Modelling methyl halide emissions from plants: From cytosol to the atmosphere

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Methyl halides affect climate through a number of important atmsopheric chemical processes, from ozone depletion to reduction of the cleansing capacity of the lower atmosphere to enhancing regional aerosol formation potentials. Despite these recognized concerns global budgets for methyl halides, including methyl chloride, methyl bromide and methyl iodide, remain poorly quantified. One major source of uncertainty within methyl halide budgets is the terrestrial biosphere. Only a few ecosystems have been quantitatively measured over full season life-cycles and our understanding of environmental parameter effects on plant emissions remains limited.

Here we present a 'from the ground up' model which predicts methyl halide emissions from plant tissues based upon estimated production rates within leaf mesophyll cell cytosol and diffusional transport through stomata, cuticle, leaf boundary layer and into the free atmosphere. This is the first model that the authors are aware of that follows trace gas transport from within plant cell tissues through diffusion to the free atmosphere.

Modelled results are compared to observational data from several plant systems to establish critical knowledge gaps within the methyl halide plant-atmosphere system. An inverse approach has also been performed to answer one of the persistent questions regarding the terrestrial biosphere and methyl halides: 'Do plants produce methyl halides as a defense mechanism'?

The effect of flood-induced redox oscillations on arsenic mobility in a calcareous fluvisol

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Contamination of floodplain soils with metals and metalloids is widespread, particularly in areas with a legacy of intense industrial activities [1], as is the case for much of Western Europe. It is well established that arsenic associated with metal oxides in soils and sediments can be released under reducing conditions experienced during flooding [2], due to desorption processes, speciation changes or mineral dissolution [3].

We show, through a combination of batch experiments, spectroscopy and thermodynamic and kinetic modelling, that the cumulative effects of redox cycling, often neglected in floodplain studies, also control arsenic mobility and that repetitive cycling in a closed system can help to attenuate arsenic mobilized during reducing conditions after a severe contamination event.

We demonstrate that this attenuation is due to a combination of fast reversible surface complexation of As to iron oxide minerals and slow irreversible adsorption/co-precipitation. This has implications for management of contaminated floodplains and suggests that controlled flooding and draining may help reduce the risk posed by arsenic in soils.

[1] Du Laing *et al.* (2009) *Sci Total Environ* **407**, 3972–3985. [2] McGeehan & Naylor (1994) *Soil Sci Soc Am J* **58**, **2**, 337–342. [3] Masscheleyn *et al.* (1991) *Environ Sci Technol* **25**, **8**, 1414–1419.