Proposal to Compare Three Absolute Broadband Infrared Instruments with the Eventual Goal of Establishing New IR Standard

- October 2016 (clear skies often with > and < 1 cm water vapor)
- ACP (NREL), IRIS (WRC), and ASR (MeteoSwiss and WRC)
- Ancillary measurements needed are water vapor and temperature profiles; AERI (possibly scanning); WISG calibrated PIRs and possibly old and new CG4s

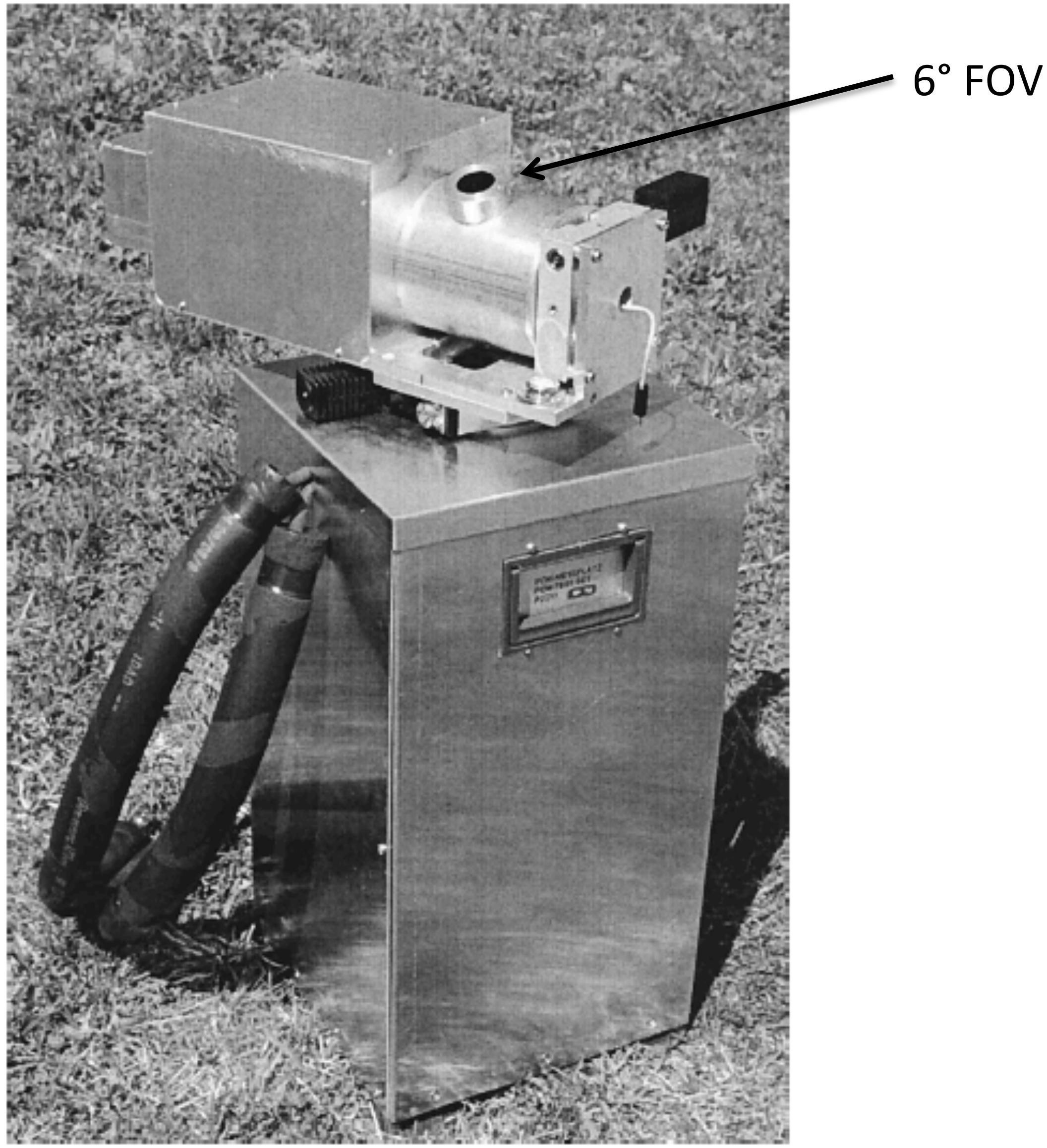

Fig. 2. ASR with reference blackbody (lower part) and rotatable detector head (upper part).

Table 2. Uncertainties due to Errors on ASR Absolute Long-Wave Irradiance Measurements

Uncertainties	Error	Measured Unit ($W\ m^{-2}$)
Type		
Uncertainty of temperature of blackbody (at 260 K)	± 0.15 K	± 0.6
Uncertainty of chopper temperature during calibration	± 0.05° K	± 0.2
Uncertainty of blackbody emittance	0.999 ± 0.0005	± 0.14
Mismatch due to pyroelectric detector sensitivity	($100\ W\ m^{-2}$) ± 0.5%	± 0.5
Field-of-view beam stray light	($100\ W\ m^{-2}$) ± 0.5%	± 0.5
Ambient air passage	($100\ W\ m^{-2}$) ± 0.5%	± 0.2
Combined standard uncertainty (rss)		± 0.98
Maximum uncertainty (worst case)		± 2.15

World Infrared Standard Group (WISG)

- PIR 31463F3* – modified w/ 3 dome thermistors
- PIR 31464F3 – modified w/ 3 dome thermistors
- CG4 FT004*
- CG4 010535

* Took part in IPASRC-I

Table 6. Pyrgeometer Measurements, AERI, and Model Calculations Compared to Absolute Sky-Scanner Measurements

Group	Sept. 22 0630–0700 LT	Sept. 24 0630–0700 LT	Sept. 29 0630–0700 LT	Sept. 30 0630–0700 LT	Average Difference W m^{-2}
USER8	276.55	306.07	271.45	275.39	
Difference to SKY	2.48	2.58	3.53	2.53	278 ± 0.50
CMDL8	273.12	302.92	267.78	272.62	
Difference to SKY	−0.95	−0.57	−0.14	−0.24	−0.48 ± 0.37
FIELD8	273.45	303.23	268.14	272.94	
Difference to SKY	−0.62	−0.26	0.22	0.08	−0.15 ± 0.38
USER7	274.10	303.34	268.11	273.21	
Difference to SKY	0.03	−0.15	0.19	0.35	0.10 ± 0.21
CMDL7	274.51	303.72	268.35	273.29	
Difference to SKY	0.44	0.23	0.43	0.43	0.38 ± 0.10
PMOD7	273.47	302.18	267.35	272.59	
Difference to SKY	−0.60	−1.31	−0.57	−0.27	−0.69 ± 0.44
FIELD7	273.95	303.28	268.71	272.79	
Difference to SKY	−0.12	−0.21	0.79	−0.07	0.10 ± 0.47
CHOPPED	267.89	298.98	262.59	268.46	
Difference to SKY	−6.18	−4.51	−5.33	−4.40	−5.11 ± 0.83
CHOPP-FIELD	273.32	303.47	268.66	273.61	
Difference to SKY	−0.75	−0.02	0.74	0.75	0.18 ± 0.72
AERI	275.93	305.39	271.38	272.97	
Difference to SKY	1.86	1.90	3.46	0.11	1.83 ± 1.37
LBLRTM no aerosols	272.10	301.72	267.48	267.83	
Difference to SKY	−1.97	−1.77	−0.40	−5.03	−2.30 ± 1.94
MODTRAN no aerosols	273.56	303.29	268.96	269.53	
Difference to SKY	−0.51	−0.20	1.04	−3.33	−0.75 ± 1.85
MODTRAN with aerosols	275.32	305.06	270.63	271.27	
Difference to SKY	1.25	1.57	2.71	−1.59	0.98 ± 1.83
Sky scan	274.07	303.49	267.92	272.86	

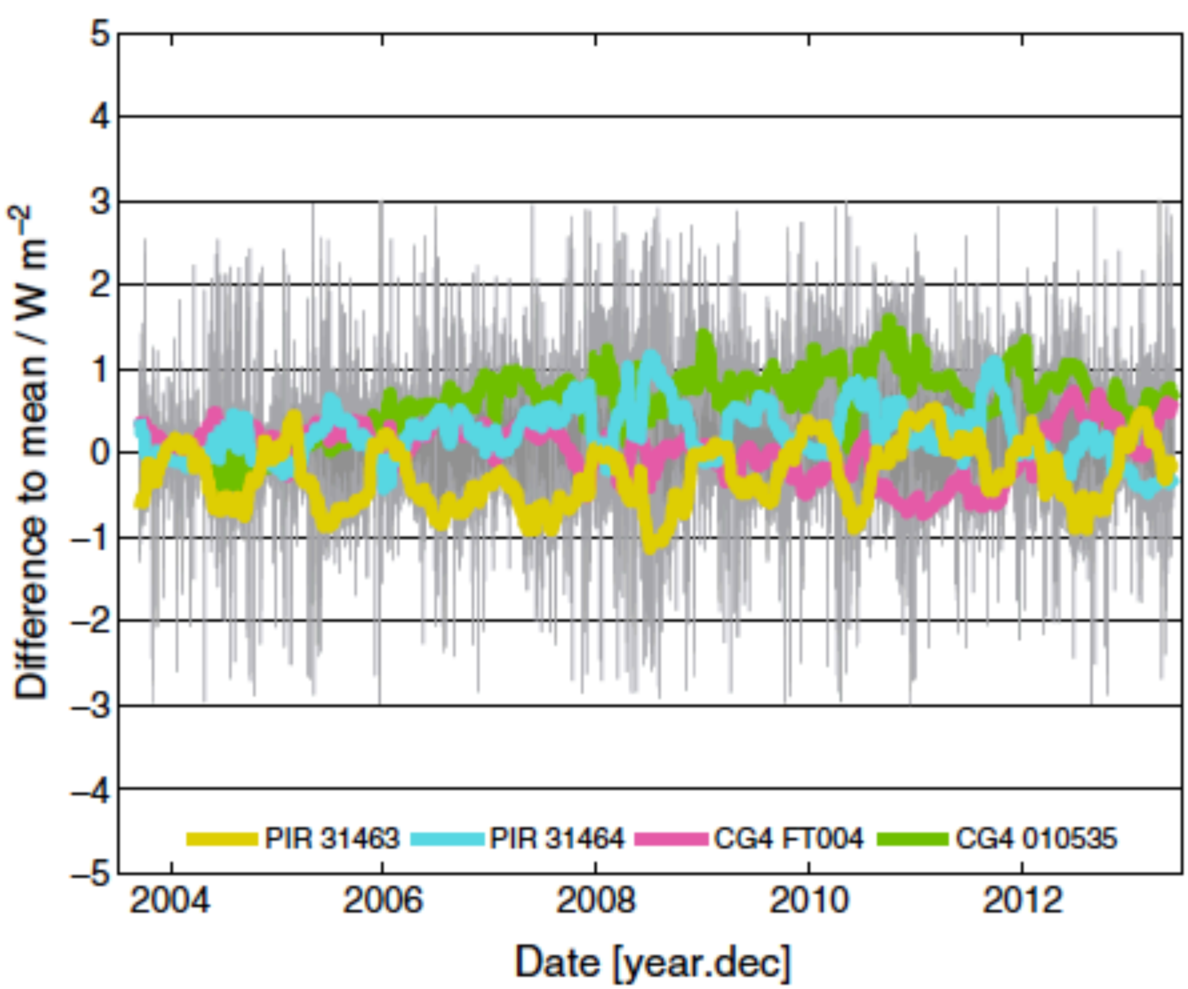

Figure 1. Residuals of downwelling irradiance measurement with respect to the average of the four pyrgeometers forming the World Infrared Standard Group. The thick curves represent the monthly moving average from daily pyrgeometer averages (shown in grey). Only nighttime data were used.

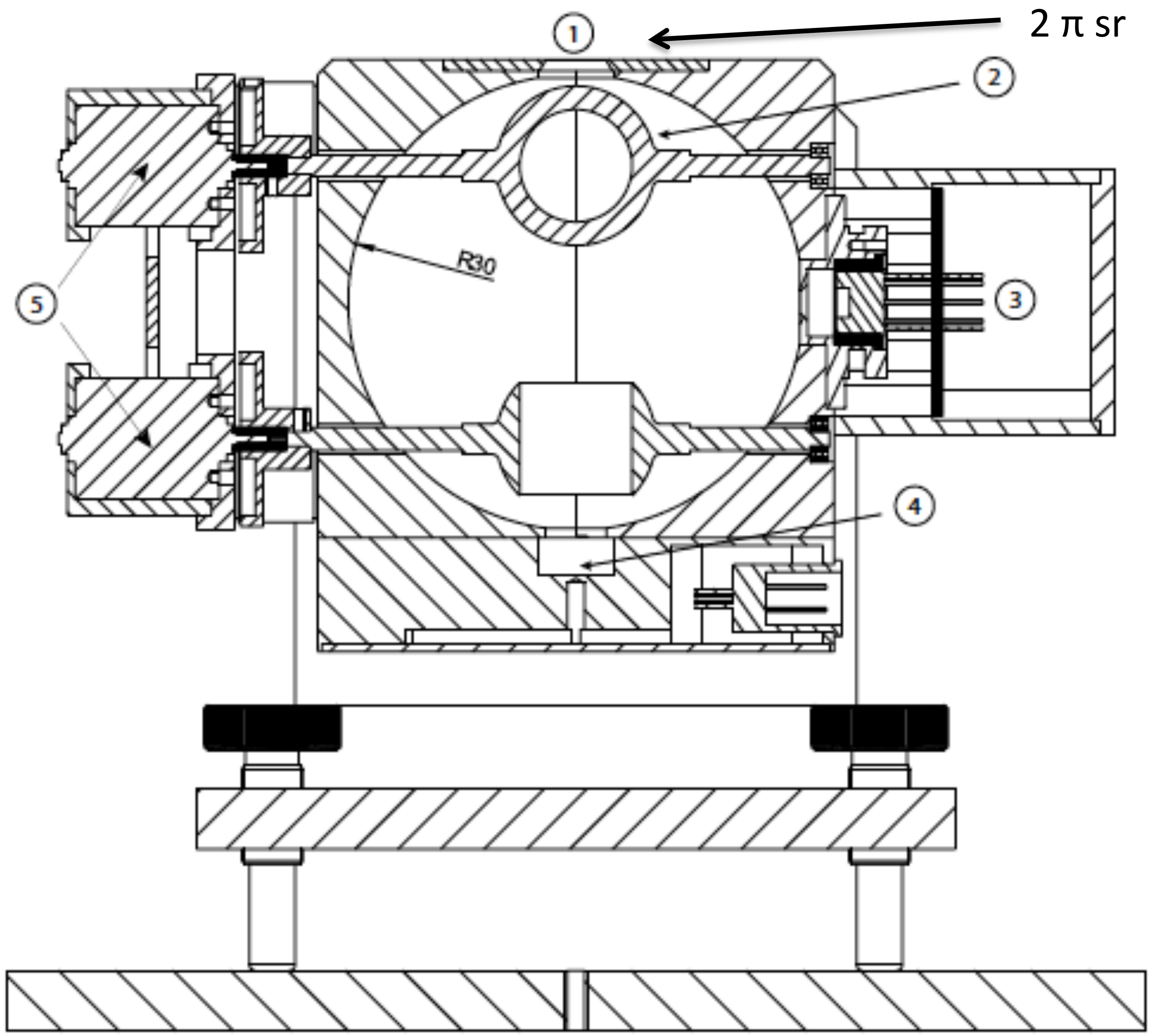

Figure 1. Schematic of the IRIS radiometer. (1) Aperture for longwave irradiance, (2) rotating shutters, 90° out of phase, (3) pyroelectric detector, (4) black coated reference cavity and thermistor, (5) shutter motors.

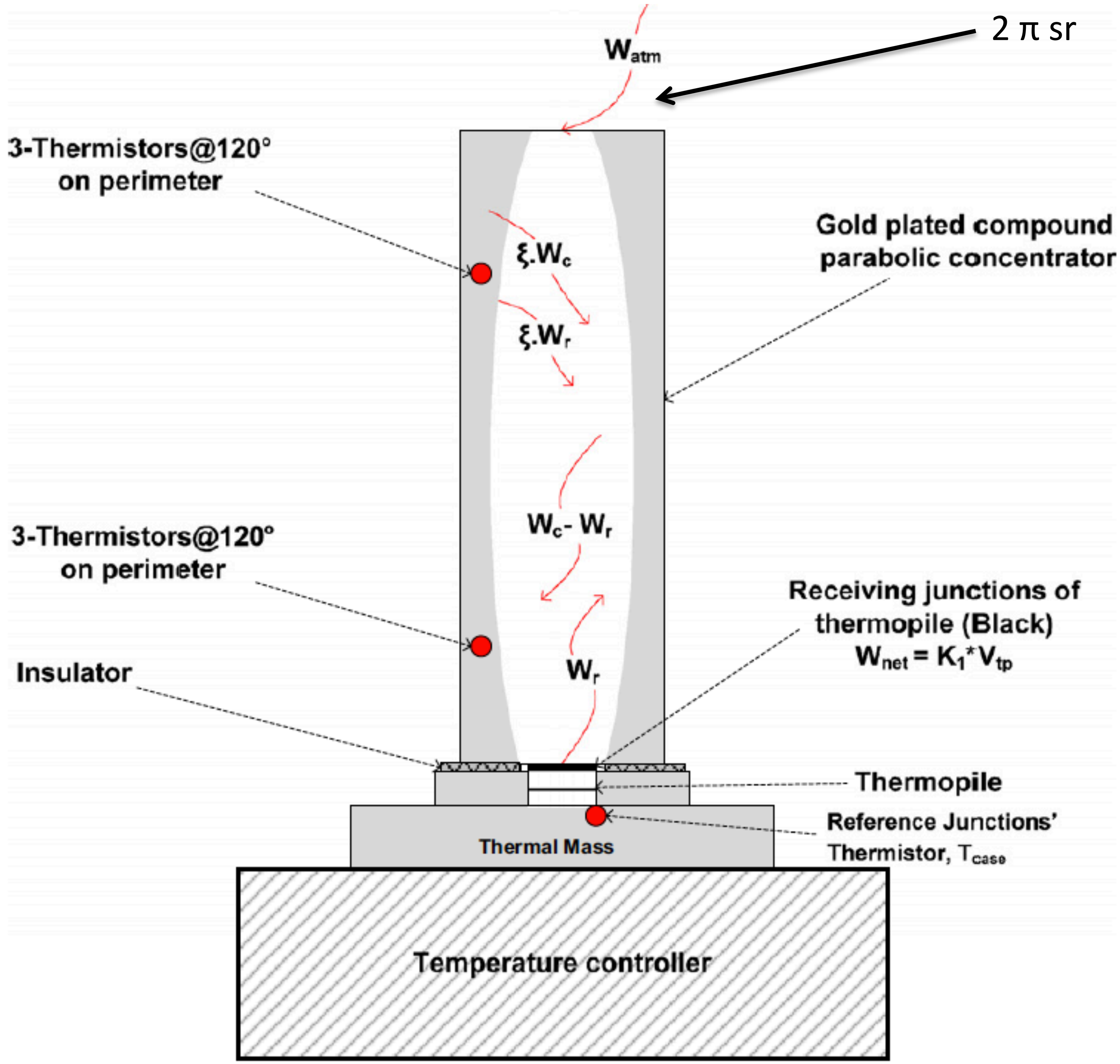

Fig. 1. Simplified diagram for absolute cavity pyrgeometer, ACP.

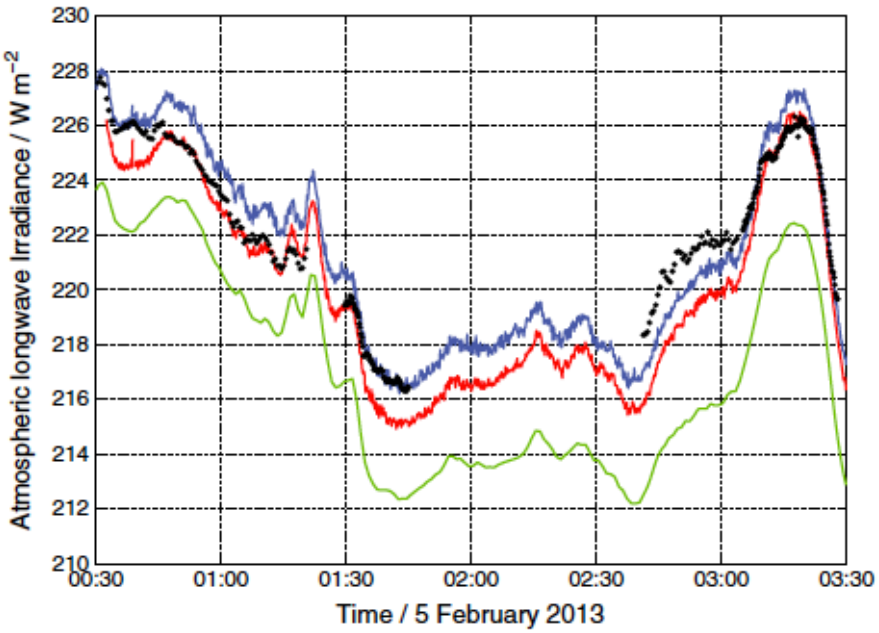

Figure 2. Downwelling atmospheric longwave irradiance measured during the night of 5 February 2013 at PMOD/WRC. The red and blue curves represent the measurements from IRIS#2 and IRIS#4, respectively; the black dots represent the measurements from the ACP, and the green curve shows the average irradiance measured by the WISG.

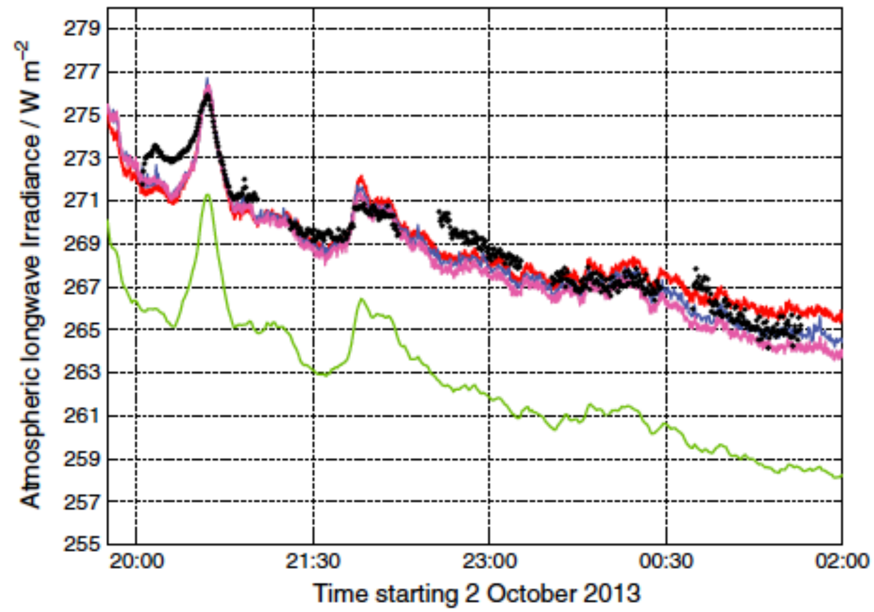

Figure 3. Downwelling atmospheric longwave irradiance measured during the night of 2–3 October 2013 at PMOD/WRC. The red, blue, and magenta curves represent the measurements from IRIS#2, IRIS#3, and IRIS#5, respectively; the black dots represent the measurements from the ACP, and the green curve shows the average irradiance measured by the WISG.

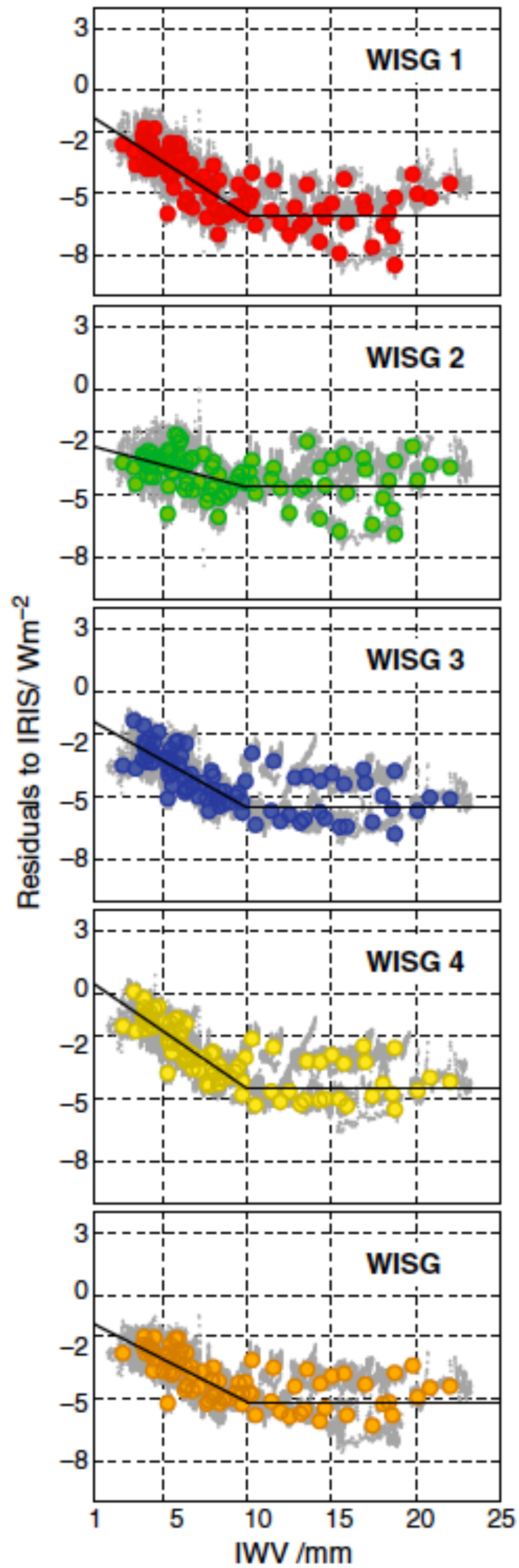

Figure 5. (top to bottom) Residuals between the atmospheric downwelling longwave irradiance measurements from the WISG pyrgeometers and IRIS#4 with respect to the atmospheric integrated water vapor (IWV). The top four panels are measurements from the individual WISG pyrgeometers, while the bottom panel shows the average WISG measurements relative to IRIS#4. The thick black lines are obtained from calculating the average offset between the WISG and IRIS at IWV larger than 10 mm, and a linear fit between the residuals and IWV below 10 mm.

Desired Instrumentation

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