Estimation of PM2.5 concentrations by fusion of multiple Earth observation satellite products

Abstract

The Aerosol Optical Depth (AOD), a measure of the scattering and absorption of light by aerosols, has been extensively used for scientific research such as monitoring air quality near the surface due to fine particles aggregated, aerosol radiative forcing (cooling effect against the warming effect by carbon dioxide CO2), aerosol long-term trend analysis and the climate change on regional and global scale. To monitor aerosols, observations by space-borne instruments have a huge advantage (nearly global coverage daily) over ground-based measurements (point observation). Global quantitative aerosol information has been derived from satellite measurements for decades.

Previous studies have shown that satellite products may not be strong predictors of ground PM2.5 levels. Additionally, another shortcoming of remote sensing is the large number of non-retrieval days due to clouds and snow cover. We propose to use aerosol-products of earth-observing satellites with global cover to augment the PM observations, and in particular to examine if fusion of different satellite products, including aerosol optical depth (AOD) retrieved by the new MAIAC algorithm, can provide more reliable estimates of ground PM levels. As part of this work, we will apply machine learning tools on satellite aerosol products from several instruments and platforms, and use unsupervised clustering techniques to divide the daily data into sub-groups with presumably related physical attributes (size, concentration, %fine, RI). Next, we will develop group-specific models for estimating ground-level PM. This will be done in a coordinated way in two complex geo-climatic regions: the Indo Gangetic Plain (IGP) - South Asia and Israel. The satellite data that will be used and the models that will be developed will be evaluated against comparable ground measurement (AERONET, PM2.5, meteorological/climatological data) and/or by standard cross-validation or sample splitting techniques.