Land - atmosphere ammonia exchange: Do we have the necessary information to contribute to a common conceptual framework for modelling biosphere atmosphere exchanges of gases and aerosols

R.-S. Massad[1], C. Flechard[2], B. Loubet[1], and E. Personne[1]

When considering biosphere – atmosphere exchange of trace gases and volatile aerosols, significant advances have been made in recent years both from an experimental and modeling point of view and on several scales, going from organ to plant to plot and to the landscape level. This was particularly stimulated by the availability of new datasets generated from technological improvements. Recent research advances thus allow us, not only to identify major mechanisms and factors affecting the exchange of trace gases and volatile aerosols between the biosphere and the atmosphere, but also to recognize several gaps in the methodologies currently used in accounting for emissions and deposition in landscape and global scale models. We can therefore aim at better quantifying the contribution of terrestrial surfaces to atmospheric pollution and the global green house gas balance. Surface/atmosphere exchange models are necessary to compute the temporal and spatial patterns of emissions and deposition at the soil, plant, field, landscape, regional and global scales. Developing a common modelling framework for air-surface exchange of reactive gases and particles was one of the main objectives of a Workshop co-organized by the COST action ABBA and theEU-FP7 project ECLAIRE.

Ammonia exchange between the land surface and the atmosphere was one of the focuses of the workshop. Models of surface/atmosphere NH3 exchange have been both develop and applied for a number of purposes and at a large range of spatial scales ranging from the leaf or plant, the canopy or ecosystem, the landscape, to the national/regional level and to the globe. The basic processes controlling surface/atmosphere NH3 exchange are relatively well understood, at least qualitatively. A wide range of factors are important, including: thermodynamics, meteorology, surface and air column heterogeneous chemistry, plant physiology and N uptake, ecosystem N cycling, compensation points, nitrogen inputs via fertilization and atmospheric deposition, leaf litter decomposition, SOM and soil microbial turnover, soil properties. There has been a gradual increase in the complexity of surface/atmosphere NH3 exchange models, from simple steady-state resistance models to dynamic, multiple layer, multiple sink/source, multiple chemical species exchange models. This reflects both the improvement in process understanding and the increasing availability of flux datasets, which are needed to parameterize models. Modelling and measuring the leaf-level processes that drive bi-directional air-surface exchange of N remains a challenge and a key issue for improving the predictive capability of existing models at the field scale.

[1] INRA, UMR1091 INRA-AgroParisTech Environnement et Grandes Cultures, 78850 Thiverval-Grignon, France
[2] INRA, Agrocampus Ouest, UMR1069 Sol Agro-hydrosystème Spatialisation, 35042 Rennes, France