RETRIEVAL OF AEROSOL MICROPHYSICAL PROPERTIES FROM THE AERONET PHOTO-POLARIMETRIC MEASUREMENTS

by

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INTRODUCTION

1.1 Background and Motivation

Atmospheric aerosols play a crucial role in the global climate change. They affect earth energy budget directly by scattering and absorbing solar and terrestrial radiation, and indirectly through altering the cloud formation, lifetime, and radiative properties [Haywood and Boucher, 2000; Ramanathan et al., 2001]. However, quantification of these effects in the current climate models is fraught with uncertainties. The global average of aerosol effective radiative forcing (ERF) were estimated to range from –0.1 to –1.9 Wm^{-2} with the best estimate of –0.9 Wm^{-2} [Boucher et al., 2013], indicating that the cooling effects of aerosol might counteract the warming effects of 1.82 ± 0.19 Wm^{-2} caused by the increase of carbon dioxide since the industrial revolution [Myhre et al., 2013]. The climate effects of aerosol particles depend on their geographical distribution, optical properties, and efficiency as cloud condensation nuclei (CCN). Key quantities pertain to the aerosol optical and cloud-forming properties include particle size distribution (PSD), chemical composition, mixing state, and morphology [Boucher et al., 2013]. While the daily aerosol optical depth (AOD) can be well measured from current satellite and ground-based remote sensing instrumentations [e.g., Holben et al., 1998; Kaufman et al., 2002], the accurate quantification of aerosol ERF is in no small part hindered by our limited knowledge about the aerosol PSD and refractive index (describing chemical composition and mixing state).

To fully understand the role of aerosol particles in the global climate change, further development in observations along with retrieval algorithms for these aerosol microphysical properties from different platforms are thus highly needed [Mishchenko et al., 2004], and the focus of this two-part series study is the characterization of aerosol properties from ground-based passive remote sensing.

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