Results of Absolute Cavity Pyrgeometer (ACP), InfraRed Integrating Sphere (IRIS), and Atmospheric Emitted Radiance Interferometer (AERI) Comparisons and CIMO Recommendations

Ibrahim Reda, Julian Gröbner, Stefan Wacker, Dave Turner, Mike Dooraghi, Christian Thomann, Chuck Long, Allison McComiskey, Manajit Sengupta, Isabelle Ruedi, Bruce Forgan

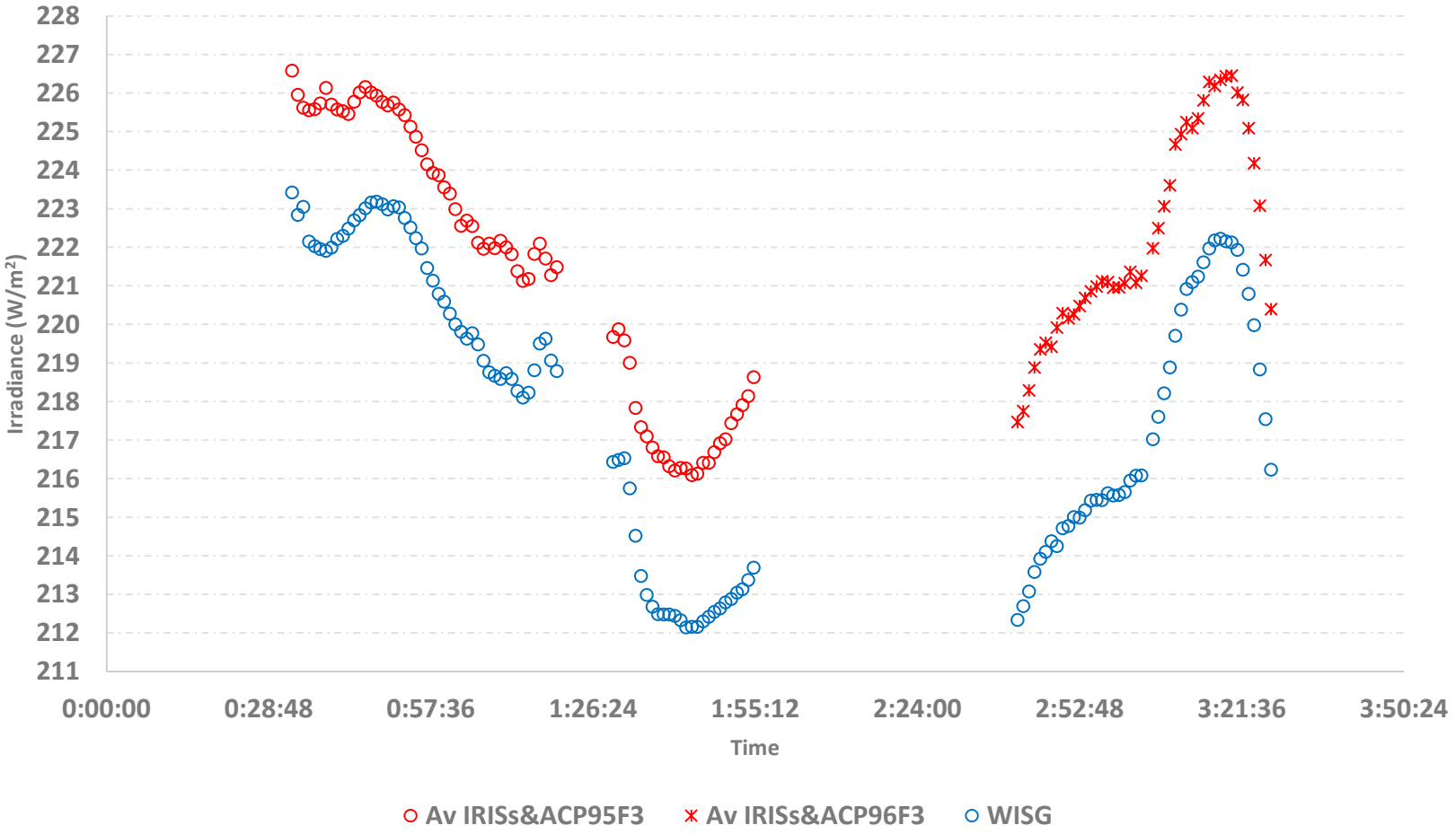
ARM/ASR Science Team Meeting
March 19, 2018

Overview

- Results of five comparisons between ACPs and IRISs.
- Difference between the longwave irradiance measured by the ACPs and IRISs versus the irradiance measured by the WISG.
- The longwave irradiance measured by the ACPs, IRISs, and AERI versus the irradiance measured by the WISG.
- Recommendations to establish the world reference for measuring the atmospheric longwave irradiance with traceability to the International System of Units (SI).

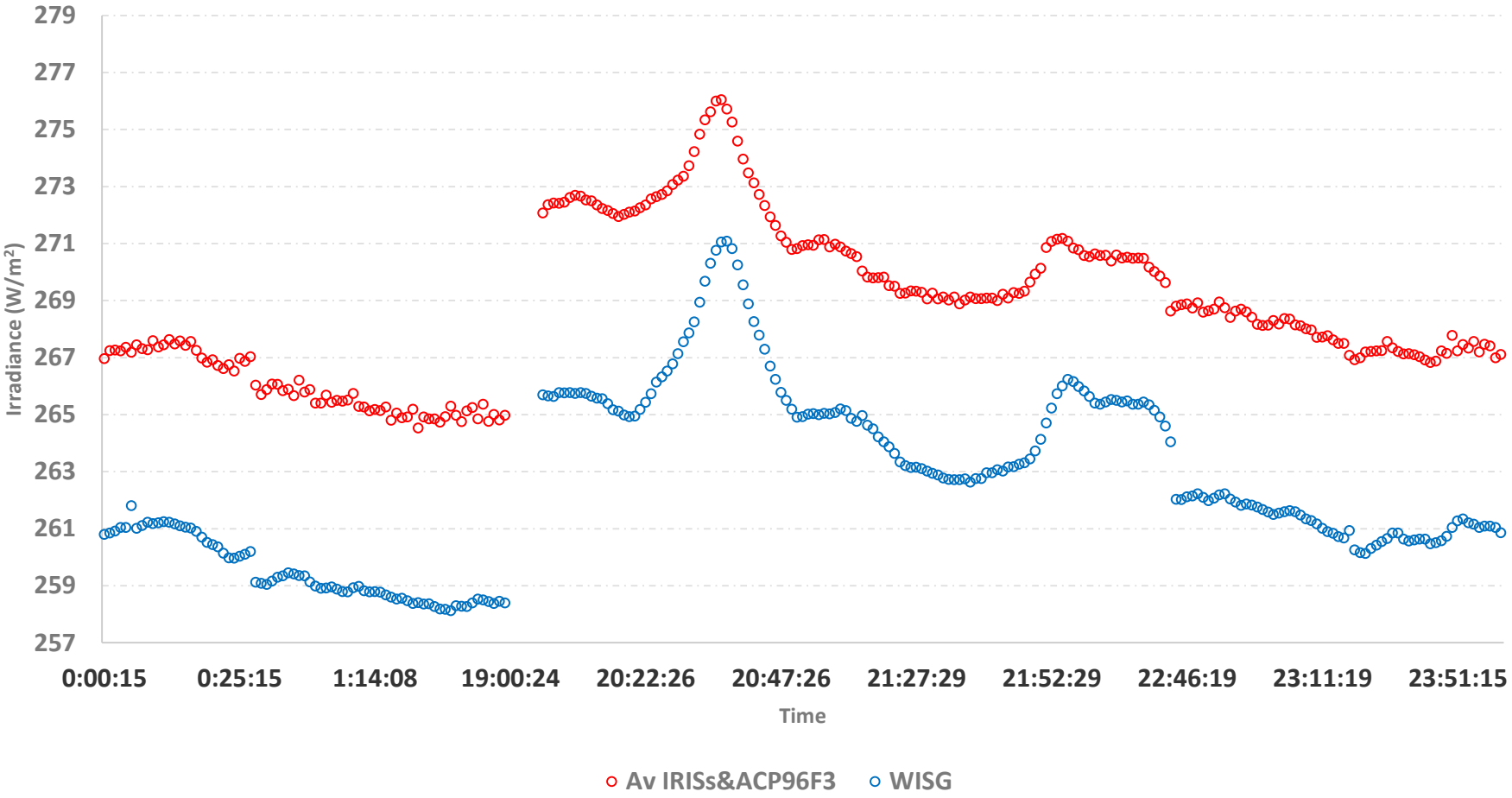
Results of First Comparison between ACPs and IRISs-Davos

Average Irradiance of Two IRISs&ACP95F3 or 96F3 versus the WISG Average Irradiance at night on Feb. 5, 2013 (~8 mm H_2O vapor column)

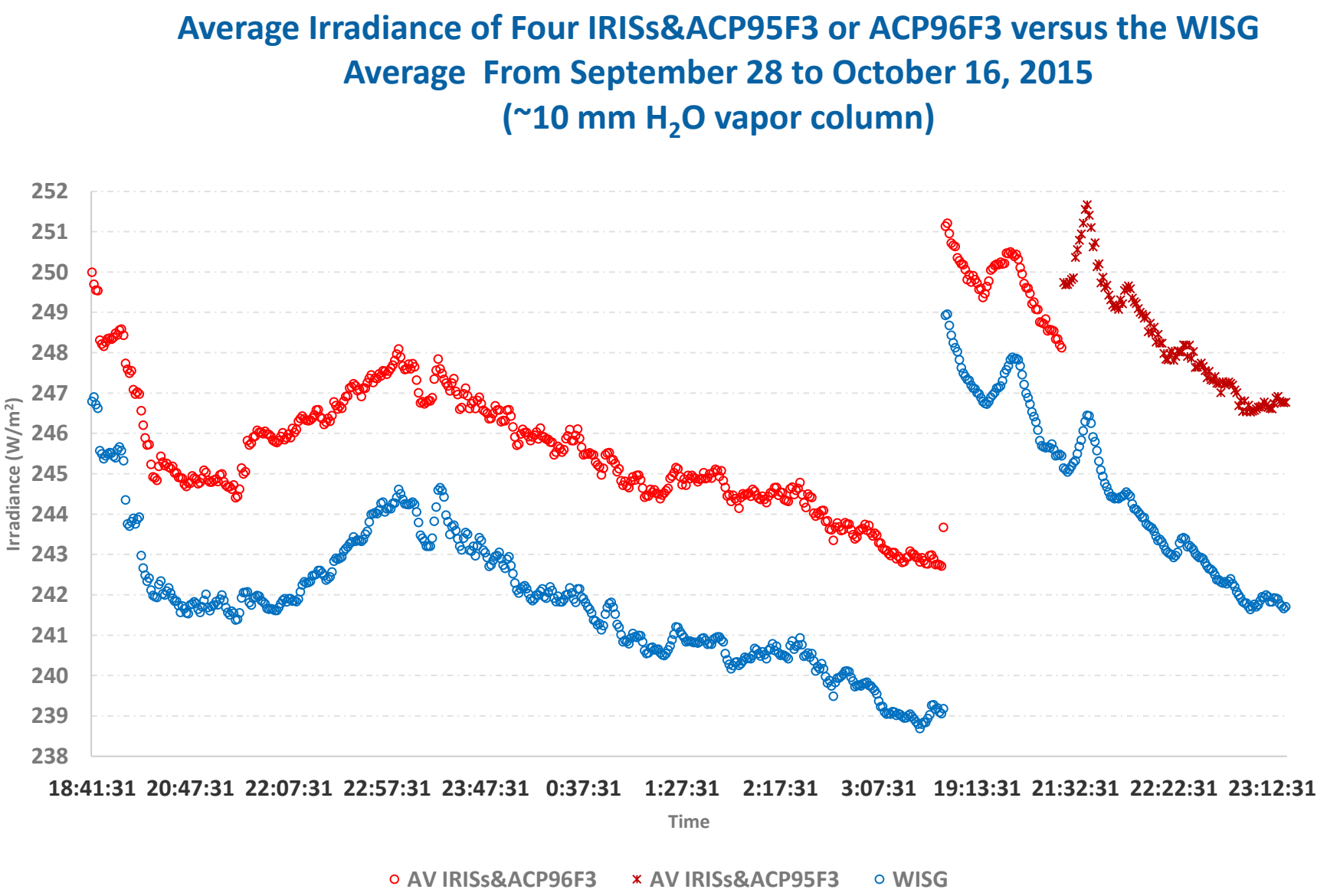


Results of Second Comparison between ACPs and IRISs-Davos

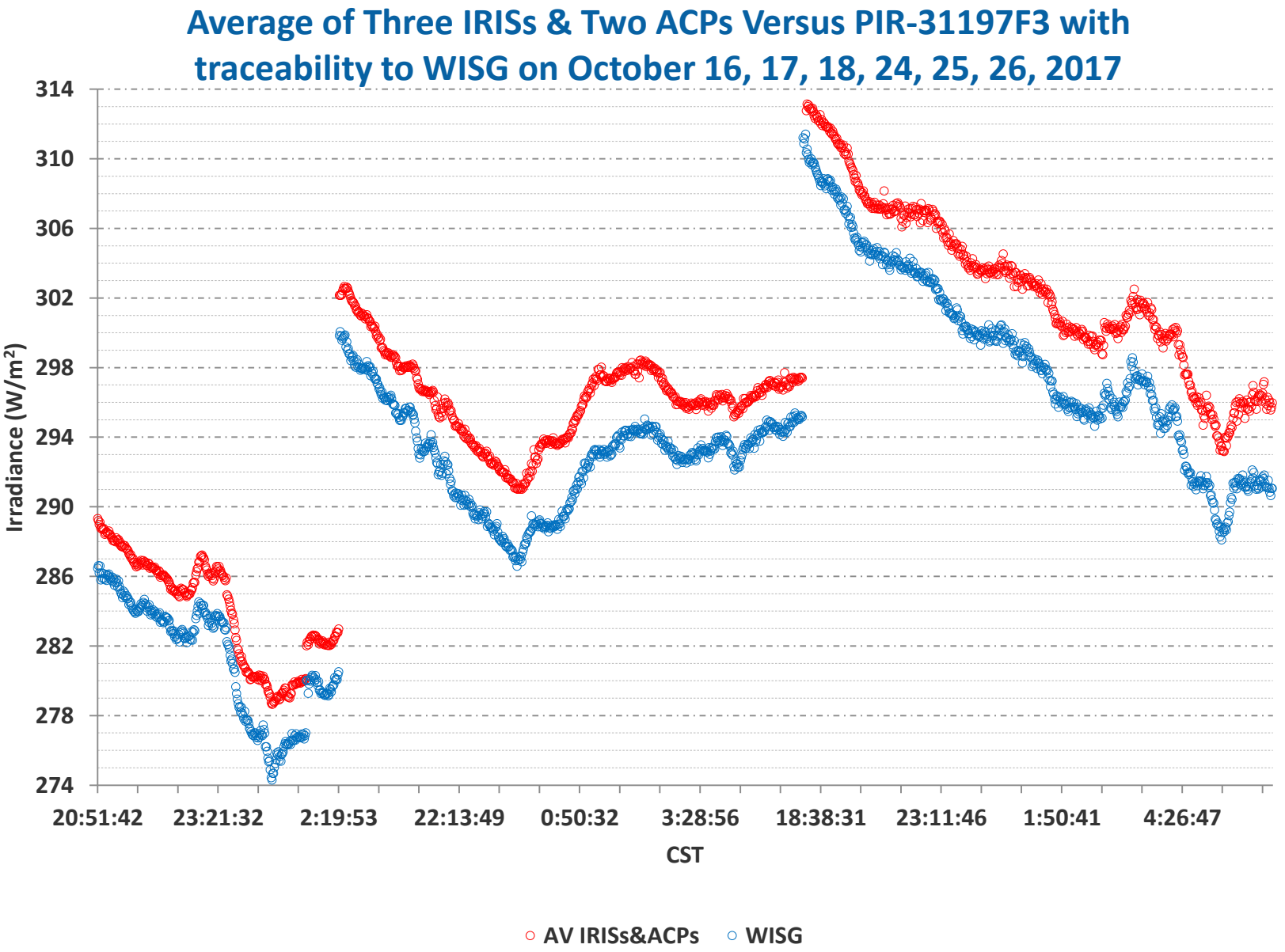
Average Irradiance of Two IRISs&ACP96F3 versus the WISG Average Irradiance on Oct. 2&3, 2013 (~15 mm H_2O vapor column)



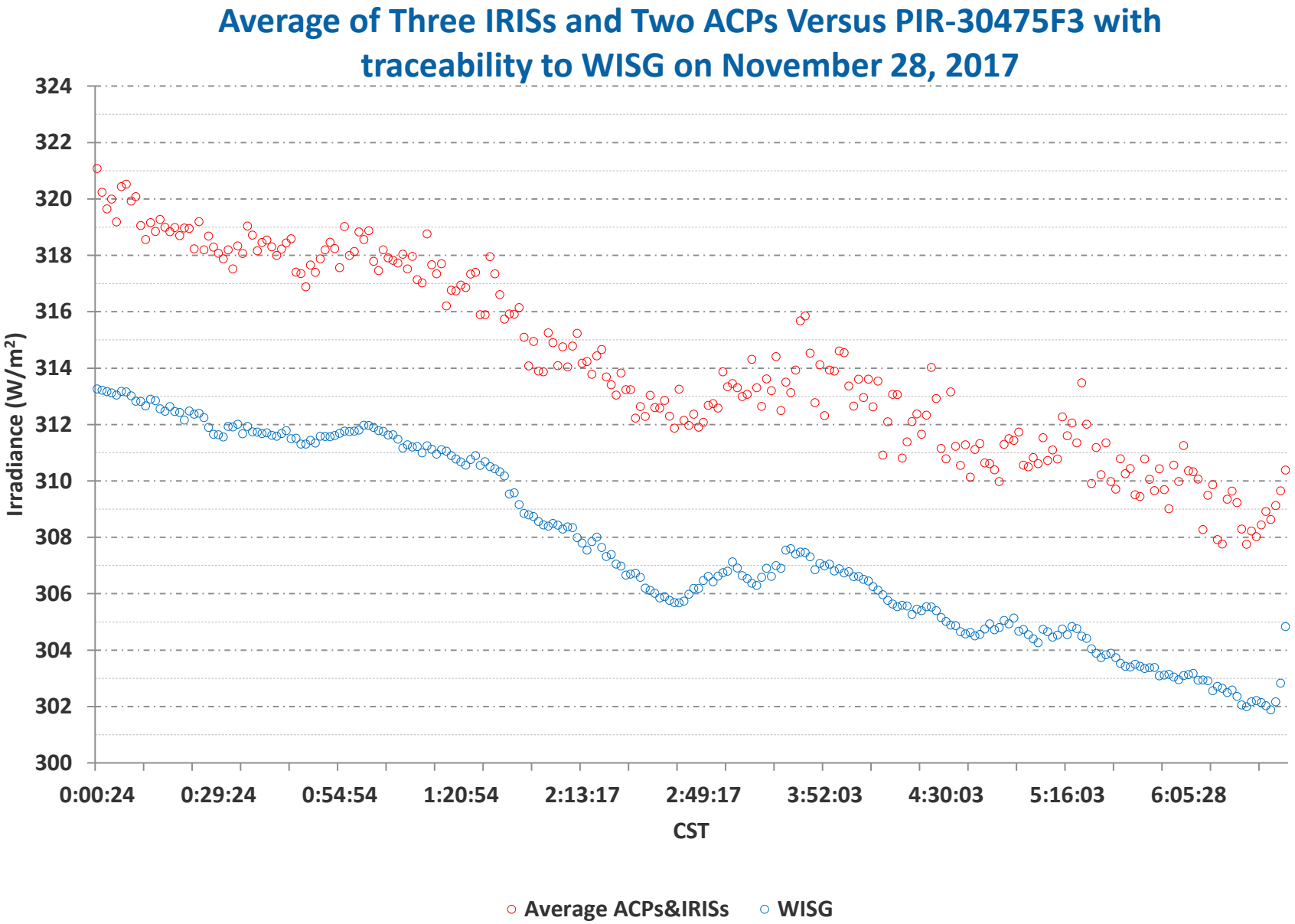
Results of Third Comparison between ACPs and IRISs-Davos



Results of Fourth Comparison between ACPs and IRISs-SGP-Phase 1



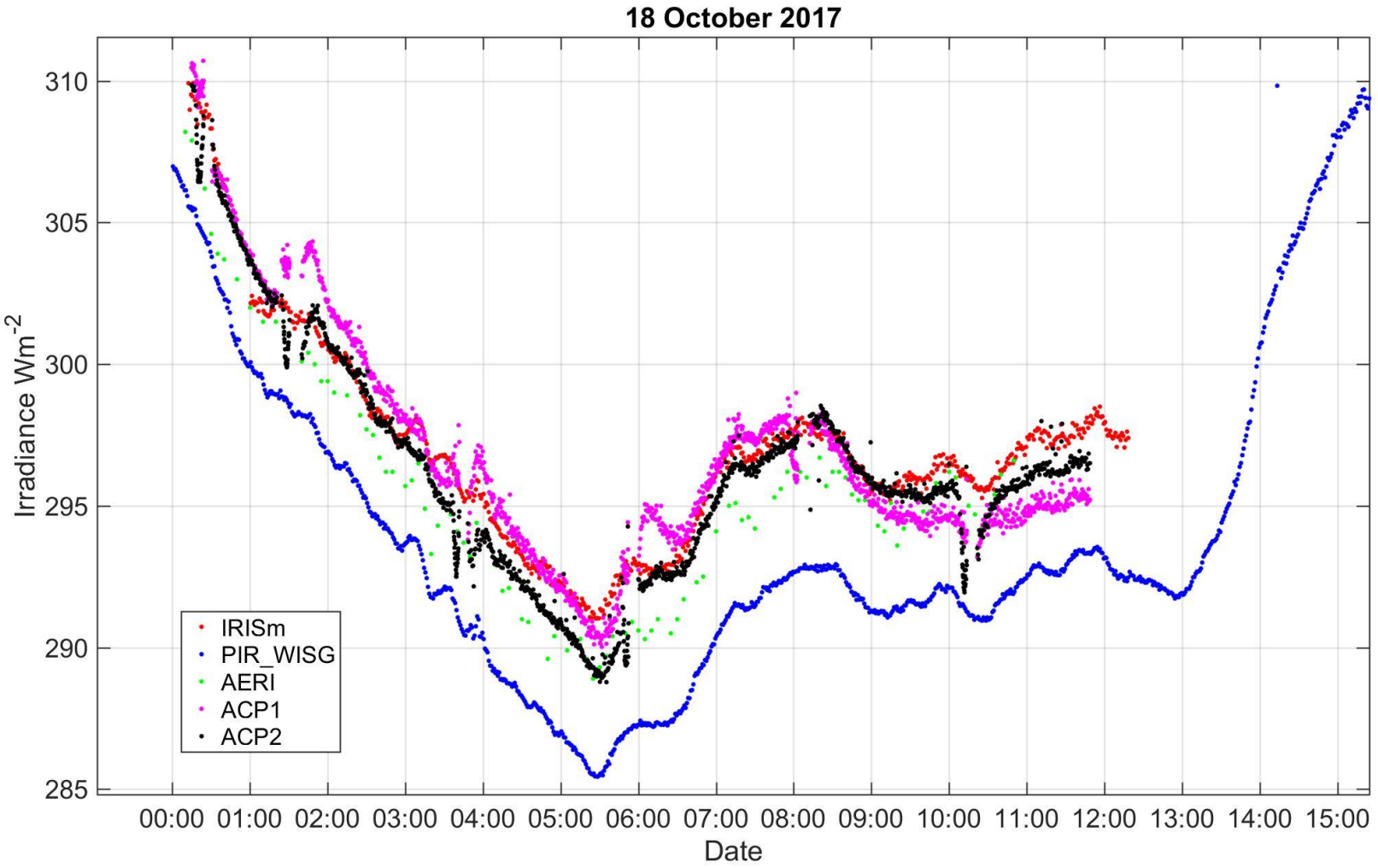
Results of Fifth Comparison between ACPs and IRISs-SGP-Phase 2



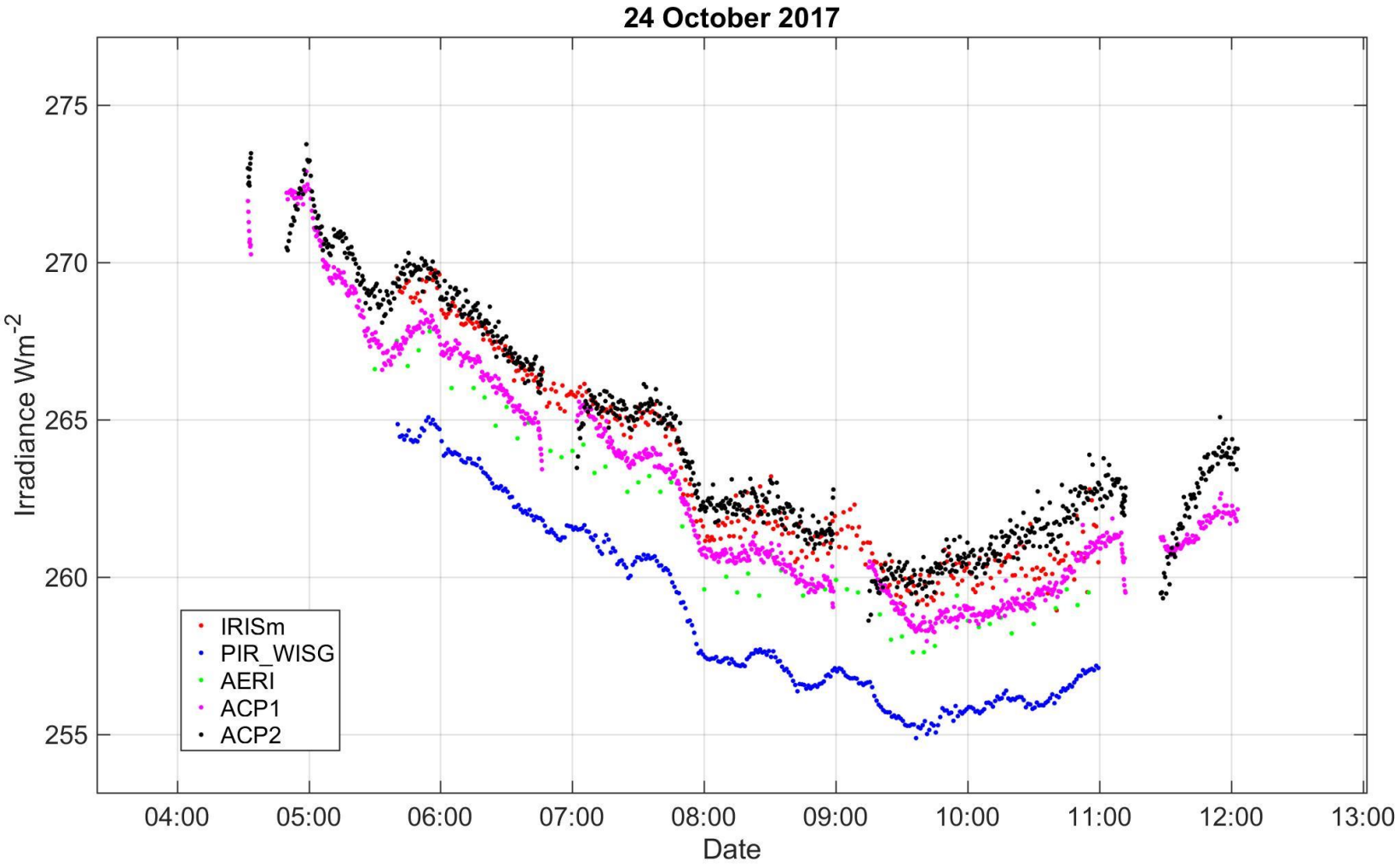
Summary of the Five comparisons

W/m^2	First	Second	Third	Fourth	Fifth
Average difference between ACPs&IRISs	0.10	0.31	-1.17	-1.58	-1.77
StDev of Difference	0.08	0.65	0.70	1.15	0.88
Difference within 95%	0.19	1.34	1.82	2.79	2.50
Average of ACPs&IRISs - WISG	3.93	6.14	3.82	3.50	6.50
StDev of Difference	0.97	0.76	0.67	0.81	0.66
Difference within 95%	4.38	6.33	4.05	3.86	6.63

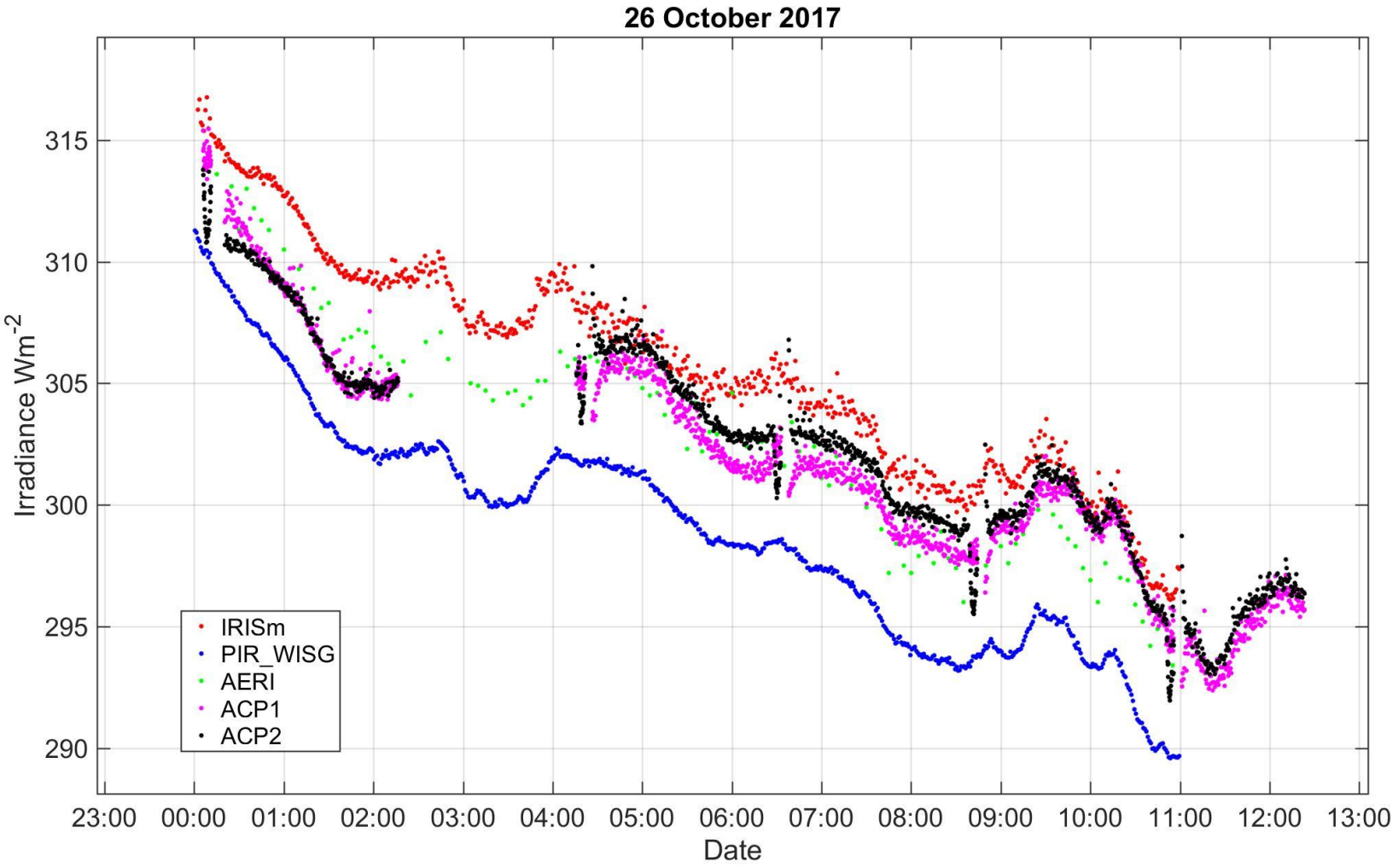
Results of Comparison between ACPs, IRISs, and AERI at SGP



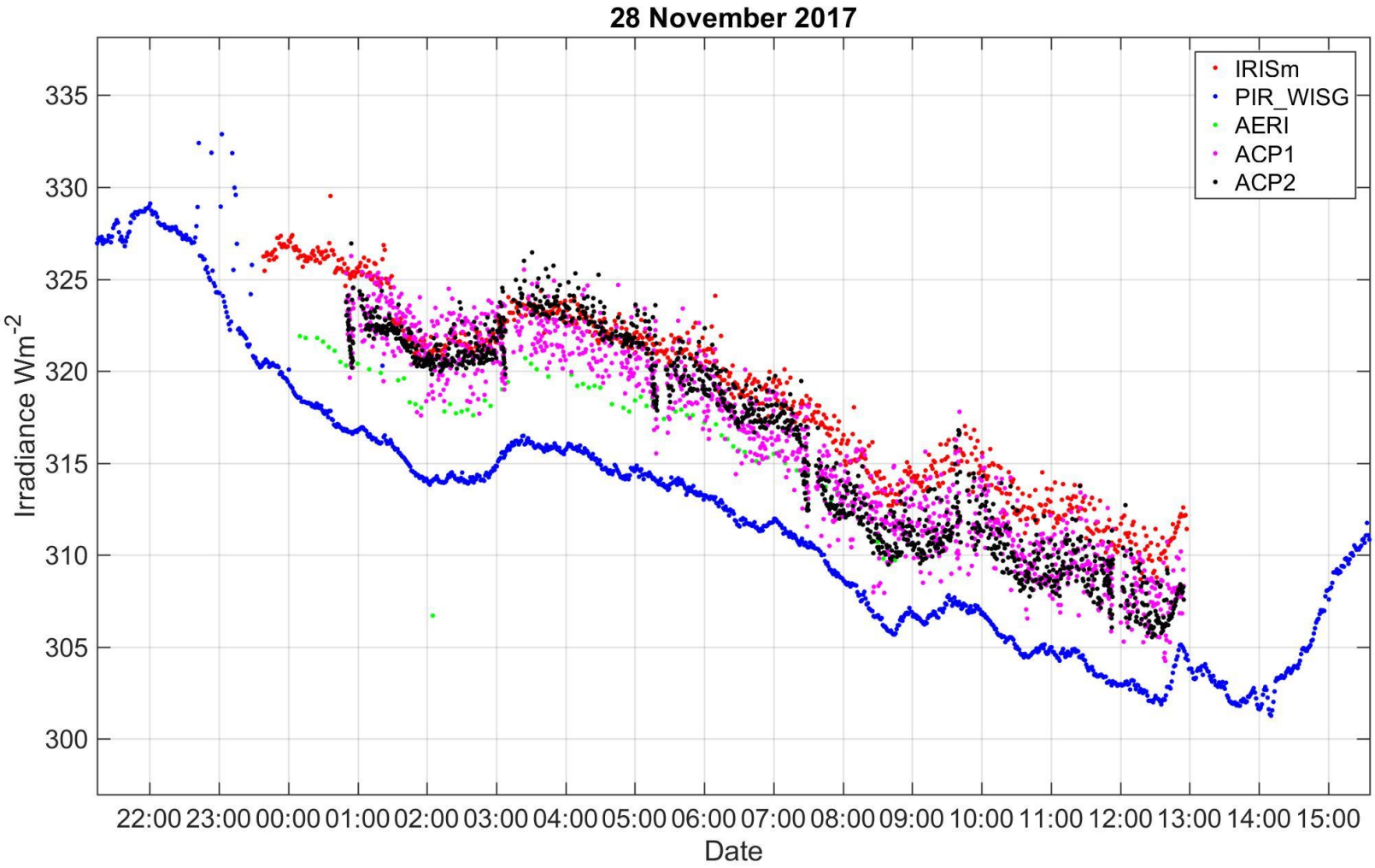
Results of Comparison between ACPs, IRISs, and AERI at SGP



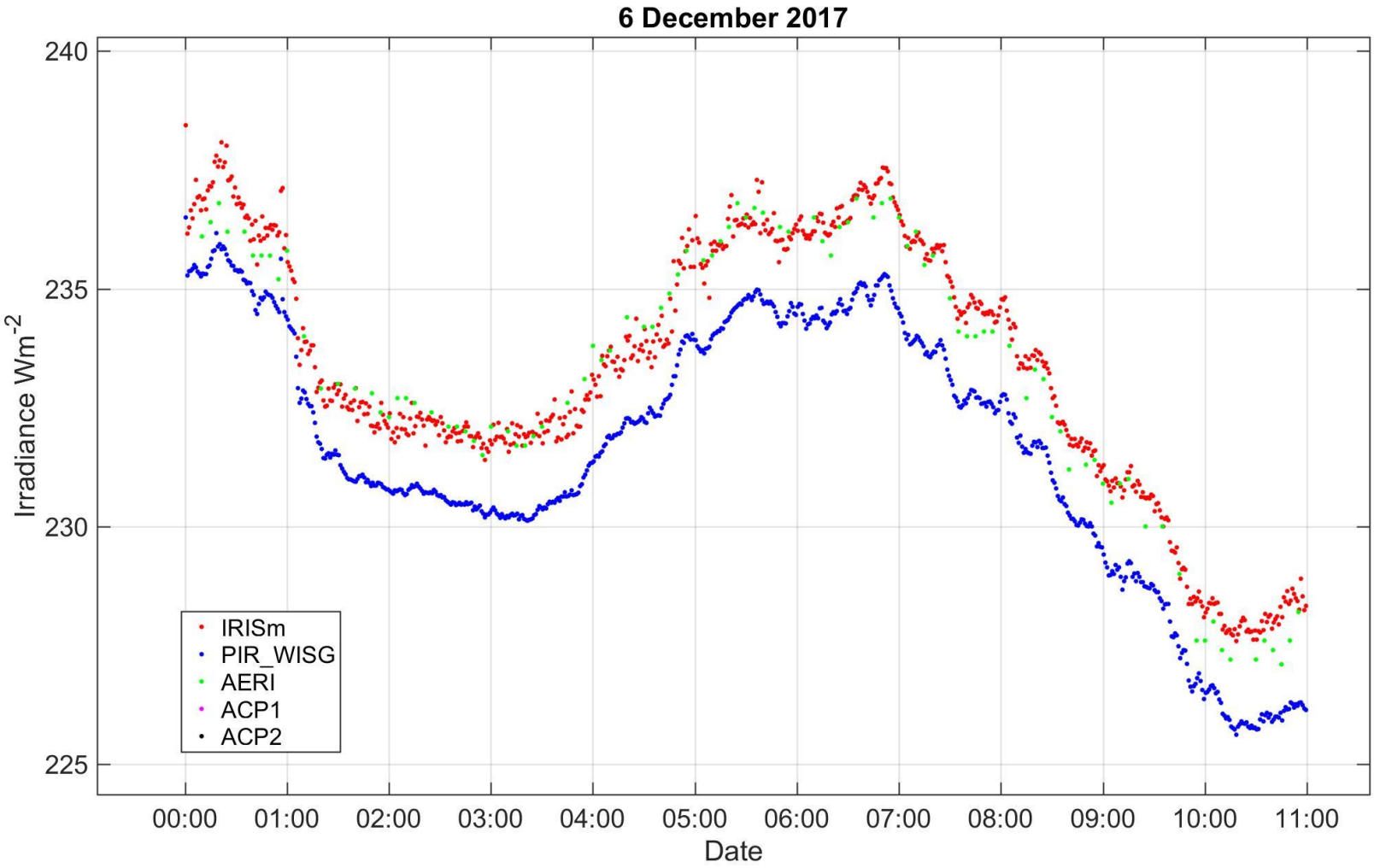
Results of Comparison between ACPs, IRISs, and AERI at SGP



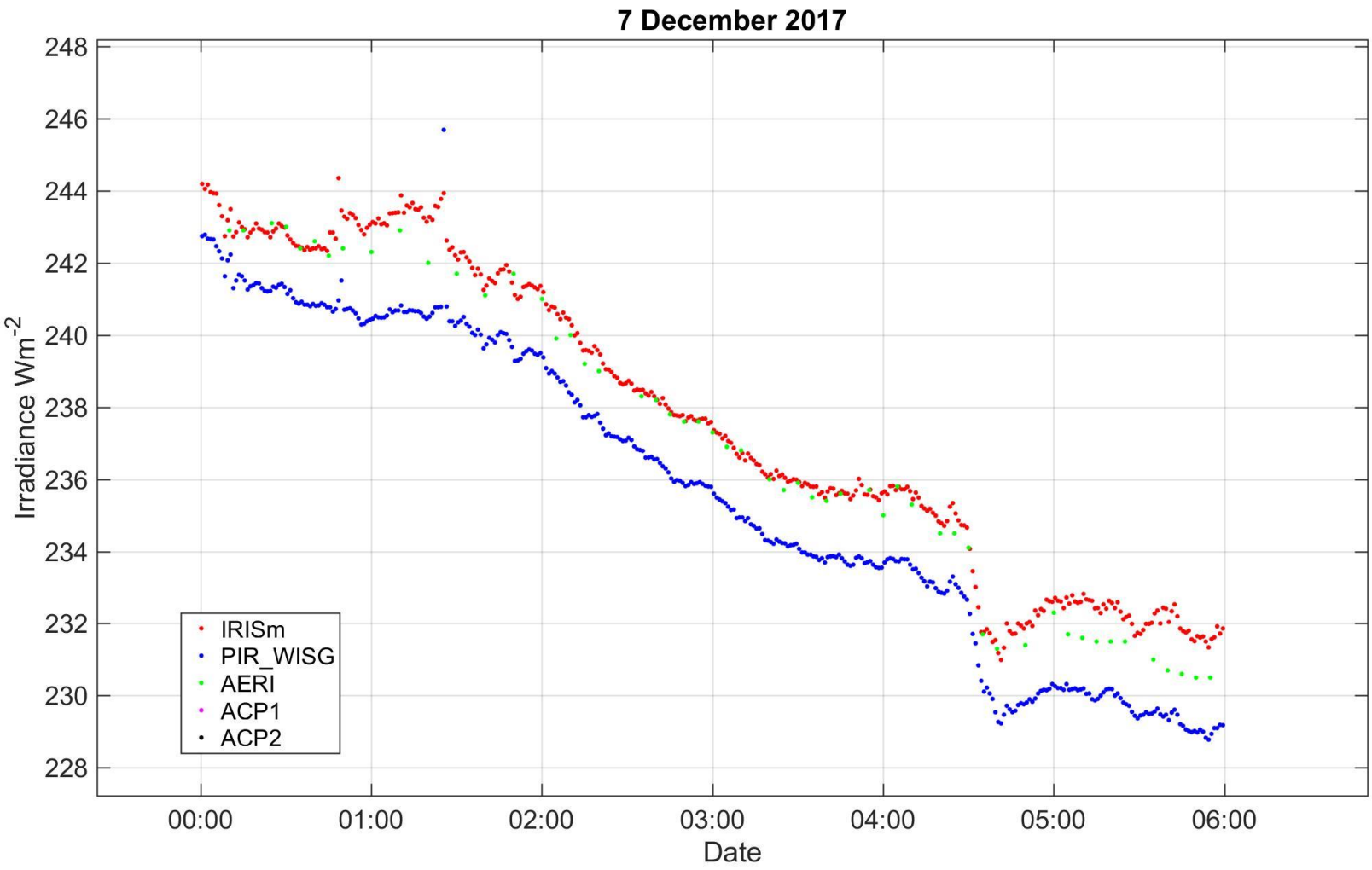
Results of Comparison between ACPs, IRISs, and AERI at SGP



Results of Comparison between ACPs, IRISs, and AERI at SGP



Results of Comparison between ACPs, IRISs, and AERI at SGP

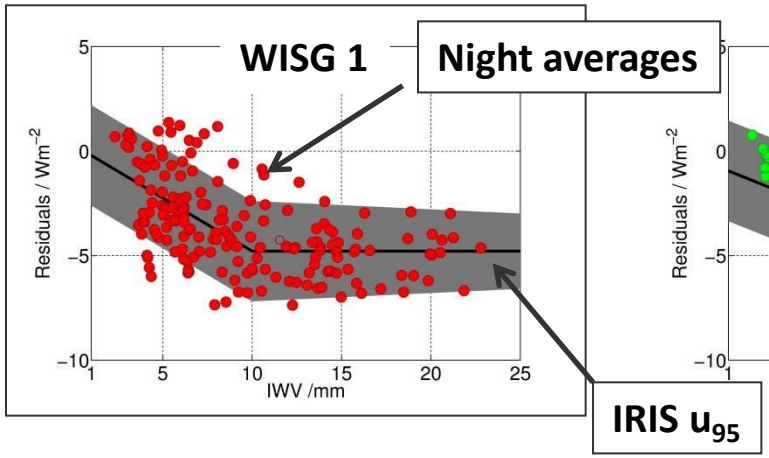


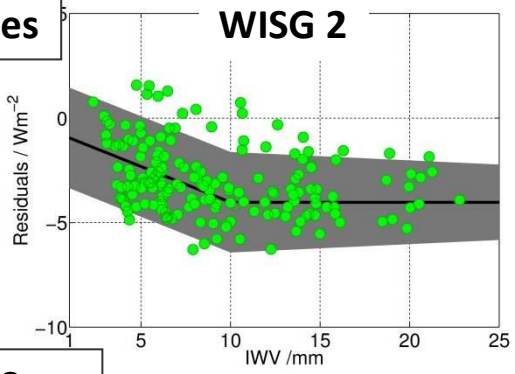
Conclusion

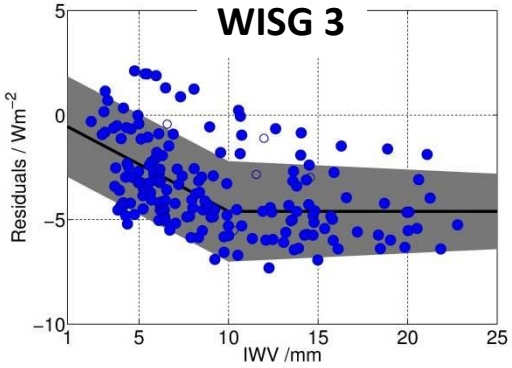
- *The difference between the irradiance measured by the ACPs, IRISs, and AERI varied from 0.2 W/m^2 to 2.5 W/m^2 based on the atmospheric conditions, which is within the stated uncertainties of ±3 W/m^2.*
- *The irradiance measured by the WISG is lower than the average irradiance measured by ACPs and IRISs, magnitude of the difference varied from 4.4 W/m^2 to 6.6 W/m^2 depending on the integrated water vapor. This was also presented by Julian in 2012 (see figure below).*

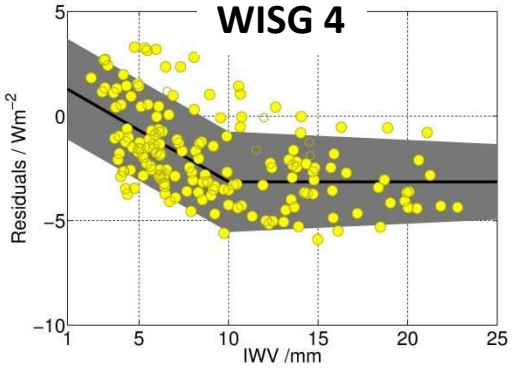
Irradiance difference (WISG minus IRIS) at PMOD

From J. Gröbner et al., JGR, 2014









Results

Average Offset (IWV>10) **-4.1 ± 1.5 Wm^{-2}**

Gradient (IWV<10) **-0.45 ± 0.1 Wm^{-2}mm^{-1}$_{IWV}$**

Set-up at DOE-ARM-SGP

Julian, Craig (SGP), Mike (NREL), Allison, and Chuck

PIR, ACPs, IRISs, PIRs, and CG4s

WMO CIMO Task Team on Radiation References

- The first session of the World Meteorological Organization (WMO) Commission for Instruments and Methods of Observation Commission (CIMO) Task Team on Radiation References (TT) was held in the National Physical Laboratory (NPL) from November 15 to 17, 2017 in Teddington, United Kingdom.
- The meeting focused on the traceability of terrestrial radiation measurements. It reviewed and evaluated recent developments of reference instruments for terrestrial radiation, and developed recommendations to the attention of CIMO on the appropriateness, requirements and timeliness for a possible future modification of the current reference.
- Relevant recommendations from the TT will be submitted to the CIMO MG (26-29 March 2018), and most likely to CIMO-17 session (12-16 October 2018, Amsterdam) for endorsement. The report of the TT meeting will encompass all the recommendations.

Newton’s Apple Tree in National Physical Laboratory, UK, London-November 2017

Nigel, Reda, Isabelle, Bruce, Julian, Peter, Alison, Nozumo

Thank You

Contact :

Ibrahim Reda

Ibrahim.Reda@nrel.gov

www.nrel.gov

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY