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Aerosol remote sensing by using cloud-based height detection Lidar

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The remote sensing of PM2.5 (particulate matter concentration with aerodynamic diameter d ≤ 2.5 μm) mass concentration is mostly based on the measurements of AOD (Aerosol Optical Depth) that is a common product of satellite and ground instruments which measure spectral radiance. The relationship between surface PM2.5 and column integrated AOD is found associated with vertical and size distribution of aerosols. In this study, a non-linear regression model combining AOD and near surface backscatter for estimation of PM2.5 is developed and tested based on 6 years ground measurements from HUBC (Howard University Beltsville Campus) facility. Overall, the non-linear model explains ~60% of the variability in hourly PM2.5. The RMSE (Root-Mean-Square Error) is ~5.83 μg/m^3 with a corresponding average PM2.5 of 15.43 μg/m^3. That is a big improvement to the linear model using AOD alone (~40% of the variability, RMSE is ~7.14 μg/m^3). The ceilometer measured near surface backscatter, which is found to improve the estimation of PM2.5-AOD relationship compared to other factors, such as aerosol size indicator, surface temperature, relative humidity, wind speed and pressure especially when AOD is large (AOD ≥ 0.3). Aerosol size indicator and two Angstrom exponents are calculated by AOD at three wavelengths of 415, 500, 860 nm and are found important to the PM2.5-AOD relationship. In addition to the HUBC site, the model is tested based on the 4 years (2012 to 2015) measurements from ARMSGP site and the nearest EPA site. The results also show the significant role of the ceilometer measured near surface backscatter on improving estimation of PM2.5. This study illustrated the potential of ceilometer on investigation of air pollution. With broad ceilometer network, ground-level particle concentrations can be better determined.

Biography

Siwei Li graduated from Department of Atmospheric and Environmental Sciences, State University of New York, Albany, and now is a Research Scientist at NOAA Center for Atmospheric Sciences, Howard University. He is also Adjunct Graduate Professor at Graduate School of Howard University. His research focuses on radiative transfer model, remote sensing of aerosols, clouds and aerosol cloud interactions.

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