

# Spectral Measurements of Downwelling Radiation Spanning UV, Visible, Near-IR, and Thermal IR

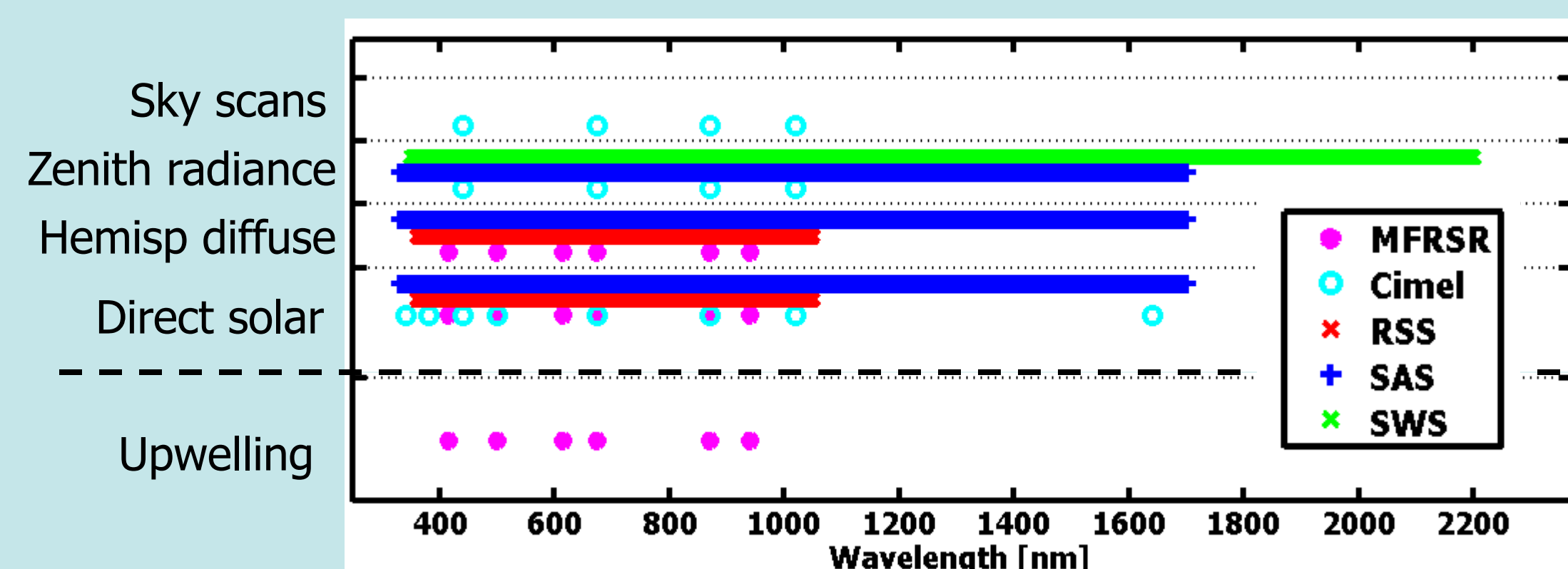
Connor Flynn , J. Barnard , D. Hopkins , A. Mendoza , D. Nelson , R. Norheim: PNNL  
Luc Rochette, M. Gaudreau, A. Lanouette: LR Tech



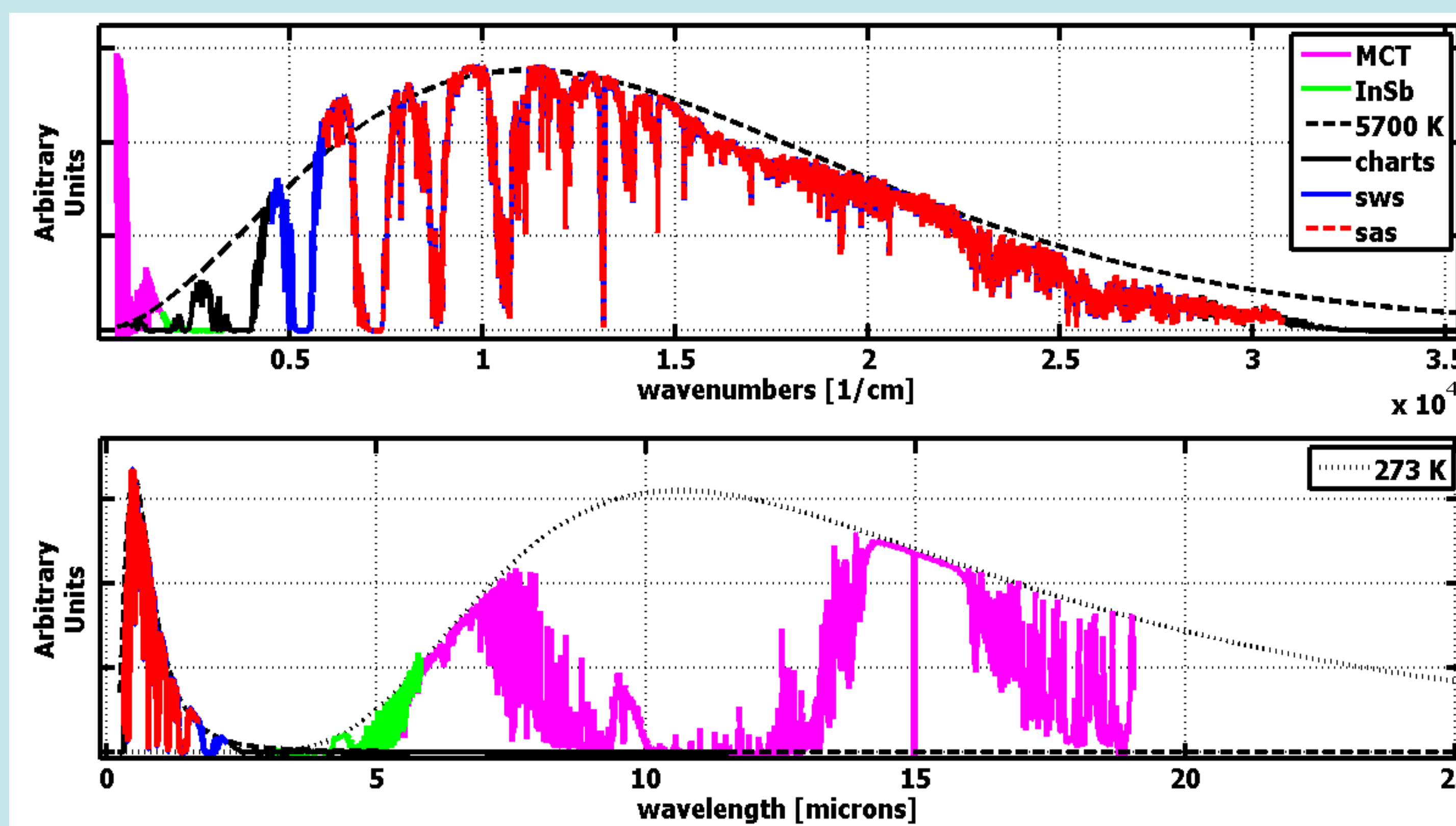
**Pacific Northwest**  
NATIONAL LABORATORY

Spectral radiometers deployed this year represent a major advancement towards full-spectral radiation closure under clear and cloudy skies from UV, visible, near IR, and thermal IR.

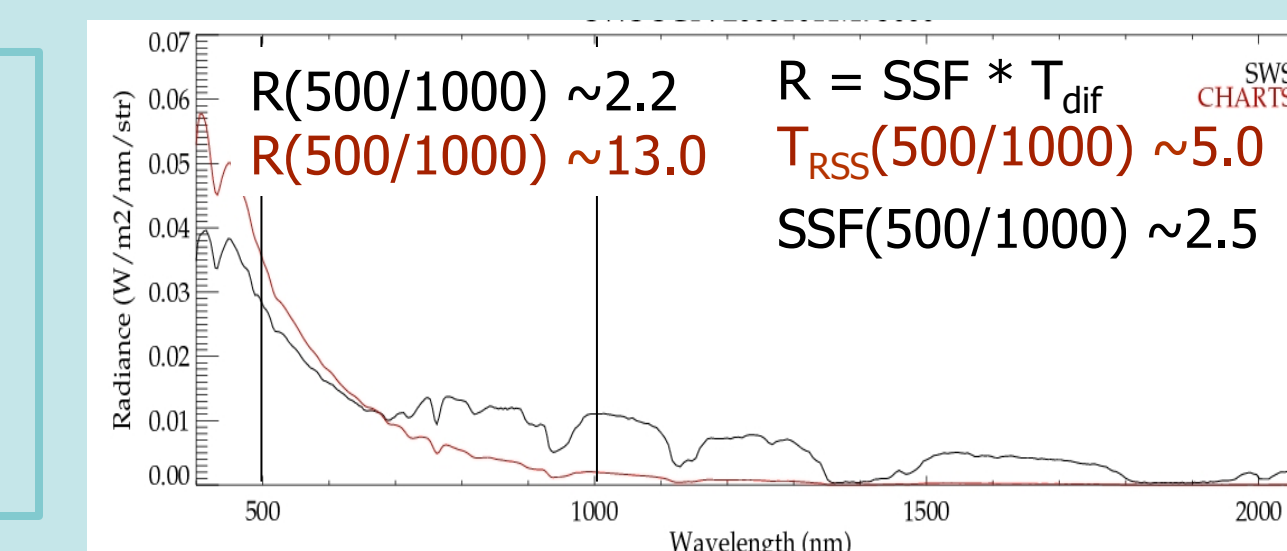
- ASSIST II, Zenith radiance 3-19  $\mu\text{m}$
- SWS, Zenith radiance  $\sim 350\text{-}2100\text{ nm}$ ,  $\sim 10\text{ nm}$  pixels
- SAS-Ze, Zenith radiance,  $\sim 325\text{-}1700\text{ nm}$ ,  $< 1\text{ nm}$  pixels
- SAS-He, direct and diffuse irradiance, same range



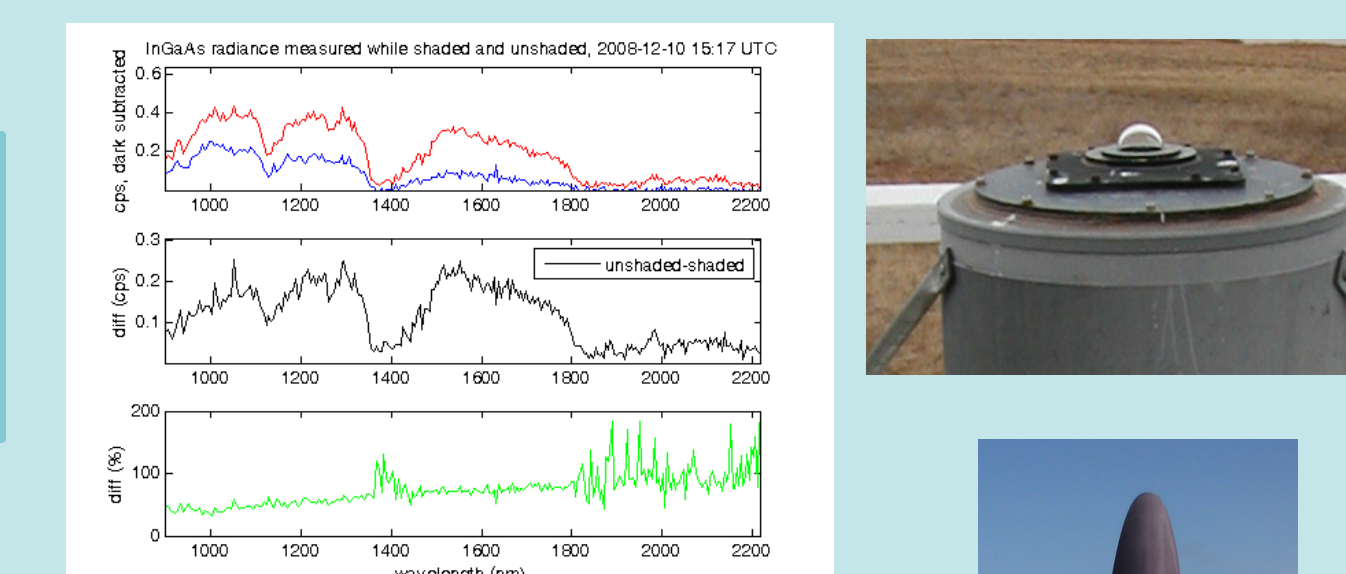
ARM's Current Zenith Radiance Spectral Coverage



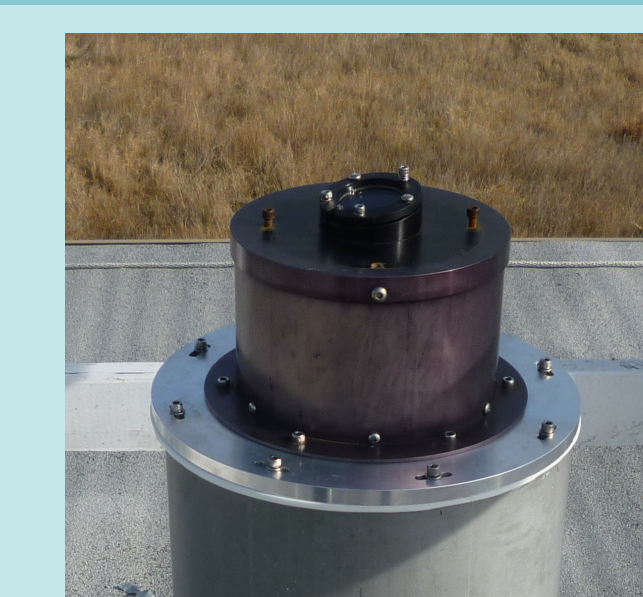
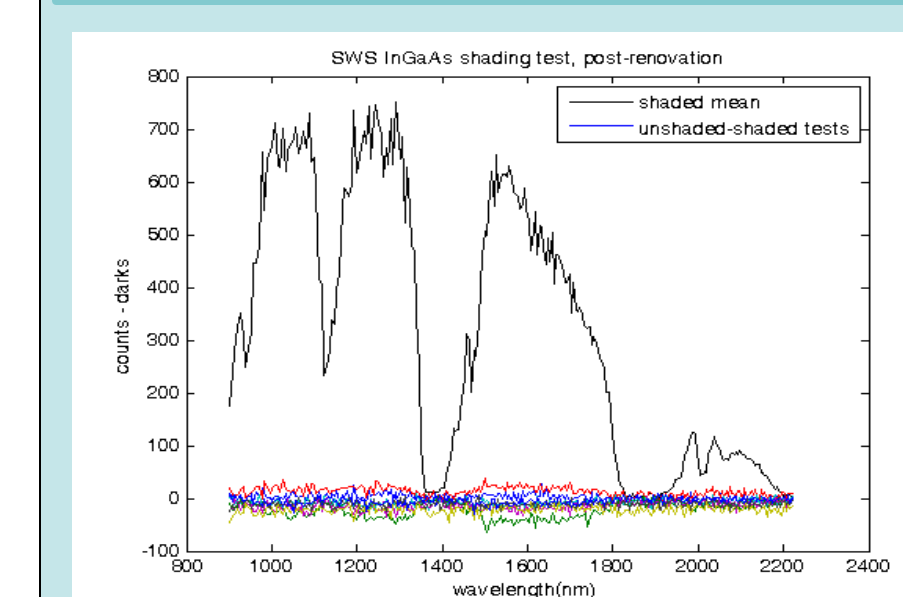
**SWS problem...**  
R(500/1000) ratio  
Way too low!



**Explanation:**  
SUN GLINT! ☹



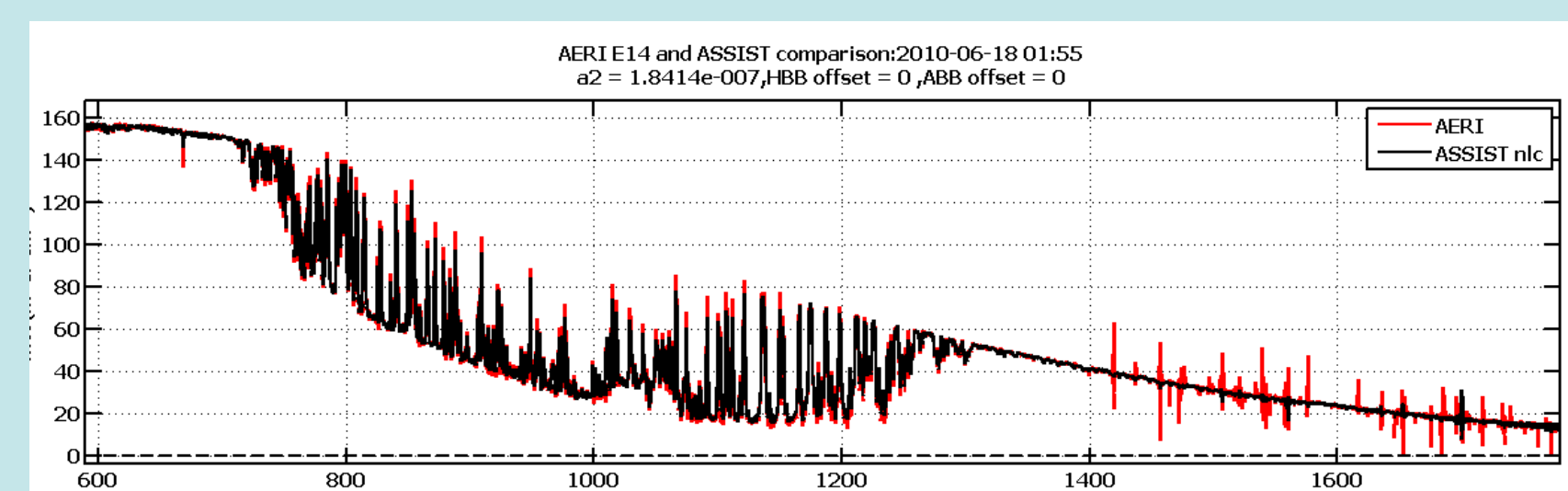
**The solution:** baffles & shading



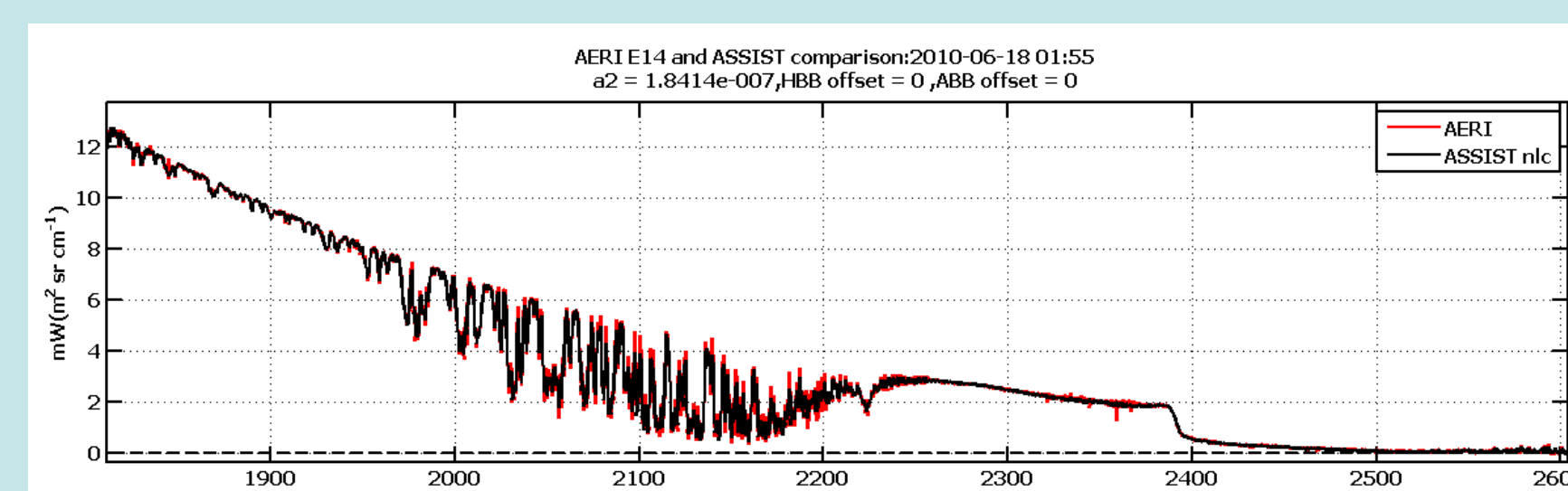
## ASSIST II:

New high-speed Fourier Transform Spectrometer from LR Tech delivering absolutely calibrated radiance spectra from  $\sim 520\text{-}3300$  wavenumbers.

During acceptance tests at SGP in June 2010 the ASSIST and AERI-E14 exhibited close agreement in measured clear sky radiances.



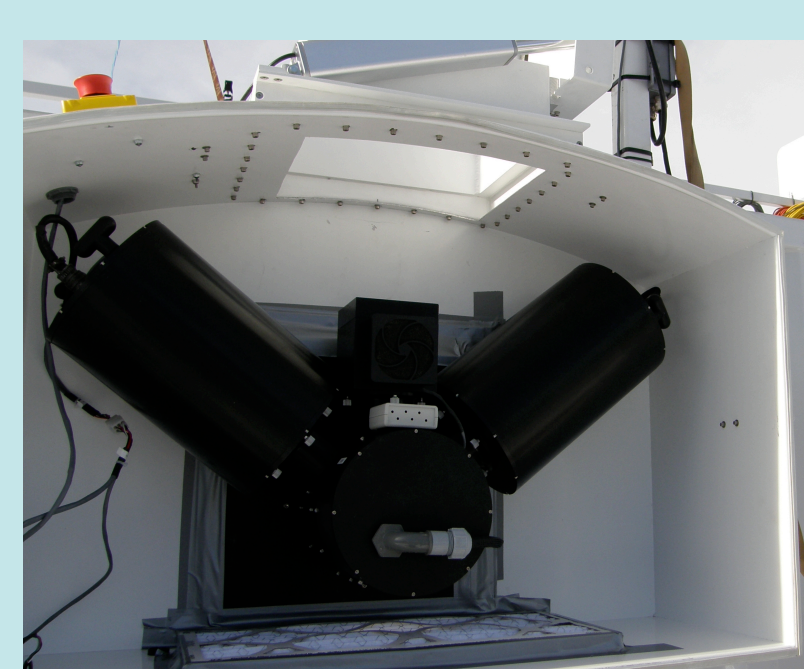
MCT detector 500-1800 wavenumbers



InSb detector 1800-3000 wavenumbers



Following the successful acceptance test, the ASSIST was deployed with the ARM Mobile Facility 2 at the Thunderhead site in support of STORMVEX.



The ASSIST routinely provides raw single-direction interferograms at 1 Hz and numerous derived products including calibrated radiances, noise-estimates, and brightness temperatures at full and degraded resolutions and at selected spectral ranges corresponding to regions of transparent, semi-transparent, and opaque atmospheric transmittance.

## Shortwave Array Spectrometers – SAS-Ze & SAS-He

New grating spectrometers providing direct and diffuse irradiance and zenith radiance spectra from two array detectors spanning  $\sim 340\text{ nm} - 1,700\text{ nm}$ .

**UV/VIS/SWIR:** Silicon CCD array

- Spectral range: 350-1100 nm
- Rayleigh resolution: 2.4 nm FWHM
- Pixel spacing  $\Delta\text{nm} = 0.5\text{ nm}$

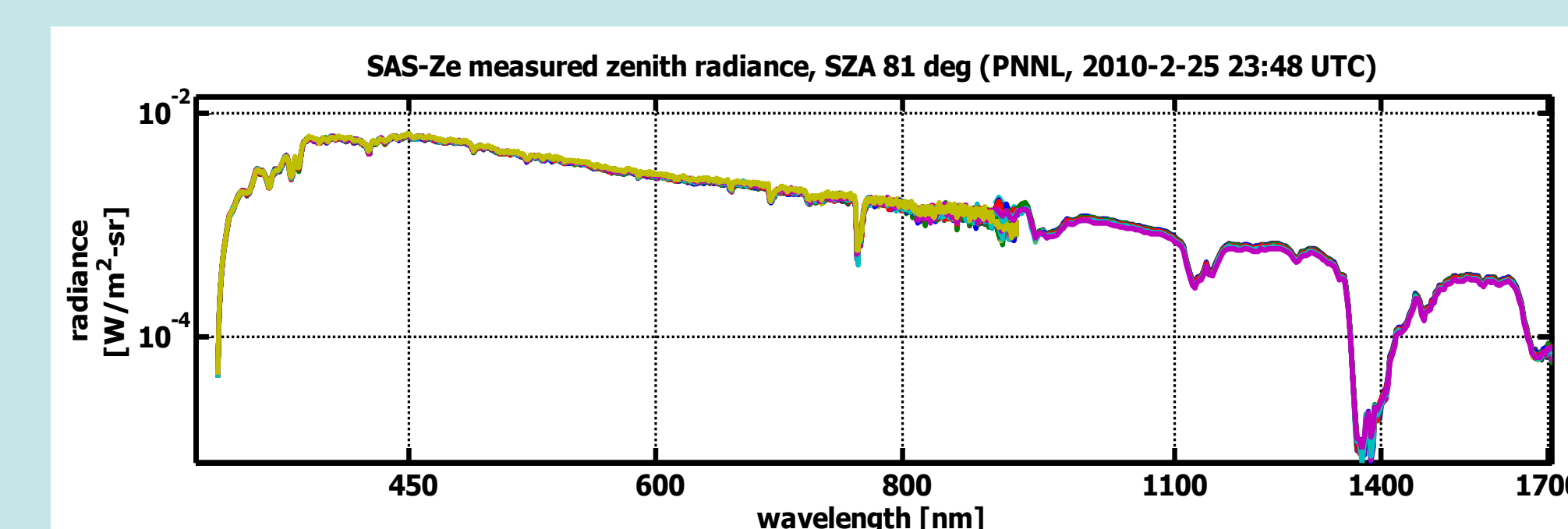
**NIR:** InGaAs CMOS/NMOS array

- Spectral range: 900-1700 nm
- Rayleigh resolution = 6 nm FWHM
- Pixel spacing  $\Delta\text{nm} = 3.3\text{ nm}$

**SAS-Ze:** Zenith radiance, 1 Hz  
Incorporates shadowband to protect from sun glint (see SWS!).

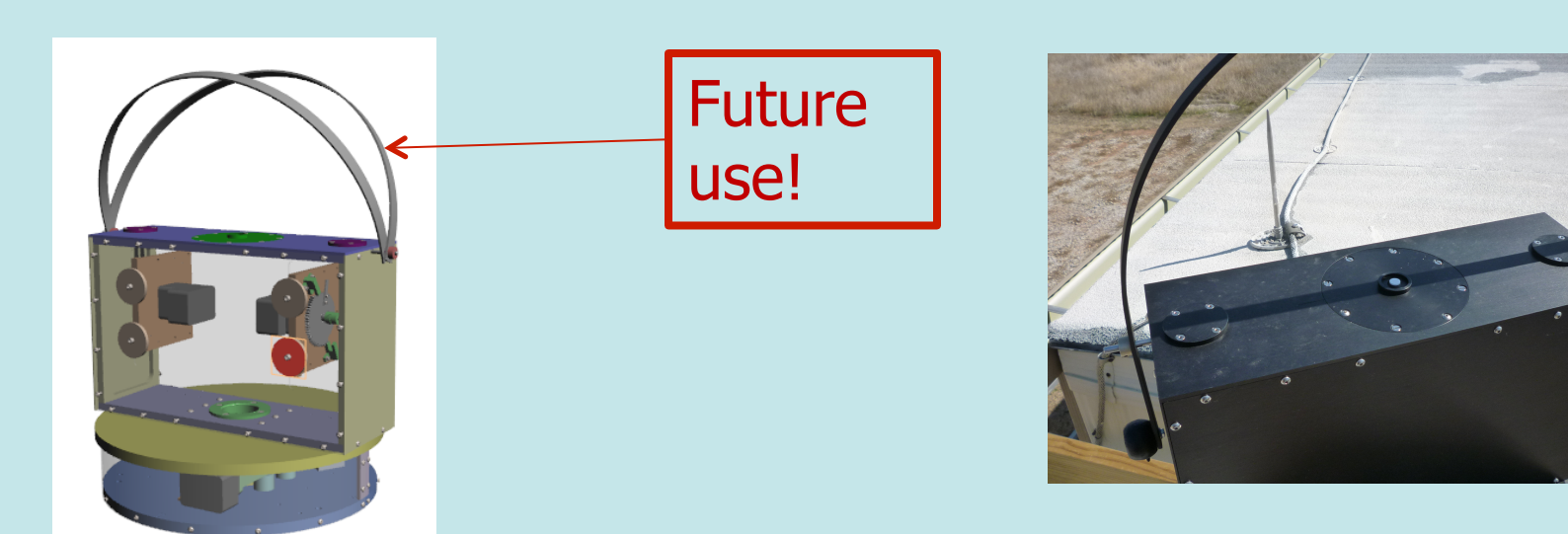


No glint!

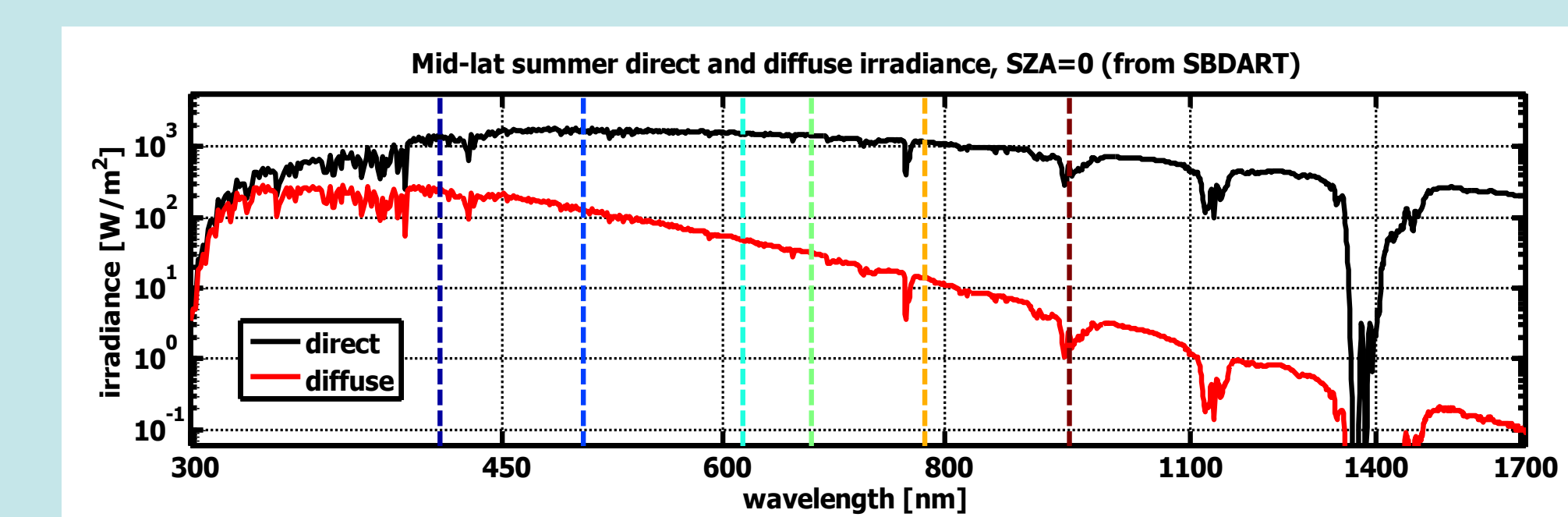


Measured SAS-Ze zenith radiance

**SAS-He:** dir. & hemisp dif irradiance  
Shadowband cycle  $\sim 20\text{-}30$  seconds  
Includes scan of sky near solar disk



Future use!



Modeled SAS-He clear sky irradiance components