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NO_x emissions in China constrained by satellite observations: a new inversion approach

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In the past 30 years China's economy showed an average growth rate of 10%, not only bringing more material wealth to its 1,300 million inhabitants, but also generating unprecedented air pollution. Because ground measurements of air quality in China are often inaccessible, satellite observations are an obvious tool to monitor country-wide pollution levels.

Observations of tropospheric NO_2 by the sun-synchronized polar-orbiting instruments OMI and GOME-2 have almost daily global coverage. To relate these observations to NO_x emissions, we implemented the regional chemical transport model CHIMERE for the Eastern Chinese domain at a 0.25 degree resolution. Differences between simulated and observed concentrations provides information on how to adjust the emission inventory. The key to solve this inversion problem is finding the spatial relationship between NO_2 concentrations and NO_x emissions. We will present a new approach for approximating these sensitivities, without the use of adjoint model code or ensemble techniques. The chemical transport model is treated as a black box, which eases implementation of data assimilation applications based on other models or other model domains. Our method is designed to perform daily top-down emission estimates of short-lived species (such as NO_x) for all grid cells (15,000) in the model domain. It takes the transport of the trace gas over the grid into account using a simplified, two-dimensional transport scheme.

The calculation of the sensitivities is fast compared to other techniques, thus enabling emission estimates from satellite observations on a daily basis. We will present some first results using OMI and GOME-2 observations over East-China. Future research will concentrate on updating the Chinese NO_x emissions operationally, which will improve air quality forecasts for China, and constructing a long time series, which will give insight in the evolution of air quality and the effectiveness of air quality measures.