



ARM



NREL
Transforming ENERGY

Breakout Session 2: SW and spectral radiometry

NREL

Broadband Radiometer Mentors

U.S. DEPARTMENT OF
ENERGY

Broadband SW radiometers

- 11:05 – 11:25 Radiometer Updates
- 11:25 – 11:55 Best Instrumentation for AMF/BSRN/SGP sites (open to discussion)

Spectral SW radiometry

- 11:55 – 12:00 Targeted scientific uses of spectral measurements – Laura updates
- 12:00 – 12:15 Manufacturer presentations
 - Aerodyne-TWST
 - John Wood-hyperspectral SPN
 - EKO
- 12:15 – 12:30 Updates on SAS-HE/ZE from mentor
 - Calibration Update
 - Shadow Update
- 12:30 – 12:55 Discussion
 - Afshin intro to SRRL cal lab capabilities
 - Possible intercomparison and Intercomparisons Commercial vs. SAS-HE/SAS-ZE
 - Are current calibration methods sufficient
 - Current state of retrievals
- 12:55 – 13:00 Summary and future work



SW Radiometer Updates – SRRL background

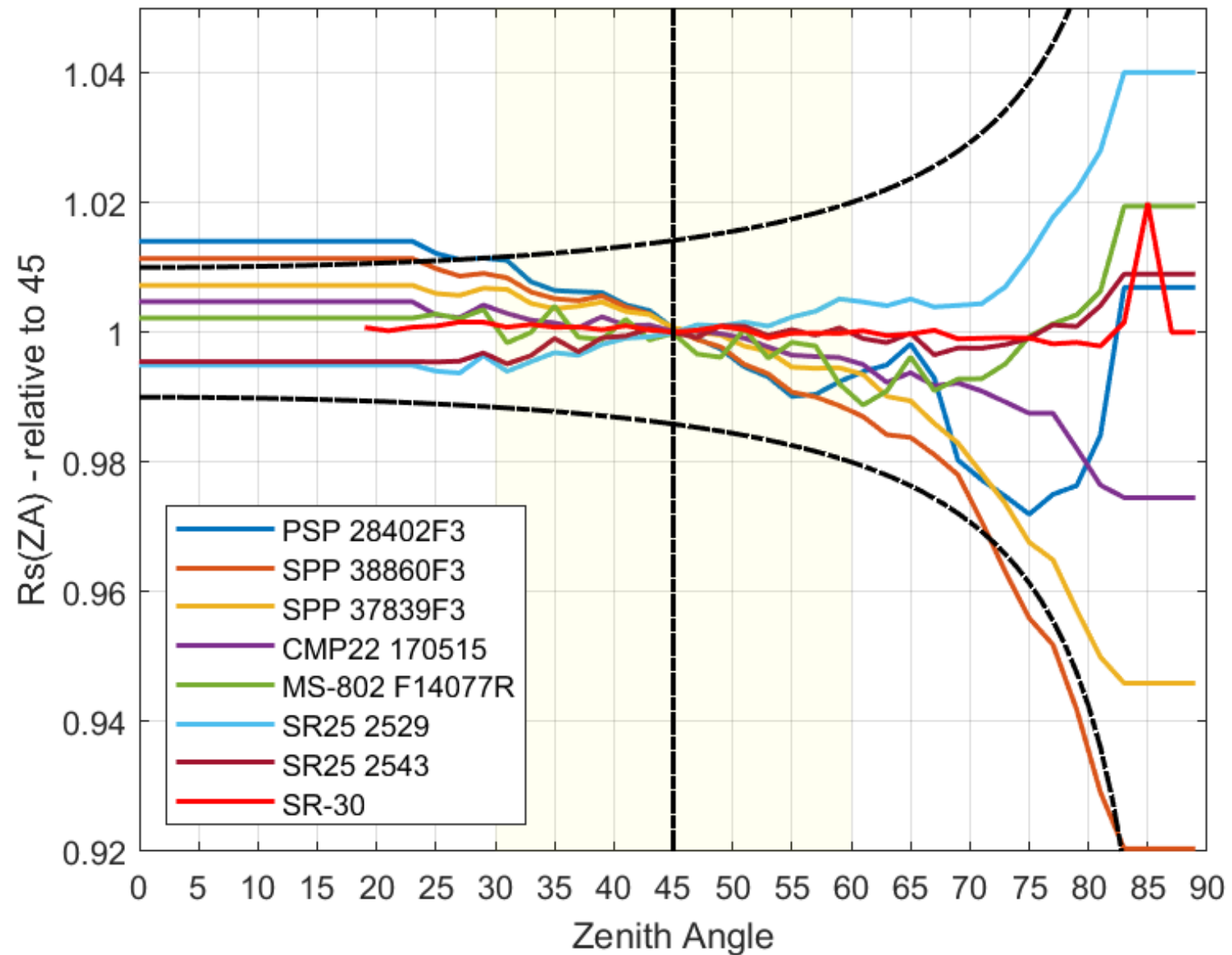
NREL has been ARM broadband radiometer for mentor for BRS, SIRS, SKYRAD, GNDRAD since 1991

- Manage calibrations (BORCAL) at NREL(SRRL - ISO17025) and SGP(RCF). Includes: data collection hardware and calibration of data collection meters and software (RCC), managing measurement assurance standards between NREL and SGP, maintain SW and LW reference instruments, maintain SW and LW absolute cavities, implementation of IR correction strategies in calibration.
- Manage SIRS design: radiometers, logger programs, hardware, upgrades since ARM inception.
- Manage Skyrad/Gndrad since 2004.
- Maintain ARM's SW and LW absolute cavity references and tracability.
- Participate in 5-year International Pyrheliometer Comparison (IPC) at PMOD/WRC to maintain international SW and LW cavity radiometer traceability to WRR and WSIG. Otherwise, hosts annual National Pyrheliometer Comparison (NPC) at NREL.

- In the last 5 years. Created more consistent radiometer systems between SIRS/Gndrad/Skyrad/BRS/etc. (i.e. added second PIR to SIRS, all sites added high flow DC ventilators, all sites use same CSI datalogger)
- 2020 - Created a test platform for proposed radiometers at SGP/CF (C1 -> S01)
- 2020 - Created a best-in-class instrument platform for radiometers at SGP/CF (BRS)
- 2020 – Add more oversight in raw data QC with help from DQO. DQO now scans any newly created b1 netCDFs and compares QC limits max/min limits, LW thermistor temperatures, tach fan RPM and as well as compares calibration factors and serial numbers from the datalogger program with BORCAL results from the aim.nrel.gov API. When tolerances are exceeded, emails go straight to instrument mentors and DQO.
- 2021 – Reevaluating Kipp heated CHP1 for NSA through IOP

- Reduce the number of datastreams by combining Skyrad/Gndrad into SIRS.
- Evaluate NREL and NOAA IR driven offset methods (Reda vs. Long)
- Replace all ARM Eppley model radiometers: PSP (pyranometer), 8-48(diffuse pyranometer) and NIP(pyrheliometer).
 - PSP and 8-48 don't meet modern standards for ISO 9060:2018 Spectrally Flat Class A (directional response, 8-48 and IR driven zero offset, PSP)
 - NIP doesn't meet WMO field of view requirements: 5.7 degrees vs. 5.0.
 - Choose different radiometers for AMFs vs. SGP?

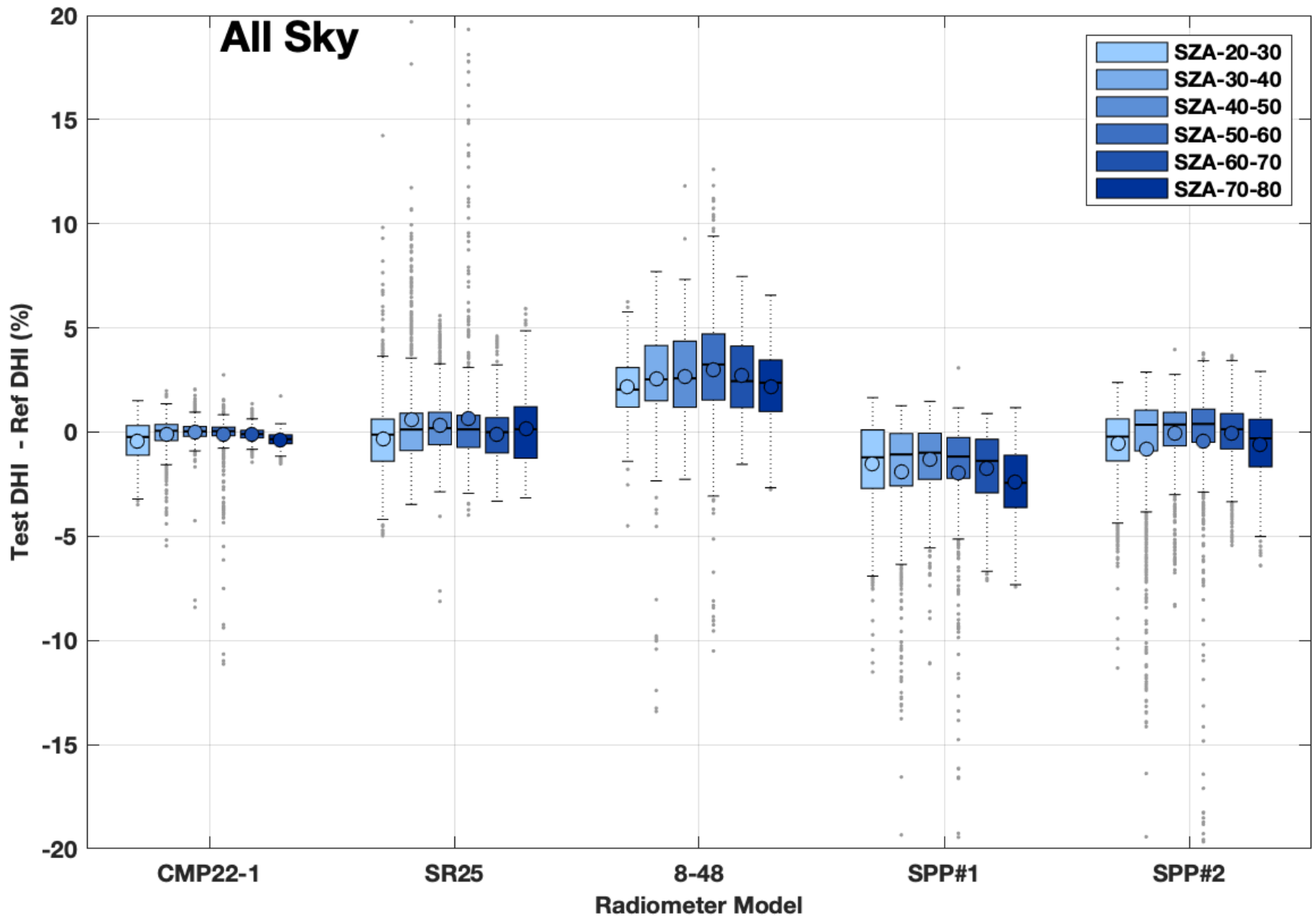
BOCAL directional response



DHI Comparison

The result demonstrated +/-1% to +/-2% deviation on average of cosine response error.

Comparison of Various DHI Pyranometer Models Using BORCAL Calibration (45 degree) Responsivity vs. Reference cal.DHI (CMP22) for 1-minute Data for the Period of 07/25/2020 - 08/11/2020

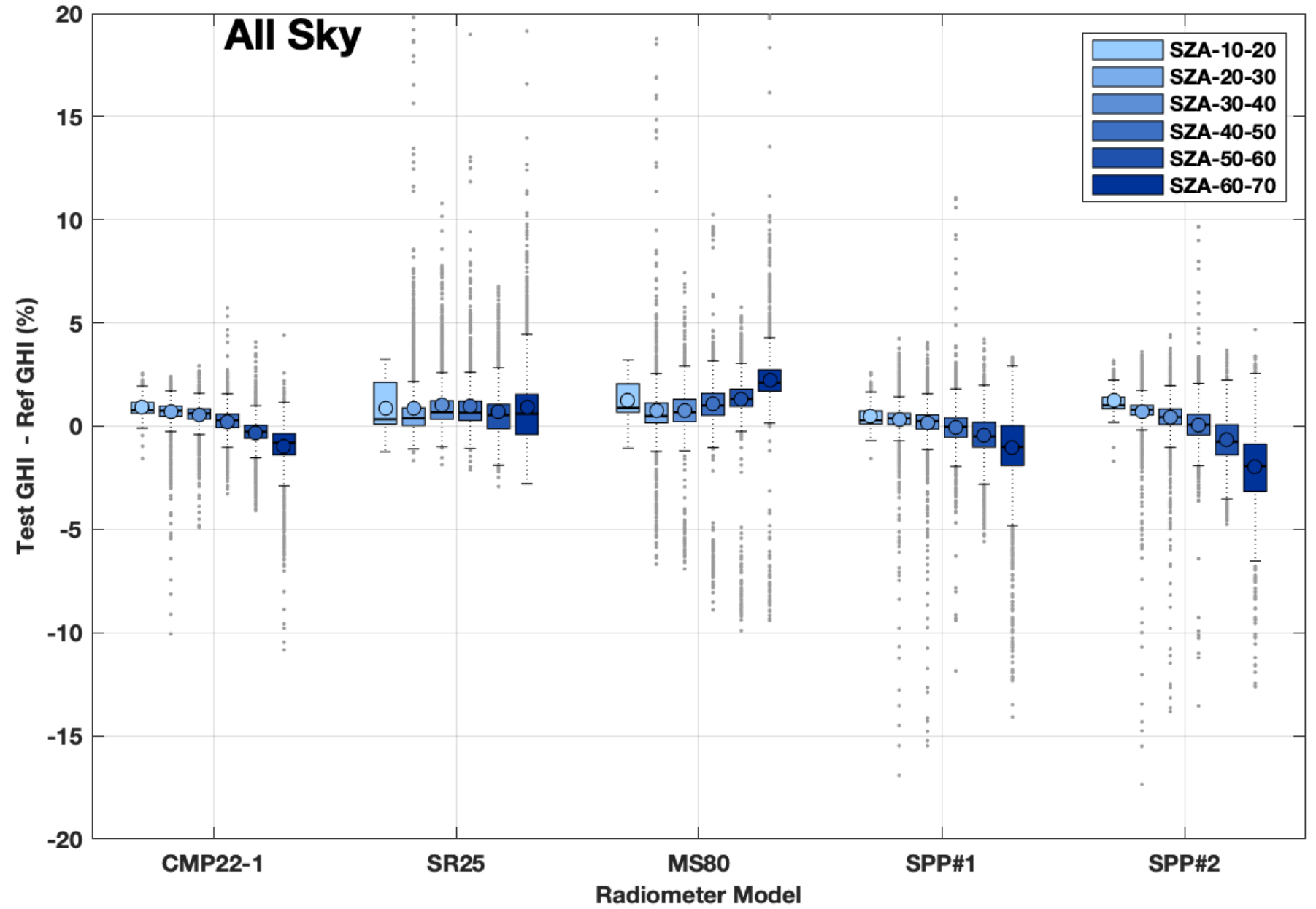


Each blue represents a 10° bin for zenith, and it also represented by the upper and lower quartiles (it is also called interquartile range) of the data in each bin. The circle in each blue box is a mean, and the black line signifies the median value. Data beyond the whiskers are plotted with a symbol (dots).

GHI Comparison

Comparison of Various GHI Pyranometer Models Using BORCAL Calibration (45 degree)

Responsivity vs. Reference cal.GHI (CHP1 & CMP22) for 1-minute Data for the Period of 08/13/2020 - 09/08/2020



Nighttime Offset Comparison for GHI measurement

Nighttime Offset Comparison (Feb. - Jul., 2020)

