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Aerosol retrieval over land: analysis of influence of surface reflectance angular anisotropy on top-of-atmosphere total and polarized reflectances

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For the retrieval of atmospheric aerosol properties from satellite measurements, the atmospheric signal should be correctly separated from the surface signal. This represents one of the most important challenges for the development of algorithms for the retrieval of aerosol properties over land surfaces.

To describe separately the surface contribution into intensity and polarization characteristics of scattered radiation the bidirectional reflection distribution function (BRDF) and bidirectional polarization distribution function (BPDF) are used. We applied the multiple-viewing angle and multi-spectral photopolarimetric measurements of Research Scanning Polarimeter (RSP) airborne instrument to test the models of BRDF and BPDF, and validate them for their applicability for aerosol retrieval over land.

The RSP measures intensity and polarization characteristics at a wide range of viewing zenith angles (from -60 to 60 degrees, counted off the zenith direction) in the nine spectral bands in the range 410-2250 nm. It is a prototype for the Aerosol Polarimetry Sensor of the NASA Glory Project. We used the RSP data obtained during the ALIVE (Aerosol Lidar Validation Experiment) measurement campaign performed in Oklahoma (USA, Southern Great Plains) in September of 2005. There are several flights in the ALIVE campaign with measurements at low altitude over land (about 200-600 m). These measurements provide good opportunity for testing and validating the models of the BRDF and BPDF for Earth surfaces.

Different BRDF and BPDF models have been tested by fitting them to RSP data. We have shown that the best fitted model parameters may be sensitive to the illumination and observation geometries. Also, different BRDF and BPDF models may show different angular behavior for different illumination geometries. These facts cause uncertainties in the BRDF and BPDF models. We performed radiative transfer calculations for a coupled atmosphere-surface system, in order to investigated how the above mentioned BRDF and BPDF models uncertainties manifest themselves at the top-of-atmosphere. Also, the possible impact on aerosol retrievals over land is discussed.