Methods to measure mass transfer kinetics, partition ratios and atmospheric fluxes of organic chemicals in forest systems

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Abstract

Vegetation plays an important role in the partitioning, transport and fate of hydrophobic organic contaminants (HOCs) in the environment. This thesis aimed at addressing two key knowledge gaps in our understanding of how plants exchange HOCs with the atmosphere: (1) To improve our understanding of the uptake of HOCs into, and transfer through, leaves of different plant species which can significantly influence the transport and fate of HOCs in the environment; and (2) To evaluate an experimental approach to measure fluxes of HOCs in the field. The methods presented in papers I, II and III contribute to increasing our understanding of the fate and transport of HOCs in leaves by offering straightforward ways of measuring mass transfer coefficients through leaves and partition ratios of HOCs between leaves, leaf lipids and lipid standards and reference materials like water, air and olive oil. The passive dosing study in paper III in particular investigated the role of the composition of the organic matter extracted from leaves in determining the capacity of the leaves to hold chemicals and found no large differences between 7 different plant species, even though literature data on leaf/air partition ratios ($K_{leaf/air}$) varies over 1-3 orders of magnitude. In paper IV we demonstrated that the modified Bowen ratio method can be extended to measure fluxes of persistent organic pollutants (POPs) if the fluxes do not change direction over the course of the sampling period and are large enough to be measured. This approach thus makes it possible to measure fluxes of POPs that usually require sampling times of days to weeks to exceed method detection limits. The experimental methods described in this thesis have the potential to support improved parameterization of multimedia models, which can then be evaluated against fluxes measured in the field using the modified Bowen ratio approach.

Keywords: *Hydrophobic organic chemicals, vegetation, modified Bowen ratio, surface-atmosphere fluxes.*

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