Assimilation of IASI NH_3 satellite observations with the LETKF methodology in the LOTOS-EUROS model

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ABSTRACT

Reactive Nitrogen (N_r) is an essential building block for all life on earth. One of the largest sources of N_r in our atmosphere is ammonia (NH_3), which originates primarily from agricultural sources (e.g. manure and fertilizer application), as well as industrial sources and natural biomass burning.

Excessive amounts of atmospheric ammonia can have significant negative impacts on both human and ecosystem health, however the atmospheric budget of NH_3 remains poorly constrained. Satellite observations of NH_3 coupled with data assimilation techniques provides a powerful approach through which the budget can be studied in detail. Several studies have reported on the assimilation and/or emission inversions of NH_3, but only seldomly have the systems themselves and/or limitations been evaluated.

In this study we apply the Observing System Simulation Experiment (OSSE) methodology not just to study the performance of the satellite data product but also the LETKF assimilation scheme in the LOTOS-EUROS model. We apply the methodology to NH_3 using simulated and real IASI-NH_3 observations, and attempt to optimize the underlying regional emission and deposition fluxes. The performance of the assimilation scheme is analysed for two domains with distinctly different atmospheric conditions within Europe. The results are intercompared with emission fields of the current state-of-the-art inventories as well as in-situ concentration and deposition data.