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Development of a novel method for Nitrogen Dioxide vertical profile retrieval

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Abstract Text
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We developed an algorithm, for the first time, to retrieve nitrogen dioxide (NO2) vertical profile (surface NO2 volume mixing ratio) using multi NO2 slant column densities (SCDs) at ultra-violet (UV) and visible (VIS) channels since the sensitivity of nadir measurements decreases due to absorption of the gas near the surface and with decreasing wavelength. Firstly, to create a look-up table, synthetic radiances were calculated from the vector discrete ordinate radiative transfer (VLIDORT) model in the UV and VIS range using various parameters such as aerosol properties (e.g., aerosol optical depth, single scattering albedo, and aerosol loading height), geometry information (e.g., solar zenith angle, viewing zenith angle, and relative azimuth angle), NO2 vertical profile, and surface reflectance. Secondly, spectral fitting was performed at an interval of 1 nm from the center wavelength of 350 nm to 380 nm with a fitting window of about 30 nm to calculate the ratio of average NO2 SCDs in the VIS range to those in UV range. To validate the NO2 vertical profile retrieval algorithm, synthetic radiances were calculated based on NO2 vertical profiles with random values. NO2 vertical profiles are assumed to have exponential distribution and are generated with random NO2 upper limits with a range of 0 to 3 km, random total NO2 VCDs with a range of 1 to 5 × 1016 molecules cm-2, and a random relaxation parameter of exponential distribution with a range of 0.5 to 1.5. The results showed that the NO2 upper limit was 0.3 km or lower and the surface NO2 volume mixing ratio was estimated within 15% error. In addition, we also retrieved tropospheric NO2 vertical profiles using OMI LV1B radiance data.

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