

SeaSTAR: A motion stabilized sun-tracking solar photometer and polarimeter

Star Tammes^{a*}, Jun Wang^a, Stephen Broccardo^b

^aUniversity of Iowa Chemical and Biochemical Engineering, Atmospheric and Environmental Research Lab, 330 South Madison Street, Iowa City, IA 52240

^bBay Area Environmental Research Institute, NASA Ames Research Park, Building 18 Room 101, Moffett Field, CA 94035

*Presenting author (stammes@uiowa.edu)

While the AERONET ground stations have been a valuable resource in the validation of space-based aerosol detection, there is currently a lack of equivalent capabilities for maritime and ocean observations and validations, as current observations rely on volunteer hand-held observations from sailors with the Microtops II. The importance of terrestrial maritime measurements is twofold. As more missions like NASA's PACE satellite [1] come online there will be more need for accurate maritime aerosol validations over the ocean. There is also increasing attention to aerosols and their role in radiative forcing, as the 2020 fuel regulations on sulfur emissions from ships have had an unintended effect in changing the Earth Radiation Budget [2].

In this presentation we share developments made on the SeaSTAR robotic system for filling this gap. With three-axis motion stabilization and 14 channels from UV through mid-IR for observations of radiance and polarization sky-scans, SeaSTAR can determine aerosol microphysical parameters with high precision even under unstable sea conditions anywhere on the globe. Also presented will be the methods of inversion used to go from raw radiance and polarization data to aerosol microphysical parameters, using the Unified Linearized Vector Radiative Transfer Model (UNL-VRTM) [3] and the improvements this offers over the standard AERONET inversion technique in determining fine and coarse mode optical properties.

References

[1] NASA, GSFC, April 2024: PACE Plankton, Aerosol, cloud ocean Ecosystem.

<https://pace.gsfc.nasa.gov/>

[2] NOAA, Jan 2025: The unintended consequences of reducing sulfur emissions from ships.

<https://cpo.noaa.gov/the-unintended-consequences-of-reducing-sulfur-emissions-from-ships/>

[3] Wang, Jun, Oct 2014: A numerical testbed for remote sensing of aerosols, and its demonstration for evaluating retrieval synergy from a geostationary satellite constellation of GEO-CAPE and GOES-R. <https://doi.org/10.1016/j.jqsrt.2014.03.020>

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