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# Aerosol Direct Net Shortwave Radiative Forcing Efficiency for Different Aerosol Types

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Aerosol direct radiative forcing efficiency (ADRFE) is defined as the change in solar flux caused by unit change in aerosol optical depth (AOD). In this study, the ADRFE at the bottom of the atmosphere was estimated at several locations on the earth. Furthermore, we defined diurnally averaged ADRFE for different aerosol types. Data provided by AERONET (Aerosol RObotic NETwork) and SolRad-Net (Solar Radiation Network) Networks were used. In addition, level 2 data from CALIOP (The Cloud-Aerosol Lidar with Orthogonal Polarization), on board CALIPSO (The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) satellite, were used.

The AERONET sun photometers provided the AOD data and the SolRad-Net pyranometers the solar flux (direct + diffuse) data. Vertical aerosol profiles were obtained from CALIOP. The AERONET includes the AERONET inversion product, from which we obtained some optical properties of the aerosol. Daily average inversion products were used. The maximum time difference between the pyranometer and the sun photometer measurements was 2 minutes. The data was cloud screened to avoid measurements with enhanced diffuse irradiance. Although AERONET level 2.0 data is already cloud screened, it is still possible that some of the data are from partially cloudy conditions. The effect of sun-earth distance variation was also considered: the solar irradiance can change as much as 6.9% from the beginning of January to the beginning of July. The aerosol type determination was based on single scattering albedo (SSA) and Ångström exponent (ÅE), which are derived from the sun photometer measurements. ÅE exponent is related to the size of the particles and SSA to the ratio of scattering in total extinction. CALIOP data were weekly averaged from the overpasses inside either 80x80 km or 120x120km boxes centered on the AERONET sites.

With aerosol typing and observations of solar flux and aerosol optical depth, solar flux attenuation by different aerosol types and aerosol load was achieved. Consequently, ADRFE at the bottom of the atmosphere was then defined for different aerosol types.