Assimilating CrIS Observations to Optimize Global NH_3 Emissions using an Ensemble Kalman Smoother

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Abstract

The transformation of our planet's environment in the last decades is reflected, among others, in changes in biodiversity, pollution levels and the frequency of extreme events. Accurate quantification of the specific contributions of certain atmospheric constituents to these changes remains largely an open issue. Ammonia (NH_3), in particular, stands out as a significant uncertainty factor. Recent studies have revealed disparities between emission databases for NH_3 and emissions estimated from observations across several locations. This study aims to refine estimates of NH_3 emissions by using high spatial resolution observations from the CrIS instrument aboard the Suomi-NPP satellite and an Ensemble Kalman filter data assimilation technique. For this task, we use the CarbonTracker Data Assimilation Shell (CTDAS), specifically tailored for NH_3. As observation operator we employ the chemistry transport model TM5-MP. The ensemble data assimilation framework is configured with 50 ensemble members and an ensemble Kalman smoother with a fixed-lag assimilation window for enhanced accuracy. The resulting posterior estimates are compared with existing NH_3 emission datasets such as the CMIP6 and MACC. The derived NH_3 concentrations are validated against in-situ observations.

Early Career Scientist

YES, I am an early career scientist.