Geophysical Research Abstracts
Vol. 17, EGU2015-15923, 2015
EGU General Assembly 2015

Evaluation of the inverse dispersion modelling method for estimating ammonia multi-source emissions using low-cost long time averaging sensor

Benjamin Loubet and Marco Carozzi
INRA, UMR 1402 INRA-AgroParisTech ECOSYS, 78850 Thiverval-Grignon, Framce

Tropospheric ammonia (NH_3) is a key player in atmospheric chemistry and its deposition is a threat for the environment (ecosystem eutrophication, soil acidification and reduction in species biodiversity). Most of the NH_3 global emissions derive from agriculture, mainly from livestock manure (storage and field application) but also from nitrogen-based fertilisers. Inverse dispersion modelling has been widely used to infer emission sources from a homogeneous source of known geometry. When the emission derives from different sources inside of the measured footprint, the emission should be treated as multi-source problem. This work aims at estimating whether multi-source inverse dispersion modelling can be used to infer NH_3 emissions from different agronomic treatment, composed of small fields (typically squares of 25 m side) located near to each other, using low-cost NH_3 measurements (diffusion samplers). To do that, a numerical experiment was designed with a combination of 3 x 3 square field sources (625 m^2), and a set of sensors placed at the centre of each field at several heights as well as at 200 m away from the sources in each cardinal directions. The concentration at each sensor location was simulated with a forward Lagrangian Stochastic (WindTrax) and a Gaussian-like (FIDES) dispersion model. The concentrations were averaged over various integration times (3 hours to 28 days), to mimic the diffusion sampler behaviour with several sampling strategy. The sources were then inferred by inverse modelling using the averaged concentration and the same models in backward mode. The sources patterns were evaluated using a soil-vegetation-atmosphere model (SurfAtm-NH_3) that incorporates the response of the NH_3 emissions to surface temperature. A combination emission patterns (constant, linear decreasing, exponential decreasing and Gaussian type) and strengths were used to evaluate the uncertainty of the inversion method. Each numerical experiment covered a period of 28 days. The meteorological dataset of the fluxnet FR-Gri site (Grignon, FR) in 2008 was employed. Several sensor heights were tested, from 0.25 m to 2 m. The multi-source inverse problem was solved based on several sampling and field trial strategies: considering 1 or 2 heights over each field, considering the background concentration as known or unknown, and considering block-repetitions in the field set-up (3 repetitions). The inverse modelling approach demonstrated to be adapted for discriminating large differences in NH_3 emissions from small agronomic plots using integrating sensors. The method is sensitive to sensor heights. The uncertainties and systematic biases are evaluated and discussed.