JAWS WORKFLOW TO HARMONIZE POLAR AUTOMATIC WEATHER STATION DATA: STATUS AND EARLY RESULTS

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http://github.com/jaws/jaws

1. OVERVIEW

Automated Weather Station and AWS-like networks are the primary source of surface-level meteorological data in remote polar regions. These networks have developed organically and independently, and deliver data to researchers in idiosyncratic ASCII formats that hinder automated processing and intercomparison among networks. NASA's AIST program supports our development of a scientific software workflow called “Justified" AWS (JAWS) to ingest AWS Level 2 (L2) data in the multiple formats now distributed, harmonize it into a common format, and deliver value-added Level 3 (L3) output suitable for distribution by the network operator, analysis by the researcher, and curation by the data center. JAWS adds scientific value to L3 output including: inferred station tilt angles (using RIGB algorithm) and accompanying radiometric and wind direction adjustments, GPS-derived ice velocity, and extrapolated surface temperatures and heat fluxes, all annotated with CF-compliant metadata.

We will discuss JAWS status and present Antarctic science results. Python-based, JAWS installs with Conda or Pip (github.com/jaws/jaws). It currently harmonizes data from four (and counting) AWS networks (AAWS, GCNet, IMAU, and PROMICE) that comprise over 130 stations and nearly 1500 station-years of data in Antarctica and Greenland. Current scientific applications include identifying and quantifying wind-driven polar night melt events and effects in Antarctica (Kuipers-Munneke et al., 2018, GRL), and estimating cloud radiative effects on Greenland (Wang et al., 2018ab, submitted to JGR). Network operators are experimenting with and providing feedback on the draft L3 format scheduled for completion in 2019. Comments, questions, and feedback from potential users and other network operators are appreciated.

2. ANTARCTIC & GREENLAND STATIONS

The JAWS workflow currently can process hourly L2 data from two networks in Antarctica comprising 59 Antarctic Automated Weather Stations (AAWS) operated by the AMRC, and 19 stations operated by the Institute for Marine and Atmospheric research Utrecht (IMAU). JAWS also works with three networks in Greenland: the Greenland Climate Network(GCNet, 26 stations), the Programme for Monitoring of the Greenland Ice Sheet (PROMICE network operated by GEUS, 25 stations), and 7 stations operated by IMAU. Together these 137 stations have recorded nearly 1500 station-years of data, more than half of which is from AAWS. Plans are to incorporate more and smaller networks once the L3 format now in beta-release is finalized.

The L3 format is based on netCDF, and is compliant with the Climate-Forecast (CF)

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metadata conventions. This common format allows datasets from all networks to be more easily inter-compared (Figure 1).

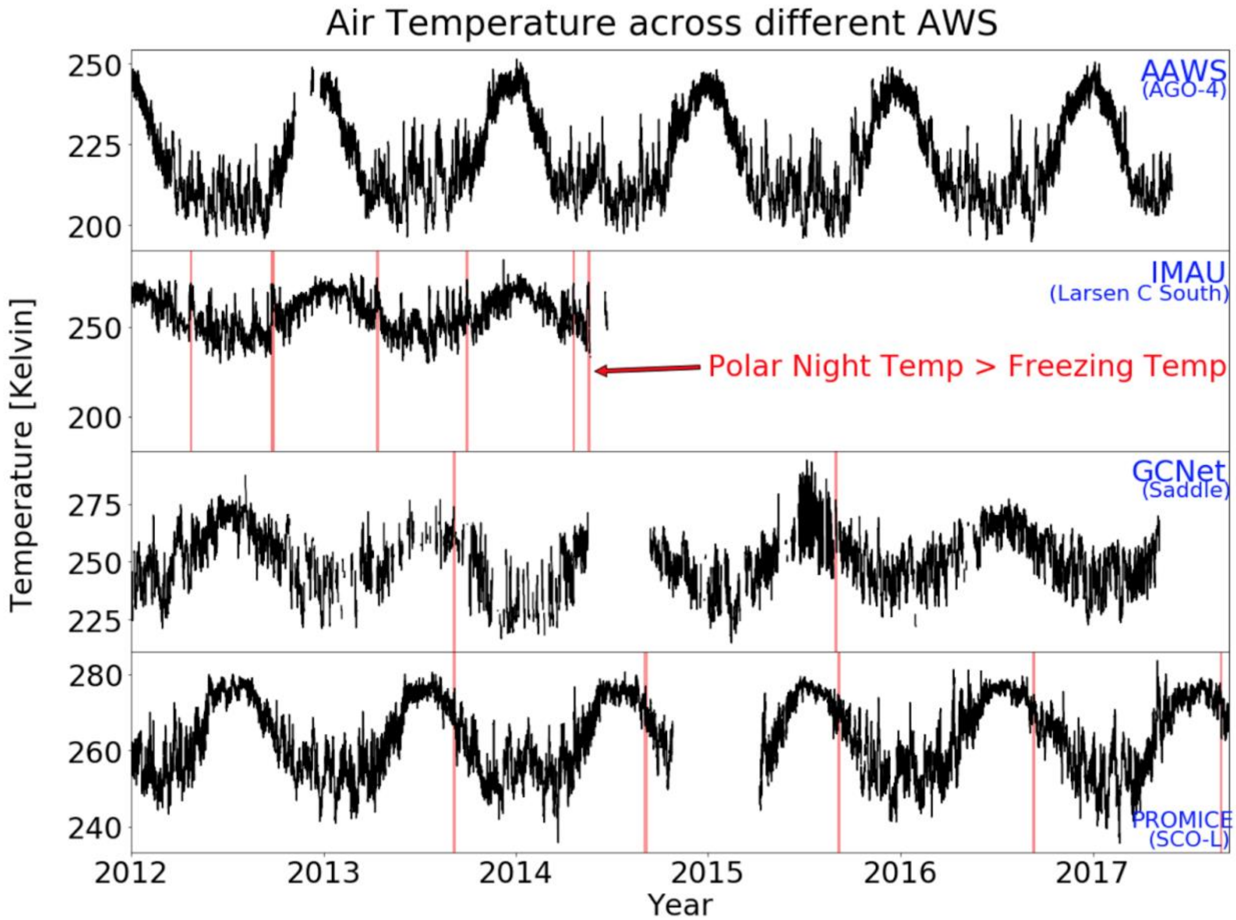

Figure 1. Temperatures from four AWS networks.

3. TILT CORRECTION

A primary goal of JAWS is to derive value-added data (zenith angles, surface flux estimates, extrapolations to standardized heights) to include with processed datasets. Most polar AWS with solar radiometry can benefit from tilt-correction (Wang et al., 2016). Using the Retrospective Iterative Geometry-Based tilt correction algorithm (RIGB) to adjust observed radiative fluxes and wind direction has improved the quality of hourly L2 data that now temporally resolves previously noisy features such as the bimodal distribution of net long wave (Wang et al., 2018a) (Figure 2).

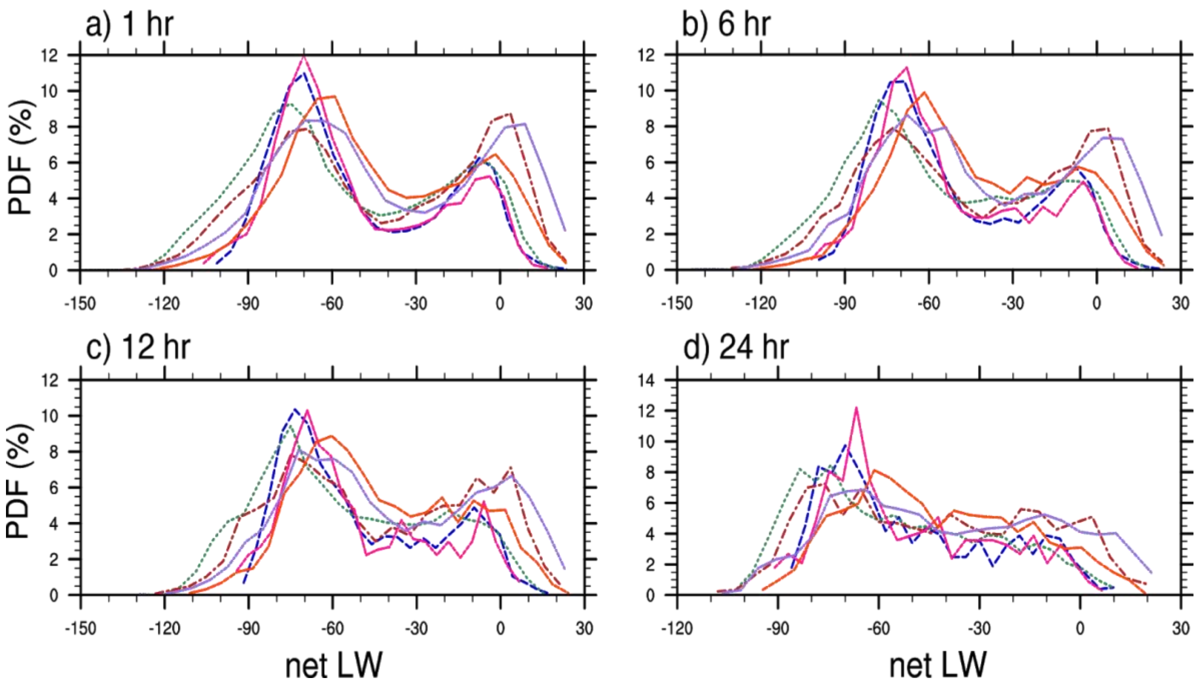

Figure 2. Hourly net LW on Greenland is bimodal.

Combining JAWS-processed data into a more spatially extensive product than any single network measures allows researchers to test gridded datasets (e.g., MERRA2, ERA-I, CERES, ASR, LENS, RACMO) against the in situ AWS measurements of surface albedo and Cloud Radiative Effects (CRE) (Wang et al., 2018b) (Figure 3).

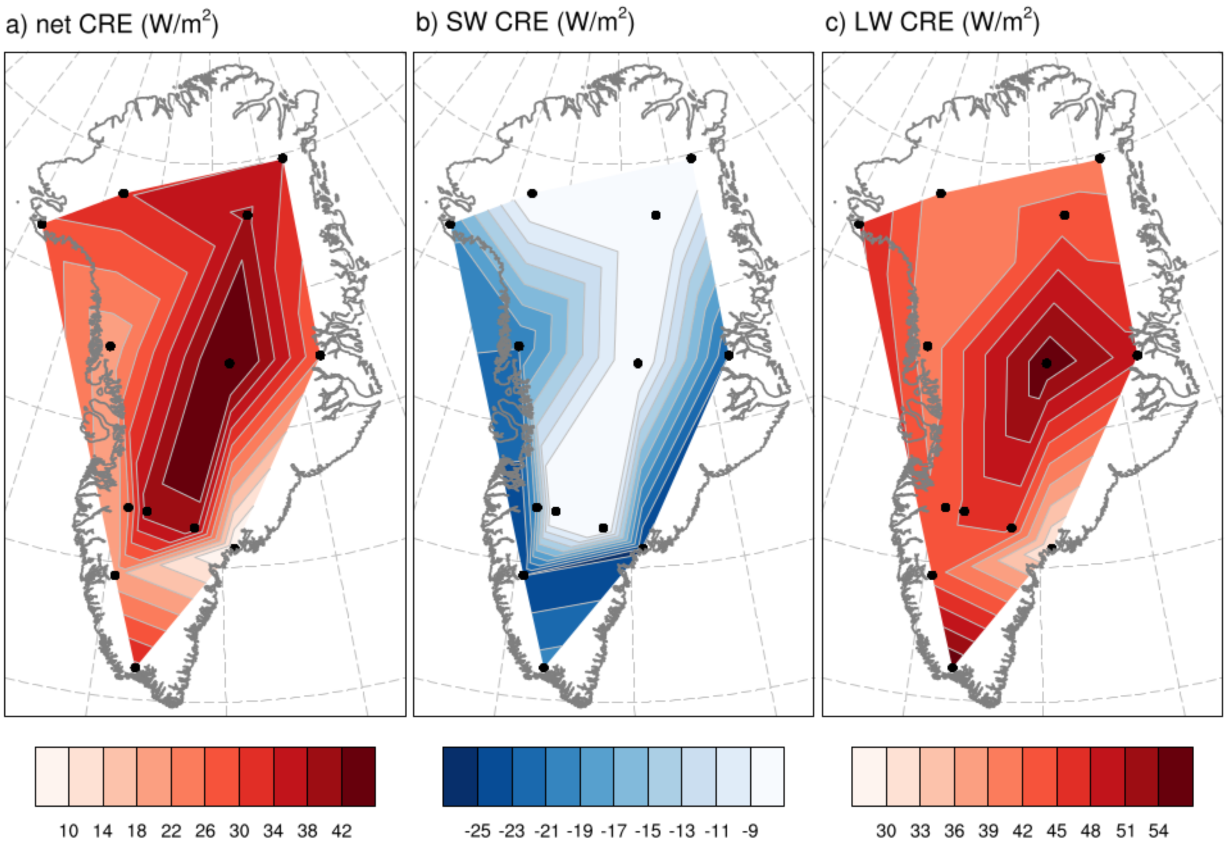

Figure 3. Melt-season CRE from AWS.

4. FOEHN-WIND DETECTION

Researchers recently discovered that foehn winds cause melt on Larsen C ice shelf even during polar night (Kuipers-Munneke et al., 2018). JAWS-processed data was used within the RACMO model to demonstrate that up to 25% of annual surface melt at an AWS in Cabinet Inlet occurs during polar night. The extent and intensity of foehn-driven melt along at other coastal locations remains unknown, though intriguing due to its potential to densify firn in ice shelves vulnerable to hydro fracture. We are developing a Foehn Detection Algorithm (FonDA) for AWS and re-analysis datasets in order to quantify polar night melt on these larger spatial scales.

5. FUTURE

JAWS was recently endorsed as a Year of Polar Prediction (YOPP) project. Summer will be dominated by work to implement RIGB in JAWS. We anticipate JAWS version 0.5 will be released in July after incorporating feedback received from collaborators and early adopters during summer face-to-face meetings, and that version 0.6 will include RIGB.

6. ACKNOWLEDGEMENTS

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