Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 3115-3127, 2007
www.atmos-chem-phys.net/7/3115/2007/

Simulation study of the aerosol information content in OMI spectral reflectance measurements

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Abstract. The Ozone Monitoring Instrument (OMI) is an imaging UV-VIS solar backscatter spectrometer and is designed and used primarily to retrieve trace gases like O_3 and NO_2 from the measured Earth reflectance spectrum in the UV-visible (270–500 nm). However, also aerosols are an important science target of OMI. The multi-wavelength algorithm is used to retrieve aerosol parameters from OMI spectral reflectance measurements in up to 20 wavelength bands. A Principal Component Analysis (PCA) is performed to quantify the information content of OMI reflectance measurements on aerosols and to assess the capability of the multi-wavelength algorithm to discern various aerosol types. This analysis is applied to synthetic reflectance measurements for desert dust, biomass burning aerosols, and weakly absorbing anthropogenic aerosol with a variety of aerosol optical thicknesses, aerosol layer altitudes, refractive indices and size distributions. The range of aerosol parameters considered covers the natural variability of tropospheric aerosols. This theoretical analysis is performed for a large number of scenarios with various geometries and surface albedo spectra for ocean, soil and vegetation. When the surface albedo spectrum is accurately known and clouds are absent, OMI reflectance measurements have 2 to 4 degrees of freedom that can be attributed to aerosol parameters. This information content depends on the observation geometry and the surface albedo spectrum. An additional wavelength band is evaluated, that comprises the O_2-O_2 absorption band at a wavelength of 477 nm. It is found that this wavelength band adds significantly more information than any other individual band.

Final Revised Paper (PDF, 471 KB) Discussion Paper (ACPD)

Citation: Veihelmann, B., Levelt, P. F., Stammes, P., and Veefkind, J. P.: Simulation study of the aerosol information content in OMI spectral reflectance measurements, Atmos. Chem. Phys., 7, 3115-3127, 2007. Bibtex EndNote Reference Manager