NOAA Global Radiation Group (G-Rad) Participation in International Comparisons Offering Traceable Calibration to World Solar Radiation Standards

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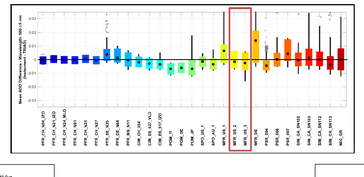
Introduction

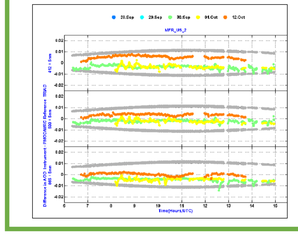
The Global Radiation Group (G-Rad) of NOAA's Global Monitoring Division (GMD) strives to collect high quality radiation data at the Earth's surface, including climate quality surface radiation budget data. High quality data collection requires accurate calibrations of field instruments that are traceable to international standards. NOAA G-Rad participated in the following World Meteorological Organization (WMO) calibration comparisons in order to calibrate our standard instruments against the accepted world standards. With our standards, we are able to perform calibrations of broadband shortwave and longwave sensors as well as broadband ultraviolet (UV) and narrowband filter radiometers both for our network instruments and as a service to other collaborators.

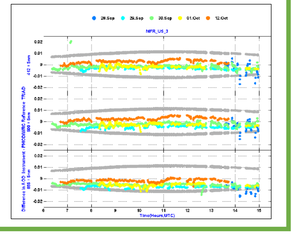
Fourth WMO Filter Radiometer Comparison (FRC) PMOD, Davos, Switzerland, 2015

The FRC, held every five years, allows instruments to be compared to the World Optical Depth Research and Calibration Centre (WORCC) reference group for aerosol optical depth (AOD). Participation in this comparison maintains traceability for field instruments that can be used in air quality and climate studies.

- Goal is to standardize current and future spectral AOD networks.
- 30 radiometers from 12 countries participated
- Reference instruments from PMOD, AERONET Europe, SKYNET, GAW-PFR, SURFRAD and the Australian aerosol network provides a starting point for global AOD measurement standardization.
- NOAA participated with two MFRSRs and one SP02 representing GMD networks.
- The following plots show the performance of the NOAA MRFSR instruments that were included in the comparison.







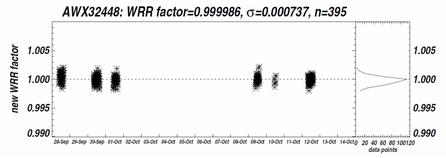
Twelfth WMO International Pyrheliometer Comparison (IPC-XII), PMOD, Davos, Switzerland, 2015

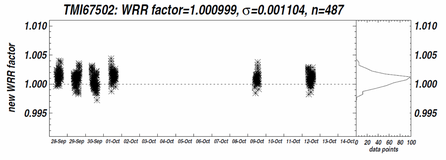
NOAA G-Rad maintains a group of active-cavity pyrheliometers that serve as the standards for the WMO Regional Radiation Center, Region IV. These cavities are used to perform calibrations for field instruments. Regular participation at the WMO IPC, held every five years, allows us to obtain new scale factors traceable to the World Radiation Reference (WRR).

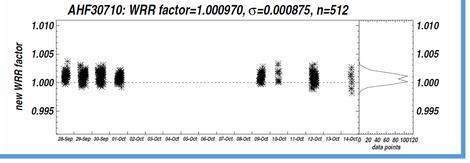
- Participation from 33 countries with 134 pyrheliometers.
- NOAA attended with six Active Cavity Pyrheliometers
- Data from nine days used to transfer WRR to NOAA standards.

WRR Scale Factor for the NOAA standard group

Serial Number	IPC XI (2010)	IPC XII (2015)	Percent Change
AWX32448	0.999939	0.999986	0.005
AWX31114	1.001244	1.001209	-0.003
AHF30710	—	1.000970	—
AHF28553	0.996842	0.997739	0.090
TMI67502	0.999294	1.000999	0.171







Annual National Renewable Energy Laboratory (NREL) National Pyrheliometer Comparison (NPC), 2017

The annual NREL National Pyrheliometer Comparison (NPC) allows us to check that our WRR scale factor has not changed since the last IPC. The NOAA standard group serves as the regional transfer standard for the instruments that participate at the NPC.

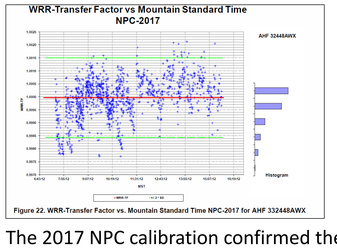


Figure 22. WRR-Transfer Factor vs. Mountain Standard Time NPC-2017 for AHF 32448AWX

The 2017 NPC calibration confirmed the stability of the NOAA cavity group. One example can be seen above with the plot for AWX 32448.

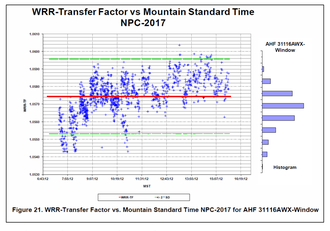


Figure 21. WRR-Transfer Factor vs. Mountain Standard Time NPC-2017 for AHF 31116AWX-Window

The above plot shows AWX31116 calibrated with a CaF_2 window. This allows data collection in all weather conditions, but changes the scale factor by approximately five percent when compared to the unwindowed cavities.

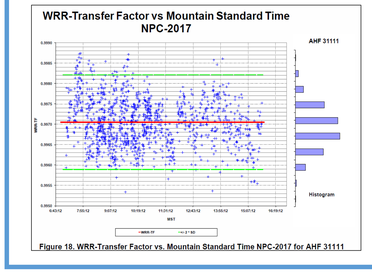


Figure 18. WRR-Transfer Factor vs. Mountain Standard Time NPC-2017 for AHF 31111

In 2017 NOAA operated AHF 31111 for the Federal University of Santa Catarina, Brazil. A traceable scale factor was assigned to their cavity so that they can continue to calibrate field instruments. The G-Rad group often collaborates with other institutions and countries to support their research.

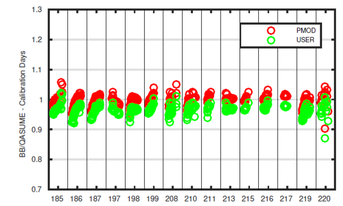
Second International UV Filter Radiometer Comparison (UVC), PMOD, Davos, Switzerland, 2017

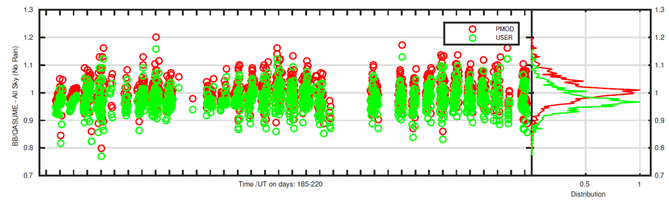
Participation in the second International UV Filter Radiometer Comparison (UVC), held every five years, allows us to obtain calibrations traceable to the standard instruments at the World Calibration Center for UV (WCCUV).

- 75 UV filter radiometers from 37 countries
- Sensors are assigned an absolute calibration (C) factor as well as spectral and angular responsivity functions (SRF and ARF).
- C is derived from outdoor data collection at SZA=40 and total column ozone of 300 DU.
- SRF converts from detector weighted irradiance to erythemal weighted irradiance.
- ARF corrects for cosine error affecting the detector.

The figure below summarizes the comparison of the PMOD and USER calibration relative to the reference. Displayed is the median of the ratio for the calibration period for each instrument.

Figure 23. Comparison of the original (USER, green) and the new (PMOD, red) calibration.





Conclusion

The G-Rad group is committed to maintaining a high standard for calibration of our instrumentation. We will continue our participation in these inter-comparisons as well as introducing new experiments to further our understanding of the calibration process.

References

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