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Developing algorithm for AOD and aerosol effective height using hyperspectral measurement, GEMS (Geostationary Environment Monitoring Spectrometer)

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The correlation between Aerosol Optical Depth (AOD) and surface aerosol concentration is poor, because of variation of the aerosol composition and aerosol vertical profiles (Corbin et al., 2002). Furthermore, both aerosol amount and its vertical distribution are known to play important roles in aerosol contributions to atmospheric radiations. In this study, we show sensitivities of spectral radiance to aerosol optical properties, and aerosol effective height in ultraviolet (UV) and visible wavelength range. Furthermore, we also present retrieval algorithm for aerosol optical properties and effective layer height of aerosol from Geostationary Environment Monitoring Spectrometer (GEMS), planned to be launched in 2018.

The algorithm retrieves AOD using an inversion method, which adopts pre-calculated lookup table (LUT) for a set of assumed aerosol modes. To develop optimized algorithm for Asia areas, the inversion data of Aerosol Robotic Network (AERONET) located in the target areas are selectively used to archive aerosol optical properties. We analyze the effect of cloud contamination on the retrieved AOD by comparing the results from different spatial resolutions (7.5 km $\times$ 7.5 km, 5 km $\times$ 5 km, 2.5 km $\times$ 7.5 km, and 1.25 km $\times$ 3.75 km). As a result, the accuracy of retrieved AOD increased as improvement of spatial resolution. In addition, improved methodology to obtain aerosol products using hyperspectral measurements, ranged from ultraviolet (UV) to visible (VIS), is discussed.

In this study, the method using the absorption bands of oxygen dimer (O_2-O_2) is adopted to estimate the effective height of aerosol. Height estimation using O_2-O_2 band has been used for cloud height retrieval on space-borne measurements, and retrieval of aerosol vertical distribution on ground-based measurements. Based on simulation studies, aerosol height is more sensible in UV radiation than in VIS radiation whereas AOD is more sensible in VIS range. The O_2-O_2 column densities were retrieved from those simulated radiances using the Differential Optical Absorption Spectroscopy (DOAS) technique. Sensitivities of O_2-O_2 column densities to the aerosol height are presented at the absorption bands of 340, 360, 380, 476, and 577 nm, respectively. From UV to VIS, O_2-O_2 retrieval using DOAS technique is useful for aerosol height detection from space-borne sensors.