# CROSS-MEDIA ANALYSIS OF POLYCHLORINATED BIPHENYLS - DERIVING OF ENVIRONMENTAL BALANCES

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## Introduction

A methodological approach for a cross-media analysis and an integrated concept of environmental data with the aim of deriving environmental balances will be presented. A model has been developed that allows the balancing methodology for environmental fate and transport between different compartments. The approach needs requirements for a technical integration on the database level and quality assurance of heterogeneous environmental data on a scientific level. Typical pattern are scattered in diagrams for PCB congeners for different compartments. Results of transformation of Indicator PCBs of one compartment (Ambient Air) to another (Bioindicators) will be illustrated by “net diagrams” with the aim for compiling an environmental balance for PCB 153.

## Materials and methods

For more than 15 years data of approximately 100 sectoral monitoring programs of Federal and Laender Agencies and Research Institutes has been stored for the substance group of polychlorinated biphenyls (PCBs) in a large database system in Germany. The so-called POP-Dioxin – Database [1] has a cross-media approach. That means data of polychlorinated biphenyls (PCBs) and other POP data in several environmental and human compartments are collected and managed in a large database system, accessible via a web-based service interface. Data on emissions and on environmental monitoring programmes of polychlorinated biphenyls (PCBs) often exist in various forms, qualities, files and databases. If the documentation does not include all relevant parameters, e.g. the scale of time and space and quality assurance, the data sets are impracticable for further use. The metadata - data about data - is an essential issue for an integrated approach for evaluation and assessment. The complete analytical data sets are stored as congeners in the data base. This allows a single congener specific approach for a cross-media evaluation procedure. The compilation of PCB-footprints and patterns in different compartments, the modeling of environmental transport and fate of PCBs needs ultimately quality assurance measures for all available data in the data base [2].
The decision to use PCB 153 for an environmental balance is based on the high accumulation potential and its persistence in the environment, with a share of 10 % of the total amount of PCBs as a representative on behalf of other PCB congeners [3.

## Results and discussion

The integration of environmental data of POPs into a common technical model of the POP-Dioxin-Database can be achieved through the metadata level, so that a search according to various criteria is possible. The flexibility of the search gives the ability to define different views of the data. By semantic relations, search criteria by time, space, compartment, and group of substances inter alia of Indicator-PCBs, the integration takes place at different levels. The first level is defined as a complex data model with relations to metadata and catalogues for standardization for data objects and data entities. The second level includes an algorithm for the calculation of the WHO-TEQ and PCB-TEQ with different factors (1998, 2006) [4]. The third level contains an interface for interacting and accessing to data for a cross-media analysis. The stored data is used for the evaluation of background contamination of the environment; on this basis updated reports on concentrations of dioxins and PCBs are generated.
In investigating the causes of contamination numerous entry and transfer paths as well as chemical interactions are verified with modern statistical methods. Recent events have shown that new information technologies can assist in finding the root cause of pollution most efficiently.
The data can be analyzed from different points of views. Because the data is stored in a congener specific manner the statistic approach allows finding pattern of typical congenere profiles. The data is compiled in such a manner to get a feeling of typical scatter plot for the compartments in the environment [5]. Fig. 1 shows a

scatterplot for Indicator PCB levels in Ambient Air for sampling sites in Germany. The congenere profiles of background stations (n=281) and data of all available data sets for monitoring stations (n=443) are similar. Low chlorinated PCB 28 are three times higher than the highest chlorinated PCB 180.

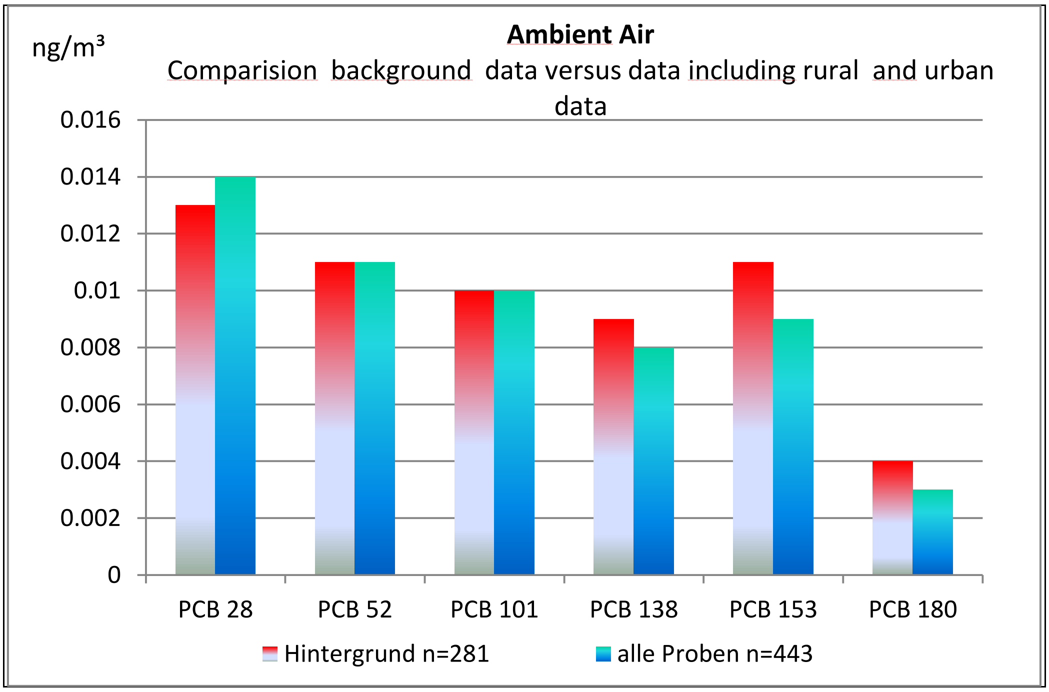


Fig. 1: Typical scatter plot for PCB 28, PCB 52, PCB 101, PCB138, PCB 153 and PCB 180 level in ambient air for the period 1991to 2004 compiled from more than 280 data sets (Background station) and more than 440 data sets of all available data in the POP-Dioxin-Database.

With respect to the methodology approach to cross – media analysing data of other compartments has to be compiled for the fingerprint analyses. Fig. 2 shows the fingerprint of the congenere profile for fish. The profile represents the transformation from low chlorinated PCBs to high chlorinated PCBs. The bioaccumulation potential of PCB 138 and PCB 153 in the compartment fish underlines the obviously trend to accumulation of POPs in biota. More than 630 data sets have been compiled with the result of 70 µg/kg fw for PCB 138 and PCB 153. In contrast, very low PCB 28, PCB 52 and PCB 101 levels with < 25 µg/kg fw were calculated and shown at Figure 2.

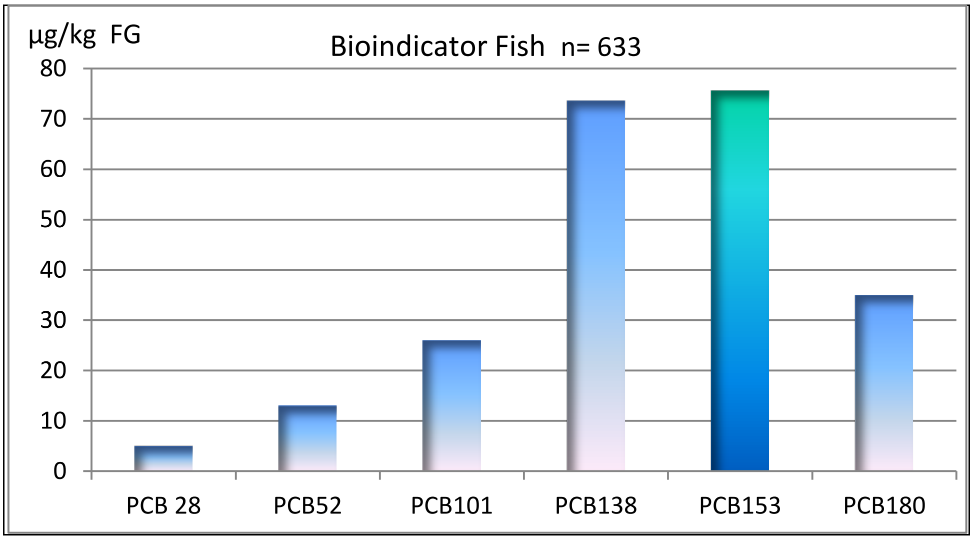


Fig. 2: Typical scatter plot for PCB 28, PCB 52, PCB 101, PCB138, PCB 153, and PCB 180 levels in the bioindicator Fish for the period of 2000 to 2006 are calculated using more than 633 data sets of all available data in the POP-Dioxin-Database.

Results of transformation of Indicator PCBs of one compartment (Ambient Air) to another (Bioindicators) are shown in Fig. 3. The methodology approach uses "net diagrams". The calculation of percentages of single congeners supports the presentation of congeners and their compartment-specific changes. The figure shows clearly a relative change of lower chlorinated PCB congeners (PCB 28>PCB 52>PCB 101>PCB 138>PCB 153>PCB 180) in ambient air condition in relation to Biota. It is evident that biological indicators in their congener patterns show shifts towards relatively large proportions of higher chlorinated PCB 101 and PCB 138, with a peak of PCB 153. That indicates a transformation process already taking place to the most stable PCBs in the environment. For other compartments like fish and falcon eggs it can also be derived from data of the POP-dioxin database.

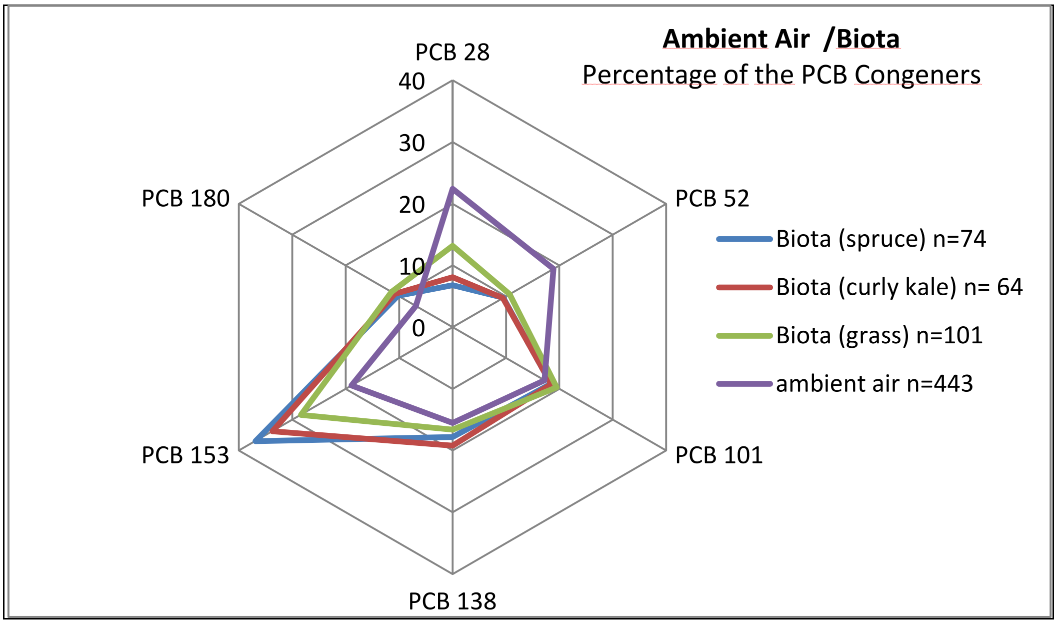

Fig. 3: Typical scatter plot for percentages of PCB 28, PCB 52, PCB 101, PCB 138, PCB 153, and PCB 180 for ambient air and bioindicator spruce, curly kale, and grass.

The development of network diagrams showing the potential of calculation and visualization of distribution patterns of indicator PCBs in various environmental compartments. To optimize the method, the following is proposed:

- Modification of the user interface for a better navigation and a cross – over media evaluation
- Enhancing the statistical module with a better interface for evaluation and visualization of special and temporal trends
- Assessment of trends in comparison to thresholds and regulations require limit values
- Interface to a GIS for the visualization of sampling sites including hot spots of data in terrestrial and aquatic ecosystems
- Compiling a map with locations of formerly plants concerning POP – production including deposits with toxic waste, sewage plants and other sources of emission.

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**References**

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