

# Air–soil exchange of PCBs: levels and temporal variations at two sites in Turkey

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**Abstract** Seasonal distribution of polychlorinated biphenyls (PCBs) at the air–soil intersection was determined for two regions: one with urban characteristics where traffic is dense (BUTAL) and the other representing the coastal zone (Mudanya). Fifty-one air and soil samples were simultaneously collected. Total PCB ( $\Sigma_{82}$  PCB) levels in the soil samples collected during a 1-year period ranged between 105 and 7,060 pg/g dry matter (dm) (BUTAL) and 110 and 2,320 pg/g dm (Mudanya). Total PCB levels in the gaseous phase were measured to be between 100 and 910 pg/m<sup>3</sup> (BUTAL) and 75 and 1,025 pg/m<sup>3</sup> (Mudanya). Variations in the concentrations were observed depending on the season. Though the PCB concentrations measured in the atmospheres of both regions in the summer months were high, they were found to be lower in winter. However, while soil PCB levels were measured to be high at BUTAL during summer months, they were found to be high during winter months in Mudanya. The direction and amount of the PCB movement were determined by calculating the gaseous phase change fluxes at air–soil intersection. While a general PCB movement from soil to air was found for BUTAL, the PCB movement from air to soil was calculated for the Mudanya region in most of the sampling events. During the warmer seasons PCB movement towards the atmosphere was observed due to evaporation from the soil. With decreases in the temperature, both decreases in the number of PCB congeners occurring in the air and a change in the direction of some congeners were observed,

possibly caused by deposition from the atmosphere to the soil. 3-CB and 4-CB congeners were found to be dominant in the atmosphere, and 4-, 5-, and 6-CBs were found to dominate in the surface soils.

**Keywords** Flux · Movement · Congeners · Temperature · Season

## Introduction

Persistent organic pollutants (POPs) are organic compounds of anthropogenic origin that can remain in nature without decomposing for long periods due to their resistance against photolytic, chemical, and biological decay. Polychlorinated biphenyl (PCB) compounds constitute a group that falls under the 12 groups of contaminants called POPs and has nonpolar features. Theoretically, 209 different PCB congeners exist (Carpenter 1998). PCBs threaten human health by accumulating in the food chain due to their lipophilic features and chemical stability (Lilienthal et al. 2000).

The ability of PCBs to accumulate in non-polar matrices is relatively high (McIntyre and Lester 1982). Soils and sediments are the primary media for accumulation (WHO 1993). For these pollutants, the atmosphere acts as the most effective transfer medium, and the terrestrial soils act as the most significant receptive medium (Hippelein and McLachlan 1998).

Once it was established that PCBs enter the food chain, cause environmental pollution, and threaten human health, their production was banned in many countries around the world and their use was restricted (Carpenter 1998). In Turkey, PCB usage in industries was restricted in 1973, and their use in open systems was completely prohibited on January 1st, 1996 (RCHC 1993). After the restriction of PCB production and usage, its emission into the atmosphere

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