Poster 626

# Evaluating Lower-Atmospheric Thermodynamic Variability over Northern Alaska under Arctic Amplification


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## Background

Arctic Amplification corresponds spatially to areas with sea ice loss, such as the Beaufort, and presents strongly in autumn as residual heat in the ocean. It is strongest near 75°N and at the surface, and is confined below ~500 hPa, mostly below 850 hPa (Serreze et al. 2009).

In autumn, the amount of sea ice in the Chukchi/Beaufort essentially sets the temperature at Barrow (Wendler et al 2014, Cox et al 2017). Longterm soundings from the NWS at Barrow (**Fig. A**) show dramatic changes in the fall boundary layer; with substantial suppression and much warming of the lower levels.

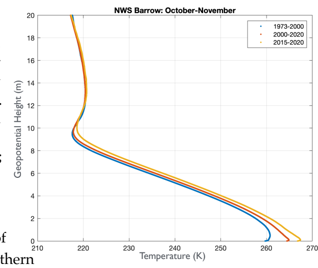


**Figure A.** Mean of all 00 and 12 UTC October and November soundings from NWS Barrow for 1973–2000 (blue), 2000–2020 (red), and 2005–2020 (gold). Data obtained from the Integrated Global Radiosonde Archive v2 (IGRA; Durre et al. 2018).

We have begun a climatological study of the lower troposphere's structure over northern Alaska. The foundation of our research is two high-resolution datasets which provide an opportunity to examine multi-year tropospheric variability, and to get a preliminary idea of its regional coherence. Our initial focus on thermodynamic quantities related to cloud formation.

## Data

The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Program has been launching radiosondes at their North Slope of Alaska (NSA) Central facility in Utqiaġvik (formerly Barrow; **Fig. B**) since April 2002, and 261km away at their Mobile facility (AMF3) in Oliktok Point (OLI) since August 2015. NSA typically launched 1 sonde per day at 00 UTC until April 2006, when they switched to launches at 06 and 18 UTC; OLI launches were typically at 00 and 18 UTC.

According to Holdridge (2020) NSA initially deployed Vaisala RS90 sondes, transitioning to RS92 starting in January 2005. The reported RH precision was 1.0% before 29 September 2006, 0.1% afterwards. Vaisala RS41-SGPs began to be launched at NSA on 18 October 2017 and at OLI on 15 November 2018.

We use data which passed all ARM quality control. Soundings with excessive temperatures or surface pressures, bad heights aloft or near the surface, giant temperature offsets, or odd discontinuities were subsequently omitted from analysis. We also removed post-launch warm temperature spikes (confined to no more than the first 5 heights above the surface value).

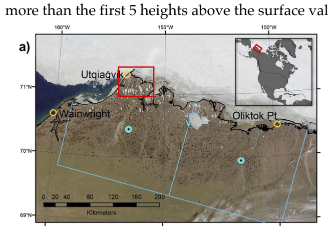


**Figure B.** A MODIS satellite image (NASA, worldview.earthdata.nasa.gov/) showing the locations of ARM's observatories in Alaska (from *Cox et al. 2017*; Fig. 1a)

## Preliminary Results

We linearly interpolated idividual soundings to a 50-m vertical grid, then recomputed relative and specific humidities using Hardy's (1998) vapor pressure formulas, which are also employed by Vaisala's sounding software. After computing monthly statistics profiles we used linear interpolation to extract time series on 4 pressure levels: 700, 850, 925, and 1000 hPa.

These time series are shown in **Figs. C**, **D**, **E**, and **F**. Superimposed on each is a non-parametric regression obtained by finding the median of pairwise slopes regression (Lanzante 1996) as implemented by Danziger (2015). The resulting slopes are listed to the right of the figure panels.

At both sites most trends are positive, except for moisture-related minima, whose trends are often negative. For all variables, the trends lead to an increase in the range of values over time at all levels. Trends over the 5-year record at Oliktok are larger than those over the 19-year record at Barrow. Further analysis is required to determine whether this is a data artifact or reflects a change in regional trends over the last several years.

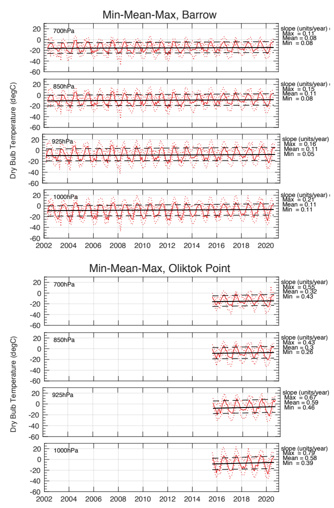


**Figure C.** Monthly mean (solid), maximum and minimum (dotted) temperatures.

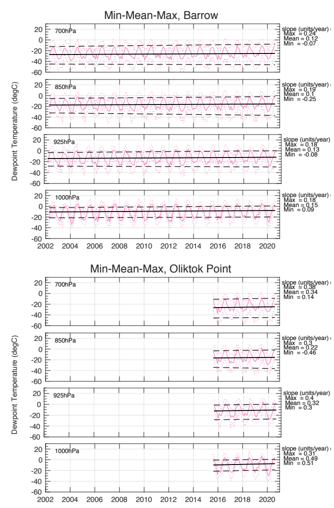


**Figure D.** Monthly mean (solid), maximum and minimum (dotted) dew points.

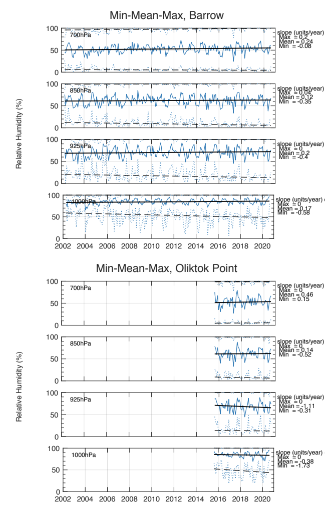


**Figure E.** Monthly mean (solid), maximum and minimum (dotted) RH with respect to water.

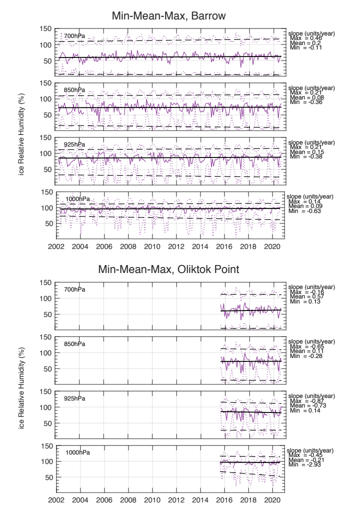


**Figure F.** Monthly mean (solid), maximum and minimum (dotted) RH with respect to ice.


**Acknowledgments** This work was supported by the U.S. Department of Energy (DOE) Atmospheric Systems Research (ASR) program under project DE-SC0013306. Data are from the ARM user facility, a U.S. DOE Office of Science user facility managed by the Biological and Environmental Research Program. Some figures use colors from www.ColorBrewer.org by Cynthia A. Brewer, Dept. of Geography, Penn State.


### Some Key References


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*presented at the AMS 34th Conference on Climate Variability and Change, 10–15 January 2021*