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Using Satellite Remote Sensing and Modelling for Insights into NO_2 Air Pollution and NO_x Emissions.

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Nitrogen oxides (NO_x) are key actors in air quality and climate change. Satellite remote sensing of tropospheric NO_2has developed rapidly with enhanced spatial and temporal resolution since initial observations in 1995. We have developed an improved algorithm and retrieved tropospheric NO_2 columns from Ozone Monitoring Instrument. Column observations of tropospheric NO_2 from the nadir-viewing satellite sensors contain large contributions from the boundary layer due to strong enhancement of NO_2 in the boundary layer. We infer ground-level NO_2 concentrations from the OMI satellite instrument which demonstrate significant agreement with in-situ surface measurements. We examine how NO_2 columns measured by satellite, ground-level NO_2 derived from satellite, and NO_x emissions obtained from bottom-up inventories relate to world's urban population. We perform inverse modeling analysis of NO_2 measurements from OMI to estimate "top-down" surface NO_x emissions, which are used to evaluate and improve "bottom-up" emission inventories. We use NO_2 column observations from OMI and the relationship between NO_2 columns and NO_xemissions from a GEOS-Chem model simulation to estimate the annual change in bottom-up NO_x emissions. The emission updates offer an improved estimate of NO_x that are critical to our understanding of air quality, acid deposition, and climate change.