

Deduce to ozone column amount from ultraviolet spectra measured with Airborne-OPUS and examination of analysis error

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Satellite observation is essential to monitor the increase of atmospheric pollutants, including tropospheric ozone, produced in East Asia, where industrial activities are increasing. IGOS-P/IGACO (2004) recommended that high spatial and temporal resolution monitoring significant stratospheric and tropospheric constituents from satellites. The recommendations have not been fully realized even by new satellite observation sensors, OMI and SCIAMACHY, which is now operated. It is significant to study satellite sensor and data processing algorithm for developing next generation monitoring system. In order to investigate requirements for a new satellite sensor and its data processing algorithm, we process the data obtained from the Airborne- Ozone and Pollution measuring Ultraviolet Spectrometer (OPUS) sensor, which was developed by JAXA/EORC as a prototype of OPUS, to deduce ozone slant column density. OPUS measures solar ultraviolet spectra backwardly scattered from the earth surface and lower atmosphere, to evaluate total and tropospheric column amounts of ozone, nitrogen dioxide, sulfur dioxide, and some other species.

Airborne-OPUS, which consists of a compact, ready-made spectrometer and a cooled CCD, measures backward-scattered ultraviolet spectra between 300 and 455 nm with a spectral resolution of 0.9 nm (FWHM) from aircraft. To evaluate the column amount of ozone, spectra between 315 and 325 nm were analyzed. The spectrum data processed in this study were obtained during Pacific Exploration and Asia and Continental Emission (PEACE)-A campaign in January 2002. On the basis of Bayesian statistics, the fitting of calculated spectra to measured ones were optimized. In the calculation, the absorption by ozone, the scattering by atmospheric molecules and the Ring effect have been considered, and the scattering by aerosols, surface albedo, and artificial continuous components have been considered as one continuum component. Deduced slant column amounts of ozone are compared with those obtained from the TOMS measurement in the same day, indicating the two observations agreed within 5 % with a good condition shown below.

The error analyses have been carried out for this data processing. The shift of the measured spectra, probably caused by airplane vibration, and the error in the instrument function (spectral resolution of the spectrograph) are significant instrumental errors. Differences in ozone column amount between this measurement and the TOMS correlate with the small shift of the analyzed spectra from the reference spectra. Interference due to absorption of SO₂ and HCHO is found to be negligible. Errors due to assumed profiles of ozone and atmospheric temperature are now estimated. We present the result of our analyses including the error analyses to discuss the sensor spec and other factors required for satellite monitoring of ozone.