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Influence of aerosols on surface reaching spectral irradiance and introduction to a new technique of estimating aerosol radiative forcing from high resolution spectral flux measurements

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Aerosol radiative forcing estimates with high certainty are required in climate change studies. The approach in estimating the aerosol radiative forcing by using the chemical composition of aerosols is not effective as the chemical composition data with radiative properties are not widely available. We look into the approach where ground based spectral radiation flux measurement is made and along with an Radtiative transfer (RT) model, radiative forcing is estimated. Measurements of spectral flux were made using an ASD spectroradiometer with 350 – 1050 nm wavelength range and a 3nm resolution during around 54 clear-sky days during which AOD range was around 0.01 to 0.7. Simultaneous measurements of black carbon were also made using Aethalometer (Magee Scientific) which ranged from around 1.5 ug/m3 to 8 ug/m3. The primary study involved in understanding the sensitivity of spectral flux due to change in individual aerosol species (Optical properties of Aerosols and Clouds (OPAC) classified aerosol species) using the SBDART RT model. This made us clearly distinguish the influence of different aerosol species on the spectral flux. Following this, a new technique has been introduced to estimate an optically equivalent mixture of aerosol species for the given location. The new method involves matching different combinations of aerosol species in OPAC model and RT model as long as the combination which gives the minimum root mean squared deviation from measured spectral flux is obtained. Using the optically equivalent aerosol mixture and RT model, aerosol radiative forcing is estimated. Also an alternate method to estimate the spectral SSA is discussed. Here, the RT model, the observed spectral flux and spectral AOD is used. Spectral AOD is input to RT model and SSA is varied till the minimum root mean squared difference between observed and simulated spectral flux from RT model is obtained. The methods discussed are limited to clear sky scenes and its accuracy to derive an optically equivalent aerosol mixture reduces when diffuse component of flux increases. In our analysis, RT model clearly shows that direct component of spectral flux is more sensitive to different aerosol species than total spectral flux which is also supported by our observed data.