Multiangle, polarimetric characterization of dust and smoke particles with the AirMSPI instrument on the NASA ER-2 aircraft

Olga V. Kalashnikova[a,*], Michael J. Garay[a], Feng Xu[a], Felix Seidel[a], David J. Diner[a], William Heinson[b], and Rajan K. Chakrabarty[c]

[a]*Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA*
[b]*NASA Goddard, Greenbelt, MD, USA*
[c]*Washington University in San Louis, San Louis, MO, USA*

[*]*Presenting author (Olga.Kalashnikova@jpl.nasa.gov)*

The role of absorbing aerosols such as smoke and dust in the climate system is of particular interest due their impact on air quality and their interaction with radiation that changes the heating profile of the atmosphere, which can in turn affect cloud formation. Multi-angle, spectropolarimetric observations are a promising tool for better characterizing these types of aerosols due, in part, to their sensitivity to layer height, absorption, and particle non-sphericity. In this presentation, we will describe both modeling and observational studies that demonstrate these capabilities.

We use a SOS vector radiative transfer code to model the angular distribution of the polarized radiation reflected from layers of aerosol embedded in a Rayleigh scattering atmosphere. The optical properties of brown carbon aerosols were derived from Washington University laboratory data of combustion of Alaskan and Indonesian peatlands with varying fuel moisture content and these are compared with canonical black carbon databases. These comparisons demonstrate the sensitivity of multi-angle, spectropolarmetric observations to aerosol microphysical details.

The Jet Propulsion Laboratory's Airborne Multiangle SpectroPolarimetric Imager (AirMSPI) acquires multiangular observations over a ±67° along-track range in eight (355, 380, 445, 470, 555, 660, 865, and 935 nm) radiometric and three (470, 660, and 865 nm) polarimetric bands with resolution up to 10 m from the NASA ER-2 high altitude research aircraft. Using data from recent field campaigns, including the Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC^{4}RS) and the Imaging Assessment and Characterization of Tropospheric Particulate Matter (ImPACT-PM) [1], we demonstrate how multi-angle, spectropolarimetric remote sensing imagery can be used to determine the composition of real atmospheric dust and smoke aerosols. For validation, the results from the AirMSPI remote sensing observations are compared with *in situ* aerosol measurements from sensors on the DC-8 (SEAC^{4}RS) and the Navy CIRPAS Twin Otter (ImPACT-PM).

Reference

[1] Kalashnikova, O. V., M. J. Garay, K. H. Bates, C. M. Kenseth, W. Kong, C. D. Cappa, *et al*., 2018: Photopolarimetric sensitivity to black carbon content of wildfire smoke: results from the 2016 ImPACT-PM field campaign. *J. Geophys. Res. Atmos.* **123**, 5376–5396. https://doi.org/10.1029/2017JD028032

Preferred mode of presentation: Oral/Poster