Measuring and Modelling VOC Fluxes between Mountain Grassland Ecosystems and the Atmosphere

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Background The biosphere and the atmosphere are linked by the exchange of mass and energy occurring at their interface. Among the many trace gases emitted by the biosphere, volatile organic compounds (VOC), have received increasing attention during the past two decades due to their role in atmospheric chemistry. VOC are emitted through anthropogenic activities and from animals, but the main source (around 90%) are plants. For grasslands there have been several studies investigating VOC emissions during and after grass cutting, when large VOC emissions from the wounded and drying plant material occur, but little is know about their background VOC emission.

The Austrian National Science Fund (FWF) has recently approved a three-year project (2007-2010) aiming at measuring and modelling fluxes of VOC between mountain grassland ecosystems and the atmosphere.

Figure 1 Location of study site in Tyrol, Austria.

Objectives Multiple cuts keep mountain grasslands in a status of vigorous growth for most of the vegetation period. We therefore hypothesise that, in addition to strong emissions of methanol, acetaldehyde, hexenals and acetone following grass cutting, grasslands will exhibit relatively high background emissions of methanol, which is formed during plant growth. Based on the results for grasslands in Australia and North America we also expect significant background fluxes of ethanol, acetaldehyde and acetone. The first objective of this project is thus to quantify the range of VOC emitted from mountain grasslands and their emission strength during the full vegetative period. Early phenomenological models of VOC emission, which relied mainly on the controls of light and temperature on VOC production, were successfully in many, but not all occasions. More recently it was realised that physicochemical characteristics, such as low volatility or diffusion, and the non-specific storage of less volatile compounds must also be taken into account in order to succeed in situations where VOC-production based algorithms fail [1]. The second objective of this project is thus to include a VOC emission module based on combined physiological and physicochemical control [1; Fig. 2] into an existing soil-vegetation-atmosphere-transfer (SVAT) model [3] and to parameterise, validate and test it using the flux measurements described above. The new model will be parameterised by means of Bayesian calibration against measured VOC, CO_2 and energy fluxes and then used to study the controls on VOC emission as well as their relation to CO_2 and energy fluxes.

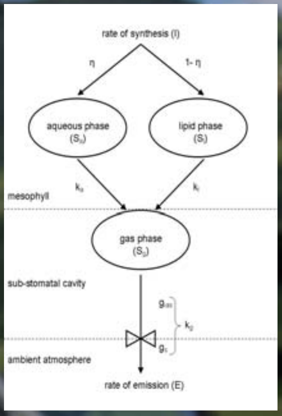

Figure 2 Schematic representation of the framework for modelling VOC fluxes (after [2]).

References

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Funding for this project is provided by the Austrian National Science Fund (FWF, P19849-B16). Attendance of this conference was supported by EC FP6 Marie-Curie iLEAPS and by ESF-VOCBAS.