Development of a novel algorithm for retrieval tropospheric Nitrogen Dioxide vertical profile using Optimal Estimation method and hyper-spectral satellite data

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For the first time, we proposed a novel algorithm for retrieval tropospheric Nitrogen dioxide (NO₂) vertical profile based on Optimal Estimation (OE) method and hyper-spectral satellite data. The NO₂ vertical profile is retrieved using multiple NO₂ Slant Column Density (SCD) in ultraviolet (UV) and visible (VIS) wavelengths. Synthetic radiances were generated to retrieve the ratio of NO₂ SCD between UV and VIS wavelengths in the various aerosol information (Aerosol Optical Depth; AOD, Single Scattering Albedo; SSA, and Aerosol Peak Height; APH), geometric information (Solar Zenith Angle; SZA, Viewing Zenith Angle; VZA, and Relative Azimuth Angle; RAA), a priori NO₂ vertical profile, and surface reflectance conditions. Spectral fittings were performed at narrow intervals on each wavelength range with fitting window of 30 nm to calculate for the ratio between average NO₂ SCD in the visible (VIS) range and those obtained in the ultraviolet (UV) range. Lastly, the vertical distribution of tropospheric NO₂ is retrieved using the ratio of NO₂ SCD at UV and VIS based on measured radiances and those obtained from LUT. Here we applied OE to finally determine the vertical profile of NO₂. In addition, we retrieved the tropospheric NO₂ vertical profile using OMI LV1B radiance data. We also, calculated the NO₂ Volume Mixing Ratio (VMR) using the retrieved tropospheric NO₂ vertical profile, and compared it with ground observation in-situ data.