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Evaluation of the sub-grid variability of models simulating atmospheric nitrogen fluxes at regional scale from models integrating processes at landscape scale

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Abstract: Agricultural activities are the main sources of ammonia emitted into the atmosphere. High concentrations and high rates of dry and wet deposition on soil and vegetation may have an impact on nearby sensitive ecosystems. The high spatial variability of atmospheric ammonia concentrations and deposition rates makes it difficult to produce accurate regional maps without using a large number of measurements or models performing at high spatial resolution. Models used at regional scale to quantify ammonia deposition perform at low spatial resolution and need to average the heterogeneous fluxes that occurred within large grids.
Using regional models may lead to under- or overestimation of fluxes and their impact on ecosystems. We propose a general statistical method applicable between two atmospheric models and that uses the subgrid information provided by the local model to average fluxes (i.e. emission and deposition) in the regional model. Different theoretical studied cases were developed by creating emission scenarios and using simplified meteorology and homogeneous land use types to compare simulation results of both models. The results show that the resolution, the emission scenarios, the forcing variables and the structure of both models generated high differences in predictions of ammonia concentration and dry deposition (2 or 3 times higher). The spatial distribution of dry deposition greatly differed between both models, but the average ammonia deposited over the simulation domain was relatively similar. The local and regional models provided different predictions of average concentration and dry deposition, but the prediction of the exceedance critical threshold was different (more than 300% for very local scales).

***Keywords**:* subgrid variability; ammonia; local and regional scales