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Results of second outdoor comparison between Absolute Cavity Pyrgeometer (ACP) and Infrared Integrating Sphere (IRIS) Radiometer at PMOD

Atmospheric System Research

Science Team Meeting (March 10-13, 2014)

by

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*** NREL , ** PMOD/WRC**

Outline

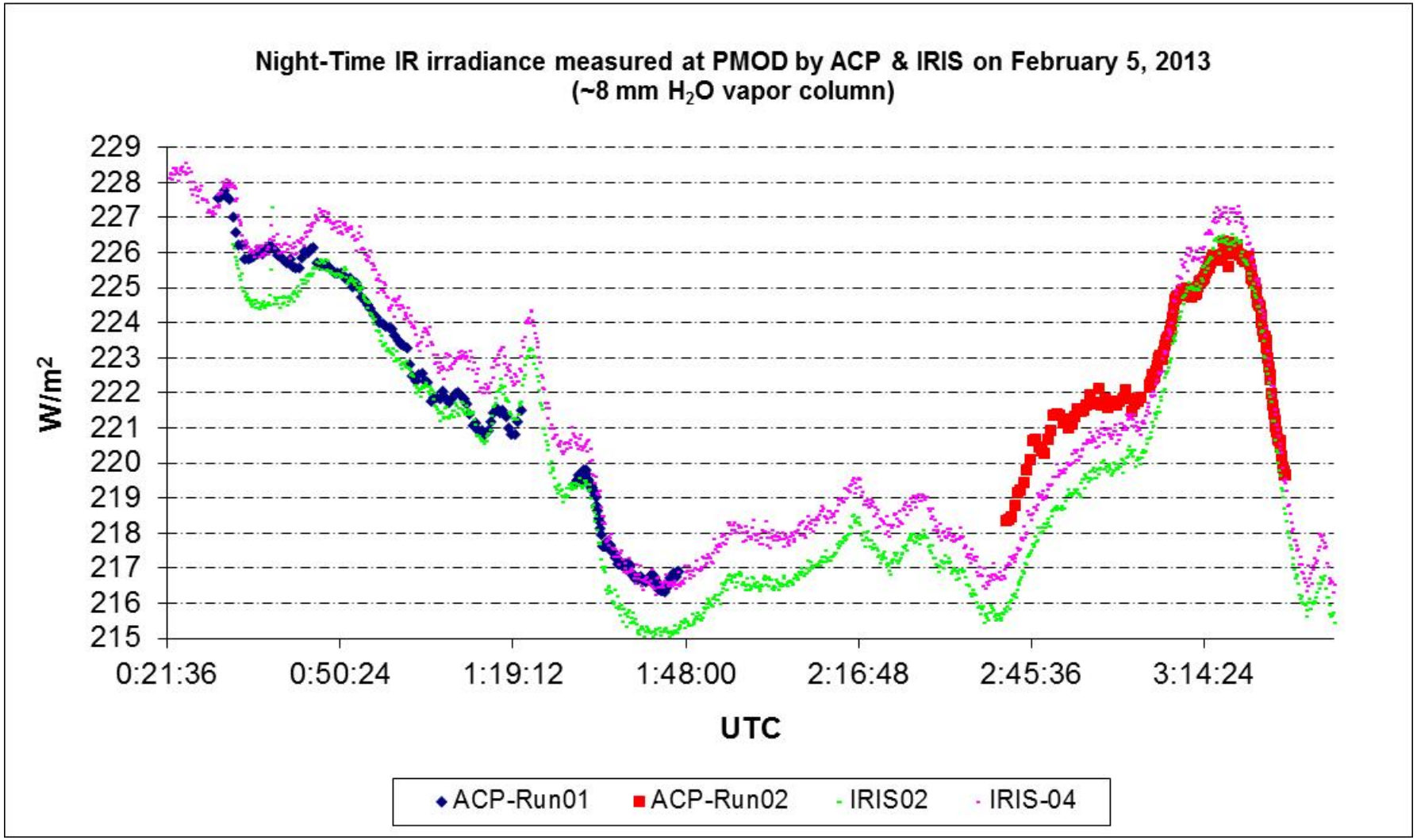
The Absolute Cavity Pyrgeometer (ACP) and InfraRed Integrating Sphere radiometer (IRIS) are developed to establish a world reference for calibrating pyrgeometers with traceability to SI units. The two radiometers are un-windowed with negligible spectral dependence, and traceable to SI units through the temperature scale (ITS-90).

The second outdoor comparison between the two designs was held from September 30 to October 11, 2013 at the Physikalisch-Metorologisches Observatorium Davos (PMOD). The difference between the irradiance measured by ACP and that of the IRIS was within 1 W/m^2 (*3 IRISs: PMOD + Australia + Germany*).

From the first and second comparisons, a difference of 4-6 W/m^2 was observed between the irradiance measured by ACP&IRIS and that of the interim World Infrared Standard Group (WISG).

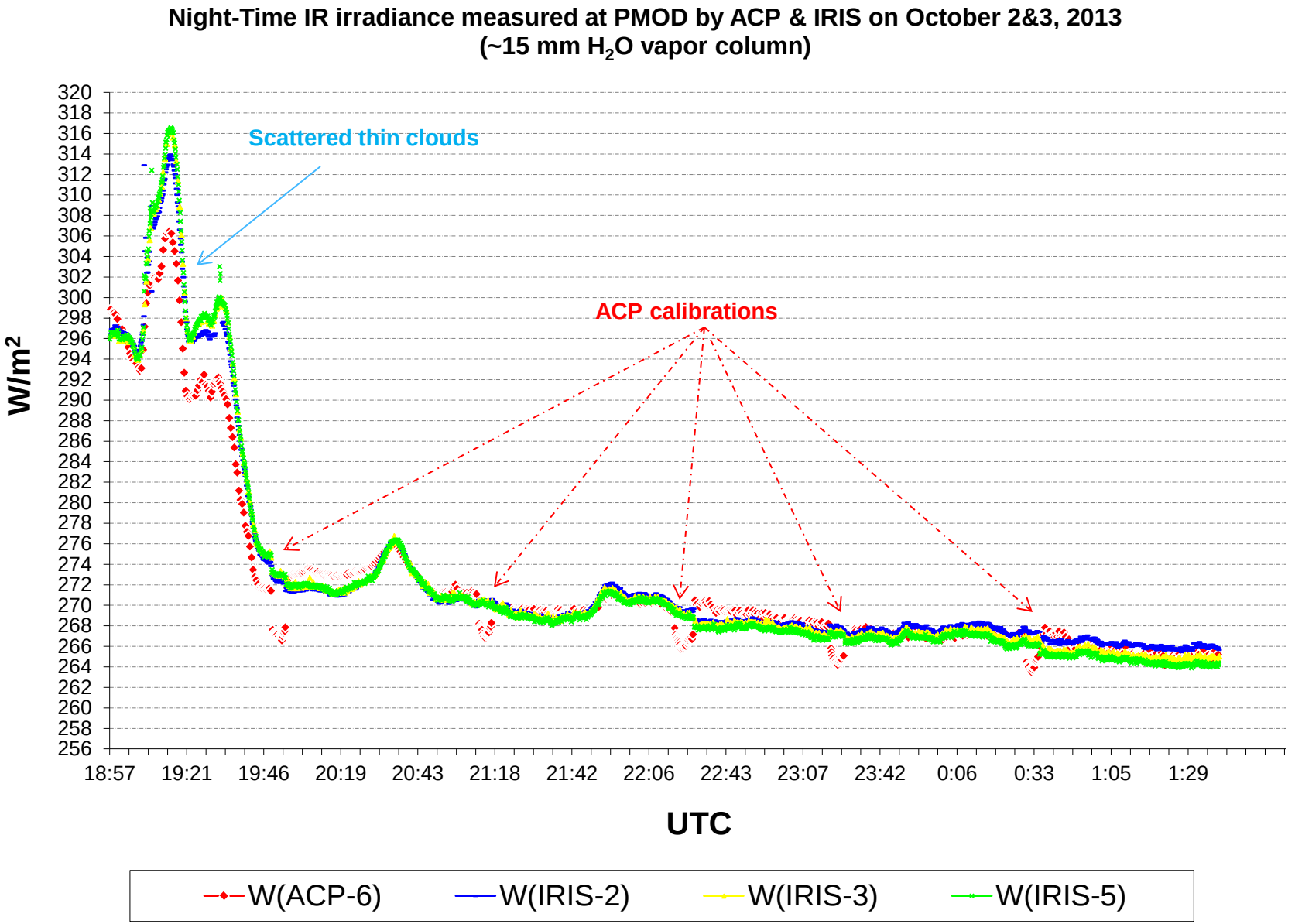
This presentation includes results from the first and second comparison in an effort to establish the world reference for pyrgeometer calibrations, a key deliverable for the World Meteorological Organization (WMO), and the DOE-ASR.

First ACP&IRIS Comparison Feb. 5, 2013



http://asr.science.energy.gov/meetings/stm/2013/presentations/ACP-ASR-presentation-58121-2013.pdf

Second ACP&IRIS Comparison-Oct. 2&3, 2013



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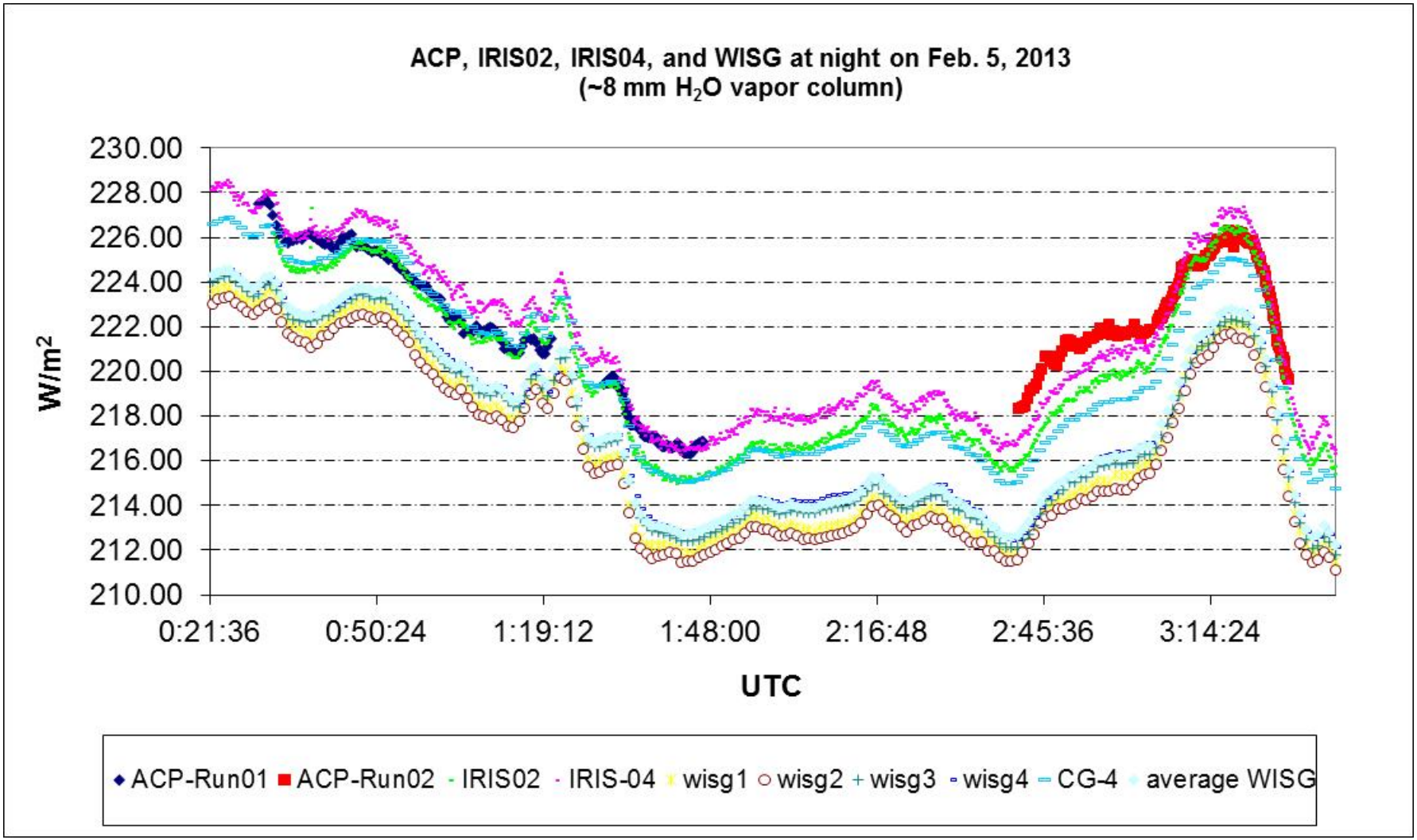

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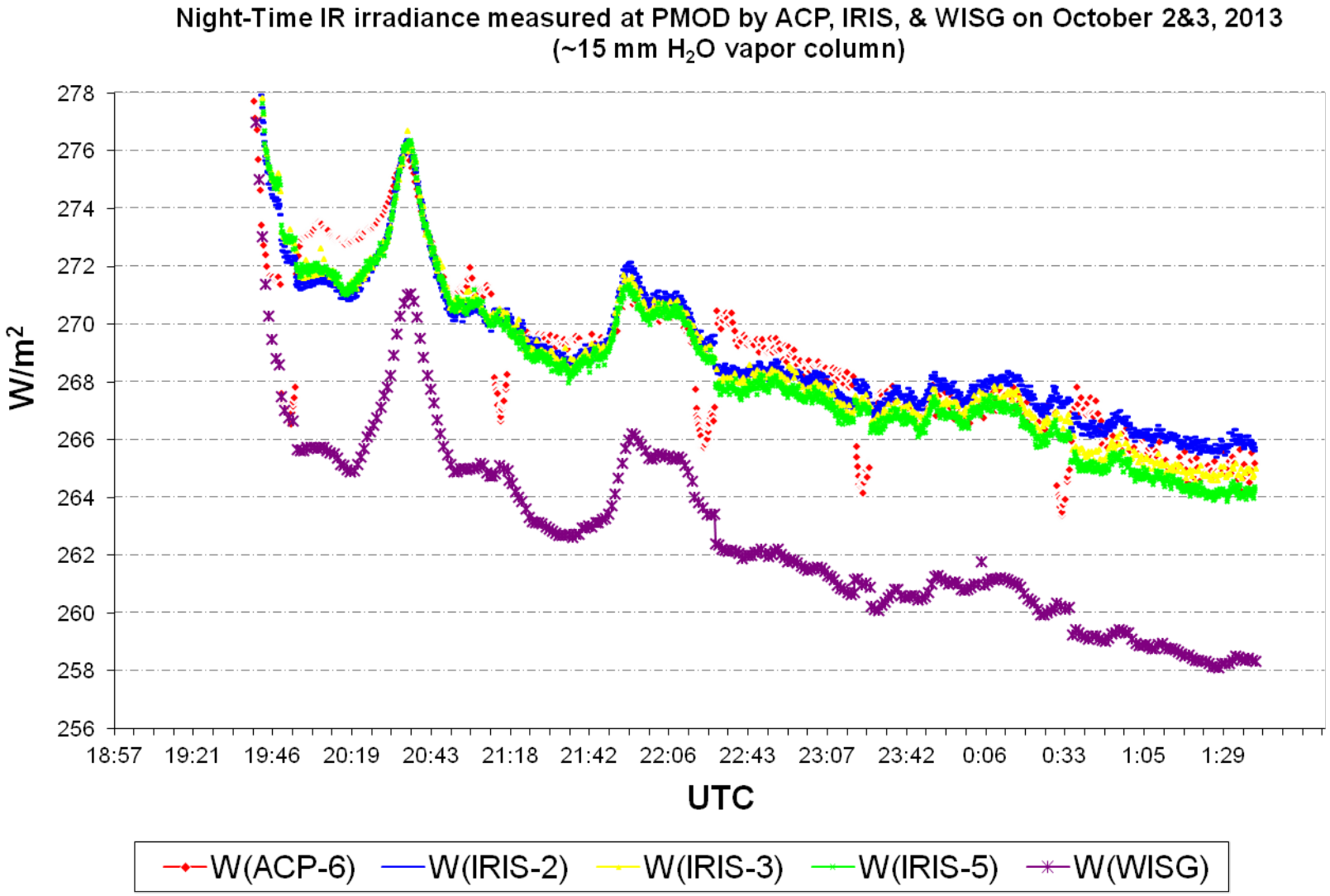
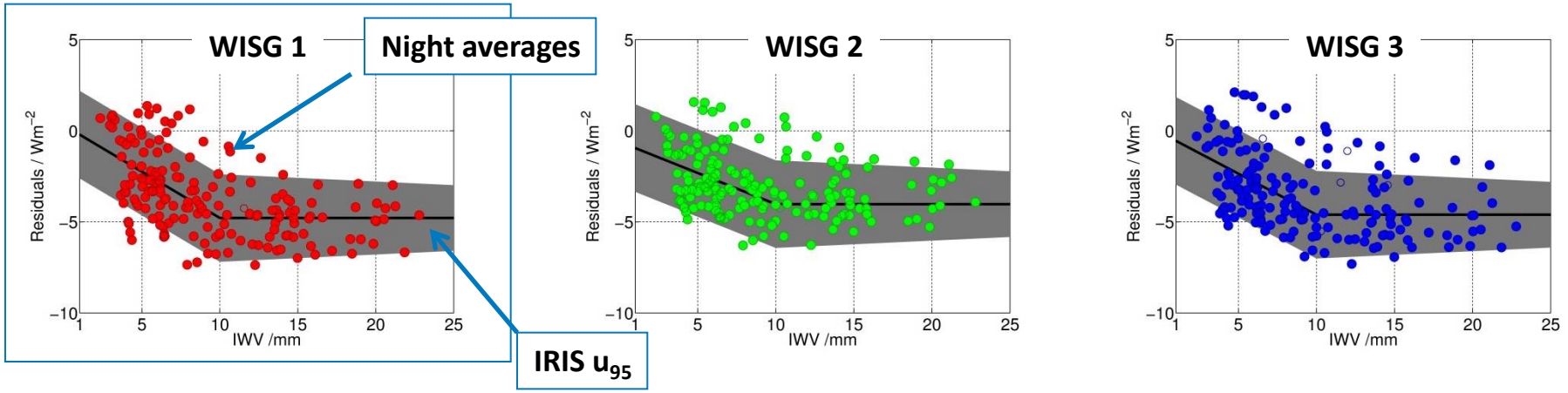


1st and 2nd ACP&IRIS Comparisons Consistent with PMOD Outdoor Data

Irradiance difference (WISG minus IRIS) at PMOD



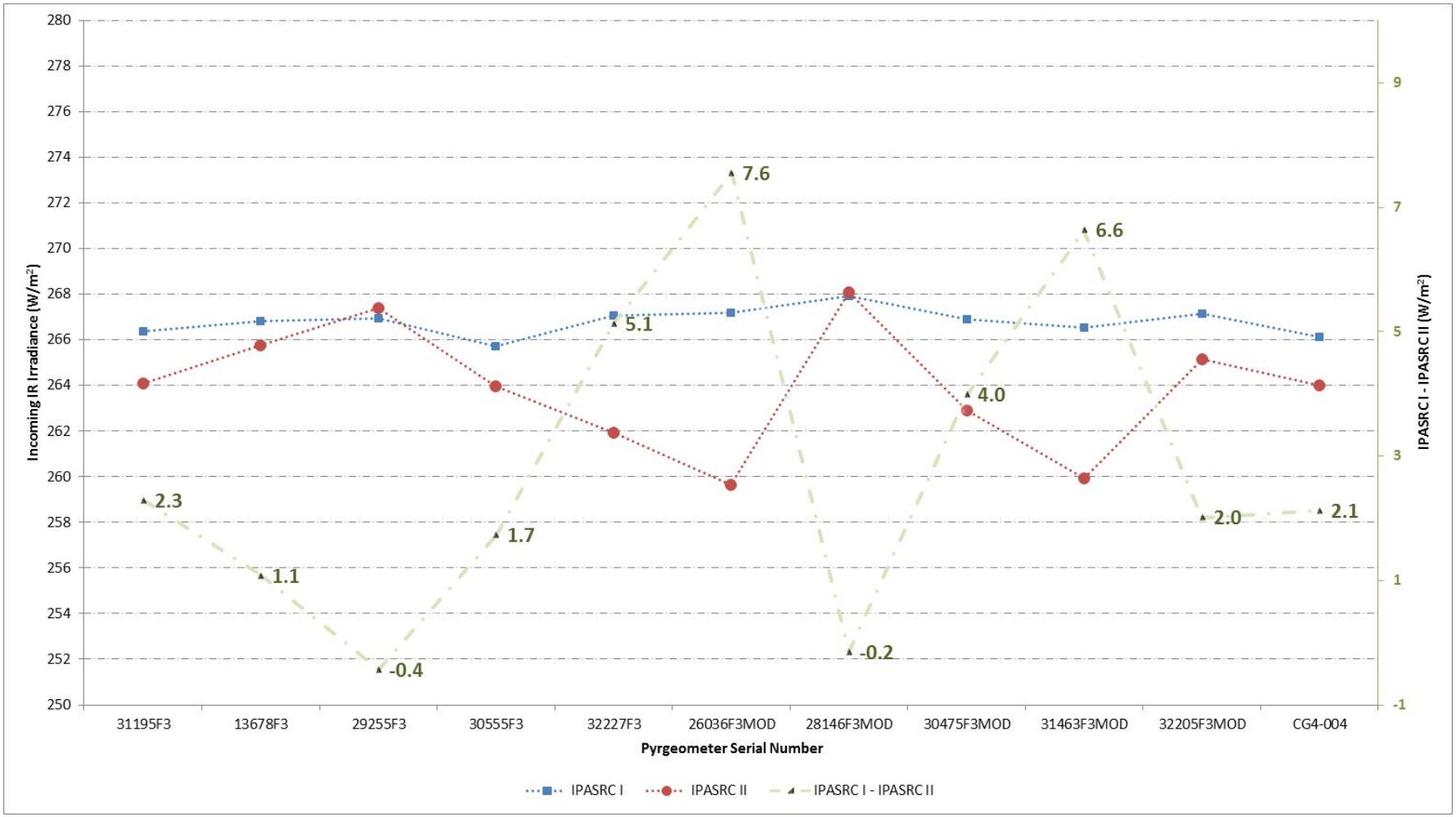
Results

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

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

From Julian's presentation, IRS2012-Germany (Data from 180 nights)

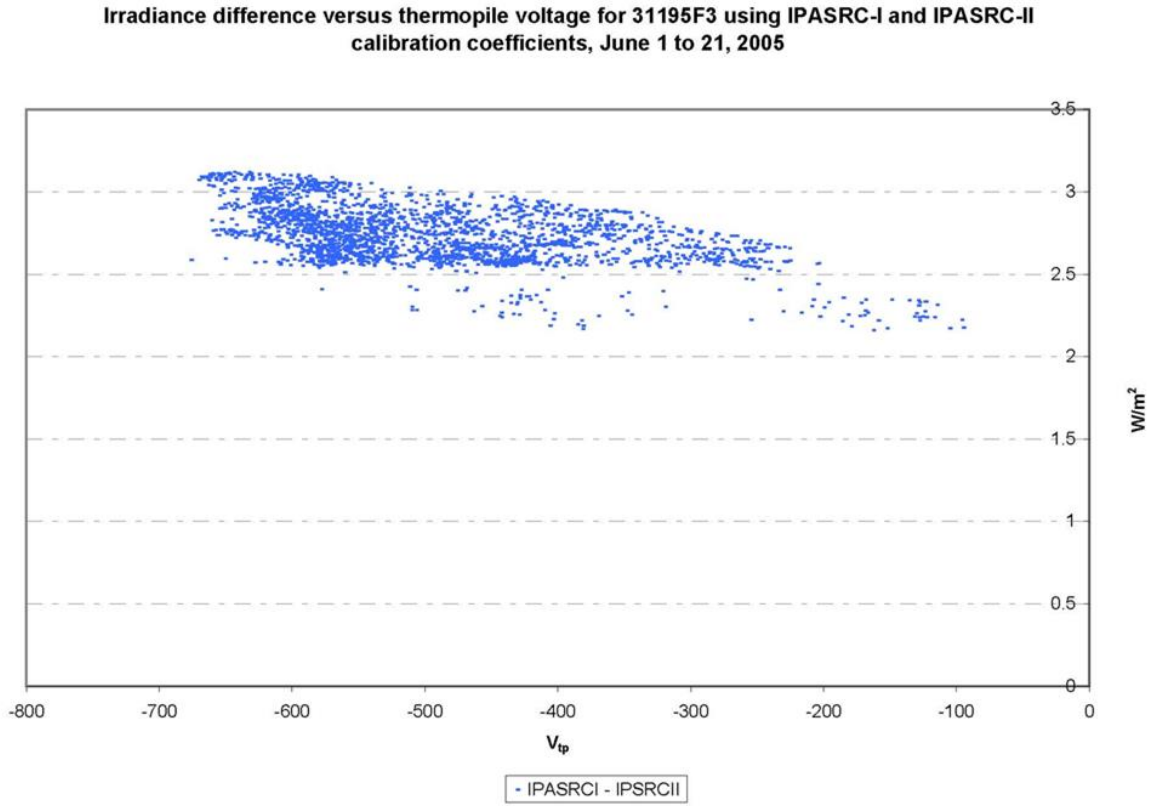
1st and 2nd ACP&IRIS Comparisons Consistent with IPASRC I&IPASRC II difference



Calculated IR incoming irradiance measured by 11 pyrgeometers using their two sets of coefficients, derived during IPASRC I & IPASRC II

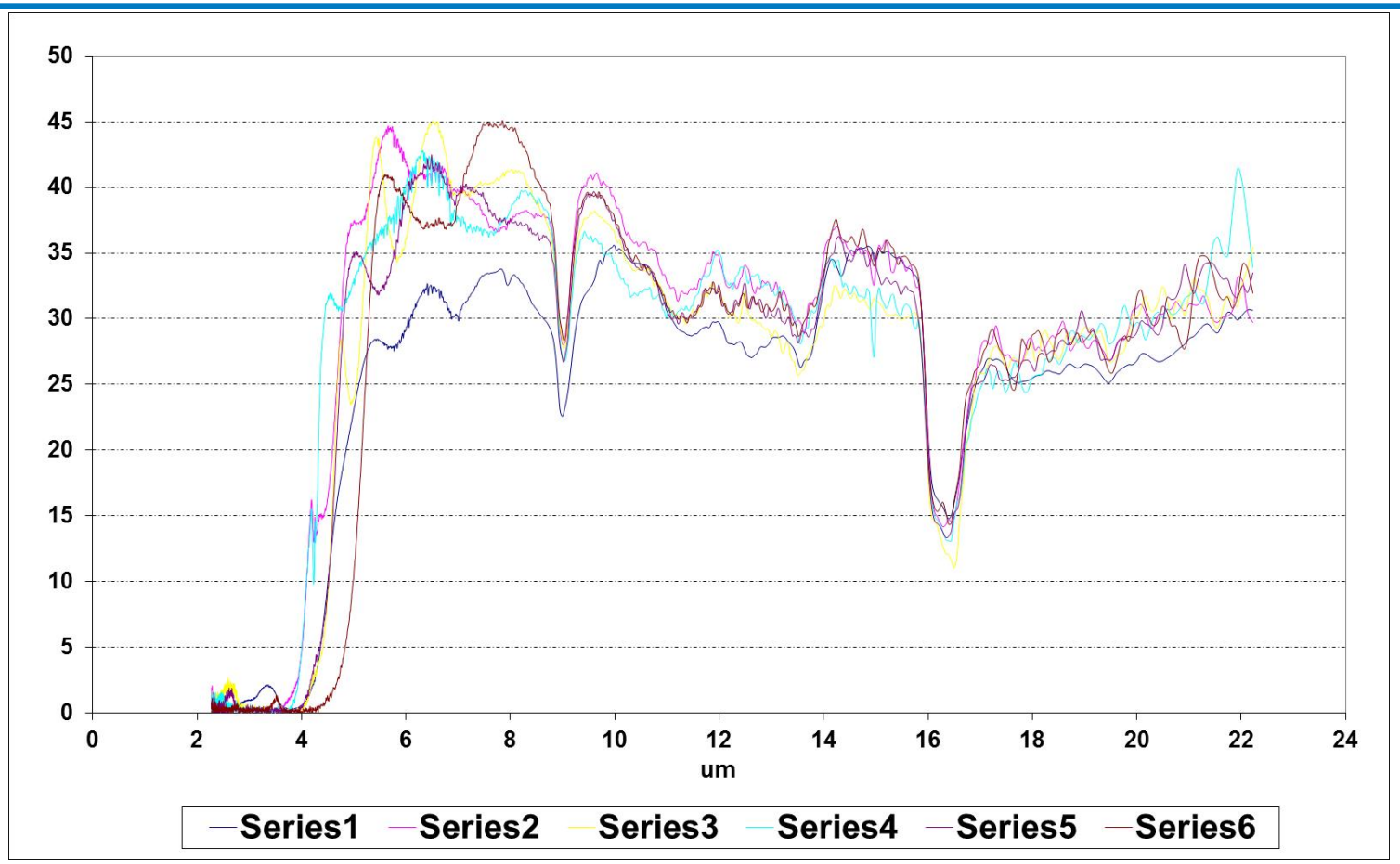
1st and 2nd ACP&IRIS Comparisons Consistent with Poster in ARM-STM-2008

Applying Results of Both International Pyrgeometer and Absolute Sky-scanning Radiometer Comparisons (IPASRC)



Reda, I.; Gröbner, J.; Stoffel, T.; Myers, D.; Forgan, B.: http://www.arm.gov/publications/proceedings/conf18/poster/P00028.pdf?id=1

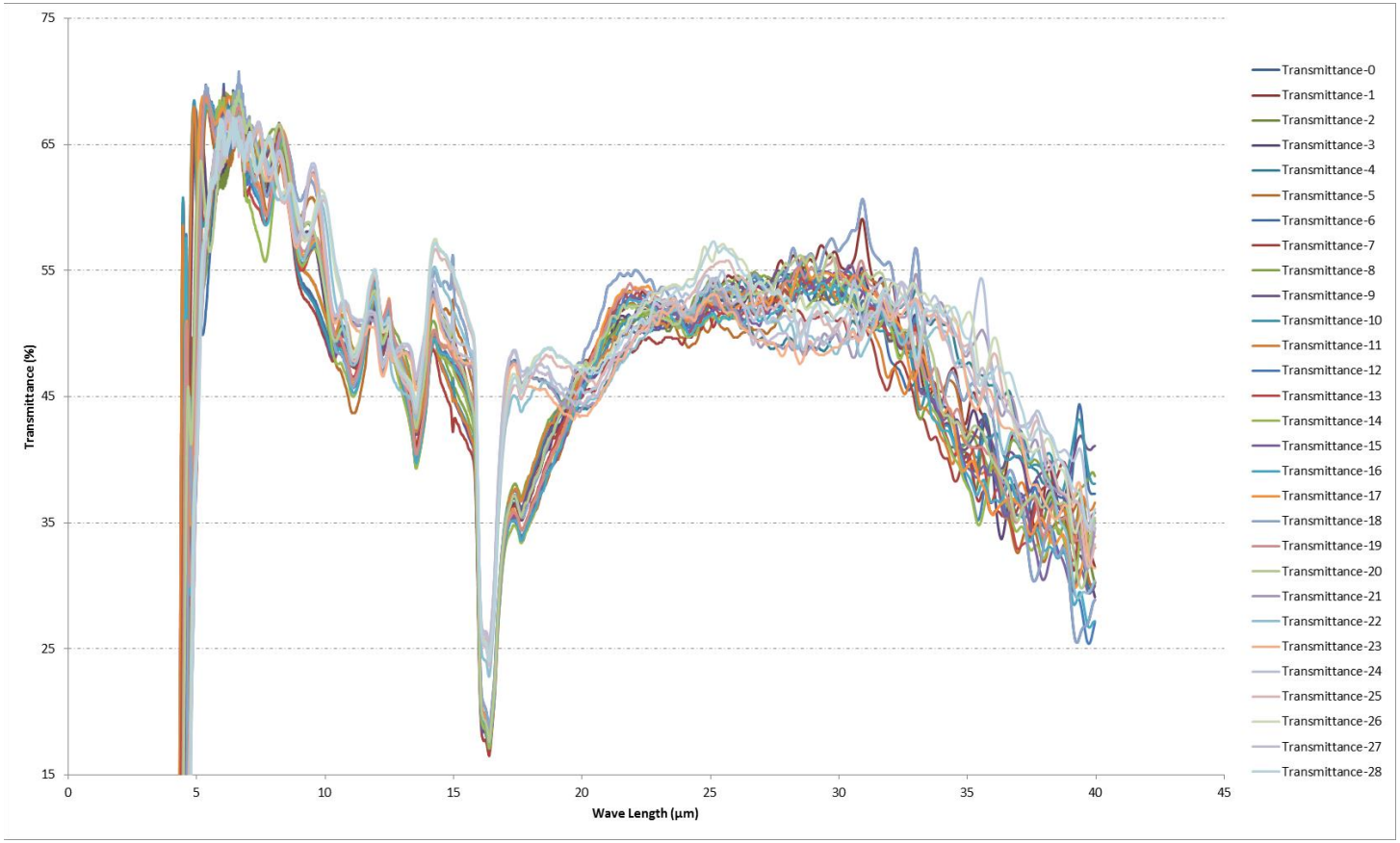
Transmission Curves of Pyreometer Domes



From: John Hickey & Tom Kirk, Eppley Laboratory, Inc.

The (4 to 6)W/m^2 difference between the irradiance measured by ACP&IRIS and that of the Interim WISG might be attributed to the variation in dome transmittance when there is a spectral difference.

Transmission Curves of Pyreometer Domes



From: Jörgen Konings, Hukseflux Thermal Sensors

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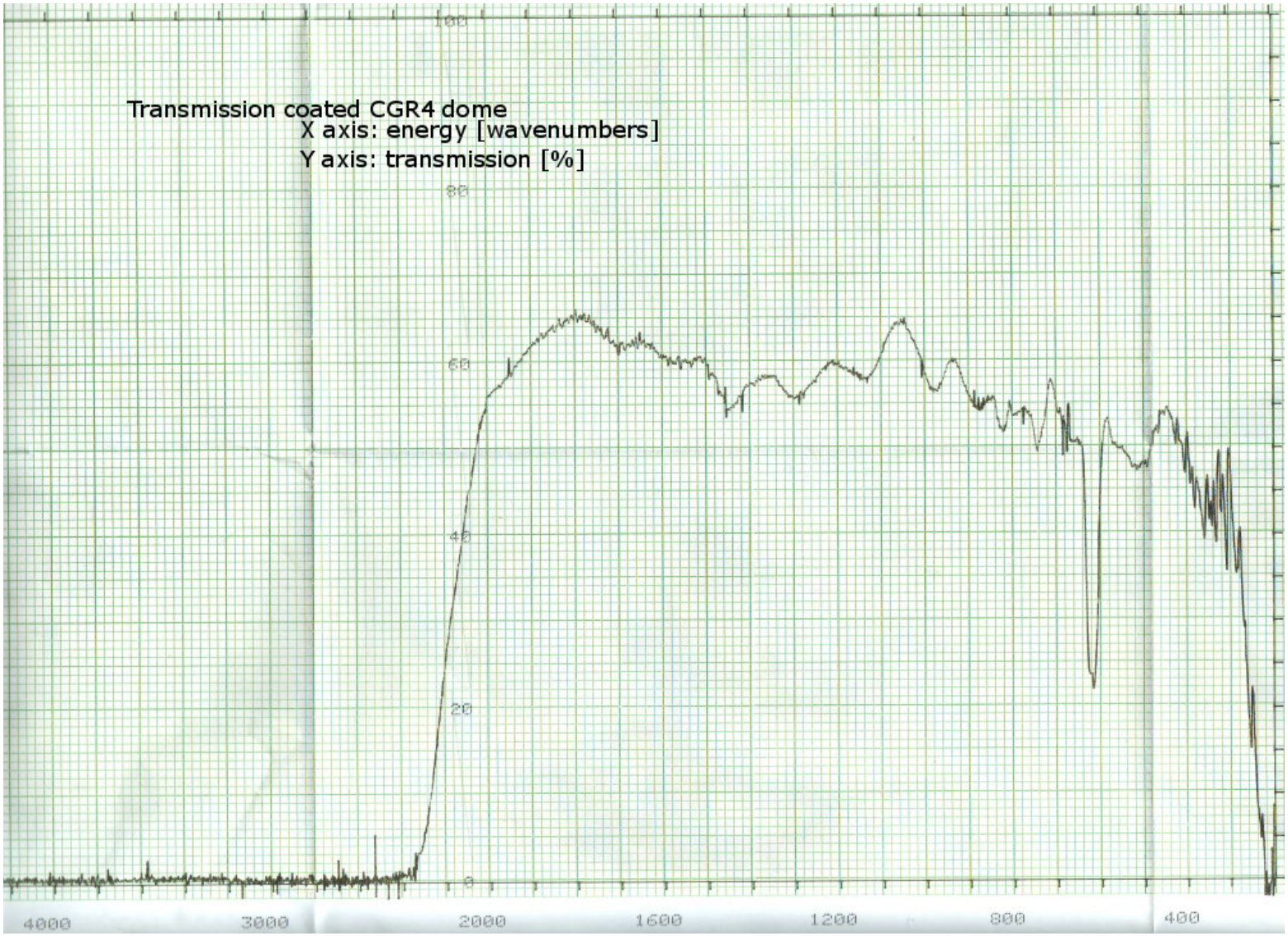
Transmission Curves of Pyreometer Domes



From: Joop Mes, Kipp&Zonen; he noticed that the curve changes from batch to batch

Preliminary Conclusions & Recommendations

1. Outdoor agreement between ACP & IRIS to within 1 W/m^2 at water vapor of 8 mm of H_2O & 15 mm of H_2O
2. Irradiance measured by WISG is 4 W/m^2 to 6 W/m^2 lower than that measured by ACP&IRIS, for 8 to 15 mm of H_2O
3. Future comparison with lower water vapor might resolve observed spectral effect on outdoor pyrgeometer calibrations (research!!)
4. Other designs might increase confidence in establishing a consensus reference with traceability to SI units
5. Once a consensus reference is established, a group of pyrgeometers with minimum dome-transmittance variation would be used as Transfer-Reference-Group for the pyrgeometers outdoor calibration.