Characterizing the optical and microphysical properties of dust plumes with multi-wavelength lidar observations

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Mineral dust aerosol is among the most dominant aerosol species by mass and is heterogeneously distributed regionally because the dust plumes can be transported over long distances from limited dust source areas through occasional dust events. Dust optical properties vary significantly with regions due to spatial heterogeneity of dominant mineralogical compositions in source areas and dust microphysical processes that change dust particle size distributions. The spatial heterogeneities of both dust distributions and optical properties lead to substantial uncertainties in dust direct radiative forcing estimation. Therefore, developing a method is essential to infer the profile of dust optical and microphysical properties using remote sensing techniques.

The overarching goal of this study is to retrieve the vertical distributions of dust extinction coefficients and effective radii from multi-wavelength lidar observations. To achieve this goal, we have developed the mineralogy-resolved dust optical property model at lidar wavelengths [1-2] (Saito and Yang, 2021; Zhang et al., 2024), showing the substantial sensitivity to dust effective radii between 0.1-2 μm. This dust optics model is incorporated into a triple-wavelength lidar simulator. In the presentation, we will introduce the application of lidar-based dust aerosol retrievals based on the triple-wavelength lidar observations made during the Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE) field campaigns [3].

References

[1] Saito, M. and P. Yang, 2021: Advanced bulk optical models linking the backscattering and microphysical properties of mineral dust aerosol. *Geophys. Res. Lett.,* **48,** *e2021GL095121*.
[2] Zhang, Y., M. Saito, P. Yang, *et al.,* 2024: The sensitivities of the spectral optical properties to dust aerosol mineralogical and microphysical properties, *J. Geophys. Res. Atmos.,* accepted.
[3] Haarig, M., A. Ansmann, D. Althausen, *et al*., 2017: Triple-wavelength depolarization-ratio profiling of Saharan dust over Barbados during SALTRACE in 2013 and 2014. *Atmos. Chem., Phys.* **17**, 10767–10794.

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