THE GERMAN DIOXIN DATABASE: PCDD/PCDF CONCENTRATIONS IN THE ENVIRONMENT – SPATIAL AND TEMPORAL TRENDS

H. Fiedler[1], M. Rappolder[2], G. Knetsch[2], and A. Basler[3]

[1]University of Bayreuth, Ecological Chemistry and Geochemistry, D-95440 Bayreuth, Germany. * Present address: UNEP Chemicals, 11-13 chemin des Anémones, CH-1219 Châtelaine (GE), Switzerland

[2]Federal Environment Agency, P.O. Box 33 00 22, D14191 Berlin, Germany

[3]Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, P.O. Box 12 06 29, D53048 Bonn, Germany

Introduction

In 1991, the 37th Conference of Environment Ministers of Germany commissioned the Joint Working Group of the Federation and the Länder on Dioxins and issued an administrative agreement on data exchange in the environmental sector between the government and the Länder (States in Germany) to compile, document, and evaluate data from monitoring and surveillance programs at the federal and the Länder level. Substances to be included are polychlorinated dibenzo-*p*-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), polychlorinated biphenyls (PCB) and other chlororganic substances; the results should be entered into a central database. This DIOXIN Database is maintained by the Federal Environmental Agency (UBA) for environmental matrices including emissions and by the Federal Institute for Consumer Safety and Veterinary Medicine (BgVV) for food and concentrations in humans.

This data exchange on the pollution from PCDD/PCDF and other chlorinated organic substances serves primarily the following objectives as:

- an overview of the level of environmental pollution,
- an indispensable basis for environmental goals and priority setting,
- a technical basis in to derive practicable and scientifically-based benchmarks and limit values, and
- a means of monitoring the success of political activities.

This paper gives overview of the concentrations of PCDD/PCDF in German soils, ambient air and deposition.

Material and Methods

The data contained in the database were collected on the basis of compartment-specific forms, which were developed by the Joint Working Group on Dioxins. Most data were provided by the Länder and forwarded to the central database. Most data have been reported on a congener-specific basis, which allows to calculate toxic equivalents either according to the International or the WHO schemes. The set-up of the database has been described earlier [1].

Data evaluation for soil and air (ambient air and particle deposition) was performed for temporal and spatial trends and for impacted and non-impacted areas. The datasets were mathematically and statistically evaluated with programs such as EXCEL and SPSS. Results for all compartments include the median, 10 and 90 percentiles as well as minimum and maximum concentrations. Numbers were given in ITEQ as the common basis (without inclusion of the detection limit for non-quantifiable

congeners when calculating the TEQ). The data distinguished between three area types of settlement structures: urban centres, urban fringe and rural areas.

Results

The 3rd and 4th reports of the Joint Working Group of the Federation and the Länder on Dioxins summarizes the data contained in the database and presents the evaluations for individual compartments [2]. Presently, the DIOXIN Database contains 117 measurement programs with a total of about 10,000 datasets. The compartments and the number of datasets are as follows: foodstuffs – 3,504, feedingstuffs – 301, sediments - 212, biota - 409, water discharges - 11, dust - 97, ambient air – 1,438, emission - 203, deposition - 854, indoor air - 1, soil terrestrial – 2,502, soil subhydric - 44, products/ mixtures - 251, wastes/recoverable materials/residues – 406.

a) Soil

2,500 samples were used for the evaluation of the compartment soil. The concentrations in soils showed a median of below 20 ng ITEQ/kg dm. The 90 percentile for all types of soils was <30 ng ITEQ/kg dm; top soils were <20 ng ITEQ/kg dm, and organic layers <50 ng ITEQ/kg dm.

The PCDD/PCDF concentrations in soils grouped for all soils (top), organic layers, and surface soils are compiled in Figure 1, which gives the median, the 90 percentile and the minimum and maximum concentrations for each of these groups.

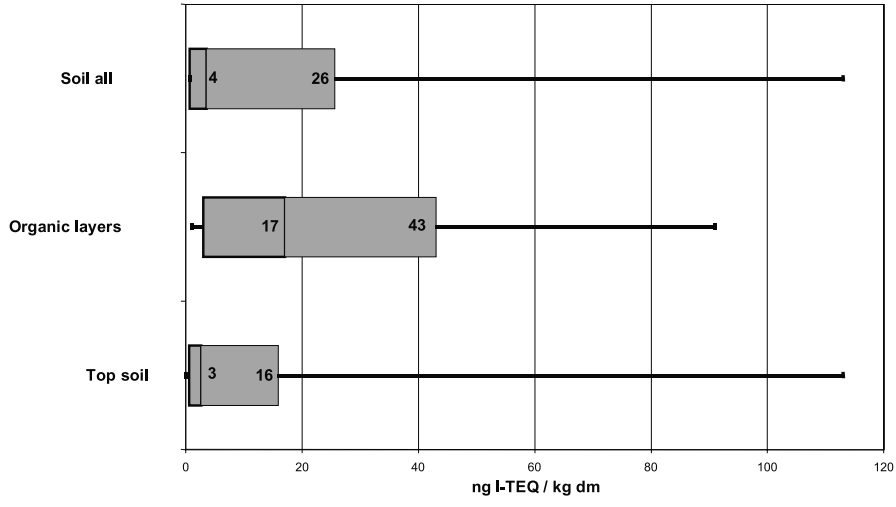

Figure 1. PCDD/PCDF concentrations (ITEQ/kg dm) in terrestrial soils (medians and 90 percentiles; congener concentrations below the limit of quantification were set zero when calculating the TEQ)

The spatial distribution according to the three area types of settlement structures - urban centers, urban fringe and rural areas gave the picture shown in Figure 2. The large number of samples did allow to differentiate between these three area types. As expected, the PCDD/PCDF concentrations were highest in urban centers followed by urban fringe soils. Lowest concentrations were found in rural areas.

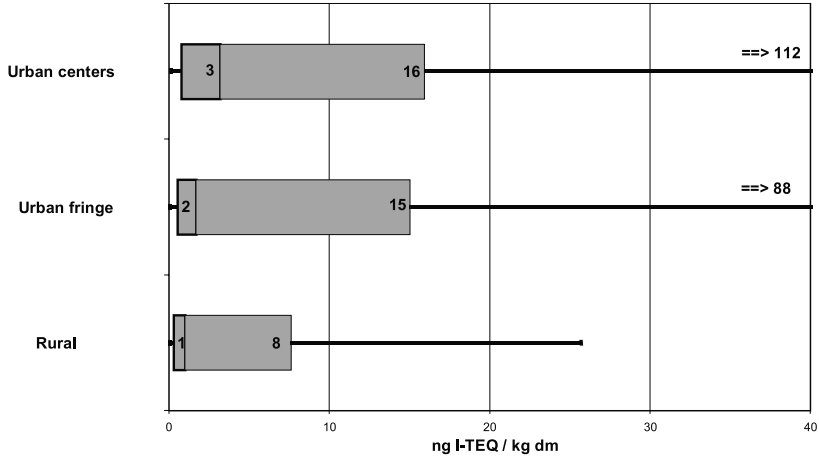

Figure 2. PCDD/PCDF concentrations (ITEQ, congener concentrations below the limit of quantification were set zero when calculating the TEQ) in minral soils from areas with no known impact from a nearby dioxin

Across all potential uses, the median of the PCDD/PCDF concentrations in soils in Germany is 3 ng ITEQ/kg dry matter (dm) in urban centers, 2 ng ITEQ/kg dm at the urban fringe, and 1 ng ITEQ/kg dm in rural areas.

b) Ambient air

The data for ambient air samples "without special impact" confirmed earlier results of seasonal variations, which peak during wintertime and a temporal declining trend in the peak concentrations since the early 1990s [3].

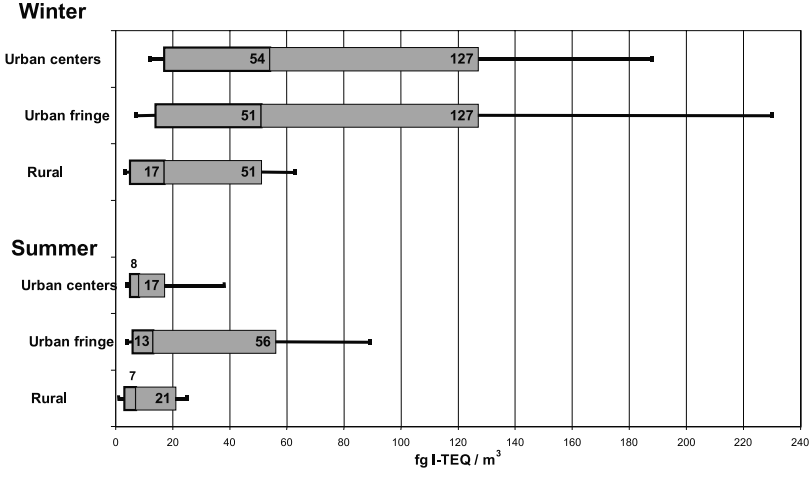

Figure 3. PCDD/PCDF concentrations (fg ITEQ) in ambient air according to area and season

The concentrations decreased approximately by half, but have leveled off since approximately 1994. At sampling locations close to cities or in urban centers, the concentrations are about 130 fg ITEQ/m³ in winter (90 P); medians range from 51 to 54 fg ITEQ/m³. Rural areas in winter as well as all other regions in summer have 90 percentile concentrations less than 60 fg ITEQ/m³ and medians <15 fg ITEQ/m³. These concentrations are shown in Figure 3.

c) Deposition

The data for the deposition samples "without special impact" confirmed the seasonal variations and the temporal declining trends of the peak winter concentrations as obtained for the ambient air samples. In urban fringe the 90 percentile is <25 pg ITEQ/m² d in summer and with winter concentrations <45 pg ITEQ/m² d; the medians for all samples are <10 pg ITEQ/m² d.

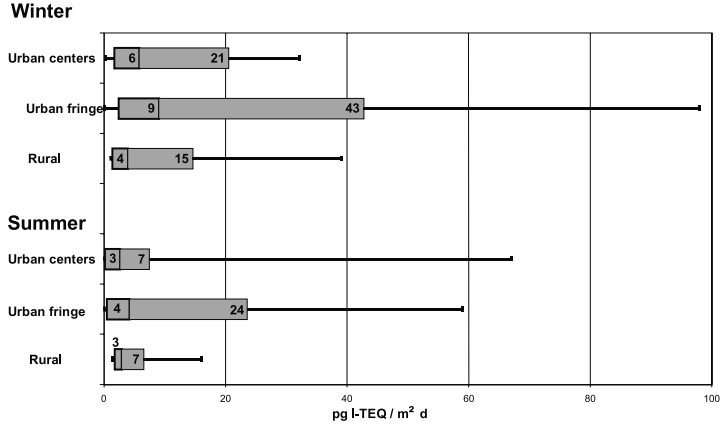

Figure 4. PCDD/PCDF concentrations (ITEQ) in deposition samples with differentiation according to area and season

Discussion

The evaluation of approx. 10,000 data sets wasere carried out primarily with regard to temporal and spatial trends, and with differentiation between impact areas and non-impacted areas. The evaluation of the data collected over the past ten years – published in the 3rd and 4th report of the Joint Working Group DIOXINS [2] – documents the success of the environmental protection measures that have been entered into force. New inputs of dioxins into the environment have been drastically reduced. The median levels that were determined for the individual compartments could be used as comparative values in order to make statements on possible environmental impacts in the case of hazardous incidents.

References

1. Knetsch, G., A. Basler, M. Büchen (2000): The German Dioxin Database – Application in Trend Monitoring of Polychlorinated Dibenzo-p-Dioxins and Furans in the Environment. Organohalogen Compd. 46, 31-34
2. Dioxine – Daten aus Deutschland, 3rd rd and 4th report of the Bund/Länder Arbeitsgruppe DIOXINE, Umweltbundesamt, Berlin, 2001 (ISBN 3-00-009326-5)
3. Fiedler, H., H. Rotter, L. Peichl, G. Knetsch, A. Basler (2000): Concentration of PCDD/PCDF in Atmospheric Samples in Germany. Organohalogen Compd. 45, 264-268