Concept of small satellite UV/visible imaging spectrometer optimized for tropospheric NO_2 measurements in air quality monitoring

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Satellite observations at nadir can potentially facilitate a better understanding of the emissions and distribution of tropospheric nitrogen dioxide, NO_2. The identification of emissions requires adequate spatiotemporal resolution measurements of the total column amounts of NO_2. The spatial resolution of previous and current observations is insufficient for the identification of NO_2 hot-spots. Switching to a spatial resolution of ~1 km x ~1 km can improve the identification of local sources of NO_2 and their emissions. To investigate the feasibility of observations with such a high spatial resolution, we simulated radiance spectra for different cases under varying parameters, such as area, season, satellite altitude, and surface reflectance by using the radiative transfer model SCIATRAN. We subsequently retrieved NO_2 slant column densities (SCDs) using the differential optical absorption spectroscopy (DOAS) technique with several fit windows. For test cases associated with polluted conditions, we found that the conceptual nadir-observing instrument on a satellite at an altitude of ~300 km involved the lowest retrieval errors for signal-to-noise ratios of around 1000 with accuracy better than the required 5% for tropospheric NO_2 SCD and that the fit window of 425--497 nm met the scientific requirements for both surface reflectance cases.

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