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Biomass burning aerosols retrieved from combination of near-UV radiance and near-IR polarization

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Carbonaceous aerosol plays an important role not only in climate but also in aerosol study. It is, however, difficult to make models of biomass burning aerosol because their properties are widely varied, strongly dependent on the biomaterial itself and on the stage of burning, and/or transportation process such as water vapor uptake.

This work intends to estimate the optical properties of biomass burning aerosols based on the combined use of CAI (Cloud aerosol imager) on GOSAT and POLDER (Polarization and directionality of Earth's reflectances) on PARASOL data. The biomass burning aerosols involve several kinds of particles together. And hence Maxwell-Garnett mixing rule, which calculates the complex refractive index for heterogeneous particle consisting of small spherical particles (called inclusions) suspended in a homogeneous medium (called matrix), is employed to explain the internal mixture of absorbing aerosols. In addition to the aerosol model, our retrieval algorithms involve estimation of the ground surface reflectance and radiation simulation in the Earth-atmosphere model. The simulated results are stored into look up tables for pixel by pixel analysis of the satellite data.

The CAI is push bloom type imager which measures both of cloud and aerosols information at four wavelengths from near UV (0.38 μm) to short infrared (1.6 μm) with the 500 m pixel resolution. The measurements at 0.38 μm have advantages of detection of carbonaceous aerosols and less ground surface reflection in comparison with the visible bands. The POLDER measures the directional polarization feature with semi-Stokes vector (I, Q, and U) at 0.49, 0.67, and 0.87 μm. The polarization information by POLDER has the big advantages to retrieve aerosol properties, especially for fine mode aerosols. Thus combination use of UV information by CAI and directional polarization information by POLDER promises to give us with the more detail of aerosol information. Simultaneous measurements of CAI and POLDER are limited because the CAI is operating on the different orbit from that of A-train satellites.

Fortunately the biomass burning plume over Western Russia in summer 2010 has been simultaneously observed with CAI and POLDER. As results, aerosol optical thickness (AOT), Angstrom exponent, and single scattering albedo (SSA) are retrieved. The retrieved values of AOT and Angstrom exponent are partially validated with AERONET ground sun photometric data. The values of AOT(0.55 μm) take about 2 over the wide surrounding area, and larger than 5 over the central part of the plume. SSA takes the values around 0.8 in the plume.