Estimating Errors in Daily Emission Fluxes with Nonlinear and Multiscale Data Assimilation

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Abstract

Top-down observational constraints on emission fluxes from satellite observations of chemical composition are subject to biases and errors stemming from transport, chemistry and prior emissions estimates. In this context, we developed an ensemble data assimilation (DA) system to optimize the initial conditions for carbon monoxide (CO) and nitrogen dioxide (NO_2) while assimilating TROPOMI observations, while also quantifying the respective emission fluxes with a distinct attribution of anthropogenic and wildfire sources. Instead of assuming normal distributions like the Ensemble Adjustments Kalman Filter (EAKF), we now apply a bounded normal rank histogram (BNRH) distribution for the prior. The goal is to efficiently estimate bounded quantities such as atmospheric mixing ratios and emission fluxes while maintaining the good performance achieved by the EAKF. This assimilation system is built on the Data Assimilation Research Testbed (DART) and includes a meteorological ensemble to assimilate weather observations within the online Community Atmosphere Model with Chemistry (CAM-chem). Global and regional DA are usually performed separately, with global boundary conditions provided to the regional domain. Unstructured grids with regional refinements have never been explored in chemical DA. Here we present the coupling between the Multi-Scale Infrastructure for Chemistry and Aerosols (MUSICA) and DART. The a priori emissions used are the CAMS-GLOB-ANTv6.2 and the Fire INventory from NCAR (FINN) version 2.5. We compare our optimized emissions with other inventories for both fire and anthropogenic sources with a focus on East-Asia and the United States of America.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

AMIGO: Analysis of eMIssions usinG Observations