Objective

- A best-estimate, verifiably ice-free data set of downwelling longwave and shortwave radiative fluxes (1 min avg) was constructed from the collective measurements. Uptime > 99%.
- The data set also includes empirically-derived operational uncertainties.
- The data set is suitable for model validation, such as the YOPPsiteMIP and as a benchmark for calculating biases caused by ice – see next section.

Results inform industry/development, ICE partnered with the international research and industry communities

- A-brief look at the Eppley VEN housing an 80 cfm 104.4 W fan and an Eppley PIB (LW).
- It’s counter-intuitive that aspiration without heat can be effective, yet field observations indicate fans keep PIBs < 0.5 C above ambient, which is equivalent to advective 104% RH w.r.t. ice at -25 C.
- This is too much heating to be explained by waste heat alone.

Radiative fluxes are fundamental observations. Frost and rime negatively impact data in the Arctic; ice is typically mitigated with heating and ventilation, but there is no agreed-upon method and all methods are poorly-documented.

Objective 1: Assess current technology.

Objective 2: Quantify the impact of icing.

Objective 3: Identify the attributes of successful ice mitigation systems.

Effects of a freezing fog on January 28, 2014

- Most systems (22/34) were effective in mitigating ice at least 80% of the time and 15/34 were 90+% effective. Many successful systems used ventilators but not heaters.

System Performance

- Half the temperature increase is attributed to waste heat from the fan while the other half is attributed to adiabatic heating from compression of the air moved by the fan, which comes to rest at the surface of the radiator.

Preliminary: Additional heat observed in the lab (a) relative to the lab (b) may be attributable to adiabatic heating from wind.

- We have produced a simple model to predict the heating associated with a selected fan.

Physical Mechanism

Many have contributed to D-ICE: Allison McCormack (NOAA-GMD), Jim Wendell (NOAA-GMD), Emil Hall (Cires/NOAA-GMD), Brian Vassel (NOAA-GMD), Christine Schutz (NOAA-GMD), Andy Clarke (NOAA-GMD), Robert Alvis (NOAA-GMD), Ole Hansen (NOAA-GMD), Kristen Lucey (AWD), Gunder King Lang (AWD), Michael Schumthson (AWD), Joost Konings (IFIC), Matt Martinec (NOAA-GMD), Tim Kirk (Eppley), Julian Gerstner (PKP-WRC), Steven Sammer (NCAR), Steve Ocksky (NCAR), Kurt Knudsen (NCAR), Mario Casella (Kipp & Zonen), Dick Jenkins (Burlington-T), Laurent Veihmeyer (Meteorwiss), Matt Shupe (NOAA-PSSD), Will Stothers (EKO), Inhabo Booth (NOAA-GMD), Nick Lewis (Univ. Colorado), Meghan Heindelberg (Univ. Colorado), Martin Stoffel (UAF), Paul Heid and (UAF), Dan Oke, (UAF), Matt Bishop (Sandia), Jim Mathe (EPOH), Mark Joyce (Sandia), Walter Broster (ARL), Bryan Thomson (NOAA-GMD), Kevin Oliver (EFT), Amanda Jones (NOAA), Ross Burgarson (NOAA-GMD) and members of the BSRN Cold Climates Issues Working Group.

D-ICE partnered with the international research and industry communities

- Cameras were used to continuously monitor 34 systems contributed by the community installed at 3 observatories across the North Slope of Alaska (NOAA Barrow, ARM Barrow, ARM Oliktok Pt).
- More than 1 million images of radiometer domes and more than 15 million minute averages of radiative fluxes were collected over 10.5 months.

D-ICE

- The De-Icing Comparison Experiment (D-ICE): A study of radiometric measurements in icing conditions
- NOAA, ESRL Physical Sciences Division, Boulder, CO; Cooperative Institute for Research in Environmental Sciences (CIRES) University of Colorado, Boulder, CO; NOAA ESRL Global Monitoring Division, Boulder, CO.