

Shortwave Array Spectroradiometer-Hemispheric (SAS-He)

Performance: Initial Evaluation using TCAP data

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Motivation

- Hyperspectral direct-sun measurements can serve as an invaluable input for simultaneous retrievals of aerosol optical depth (AOD), major trace gases and particle size distributions.
- The required hyperspectral measurements are provided by a new ARM ground-based radiometer, the so-called Shortwave Array Spectroradiometer-Hemispheric (SAS-He).
- How well does this radiometer perform under challenging observational conditions with large day-to-day and diurnal AOD changes?**

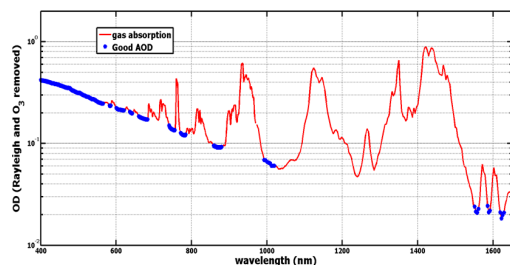


Fig. 2. Example of SAS-He total optical depth (OD) spectrum with Rayleigh component and O₃ removed for a day of interest (August 30, 2012). Blue markings show approximate spectral regions where AOD may be effectively retrieved.

Measurements

- SAS-He** data. New instrument with ultraviolet-visible-near-infrared (UV-VIS-NIR) and shortwave infrared (SWIR) spectrometers (Fig. 1) has wide spectral coverage (350-1700 nm) and moderate spectral resolution (about 2.4 nm, UV-VIS-NIR; about 6 nm, SWIR).
- MFRSR** data. Multifilter Rotating Shadowband Radiometer (MFRSR) is predecessor of SAS-He and provides AOD at 5 wavelengths (415, 500, 615, 675, and 870 nm).
- AERONET** data. Sun sunphotometers supported by Aerosol Robotic Network (AERONET) Program provides AODs at 7 wavelengths (380, 440, 500, 675, 870, 1020 and 1640 nm).

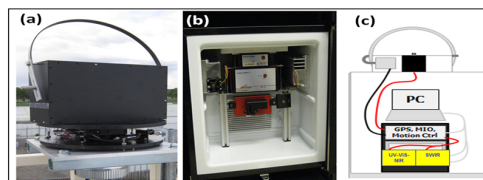


Fig. 1. The SAS-He design: (a) shadow band and sky collection optics mounted outside, (b) UV-VIS-NIR and SWIR spectrometers housed inside refrigerator, (c) instrument layout concept.

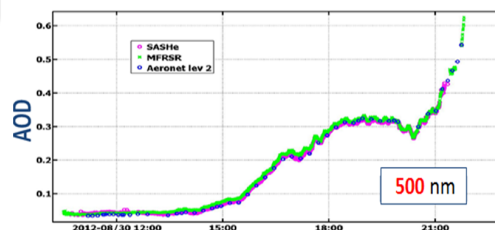


Fig. 3. Time series of AOD at 500 nm wavelength for a day of interest (August 30, 2012) from SAS-He, MFRSR and AERONET.

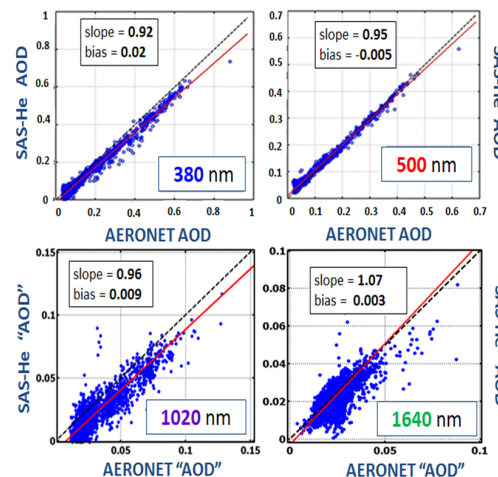


Fig. 5. Scatterplots of SAS-He versus AERONET AOD at 2 wavelengths (380, 500 nm) (top). Scatterplots of SAS-He versus AERONET "AOD" as residual of total OD minus Rayleigh OD at 2 wavelengths (1020, 1640 nm) (bottom).

Summary

- We introduce a new radiometer, the Shortwave Array Spectroradiometer-Hemispheric (SAS-He), with wide spectral coverage (350-1700 nm) and moderate spectral resolution.
- We illustrate its initial performance by comparing SAS-He AODs with those derived from collocated independent measurements at the US coastal region (TCAP data).
- We demonstrate that, on average, the SAS-He AODs closely match the MFRSR and AERONET AODs in the UV and VIS spectral ranges throughout several months having large day-to-day and diurnal AOD changes.

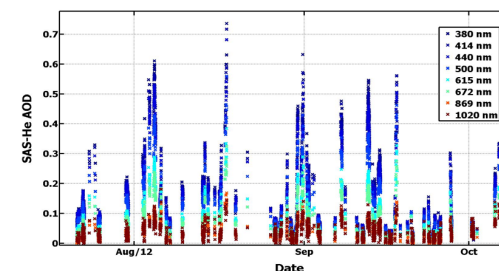


Fig. 4. Example of time series of SAS-He AODs at 8 selected wavelengths. These wavelengths have been selected for comparison of SAS-He AODs with those obtained from MFRSR and AERONET measurements (Fig. 5).

Approach

- To illustrate performance of SAS-He, we take advantage of integrated dataset collected during Two-Column Aerosol Project (TCAP) over US coastal region. This region is strongly affected by anthropogenic and natural aerosols due to its proximity to major urban and industrial sources.
- We calculate SAS-He AODs for selected MFRSR/AERONET wavelengths as residual of total optical depth (OD) minus pressure-corrected Rayleigh OD and O₃ (Fig. 2).
- We compare SAS-He AODs with those obtained from MFRSR and AERONET data. Our AOD comparison involves diurnal (Fig. 3) and day-to-day (Fig. 4) time series, and scatterplots (Fig. 5).