Estimating $PM_{2.5}$ exposure across New York State from satellite observations

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Abstract

Satellite data offer the potential to fill the gaps of the sparse, limited sampling of *in situ* air pollutant measurement networks. We use satellite observed Aerosol Optical Depth (AOD) to estimate the concentration of near surface $PM_{2.5}$ over the New York State in 2011. We use a global chemical transport model (GEOS-Chem) and a regional air quality model (CMAQ) to estimate the AOD-$PM_{2.5}$ scaling factors that represent the optical properties of the particles and relationships between the planetary boundary layer and full atmospheric column. We used the FlexAOD software to calculate AOD consistently (i.e., same assumed optical properties, size distribution) from hourly, 3-D aerosol and meteorological fields archived from both the CMAQ and GEOS-Chem models. We apply the model derived AOD-$PM_{2.5}$ scaling factors to MODIS-derived AOD to estimate the concentration of near surface $PM_{2.5}$. We find that even if the same MODIS AOD products are used, differences in AOD-$PM_{2.5}$ scaling factors produce different estimates of $PM_{2.5}$. Deriving surface $PM_{2.5}$ from column AOD requires first a conversion from column AOD to surface AOD, which is mainly dependent on the vertical profile; and second a conversion from surface AOD to surface $PM_{2.5}$, which is mainly affected by the optical properties. We find that the former primarily drives the spatial variation in the AOD-$PM_{2.5}$ scaling factors.