Geophysical Research Abstracts
Vol. 20, EGU2018-7582, 2018
EGU General Assembly 2018

Quantification of Global Ammonia Sources constrained by a Bayesian Inversion Technique (COMBAT)

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Ammonia (NH3) has been proved very important for humans mainly because it sustains life as a major component in the global nitrogen cycle. Over 40% of the global population owe their lives to the industrial synthesis of ammonia for fertilizer production (Haber-Bosch process). However, ammonia has received a lot of attention in the recent past due to its major consequences for the population and the environment through secondary formation of PM2.5 after heterogeneous reactions with abundant atmospheric constituents. The global rise of population has almost doubled ammonia emissions since the 70s, as a result of both artificial and natural emissions. In the present proposal (COMBAT), we attempt, for the first time, to quantify regional and global emissions of ammonia using a Bayesian inversion framework. For this reason, we will first develop a chemical scheme to account for the loss of ammonia through atmospheric reactions in the Lagrangian model FLEXPART. The model will then run backward in time for the calculation of the source-receptor relationships (SRRs). The SRRs along with ground-based measurements from the European Monitoring and Evaluation Programme (EMEP) and from the National Atmospheric Deposition Program (NADP) will be used in the inversion algorithm for the calculation of ammonia emissions. For the areas, where ground-based observations are lacking, satellite measurements will be used from the Atmospheric Infrared Sounder (AIRS) instrument of NASA's (National Aeronautics and Space Administration) Aqua satellite. The resulting optimised fluxes will be used to identify hot-spot emission areas and to verify bottom-up emission datasets, independently. In addition, a Eulerian model that includes full chemistry will be employed, in order to study potential effects on the population and the environment from the secondary particle formation. This will give scientists a better chance to quantify the environmental risk of the use of ammonia in agriculture.