DEPOSITION SAMPLING OF POP IN THE ALPS

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Abstract

A heated modification of a deposition sampling technique has been used within the project MONARPOP, which offered the opportunity to collect bulk deposition over three months at the three high altitude sampling sites Weissfluhjoch (CH; 2663 m), Zugspitze (D; 2650 m) and Sonnblick (A; 3106 m). Presented are the results of six times three to six months continuous sampling. For most of the POP analysed so far, similar concentrations are found at the remote high altitude sites in the Alps as in rural lowlands.

Introduction

In the years 2005 to 2007 a comprehensive investigation of POP in the Alps was carried out within the framework of the project **MONARPOP (Mo**nitoring **N**etwork in the **A**lpine **R**egion for **P**ersistent and other **O**rganic **P**ollutants) [1,2]. Its main goal was to investigate the present contamination of the Alps with POP and to understand the role of high mountains in the global atmospheric transport of POP [3,4]. One question in this context was if POP deposition on to the Alps and especially at high altitudes occurs in a considerable amount.

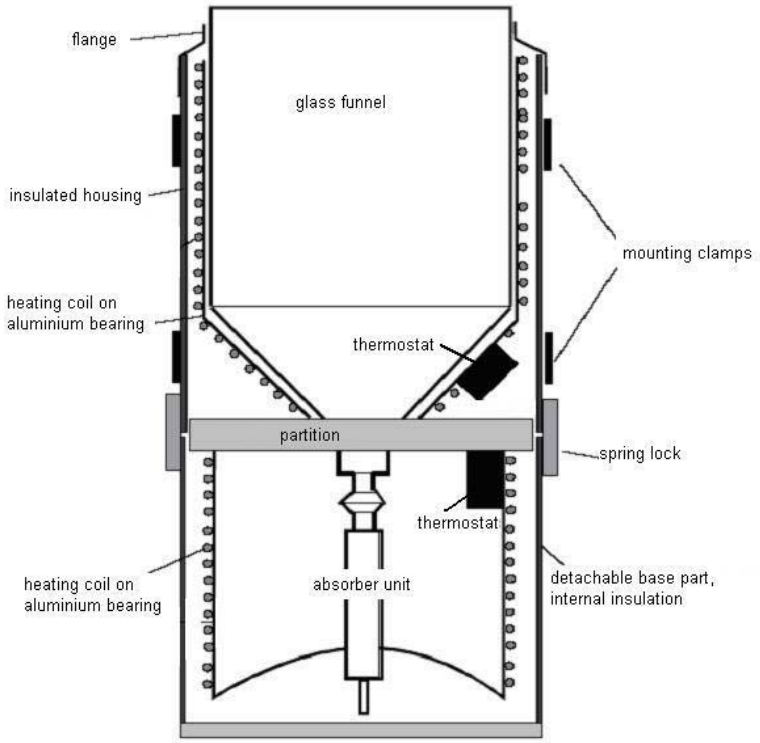
This required the sampling of bulk deposition of POP at high altitude sites where low temperatures and high wind speeds are a challenge.

Material and Methods

High altitude deposition measurement sites were located at three alpine summits, taking advantage of the infra-structures of well equipped meteorological stations to operate POP samplers. The selected sites were Weissfluhjoch (CH; 2663 m), Zugspitze (D; 2650 m) and Sonnblick (A; 3106 m). These sites are staffed around the year which ensured maintenance of the sampling equipment.

For the measurements samplers were built according to DIN 19739-1, "Measurement of atmospheric deposition of organic trace substances – funnel adsorber method" [5], but necessarily as a heated version. The samplers contain a temperature controlled heated glass funnel to collect the precipitation and to melt the snow. From the bottom of the funnel the precipitation runs through a small hole into a XAD filled glass cartridge, where the substances of interest are adsorbed. The glass cartridge was placed in a temperature controlled heated and light protected chamber to avoid destruction of the cartridge by freezing and the decomposition of POP by UV radiation. A technical drawing of a deposition sampler is shown in figure 1.

Figure 1: Technical drawing of bulk deposition sampler



At each of the three sampling sites seven deposition samplers were installed for the different groups of POP substances and other organic pollutants of interest. At the measuring site Sonnblick seven additional cartridges were mounted in a meteorological cabin as a kind of passive sampler. There they were exposed to air but not influenced by precipitation. The amount sampled in the meteorological cabin was negligible compared to the concentrations of the real deposition samplers.

Six three-to-six-month sampling periods have elapsed between Spring 2005 and Summer 2007. The different cartridges were analysed for polychlorinated Dibenzo-p-dioxins and Dibenzofurans [A], polychlorinated Biphenyls [A], Organochlorine Pesticides [D], Polyaromatic Hydrocarbons [G], Chlorinated Paraffines, Polybrominated Diphenylethers [E], Nitrophenols [A] and Trichloroacetic acid [A].
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Results and Discussion
For most of the analysed substances the detected concentrations are similar to those found in rural lowlands. This means that long range transport leads to a sizeable amount of deposition in remote mountainous areas.

Similar concentration ratios between the three sampling sites could be found for some groups of substances during all sampling periods as is the case with PCDD/F. In figure 2 the PCDD/F deposition rates are shown for the three sampling sites over the six sampling periods. It can be seen clearly that the highest deposition rates are always found at sampling site Sonnblick. For the dioxin-like PCB the ratios change between winter periods and the other seasons, as this can be seen in figure 3. This indicates that the influence of different sources may change from season to season for some substances, for others not.

The results presented here are mean concentrations over a sampling period of three months, which means that transient peaks have minor influence on the results. It could be shown that long term sampling of deposition at inhospitable sites is possible with the used equipment.

Acknowledgement
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Figure 2: PCDD/F deposition rates [pg TEQ / m².d] at three high altitude sampling sites in the Alps for six sampling periods

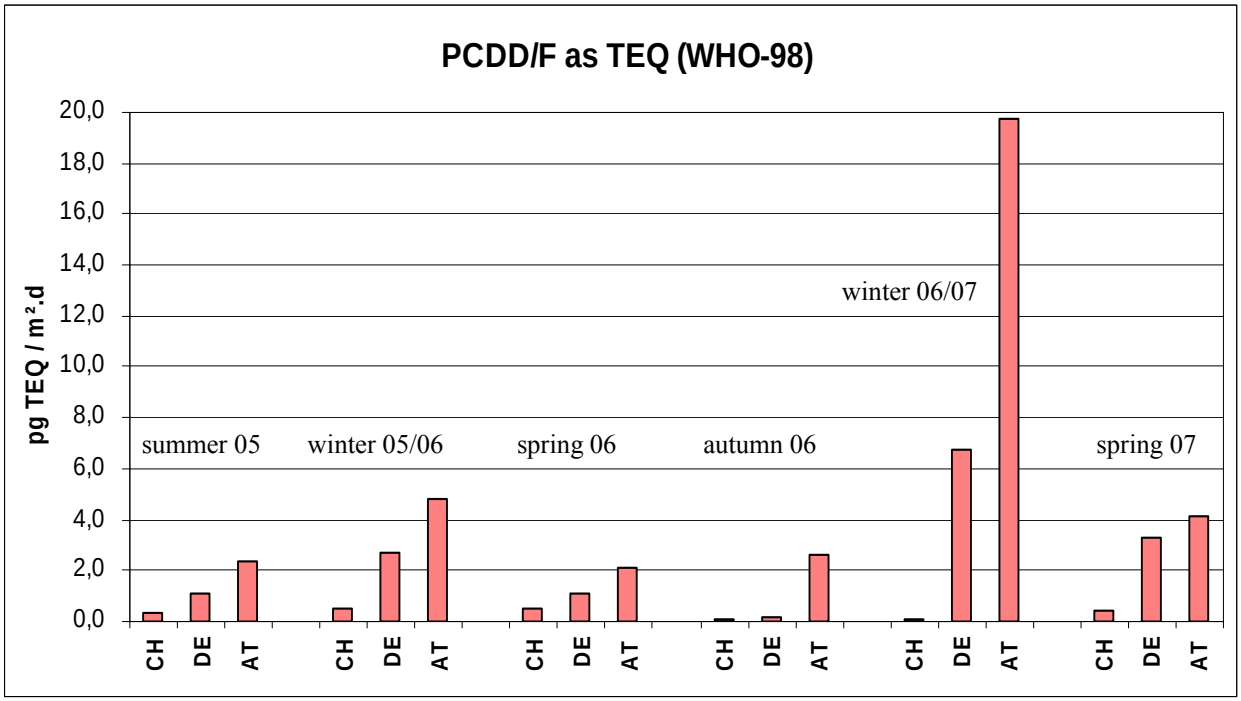

Figure 3: dioxinlike PCB deposition rates [pg TEQ / m².d] at three high altitude sampling sites in the Alps for six sampling periods