

Broadband Radiometry Instrument Focus Group

ARM/ASR PI Meeting,

Tysons, VA

March 16, 2017

Welcome!

- **Major topic areas to cover:**
 - **Instrument Issues**
 - **Group charge and focus**
 - **Related campaigns**
 - **Other?**

Agenda

- **Instrument Issues:**

- Status update on Ventilation issues progress (Mike Ritsche) [10 min]
- Progress on downward facing radiometer ventilation design? (Mike Ritsche) [2 min]
- ShipRad/PRP progress (Mike Reynolds) [5 min]
- Status update on IR calibrations progress (Mike Dooraghi) [10 min]
- Discussion: [20 min]
 - Are we ready to recommend reprocessing of historical LW data yet?
 - Ventilator issues?
 - Etc.

- **Group Charge and Focus:**

- Expanding the group to include spectral radiometers (Laura Riihimaki) [5 min]
- Discussion [20 min]

- **Related Campaigns:**

- Fall 2017 Absolute IR Instrument Campaign (Allison McComiskey) [10 min]
- Ongoing IR Loss Methodologies Study (Chuck Long) [8 min]
- Collaboration with 2017-18 Cold Climate mitigation campaign (Chuck Long) [7 min]

- **Other**

- **General Discussion**

ARM Ship Radiometer Systems

- **MAGIC campaign included adding SPN1 to PRP to test tilt correction of SW data**
 - 1-sec sampling
 - Ship navigation data
 - Issue with latency of IP communications
- **Discussion agreed to redesign**
 - Separate FRSR and broadband systems
 - Copy AAF design for broadband

ShipRad Systems



- 3 systems, each treated as unit
- Need to characterize angular offset between SW radiometers and nav
- 2 in use, one as spare

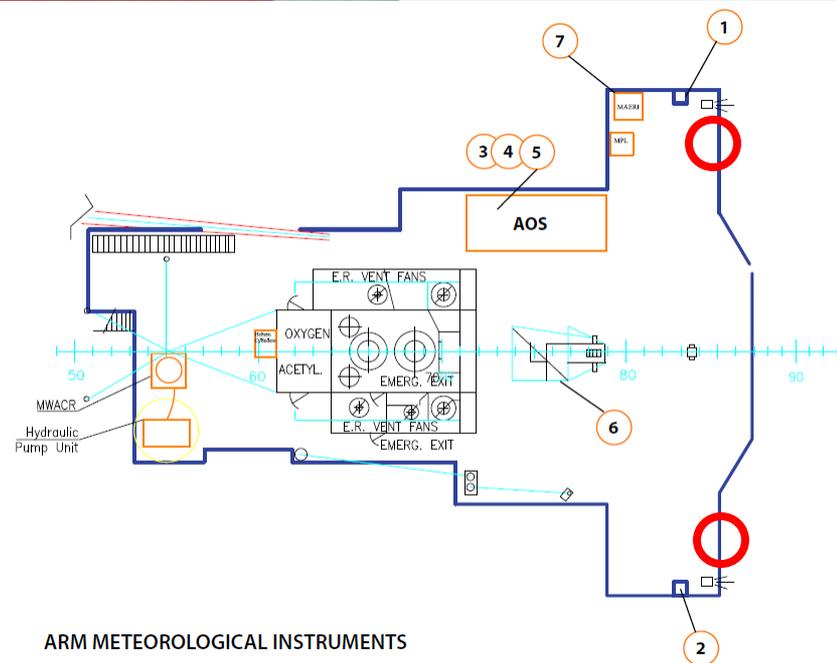


Each unit has standard shaded SPN, modified unshaded SPN, PIR, aspirated T/RH probe, VectorNav 3000 navigation unit, Campbell CR1000 logger

MARCUS Campaign



Location



ARM METEOROLOGICAL INSTRUMENTS

IR Loss Methodologies Study

- **Poster:**
 - **“A Study of IR Loss Correction Methodologies for Commercially Available Pyranometers”**
 - **Chuck Long, Afshin Andreas, John Augustine, Mike Dooraghi, Aron Habte Emiel Hall, Mark Kutchenreiter, Allison McComiskey, Ibrahim Reda, Manajit Sengupta**
 - **Poster session B1, Wed 3:30 - 5:00 pm, Tysons Ballroom, Poster# 63**

IR Loss Methodologies Study

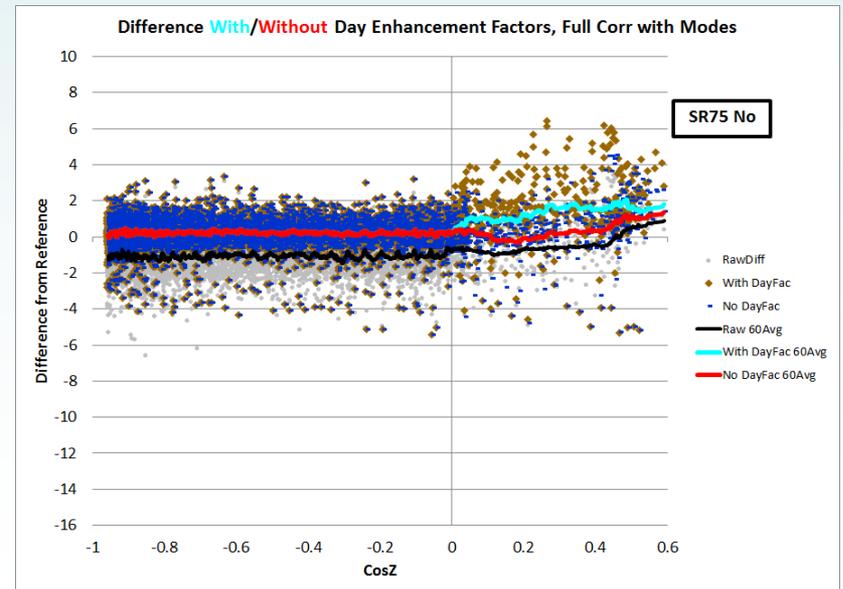
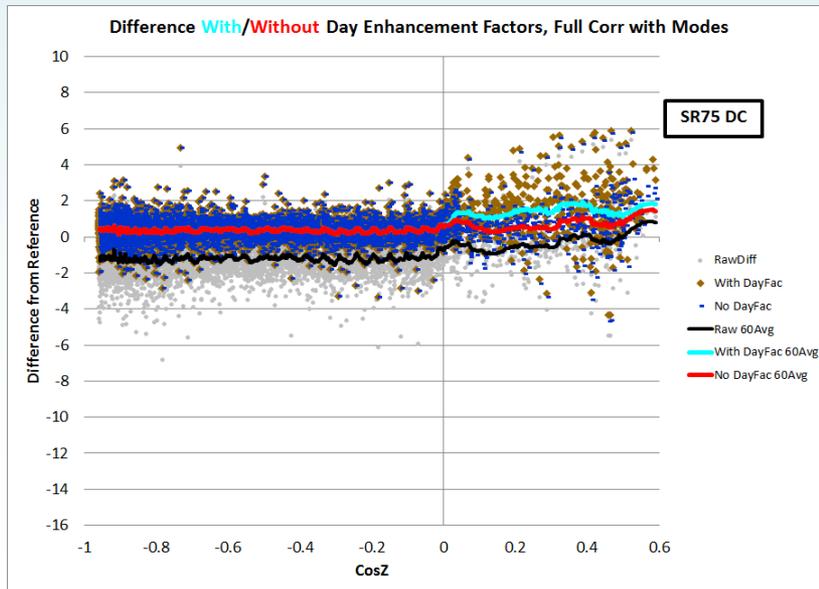
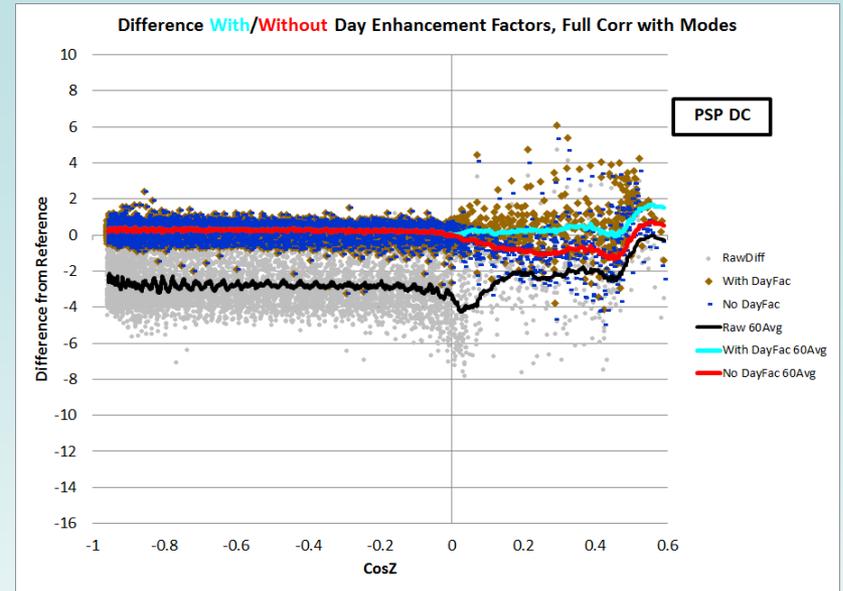
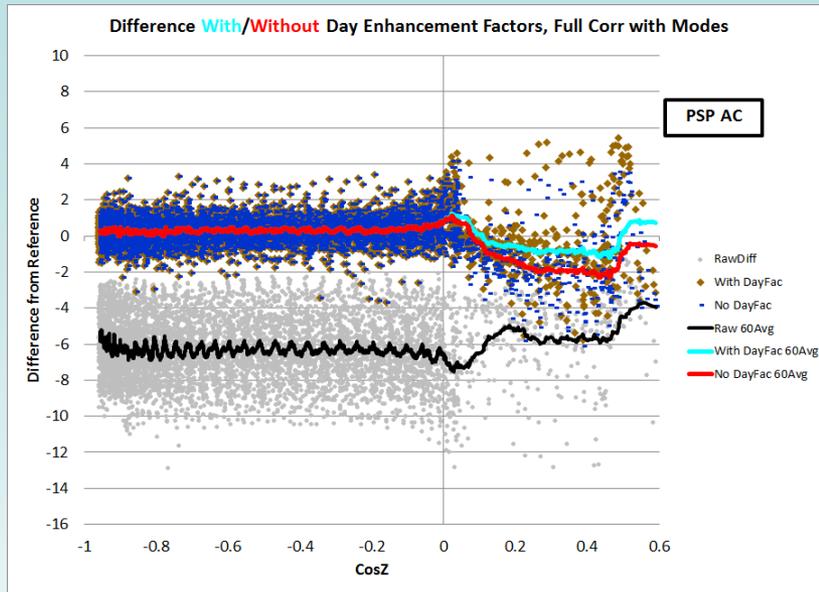
- **Being conducted at NREL SRRL facility**
 - Start Nov 11, 2016
 - Run through spring
- **Common commercially available pyranometers**
- **DC ventilated and no ventilator**

Model	Ventilation	Provider
PIR	Ventilated DC	SRRL
PIR	Ventilated AC	SRRL
PIR	Unventilated	SRRL
CGR4	Ventilated DC	SRRL
CG4	Unventilated	SRRL
SR-75	Ventilated DC	NOAA
SR-75	Unventilated	NOAA
MS-80	Ventilated	SRRL
MS-80	Unventilated	SRRL
PSP	Ventilated DC	SRRL
PSP	Ventilated AC	SGP
PSP	Unventilated	SGP
CMP 11	Ventilated DC	SRRL
CMP 11	Unventilated	SRRL
CMP22	Ventilated DC	SRRL
CMP22	Unventilated	SRRL
SR-25	Unventilated	SRRL
Direct CHP1	N/A	SRRL
Diffuse B&W	Ventilated DC	SRRL
Diffuse CMP22	Ventilated DC	SRRL

IR Loss Methodologies Study

- Methodologies include:
 - cgswda = all-data detector only, no day factor (Dutton et al.)
 - Cgswfa = all-data full, no day factor ***
 - Cgswdm = dry/moist mode detector only, no day factor
 - cgswfm = dry/moist mode full, no day factor ***
 - cgswdaf = all-data detector only with day factor
 - Cgswfaf = all-data full, with day factor ***
 - Cgswdmf = dry/moist mode detector only, with day factor
 - Cgswfmf = dry/moist mode full, with day factor ***
 - TC = Thermal Correction using Effective Net Infrared and Instrument Rnet
 - ZC = Zenith Correction using 2-degree AM/PM Averaged Responsivity vs Zenith Angle
 - TZC = Thermal and Zenith Correction
- Pyrgeometer data from ventilated or no ventilator PIR or **CGR4**, actual or “**effective**” instrument net IR

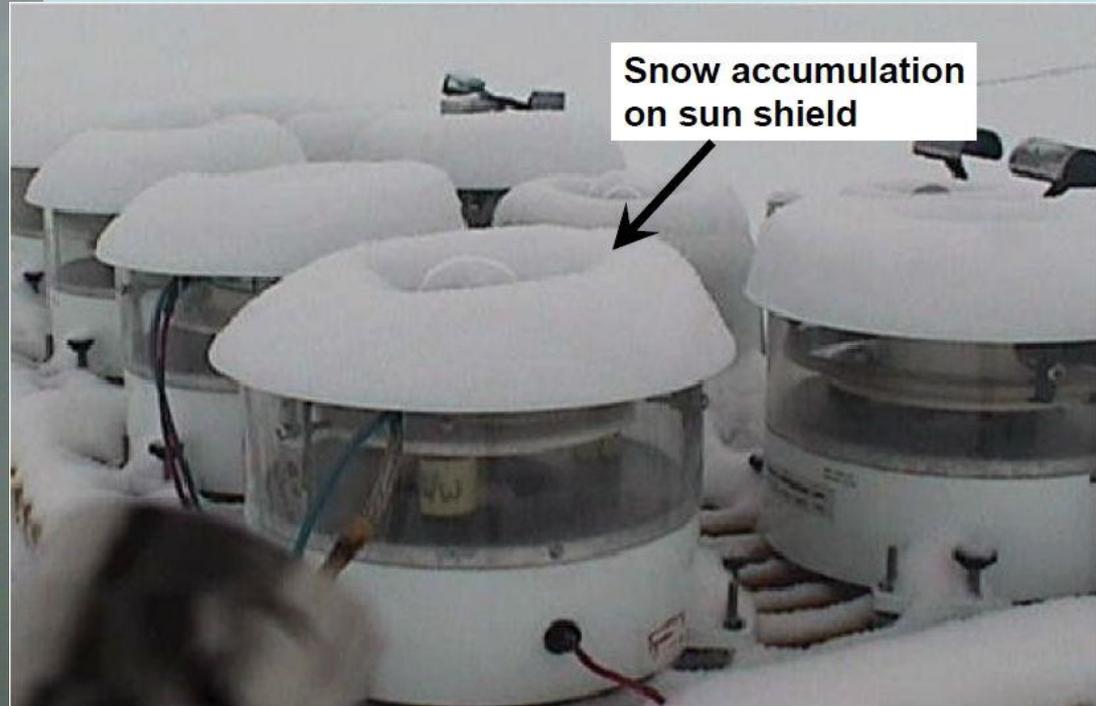
IR Loss Methodologies Study



It's a cold world out there!



Storm Peak Lab riming, CO, Oct 10, 2010

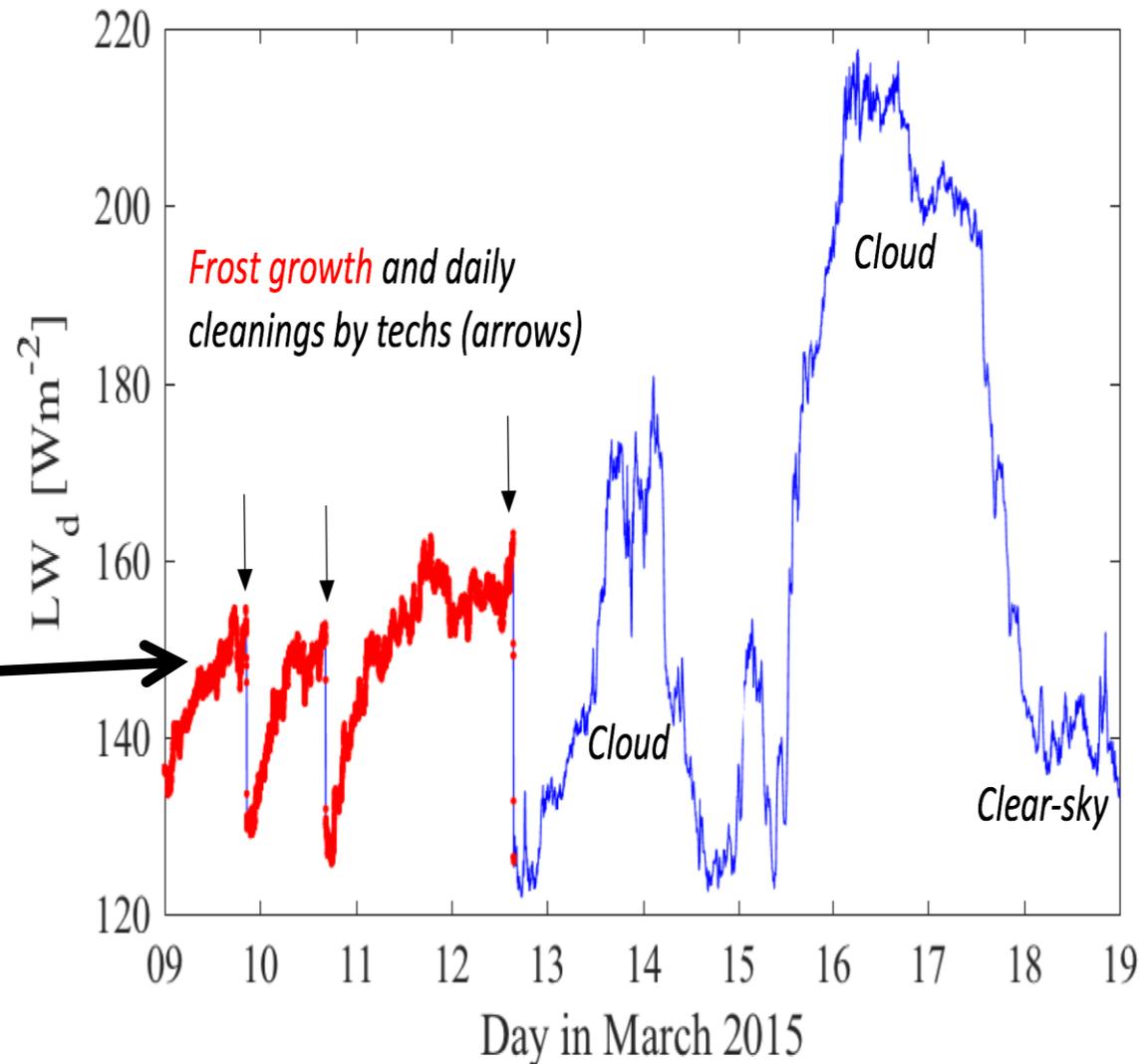


NSA Radiometer IOP

Cold Climate Issues

- **Instruments impacted by meteorological conditions: snow, frost rime, etc.**
- **Other issues include:**
 - **Thermopile sensitivity at cold temperatures**
 - **Hazardous conditions for personnel**
 - **Cracking of electrical cables due to cold temps**
 - **Possibly shifting bases for instrument stands**
 - **Etc.**

NOAA Barrow Example



**More than 20
 Wm^{-2} increase
in downwelling
LW due to frost**



NSA IOP Tests Performed

- **Eppley instruments only**
- **Two different fan output flow volumes**
 - **Standard speed and high speed (18/44 CFM)**
- **AC vs. DC powered ventilator heaters**
- **Optimal heater placement inside ventilator (IR effects versus mitigation)**
- **Various heater designs**
- **Effects of insulation on sun shield**
 - **More heat to dome**

Radiometer Dome and Shield Accumulation

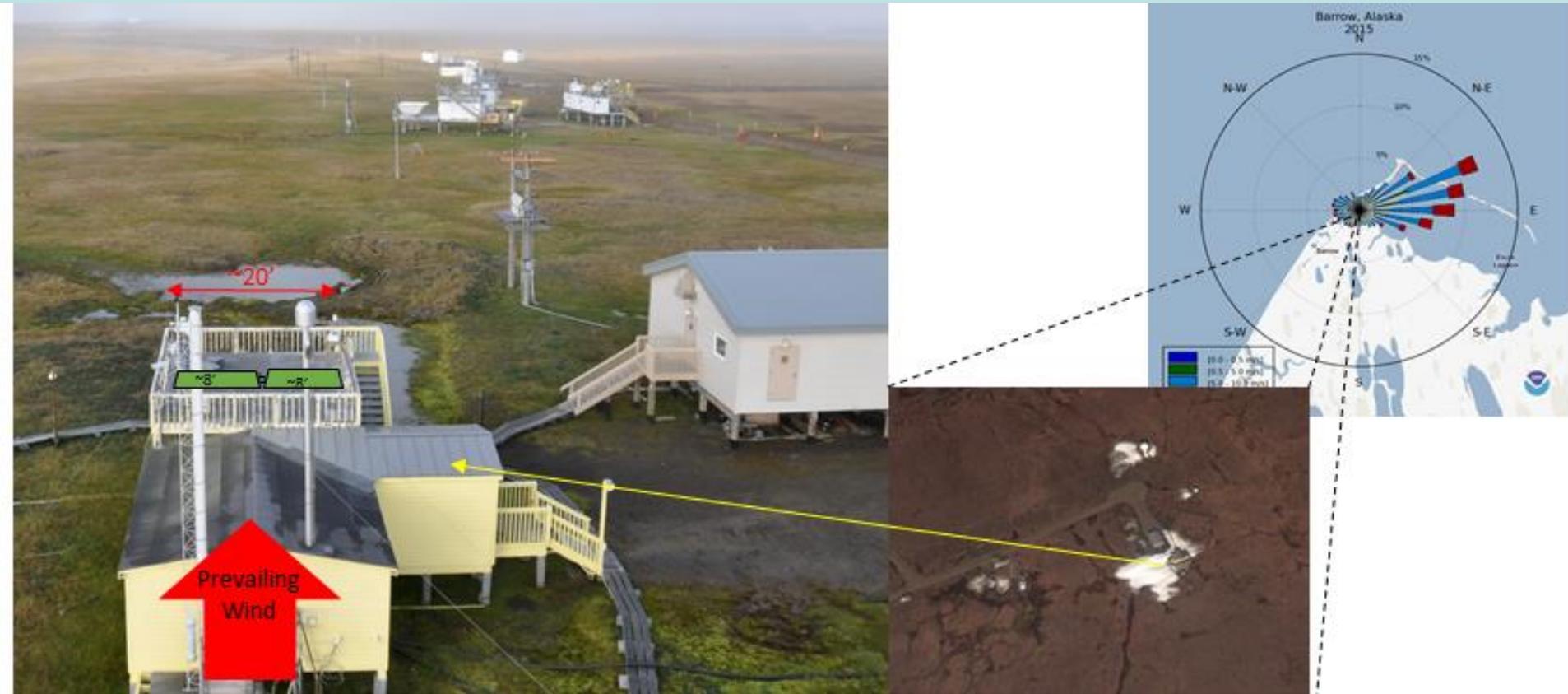
- PIR most susceptible to rime accumulation on sun shield
 - Or wind direction effect?
- Snow accumulation for all



Conclusions

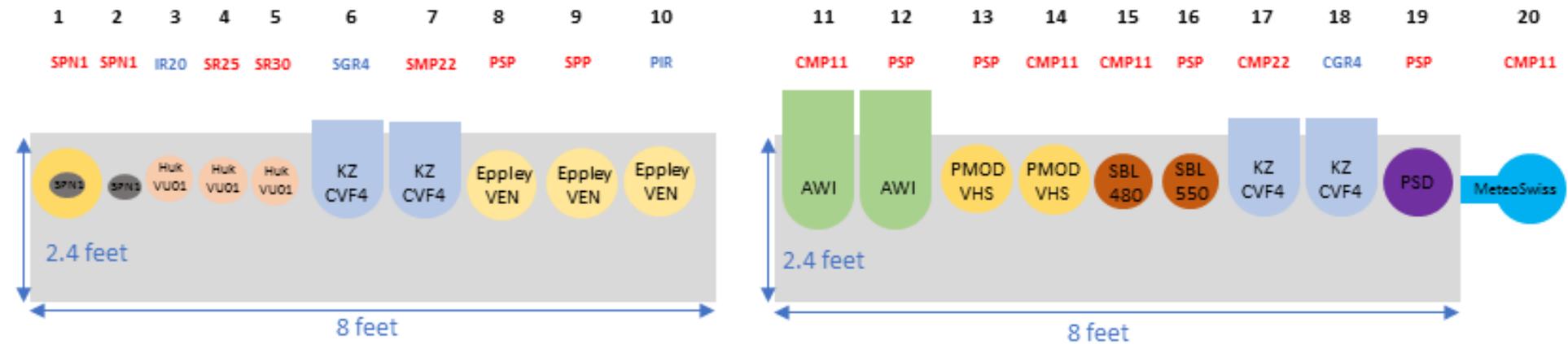
- **Eppley ventilator sun shield too flat on top for optimal cold climate use**
- **Higher speed fans are better**
- **Better design would have steeper sun shield and air flow more directed over dome**
- **Heating helps, but insufficient for all cases**
 - **Balance between heating and increased IR offset effects**

De-Icing Comparison Experiment



**Chris Cox, Chair BSRN CCI WG
NOAA Barrow site**

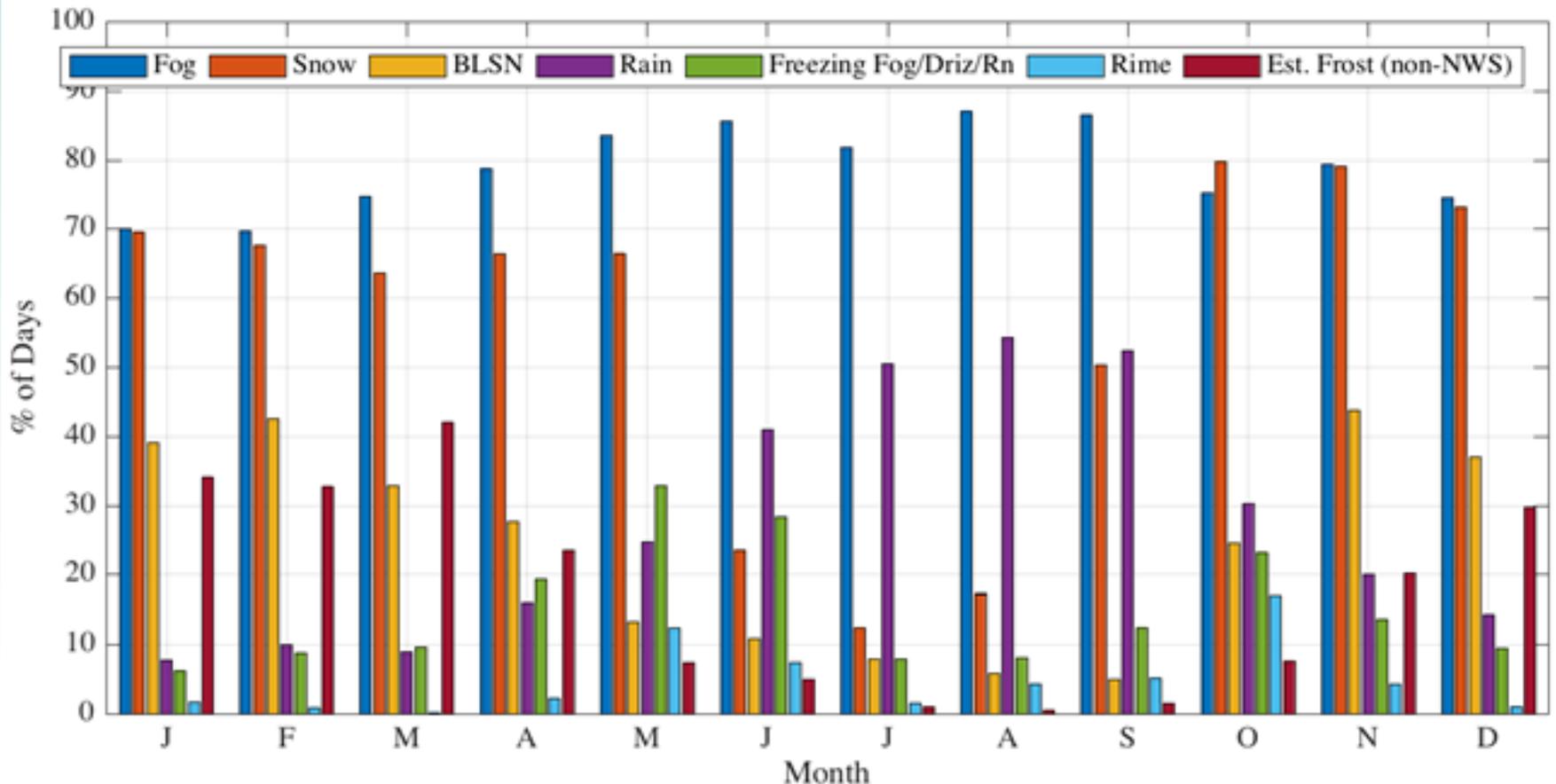
Preliminary Experimental Layout



So far about 20 radiometers, EKO still to come
9 different ventilator designs

Barrow Climatology

Campaign will run August 2017 – July 2018
Additional permutations and/or changes are dependent
on conditions experienced

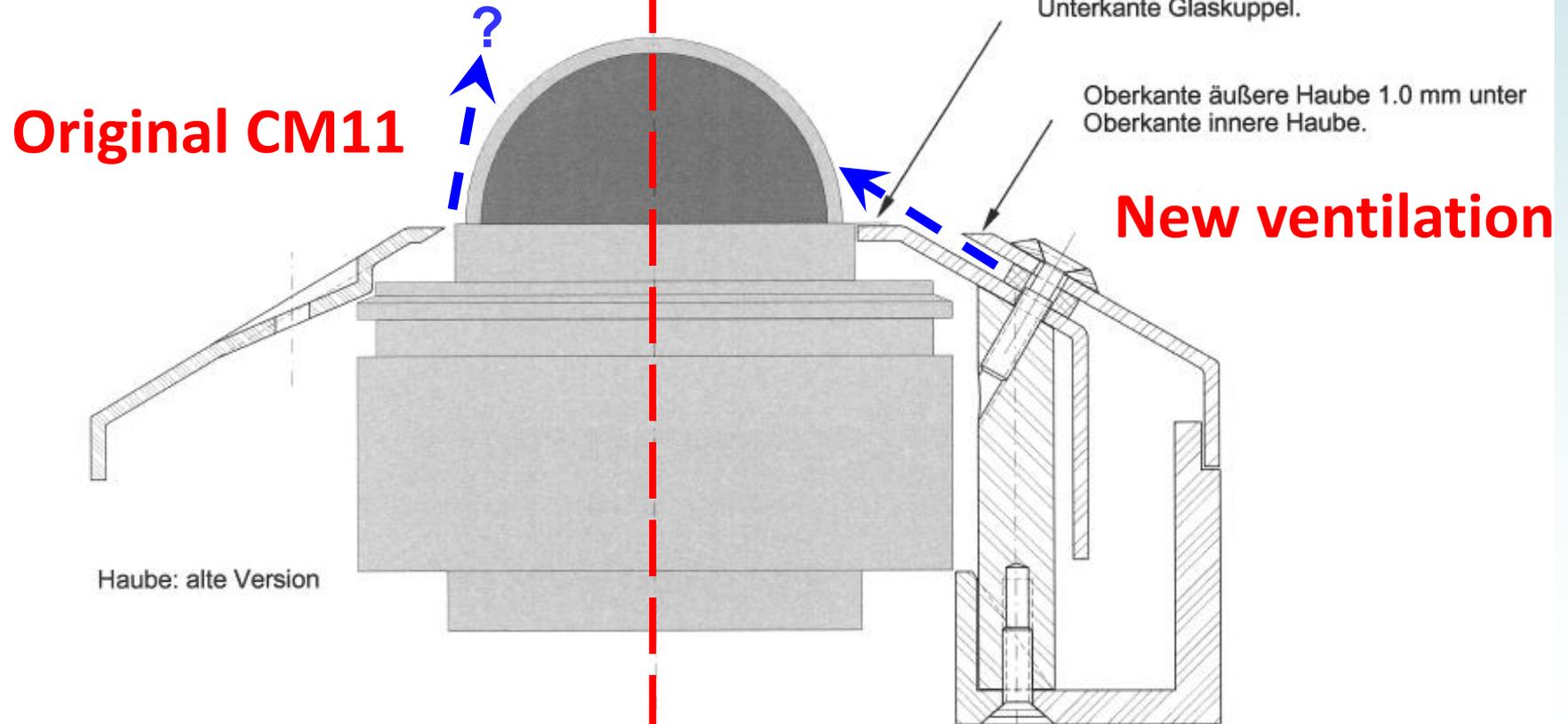


ARM Interest, Contribution?

- **What configuration of ventilator fans and heating is ARM currently deploying?**
- **Can ARM mount a camera to monitor operational instruments, 10-minute images?**
- **Any interest in trying any other configurations?**

Gert: New ventilator design

15 Watt ventilator with a strong air stream not touching the body of the instrument but only the dome.
Additional heating option just before the outlet not needed.



Ventilation blocking: Jungfraujoch, Sonnblick Mountain Observatory



Internal heating

Radiometers at Storm Peak Lab, CO, winter 2010



- **STORMVEX Campaign**
- **Significant riming and “100 year” snow**
- **SPN-1 virtually unaffected**
- **Recommend as ancillary radiometer?**

Matsui, N., Long, C. N., Augustine, J., Halliwell, D., Uttal, T., Longenecker, D., Niebergall, O., Wendell, J., and Albee, R., 2012: Evaluation of Arctic broadband surface radiation measurements, *Atmos. Meas. Tech.*, 5, 429-438, doi:10.5194/amt-5-429-2012.

SPN resistance to snow



**SIRTA site, near Paris France,
Jordi Badosa and Martial Haeffelin**

- **It snowed!**
- **SPN-1 not buried**
- **Recommend as ancillary radiometer?**
 - **Serve as QC tool for components**
 - **Serves as “best estimate” when primary contaminated**