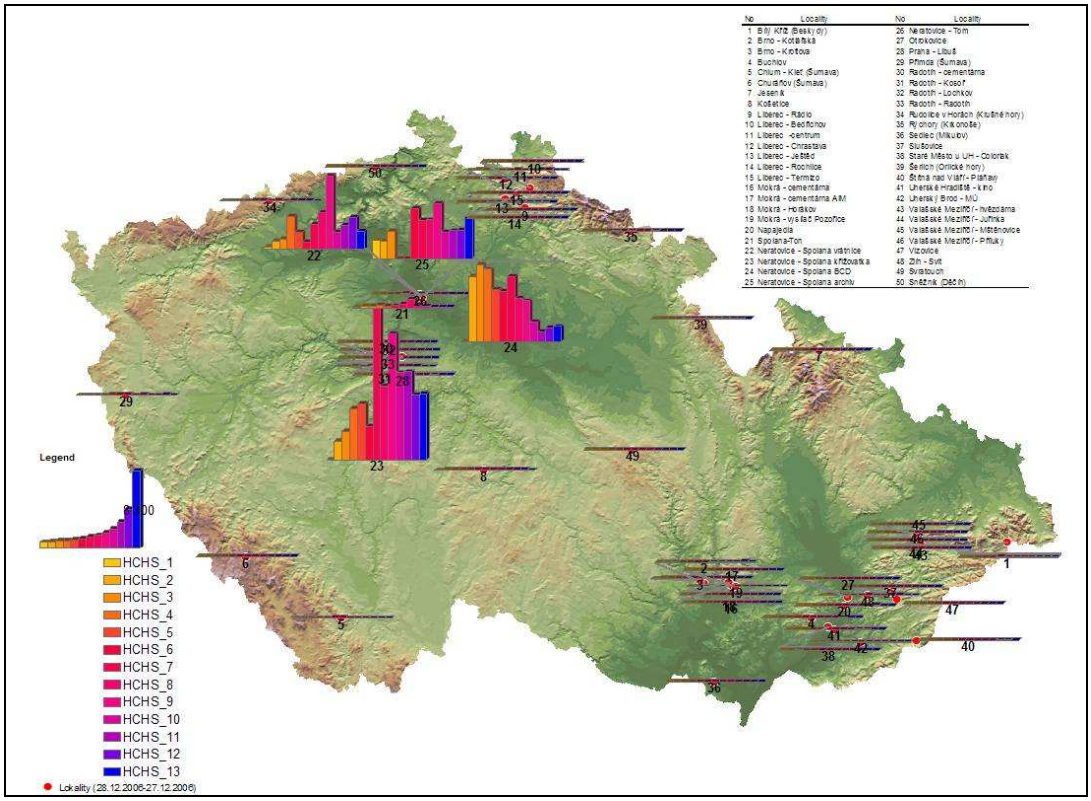

Figure 17: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng $filter^{-1}$) in the Czech Republic, 2006

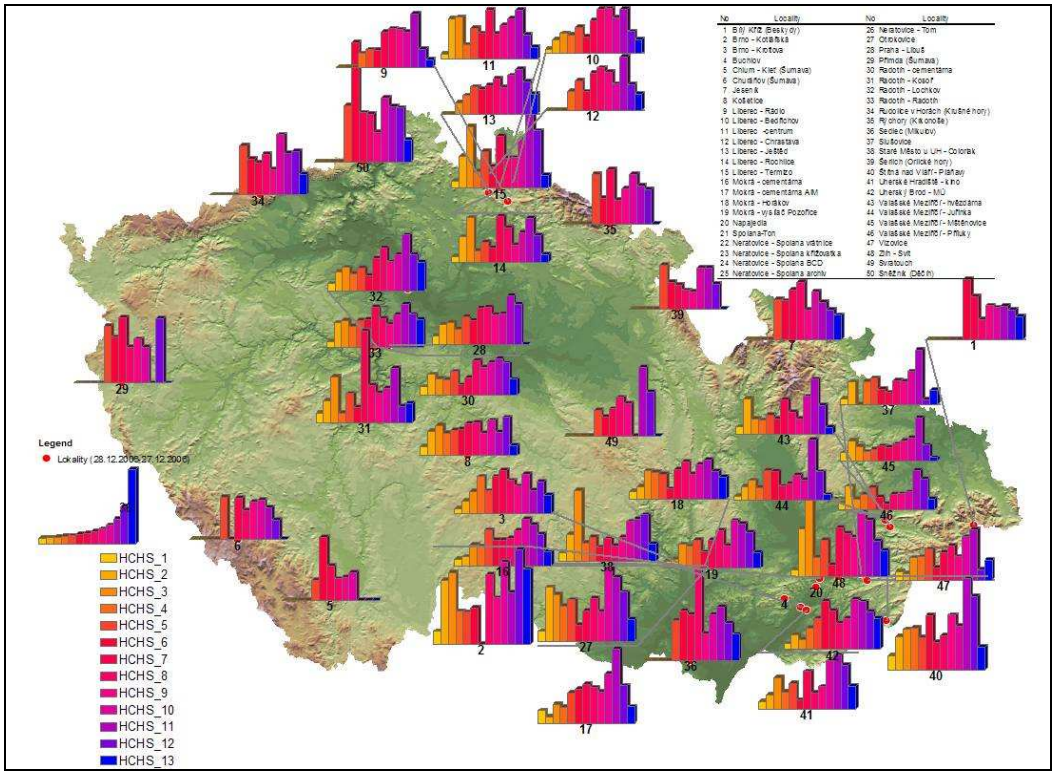

Figure 18: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in the Czech Republic (hotspots omitted), 2006

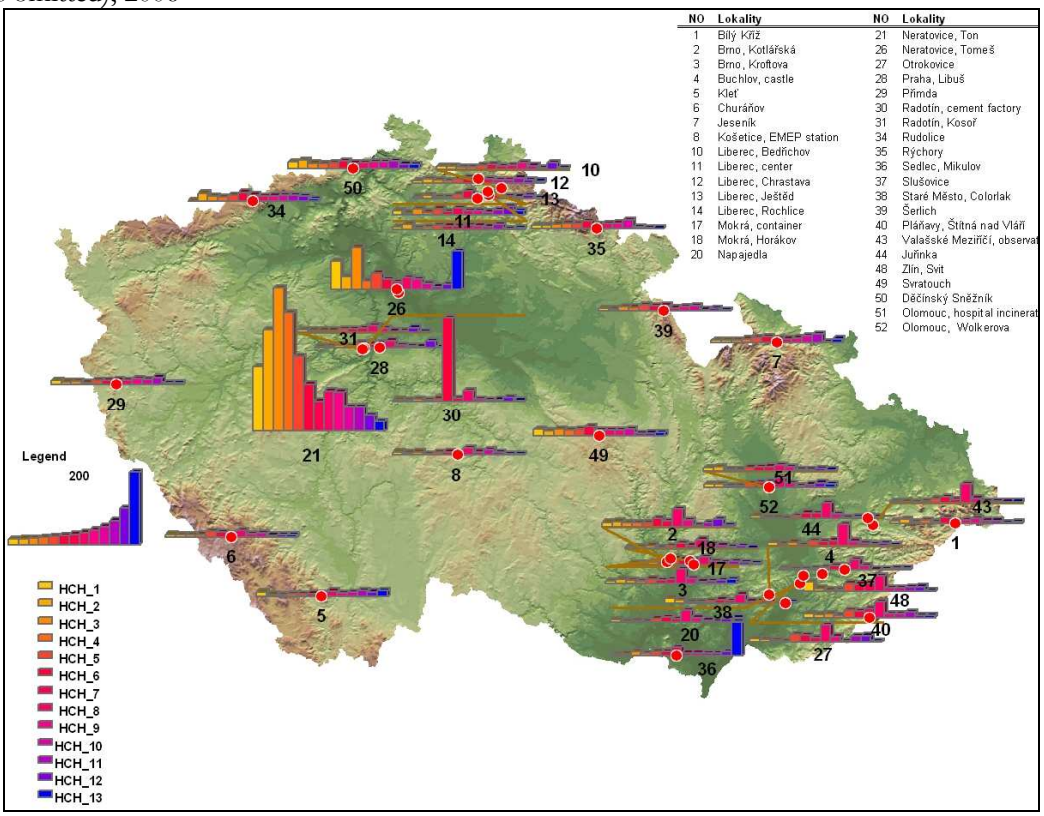

Figure 19: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

DDT concentrations (the sum of *p,p´*-and *o,p´*-DDE, DDD, and DDT) ranged over 3 orders of magnitude even when Spolana was excluded (Figures 20-22; Tables VI-5 and VI-6). Higher level (up to 500 ng filter^{-1}/5 ng m^{-3} for the sum of DDTs) was measured in the Buchlov castle area, and also at several other rural sites. Low levels (1-2 ng per filter) were found at some mountain backgrounds (Klet', Churáňov). As can be seen in Fig. 10, enhanced levels of DDTs (factor of 2-3) were measured in the warmest months. In the Buchlov castle, summer values were more than ten times higher when compared to the winter ones. As in the previous case, the summer increase of concentrations was insignificant in the mountain regions.

The air samples from Spolana had DDT compounds distribution similar to soil samples – levels of *p,p´*- DDT and *p,p´*- DDE were comparable. *p,p´*- DDT prevailed in the air samples from Buchlov, *p,p´*- DDE dominated at all the other sampling sites.

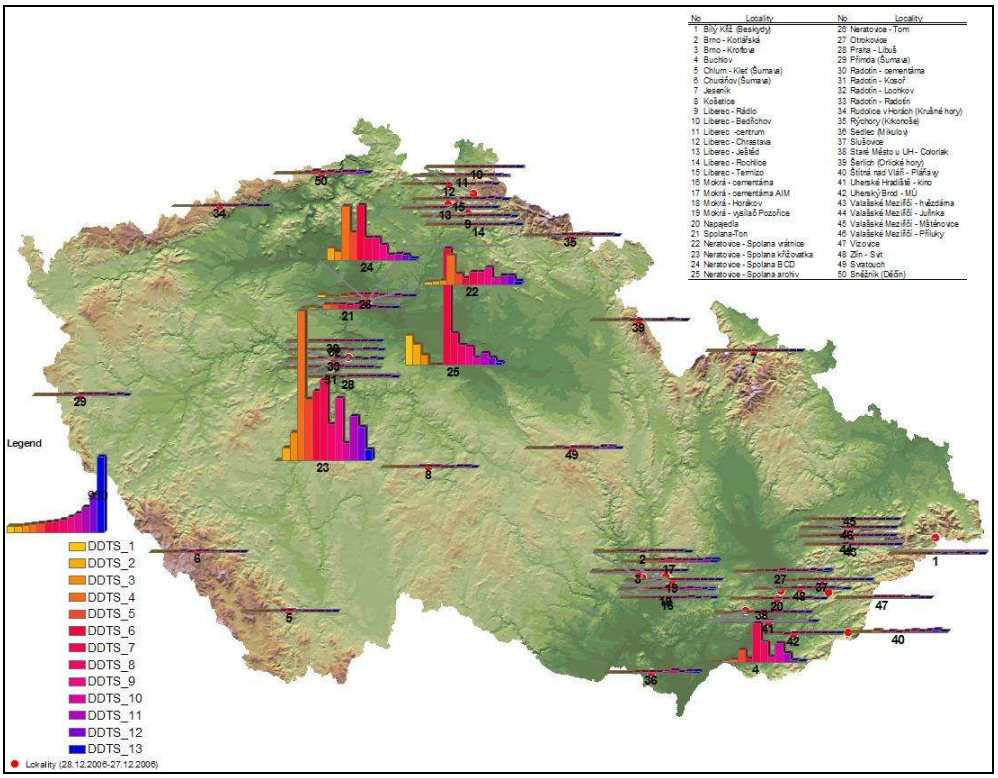

Figure 20: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2006

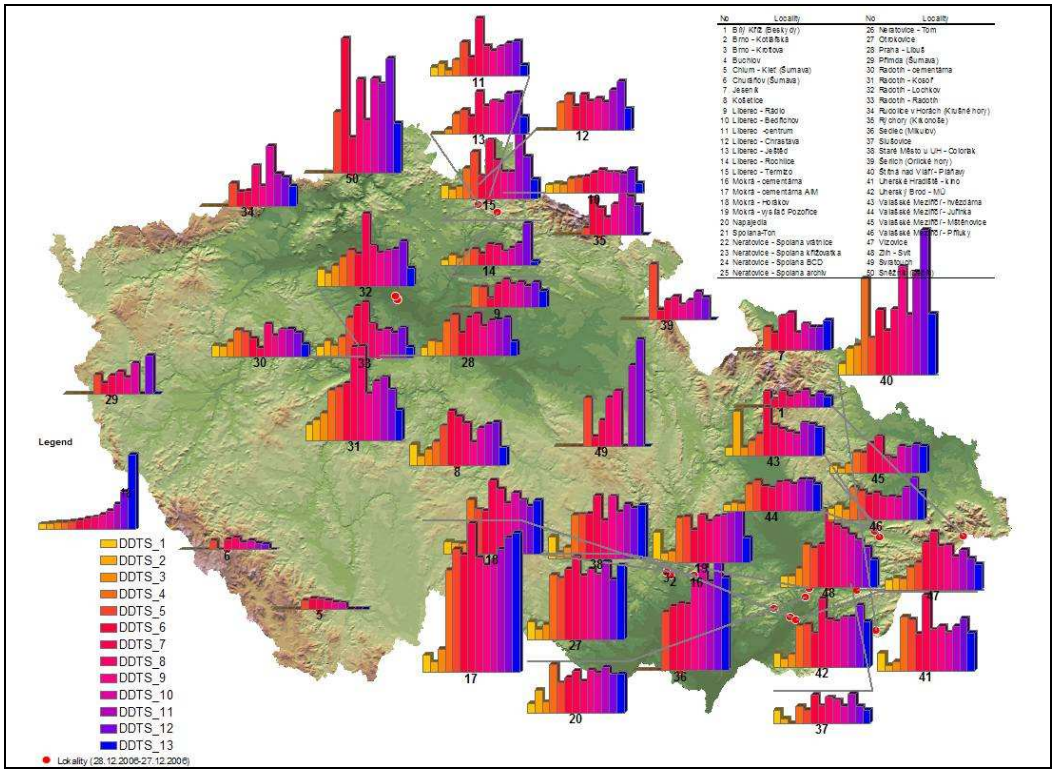

Figure 21: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in the Czech Republic (hotspots omitted), 2006

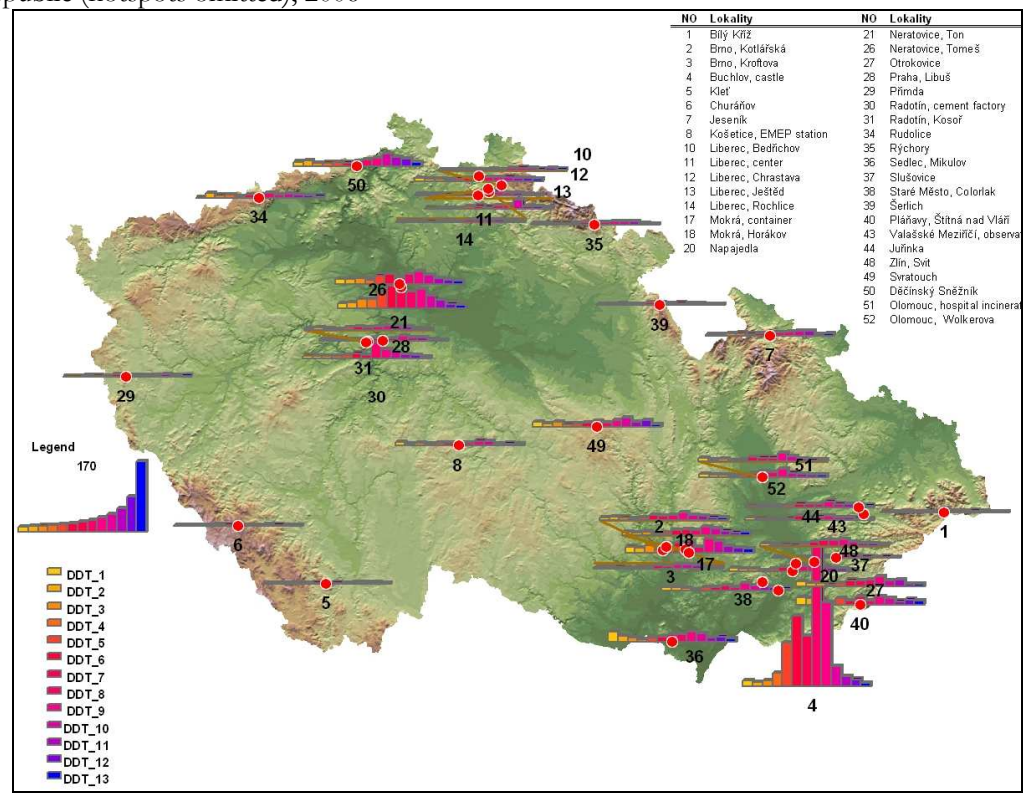

Figure 22: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

HCB distribution (with Spolana excluded) resembled the very flat spatial distribution of HCHs (Figures 23-25, Tables VI-7 and VI-8). Levels fluctuated around 10 ng per filter (100 pg m^{-3}) showing no significant difference between urban and rural sites. As in the case of HCHs, mountain background sites did not show significantly lower levels, on the contrary, several of them had concentrations above the average. Seasonal variability is interesting in this case. While Figures 23 and 25 show a typical seasonal trend with summer maxima at the Spolana sites where the atmospheric HCB originates from heavily contaminated soils, Figure 24 demonstrates a different picture for the rest of the country. Many individual diagrams with monthly levels indicate the elevated concentration in the winter time, possibly connected to the combustion and seasonal heating. This effect is even more pronounced for pentachlorobenzene as a degradation product of HCB (Figure 26). Variability between the individual sites corresponds with the multiple origin of atmospheric HCB, then.

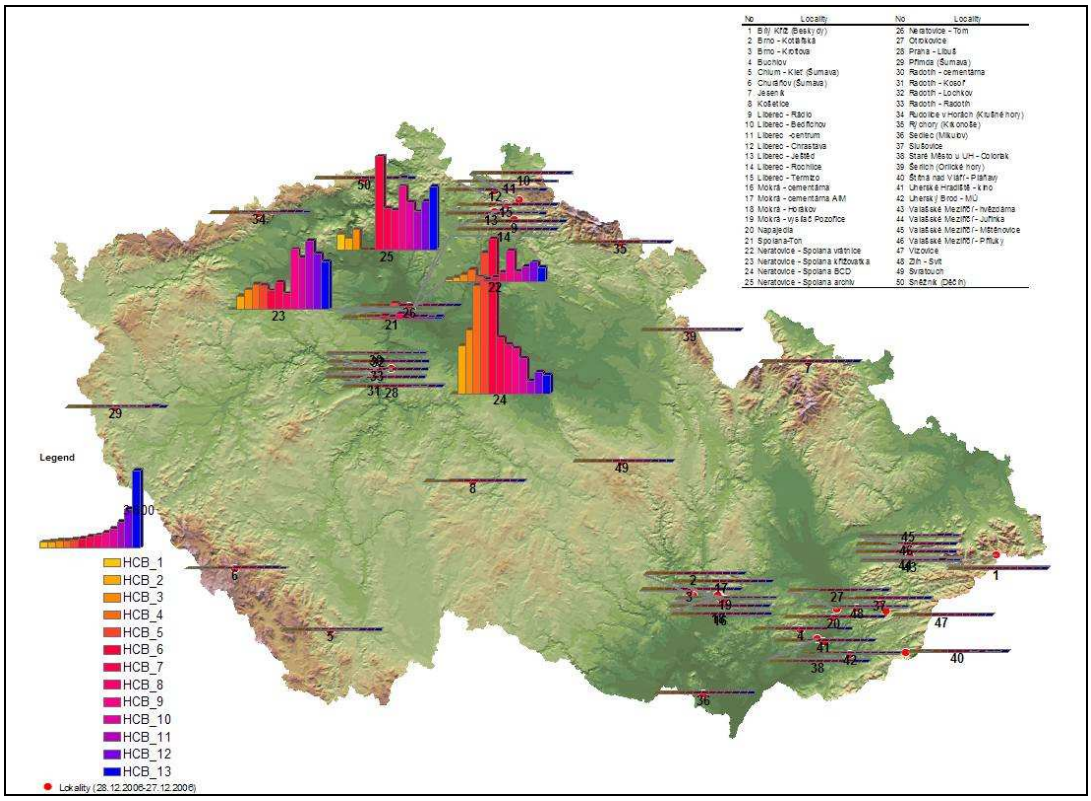

Figure 23: HCB levels in ambient air (PAS, ng $filter^{-1}$) in the Czech Republic, 2006

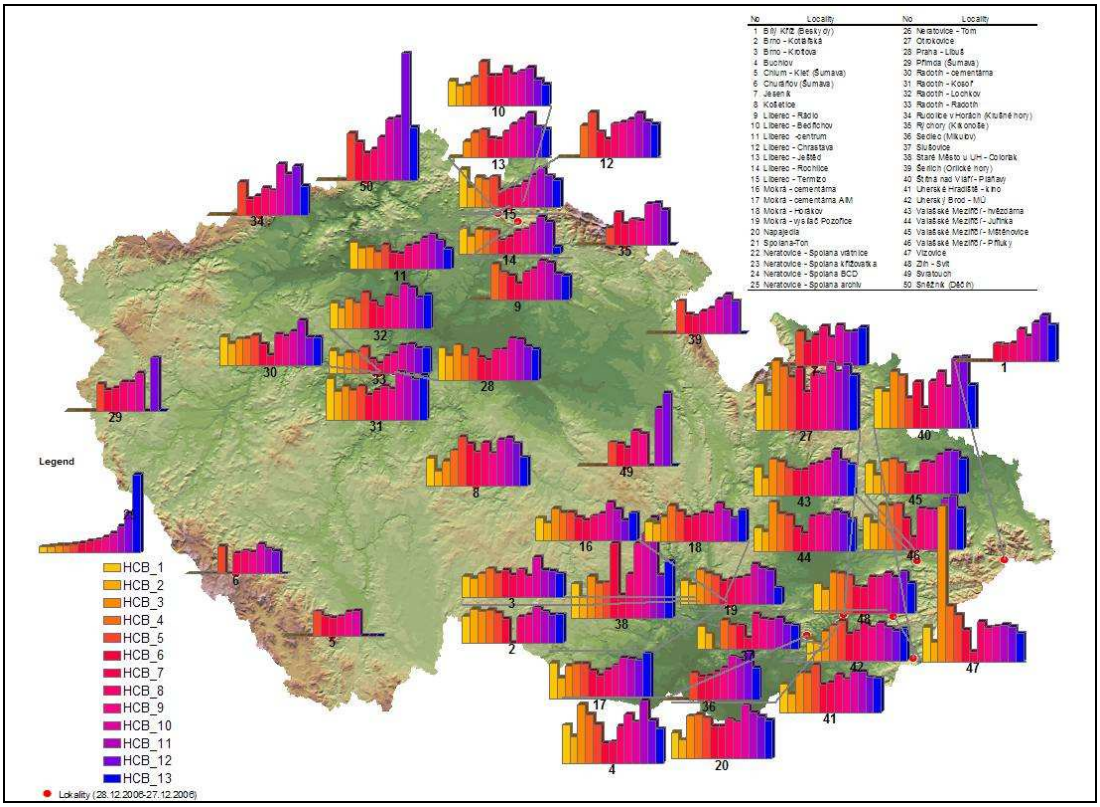

Figure 24: HCB levels in ambient air (PAS, ng filter^{-1}) in the Czech Republic (hotspots omitted), 2006

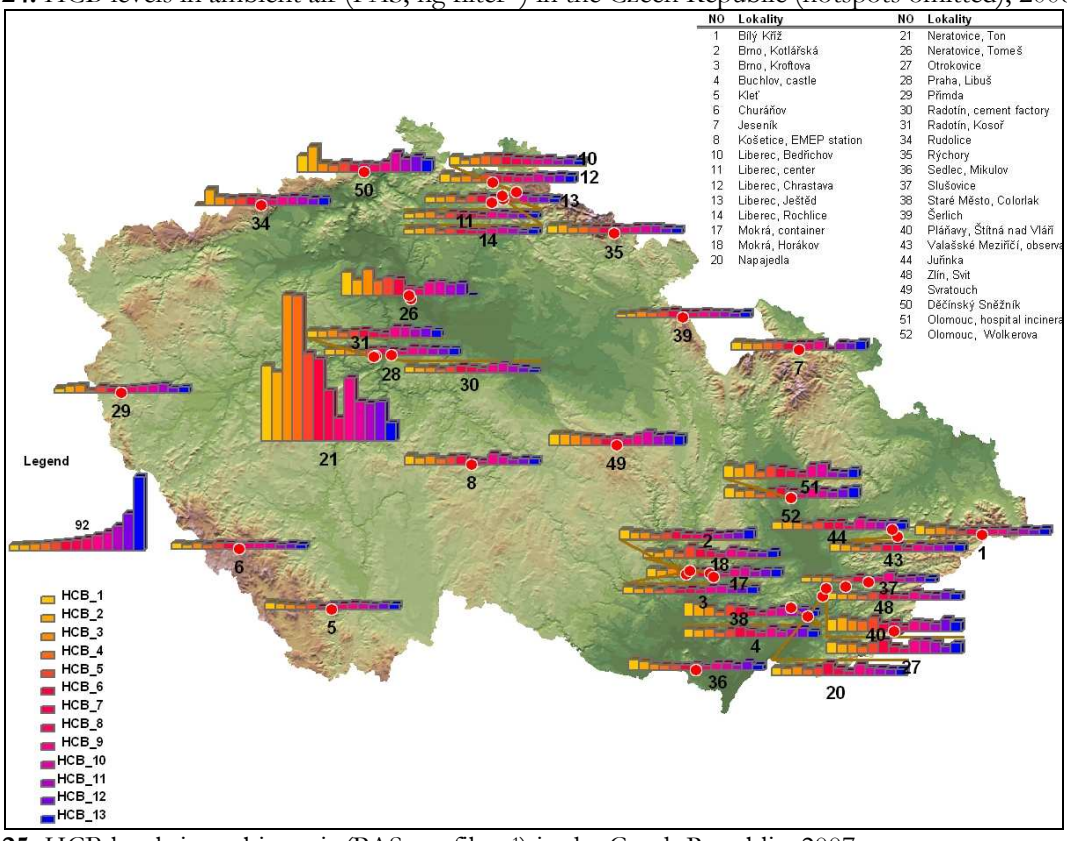

Figure 25: HCB levels in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

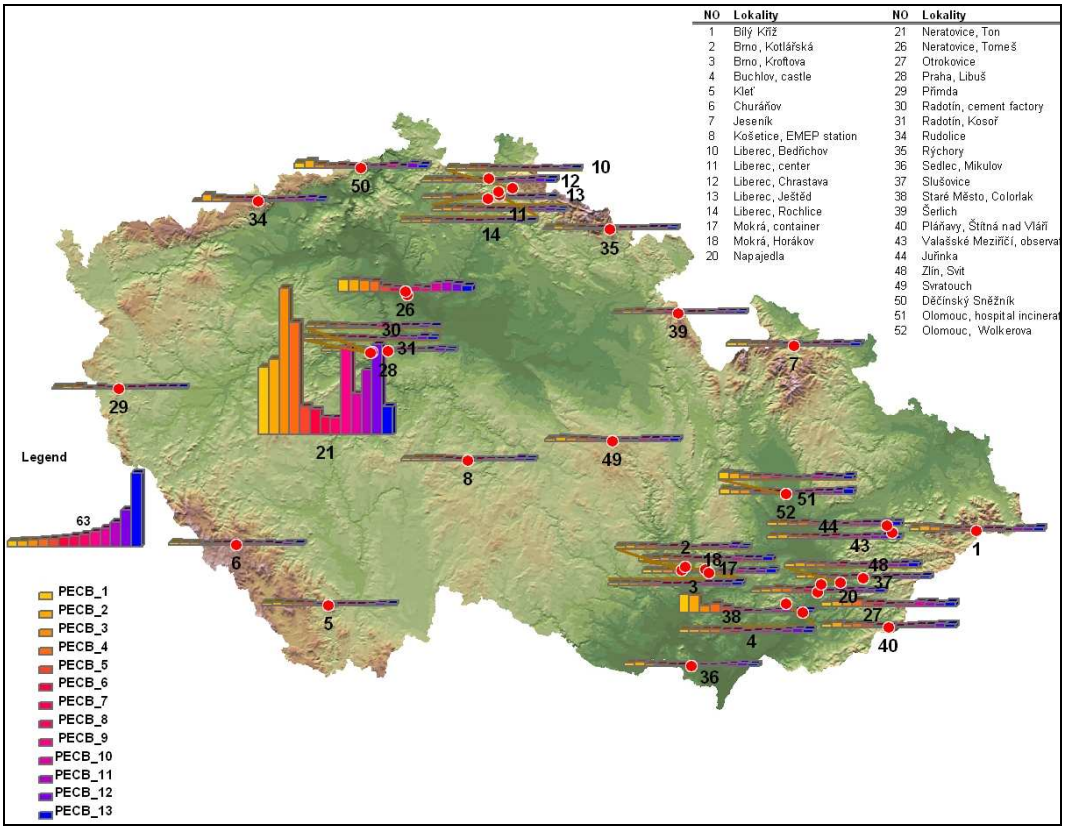

Figure 26: PeCB levels in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

As expected, highest atmospheric levels of **polyaromatic hydrocarbons** were determined in the vicinity of DEZA oil refinery in Valašské Meziříčí (from 2.7 to 205 μg per filter corresponding to 27 ng m^{-3} and 2 μg m^{-3}) (Tables VI-10 and VI-11, Figures 27 and 28). The maxima at those sites were about one order of magnitude higher than at the rural sites but only about three times higher than at the sampling sites affected by heavy traffic (Brno, Kotlářská, Zlín or Uherské Hradiště) and two times higher than in the small towns affected by local combustion in the winter time (Slušovice, Vizovice, Otrokovice). The air concentrations at the mountain sites varied over one order of magnitude but generally, they were significantly lower than the other sites.

Typical seasonal variability of the atmospheric concentrations of PAHs is demonstrated in both, Tables (VI-1–VI-11) and Figures (27-28). PAH data show typical winter maxima indicating that the local seasonal heating is a major source of these compounds in atmosphere. We can compare temperature conditions between winters of 2005/6 and 2006/7. Harsh winter conditions in 2005/6 with temperatures below 0 °C for more than two months caused the high emissions of PAHs from local heating systems. Correspondingly, there were higher amounts of PAHs in ambient air in January and February of 2006 (see Figure 27) when compared to the situation one year later (see Figure 28). This case confirms capability of PAS to capture the seasonal variations of the POP (including PAHs) concentrations in air.

Variability of the PAH concentrations is presented in Tables VI-10 and VI-11 where the minima, maxima, mean and median values from all sites and all campaigns were summarized.

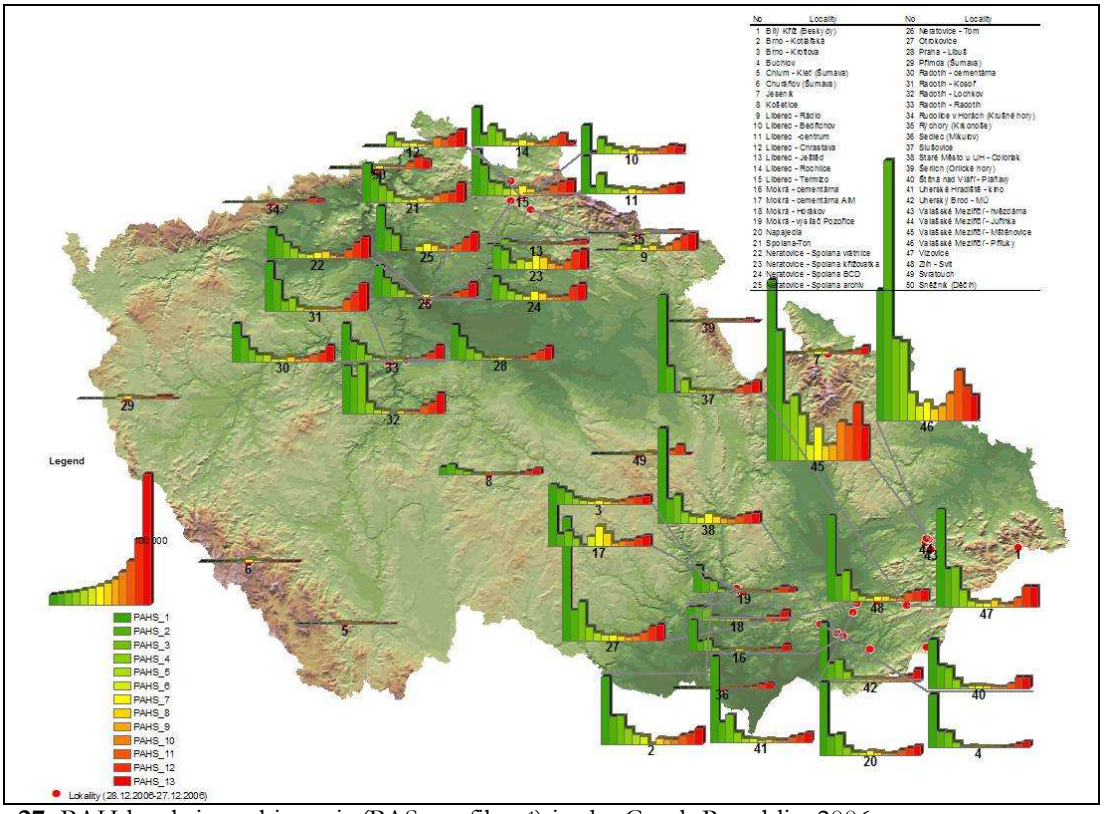

Figure 27: PAH levels in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2006

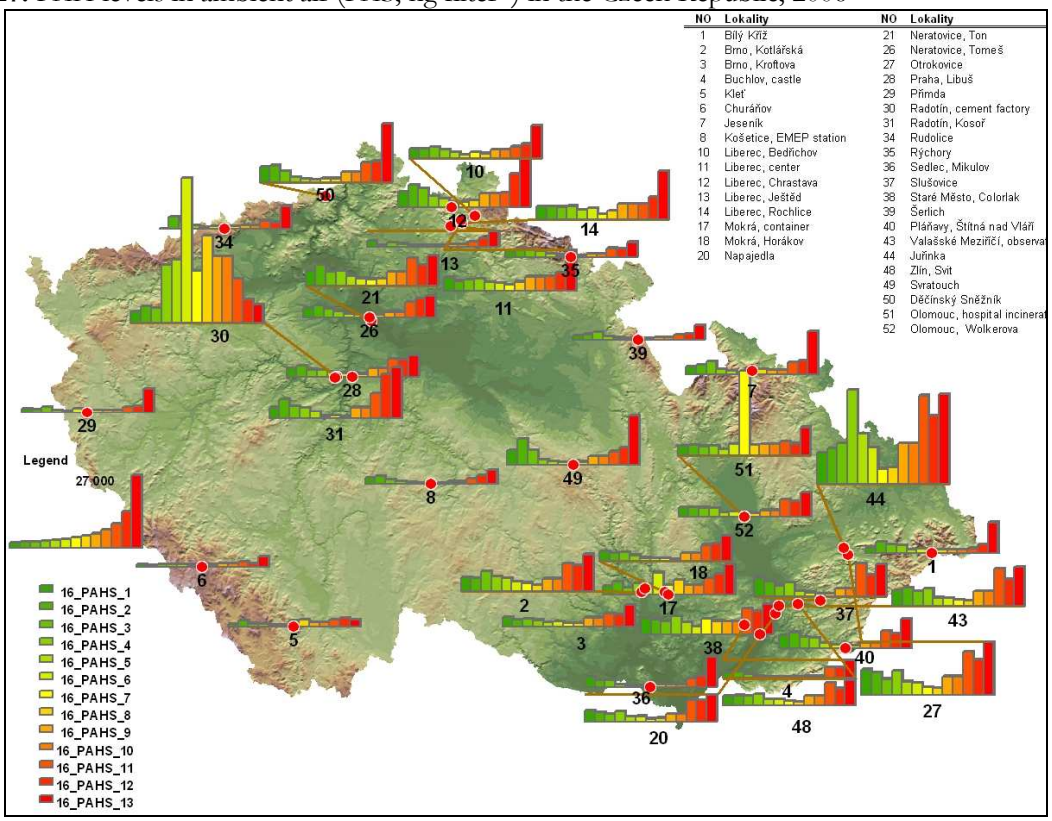

Figure 28: PAH levels in ambient air (PAS, ng filter^{-1}) in the Czech Republic, 2007

5.1.2.1.2 MONET-CZ conclusions

Czech Republic is the first from the signatory countries of the Stockholm Convention that offers fully **developed and functional tool capable of providing information on the Central European levels of POPs and the long-term trends** in those levels. The major advantage is availability of consistent high volume POPs monitoring data from Košetice EMEP station. This dataset with established time trends for the last ten years can itself serve the evaluation of the future trends in the atmospheric concentration of POPs. Parallel PAS monitoring in Košetice in the last three years gives another unique calibration dataset and at the same time, a centerpiece of the PAS network in the Czech Republic. Total amount of 16 background sites covering the country including the border mountains allows us to study the spatial variability in the background POPs concentration in various stations as well as to avoid the false interpretations derived from one site only. It can also evaluate an impact of various sources and the effectiveness of measures applied to reduce this impact. For this purpose, we succeeded in getting the interest and support of the industrial bodies as well as the local authorities and in consequent establishment of informal consortium, technically and financially supporting further development of the network (**MONET-CZ**). This is a unique achievement in the global scale.

There are other key aspects of the **MONET-CZ network**. Such well characterized region in the Central Europe with the dense monitoring network provides the core element for the spin-off projects in other countries of the Central, Southern and Eastern Europe. Since many of those countries lack not only data on the POP levels in the atmosphere but also appropriate monitoring and laboratory capacities, this aspect is very valuable.

5.1.2.2 MONET-CEEC

5.1.2.2.1 Introduction

The results from the application of PUF passive samplers during the **APOPSBAL** project together with the results from the **MONET-CZ** clearly confirmed that the passive air samplers proved to be a powerful technique capable of detecting the POP concentrations ranging over four orders of the magnitude providing the information very comparable to the conventional techniques for the fraction of the price (Klanova et al 2007b, 2008a). Beside the costs, an **integrative character of the sample** and the feasibility of obtaining the temporally resolved data are the main advantages of this method. It is necessary to consider a possible uncertainty caused by the variations in the sampling rates in the field conditions when interpreting the results. However it is encouraging that even in the simplest design without the application of performance reference compounds the error is limited to the factor of 2-3. This is very acceptable for a preliminary screening of the regions with no monitoring data.

Based on the **experiences from the Czech monitoring network**, **MONET-CEEC** project was initiated in 2006 with the goal of building the monitoring capacity in this region. Sampling sites for all three phases of the MONET_CEEC Project have been selected in cooperation with the local partners in all participating countries (Tables V-1 – V-3 and Figures 4 and 5). A background site was included in most countries as a potential candidate of background monitoring for the effectiveness evaluation of the Stockholm Convention. Whenever possible, gradient of other sites (rural, urban, and industrial) was developed also to address the range of contamination, possible sources and spatial variations. Soil samples were collected from the air sampling sites as a part of the study.

5.1.2.2.2 Results

Results from the first year (2006, 5 sampling periods March-August, 28 days each) and **second year** (2007, 5 sampling periods March-August, 28 days each) of the Central and Eastern European passive air screening campaign at 58 and 57 sampling sites, respectively, are presented in **Annex VII**. Whenever the general schedule was broken due to the local problems (sampling periods few days shorter or longer), results were re-calculated for 28 days to make it comparable. In few cases (Romania) the sites have only been sampled for one or two months and results did not provide a range of the seasonal variability. In those cases, the individual sampling seasons have to be compared rather than the median values.

Annex VII gives statistical evaluation of measured concentrations of PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 153, PCB 138, and PCB 180), OCPs (α- HCH, β-HCH, γ-HCH, δ-HCH, *p,p´*-and *o,p´*-DDE, DDD, and DDT, HCB, and PeCB), and polyaromatic hydrocarbons (16 US EPA) at each sampling site including their variations over 5 months.

An **overview of temporal and spatial fluctuations** in the geographic information system is presented in the Figures 29-49.
A **brief comparison of aggregated data** from the **MONET-CEEC** project and data from the **Czech network** is presented here. All sampling sites were monitored continuously in the Czech Republic in 2006 and 2007; however, for following comparison only data from 5 months corresponding to CEEC campaigns were selected.

Since the variability in the sets of sampling sites in various countries makes any comparison difficult, sampling sites in the **Czech Republic** were classified according to their category into three groups and POP data are presented separately for each group. First group (A) includes only 16 background sites of various types (urban, rural, mountain). Second one (B) contains all sampling sites in the Czech Republic except for 7 sites with heaviest contamination with one or more pollutants (vicinity of Spolana Neratovice, for instance). Third group (C) includes the hotspots as well as all remaining sites. This way, results from each country can be compared to one of the groups, according to the category of sampling sites.

In **Slovakia**, for instance, all sites were the background sites. Similar situation is in **Latvia.** In the rest of the **Baltic countries** a variety of background, rural, urban and industrial sites were sampled as well as in **Romania.** In **Serbia and the Czech Republic**, known hotspots were included. In **Bulgaria,** the sites ranged from industrial facilities to rural background, similar to **Moldova** and **Montenegro**. Industrial sites and industrial background we selected for the screening study in **Russian federation, in Bashkyria.** On the contrary, in **Croatia and Hungary**, only various sites in the capitol city were monitored (urban and urban background). In **Macedonia, Slovenia and Poland**, a majority of sites were backgrounds.

For **PCBs in 2006**, the highest atmospheric levels were found in Romania (Braila, Timisoara, Deva). Amounts of PCBs (7 congeners) sequestered in PAS filters in Braila or Timisoara varied around 1 μg per filter (since the passive sampler of this design samples about 100 cubic meters per 28 days, those values roughly correspond to 10 ng m^{-3}). Levels were also higher in Serbia (Kragujevac) where the soil is known to be contaminated with PCBs, and other industrial sites. On the other hand, the levels never exceeded 10 ng per filter significantly (100 pg m^{-3}) on most of the rural and mountain sites (Figure 29). Variability of PCB concentrations can be seen in Table 9 and VII-1 where the minima, maxima, mean and median values from all sites and all campaigns were summarized.

Median PCB concentrations in the air samples were highest in Bosnia, Romania and Serbia (41, 36, 34 ng $filter^{-1}$, respectively) (Table 9). While in Bosnia and Serbia it might be connected to previous war damage, in Romania wastes, storages of used equipment, and contaminated buildings and soils must be the reason for high ambient air levels. Romania also shows the highest variability of data and maxima one order of

magnitude higher than other two sites. On the contrary, median values in the Baltic countries were one order of magnitude lower than in Bosnia or Romania, lowest levels were found in Latvia but this can be just because the campaign was performed on the background sites in Latvia. Czech and Slovak republics as the countries where PCBs were widely used are between those two extremes. Median PCB concentration at background sites in CR was comparable with Latvia, but even the median value of the full network in CR was significantly lower than the one measured at background sites in Slovakia. When various sampling sites in the Czech Republic were compared, PCB concentration maxima were about twice as high at contaminated sites than they were at randomly selected sites while the median concentrations were the same. Median concentration at the background sites was at about a half of the median concentration of all air samples, while the background maxima only reached one third of the all sites maxima.

Table 9: Comparison of the PCB concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2006

AIR/PCBs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bosnia and Herzegovina	2	6.1	71.6	40.0	40.5
Estonia	5	1.4	69.9	14.2	6.8
Latvia	5	1.9	16.1	5.4	5.4
Lithuania	5	1.7	43.7	11.8	9.8
Romania	20	2.4	1 025.9	108.2	36.2
Serbia	7	5.3	107.8	38.6	34.3
Slovakia	11	1.3	60.6	17.4	13.8
Czech Republic (A)	16	1.2	19.1	5.7	4.6
Czech Republic (B)	43	1.2	65.1	11.7	8.1
Czech Republic (C)	50	1.2	133.2	13.5	8.8

Figure 29: PCB levels (7 indicators) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2006

In **2007**, the highest atmospheric levels of **PCBs** were found in Montenegro. Amounts of PCBs (7 congeners) sequestered in PAS filters in Niksic varied around 100 ng per filter (since the passive sampler of this design samples about 100 cubic meters per 28 days, those values roughly correspond to 1 ng m^{-3}). Levels were also higher in Russia (Baskiria) within the industrial complex Ufa, Slovenia (Celje) and other industrial sites. Even higher levels of PCBs were measured in Romania (Iasi), on the site that has been a part of the screening study in 2006 already. On the other hand, the levels never exceeded 10 ng per filter significantly (100 pg m^{-3}) on most of the rural sites (Figures 30 and 31). Variability of PCB concentrations can be seen in Table VII-2 where the minima, maxima, mean and median values from all sites and all campaigns were summarized. Median levels of PCBs varied almost over two orders of magnitude between the sites.

Median PCB concentrations in the air samples were highest in Montenegro, Russia and Bulgaria (24, 21, 19 ng filter^{-1}, respectively). Montenegro also showed the highest variability of data and the highest maxima (Table 10). While in Montenegro it might be connected to previous war damage, in Russia it is a result of the industrial activities. Some sites with high maxima were also found in Slovenia. Generally, the sites in the Central Europe (the Czech Republic, Poland and Hungary) demonstrated significantly lower concentrations (20-50%) than those in the Southern Eastern Europe. Wastes, storages of used equipment, contaminated buildings and soils must be responsible for high ambient air levels in this region.

Table 10: Comparison of the PCB concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2007

AIR/ PCB	Number Of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bulgaria	6	3.4	37.8	19.5	19.0

AIR/ PCB	Number Of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Croatia	5	8.3	27.5	17.0	16.0
Hungary	5	3.7	17.1	8.3	7.5
Macedonia	6	1.9	29.1	14.4	12.5
Moldova	7	4.3	36.5	12.6	11.0
Montenegro	7	2.6	124.0	32.8	24.2
Poland	6	3.0	10.6	5.3	4.9
Russia	5	10.5	67.9	27.2	20.6
Slovenia	7	1.5	80.2	19.0	10.6
Czech Republic (A)	15	1.5	12.2	5.8	5.6
Czech Republic (B)	37	1.5	78.3	11.3	7.6

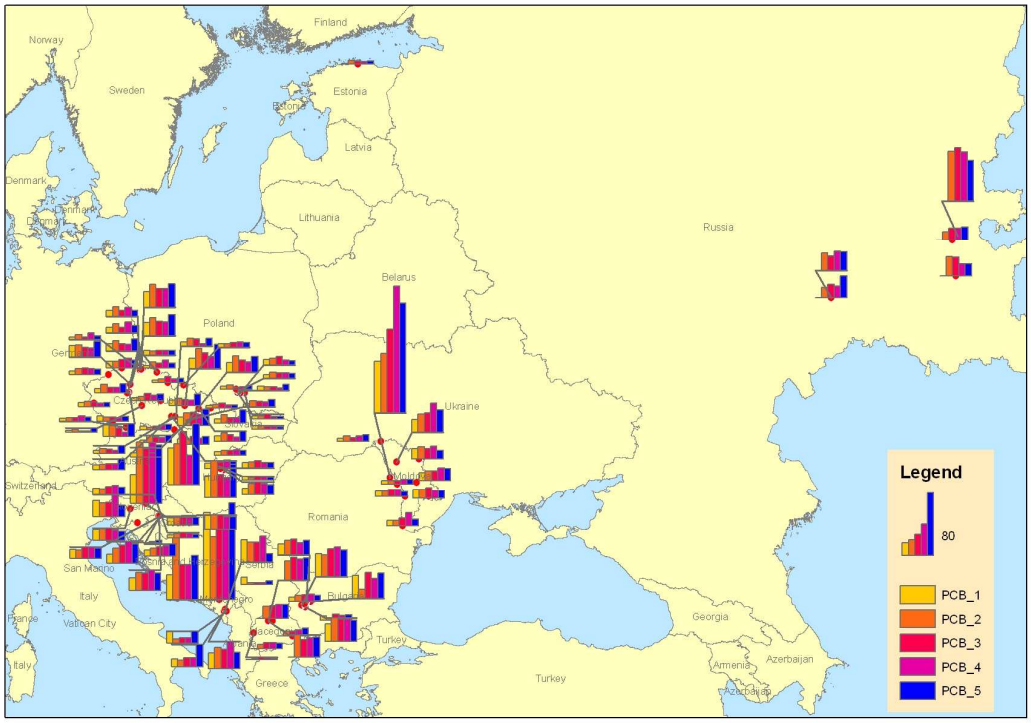

Figure 30: PCB levels (7 indicators) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

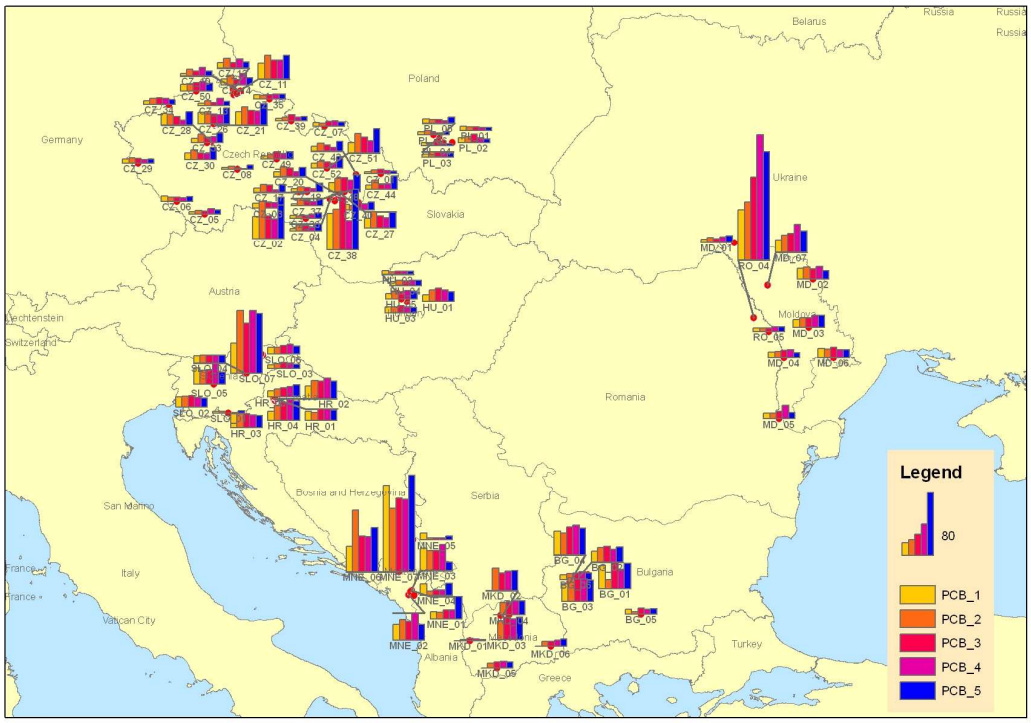

Figure 31: PCB levels (7 indicators) in the ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (Russia excluded), March - August, 2007

In **2006**, the highest atmospheric levels of **HCHs** were determined in Romanian sites Turda and Onesti (median concentrations of 2 and 1 μg filter^{-1}, respectively). HCH levels found in most of other Romanian cities (in hundreds of ng filter^{-1}) are, however, still about one order of magnitude higher than in most other countries (Figures 32 and 33). Beside the industrial sites, HCH levels were also elevated in all capitol cities. Variability of HCH concentrations can be seen in Table VII-3 where the minima, maxima, mean and median values were summarized.

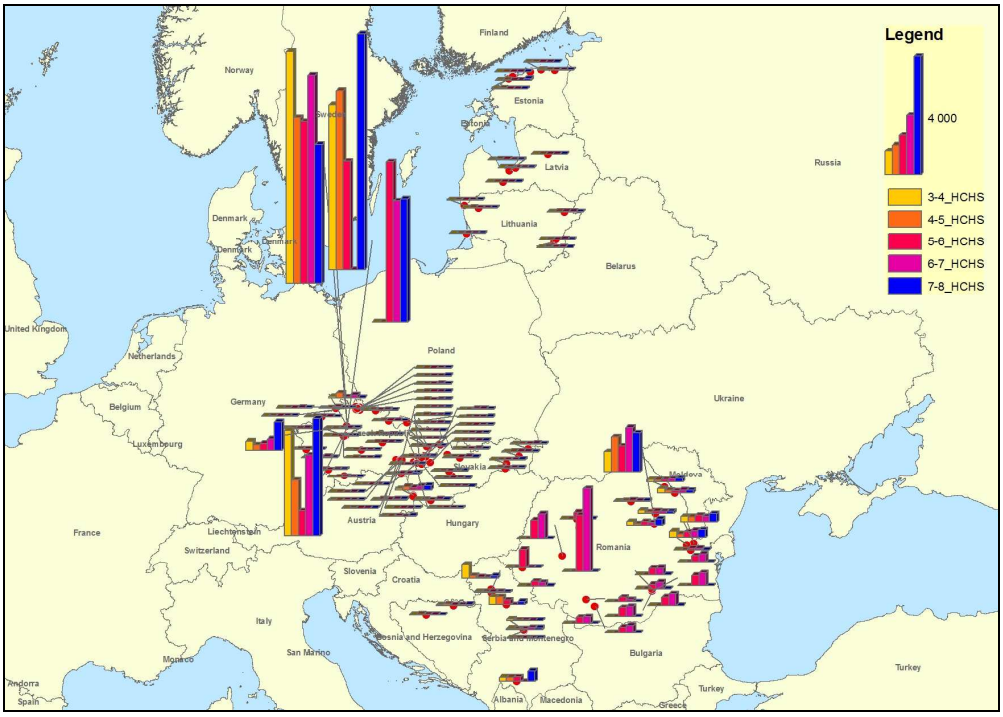

Figure 32: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2006

Air samples from the Czech Republic demonstrated a range of HCH concentrations at various sites. While maxima at contaminated sites reached as high as 5.4 μg filter^{-1}, they stayed bellow 57 ng filter^{-1} at remaining sites. The median values, however, shed the difference: 14 ng filter^{-1} is the median concentration for all sites, and 17 ng filter^{-1} for the backgrounds. These values are similar to the ones found in Baltic countries. Levels in Slovakia were some 50 % higher than in CR and similar to Bosnia, in Serbia they were four times higher than CR. The highest air contamination was found in Romania. Atmospheric maxima of 2.8 μg filter^{-1} were comparable to the Czech Republic but the median value was one order of magnitude higher than CR because elevated levels of atmospheric HCHs were found at many sites (Table 11).

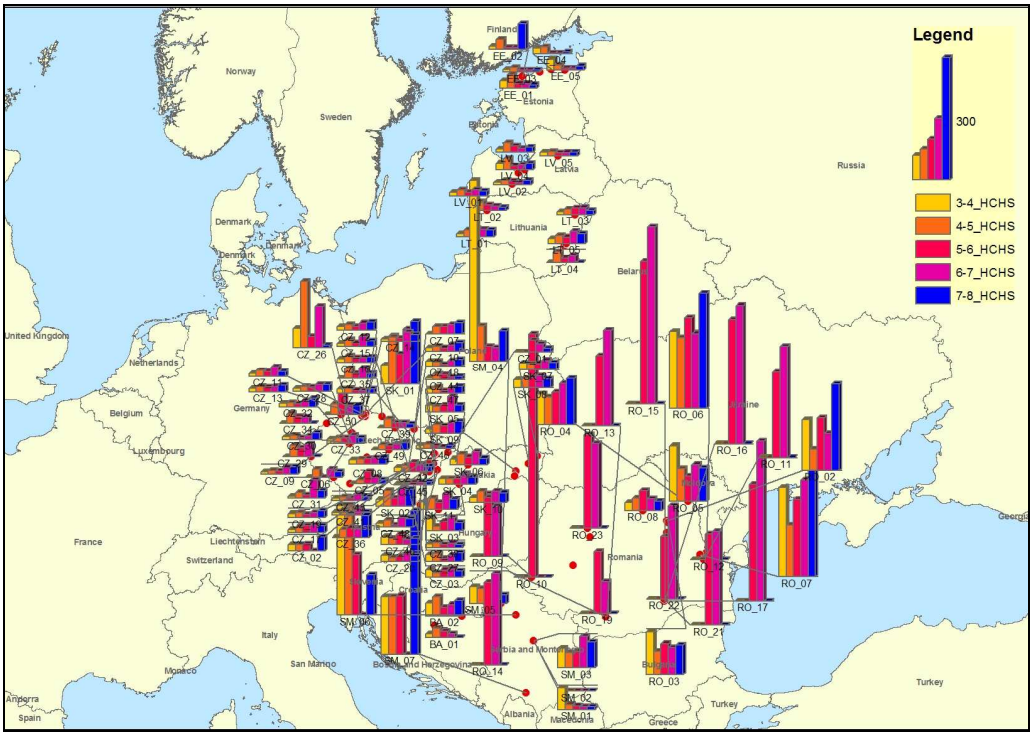

Figure 33: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (hotspots omitted), March - August, 2006

Table 11: Comparison of the HCH concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2006

AIR/HCHs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bosnia and Herzegovina	2	8.6	46.5	23.3	21.5
Estonia	5	1.4	63.5	14.4	10.3
Latvia	5	5.6	27.2	11.3	11.1
Lithuania	5	7.3	30.7	16.4	16.6
Romania	20	19.4	2 767.0	358.0	209.9
Serbia	7	6.7	443.9	87.7	48.0
Slovakia	11	10.4	156.4	30.1	23.0
Czech Republic (A)	16	7.5	56.9	17.9	16.5
Czech Republic (B)	43	4.3	56.9	15.5	13.7
Czech Republic (C)	50	2.9	5 407.3	146.3	13.7

In **2007**, the highest atmospheric levels of **HCHs** were determined in Russian sites Chapaevsk and Ufa (up to 0.5 μg filter^{-1} which corresponds to 5 ng m^{-3}). Median levels of HCHs in hundreds of nanograms per filter were also found in Macedonia (Skopje), Moldovian site Rezina had a median concentration of 80 ng filter^{-1} with maxima reaching 150 ng filter^{-1}. HCH levels one order of magnitude lower (in tens of nanograms) were

found in the industrial, urban and rural sites in the other countries. Generally low concentrations were measured In Poland, Slovenia and Croatia (Figures 34 and 35). Variability of HCH concentrations can be seen in Table VII-4 where the minima, maxima, mean and median values were summarized.

Air samples from the Czech Republic demonstrated a range of HCH concentrations at various sites. While maxima at contaminated sites reached as high as 237 ng filter^{-1}, they stayed bellow 26 ng filter^{-1} at remaining sites. The median values, however, shed the difference: 14 ng filter^{-1} was the median concentration for all sites, as well as for the backgrounds. These values are similar to the ones found in Poland, Slovenia, and Croatia, except that these countries did not manifest such a high variability between the concentrations at the individual sites. Similar to the Czech Republic, Macedonia or Moldova had the sites with the maxima about an order of magnitude higher than the median value. It is probably connected to some stockpiles, storage places or the old burdens of pesticides (Table 12).

Table 12: Comparison of the HCH concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2007

AIR/ HCH	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bulgaria	6	5.5	95.7	23.1	23.2
Croatia	5	4.2	16.8	10.3	9.9
Hungary	5	13.1	44.3	30.3	31.7
Macedonia	6	8.3	343.5	88.1	18.3
Moldova	7	20.8	158.0	46.3	41.0
Montenegro	7	0.8	56.9	16.3	9.1
Poland	6	3.4	18.4	9.5	8.3
Russia	5	15.9	530.0	137.6	127.4
Slovenia	7	3.6	35.4	10.0	8.2
Czech Republic (A)	15	4.8	26.1	14.0	14.2
Czech Republic (B)	37	4.8	236.9	20.7	14.0

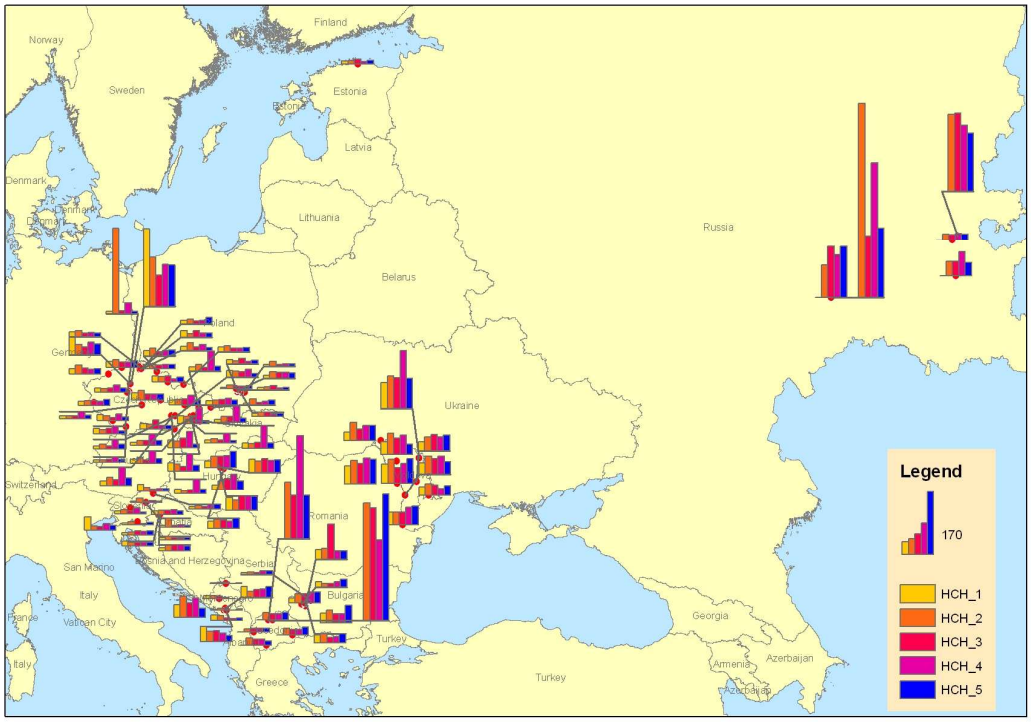

Figure 34: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

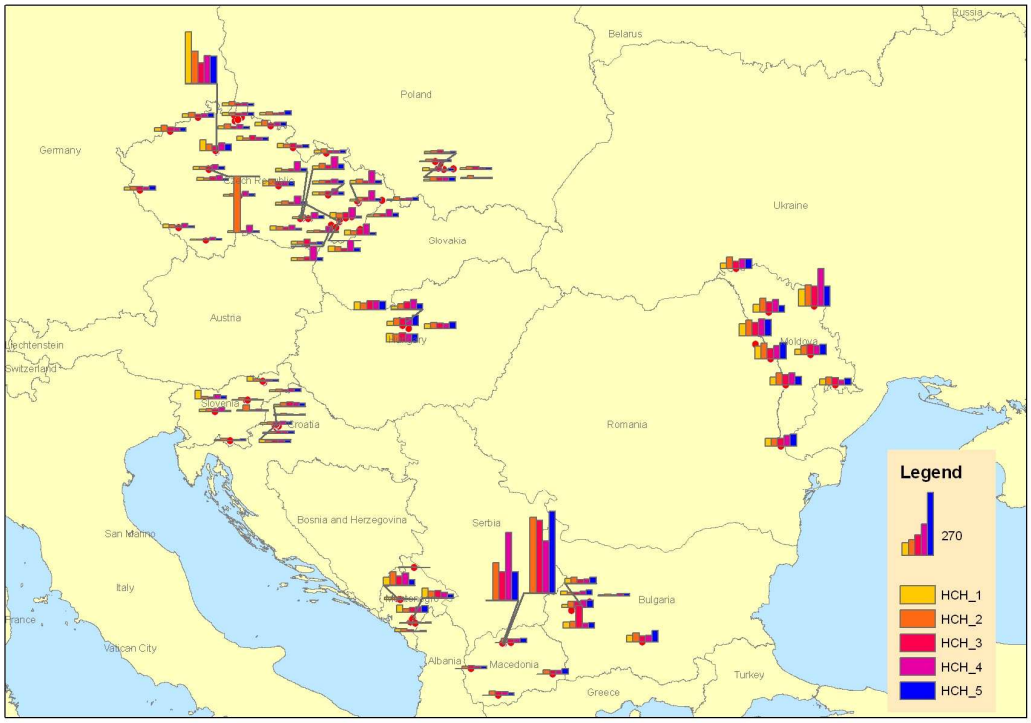

Figure 35: HCH levels (sum of α, β, γ, δ-HCH) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (Russia excluded), March - August, 2007

Romania also had the sites most heavily contaminated with **DDT and its metabolites** (maxima of DDTs levels at all sites in Bucuresti exceeded 200 ng filter^{-1}) in **2006**. In other countries, capitol cities were also most contaminated, even though they stayed on the levels one order of magnitude lower (Figures 36 and 37). Summary of DDT concentrations can be observed in Table VII-5 providing the minima, maxima, mean and median values from all sites and all campaigns.

Median atmospheric concentration of DDTs was highest in Romania (44 ng filter^{-1}) while it was 20 times lower in the Baltic countries and 5 times lower in the Czech and Slovak Republics or Serbia (103-104). The air concentration was never higher than 5 ng filter^{-1} in Estonia and Latvia, but tens of nanograms per filter were found in Lithuania or Slovakia. In Romania, Serbia and the Czech Republic, hundreds of nanograms per filter were measured as maxima. In the Czech Republic, the air concentration of 1.5 μg filter^{-1} was found at the Spolana remediation site, but hundreds of nanograms of DDTs were also measured in the filters from one of the background sites. The range of results from the Czech Republic demonstrates how much the selection of sampling sites alters final data (Table 13).

Table 13: Comparison of the DDT concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2006

AIR/DDTs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bosnia and Herzegovina	2	0.7	5.2	2.6	2.8
Estonia	5	0.5	3.7	1.7	1.6
Latvia	5	1.1	5.3	2.2	2.5
Lithuania	5	0.6	36.4	5.6	2.2
Romania	20	4.0	253.1	61.9	44.1
Serbia	7	0.2	132.0	22.6	8.3
Slovakia	11	2.7	36.1	11.8	9.8
Czech Republic	15	1.5	31.8	7.8	5.6
Czech Republic (A)	16	1.5	491.6	19.7	5.9
Czech Republic (B)	43	1.5	491.6	13.9	9.2
Czech Republic (C)	50	1.5	1 458.5	27.3	9.2

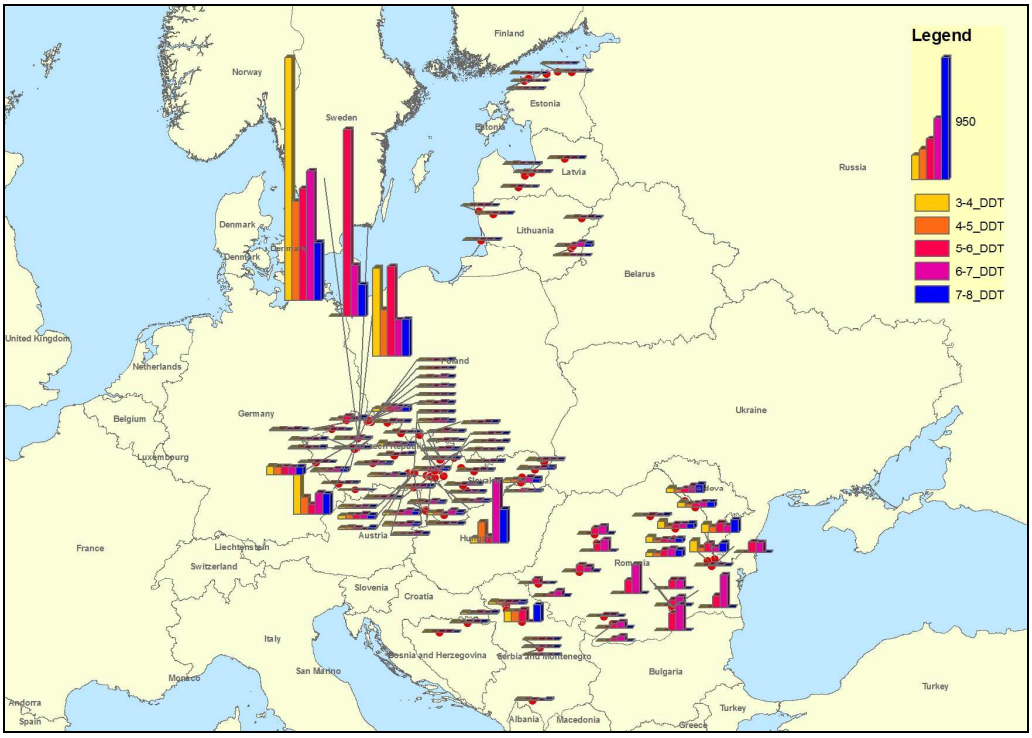

Figure 36: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2006

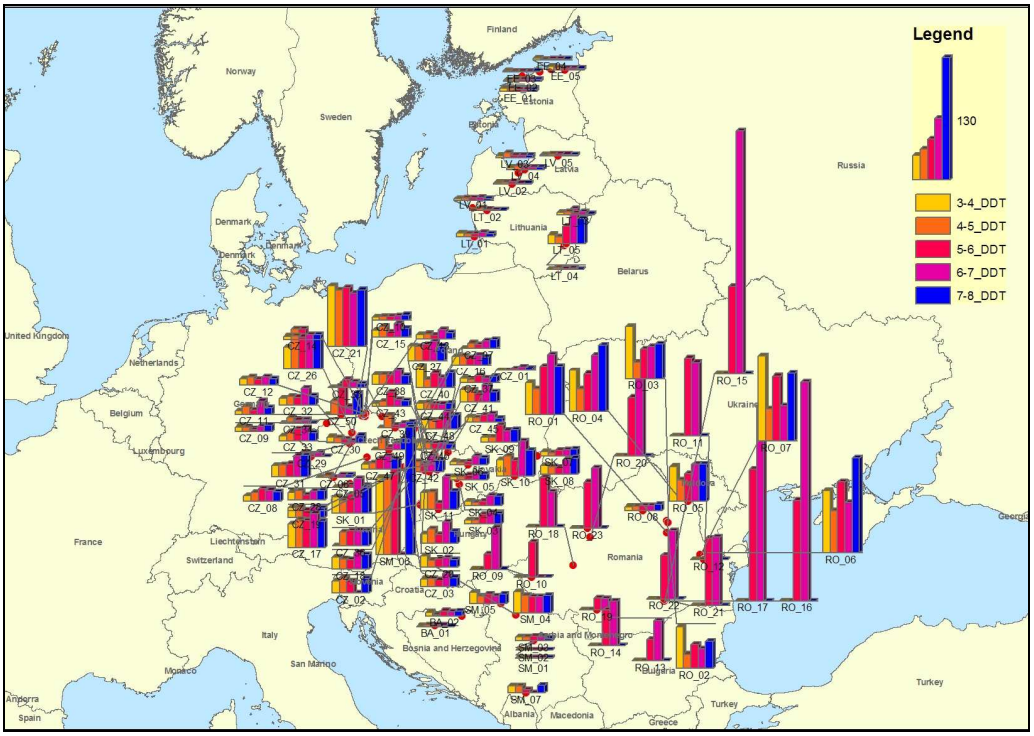

Figure 37: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (hotspots omitted), March - August, 2006

Atmospheric levels of DDTs were less variable than those of PCBs and HCHs, they varied within one order of magnitude. In **2007**, the highest median values were measured in Moldova (almost 50 ng filter^{-1}), while concentrations about one order of magnitude were found at most of the sites in Slovenia and Montenegro. Lowest leves were measured in Croatia where none of the sampling sites exceeded 7 ng filter^{-1} (median value of 6 ng filter^{-1}) (Figures 38 and 39). Summary of DDT concentrations can be observed in Table VII-6 providing the minima, maxima, mean and median values from all sites and all campaigns.

Median atmospheric concentration of DDTs was highest in Moldova (36 ng filter^{-1}) while it was an order of magnitude lower in the Montenegro or Croatia and 5 times lower in the Czech Republics, Slovenia or Poland (Table 14). In the Czech Republics, hundreds of nanograms per filter were measured as maxima. In the Czech Republic, the air concentration of 1.5 μg filter^{-1} was found at the Spolana remediation site, but hundreds of nanograms of DDTs were also measured in the filters from one of the background sites. The range of results from the Czech Republic demonstrates how much the selection of sampling sites alters final data.

Table 14: Comparison of the DDT concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2007

AIR / DDT	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bulgaria	6	3.9	36.1	14.4	13.3
Croatia	5	1.6	6.9	4.0	4.0
Hungary	5	9.0	25.9	16.2	16.3
Macedonia	6	2.5	25.4	14.3	14.0
Moldova	7	16.5	65.0	37.6	35.9
Montenegro	7	1.3	11.3	4.4	3.5
Poland	6	3.5	18.2	7.9	6.8
Russia	5	2.6	24.4	12.7	12.9
Slovenia	7	2.5	14.2	7.2	6.6
Czech Republic (A)	15	1.8	24.0	7.1	5.7
Czech Republic (B)	37	1.8	335.1	15.1	8.4

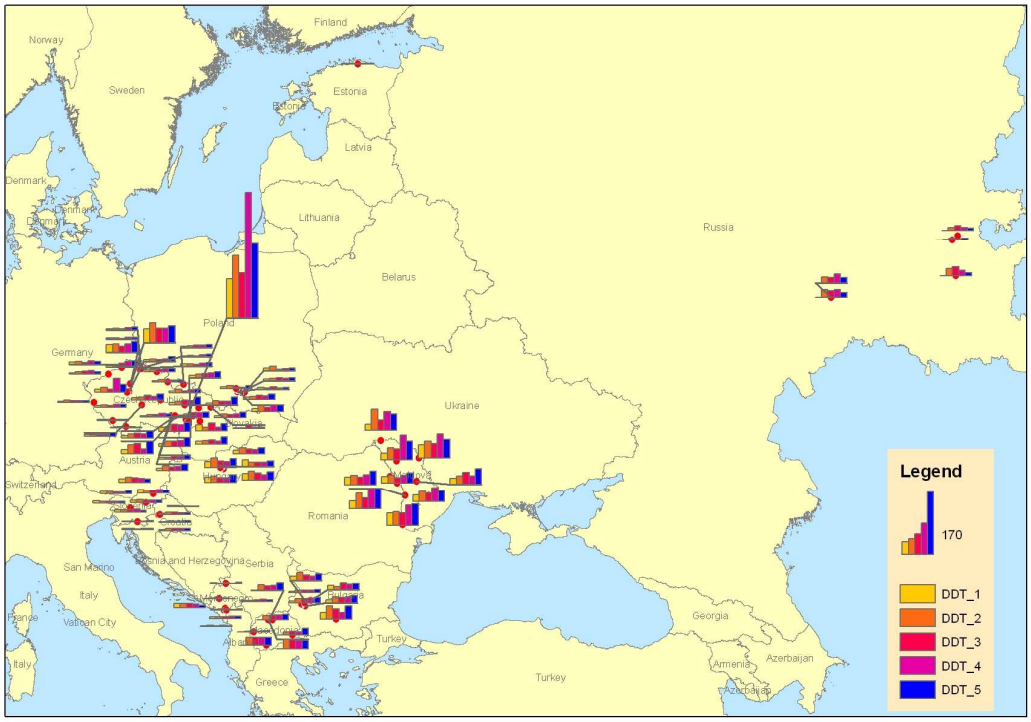

Figure 38: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

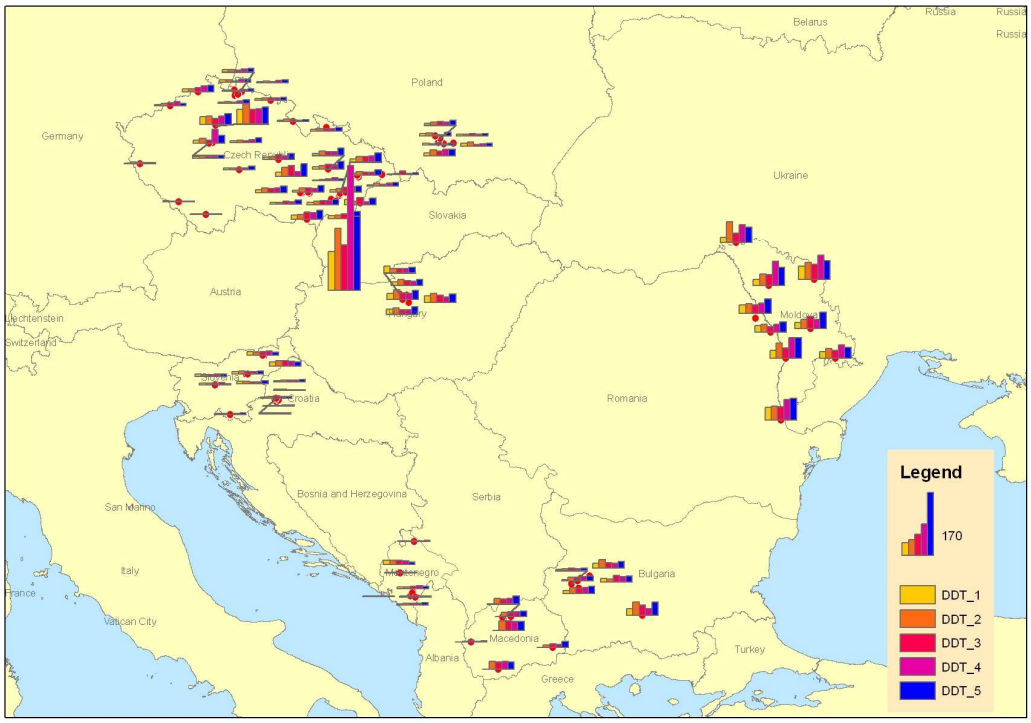

Figure 39: DDT levels (sum of *o,p'*- and *p,p'*-DDT, DDE, DDD) in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (Russia excluded), March - August, 2007

Uniform distribution in ambient air is **typical for HCB.** Concentrations were very low in all Baltic countries in **2006**, some elevated levels were found in Romania and at several industrial sites in other countries as well (Figures 41 and 42). Minima, maxima, mean and median values of HCB concentrations are listed in Table VII-7 for all sampling sites.

Median atmospheric levels of HCB were found to be quite uniform in the Central and Eastern European region although slightly lower levels were measured in the Baltic countries (Table 15). Extremely high HCB concentration (4.4 μg filter^{-1}) was only found at Spolana remediation site, all the other maxima varied within the factor of two.

Table 15: Comparison of the HCB concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2006

AIR/HCB	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bosnia and Herzegovina	2	0.1	7.7	5.8	6.0
Estonia	5	1.1	8.7	4.0	5.0
Latvia	5	3.6	7.5	5.7	5.4
Lithuania	5	4.4	13.0	7.4	7.6
Romania	20	1.8	16.3	8.0	7.3
Serbia	7	0.5	20.2	6.7	5.7
Slovakia	11	5.7	14.1	9.0	8.5
Czech Republic (A)	16	5.1	17.0	9.0	8.0
Czech Republic (B)	43	3.1	23.9	9.4	8.8
Czech Republic (C)	50	3.1	4 369.2	56.0	9.3

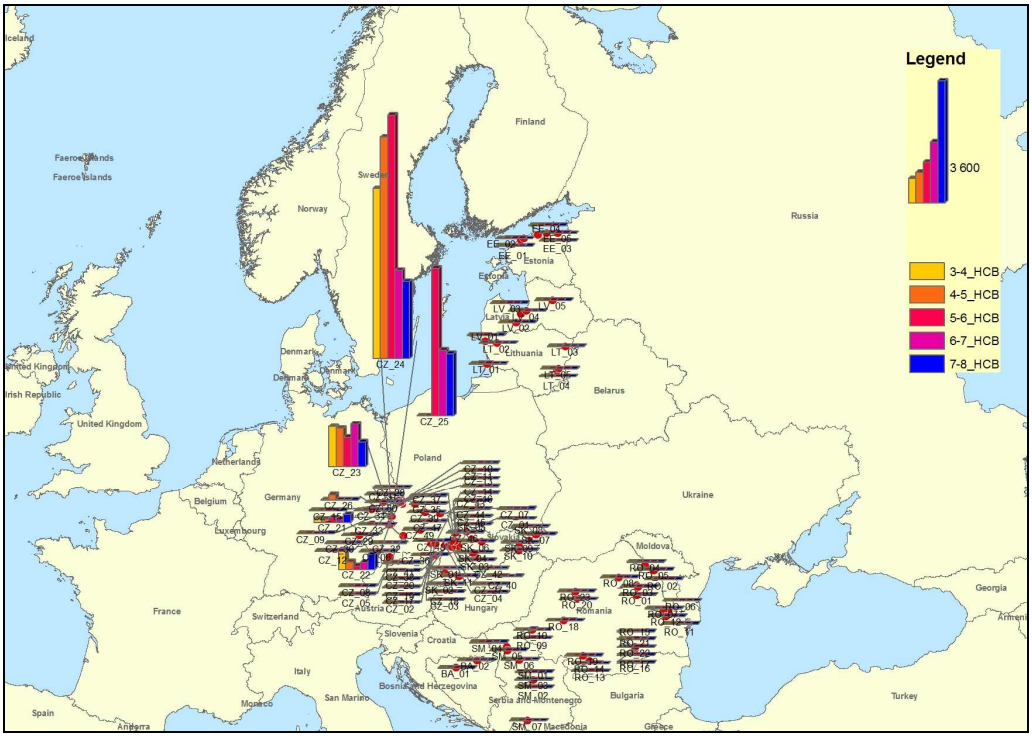

Figure 40: HCB levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2006

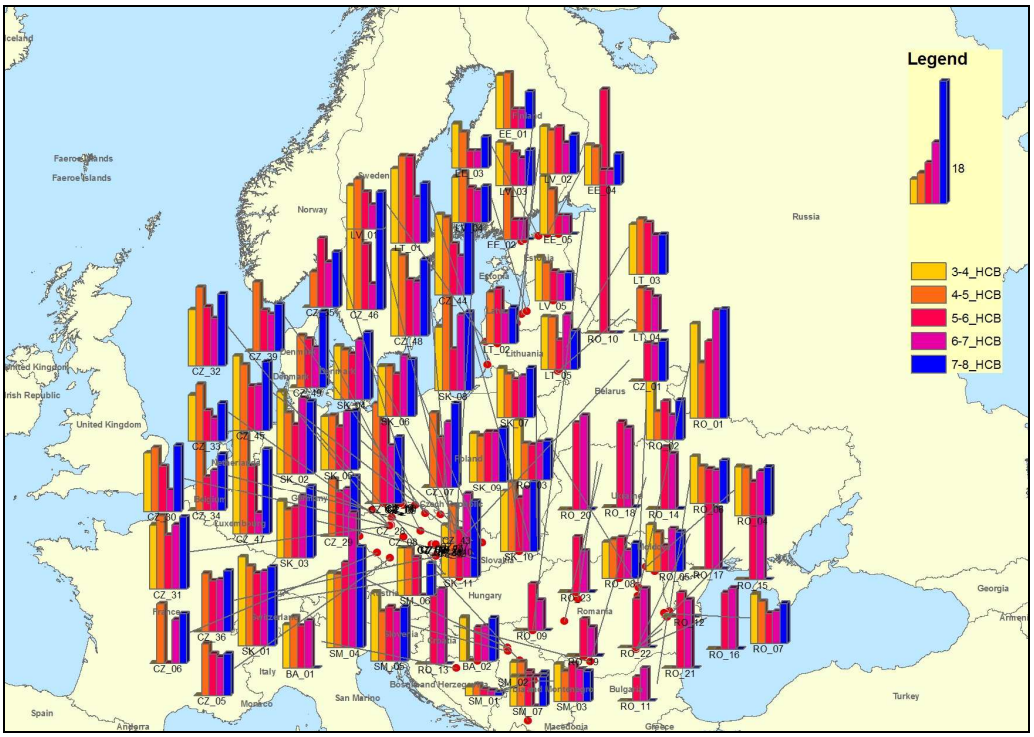

Figure 41: HCB levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (hotspots omitted), March - August, 2006

Similar uniform distribution in ambient in **2007** was found. Concentrations were very low in all countries, some elevated levels were only found in Russia, at the industrial sites Ufa and Chapaevsk (Figures 42 and 43). Minima, maxima, mean and median values of HCB concentrations are listed in Table VII-8 for all sampling sites.

Median atmospheric levels of HCB were found to be quite uniform in the Central and Eastern European region with the exception of Russia (Table 16). Extremely high HCB concentration was only found at some hot spots in the Czech Republic, all the other maxima varied within the factor of two.

Table 16: Comparison of the HCB concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2007

AIR / HCB	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bulgaria	6	2.6	15.0	6.2	5.3
Croatia	5	2.8	5.5	4.2	4.1
Hungary	5	4.3	9.2	6.9	7.0
Macedonia	6	2.5	6.5	4.0	3.9
Moldova	7	3.1	7.5	5.3	5.2
Montenegro	7	2.3	5.1	3.4	3.5
Poland	6	2.8	11.4	6.5	6.3
Russia	5	5.5	64.9	20.9	19.6
Slovenia	7	3.1	7.5	4.7	4.5
Czech Republic (A)	15	3.1	13.2	8.2	8.3
Czech Republic (B)	37	3.1	110.5	10.8	8.7

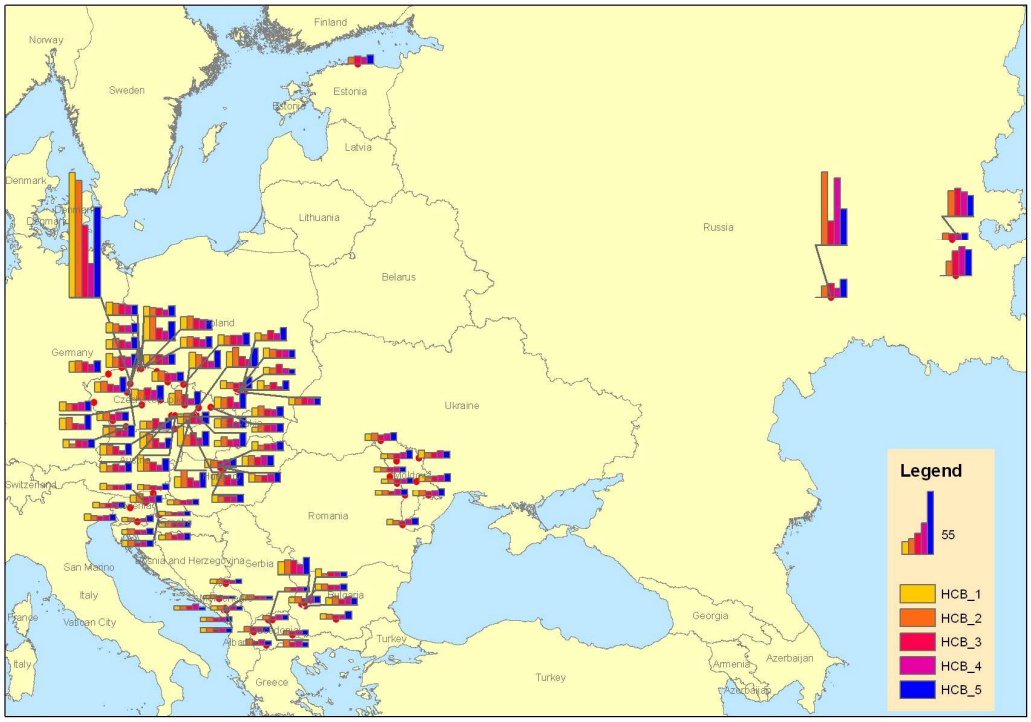

Figure 42: HCB levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

Figure 43: HCB levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, (Russia excluded), March - August, 2007

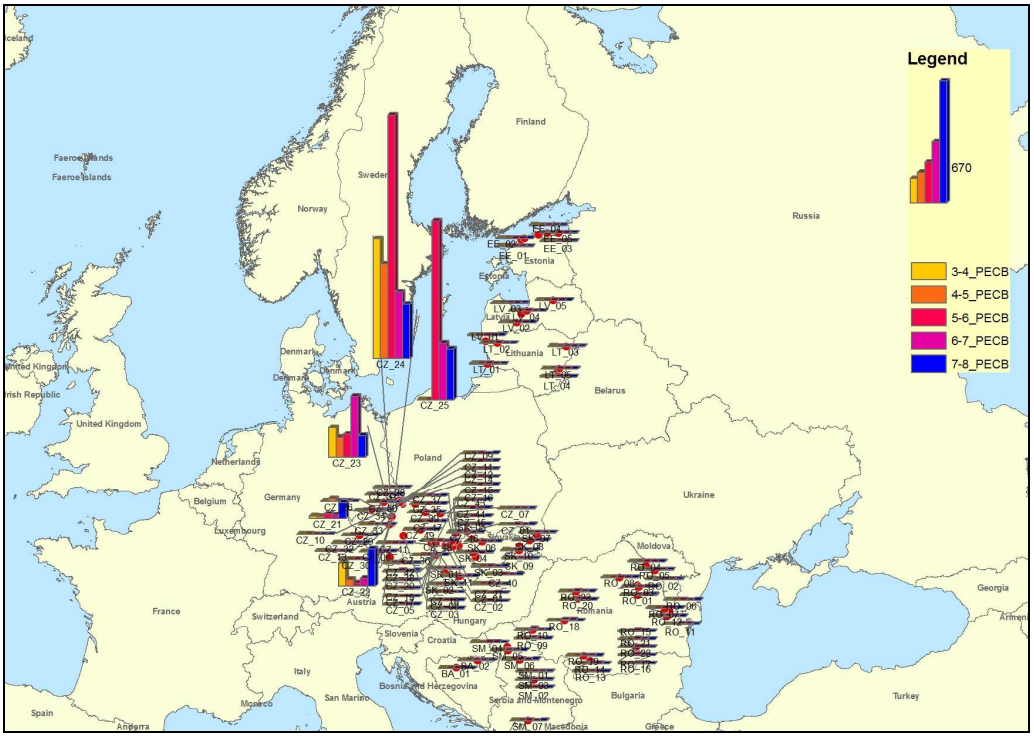

Figure 44: PeCB levels in the ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe March - August, 2006

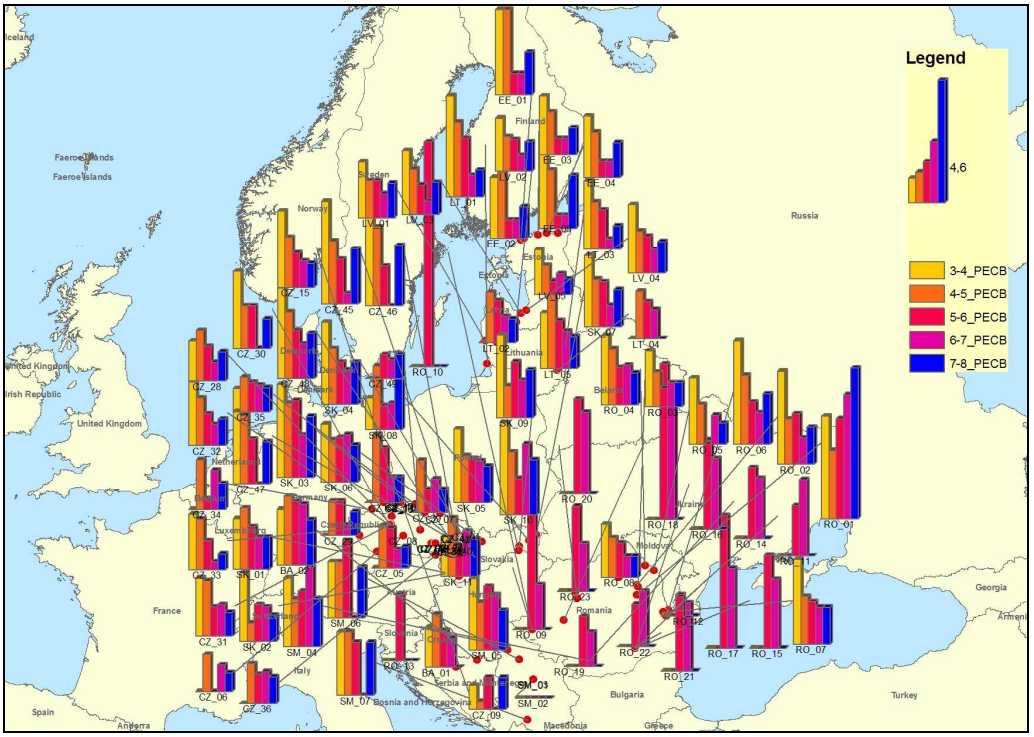

Figure 45: PeCB levels in the ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe (hotspots omitted), March - August, 2006

Figure 46: PeCB levels in the ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

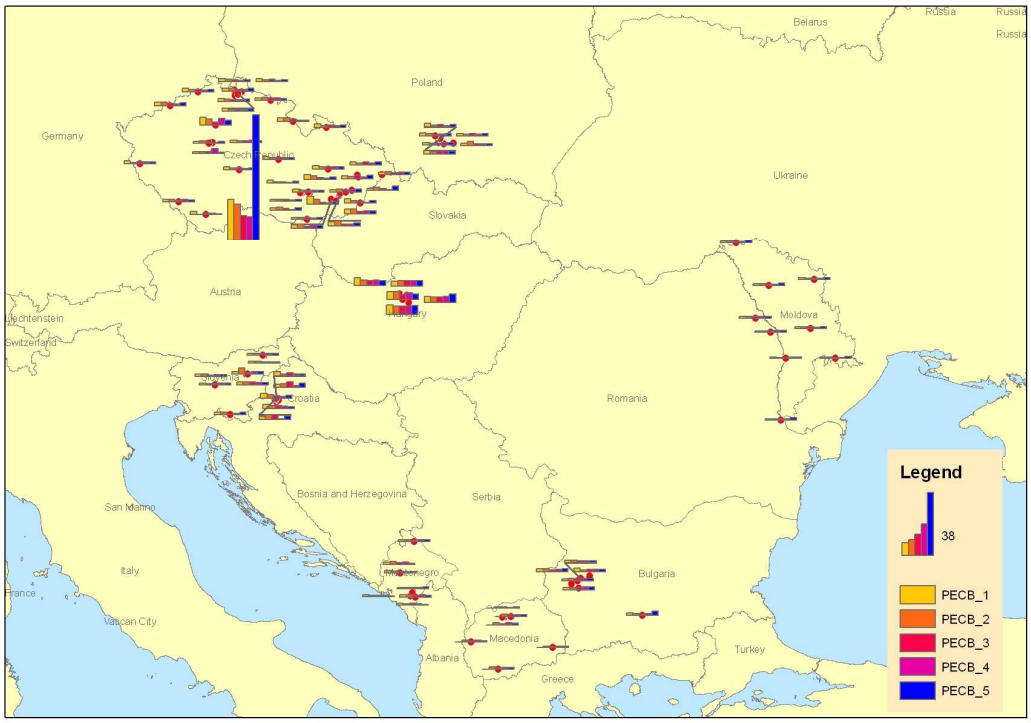

Figure 47: PeCB levels in the ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

Highest atmospheric concentrations of **PAHs** were again found in Romania in **2006**. Maxima of 170 μg filter^{-1} were measured in Deva in the summer season which means that levels at least 1-2 orders of magnitude higher can be expected in the winter time (Figure 48). Detailed information is summarized in Table VII-9.

Median atmospheric concentration of PAHs was lowest in Latvia, possibly due to the selection of background sites. It compares well to the set of background sites in the Czech Republic. PAH levels in the other two Baltic countries were similar to the Czech network; higher concentrations were found in Serbia, Bosnia and Slovakia. It is an interesting finding in case of Slovakia since Slovakian network consisted of background sites. Many of them were, however, urban sites where the influence of local heating systems is to be expected. Highest median concentration (7.3 μg filter^{-1}) and also highest maxima (170 μg filter^{-1}) were again found in Romania (Table 17 and Figure 48).

Table 17: Comparison of the PAH concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2008

AIR/PAHs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bosnia and Herzegovina	2	2 626	5 708	4 327	4 145
Estonia	5	934	9 086	4 031	3 143
Latvia	5	322	9 928	2 199	802
Lithuania	5	639	10 992	3 017	2 438
Romania	20	1 330	170 809	17 203	7 281
Serbia	7	667	94 352	16 068	4 045
Slovakia	11	688	22 711	6 184	4 287
Czech Republic (A)	16	253	6 926	1 536	1 171
Czech Republic (B)	43	253	22 442	3 262	2 218
Czech Republic (C)	50	253	61 850	4 892	2 544

In **2007**, highest median values of the atmospheric concentrations of PAHs were found in Bulgaria (Sofia), Macedonia (Skopje), and Montenegro (Srpska) (between 10 and 15 μg filter^{-1}). Maxima of 120 μg filter^{-1} (1.2 μg m^{-3}) were, however, measured in Russia in the background to the Chapaevsk industrial complex. It has to be considered that these summer levels can be expected to increase at least 1-2 orders of magnitude in the winter time (Figure 49). Detailed information is summarized in Table VII-10.

Median atmospheric concentration of PAHs was highest in Montenegro (6.1 μg filter^{-1}) and Russia (5.4 μg filter^{-1}), possibly due to the selection of industrial sites. In Russia, the air concentrations as high as 120 μg filter^{-1} were found (Table 18).

Table 18: Comparison of the PAH concentrations in the passive air samples from various Central, Southern and Eastern European countries in 2007

AIR / 16 PAHs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Bulgaria	6	1 202	21 412	4 696	2 564
Croatia	5	1 019	7 579	2 962	2 759

AIR / 16 PAHs	Number of sites	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Hungary	5	640	2 155	1 352	1 277
Macedonia	6	600	12 913	3 708	1 897
Moldova	7	764	6 721	2 073	1 637
Montenegro	7	2 447	16 784	6 521	6 126
Poland	6	1 414	5 102	3 069	2 932
Russia	5	2 434	120 568	14 461	5 429
Slovenia	7	159	3 815	2 367	2 370
Czech Republic (A)	15	169	2 488	948	867
Czech Republic (B)	37	161	53 504	2 899	1 425

Figure 48: PAH levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe March - August, 2006

Figure 49: PAH levels in ambient air (PAS, ng filter^{-1}) in Central, Eastern and Southern Europe, March - August, 2007

5.1.2.2.3 MONET-CEECs - conclusions

Since the **MONET-CEEC project** has been designed as a **satellite to the MONET-CZ network,** knowledge and experience generated in the core network of the Czech Republic served as a base for the evaluation and interpretation of the PAS screening study in the Central and Eastern European countries. Network of partner institutions was established and they cooperated in designing the pilot screening study in the CEE region in 2006-2008. Transfer of know-how, educational and training activities were an important part of the MONET-CEEC project.

The potential of passive air sampling technique as a tool capable of providing seasonally and spatially resolved information on the local sources and levels of contamination was explored in this study on demand of establishment of the cost-effective long-term monitoring in this area. The passive air samplers proved to be a powerful technique capable of detecting the concentrations ranging over four orders of magnitude providing the information very comparable with the conventional techniques.

5.1.2.3 MONETs – general conclusions

This report summarizes results of the **ambient air monitoring of POPs in the Central and Eastern European region in 2006 and 2007.** Data are derived from the model monitoring network based on the passive sampling technique.

We have to be aware of **two major limitations** of this method. One is the semi**-quantitative nature of PAS data.** Due to the character of the sampler, no exact air concentrations can be derived even though they can be estimated from the amounts of POPs sequestered in polyurethane foam and sampled volume derived from parallel passive and active sampling. Results of several laboratory and field calibration studies indicated that the variability in such estimated sampling rates remains within the factor of 2-3, and this uncertainty have to be always considered when interpreting data. This, however, means that we are still getting very valuable time-integrated data giving more representative characterization of the sampling site than accidental short-time high volume sampling. The uncertainty can be further reduced by application of performance reference compounds.

Second disadvantage of PAS is a limited sampling of the atmospheric particulate matter causing underestimation of the air concentrations for those compounds with a significant fraction associated with the particulate matter. However, the predominance of gaseous PCBs and organochlorine pesticides in the atmosphere is well-known. On average, particle bound PCBs account for less than 5 % of the total amount of PCBs in the atmosphere. Situation gets more complicated with polychlorinated dibenzo-*p*-dioxins and furans, and especially with polyaromatic hydrocarbons. Experiments focused on characterization of the fine particulate fraction sequestered by PAS are currently in progress in our center.

We can, however, conclude that **passive sampling technique** is fully applicable in the **long term monitoring** projects and capable to fulfill the tasks of **determination of the POP levels** in ambient air, evaluation of the **spatial and temporal trends** in distribution of POPs, **impact evaluation** of point and diffusive sources, and **assessment of short- and long-range transport of POPs**. All of these are important in the process of establishment of relevant arrangements for the **effectiveness evaluation** of the international conventions and fulfilling the international obligations of the Czech Republic.

5.1.2.4 GAPS

5.1.2.4.1 Results

PUF-disk PAS were deployed at four Eastern European sites in 2005. Table 19 shows the exposure times (days), average temperatures (°C) and effective sampling rates (m^3 day^{-1}) for each of four sampling periods at each site. Generally, the PAS sampling occurs as follows: January–March (Period 1); April–June (Period 2); July–September (Period 3); and October–December (Period 4). The air concentrations (pg m^{-3}) at each of four sampling periods are presented in Table 20 for selected target chemicals, several of which are POPs listed under Annex A of the Stockholm Convention on POPs. Results are reported for: *cis*-chlordane (CC), *trans*-chlordane (TC) and *trans*-nonachlor (TN); *p,p'*-dichlorodiphenyltrichloroethane (DDT) and *p,p'*-dichlorodiphenyl-dichloroethylene (DDE); dieldrin; heptachlor (HEPT) and heptachlor epoxide (HEPX); polychlorinated biphenyls (PCBs); α-hexachlorocyclohexane (α-HCH); γ-HCH; endosuflan I (Endo I), endosulfan II (Endo II) and endosulfan sulfate ($EndoSO_4$).

XAD-based PAS were deployed at three Eastern European sites in 2005 and four sites in 2006. By sampling air for one year, XAD resin-based PAS provide annually averaged concentrations of organic pollutants. Table 21 reports the sampling durations and the sequestered amounts of selected OCPs in ng/PAS. Results are reported for pesticides that are classified under the Stockholm Convention: CC, TC, TN, DDT, DDE, dieldrin, HEPT, and HEPX (acronyms defined in previous paragraph) and for pesticides that are not classified under Stockholm Convention, including α- and γ- HCH, Endo I and II, $EndoSO_4$, chlorothalonil (CT), dacthal (DT), and trifluralin (TF).

5.1.2.4.2 References

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Table 19: Exposure times, average temperatures and effective sampling rates during deployment periods for PUF-disk sampling in 2005

2005	Period 1			Period 2			Period 3			Period 4		
Site ID	**Exposure Time (Days)**	**Average Temp (°C)**	**R# (m^3 day^{-1})**	**Exposure Time (Days)**	**Average Temp (°C)**	**R# (m^3 day^{-1})**	**Exposure Time (Days)**	**Average Temp (°C)**	**R# ($m^3 day^{-1}$)**	**Exposure Time (Days)**	**Average Temp (°C)**	**R# (m^3 day^{-1})**
EE01	139	-3	1.5	91	8	3.2	92	17	2.4	89	4	2.1
EE02	139	-3	2.5	104	9	2.9	92	23	2.1	91	8	1.3
EE03	103	13	4.5	92	11	2.9	92	23	1.9	98	4	3.8*

R = effective sampling rate

* Mean sampling rate calculated based on 4 sampling periods.

** Sample not available

NS = No deployment in 2005

Table 20: Air concentrations (pg m^{-3}) of OCPs, PCBs and PBDEs in 2005 using PUF-disk samplers

2005 – Period 1															
Site ID	**α-HCH**	**γ-HCH**	**HEPT**	**HEPX**	**TC**	**CC**	**TN**	**Endo I**	**Endo II**	**EndoSO$_4$**	**Dieldrin**	**ppDDE**	**ppDDT**	**PCBs#**	**PBDEs##**
EE01	36	15	BDL	BDL	1	11	1.4	30	BDL	BDL	BDL	BDL	BDL	234	BDL
EE02	6	10	BDL	4.2	BDL	0.5	0.3	22	1.2	BDL	5	19	BDL	241	BDL
EE03	16	20	BDL	BDL	0.4	0.7	0.8	29	BDL	BDL	BDL	32	BDL	62	2
2005 – Period 2															
Site ID	**α-HCH**	**γ-HCH**	**HEPT**	**HEPX**	**TC**	**CC**	**TN**	**Endo I**	**Endo II**	**EndoSO$_4$**	**Dieldrin**	**ppDDE**	**ppDDT**	**PCBs#**	**PBDEs##**
EE01	40	20	BDL	BDL	0.2	0.4	0.6	23	1.3	0.4	29	19	--	158	BDL
EE02	8.5	14	BDL	BDL	0.4	0.7	0.8	131	17	1.1	22	32	--	50	BDL
EE03	13	36	BDL	BDL	0.7	1.3	1.4	528	69	5.6	53	90	--	68	BDL
MDL	**0.1**	**0.3**	**0.1**	**0.1**	**0.1**	**0.4**	**0.2**	**0.7**	**0.8**	**0.5**	**0.14**	**0.1**	**0.5**	**0.12**	**3.7**
2005 – Period 3															
Site ID	**α-HCH**	**γ-HCH**	**HEPT**	**HEPX**	**TC**	**CC**	**TN**	**Endo I**	**Endo II**	**EndoSO$_4$**	**Dieldrin**	**ppDDE**	**ppDDT**	**PCBs#**	**PBDEs##**
EE01	41	11	BDL	BDL	BDL	1	1	18	2	BDL	BDL	BDL	--	307	BDL
EE02	33	37	BDL	22	1	3	2	194	24	2	35	80	--	135	BDL
EE03	37	56	BDL	19	1	4	2	491	85	8	38	137	--	158	BDL
2005 – Period 4															
Site ID	**α-HCH**	**γ-HCH**	**HEPT**	**HEPX**	**TC**	**CC**	**TN**	**Endo I**	**Endo II**	**EndoSO$_4$**	**Dieldrin**	**ppDDE**	**ppDDT**	**PCBs#**	**PBDEs##**
EE01	43	21	BDL	BDL	1	1	1	33	2	0	BDL	29	--	350	BDL
EE02	52	69	BDL	36	2	5	3	241	24	2	22	159	--	189	BDL
EE03	22	55	BDL	BDL	1	3	1	43	2	BDL	4	30	--	109	BDL
MDL	**0.1**	**0.3**	**0.1**	**0.1**	**0.1**	**0.4**	**0.2**	**0.7**	**0.8**	**0.5**	**0.14**	**0.1**	**0.5**	**0.12**	**3.7**

Sum of 48 PCB congeners

Sum of PBDE-47, 99, 100

NA = PUF disk not deployed during the period/sample not available

MDL = method detection limit (pg m^{-3}); BDL = below detection limit

Table 21: Length of sampling in days and amounts of selected organochlorine pesticides sequestered in XAD-based PAS in ng/PAS

Year 1 – 2005

Site ID	Days	α-HCH	γ-HCH	HEPT	HEPX	TC	CC	TN	Endo I	Endo II	EndoSO4	Dieldrin	ppDDE	ppDDT	TF	CT	DT
EE02	349	7.2	5.8	ND	0.4	0.2	0.3	0.3	3.1	ND	ND	ND	4.2	ND	19	0.3	BMDL
EE03	370	9.5	13	ND	ND	0.3	0.3	0.4	10	ND	ND	ND	8.2	1.3	89	8.2	0.2
MDL		0.1	0.1	0.2	0.1	0.04	0.06	0.09	0.09	0.03	0.02	0.5	0.3	0.3	0.08	0.1	0.04

Year 2 – 2006

Site ID	Days	α-- HCH	γ-- HCH	HEPT	HEPX	TC	CC	TN	Endo I	Endo II	EndoSO4	Dieldrin	ppDDE	ppDDT	TF	CT	DT
EE01	343	5.9	2.5	ND	ND	0.1	ND	0.1	5.6	0.5	0.2	ND	ND	ND	BMDL	3.2	BMDL
EE02	365	4.7	4.9	ND	ND	0.1	0.2	0.2	9.9	1.1	0.3	ND	ND	ND	22	84	0.6
EE03	355	4.9	7.2	ND	0.9	0.1	0.2	0.2	17	2.1	0.7	ND	ND	ND	172	233	0.9
MDL		0.2	0.2	0.4	0.4	0.03	0.07	0.04	0.5	0.05	0.03	0.9	-	-	0.05	1.2	0.2

MDL = below method of detection limit
ND = not detected
MDL = method of detection limit (ng/PAS)

Table 22: Length of sampling in days and amounts of selected organochlorine pesticides sequestered in XAD-based PAS in pg m^{-3}

Year 1 – 2005

Site ID	Days	α-HCH	γ-HCH	HEPT	HEPX	TC	CC	TN	Endo I	Endo II	$EndoSO_4$	Dieldrin	ppDDE	ppDDT	TF	CT	DT
EE02	349	21	17	ND	1.1	0.6	0.9	0.9	8.9	ND	ND	ND	12	ND	54	0.9	BMDL
EE03	370	26	36	ND	ND	0.8	0.8	1.1	28	ND	ND	ND	22	3.5	241	22	0.5
MDL		0.4	0.3	0.6	0.3	0.1	0.2	0.3	0.3	0.08	0.05	1.2	0.9	0.9	0.2	0.4	0.1

Year 2 – 2006

Site ID	Days	α--HCH	γ--HCH	HEPT	HEPX	TC	CC	TN	Endo I	Endo II	$EndoSO_4$	Dieldrin	ppDDE	ppDDT	TF	CT	DT
EE01	343	17	7.3	ND	ND	0.3	ND	0.3	16	1.5	0.6	ND	ND	ND	BMDL	9.3	BMDL
EE02	365	13	13	ND	ND	0.3	0.5	0.5	27	3.0	0.8	ND	ND	ND	60	231	1.6
EE03	355	14	20	ND	2.5	0.3	0.6	0.6	49	5.9	2.0	ND	ND	ND	485	656	2.5
MDL		0.5	0.5	1.1	1.1	0.08	0.2	0.1	1.4	0.1	0.08	2.5	-	-	0.1	3.3	0.5

BMDL = below method of detection limit
ND = not detected
MDL = method of detection limit (pg/m^3)

5.1.2.5 International research projects

As for data from APOPSBAL project, the amounts of OCPs, PCBs and PAHs were determined in the samples from the first exposure period (between 7/14/2004 and 8/11/2004). The highest amount of **PCBs** captured in the PUF filter in 28 days was 6 μg for the sum of 7 indicator congeners (2 μg for the individual congeners) in Zastava factory in Kragujevac, Serbia, while the same sum only reached hundreds of nanograms in other PCB contaminated sites (Zadar, Tuzla), and stayed in the range of tens of nanograms in the residential areas. This corresponds to the results of the active air sampling when the air concentrations in Zastava were as high as 40 ng m^{-3}, but the levels in other industrial objects and the storage places were bellow 10 ng m^{-3}, and the concentrations in residential and background areas never exceeded 200 pg m^{-3} (Klanova et al., 2007a).

A generally decreasing trend in the levels of **PCBs** in the atmosphere corresponding with a decrease of the average daily temperatures in this region between July and December was observed in all sampling sites indicating enhanced evaporation of chlorinated compounds from the secondary sources during the warm season.

The amounts of **OCPs** sequestered in the PAS filters remained bellow 20 ng per filter for both **HCHs and DDTs** in all places except for Zastava Kragujevac, where the levels reached 80 ng for HCHs and 100 ng for DDTs. It means the atmospheric concentrations in Zastava factory were almost an order of the magnitude higher than on the other sites.

The PAH summer air maxima never exceeded 10 μg per filter even in the industrial cities (Zagreb, Poljana, Tuzla, Pancevo, Kragujevac) while the winter maxima went as high as 140 μg per filter in Tuzla. The winter levels doubled in Kragujevac or Pancevo when compared with those of summer but they increased more than twenty-fold between summer and winter in Tuzla. Whole Tuzla region has the PAH levels about one order of the magnitude higher than all the other sampling sites and the pollution sources as well as toxicological risks were assessed in independent studies and published separately (Skarek et al., 2008).

Development of passive air sampling devices capable of being deployed in many locations at the same time opens new possibilities not only for the large scale but also for regional monitoring projects (Klanova et al., 2006b). Since this technique offers information about a long-term contamination of selected sites, it also becomes a very suitable tool for the evaluation of the spatial and temporal variations and trends of the atmospheric concentrations of POPs. Here the passive samplers were **successfully applied on the regional level** as a screening method for the comparison of the atmospheric contamination of various sites in the Western Balkan affected by war accidents.

The study revealed a very good agreement between the results obtained from the initial high volume air sampling campaigns performed in Croatia, Serbia, and Bosnia and Herzegovina in 2003–2004 and from the passive air sampling campaign. Both the range of concentrations and the congener distribution derived from two techniques corresponded very well. While the air concentrations in Serbia determined with a high volume sampler varied from 100 pg m^{-3} to 40 ng m^{-3} for the sum of 7 indicator PCBs, the amount of PCBs in a PAS filter ranged between 20 and 6 000 ng per filter which indicates the average sampling rate around 5 m^3 per day.

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5.2 Mother milk and blood

5.2.1 Introduction

Once **POPs** are in the **bodies of mothers,** they are readily **transferred to the fetus via the placenta** and to **infants via human milk.** As **human milk** is the most suitable food for newborn infants, the contamination of food and human milk by POPs is of a particular concern. Available data demonstrate that **contamination of human milk and food by POPs is a worldwide phenomenon.** Nevertheless, there has been little monitoring of POPs body burdens and environmental levels in the developing countries. In some cases only a limited number of journal articles on environmental contamination, population exposure to POPs, and possible health effects in poor and developing countries is available.

Except for the **Czech Republic**, no reported country from the Central and Eastern European region has been conducting regular national human biomonitoring of at least some Stockholm Convention POPs. Fortunately, some countries such as Bulgaria, Croatia, Hungary, Slovakia as well as the Czech Republic participated in the last two **WHO-coordinated surveys of human milk for POPs** that involved the analysis of pooled human milk samples collected in 2001 and 2006. **No data** (meeting certain QA/QC criteria) on POPs levels in human milk or maternal blood is publicly available in the following countries from the region: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Estonia, Georgia, Kazakhstan, Kyrkyzstan, Lithuania, Macedonia, Moldova, Montenegro, Serbia, Slovenia, Tajikistan, and Turkmenistan. Other countries such as Bulgaria, Hungary, Latvia, Ukraine, and Uzbekistan have only very limited information available acquired either from participation in one or two WHO-coordinated surveys of human milk for POPs or from a short-term national survey. POPs levels in milk and blood collected in northern parts of Russia were measured within the Arctic Monitoring and Assessment Programme. **Most data on POPs levels in maternal blood from Slovakia** comes from the research projects focused on PCB-contaminated areas and adjacent control areas.

5.2.2 Collection of data on POPs in humans (milk and blood)

5.2.2.1 Albania

Although Albania participated in some international studies in which PCDD/PCDF and PCB analyses were involved, these studies were realized before 1998 and they are not acceptable for this report. Nevertheless, PCDD, PCDF and PCB levels in human milk from Albania measured within the 2nd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk conducted in 1993 were significantly lower than those in human milk from other participating countries (except for Hungary and Pakistan). Unfortunately, Albania has not participated in the 3rd WHO exposure study. There is no Albanian national monitoring aimed at POPs although at least hexachlorocyclohexane (HCH) residues should be monitored in human milk or blood since this pollutant was produced in Albania at low-level technology until the early 1990's.

5.2.2.2 Armenia

Armenia has not participated in any of four surveys on the POP levels in human milk coordinated by WHO in 1988, 1993, 2002, and 2006. No data on SC POPs levels in human milk or blood taken from Armenia is available (in 1993-2000, milk samples were analyzed for DDT and lindane but the QA/QC criteria were not met because gas chromatography with packed columns was used).

5.2.2.3 Azerbaijan

In spite of DDT production in Azerbaijan between 1958 and 1980 (489.549 metric tons of 5 % DDT powder) and large scale application of this pesticide on the Azerbaijan cotton fields, human exposure of both, occupationally exposed workers and general population to this pollutant and its metabolites and degradation products has not been monitored and evaluated. Data on human exposure to other POPs are also not available. Azerbaijan has not

participated in any of four surveys on POPs levels in human milk coordinated by WHO in 1988, 1993, 2002, and 2006.

5.2.2.4 Belarus

Although some SC organochlorine pesticides (HCB, DDT/DDE) were analyzed in human milk and adipose tissue, the samples were collected before 1998. Belarus did not participate in any of the WHO-coordinated exposure studies on PCB, PCDD and PCDF levels in human milk.

5.2.2.5 Bosnia and Herzegovina

No information on the human exposure to Stockholm Convention POPs is available from Bosnia and Herzegovina after it became independent in the 1990s after the Bosnian War.

5.2.2.6 Bulgaria

No monitoring or research activities aimed at POPs levels in human milk and blood have been conducted in Bulgaria. Participation in the 3rd exposure study on POPs levels in human milk coordinated by WHO is an exception. The study has shown that PCDD/PCDF levels as well as PCB ones were among the lowest out of 26 participating countries.

A/1 Study-specific information

Country:	**Bulgaria**
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	3 sites – Sofia, Blagoevgrad, and Bankya (background)
Sampling year(s):	2001
No. of donors:	28
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.* *Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.* *National Implementation Plan for the Management of Persistent Organic Pollutants (POPs) in the Republic of Bulgaria, 2006*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid	Gravimetric

determination (e.g. gravimetric, enzymatic):
QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied): Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (3 samples analysed)

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 23: Chlordane (pooled sample of milk samples collected in Bankya)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	18.5			
cis-nonachlor				
trans-nonachlor	10.3			
Chlordane (group)*	**17.9**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 24: Heptachlor (pooled sample of milk samples collected in Bankya)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Heptachlor				
cis-heptachlor epoxide	12.5			
trans-heptachlor epoxide				
Heptachlor (group) *	**12.5**			

Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

Table 25: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	13.34	13.03	9.64	16.33
PCB 153	16.36	15.90	11.37	20.29
PCB 180	9.66	9.25	6.38	13.20
PCB 118				

Sum PCB_6 (28,52,101,138,153,180)		**42** (median)	**32**	**52**
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**39.4**	**38.2**	**27.4**	**49.8**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

A/3 Summary table of reported POPs levels

Table 26: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin*	ng g^{-1} lw		< 0.5		
Chlordane (group)*	ng g^{-1} lw		17.9		
DDT (group)*	ng g^{-1} lw		500		
Dieldrin*	ng g^{-1} lw		4.0		
Endrin (group)*	ng g^{-1} lw		< 0.5		
Heptachlor (group)*	ng g^{-1} lw		12.5		
HCB*	ng g^{-1} lw		12.0		
Mirex	ng g^{-1} lw				
Toxaphene*	ng g^{-1} lw		< 1.5		
PCBs	ng g^{-1} lw		42	32	52
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		4.21	3.74	4.70
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		6.14	5.08	7.11

* Pooled sample of milk samples collected in Bankya

5.2.2.7 Croatia

Croatia participated in 1988, 1993, and 2002 WHO-coordinated studies on PCB, PCDD and PCDF levels in human milk. The results show that the levels of those POPs have decreased. Human milk samples taken in 2000 in Zagreb and Krk areas were analyzed for DDT congeners, HCB and PCBs. Much data on PCBs and OCPs in Croatian human milk was published but samples had been collected before 1998.

A/1 Study-specific information

Country:	**Croatia**		
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.		
Matrix (e.g. milk, blood):	Milk		
Sampling site(s):	2 sites		
Sampling year(s):	2000-2001		
No. of donors:			
Donors' age (yrs):Zagreb	Average: 29.5	Min: 22	Max: 42
Donors' age (yrs):Krk	Average: 23.9	Min: 20	Max: 27
For blood: proportion of female donors (%)			
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.*		

Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (2 samples analysed)

* Participation in proficiency testing schemes.

A/3 Summary table of reported POPs levels

Table 27: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw		135	121	150
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		7.17	6.82	7.52
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		6.40	5.99	6.80

B/1 Study-specific information

Country:	**Croatia**
Activity (e.g.. monitoring, research):	Research project under the Ministry of Science, Education and Sports, Republic of Croatia
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	1 site – Zagreb
Sampling year(s):	2000
No. of donors:	29

Donors' age (yrs):	Average: 29 Min: 21 Max: 43
For blood: proportion of female donors (%)	
Literature source:	*Herceg Romanič, S., Krauthacker, B., Bull. Environ. Contam. Toxicol. 76, 705-711 (2006)*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☐PT participation* ☐Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 28: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT				
p,p'-DDT		19.4	< 1.6	424.0
o,p'-DDD				
p,p'-DDD		2	< 1.6	157.0
o,p'-DDE				
p,p'-DDE		257	84.8	911.6
DDT (group) *				

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 29: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
PCB 28		8.3	< 1.6	24
PCB 52		12.5	< 1.6	14
PCB 101		2.6	< 1.6	24

PCB 138		33.1	10.6	62
PCB 153		41.5	16.7	108.7
PCB 180		13.5	< 1.6	40
PCB 118		*4.5*	*< 1.6*	*69.7*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

B/3 Summary table of reported POPs levels

Table 30: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw		12.5	< 1.6	47.15
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

C/1 Study-specific information

Country: **Croatia**

Activity (e.g.. monitoring, research): Research project under the Ministry of Science, Education and Sports, Republic of Croatia

Matrix (e.g. milk, blood): Milk

Sampling site(s): 1 site – Krk

Sampling year(s): 2000

No. of donors: 23

Donors' age (yrs): Average: 26 Min: 18 Max: 40

For blood: proportion of female donors (%)

Literature source: *Krauthacker B., personal communication*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☐PT participation* ☐Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was aplied):

* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 31: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT		13.7	< 1.6	64.15
o,p'-DDD				
p,p'-DDD		5.0	< 1.6	20.41
o,p'-DDE				
p,p'-DDE		226.5	60.6	1 286.7
DDT (group) *				

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 32: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28		10.5	< 1.6	39.9
PCB 52		10.4	< 1.6	66.9
PCB 101		2.9	3.5	34.3
PCB 138		32.6	16.9	168
PCB 153		38.8	7.1	213
PCB 180		19.4	< 1.6	82.7
PCB 118		*5.1*	*< 1.6*	*19.5*
Sum PCB$_6$ (28,52,101,138,153,180)				
Sum PCB$_7$ (28,52,101,118,138,153,180)				

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

C/3 Summary table of reported POPs levels

Table 33: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw		7.4	< 1.6	105.3
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

5.2.2.8 Czech Republic

The Czech Republic is the only country in this region that has been performing the long-term systematic monitoring of some POPs in human milk. The country participated in the 2nd, 3rd and 4th of the WHO-coordinated exposure studies on POPs in human milk.

A/1 Study-specific information

Country:	**Czech Republic**
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	1. Uherske Hradiste; 2. Kladno; 3. Liberec
Sampling year(s):	2000
No. of donors:	
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.* *Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor

	☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/MS ☐Isotope dilution Which POPs:
	☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
	☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/ECD Which POPs:
	☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
	☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes:	Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (3 samples analysed)

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 34: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	4.5			
cis-nonachlor				
trans-nonachlor	2.7			
Chlordane (group)*	**4.4**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 35: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Heptachlor				
cis-heptachlor epoxide	1.5			
trans-heptachlor epoxide				
Heptachlor (group) *	**1.5**			

* Sum of all detected analytes calculated as heptachlor
As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

A/3 Summary table of reported POPs levels

Table 36: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw	< 0.5			
Chlordane (group)	ng g^{-1} lw	7.2			

POP	Unit	Average	Median	Min	Max
DDT (group)	ng g^{-1} lw	422			
Dieldrin	ng g^{-1} lw	2.0			
Endrin (group)	ng g^{-1} lw	< 0,5			
Heptachlor (group)	ng g^{-1} lw	1.5			
HCB	ng g^{-1} lw	76.0			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw	< 1.5			
PCBs	ng g^{-1} lw		502	496	1 009
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		15.24	14.32	28.48
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		7.78	7.44	10.73

B/1 Study-specific information

Country: **Czech Republic**

Activity (e.g.. monitoring, research): 4th WHO-coordinated survey of human milk for persistent organic pollutants (POPs)

Matrix (e.g. milk, blood): Milk

Sampling site(s): Across the Czech Republic

Sampling year(s): 2006

No. of donors:

Donors' age (yrs): Average: Min: Max:

For blood: proportion of female donors (%)

Literature source:
Malisch R.: 4th WHO-coordinated survey of human milk for POPs. Report of status and results as available on 11 Aug 2006.
Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☒Aldrin ☒Chlordane gr. ☒DDT group ☒Dieldrin ☒Endrin gr. ☒Heptachlor
☒HCB ☒Mirex ☒Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes:
Milk samples were collected according to the WHO protocol.
The individual samples were pooled prior to analysis (1 sample analysed).

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 37: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)	nd			
trans-chlordane (gamma-chlordane)	nd			
oxychlordane	2.2			
cis-nonachlor	nd			
trans-nonachlor	1.7			
Chlordane (group)*	**2.1**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 38: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT	nd			
p,p'-DDT	12.8			
o,p'-DDD	nd			
p,p'-DDD	1.4			
o,p'-DDE	nd			
p,p'-DDE	310.5			
DDT (group) *	**360.8**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 39: Endrin

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
Endrin	nd			
Endrin ketone	nd			
Endrin (group) *	nd			

* Sum of all detected analytes calculated as endrin

Table 40: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
Heptachlor	nd			

cis-heptachlor epoxide	0.6			
trans-heptachlor epoxide	nd			
Heptachlor (group) *	0.5			

* Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

Table 41: Toxaphene

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
Parlar 26	nd			
Parlar 50	nd			
Parlar 62	nd			
Toxaphene *	nd			

* Sum of the three congeners

Table 42: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28	1.56			
PCB 52	0.14			
PCB 101	0.37			
PCB 138	85.48			
PCB 153	155.54			
PCB 180	132.77			
PCB 118	*11.12*			
Sum PCB$_6$ (28,52,101,138,153,180)	**375.86**			
Sum PCB$_7$ (28,52,101,118,138,153,180)	**386.98**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 43: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
PCB 77	2.81	2.81	2.81					
PCB 81	2.16	2.16	2.16					
PCB 126	50.94	50.94	50.94					
PCB 169	29.49	29.49	29.49					
non-*ortho* PCBs (WHO_{1997} TEQ)	**5.39**	**5.39**	**5.39**					
PCB 105 ng/g, lipid adjusted	1.35	1.35	1.35					

PCB 114	ng/g, lipid adjusted	0.31	0.31	0.31					
PCB 118	ng/g, lipid adjusted	11.12	11.12	11.12					
PCB 123	ng/g, lipid adjusted	0.06	0.06	0.06					
PCB 156	ng/g, lipid adjusted	13.74	13.74	13.74					
PCB 157	ng/g, lipid adjusted	1.11	1.11	1.11					
PCB 167	ng/g, lipid adjusted	3.53	3.53	3.53					
PCB 189	ng/g, lipid adjusted	1.57	1.57	1.57					
mono-*ortho* PCBs (WHO_{1997} TEQ)		**9.03**	**9.03**	**9.03**					
dl-PCBs (WHO_{1997} TEQ)		**14.41**	**14.41**	**14.41**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable

Table 44: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	Lower	middle	upper		
2,3,7,8-Cl4DD	0.56	0.56	0.56					
1,2,3,7,8-Cl5DD	1.48	1.48	1.48					
1,2,3,4,7,8-Cl6DD	0.69	0.69	0.69					
1,2,3,6,7,8-Cl6DD	3.89	3.89	3.89					
1,2,3,7,8,9-Cl6DD	0.97	0.97	0.97					
1,2,3,4,6,7,8-Cl7DD	5.51	5.51	5.51					
Cl8DD	24.75	24.75	24.75					
PCDDs (WHO_{1997} TEQ)	**2.65**	**2.65**	**2,65**					
2,3,7,8-Cl4DF	0.39	0.39	0.39					
1,2,3,7,8-Cl5DF	0.23	0.23	0.23					
2,3,4,7,8-Cl5DF	10.17	10.17	10.17					
1,2,3,4,7,8-Cl6DF	2.37	2.37	2.37					
1,2,3,6,7,8-Cl6DF	2.05	2.05	2.05					
1,2,3,7,8,9-Cl6DF	0.63	0.63	0.63					
2,3,4,6,7,8-Cl6DF	0.019	0.019	0.038					
1,2,3,4,6,7,8-Cl7DF	1.52	1.52	1.52					
1,2,3,4,7,8,9-Cl7DF	0.03	0.03	0.03					
Cl8DF	0.23	0.23	0.23					
PCDFs (WHO_{1997} TEQ)	**5.66**	**5.66**	**5.66**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**8.31**	**8.31**	**8.31**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable
- nd – not detected

B/3 Summary table of reported POPs levels

Table 45: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw	nd			
Chlordane (group)	ng g^{-1} lw	2.1			
DDT (group)	ng g^{-1} lw	361			
Dieldrin	ng g^{-1} lw	1.3			
Endrin (group)	ng g^{-1} lw	nd			
Heptachlor (group)	ng g^{-1} lw	0.5			
HCB	ng g^{-1} lw	46.6			
Mirex	ng g^{-1} lw	nd			
Toxaphene	ng g^{-1} lw	nd			
PCBs	ng g^{-1} lw	376			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	14.41			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	8.31			

C/1 Study-specific information

Country:	**Czech Republic**
Activity (e.g.. monitoring, research):	National human biomonitoring
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	5 urban areas (Kromeriz, Liberec, Ostrava, Praha, Uherske Hradiste)
Sampling year(s):	2005
No. of donors:	355
Donors' age (yrs):	Average: 28 Min: 17 Max: 43
For blood: proportion of female donors (%)	
Literature source:	*http://www.szu.cz/uploads/documents/chzp/biomonitoring/biologicky_monitoring_05.pdf* *Černá M., personal communication*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs:

☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes: Milk samples were collected according to the WHO protocol.

* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 46: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT	0.8	0.6	< 0.1	3.5
p,p'-DDT	9.6	8.2	1.5	37.9
o,p'-DDD				
p,p'-DDD	1.1	0.8	< 0.03	13.1
o,p'-DDE	0.4	0.3	< 0.03	2.7
p,p'-DDE	422	342	53	2 420
DDT (group) *	**482**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 47: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28^{+31}	2.6	2.1	0.6	18
PCB 52	0.2	0.2	< 0.03	0.9
PCB 101	0.9	0.7	< 0.1	4.5
PCB 138	126	111	15	678
PCB 153	206	185	34	1 020
PCB 180	177	160	16	786
PCB 118	*14*	*12*	*2*	*48*
Sum PCB_6 (28,52,101,138,153,180)	**513**	**461**	**95**	**2 502**
Sum PCB_7 (28,52,101,118,138,153,180)	**527**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

C/3 Summary table of reported POPs levels

Table 48: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	482			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	87	66	< 0.1	833
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	513	461	95	2 502
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

D/1 Study-specific information

Country: **Czech Republic**

Activity (e.g.. monitoring, research): National human biomonitoring

Matrix (e.g. milk, blood): Milk

Sampling site(s): 5 urban areas (Kromeriz, Liberec, Ostrava, Praha, Uherske Hradiste)

Sampling year(s): 2006

No. of donors: 229

Donors' age (yrs): Average: 28 Min: 17 Max: 40

For blood: proportion of female donors (%)

Literature source: *http://www.szu.cz/uploads/documents/chzp/biomonitoring/biologicky_monitoring_06.pdf*
Černá M., personal communication

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes: Milk samples were collected according to the WHO protocol.

* Participation in proficiency testing schemes.

D/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 49: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT	0.9	0.7	< 0.1	5.4
p,p'-DDT	14.8	11.3	1.2	133
o,p'-DDD				
p,p'-DDD	0.9	0.7	< 0.04	6.3
o,p'-DDE	0.2	0.2	< 0.01	2.5
p,p'-DDE	383	304	56	2 342
DDT (group) *	**444**			

* Sum of all detected analytes calculated as DDT
As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 50: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28^{+31}	2.4	1.8	nd	82.7
PCB 52	0.2	0.2	nd	1.2
PCB 101	0.6	0.5	nd	5.6
PCB 138	157	136	31	659
PCB 153	248	219	45	139
PCB 180	159	146	14	711
PCB 118	*15*	*13*	*nd*	*87*
Sum PCB$_6$ (28,52,101,138,153,180)	**567**	**500**	**96**	**2 524**
Sum PCB$_7$ (28,52,101,118,138,153,180)	**582**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

D/3 Summary table of reported POPs levels

Table 51: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	444			
Dieldrin	ng g^{-1} lw				

Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	70	52	< 0.1	669
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	567	500	96	2 524
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

E/1 Study-specific information

Country: **Czech Republic**

Activity (e.g.. monitoring, research): National human biomonitoring

Matrix (e.g. milk, blood): Milk

Sampling site(s): 5 urban areas (Kromeriz, Liberec, Ostrava, Praha, Uherske Hradiste)

Sampling year(s): 2007

No. of donors: 252

Donors' age (yrs): Average: 28.5 Min: 16 Max: 38

For blood: proportion of female donors (%)

Literature source: *http://www.szu.cz/uploads/documents/chzp/biomonitoring/Odb_zprava_genet_07.pdf*
Černá M., personal communication

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes: Milk samples were collected according to the WHO protocol.

* Participation in proficiency testing schemes.

E/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 52: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT	0.9	0.7	< 0.1	8.5
p,p'-DDT	16.9	11.7	1.6	225

o,p'-DDD				
p,p'-DDD	1.6	1.3	< 0.15	9.3
o,p'-DDE				
p,p'-DDE	376	304	40	2 600
DDT (group) *	**437**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 53: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28^{+31}	2.9	2.0	0.5	39.0
PCB 52	0.2	0.2	< 0.05	1.5
PCB 101	0.8	0.6	< 0.1	6.6
PCB 138	144	110	19	1 900
PCB 153	259	208	34	3 060
PCB 180	204	161	13	2 840
PCB 118	*13*	*10*	*2*	*247*
Sum PCB_6 (28,52,101,138,153,180)	**611**			
Sum PCB_7 (28,52,101,118,138,153,180)	**624**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

E/3 Summary table of reported POPs levels

Table 54: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	437			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	91	66	8.1	1085
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	611			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

F/1 Study-specific information

Country:	**Czech Republic**
Activity (e.g.. monitoring, research):	Research project VaV 520/6/99
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	1 urban site – Prague
Sampling year(s):	2000
No. of donors:	15
Donors' age (yrs):	Average: 26 Min: 23 Max: 30
For blood: proportion of female donors (%)	
Literature source:	*Bencko V., Cerná M., Jech L., Smid J.: Exposure of breast-fed children in the Czech Republic to PCDDs, PCDFs, and dioxin-like PCBs. Environ. Toxicol. Pharmacol. 18, 2004, 83-90.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☒dl-PCBs ☒PCDDs/Fs
	☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes:	All the donating mothers were primiparae.

* Participation in proficiency testing schemes.

F/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 55: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Median			Min	Max
		lower	middle	upper	lower	middle	upper		
PCB 77		18.0	18.0	18.0	18.17	18.17	18.17	12.4	24.0
PCB 81									
PCB 126		134.9	134.9	134.9	98.3	98.3	98.3	71.4	458
PCB 169		75.4	75.4	75.4	65.55	65.55	65.55	39.3	150.8
non-*ortho* PCBs (WHO_{1997} TEQ)		**14.25**	**14.25**	**14.25**					
PCB 105	ng/g, lipid adjusted	3.9	3.9	3.9	3.09	3.09	3.09	2.11	11.2
PCB 114	ng/g, lipid adjusted								
PCB 118	ng/g, lipid adjusted	34.4	34.4	34.4	28.4	28.4	28.4	13.2	89.2
PCB 123	ng/g, lipid adjusted								

PCB 156	ng/g, lipid adjusted	23.3	23.3	23.3	19.3	19.3	19.3	10.2	64.2
PCB 157	ng/g, lipid adjusted	2.73	2.73	2.73	2.7	2.7	2.7	1.5	5.74
PCB 167	ng/g, lipid adjusted	8.2	8.2	8.2	7.45	7.45	7.45	3.09	20.5
PCB 189	ng/g, lipid adjusted	2.67	2.67	2.67	1.96	1.96	1.96	1.09	5.82
mono-*ortho* PCBs (WHO_{1997} TEQ)		**17.19**	**17.19**	**17.19**					
dl-PCBs (WHO_{1997} TEQ)		**31.44**	**31.44**	**31.44**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 56: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Median			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	5.83	5.83	5.83	5.97	5.97	5.97	1.15	13.9
1,2,3,7,8-Cl5DD	3.86	3.86	3.86	3.6	3.6	3.6	nd	6.94
1,2,3,4,7,8-Cl6DD	1.85	1.85	1.85	1.6	1.6	1.6	0.84	4.79
1,2,3,6,7,8-Cl6DD	9.07	9.07	9.07	7.26	7.26	7.26	3.34	29.7
1,2,3,7,8,9-Cl6DD	2.75	2.75	2.75	2.4	2.4	2.4	nd	7.66
1,2,3,4,6,7,8-Cl7DD	16.03	16.03	16.03	14.34	14.34	14.34	5.85	43.1
Cl8DD	82.1	82.1	82.1	62.1	62.1	62.1	23.4	205
PCDDs (WHO_{1997} TEQ)	**11.23**	**11.23**	**11.23**					
2,3,7,8-Cl4DF	2.31	2.31	2.31	1.75	1.75	1.75	0.67	5.63
1,2,3,7,8-Cl5DF	0.89	0.89	0.89	0.8	0.8	0.8	nd	2.35
2,3,4,7,8-Cl5DF	20.5	20.5	20.5	20.11	20.11	20.11	10.03	33.5
1,2,3,4,7,8-Cl6DF	6.84	6.84	6.84	6.59	6.59	6.59	3.34	11.5
1,2,3,6,7,8-Cl6DF	5.15	5.15	5.15	4.8	4.8	4.8	2.51	11.5
1,2,3,7,8,9-Cl6DF	0.41	0.41	0.41	0.23	0.23	0.23	nd	0.99
2,3,4,6,7,8-Cl6DF	2.01	2.01	2.01	2.02	2.02	2.02	0.84	3.83
1,2,3,4,6,7,8-Cl7DF	6.13	6.13	6.13	4.19	4.19	4.19	2.09	29.0
1,2,3,4,7,8,9-Cl7DF	0.74	0.74	0.74	0.51	0.51	0.51	nd	2.66
Cl8DF	4.6	4.6	4.6	2.35	2.35	2.35	0.81	37.0
PCDFs (WHO_{1997} TEQ)	**12.04**	**12.04**	**12.04**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**23.26**	**23.26**	**23.26**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

F/3 Summary table of reported POPs levels

Table 57: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	31.44			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	23.26			

G/1 Study-specific information

Country: **Czech Republic**

Activity (e.g.. monitoring, research): Research project VaV 520/6/99

Matrix (e.g. milk, blood): Milk

Sampling site(s): 1 urban site – Uherske Hradiste

Sampling year(s): 2000

No. of donors: 15

Donors' age (yrs): Average: 26 Min: 20 Max: 36

For blood: proportion of female donors (%)

Literature source: *Bencko V., Cerná M., Jech L., Smid J.: Exposure of breast-fed children in the Czech Republic to PCDDs, PCDFs, and dioxin-like PCBs. Environ. Toxicol. Pharmacol. 18, 2004, 83-90.*

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☒dl-PCBs ☒PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes: All the donating mothers were primiparae.

* Participation in proficiency testing schemes.

G/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 58: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Median			Min	Max
		lower	middle	Upper	Lower	middle	upper		
PCB 77		15.6	15.6	15.6	13.4	13.4	13.4	3.47	42,2
PCB 81									
PCB 126		256.6	256.6	256.6	171.3	171.3	171.3	76.3	1 123
PCB 169		111.5	111.5	111.5	86.6	86.6	86.6	42.9	280
non-*ortho* PCBs (WHO_{1997} TEQ)		**26.78**	**26.78**	**26.78**					
PCB 105	ng/g, lipid adjusted	6.47	6.47	6.47	4.39	4.39	4.39	0.36	25.3
PCB 114	ng/g, lipid adjusted								
PCB 118	ng/g, lipid adjusted	69.9	69.9	69.9	41.6	41.6	41.6	22.5	232
PCB 123	ng/g, lipid adjusted								
PCB 156	ng/g, lipid adjusted	65.5	65.5	65.5	43.5	43.5	43.5	21	194
PCB 157	ng/g, lipid adjusted	5.15	5.15	5.15	3.52	3.52	3.52	1.71	13.2
PCB 167	ng/g, lipid adjusted	21.3	21.3	21.3	15.5	15.5	15.5	5.67	73.9
PCB 189	ng/g, lipid adjusted	7.38	7.38	7.38	6,62	6.62	6.62	nd	17.8
mono-*ortho* PCBs (WHO_{1997} TEQ)		**43.91**	**43.91**	**43.91**					
dl-PCBs (WHO_{1997} TEQ)		**70.69**	**70.69**	**70.69**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 59: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg/g, lipid adjusted)							
	Average			Median			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	1.84	1.84	1.84	1.48	1.48	1.48	0.73	6.02
1,2,3,7,8-Cl5DD	3.73	3.73	3.73	3.73	3.73	3.73	1.8	6.17
1,2,3,4,7,8-Cl6DD	1.36	1.36	1.36	1.36	1.36	1.36	0.67	2.57
1,2,3,6,7,8-Cl6DD	6.63	6.63	6.63	6.28	6.28	6.28	2.53	10.86
1,2,3,7,8,9-Cl6DD	1.77	1.77	1.77	1.44	1.44	1.44	1.08	4.12
1,2,3,4,6,7,8-Cl7DD	8.87	8.87	8.87	7.91	7.91	7.91	3.6	19.21
Cl8DD	41.5	41.5	41.5	30.06	30.06	30.06	12.7	113.7
PCDDs (WHO_{1997} TEQ)	**6.44**	**6.44**	**6.44**					

2,3,7,8-Cl4DF	2.29	2.29	2.29	2.14	2.14	2.14	0.47	9.77
1,2,3,7,8-Cl5DF	1.19	1.19	1.19	1.07	1.07	1.07	nd	2.57
2,3,4,7,8-Cl5DF	31.03	31.03	31.03	23.3	23.3	23.3	12.7	133.7
1,2,3,4,7,8-Cl6DF	9.66	9.66	9.66	7.14	7.14	7.14	3.53	35.9
1,2,3,6,7,8-Cl6DF	5.46	5.46	5.46	4.83	4.83	4.83	2.33	10.86
1,2,3,7,8,9-Cl6DF	0.6	0.6	0.6	0.6	0.6	0.6	nd	0.67
2,3,4,6,7,8-Cl6DF	2.16	2.16	2.16	2.09	2.09	2.09	0.94	5.01
1,2,3,4,6,7,8-Cl7DF	6.38	6.38	6.38	3.05	3.05	3.05	1.47	29.3
1,2,3,4,7,8,9-Cl7DF	0.47	0.47	0.47	0.47	0.47	0.47	nd	0.6
Cl8DF	2.72	2.72	2.72	1.61	1.61	1.61	0.52	12.35
PCDFs (WHO_{1997} TEQ)	**17.66**	**17.66**	**17.66**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**24.30**	**24.30**	**24.30**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

G/3 Summary table of reported POPs levels

Table 60: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	70.69			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	24.30			

H/1 Study-specific information

Country: **Czech Republic**

Activity (e.g.. monitoring, research): Research project VaV 520/6/99

Matrix (e.g. milk, blood): Milk

Sampling site(s): 1 urban site – Liberec

Sampling year(s): 2000

No. of donors:	11
Donors' age (yrs):	Average: 25 Min: 20 Max: 31
For blood: proportion of female donors (%)	
Literature source:	*Bencko V., Cerna M., Jech L., Smid J.: Exposure of breast-fed children in the Czech Republic to PCDDs, PCDFs, and dioxin-like PCBs. Environ. Toxicol. Pharmacol. 18, 2004, 83-90.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes:	All the donating mothers were primiparae.

* Participation in proficiency testing schemes.

H/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 61: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Median			Min	Max
		lower	middle	upper	Lower	middle	upper		
PCB 77		12.9	12.9	12.9	7.5	7.5	7.5	4.23	63.3
PCB 81									
PCB 126		66.1	66.1	66.1	65	65	65	26.9	104
PCB 169		41.6	41.6	41.6	40,0	40,0	40,0	19.2	58.8
non-*ortho* PCBs (WHO_{1997} TEQ)		**7.03**	**7,03**	**7.03**					
PCB 105	ng/g, lipid adjusted	1.49	1.49	1.49	1.31	1.31	1.31	Nd	3.33
PCB 114	ng/g, lipid adjusted								
PCB 118	ng/g, lipid adjusted	14.9	14.9	14.9	14.0	14.0	14.0	6.12	24.4
PCB 123	ng/g, lipid adjusted								
PCB 156	ng/g, lipid adjusted	16.2	16.2	16.2	16.2	16.2	16.2	8.23	23.4
PCB 157	ng/g, lipid adjusted	1.34	1.34	1.34	1,44	1,44	1,44	0.71	1.87
PCB 167	ng/g, lipid adjusted	4.54	4.54	4.54	4.19	4.19	4.19	nd	6.66
PCB 189	ng/g, lipid adjusted	1.59	1.59	1.59	1.71	1.71	1.71	0.83	2.11
mono-*ortho* PCBs (WHO_{1997} TEQ)		**10.61**	**10.61**	**10.61**					

dl-PCBs (WHO_{1997} TEQ)	**17.64**	**17.64**	**17.64**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g_{-1} lipid is preferable

Table 62: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Median			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	1.62	1.62	1.62	1.66	1.66	1.66	0.83	2.38
1,2,3,7,8-Cl5DD	2.21	2.21	2.21	1.86	1.86	1.86	1.44	3.07
1,2,3,4,7,8-Cl6DD	0.89	0.89	0.89	0.85	0.85	0.85	0.51	1.44
1,2,3,6,7,8-Cl6DD	4.45	4.45	4.45	4.49	4.49	4.49	3.1	5.99
1,2,3,7,8,9-Cl6DD	1.26	1.26	1.26	1.14	1.14	1.14	0.84	1.79
1,2,3,4,6,7,8-Cl7DD	6.3	6.3	6.3	6.35	6.35	6.35	2.84	12.9
Cl8DD	28.5	28.5	28.5	27.6	27.6	27.6	16.7	39.6
PCDDs (WHO_{1997} TEQ)	**4.56**	**4.56**	**4.56**					
2,3,7,8-Cl4DF	0.97	0.97	0.97	1.05	1.05	1.05	0.42	1.46
1,2,3,7,8-Cl5DF	0.36	0.36	0.36	0.37	0.37	0.37	nd	0.59
2,3,4,7,8-Cl5DF	12	12	12	10.54	10.54	10.54	6.22	18.8
1,2,3,4,7,8-Cl6DF	3.4	3.4	3.4	3.12	3.12	3.12	2.01	5.45
1,2,3,6,7,8-Cl6DF	2.49	2.49	2.49	2.68	2.68	2.68	143	3.29
1,2,3,7,8,9-Cl6DF	0	0	0	nd	nd	nd	nd	nd
2,3,4,6,7,8-Cl6DF	0.85	0.85	0.85	0.77	0.77	0.77	0.36	1.58
1,2,3,4,6,7,8-Cl7DF	1.84	1.84	1.84	1.66	1.66	1.66	1.0	4.33
1,2,3,4,7,8,9-Cl7DF	0.13	0.13	0.13	0.11	0.11	0.11	nd	0.21
Cl8DF	0.96	0.96	0.96	0.88	0.88	0.88	0.55	2.08
PCDFs (WHO_{1997} TEQ)	**6.81**	**6.82**	**6.83**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**11.36**	**11.37**	**11.38**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable
- nd – not detected

H/3 Summary table of reported POPs levels

Table 63: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				

Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	17.64			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	11.37			

5.2.2.9 Estonia

No data on the SC POPs levels in human milk or blood from Estonia has been published since 1998. Although DDT, DDE and PCBs as well as PCDDs/PCDFs and dl-PCBs (2nd WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk) were analyzed in milk, the samples were collected before 1998 (in the 1970s – early 90s).

5.2.2.10 Georgia

The levels of POPs have not been measured in human milk or blood from Georgia. Georgia has not participated in any of the four WHO-coordinated exposure studies on POPs levels in human milk. A 2005 inventory in 2005 showed that more than 300 thousands metric tons of obsolete pesticides were often inappropriately stored around the country. Part of the stockpiled obsolete pesticides belongs to the POPs group.

5.2.2.11 Hungary

No data on POPs levels in human milk or blood collected in Hungary in the last decade are publicly available except the levels of some POPs determined in pooled human milk samples within all the four WHO-coordinated surveys of human milk for POPs. As last two surveys involved samples collected after 1998, findings may be reported here.

A/1 Study-specific information

Country:	**Hungary**		
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.		
Matrix (e.g. milk, blood):	Milk		
Sampling site(s):	3 sites		
Sampling year(s):	2000 – 2001		
No. of donors:			
Donors' age (yrs):	Average:	Min:	Max:
For blood: proportion of female donors (%)			
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.* *Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP*		

GMP ROG workshop in Geneva, 19-23 May 2008.

Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (3 samples analyzed)

* Participation in proficiency testing schemes.

A/3 Summary table of reported POPs levels

Table 64: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw		34	29	59
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		2.87	2.38	4.24
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		6.79	5.26	7.46

B/1 Study-specific information

Country:	**Hungary**
Activity (e.g,. monitoring, research):	4th WHO-coordinated survey of human milk for persistent organic pollutants (POPs)
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Across Hungary
Sampling year(s):	2006
No. of donors:	

Donors' age (yrs):	Average:		Min:		Max:	
For blood: proportion of female donors (%)						
Literature source:	WHO, personal communication					
Analytical method:	☒HRGC/HRMS	☒Isotope dilution		Which POPs:		
	☒Aldrin	☒Chlordane gr.	☒DDT group	☒Dieldrin	☒Endrin gr.	☒Heptachlor
	☒HCB	☒Mirex	☒Toxaphene	☒PCBs	☒dl-PCBs	☒PCDDs/Fs
	☐HRGC/MS-MS	☐Isotope dilution		Which POPs:		
	☐Aldrin	☐Chlordane gr.	☐DDT group	☐Dieldrin	☐Endrin gr.	☐Heptachlor
	☐HCB	☐Mirex	☐Toxaphene	☐PCBs	☐dl-PCBs	☐PCDDs/Fs
	☐HRGC/MS	☐Isotope dilution		Which POPs:		
	☐Aldrin	☐Chlordane gr.	☐DDT group	☐Dieldrin	☐Endrin gr.	☐Heptachlor
	☐HCB	☐Mirex	☐Toxaphene	☐PCBs	☐dl-PCBs	☐PCDDs/Fs
	☐HRGC/ECD			Which POPs:		
	☐Aldrin	☐Chlordane gr.	☐DDT group	☐Dieldrin	☐Endrin gr.	☐Heptachlor
	☐HCB	☐Mirex	☐Toxaphene	☐PCBs	☐dl-PCBs	☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric					
QA/QC:	☒Applied		☒PT participation*		☒Laboratory accredited	
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The individual samples were pooled prior to analysis (1 sample analyzed).					

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 65: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)	nd			
trans-chlordane (gamma-chlordane)	nd			
Oxychlordane	0.7			
cis-nonachlor	nd			
trans-nonachlor	0.7			
Chlordane (group)*	**0.7**			

* Sum of all detected analytes calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 66: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT	nd			
p,p'-DDT	14.6			
o,p'-DDD	nd			
p,p'-DDD	2.5			

o,p'-DDE	nd			
p,p'-DDE	386.9			
DDT (group) *	**449.4**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 67: Endrin

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Endrin	nd			
Endrin ketone	nd			
Endrin (group) *	**nd**			

* Sum of all detected analytes calculated as endrin

Table 68: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Heptachlor	nd			
cis-heptachlor epoxide	nd			
trans-heptachlor epoxide	nd			
Heptachlor (group) *	**nd**			

* Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

Table 69: Toxaphene

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Parlar 26	nd			
Parlar 50	nd			
Parlar 62	nd			
Toxaphene *	**nd**			

* Sum of the three congeners

Table 70: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	0.86			
PCB 52	0.13			
PCB 101	0.14			

PCB 138	4.84			
PCB 153	7.98			
PCB 180	4.37			
PCB 118	*2.03*			
Sum PCB_6 (28,52,101,138,153,180)	**18.32**			
Sum PCB_7 (28,52,101,118,138,153,180)	**20.35**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 71: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Geometric mean			Min	Max
		lower	middle	upper	Lower	middle	upper		
PCB 77	ng/g, lipid adjusted	2.35	2.35	2.35					
PCB 81	ng/g, lipid adjusted	1.31	1.31	1.31					
PCB 126	ng/g, lipid adjusted	11.92	11.92	11.92					
PCB 169	ng/g, lipid adjusted	7.06	7.06	7.06					
non-*ortho* PCBs (WHO_{1997} TEQ)		**1.26**	**1.26**	**1.26**					
PCB 105	ng/g, lipid adjusted	0.47	0.47	0.47					
PCB 114	ng/g, lipid adjusted	0.09	0.09	0.09					
PCB 118	ng/g, lipid adjusted	2.03	2.03	2.03					
PCB 123	ng/g, lipid adjusted	0.03	0.03	0.03					
PCB 156	ng/g, lipid adjusted	0.86	0.86	0.86					
PCB 157	ng/g, lipid adjusted	0.14	0.14	0.14					
PCB 167	ng/g, lipid adjusted	0.25	0.25	0.25					
PCB 189	ng/g, lipid adjusted	0.07	0.07	0.07					
mono-*ortho* PCBs (WHO_{1997} TEQ)		**0.81**	**0.81**	**0.81**					
dl-PCBs (WHO_{1997} TEQ)		**2.07**	**2.07**	**2.07**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 72: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	0.61	0.61	0.61					
1,2,3,7,8-Cl5DD	1.36	1.36	1.36					
1,2,3,4,7,8-Cl6DD	1.15	1.15	1.15					

1,2,3,6,7,8-Cl6DD	5.86	5.86	5.86					
1,2,3,7,8,9-Cl6DD	1.25	1.25	1.25					
1,2,3,4,6,7,8-Cl7DD	8.75	8.75	8.75					
Cl8DD	47.14	47.14	47.14					
PCDDs (WHO_{1997} TEQ)	**2.89**	**2.89**	**2.89**					
2,3,7,8-Cl4DF	0.25	0.25	0.25					
1,2,3,7,8-Cl5DF	0.21	0.21	0.21					
2,3,4,7,8-Cl5DF	3.38	3.38	3.38					
1,2,3,4,7,8-Cl6DF	1.33	1.33	1.33					
1,2,3,6,7,8-Cl6DF	1.15	1.15	1.15					
1,2,3,7,8,9-Cl6DF	0.47	0.47	0.47					
2,3,4,6,7,8-Cl6DF	0.03	0.03	0.03					
1,2,3,4,6,7,8-Cl7DF	1.69	1.69	1.69					
1,2,3,4,7,8,9-Cl7DF	0.04	0.04	0.04					
Cl8DF	0.22	0.22	0.22					
PCDFs (WHO_{1997} TEQ)	**2.04**	**2.04**	**2.04**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**4.93**	**4.93**	**4.93**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

B/3 Summary table of reported POPs levels

Table 73: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw	nd			
Chlordane (group)	ng g^{-1} lw	0.7			
DDT (group)	ng g^{-1} lw	449			
Dieldrin	ng g^{-1} lw	1.7			
Endrin (group)	ng g^{-1} lw	nd			
Heptachlor (group)	ng g^{-1} lw	nd			
HCB	ng g^{-1} lw	12.0			
Mirex	ng g^{-1} lw	nd			
Toxaphene	ng g^{-1} lw	nd			
PCBs	ng g^{-1} lw	18.3			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	2.07			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	4.93			

5.2.2.12 Kazakhstan

Human exposure to POPs in Kazakhstan is expected to be high due to extensive agricultural use of pesticides including defoliants containing PCDDs/PCDFs on cotton fields, fish consumption from the heavily contaminated Aral Sea region, and use of PCBs in industrialized areas. It was found that HCH isomers, DDT congeners, HCB and PCDD/PCDF levels in human milk collected in southern Kazakhstan were much higher than background levels in Europe and USA. The highest exposure was observed in rural areas. Unfortunately no data can be used for this report because milk samples were collected before 1998. Since 1998, no results on POPs content in human milk or blood samples have been published.

5.2.2.13 Kyrgyzstan

No data on POPs levels in human milk and blood are reported in Kyrgyzstan. This country has participated in no WHO-coordinated exposures studies on POPs levels in human milk.

5.2.2.14 Latvia

There has been no regular human biomonitoring of POPs in Latvia. Although Latvia has not participated in the WHO-coordinated exposure studies on POPs in human milk, limited number of human milk samples were collected in 2004 according to the WHO protocol and analyzed for PCDDs/PCDFs and some organochlorine pesticides.

A/1 Study-specific information

Country:	**Latvia**
Activity (e.g.. monitoring, research):	Preparation of the Latvian National Implementation Plan for POPs.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Olaine town
Sampling year(s):	2004
No. of donors:	15
Donors' age (yrs):	Average: 25.7 Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Kocan A., personal communication* *Bake M, et al. Assessment of the exposure of breast milk to persistent organic pollutants in Latvia. Int. J. Hyg. Environ.-Health 210, 2007, 483-489.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Milk samples were collected according to the WHO protocol. The 15 samples from the site were pooled prior to analysis (1 sample analyzed).

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 74: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT	2.82			
p,p'-DDT	22.41			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE	< 0.044			
p,p'-DDE	194			
DDT (group) *	**238**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 75: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	2.01	2.01	2.01					
1,2,3,7,8-Cl5DD	2.67	2.67	2.67					
1,2,3,4,7,8-Cl6DD	0.80	0.80	0.80					
1,2,3,6,7,8-Cl6DD	3.06	3.06	3.06					
1,2,3,7,8,9-Cl6DD	0.77	0.77	0.77					
1,2,3,4,6,7,8-Cl7DD	3.64	3.64	3.64					
Cl8DD	45.47	45.47	45.47					
PCDDs (WHO_{1997} TEQ)	**5.18**	**5.18**	**5.18**					
2,3,7,8-Cl4DF	0.68	0.68	0.68					
1,2,3,7,8-Cl5DF	0.60	0.60	0.60					
2,3,4,7,8-Cl5DF	11.76	11.76	11.76					
1,2,3,4,7,8-Cl6DF	2.12	2.12	2.12					
1,2,3,6,7,8-Cl6DF	1.62	1.62	1.62					
1,2,3,7,8,9-Cl6DF	0	0	0					
2,3,4,6,7,8-Cl6DF	0.32	0.32	0.32					

1,2,3,4,6,7,8-Cl7DF	1.26	1.26	1.26					
1,2,3,4,7,8,9-Cl7DF	0	0.01	0.02					
Cl8DF	0.41	0.41	0.41					
PCDFs (WHO_{1997} TEQ)	**6.40**	**6.41**	**6.41**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**11.57**	**11.58**	**11.59**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable
- nd – not detected

A/3 Summary table of reported POPs levels

Table 76: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	238			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	25.5			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	11.58			

B/1 Study-specific information

Country:	**Latvia**
Activity (e.g.. monitoring, research):	Preparation of the Latvian National Implementation Plan for POPs.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Smiltene town
Sampling year(s):	2004
No. of donors:	15
Donors' age (yrs):	Average: 25.8 Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Kocan A., personal communication* *Bake M, et al. Assessment of the exposure of breast milk to persistent organic* pollutants in *Latvia. Int. J. Hyg. Environ.-Health 210, 2007, 483-489.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Milk samples were collected according to the WHO protocol.
The 15 samples from the site were pooled prior to analysis (1 sample analyzed).

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 77: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT	7.70			
p,p'-DDT	43.29			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE	< 0.028			
p,p'-DDE	188			
DDT (group) *	**223**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Tabe 78: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			**Geometric mean**			**Min**	**Max**
	lower	**middle**	**upper**	**Lower**	**middle**	**upper**		
2,3,7,8-Cl4DD	1.28	1.28	1.28					
1,2,3,7,8-Cl5DD	1.873	1.873	1.873					
1,2,3,4,7,8-Cl6DD	0.763	0.763	0.763					
1,2,3,6,7,8-Cl6DD	2.626	2.626	2.626					
1,2,3,7,8,9-Cl6DD	0.518	0.518	0.518					
1,2,3,4,6,7,8-Cl7DD	3.879	3.879	3.879					

Cl8DD	31.962	31.962	31.962					
PCDDs (WHO_{1997} TEQ)	**3.59**	**3.59**	**3.59**					
2,3,7,8-Cl4DF	0.378	0.378	0.378					
1,2,3,7,8-Cl5DF	0.399	0.399	0.399					
2,3,4,7,8-Cl5DF	8.813	8.813	8.813					
1,2,3,4,7,8-Cl6DF	1.338	1.338	1.338					
1,2,3,6,7,8-Cl6DF	1.509	1.509	1.509					
1,2,3,7,8,9-Cl6DF	0	0	0					
2,3,4,6,7,8-Cl6DF	0.688	0.688	0.688					
1,2,3,4,6,7,8-Cl7DF	1.706	1.706	1.706					
1,2,3,4,7,8,9-Cl7DF	0	0	0					
Cl8DF	0.302	0.302	0.302					
PCDFs (WHO_{1997} TEQ)	**4.83**	**4.84**	**4.84**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**8.42**	**8.42**	**8.42**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

B/3 Summary table of reported POPs levels

Table 79: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	223			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	18.9			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	8.42			

5.2.2.15 Lithuania

No human biomonitoring of POPs has been realized in Lithuania since 1998. Lithuania has not participated in any of the WHO-coordinated exposure studies on POPs in human milk.

5.2.2.16 Macedonia

No information on the POPs levels in the human population of Macedonia is publicly available.

5.2.2.17 Moldova

No information on the POPs levels in the human population of Moldova measured after 1998 is available.

5.2.2.18 Montenegro

No information on the POPs levels in the human population of Montenegro measured after 1998 is available.

5.2.2.19 Poland

Some POPs were determined in human blood samples within surveys initiated by NGO's and research projects. No monitoring data are available since 1998. Poland has not participated in the 3rd and 4th round of WHO-coordinated exposures studies on POPs levels in human milk.

A/1 Study-specific information

Country:	**Poland**
Activity (e.g.. monitoring, research):	Research projects (PUMS DS grant No 502-3-0003439 and a GOA project (2001) of the University of Antwerp)
Matrix (e.g. milk, blood):	Milk (colostrum)
Sampling site(s):	Wielkopolska region
Sampling year(s):	2004
No. of donors:	22
Donors' age (yrs):	Average: 30 Min: 22 Max: 28
For blood: proportion of female donors (%)	
Literature source:	*Jaraczewska K., et al. Distribution of polychlorinated biphenyls, organochlorine pesticides and polybrominated diphenyl ethers in human umbilical cord serum, maternal serum and milk from Wielkopolska region, Poland. Science of the Total Environment 372, 2006, 20–31.*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☒HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☒Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid	Gravimetric

determination (e.g. gravimetric, enzymatic):
QA/QC: ☒Applied ☒PT participation* ☐Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied): Colostrum milk (lipid content was 2 %) was collected 3-4 day after delivery.

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Table 80: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	3.3	2.8	1.0	11.8
cis-nonachlor				
trans-nonachlor	3.9	3.1	1.0	14.9
Chlordane (group)*	**3.2**	**2.7**	**1.0**	**11.4**

* Sum of all detected analytes calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 81: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT				
p,p'-DDT	50.8	41.6	19.6	175
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	817	634	294	2 747
DDT (group) *	**961**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 82: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28				
PCB 52				
PCB 101	0.8	0.5	< 1	2.6
PCB 138	25.6	22.7	9.3	64.1

PCB 153	39.8	35.1	14.7	101
PCB 180	30.3	27	10.8	91.9
PCB 118	*7.2*	*6.3*	*4.3*	*15.0*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_4 (101,138,153,180)	**96.5**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

A/3 Summary table of reported POPs levels

Table 83: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	3.2	2.7	1.0	11.4
DDT (group)	ng g^{-1} lw	961			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	32.2	28.6	11.8	61.8
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

B/1 Study-specific information

Country: **Poland**

Activity (e.g.. monitoring, research): Research project (Polish State Committee of Scientific Research under Grant 754/PO5/99/1)

Matrix (e.g. milk, blood): Milk

Sampling site(s): Wielkopolska region

Sampling year(s): 2000 – 2001

No. of donors: 14

Donors' age (yrs): Average: 25,2 Min: 17 Max: 31

For blood: proportion of female donors (%)

Literature source: *Szyrwinska K., Lulek J. Exposure to specific polychlorinated biphenyls and some chlorinated pesticides via breast milk in Poland. Chemosphere 66, 2007, 1895–1903*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☐Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): The samples were collected according to the WHO protocol.

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Table 84: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	76	70.3	48.7	114
o,p'-DDD				
p,p'-DDD	3.68	3.39	2.04	5.45
o,p'-DDE				
p,p'-DDE	1 114	1 051.6	493	2 519
DDT (group) *	**1 314**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 85: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	0.81	0.88	0.07	1.3
PCB 52	1.11	1.13	0.76	1.5
PCB 101	0.03	< LOD	< LOD	0.47
PCB 138	35.3	27	10.5	168.8
PCB 153	45.6	36.3	13.7	178.9
PCB 180	24.4	16.6	6.5	119.8
PCB 118	7.41	5.82	2.38	16.13
Sum PCB$_6$ (28,52,101,138,153,180)	**107.3**	**90.3**	**35.0**	**485.9**
Sum PCB$_7$ (28,52,101,118,138,153,180)	**114.7**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

B/3 Summary table of reported POPs levels

Table 86: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	1 314			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	22.5	22.0	13.7	36.7
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	107.3	90.3	35.0	485.9
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

C/1 Study-specific information

Country: **Poland**

Activity (e.g.. monitoring, research): Activity of a Polish non-governmental organization (WPA)

Matrix (e.g. milk, blood): Milk

Sampling site(s): Brzeg Dolny town

Sampling year(s): 2001

No. of donors: 11

Donors' age (yrs): Average: 29 Min: Max:

For blood: proportion of female donors (%)

Literature source:
Persistent organic pollutants in Poland: Study on human breast milk. Waste Prevention Association "3R" Krakow, April 2002
Persistent Organic Pollutants. Vol. I. National Profile – Poland. Warsaw 2002, Zurek J., Sadowski M. (Ed.), ISBN 83-85805-88-5
Kocan A., personal communication

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid Gravimetric

determination (e.g. gravimetric, enzymatic):
QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied): The samples were collected according to the WHO protocol. All the individual milk samples had been pooled to 1 sample which was analysed.

* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Table 87: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT				
p,p'-DDT	99.8			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	1 320			
DDT (group) *	**1 571**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 88: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28	1.07			
PCB 52	<0.12			
PCB 101	<0.09			
PCB 138	156			
PCB 153	22.0			
PCB 180	12.7			
PCB 118	*4.93*			
Sum PCB$_6$ (28,52,101,138,153,180)	**61.2**			
Sum PCB$_7$ (28,52,101,118,138,153,180)	**66.1**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 89: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	Lower	middle	upper		

2,3,7,8-Cl4DD	1.8	1.8	1.8					
1,2,3,7,8-Cl5DD	2.7	2.7	2.7					
1,2,3,4,7,8-Cl6DD	1.5	1.5	1.5					
1,2,3,6,7,8-Cl6DD	8.3	8.3	8.3					
1,2,3,7,8,9-Cl6DD	2.0	2.0	2.0					
1,2,3,4,6,7,8-Cl7DD	10.1	10.1	10.1					
Cl8DD	40.2	40.2	40.2					
PCDDs (WHO_{1997} TEQ)	**5.79**	**5.79**	**5.79**					
2,3,7,8-Cl4DF	1.3							
1,2,3,7,8-Cl5DF	0.6							
2,3,4,7,8-Cl5DF	10.7							
1,2,3,4,7,8-Cl6DF	6.4							
1,2,3,6,7,8-Cl6DF	3.3							
1,2,3,7,8,9-Cl6DF	< LOD							
2,3,4,6,7,8-Cl6DF	1.2							
1,2,3,4,6,7,8-Cl7DF	3.4							
1,2,3,4,7,8,9-Cl7DF	0.3							
Cl8DF	1.5							
PCDFs (WHO_{1997} TEQ)	**6.64**							
PCDDs+PCDFs (WHO_{1997} TEQ)	**12.42**							

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

C/3 Summary table of reported POPs levels

Table 90: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	1 571			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	34.9			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	61.2			

dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	12.42			

D/1 Study-specific information

Country: **Poland**

Activity (e.g,. monitoring, research): Activity of a Polish non-governmental organization (WPA)

Matrix (e.g. milk, blood): Milk

Sampling site(s): Tarnow town

Sampling year(s): 2001

No. of donors: 10

Donors' age (yrs): Average: 23 Min: Max:

For blood: proportion of female donors (%)

Literature source: *Persistent organic pollutants in Poland: Study on human breast milk. Waste Prevention Association "3R" Krakow, April 2002*
Persistent Organic Pollutants. Vol. I. National Profile – Poland. Warsaw 2002, Zurek J., Sadowski M. (Ed.), ISBN 83-85805-88-5
Kocan A., personal communication

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): The samples were collected according to the WHO protocol. All the individual milk samples had been pooled to 1 sample which was analysed.

* Participation in proficiency testing schemes.

D/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Table 91: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT				
p,p'-DDT	50.9			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				

p,p'-DDE	686			
DDT (group) *	**816**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 92: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28	1.1			
PCB 52	< 0.12			
PCB 101	0.29			
PCB 138	16			
PCB 153	24.3			
PCB 180	17			
PCB 118	*6.33*			
Sum PCB_6 (28,52,101,138,153,180)	**58.8**			
Sum PCB_7 (28,52,101,118,138,153,180)	**65.1**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 93: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	1.6	1.6	1.6					
1,2,3,7,8-Cl5DD	3.1	3.1	3.1					
1,2,3,4,7,8-Cl6DD	1.5	1.5	1.5					
1,2,3,6,7,8-Cl6DD	7.0	7.0	7.0					
1,2,3,7,8,9-Cl6DD	1.7	1.7	1.7					
1,2,3,4,6,7,8-Cl7DD	17.5	17.5	17.5					
Cl8DD	62.9	62.9	62.9					
PCDDs (WHO_{1997} TEQ)	**5.90**	**5.90**	**5.90**					
2,3,7,8-Cl4DF	0.9							
1,2,3,7,8-Cl5DF	0.5							
2,3,4,7,8-Cl5DF	10.3							
1,2,3,4,7,8-Cl6DF	4.3							
1,2,3,6,7,8-Cl6DF	2.9							
1,2,3,7,8,9-Cl6DF	< LOD							
2,3,4,6,7,8-Cl6DF	1.4							

1,2,3,4,6,7,8-Cl7DF	2.4							
1,2,3,4,7,8,9-Cl7DF	0.2							
Cl8DF	0.8							
PCDFs (WHO_{1997} TEQ)	**6.15**							
PCDDs+PCDFs (WHO_{1997} TEQ)	**12.05**							

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

D/3 Summary table of reported POPs levels

Table 94: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	816			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	31.5			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	58.8			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	12.05			

E/1 Study-specific information

Country:	**Poland**
Activity (e.g.. monitoring, research):	Activity of a Polish non-governmental organization (WPA)
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Wloclawek town
Sampling year(s):	2001
No. of donors:	10
Donors' age (yrs):	Average: 27 Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Persistent organic pollutants in Poland: Study on human breast milk. Waste Prevention Association "3R" Krakow, April 2002* *Persistent Organic Pollutants. Vol. I. National Profile – Poland. Warsaw 2002, Zurek J., Sadowski M. (Ed.), ISBN 83-85805-88-5* *Kocan A., personal communication*

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): The samples were collected according to the WHO protocol. All the individual milk samples had been pooled to 1 sample which was analysed.

* Participation in proficiency testing schemes.

E/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Table 95: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	49.9			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	730			
DDT (group) *	**864**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Tble 96: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	1.07			
PCB 52	< 0.12			
PCB 101	< 0.09			
PCB 138	15.6			
PCB 153	22			
PCB 180	12.7			

PCB 118	*4.93*			
Sum PCB_6 (28,52,101,138,153,180)	**51.5**			
Sum PCB_7 (28,52,101,118,138,153,180)	**56.4**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 97: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	1.8	1.8	1.8					
1,2,3,7,8-Cl5DD	3.9	3.9	3.9					
1,2,3,4,7,8-Cl6DD	1.4	1.4	1.4					
1,2,3,6,7,8-Cl6DD	9.7	9.7	9.7					
1,2,3,7,8,9-Cl6DD	2.1	2.1	2.1					
1,2,3,4,6,7,8-Cl7DD	9.1	9.1	9.1					
Cl8DD	59.3	59.3	59.3					
PCDDs (WHO_{1997} TEQ)	**7.12**	**7.12**	**7.12**					
2,3,7,8-Cl4DF	1.3							
1,2,3,7,8-Cl5DF	0.5							
2,3,4,7,8-Cl5DF	9.9							
1,2,3,4,7,8-Cl6DF	3.9							
1,2,3,6,7,8-Cl6DF	2.3							
1,2,3,7,8,9-Cl6DF	< LOD							
2,3,4,6,7,8-Cl6DF	1.1							
1,2,3,4,6,7,8-Cl7DF	3.2							
1,2,3,4,7,8,9-Cl7DF	0.2							
Cl8DF	1.0							
PCDFs (WHO_{1997} TEQ)	**5.87**							
PCDDs+PCDFs (WHO_{1997} TEQ)	**12.99**							

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

E/3 Summary table of reported POPs levels

Table 98: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				

Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	864			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	22.6			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	51.5			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	12.99			

5.2.2.20 Romania

Romania has conducted no long-term monitoring of POPs in human milk or blood. However, it participated in the 3rd WHO-coordinated exposures study on PCB, PCDD, and PCDF levels in human milk. Moreover, PCBs and some OCPs were analyzed in the human population of industrial-agricultural Iassy area within the research projects.

A/1 Study-specific information

Country:	**Romania**
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	3 sites
Sampling year(s):	2000 – 2001
No. of donors:	
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.* *Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric,	Gravimetric

enzymatic):			
QA/QC:	☒Applied	☒PT participation*	☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (3 samples analysed)		

* Participation in proficiency testing schemes.

A/3 Summary table of reported POPs levels

Table 99: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw		173	165	198
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		8.06	8.05	8.11
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		8.86	8.37	12.00

B/1 Study-specific information

Country:	**Romania**
Activity (e.g.. monitoring, research):	Research
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	1 site – Iassy District
Sampling year(s):	2005
No. of donors:	142
Donors' age (yrs):	Average: 48.5 Min: 8 Max: 90
For blood: proportion of female donors (%)	56
Literature source:	*Dirtu A.C., et al. Organohalogenated pollutants in human serum from Iassy, Romania and their relation with age and gender. Environment International 32, 2006, 797–803.*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
	☒HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/ECD Which POPs:

☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Enzymatic

QA/QC: ☒Applied ☒PT participation* ☐Laboratory accredited

Notes:

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 100: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT		42	< 6	271
p,p'-DDT	490	339	93	15 109
o,p'-DDD				
p,p'-DDD		6,0	< 6	128
o,p'-DDE				
p,p'-DDE	2 990	1 975	337	24 280
DDT (group)*	**3 824***	**2 420**	**446**	**34 930**

* Sum of *p,p'*-DDE, *o,p'*-DDT, *p,p'*-DDD and *p,p'*-DDT (not calculated as DDT)

** Sum of *p,p'*-DDE and *p,p'*-DDT calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 101: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28		< 6	< 6	< 6
PCB 52		< 6	< 6	< 6
PCB 101		< 6	< 6	6,9
PCB 138	57	38	4,4	461
PCB 153	138	102	10	1 108
PCB 180	163	107	11	1 647
PCB 118	*16*	*12*	*< 4*	*178*
Sum PCB$_6$ (28,52,101,138,153,180)				
Sum PCB$_7$ (28,52,101,118,138,153,180)				
Sum PCB$_4$ (118,138,153,180)	**344**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

B/3 Summary table of reported POPs levels

Table 102: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	3 924	2 420		
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw		30	< 2	107
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	344			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

C/1 Study-specific information

Country: **Romania**

Activity (e.g.. monitoring, research): Research

Matrix (e.g. milk, blood): Blood

Sampling site(s): 1 site – Iassy District

Sampling year(s): 2000

No. of donors: 20 mothers (at delivery)

Donors' age (yrs): Average: Min: 19 Max: 32

For blood: proportion of female donors (%)

Literature source:
Covaci A., et al. Selected persistent organochlorine pollutants in Romania. Sci.Total Environ. 280, 2001, 143-152.
Dirtu A.C., et al. Organohalogenated pollutants in human serum from Iassy, Romania and their relation with age and gender. Environment International 32, 2006, 797–803.

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Enzymatic

QA/QC: ☒Applied ☒PT participation* ☐Laboratory accredited

Notes:
* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 103: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	210			
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	800			
DDT (group) *	**1 102**			

* Sum of *p,p'*-DDE and *p,p'*-DDT calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 104: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	12			
PCB 153	16			
PCB 180	14			
PCB 118	*2*			
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_4 (118,138,153,180)	**44**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

C/3 Summary table of reported POPs levels

Table 105: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				

DDT (group)	ng g^{-1} lw	1 102			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	14			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	44			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

D/1 Study-specific information

Country:	**Romania**
Activity (e.g.. monitoring, research):	Research
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	1 site – Iassy District
Sampling year(s):	2000
No. of donors:	19 mothers
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Covaci A, Hura C, Schepens R.: Determination of selected persistent organochlorine pollutants in human milk using solid phase disk extraction and narrow bore capillary GC-MS. Chromatographia 54, 2001, 247-252.* *Dirtu A.C., et al. Organohalogenated pollutants in human serum from Iassy, Romania and their relation with age and gender. Environment International 32, 2006, 797–803.*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Enzymatic
QA/QC:	☒Applied ☒PT participation* ☐Laboratory accredited
Notes:	

* Participation in proficiency testing schemes.

D/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 106: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT	25.6	15.0	nd	74.9
p,p'-DDT	410	252	66.3	1 308
o,p'-DDD				
p,p'-DDD	59.6	39.0	8.7	240
o,p'-DDE				
p,p'-DDE	2 200	1 617	328	8 856
DDT (group) *	**2 954**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 107: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	16.3			
PCB 52	nd	nd	nd	4.3
PCB 101	nd	nd	nd	6.0
PCB 138	32.3	19.6	5.3	153
PCB 153	77.6	50.0	13.0	353
PCB 180	82.6	56.9	13.3	437
PCB 118	*8.7*	*8.7*	*nd*	*17.6*
Sum PCB$_6$ (28,52,101,138,153,180)	**208.8**			
Sum PCB$_7$ (28,52,101,118,138,153,180)	**217.5**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

D/3 Summary table of reported POPs levels

Table 108: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	2 954			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	20.6	18.6	3.3	57.9

Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	209			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

5.2.2.21 Russian Federation

The only monitoring of POPs in Russia involving human samples is performed within the Arctic Monitoring and Assessment Programme which covers mainly the Arctic environment. Russia participated in the 3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk. Certain data on the POPs levels in human milk and blood is available from the short-term local surveys.

A/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): 3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.

Matrix (e.g. milk, blood): Milk

Sampling site(s): 7 sites

Sampling year(s): 2000 – 2001

No. of donors:

Donors' age (yrs): Average: Min: Max:

For blood: proportion of female donors (%)

Literature source:
Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.
Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied):
Milk samples were collected according to the WHO protocol.
The samples from each site were pooled prior to analysis (7 samples analyzed)

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 109: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	6.3			
cis-nonachlor				
trans-nonachlor	7.0			
Chlordane (group)*	**13.3**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 110: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
Heptachlor				
cis-heptachlor epoxide	1.3			
trans-heptachlor epoxide				
Heptachlor (group) *	**1.3**			

* Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

A/3 Summary table of reported POPs levels

Table 111: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw	< 0.5			
Chlordane (group)	ng g^{-1} lw	13.3			
DDT (group)	ng g^{-1} lw	608			
Dieldrin	ng g^{-1} lw	2.0			
Endrin (group)	ng g^{-1} lw	< 0.5			
Heptachlor (group)	ng g^{-1} lw	1.3			
HCB	ng g^{-1} lw	43.3			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw	6.4			
PCBs	ng g^{-1} lw		126	84	311
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		13.45	12.92	22.95

PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		9.36	7.16	12.93

B/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Locally initiated research

Matrix (e.g. milk, blood): Milk

Sampling site(s): Chapaevsk (Samara region)

Sampling year(s): 1998

No. of donors: 40

Donors' age (yrs): Average: 22 Min: 17 Max: 42

For blood: proportion of female donors (%)

Literature source: *Revich B., et al.: Dioxin exposure and public health in Chapaevsk, Russia. Chemosphere 43, 2001, 951-966.*

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☐Applied ☐PT participation* ☐Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Milk samples were collected according to the WHO protocol.
40 milk samples collected were pooled to 7 samples that were analyzed.

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 112: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	Lower	middle	upper		
2,3,7,8-Cl4DD	23.2	23.2	23.2					
1,2,3,7,8-Cl5DD	7.88	7.88	7.88					
1,2,3,4,7,8-Cl6DD	2.78	2.78	2.78					
1,2,3,6,7,8-Cl6DD	26.5	26.5	26.5					
1,2,3,7,8,9-Cl6DD	4.27	4.27	4.27					
1,2,3,4,6,7,8-Cl7DD	10.3	10.3	10.3					

Cl8DD	426.4	426.4	426.4					
PCDDs (WHO_{1997} TEQ)	**34.58**	**34.58**	**34.58**					
2,3,7,8-Cl4DF			1.87					
1,2,3,7,8-Cl5DF	9.08	9.08	9.08					
2,3,4,7,8-Cl5DF	6.73	6.73	6.73					
1,2,3,4,7,8-Cl6DF	16.97	16.97	16.97					
1,2,3,6,7,8-Cl6DF	11.35	11.35	11.35					
1,2,3,7,8,9-Cl6DF	7.88	7.88	7.88					
2,3,4,6,7,8-Cl6DF	3.02	3.02	3.02					
1,2,3,4,6,7,8-Cl7DF	1.87	1.87	1.87					
1,2,3,4,7,8,9-Cl7DF	1.87	1.87	1.87					
Cl8DF	2	2	2					
PCDFs (WHO_{1997} TEQ)	**7.97**	**7.97**	**7.97**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**42.55**	**42.55**	**42.55**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

B/3 Summary table of reported POPs levels

Table 113: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	42.55			

C/1 Study-specific information

Country:	**Russia**
Activity (e.g.. monitoring, research):	International POPs Elimination Project (IPEP)

Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Magnitogorsk (Chelabinsk region)
Sampling year(s):	1998
No. of donors:	25
Donors' age (yrs):	Average: 25 Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Levels of polychlorinated dibenzo-p-dioxins (PCDD/Fs) and Polychlorinated Biphenyls (PCBs) in the Breast Milk of Women Residents of Magnitogorsk. [Report]. "Iskorka" City Non-governmental Movement, Chelyabinsk 2004.*

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☐Applied ☐PT participation* ☐Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk was collected according to the WHO protocol. 25 samples collected were pooled to 1 sample that was analyzed.

* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 114: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Geometric mean			Min	Max
		lower	middle	upper	lower	middle	upper		
PCB 77		16.87							
PCB 81		7.74							
PCB 126		0							
PCB 169		14.28							
non-*ortho* PCBs (WHO_{1997} TEQ)		**0.15**							
PCB 105	ng/g, lipid adjusted	12.23	12.23	12.23					
PCB 114	ng/g, lipid adjusted	1.78	1.78	1.78					
PCB 118	ng/g, lipid adjusted	39.97	39.97	39.97					
PCB 123	ng/g, lipid adjusted	0.66	0.66	0.66					
PCB 156	ng/g, lipid adjusted	8.29	8.29	8.29					

PCB 157	ng/g, lipid adjusted	1.81	1.81	1.81					
PCB 167	ng/g, lipid adjusted	2.02	2.02	2.02					
PCB 189	ng/g, lipid adjusted	2.33	2.33	2.33					
mono-*ortho* PCBs (WHO_{1997} TEQ)		**11.48**	**11.48**	**11.48**					
dl-PCBs (WHO_{1997} TEQ)		**11.62**							

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 115: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	**Levels (pg g^{-1}, lipid adjusted)**							
	Average			**Geometric mean**			**Min**	**Max**
	lower	**middle**	**upper**	**Lower**	**middle**	**upper**		
2,3,7,8-Cl4DD	2.3	2.3	2.3					
1,2,3,7,8-Cl5DD	0.50	0.50	0.50					
1,2,3,4,7,8-Cl6DD	2.02	2.02	2.02					
1,2,3,6,7,8-Cl6DD	4.0	4.0	4.0					
1,2,3,7,8,9-Cl6DD	0.94	0.94	0.94					
1,2,3,4,6,7,8-Cl7DD	5.59	5.59	5.59					
Cl8DD	23.13	23.13	23.13					
PCDDs (WHO_{1997} TEQ)	**3.55**	**3.55**	**3.55**					
2,3,7,8-Cl4DF	1.05	1.05	1.05					
1,2,3,7,8-Cl5DF	0.91	0.91	0.91					
2,3,4,7,8-Cl5DF	5.67	5.67	5.67					
1,2,3,4,7,8-Cl6DF	3.73	3.73	3.73					
1,2,3,6,7,8-Cl6DF	0.08	0.08	0.08					
1,2,3,7,8,9-Cl6DF	0.08	0.08	0.08					
2,3,4,6,7,8-Cl6DF	1.71	1.71	1.71					
1,2,3,4,6,7,8-Cl7DF	2.57	2.57	2.57					
1,2,3,4,7,8,9-Cl7DF	0.05	0.05	0.05					
Cl8DF	0.09	0.09	0.09					
PCDFs (WHO_{1997} TEQ)	**3.57**	**3.57**	**3.57**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**7.12**	**7.12**	**7.12**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

C/3 Summary table of reported POPs levels

Table 116: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	11.62*			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	7.12			

* lower bound concentration

D/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Environmental Toxicology Program of the US National Institute of Environmental Health Sciences and by Public Health Service Grants ES00260 and CA16087

Matrix (e.g. milk, blood): Blood

Sampling site(s): Chapaevsk (Samara region)

Sampling year(s): 1998

No. of donors: 24

Donors' age (yrs): Average: Min: 20 Max: :> 60

For blood: proportion of female donors (%) 50

Literature source: *Akhmedhkhanov A., et al.: Characterization of dioxin exposure in residents of Chapaevsk, Russia. J Exp Anal Environ Epidem 12, 2002, 409 – 417.*

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☐Laboratory accredited

Notes:

* Participation in proficiency testing schemes.

D/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 117: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	Lower	middle	upper		
PCB 77	nq	nq	nq					
PCB 81	3.4	3.4	3.4					
PCB 126	134.3	134.3	134.3					
PCB 169	65	65	65					
non-*ortho* PCBs (WHO_{1997} TEQ)	**14.08**	**14.08**	**14.08**					
PCB 105								
PCB 114								
PCB 118								
PCB 123								
PCB 156								
PCB 157								
PCB 167								
PCB 189								
mono-*ortho* PCBs (WHO_{1997} TEQ)								
dl-PCBs (WHO_{1997} TEQ)								

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 118: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	8.3	8.3	8.3					
1,2,3,7,8-Cl5DD	16.1	16.1	16.1					
1,2,3,4,7,8-Cl6DD	12.1	12.1	12.1					
1,2,3,6,7,8-Cl6DD	51.6	51.6	51.6					
1,2,3,7,8,9-Cl6DD	7.9	7.9	7.9					
1,2,3,4,6,7,8-Cl7DD	31.7	31.7	31.7					
Cl8DD	250.2	250.2	250.2					
PCDDs (WHO_{1997} TEQ)	**31.90**	**31.90**	**31.90**					

2,3,7,8-Cl4DF	1.3	1.3	1.3					
1,2,3,7,8-Cl5DF	1.4	1.4	1.4					
2,3,4,7,8-Cl5DF	22.8	22.8	22.8					
1,2,3,4,7,8-Cl6DF	23.5	23.5	23.5					
1,2,3,6,7,8-Cl6DF	10.5	10.5	10.5					
1,2,3,7,8,9-Cl6DF	0.50	0.50	0.50					
2,3,4,6,7,8-Cl6DF	1.8	1.8	1.8					
1,2,3,4,6,7,8-Cl7DF	5.4	5.4	5.4					
1,2,3,4,7,8,9-Cl7DF	0.8	0.8	0.8					
Cl8DF	52.5	52.5	52.5					
PCDFs (WHO_{1997} TEQ)	**15.25**	**15.27**	**15.30**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**47.15**	**47.17**	**47.20**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable
- Nd – not detected

D/3 Summary table of reported POPs levels

Table 119: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	47.17	46.6		

E/1 Study-specific information

Country:	**Russia**
Activity (e.g.. monitoring, research):	GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Chukotka peninsula

Sampling year(s):	2001 – 2002
No. of donors:	48
Donors' age (yrs):	Average: 24.2 Min: 15 Max: 41
For blood: proportion of female donors (%)	
Literature source:	*Eik Anda E, Nieboer E, Dudarev AA, Sandanger TM, Odland JØ:. Intra- and intercompartmental associations between levels of organochlorines in maternal plasma, cord plasma and breast milk, and lead and cadmium in whole blood, for indigenous peoples of Chukotka, Russia. J.Environ.Monit. 9, 2007, 884-893.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☒Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes:	WHO protocol for human milk collection was applied

* Participation in proficiency testing schemes.

E/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 120: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
Oxychlordane	163	41	2	1 070
cis-nonachlor	12	6	1	80
trans-nonachlor	100	43	6	595
Chlordane (group)*	**158**	**40**	**1,9**	**1 035**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 121: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
o,p'-DDT				
p,p'-DDT	31	23	3	160

o,p'-DDD				
p,p'-DDD	9	6	1	33
o,p'-DDE				
p,p'-DDE	266	225	62	812
DDT (group) *	**338**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 122: Toxaphene

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Parlar 26	15	7	< 0.5	101
Parlar 50	18	9	< 0.5	112
Parlar 62				
Toxaphene *				

* Sum of the three congeners

Table 123: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	7	6	1	34
PCB 52				
PCB 101				
PCB 138	36	24	5	135
PCB 153	167	82	15	1 252
PCB 180	28	17	4	122
PCB 118	*41*	*27*	*5*	*148*
Sum PCB_6 (28,52,101,138,153,180)	**238**			
Sum PCB_7 (28,52,101,118,138,153,180)	**279**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

E/3 Summary table of reported POPs levels

Table 124: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	158	40	1.9	1 035
DDT (group)	ng g^{-1} lw	338			

Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	192	140	28	934
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	238			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

F/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Extended data base (346 puerpera) including data base (220 puerpera) of GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).

Matrix (e.g. milk, blood): Blood

Sampling site(s): Chukotka peninsula coastal areas

Sampling year(s): 2001 – 2003

No. of donors: 68

Donors' age (yrs): Average: 26 Min: 15 Max: 41

For blood: proportion of female donors (%) 100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Blood taken from pregnant women (Chukchi & Eskimos ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

F/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 125: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)

	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	73.94	41.15	0.98	549.64
cis-nonachlor				
trans-nonachlor	99.42	63.55	7.14	531.43
Chlordane (group)*	**71.50**	**39.79**	**0.95**	**531.50**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 126: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
o,p'-DDT				
p,p'-DDT	43.43	31.5	8.57	171.43
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	380.69	322.79	105.71	997.14
DDT (group) *	**467.77**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 127: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28				
PCB 52				
PCB 101				
PCB 138	58.45	48.58	12.86	168.14
PCB 153	214.73	158.79	27.14	687.14
PCB 180	42.46	32.93	8	148.43
PCB 118	*61.54*	*49.55*	*10*	*212.86*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**315.64**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

F/3 Summary table of reported POPs levels

Table 128: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	71.50	39.79	0.95	531.50
DDT (group)	ng g^{-1} lw	467.77			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	229.71	182.49	46.43	862.86
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

G/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Extended data base (346 puerpera) including data base (220 puerpera) of GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).

Matrix (e.g. milk, blood): Blood

Sampling site(s): Chukotka peninsula inland areas

Sampling year(s): 2001 – 2003

No. of donors: 58

Donors' age (yrs): Average: 25 Min: 18 Max: 40

For blood: proportion of female donors (%) 100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Blood taken from pregnant women (Chukchi ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

G/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 129: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	2.88	1.83	0.98	24.29
cis-nonachlor				
trans-nonachlor	8.18	6.48	2.14	36.71
Chlordane (group)*	**2.78**	**1.77**	**0.95**	**23.49**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 130: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	38.51	29.78	8.57	145.71
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	261.53	202.47	10.14	907.14
DDT (group) *	**330.02**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 131: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	20.91	16.47	7.14	102.86
PCB 153	36.92	28.88	5	140.14
PCB 180	10.86	8.88	2.86	41.71

PCB 118	*34.28*	*23.58*	*4.29*	*199.71*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**68.69**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

G/3 Summary table of reported POPs levels

Table 132: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	2.78	1.77	0.95	23.49
DDT (group)	ng g^{-1} lw	330.02			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	92.28	74.03	20	388.57
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

H/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Extended data base (346 puerpera) including data base (220 puerpera) of GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).

Matrix (e.g. milk, blood): Blood

Sampling site(s): Kola peninsula

Sampling year(s): 2001 – 2003

No. of donors: 16

Donors' age (yrs): Average: 22 Min: 18 Max: 32

For blood: proportion of female donors (%) 100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

	☐HRGC/ECD Which POPs: ☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Blood taken from pregnant women (Saami, Nentsi & Komi ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

H/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 133: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	1.48	1.25	0.98	4.62
cis-nonachlor				
trans-nonachlor	5.72	4.11	2.14	18
Chlordane (group)*	**1.43**	**1.21**	**0.95**	**4.47**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 134: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	44.13	35.1	8.57	114.43
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	357.96	294.09	109.57	937
DDT (group) *	**443.13**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 135: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**

PCB 28				
PCB 52				
PCB 101				
PCB 138	37.39	31.09	7.14	80.86
PCB 153	43.38	36.63	5	71
PCB 180	16.71	13.28	2.86	40.43
PCB 118	*35.43*	*24.85*	*4.29*	*86.14*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**97.48**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

H/3 Summary table of reported POPs levels

Table 136: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	1.43	1.21	0.95	4.47
DDT (group)	ng g^{-1} lw	443.13			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	60.62	49.22	21.43	233.29
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

I/1 Study-specific information

Country:	**Russia**
Activity (e.g.. monitoring, research):	Extended data base (346 puerpera) including data base (220 puerpera) of GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	Pechora River basin (Nenetsk AO)
Sampling year(s):	2001 – 2003
No. of donors:	38
Donors' age (yrs):	Average: 23 Min: 16 Max: 38
For blood: proportion of female donors (%)	100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Blood taken from pregnant women (Nentsi ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

I/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 137: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	2.16	1.59	0.98	8.4
cis-nonachlor				
trans-nonachlor	7.71	4.71	2.14	44.29
Chlordane (group)*	**2.09**	**1.54**	**0.95**	**8.12**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 138: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
o,p'-DDT				
p,p'-DDT	56.18	37.6	8.57	264.29
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	303.17	226.99	8.57	777.14

DDT (group) *	**394.11**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 139: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	27.83	21.87	7.14	80
PCB 153	88.21	64.41	5	341.43
PCB 180	39.4	25.37	2.86	185.71
PCB 118	*20,8*	*17,34*	*4,29*	*42,86*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**155.44**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

I/3 Summary table of reported POPs levels

Table 140: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	2.09	1.54	0.95	8.12
DDT (group)	ng g^{-1} lw	394.11			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	101.08	80.69	21.14	297.14
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

J/1 Study-specific information

Country:	**Russia**
Activity (e.g.. monitoring,	Extended data base (346 puerpera) including data base (220 puerpera) of

research):	GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	Taymir peninsula
Sampling year(s):	2001 – 2003
No. of donors:	69
Donors' age (yrs):	Average: 27 Min: 16 Max: 42
For blood: proportion of female donors (%)	100 % puerpera
Literature source:	*Russian Artic PTS data by A. Dudarev, 2008.*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs ☒HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs ☐HRGC/ECD Which POPs: ☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Blood taken from pregnant women (Dolgani ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

J/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 141: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	3.51	2.36	0.98	15.4
cis-nonachlor				
trans-nonachlor	15.41	11.55	2.14	62.86
Chlordane (group)*	**3.39**	**2.28**	**0.95**	**14.89**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 142: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**

o,p'-DDT				
p,p'-DDT	40.41	30.37	8.57	121.43
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	297.68	213.86	30	1 092.86
DDT (group) *	**372.22**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 143: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	35.74	29.35	7.14	105.71
PCB 153	69.84	56.61	14.29	230
PCB 180	24.62	19.55	2.86	80
PCB 118	*39.67*	*31.72*	*4.29*	*122.29*
Sum PCB_6 (28,52,101,138,153,180)				
Sum PCB_7 (28,52,101,118,138,153,180)				
Sum PCB_3 (138,153,180)	**130.20**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

J/3 Summary table of reported POPs levels

Table 144: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	3.39	2.28	0.95	14.89
DDT (group)	ng g^{-1} lw	372.22			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	100.25	81.97	10	300
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				

PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

K/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Extended data base (346 puerpera) including data on 220 puerpera of GEF/AMAP/RAIPON project "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North" (2000-2004).

Matrix (e.g. milk, blood): Blood

Sampling site(s): Norilsk town (Taymir peninsula)

Sampling year(s): 2001 – 2003

No. of donors: 59

Donors' age (yrs): Average: 27 Min: 16 Max: 37

For blood: proportion of female donors (%) 100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Blood taken from pregnant women (Russian ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

K/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 145: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
Oxychlordane	1.26	1.12	0.98	7.21
cis-nonachlor				
trans-nonachlor	4.19	3.38	2.14	15

Chlordane (group)*	**1.22**	**1.08**	**0.95**	**6.97**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 146: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
o,p'-DDT				
p,p'-DDT	68.48	47.74	12.14	895.29
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	552.08	452.05	113.29	2 806.43
DDT (group) *	**683.85**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 147: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Geom. mean	Min	Max
PCB 28				
PCB 52				
PCB 101				
PCB 138	27.5	23.47	7.14	83.43
PCB 153	48.3	40.08	5	199.71
PCB 180	14.76	11.14	2.86	51.29
PCB 118	*36.15*	*30.65*	*8.57*	*193.57*
Sum PCB$_6$ (28,52,101,138,153,180)				
Sum PCB$_7$ (28,52,101,118,138,153,180)				
Sum PCB$_3$ (138,153,180)	**90.56**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

K/3 Summary table of reported POPs levels

Table 148: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				

Chlordane (group)	ng g^{-1} lw	1.22	1.08	0.95	6.97
DDT (group)	ng g^{-1} lw	683.85			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	42.42	36.7	11.29	176.43
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

L/1 Study-specific information

Country: **Russia**

Activity (e.g.. monitoring, research): Aleut International Association project "Persistent Toxic Substances (PTS). Food Safety of the Indigenous People in Kamchatka Pennisula and Commander Islands of the Russian Federation", 2003-2004)

Matrix (e.g. milk, blood): Blood

Sampling site(s): Kamchatka

Sampling year(s): 2001 – 2003

No. of donors: 8

Donors' age (yrs): Average: 21 Min: 15 Max: 39

For blood: proportion of female donors (%) 100 % puerpera

Literature source: *Russian Artic PTS data by A. Dudarev, 2008.*

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☒HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☒DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☒HCB
☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs+PCDFs

☐HRGC/ECD Which POPs:
☐Aldrin ☐DDT group ☐Dieldrin ☐Endrin group ☐Heptachlor ☐HCB
☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs+PCDFs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Blood taken from pregnant women (Koryaki & Eveni ethnicity) was collected, processed and analyzed according to AMAP standardized protocols.

* Participation in proficiency testing schemes.

L/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 149: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
oxychlordane	4.81	3.7	0.98	10.64
cis-nonachlor				
trans-nonachlor	22.57	15.82	4.57	75
Chlordane (group)*	**4.65**	**3.58**	**0.95**	**10.29**

* Sum of all detected analytes (but nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 150: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	20.46	16.2	8.57	48.43
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	256.89	249.24	146.71	350.43
DDT (group) *	**306.80**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 151: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28				
PCB 52				
PCB 101				
PCB 138	16.89	14.83	7.14	27.71
PCB 153	45.21	41.01	16.86	74
PCB 180	12.98	12.25	6.71	17.29
PCB 118	*25.23*	*22.57*	*8.71*	*36.43*
Sum PCB$_6$ (28,52,101,138,153,180)				
Sum PCB$_7$ (28,52,101,118,138,153,180)				
Sum PCB$_3$ (138,153,180)	**75.08**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

L/3 Summary table of reported POPs levels

Table 152: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw	4.65	3.58	0.95	10.29
DDT (group)	ng g^{-1} lw	306.80			
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	43.77	41.12	26.71	77.86
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

5.2.2.22 Serbia

No data on POPs levels in human milk or blood is available from any monitoring or research activities in Serbia except for the paper on the PCB levels in colostrum milk. In this case, however, results are related to a whole milk basis (lipid content is not reported).

5.2.2.23 Slovakia

There has been no systematic human biomonitoring of SC POPs in the period of 1998-2007 in Slovakia. Almost all accessible data has originated from the research projects. These projects were focused on the northern part of the District of Michalovce situated in eastern Slovakia where about 21 500 metric tons of PCB mixture called Delor was manufactured in 1959-1984. Stropkov and Svidnik districts located nearby were selected as a referential area. Tens of tons of PCBs escaped to the local environment during the production. Increased PCB levels have been observed in food (hen's eggs, milk, meat) produced from locally raised animals.

A/1 Study-specific information

Country:	**Slovakia**
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	1. Michalovce District – PCB production in 1959-1984 in Strazske town (Chemko factory) 2. Stropkov District – a comparative agriculture/forest area about 35 km upwind and upstream Strazske 3. Villages near the municipal waste incinerator of Kosice

	4. Nitra District – predominantly an agricultural area
Sampling year(s):	2001
No. of donors:	40 (10 from each site)
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.* *Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The 10 samples from each site were pooled prior to analysis (4 samples analyzed)

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Tabe 153: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	2.78	2.43	1.56	5.54
PCB 52	0.35	0.31	0.18	0.64
PCB 101	0.93	0.77	0.51	2.02
PCB 138	137.86	133.48	97.44	190.23
PCB 153	169.97	165.90	121.74	222.52
PCB 180	147.97	144.03	109.29	200.24
PCB 118	*11.13*	*10.49*	*7.00*	*17.74*
Sum PCB_6 (28,52,101,138,153,180)	**459.86**	**447.28**	**331.39**	**621.19**
Sum PCB_7 (28,52,101,118,138,153,180)	**470.99**	**457.85**	**338.39**	**638.93**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 154: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener		Levels (pg g^{-1}, lipid adjusted)							
		Average			Geometric mean			Min	Max
		lower	middle	upper	Lower	middle	upper		
PCB 77		6.75	6.75	6.75	6.63	6.63	6.63	4.78	7.96
PCB 81		4.38	4.38	4.38	4.05	4.05	4.05	2.88	7.62
PCB 126		47.02	47.02	47.02	46.48	46.48	46.48	39.20	58.54
PCB 169		32.00	32.00	32.00	31.44	31.44	31.44	25.13	40.16
non-*ortho* PCBs (WHO_{1997} TEQ)		**5.30**	**5.30**	**5.30**	**5.25**	**5.25**	**5.25**	**4.52**	**6.26**
PCB 105	ng/g, lipid adjusted	2.02	2.02	2.02	1.77	1.77	1.77	1.15	4.02
PCB 114	ng/g, lipid adjusted	0.49	0.49	0.49	0.44	0.44	0.44	0.27	0.88
PCB 118	ng/g, lipid adjusted	11.13	11,13	11.13	10.49	10.49	10.49	7.00	17.74
PCB 123	ng/g, lipid adjusted	0	0.0035	0.07	0	0.0035	0.07		
PCB 156	ng/g, lipid adjusted	12.58	12.58	12.58	12.13	12.13	12.13	9.02	18.45
PCB 157	ng/g, lipid adjusted	1.47	1.47	1.47	1.43	1.43	1.43	1.15	2.02
PCB 167	ng/g, lipid adjusted	4.74	4.74	4.74	4.58	4.58	4.58	3.35	6.81
PCB 189	ng/g, lipid adjusted	1.83	1.83	1.83	1.71	1.71	1.71	1.24	3.06
mono-*ortho* PCBs (WHO_{1997} TEQ)		**8.99**	**8.99**	**8.99**	**8.52**	**8.52**	**8.52**	**8.52**	**13.22**
dl-PCBs (WHO_{1997} TEQ)		**14.29**	**14.29**	**14.29**	**13.83**	**13.83**	**13.83**	**10.71**	**19.48**

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable

Table 155: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	0.74	0.74	0.74	0.73	0.73	0.73	0.68	0.93
1,2,3,7,8-Cl5DD	2.02	2.02	2.02	2.00	2.00	2.00	1.66	2.39
1,2,3,4,7,8-Cl6DD	1.26	1.26	1.26	1.25	1.25	1.25	1.19	1.38
1,2,3,6,7,8-Cl6DD	4.58	4.58	4.58	4.54	4.54	4.54	3.63	5.09
1,2,3,7,8,9-Cl6DD	1.50	1.50	1.50	1.49	1.49	1.49	1.26	1.67
1,2,3,4,6,7,8-Cl7DD	8.67	8.67	8.67	7.96	7.96	7.96	4.80	14.94
Cl8DD	39.21	39.21	39.21	34.22	34.22	34.22	20.03	76.92
PCDDs (WHO_{1997} TEQ)	**3.77**	**3.77**	**3.77**	**3.76**	**3.76**	**3.76**	**3.43**	**4.15**
2,3,7,8-Cl4DF	0.71	0.71	0.71	0.70	0.70	0.70	0.55	0.93
1,2,3,7,8-Cl5DF	0.47	0.47	0.47	0.46	0.46	0.46	0.31	0.60
2,3,4,7,8-Cl5DF	8.74	8.74	8.74	8.66	8.66	8.66	7.75	10.73
1,2,3,4,7,8-Cl6DF	4.76	4.76	4.76	4.73	4.73	4.73	4.07	5.36

1,2,3,6,7,8-Cl6DF	3.14	3.14	3.14	3.12	3.12	3.12	2.71	3.46
1,2,3,7,8,9-Cl6DF	0.92	0.92	0.92	0.91	0.91	0.91	0.74	1.10
2,3,4,6,7,8-Cl6DF	0	0.06	0.12			0.11	0.05	0.19
1,2,3,4,6,7,8-Cl7DF	1.91	1.91	1.91	1.88	1.88	1.88	1.49	2.42
1,2,3,4,7,8,9-Cl7DF	0.06	0.07	0.07			0.06	0.04	0.15
Cl8DF	0.36	0.36	0.36	0.25	0.25	0.25	0.08	0.85
PCDFs (WHO_{1997} TEQ)	**5.55**	**5.56**	**5.57**	**5.52**	**5.52**	**5.53**	**4.88**	**6.44**
PCDDs+PCDFs (WHO_{1997} TEQ)	**9.32**	**9.33**	**9.34**	**9.31**	**9.32**	**9.32**	**8.60**	**9.85**

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ/g lipid is preferable
- nd – not detected

A/3 Summary table of reported POPs levels

Table 156: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw				
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw				
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	460	447	331	621
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	14.29	13.83	10.71	19.48
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	9.34	9.32	8.60	9.85

B/1 Study-specific information

Country:	**Slovakia**
Activity (e.g,. monitoring, research):	4th WHO-coordinated survey of human milk for persistent organic pollutants (POPs)
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Across Slovakia
Sampling year(s):	2006
No. of donors:	51
Donors' age (yrs):	Average: 25.1 Min: 16 Max: 29
For blood: proportion of female donors (%)	
Literature source:	*Malisch R.: 4th WHO-coordinated survey of human milk for POPs. Report of status and results as available on 11 Aug 2006.*

	Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☒Aldrin ☒Chlordane gr. ☒DDT group ☒Dieldrin ☒Endrin gr. ☒Heptachlor ☒HCB ☒Mirex ☒Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Milk samples were collected according to the WHO protocol. The individual samples were pooled prior to analysis (1 sample analyzed).

* Participation in proficiency testing schemes.

B/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 157: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)	nd			
trans-chlordane (gamma-chlordane)	nd			
Oxychlordane	1.7			
cis-nonachlor	nd			
trans-nonachlor	0.8			
Chlordane (group)*	**1.6**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 158: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT	nd			
p,p'-DDT	10.6			
o,p'-DDD	nd			
p,p'-DDD	nd			
o,p'-DDE	nd			

p,p'-DDE	328.7			
DDT (group) *	**377.5**			

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 159: Endrin

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Endrin	nd			
Endrin ketone	nd			
Endrin (group) *	nd			

* Sum of all detected analytes calculated as endrin

Table 160: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Heptachlor	nd			
cis-heptachlor epoxide	nd			
trans-heptachlor epoxide	nd			
Heptachlor (group) *	nd			

* Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

Table 161: Toxaphene

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
Parlar 26	nd			
Parlar 50	nd			
Parlar 62	nd			
Toxaphene *	nd			

* Sum of the three congeners

Table 162: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Geom. mean**	**Min**	**Max**
PCB 28	2.01			
PCB 52	0.38			
PCB 101	0.38			
PCB 138	57.86			

PCB 153	107.17			
PCB 180	86.81			
PCB 118	*7.25*			
Sum PCB$_6$ (28,52,101,138,153,180)	**254.61**			
Sum PCB$_7$ (28,52,101,118,138,153,180)	**262.86**			

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

Table 163: dl-PCBs (dioxin-like polychlorinated biphenyls)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
PCB 77	4.38	4.38	4.38					
PCB 81	2.61	2.61	2.61					
PCB 126	34.99	34.99	34.99					
PCB 169	22.26	22.26	22.26					
non-*ortho* PCBs (WHO$_{1997}$ TEQ)	**3.72**	**3.72**	**3.72**					
PCB 105 ng/g, lipid adjusted	1.10	1.10	1.10					
PCB 114 ng/g, lipid adjusted	0.24	0.24	0.24					
PCB 118 ng/g, lipid adjusted	7.25	7.25	7.25					
PCB 123 ng/g, lipid adjusted	0.05	0.05	0.05					
PCB 156 ng/g, lipid adjusted	9.73	9.73	9.73					
PCB 157 ng/g, lipid adjusted	0.79	0.79	0.79					
PCB 167 ng/g, lipid adjusted	2.33	2.33	2.33					
PCB 189 ng/g, lipid adjusted	1.18	1.18	1.18					
mono-*ortho* PCBs (WHO$_{1997}$ TEQ)	**6.36**	**6,36**	**6.36**					
dl-PCBs (WHO$_{1997}$ TEQ)	**10.08**	**10.08**	**10.08**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable

Table 164: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD	0.39	0.39	0.39					
1,2,3,7,8-Cl5DD	1.5	1.5	1.5					
1,2,3,4,7,8-Cl6DD	0.71	0.71	0.71					
1,2,3,6,7,8-Cl6DD	3.88	3.88	3.88					

1,2,3,7,8,9-Cl6DD	1.02	1.02	1.02					
1,2,3,4,6,7,8-Cl7DD	5.11	5.11	5.11					
Cl8DD	21.04	21.04	21.04					
PCDDs (WHO_{1997} TEQ)	**2.50**	**2.50**	**2.50**					
2,3,7,8-Cl4DF	0.42	0.42	0.42					
1,2,3,7,8-Cl5DF	0.23	0.23	0.23					
2,3,4,7,8-Cl5DF	6.81	6.81	6.81					
1,2,3,4,7,8-Cl6DF	2.44	2.44	2.44					
1,2,3,6,7,8-Cl6DF	1.85	1.85	1.85					
1,2,3,7,8,9-Cl6DF	0.53	0.53	0.53					
2,3,4,6,7,8-Cl6DF	0	0	0					
1,2,3,4,6,7,8-Cl7DF	1.1	1.1	1.1					
1,2,3,4,7,8,9-Cl7DF	0	0	0					
Cl8DF	0.15	0.15	0.15					
PCDFs (WHO_{1997} TEQ)	**3.95**	**3.95**	**3.95**					
PCDDs+PCDFs (WHO_{1997} TEQ)	**6.46**	**6.46**	**6.46**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

B/3 Summary table of reported POPs levels

Table 165: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Geom. mean	Min	Max
Aldrin	ng g^{-1} lw	nd			
Chlordane (group)	ng g^{-1} lw	1.6			
DDT (group)	ng g^{-1} lw	377			
Dieldrin	ng g^{-1} lw	nd			
Endrin (group)	ng g^{-1} lw	nd			
Heptachlor (group)	ng g^{-1} lw	nd			
HCB	ng g^{-1} lw	47.4			
Mirex	ng g^{-1} lw	Nd			
Toxaphene	ng g^{-1} lw	Nd			
PCBs	ng g^{-1} lw	255			
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw	10.08			
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw	6,46			

C/1 Study-specific information

Country:	**Slovakia**
Activity (e.g.. monitoring, research):	Burden of the human population living in a PCB-contaminated area in eastern Slovakia (pilot research project)
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	Michalovce District – PCB production in 1959-1984 in Strazske town (Chemko)
Sampling year(s):	1998
No. of donors:	215
Donors' age (yrs):	Average: 48.9 Min: 18 Max: 78
For blood: proportion of female donors (%)	50.2
Literature source:	*Kocan A, et al. Burden of the environment and human population in an area contaminated with PCBs [Project of MoE of Slovakia – Final report], 1999 http://www.shmu.sk/File/SLO01G31/1TR2_Monit.pdf*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Enzymatic
QA/QC:	☒Applied ☒PT participation* ☐Laboratory accredited
Notes:	

* Participation in proficiency testing schemes.

C/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 166: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	140.9	113.5	29.7	908.6
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	3 865	3 008	118.3	19 912
DDT (group) *	**4 451**	**3 448**	**174.5**	**22 385**

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 167: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	58.7	39.4	5.8	1 206
PCB 52	13.3	9.7	< 3	220.2
PCB 101	11.9	5.5	2.1	330.6
PCB 138	819.0	541.0	23.4	10 248
PCB 153	1 278	862.2	47.0	17 492
PCB 180	1 185	742.2	95.8	19 840
PCB 118	*208.5*	*111.8*	*10.1*	*4 33*
Sum PCB_6 (28,52,101,138,153,180)	**3 366**	**2 185**	**256.7**	**48 404**
Sum PCB_7 (28,52,101,118,138,153,180)	**3 574**	**2 327**	**266.8**	**50 274**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

C/3 Summary table of reported POPs levels

Table 168: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	4 451	3 448	174	22 385
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	1 921	1 466	54	8 505
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	3 366	2 185	257	48 404
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

D/1 Study-specific information

Country:	**Slovakia**
Activity (e.g.. monitoring, research):	Burden of the human population living in a PCB-contaminated area in eastern Slovakia (pilot research project)
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	Stropkov Districts – a comparative agriculture/forest area about 35 km upwind and upstream Strazske
Sampling year(s):	1998
No. of donors:	205

Donors' age (yrs):	Average: 45,2 Min: 19 Max: 83
For blood: proportion of female donors (%)	50,7
Literature source:	*Kocan A, et al. Burden of the environment and human population in an area contaminated with PCBs [Project of MoE of Slovakia – Final report], 1999 http://www.shmu.sk/File/SLO01G31/1TR2_Monit.pdf*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☒HRGC/ECD Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Enzymatic
QA/QC:	☒Applied ☒PT participation* ☐Laboratory accredited
Notes:	

* Participation in proficiency testing schemes.

D/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 169: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	97.6	77.2	22.7	917.6
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	2 580	2 002	334.9	15 575
DDT (group) *	**2 996**	**2 315**	**440.0**	**17 467**

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 170: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	33.3	27.1	5.4	870.1
PCB 52	8.1	6.3	< 3	209.0

PCB 101	5.8	4.2	1.2	217.4
PCB 138	232.4	206.6	56.0	1 261
PCB 153	386.6	347.3	85.4	2 123
PCB 180	331.0	275.6	82.5	2 898
PCB 118	*42.6*	*36.6*	*6.1*	*345.3*
Sum PCB_6 (28,52,101,138,153,180)	**1 000**	**879.3**	**251.7**	**6 365**
Sum PCB_7 (28,52,101,118,138,153,180)	**1 043**	**918.2**	**257.8**	**6 418**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

D/3 Summary table of reported POPs levels

Table 171: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	2 996	2 315	440	17 467
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	1 622	1 173	82	20 389
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	1 000	879	252	6 365
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

E/1 Study-specific information

Country:	**Slovakia**
Activity (e.g.. monitoring, research):	Evaluating human health risk from low-dose and long-term PCB exposure (research project)
Matrix (e.g. milk, blood):	Blood
Sampling site(s):	Michalovce District – PCB production in 1959-1984 in Strazske town (Chemko)
Sampling year(s):	2001
No. of donors:	1009
Donors' age (yrs):	Average: 44.6 Min: 17 Max: 78
For blood: proportion of female donors (%)	57.0
Literature source:	*Kocan A, et al. Organohalogen Compounds 66, 2004, 3539-3546* *http://www.shmu.sk/File/SLO01G31/1TR2_Monit.pdf*
Analytical method:	☐HRGC/HRMS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs ☐HRGC/MS-MS ☐Isotope dilution Which POPs:

☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Enzymatic

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes:

* Participation in proficiency testing schemes.

E/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 172: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	102.7	72.9	4.5	895.8
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	3 161	2 521	262.7	22 382
DDT (group) *	**3 624**	**2 886**	**324.4**	**25 205**

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 173: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	17.3	6.4	< 1.8	564.7
PCB 52	6.7	3.9	< 1.6	625.2
PCB 101	7.3	3.6	0.9	252.6
PCB 138	572.3	352.2	56.5	14 050.4
PCB 153	911.8	578.3	96.2	25 088.8
PCB 180	913.4	526.3	90.8	44 673.2
PCB 118	*101.6*	*63.8*	*3.5*	*3 539.5*
Sum PCB$_6$ (28,52,101,138,153,180)	**2 429**	**1 498**	**260.8**	**67 286**
Sum PCB$_7$ (28,52,101,118,138,153,180)	**2 531**	**1 562**	**269.7**	**67 573**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

E/3 Summary table of reported POPs levels

Table 174: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	3 624	2 886	324	25 205
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	1 015	690	26.2	17 928
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	2 429	1 498	261	67 286
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

F/1 Study-specific information

Country: **Slovakia**

Activity (e.g.. monitoring, research): Evaluating human health risk from low-dose and long-term PCB exposure (research project)

Matrix (e.g. milk, blood): Blood

Sampling site(s): Svidnik+Stropkov Districts – a comparative agriculture/forest area about 50 km upwind and upstream Strazske

Sampling year(s): 2001

No. of donors: 1038

Donors' age (yrs): Average: 43.9 Min: 17 Max: 66

For blood: proportion of female donors (%) 57.0

Literature source: *Kocan A, et al. Organohalogen Compounds 66, 2004, 3539-3546*
http://www.shmu.sk/File/SLO01G31/1TR2_Monit.pdf

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid Enzymatic

determination (e.g. gravimetric, enzymatic):
QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited
Notes:
* Participation in proficiency testing schemes.

F/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 175: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	49.3	33.2	1.8	940.3
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	1 755	1 368	54.0	12 747
DDT (group) *	**2 005**	**1 566**	**70.1**	**14 378**

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 176: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	6.2	3.2	< 2.2	217.4
PCB 52	5.0	3.8	< 1.6	239.9
PCB 101	3.3	2.9	< 1.2	88.0
PCB 138	165.0	140.9	8.5	3 500
PCB 153	266.5	232.1	38.8	5 193
PCB 180	245.6	202.8	42.4	4 809
PCB 118	*24.8*	*21.4*	*2.1*	*720.0*
Sum PCB$_6$ (28,52,101,138,153,180)	**691.6**	**595.0**	**112.5**	**13 513**
Sum PCB$_7$ (28,52,101,118,138,153,180)	**716.3**	**618.0**	**115.4**	**13 794**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

F/3 Summary table of reported POPs levels

Table 177: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	2 005	1 566	70,1	14 378
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	829	639	21.7	11 421
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	692	595	112	13 513
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

G/1 Study-specific information

Country: **Slovakia**

Activity (e.g.. monitoring, research): Early Childhood Development and PCB Exposure in Slovakia (research project)

Matrix (e.g. milk, blood): Blood

Sampling site(s): Michalovce District – PCB production in 1959-1984 in Strazske town (Chemko) and Svidnik+Stropkov Districts – a comparative agriculture/forest area about 50 km upwind and upstream Strazske

Sampling year(s): 2002 – 2004

No. of donors: 1094

Donors' age (yrs): Average: 25.8 Min: 18 Max: 44

For blood: proportion of female donors (%) 100

Literature source:

Analytical method:

☐HRGC/HRMS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☒HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☒HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Enzymatic

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes: Blood was taken from mothers after delivery

* Participation in proficiency testing schemes.

G/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 178: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
o,p'-DDT				
p,p'-DDT	35.0	20.8	< 0.8	5 716
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE	541.2	424.5	0.1	10 468
DDT (group) *	**637.4**	**499.2**	**5.2**	**17 378**

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 179: PCBs (marker polychlorinated biphenyls)

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	**Median**	**Min**	**Max**
PCB 28	nd			
PCB 52	nd			
PCB 101	nd			
PCB 138	127.0	88.0	5.3	2 805
PCB 153	192.8	138.1	11.4	3 959
PCB 180	181.3	124.4	17.0	2 877
PCB 118	*14.0*	*8.3*	*< 0.2*	*509.6*
Sum PCB$_6$ (28,52,101,138,153,180)	**498.5**	**350.9**	**40.9**	**9 640**
Sum PCB$_7$ (28,52,101,118,138,153,180)	**512.5**	**360.7**	**41.4**	**10 150**

As an orientation: Out of these congeners, 138, 153 and 180 will generally contribute to >90 % of the sum the 6 marker PCB congeners (valid for human samples)

nd – more than 2/3 of results were below the LOQ

G/3 Summary table of reported POPs levels

Table 180: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; as to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw	637	499	5.2	17 378
Dieldrin	ng g^{-1} lw				

Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw	105	66.1	< 0.1	3 011
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw	499	351	40.9	9 640
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw				

5.2.2.24 Slovenia

No information on the POPs levels in Slovenian human milk or blood were published or otherwise reported. Slovenia has participated in none of four WHO-coordinated exposure studies on POPs levels in human milk that were organized in 1988, 1993, 2002 and 2006.

5.2.2.25 Tajikistan

No information on the POPs levels in human milk or blood collected in Tajikistan were published or otherwise reported. Tajikistan has participated in none of four WHO-coordinated exposure studies on POPs levels in human milk that were organized in 1988, 1993, 2002 and 2006.

5.2.2.26 Turkmenistan

No information on the POPs levels in human milk or blood collected in Tajikistan are published or otherwise reported. Tajikistan has participated in none of four WHO-coordinated exposure studies on POPs levels in human milk that were organized in 1988,1993, 2002, and 2006.

5.2.2.27 Ukraine

Ukraine participated in the 3rd round of the WHO-coordinated exposure study on the PCB, PCDD and PCDF levels in human milk. No other monitoring data regarding POPs in human milk or blood collected after 1998 are available.

A/1 Study-specific information

Country:	**Ukraine**		
Activity (e.g.. monitoring, research):	3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk.		
Matrix (e.g. milk, blood):	Milk		
Sampling site(s):	3 sites		
Sampling year(s):	2000 – 2001		
No. of donors:			
Donors' age (yrs):	Average:	Min:	Max:
For blood: proportion of female donors (%)			
Literature source:	*Malisch R., van Leeuwen FXR.: Results of the WHO-coordinated exposure study on the levels of PCBs, PCDDs and PCDFs in human milk. Organohalogen Compounds 64, 2003, 140-143.*		

Malisch R.: Results from 3rd and 4th round of WHO-coordinated studies presented at the UNEP GMP ROG workshop in Geneva, 19-23 May 2008.

Analytical method:

☒HRGC/HRMS ☒Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☒dl-PCBs ☒PCDDs/Fs

☐HRGC/MS-MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/MS ☐Isotope dilution Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

☐HRGC/ECD Which POPs:
☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs

Analytical method for lipid determination (e.g. gravimetric, enzymatic): Gravimetric

QA/QC: ☒Applied ☒PT participation* ☒Laboratory accredited

Notes (e.g. if the WHO protocol for human milk collection was applied): Milk samples were collected according to the WHO protocol. The samples from each site were pooled prior to analysis (3 samples analyzed)

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 181: Chlordane

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
cis-chlordane (alpha-chlordane)				
trans-chlordane (gamma-chlordane)				
Oxychlordane	4.8			
cis-nonachlor				
trans-nonachlor	6.7			
Chlordane (group)*	**4.6**			

* Sum of all detected analytes (but *trans*-nonachlor) calculated as chlordane

As an orientation: Only oxychlordane and *trans*-nonachlor are to be expected in human samples

Table 182: Heptachlor

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
Heptachlor				
cis-heptachlor epoxide	1.5			
trans-heptachlor epoxide				
Heptachlor (group) *	**1.5**			

* Sum of all detected analytes calculated as heptachlor

As an orientation: Only *cis*-heptachlor epoxide is considered to be bioaccumulated

A/3 Summary table of reported POPs levels

Table 183: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw	< 0.5			
Chlordane (group)	ng g^{-1} lw	4.6			
DDT (group)	ng g^{-1} lw	1 070			
Dieldrin	ng g^{-1} lw	< 0.5			
Endrin (group)	ng g^{-1} lw	< 0.5			
Heptachlor (group)	ng g^{-1} lw	1.5			
HCB	ng g^{-1} lw	73.3			
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw	16.7			
PCBs	ng g^{-1} lw		136	103	148
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw		19.95	14.10	22.00
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		10.04	8.38	10.16

5.2.2.28 Uzbekistan

Uzbekistan has participated in no WHO-coordinated exposure studies on POPs levels in human milk. However, basic data on the levels of POPs in human milk exists thanks a research activity.

A/1 Study-specific information

Country:	**Uzbekistan**
Activity (e.g.. monitoring, research):	Research
Matrix (e.g. milk, blood):	Milk
Sampling site(s):	Karakalpakstan
Sampling year(s):	1999
No. of donors:	41
Donors' age (yrs):	Average: Min: Max:
For blood: proportion of female donors (%)	
Literature source:	*Ataniyazova O.A., et al. Levels of certain metals, organochlorine pesticides and dioxins in cord blood, maternal blood, human milk and some commonly used nutrients in the surroundings of the Aral Sea (Karakalpakstan, Republic of Uzbekistan). Acta Paediatr. 90, 2001, 801-808.*
Analytical method:	☒HRGC/HRMS ☒Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☒PCBs ☐dl-PCBs ☒PCDDs/Fs
	☐HRGC/MS-MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor ☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☒HRGC/MS ☐Isotope dilution Which POPs: ☐Aldrin ☐Chlordane gr. ☒DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor

	☒HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
	☐HRGC/ECD Which POPs:
	☐Aldrin ☐Chlordane gr. ☐DDT group ☐Dieldrin ☐Endrin gr. ☐Heptachlor
	☐HCB ☐Mirex ☐Toxaphene ☐PCBs ☐dl-PCBs ☐PCDDs/Fs
Analytical method for lipid determination (e.g. gravimetric, enzymatic):	Gravimetric
QA/QC:	☒Applied ☒PT participation* ☒Laboratory accredited
Notes (e.g. if the WHO protocol for human milk collection was applied):	Five pooled samples (1 pool = 8 individual samples) were analysed for PCDDs and PCDFs. DDT, DDE and HCB were analysed in all the 41 milk samples.

* Participation in proficiency testing schemes.

A/2 Compilation of raw data (relevant analytes) and calculation of sum parameters

Report of average (arithmetic mean), median (or geometric mean), minimum, and maximum values

Table 184: DDT

Congener	Levels (ng g^{-1}, lipid adjusted)			
	Average	Median	Min	Max
o,p'-DDT				
p,p'-DDT		70	< 15	297
o,p'-DDD				
p,p'-DDD				
o,p'-DDE				
p,p'-DDE		873	312	4 035
DDT (group) *		1 043		

* Sum of all detected analytes calculated as DDT

As an orientation: p,p'-DDE is to be expected to contribute > 90 % to DDT group in human samples
Recent exposure might be detected from the ratio of p,p'-DDE/p,p'-DDT

Table 185: PCDDs (polychlorinated dibenzo-*p*-dioxins, dioxins)**, PCDFs** (polychlorinated dibenzofurans, furans)

Congener	Levels (pg g^{-1}, lipid adjusted)							
	Average			Geometric mean			Min	Max
	lower	middle	upper	lower	middle	upper		
2,3,7,8-Cl4DD			16.10				10.60	31.20
1,2,3,7,8-Cl5DD			4.84				3.10	11.60
1,2,3,4,7,8-Cl6DD			1.00				0.78	1.13
1,2,3,6,7,8-Cl6DD			2.98				2.70	4.81
1,2,3,7,8,9-Cl6DD			0.79				0.64	1.45
1,2,3,4,6,7,8-Cl7DD			4.71				3.70	5.25
Cl8DD			20.70				14.00	21.20
PCDDs (WHO_{1997} TEQ)			**21.47**					
2,3,7,8-Cl4DF			0.48				0.41	2.38
1,2,3,7,8-Cl5DF			0.32				0.27	1.17

2,3,4,7,8-Cl5DF			3.90				3.48	5.21
1,2,3,4,7,8-Cl6DF			1.84				1.57	2.17
1,2,3,6,7,8-Cl6DF			1.57				1.35	2.07
1,2,3,7,8,9-Cl6DF			0.05				0.05	0.11
2,3,4,6,7,8-Cl6DF			0,92				0.83	1.21
1,2,3,4,6,7,8-Cl7DF			1,26				1.08	1.84
1,2,3,4,7,8,9-Cl7DF			0,06				0.05	0.10
Cl8DF			0,18				0.13	0.24
PCDFs (WHO_{1997} TEQ)			**2,47**					
PCDDs+PCDFs (WHO_{1997} TEQ)			**23,93**					

- Lower bound: concentration of not detected analyte = 0;
- Middle bound: concentration of not detected analyte = ½ LOQ;
- Upper bound: concentration of not detected analyte = LOQ
- For TEQ values: < 20 % difference between lower and upper bound values at ranges > 1 pg TEQ g^{-1} lipid is preferable
- nd – not detected

A/3 Summary table of reported POPs levels

Table 186: Report of average (arithmetic mean), median or geometric mean, minimum, and maximum values; As to dl-PCBs and PCDDs+PCDFs, middle bound values (if available) are reported.

POP	Unit	Average	Median	Min	Max
Aldrin	ng g^{-1} lw				
Chlordane (group)	ng g^{-1} lw				
DDT (group)	ng g^{-1} lw		1 043		
Dieldrin	ng g^{-1} lw				
Endrin (group)	ng g^{-1} lw				
Heptachlor (group)	ng g^{-1} lw				
HCB	ng g^{-1} lw		28	< 5	109
Mirex	ng g^{-1} lw				
Toxaphene	ng g^{-1} lw				
PCBs	ng g^{-1} lw				
dl-PCBs	pg WHO_{1997} TEQ g^{-1} lw				
PCDDs+PCDFs	pg WHO_{1997} TEQ g^{-1} lw		23.93		

6 CAPACITY BUILDING

Several countries might be able to organize monitoring, but several obstacles hindered any achievements: resources for analyses were lacking; limited capacity was available in the region for measurement and analysis (in particular for dioxins and furans) and the costs of replacing the old equipment were high.

Following capacity needs were identified in the region: strengthening the infrastructure for analyzing the core media in existing laboratories (i.e. capacity to analyze other media might already exist); human capacity building;

strengthening the implementation of the QA/QC procedures (including meeting the needs for standards and consumables); strengthening the skills for the sampling and analysis; in-lab training and further assistance for the analyses of dioxins/furans and other persistent organic pollutants; inter-calibration tests. RECETOX and NILU offered to serve as the strategic partners for passive air sampling and analysis, and the EMEP Meteorological Synthesizing Centre-East offered modeling data to supplement the monitoring information.

Some regional institutes and laboratories that would benefit from capacity building: Serbia - Institute for public health and Institute for chemistry, technology and ecology (Centre for chemistry); Moldova - National scientific practice centre of preventive medicine (laboratory); Bosnia – Institute for public health; Armenia – State monitoring lab; Lithuania – State institute of health services; the Former Yugoslav Republic of Macedonia – Institute of Public Health, Faculty of Veterinary Medicine; Latvia – Hygienic survey institute; Romania – national institute for environment protection and national institute of public health, Institute for agriculture and food. The workshop participants noted that Azerbaijan, Belarus and Georgia might also benefit from some capacity building and would need to be contacted for additional information on their laboratory capacity and needs.

The representative of MONARPOP offered to assist countries by facilitating the sampling and analysis of dioxins through national institutes working in the program as well as through contact with partner institutes in Italy and Switzerland provided funds could be identified for such assistance. RECETOX offered to assist countries in the monitoring projects.

Some strategic partnerships still exist in the CEE region – RECETOX MONET-CEECs covers the ambient air monitoring of POPs using the polyurethane passive samplers – 20 CEE countries and 2 countries of Central Asia; Russian Federation - AMAP for air and human data (with Canadian funding); Russian Federation – with countries of the former Union of Soviet Socialist Republics (support for and training in analysis: 5 labs accredited for dioxin analysis and others for other POPs); Poland - 5 labs and possible analytical partnerships; Czech Republic and Slovak Republic - support for analysis; Moldova - support for non-dioxin POPs analysis; WHO 4th round human milk biomonitoring program (Czech Republic, Hungary, Slovakia); RECETOX passive sampling to be extended further in the framework of the ongoing project supported by the Secretariat; EMEP model assessment at regional level (data, assessment, etc…); EMEP support for guidance on monitoring and training for laboratory analysis; Possible AMAP project in cooperation with the Stockholm Convention Secretariat funded from the Canadian POPs Fund.

While emphasizing there was limited funding, the workshop participants were encouraged to join the WHO program conducted in cooperation with UNEP on biomonitoring of human milk for persistent organic pollutants, by expressing an intention of interest to join the sampling program. The representative of WHO informed the workshop of the program for proficiency testing of national laboratories which would also be undertaken providing funds were available. Interested countries were encouraged to contact WHO to join the program.

There is a marked difference between the CEE countries with respect to number of institutions and experts working in the field of dioxin, PCBs and OCPs research and analysis. In the CEE countries, the largest number of experts and institutions can be found in countries like Poland, Czech Republic, Slovakia and Russian Federation. With respect to the analytical capacity there is probably a sufficient number of PCB and OCP analyzing laboratories in every country, even though they might not all meet the quality standard requirements set in the European and international legislation. On the other hand, the dioxin analytical capacity is not always sufficient. Several countries reported that they do not have any analytical facility for dioxins at all. As the consequence, most of the analyses performed in the CEE countries were restricted to indicator PCBs and OCPs, whereas analyses of PCDDs/Fs and dioxin-like PCBs were not available. Majority of data on PCDDs/Fs and dioxin-like PCBs were still available from countries like Czech Republic, Poland, and Slovakia.

Some country experts stated that technical equipment of national or regional laboratories has been improved recently as a consequence of the capacity building projects launched by the European Community or international organizations like the WHO, but the correct handling of samples during all steps of the analytical process may still not be always satisfactory.

A large number of projects and activities have been launched in the last years with the intention to support capacity building in the new EU member states at different levels. Legislation as well as enforcement have been strongly supported through these measures. Financial, technical and administrative support for the capacity building with

respect to the adoption of the acquis communautaire in the new states is supported mainly via three program instruments (PHARE, ISPA and SARPAD) focusing on three different aspects of preparatory actions in the process of the Accession.

In this context, all countries participate in UNEP, UNIDO,UNDP/GEF funded projects on enabling activities in the field of implementation of the obligation under the Stockholm Convention, that started between 2001 and the end of 2002 and will lead to the development of National Inventories and National Implementation Plans (NIP).

For the realization of the projects, National Focal points and Coordinators have been appointed and nominated. They have a task of coordinating a network of different expert organizations including the Ministries of Environment, Health, Agriculture, Transport, Internal Affairs and Economy.

By this approach, information from the environment and health as well as some statistical and economic information can be combined and evaluated by one expert team. Furthermore, UNEP promotes information transfer and knowledge exchange by frequent meetings of the representatives of various WHO regions and subregions enhancing discussion and training projects.

WHO has conducted periodic studies on the levels of dioxins and PCBs in mother's milk every five years in order to give a comparative overview on the contamination levels in different countries across the world. Whereas the project started mainly with EU Member States in the first round of the project in 1987-88, it has been covering a total of 26 countries around the world in the third round (2001-2002) including some countries of the CEE region. In this study, strict quality standards with respect to comparability of data have been set up for the sampling and analytical procedures resulting in highly comparable information of the human milk levels in the participating countries.

The added value of the project is the information on:

- Major sources of human contamination expressed by the proportion of PCDD/F and PCB contamination as well as the specific country patterns of PCBs
- Awareness raising for the potential risk the general population is being exposed to, and enhancing activities to reduce or eliminate possible dioxin or PCB sources.
- Laboratory capacity building as the participating laboratories have to undergo sophisticated inter-calibration studies.

Regional cooperations among the Candidate Countries or involving Candidate Countries have been established at different levels of the scientific and political society. One example of the intergovernmental cooperation within the countries of the region is the BALTIC ENVIRONMENTAL FORUM (BEF). The project started in 1995 as an information exchange forum for the three Baltic States to coordinate information, expertise and experience exchange in the environmental field via workshops, training programs and publications.

In the view of dioxins and PCBs the Baltic Chemicals Programme (BAltic States Regional Cooperation programme on Chemicals CONtrol) BACCON is an important platform for supporting the capacity building and enforcement in the Baltic Countries. The current BACCON 3 project started in August, 2003 and is focused on cooperation of various stakeholders as well as enforcement of inspection.

Another example is the DANCEE (Danish Cooperation for Environment in Eastern Europe) initiative initiated and financed mainly by the Danish EPA. DANCEE has performed several projects in the Baltic States and Poland focused on a survey on dioxin and PCB sources and emissions in that region. Detailed information on these projects is documented at the web site of the Danish Environmental Agency and published in the "Survey on Dioxin Sources in the Baltic Region".
Some other activities which are focused on the capacity building and regional cooperation are for example:

- MONET-CEECs background monitoring network that has been established and covered by the Czech Republic and the RECETOX Centre
- RECETOX and some other institutes offered their training capacities

- RECETOX have organized the international Summer schools focused on the environmental chemistry and ecotoxicology of POPs with a special focus on the implementation of the Global monitoring plan.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Many Eastern European countries suffer the **lack of data on concentrations of persistent organic pollutants in the environmental matrices.** This absence of information is preventing the local authorities from taking the adequate actions to protect the people and environment. This is even more alarming in the countries recently affected by the wars where the chemicals released to the environment during the military operations can cause a significant ecological damage and health effects on the population.

Ambient air monitoring is not common in the CEE region and very few relevant atmospheric data is available. Data on the ambient air levels of PCBs and OCPs, for instance, has been only reported from eight countries (Czech Republic, Croatia, Estonia, Latvia, Lithuania, Poland, Slovakia, Slovenia), and even some of these campaigns have only been episodic.

The only **long-term monitoring program** focused on POPs in ambient air performed in the CEE region is the integrated monitoring program at Kosetice observatory in the Czech Republic which is also a part of EMEP background monitoring. Atmospheric POPs have been measured using a **high volume active sampler** since 1988, sampling and analytical methods have been consistent since 1996. Twelve years of monitoring data from the Kosetice observatory was used for an assessment of the long-term trends of POPs in the ambient air at the Central European continental background. Presented results demonstrated that the long-term background monitoring is not only an excellent way to study the regional levels and trends but also a powerful tool for evaluation of the impact of various local and regional events – from industrial accidents to natural disasters. As such, this approach has a potential to play a crucial role in the implementation of regional and global measures and conventions on persistent toxic substances.

Majority of information on the POP levels in ambient air in CEEC is derived from the **passive air monitoring projects**. Model passive air monitoring network (MONET-CZ) has been developed in the Czech Republic since 2003 as a contribution to the ongoing national POPs inventory in the Czech Republic. and currently consists of 37 sampling sites, including 15 backgrounds (industrial, urban, rural, mountain) and variety of sites influenced by primary and secondary POP sources. Based on the results from this network, various aspects of the POP contamination can be addressed, from an impact of the point sources or the old burdens, through spatial or seasonal variability, to the long term trends in the background areas. Detailed information can be found in the MONET-CZ report.

The Czech Republic is the first from the signatory countries of the Stockholm convention that offers **fully developed and functional tool** capable of providing information on the **Central European levels of POPs** and the **long-term trends** in those levels. The major advantage is availability of consistent high volume POPs monitoring data from Košetice EMEP station. This dataset with established time trends for the last twelve years can itself serve the evaluation of the future trends in the atmospheric concentration of POPs. Parallel PAS monitoring in Košetice in the last three years gives another unique calibration dataset and at the same time, a centerpiece of the PAS network in the Czech Republic.

There are other key aspects of the MONET-CZ network. Such well characterized region in Central Europe with the dense monitoring network provides the core element for the **spin-off projects** in other countries of Central, Southern and Eastern Europe. Since many of these countries lack not only data on the POP levels in the atmosphere but also appropriate monitoring and laboratory capacities, this aspect is very valuable.

In general, data on the **POP contamination of ambient air in the Central and Eastern European Region is insufficient**, and the lack of regular monitoring is a priority problem. Based on the evaluation of the technical and financial capabilities of available local laboratories it has been concluded that they are capable of providing OCP and PCB analyses but they require both financial and human resources to obtain or replace equipment, and to attract and train the skilled personnel. Higher effectiveness of data collection cannot be achieved without the methodological coordination of the individual monitoring programs.

Based on the experiences from the Czech monitoring network, **MONET-CEEC project** was initiated in 2006 with the goal of building the monitoring capacity in this region. Network of partner institutions was established and they cooperated in designing the pilot screening study in the CEE region in 2006-2008. Transfer of know-how, educational and training activities were an important part of the MONET-CEEC project.

Sampling sites for three phases of the MONET-CEEC Project have been selected in cooperation with the local partners in all participating countries. A **background site** was included in most countries as a potential candidate of background monitoring for the effectiveness evaluation of the Stockholm Convention. Whenever possible, **gradient** of other sites (rural, urban, and industrial) was developed also to address the range of contamination, possible sources and spatial variations. Soil samples were collected from the air sampling sites as a part of the study.

The results revealed **great differences between the POP levels in the individual countries**. While the highest median levels of studied POPs were found in Southern Europe and Russia, the lowest values were measured in Central Europe and the Baltic countries.

Median **PCB concentrations** in the air samples were highest in Bosnia and Herzegovina, Romania, Serbia, Montenegro and Russia. Generally, the sites in Central Europe (the Czech Republic, Poland and Hungary) demonstrated significantly lower concentrations (20-50%) than those in Southern and Eastern Europe. Wastes, storages of used equipment, contaminated buildings and soils must be responsible for high ambient air levels in this region.
When looking at background sites, higher PCB concentrations were measured in Serbia, Croatia, Montenegro, Bosnia and Herzegovina which is the area of the was damage. Elevated PCB level was also found in Russia where it is connected to the industrial contamination. All EMEP stations had very low contamination.

Air samples from the industrial sites in Romania and Russia had extremely high **levels of HCHs**. Median level in this set of samples was one order of magnitude higher than those in other countries. Air samples from Serbia, Macedonia, the Czech Republic or Moldova also varied widely in HCH concentrations.
Elevated median levels of HCHs at the background sites were observed in Romania, Moldova, Serbia, Hungary and Montenegro. They are probably connected to the old burdens from production and improper storage of pesticides in these countries. Lowest concentrations were determined in Estonia, Poland, Croatia and Slovenia.

Median **atmospheric concentration of DDTs** was highest in Romania and Moldova while it was an order of magnitude lower in the Montenegro or Croatia and 5 times lower in the Czech Republic, Slovenia or Poland.
DDT levels at background sites were also highest in Moldova and Romania, but in Bulgaria, Hungary or the Czech Republic they were elevated as well.

Atmospheric levels of HCB were found to be quite uniform in the Central and Eastern European region with the exception of Russia. Extremely high HCB concentration was found at some hot spots in the Czech Republic, all the other maxima varied within the factor of two.
Bosnia and Herzegovina, but also the EMEP station Kosetice had higher HCB concentrations than all the others backgrounds.

Air samples from Romania, Montenegro, Russia, Bosnia and Herzegovina had the highest median **concentration of PAHs**, possibly due to the selection of industrial sites.
Romania and Montenegro had both very high PAH concentrations also for backgrounds. On the contrary, all EMEP stations had low and comparable median PAH levels.

Although these results are, of course, not representative for all countries, they give a **very good starting point for establishment of continuous and coordinated background POP monitoring** in the CEE region. We can conclude that passive sampling technique is fully applicable in the long term monitoring projects and capable to fulfill the tasks of determination of levels of POPs in the ambient air, evaluation of the spatial and temporal trends in distribution of POPs, impact evaluation of point and diffusive sources, and assessment of the short- and long-range transport of POPs. All of these are important in the process of establishment of relevant arrangements for the effectiveness evaluation of the international conventions and fulfilling the international obligations of the Czech Republic.

Out of **28 countries** of to the Central and Eastern European Region, certain amount of data on the **POPs levels in human milk or blood** collected in the period of 1998 – 2008 are available from **11 countries**: Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Poland, Romania, Russia, Slovakia, Ukraine, and Uzbekistan.

Countries such as Bulgaria, Croatia, Czech Republic, Hungary, Romania, Russia, Slovakia, and Ukraine participated in the 3rd round of WHO-coordinated exposure study on PCB, PCDD and PCDF levels in human milk. Within this study, organochlorine pesticides (chlordane, DDT, dieldrin, endrin, heptachlor, HCB, and toxaphene) were also determined in human milk samples from Bulgaria, Czech Republic, Russia, and Ukraine. The Czech Republic, Hungary and Slovakia participated also in the 4th round. Although only several tens of human milk samples had been collected in each participating country and the samples were pooled to several samples, the results of these studies are often the only comparable data on POPs levels in the region. Comparison of median PCB, dl-PCB and PCDDs+PCDFs levels found in pooled human milk samples collected according to a WHO protocol in 8 CEE countries is presented in Figures 50 and 51.

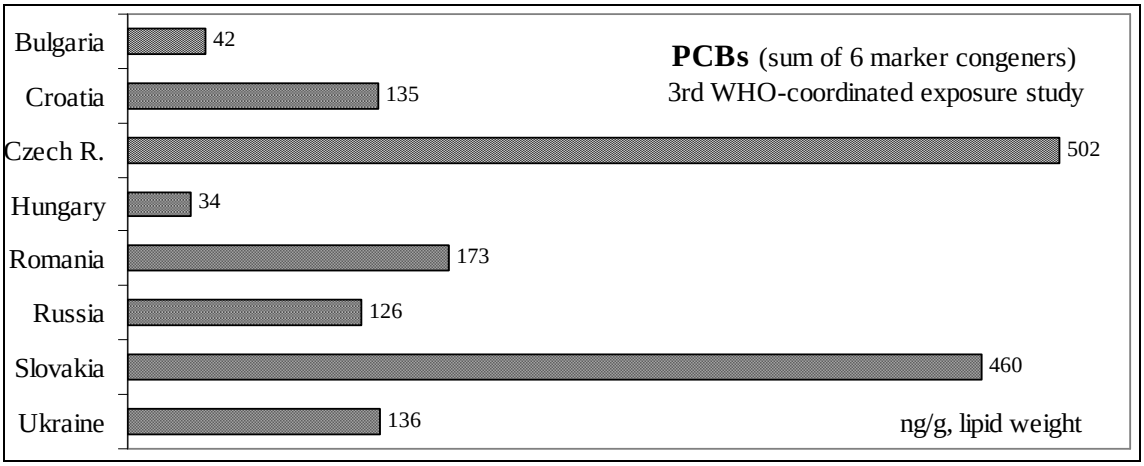

Figure 50: Comparison of median PCB levels found in pooled human milk samples collected according to a WHO protocol in 8 CEE countries

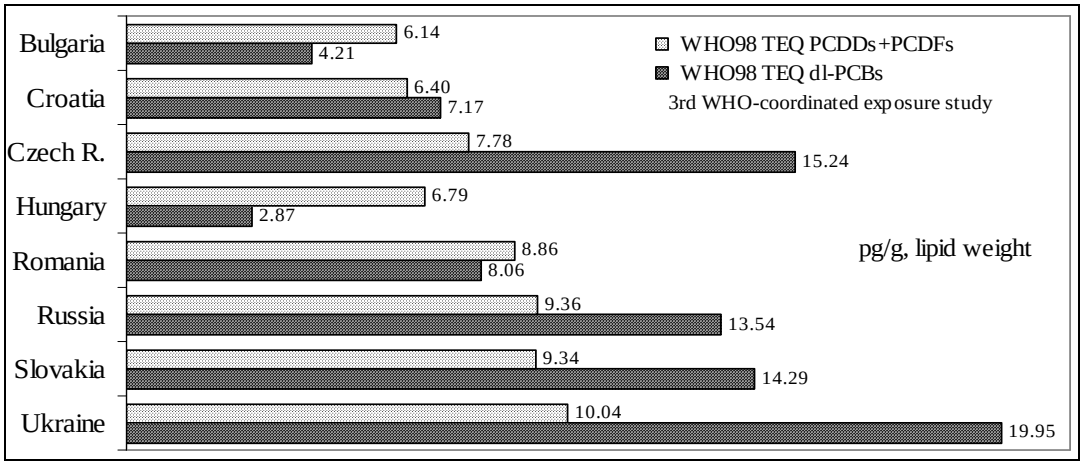

Figure 51: Comparison of median dl-PCB and PCDDs/Fs levels found in pooled human milk samples collected according to a WHO protocol in 8 CEE countries

DDT group (calculated as all DDTs) and HCB levels found within monitoring programs, WHO-coordinated exposure studies and research projects conducted in some CEE countries are illustrated on Figures 52 and 53.

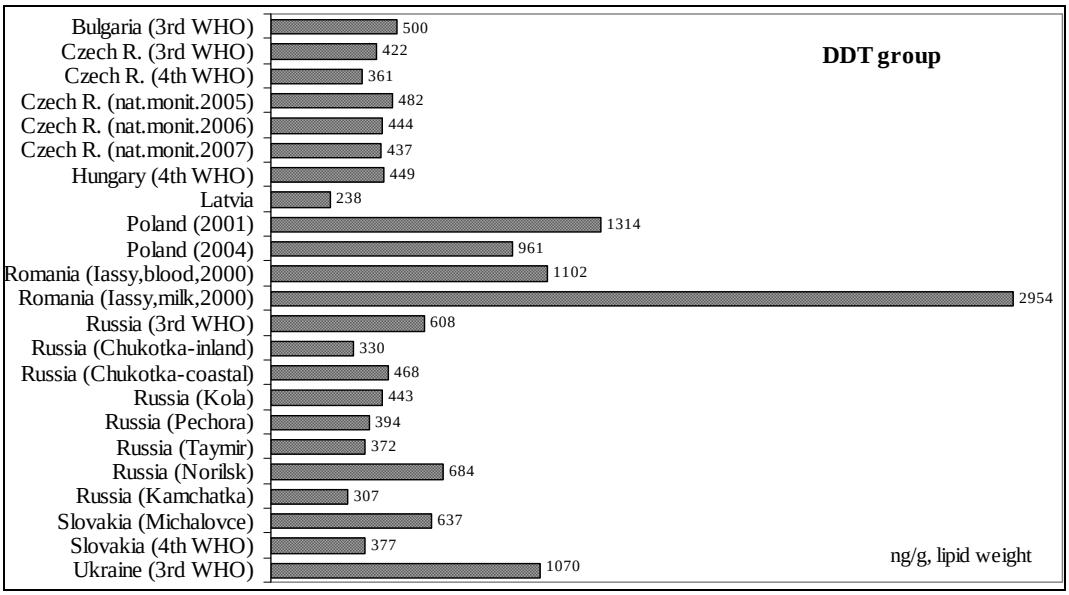

Figure 52: Comparison of median DDT levels found in pooled human milk samples collected according to a WHO protocol in 8 CEE countries

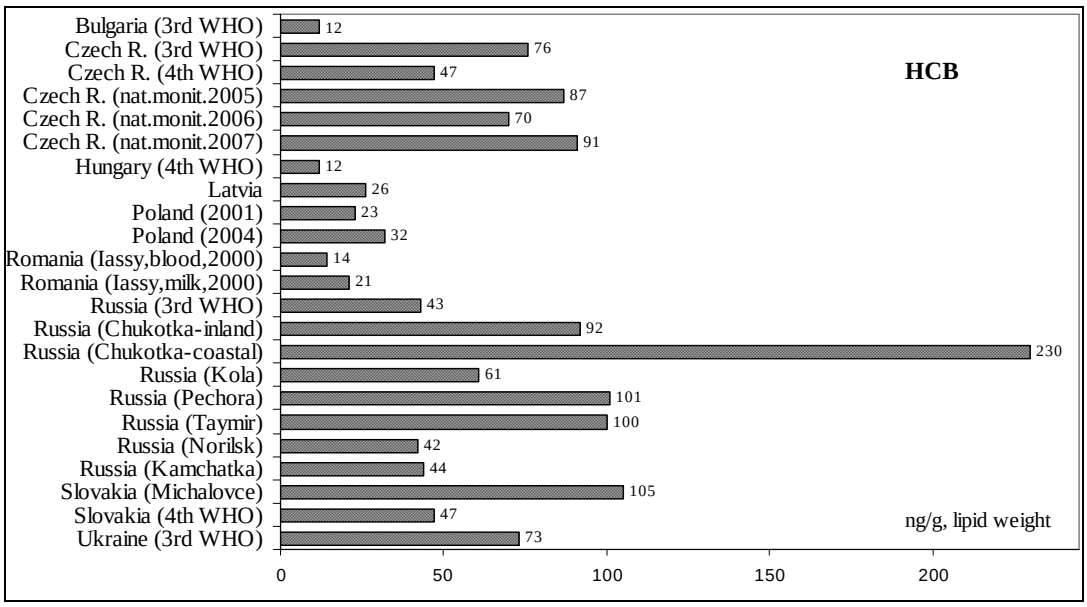

Figure 53: Comparison of median HCB levels found in pooled human milk samples collected according to a WHO protocol in 8 CEE countries

Except for the Czech Republic, **no systematic and regular human biomonitoring of POPs** has been performed in the Central and Eastern European countries since 1998. With regards to dioxins, dl-PCBs and marker PCBs, the 3rd and 4th round of WHO-coordinated exposure studies have given the most reliable results because, in spite of a small number of milk samples, the samples were collected, stored and shipped according to a WHO protocol and pooled samples were analyzed by the same laboratory meeting the strict QA/QC criteria. The highest marker PCB levels were found in milk samples collected from the Czech Republic and Slovakia both in the 3rd round and the 4th one. Surprisingly, the highest dioxin-like PCBs expressed as WHO_{98} TEQ were found in milk samples from Ukraine although marker PCB levels were several times lower than those in samples from the Czech Republic and Slovakia (see Figures 50 and 51).

Other CEE countries such as Azerbaijan, Georgia, Lithuania, Moldova and Tajikistan are participating in the UNEP/WHO human milk survey being performed in the second half of 2008. Results are expected in autumn of 2009. Thus, **no data on the POPs levels in human milk or maternal blood** have been available for the purpose of this report **from 12 out of 28 countries** of the CEE region (Albania, Armenia, Belarus, Bosna-Herzegovina, Estonia, Kazakhstan, Kyrgyzstan, Macedonia, Montenegro, Serbia, Slovenia, and Turkmenistan).

7.2 Recommendations

The **background station in Košetice**, Czech Republic with fully developed system of the integrated monitoring and established trends of the atmospheric POPs in the last decade should serve as a regional **air monitoring superstation** using both, the active and passive sampling.

Košetice is the only station worldwide which serves the purpose of the **three major air monitoring programs generating POPs data for the GMP**: EMEP, MONET and GAPS. The high volume samplers from the EMEP program have been employed side by side with the PUF passive samplers from the MONET project as well as both (PUF and XAD) PAS samplers from the GAPS project since 2005. The fact that it can serve as an intercalibration site for all three large-scale monitoring projects makes Košetice station quite unique and very valueable.

Having the Košetice station as a superstation in the center of the region, **greater spatial and temporal resolution** of data can be achieved by deployment of passive samplers and establishment of the **PAS monitoring network** in CEE region. This network must be based on the results of three phases of the MONET-CEEC project. **Following steps** have to be completed to achieve this goal.

- Third phase (2008) of the MONET-CEEC project covering Belarus, Ukraine, Armenia, Kyrgyzstan, and Kazakhstan will be completed and all sample analyzed.
- Progress report for the third phase of MONET-CEEC will be issued in January, 2009.
- Data from all three phases of MONET-CEEC and three years of MONET-CZ projects will be aggregated and used for the final report on the POP levels in ambient air of the CEE region issued in March, 2009.
- This final report will be a major contribution of the CEE region to the first phase of the Global Monitoring Plan under the Stockholm Convention.
- Based on this report, one background site suitable for the continuous POP monitoring will be selected in each country in cooperation with local authorities.
- CEE regional background monitoring network consisting of selected sites will be initialized in January, 2009, supported from the budget of the Central and Eastern European POPs Centre, RECETOX and national sources.
- Project will be managed and supervised by RECETOX, sampling will be maintained by local personnel, filter supply and analysis by RECETOX laboratories.
- All local partners participating in the pilot phases are encouraged to continue this cooperation and take the necessary responsibility in the long-term project.
- They are also encouraged to use this opportunity to establish their national monitoring studies as a spin-off activity. MONET-CEEC background network can serve as a backbone to which the national PAS monitoring projects can be attached. This way, it will also serve the purpose of the capacity building in the CEE region.
- The local laboratories can collect and analyze duplicate samples from the MONET-CEEC sites to ensure the comparability of their results. Intercalibration study can be organized by RECETOX if needed.
- Capacities of the RECETOX laboratories are available for the training courses and the transfer of knowledge.
- RECETOX Summer School in Environmental Chemistry and Ecotoxicology is another platform that can be exploited for this purpose¨.

As some countries of the region (Czech Republic, Slovakia, Slovenia, Croatia, Russian Federation, Poland, Ukraine) have sufficient capacity for the regular monitoring of air and human samples as well as for training, newly established partner's network should serve the purpose of the capacity building and the transfer of knowledge in the CEE region.

Annex I

Country information - National POPs inventories, National implementation plans

Table I-1: Country information – national POPs inventories, National implementation plans

Country	SC		National POPs inventory				
	Signed	Ratified	Developed	Under development	Upgrade (frequency)	Publicly available	Web site
Albania	05/12/2001	04/10/2004	Yes				
Armenia	23/05/2001	26/11/2003	Yes		Yearly	Yes	Printed form
Azerbaijan		13/01/2004	2006				
Belarus		03/02/2004	Yes				
Bosnia and Herzegovina	23/05/2001						
Bulgaria	23/05/2001	20/12/2003	Yes		Yearly	Yes	http://nfp-bg.eionet.eu.int/ncesd/bul/bulletins.html (emissions) http://www.chemicals.moew.government.bg
Croatia	23/05/2001	30/01/2007	2004		No	No	
Czech Republic	23/05/2001	06/08/2002	2002		Yearly	Yes	
Estonia	Not	Not	Yes		Yearly	Yes	www.envir.ee www.klab.ee
Georgia	23/05/2001	04/10/2006					
Hungary	23/05/2001	14/03/2008	Yes			Not yet	
Latvia	23/05/2001	28/10/2004	Yes		No	No	
Lithuania	17/05/2002	05/12/2006	2002 - 2005		2005	Partly	http://aaa.am.lt (PCDDs/Fs – 2002)
Macedonia	23/05/2001	27/05/2004	Yes				
Moldova	23/05/2001	07/04/2004	Yes		Yearly	Yes	www.moldovapops.md
Montenegro	23/10/2006						
Poland	23/05/2001		1990		Yearly	Yes	http://emisje.ios.edu.pl/kcie/englishMain.htm
Romania	23/05/2001	28/10/2004	1990		Yearly	Yes	
Russian Federation	22/05/2002						
Serbia	02/05/2002						
Slovakia	23/05/2001	05/08/2002	1997 air 2003 other		Yearly (air)	Yes	www.emep.int air http://www.shmu.sk/sk/?page=11 other (Slovak language) partly in NIP www.pops.int
Slovenia	23/05/2001	04/05/2004	2005	2008	Yearly	Yes	
Ukraine	23/05/2001	25/09/2007	2001-2004		2005	Yes	www.chem.unep.ch/pops/pcb_activities/
Kazakhstan	23/05/2001	09/11/2007					
Kyrgyzstan	16/05/2002	12/12/2006					
Tajikistan							

Country	National Implementation Plan				
	Developed/ transmitted	Under development	Accepted	Publicly available	Website
Albania	02/01/2007		Yes		
Armenia	29/04/2006		Yes	Yes	Printed form
Azerbaijan		Yes			
Belarus	17/01/2007				
Bosnia and Herzegovina					
Bulgaria	20/03/2007		Yes	Yes	http://www.chemicals.moew.government.bg
Croatia	2004		No	No	
Czech Republic	08/05/2004		Yes	Yes	
Estonia	2005		Yes	Yes	www.envir.ee www.klab.ee
Georgia	Yes		No		
Hungary	2007		Not yet	Not yet	
Latvia	07/06/2005		Yes		
Lithuania	06/04/2007		Yes	Yes	http://www3.lrs.lt/dokpaieska/forma_l.htm www.am.lt
Macedonia	02/09/2005		Yes	Yes	
Moldova	25/08/2005		Yes	Yes	www.moldovapops.md
Montenegro					
Poland	2004		No	Yes	http://www.mos.gov.pl/2strony_tematyczne/ochrona_powietrza/konwencje_ekologiczne/konwencja_sztokholmska/NIP-Poland-eng.pdf
Romania	12/04/2006		Yes	Yes	www.popsromania.ro
Russian Federation	2008				
Serbia		Yes			
Slovakia	12/06/2006		Yes	Yes	http://www.enviro.gov.sk/servlets/files/15397 SK, htm l version www.enviro.gov.sk/servlets/files/14650 (SK pdf version) www.pops.int (EN)
Slovenia	2004		No	Yes	
Ukraine	2006	Yes	No	Yes	
Kazakhstan		Yes			
Kyrgyzstan		Yes			
Tajikistan					

Annex II

Production, usage, banning, monitoring of POPs in the CEECs

Table II-1: – Production, usage, banning, inventories, monitoring of POPs in the CEECs (CACs – no available information)

Aldrin	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	Yes	1990	Yes	Yes			A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	1970		No			
Azerbaijan	No				No	Yes ??	S, R	
Belarus					No	Yes ??	W, S, F	
Bosnia and Herzegovina								
Bulgaria	No	1960-1969	1969	Stocks	1 395 kg assumed, mixed with other pesticides, identification impossible	Yes	S, GW	
Croatia	No	1958	1972	Yes	No	Yes	W	
Czech Republic	No	1962-1963	1980	Yes	No	No	-	
Estonia	No	No	1999		No	Yes, NR	A, W, S, F, FE, HB	
Georgia								
Hungary	Yes	1959-1970	1967	yes	Possible			
Latvia	No	No	1972		No	Yes	W	NR – not regularly
Lithuania	No		1972		No	Yes	F, FE	
Macedonia	No		1982		No	No		
Moldova	No	Until 1972	1972		No	No		
Montenegro								
Poland	No	Until 1976	2003	No	Possible	Yes	SED	
Romania	No	1975-1980	1988	No		No		
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	Until 1973	1973	Yes	Possible	No		
Slovenia	Yes until 1976	No	1977	No	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No	Until 1985	1985 – USSR 1997 - Ukraine	General OP inventory		Yes, NR	G, S, F	

Chlordane	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	Yes	1990	Yes	Yes	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	1970		No			
Azerbaijan	No				No			
Belarus					No			
Bosnia and Herzegovina								
Bulgaria	No	No			No	Yes	S, GW	
Croatia	No	1955	1971	Yes	No	Yes	W	
Czech Republic	No	No	No	No	No	No	-	
Estonia	No	No	1999		No	No		
Georgia								
Hungary	No	1961 (0,1t)		Yes	No			
Latvia	No	No	2000		No	No		NR – not regularly
Lithuania	No				No	Yes	F, FE	
Macedonia	No		1982		No	No		
Moldova	No	No	No	No	No	No		
Montenegro								
Poland	No	No	2004	No	No	No		
Romania	No	1975-1980	1988	No		No		
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	No	1973	No	No	No		
Slovenia	No	No	1972	No	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No		1997	General OP inventory		Yes, NR	S	

DDT	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	From 1946	1990	Yes	3 t	??		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No		1970		No	Yes, NR	W, S, F, HM	
Azerbaijan	1958-1980	1947-1985			783.9 t	Yes	S, R	
Belarus					718 t	Yes	W, S, F	
Bosnia and Herzegovina								
Bulgaria	No	1950-1969	1969	Yes	10.794 t assumed, mixed with other pesticides, identification impossible	Yes	GW, S	
Croatia	No	Since 1944	1972	Yes	No	Yes	A, W, HM – research projects	
Czech Republic	Since 1951	1951-1983	1974	Yes	No	Yes	A, W, SED, S, B, HM, F, FE	
Estonia	No	Until 1977	1967		No	Yes	B; NR - A, W, S	
Georgia								
Hungary	Yes	1950-1970	1967	Yes	No	Yes		
Latvia	No	1966	1966	Yes	> 200 t	Yes	NR	NR – not regularly
Lithuania	No	Yes	1972	1996-9	No	Yes, NR	A, F, FE	
Macedonia	No	1947-1959	1982	Yes	2.5 t	No		
Moldova	No	Until 1972	1970		No	Yes	W, SED, S, F, HM	
Montenegro								
Poland	Until 1978	Until 1976	2003	No	Yes	Yes	W, SED, B, F, FE	
Romania	Until 1965	1948-1965	1988	No		No		
Russian Federation	1946-1986			Yes	151 t	??		
Serbia								
Slovakia	No	Until 1973	1973	Yes	Possible	Yes, NR		
Slovenia	No	No. since1972	1996	Yes	78,5 kg PPP	Yes (W, DW, GW, F, FE, waste)		
Ukraine	1954 - 1986	1945 - 1989	1970 – 1989 USSR 1997 - Ukraine	Yes	Yes	Yes	G, S, - Hydromet; HM, HB, F, B - research	

Dieldrin	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	Yes	1990	Yes	Yes	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	1978		No			
Azerbaijan	No							
Belarus					No			
Bosnia and Herzegovina								
Bulgaria	No	1960-1969	1969	Yes	1.595 t assumed, mixed with other pesticides, identification impossible	Yes	GW, S	
Croatia	No	1958	1972	Yes	No	Yes	A, W, HM – research projects	
Czech Republic	No	No	No	No	No	No		
Estonia	No	No	1999		No	No		
Georgia								
Hungary	No	1959-1967	1967	Yes	Possible	Yes		
Latvia	No	No	2000		No	Yes	W	NR – not regularly
Lithuania	No		1970		No	Yes	F, FE	
Macedonia	No		1982			No		
Moldova	No	No	No		No	No		
Montenegro								
Poland	No	Until 1976	2003	No	Possible	Yes	SED	
Romania	No	1965-1970	1988	No		No		
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	No	1973	Yes	No	No		
Slovenia	No	No	1972	No	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No		1997	General OP inventory		Yes, NR	S	

Endrin	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	No	No						A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	No		No	No		
Azerbaijan	No					Yes	S	
Belarus					No			
Bosnia and Herzegovina								
Bulgaria	No	1960-1969	1969	Yes	0.204 t assumed, mixed with other pesticides, identification impossible	Yes	GW, S	
Croatia	No	1957	1989	Yes	No	Yes	W	
Czech Republic	No	1960-1983	1984	Yes	No	No		
Estonia	No	No	1999		No	No		
Georgia								
Hungary								
Latvia	No	No	2000		No	Yes	W	NR – not regularly
Lithuania	No		1970		No	Yes	F, FE	
Macedonia	No		1982			No		
Moldova	No	No	No		No	No		
Montenegro								
Poland	No	Until 1973	2003	No	Possible	Yes	SED	
Romania	No	1975-1980	1988	No		No		
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	Until 1973	1973	Yes	Possible	No		
Slovenia	No	No	1988	No	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No		1997	General OP inventory		Yes, NR	S	

Heptachlor	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	Yes	1990	Yes	Yes ??	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	1986		No			
Azerbaijan	No				No			
Belarus					No	Yes ??	W, S	
Bosnia and Herzegovina								
Bulgaria	No	1960-1991	1991	Yes	7.592 t assumed, mixed with other pesticides, identification impossible	Yes	GW, S	
Croatia	No	1956	1973	Yes	No	Yes	W	
Czech Republic	No	1970-1985	1989	Yes	No	No		
Estonia	No	No	1999		No	No		
Georgia								
Hungary								
Latvia	No	No	1986		No	No		NR – not regularly
Lithuania	No		1986		No	Yes	F, FE	
Macedonia	No		1982			No		
Moldova	No	Until 1987	1986		No	No		
Montenegro								
Poland	No	1966	2004	No	Possible	Yes	SED	
Romania	Until 1965	1975-1990	1988	No	3.544 t	No		
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	Until 1973	1973	Yes	Possible	No		
Slovenia	No	No	1974	No	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No		1986 – USSR 1997 - Ukraine	General OP inventory		Yes, NR	G, S, F	

Hexachlorobenzene	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania								A – air
Armenia	No	No	No		No	Yes, NR	W, S, F	W – water
Azerbaijan	No							G – ground water
Belarus					No	Yes	W, S, F	SED – sediment
Bosnia and Herzegovina								S – soils
Bulgaria	No	No		Emissions	No, never imported	No		B – biota
Croatia	No	1962	1980	Yes	No	Yes	A, W, HM – research projects	HM – human milk
Czech Republic	Until 1969	1959-1977	1977	Yes	No	Yes	A, W, SED, S, B, F, FE, HM, HB	HB – human blood
Estonia	No		1999		No	Yes	B; NR - A, W, S	F – food
Georgia								FE – feedstuffs
Hungary	No	1949-1967	1967	Yes	Possible	Yes		O – oil
Latvia	No	No	2000	Yes	No	Yes	W	R - residues
Lithuania	No		1981		No	Yes	A, F, FE	NR – not regularly
Macedonia	No		1982			No		
Moldova	No	No	No	Yes	No	Yes (since 2008)	W, SED, S	
Montenegro								
Poland	No	Until 1979	2004	Yes	Possible	Yes	SED, B, F	
Romania	No	1975-1990	1988	Emissions		No		
Russian Federation	Yes		No					
Serbia								
Slovakia	Until 1969**	Until 1985	1985	Yes	No	No		
Slovenia	No	No	1981	Yes, Air	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No		1997	General OP inventory	By-product waste	Yes, NR	G – Hydromet; HM, HB - research	

Mirex	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	No	No				No		A – air
Armenia	No	No	No		No	No		W – water
Azerbaijan								G – ground water
Belarus					No	No		SED – sediment
Bosnia and Herzegovina								S – soils
Bulgaria	No	No			No, never imported	No		B – biota
Croatia	No	No			No	No		HM – human milk
Czech Republic	No	No			No	No		HB – human blood
Estonia	No	No	1999		No	No		F – food
Georgia								FE – feedstuffs
Hungary								O – oil
Latvia	No	No	2000		No	No		R - residues
Lithuania	No	No			No	No		
Macedonia	No		1982		No	No		NR – not regularly
Moldova	No	No	No		No	No		
Montenegro								
Poland	No	No	2004		No	No		
Romania								
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	No	1973			No		
Slovenia	No	No		No	No	No		
Ukraine	No	Never	Not registered	No	No	No		

PCBs	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	No	Yes		Yes	Yes	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	Yes		Yes	No	Yes	W, S, F, HM	
Azerbaijan	No	Yes			384 t	Yes	S, R, O	
Belarus	No	Yes		Yes	Yes	Yes		
Bosnia and Herzegovina								
Bulgaria	No	Since 1950		Yes	Yes, PCB oils in phased out equipment	Yes	GW, S	
Croatia	No	Yes	1989/2025*	Yes	No	Yes	A, W, HM –research projects	
Czech Republic	1959-1984**	Until 2010	2010	Yes		Yes	A, W, SED, S, B, F, FE, HM, HB	
Estonia	No	Until 2010	2010	Yes	No	Yes	B; NR - A, W, S. O	
Georgia								
Hungary	No	Until 2010	2010	Yes	Yes	Yes		
Latvia	No	Yes	2000, in closed system until 2010	Yes	30 t	Yes	All matrices	NR – not regularly * usage in closed systems ** Former Czechoslovakia
Lithuania	No	Until 2010	1996	1996	No	Yes	W; NR: A, HM, B, F, FE	
Macedonia	No	Yes		Yes	???	No		
Moldova	No	Yes		Yes	Yes	Yes	O, W, SED, S	
Montenegro								
Poland	Since 1976	Until 2010	2001	Yes	Yes	Yes	W, SED, F	In EU member countries – year 2010 is stipulated in the Council Directive 96/59/EC only for big equipment with PCB volumes of more than 5 dm3. For the other small equipment is stipulated term in the Part II of the Annex A of the SC until 2028.
Romania	No	1954-1985		Stocks	Yes	Yes	A, W, S, O	
Russian Federation	Until 1993		1998-2003					
Serbia								
Slovakia	1959-1984**	Until 2010	2010	Yes	Yes	Yes	W, HM	
Slovenia	Yes until 1984	Yes, In transformers,	2010 Action Plan for disposal of PCB	Yes, Air	No	Yes (W, DW, GW, F, FE, waste)		
Ukraine	No	Yes	No	Yes	Yes	Yes	W, G, S, B, SED, HM - research	

PCDDs/Fs	Inventory	Monitoring	Matrices	Used abbreviations
Albania	Yes	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	Yes	No		
Azerbaijan	Yes			
Belarus	Yes	No		
Bosnia and Herzegovina				
Bulgaria	Yes	No		
Croatia	Yes	Yes, NR	A, HM – research projects	
Czech Republic	Yes	Yes	A, SED, S, F, HM, HB	
Estonia	Yes	Yes	F, B; NR - A, S	
Georgia				
Hungary	Yes	Yes		
Latvia	Yes	Yes	A, HM, HB	NR – not regularly
Lithuania	Yes		F, FE	
Macedonia	Yes	No		
Moldova	Yes	No		
Montenegro				
Poland	Yes	Yes	F	
Romania	Yes	No		
Russian Federation				
Serbia				
Slovakia	Yes	No		
Slovenia	No	No	Yes (W, DW, GW, F, FE, waste)	
Ukraine	Yes	No		

Toxaphen	Production	Usage	Banned	Inventory	Obsolete stocks	Monitoring	Matrices	Used abbreviations
Albania	Yes	Yes	1990	Yes	Yes	No		A – air W – water G – ground water SED – sediment S – soils B – biota HM – human milk HB – human blood F – food FE – feedstuffs O – oil R - residues
Armenia	No	No	No		No	No		
Azerbaijan	No							
Belarus					No	No		
Bosnia and Herzegovina								
Bulgaria	No	1960-1985	1985	Yes	0.72 t assumed, mixed with other pesticides, identification impossible	Yes	GW, S	
Croatia	No	1957	1884	No	No	No		
Czech Republic	No	1958-1987	1986	Yes	No	No		
Estonia	No	No	1999		No	No		
Georgia								
Hungary	No	1958-1992	1992					
Latvia	No	1966-1992	2000	Yes	5 t	No		NR – not regularly
Lithuania	No	Yes		1996-1999	No	Yes, NR	A,W, S	
Macedonia	No		1982		No	No		
Moldova	No	Until 1996	1991		No	No		
Montenegro								
Poland	Until 1971	Until 1987	2004	No	Yes	No		
Romania		1975-1990			2.942 t			
Russian Federation	No		No	Yes				
Serbia								
Slovakia	No	Until 1973	1973	Yes	Possible	No		
Slovenia	No	No	1983	No	No	No		
Ukraine	No		1997	General OP inventory		Yes, NR	G	

Annex III

Overview of existing monitoring programs in the CEE region

Table III-1: Overview of existing monitoring programs for the CEE Regional monitoring report – Phase I

Country	Background air		Human		Other relevant data	Period	Data available for other media (water, food, feed, sediment, soil, needles) except where specified
	HV	PAS	Blood	Milk			
Albania							
Armenia		2008			Only old data on blood Milk data only from contaminated sites	2002-2004	
Azerbaijan		2008					Soil, residues
Belarus		2008					
Bosnia and Herzegovina	2005	2006			Blood and Milk data old	Human data 20 years ago	
Bulgaria		2007		x	Detailed report on milk data not available in country.	WHO-3-rd round	
Croatia	Yes, NR	2007	x	x	Waters and sediments	WHO-1,2 3-rd round	
Czech Republic	EMEP	2004 – 2008 – regular national monitoring	x	x	Biotic samples, food chains	From the 1980s	W, SED, S, F, FE, B, NE, HM, HB
Estonia		2006-7	x		Blood data validity will be confirmed		
Georgia							
Hungary		2007		x	Milk data validity will be confirmed Natl inst of food safety & nutrition	WHO-1,2 3,4-rd round	
Latvia		2006		x-res	Blood data from contaminated site (occupational exposure) Validity of data to be confirmed	2003-2004 research	
Lithuania	PAH only	2006				Human data Before 1996	
Macedonia		2007	x-res	x-res	Will be clarified	Analysis of some pesticides	
Moldova		2007		x-res	Milk data from contaminated site	2005- 2007	
Montenegro		2007			Will be clarified		
Poland	x-res	2007	x-res	x-res	Will be clarified	Human data 2002-2004	

Country	Background air		Human		Other relevant data	Period	Data available for other media (water, food, feed, sediment, soil, needles) except where specified
	HV	PAS	Blood	Milk			
					Inst for env protection in Warsaw for Milk Data		
Romania		2006		x-res	Might be exposure data Will be confirmed	2001-2002	
Russian Federation	x	2007	x	x-res	Will be submitted/distinction between hotspots and ref levels		
Serbia	x-res	2005-6				HV-pesticides since 1980 PCBs since 1999	
Slovakia	x-res	2006	x-res	x	Will be submitted/distinction between hotspots and ref levels	HV-1997 WHO-2,3, 4,	
Slovenia		2007	x	x	To be clarified	Human-2005 Starting with 2008 will be regular M+B	
Ukraine		2008	x-res	x-res	DDT (and metabolites), HCB – state environmental monitoring, Hydromet (G, S) Aldrin, DDT (and metabolites), heptachlor, toxaphen – state sanitary epidemiological service, Ministry of Health, NR (W, G, F, A) All POPs (except PCDDs/Fs) – research (S, SE, B, W, G, HB, HM)	Hydromet generalized data – 1993-2003 Ministry of Health data – 2005, available data on DDT (F, FE, B)– since 1950 Research data – since 1960s	
Kyrgyzstan		2008					
Kazakhstan		2008					
Tajikistan							

x-res research data only

Table III-2: Capacities available in the Central and Eastern European region including for provision of capacity assistance/strengthening

Country	POPs lab	Dioxin lab	Air sampling capacity	Provide capacity strengthening/QC	Training, handling	Assistance capacity
Albania						
Armenia	x-very limited					
Azerbaijan						
Belarus	x					
Bosnia and	x					
Bulgaria	x					
Croatia	x	x-stack gas	x			
Czech Republic	x	x	x	x	x	x
Estonia	x		x	x	x	x
Georgia						
Hungary	x					
Latvia	x					
Lithuania	x		x			
Macedonia	x					
Moldova	x					x
Montenegro	x					
Poland	x	x	x			x
Romania	x		x			
Russian Federation	x	x	x			x
Serbia	x					
Slovakia	x	x	x			x
Slovenia	x	x	x			x
Ukraine	x	x	x			x
Kazakhstan						
Kyrgyzstan	x					
Tajikistan						

Annex IV

MONET-CZ sampling sites 2006, 2007

MONET-CZ sampling sites, 2006, 2007

Table IV-1: MONET-CZ, basic characteristics of the passive air sampling sites in the Czech Republic, 2006

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	CODE	Northern latitude	Eastern longitude
Bílý Kříž Beskydy mountains	CHMI observatory, mountain background, north-eastern part	CZ_01	49.50261111	18.53855556
Brno, Kotlářská	Urban area, city center, residential, heavy traffic pollution	CZ_02	49.20534000	16.59721000
Brno, Kroftova	Urban residential area, traffic	CZ_03	49.21652000	16.56783000
Buchlov castle	Rural background, inland	CZ_04	49.10768000	17.31092000
Klet', Chlum Šumava mountains	Observatory, mountain background, southern border	CZ_05	48.86389000	14.28441000
Churáňov Šumava mountains	CHMI observatory, mountain background, southern border	CZ_06	49.06844000	13.61488000
Jeseník, Jeseníky mountains	CHMI observatory, mountain background, north-eastern part	CZ_07	50.24225000	17.19022222
Košetice, EMEP station	CHMI observatory, rural background, inland local combustion	CZ_08	49.57345000	15.08041000
Liberec, Rádlo	Rural residential area	CZ_09	50.70387000	15.12775000
Liberec, Bedřichov	Rural residential area	CZ_10	50.79003000	15.14616000
Liberec	Urban residential area, city center	CZ_11	50.76501000	15.05385000
Liberec, Chrastava	Residential site	CZ_12	50.81621000	14.97284000
Liberec, Ještěd	Mountain background	CZ_13	50.73271000	14.98524000
Liberec, Rochlice	Urban residential area	CZ_14	50.75171000	15.05925000
Liberec, Termizo	Urban area, communal waste incinerator	CZ_15	50.75681000	15.05698000
Mokrá, administration	Rural industrial site, administration building of the cement factory	CZ_16	49.21475000	16.76603000
Mokrá, CHMI container	CHMI observatory, rural industrial area, cement factory, traffic	CZ_17	49.20822000	16.77848000
Mokrá, Horákov	Rural residential area	CZ_18	49.21949000	16.75528000
Mokrá, Pozořice	Rural background	CZ_19	49.20558000	16.80182000
Napajedla	Urban area, residential/industrial, city center	CZ_20	49.17089000	17.51635000
Neratovice, Ton	Urban residential area, impacted by Spolana Neratovice	CZ_21	50.26470000	14.52415000
Neratovice, Spolana gate	Spolana chemical factory, HCH, DDT, HCB contamination, impact of remediation	CZ_22	50.26720000	14.52495000
Neratovice, Spolana crossroad	Spolana chemical factory, HCH, DDT, HCB contamination, impact of remediation	CZ_23	50.26695000	14.52212000
Neratovice, Spolana BCD	Spolana chemical factory, HCH, DDT, HCB contamination, impact of remediation	CZ_24	50.26625000	14.52179000
Neratovice, Spolana archive	Spolana chemical factory, HCH, DDT, HCB contamination, impact of remediation	CZ_25	50.26564000	14.52065000
Neratovice,	Rural residential area,	CZ_26	50.27809000	14.50628000

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	CODE	Northern latitude	Eastern longitude
Tomeš	impacted by Spolana Neratovice			
Otrokovice	Urban area, residential/industrial, city center	CZ_27	49.20830000	17.53549000
Praha, Libuš	Urban background	CZ_28	50.00661000	14.44624000
Přimda Šumava mountains	CHMI observatory, mountain background, southern border	CZ_29	49.66959000	12.67785000
Radotín cement factory	Urban industrial area, cement factory	CZ_30	49.99481000	14.34002000
Radotín, Kosoř	Rural residential area	CZ_31	49.99046000	14.32968000
Radotín, Lochkov	Urban residential area	CZ_32	50.00095000	14.35251000
Radotín, Radotín	Residential site	CZ_33	49.98985000	14.34858000
Rudolice Krušné hory	CHMI observatory, mountain background, north-western border	CZ_34	50.57979000	13.41922000
Rýchory Krkonoše mountain	CHMI observatory, mountain background, northern border	CZ_35	50.66046000	15.85006000
Sedlec, Mikulov	CHMI observatory, rural background, southern-eastern part	CZ_36	48.79175000	16.72450000
Slušovice	Rural residential area	CZ_37	49.24947000	17.80920000
Staré Město Colorlak	Industrial site, paint factory, former PCB consumer	CZ_38	49.07526000	17.42685000
Šerlich Orlické hory	CHMI observatory, mountain background, northern border	CZ_39	50.32804000	16.38353000
Pláňavy Štítná nad Vláří	Rural background, eastern border	CZ_40	49.04776000	18.00781000
Uherské Hradiště	Urban residential area, traffic	CZ_41	49.06744000	17.46887000
Uherský Brod	Urban residential area	CZ_42	49.02421000	17.64270000
Valašské Meziříčí observatory	Urban residential area	CZ_43	49.46365000	17.97371000
Valašské Meziříčí, Juřinka	Rural residential area, affected by DEZA refinery	CZ_44	49.48951000	17.93849000
Valašské Meziříčí, Mštěnovice	Rural residential area, affected by DEZA refinery	CZ_45	49.50579000	17.95906000
Valašské Meziříčí, Příluky	Rural residential area, affected by DEZA refinery	CZ_46	49.50925000	17.94174000
Vizovice	Rural residential area	CZ_47	49.22204000	17.85408000
Zlín, Svit	Urban industrial area	CZ_48	49.22386000	17.66058000
Svratouch	CHMI observatory, rural background	CZ_49	49.73507000	16.03413000
Sněžník, Děčín	CHMI observatory, mountain background, north-western border	CZ_50	50.78951000	14.08684000

Table IV-2: MONET-CZ, basic characteristics of the passive air sampling sites in the Czech Republic, 2007

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	CODE	Northern latitude	Eastern longitude
Bílý Kříž Beskydy mountains	CHMI observatory, mountain background, north-eastern part	CZ_01	49.50261111	18.53855556
Brno, Kotlářská	Urban area, city center, residential, heavy traffic pollution	CZ_02	49.20534000	16.59721000
Brno, Kroftova	Urban residential area, traffic	CZ_03	49.21652000	16.56783000
Buchlov castle	Rural background, inland	CZ_04	49.10768000	17.31092000
Kleť, Chlum Šumava mountains	Observatory, mountain background, southern border	CZ_05	48.86389000	14.28441000
Churáňov Šumava mountains	CHMI observatory, mountain background, southern border	CZ_06	49.06844000	13.61488000
Jeseník, Jeseníky mountains	CHMI observatory, mountain background, north-eastern part	CZ_07	50.24225000	17.19022222
Košetice, EMEP station	CHMI observatory, rural background, inland local combustion	CZ_08	49.57345000	15.08041000
Liberec, Bedřichov	Rural residential area	CZ_10	50.79003000	15.14616000
Liberec	Urban residential area, city center	CZ_11	50.76501000	15.05385000
Liberec, Chrastava	Residential site	CZ_12	50.81621000	14.97284000
Liberec, Ještěd	Mountain background	CZ_13	50.73271000	14.98524000
Liberec, Rochlice	Urban residential area	CZ_14	50.75171000	15.05925000
Mokrá, CHMI container	CHMI observatory, rural industrial area, cement factory, traffic	CZ_17	49.20822000	16.77848000
Mokrá, Horákov	Rural residential area	CZ_18	49.21949000	16.75528000
Napajedla	Urban area, residential/industrial, city center	CZ_20	49.17089000	17.51635000
Neratovice, Ton	Urban residential area, impacted by Spolana Neratovice	CZ_21	50.26470000	14.52415000
Neratovice, Tomeš	Rural residential area, impacted by Spolana Neratovice	CZ_26	50.27809000	14.50628000
Otrokovice	Urban area, residential/industrial, city center	CZ_27	49.20830000	17.53549000
Praha, Libuš	Urban background	CZ_28	50.00661000	14.44624000
Přimda Šumava mountains	CHMI observatory, mountain background, southern border	CZ_29	49.66959000	12.67785000
Radotín cement factory	Urban industrial area, cement factory	CZ_30	49.99481000	14.34002000
Radotín, Kosoř	Rural residential area	CZ_31	49.99046000	14.32968000
Rudolice Krušné hory	CHMI observatory, mountain background, north-western border	CZ_34	50.57979000	13.41922000
Rýchory Krkonoše mountain	CHMI observatory, mountain background, northern border	CZ_35	50.66046000	15.85006000
Sedlec, Mikulov	CHMI observatory, rural background, southern-eastern part	CZ_36	48.79175000	16.72450000

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	CODE	Northern latitude	Eastern longitude
Slušovice	Rural residential area	CZ_37	49.24947000	17.80920000
Staré Město Colorlak	Industrial site, paint factory, former PCB consumer	CZ_38	49.07526000	17.42685000
Šerlich Orlické hory	CHMI observatory, mountain background, northern border	CZ_39	50.32804000	16.38353000
Pláňavy Štítná nad Vláří	Rural background, eastern border	CZ_40	49.04776000	18.00781000
Valašské Meziříčí observatory	Urban residential area	CZ_43	49.46365000	17.97371000
Valašské Meziříčí, Juřinka	Rural residential area, affected by DEZA refinery	CZ_44	49.48951000	17.93849000
Zlín, Svit	Urban industrial area	CZ_48	49.22386000	17.66058000
Svratouch	CHMI observatory, rural background	CZ_49	49.73507000	16.03413000
Sněžník, Děčín	CHMI observatory, mountain background, north-western border	CZ_50	50.78951000	14.08684000
Olomouc, hospital incinerator	Urban site, hospital incinerator	CZ_51		
Olomouc, Wolkerova	Urban residential area	CZ_52		

Annex V

MONET-CEECs sampling sites, 2006, 2007, 2008

MONET-CEECs sampling sites, 2006, 2007, 2008

Table V-1: MONET-CEECs, phase I, basic characteristics of the sampling sites in Central, Eastern and Southern Europe, 2006

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Banja Luka, Incel factory	Industrial site, former cellulose production, transformer storage nearby	**Bosnia and Herzegovina**	BA_01	44.77339722	17.22635000
Modriča, oil refinery	Industrial site		BA_02	44.95444444	18.30361111
Tallinn, Rahu, city monitoring station	Urban site, northern Estonia, traffic pollution	**Estonia**	EE_01	59.45611111	24.68972222
Muuga Port, industrial station	Suburban site, northern, port, transport, oil products		EE_02	59.49444444	24.93083333
Lahemaa, EMEP station	Background site, eastern Estonia, long-range transport		EE_03	59.51527778	25.92805556
Kunda, industrial station	Suburban site, north-eastern, cement and a pulp-mill industries		EE_04	59.50277778	26.55777778
Kohtla Järve, industrial station	Suburban site, eastern Estonia, chemical industry		EE_05	59.40972222	27.27861111
Rucava, **EMEP station**	Background site, south-eastern Latvia, iron and steel industry, coal combustion for	**Latvia**	LV_01	56.16195556	21.17321667
Dobele, meteo station	Suburban site, intensive agriculture, chemical industry		LV_02	56.61990278	23.31963333
Olaine, air quality monitoring station	Urban background, chemical and pharmaceutical industries, waste burning		LV_03	56.89833333	23.74333333
Riga, city park	Urban site, seaport, traffic, fuel		LV_04	56.95491667	24.10508333
Zoseni, **EMEP station**	Background site, coal and wood burning local heating systems		LV_05	57.13507778	25.90561944
Preila, research institute	Background site, seashore, local heating	**Lithuania**	LT_01	55.35000000	21.06666667
Plateliai, integrated monitoring station	Background site, western Lithuania		LT_02	56.01722222	21.87444444
Rugšteliškis, integrated monitoring station	Background site, eastern Lithuania, national park		LT_03	55.44055556	26.06666667
Paneriai, research	Urban background, western		LT_04	54.65833333	25.23777778

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
institute	Vilnius, traffic influence				
Vilnius, center	Industrial site, intensive traffic		LT_05	54.71027778	25.34444444
Onesti - Borzesti	Industrial site, central Moldavia, chemical industry and oil refinery	**Romania**	RO_01	46.23333333	26.80000000
Bacau, city center	Urban site, east of Bacau, paper and chemical industry		RO_02	46.56666667	26.91666667
Radomiresti, cattle farm	Rural site, agriculture		RO_03	46.50000000	26.95000000
Iasi, center	Urban site, water treatment plant, steel, ceramics, pharmaceutical industries		RO_04	47.16666667	27.56666667
Raducaneni, garden	Rural area, southern part of Iasi, agriculture		RO_05	46.93333333	27.93333333
Galati	Industrial site, iron and steel industries		RO_06	45.43333333	28.15000000
Cuca, garden	Rural site, north of Galati		RO_07	45.43333333	27.88333333
Ruginesti	Background site, mountains		RO_08	46.98333333	26.08333333
Timisoara, city center	Urban site, western part of Banatului Field, metallurgy		RO_09	45.74944444	21.22722222
Timisoara, incinerator	Industrial, burning of municipal, hospital and toxic wastes		RO_10	45.74944444	21.22722222
Braila, city center	Urban site, southeastern Romania, port, ship-building industry		RO_11	45.26666667	27.98333333
Braila Com	Industrial site, chemical industry, waste treatment		RO_12	45.26666667	27.98333333
Craiova, central market	Urban site, west of Bucharest, commercial center		RO_13	44.31857000	23.80624000
Craiova, city hall	Industrial site, electro technical industry		RO_14	44.31914000	23.79671000
Bucuresti, center	Urban site, capital city, southern Romania		RO_15	44.41666667	26.11666667
Bucuresti, Snagov	Residential zone of Bucharest		RO_16	44.41666667	26.11666667
Bucuresti, I.C.I.M.	National institute for environmental protection		RO_17	44.41666667	26.11666667
Deva	Urban site, county capitol, mining, civil engineering		RO_18	45.88333333	22.90000000
Filiasi, TMD	Industrial site, electrical, chemical, textile and food		RO_19	44.55000000	23.51666667

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
	industries, extensive agriculture				
Turda, city hall	Urban, metallurgy, glass and textile industries		RO_20	46.56666667	23.78333333
Voluntari, Oras	Rural, north-east of Bucharest		RO_21	44.46666667	26.13333333
Voluntari, Oras, duplicate	Rural, north-east of Bucharest		RO_22	44.46666667	26.13333333
Cluj-Napoca, A.R.P.M.	Urban site, north-western Romania, IT, industry, waste storage		RO_23	46.81666667	23.75000000
Kragujevac, Zastava, Lakirnica	Industrial site, war damage of PCB-filled transformers, remediation	**Serbia and Montenegro**	SM_01	46.23333333	26.80000000
Kragujevac, Zastava, Energetika	Industrial site, functional PCB - filled transformer		SM_02	44.00291667	20.91294444
Kragujevac, PMF	Urban cite		SM_03	44.01783333	20.90700000
Novi Sad, Refinery	Industrial, oil refinery		SM_04	45.27838889	19.87019444
Fruška Gora	Background site		SM_05	45.15916667	19.86280556
Beograd	Urban site		SM_06	44.78623056	20.38217500
Grabovac	Industrial site		SM_07	42.62916667	20.35138889
Bratislava, Trnavské mýto	Urban site, traffic pollution	**Slovakia**	SK_01	48.15850000	17.12877778
Bratislava, Mamateyova	Urban background site		SK_02	48.12508333	17.12563889
Ziar nad Hronom, Dukelských hrdinov	Suburban background site		SK_03	48.58358056	18.85052778
Handlová, Morovianska cesta	Urban background site		SK_04	48.73311111	18.75647222
Žilina, Obežná	Urban background site		SK_05	49.21144444	18.77122222
Ružomberok, Riadok	Urban background site		SK_06	49.07908333	19.30250000
Starina, dam, **EMEP station**	Background site		SK_07	49.04269444	22.26000000
Strážske, Mierová	Urban background site		SK_08	48.87411111	21.83702778
Košice, Strojárska	Urban background site		SK_09	48.72675000	21.25188889
Veľká Ida, ŽSR	Suburban industrial site		SK_10	48.59216667	21.17516667
Topolniky, ASZOD **EMEP station**	Rural background site		SK_11	47.95941667	17.86013889

Table V-2: MONET-CEECs, phase II, basic characteristics of the sampling sites in Central, Eastern and Southern Europe, 2007

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Sofia, IMS Gara Yana	Industrial site in the suburban area of industrial town, metallurgy	**Bulgaria**	BG_01	42.7321667	23.5577778
Sofia, TMS Orlov most	Traffic-affected site in the urban area		BG_02	42.6900000	23.3358333
Sofia, UBMS Hipodruma	Urban background site		BG_03	42.5113889	23.3047222
Pernik, IMS Tsarkva	Urban background near to the metallurgic enterprise (steel factory) and large combustion plant		BG_04	42.5881250	23.1161111
Plovdiv, UBMS Dolni Voden	Rural background near to the smelter with a production of non-ferrous metals and lead and zinc alloys		BG_05	42.0236111	24.8372222
Sofia, NBMS Bojana	Residential/natural background site in Vitosha mountains (clean area)		BG_06	42.6430167	23.2636500
Đorđićeva ulica	Centre of Zagreb, urban site affected by traffic	**Croatia**	HR_01	45.8114167	15.9891944
Črnomerec	Western part of Zagreb, urban site		HR_02	45.8122500	15.9486667
Siget	Southern part of Zagreb, urban background with parks		HR_03	45.7735278	15.9845833
Peščenica	Eastern part of Zagreb, a vicinity of the industrial zone		HR_04	45.8047222	16.0329167
IMI	Northern part of Zagreb, urban background with gardens		HR_05	45.8359444	15.9829444
Lahemaa	EMEP background station	**Estonia**	EE_03	59.5152778	25.9280556
Budapest, XVIII. Ker. Gilice tér	Residential area, urban background site, main pollution from the traffic and residential heating	**Hungary**	HU_01	47.4298889	19.1811944
Budapest, II. ker. Pesthidegkút, Községház u. 10.	Residential area, urban background site, good ventilation, main pollution from the traffic and residential heating. 265 m a.s.l.		HU_02	47.5618611	18.9609167
Budapest I. ker. Széna tér	Urban site, downtown area, obstructed ventilation, affected by heavy traffic and residential heating. 123 m a.s.l.		HU_03	47.5088333	19.0276944
Budapest XV. ker. Kőakás park	Urban site, residential area, traffic, municipal solid waste incinerator of Budapest (2,5 km). 122 m a.s.l.		HU_04	47.5445278	19.1441389
Budapest XI ker. Kosztolányi Dezső tér	Urban site, downtown area, good ventilation, affected by heavy traffic and residential heating, sampling site is in a park. 133 m a.s.l.		HU_05	47.4747500	19.0404444
Lazaropole	Rural site located on a hill opposite of the village. The surrounding area is generally open and comprises of	**Macedonia**	MKD_01	41.5400833	20.6958611

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
	meadows and residential homes.. 1 333 m a.s.l.				
Skopje - OHIS	Urban residential site, surrounding area is generally open and comprises of meadows and residential houses. 236 m a.s.l.		MKD_02	41.9842306	21.4755000
Skopje - MEPP	Urban site located at the university grounds, open area, small trees. The nearest road with a high traffic density is only 5 m away. 200 m a.s.l.		MKD_03	41.9984167	21.4460556
Rafinery	MEPP Bujkovci. 312 m a.s.l.		MKD_04	42.0055556	21.6525000
Bitola	Sampling site located 250 m from the nearest road, open area with residence facilities. The nearest factory 350 m away. 600 m a.s.l.		MKD_05	41.0471944	21.3557778
Strumica	MEPP Background monitoring site. 232 m a.s.l.		MKD_06	41.4419444	22.6652778
Briceni	North edge, border with Ukraine	**Moldova**	MD_01	48.4000000	27.1000000
Rezina	Industrial site, cement and metallurgical factories		MD_02	47.8000000	29.0000000
Chisinau	Industrial site, the capital of the country		MD_03	47.0000000	28.9000000
Leova	EMEP station, border with Romania		MD_04	46.5000000	28.3000000
Giurgiulesti	Industrial site in the vicinity of the pesticide dump (Cismichioi) and Terminus Petroleum enterprise		MD_05	45.4666667	28.1833333
Stefan Voda	Rural site		MD_06	46.5000000	29.5000000
Balti	Industrialized urban site in the northern part of Moldova		MD_07	47.7000000	27.9000000
Center of Podgorica	Urban monitoring station, close to the Government of Podgorica	**Montenegro**	MNE_01	42.4410167	19.2899667
Vilage Srpska	Industrial site, south of Podgorica, near the aluminium factory		MNE_02	42.3743333	19.2232000
CETI	Suburban site in Podgorica, affected by traffic		MNE_03	42.4245333	19.2673500
Pljevlja	Urban site, centre of the town, traffic		MNE_04	42.3577667	19.3507167
Pljevlja Komini	Industrial site near thermal power plant		MNE_05	43.3452333	19.3213500
Niksic - centre	Urban site, centre of the town, brewery, traffic		MNE_06	42.7806667	18.9518000
Niksic	Industrial site near the steel factory		MNE_07	42.7827667	18.9856667
Szarów	Residential rural area, Institute of Botany, downwinds (8 km) from Nowa Huta Steel. 232 m a.s.l.	**Poland**	PL_01	49.9946392	20.2672861
Wieliczka	Residental area 1.5 km from Krakow, private garden, low traffic, municiplal waste dump site, waste burning. 232 m a.s.l.		PL_02	49.9891639	20.0367389

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Al.Krasinskiego	Residental area, private garden, intermediate traffic. 218 m a.s.l.		PL_03	50.0562333	19.9266528
Wichrowa	Residental area influenced by industrial activities (ca 3-4 km). 244 m a.s.l.		PL_04	50.0067056	19.9039500
Warszawska	Residental area, heavy traffic. Close to the Krakow main railway and main bus stations. 215 m a.s.l.		PL_05	50.0716806	19.9441000
Zabierzów	Rural residential site, private garden, 2 km from the Krakow Balice Airport. 221 m a.s.l.		PL_06	50.1088306	19.8250583
Ufa	Industrial site in Baskiria, dioxin pollution	**Russia**	RU_01	54.8333333	56.0833333
Ufa - background	Baskiria, industrial background site of Ufa		RU_02	54.7000000	55.8000000
Sterlitamak	Baskiria, South Ural		RU_03	53.6333333	55.9833333
Chapaevsk	Industrial site in Samara region, where organochlorine pesticides were produced.. Sampling site 0,5 km from the factory.		RU_04	52.9833333	49.7166667
Chapaevsk - background	Industrial background site		RU_05	52.9833333	49.7166667
Iskrba	Rural background (EMEP station)	**Slovenia**	SLO_01	45.5613890	14.8627780
Ljubljana	Urban background		SLO_02	46.0656060	14.5127280
Maribor OZADSE	Urban background		SLO_03	46.5413111	15.6841139
Celje	Urban background		SLO_04	46.2344610	15.2624110
Ljubljana	Urban site affected by traffic		SLO_05	46.0544310	14.5042170
Maribor (AMP)	Urban site affected by traffic		SLO_06	46.5590440	15.6517580
Celje	Industrial background		SLO_07	46.2420900	15.2950200
Iasi	Urban site, water treatment plant, steel, ceramics, pharmaceutical industries	**Romania**	RO_04	47.1666700	27.5666700
Raducaneni	Rural area, southern part of Iasi, agriculture		RO_05	46.9333300	27.9333300

Table V-3: MONET-CEECs, phase III, basic characteristics of the sampling sites in Central, Eastern and Southern Europe, 2008

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Sevan, Tsovagyugh village		**Armenia**	AR_01		
Hrazdan			AR_02		
Yerevan,			AR_03		

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Davidashen district					
Yerevan, Dalmai Gardens, Solar Institute			AR_04		
Amberd, meteo station			AR_05		
Artashat, meteo station			AR_06		
Kapan			AR_07		
Berezinsky nature reserve	Background place, central-eastern part	**Belarus**	BE_01	55˚29’	28˚21’
Visokoie	Transboundary pollution, south-western part and LRTAP point		BE_02	52˚20’	23˚20’
Minsk	Mobile sources pollution, capital and central part		BE_03	53˚55’	27˚35’
Lida	Pollution with PCBs (in this town they used PCBs for 30 years for paint production), north-western part		BE_04	53˚51’	25˚19’
Polotsk	PAH pollution (oil refinery plant), northern part		BE_05	55˚29’	28˚46’
Mogilev	Industrial area (many kinds of sources of pollutants), eastern part		BE_06	53˚55’	30˚20’
Gomel	Industrial area (many kinds of sources of pollutants), south-eastern part		BE_07	52˚25’	31˚00’
Ust-Kamenogorsk	Capacitor plant - on the territories of plant (outside) near building of impregnation workshop (height – 4 m)	**Kazakhstan**	KA_01		
Ust-Kamenogorsk	Capacitor plant inside of impregnation workshop building (height – 5 m)		KA_02		
Ust-Kamenogorsk	City center, on the roof of Kazhydromet local office building (height – 15 m)		KA_03		
Pavlodar	Kazhydromet meteostation, on the roof of station building (height – 3 m)		KA_04		
Ekibustooz	Power station (Pavlodar oblast) in building (height – 3 m)		KA_05		
Karaganda	Meteostation		KA_06		
Temirtau	Mittal Stil Temirtau power ministation		KA_07		
Balchash	Exc-military base		KA_08		
Borovoe	Meteostation (EMEP station)		KA_09		
Atyrau	Meteostation		KA_10		
Kok-Djar village	In the south-east of Bishkek	**Kyrgyzstan**	KY_01	N 42^0 48' 21,4"	E 074^0 38'45,1"
Kirgizia 1 - Erkin-Too str. 2	In the south-west of Bishkek		KY_02	N 42^0 49' 11,5"	E 074^0 34'18,5"
35, Aidaraliev str.	In the centre of Bishkek		KY_03	N 42^0 51' 24,8"	E 074^0 35'40,0"
Prigirodnoe village, 92/2 Dorojnaya str.	In the north-west of Bishkek		KY_04	N 42^0 54' 17,9"	E 074^0 31'48,3"

SAMPLING SITE	CHARACTERISTICS, POLLUTION SOURCE	COUNTRY	CODE	Northern latitude	Eastern longitude
Osmonkul str.	In the north-east of Bishkek		KY_05	N 42^0 54' 09,0"	E 074^0 37'37,0"
Kyiv	Urban residential area with a medium traffic	**Ukraine**	UA_01	N – 50° 31' 03,5"	E – 30° 26' 51,6"
Kyiv	Partly industrial area, nearby one of the main Kyiv arterial street.		UA_02	N – 50° 27' 44,0"	E – 30° 26' 33,0"
Kyiv	Post-industrial area (former DDT production)		UA_03	N – 50° 27' 13,6"	E – 30° 38' 28,7"
Oseshchyna	Suburban residential area to the north of Kyiv		UA_04	N – 50° 34' 51,5"	E – 30° 31' 54,5"
Lisove	Suburban area, westward of Kyiv, background for Kyiv		UA_05	N – 50° 28' 00,0"	E – 30° 06' 40,5"
Osokorky	Suburban settlement area, southward of Kyiv nearby an incineration plant		UA_06	N – 50° 22' 45,4"	E – 30° 36' 26,8"

Annex VI

MONET-CZ - results 2006, 2007

Table VI-1: Statistical evaluation of PCB concentrations determined in the passive air samples from 50 sites in the Czech Republic in 2006 (13 sampling periods were included for each site)

Sampling site/PCBs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Bílý Kříž	3.5	5.9	4.3	4.1
Brno, Kotlářská	21.9	63.2	36.0	36.4
Brno, Kroftova	5.5	16.8	8.5	7.0
Buchlov	4.4	10.5	7.6	7.8
Kleť	1.5	4.9	3.0	3.0
Churáňov	2.3	6.3	3.9	3.6
Jeseník	4.0	6.6	5.0	4.6
Košetice	1.2	8.4	4.3	4.1
Liberec, Rádlo	2.6	11.4	6.3	6.6
Liberec, Bedřichov	2.1	9.1	5.6	6.0
Liberec, center	10.3	26.9	17.7	18.2
Liberec, Chrastava	5.4	12.6	9.9	10.1
Liberec, Ještěd	2.1	6.9	4.3	4.4
Liberec, Rochlice	1.4	15.9	8.0	7.7
Liberec, Termizo	8.9	50.2	24.7	22.8
Mokrá, administration	4.7	11.1	6.7	6.4
Mokrá, CHMI container	5.8	16.7	9.7	9.0
Mokrá, Horákov	3.4	8.4	4.9	4.6
Mokrá, Pozořice	1.7	7.4	5.1	5.4
Napajedla	5.4	15.2	8.6	7.7
Spolana, Tón	8.5	39.9	17.6	18.5
Spolana, gate	8.9	133.2	47.7	35.7
Spolana, archive	11.3	47.1	25.0	21.0
Spolana, Tomeš	5.8	21.8	13.7	13.8
Otrokovice	8.0	33.3	16.9	15.0
Praha, Libuš	5.1	17.6	10.3	10.6
Přimda	0.1	9.1	4.9	5.0
Radotín, cement	6.0	18.3	9.4	9.3
Radotín, Kosoř	6.5	15.4	10.2	11.2
Radotín, Lochkov	4.2	15.9	8.2	8.0
Radotín	8.1	54.9	25.5	22.8
Rudolice	3.0	10.3	6.3	6.5
Rýchory	3.3	7.6	5.1	5.0
Sedlec	2.1	6.7	4.1	3.7

Sampling site/PCBs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Slušovice	3.5	12.5	7.3	7.2
Staré Město, Colorlak	12.0	76.0	43.8	44.2
Šerlich	1.4	8.2	3.8	3.7
Pláňava	5.1	11.9	8.9	9.0
Uherské Hradiště	4.4	10.8	7.6	8.1
Uherský Brod	4.0	12.1	7.2	7.0
Val. Mez. Observatory	3.9	13.1	8.2	8.3
Val. Mez. Juřinka	2.6	11.9	7.5	6.7
Val. Mez. Mštěnovice	2.8	9.9	6.3	6.0
Val. Mez.Příluky	3.1	8.0	5.8	6.0
Vizovice	3.5	15.7	8.1	8.3
Zlín	8.0	30.3	17.7	17.2
Svratouch	2.5	9.8	6.2	6.1
Sněžník	4.5	19.1	12.3	11.2
Brno, Kamenice	8.8	18.9	13.2	12.7
Olomouc	4.4	17.4	8.1	6.9

Table VI-2: Statistical evaluation of PCB concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/PCBs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	2.8	6.2	4.3	4.0
Brno, Kotlářská	15.3	47.9	28.9	28.5
Brno, Kroftova	3.2	14.2	6.4	6.5
Buchlov, castle	3.4	9.1	5.7	4.8
Kleť, Šumava mountains	2.2	6.8	4.1	4.3
Churáňov, Šumava mountains	2.7	9.7	5.9	5.5
Jeseník, Jeseníky mountains	3.3	7.0	4.7	4.4
Košetice, EMEP station	1.5	5.2	2.9	2.6
Liberec, Bedřichov	2.4	10.3	4.7	3.3
Liberec, center	10.1	33.3	19.8	18.6
Liberec, Chrastava	5.2	12.2	7.8	7.1
Liberec, Ještěd	2.2	8.7	4.0	3.4
Liberec, Rochlice	3.9	14.4	7.5	7.0
Mokrá, container	3.3	10.0	6.2	5.4
Mokrá, Horákov	2.6	10.7	5.1	4.0
Napajedla	3.6	12.4	6.8	5.8

Sampling site/PCBs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Neratovice, Ton	7.6	26.9	14.1	11.8
Neratovice, Tomeš	8.0	19.9	11.5	9.6
Otrokovice	6.3	21.1	12.5	12.8
Praha, Libuš	5.4	16.7	9.4	7.8
Přimda, Šumava mountains	3.0	6.8	4.8	4.6
Radotín, cement factory	3.9	15.3	8.0	7.5
Radotín, Kosoř	5.2	12.1	7.1	6.3
Rudolice, Krušné mountains	3.7	9.4	6.3	6.2
Rýchory, Krkonoše mountains	2.1	7.1	5.4	5.8
Sedlec, Mikulov	2.0	7.0	4.2	4.4
Slušovice	2.7	9.3	5.2	4.8
Staré Město, Colorlak	22.0	78.3	41.2	37.8
Šerlich, Orlické mountains	2.1	7.5	3.9	3.3
Pláňavy, Štítná nad Vláří	5.4	9.8	7.3	6.9
Valašské Meziříčí, observatory	3.9	12.6	6.5	5.4
Juřinka	4.2	16.8	6.8	6.1
Zlín, Svit	5.9	20.9	11.2	11.0
Svratouch	4.2	9.5	6.8	6.6
Děčínský Sněžník, Krušné mountains	7.6	14.4	9.9	9.8
Olomouc, hospital incinerator	5.0	31.0	14.5	11.7
Olomouc, Wolkerova	3.3	14.7	7.2	6.8

Table VI-3: Statistical evaluation of HCH concentrations determined in the passive air samples from 50 sites in the Czech Republic in 2006 (13 sampling periods were included for each site)

Sampling site/HCHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Bílý Kříž	9.6	28.6	16.3	15.5
Brno, Kotlářská	6.0	44.8	26.4	27.5
Brno, Kroftova	2.1	20.4	12.7	12.9
Buchlov	7.6	39.1	18.9	18.9
Kleť	9.3	30.0	13.9	12.3
Churáňov	5.6	20.3	15.0	16.4
Jeseník	11.7	27.4	18.8	18.5
Košetice	4.4	18.2	12.1	12.1
Liberec, Rádlo	3.6	25.7	13.2	12.8
Liberec, Bedřichov	2.0	21.4	12.4	10.4
Liberec, center	2.4	23.5	14.4	14.7

Sampling site/HCHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Liberec, Chrastava	7.6	25.4	14.5	13.3
Liberec, Ještěd	5.6	21.5	13.4	13.0
Liberec, Rochlice	2.9	21.9	12.1	12.1
Liberec, Termizo	3.2	41.6	18.2	15.4
Mokrá, administration	3.2	22.3	12.4	12.2
Mokrá, CHMI container	3.1	35.6	14.9	14.9
Mokrá, Horákov	3.6	18.5	11.8	12.6
Mokrá, Pozořice	3.4	22.8	12.4	11.4
Napajedla	4.0	71.2	16.6	12.7
Spolana, Tón	97.5	952.1	256.1	188.2
Spolana, gate	256.4	7 907.4	2 536.7	1 994.8
Spolana, archive	1 853.8	5 946.4	3 618.7	3 047.2
Spolana, Tomeš	7.4	164.1	49.1	36.7
Otrokovice	4.8	35.4	18.9	19.8
Praha, Libuš	0.1	23.4	12.5	13.3
Přimda	0.1	31.1	20.0	20.9
Radotín, cement	3.7	17.3	10.5	9.6
Radotín, Kosoř	4.5	43.5	15.0	13.7
Radotín, Lochkov	3.3	26.4	13.3	13.6
Radotín	2.8	20.5	13.3	13.2
Rudolice	9.7	28.6	18.4	19.2
Rýchory	8.2	25.9	17.3	16.7
Sedlec	12.6	53.9	23.2	21.8
Slušovice	2.1	26.0	10.1	10.7
Staré Město, Colorlak	4.2	33.5	13.5	11.3
Šerlich	5.6	20.9	13.1	11.7
Pláňava	6.8	43.2	22.2	19.4
Uherské Hradiště	3.6	25.6	12.7	10.8
Uherský Brod	2.7	23.9	14.3	14.7
Val. Mez. Observatory	3.2	26.3	11.3	9.3
Val. Mez. Juřinka	1.8	28.6	10.0	9.1
Val. Mez. Mštěnovice	1.6	20.5	7.8	7.0
Val. Mez.Příluky	2.9	18.8	8.4	7.4
Vizovice	3.1	24.0	11.3	11.1
Zlín	3.3	37.8	19.0	18.9
Svratouch	9.2	32.8	16.7	14.3
Sněžník	10.5	56.9	26.4	25.7
Brno, Kamenice	5.2	40.1	22.1	21.2
Olomouc	6.1	21.2	15.4	17.4

Table VI-4: Statistical evaluation of HCH concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/HCHs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	1.9	16.3	8.0	7.7
Brno, Kotlářská	3.9	50.4	16.8	13.0
Brno, Kroftova	5.0	40.1	11.2	8.2
Buchlov, castle	2.3	61.3	13.0	9.1
Kleť, Šumava mountains	4.8	16.6	10.3	9.6
Churáňov, Šumava mountains	5.4	18.5	9.7	8.1
Jeseník, Jeseníky mountains	1.2	23.8	11.0	9.7
Košetice, EMEP station	1.5	18.8	7.6	7.8
Liberec, Bedřichov	2.9	18.3	9.6	9.2
Liberec, center	5.2	23.5	12.7	11.5
Liberec, Chrastava	6.3	16.9	10.9	10.4
Liberec, Ještěd	3.2	21.9	9.7	9.7
Liberec, Rochlice	3.7	16.1	9.9	10.5
Mokrá, container	3.4	20.8	9.3	7.3
Mokrá, Horákov	0.9	25.3	8.3	7.8
Napajedla	3.0	35.5	10.2	8.7
Neratovice, Ton	27.6	408.8	161.3	115.6
Neratovice, Tomeš	7.7	120.1	43.5	29.3
Otrokovice	3.3	48.8	14.5	12.8
Praha, Libuš	3.8	21.2	10.0	8.3
Přimda, Šumava mountains	4.3	20.9	11.3	11.5
Radotín, cement factory	3.0	236.8	25.8	5.6
Radotín, Kosoř	2.9	20.7	9.6	8.5
Rudolice, Krušné mountains	6.0	24.3	15.1	14.8
Rýchory, Krkonoše mountains	2.3	26.0	13.0	14.0
Sedlec, Mikulov	4.9	108.7	18.4	9.5
Slušovice	1.9	30.6	8.4	5.8
Staré Město, Colorlak	5.2	26.2	9.5	7.5
Šerlich, Orlické mountains	3.9	16.7	10.6	11.4
Pláňavy, Štítná nad Vláří	5.7	45.3	15.4	11.8
Valašské Meziříčí, observatory	3.2	53.5	10.6	5.4
Juřinka	1.3	44.7	10.2	7.1
Zlín, Svit	2.1	43.2	15.1	10.8
Svratouch	7.1	26.0	15.9	17.2
Děčínský Sněžník, Krušné mountains	10.4	22.8	16.7	16.2
Olomouc, hospital incinerator	4.0	17.7	9.6	10.3

Sampling site/HCHs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Olomouc, Wolkerova	3.4	26.7	10.6	8.5

Table VI-5: Statistical evaluation of DDT concentrations determined in the passive air samples from 50 sites in the Czech Republic in 2006 (13 sampling periods were included for each site)

Sampling site/DDTs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Bílý Kříž	1.9	4.1	3.0	2.9
Brno, Kotlářská	3.7	17.4	12.6	13.2
Brno, Kroftova	3.0	15.4	8.3	8.1
Buchlov	4.4	491.6	115.1	50.6
Kleť	1.0	2.3	1.7	1.9
Churáňov	0.6	2.8	1.8	2.0
Jeseník	4.0	8.9	6.1	5.5
Košetice	2.5	13.0	7.7	8.9
Liberec, Rádlo	2.2	6.7	5.1	5.3
Liberec, Bedřichov	2.0	5.7	3.9	4.0
Liberec, center	1.5	13.7	5.8	6.0
Liberec, Chrastava	5.1	11.5	7.5	7.1
Liberec, Ještěd	1.0	9.8	6.3	6.5
Liberec, Rochlice	0.9	9.9	3.7	3.3
Liberec, Termizo	2.3	17.7	7.7	6.5
Mokrá, administration	2.5	13.0	8.1	8.7
Mokrá, CHMI container	2.5	35.3	23.2	27.2
Mokrá, Horákov	2.5	17.3	10.5	12.0
Mokrá, Pozořice	2.2	13.3	8.8	10.6
Napajedla	2.2	11.5	8.0	9.1
Spolana, Tón	11.6	63.1	37.6	30.3
Spolana, gate	28.3	368.4	121.5	115.0
Spolana, archive	37.1	1 458.5	313.1	229.6
Spolana, Tomeš	9.5	42.4	26.5	23.6
Otrokovice	2.5	19.7	13.4	15.3
Praha, Libuš	2.1	10.0	6.8	8.2
Přimda	0.1	8.9	4.3	4.2
Radotín, cement	2.1	7.7	4.7	5.0
Radotín, Kosoř	3.7	22.2	12.1	12.0
Radotín, Lochkov	3.1	17.1	7.9	7.9
Radotín	2.5	13.2	6.7	6.3

Sampling site/DDTs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Rudolice	3.4	14.1	6.6	5.4
Rýchory	1.5	9.8	6.5	7.0
Sedlec	13.9	34.4	21.3	21.0
Slušovice	1.2	7.0	4.4	4.1
Staré Město, Colorlak	1.5	14.9	9.9	10.6
Šerlich	2.2	13.0	5.2	4.5
Pláňava	2.6	34.2	16.1	14.9
Uherské Hradiště	1.3	18.1	9.3	9.9
Uherský Brod	1.9	16.1	9.5	10.7
Val. Mez. Observatory	1.9	15.2	6.4	6.2
Val. Mez. Juřinka	1.5	7.5	5.5	6.2
Val. Mez. Mštěnovice	1.0	8.7	4.9	5.0
Val. Mez.Příluky	2.6	9.9	5.9	6.0
Vizovice	2.3	13.7	7.2	7.4
Zlín	2.5	18.2	9.6	10.0
Svratouch	2.4	25.3	12.8	12.3
Sněžník	8.4	31.8	19.1	21.1
Brno, Kamenice	3.2	24.6	15.2	16.1
Olomouc	5.3	9.7	7.6	7.6

Table VI-6: Statistical evaluation of DDT concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/DDTs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	1.8	9.6	3.4	2.7
Brno, Kotlářská	4.1	17.6	9.3	8.0
Brno, Kroftova	3.4	11.1	6.3	5.1
Buchlov, castle	8.4	335.1	83.9	31.5
Klet', Šumava mountains	1.6	3.9	2.5	2.5
Churáňov, Šumava mountains	1.3	3.8	2.4	2.6
Jeseník, Jeseníky mountains	3.8	11.0	6.3	5.7
Košetice, EMEP station	3.4	11.1	5.9	5.4
Liberec, Bedřichov	2.4	6.8	3.9	3.1
Liberec, center	2.9	22.8	7.2	6.2
Liberec, Chrastava	3.8	9.9	6.4	6.6
Liberec, Ještěd	2.8	9.0	5.0	4.0
Liberec, Rochlice	2.5	6.3	4.3	4.1

Sampling site/DDTs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Mokrá, container	6.9	33.6	17.3	14.5
Mokrá, Horákov	3.3	18.4	9.2	7.7
Napajedla	2.7	15.7	8.2	7.5
Neratovice, Ton	6.9	53.1	26.7	21.2
Neratovice, Tomeš	7.9	29.3	16.5	14.3
Otrokovice	5.2	23.2	11.7	11.3
Praha, Libuš	3.3	12.8	6.2	5.0
Přimda, Šumava mountains	1.5	5.6	3.7	3.8
Radotín, cement factory	2.1	8.9	5.4	5.3
Radotín, Kosoř	5.4	37.8	12.0	8.1
Rudolice, Krušné mountains	2.8	10.4	7.1	6.9
Rýchory, Krkonoše mountains	2.7	9.0	6.0	5.8
Sedlec, Mikulov	7.6	24.1	15.1	13.8
Slušovice	2.2	9.0	4.2	3.7
Staré Město, Colorlak	3.6	18.7	9.4	9.1
Šerlich, Orlické mountains	2.4	6.8	4.3	4.4
Pláňavy, Štítná nad Vláří	5.2	19.9	12.9	12.3
Valašské Meziříčí, observatory	2.2	9.5	5.5	4.9
Juřinka	4.0	15.2	7.3	6.2
Zlín, Svit	3.2	15.4	7.9	6.1
Svratouch	6.5	21.3	11.4	11.1
Děčínský Sněžník, Krušné mountains	7.9	28.3	13.7	11.7
Olomouc, hospital incinerator	3.3	20.1	8.3	7.0
Olomouc, Wolkerova	3.3	20.0	8.6	8.0

Table VI-7: Statistical evaluation of HCB concentrations determined in the passive air samples from 50 sites in the Czech Republic in 2006 (13 sampling periods were included for each site)

Sampling site/HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Bílý Kříž	5.4	14.9	9.4	9.3
Brno, Kotlářská	7.7	11.4	9.5	9.4
Brno, Kroftova	6.2	12.9	8.2	7.7
Buchlov	6.5	20.4	13.0	12.6
Kleť	5.7	9.2	7.2	7.6
Churáňov	6.5	9.6	7.7	7.3
Jeseník	7.4	13.0	10.7	11.0
Košetice	5.0	15.9	11.8	11.6

Sampling site/HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Liberec, Rádlo	5.2	12.6	9.4	9.0
Liberec, Bedřichov	6.3	14.1	9.6	9.6
Liberec, center	5.1	11.2	7.7	7.5
Liberec, Chrastava	5.8	14.5	10.9	11.0
Liberec, Ještěd	5.2	14.3	9.0	9.0
Liberec, Rochlice	2.4	12.0	7.5	7.9
Liberec, Termizo	5.7	12.8	9.0	9.0
Mokrá, administration	5.7	12.3	8.4	8.7
Mokrá, CHMI container	6.7	14.5	10.8	11.2
Mokrá, Horákov	5.6	12.0	8.8	9.0
Mokrá, Pozořice	5.2	12.8	9.0	8.9
Napajedla	6.1	17.4	12.3	12.9
Spolana, Tón	41.9	230.0	96.9	90.2
Spolana, gate	83.6	1 441.9	483.0	435.3
Spolana, archive	547.3	4 369.2	2 061.5	1 944.1
Spolana, Tomeš	7.2	163.4	28.1	19.5
Otrokovice	11.3	22.5	18.1	18.4
Praha, Libuš	6.3	13.5	9.8	10.0
Přimda	0.1	17.1	8.9	9.1
Radotín, cement	3.3	14.5	9.0	9.1
Radotín, Kosoř	8.1	15.4	11.5	10.9
Radotín, Lochkov	6.8	14.3	10.1	10.2
Radotín	3.4	9.3	6.9	6.9
Rudolice	5.1	16.3	10.2	9.2
Rýchory	5.3	13.5	9.5	9.7
Sedlec	7.6	15.5	10.8	10.3
Slušovice	3.8	11.5	8.2	8.0
Staré Město, Colorlak	6.5	32.4	16.5	13.8
Šerlich	3.6	12.4	8.2	8.0
Pláňava	6.5	23.2	15.8	15.1
Uherské Hradiště	6.1	15.6	11.4	11.5
Uherský Brod	6.0	12.8	10.1	10.5
Val. Mez. Observatory	5.9	14.8	10.2	10.2
Val. Mez. Juřinka	5.8	15.9	10.6	11.4
Val. Mez. Mštěnovice	6.2	13.7	10.1	10.2
Val. Mez.Příluky	3.8	17.2	12.4	13.1
Vizovice	3.1	50.4	13.9	11.4
Zlín	7.6	13.2	10.9	11.4
Svratouch	5.9	23.5	12.1	10.8

Sampling site/HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Sněžník	8.8	41.0	17.6	15.1
Brno, Kamenice	7.9	14.4	11.2	11.2
Olomouc	8.4	15.2	11.6	11.8

Table VI-8: Statistical evaluation of HCB concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/HCB	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	4.5	12.0	7.4	7.0
Brno, Kotlářská	4.9	11.4	8.0	7.8
Brno, Kroftova	4.8	9.3	7.1	7.2
Buchlov, castle	6.2	12.6	9.7	10.2
Kleť, Šumava mountains	3.1	8.5	6.6	6.9
Churáňov, Šumava mountains	5.1	7.7	6.6	7.2
Jeseník, Jeseníky mountains	<LOQ	10.3	8.2	8.5
Košetice, EMEP station	4.8	13.2	8.7	8.3
Liberec, Bedřichov	5.7	11.7	8.9	8.9
Liberec, center	4.8	9.0	7.4	7.4
Liberec, Chrastava	6.4	11.9	9.6	9.7
Liberec, Ještěd	5.0	10.0	8.0	8.2
Liberec, Rochlice	4.3	9.0	6.9	7.3
Mokrá, container	3.7	11.5	8.6	8.7
Mokrá, Horákov	5.3	14.7	8.8	8.4
Napajedla	5.7	15.5	9.4	8.8
Neratovice, Ton	22.3	184.1	85.2	79.8
Neratovice, Tomeš	<LOQ	32.3	17.3	17.2
Otrokovice	6.3	17.1	12.5	13.0
Praha, Libuš	5.6	10.3	8.5	8.8
Přimda, Šumava mountains	3.2	10.6	7.6	7.4
Radotín, cement factory	4.5	12.1	7.6	7.5
Radotín, Kosoř	5.8	13.5	9.5	9.2
Rudolice, Krušné mountains	7.2	19.6	10.4	9.9
Rýchory, Krkonoše mountains	6.9	11.7	9.0	8.7
Sedlec, Mikulov	5.8	13.9	8.7	7.6
Slušovice	4.5	12.0	7.1	7.2
Staré Město, Colorlak	5.1	17.7	10.9	10.8
Šerlich, Orlické mountains	4.9	9.1	7.3	7.1

Sampling site/HCB	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Pláňavy, Štítná nad Vláří	6.7	17.6	12.7	12.5
Valašské Meziříčí, observatory	4.9	9.7	8.2	8.7
Juřinka	5.6	13.7	9.7	9.8
Zlín, Svit	5.3	10.1	7.8	7.5
Svratouch	8.5	17.3	12.1	11.9
Děčínský Sněžník, Krušné mountains	8.5	31.5	15.2	12.1
Olomouc, hospital incinerator	5.6	16.8	11.5	11.7
Olomouc, Wolkerova	4.8	12.7	9.7	10.0

Table VI-9: Statistical evaluation of PeCB concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/PeCB	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	<LOQ	4.1	2.2	2.4
Brno, Kotlářská	0.4	2.9	1.8	1.8
Brno, Kroftova	0.5	2.9	1.8	2.1
Buchlov, castle	1.0	3.5	2.4	2.8
Kleť, Šumava mountains	0.3	2.8	1.5	1.6
Churáňov, Šumava mountains	0.6	2.5	1.5	1.5
Jeseník, Jeseníky mountains	0.9	2.6	1.8	1.7
Košetice, EMEP station	0.8	2.5	1.7	1.8
Liberec, Bedřichov	1.0	2.6	1.8	1.8
Liberec, center	0.9	2.9	1.9	1.9
Liberec, Chrastava	1.0	3.4	2.1	2.2
Liberec, Ještěd	1.3	2.8	1.8	1.8
Liberec, Rochlice	0.3	3.0	1.8	1.9
Mokrá, container	1.0	3.5	2.1	2.5
Mokrá, Horákov	1.0	3.3	2.0	2.1
Napajedla	0.9	3.9	2.5	2.4
Neratovice, Ton	14.5	126.7	53.8	56.5
Neratovice, Tomeš	1.8	10.8	6.5	6.7
Otrokovice	1.6	5.5	3.3	3.6
Praha, Libuš	1.0	3.0	1.8	2.1
Přimda, Šumava mountains	0.2	2.4	1.5	1.6
Radotín, cement factory	1.0	3.0	1.8	1.7
Radotín, Kosoř	0.5	3.0	1.8	2.0
Rudolice, Krušné mountains	0.9	5.6	2.3	2.1

Sampling site/PeCB	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Rýchory, Krkonoše mountains	1.1	3.7	1.9	1.8
Sedlec, Mikulov	0.8	3.9	2.0	2.0
Slušovice	0.5	3.1	2.1	2.2
Staré Město, Colorlak	0.9	15.9	5.2	2.9
Šerlich, Orlické mountains	1.0	2.9	1.9	2.2
Pláňavy, Štítná nad Vláří	0.6	4.2	2.4	2.5
Valašské Meziříčí, observatory	1.2	3.3	2.2	2.2
Juřinka	1.2	3.7	2.7	2.8
Zlín, Svit	1.1	3.2	2.2	2.3
Svratouch	1.1	3.5	2.1	2.2
Děčínský Sněžník, Krušné mountains	1.2	6.4	2.7	2.3
Olomouc, hospital incinerator	0.8	6.0	2.9	2.6
Olomouc, Wolkerova	1.3	4.5	2.5	2.3

Table VI-10: Statistical evaluation of PAH concentrations determined in the passive air samples from 50 sites in the Czech Republic in 2006 (13 sampling periods were included for each site)

Sampling site/PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Bílý Kříž	658.8	4 500.7	2 400.9	2 486.1
Brno, Kotlářská	3 747.2	53 329.0	13 760.6	8 126.0
Brno, Kroftova	1 560.6	15 076.2	5 478.3	4 250.1
Buchlov	253.1	41 481.7	6 189.6	1 030.6
Kleť	436.5	2 427.5	930.6	766.6
Churáňov	480.3	2 535.5	1 215.2	828.3
Jeseník	670.7	5 623.8	2 257.1	2 116.3
Košetice	328.2	7 807.2	2 501.2	1 315.5
Liberec, Rádlo	2 040.6	13 169.0	5 874.7	4 469.8
Liberec, Bedřichov	528.4	21 755.0	5 694.4	3 899.1
Liberec, center	2 245.8	29 062.2	7 128.6	4 802.3
Liberec, Chrastava	1 926.2	12 667.4	5 876.0	5 128.2
Liberec, Ještěd	362.2	3 861.1	1 539.5	922.4
Liberec, Rochlice	2 044.8	30 141.9	8 040.4	4 787.3
Liberec, Termizo	3 509.6	35 948.8	10 987.1	8 474.0
Mokrá, administration	617.7	24 367.9	4 625.2	1 904.1
Mokrá, CHMI container	624.5	39 201.9	9 865.0	7 665.2
Mokrá, Horákov	822.5	11 074.6	4 316.2	2 860.5
Mokrá, Pozořice	753.8	20 732.6	4 479.0	1 847.6

Sampling site/PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MEDIAN (ng filter^{-1})
Napajedla	1 010.2	57 033.8	9 567.4	3 899.5
Spolana, Tón	1 841.9	29 939.2	9 225.6	6 523.7
Spolana, gate	2 061.0	23 784.6	9 238.3	6 569.7
Spolana, archive	2 464.9	35 220.4	10 520.5	6 087.1
Spolana, Tomeš	1 104.8	24 817.6	6 684.2	3 477.6
Otrokovice	3 149.0	96 946.1	16 910.7	6 668.3
Praha, Libuš	1 097.1	27 797.4	7 127.7	3 953.5
Přimda	731.9	3 529.8	1 823.6	1 919.1
Radotín, cement	2 582.1	30 120.6	8 520.8	5 586.6
Radotín, Kosoř	946.2	38 264.0	10 164.5	7 842.0
Radotín, Lochkov	1 017.8	38 551.3	11 888.5	6 508.9
Radotín	1 944.9	30 030.0	7 929.2	4 056.6
Rudolice	431.1	3 299.0	1 375.4	1 326.9
Rýchory	527.2	1 875.7	1 173.2	1 320.2
Sedlec	528.2	4 431.5	1 538.2	843.7
Slušovice	955.3	76 922.5	11 658.9	3 665.3
Staré Město, Colorlak	3 660.4	74 991.0	13 800.8	7 282.9
Šerlich	442.2	1 675.4	900.0	748.1
Pláňava	1 207.0	38 483.9	8 188.5	3 580.0
Uherské Hradiště	1 529.4	67 197.2	10 894.0	3 888.3
Uherský Brod	1 440.9	46 103.4	9 018.0	3 923.0
Val. Mez. Observatory	2 727.3	111 579.8	20 694.1	8 829.1
Val. Mez. Juřinka	3 648.1	150 091.0	38 334.2	32 026.3
Val. Mez. Mštěnovice	11 935.4	141 916.1	43 748.0	30 788.8
Val. Mez.Příluky	9 123.2	204 699.5	46 819.9	21 511.8
Vizovice	2 343.8	76 839.5	15 934.4	7 152.9
Zlín	2 392.5	67 518.1	12 684.0	6 627.6
Svratouch	735.6	7 184.2	2 560.8	2 207.3
Sněžník	1 202.4	9 229.8	3 441.0	2 084.9
Brno, Kamenice	1 419.8	23 047.6	5 845.4	3 341.6
Olomouc	1 586.6	7 124.8	4 241.5	3 897.3

Table VI-11: Statistical evaluation of PAH concentrations determined in the passive air samples from 37 sites in the Czech Republic in 2007 (13 sampling periods were included for each site)

Sampling site/PAHs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Bílý Kříž, Beskydy mountains	1099.8	11277.6	2783.6	1762.0

Sampling site/PAHs	MIN (ng filter $^{-1}$)	MAX (ng filter $^{-1}$)	MEAN (ng filter $^{-1}$)	MEDIAN (ng filter $^{-1}$)
Brno, Kotlářská	2309.8	13527.5	6058.1	4812.0
Brno, Kroftova	1333.9	8028.3	3122.9	2527.5
Buchlov, castle	160.6	6443.1	1674.9	570.4
Kleť, Šumava mountains	498.3	3054.6	1653.3	1676.3
Churáňov, Šumava mountains	509.3	3701.8	1184.7	980.5
Jeseník, Jeseníky mountains	856.3	16054.6	3659.7	2074.3
Košetice, EMEP station	169.1	5137.1	1626.9	1047.1
Liberec, Bedřichov	1377.1	12210.8	3863.7	3338.2
Liberec, center	2147.8	15009.9	4932.5	4180.9
Liberec, Chrastava	1609.7	18963.1	5925.3	4979.8
Liberec, Ještěd	314.6	5607.9	1411.3	849.8
Liberec, Rochlice	1866.7	17726.4	5517.4	4827.8
Mokrá, container	2487.5	11106.0	5202.7	4609.2
Mokrá, Horákov	502.6	9119.0	3084.7	2716.4
Napajedla	948.9	9800.8	3815.8	2747.5
Neratovice, Ton	2308.4	11041.6	5423.9	5006.7
Neratovice, Tomeš	852.6	8075.3	3241.0	2198.6
Otrokovice	1875.2	14182.4	6097.3	5280.7
Praha, Libuš	943.0	7785.4	3264.1	2575.6
Přimda, Šumava mountains	770.5	8989.9	2027.5	1299.4
Radotín, cement factory	4080.1	53503.6	18234.9	16858.1
Radotín, Kosoř	605.2	19213.9	5902.1	4356.7
Rudolice, Krušné mountains	607.1	8311.4	2231.7	1238.5
Rýchory, Krkonoše mountains	459.0	5452.4	2064.8	1970.8
Sedlec, Mikulov	389.3	11001.9	2423.1	919.0
Slušovice	813.0	12100.1	4807.5	3954.1
Staré Město, Colorlak	2806.8	10959.3	5976.3	5386.7
Šerlich, Orlické mountains	415.3	5343.7	1509.0	1078.4
Pláňavy, Štítná nad Vláří	910.6	10669.1	3774.1	3735.1
Valašské Meziříčí, observatory	2559.5	19364.1	8326.0	6929.1
Juřinka	5563.9	34912.2	17954.8	14970.0
Zlín, Svit	1434.8	9500.4	4090.1	3643.7
Svratouch	1058.7	18257.2	4718.9	3108.7
Děčínský Sněžník, Krušné mountains	870.8	21487.4	4883.5	3627.0
Olomouc, hospital incinerator	2257.1	31611.6	6437.1	3831.8
Olomouc, Wolkerova	1345.5	8783.2	3450.7	3125.2

Annex VII

MONET-CEECs - results 2006, 2007

Table VII-1: Statistical evaluation of PCB concentrations determined in the passive air samples from 58 sites in Central and Eastern Europe (5 sampling periods for most sites) in 2006

SAMPLING SITE/PCBs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Banja Luka, Incel factory	53.5	71.6	63.9	65.3
Modriča, oil refinery	6.1	23.4	16.0	15.8
Tallinn, Rahu, city monitoring station	18.8	69.9	44.0	43.6
Muuga Port, industrial station	2.6	12.3	7.2	6.8
Lahemaa, EMEP station	1.9	4.6	3.0	2.7
Kunda, industrial station	1.4	5.0	3.5	3.8
Kohtla Järve, industrial station	7.9	27.8	13.3	8.8
Rucava, EMEP station	1.9	4.2	3.3	3.5
Dobele, meteo station	2.6	6.0	4.8	5.4
Olaine, air quality monitoring station	2.9	5.7	5.0	5.7
Riga, city park	7.3	16.1	10.9	11.1
Zoseni, EMEP station	2.3	3.9	3.0	2.9
Preila, research institute	6.9	10.2	9.1	9.8
Plateliai, integrated monitoring station	3.0	9.9	5.3	4.2
Rugšteliškis, integrated monitoring station	1.7	12.3	5.7	4.3
Paneriai, research institute	16.8	43.7	27.2	21.1
Vilnius, center	6.8	18.1	11.8	11.2
Onesti - Borzesti	21.7	47.1	33.7	34.8
Bacau, city center	10.3	24.6	17.8	18.5
Radomiresti, cattle farm	4.2	16.4	10.4	10.2
Iasi, center	11.4	26.2	17.8	15.2
Raducaneni, garden	3.6	10.7	6.3	4.9
Galati	14.5	37.2	22.1	15.7
Cuca, garden	2.8	10.8	7.1	8.5
Ruginesti	2.4	5.7	4.1	4.6
Timisoara, city center	867.8	1 025.9	946.9	946.9
Timisoara, incinerator				85.3
Braila, city center	66.2	1 019.7	400.2	114.8
Braila Com				1 110.5
Craiova, central market	22.9	37.0	30.0	30.0
Craiova, city hall	29.8	32.7	31.3	31.3
Bucuresti, center	40.3	86.6	63.5	63.5
Bucuresti, Snagov	38.2	77.0	57.6	57.6
Bucuresti, I.C.I.M.	35.5	40.5	38.0	38.0

SAMPLING SITE/PCBs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Deva	38.3	58.1	48.2	48.2
Filiasi, TMD	377.9	387.7	382.8	382.8
Turda, city hall	40.7	41.5	41.1	41.1
Voluntari, Oras	34.3	38.2	36.2	36.2
Voluntari, Oras, duplicate	22.7	27.3	25.0	25.0
Cluj-Napoca, A.R.P.M.	51.7	53.5	52.6	52.6
Kragujevac, Zastava, Lakirnica	60.5	79.4	73.0	77.2
Kragujevac, Zastava, Energetika	63.5	107.8	73.5	65.9
Kragujevac, PMF	10.7	29.7	19.6	20.3
Novi Sad, Refinery	24.9	60.5	41.1	39.4
Fruška Gora	12.5	22.0	18.4	18.7
Beograd	29.8	40.0	34.6	34.3
Grabovac	5.3	13.9	9.6	9.6
Bratislava, Trnavské mýto	22.0	60.6	36.7	28.0
Bratislava, Mamateyova	6.0	29.0	15.3	11.7
Ziar nad Hronom, Dukelských hrdinov	9.2	19.8	13.3	10.8
Handlová, Morovianska cesta	2.1	11.9	6.7	4.7
Žilina, Obežná	16.3	42.3	27.9	25.1
Ružomberok, Riadok	6.4	27.4	16.0	13.8
Starina, EMEP station	1.3	9.0	5.0	3.6
Strážske, Mierová	10.3	34.3	21.3	17.8
Košice, Strojárska	7.2	27.9	17.5	18.6
Veľká Ida, pri ŽSR	2.4	46.7	24.1	21.6
Topolniky, ASZOD, EMEP station	1.9	13.2	7.4	9.6

Table VII-2: Statistical evaluation of PCB concentrations determined in the passive air samples from 57 sites in Central and Eastern Europe (5 sampling periods for most sites) in 2007

SAMPLING SITE / PCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Sofia-IMS Gara Yana	11.3	32.7	26.1	29.4
Sofia-TMS Orlov most	13.9	19.5	17.1	18.2
Sofia-UBMS Hipodruma	22.2	29.6	27.0	28.1
Pernik-IMS Tsarkva	27.4	37.8	32.8	33.9
Plovdiv-UBMS Dolni Voden	3.4	7.6	6.0	6.4
Sofia - NBMS Bojana	6.0	9.6	8.0	8.1
Dordičeva	10.6	14.7	12.9	13.1
Črnomerec	15.8	25.7	21.8	22.4

SAMPLING SITE / PCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Siget	15.8	18.2	17.3	17.8
Peščenica	11.7	27.5	21.3	23.4
IMI	8.3	16.0	11.9	11.6
Lahemaa	1.4	4.1	3.2	3.6
Budapešť - XVIII. Gilice tér	8.6	17.1	13.6	14.7
Budapešť - II. Pesthidegkút	3.7	5.4	4.6	4.6
Budapešť - I. Széna tér	7.5	9.3	7.9	7.5
Budapešť - XV. Koakás park	5.1	7.2	6.4	6.7
Budapešť - XI. Kosztdányi D. tér	7.0	10.8	9.1	9.1
Lazaropole	1.9	3.1	2.4	2.2
Skopje - OHIS	22.1	28.7	25.2	24.9
Skopje - MEPP	24.7	29.1	27.3	27.6
Rafinery	15.5	18.2	17.1	17.3
Bitola	6.1	8.0	7.3	7.5
Strumica	6.3	9.5	7.4	7.0
Briceni	4.3	8.8	6.4	6.7
Rezina	11.0	16.4	14.1	13.8
Chisinau	10.1	16.1	13.4	12.7
Leova	6.2	9.9	8.0	7.6
Giurgiulesti	6.8	16.9	9.7	8.1
Stefan Voda	9.7	13.4	11.2	11.3
Balti	16.2	36.5	25.7	24.8
Center of Podgorica	8.2	28.1	13.7	11.1
Village Srpska	20.0	34.7	25.2	24.2
CETI	10.7	32.6	24.3	25.1
Center of Pljevlja	5.5	15.6	10.1	7.3
Komini	2.6	9.3	4.6	3.1
Niksic - centre	32.2	78.8	51.6	45.4
Niksic	80.6	124.0	100.5	94.3
Szarów	3.7	5.0	4.3	4.3
Wieliczka	5.2	10.6	7.4	6.6
Al.Krasinskiego	4.6	7.6	6.3	6.5
Wichrowa	3.0	5.9	4.1	4.1
Warszawska	3.1	8.1	5.2	5.1
Zabierzów	3.0	5.9	4.2	4.4
Ufa	51.4	67.9	61.2	62.7
Ufa - background	10.5	16.7	14.6	15.6
Sterlitamak	15.4	24.6	19.9	19.7
Chapaevsk	18.4	25.0	22.6	23.5

SAMPLING SITE / PCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Chapaevsk - background	12.7	27.5	17.7	15.4
Iskrba	1.5	3.2	2.5	2.6
Ljubljana	11.6	15.3	13.6	13.7
Maribor OZADSE	4.6	7.1	5.9	5.7
Celje	9.4	10.2	9.8	9.8
Ljubljana - centre	15.2	28.1	20.1	18.5
Maribor (AMP)	8.4	13.0	10.3	10.2
Celje - centre	38.2	80.2	67.5	75.8
Iasi	65.3	160.7	109.4	106.5
Raducaneni	4.9	6.6	5.6	5.1

Table VII-3: Statistical evaluation of HCH concentrations determined in the passive air samples from 58 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2006

SAMPLING SITE/HCHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Banja Luka, Incel factory	8.6	23.0	13.9	12.0
Modriča, oil refinery	20.8	46.5	32.7	30.9
Tallinn, Rahu, city monitoring station	9.0	34.7	18.8	15.7
Muuga Port, industrial station	4.6	63.5	25.0	15.9
Lahemaa, EMEP station	4.2	10.5	6.3	5.2
Kunda, industrial station	1.4	16.7	9.1	9.1
Kohtla Järve, industrial station	4.5	26.4	12.9	10.3
Rucava, EMEP station	8.6	14.4	11.4	11.3
Dobele, meteo station	5.6	11.6	8.6	9.7
Olaine, air quality monitoring station	6.5	22.5	12.5	11.1
Riga, city park	8.3	27.2	15.5	14.3
Zoseni, EMEP station	6.8	9.9	8.6	8.9
Preila, research institute	8.4	20.8	16.6	17.9
Plateliai, integrated monitoring station	8.8	22.4	14.2	12.7
Rugšteliškis, integrated monitoring station	7.3	17.1	12.8	13.7
Paneriai, research institute	10.6	26.4	17.9	16.6
Vilnius, center	12.2	30.7	20.5	19.5
Onesti - Borzesti	678.4	1 490.0	1 106.1	1 179.4
Bacau, city center	51.8	212.1	121.2	124.1
Radomiresti, cattle farm	56.8	105.7	75.6	73.0
Iasi, center	67.7	113.4	87.5	79.9
Raducaneni, garden	62.3	136.9	90.4	81.8

SAMPLING SITE/HCHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Galati	174.5	284.5	211.9	191.0
Cuca, garden	126.9	274.0	209.6	219.7
Ruginesti	19.4	48.4	29.6	28.1
Timisoara, city center	123.2	153.5	138.4	138.4
Timisoara, incinerator				599.1
Braila, city center	55.4	274.3	179.9	209.9
Braila Com				55.6
Craiova, central market	173.8	237.0	205.4	205.4
Craiova, city hall	202.4	223.8	213.1	213.1
Bucuresti, center	352.7	437.3	395.0	395.0
Bucuresti, Snagov	307.4	342.0	324.7	324.7
Bucuresti, I.C.I.M.	286.0	392.1	339.1	339.1
Deva	611.0	826.3	718.6	718.6
Filiasi, TMD	78.3	152.4	115.4	115.4
Turda, city hall	1 871.9	2 767.0	2 319.4	2 319.4
Voluntari, Oras	224.2	229.6	226.9	226.9
Voluntari, Oras, duplicate	153.0	228.9	191.0	191.0
Cluj-Napoca, A.R.P.M.	208.0	229.0	218.5	218.5
Kragujevac, Zastava, Lakirnica	6.7	52.9	17.6	8.3
Kragujevac, Zastava, Energetika	<LOQ	0.3	0.3	0.2
Kragujevac, PMF	37.4	77.6	53.4	48.0
Novi Sad, Refinery	32.6	443.9	135.1	74.6
Fruška Gora	21.5	41.1	32.1	33.6
Beograd	98.0	269.3	163.1	142.6
Grabovac	141.4	351.9	212.3	143.7
Bratislava, Trnavské mýto	48.4	156.4	107.9	120.6
Bratislava, Mamateyova	16.3	43.0	31.9	38.5
Ziar nad Hronom, Dukelských hrdinov	11.8	32.6	24.0	23.7
Handlová, Morovianska cesta	13.6	25.5	16.7	14.1
Žilina, Obežná	14.1	38.5	20.5	16.6
Ružomberok, Riadok	14.8	32.5	21.8	19.3
Starina, EMEP station	15.9	23.8	18.3	17.3
Strážske, Mierová	20.8	30.1	24.2	23.0
Košice, Strojárska	10.4	28.5	20.7	21.3
Veľká Ida, pri ŽSR	12.2	28.3	21.0	24.1
Topolniky, ASZOD, EMEP station	15.5	38.1	24.5	23.5

Table VII-4: Statistical evaluation of HCH concentrations determined in the passive air samples from 57 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2007

SAMPLING SITE / HCH	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Sofia-IMS Gara Yana	5.5	11.6	8.7	8.3
Sofia-TMS Orlov most	14.1	25.3	20.1	20.8
Sofia-UBMS Hipodruma	22.7	95.7	39.5	26.0
Pernik-IMS Tsarkva	9.7	21.5	14.3	15.1
Plovdiv-UBMS Dolni Voden	25.6	47.9	32.3	26.3
Sofia - NBMS Bojana	12.3	29.1	23.6	24.4
Dordičeva	8.5	16.8	14.1	15.4
Črnomerec	9.5	13.1	10.4	9.7
Siget	4.2	9.5	6.8	6.9
Peščenica	6.4	11.4	9.6	10.2
IMI	8.7	12.0	10.5	10.4
Lahemaa	5.6	12.0	8.8	9.2
Budapešť - XVIII. Gilice tér	19.9	28.8	23.4	23.0
Budapešť - II. Pesthidegkút	27.2	38.5	34.9	36.5
Budapešť - I. Széna tér	31.9	37.3	34.4	33.8
Budapešť - XV. Koakás park	13.1	41.9	26.7	24.4
Budapešť - XI. Kosztdányi D. tér	19.0	44.3	31.9	31.7
Lazaropole	8.3	10.9	9.9	10.2
Skopje - OHIS	219.2	343.5	297.2	313.1
Skopje - MEPP	119.5	284.3	170.3	138.6
Rafinery	16.4	19.3	17.9	17.9
Bitola	12.1	19.4	16.2	16.7
Strumica	13.7	21.5	16.9	16.2
Briceni	23.9	49.8	37.5	41.0
Rezina	71.1	158.0	96.7	83.9
Chisinau	24.4	44.4	37.6	37.9
Leova	31.4	50.3	41.8	43.4
Giurgiulesti	33.7	50.6	40.0	34.4
Stefan Voda	20.8	33.4	27.4	28.5
Balti	28.0	57.7	43.1	43.6
Center of Podgorica	16.0	41.3	27.6	28.3
Village Srpska	4.0	13.7	8.5	6.8
CETI	16.2	30.6	24.0	22.8
Center of Pljevlja	1.5	6.1	3.6	3.9
Komini	0.8	3.1	2.3	2.6
Niksic - centre	25.0	56.9	41.5	39.0

SAMPLING SITE / HCH	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Niksic	1.6	9.1	6.3	7.6
Szarów	5.4	13.5	7.2	5.7
Wieliczka	7.4	11.6	9.3	8.2
Al.Krasinskiego	7.4	18.4	14.7	16.0
Wichrowa	6.9	15.0	10.6	10.1
Warszawska	5.6	11.3	8.0	7.1
Zabierzów	3.4	9.7	7.2	7.6
Ufa	159.3	213.7	190.7	194.9
Ufa - background	15.9	18.3	16.7	16.2
Sterlitamak	36.8	66.3	45.5	39.5
Chapaevsk	169.2	530.0	314.4	279.1
Chapaevsk - background	87.7	139.9	120.6	127.4
Iskrba	4.3	8.7	6.3	6.1
Ljubljana	8.5	35.4	17.2	12.7
Maribor OZADSE	7.1	13.2	10.2	10.6
Celje	4.3	24.5	9.1	5.3
Ljubljana - centre	5.3	16.7	10.4	9.4
Maribor (AMP)	6.0	19.2	10.2	7.9
Celje - centre	3.6	12.0	5.9	4.3
Iasi	49.4	71.3	62.1	65.4
Raducaneni	43.9	68.9	57.5	55.3

Table VII-5: Statistical evaluation of DDT concentrations determined in the passive air samples from 58 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2006

SAMPLING SITE/DDTs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Banja Luka, Incel factory	0.7	1.5	1.2	1.4
Modriča, oil refinery	1.3	5.2	3.9	4.3
Tallinn, Rahu, city monitoring station	2.3	3.7	3.0	2.9
Muuga Port, industrial station	1.1	2.6	1.8	1.6
Lahemaa, EMEP station	0.5	1.3	0.8	0.8
Kunda, industrial station	0.6	1.8	1.0	0.8
Kohtla Järve, industrial station	1.4	3.5	2.2	1.9
Rucava, EMEP station	1.7	3.3	2.4	2.6
Dobele, meteo station	1.1	2.8	1.8	1.8
Olaine, air quality monitoring station	2.1	5.3	3.0	2.6
Riga, city park	2.0	3.8	2.6	2.5

SAMPLING SITE/DDTs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Zoseni, EMEP station	1.2	1.8	1.5	1.5
Preila, research institute	3.2	4.6	3.9	3.7
Plateliai, integrated monitoring station	0.6	2.8	1.5	1.3
Rugšteliškis, integrated monitoring station	0.7	3.0	2.1	2.2
Paneriai, research institute	0.8	2.1	1.4	1.2
Vilnius, center	6.8	36.4	19.2	18.2
Onesti - Borzesti	26.7	63.0	44.8	50.6
Bacau, city center	14.9	43.5	26.4	25.1
Radomiresti, cattle farm	18.2	55.1	35.3	34.2
Iasi, center	23.3	69.6	46.9	42.7
Raducaneni, garden	22.6	38.6	33.0	36.3
Galati	43.6	98.0	66.4	64.4
Cuca, garden	33.2	88.9	59.3	67.3
Ruginesti	4.0	6.5	4.9	4.7
Timisoara, city center	15.9	43.5	29.7	29.7
Timisoara, incinerator				36.4
Braila, city center	8.9	81.7	55.9	77.1
Braila Com				7.9
Craiova, central market	22.3	41.9	32.1	32.1
Craiova, city hall	37.2	46.4	41.8	41.8
Bucuresti, center	92.0	253.1	172.5	172.5
Bucuresti, Snagov	104.2	227.1	165.6	165.6
Bucuresti, I.C.I.M.	136.7	201.9	169.3	169.3
Deva	36.4	51.8	44.1	44.1
Filiasi, TMD	11.7	12.3	12.0	12.0
Turda, city hall	61.1	90.3	75.7	75.7
Voluntari, Oras	69.8	71.2	70.5	70.5
Voluntari, Oras, duplicate	45.5	70.6	58.1	58.1
Cluj-Napoca, A.R.P.M.	47.8	62.5	55.1	55.1
Kragujevac, Zastava, Lakirnica	0.2	0.6	0.3	0.3
Kragujevac, Zastava, Energetika	<LOQ	<LOQ	<LOQ	<LOQ
Kragujevac, PMF	2.1	4.6	3.7	4.0
Novi Sad, Refinery	16.4	21.7	18.1	18.0
Fruška Gora	7.5	11.6	9.1	9.3
Beograd	79.8	132.0	98.5	91.1
Grabovac	2.9	7.6	5.9	7.2
Bratislava, Trnavské mýto	12.9	36.0	22.5	19.5
Bratislava, Mamateyova	8.9	22.2	13.6	12.4
Ziar nad Hronom, Dukelských hrdinov	4.0	12.2	8.1	9.8

SAMPLING SITE/DDTs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Handlová, Morovianska cesta	3.5	10.3	6.6	4.8
Žilina, Obežná	3.0	6.6	4.8	4.9
Ružomberok, Riadok	2.9	9.1	5.1	3.3
Starina, EMEP station	2.7	6.6	5.0	5.3
Strážske, Mierová	7.3	16.8	11.4	9.6
Košice, Strojárska	5.3	17.8	10.9	12.3
Veľká Ida, pri ŽSR	15.9	36.1	23.2	20.6
Topolniky, ASZOD, EMEP station	6.4	33.3	18.7	17.7

Table VII-6: Statistical evaluation of DDT concentrations determined in the passive air samples from 57 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2007

SAMPLING SITE / DDT	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Sofia-IMS Gara Yana	7.2	17.9	13.0	14.3
Sofia-TMS Orlov most	12.0	21.8	15.7	14.3
Sofia-UBMS Hipodruma	7.1	19.0	14.2	15.7
Pernik-IMS Tsarkva	3.9	7.6	6.1	6.0
Plovdiv-UBMS Dolni Voden	17.9	36.1	27.1	28.0
Sofia - NBMS Bojana	4.4	13.1	10.1	10.5
Dordičeva	3.9	6.9	5.6	5.8
Črnomerec	3.2	4.3	4.0	4.2
Siget	1.6	2.9	2.2	2.2
Peščenica	2.6	4.4	3.2	3.0
IMI	3.5	5.5	4.7	5.0
Lahemaa	1.0	1.9	1.5	1.6
Budapešť - XVIII. Gilice tér	14.3	23.0	19.2	19.0
Budapešť - II. Pesthidegkút	10.4	17.3	12.8	11.3
Budapešť - I. Széna tér	13.1	20.2	15.7	14.0
Budapešť - XV. Koakás park	9.0	16.3	12.8	11.9
Budapešť - XI. Kosztdányi D. tér	16.6	25.9	20.4	17.7
Lazaropole	2.5	5.2	3.5	3.2
Skopje - OHIS	11.8	20.2	15.1	14.1
Skopje - MEPP	23.1	25.4	24.1	24.0
Rafinery	10.7	14.2	12.3	12.3
Bitola	19.8	20.9	20.2	20.0
Strumica	7.1	17.0	10.4	8.6
Briceni	16.9	57.4	39.4	44.3

SAMPLING SITE / DDT	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Rezina	35.9	64.8	47.4	46.1
Chisinau	16.5	42.5	27.6	23.6
Leova	21.0	55.4	40.3	41.4
Giurgiulesti	34.0	58.1	43.3	36.5
Stefan Voda	18.0	36.5	26.6	26.9
Balti	17.1	65.0	38.4	31.3
Center of Podgorica	4.3	7.7	5.7	5.5
Village Srpska	2.3	3.3	3.0	2.9
CETI	4.1	6.4	5.1	5.2
Center of Pljevlja	2.4	3.5	3.0	3.3
Komini	1.3	3.5	2.0	1.8
Niksic - centre	6.7	11.3	9.9	10.4
Niksic	1.6	2.2	1.9	2.0
Szarów	4.6	11.2	7.1	6.8
Wieliczka	4.6	7.5	6.0	6.0
Al.Krasinskiego	8.3	18.2	14.3	16.0
Wichrowa	3.6	6.0	4.4	4.3
Warszawska	5.9	13.6	9.4	8.9
Zabierzów	3.5	9.0	5.9	5.7
Ufa	6.5	12.8	9.5	9.4
Ufa - background	2.6	4.4	3.6	3.8
Sterlitamak	8.6	24.4	16.2	16.0
Chapaevsk	13.1	23.7	16.8	15.2
Chapaevsk - background	12.1	19.9	17.1	18.3
Iskrba	2.5	4.0	3.1	2.9
Ljubljana	5.3	6.5	5.9	5.9
Maribor OZADSE	10.5	14.2	12.2	12.3
Celje	4.5	8.3	6.1	6.0
Ljubljana - centre	3.9	6.7	5.7	6.1
Maribor (AMP)	7.7	10.4	8.9	9.1
Celje - centre	6.7	8.9	7.4	7.1
Iasi	22.1	38.5	27.4	25.8
Raducaneni	15.1	28.6	21.0	21.1

Table VII-7: Statistical evaluation of HCB concentrations determined in the passive air samples from 58 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2006

SAMPLING SITE/HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Banja Luka, Incel factory	6.3	7.7	6.9	6.8
Modriča, oil refinery	0.1	6.5	4.6	5.2
Tallinn, Rahu, city monitoring station	2.3	3.7	3.0	2.9
Muuga Port, industrial station	1.1	2.6	1.8	1.6
Lahemaa, EMEP station	2.5	6.6	4.8	5.0
Kunda, industrial station	2.2	5.9	4.6	5.1
Kohtla Järve, industrial station	2.8	8.7	6.0	6.7
Rucava, EMEP station	3.6	7.5	5.7	5.5
Dobele, meteo station	4.6	7.1	6.2	6.5
Olaine, air quality monitoring station	4.1	6.5	5.4	5.3
Riga, city park	4.8	7.5	6.0	5.4
Zoseni, EMEP station	4.1	6.5	5.0	4.4
Preila, research institute	6.8	13.0	10.5	11.1
Plateliai, integrated monitoring station	4.7	8.2	6.5	6.5
Rugšteliškis, integrated monitoring station	6.0	8.4	7.2	7.6
Paneriai, research institute	5.2	6.5	6.0	6.2
Vilnius, center	4.4	8.2	6.8	7.8
Onesti - Borzesti	8.3	16.3	13.3	14.1
Bacau, city center	3.7	9.3	5.8	5.8
Radomiresti, cattle farm	5.2	8.9	6.2	5.6
Iasi, center	5.2	7.5	6.8	7.3
Raducaneni, garden	3.8	7.0	5.8	5.9
Galati	5.1	7.2	6.0	5.7
Cuca, garden	4.5	7.4	5.8	6.0
Ruginesti	4.2	6.1	5.4	5.4
Timisoara, city center	4.5	7.0	5.8	5.8
Timisoara, incinerator				36.5
Braila, city center	1.8	4.9	3.4	3.6
Braila Com				1.6
Craiova, central market	10.2	11.2	10.7	10.7
Craiova, city hall	8.4	9.4	8.9	8.9
Bucuresti, center	9.3	9.4	9.4	9.4
Bucuresti, Snagov	8.4	9.1	8.8	8.8
Bucuresti, I.C.I.M.	9.1	10.2	9.6	9.6
Deva	12.0	12.9	12.5	12.5
Filiasi, TMD	4.3	5.6	4.9	4.9

SAMPLING SITE/HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Turda, city hall	13.1	14.2	13.7	13.7
Voluntari, Oras	10.2	11.3	10.8	10.8
Voluntari, Oras, duplicate	7.3	8.8	8.0	8.0
Cluj-Napoca, A.R.P.M.	6.2	8.3	7.2	7.2
Kragujevac, Zastava, Lakirnica	0.5	1.6	1.0	0.9
Kragujevac, Zastava, Energetika	<LOQ	<LOQ	<LOQ	<LOQ
Kragujevac, PMF	4.5	5.7	5.0	4.8
Novi Sad, Refinery	11.0	20.2	14.0	12.7
Fruška Gora	7.4	10.3	8.3	8.1
Beograd	4.8	7.1	6.1	6.3
Grabovac	5.1	6.6	5.6	5.2
Bratislava, Trnavské mýto	10.8	13.3	11.8	11.8
Bratislava, Mamateyova	7.3	12.3	10.2	10.8
Ziar nad Hronom, Dukelských hrdinov	7.2	10.8	8.7	8.5
Handlová, Morovianska cesta	6.8	10.0	8.2	8.0
Žilina, Obežná	6.4	8.8	8.0	8.1
Ružomberok, Riadok	6.3	9.0	7.8	7.5
Starina, EMEP station	5.7	7.4	6.6	6.5
Strážske, Mierová	6.2	14.1	10.5	11.3
Košice, Strojárska	6.9	8.1	7.5	7.5
Veľká Ida, pri ŽSR	8.0	10.6	9.6	9.6
Topolniky, ASZOD, EMEP station	7.2	12.5	9.9	10.8

Table VII-8: Statistical evaluation of HCB concentrations determined in the passive air samples from 57 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2007

SAMPLING SITE / HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Sofia-IMS Gara Yana	2.6	6.8	4.5	4.2
Sofia-TMS Orlov most	8.4	15.0	11.8	12.3
Sofia-UBMS Hipodruma	4.8	7.5	6.2	6.3
Pernik-IMS Tsarkva	4.1	5.3	4.8	5.2
Plovdiv-UBMS Dolni Voden	3.7	6.8	4.8	4.3
Sofia - NBMS Bojana	3.6	5.5	4.8	5.3
Dordičeva	3.6	4.5	4.1	4.2
Črnomerec	3.1	5.2	4.5	5.1
Siget	2.8	4.2	3.6	3.6
Peščenica	4.1	5.5	4.8	5.0

SAMPLING SITE / HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
IMI	3.4	4.9	4.0	3.8
Lahemaa	0.1	7.8	5.2	5.6
Budapešť - XVIII. Gilice tér	5.3	7.0	5.9	5.7
Budapešť - II. Pesthidegkút	4.3	7.4	6.0	6.0
Budapešť - I. Széna tér	5.8	8.4	6.9	6.9
Budapešť - XV. Koakás park	7.2	9.2	8.5	8.9
Budapešť - XI. Kosztdányi D. tér	5.8	8.3	7.0	7.0
Lazaropole	4.2	4.8	4.5	4.4
Skopje - OHIS	3.2	3.5	3.3	3.3
Skopje - MEPP	4.0	6.5	5.0	4.8
Rafinery	2.5	4.1	3.6	4.0
Bitola	3.0	5.1	4.1	4.0
Strumica	2.8	3.9	3.4	3.5
Briceni	4.7	7.1	5.9	5.8
Rezina	5.0	7.3	6.0	6.1
Chisinau	4.6	7.1	5.5	5.6
Leova	3.7	6.3	5.1	5.0
Giurgiulesti	3.1	5.8	4.4	4.5
Stefan Voda	4.1	7.1	5.3	5.2
Balti	4.2	7.5	5.2	4.4
Center of Podgorica	2.7	4.2	3.6	3.6
Village Srpska	2.6	4.0	3.2	2.8
CETI	3.0	3.8	3.5	3.5
Center of Pljevlja	3.0	4.0	3.6	3.7
Komini	3.0	4.0	3.5	3.6
Niksic - centre	2.6	5.1	3.7	3.6
Niksic	2.3	3.4	2.8	2.8
Szarów	5.7	7.0	6.1	5.7
Wieliczka	5.0	11.4	7.5	6.4
Al.Krasinskiego	7.0	8.6	7.4	7.1
Wichrowa	4.3	8.6	5.8	5.2
Warszawska	2.8	8.1	5.9	6.3
Zabierzów	4.9	10.4	6.6	5.5
Ufa	18.0	24.6	21.6	21.8
Ufa - background	5.5	6.6	6.1	6.1
Sterlitamak	12.7	25.6	20.7	22.2
Chapaevsk	22.1	64.9	44.8	46.1
Chapaevsk - background	7.9	15.6	11.4	11.0
Iskrba	3.1	5.4	4.0	3.7

SAMPLING SITE / HCB	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Ljubljana	3.5	5.9	4.7	4.4
Maribor OZADSE	4.1	4.8	4.4	4.3
Celje	3.9	5.5	4.6	4.3
Ljubljana - centre	3.9	5.1	4.6	4.8
Maribor (AMP)	3.4	5.2	4.2	4.0
Celje - centre	5.1	7.5	6.2	6.3
Iasi	3.6	4.5	4.1	4.1
Raducaneni	3.7	5.0	4.1	4.1

Table VII-9: Statistical evaluation of PAH concentrations determined in the passive air samples from 58 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2006

SAMPLING SITE/PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Banja Luka, Incel factory	3 857	5 698	4 636	4 494
Modriča, oil refinery	2 626	5 708	4 018	3 796
Tallinn, Rahu, city monitoring station	5 242	9 086	6 971	6 778
Muuga Port, industrial station	2 687	8 302	4 875	4 255
Lahemaa, EMEP station	934	4 953	2 420	1 896
Kunda, industrial station	1 237	3 552	2 362	2 330
Kohtla Järve, industrial station	2 325	5 495	3 526	3 143
Rucava, EMEP station	502	5 640	1 759	735
Dobele, meteo station	624	6 472	2 228	802
Olaine, air quality monitoring station	1 258	5 291	2 179	1 495
Riga, city park	1 878	9 928	4 029	2 004
Zoseni, EMEP station	322	2 187	801	555
Preila, research institute	902	10 992	3 337	1 561
Plateliai, integrated monitoring station	639	2 250	1 451	1 457
Rugšteliškis, integrated monitoring station	786	7 928	3 157	2 813
Paneriai, research institute	2 947	4 596	3 752	3 715
Vilnius, center	1 282	6 536	3 388	2 438
Onesti - Borzesti	5 066	31 522	13 955	8 624
Bacau, city center	3 781	12 806	7 852	7 288
Radomiresti, cattle farm	1 539	9 269	4 326	3 428
Iasi, center	1 691	10 089	5 345	5 325
Raducaneni, garden	2 579	11 614	5 464	3 181
Galati	5 728	19 370	13 428	14 169
Cuca, garden	5 093	15 332	7 908	6 305

SAMPLING SITE/PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Ruginesti	1 330	98 805	22 927	3 797
Timisoara, city center	9 564	12 213	10 888	10 888
Timisoara, incinerator				7 906
Braila, city center	4 704	7 278	6 157	6 491
Braila Com				5 565
Craiova, central market	5 617	8 305	6 961	6 961
Craiova, city hall	6 739	8 863	7 801	7 801
Bucuresti, center	50 448	58 004	54 226	54 226
Bucuresti, Snagov	35 128	54 833	44 980	44 980
Bucuresti, I.C.I.M.	4 297	5 462	4 880	4 880
Deva	45 777	170 809	108 293	108 293
Filiasi, TMD	7 073	8 076	7 574	7 574
Turda, city hall	6 876	7 686	7 281	7 281
Voluntari, Oras	5 164	6 176	5 670	5 670
Voluntari, Oras, duplicate	4 351	5 436	4 893	4 893
Cluj-Napoca, A.R.P.M.	8 637	12 269	10 453	10 453
Kragujevac, Zastava, Lakirnica	70 465	94 352	83 252	82 414
Kragujevac, Zastava, Energetika	4 108	8 547	5 271	4 549
Kragujevac, PMF	2 328	7 928	4 004	2 885
Novi Sad, Refinery	2 968	6 599	4 178	3 995
Fruška Gora	667	1 789	1 359	1 613
Beograd	6 271	14 229	10 434	10 617
Grabovac	2 717	5 165	3 976	4 045
Bratislava, Trnavské mýto	5 797	16 827	9 458	8 890
Bratislava, Mamateyova	2 270	5 539	3 309	2 942
Ziar nad Hronom, Dukelských hrdinov	2 815	14 063	6 945	6 065
Handlová, Morovianska cesta	5 261	10 618	6 820	5 711
Žilina, Obežná	3 139	15 583	6 441	4 138
Ružomberok, Riadok	2 921	17 089	6 888	4 287
Starina, EMEP station	688	2 976	1 180	746
Strážske, Mierová	2 014	8 515	3 883	2 985
Košice, Strojárska	2 314	22 228	8 057	5 081
Veľká Ida, pri ŽSR	1 001	22 711	12 513	11 754
Topolniky, ASZOD, EMEP station	820	6 578	2 527	1 489

Table VII-10: Statistical evaluation of PAH concentrations determined in the passive air samples from 57 sites in the Central and Eastern Europe (5 sampling periods for most sites) in 2007

SAMPLING SITE / 16 PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Sofia-IMS Gara Yana	11 455	21 412	15 654	14 417
Sofia-TMS Orlov most	2 272	4 059	3 252	3 023
Sofia-UBMS Hipodruma	2 211	3 723	2 721	2 496
Pernik-IMS Tsarkva	2 318	3 762	2 922	2 632
Plovdiv-UBMS Dolni Voden	1 477	2 489	1 953	1 939
Sofia - NBMS Bojana	1 202	2 665	1 675	1 535
Dordičeva	2 525	3 413	3 125	3 235
Črnomerec	3 489	7 579	5 678	5 545
Siget	1 571	2 711	2 020	1 978
Peščenica	2 166	2 839	2 673	2 776
IMI	1 019	1 561	1 316	1 336
Lahemaa	328	689	505	525
Budapešť - XVIII. Gilice tér	910	1 880	1 203	986
Budapešť - II. Pesthidegkút	796	1 494	1 092	1 002
Budapešť - I. Széna tér	1 385	2 155	1 834	1 916
Budapešť - XV. Koakás park	640	991	812	762
Budapešť - XI. Kosztdányi D. tér	1 658	1 971	1 820	1 788
Lazaropole	600	1 430	1 000	985
Skopje - OHIS	4 206	4 512	4 319	4 280
Skopje - MEPP	9 991	12 913	11 728	12 004
Rafinery	1 633	1 977	1 861	1 916
Bitola	1 530	2 411	1 920	1 870
Strumica	1 118	1 642	1 422	1 465
Briceni	1 338	2 257	1 765	1 631
Rezina	2 359	3 224	2 784	2 661
Chisinau	1 095	1 637	1 315	1 362
Leova	764	1 211	958	973
Giurgiulesti	2 222	3 470	2 703	2 494
Stefan Voda	869	1 299	1 088	1 090
Balti	2 352	6 721	3 897	3 360
Center of Podgorica	3 320	6 543	4 368	3 852
Village Srpska	7 144	16 784	11 511	11 105
CETI	3 648	8 553	6 379	6 486
Center of Pljevlja	4 502	9 827	6 688	6 126
Komini	2 447	10 136	6 185	5 623
Niksic - centre	3 450	6 167	4 535	4 402

SAMPLING SITE / 16 PAHs	MIN (ng filter^{-1})	MAX (ng filter^{-1})	MEAN (ng filter^{-1})	MED (ng filter^{-1})
Niksic	3 885	7 463	5 977	6 251
Szarów	1 737	3 936	2 610	1 922
Wieliczka	1 488	4 249	2 611	2 517
Al.Krasinskiego	3 480	5 102	4 090	3 782
Wichrowa	1 414	3 206	2 180	2 141
Warszawska	2 116	4 995	4 247	4 711
Zabierzów	1 707	3 927	2 678	2 127
Ufa	3 844	5 913	4 961	5 044
Ufa - background	2 434	4 606	3 479	3 439
Sterlitamak	5 151	6 620	6 103	6 320
Chapaevsk	5 331	74 822	23 135	6 193
Chapaevsk - background	5 066	120 568	34 625	6 434
Iskrba	159	1 340	625	501
Ljubljana	2 152	2 935	2 446	2 323
Maribor OZADSE	1 691	2 444	2 110	2 119
Celje	1 818	3 054	2 358	2 418
Ljubljana - centre	3 068	3 815	3 280	3 119
Maribor (AMP)	3 069	3 759	3 272	3 197
Celje - centre	1 382	2 787	2 128	2 167
Iasi	2 527	5 447	4 582	4 833
Raducaneni	6 933	9 768	7 887	7 700