Comparisons of Sunphotometer-Derived Optical Depths and Surface Radiation Measurements and Their Effects on the Aerosol Surface Forcing Efficiency Estimation

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The instantaneous direct surface radiative forcing by atmospheric aerosols can be estimated using total-column aerosol optical depth (AOD) and surface solar irradiance (SSI) measurements. Uncertainties in AOD and SSI determine the accuracy of the instantaneous surface forcing efficiency (FE), where FE is defined as the aerosol forcing per unit AOD. These quantities are also important as input for radiative transfer models. Therefore, measuring the AOD and SSI more accurately contributes to reducing the uncertainty in estimating FE for the real atmosphere.

We present the AOD_{500nm} and SSI measured by sunphotometers and radiometers at the Gosan surface site in Korea as part of the Asian Pacific Regional Aerosol Characterization Experiment (ACE-Asia). A comparison of these quantities under cloud-free conditions was performed. We examine the variances that are introduced in direct determination of FE from the AOD and SSI data.

During ACE-Asia, the clear-sky AODs and SSI, measured simultaneously by three independently calibrated sunphotometers and radiometers, agree within the uncertainties of each instrument (Figure 1). The AOD_{500nm} and SSI differed by 2-6% and <2.2% for coincident measurements, respectively. Directly determined FE, estimated on the basis of different instruments, exhibited little variance. The average broadband FE at 60º solar-zenith angle for three instruments is −213.17, 134.83, −79.33, and −88.86 Wm^{-2} for direct, diffuse, total, and global components of solar irradiance.

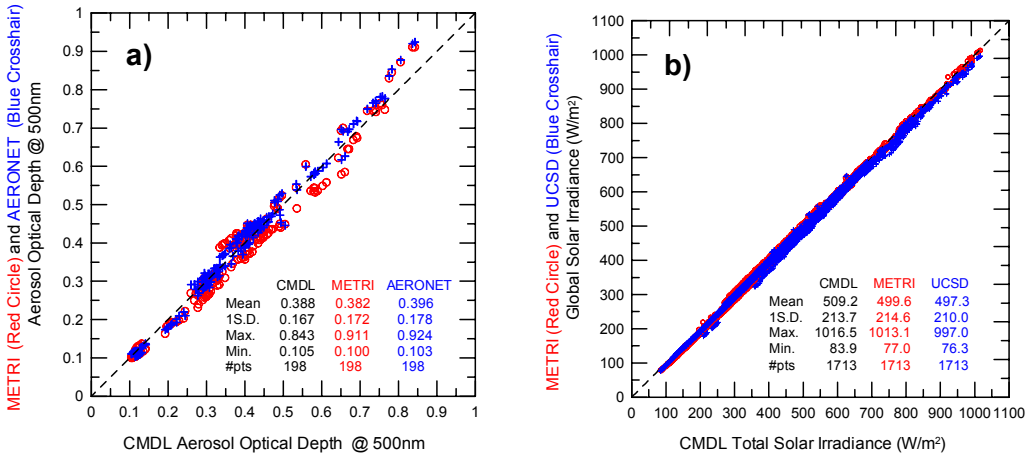

Figure 1. Scatterplots of simultaneously measured (a) AOD_{500nm} for the Aerosol Robotics Network (AERONET) and the Korean Meteorological Research Institute (METRI) relative to the CMDL sunphotometer and (b) solar irradiance for total (CMDL) and global (METRI and University of California, San Diego) components during the ACE-Asia Intensive Observation Period (IOP).