Winter 2017-2018 Results from the De-Icing Comparison Experiment (D-ICE) at NOAA's Barrow Atmospheric Baseline Observatory, Utqiaġvik, Alaska

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In cold climates, ice in many forms including frost, rime, snow, etc. frequently obscures broadband longwave and shortwave sensors, contaminating measurements. Since icing occurs under particular meteorological conditions, associated data losses constitute a climatological bias. Furthermore, the signal is difficult to distinguish from that of clouds, hampering efforts to identify contamination in post-processing. The De-Icing Comparison Experiment (D-ICE) is evaluating systems designed to mitigate the formation of ice using various configurations of ventilation and heating within customized housings, and also aims to characterize any potentially adverse effects of the techniques themselves. Since August 2017, data from a suite of 25 systems has been collected alongside standard units operating with only regularly-scheduled manual cleaning by human operators at the ESRL/GMD Baseline Surface Radiation Network (BSRN) station in Utqiaġvik (formerly Barrow), Alaska. Icing on the sensors is monitored visually using cameras recording images every 10-15 minutes at the ESRL/GMD observatory, as well as the operational stations at the nearby Department of Energy Atmospheric Radiation Measurement (ARM) Program North Slope Alaska site and the more distant ARM Oliktok Point mobile facility, 250 km east of Utqiaġvik.

Previous experience within the BSRN community suggests that aspiration of ambient air alone may be sufficient to maintain ice-free radiometers. Initial results based on data collected from November 2017 through February 2018 support this assertion. Most tested systems are observed to significantly reduce icing with several showing markedly little vulnerability (90%+ reduction in the frequency of ice). However, we have also observed large variability in performance between systems, some of which differ in only very minor ways, implying the effectiveness of ventilation is highly sensitive to subtle variations in design. Generally, the systems are more effective at mitigating ice on pyrgeometers than pyranometers, possibly because the former have lower profile domes. For November-February, we compared the raw (pre-quality control) upward-facing BSRN pyrgeometer data to a best-estimate downwelling longwave (LWD) time series constructed from a combination of the data from the D-ICE pyrgeometers when the instruments were ice-free. During brief periods, icing was observed to enhance the BSRN LWD by up to 55 W m^{-2}. However, despite the fact that the ambient air on the D-ICE platform was saturated w.r.t. ice ~49% of the time, we estimate the operational BSRN data suffered only a small positive bias caused by icing when averaged over time (+1.4 W m^{-2}).

Figure 1. The D-ICE platform at the ESRL/GMD observatory, Utqiaġvik, Alaska, on 6 November 2017. Photo by Station Chief, Bryan Thomas.