Dioxins and PCBs in solid matter from the river Elbe, its tributaries and the North Sea (longitudinal profile, 2008)
Abstract:
The most recent longitudinal sampling profile, taken in 2008 from the river Elbe and its tributaries Vltava (Moldau), Mulde, Spittelwasser, Saale, Bode the Stör and the North Sea near Helgoland, shows contaminations of solid matter with polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans (dioxins, PCDD/Fs) and polychlorinated biphenyls (PCBs). While the dioxin contamination is mainly located along the German part of the catchment, PCBs are more abundant in the Czech section. In some of the 43 solid samples investigated high levels of contamination were detected. Selected orientation benchmarks for dioxins and PCBs in sediments and fish are exceeded, suggesting
potential hazards for organisms in the contaminated rivers and for human consumption. Elevated dioxin concentrations in the Spittelwasser-Mulde system and the Saale catchment, together with consistent dioxin congener patterns Elbe downstream of the confluence, indicate that the region of Bitterfeld-Wolfen is the predominant source of the dioxin pollution, which can be traced until far offshore in the sediments of the North Sea near Helgoland. Thermal metal, presumably Magnesium production via fused salt electrolysis during the 2nd world war is the most probable primary, historic source of the dioxin contamination. The spatial distribution of dioxins as seen in 2008 matched well with earlier campaigns in 2002, both for aquatic solids and alluvial soils, suggesting minor change of the situation since then. Also the samples from the North Sea revealed elevated levels of dioxins that display the congener pattern from the Bitterfeld-Wolfen Region. In contrast to the PCDD/Fs, PCBs are mainly present in the in the Upper Elbe in the Czech Republic. After the German border PCBs display an overall decrease. Other than PCDD/Fs, PCB emissions into the Elbe cannot be attributed to a dominant source or region. Indicator PCBs did rise more or less constantly in concentration until the German border, suggesting a variety of cumulative emission sources along the whole Czech stretch. Thus, no specific recommendation on how to decrease the PCB pressure on the River Elbe can be given on the basis of the data acquired in this study. Detailed regional scale monitoring in the Czech stretch, together with the evaluation of production statistics regarding potential PCB sources are needed here. After all the PCB toxicity in eel is exceeding that of PCDD/F up to an order of magnitude (investigations of eels taken after the flood event in August 2002). As an amendment to the chemical analyses, two Ah-receptor based bioassays (DR CALUXR and EROD), which display the dioxin–like activity of all pollutants present, were performed on a subset of the samples (blind study). For The DR CALUXR the comparison revealed a good agreement between the HRGC/HRMS results along the German stretch and the bioassay. However, along the Czech section of the Elbe the DR CALUXR displayed a 10 times higher dioxin-like activity than the chemical analyses. This suggests that the solid material in the Czech section contains additional persistent dioxin-like acting pollutants. In comparison to the DR CALUXR test, the EROD assay displayed even higher dioxin-like activities. The differences can be explained by the fact that the clean up procedure for the DR CALUXR eliminated the less persistent organic pollutants in the extract, while the EROD procedure remained sensitive to those. Regarding the risk for the aquatic food chain and the human diet, the reduction of PCBs in the River Elbe ecosystem appears crucial as indicated by the dominance of the PCB over the PCDD/Fs in toxicity equivalents detected in eel samples.

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