Workshop on "Recent advancements in remote sensing and modeling of aerosols, clouds and surfaces",
GRASP ACE Summer school,
Lille, France, May 22-26, 2023

Advancements in observations of atmospheric aerosol absorption over the past 25 years

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Absorption of solar radiation by atmospheric aerosols depends on the interaction of complex chemical, physical, and radiative processes, each of which continue to evolve during aerosol transport. Some of these processes are beyond the complexity captured in current Earth System models and some of them are equally difficult to constrain with observations. Hence, multi-instrument observations to accurately measure aerosol absorption in its environmental context at various stages of this processing seem a sensible approach to the refinement and validation of atmospheric models, and to the combined use of models and observations to study the resulting aerosol impacts on climate. This talk will present observations of atmospheric aerosols from a selection of field deployments and satellite retrievals over the past 25 years, emphasizing the evolution of measurement capabilities.

Given the need to develop new observational constraints for aerosol absorption, we showcase how recently collected remote sensing datasets are used to develop novel aerosol retrieval algorithms, using polarimeter and lidar measurements as retrieval inputs. We will describe the significance of aerosol absorption to the scientific objectives of the NASA AOS (Atmosphere Observing System) project, recommended by the 2017 Decadal Survey and recently promoted to phase-A status. We will discuss new joint lidar-polarimeter retrieval simulations that help assess potential satellite architectures and instrument combinations for the AOS mission. Based on the intercomparisons between models and observations, we will conclude with an assessment of how aerosol absorption estimates can be constrained by future measurement concepts.

Keywords: aerosol absorption, field observations, retrieval algorithms