BULK ATMOSPHERIC DEPOSITION OF PERSISTENT ORGANIC POLLUTANTS AND PAHS IN CENTRAL EUROPE

Nežiková Barbora[1], Degrendele Céline[1], Čupr Pavel[1], Hohenblum Philipp[2], Moche Wolfgang[2], Prokeš Roman[1], Vaňková Lenka[1], Kukučka Petr[1], Martiník Jakub[1], Audy Ondřej[1], Přibylová Petra[1], Holoubek Ivan[1], Weiss Peter[2], Klánová Jana[1], Lammel Gerhard[1,3]

[1]Masaryk University, Research Centre for Toxic Compounds in the Environment, Brno, Czech Republic, 625 00 Brno, e-mail: nezikova@recetox.muni.cz; [2]Umweltbundesamt, Wien, Austria, 1093; [3]Max Planck Institute for Chemistry, Multiphase Chemistry Department, Mainz, Germany, 55128

Introduction

Polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) are ubiquitous and toxic contaminants. Once they are emitted into the atmosphere, they are partitioning between the gaseous and the particulate phases. One way of transferring these compounds from the atmosphere to other compartments of the environment is via deposition (dry or wet). Very few data exist on deposition fluxes on the regional scale. The aim of this study is to provide novel deposition data for Central Europe and to explore the seasonal and spatial variations of these.

Materials and methods

Total deposition samples were simultaneously collected at six sites in the Czech Republic and Austria from September 2011 to August 2012. Additional deposition samples were collected at Czech sites in 2012 - 2015. The sampling duration was three months with filters changed every month.

Except one rural Czech site, all sites can be considered as background sites with limited anthropogenic influence. The deposition samplers used[1] consist of a collecting vessel (250 mm diameter) made of borosilicate glass, a stainless-steel particulate filter holder located at the bottom of the collection vessel and a glass column containing the sorbent XAD-2.

All samples were extracted in dichloromethane using an automatic Soxhlet extractor, pre-cleaned on silica column, and were analysed by means of gas chromatography and mass spectrometry. The targeted compounds were 15 PAHs, 6 PCBs and 12 OCPs.

Results

For all seasons and sites investigated, Σ_{15}PAHs deposition fluxes ranged 23.2 – 1053.8 ng m^{-2} d^{-1}, while Σ_6PCBs and Σ_{12}OCPs total deposition fluxes ranged 64.3 – 4387.5 and 410.3 – 7835.4 pg m^{-2} d^{-1}, respectively. Fluoranthene and pyrene were the main contributors to the PAHs' deposition fluxes, accounting on average for 19 % each, while deposition fluxes of PCBs and OCPs were dominated by PCB153 (26 %) and γ-hexachlorobenzene (30 %), respectively.

In case of PAHs, significantly higher deposition fluxes were observed at the rural site Znojmo-Kuchařovice (KUC). This suggests that primary emissions are controlling PAHs' deposition fluxes. The highest deposition flux of Σ_{15}PAHs was generally found in spring. For Σ_6PCBs, a significantly higher deposition flux was observed in KUC. There were no clear seasonal variations found for deposition fluxes of PCBs. For Σ_{12}OCPs, no clear spatial trend was found, and the seasonal maximum was observed in summer.

In case of PAHs, their partitioning amongst the filters and XAD sorbent varied with compound and season. Although OCPs and PCBs in air hardly partition to the particulate phase, on average 44 % of their deposition fluxes were found on filters, suggesting that deposition of the particulate phase is more efficient than of the gaseous substances, or that the latter is subject to negative sampling artefacts.

Acknowledgements

This work was carried out with the support of core facilities of the RECETOX Research Infrastructure, project LM2015051, and by ACTRIS-CZ, project LM2015037, funded by the Ministry of Education, Youth and Sports of the Czech Republic under the activity "Projects of major infrastructures for research, development and innovations" and by the Programme of the European Territorial Cooperation Austria Czech Republic 2007-2013 (no. M00124, MonAirNet).

References

1. Čupr P., Pěnkava B.: Atmospheric deposition sampler, CS: Vzorkovač atmosférické depozice. *Czech patent #23347 (2012)*