Geophysical Research Abstracts
Vol. 20, EGU2018-19522-1, 2018
EGU General Assembly 2018

Model-driven flux data analysis – new insights from using a coupled NH_3-CO_2 biosphere-atmosphere exchange scheme

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Biosphere-atmosphere exchange schemes are routinely used within air quality models to simulate the dry deposition of trace gases and aerosols to terrestrial surfaces. Nowadays they are able to accurately infer dry deposition fluxes from standard meteorological variables and measured or modelled concentrations only. They are not only valuable as a predictive tool in the absence of direct flux measurements, but also as a means to analyse, interpret, and quality-check data from micrometeorological stations.

Currently, these models are usually structured in such a way that the dry deposition process is modelled on a per-species basis, with little to no chemical and/or physiological interactions between the compounds of interest. Stomatal controls are often modelled empirically with average input parameters based on ecosystem type.

In this contribution we demonstrate the practical value of model-driven flux data analysis by extending a state-of-the art NH_3 biosphere-atmosphere exchange scheme with a new additional, simultaneously computed pathway for CO_2 exchange. Interactions between the two are modelled for both the non-stomatal and the stomatal pathway, e.g. through the use of a photosynthesis-driven stomatal conductance model. Preliminary results suggest that complementing the analysis of measured NH_3 flux data with (measured or modelled) CO_2 fluxes can indeed help with the interpretation of flux patterns. Using CO_2 fluxes as input data for a dry deposition inferential model allows for a more mechanistic representation of stomatal controls compared to purely empirical models, and can provide a more accurate prediction and assessment of N deposition at long-term CO_2 eddy-covariance sites. Coupled NH_3-CO_2 modelling may therefore be promising for regional air quality models.