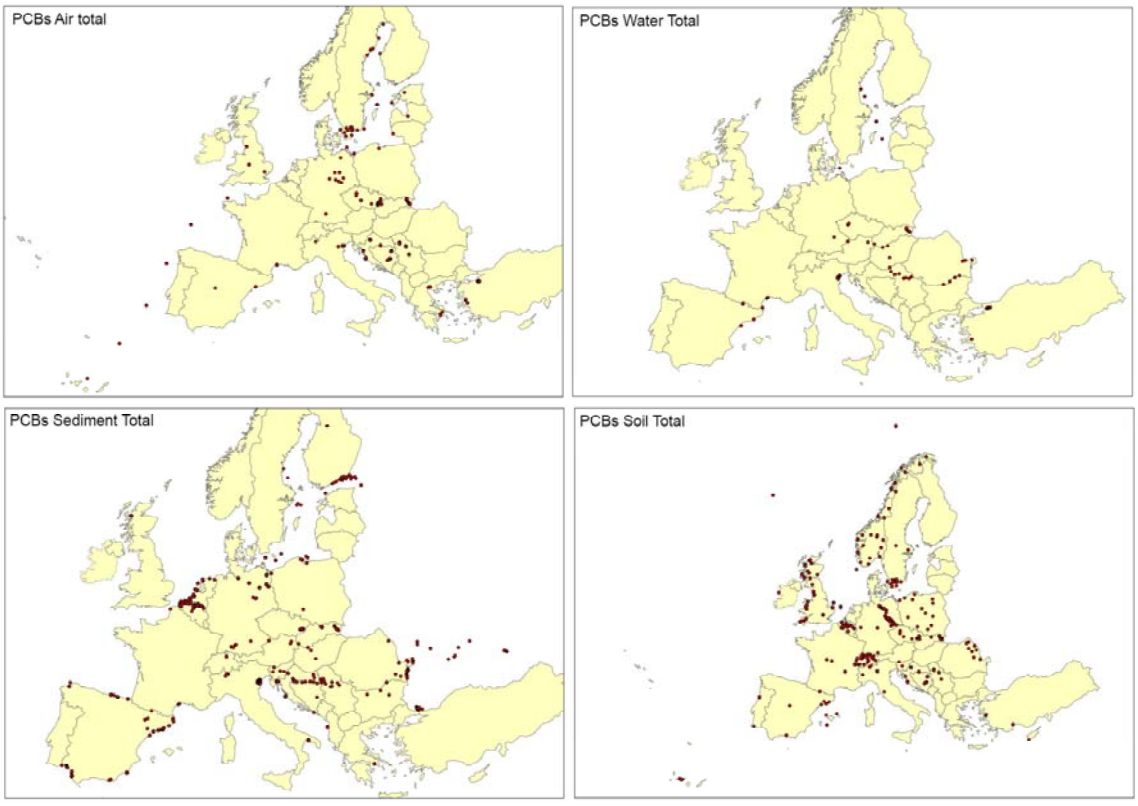
JRC Scientific and Technical Reports

A compilation of Europe-wide databases from published measurements of PCBs, Dioxins and Furans

Alberto Pistocchi, Carolina Alamo, Javier Castro-Jiménez, Athanasios Katsogiannis, Saudade Pontes, Gunther Umlauf, Pilar Vizcaino



JRC EUROPEAN COMMISSION

Institute for Environment and Sustainability

EUR 24266 EN - 2010

The mission of the JRC-IES is to provide scientific-technical support to the European Union's policies for the protection and sustainable development of the European and global environment.

European Commission
Joint Research Centre
Institute for Environment and Sustainability

Contact information
Address: Alberto Pistocchi, JRC, TP 460, Via Fermi 2749, 21027 Ispra (VA), Italy
E-mail: alberto.pistocchi@jrc.ec.europa.eu
Tel.: 00 39 0332 785591
Fax: 00 39 0332 785601

http://ies.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

JRC 56756

EUR 24266 EN
ISBN 978-92-79-15066-1
ISSN 1018-5593
doi:10.2788/66521

Luxembourg: Publications Office of the European Union

Printed in Italy

Table of contents

List of figures

List of tables:

1. Introduction

Chemical risk assessment always entails an evaluation of expected environmental concentrations of substances; these concentrations may be predicted using more or less sophisticated mathematical models (predicted environmental concentrations or PECs) or may be chosen on the basis of experimental observations and monitoring activities. The latter are usually relatively expensive, as they require sampling and laboratory analyses. The former are usually relatively inexpensive, especially when using simple back-of-the-envelope calculations as is current practice in the early, more generic stages of risk assessment. When using a mathematical model, however, observations are still fundamental in evaluating whether predictions are realistic and cannot be avoided; on the contrary, the more observations are available, the stronger confidence can be built in a model that proves its ability to reproduce them correctly.

Models tend to be more and more spatially explicit and to include probabilistic assessment moving from the concept of a single representative or worst case PEC, to a frequency distribution of PECs. Spatially explicit models provide site specific information and allow capturing spatial trends, but need to be tested with data in turn equally reflecting spatial variations. Only a few cases exist where spatially explicit models have been tested with observations, in particular the model capability to reproduce the spatial pattern of observed concentrations (Pistocchi et al.,2009).

The difficulties in accurately matching observations and predictions has lead to the attitude of jointly interpreting data and models, instead of relying only on an alternatively "model-" or "observation-based" approach to chemical assessment.

Despite the importance of observation data, most of the substances of potential concern for chemical risk assessment are not routinely monitored. Programmes providing routine monitoring of chemicals in Europe include some marine protection conventions (e.g. HELCOM in the Baltic*: http://www.helcom.fi/*, OSPAR in the North-East Atlantic: www.ospar.org, the Barcelona convention (MEDPOL) in the Mediterranean *Sea*; *http://www.unepmap.org/)*, national water monitoring under the European Water Framework Directive 60/2000/EC, international conventions such as the Stockholm convention on persistent organic pollutants (POPs) (www.pops.int) and the UNECE LRTAP Protocol on POPs (http://www.unece.org/env/lrtap/), and the AMAP (Arctic monitoring and assessment programme: http://www.amap.no/). All these programmes cover partly overlapping spatial domains, with different temporal frequency and different target environmental media. Data are gradually brought to centralized repositories managed at European level by the European Environmental Agency (EEA), EMEP, or other organizations but the availability and comparability of data is still an issue.

In parallel to monitoring programmes, a wealth of observation data on POPs as well as other chemicals of concern is daily published in scientific papers in many international journals. This information is relatively cheap to obtain, and usually undergoes processes of peer reviewing before publication that ensure, in principle, a reasonable level in the quality of the data. Published papers are therefore an attractive and easily accessible source for monitoring data. On the other hand, observations published in journals are sparse, complex in interpretation or simply not intercomparable, and specific to areas of interest for individual case studies. These facts make scientific literature reporting on pollutants concentrations in the environment rather heterogeneous in terms of analytical techniques, spatial and temporal density of samples and environmental matrixes sampled, and unevenly distributed in space. As such, they can not be easily used in chemical risk assessment.

In this work, we discuss the usefulness and limitations in building compilations of published monitoring data, by describing a feasibility study on polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), for which observed concentration data were retrieved from scientific journal articles published between

2000 and 2009. These chemicals are typical POPs and are of constantly high concern for their potential adverse effects on human health and ecosystems. PCBs were mainly used by the power industry in electrical transformers, capacitors, hydraulic equipment, and as lubricants. These compounds were also added to many consumer products, like adhesives, waxes and inks. Since the mid 1970s PCBs have been banned from active use in most countries due to their toxicity and extreme persistence. However, sediments of rivers, lakes, and oceans, and soils of temperate areas, as well as marine waters are primary locations for PCB accumulation in the environment and, therefore, themselves can act as emission sources if environmental conditions change.

PCDD/Fs are formed as unintentional by-products of chemical manufacturing and incineration processes, as well as natural processes such as volcanic eruptions, and biomass burning. Emissions from incineration of industrial wastes such as metal reclamation and domestic heating (especially in central Europe) are considered as current sources of PCDD/Fs to the environment.

There are 209 PCB congeners, with a range of physical-chemical properties which is rather representative of POPs in general, and 210 PCDD/F congeners, also spanning a relatively wide range of physico-chemical properties. However, both types of substances are non-polar, with a high affinity for carbon (organic matter), low volatility and solubility. Therefore, they tend to absorb or adsorb to suspended particulate matter in air and water, to sediments, to the organic fraction of soils, and to lipids.

A database of published observed concentrations of PCBs and PCDD/Fs in air, soil sediments and water was built as described in details in the following chapters. As continental scale assessment is aimed more at the evaluation of the regional distribution of contamination, we excluded from the database those measurements taken close to known PCB or PCCD/F pollution sources of exceptional entity such as waste incinerators or contaminated sites.

After presenting and interpreting the results of the literature search, we critically examine the completeness and usability of this information, and generally speaking the usefulness of data compilations in the framework of chemical risk assessment.

2. Data acquisition method

Many local scientific studies measure PCBs and/or PCDD/Fs concentrations in the environment. Sometimes these studies are published, and the values measured or monitored are published in the reports. The method for acquiring the data consists in searching for this kind of data inside these articles, recording them in a database when they are relevant.

The articles were searched on the Scopus® website (www.scopus.com), by different combination of keywords. The keywords used were country name, “dioxin”, “pcb”, and media (“soil”, “water”, etc). They were normally combined like the following examples:

- (dioxin OR pcb) AND (soil OR water OR sediment OR air)
- (dioxin OR pcb) AND (soil OR water OR sediment OR air) AND Croatia

In the database, we also included data easily available from JRC technical reports or anyway activities performed at the JRC IES RWER Unit, for which references are provided on a case by case basis. A particularly important source of information for the Danube catchment is the so called JDS2, Joint Danube Survey 2 (http://www.icpdr.org/jds/) to which the JRC contributed.

The following table summarizes the different searches that were performed in Scopus, considering both dioxins and PCBs.

		PCDD - Dioxins				PCDF - Furans				PCBs			
ISO_2DIGIT	COUNTRY_NAME	Soil	Air	Water	Sediments	Soil	Air	Water	Sediments	Soil	Air	Water	Sediments
AL	Albania	X	X	X	X	X	X	X	X	X	X	X	X
AT	Austria	X	X	X	X	X	X	X	X	X	X	X	X
BE	Belgium	X	X	X	X	X	X	X	X	X	X	X	X
BA	Bosnia & Herzegovina	X	X	X	X	X	X	X	X	X	X	X	X
BG	Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X
HR	Croatia	X	X	X	X	X	X	X	X	X	X	X	X
CY	Cyprus	X	X	X	X	X	X	X	X	X	X	X	X
CZ	Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X
DK	Denmark	X	X	X	X	X	X	X	X	X	X	X	X
EE	Estonia	X				X							
FI	Finland	X				X							
FR	France	X	X	X	X	X	X	X	X				
DE	Germany	X				X							
GR	Greece	X	X	X	X	X	X	X	X	X	X	X	X
HU	Hungary	X	X	X	X	X	X	X	X	X	X	X	X
IE	Ireland	X				X							
IT	Italy	X				X							
LV	Latvia	X	X	X	X	X	X	X	X	X	X	X	X
LT	Lithuania	X	X	X	X	X	X	X	X	X	X	X	X
LU	Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X
MK	FYROM	X	X	X	X	X	X	X	X	X	X	X	X
MT	Malta	X	X	X	X	X	X	X	X	X	X	X	X
ME	Montenegro	X	X	X	X	X	X	X	X	X	X	X	X
NL	Netherlands	X	X	X	X	X	X	X	X	X	X	X	X
NO	Norway	X				X							
PL	Poland	X	X	X	X	X	X	X	X	X	X	X	X
PT	Portugal	X				X							
RO	Romania	X	X	X	X	X	X	X	X	X	X	X	X
RS	Serbia	X	X	X	X	X	X	X	X	X	X	X	X
SK	Slovakia	X	X	X	X	X	X	X	X	X	X	X	X
SI	Slovenia	X	X	X	X	X	X	X	X	X	X	X	X
ES	Spain	X	X	X	X	X	X	X	X	X	X	X	X
SE	Sweden	X				X							
CH	Switzerland	X				X							
TR	Turkey	X	X	X	X	X	X	X	X	X	X	X	X
UK	United Kingdom	X				X							

Table 1: Searches performed on Scopus®.

The literature search that has been conducted was restricted by the resources available for this study. As such, it cannot claim to be a complete survey of what is available from the literature. However, it gives a good indication of what is realistically achievable for a chemical within reasonable time limits of e.g. a couple of man-months.

The database was built as a Microsoft Office Excel® file, with a single table. In this table the following data is stored for each piece of data published in the retrieved literature (each of the retrieved references usually displays more than one sampling location):

- Reference to the article the measurement is taken from
- Country of sampling
- Sampling site
- Start / end date of the study
- Media sampled
- Measurement units
- Concentrations of each PCBs or PCDD/Fs congener

– Whether the sampled site corresponds to a background value or not
– Sampling site coordinates
– Sum of the concentration of all congeners reported for each specific case

The coordinates are normally captured using Google Earth® when there are not specified in the article, from geographic references in the article (such as maps or city names). In any case, a qualitative evaluation on the reliability of the reported coordinates is performed using Google Earth ®.

3. Overall spatio-temporal and congener distribution of the samples

3.1 PCBs

The following chart shows the number of sample points obtained for PCB analysis, per media and year.

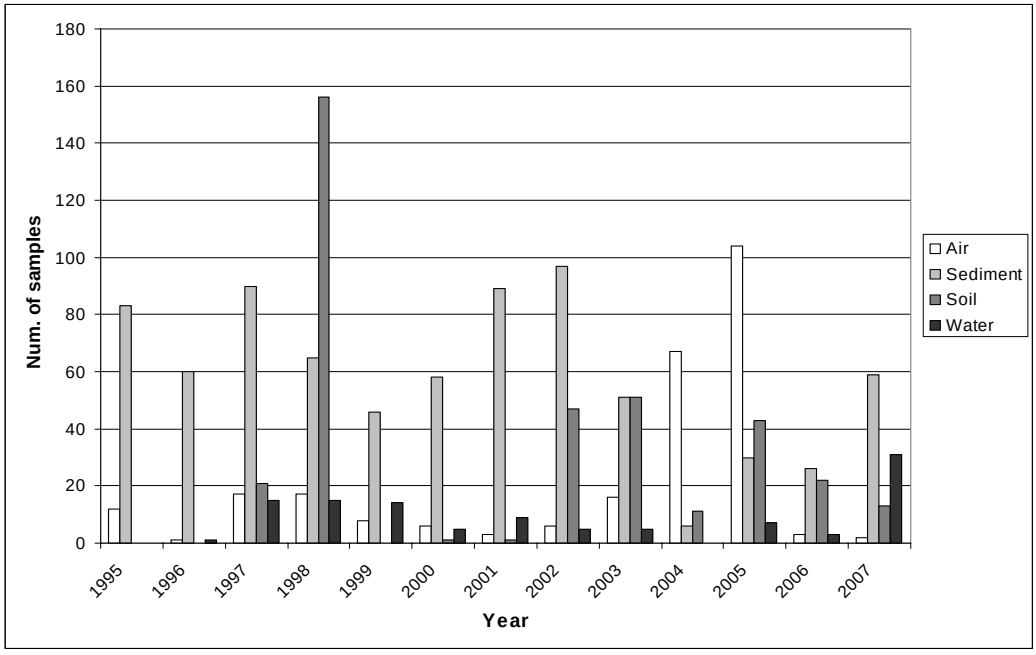


Figure 1: Number of sample points per media and year

The following diagram shows the mobile sum of the number of samples over three years, i.e. each year plus its previous and following years.

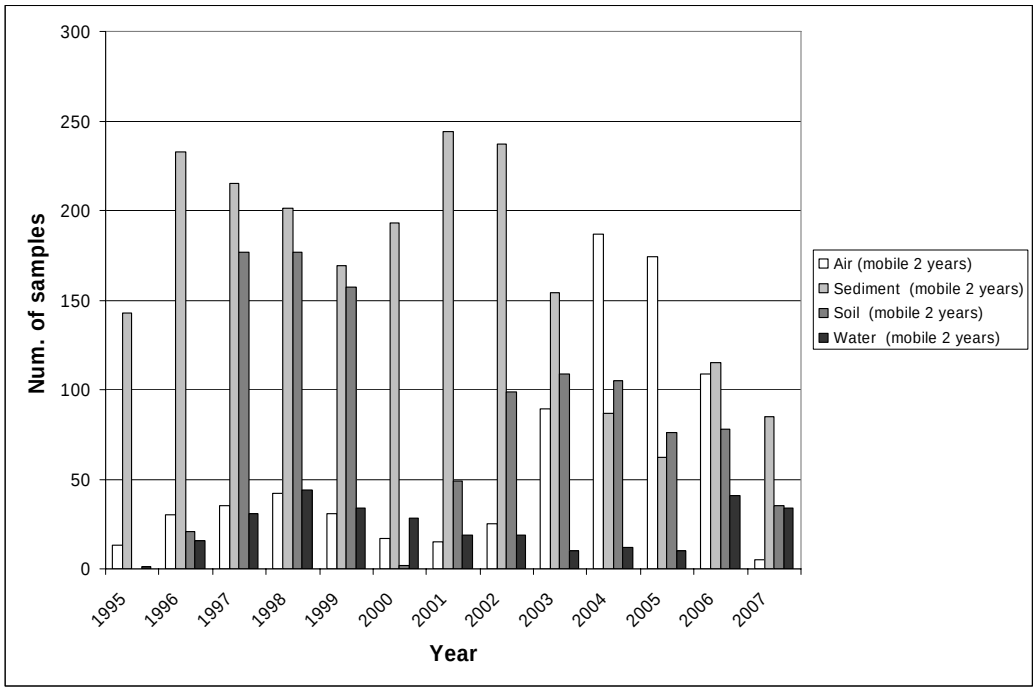


Figure 2: Mobile sum of the number of samples, per media and year

From the number of samples per year and the mobile sum charts, the following can be observed:

- the water samples are much less frequent than the number of samples that can be found for other media
- the year to year variability in number of samples is very high
- pooling together ± 1 year improves the availability of data
- the trend of number of samples in sediments decreases with the years while in air the trend observed increases, and in soil and water remains more or less equal.

The following four charts show the box and whiskers plot for each media, containing the mean concentration (+/- the standard deviation) of observed total PCBs, and their the median. Statistics are computed on the whole dataset for Europe.

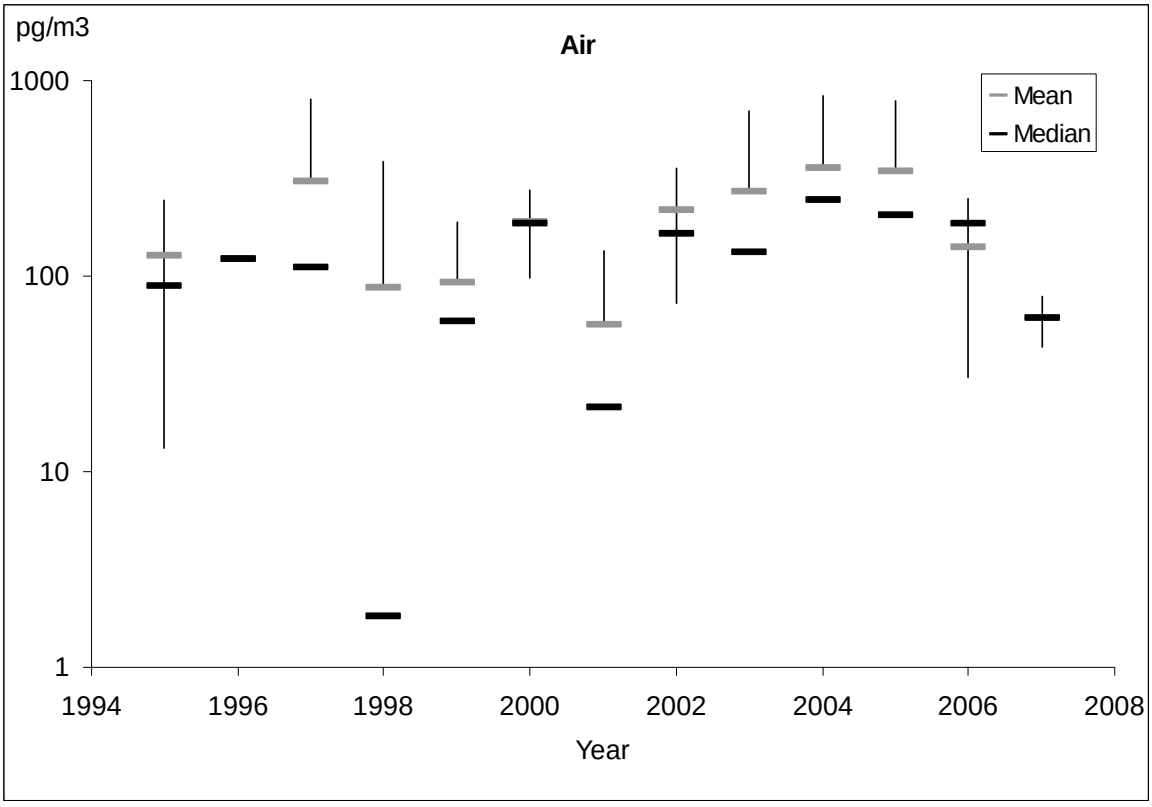


Figure 3: box and whiskers plot showing the air PCBs data distribution per year

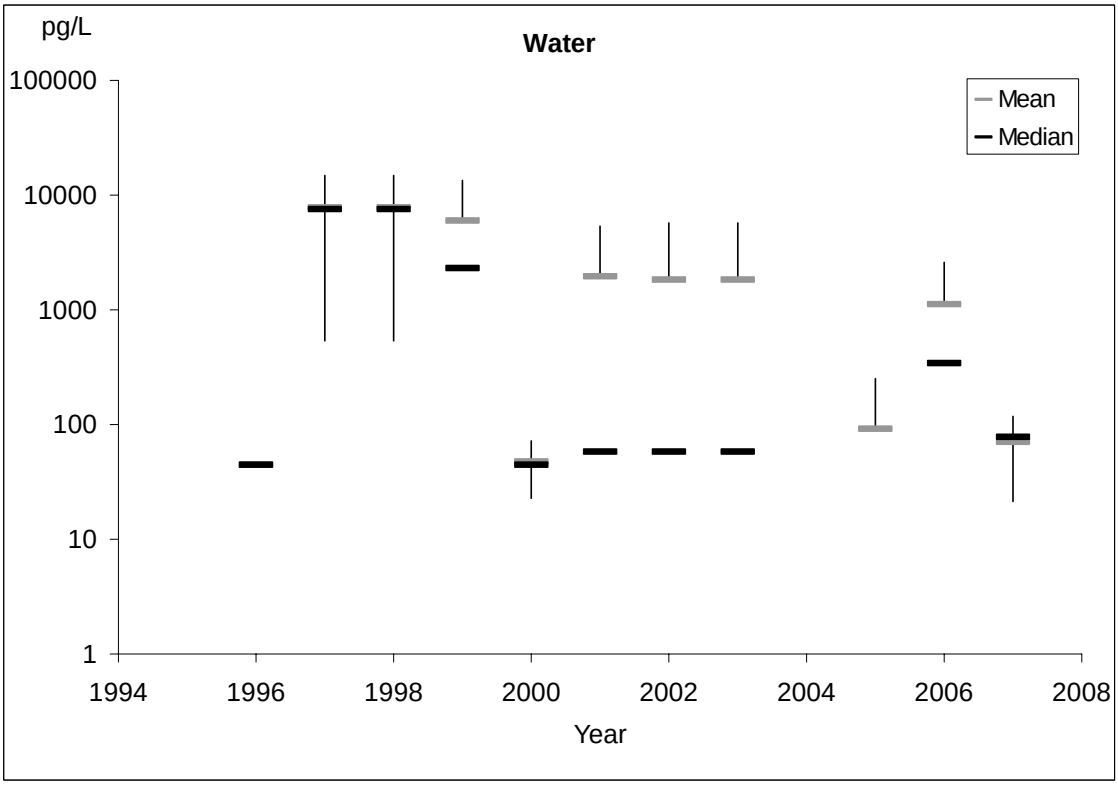


Figure 4: box and whiskers plot showing the water PCBs data distribution per year

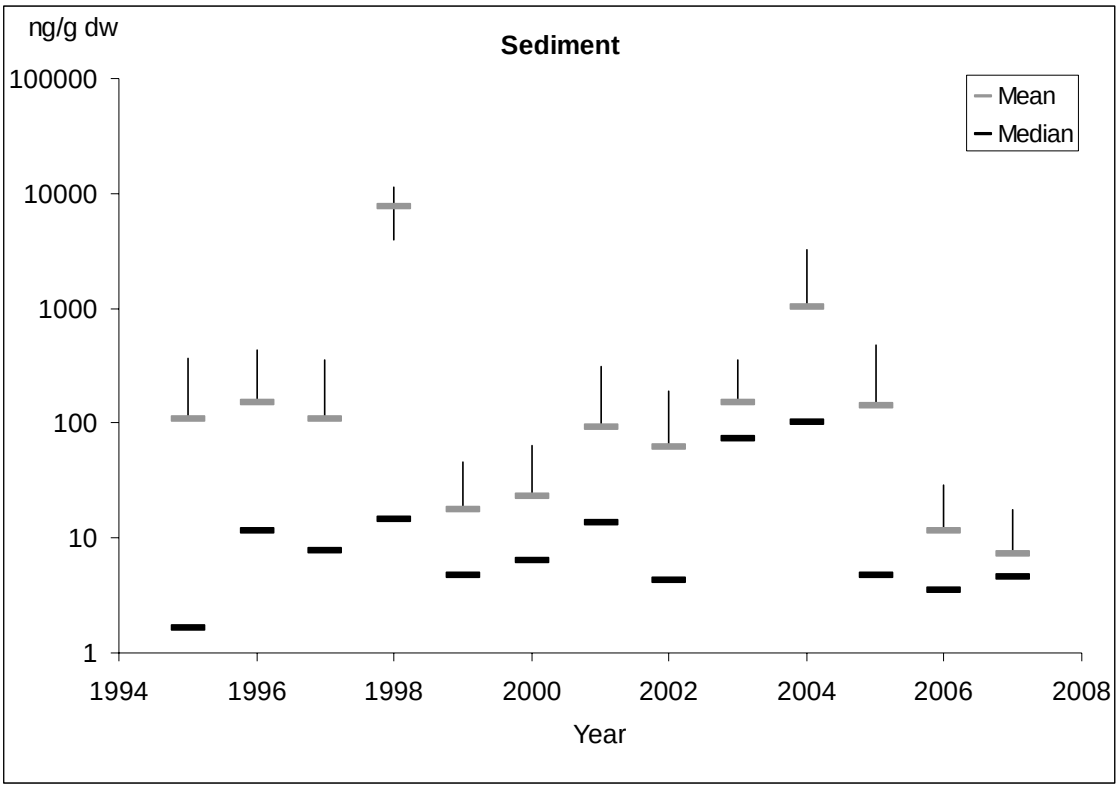


Figure 5: box and whiskers plot showing the sediment PCBs data distribution per year

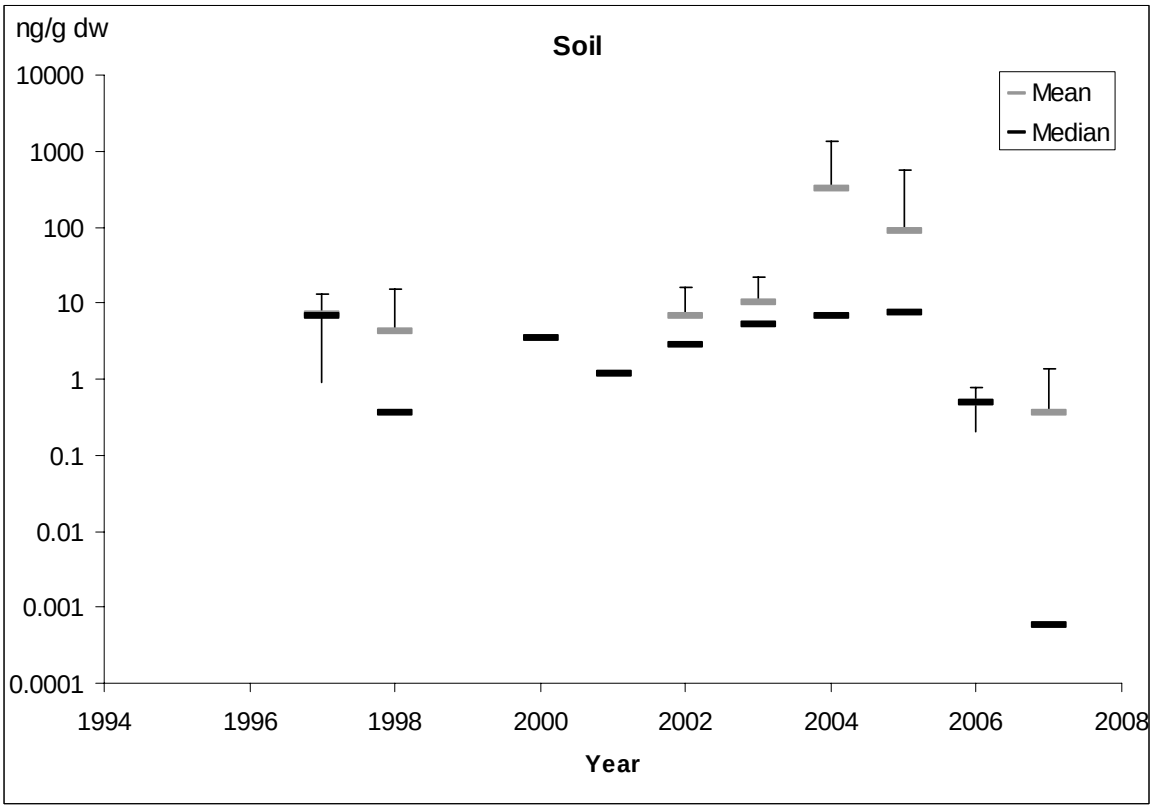


Figure 6: Diagram box showing the soil PCBs data distribution per year

The plots highlight no significant trend regarding PCBs concentration in time, in any of the media considered.
The following charts show the histograms of concentration of PCBs for each media.

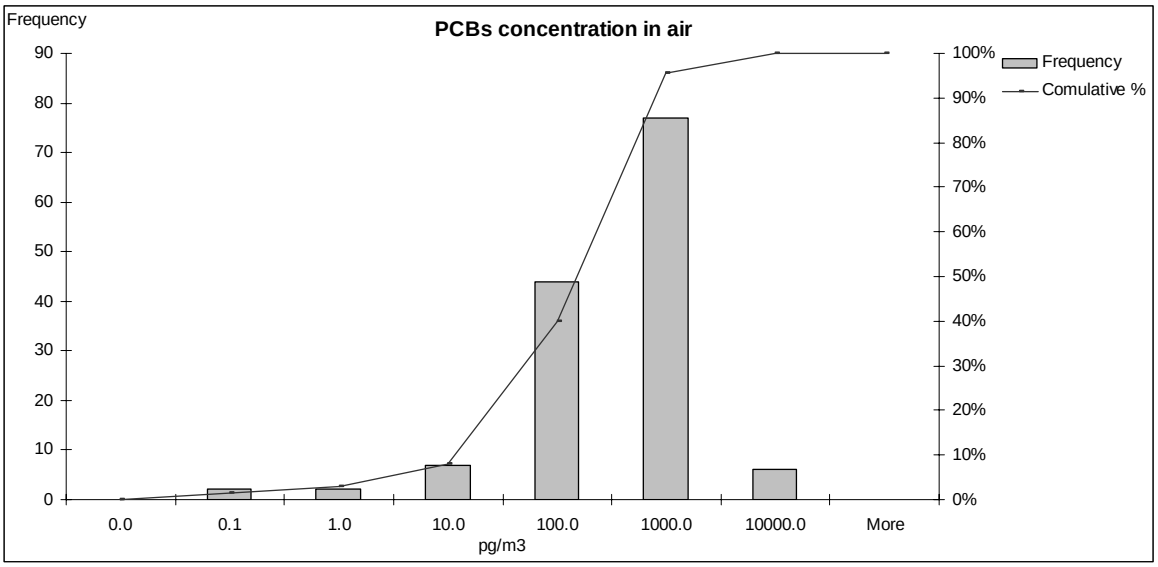


Figure 7: PCBs concentration in air

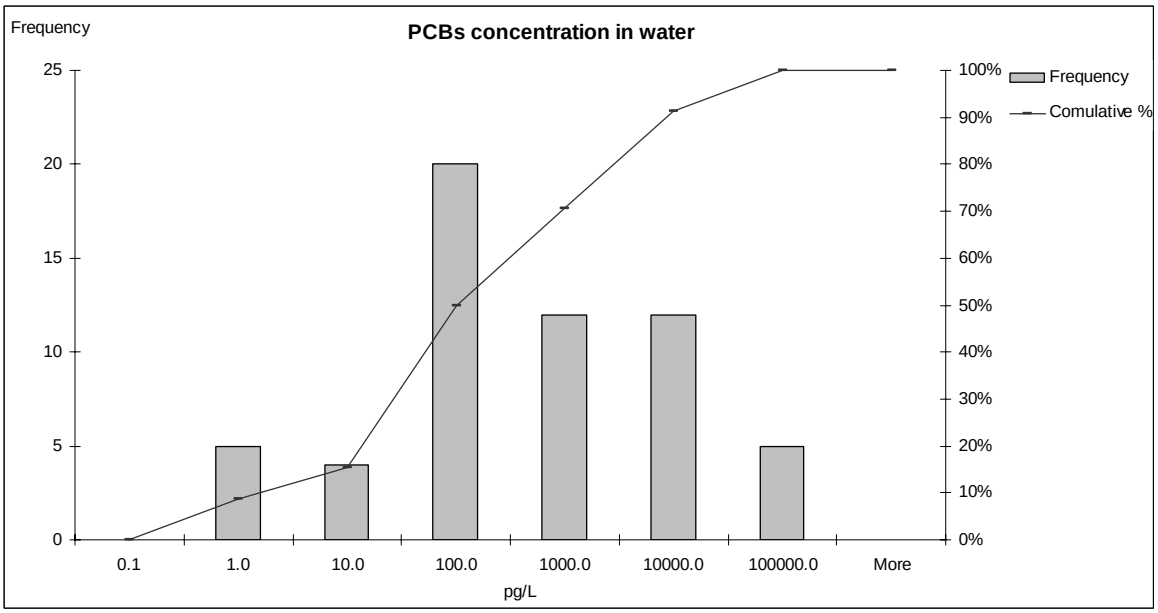


Figure 8: PCBs concentration in water

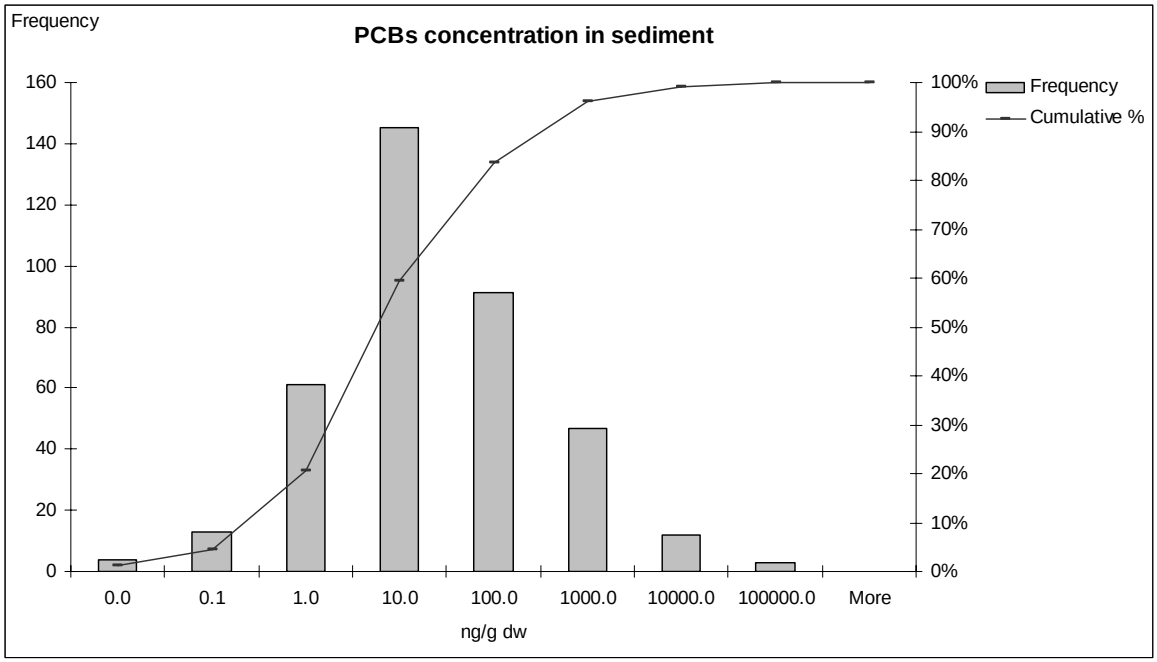


Figure 9: PCBs concentration in sediment

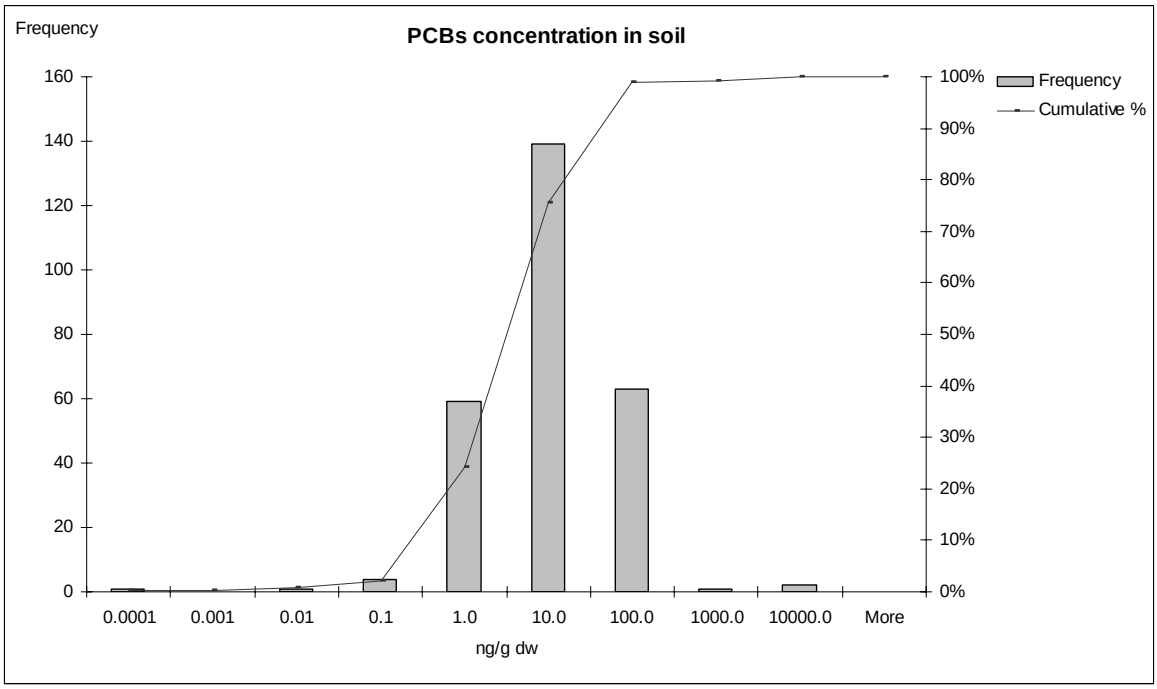


Figure 10: PCBs concentration in soil

The previous figures show outlier-like values for each media. In the case of air, the highest values belong to sample points located in urban areas. The same happens with soil: the highest values correspond to values at Zadar, Croatia (Picer, 2006). In the case of water, the highest values correspond to the study done by Telli-Karakov, in 2002, in the Izmir Bay, in Turkey. In sediments the highest values correspond to a sample point at the coast of Belgium, where there is a strong influence from a river whose catchment has a large urban and industrial burden.

The following maps show the spatial distribution of the sampling points by media.

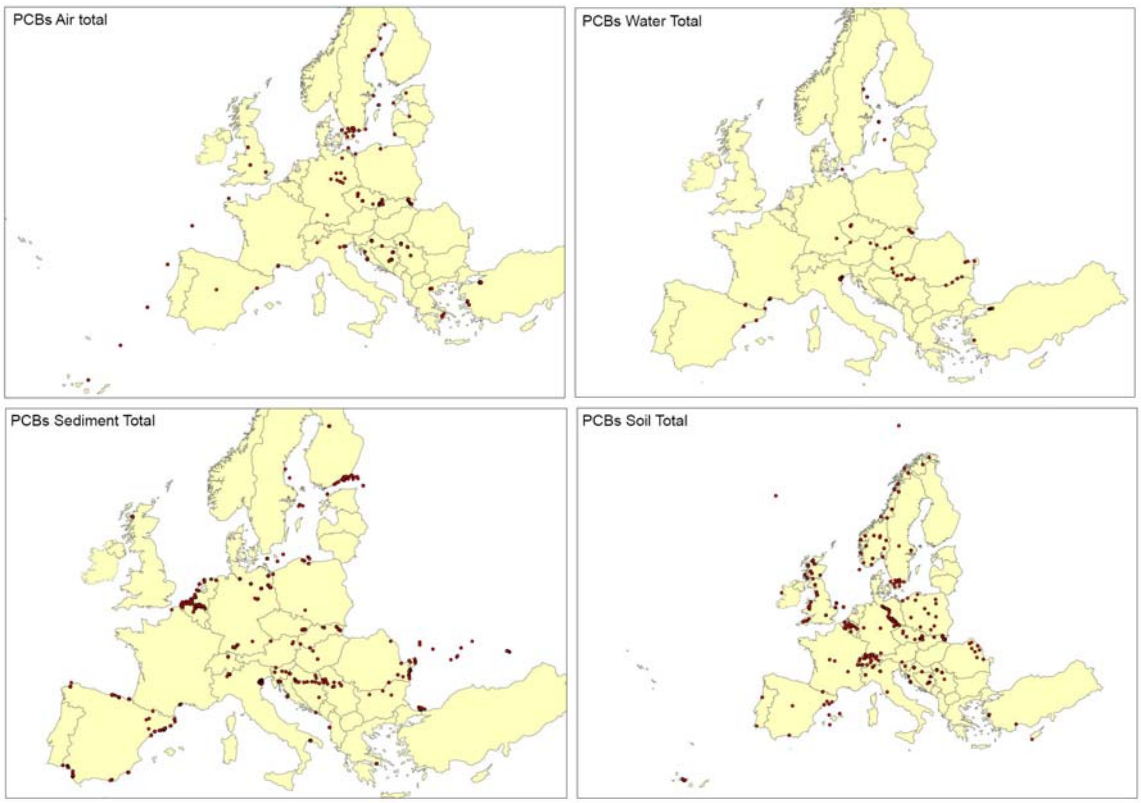


Figure 11: Maps showing the distribution of the sampling points per media

The maps show that the samples are reasonably evenly distributed in Europe in the case of soils. For air, water, and sediments, the spatial distribution seems to be more clustered into a few focus areas. Original spatial sampling campaigns (such as the above mentioned JDS2 for Danube) clearly determine focus areas in the above maps. It's also interesting to note how, for a specific time window, the studies appear to be more clustered in specific regions rather than being homogeneously distributed, as shown in annex 1 where the geographic distribution of the sample points, grouped by moving time windows of three years, is presented for further detail.

An important issue when comparing ambient levels of PCBs is the high variability on the number and type PCB congeners reported depending on the study. In addition, not all PCB congener gives the same information. For example, dioxin-like PCB (DL-PCBs) may give more toxic effects related information whereas 'indicator' PCB (except CB-118) gives an idea of the overall spatial distribution of PCBs in the environment since these 7 congeners are ubiquous in many environmental compartments. In general, even if there are 209 different PCB congeners, most of the studies only focus on a small subset of them. Moreover, some studies don't specify the individual congeners studied. The following plot shows the percentage of studies grouped by the number of PCB congeners considered. From the graph, it is apparent that 18% of the studies does not provide details on the congeners investigated; 5% concerns the 12 "dioxin-like" PCB congeners, and 23% the 7 indicator PCBs. However, a vast majority (54%) of the studies does not refer to a standard set of congeners, which makes comparisons more difficult as mentioned before (Figure 13). Figure 14 shows the number of samples containing each PCB congener, PCB118 being the most frequent one. Among the 209 PCBs, seven of them are anyway the most frequently studied.

For the PCB 118, which is the most frequent in the PCBs data collected, Figure 12 shows the mobile sum of the number of samples for each year, ± 1 year.

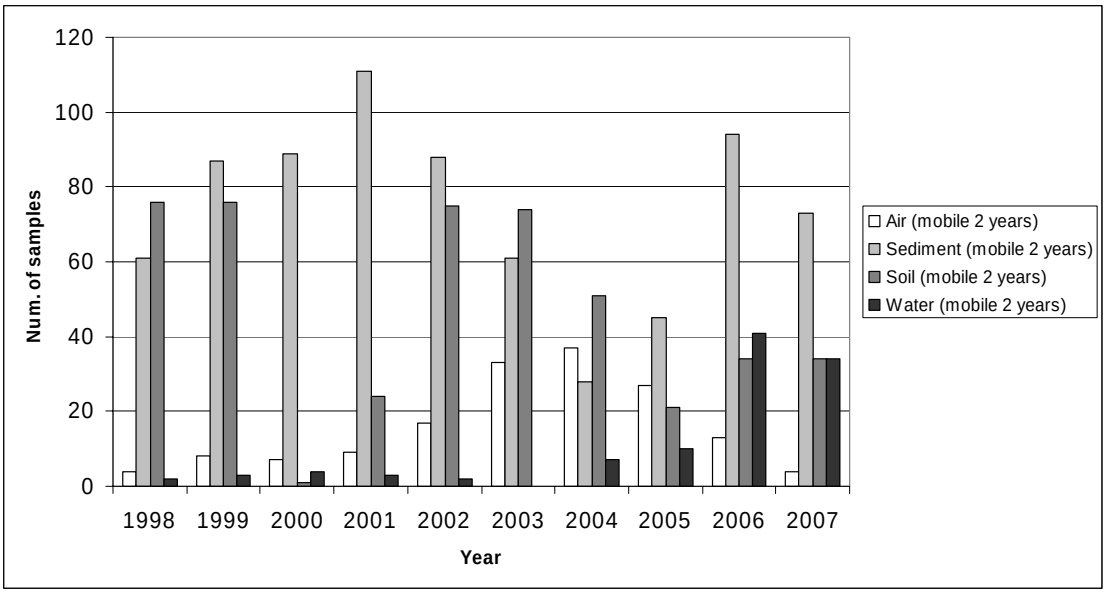


Figure 12: Mobile sum of the number of samples analysed for PCB118, per media and year

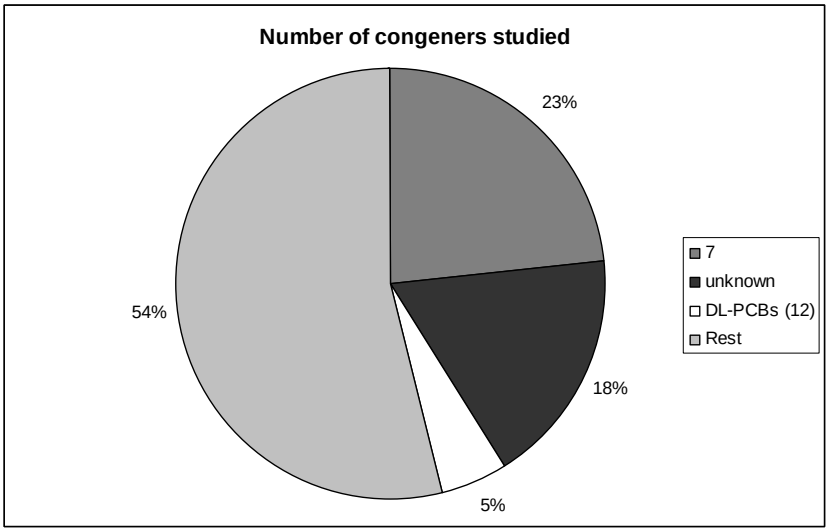


Figure 13: Groups of PCB congeners studied in each study. (DL-PCBs means "dioxin-like PCBs")

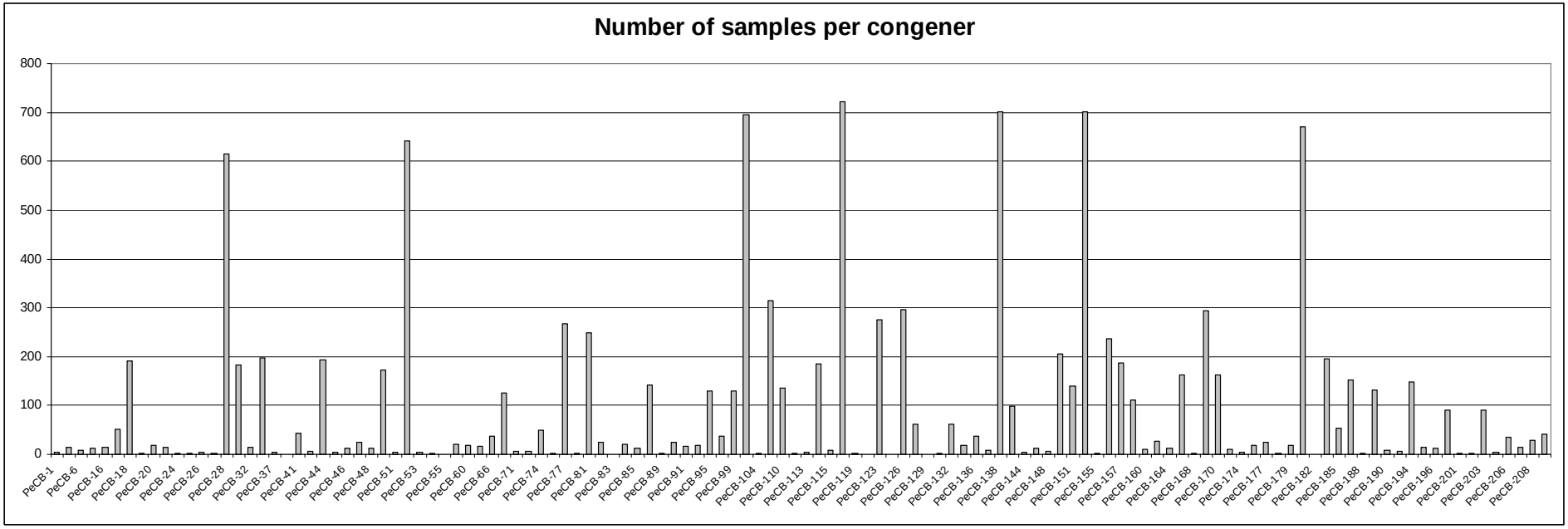


Figure 14: number of samples per PCB congener

In air and water, PCBs are analyzed sometimes just on gas (dissolved) phase, or particulate phase, and some other times on both phases. Some studies don't specify any difference among phases (so the phase is unknown), or the sum of both. The following table shows the percentages for phase distribution for air and water.

Air phases	Total
Air (gas+particle) Phase	55,33%
Air (gas phase)	41,00%
Air (part phase)	3,67%

Table 2: percentage of phase distribution in air studies

Water phases	Total
Water (Dissolved phase)	52,78%
Water (Dissolved + particle) phase	38,89%
Water (phase unknown)	8,33%

Table 3: percentage of phase distribution in water studies

3.2 PCDD/Fs

The following chart shows the number of sample points obtained, per media and year:

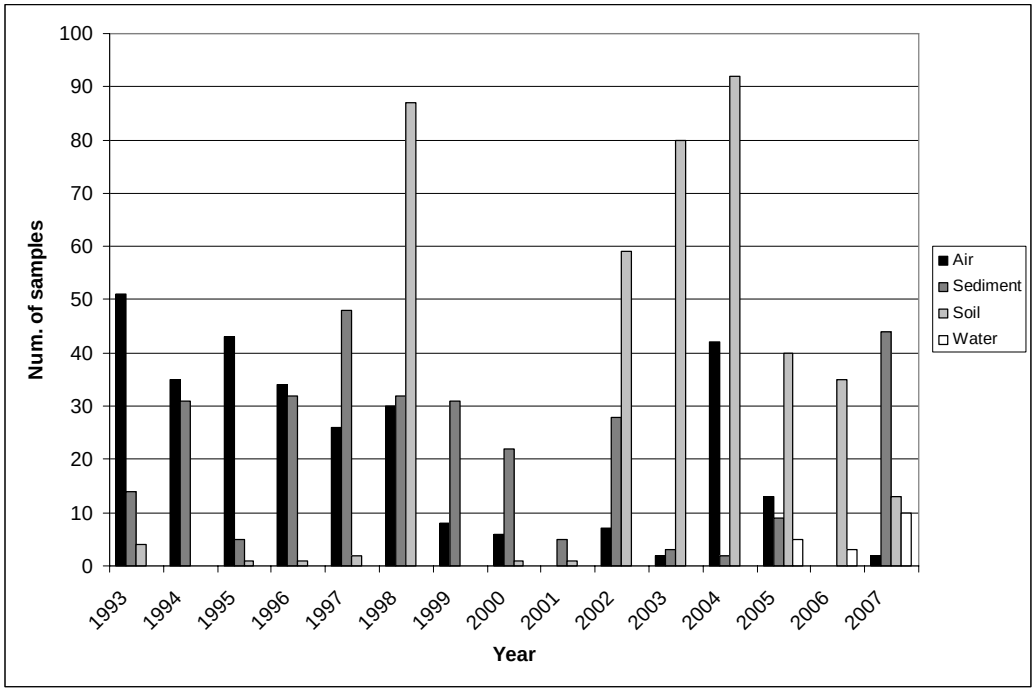


Figure 15: PCDD/Fs number of samples per year and media

The following diagram shows the mobile sum of the number of samples over three years, i.e. each year plus its previous and following years.

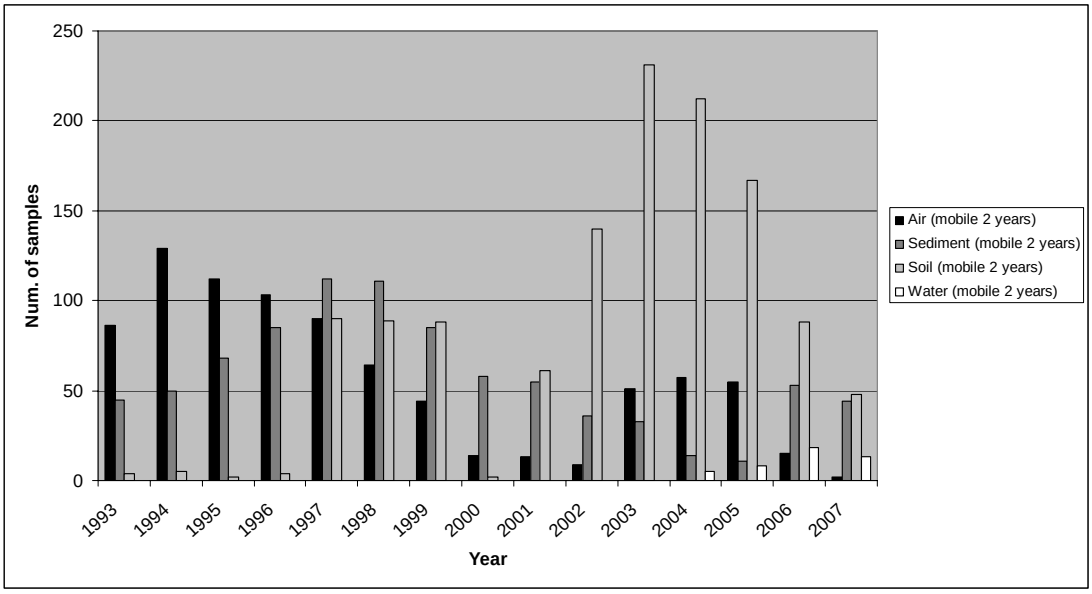


Figure 16: Mobile sum of the number of PCDD/Fs samples, per media and year

From the above charts, it can be observed that the water samples are much less frequent than the number of samples that can be found for other media; before 2004 there were no water samples and the year to year variability in the number of samples is very high; pooling together mobile time windows of three years improves the availability of data.

The following four charts show the diagram boxes for each media (containing the average concentration of total PCDD/Fs observed, the median, and +/- the standard deviation for each year).

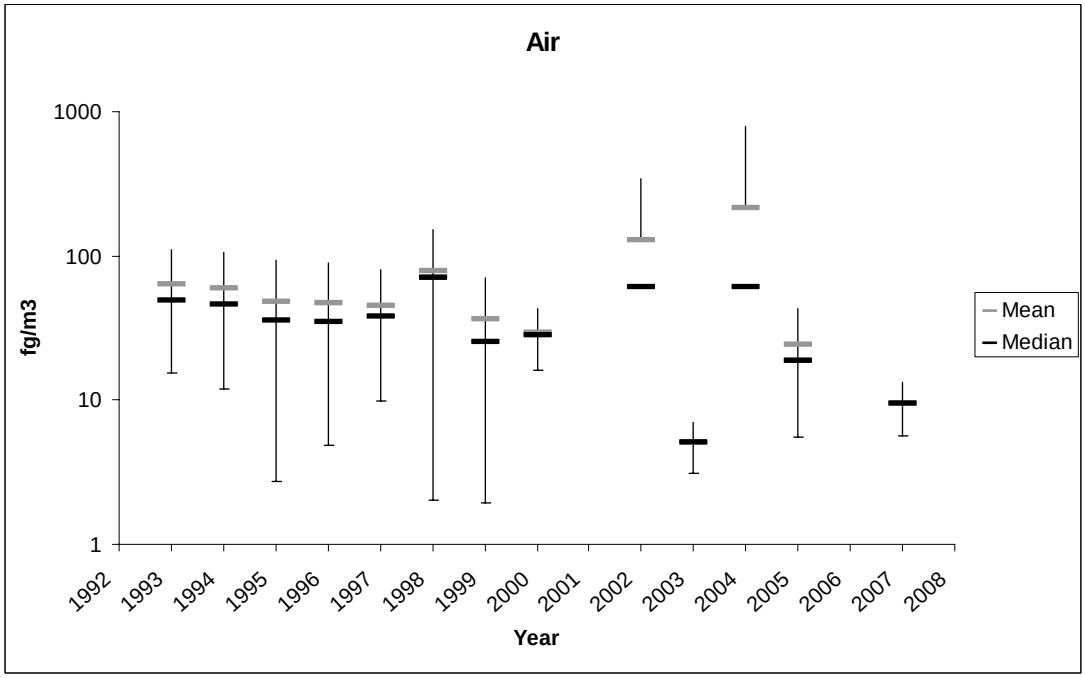


Figure 17: box and whiskers plot showing the air PCDD/Fs data distribution per year

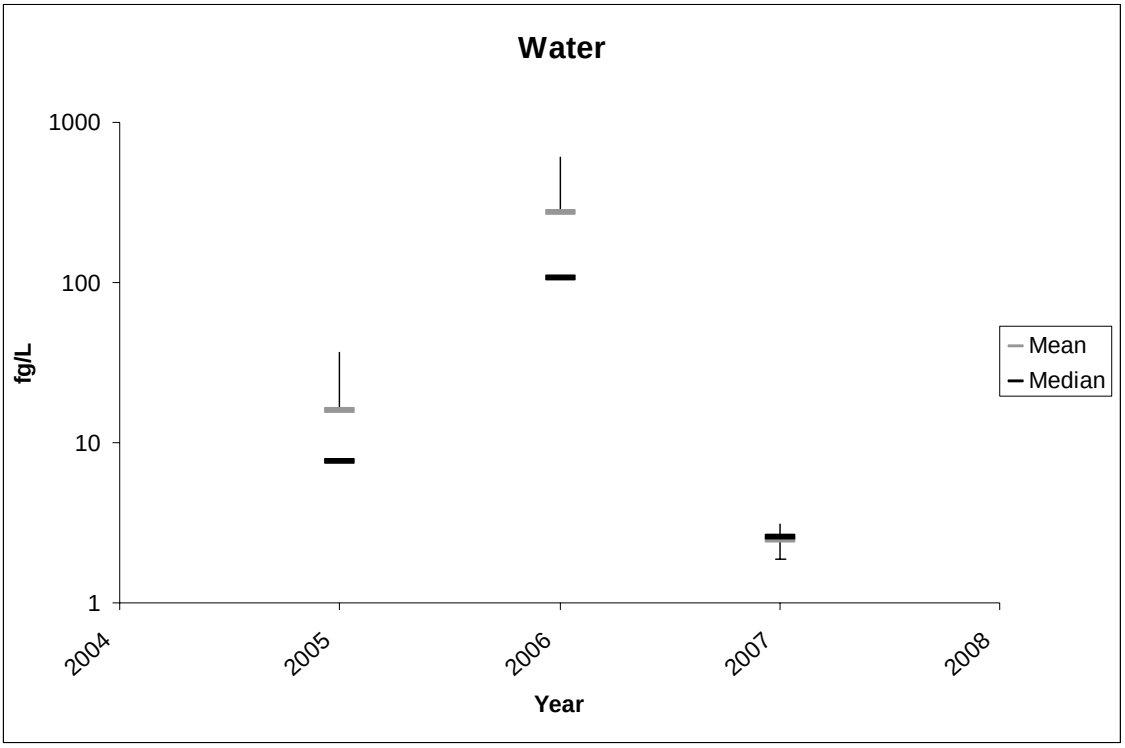


Figure 18: box and whiskers plot showing the water PCDD/Fs data distribution per year

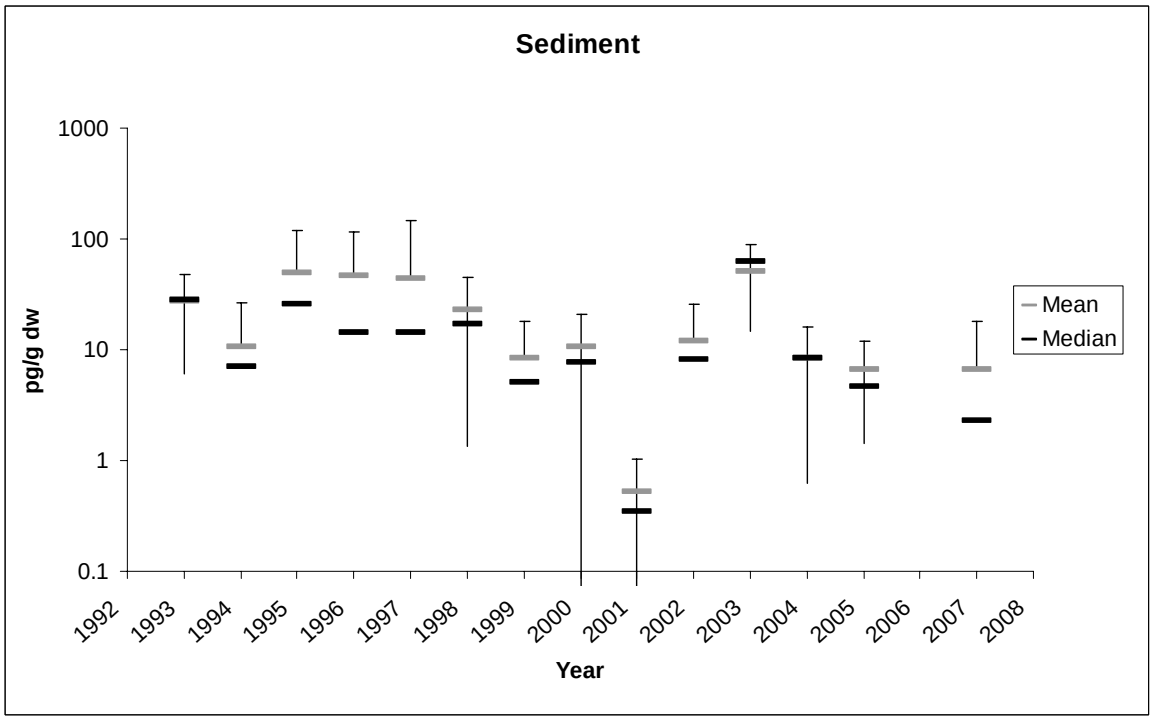


Figure 19: box and whiskers plot showing the sediment PCDD/Fs data distribution per year

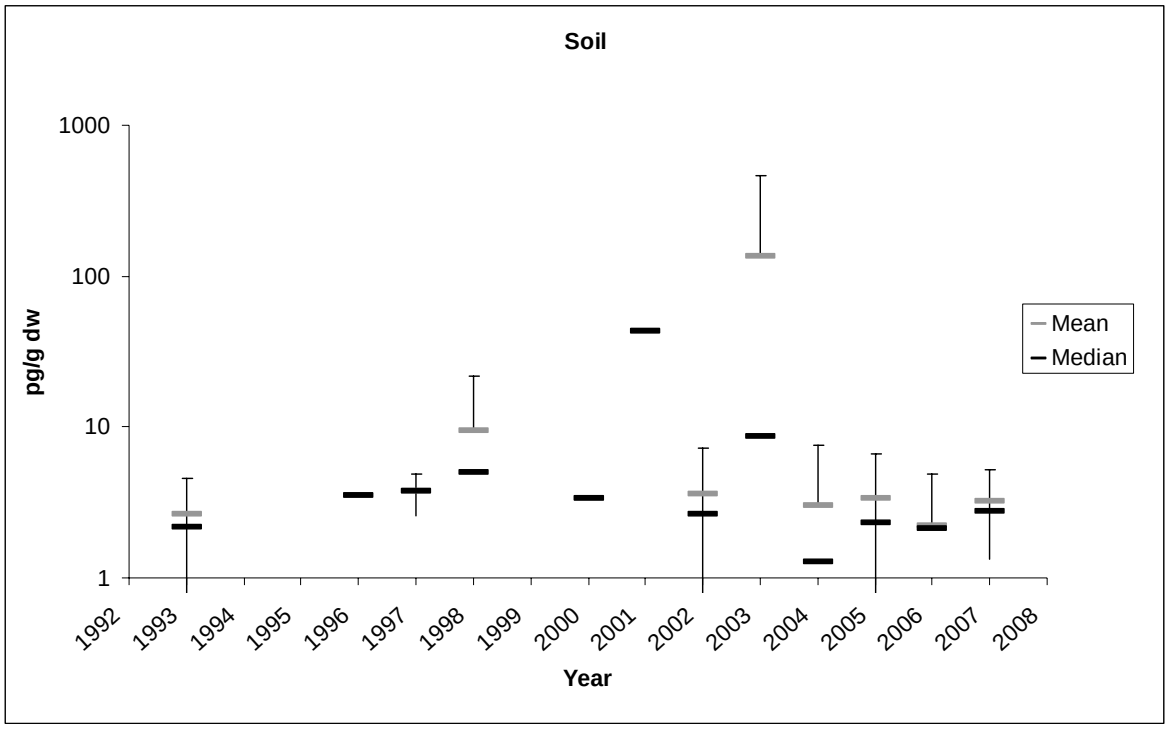


Figure 20: box and whiskers plot showing the soil PCDD/Fs data distribution per year

The box and whiskers plots don't show any clear trend for any of the four media studied.

The maps of Figure 21 show the spatial distribution of the sampling points by media. In the case of PCDD/Fs, the best geographic coverage is for soils and sediments. However, the spatial distribution of samples is always clustered in focus areas.

It's also important to stress that the number of PCDD/F congeners analysed in each case do not vary very much, all the studies only focusing on a subset of the many congeners. The following table highlights that the majority of the studies focuses on 17 congeners.When congeners are not reported, most of the times this is due to concentrations being below the level of detection.

Number congeners	Total
17	75,89%
5	23,25%
2	0,85%

Table 4: Percentage of studies, according to the number of PCDD/Fs congeners studied

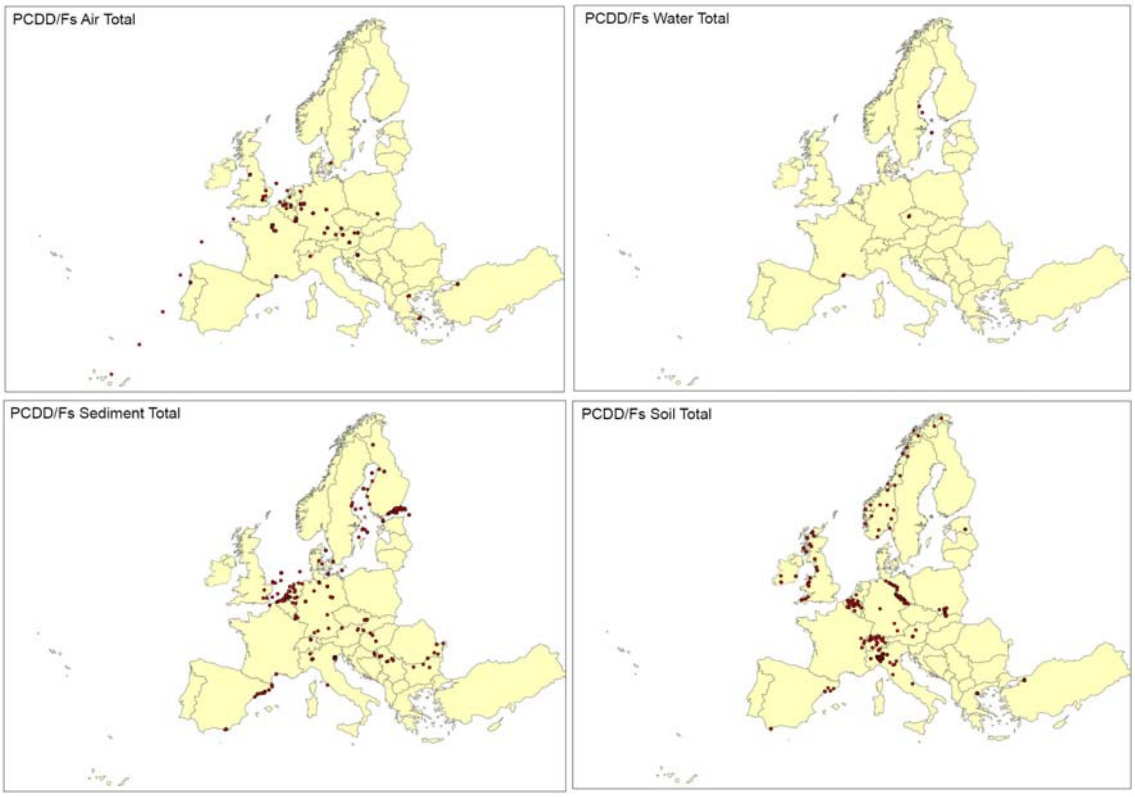


Figure 21: Maps showing the geographic distribution of the samples, per media. "Total" means that maps display the whole dataset.

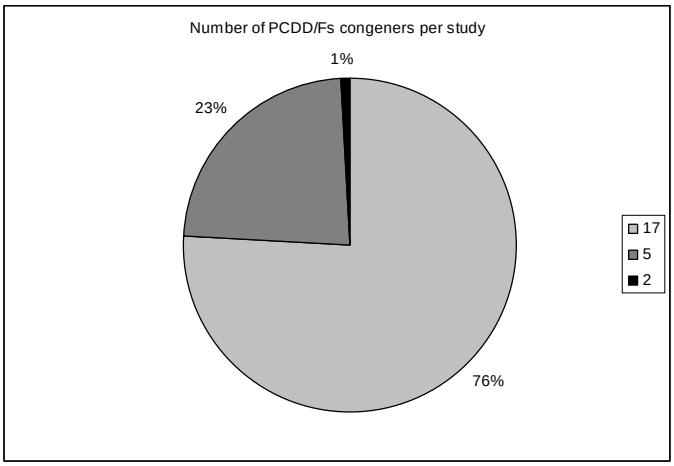


Figure 22: of studies, according to the number of PCDD/Fs congeners studied

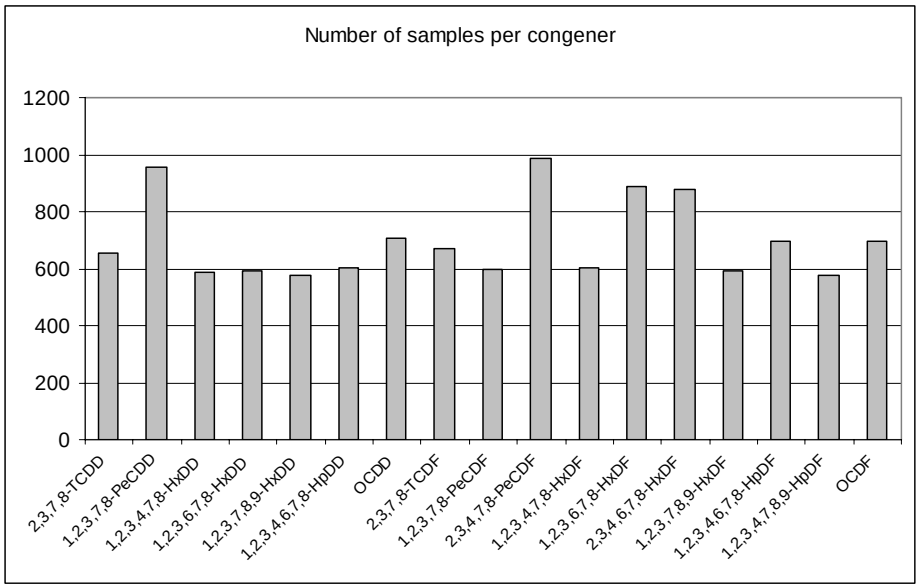


Figure 23: number of samples per PCDD/Fs congener

The majority of the studies represented the total PCDD/F concentration in terms of WHO-TEQ (65% of the studies), while the rest refer to I-TEQ (35% of the studies). What about the ones which report absolutes concentrations???)

In air and water, PCDD/Fs are analyzed sometimes on gas (dissolved phase), sometimes on particulate phase. Some studies specify what the concentration in each phase is if they have studied both, some specify one phase or the other, and finally others don't specify the phases of measurement, or provide the sum of both. The following tables show the percentages of occurrence of the phase of measurement for air and water.

Air phases	Total
Air (Gas+particle) Phase	97,58%
Air (phase unknown)	1,21%
Air (part phase)	0,91%
Air (gas phase)	0,30%

Table 5: air phases where PCDD/Fs are described, distribution breakdown

Water phases	Total
Water (Dissolved phase)	72,22%
Water (Particle phase)	27,78%

Table 6: water phases where PCDD/Fs are described, distribution breakdown

4. Spatial correlation

The result of the data collection is a georeferenced database of PCBs or PCDD/Fs concentrations for different years. The first question we might be interested in answering is whether the PCBs have an overall spatial trend in Europe. In order to analyze that, geostatistical techniques should be used.

Data for each environmental medium (air, soil, water, sediments) were selected for each moving time window of one year +/- 1 year and the spatial distribution of concentrations is examined in terms of:

- the variogram cloud
- the variogram surface

- the omnidirectional variogram
- if relevant (if spatial trends are observed), the directional variogram(s) in the directions where a spatial trend is observed in the variogram surface.

For these operations, we used the popular VARIOWIN® software: http://www-sst.unil.ch/research/variowin/.

The variogram cloud indicate the presence of more than one statistically homogeneous population of data within the data set; the variogram surface allows detecting directions of anisotropy; the variograms capture spatialcorrelation and indicate whether the data are, t a certain extent, continuous in space. Further details and the basic concepts of geostatistics can be found e.g. in Clarke, 1979.

In general, all variograms that have been calculated do not indicate strong spatial correlation of the data. This was largely expected given the heterogeneity of the data and their being referred to different study locations in Europe. However, in some cases a less weak spatial correlation emerges as shown in more details in the examples below. In general, a short-range spatial correlation (i.e. a positive slope of the variogram near the origin, or "near trend") indicates spatial continuity of the samples, while a long-range spatial correlation (i.e. a positive slope of the variogram distant from the origin, or "distant trend") indicates continental scale gradients of concentrations. The results discussed in the examples below, and the full set of analysed variographies provided in Annex 2, are to be seen as purely explorative analyses and not to be taken as rigorous geostatistical analyses, which instead would require separating the samples in homogeneous clusters; their purpose is just to giveataste of the type of spatial correlation that may be found in such heterogeneous data set.

In the periods 1997-1999, and 2003-2005, the concentrations of PCBs in soils show some spatial correlation, as the variance grows with distance (Figure 27 and Figure 28 respectively). The variogram clouds show different sills of variance, corresponding to the different clusters of data points in Europe.

For the period 2004-2006, no spatial correlation appears (Figure 29).

With reference to the years 2004-2006, the analysis was repeated using 3 geographical subsets, corresponding to three clusters of samples which are apparent on the map (Figure 30): Belgium, Czech Republic, and the Balkans. However, also in this case spatial correlation is absent (Figure 31, Figure 32, Figure 33).

The same analysis for soil has been made for PCB congener 118, but only for the periods where this PCB congener was more frequent. It apparently shows a spatial correlation as well, especially for the period 1998-2000 (Figure 34), and less so for the other years (Figure 35, Figure 36).

For sediments, result for the period 2001-2003 shows some spatial correlation (Figure 37).

The complete set of the geostatistical analyses prepared are included in Annex 2. A summary of the trends found is provided in Table 7.

The analyses on PCDD/Fs were not conclusive, probably because of the small amount of sample points available. There were more samples for soil, but no spatial correlation was found. The results of the analyses are included in annex 2. A summary of the results is provided in Table 8.

As a benchmark to understand what one may expect in terms of spatial correlation of POPs at the European scale, variograms may be computed for natively spatially distributed datasets. We show here the examples of the passive sampler data concerning PCBs in air described in Jaward et al., 2004, and the data for soils presented in Meijer et al., 2003; these data were used in Pistocchi, 2008, to evaluate a European model of chemical fate. In the following graphs, the variograms are displayed.the passive samplers show no significant spatial correlation (the variogram is almost a pure nugget effect)[1]. On the contrary, soil data show some trend in spatial correlation, which is more pronounced when referring to concentrations normalized by organic matter content. However, the trend is always rather weak with respect to the nugget.

[1] In geostatistical jargon, "nugget" is the variance at very short distance between sample points.

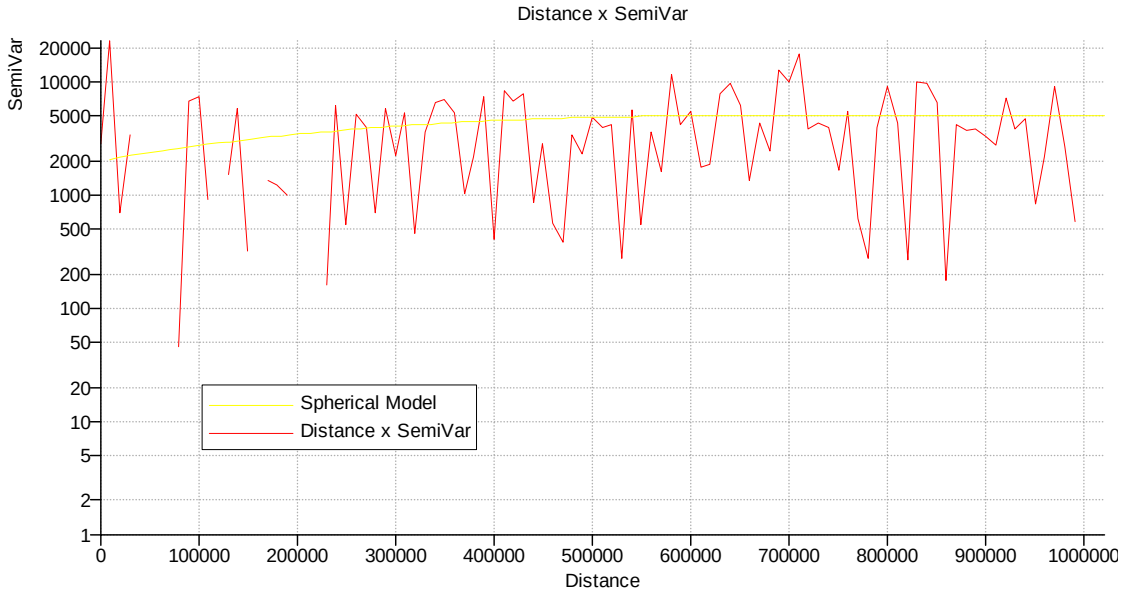


Figure 24 – variogram of the data on total PCB mass in air passive samplers from Jaward et al., 2004

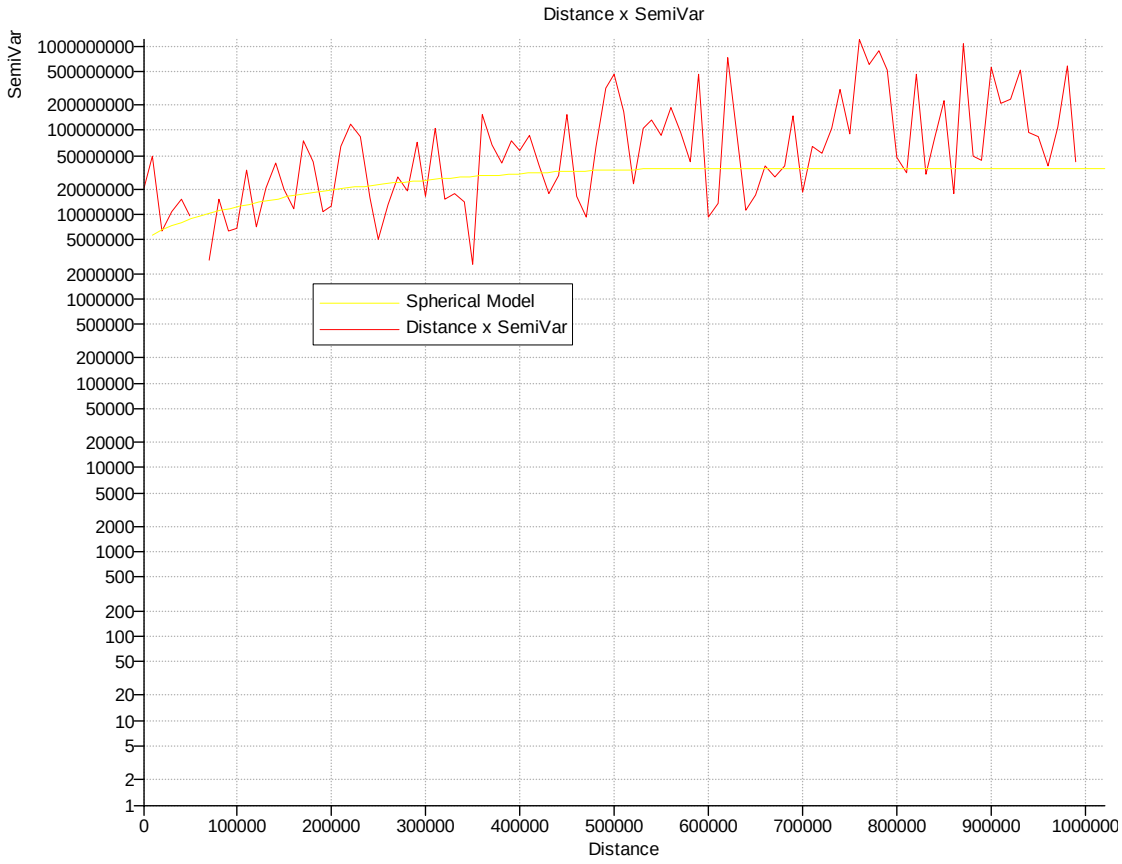


Figure 25 - variogram of the data on total PCB concentration in soil from Meijer et al., 2003

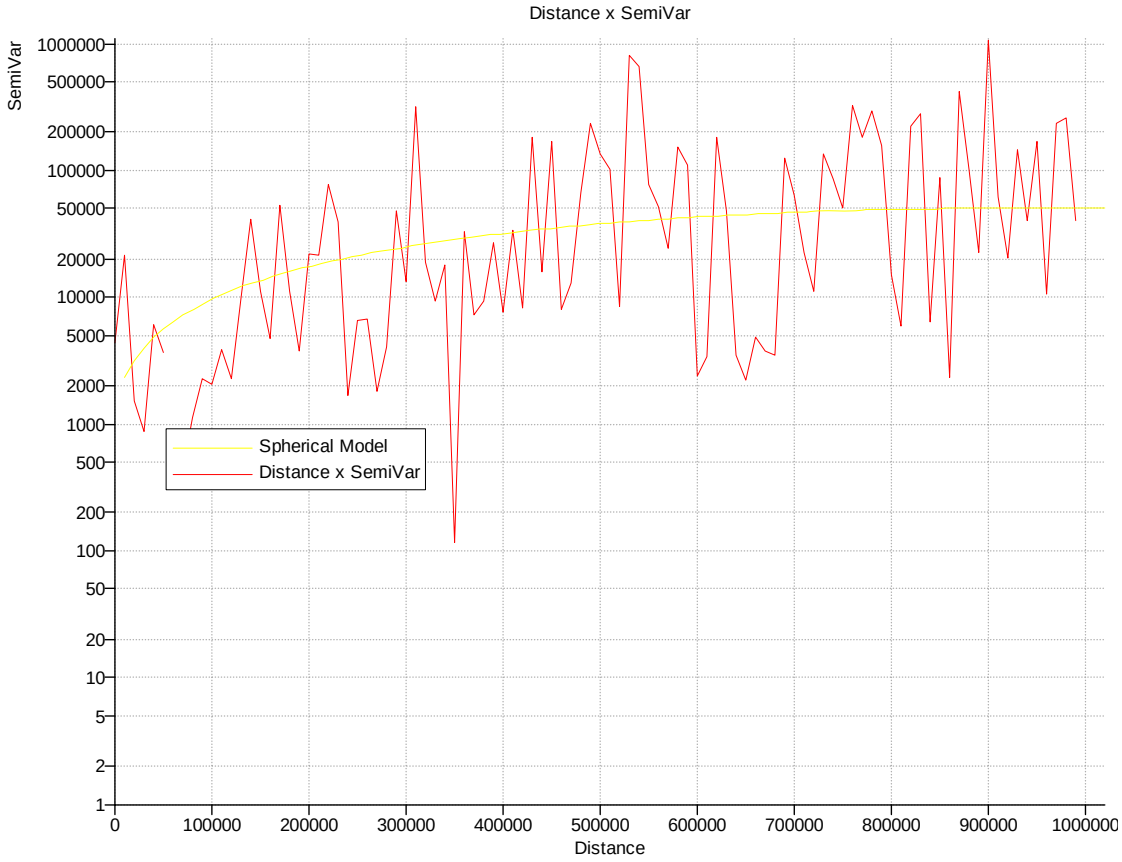


Figure 26 - variogram of the data on total PCB concentration in soil from Meijer et al., 2003; concentration normalized by organic matter content of soils.

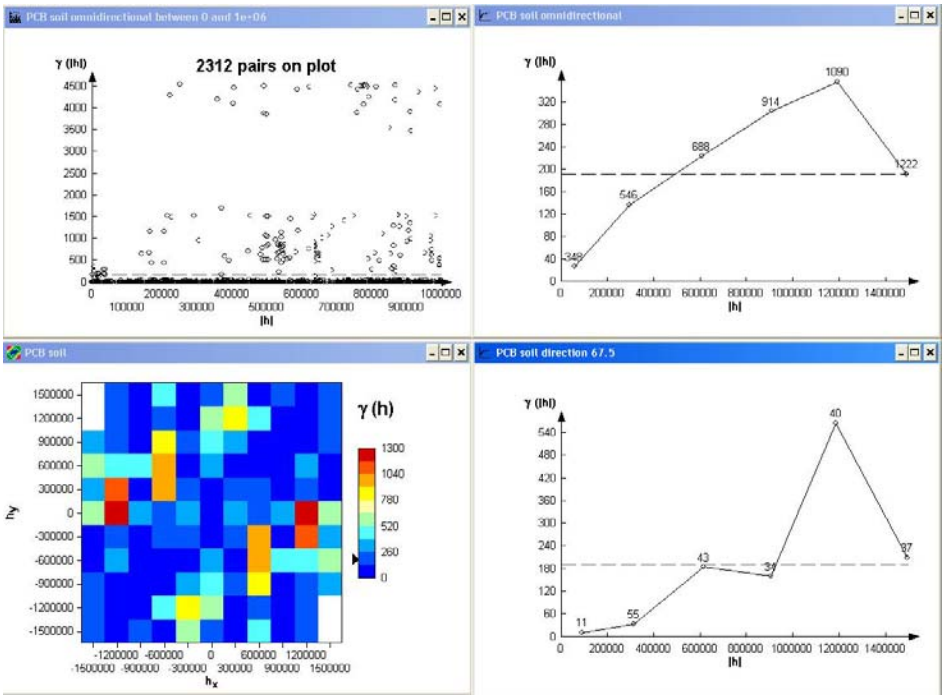


Figure 27: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 1997-1999

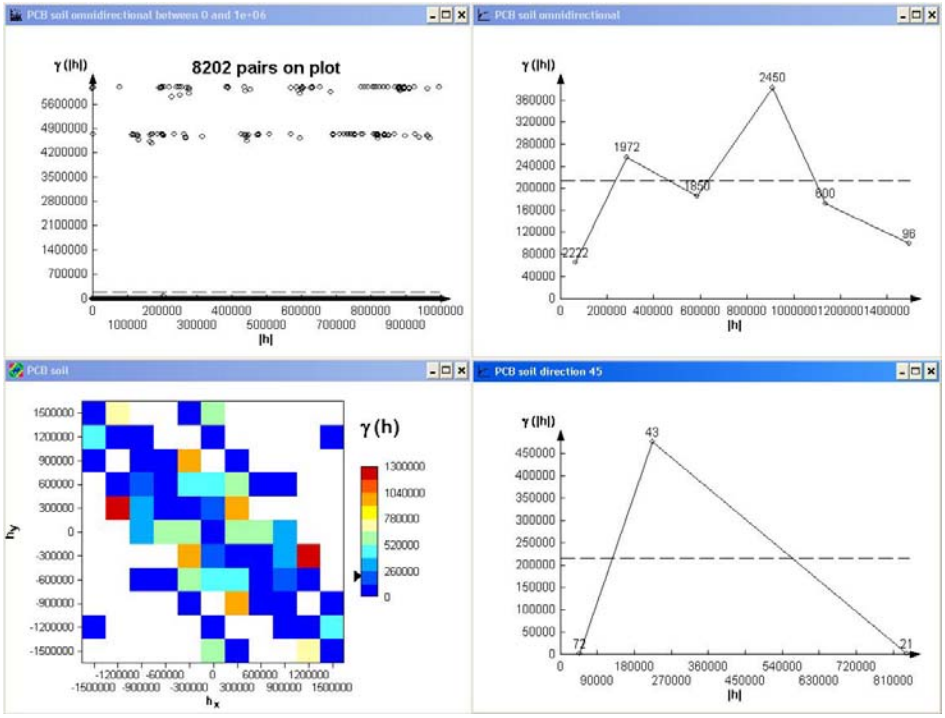


Figure 28: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2003-2005

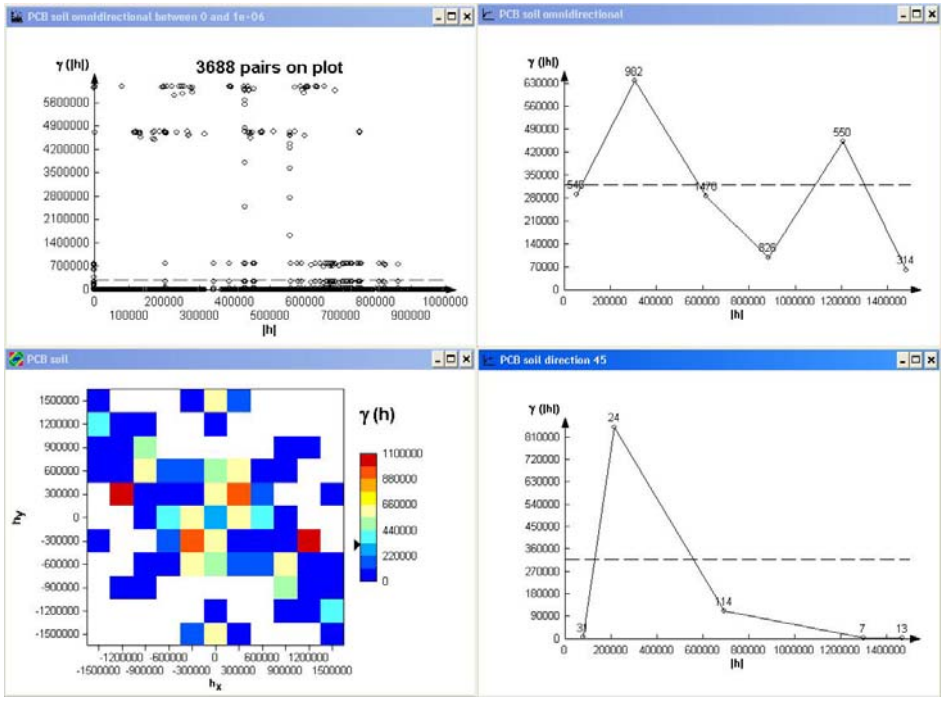


Figure 29: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2004-2006

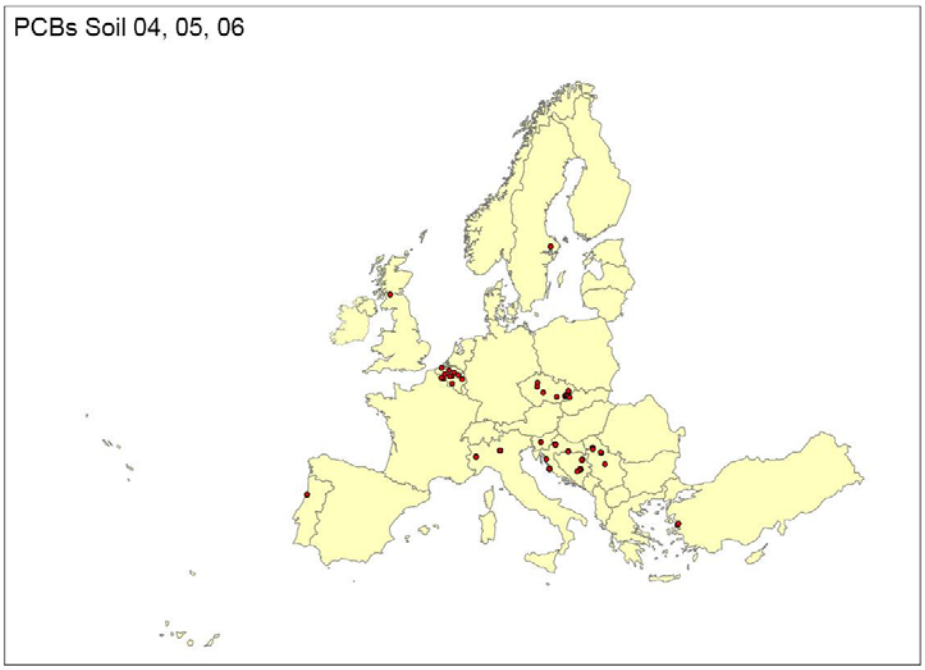


Figure 30: map showing how PCBs samples on soil in the period 2004-2006 are spatially clustered

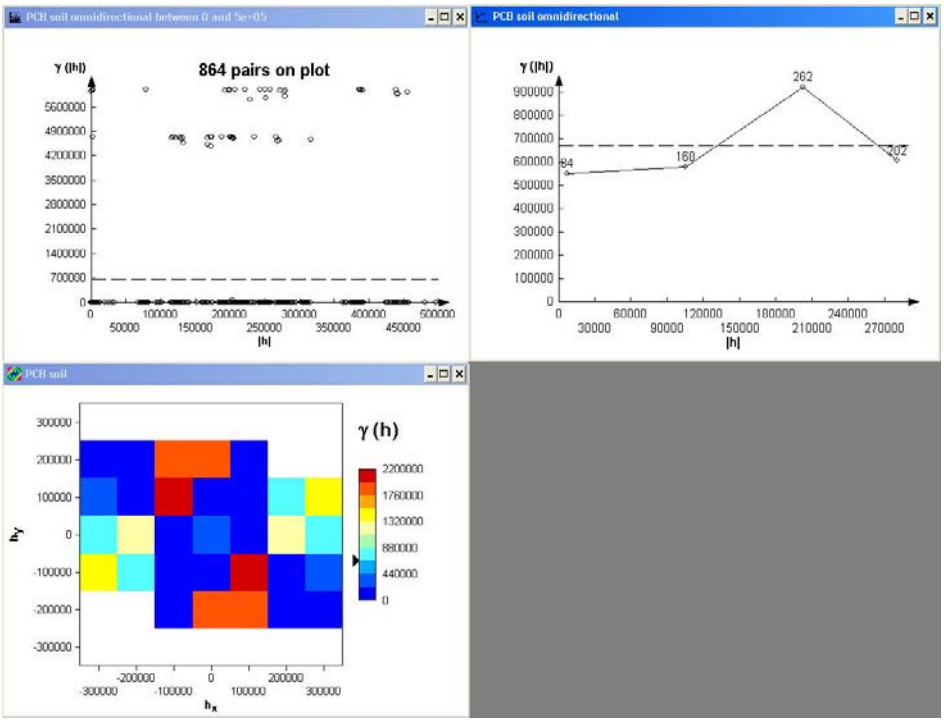


Figure 31: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2004-2006 in the Balkan Peninsula

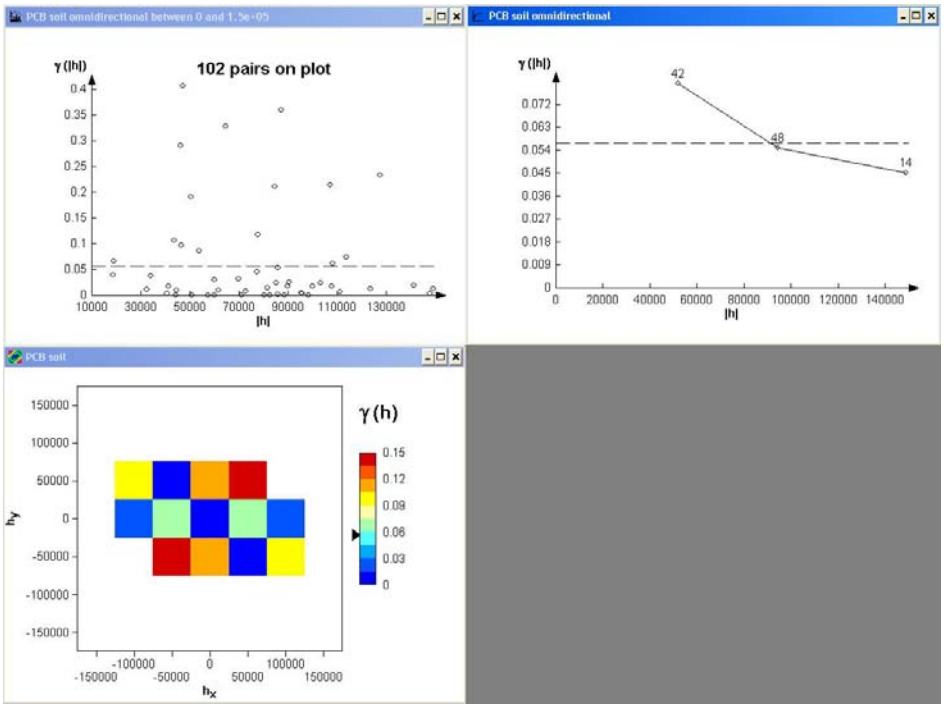


Figure 32: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2004-2006 in Belgium

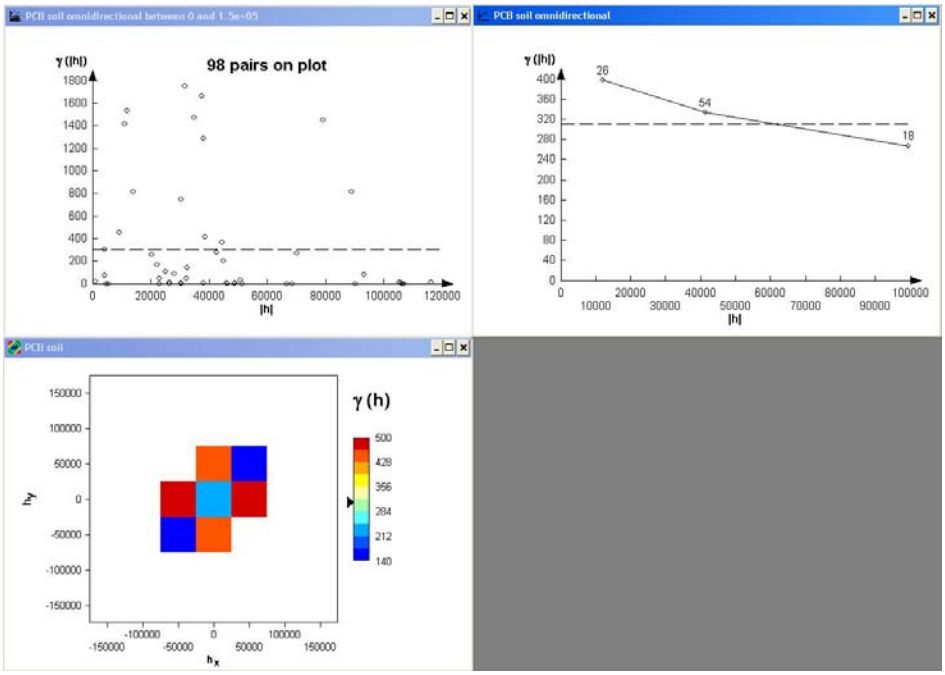


Figure 33: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2004-2006 in the Czech Republic

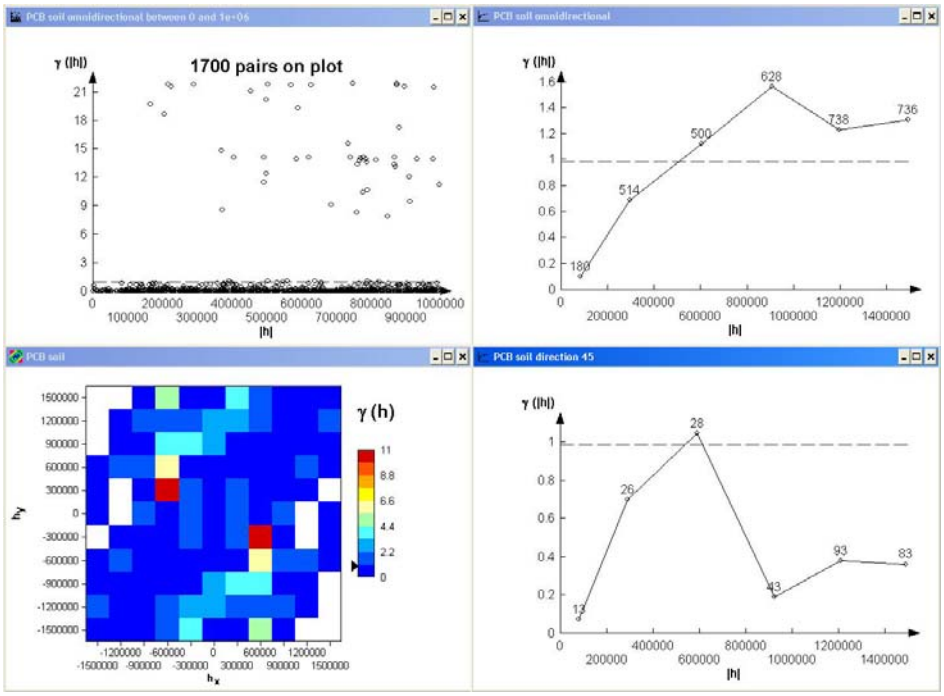


Figure 34: variogram cloud, variogram surface, and directional variograms for the PCB 118 soil concentrations, period 1998-2000

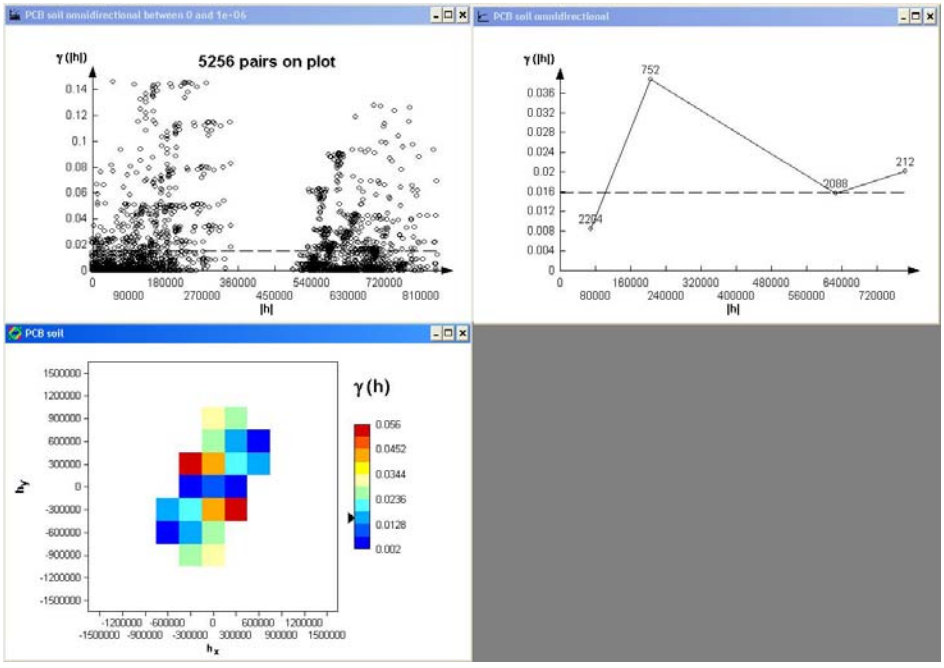


Figure 35: variogram cloud, variogram surface, and directional variograms for the PCB 118 soil concentrations, period 2001-2003

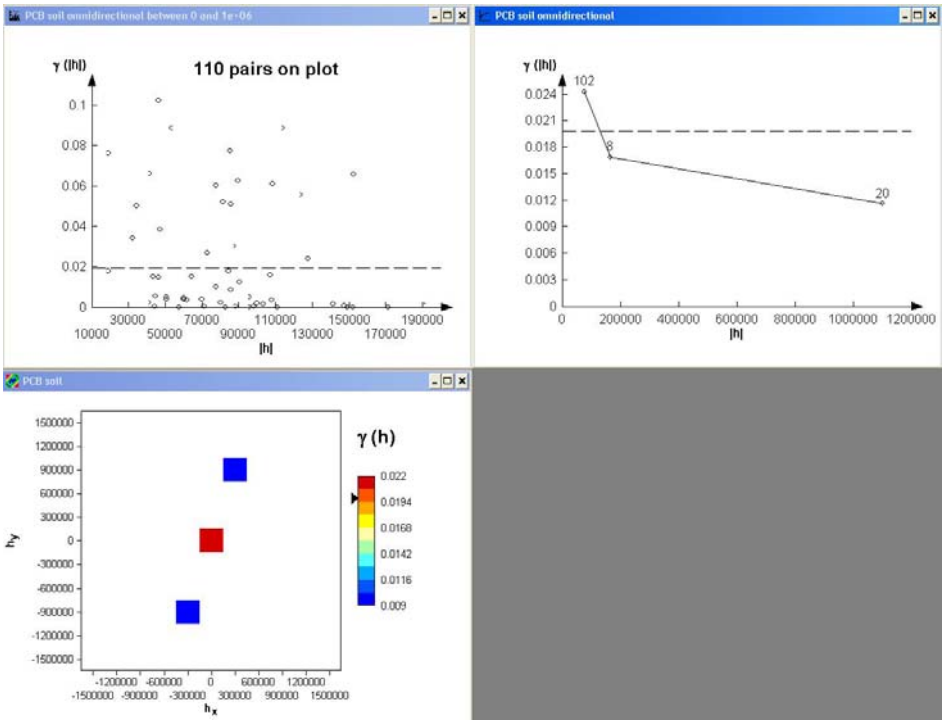


Figure 36: variogram cloud, variogram surface, and directional variograms for the PCB 118 soil concentrations, period 2005-2007

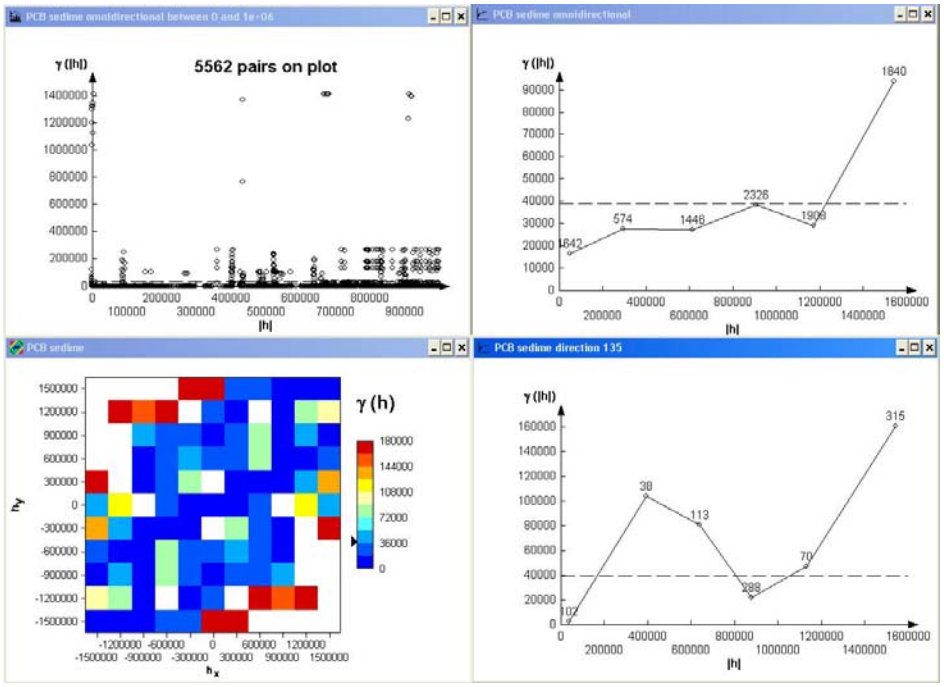


Figure 37: variogram cloud, variogram surface, and directional variograms for the PCBs sediment concentrations, period 2001-2003

		Tri-annual period	Near trend	Distant trend	No trend
PCBs	Soil	1996-1998	x		
		1997-1999	x		
		1998-2000	x		
		2000-2002	x	x	
		2001-2003		x	
		2002-2004			x
		2003-2005	x		
		2004-2006			x
	Sediment	1998-2000			x
		1999-2001	x	x	
		2001-2003		x	
		2005-2007			x
	Water	2005-2007	x		
	Air	2005-2007	x	x	

Table 7: Summary table showing the geostatistical trends analyzed for PCBs

		Tri-annual period	Near trend	Distant trend	No trend
PCDD/Fs	Soil	1998-2000	x	x	
		2002-2004		x	
		2004-2006			x
	Sediment	1994-1996			x
		1996-1998			x
		1998-2000			x
		2001-2003			x
		2005-2007			x
	Water	2005-2007		x	
	Air	1994-1996			x
		1996-1998			x
		1997-1999			x
		2002-2004			x
		2004-2006			x

Table 8: Summary table showing the geostatistical trends analyzed for PCBs

5. Conclusions

Building a database of monitored concentrations of PCBs and PCDD/Fs entails considerable efforts. For the database presented here, an equivalent 2 man-months of bibliographic research by non-specialist scientific support personnel was invested, which gives an idea of the cost of compilations of data. The data collected show a relatively high heterogeneity, as environmental data from various local, small scale projects may have an enormous spatial and seasonal difference. The latter, for air and vegetation data, when sampled in different seasons may bring in a factor of 10 variations for dioxins, and little less for PCBs. In water the variability may be even higher. The variation in time shown by the data seems to be affected by the combination of different spatial clusters of data; also the evolution in time of the different experimental setups may have an influence. A time series of measurements at a single given location is the one way to assess the temporal trends of chemical concentrations. An option is to refer to existing (and increasingly available) monitoring stations such as the ones described in the German UBA report "Dioxine, Daten aus Deutschland - 5. Bericht" (http://www.umweltdaten.de/publikationen/fpdf-l/3328.pdf) or the EMEP network (although not all

Europe is so far covered; Castro-Jiménez et al. 2009). Different data series should be compared using normalized data or the time derivatives of concentrations.

Time series of data in Soils often highlight weak time trends because of the relatively long memory of this medium which reflects a more integral response to chemicals, while spatially distributed monitoring may yield interesting data sets (e.g. Meijer et al., 2003). As capturing spatial trends requires comparable, simultaneous measurements at different locations in space, which is presently far from being routinely done in the European Union or elsewhere for most chemicals, the compilation of published data in soils seems the most promising exercise. Despite the limitations highlighted above, the data collected from the literature reveal some (although weak) spatial trends that suggest the possibility of using data compilations for the evaluation of models of chemical fate at continental scale. Compilations of measured concentrations of PCDD/Fs were prepared for the European Commission in the past years (D.Buckley-Golder, Compilation of EU Dioxin exposure and health data, 1999: http://ec.europa.eu/environment/dioxin/download.htm#CompilationofEUDioxinexposureandhealthdata) in order to estimate the population exposure to these chemicals; however, it does not seem that more recent compilation exercises have been undertaken in Europe.

In order to obtain similar performances in other media, longer-memory, integral observations should be collected: increasingly, indirect measurement methods are being proposed such as passive samplers for atmospheric gas-phase concentration and the monitoring of lipids e.g. from animal tissues or dairy produce, which deliver a sort of "time-integral" of exposure as they reflect exposure over rather long periods.

In addition, having a database of measured environmental concentrations (MEC) may be very useful in order to complement and corroborate predicted environmental concentrations (PEC) that are employed in the exposure and risk assessment under the REACH regulation, particularly for persistent, bioaccumulative and toxic (PBT) chemicals. Such a dataset may help building confidence, or highlight limitations since predictive models seem to be able to reproduce observations only to a limited extent. However, the data included in the present work should be further validated for this purpose. It is therefore recommended that specialised staff to be dedicated to the data suitability analysis for this purpose or that available data validation procedures under Chemical safety assessment (CSA) are implemented. Klimisch *et al* (1997) developed a scoring system to assess the reliability of data, particularlyfrom toxicological and ecotoxicological studies, that may be extended to physico-chemical and environmental fate and behaviour studies. This is the method currently employed under REACH for data validation. The present data compilations it is in any case a first step of this direction.

ANNEX 1. Mobile sum of samples of each year ± 1 year maps

PCBs

5.1.1 Air

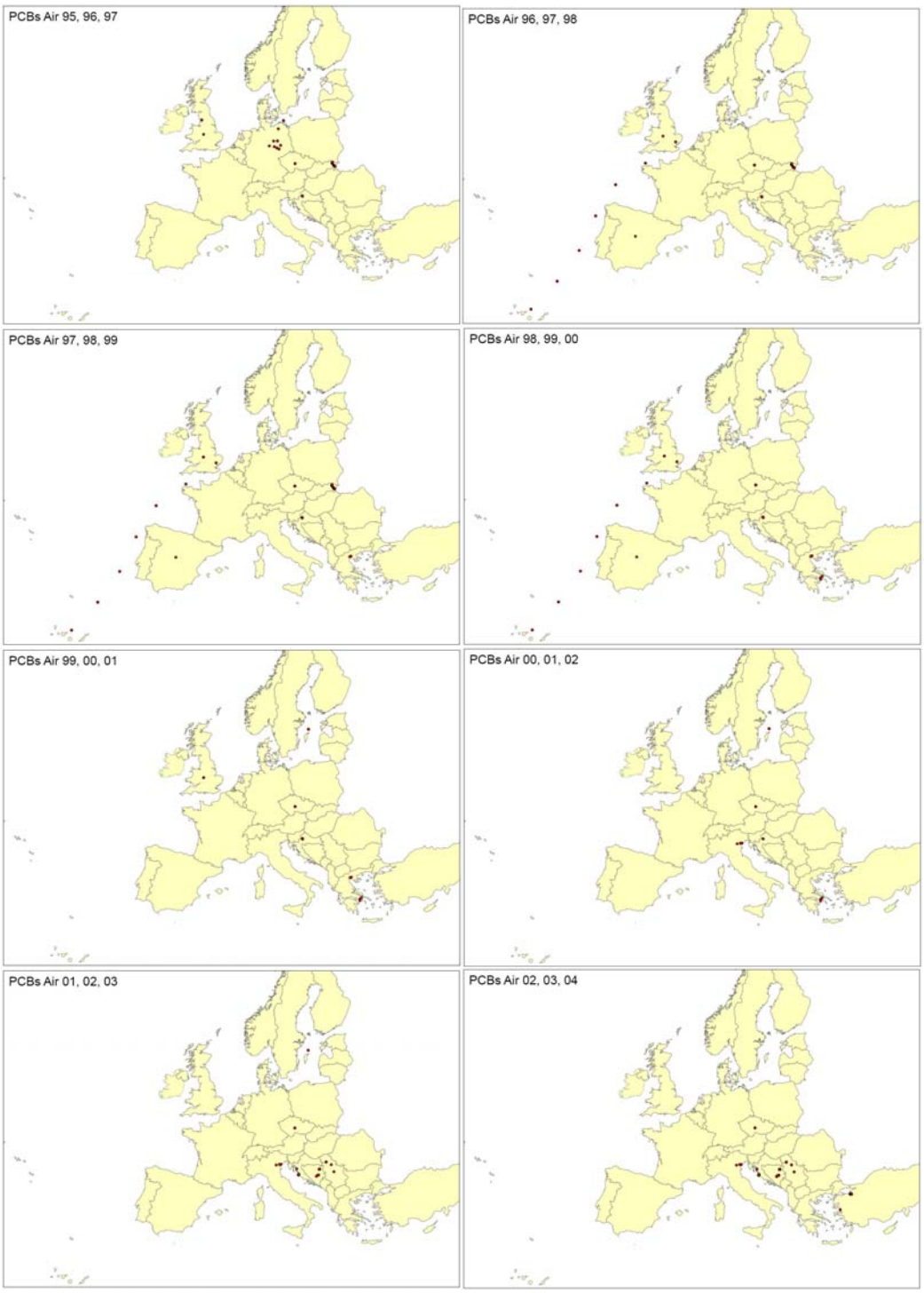
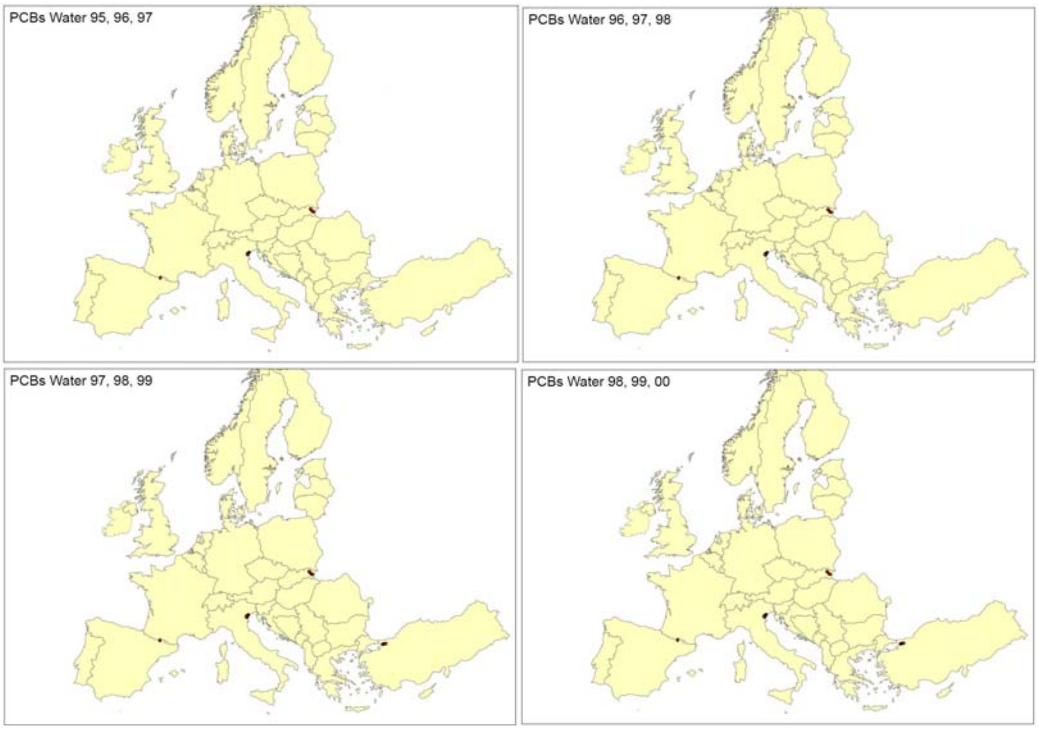

PCBs Air 95, 96, 97
PCBs Air 96, 97, 98
PCBs Air 97, 98, 99
PCBs Air 98, 99, 00
PCBs Air 99, 00, 01
PCBs Air 00, 01, 02
PCBs Air 01, 02, 03
PCBs Air 02, 03, 04

Figure 38: Mobile sum of samples of each year ± 1 year maps, PCBs in air

5.1.2 Water



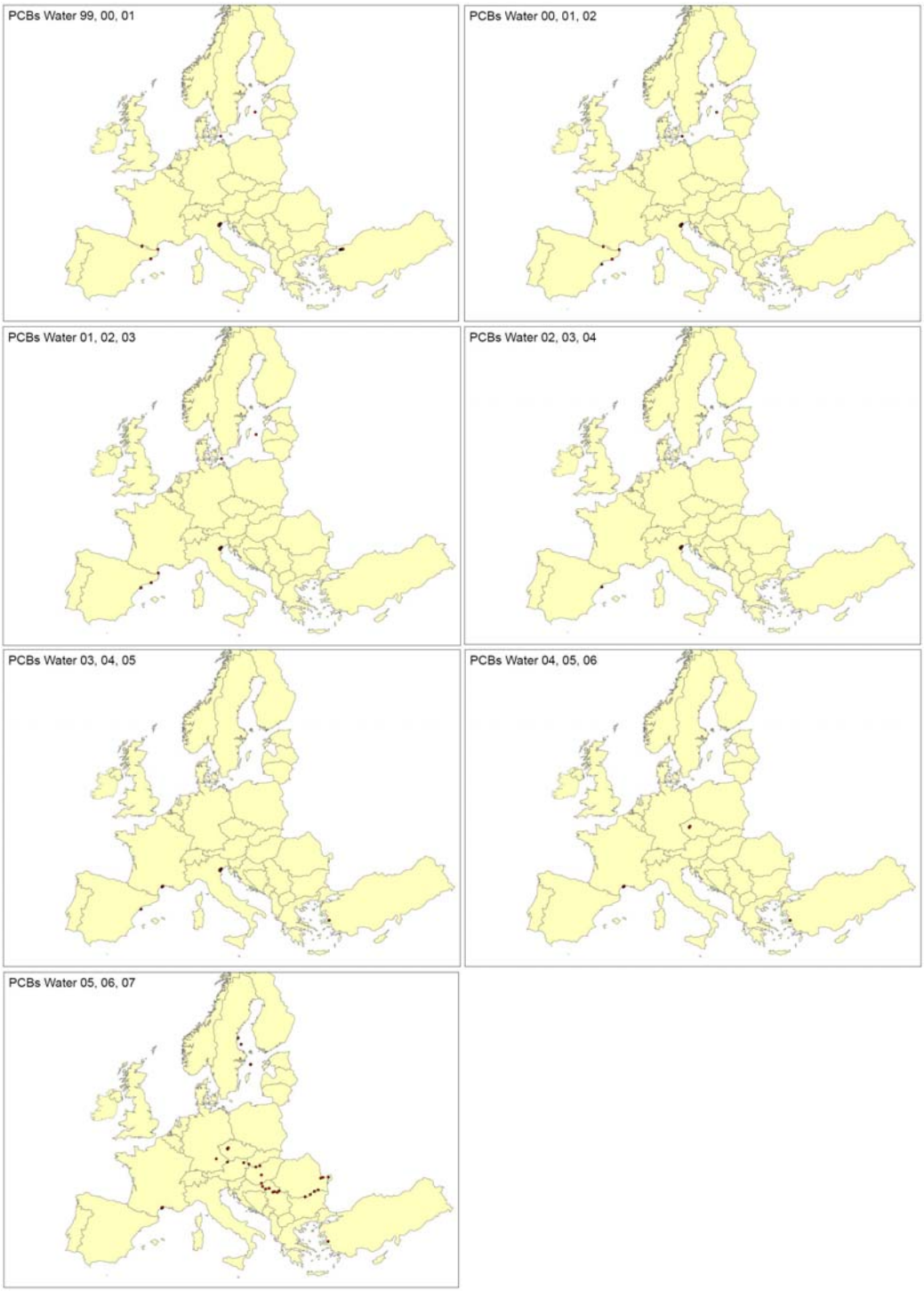
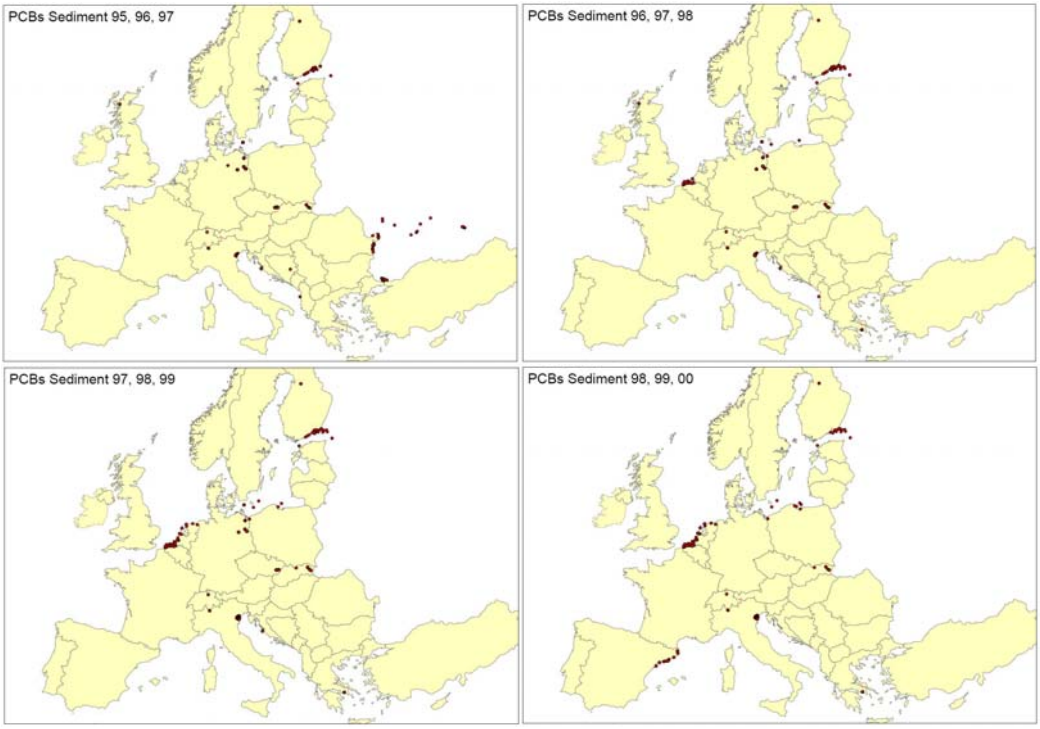
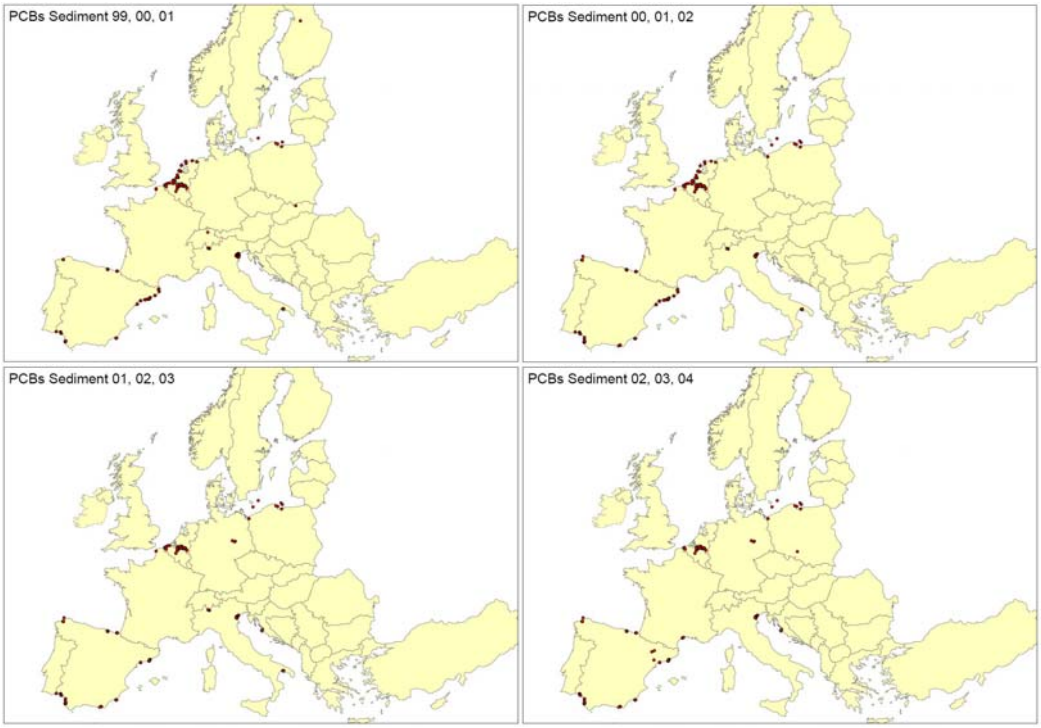


Figure 39: Mobile sum of samples of each year ± 1 year maps, PCBs in water

5.1.3 Sediment





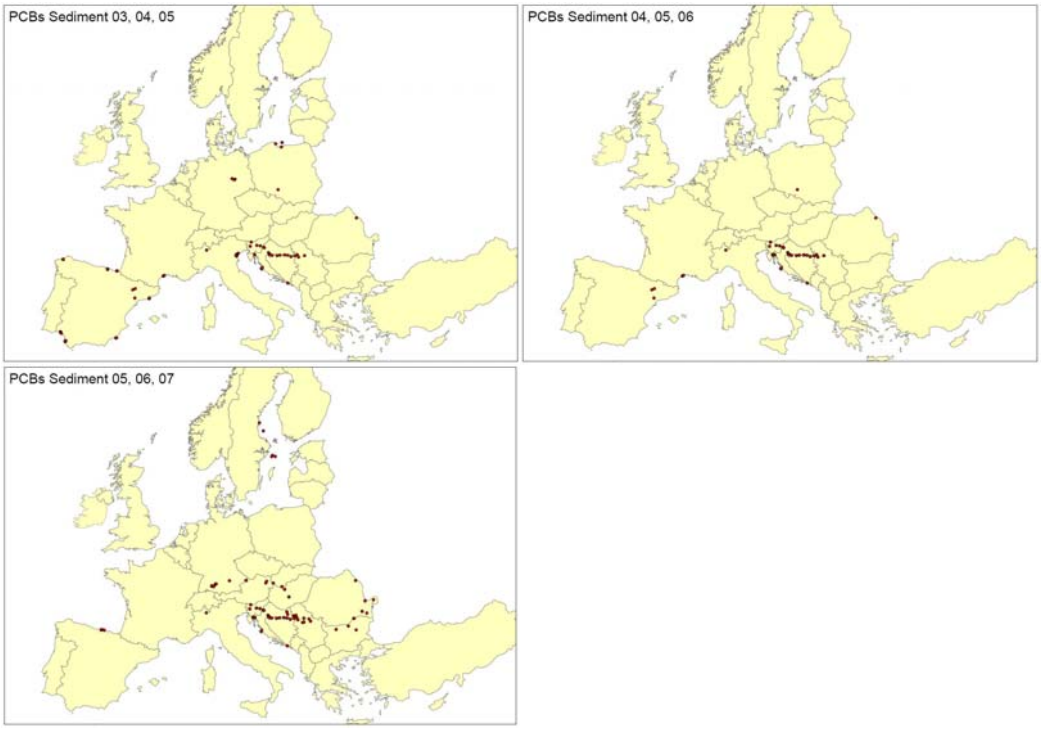


Figure 40: Mobile sum of samples of each year ± 1 year maps, PCBs in sediment

5.1.4 Soil

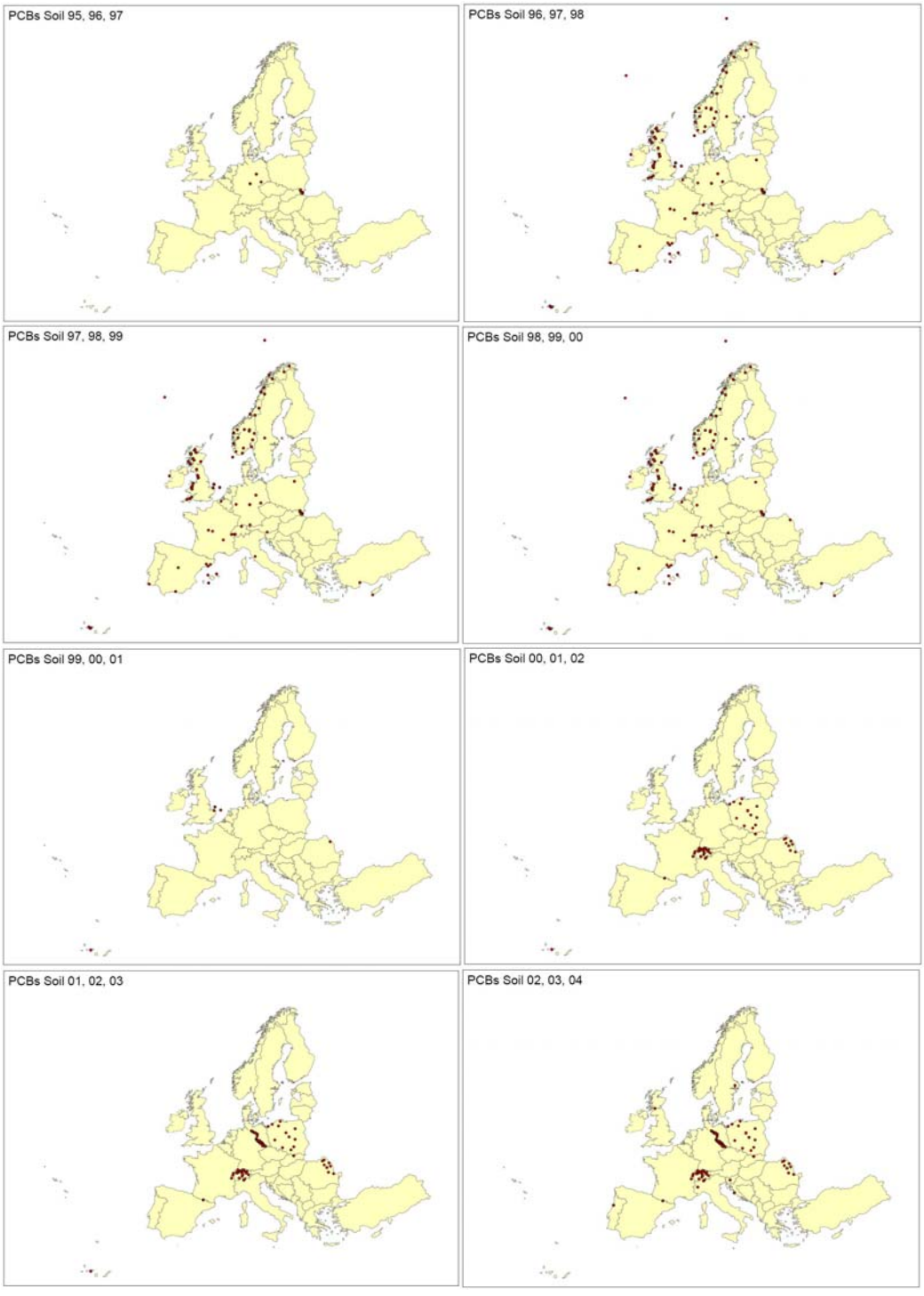
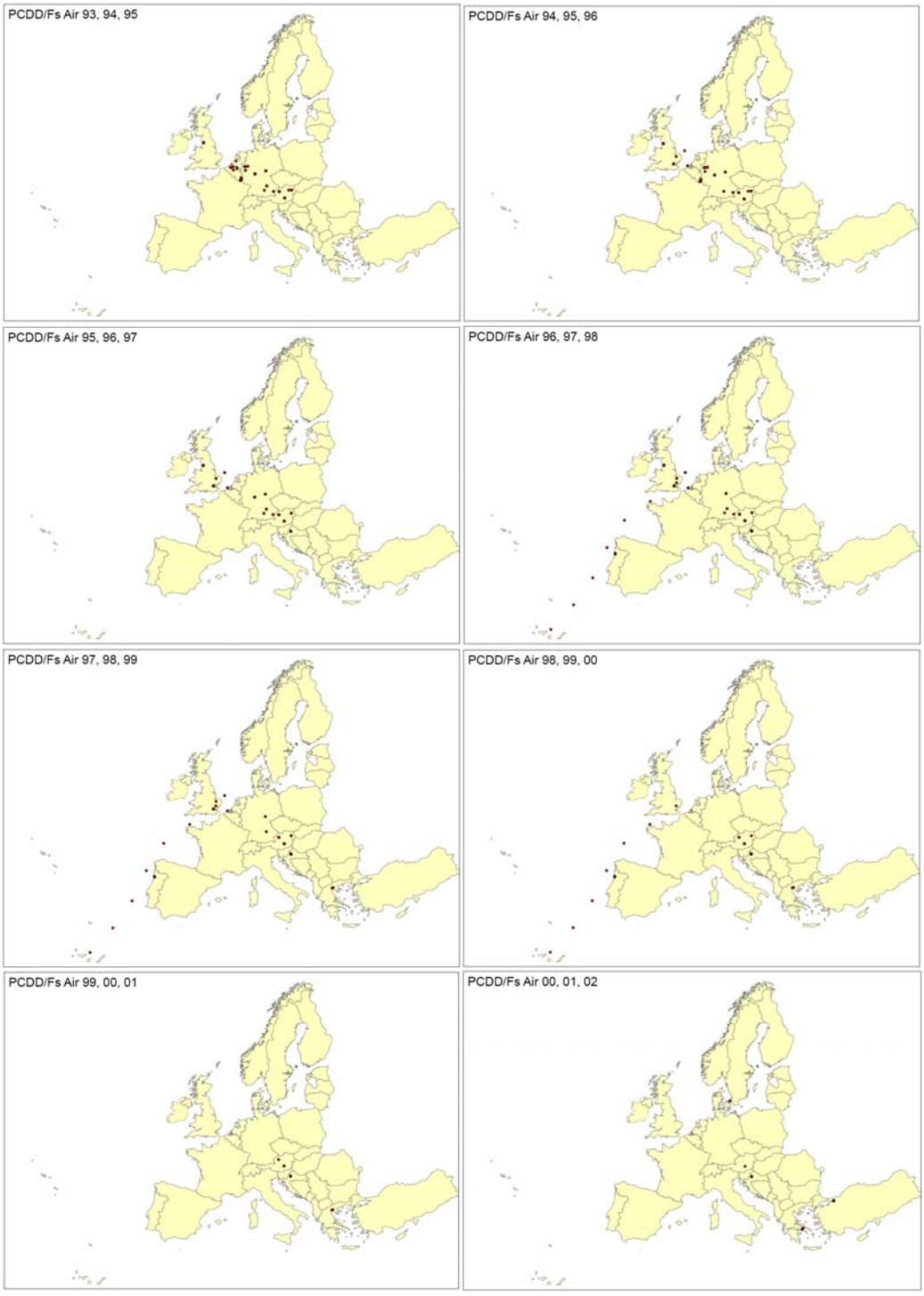

PCBs Soil 95, 96, 97
PCBs Soil 96, 97, 98
PCBs Soil 97, 98, 99
PCBs Soil 98, 99, 00
PCBs Soil 99, 00, 01
PCBs Soil 00, 01, 02
PCBs Soil 01, 02, 03
PCBs Soil 02, 03, 04

Figure 41: Mobile sum of samples of each year ± 1 year maps, PCBs in soil

5.2 PCDD/Fs

5.2.1 Air



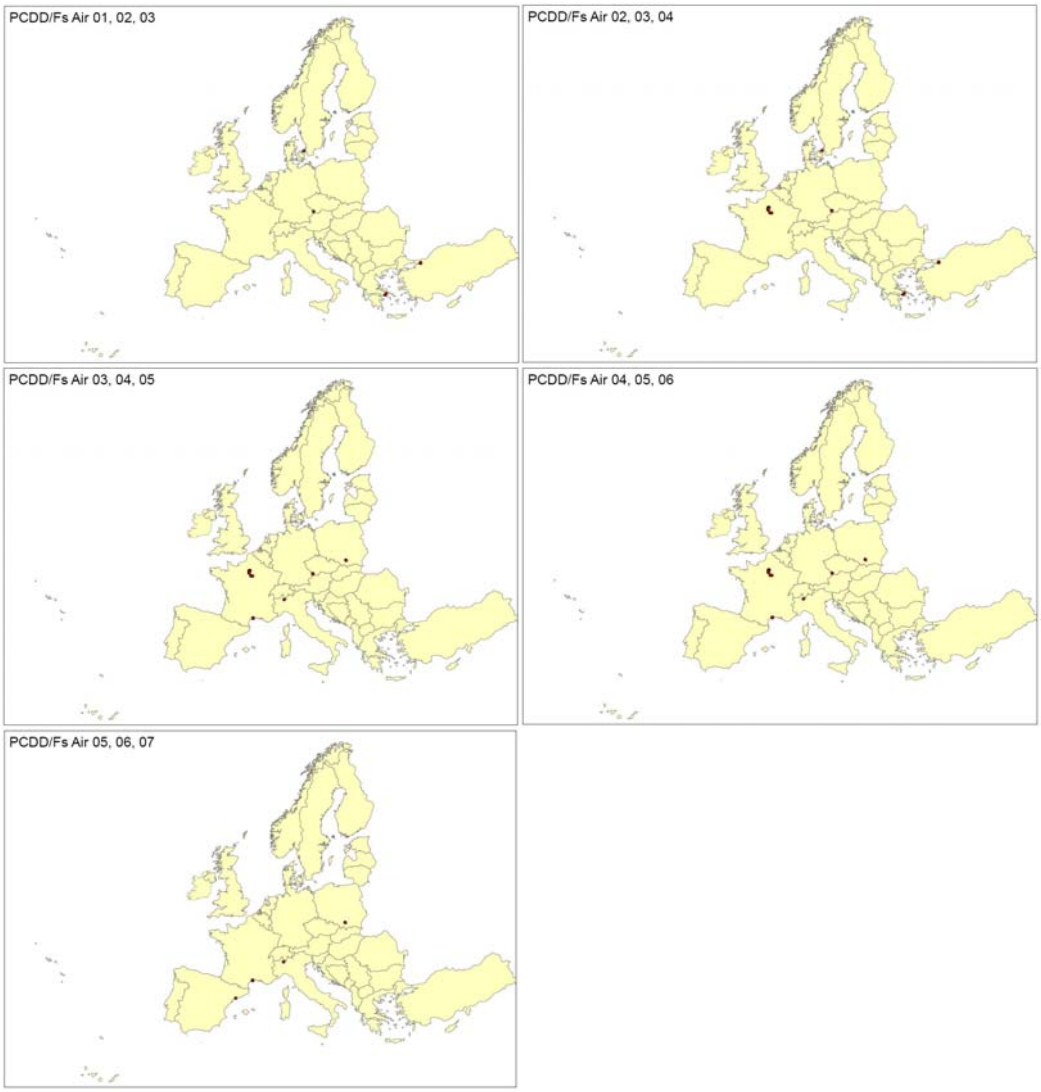


Figure 42: Mobile sum of samples of each year ± 1 year maps, PCDD/Fs in air

5.2.2 Water

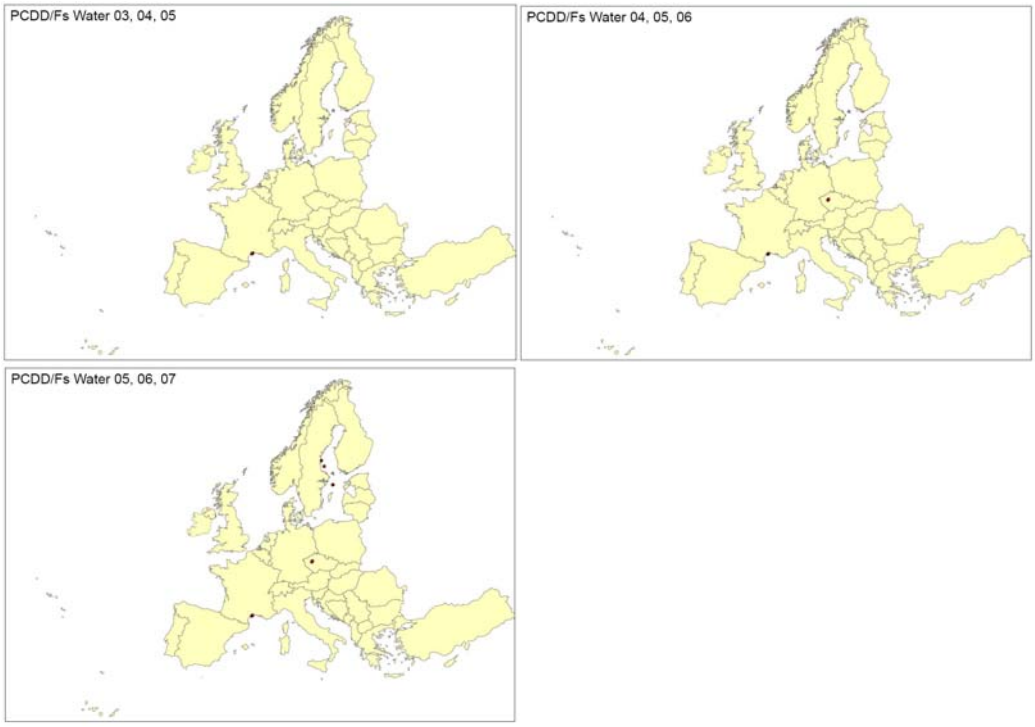


Figure 43: Mobile sum of samples of each year ± 1 year maps, PCDD/Fs in water

5.2.3 Sediment

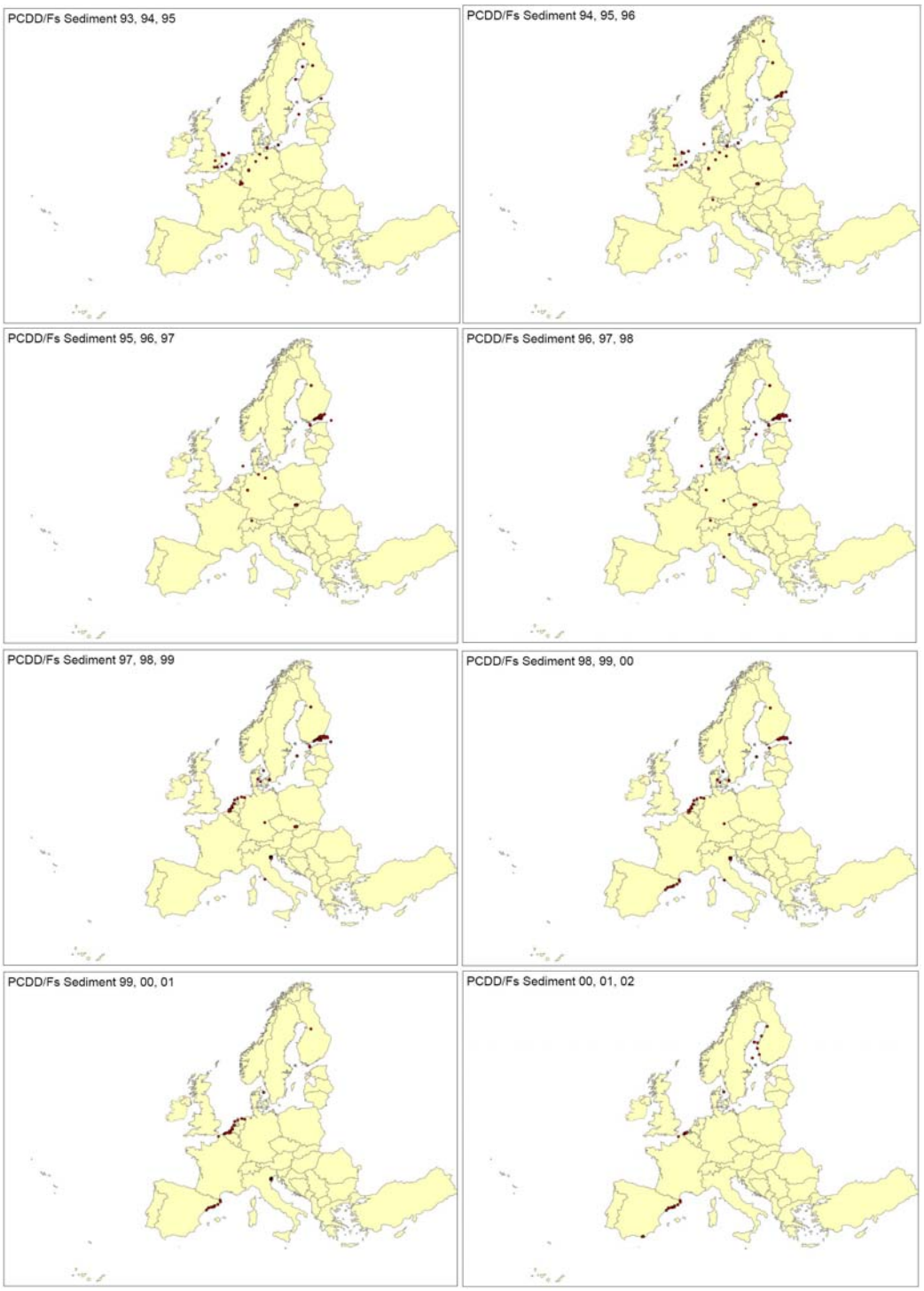


Figure 44: Mobile sum of samples of each year ± 1 year maps, PCDD/Fs in sediment

5.2.4 Soil

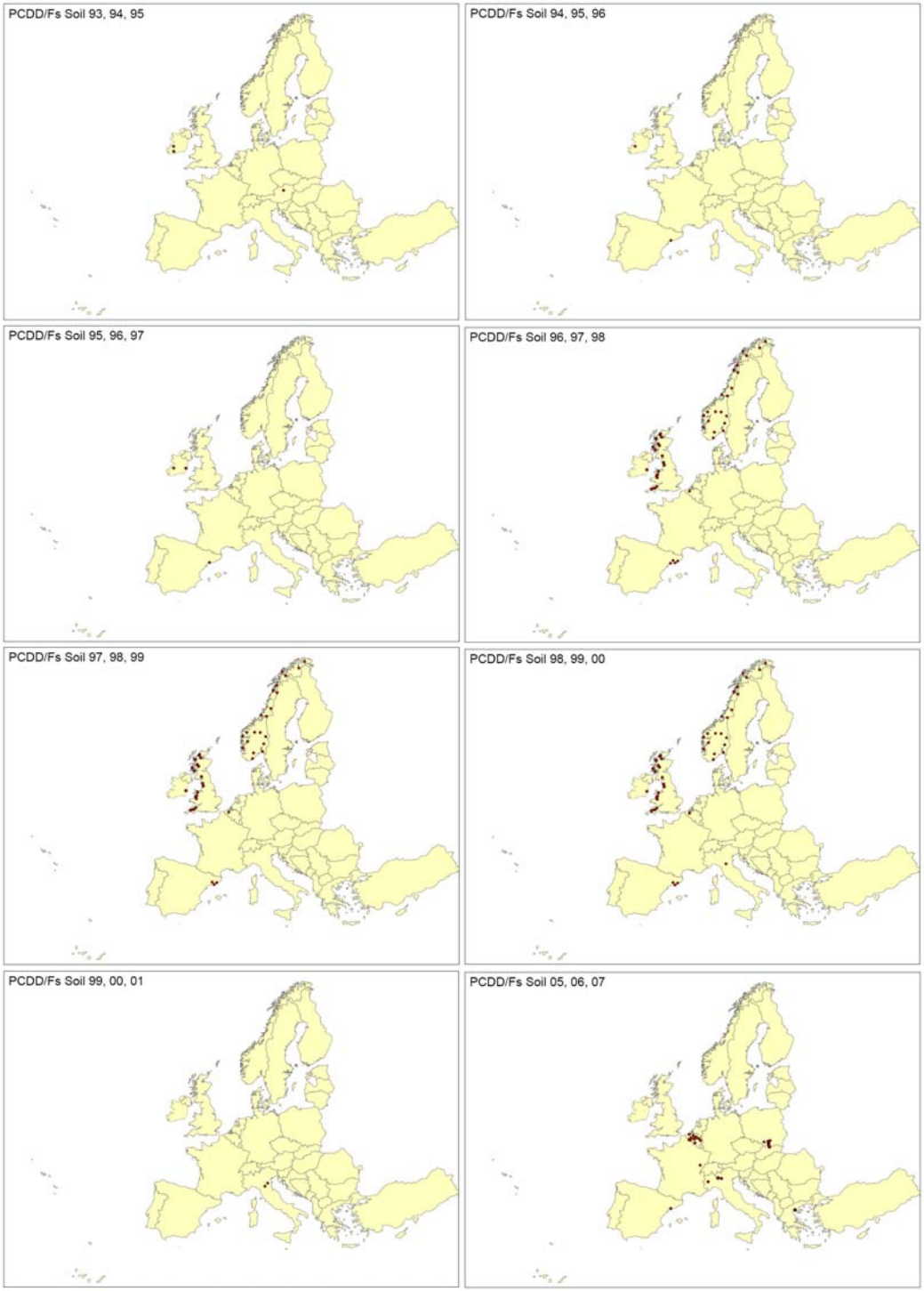

PCDD/Fs Soil 93, 94, 95
PCDD/Fs Soil 94, 95, 96
PCDD/Fs Soil 95, 96, 97
PCDD/Fs Soil 96, 97, 98
PCDD/Fs Soil 97, 98, 99
PCDD/Fs Soil 98, 99, 00
PCDD/Fs Soil 99, 00, 01
PCDD/Fs Soil 05, 06, 07

Figure 45: Mobile sum of samples of each year ± 1 year maps, PCDD/Fs in soil

ANNEX 2. Results of the geostatistical analysis

5.3 PCBs

The geostatistical studies were done for soil in the following years:

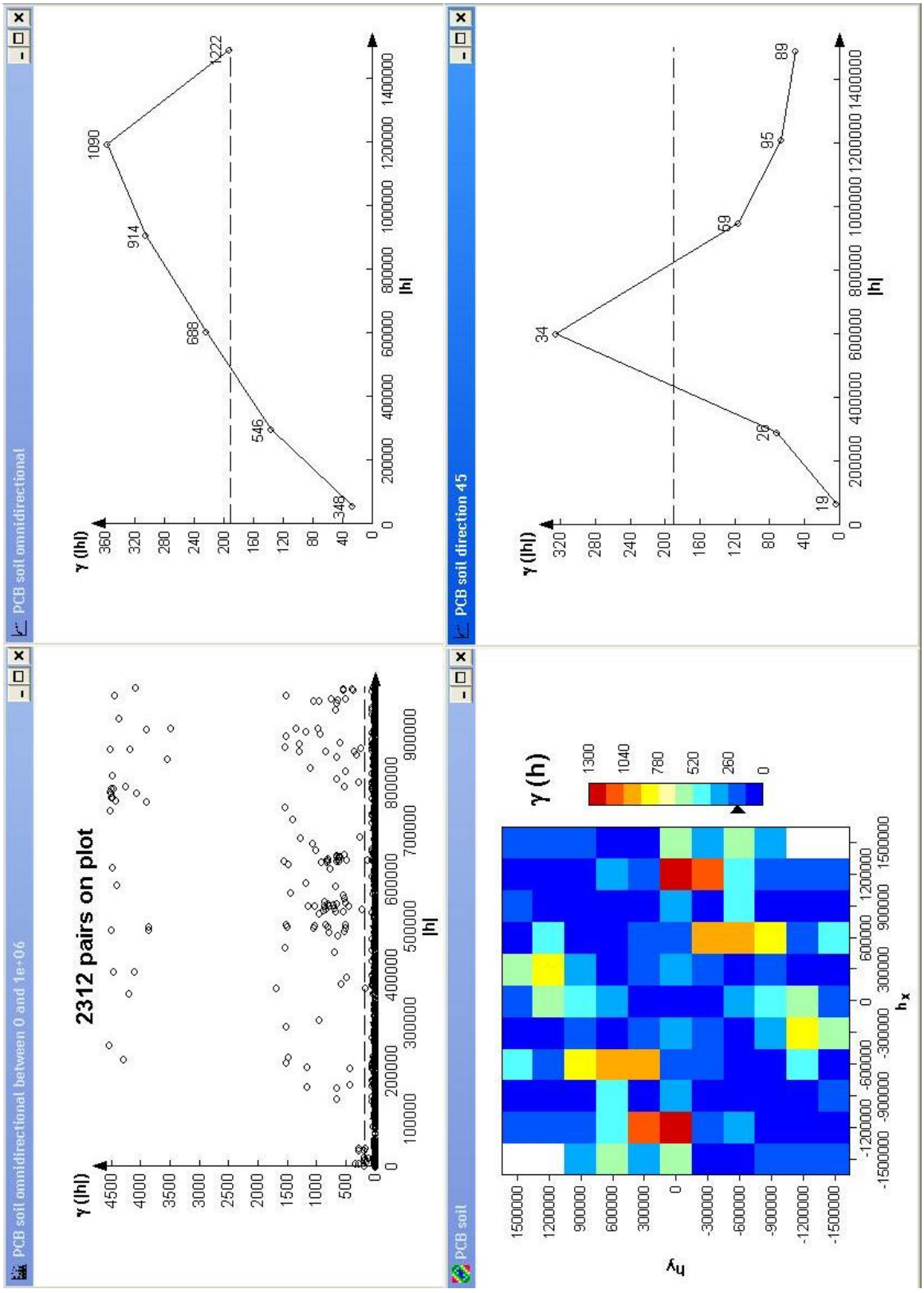


Figure 46: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 1996-1998

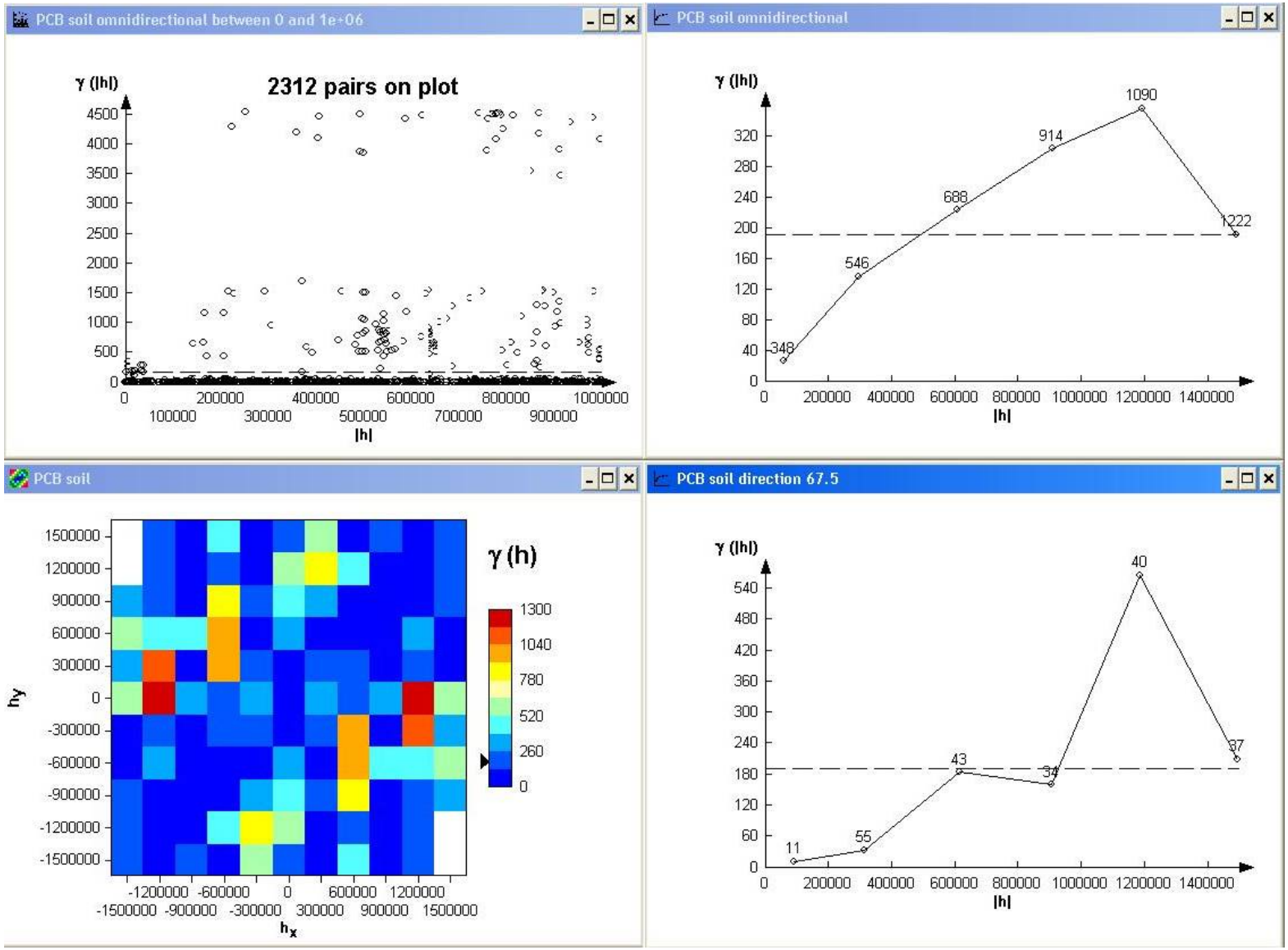


Figure 47: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 1997-1999

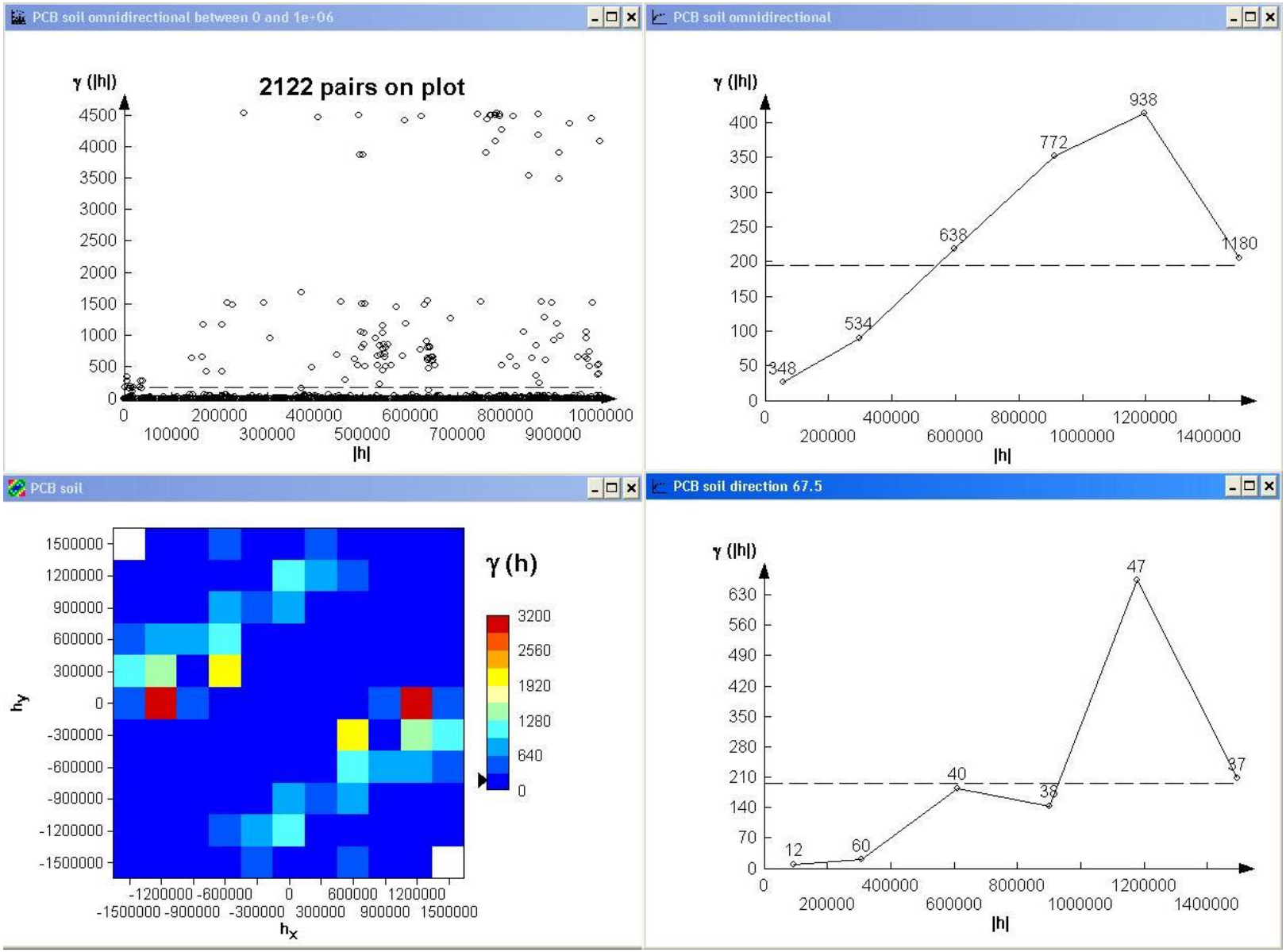


Figure 48: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 1998-2000

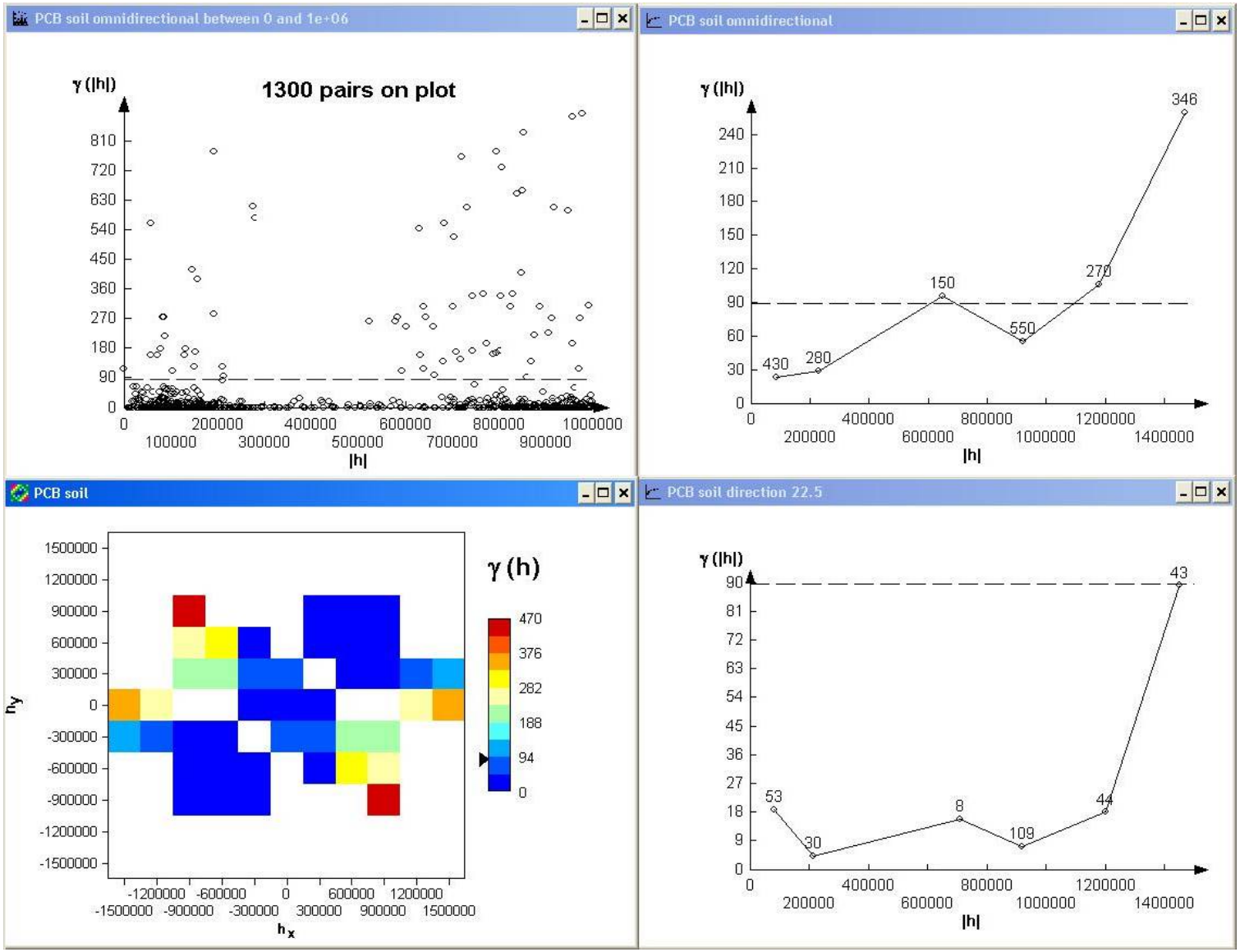


Figure 49: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2000-2002

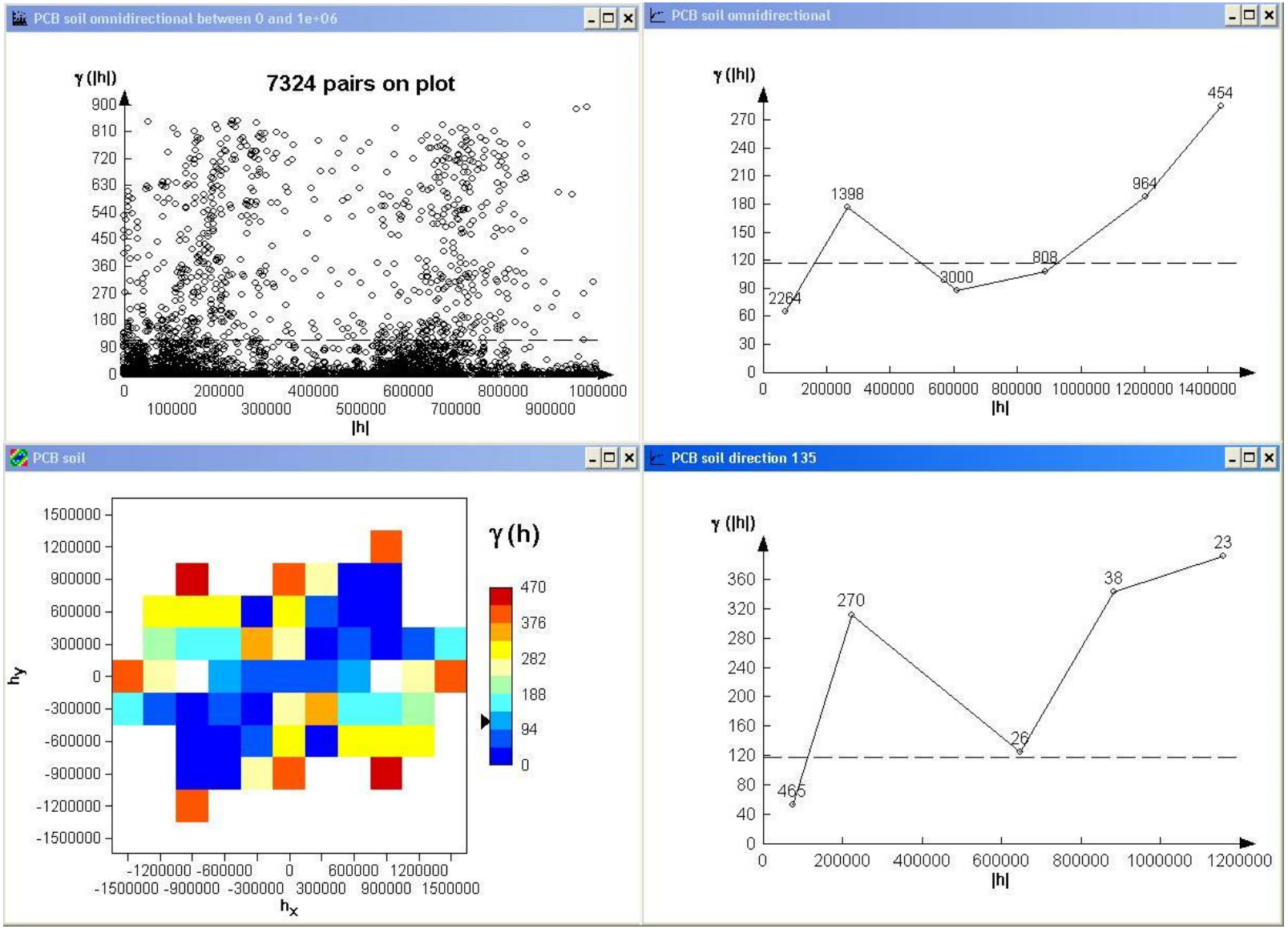


Figure 50: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2001-2003

53

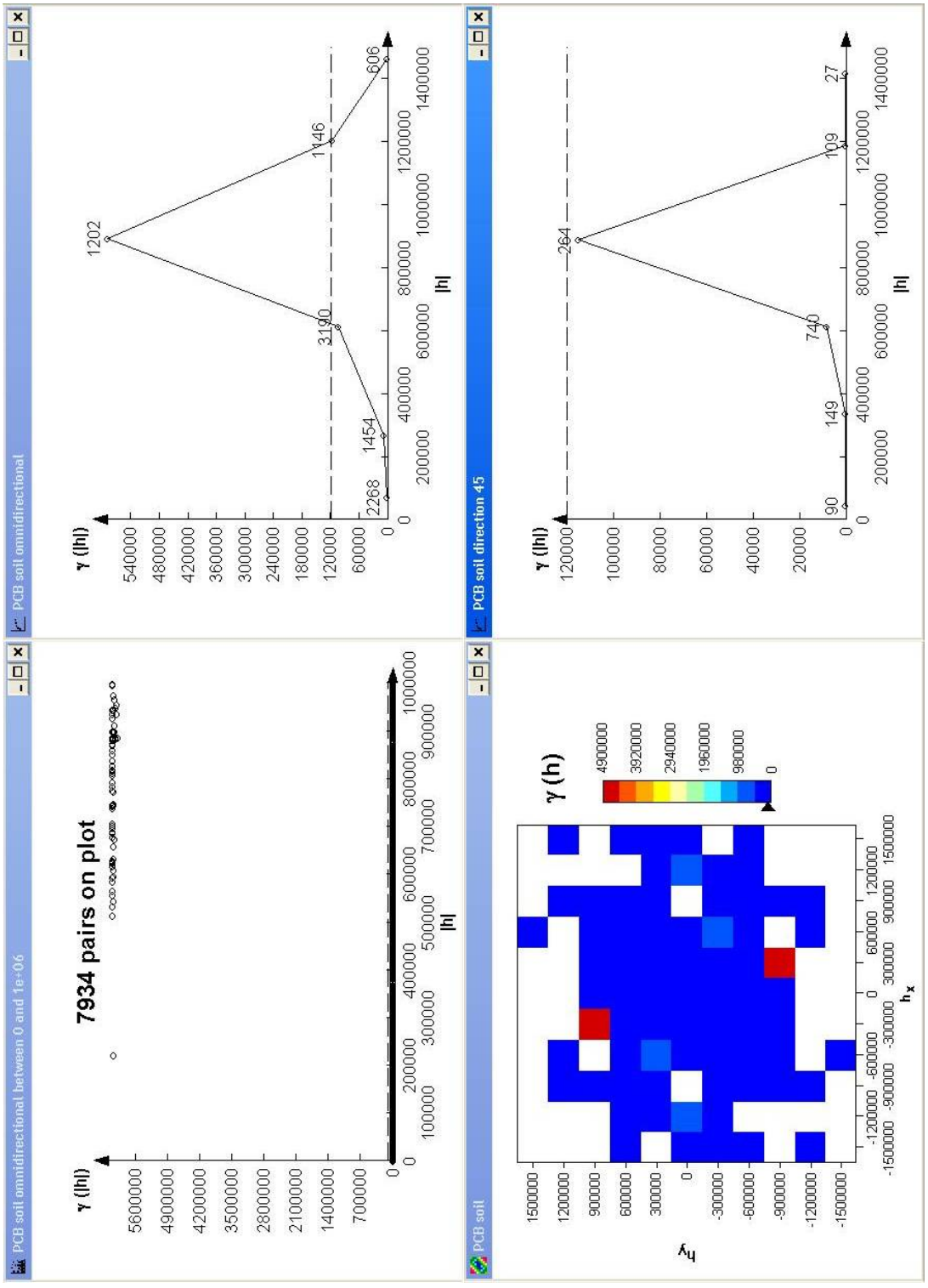


Figure 51: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2002-2004

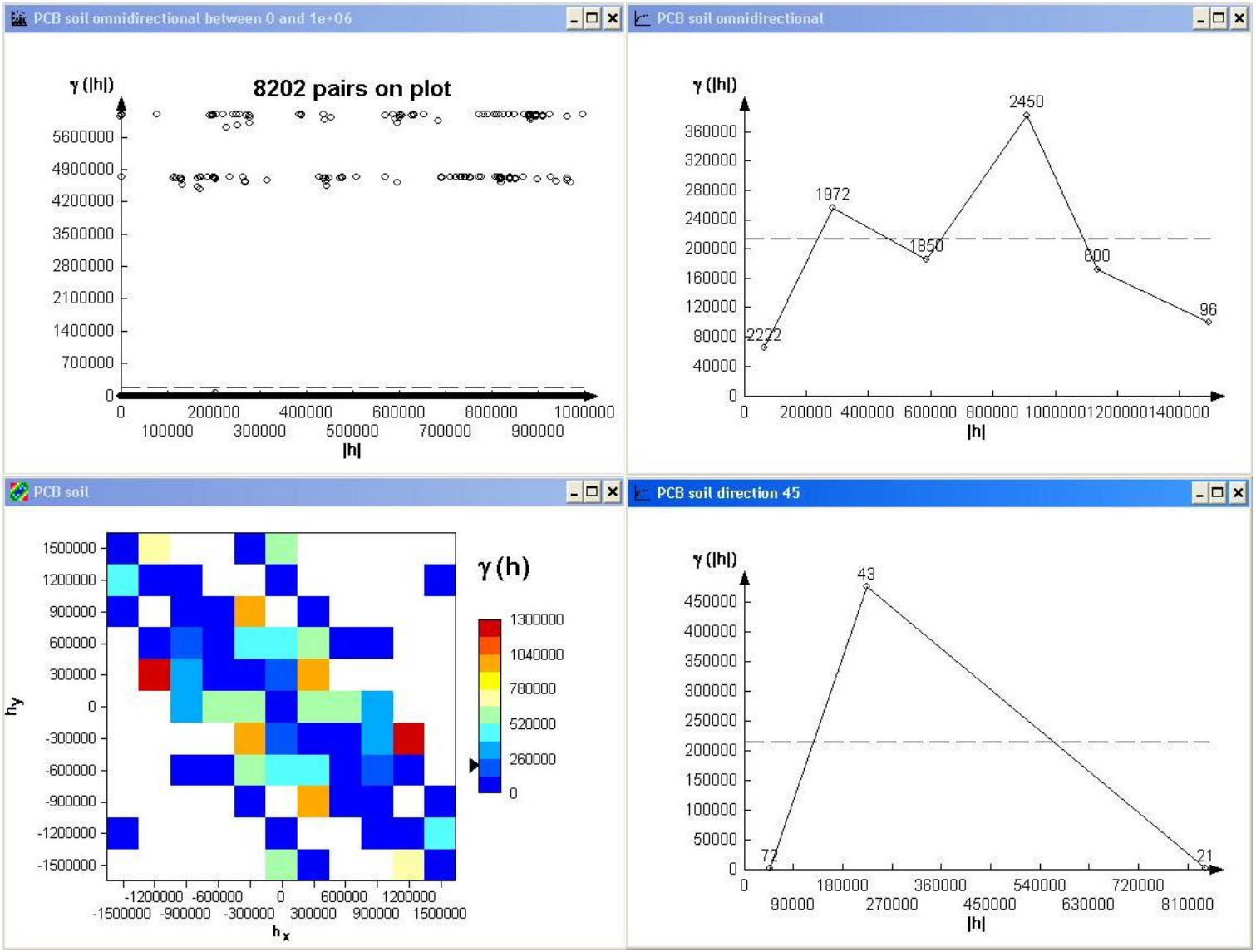


Figure 52: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2003-2005

55

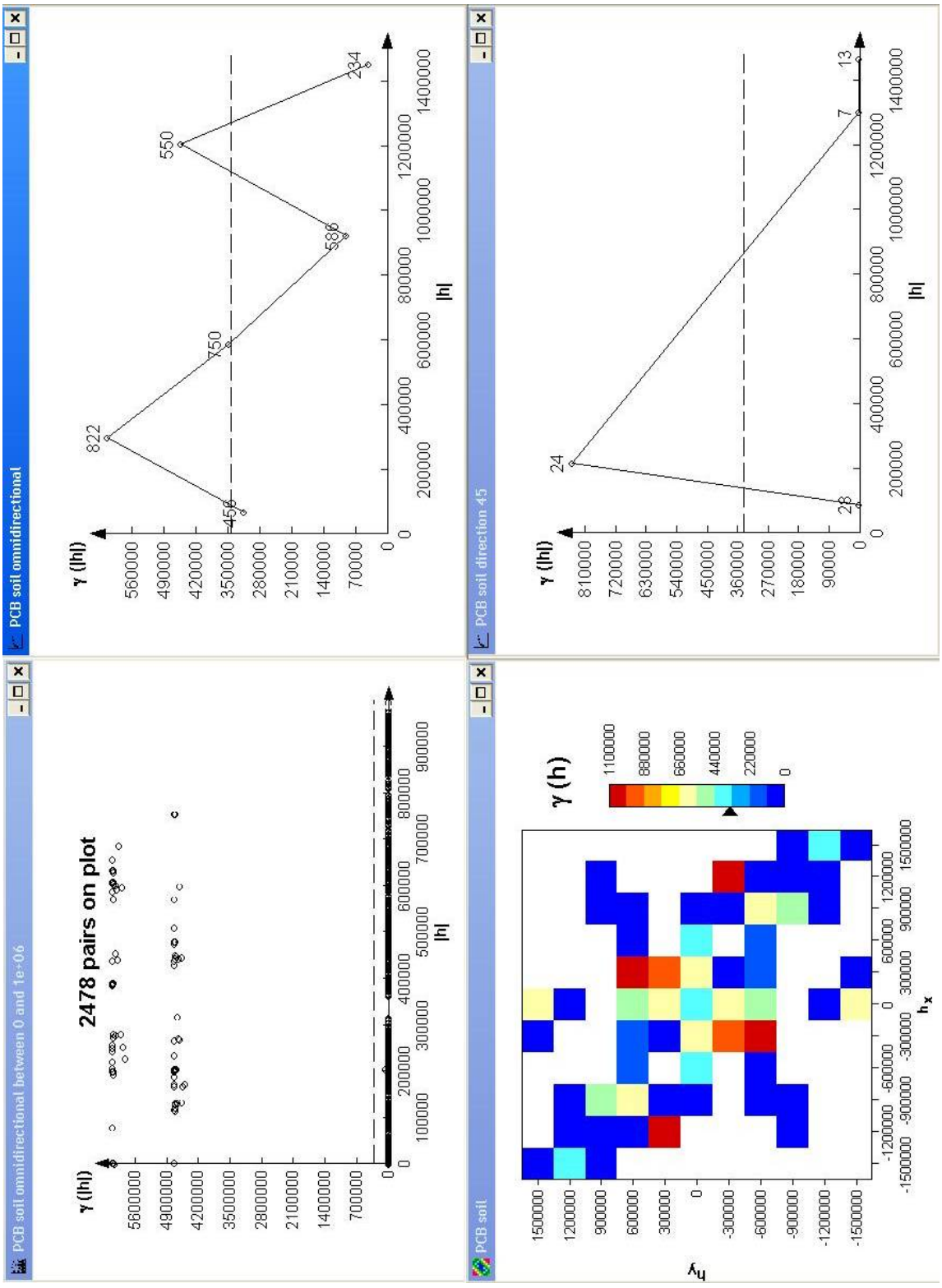


Figure 53: variogram cloud, variogram surface, and directional variograms for PCBs soil concentrations, period 2004-2006

The geostatistical studies done for sediments have been selected for the three years periods where the data has a better geographic coverage:

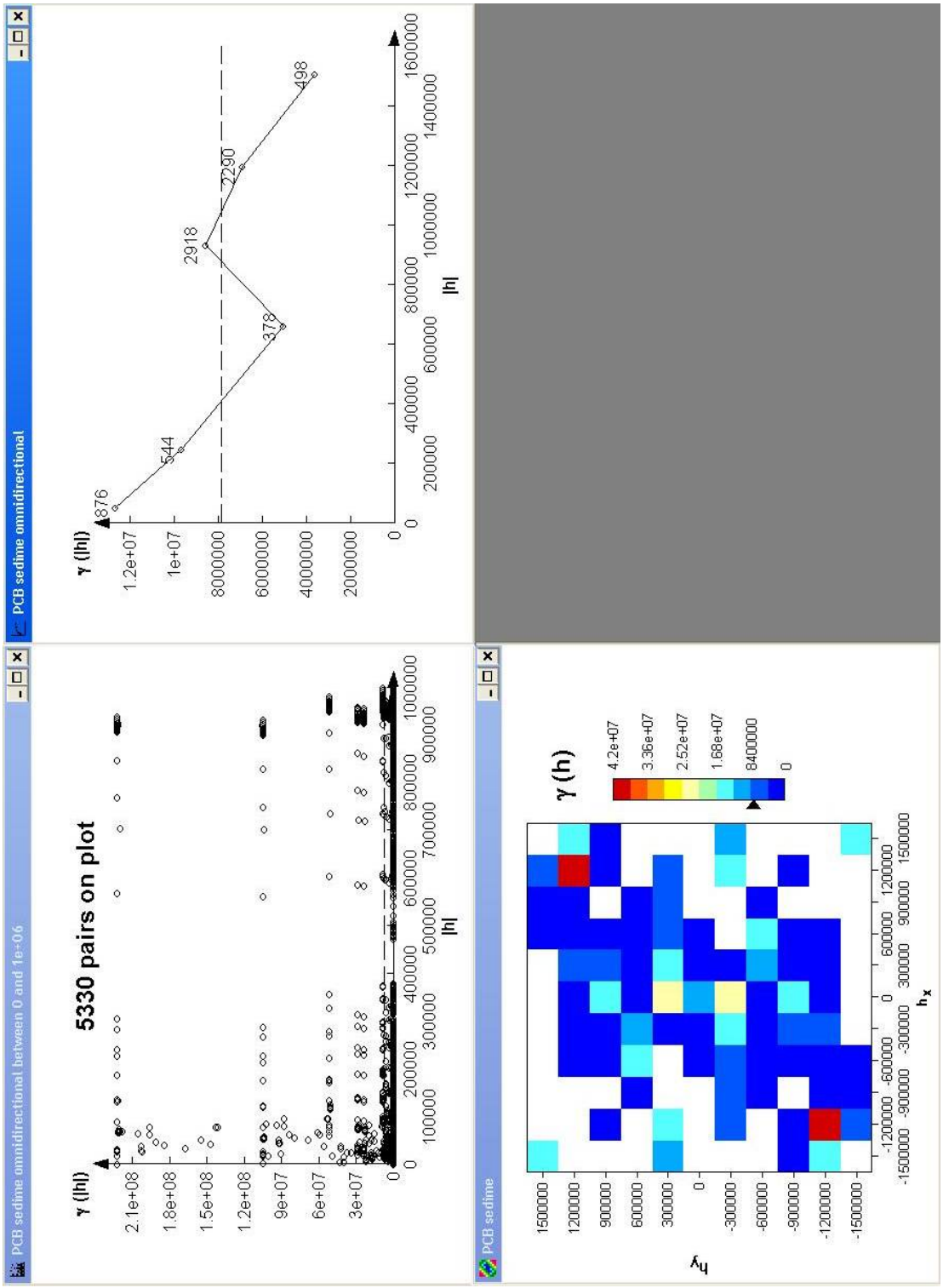


Figure 54: variogram cloud, variogram surface, and directional variograms for PCBs sediment concentrations, period 1998-2000

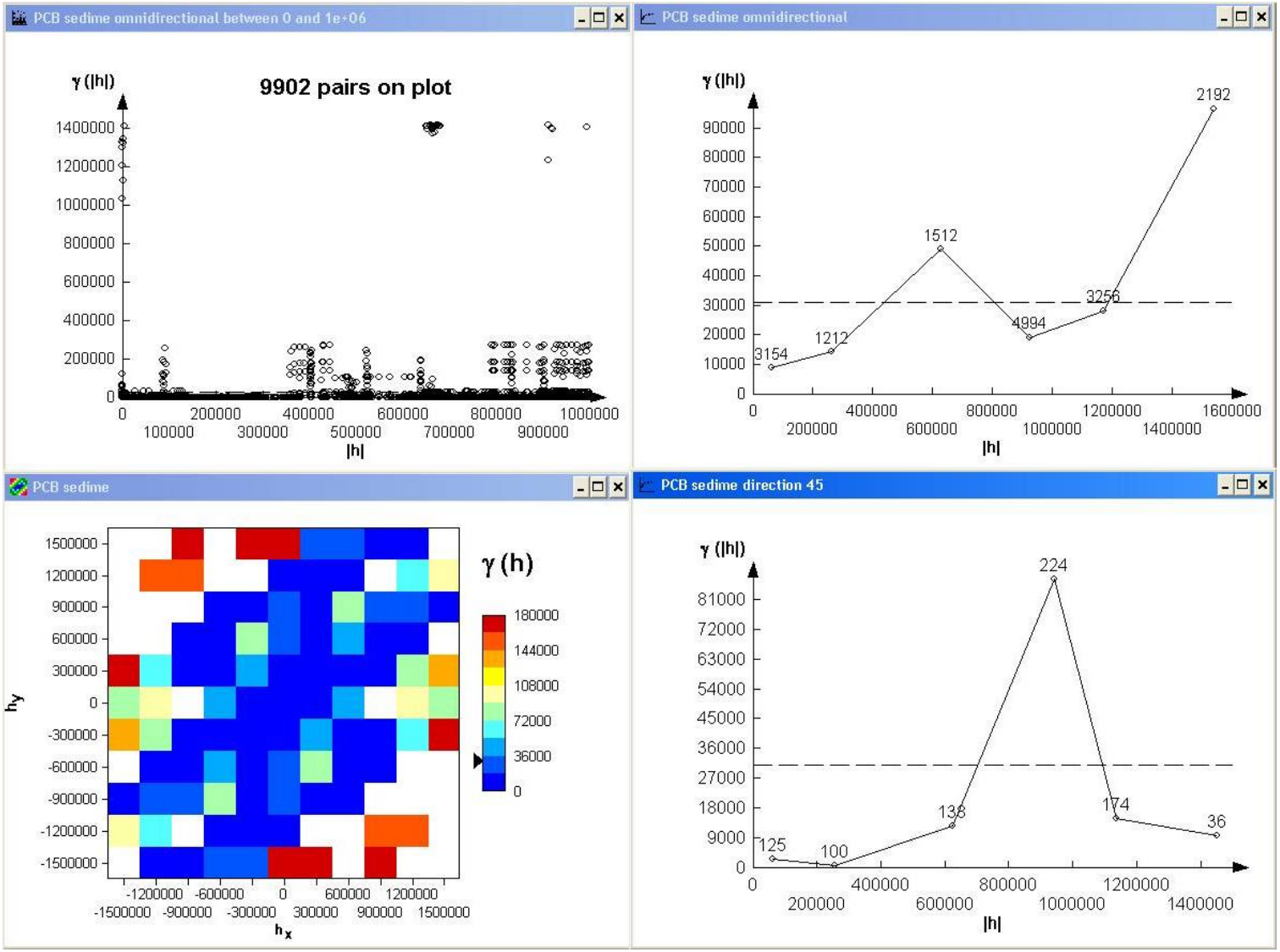


Figure 55: variogram cloud, variogram surface, and directional variograms for PCBs sediment concentrations, period 1999-2001

58

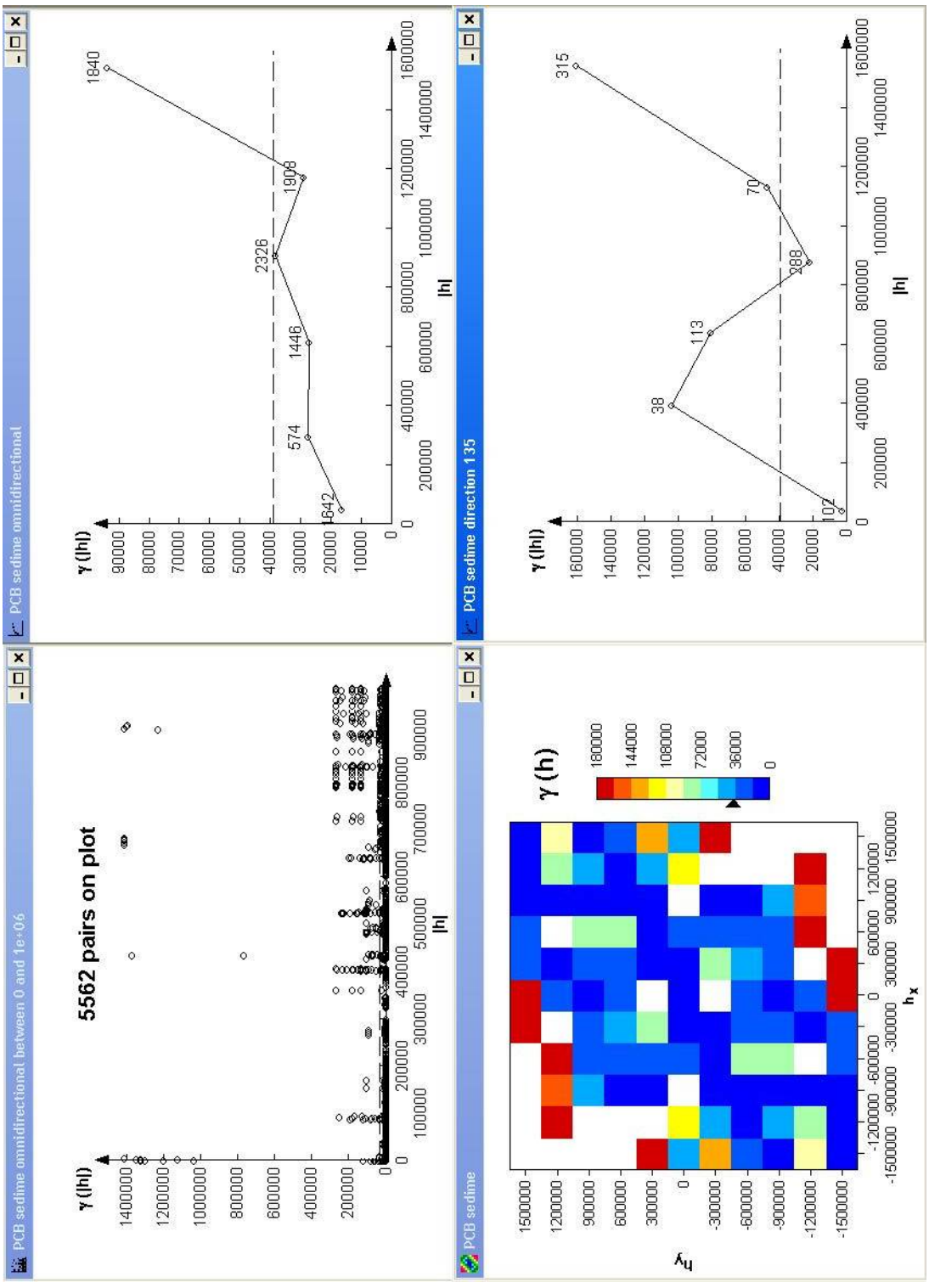


Figure 56: variogram cloud, variogram surface, and directional variograms for PCBs sediment concentrations, period 2001-2003

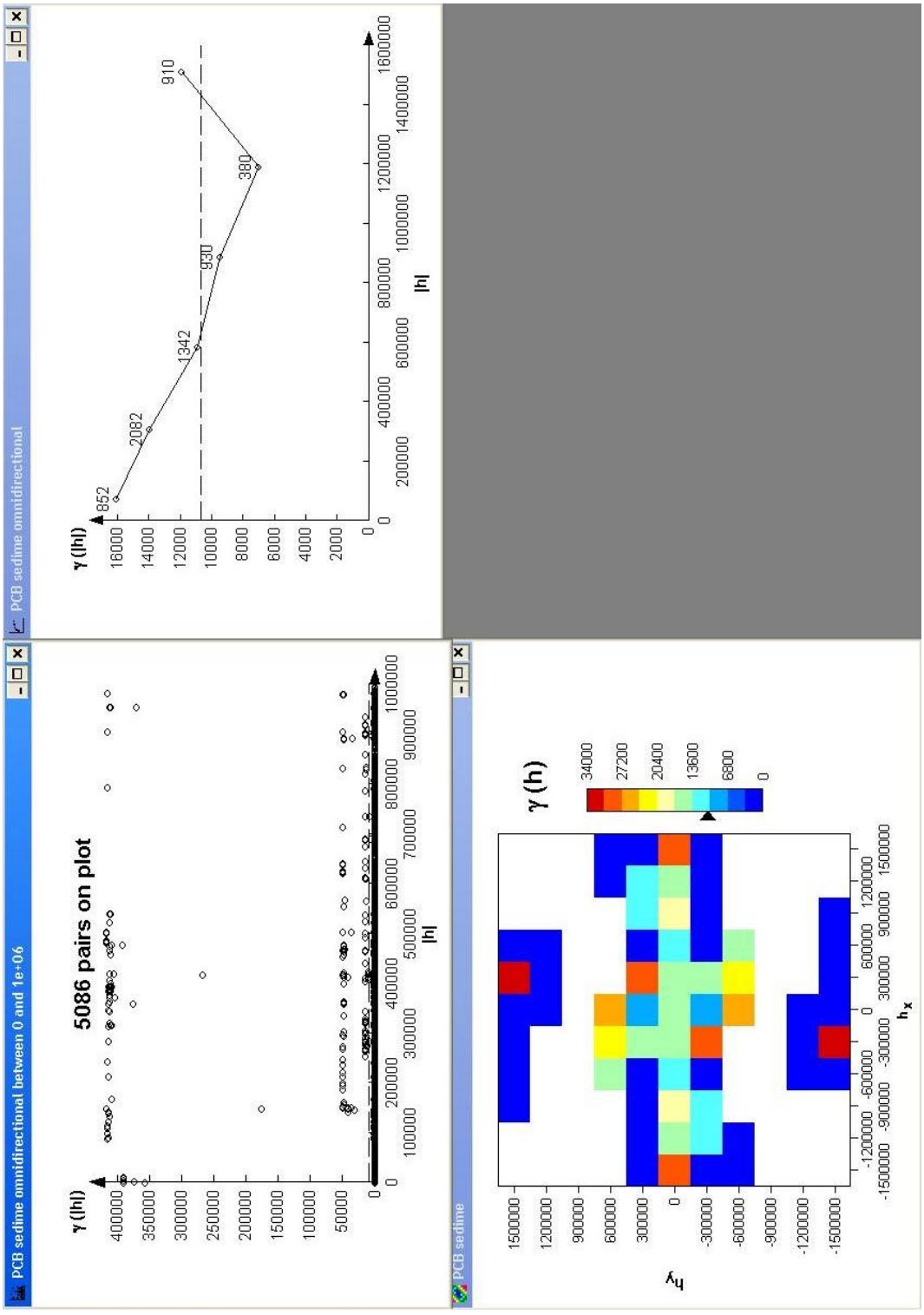
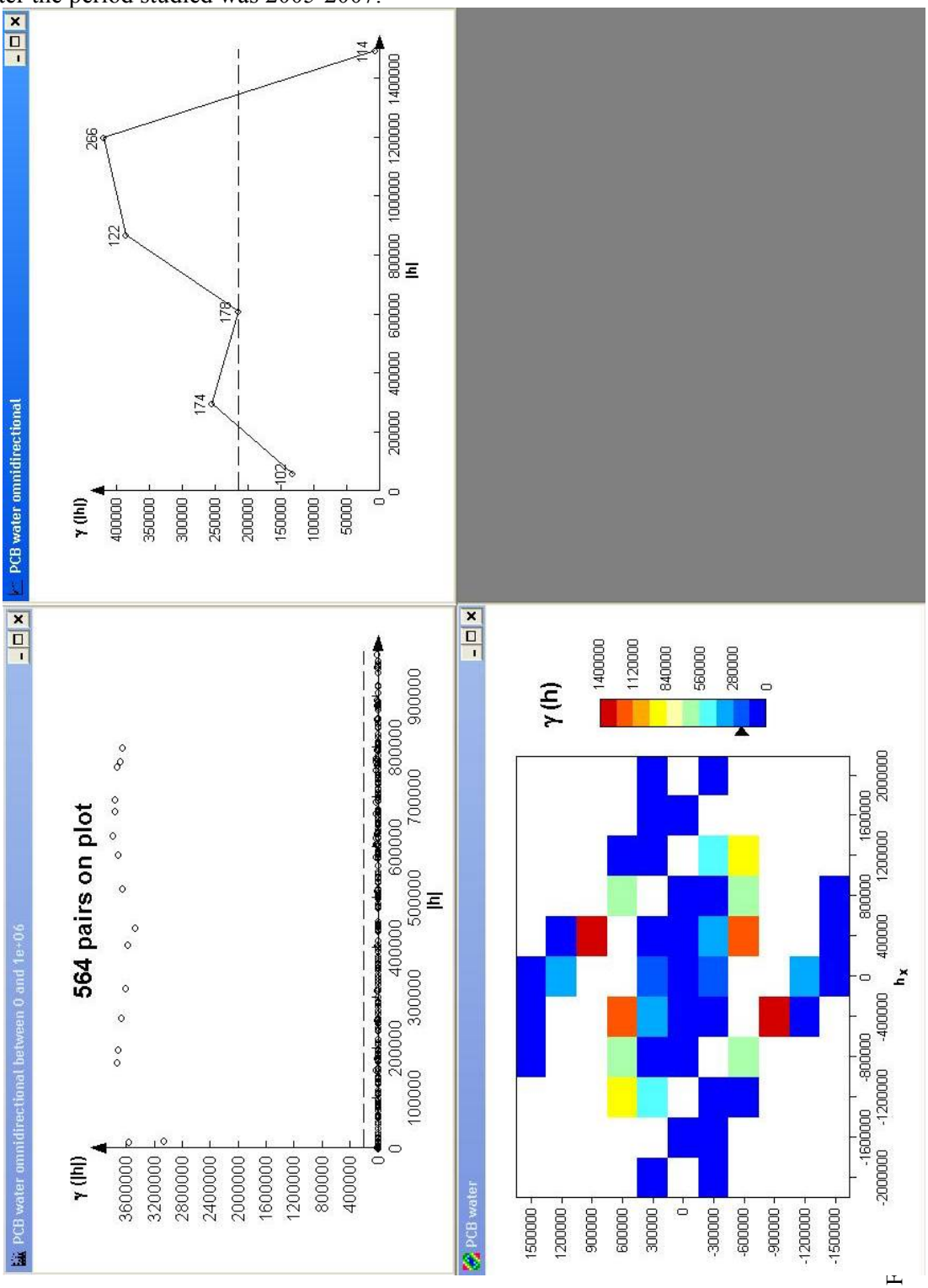


Figure 57: variogram cloud, variogram surface, and directional variograms for PCBs sediment concentrations, period 2005-2007

For water the period studied was 2005-2007:



For air the period studied was 2005-2007:

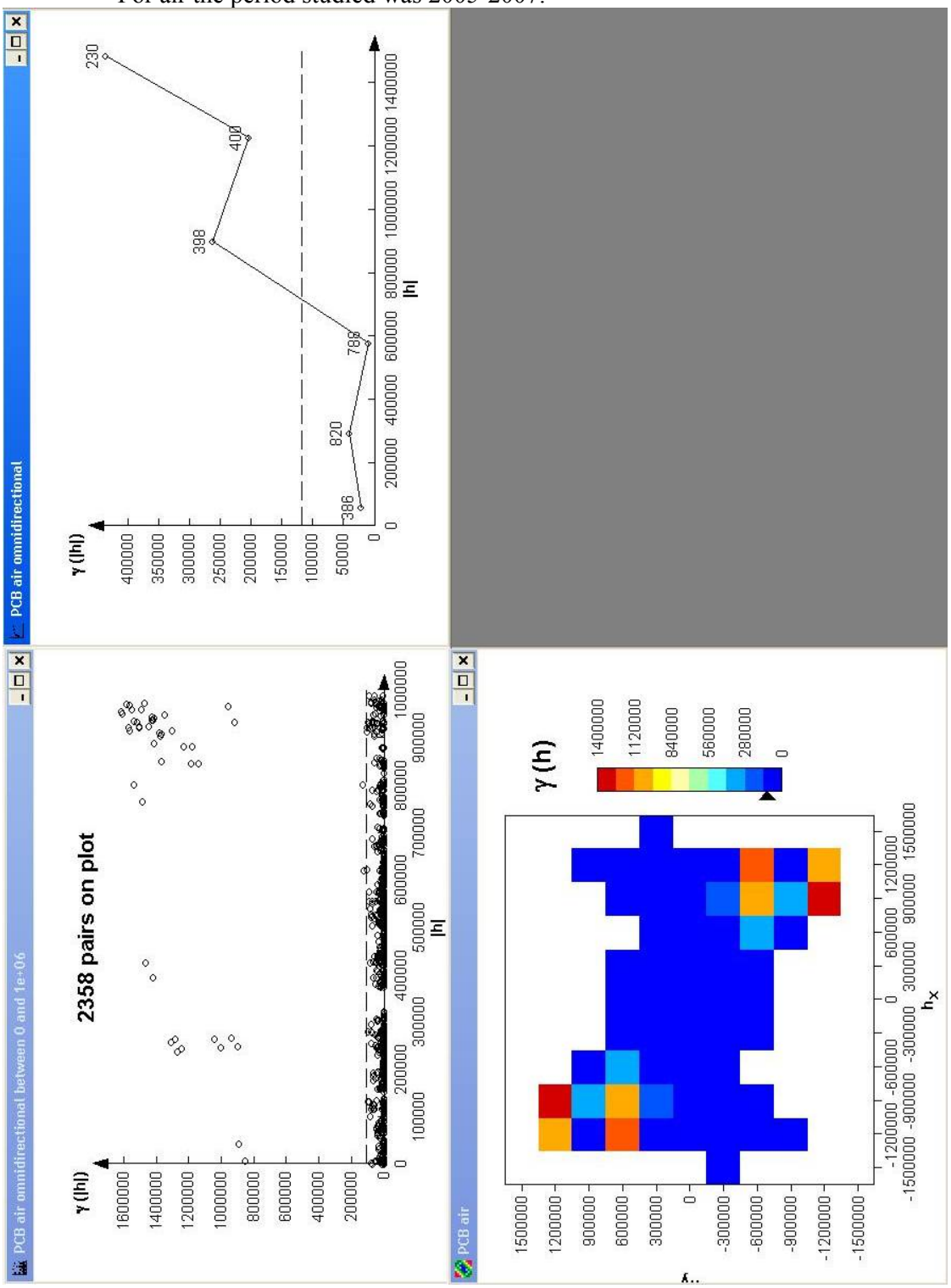


Figure 59: variogram cloud, variogram surface, and directional variograms for PCBs air concentrations, period 2005-2007

5.4 PCDD/Fs

These are the results found for air:

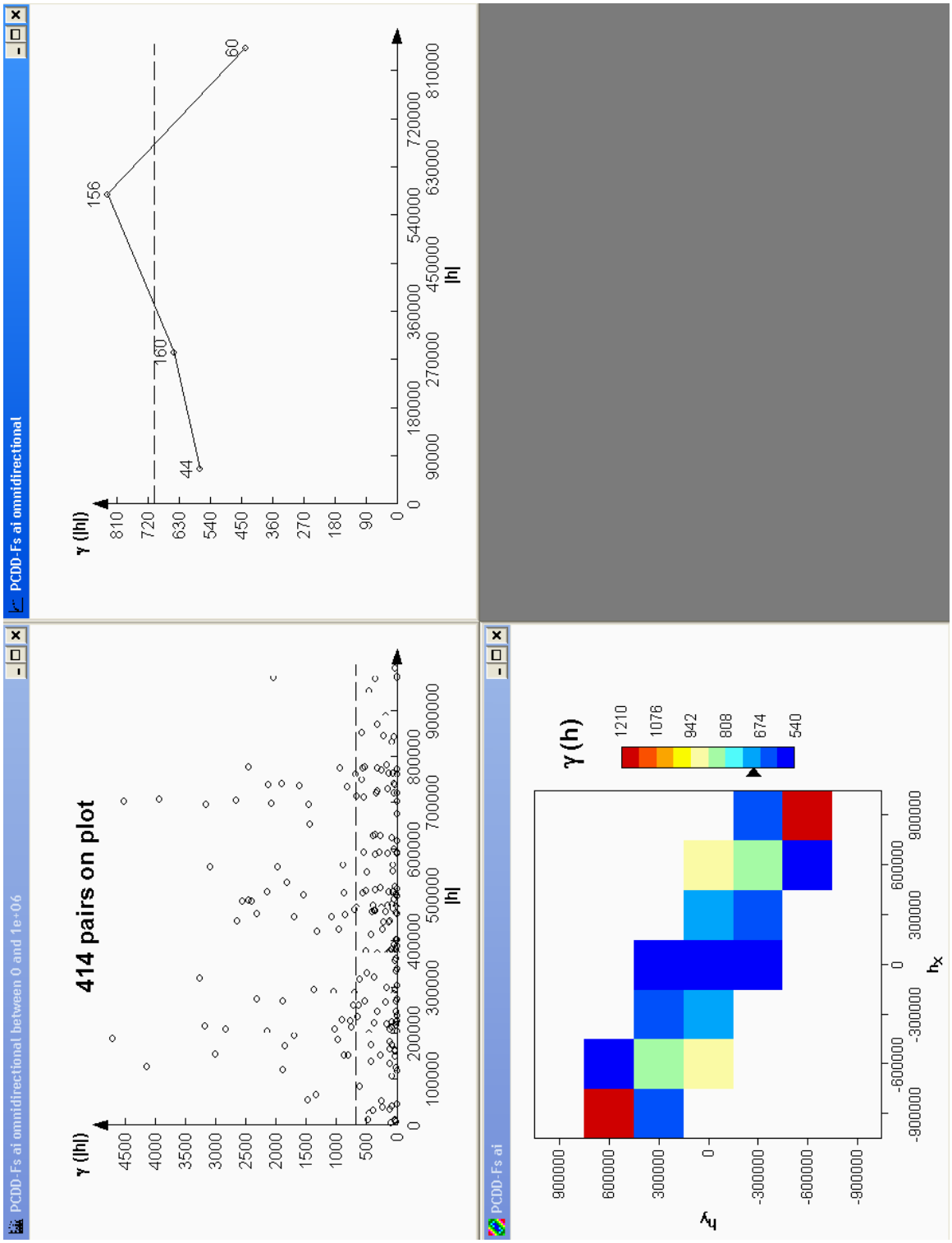


Figure 60: variogram cloud, variogram surface, and directional variograms for PCDD/Fs air concentrations, period 1994-1996

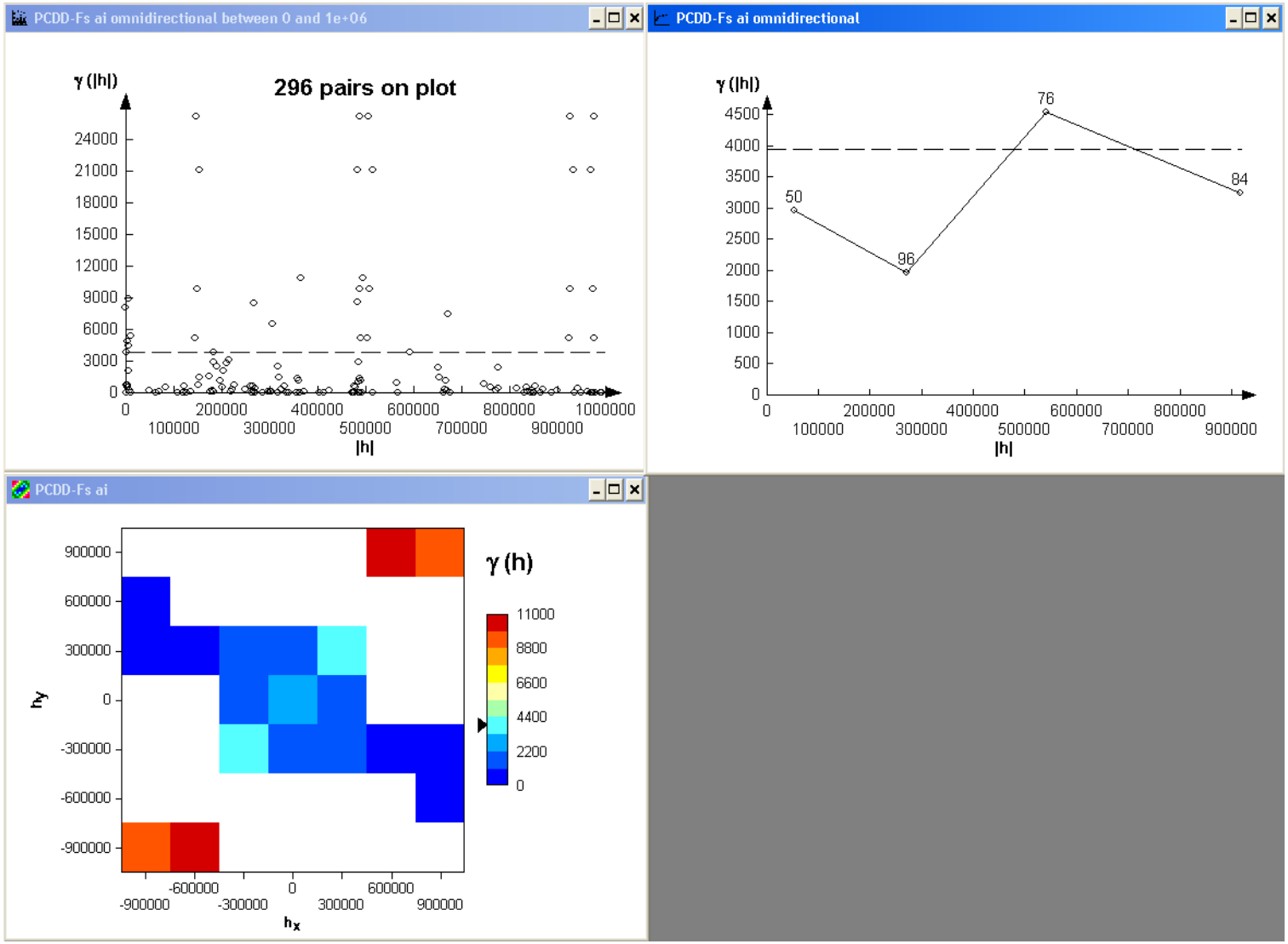


Figure 61: variogram cloud, variogram surface, and directional variograms for PCDD/Fs air concentrations, period 1996-1998

64

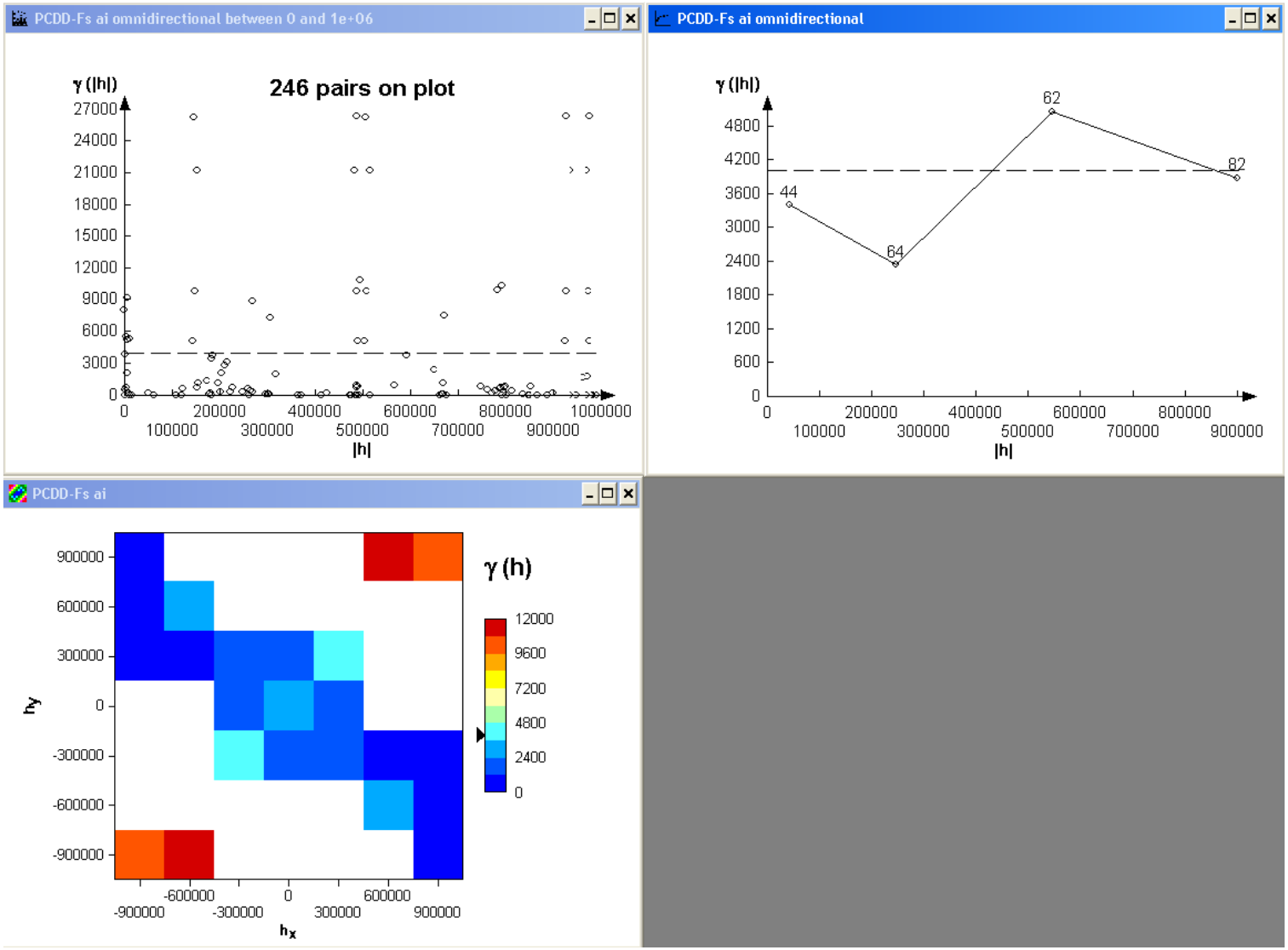


Figure 62: variogram cloud, variogram surface, and directional variograms for PCDD/Fs air concentrations, period 1997-1999

65

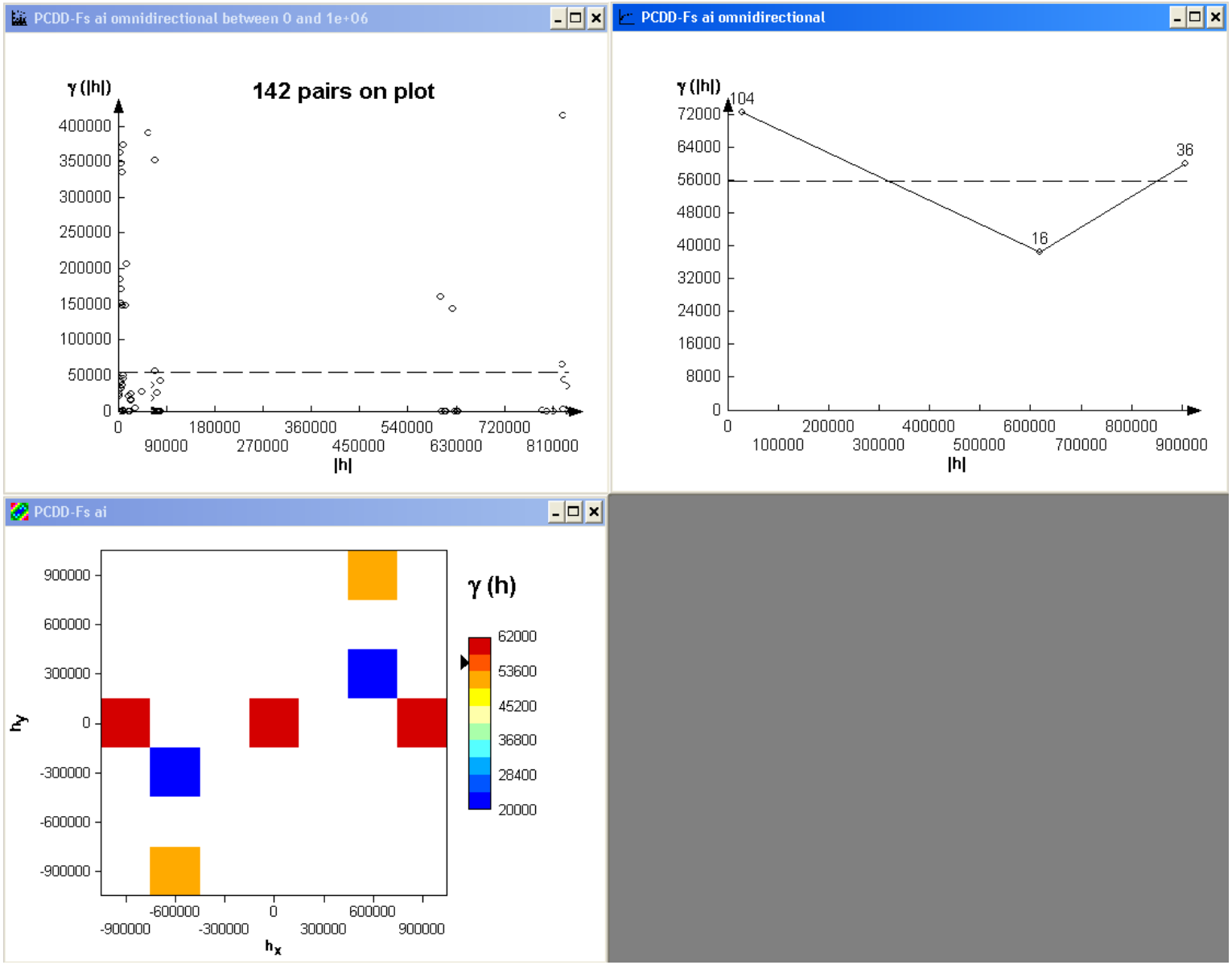


Figure 63: variogram cloud, variogram surface, and directional variograms for PCDD/Fs air concentrations, period 2002-2004

99

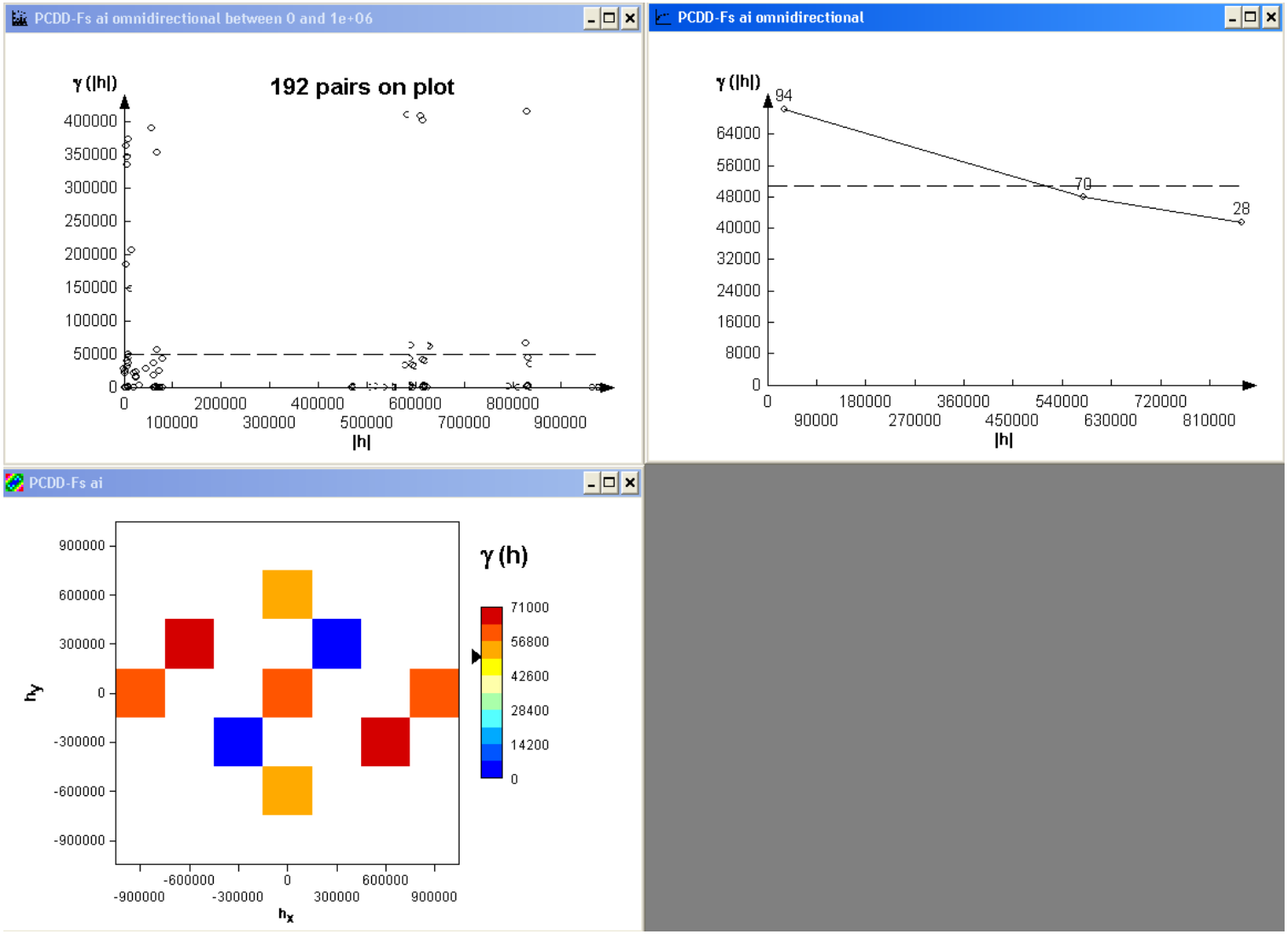


Figure 64: variogram cloud, variogram surface, and directional variograms for PCDD/Fs air concentrations, period 2004-2006

67

These are the results found for water:

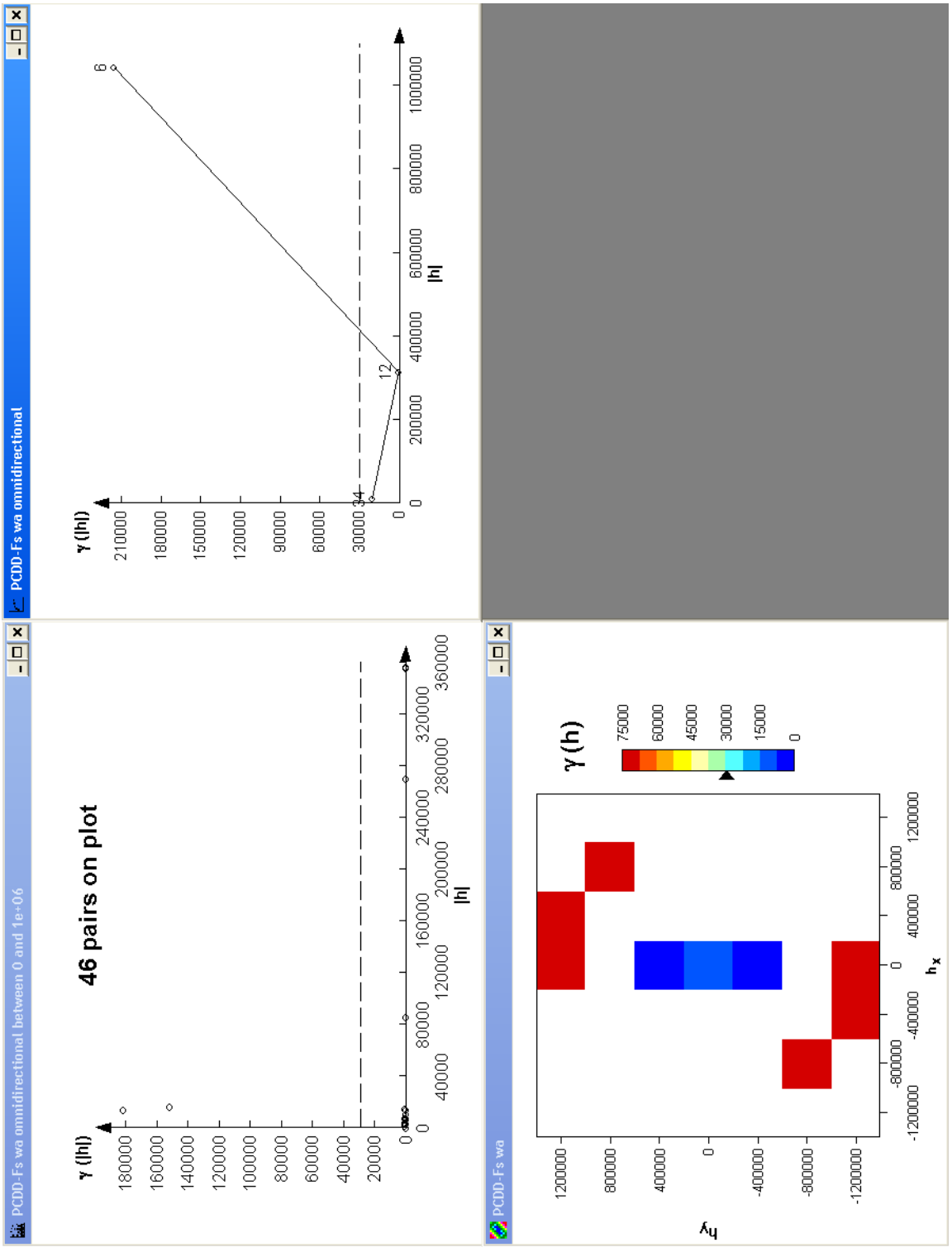


Figure 65: variogram cloud, variogram surface, and directional variograms for PCDD/Fs water concentrations, period 2005-2007

These are the results found for sediment:

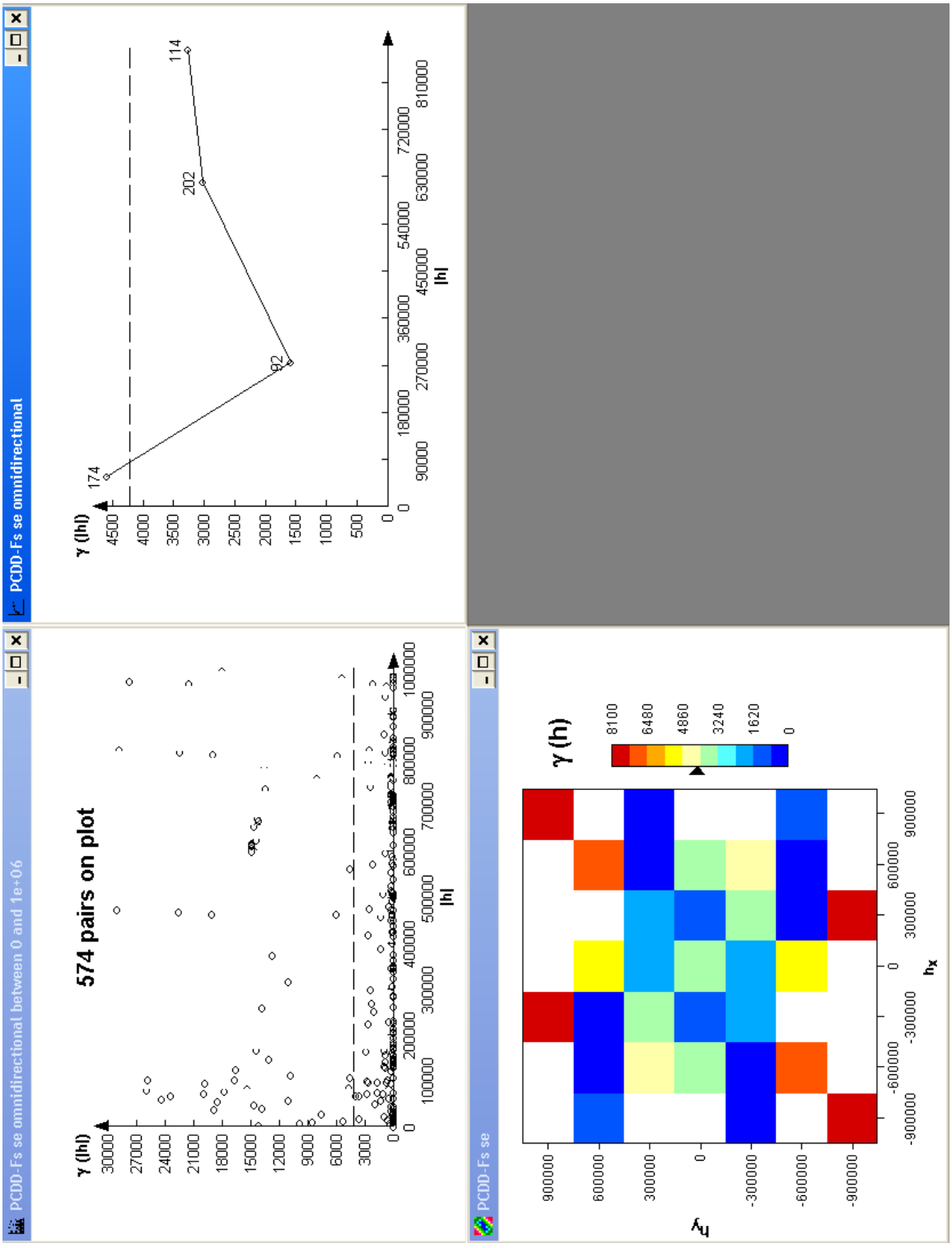


Figure 66: variogram cloud, variogram surface, and directional variograms for PCDD/Fs sediment concentrations, period 1994-1996

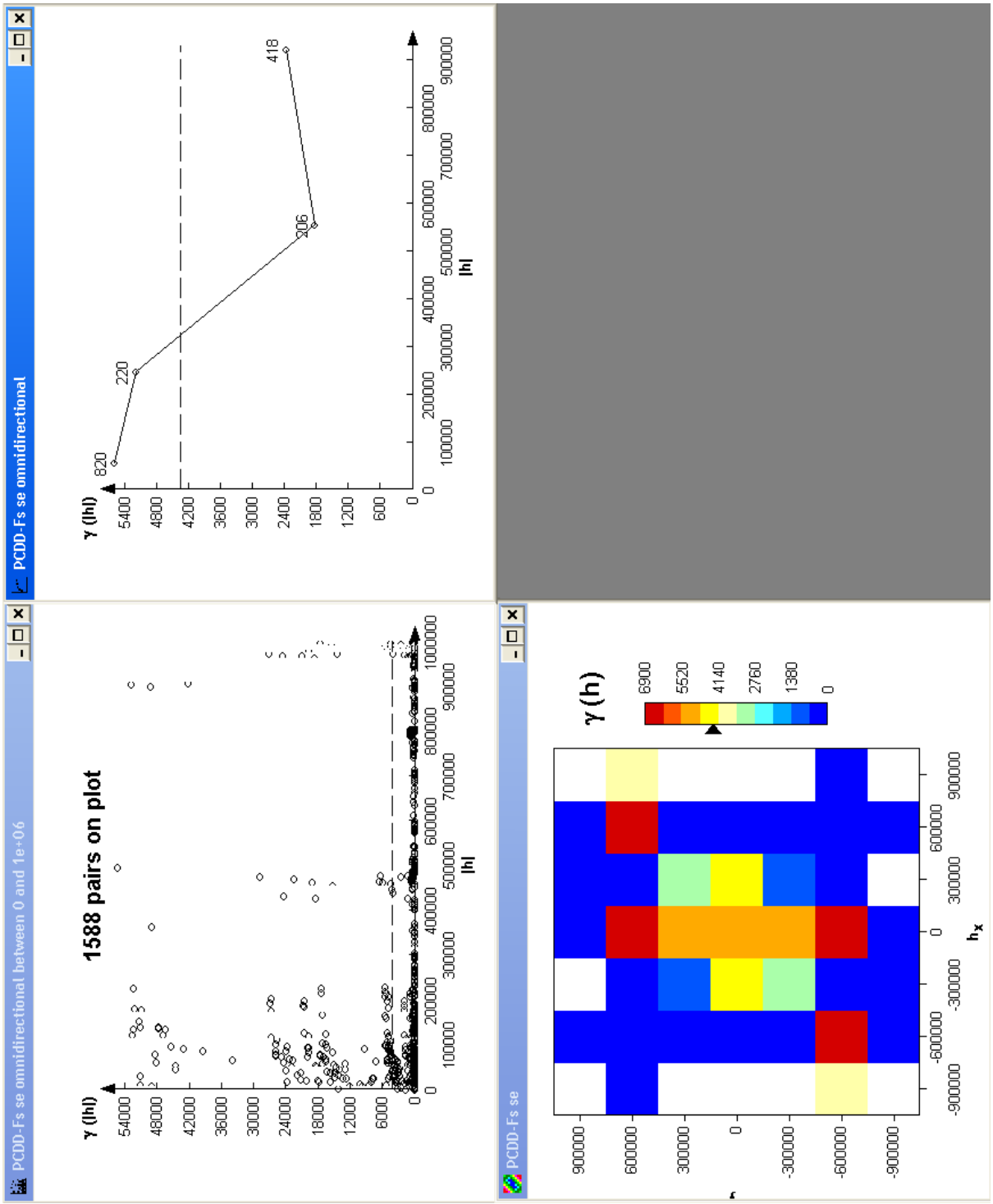


Figure 67: variogram cloud, variogram surface, and directional variograms for PCDD/Fs sediment concentrations, period 1996-1998

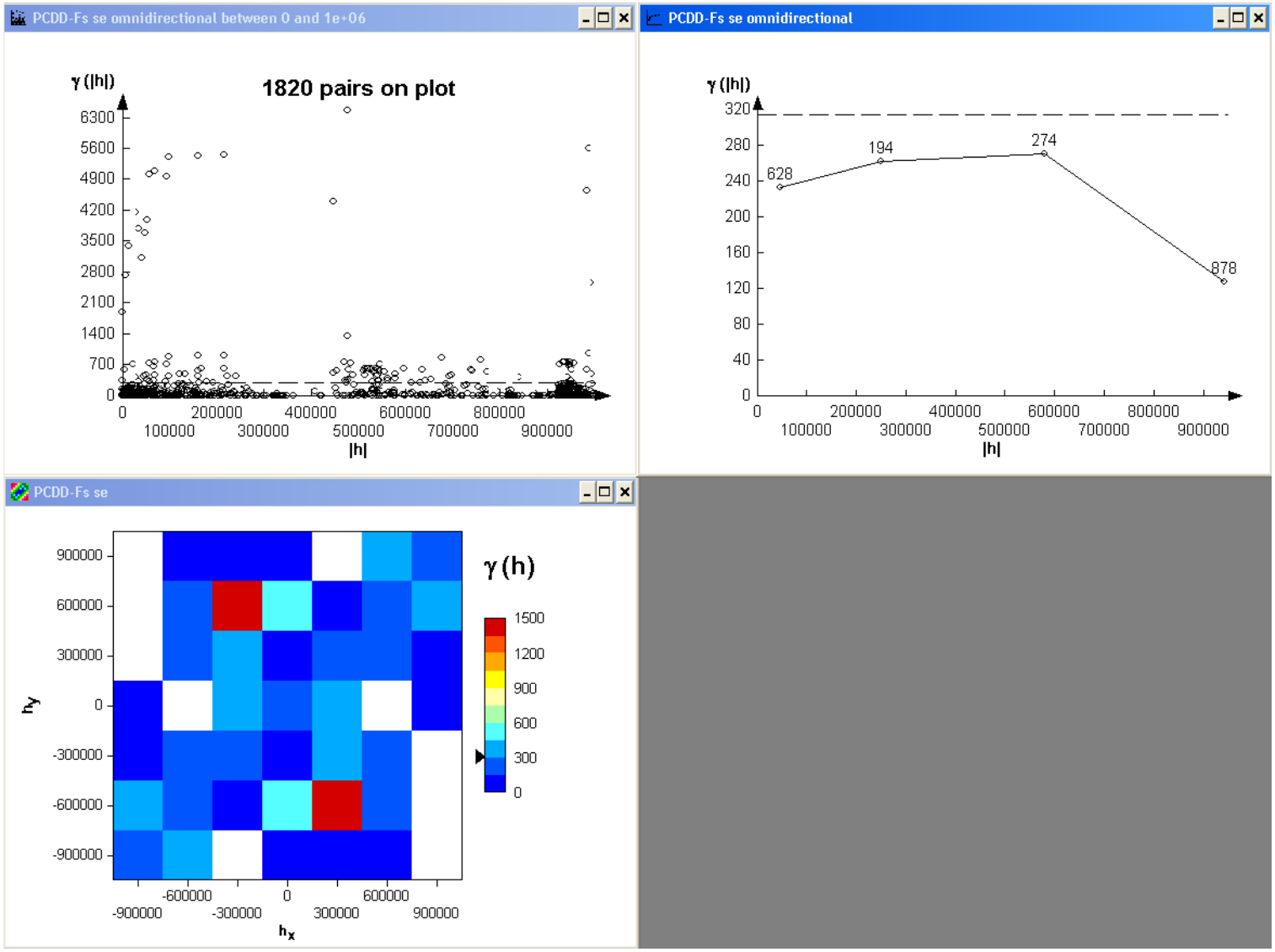


Figure 68: variogram cloud, variogram surface, and directional variograms for PCDD/Fs sediment concentrations, period 1998-2000

71

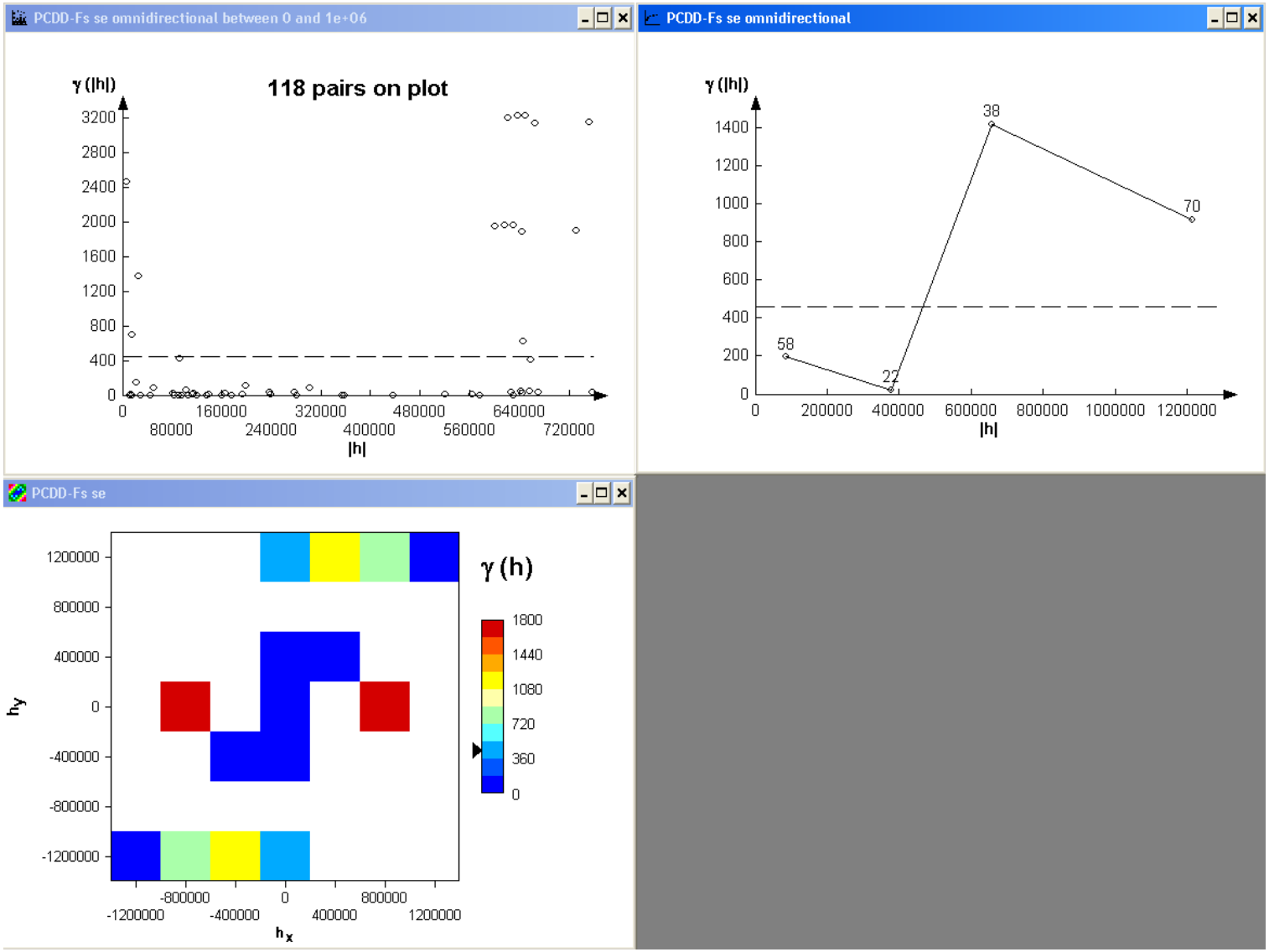


Figure 69: variogram cloud, variogram surface, and directional variograms for PCDD/Fs sediment concentrations, period 2001-2003

72

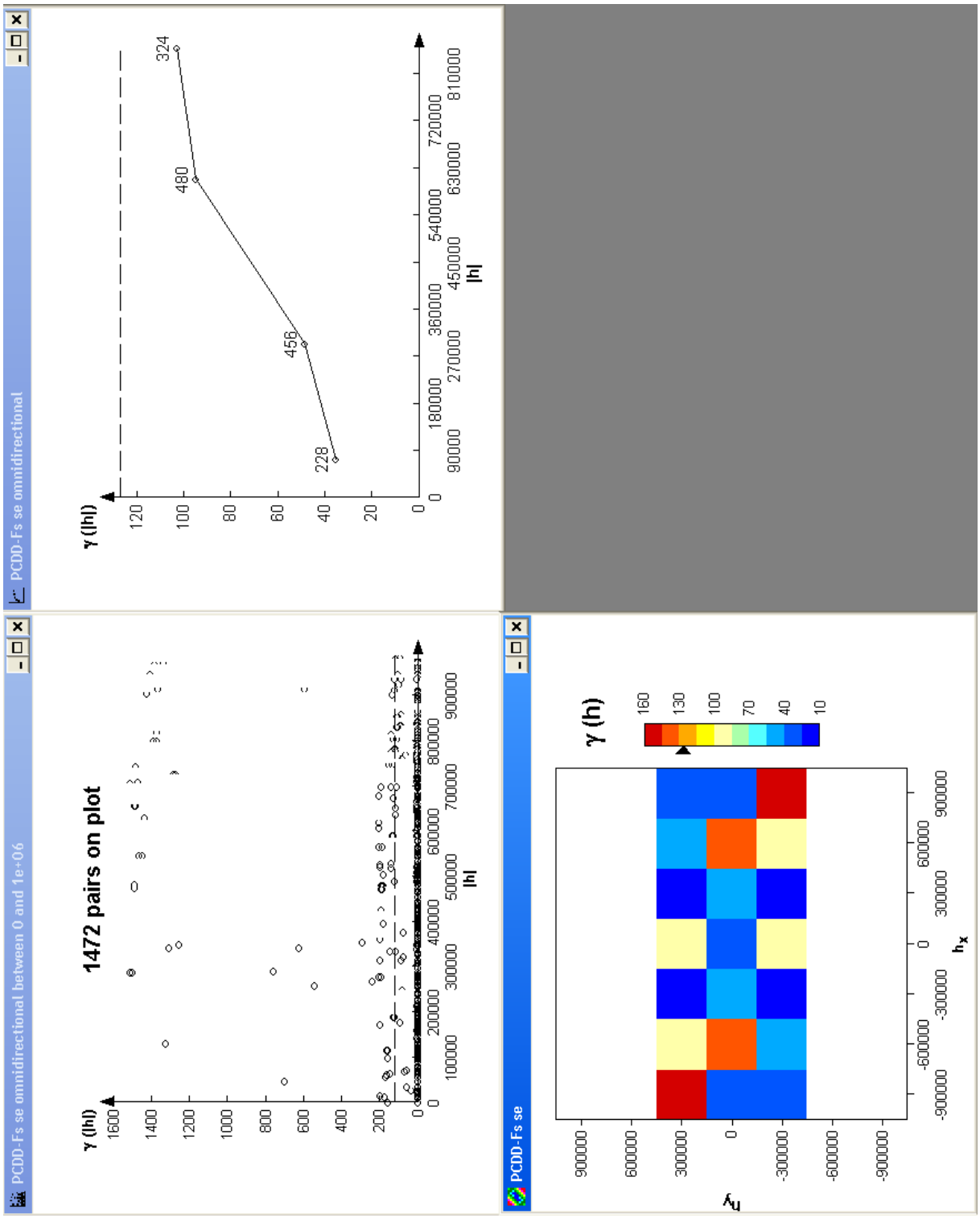


Figure 70: variogram cloud, variogram surface, and directional variograms for PCDD/Fs sediment concentrations, period 2005-2007

These are the results found for soil:

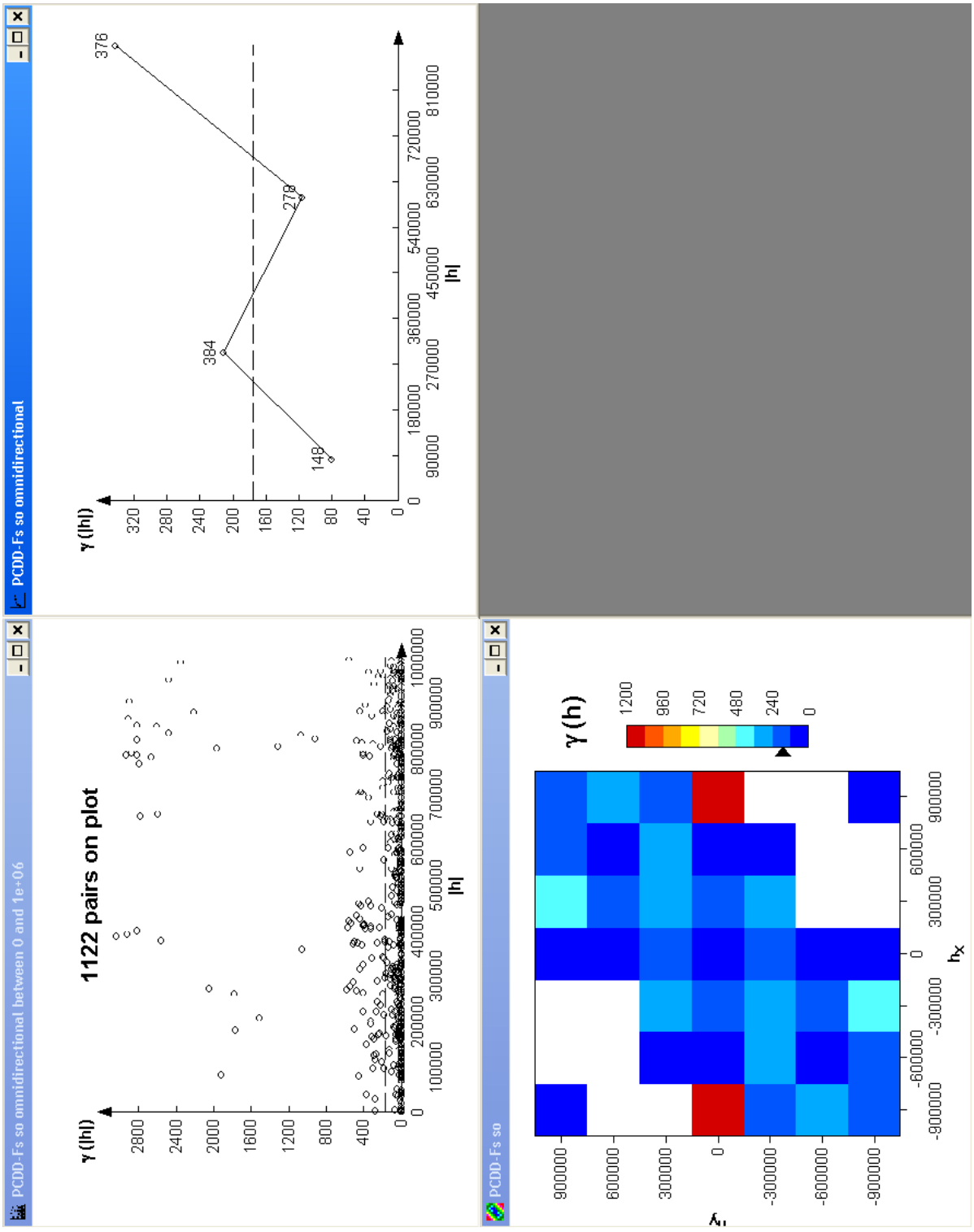


Figure 71: variogram cloud, variogram surface, and directional variograms for PCDD/Fs soil concentrations, period 1998-2000

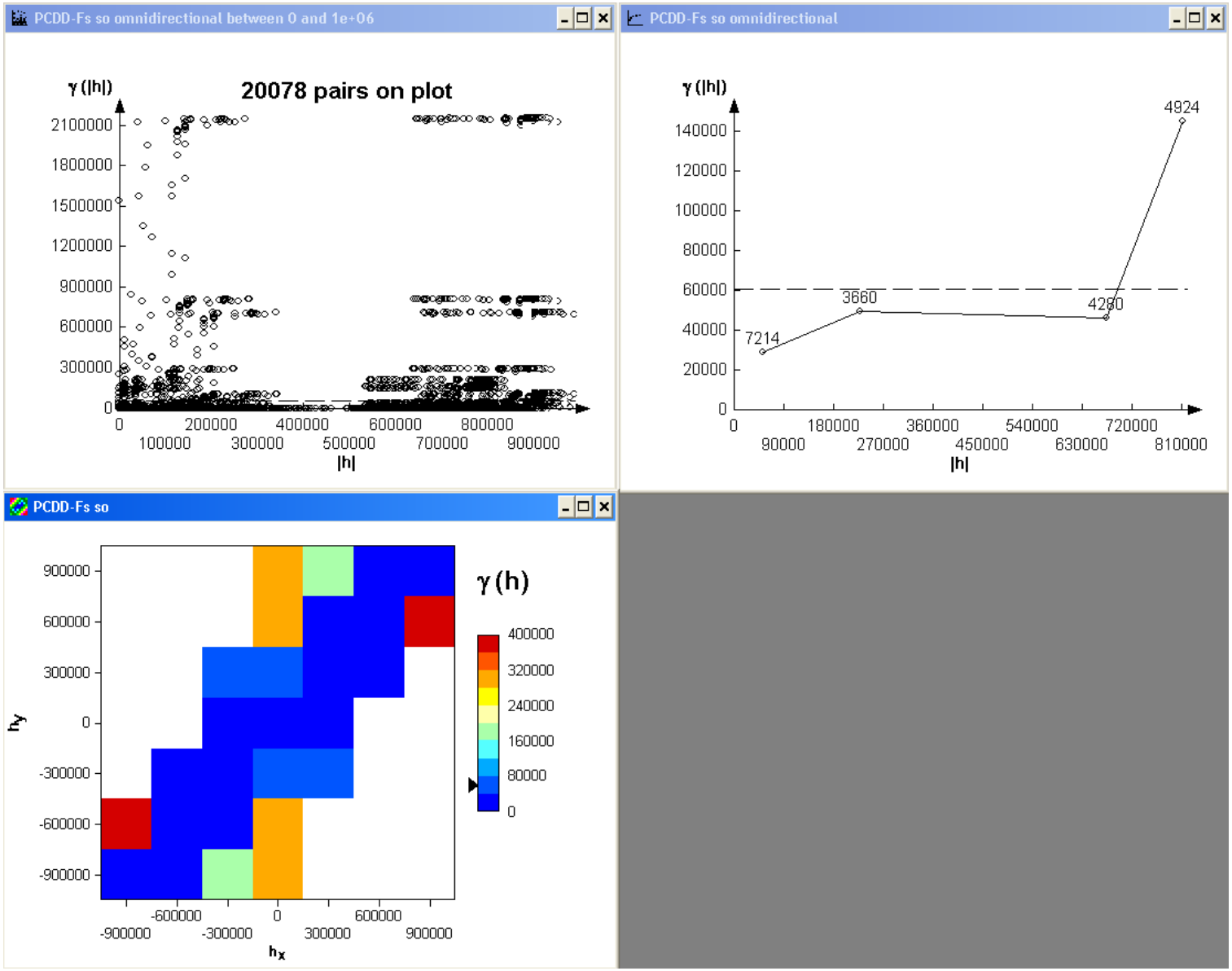


Figure 72: variogram cloud, variogram surface, and directional variograms for PCDD/Fs soil concentrations, period 2002-2004

75

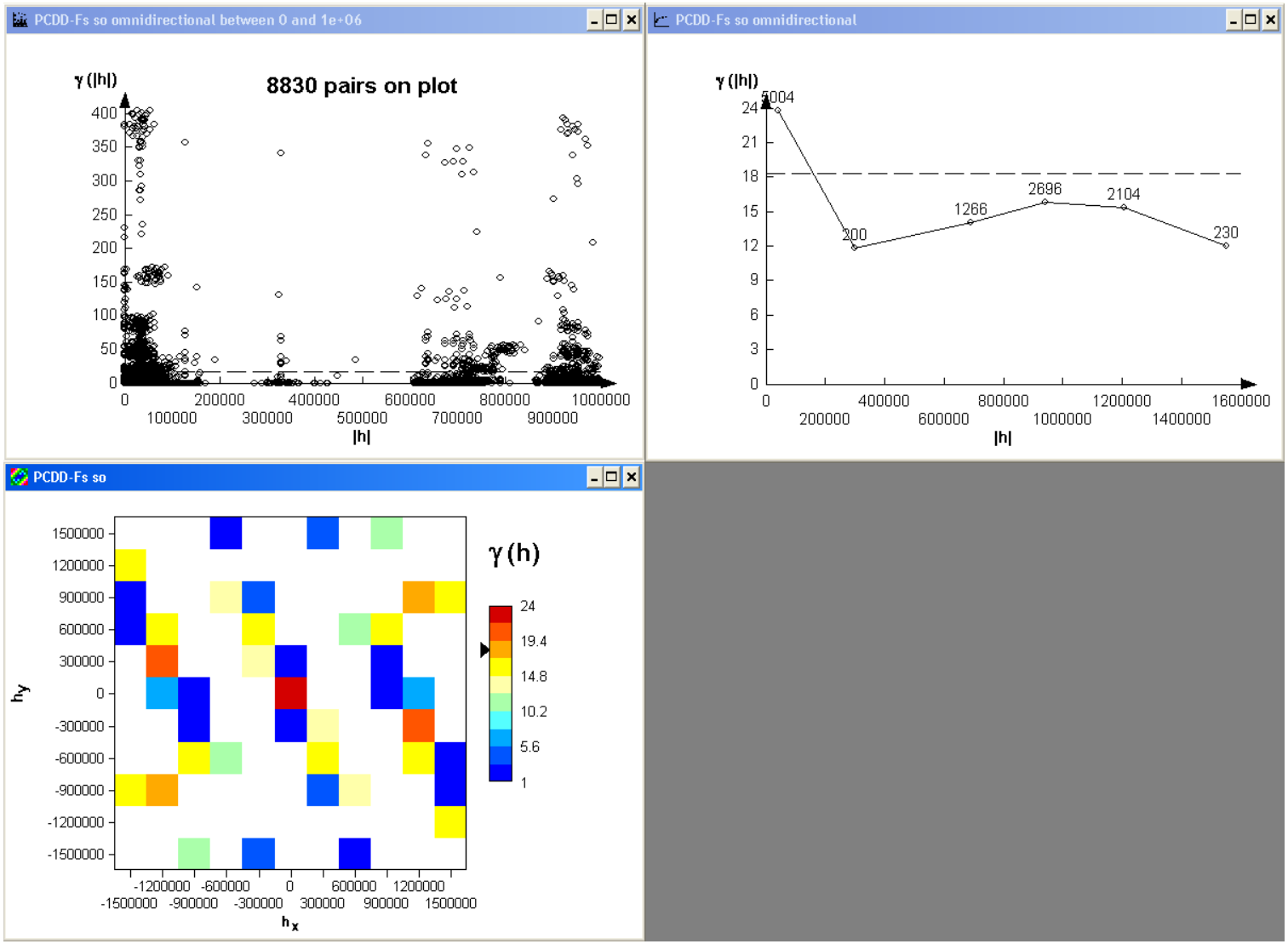


Figure 73: variogram cloud, variogram surface, and directional variograms for PCDD/Fs soil concentrations, period 2004-2006

76

Bibliography

1. Agramunt, M. C., Schuhmacher, M., Hernandez, J. M., Domingo, J. L., 2005: Levels of dioxins and furans in plasma of nonoccupationally exposed subjects living near a hazardous waste incinerator. Journal of exposure Analysis and Environmental Epidemiology 15, 29-34.
2. Agrell, C., Larsson, P., Okla, L., Agrell, J., 2002: PCB congeners in precipitation, wash out ratios and depositional fluxes within the Baltic Sea region, Europe. Atmospheric Environment 36 (2002) 371–383.
3. Agrell, C., Okla, L., Larsson, P., Backe, C., Wania, F., 1999. Evidence of latitudinal fractionation of polychlorinated biphenyl congeners along the Baltic Sea region. Environmental Science and Technology 33, 1149–1156.
4. Andersson M., Ottesen R.T., 2008: Levels of dioxins and furans in urban surface soil in Trondheim, Norway. Environmental Pollution 152 (3), pp. 553-558.
5. Antizar-Ladislao, B., 2009: Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, phthalates and organotins in northern Atlantic Spain's coastal marine sediments. Journal of Environmental Monitoring 11 (1), pp. 85-91.
6. Antunes, P., Viana, P., Vinhas, T., Capelo, J.L., Rivera, J., Gaspar, E.M.S.M., 2008: Optimization of pressurized liquid extraction (PLE) of dioxin-furans and dioxin-like PCBs from environmental samples. Talanta 75 (4), pp. 916-925.
7. Backe, C., Cousins, I.T., Larsson, P., 2004: PCB in soils and estimated soil–air exchange fluxes of selected PCB congeners in the south of Sweden. Environmental Pollution 128 (1-2), pp. 59-72.
8. Bakoglu, M., Karademir, A., Durmusoglu, E., 2005: Evaluation of PCDD/F levels in ambient air and soils and estimation of deposition rates in Kocaeli, Turkey Chemosphere 59 (10), pp. 1373-1385.
9. Barbiere M., Umlauf G., Skejo-Andresen H., 1999 Campionamento analitico della zona B di Seveso e Comuni limitrofi per la ricerca della 2,3,7,8-TCDD residua (V fase) e baccordo aggiuntivo per la Zona A. DG JRC Ispra. Contratto N° 14918-1999-03 T1 ED ISP I Final Report.
10. Begonja Kolar, A., Hršak, D., Fingler, S., Ćetković, H., Petrić, I., Kolić, N.U., 2007: PCB-degrading potential of aerobic bacteria enriched from marine sediments. International Biodeterioration and Biodegradation 60 (1), pp. 16-24.
11. Bervoets, L., Voets, J., Covaci, A., Chu, S., Qadah, D., Smolders, R., Schepens, P., Blust, R., 2005: use of transplanted zebra mussels (Dreissena polymorpha) to assess bioavailability of microcontaminants in flemish surface waters. Environmental Science and Technology 39 (6), pp. 1492-1505.
12. Biasioli, M., Ajmone-Marsan, F., 2007: Organic and inorganic diffuse contamination in urban soils: the case of Torino (Italy). Journal of Environmental Monitoring 9 (8), pp. 862-868.
13. Binelli, A., Provini, A., 2003. Risk for human health of some POPs due to fish from Lake Iseo. Ecotoxicology and Environmental Safety 58, 139–145.
14. Binelli, A., Provini, A., 2003. The PCB pollution of Lake Iseo (N. Italy) and the role of biomagnification in the pelagic food web. Chemosphere 53, 143–151.
15. Biphenyls in the Eastern Mediterranean. Environmental Science and Technology, 38, 3011-3018.
16. Bozlaker, A., Odabasi, M., Muezzinoglu, A., 2008: Dry deposition and soil–air gas exchange of polychlorinated biphenyls (PCBs) in an industrial area. Environmental Pollution 156 (3), pp. 784-793.
17. Buckley-Golder, D., 1999: Compilation of EU Dioxin Exposure and Health Data. European Commission DG Environment and UK Department of the Environmental Transport and the Regions. Report Number AEAT/EEQC/0016.
18. Burreau, S., Zebühr, Y., Broman, D., Ishaq, R., 2004. Biomagnification of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) studied in pike (Esox lucius), perch (Perca fluviatilis) and roach (Rutilus rutilus) from the Baltic Sea. Chemosphere 55, 1043–1052.

19. Cachada, A., Lopes, L.V., Hursthouse, A.S., Biasioli, M., Grčman, H., Otabbong, E., Davidson, C.M., Duarte, A.C., 2009: The variability of polychlorinated biphenyls levels in urban soils from five European cities. Environmental Pollution 157 (2), pp. 511-518.

20. Capuano, F., Cavalchi, B., Martinelli, G., Pecchini, G., Renna E., Scaroni, I., Bertacchi, M., Bigliardi, G., 2005: Environmental prospection for PCDD/PCDF, PAH, PCB and heavy metals around the incinerator power plant of Reggio Emilia town (Northern Italy) and surrounding main roads. Chemosphere 58, 1563-1569.

21. Cardellicchio, N., Buccolieri, A., Giandomenico, S., Lopez, L., Pizzulli, F., Spada, L., 2007: Organic pollutants (PAHs, PCBs) in sediments from the Mar Piccolo in Taranto (Ionian Sea, Southern Italy). Marine Pollution Bulletin 55 (10-12), pp. 451-458.

22. Casado-Martínez, M.C., Buceta, J.L., Belzunce, M.J., DelValls, T.A., 2006: Using sediment quality guidelines for dredged material management in commercial ports from Spain. Environment International 32 (3), pp. 388-396.

23. Casado-Martínez, M.C., Forja, J.M., DelValls, T.A., 2009: A multivariate assessment of sediment contamination in dredged materials from Spanish ports. Journal of Hazardous Materials 163 (2-3), pp. 1353-1359.

24. Castro-Jiménez, J., Deviller, G., Ghiani, M., Loos, R., Mariani, G., Skejo, H., Umlauf, G., Wollgast, J., Laugier, T., Héas-Moisan, K., Léauté, F., Munschy, C., Tixier, C., Tronczyński, J., 2008: PCDD/F and PCB multi-media ambient concentrations, congener patterns and occurrence in a Mediterranean coastal lagoon (Etang de Thau, France). Environmental Pollution 156 (1), pp. 123-135.

25. Castro-Jiménez, J., Mariani, G., Eisenreich, S.J., Christoph, E.H., Hanke, G., Canuti, E., Skejo, H., and Umlauf, G., 2008: Atmospheric input of POPs into Lake Maggiore (Northern Italy): PCDD/F and dioxin-like PCB profiles and fluxes in the atmosphere and aquatic system. Chemosphere 73 (1 SUPPL.), pp. S122-S130

26. Castro-Jiménez, J. , S. Dueri, S.J. Eisenreich, G. Mariani, H. Skejo, G. Umlauf and J.M. Zaldívar (2009). Polychlorinated biphenyls (PCBs) in the atmosphere of sub-alpine northern Italy. Environmental Pollution 157, 1024-1032

27. Catalan, J., Ventura, M., Vives, I., Grimalt, J.O., 2004: The roles of food and water in the bioaccumulation of organochlorine compounds in high mountain lake fish. Environmental Science and Technology 38 (16), pp. 4269-4275.

28. Cenci, R.M., Sena, F., Filippi, N., Umlauf, G., Beone, G.M., Lodigiani, G., Gaulio, W., Musmeci, L., Benedetti, A., Jones, R., 2007: Monitoring during Time of Relapses of an Incineration Plant. Eleventh International Waste Management and Landfill Symposium, 1-5 October 2007. Sardinia, Italy.

29. Cetin, B., Yatkin, S., Bayram, A., Odabasi, M., 2007: Ambient concentrations and source apportionment of PCBs and trace elements around an industrial area in Izmir, Turkey. Chemosphere 69 (8), pp. 1267-1277.

30. Christoph, E. H., Ghiani, M., Mariani, G., Mueller, A., Paradiz, B., Skejo, H., Umlauf, G., Levels and Patterns of PCDD/FS in air, soil, and Biota from Krakow and the Malopolska region (Poland), 2006. Workshop of the Krakow Project, May 2006. Krakow, Poland.

31. Chrysikou, L.P., Gemenetzis, P.G., Samara, C.A., 2009: Wintertime size distribution of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the urban environment: Street- vs rooftop-level measurements. Atmospheric Environment 43 (2), pp. 290-300.

32. Cindoruk, S.S., Esen, F., Tasdemir, Y., 2007: Concentration and gas/particle partitioning of polychlorinated biphenyls (PCBs) at an industrial site at Bursa, Turkey. Atmospheric Research 85 (3-4), pp. 338-350.

33. Cindoruk, S.S., Tasdemir, Y., 2009: Dynamics of atmospheric polychlorinated biphenyls (PCBs): concentrations, patterns, partitioning, and dry deposition level estimations in a residential site of Turkey. Environmental Monitoring and Assessment, pp. 1-14.

34. Cornelissen, G., Cousins, I.T., Wiberg, K., Tysklind, M., Holmstro□m, H., Broman, D., 2008: Black carbon-dominated PCDD/Fs sorption to soils at a former wood impregnation site. Chemosphere 72 (10), pp. 1455-1461.

35. Cornelissen, G., Wiberg, K., Broman, D.A.G., Arp, H.P.H., Persson, Y., Sundqvist, K., Jonsson, P., 2008: Freely Dissolved Concentrations and Sediment-Water Activity Ratios of PCDD/Fs and PCBs in the Open Baltic Sea. Environmental Science and Technology 42 (23), pp. 8733-8739.

36. Costopoulou, D., Vassiliadou, I., Papadopoulos, A., Makropoulos, V. Leondiadis, L., 2006: levels of dioxins, furans and PCBs in human serum and milk of people living in Greece. Chemosphere 65, 1462-1469.

37. Coutinho, M., Ferreira, J., Gomes, P., Mata, P., Borrego, C., 2001: Atmospheric baseline levels of PCDD and PCDF in the region of Oporto. Chemosphere 43 (4-7), pp. 497-500.

38. Coutinho, M., Pereira, M., Borrego C., 2007: Monitoring of ambient air PCDD/F levels in Portugal. Chemosphere 67, 1715–1721.

39. Covaci, A., Hura, C., Schepens, P., 2001: Selected persistent organochlorine pollutants in Romania. Science of the Total Environment 280 (1-3), pp. 143-152.

40. Currado, G.M., Harrad, S., 2000: Factors Influencing Atmospheric Concentrations of Polychlorinated Biphenyls in Birmingham, U.K. Environmental Science and Technology 34 (1), pp. 78-82.

41. Danis, B., Debacker, V., Trujilo Miranda, C., Dubois, Ph., 2006: Levels and effects of PCDD/Fs and co-PCBs in sediments, mussels, and sea stars of the intertidal zone in the southern North Sea and the English Channel. Ecotoxicology and Environmental Safety 65 (2), pp. 188-200.

42. Danis, B., Wantier, P., Dutrieux, S., Flammang, R., Dubois, Ph., Warnau, M., 2004: Contaminant levels in sediments and asteroids (Asterias rubens L., Echinodermata) from the Belgian coast and Scheldt estuary: polychlorinated biphenyls and heavy metals. Science of the Total Environment 333 (1-3), pp. 149-165.

43. Dioxins in the Francilian (Ile-de-France) ambient air, 2005. Pollution Atmospherique (187), pp. 355-360.

44. Dragan, D., Cucu-Man, S., Dirtu, A.C., Mocanu, R., Vaeck, L.V., Covaci, A., 2006: Occurrence of organochlorine pesticides and polychlorinated biphenyls in soils and sediments from Eastern Romania. International Journal of Environmental Analytical Chemistry 86 (11), pp. 833-842.

45. Dvorska, A., Lammel, G., Holoubek, I, 2009: Recent trends of persistent organic pollutants in air in central Europe - Air monitoring in combination with air mass trajectory statistics as a tool to study the effectivity of regional chemical policy. Atmospheric Environment 43 (6), pp. 1280-1287.

46. Dvorska, A., Lammel, G., Klanova, J., Holoubek, I., 2008: Kosetice, Czech Republic – ten years of air pollution monitoring and four years of evaluating the origin of persistent organic pollutants. Environmental Pollution 156 (2), pp. 403-408.

47. Eljarrat, E., Caixach, J., Rivera, J., De Torres, M., Ginebreda, A., 2001: Toxic Potency Assessment of Non- and Mono-ortho PCBs, PCDDs, PCDFs, and PAHs in Northwest Mediterranean Sediments (Catalonia, Spain). Environmental Science and Technology 35 (18), pp. 3589-3594.

48. Eljarrat, E., De La Cal, A., Larrazabal, D., Fabrellas, B., Fernandez-Alba, A.R., Borrull, F., Marce, R.M., Barcelo, D., 2005: Occurrence of polybrominated diphenylethers, polychlorinated dibenzo-p-dioxins, dibenzofurans and biphenyls in coastal sediments from Spain. Environmental Pollution 136 (3), pp. 493-501.

49. Eljarrat, E., Martínez, M.A., Sanz, P., Concejero, M.A., Piña, B., Quirós, L., Raldúa, D., Barceló, D., 2008: Distribution and biological impact of dioxin-like compounds in risk zones along the Ebro River basin (Spain). Chemosphere 71 (6), pp. 1156-1161.

50. Falandysz, J., Wyrzykowska, B., Warzocha, J., Barska, I., Garbacik-Wesolowska, A., Szefer, P., 2004. Organochlorine pesticides and PCBs in perch Perca fluviatilis from the Odra/Oder river estuary, Baltic Sea. Food Chemistry 87, 17-23.

51. Fillmann, G., Readman, J. W., Tolosa, I., Bartocci, J., Villeneuve, J. P., Cattini, C., Mee, L. D., 2002: Persistent organochlorine residues in sediments form the Black Sea. Marine Pollution Bulletin 44, 122-133.

52. Floret, N., Lucot, E., Badot, P.-M., Mauny, F., Viel, J.-F., 2007: A municipal solid waste incinerator as the single dominant point source of PCDD/Fs in an area of increased non-Hodgkin's lymphoma incidence. Chemosphere 68 (8), pp. 1419-1426.

53. Focant, J. F., Pirard, C., Thielen C., De Pauw, E., 2002: Levels and profiles of PCDDs, PCDFs and cPCBS in Belgian breast milk. Estimate of infant intake. Chemosphere 48, 763-770.

54. Furberg, A. S., Sandanger, T., Thune, I., Burkow I. C., Lundand E., 2002. Fish consumption and plasma levels of organochlorines in a female population in Northern Norway. Journal of Environmental Monitoring, 4, 175-181.

55. Galanopoulou, S., Vgenopoulos, A., Conispoliatis, N., 2005: DDTs and other chlorinated organic pesticides and polychlorinated biphenyls pollution in the surface sediments of Keratsini harbour, Saronikos gulf, Greece. Marine Pollution Bulletin 50 (5), pp. 520-525.

56. Gambaro, A., Manodori, L., Moret, I., Capodaglio, G., Cescon, P., 2004: Determination of polychlorobiphenyls and polycyclic aromatic hydrocarbons in the atmospheric aerosol of the Venice Lagoon. Analytical and Bioanalytical Chemistry 378 (7), pp. 1806-1814.

57. García-Alonso S., Pérez-Pastor R. M., 2003: Occurrence of PCBs in ambient air and surface soil in an urban site of Madrid. Water, Air, and Soil Pollution 146 (1-4), pp. 283-295.

58. García-Flor, N., Guitart, C., Bodineau, L., Dachs, J., Bayona, J.M., Albaigés, J., 2005: Comparison of sampling devices for the determination of polychlorinated biphenyls in the sea surface microlayer. Marine Environmental Research 59 (3), pp. 255-275.

59. Gómez-Gutiérrez, A.I., Jover, E., Bodineau, L., Albaigés J., Bayona J. M., 2006: Organic contaminant loads into the Western Mediterranean Sea: Estimate of Ebro River inputs. Chemosphere 65, 224–236.

60. Gómez-Gutiérrez, A.I., Jover, E., Bodineau, L., Albaigés, J., Bayona, J.M., 2006: Organic contaminant loads into the Western Mediterranean Sea: Estimate of Ebro River inputs. Chemosphere 65 (2), pp. 224-236.

61. Götz, R., Bauer, O.-H., Friesel, P., Herrmann, T., Jantzen, E., Kutzke, M., Lauer, R., Paepke, O., Roch, K., Rohweder, U., Schwartz, R., Sievers, S., Stachel, B., 2007: Vertical profile of PCDD/Fs, dioxin-like PCBs, other PCBs, PAHs, chlorobenzenes, DDX, HCHs, organotin compounds and chlorinated ethers in dated sediment/soil cores from flood-plains of the river Elbe, Germany. Chemosphere 67 (3), pp. 592-603.

62. Green, N.J.L., Jones, J.L., Jones, K.C., 2001: PCDD/F deposition time trend to esthwaite water, U.K., and its relevance to sources. Environmental Science and Technology 35 (14), pp. 2882-2888.

63. Grimalt, J.O., Van Drooge, B.L., Ribes, A., Vilanova, R.M., Fernandez, P., Appleby, P., 2004: Persistent organochlorine compounds in soils and sediments of European high altitude mountain lakes. Chemosphere 54 (10), pp. 1549-1561.

64. Gustaffson, O., Axelman, J., Broman, D., Eriksson, M., Dahlgaard, H., 2001: Process-diagnostic patterns of chlorobiphenyl congeners in two radiochronologically characterized sediment cores from the northern Baffin Bay.Chemosphere 45, 759-766.

65. Harrad, S., Mao, H., 2004: Atmospheric PCBs and organochlorine pesticides in Birmingham, UK: concentrations, sources, temporal and seasonal trends. Atmospheric Environment 38 (10), pp. 1437-1445.

66. Hassanin, A., Lee, R.G.M., Steinnes, E., Jones, K.C., 2005: PCDD/Fs in Norwegian and U.K. Soils: Implications for Sources and Environmental Cycling. Environmental Science and Technology 39 (13), pp. 4784-4792.

67. Heath, E., Ščančar, J., Zuliani, T., Milačič R., 2009: A complex investigation of the extent of pollution in sediments of the Sava River: part 2: persistent organic pollutants. Environmental Monitoring and Assessment, pp. 1-17.

68. Herceg Romanić, S., Krauthacker, B., 2000: Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air Collected in Zagreb, Croatia. Bulletin of Environmental Contamination and Toxicology 64 (6), pp. 811-816.

69. Herceg Romanić, S., Krauthacker, B., 2003: Comparison of Ambient Air Levels of PCBs and Organochlorine Pesticides at Two Sites in Zagreb, Croatia. Bulletin of Environmental Contamination and Toxicology 71 (5), pp. 1034-1041.

70. Hilscherova, K., Kannan, K., Kang, Y.-S., Holoubek, I., Machala, M., Masunag, S., Nakanishi, J., Giesy, J.P., 2001: Characterization of dioxin-like activity of sediments from a czech river basin. Environmental Toxicology and Chemistry 20 (12), pp. 2768-2777.

71. Hovmand, M.F., Vikelsøe, J., Andersen, H.V.: Atmospheric bulk deposition of dioxin and furans to Danish background areas. Atmospheric Environment 41 (11), pp. 2400-2411.

72. Isosaari, P., Kankaanpää, H., Mattila, J., Kiviranta, H., Verta, M., Salo, S., Vartiainen, T., Spatial Distribution and Temporal Accumulation of Polychlorinated Dibenzo-p-dioxins, Dibenzofurans, and Biphenyls in the Gulf of Finland. Environmental Science and Technology, 38, 2560-2565.

73. Isosaari, P., Pajunen, H., Vartiainen, T., 2002: PCDD/F and PCB history in dated sediments of a rural lake. Chemosphere 47 (6), pp. 575-583.

74. Jaward, F., Farrar, N. J., Harner, T., Sweetman, A., Jones, K. C., 2004: Passive air sampling of PCBs, PBDEs and Organochlorine Pesticides Across Europe. Environmental Science and Technology, 38, 34-41.

75. Jaward, F., Meijer S., Steinnes, E., Thomas, G., Jones, K., 2004: Further Studies on the Latitudinal and Temporal Trends of Persistent Organic Pollutants in Norwegian and U.K. Background Air. Environmental Science and Technology, 38, 2523-2530.

76. JDS2- Joint Danube Survey 2. Supported by the Danube Countries, European Commission. Published by:ICPDR – International Commission for the Protection of the Danube River, 2008. http://www.icpdr.org/jds/files/ICPDR_Technical_Report_for_web_low_corrected.pdf

77. Karl, H., Ruoff, U., 2007: Dioxins, dioxin-like PCBs and chloroorganic contaminants in herring *Clupea harengus*, from different fishing grounds of the Baltic Sea. Chemosphere 67 S90-S95.

78. Keiter, S., Grund, S., Van Bavel, B., Hagberg, J., Engwall, M., Kammann, U., Klempt, M., Manz, W. , Olsman, H., Braunbeck, T., Hollert, H., 2008: Activities and identification of aryl hydrocarbon receptor agonists in sediments from the Danube river. Analytical and Bioanalytical Chemistry 390 (8), pp. 2009-2019.

79. Kierkegaard, A., Asplund, L., Dewit, C., McLachlan, M., 2007: Fate of Higher brominated PBDEs in Lactating Cows. Environmental Science and Technology, 41, 417-423.

80. Kirchner, M., Henkelmann, B., Jakobi, G., Kotalik, J., Fischer, N., Oxynos, K., Schramm, K.-W., 2006: Concentration measurements of PCDD/F in air and spruce needles in the Bavarian Forest and Bohemian Forest (Sumava): First results. Ecotoxicology and Environmental Safety 63 (1), pp. 68-74.

81. Klánová, J., Kohoutek, J., Kostrhounová, R., Holoubek, I., 2007: Are the residents of former Yugoslavia still exposed to elevated PCB levels due to the Balkan wars? Part 1: air sampling in Croatia, Serbia, Bosnia and Herzegovina. Environment International 33 (6), pp. 719-726.

82. Klimisch H., Andreae M. and Tillmann U. (1997) - A systematic approach for evaluating the quality of experimental toxicological and ecotoxicological data. Regul Toxicol Pharm, 25, 1-5.

83. Kocan, A., Petrik, J., Jursa, S., Chovancova, J., Drobna, B., 2001: Environmental contamination with polychlorinated biphenyls in the area of their former manufacture in Slovakia. Chemosphere 43 (4-7), pp. 595-600.

84. Koci K., 1998: The Trend of POP Pollution in the Albanian Adriatic Coast: Case study: PCBs (1992-1996). Case Study of PCBs UNEP/IFCS (1992-1996), pp. 101-106.

85. Kočí, V., Ocelka, T., Dragoun, D., Vít, M., Grabic, R., Šváb, M., 2007: Concentration of organochlorine pollutants in surface waters of the Central European Biosphere Reserve Krivoklatsko. Environmental Science and Pollution Research 14 (2), pp. 94-101.

86. Kouimtzis, T., Samara, C., Voutsa, D., Balafoutis, C., Müller, L., 2002: PCDD/Fs and PCBs in airborne particulate matter of the greater Thessaloniki area, N. Greece. Chemosphere 47 (2), pp. 193-205.

87. Krauthacker, B., Herceg Romanić, S., Wilken, M., Milanović, Z., 2006: PCDD/Fs in ambient air collected in Zagreb, Croatia. Chemosphere 62 (11), pp. 1829-1837.

88. Lake, I.R., Foxall, C.D., Lovett, A.A., Fernandes, A., Dowding, A., White, S., Rose, M., 2005: Effects of River Flooding on PCDD/F and PCB Levels in Cows' Milk, Soil, and Grass. Environmental Science and Technology 39 (23), pp. 9033-9038.

89. Lee, R. G., Jones, K., 1999: Gas-Particle Partitioning of Atmospheric PCDD/Fs: Measurements and Observations on Modeling. Environmental Science and Technology. 33, 3596-3604.

90. Lee, R.G.M., Green, N.J.L., Lohmann, R., Jones, K.C., 1999: Seasonal, Anthropogenic, Air Mass, and Meteorological Influences on the Atmospheric Concentrations of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (PCDD/Fs): Evidence for the Importance of Diffuse Combustion Sources. Environmental Science and Technology 33 (17), pp. 2864-2871.

91. Lee, R.G.M., Hung, H., Mackay, D., Jones, K.C., 1998: Measurement and Modeling of the Diurnal Cycling of Atmospheric PCBs and PAHs. Environmental Science and Technology 32 (14), pp. 2172-2179.

92. Lee, R.G.M., Jones, K.C., 1999: The influence of meteorology and air masses on daily atmospheric pcb and pah concentrations at a UK location. Environmental Science and Technology 33 (5), pp. 705-712.

93. Lohmann R., Ockenden W. A., Shears, J., Jones K. C., 2001: Atmospheric Distribution of Polychlorinated Dibenzo-p-dioxins, Dibenzofurans (PCDD/FS), and Non-Ortho Biphenyls (PCBs) along a North-South Atlantic Transect. Environmental Science and Technology, 35, 4046-4053.

94. Malisch, R., Baum, F., 2007: PCDD/Fs, Dioxin-like, PCBs and marker Pcbs in eggs of peregrine falcons from Germany. Chemosphere 67, S1-S15.

95. Mandalakis, M., Stephanou, E., G., 2004: Wet Deposition of Polychlorinated

96. Mandalakis, M., Tsapakis, M., Tsoga, A., Stephanou, E.G. 2002: Gas–particle concentrations and distribution of aliphatic hydrocarbons, PAHs, PCBs and PCDD/Fs in the atmosphere of Athens (Greece). Atmospheric Environment 36 (25), pp. 4023-4035.

97. Manodori, L., Gambaro, A., Moret, I., Capodaglio, G., Cairns, W.R.L., Cescon, P., 2006: Seasonal evolution of gas-phase PCB concentrations in the Venice Lagoon area. Chemosphere 62 (3), pp. 449-458.

98. Martinez K., Abad E., Rivera J., 2006: Surveillance programme on dioxin levels in soils in the Campo de Gibraltar (Southwest Spain). Chemosphere 65 (3), pp. 382-389

99. Martinez, M., Diaz Ferrero, J., Marti, R., Broto-Puig, F., Comellas, L., Rodriguez-Larena, M. C., 2000: Analysis of dioxin-like compounds in vegetation and soil samples in burned in Catalan forest fires. Comparison with the corresponding unburned material. Chemosphere 41, 1927-1935.

100. Meijer, S. J., Ockenden, W. A., Sweetman, A., Breivik, K., 2003: Global Distribution and Budget of PCBs and HCB in Background Surface Soils: Implications for Sources and Environmental Processes. Environmental Science and Technology, 37, 667-672.

101. Meijer, S.N., Halsall, C.J., Harner, T., Peters, A.J., Ockenden, W.A., Johnston, A.E., Jones, K.C., 2001: Organochlorine Pesticide Residues in Archived UK Soil. Environmental Science and Technology 35 (10), pp. 1989-1995.

102. Micheletti, C., Critto, A., Marcomini, A., 2007: Assessment of ecological risk from bioaccumulation of PCDD/Fs and dioxin-like PCBs in a coastal lagoon. Environmental International 33, 45-55.

103. Miniero, R., Ingelido, A.M., Iamiceli, A.L., Ferri, F., Iacovella, N., Fulgenzi, A.R., De Felip, E., di Domenico, A., 2007: High concern chemicals in top layer sediments of the northern Adriatic seabed as markers of old waste dumpings. Chemosphere 68 (9), pp. 1788-1797.

104. Moret, I., Piazza, R., Benedetti, M. Gambara, A., Barbante, C., Cescon, P., 2001: Determination of polychlorobiphenys in Venice Lagoon sediments. Chemosphere 43, 539-565.

105. Nadal, M., Mari, M., Schuhmacher, M., Domingo, J.L., 2009: Multi-compartmental environmental surveillance of a petrochemical area: Levels of micropollutants. Environment International 35 (2), pp. 227-235.

106. Noren K., Meironyte, D., 2000: Certain organochlorine and organobromine contaminants in Swedish human milk in perspective of past 20-30 years. Chemosphere 40, 1111-1123.

107. Novák, J., Jálová, V., Giesy, J.P., Hilscherová, K., 2009: Pollutants in particulate and gaseous fractions of ambient air interfere with multiple signaling pathways in vitro. Environment International 35 (1), pp. 43-49.

108. Odabasi, M., Cetin, B., Demircioglu, E., Sofuoglu, A. 2008: Air–water exchange of polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) at a coastal site in Izmir Bay, Turkey. Marine Chemistry 109 (1-2), pp. 115-129.

109. Picer, M., Kovačević, R., Picer, N., Kobasić, V.H., Čalić, V., Zorić, S., 2006: Characterization of Soil and Sediment Samples Collected from the Zadar Area, Croatia, by GC-ECD PCB Analysis and Bioassay. Bulletin of Environmental Contamination and Toxicology 77 (5), pp. 687-693.

110. Rappolder, M., Schröter-Kermani, C., Schädel, S., Waller U., Körner, W., 2007: Temporal trends and spatial distribution of PCDD, PCDF and PCB in pine and spruce shoots. Chemosphere 67, 1887-1896.

111. Riba, I., Casado-Martinez, C., Forja, J., Del Valls, A., 2004: Sediment quality in the Atlantic Coast of Spain. Environment Toxicology and Chemistry, 23, 2, 271-282.

112. Ribes, A., Grimalt, J.O., Torres Garcia, C.J., Cuevas, E., 2002: Temperature and Organic Matter Dependence of the Distribution of Organochlorine Compounds in Mountain Soils from the Subtropical Atlantic (Teide, Tenerife Island). Environmental Science and Technology 36 (9), pp. 1879-1885.

113. Ricking, M., Koch, M., Rotard, W., 2005: Organic pollutants in sediment cores of NE-Germany: Comparison of the marine Arkona Basin with freshwater sediments. Marine Pollution Bulletin 50, 1699-1705.

114. Roots, O., Henkelmann, B., Schramm, K.-W., 2004: Concentrations of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in soil in the vicinity of a landfill. Chemosphere 57 (5), pp. 337-342.

115. Rose, N. L., Rippey, B., 2002: The historical record of PAH, PCB, trace metal and fly-ash particle deposition at a remote lake in north-west Scotland. Environmental Pollution 117, 121-132.

116. Ružičková, P., Klánová, J., Čupr, P., Lammel, G., Holoubek, I., 2008: An Assessment of Air-Soil Exchange of Polychlorinated Biphenyls and Organochlorine Pesticides Across Central and Southern Europe. Environmental Science and Technology 42 (1), pp. 179-185.

117. Salihoglu, G., Tasdemir, Y., 2009: Prediction of the PCB pollution in the soils of Bursa, an industrial city in Turkey. Journal of Hazardous Materials 164 (2-3), pp. 1523-1531.

118. Sapota, G., 2006: Persistent organic pollutants (POPs) in bottom sediments from the Baltic Sea. Oceanological and Hydrobiological Studies 35 (4), pp. 295-306.

119. Schmid, P., Gujer, E., Zennegg M., Studer, C., 2003: Temporal and local trends of PCDD/F levels in cows milk in Switzerland. Chemosphere 53, 129-136.

120. Schmid, P., Gujer, E., Zennegg, M., Bucheli, T.D., Desaules, A., 2005: Correlation of PCDD/F and PCB concentrations in soil samples from the Swiss soil monitoring network (NABO) to specific parameters of the observation sites. Chemosphere 58 (3), pp. 227-234.

121. Schuhmacher M., Nadal M., Domingo J.L., 2009: Environmental monitoring of PCDD/Fs and metals in the vicinity of a cement plant after using sewage sludge as a secondary fuel. Chemosphere 74 (11), pp. 1502-1508.

122. Schuhmacher, M., Domingo, J.L., Kiviranta, H., Vartiainen, T., 2004: Monitoring dioxins and furans in a population living near a hazardous waste incinerator: levels in breast milk. Chemosphere 57, 43-49.

123. Schuhmacher, M., Jones, K., Domingo, J.L., 2006: Air-vegetation transfer of PCDD/PCDFs: an assessment of field data and implications for modeling. Environmental Pollution 142, 143-150.

124. Schuhmacher, M., Kiviranta, H., Vartiainen, T., Domingo, J.L., 2007: Concentrations of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) in milk of women from Catalonia, Spain. Chemosphere 67, S295–S300.

125. Siddik Cindoruk, S., Tasdemir, Y., 2007: Characterization of gas/particle concentrations and partitioning of polychlorinated biphenyls (PCBs) measured in an urban site of Turkey. Environmental Pollution 148 (1), pp. 325-333.

126. Stronkhorst, J., Leonards, P., Murk, A.J., 2002: Using the dioxin receptor–calux in vitro bioassay to screen marine harbor sediments for compounds with a dioxin-like mode of action. Environmental Toxicology and Chemistry 21 (12), pp. 2552-2561.

127. Telli-Karakoç, F., Tolun, L., Henkelmann, B., Klimm, C., Okay, O., Schramm, K.-W., 2002: Polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) distributions in the Bay of Marmara sea: Izmit Bay. Environmental Pollution 119 (3), pp. 383-397.

128. Terschure A. H. Larsson P., Agrell, C., Boon, J. P., 2004: Atmospheric Transport of Polybrominated Diphenyl Ethers and Polychlorinated Biphenyls to the Baltic Sea. Environmental Science and Technology, 38, 1282-1287.

129. Traven, L., Žaja, R., Lončar, J., Smital, T., Mićović, V., 2008: CYP1A induction potential and the concentration of priority pollutants in marine sediment samples – In vitro evaluation using the PLHC-1 fish hepatoma cell line. Toxicology in Vitro 22 (6), pp. 1648-1656.

130. Tsakovski, S., Kudlak, B., Simeonov, V., Wolska, L., Namiesnik, J. 2009: Ecotoxicity and chemical sediment data classification by the use of self-organising maps. Analytica Chimica Acta 631 (2), pp. 142-152.

131. Turrio-Baldassarri, L., Abate, V., Alivernini, S., Battistelli, C.L., Carasi, S., Casella, M., Iacovella, N., Iamiceli, A.L., Indelicato, A., Scarcella, C., La Rocca, C., 2007: A study on PCB, PCDD/PCDF industrial contamination in a mixed urban-agricultural area significantly affecting the food chain and the human exposure. Part I: Soil and feed. Chemosphere 67 (9), pp. 1822-1830.

132. Van Overmeire, I., Waegeneers, N., Sioen, I., Bilau, M., De Henauw, S., Goeyens, L., Pussemier, L., Eppe, G., 2009: PCDD/Fs and dioxin-like PCBs in home-produced eggs from Belgium: Levels, contamination sources and health risks. Science of the Total Environment.

133. Vassiliadou, I., Papadopoulos, A., Costopoulou, D., Vasiliadou, S., Christoforou, S., Leondiadis, L., 2009: Dioxin contamination after an accidental fire in the municipal landfill of Tagarades, Thessaloniki, Greece. Chemosphere 74 (7), pp. 879-884.

134. Verta, M., Salo, S., Korhonen, M., Assmuth, T., Kiviranta, H., Koistinen, J., Ruokojärvi, P., Isosaari, P., Bergqvist, P.-A., Tysklind, M., Cato, I., Vikelsøe, J., Larsen, M.M., 2007: Dioxin concentrations in sediments of the Baltic Sea – A survey of existing data. Chemosphere 67 (9), pp. 1762-1775.

135. Vives, I., Umlauf, G., Christoph, E. H., Mariani, G., Ghiani, M., Skejo, H., Cenci, R., Bidoglio, G., 2006: Soil Contamination with Pcdd/Fs as a Function of Different Types of Land Use in a Semi-Rural Region in Northern Italy. Organohalogen Compounds 68, 1034-1038.

136. Vondracek, J., Machala, M., Minksova, K., Blaha, L., Murk, A., Kozubik, A., Hofmanova, J., Hilscherova, K., Ulrich, R., Ciganek, M., Neca, J., Svrckova, D., Holoubek, I., 2001: Monitoring River Sediments Contaminated Presominantly with Polyaromatic Hydrocarbons by Chemical and in Vitro Bioassay Techniques. Environmental Toxicology and Chemistry 20, 1499-1506.

137. Vondráček, J., Machala, M., Minksová, K., Bláha, L., Murk, A.J., Kozubík, A., Hofmanová, J., Hilscherová, K., Ulrich, R., Ciganek, M., Neča, J., Švrčková, D., Holoubek, I., 2001: Monitoring river sediments contaminated predominantly with polyaromatic hydrocarbons by chemical and in vitro bioassay techniques. Environmental Toxicology and Chemistry 20 (7), pp. 1499-1506.

138. Wenzel, K. D., Hubert, A., Weissflog, L., Kuhne, R., Popp, P., Kindler, A., Schuurmann, G., 2006: Influence of different emission sources on atmospheric organochlorine patterns in Germany. Atmospheric Environment 40, 943-957.

139. Wenzel, K. D., Manz, M., Hubert, A., Schuurmann, G., 2002: Fate of POP's (DDX, HCHs, PCBs) in upper soil layers of pine forests. The Science of the Total Environment 286, 143-154.

140. Wittsiepe, J., Furst, P., Schrey, P., Lemm, F., Kraft, M., Eberwein, G., Winneke, G., Wilhelm, M., 2007: PCDD/F and dioxin-like PCB in human blood and milk from German mothers. Chemosphere 67, S286-S294.

141. Wodarg, D., Komp, P., McLachlan, M. S., 2004: A baseline study of polychlorinated biphenyl and hexachlorobenzene concentrations in the western Baltic Sea and Baltic Proper. Marine Chemistry 87, 23-26.

142. Wyrzykowska, B., Hanari, N., Orlikowska, A., Bochentin, I., Rostkowski, P., Falandysz, J., Taniyasu, S., Horii, Y., Jiang, Q., Yamashita, N, 2007: Polychlorinated biphenyls and -naphthalenes in pine needles and soil from Poland – Concentrations and patterns in view of long-term environmental monitoring. Chemosphere 67 (9), pp. 1877-1886.

143. Zennegg, M., Kohler, M., Hartmann, P.C., Sturm, M., Gujer, E., Schmid, P., Gerecke, A.C., Heeb, N.V., Kohler, H.-P.E., Giger, W., 2007: The historical record of PCB and PCDD/F deposition at Greifensee, a lake of the Swiss plateau, between 1848 and 1999. Chemosphere 67 (9), pp. 1754-1761.

European Commission

EUR 24266 EN – Joint Research Centre – Institute for Environment and Sustainability
Title: A Compilation of Europe-Wide Databases from Published Measurements of PCBs, Dioxins and Furans
Author(s): Alberto Pistocchi, Carolina Alamo, Javier Castro-Jiménez, Athanasios Katsogiannis, Saudade Pontes, Gunther Umlauf, Pilar Vizcaino
Luxembourg: Publications Office of the European Union
2010 – 84 pp. – 21 x 29.7 cm
EUR – Scientific and Technical Research series – ISSN 1018-5593
ISBN 978-92-79-15066-1
doi:10.2788/66521

Abstract

Chemical risk assessment always entails an evaluation of expected environmental concentrations of substances; these concentrations may be predicted using mathematical models or may be chosen on the basis of experimental observations and monitoring activities.

The work discusses the usefulness and limitations in building compilations of published monitoring data by describing a feasibility study on polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), for which observed concentration data were retrieved from scientific journal articles published between 2000 and 2009.

These chemicals are typical POPs and are of constantly high concern for their potential adverse effects on human health and ecosystems. PCBs were mainly used by the power industry in electrical transformers, capacitors, hydraulic equipment, and as lubricants. PCDD/Fs are formed as unintentional by-products of chemical manufacturing and incineration processes, as well as natural processes such as volcanic eruptions, and biomass burning. Emissions from incineration of industrial wastes such as metal reclamation and domestic heating (especially in central Europe) are considered as current sources of PCDD/Fs to the environment.

A database of published observed concentrations of PCBs and PCDD/Fs in air, soil sediments and water was built as described in details in the report. As continental scale assessment is aimed more at the evaluation of the regional distribution of contamination, we excluded from the database those measurements taken close to known PCB or PCCD/F pollution sources of exceptional entity such as waste incinerators or contaminated sites.

After presenting and interpreting the results of the literature search, we critically examine the completeness and usability of this information, and the usefulness of data compilations in the framework of chemical risk assessment.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

JRC
EUROPEAN COMMISSION

LB-NA-24266-EN-C

Publications Office

ISBN 978-92-79-15066-1