Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)
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AAS21-05 Room:106 Time:May 19 10:00-10:15

Multiple species constraints on surface NOx emission inversion

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Satellite NO2, CO, O3, and HNO3 data are assimilated into a chemical transport model to estimate global surface NOx emissions and their seasonal variation in 2007. The data assimilation of data for multiple species provides comprehensive constraints on the NOx emissions by limiting model errors in NOx chemistry. The non-NO2 data changed the regional and hemispheric monthly total NOx emissions by 50% and 13-29%, respectively. These large changes introduced by the inclusion of non-NO2 data imply a large uncertainty in the NOx emissions inverted from NO2 data only. Compared to the emission inventories, the estimated NOx emissions show enhanced seasonal variations with the maximum emissions at most of the northern mid-latitudes occurring 1-2 months earlier. An analysis of the background error covariance demonstrates that additional constraints from other chemically related species (e.g., isopren and formaldehyde) have the potential to further improve surface NOx emission analyses.

Keywords: NOx emission, Data assimilation, Satellite observation