Information content in AERONET photo-polarimetric measurements for aerosol microphysical properties

XIAOGUANG XU[1] AND JUN WANG[1]

[1]Univ. of Nebraska-Lincoln, Lincoln, NE 68588, USA (xxu@huskers.unl.edu, jwang7@unl.edu)

The Aerosol Robotic Network (AERONET) has been providing aerosol products of optical depth (AOD), size, and refractive index at more than 200 sites around the world. These aerosol microphysical products, inverted from Sun and sky radiance measurements, are valuable resources to study aerosol optical climatology and most importantly to validate aerosol products from satellite sensors. Until recently, however, such fulfillment of AERONET products faces challenges with the advent of multi-spectral and multi-angular photo-polarimetric satellite observations. High accurate retrievals of aerosol microphysical parameters can be made from multi-angular photo-polarimetric measurements and their expected accuracy demands the AERONET retrieval algorithm to include polarization in the inversion.

This study aims to examine the potential aerosol microphysical information contained in the AERONET photo-polarimetric observations and to provide theoretical error analysis for an proposed new inversion algorithm. We have constructed a numerical testbed to generate synthetic simulation of AERONET radiance and degree of polarization in 440, 675, 870, and 1020 nm with the present of bi-modal aerosols. The synthetic data are made for various aerosol loading and fine-coarse situations, and a range of solar elevations. The Bayesian statistical approach then is applied to relate information contained in the synthetic data as well as the retrieval errors to the instrumental as well as a priori characteristics. The results show remarkable increase of information and decrease in retrieval errors by adding multi-spectral polarization and offer suggestions for future measurement concept design and optimal retrieval strategy.