Geophysical Research Abstracts
Vol. 15, EGU2013-8592, 2013
EGU General Assembly 2013

Polarimetric Remote Sensing of Atmospheric Aerosols

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To reduce the large uncertainty on the aerosol effects on cloud formation and climate, accurate satellite measurements of aerosol optical properties (optical thickness, single scattering albedo, phase function) and microphysical properties (size distribution, refractive index, shape) are essential. Satellite instruments that perform multi-angle photopolarimetric measurements have the capability to provide these aerosol properties with sufficient accuracy. The only satellite instrument currently in space that performs multi-angle photopolarimetric measurements is the POLDER-3 instrument onboard the PARASOL microsatellite. PARASOL provides measurements of a ground scene under (up to) 16 viewing geometries in 9 spectral bands (3 for polarization). In order to make full use of the capability of PARASOL measurements of intensity and polarization properties of reflected light at multiple viewing angles and multiple wavelengths, we developed a retrieval algorithm that considers a continuous parameter space for aerosol microphysical properties (size distribution and refractive index) and properly accounts for land or ocean reflection by retrieving land and ocean parameters simultaneously with aerosol properties. Here, we present the key aspects of our PARASOL retrievals (inverse method, forward model, information content, cloud screening, computational aspects) as well as a validation of retrieved aerosol properties with ground-based measurements of the AERONET network. Also, we discuss required improvements for the next generation of polarimetric instruments dedicated to aerosol remote sensing and introduce a new spectropolarimetric instrument named SPEX. We will demonstrate the capabilities of SPEX based on ground based field measurements and characterization measurements in the labatory.