

ARM

Evaluation of the hyperspectral radiometer (HSR1) at the ARM SGP site

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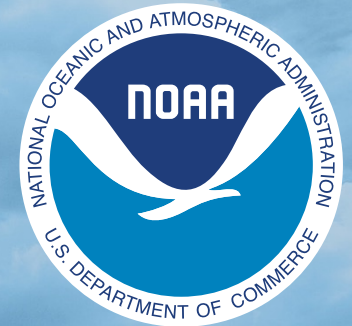
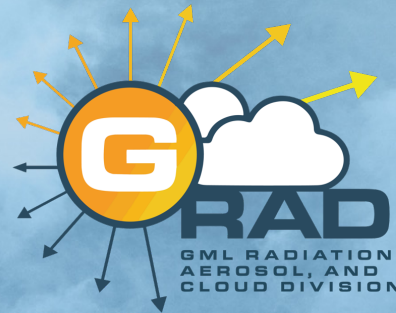
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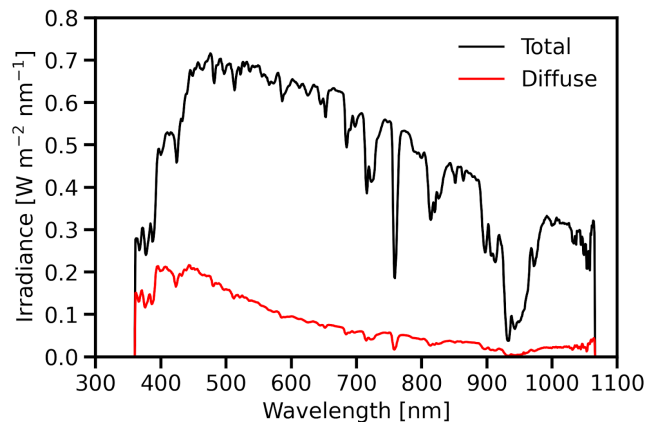
⁵ARGONNE NATIONAL LABORATORY

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ARM Introduction

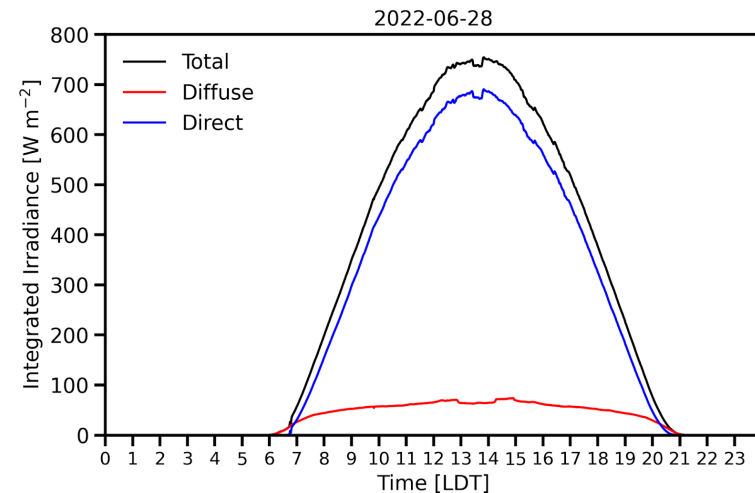
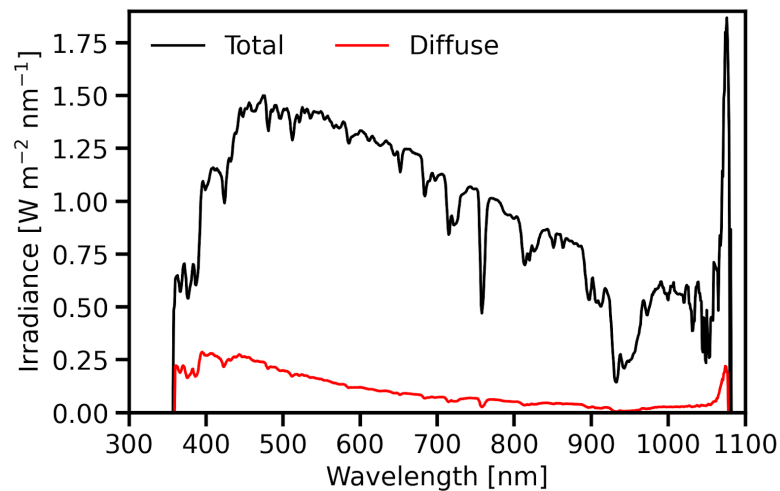
- The HSR1 prototype instrument developed by John Wood measures total and diffuse spectral irradiances from 360 to 1100 nm (spectral resolution of 3 nm)
 - The HSR1 has a shadow pattern and seven sensors (following SPN1 design)
- Location: ARM SGP site in Oklahoma on the Guest Instrument Facility (GIF)
- Time period: mid May to mid July 2022



Wood et al. (2017, AMT)



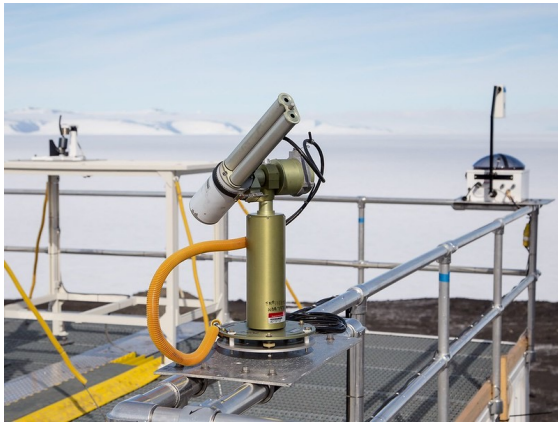
- Measurement noise due to straylight issues
 - Noted for wavelengths < 400 nm and wavelengths > 950 nm
 - Particularly noted for wavelengths > 1000 nm
- Step functions due to channel switching
- Data logging was interrupted by PC processing or possible software updates



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HSR1 evaluation

- HSR1 spectral irradiance and aerosol optical depth (AOD) compared to other collocated instruments including the:



Cimel sunphotometer (CSPHOT) (AERONET Level 2)



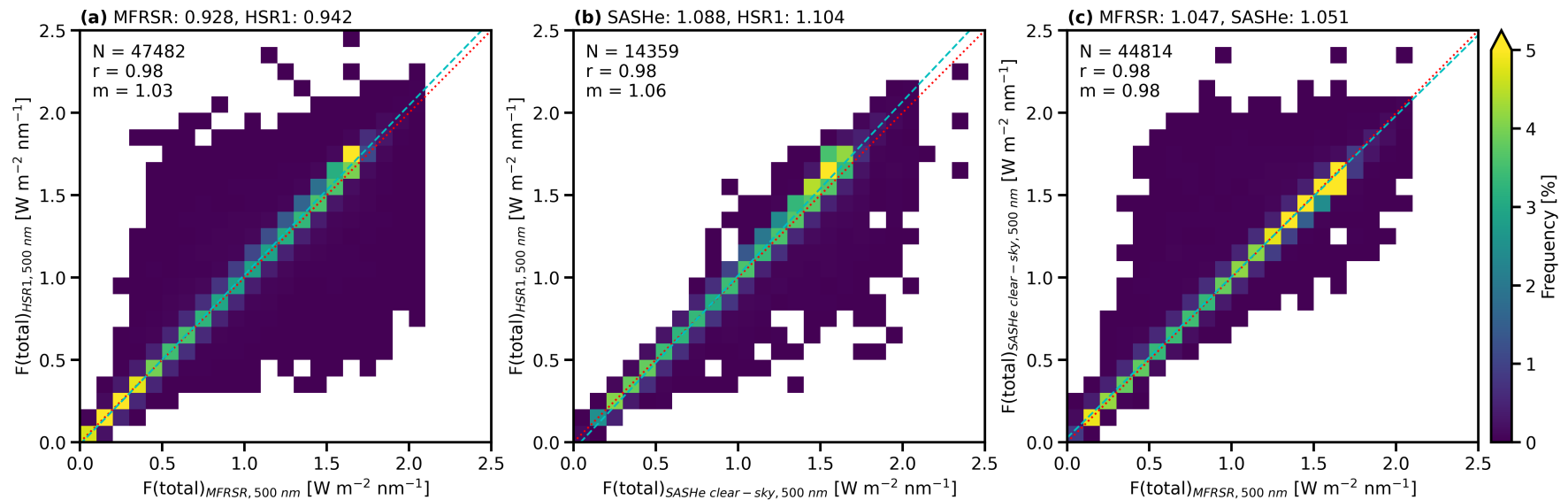
multifilter rotating shadowband radiometer (MFRSR) C1 & E13



shortwave array spectroradiometer-hemispheric (SASHe) (*clear-sky only*) 4

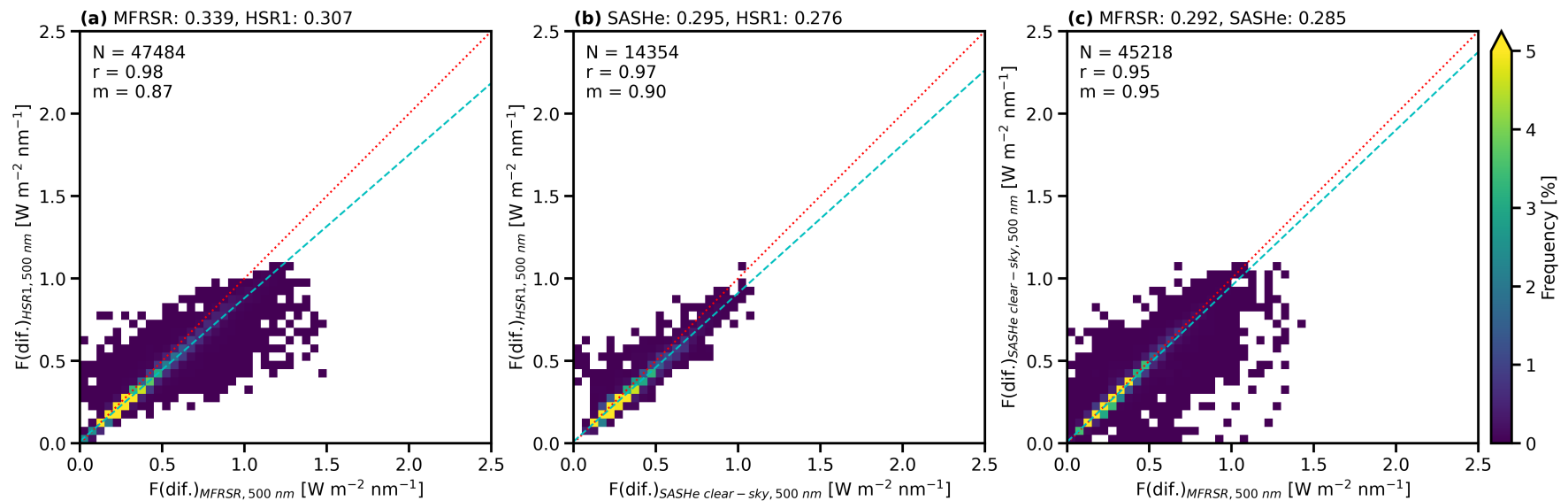
Spectral total irradiance comparison, 500 nm

- HSR1 total irradiance slightly larger than MFRSRs and SASHe by 1-2%
- MFRSR and SASHe total irradiances largely agree



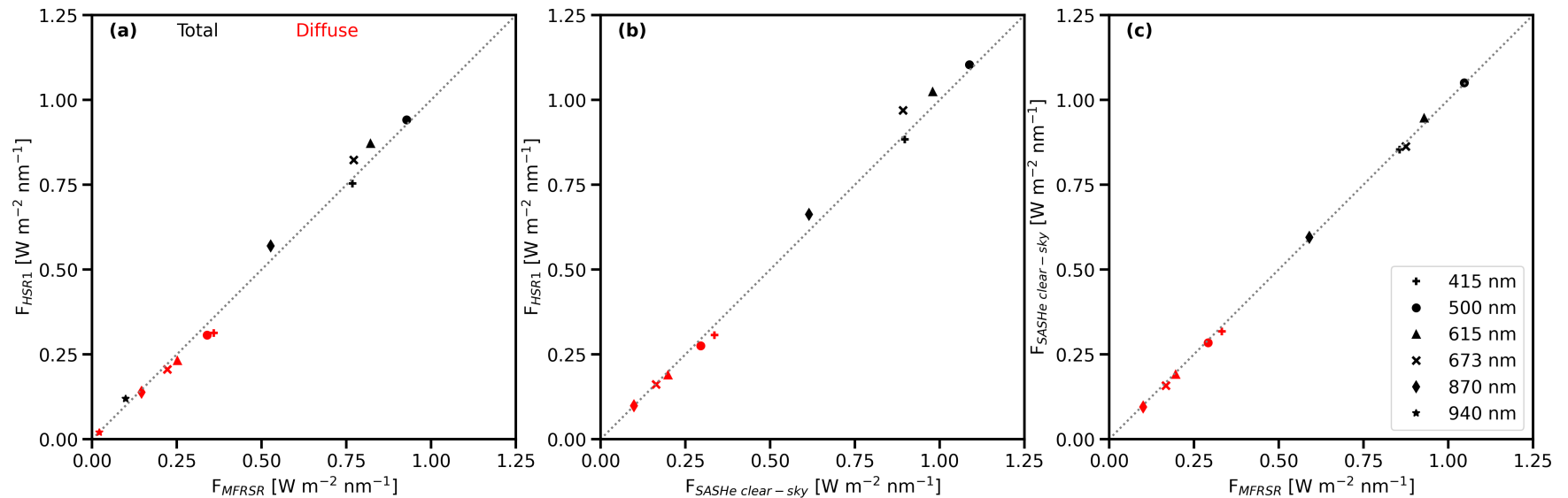
Spectral diffuse irradiance comparison, 500 nm

- HSR1 diffuse irradiance is smaller than MFRSRs by 10%
- HSR1 diffuse irradiance is smaller than SASHe by 6%
- MFRSR and SASHe diffuse irradiances largely agree

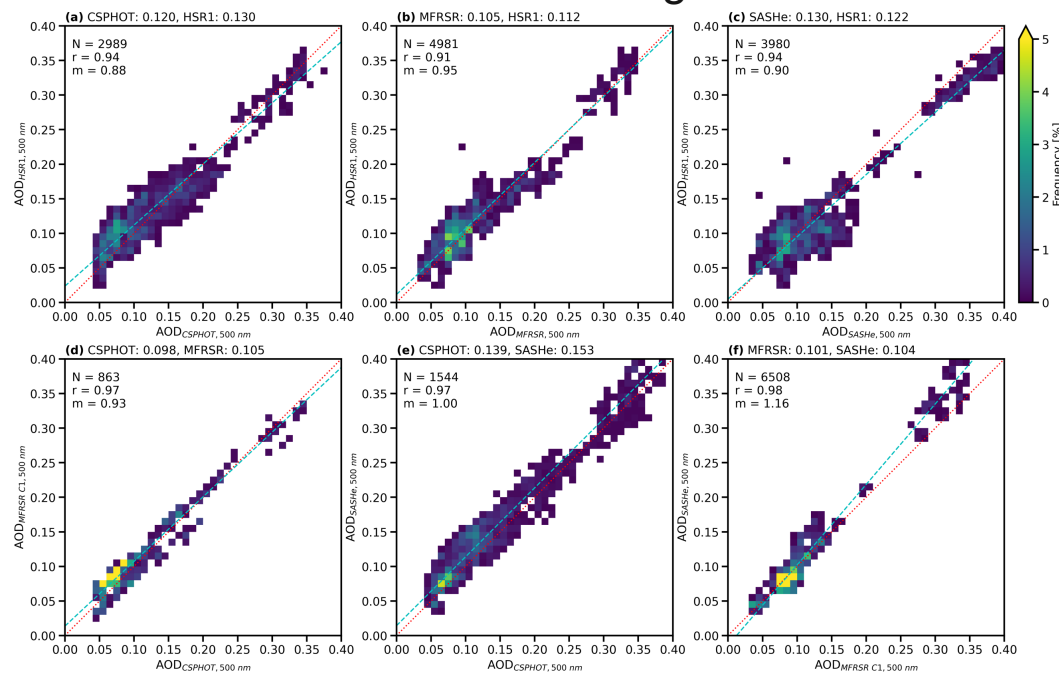


Spectral total and diffuse irradiance comparison

- HSR1 spectral total irradiance larger than MFRSRs by 10% or less
 - Except at 415 nm (smaller) and at 940 nm (even larger)
- HSR1 spectral diffuse irradiance smaller than MFRSRs by ~5-15%
- HSR1/SASHe spectral total/diffuse irradiances comparison similar to HSR1/MFRSR
- MFRSR and SASHe clear-sky spectral total and diffuse irradiance largely agree

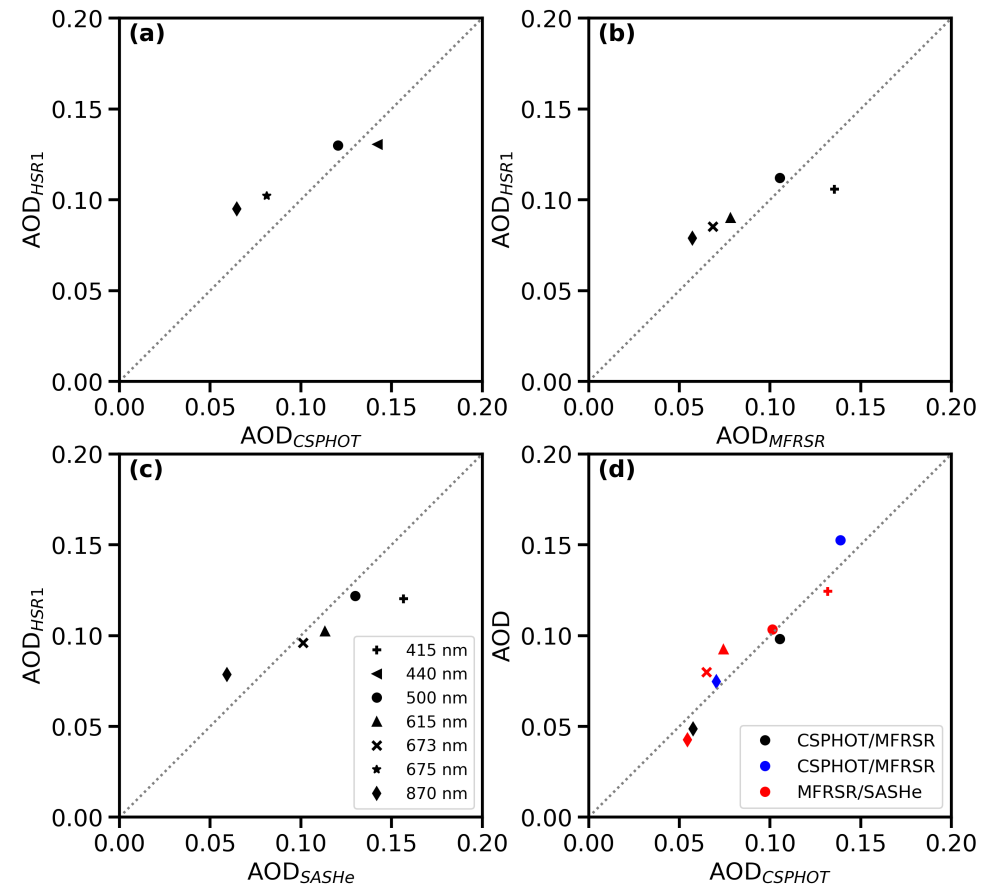


- HSR1 AOD retrieved via Langley's for clear-sky periods
- HSR1 AOD is larger than the CSPHOT and MFRSRs AOD by 0.007-0.017 (6-18%)
 - HSR1 mean AOD is within 0.01 of CSPHOT mean AOD (CSPHOT's reported uncertainty)
- HSR1 AOD is smaller than the SASHe AOD by 0.008 (6%)
- CSPHOT and MFRSR AODs agree well with each other, 0.01 (10%) or less



Aerosol optical depth (AOD) comparison

- HSR1 AOD is larger than the CSPHOT and MFRSRs AOD
 - Especially at higher wavelengths
 - Except at 415/440 nm
- HSR1 AOD is smaller than the SASHe AOD
 - Except at 870 nm
- CSPHOT and MFRSR AODs agree well with each other
 - 0.01 or less

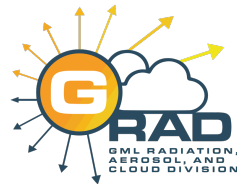


ARM Summary

- The HSR1 prototype instrument was evaluated at the ARM SGP site
- HSR1 spectral irradiances were compared to MFRSRs, SASHe
 - MFRSRs and HSR1 all-sky irradiances agree well
 - HSR1 total irradiance slightly larger and diffuse irradiance smaller
 - SASHe and HSR1 clear-sky irradiances also agreed
- HSR1 spectral AODs were compared to CSPHOT, MFRSRs, and SASHe
 - HSR1 AOD is larger than the CSPHOT and MFRSRs AOD
 - HSR1 mean AOD at 500 nm is within 0.01 of CSPHOT mean AOD (CSPHOT's reported uncertainty)
 - HSR1 AOD is smaller than the SASHe AOD
 - CSPHOT and MFRSRs AODs agree well
- Manuscript under review with AMT

The ARM logo consists of the letters "ARM" in a bold, blue, sans-serif font, with a light blue curved line underneath.

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The CIRES logo features a stylized mountain range with three peaks in shades of blue and green, above the letters "CIRES" in a bold, blue, sans-serif font.