Spatiotemporal Estimates of Surface PM2.5 Concentrations in the Western U.S. Using NASA MODIS Aerosol Retrievals and Data Assimilation Techniques

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Abstract
Previous investigations have successfully estimated surface air pollution concentrations by creating statistical data fusion models in conjunction with aerosol satellite retrievals. However, the models developed for the eastern U.S. are often being used in the western U.S. without modifications. In this regard, these models are not robust in the western U.S. due to specific regional characteristics including: irregular topography that leads to complicated boundary layer physics; pollutant mixtures, heterogeneous vertical profiles of aerosol; and higher surface reflectance. With those considerations in mind, we apply a data fusion model to estimate surface PM2.5 concentrations in the western U.S. We also utilize new collections of aerosol products from the Terra and Aqua MODIS instruments as a spatial predictor of PM2.5 and emissions covariates from the NEI, which are prepared using the SMOKE emissions processing tool. The horizontal spatial resolution of the model is 12 km over the western U.S. and the temporal domain is daily over the study period of 2012-2013. The model incorporates spatially-resolved meteorological fields from WRF, elevation, population density, land cover information, surface reflectance, fire radiative power from MODIS, and plume injection height (PIH) from the Multi-Angle Implementation of Atmospheric Correction (MAIAC) as covariates to improve PM2.5 prediction performance. The novelty of this work relies on the use of high-resolution, temporally-resolved physics and emissions variables as covariates and satellite retrievals of PIH. Based on our previous research, the combination of high-resolution planetary boundary layer and PIH provides information on levels of aerosol pollution near-ground or aloft. Therefore, the covariates were selected to account for complex atmospheric physics and meteorological phenomena that govern the aerosol transport in mountainous regions. It is expected that by selecting a configuration of these physical variables, the PM2.5 concentration estimates in the data fusion model will be improved.