Near-Real Time Monitoring of Cold Air Aloft for Aviation Safety in the United States and Canada

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Background and Data

- Monitoring temperature at cruising altitudes is important for aircrafts flying over the United States and Canada during winter months.
- Cold air aloft can be hazardous as jet fuel begins to gel at -65 C, which can cause engine malfunctions and increase risk of aircraft loss.
- Low number of upper air observations (especially at the higher latitudes where both cold air and great circle airways are common) makes it difficult to identify regions to be avoided.
- **Solution:** Use of near-real time observations from polar-orbiting satellite sounders
- Temperature observations from five pressure levels near cruising altitudes are retrieved from NUCAPS thermodynamic profiles.
- These observations are displayed in RealEarth, a web-based display program developed by the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison, and update in near-real time.

Data Used

Satellite sounder data: NOAA-Unique Combined Atmospheric Processing System (NUCAPS)
- Uses brightness temperature observations from the Cross-track InfraRed Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) onboard the NASA Suomi-NPP (SNPP) and the NOAA-20 satellites.
- Community Satellite Processing Package (CSPP) NUCAPS is used in this study
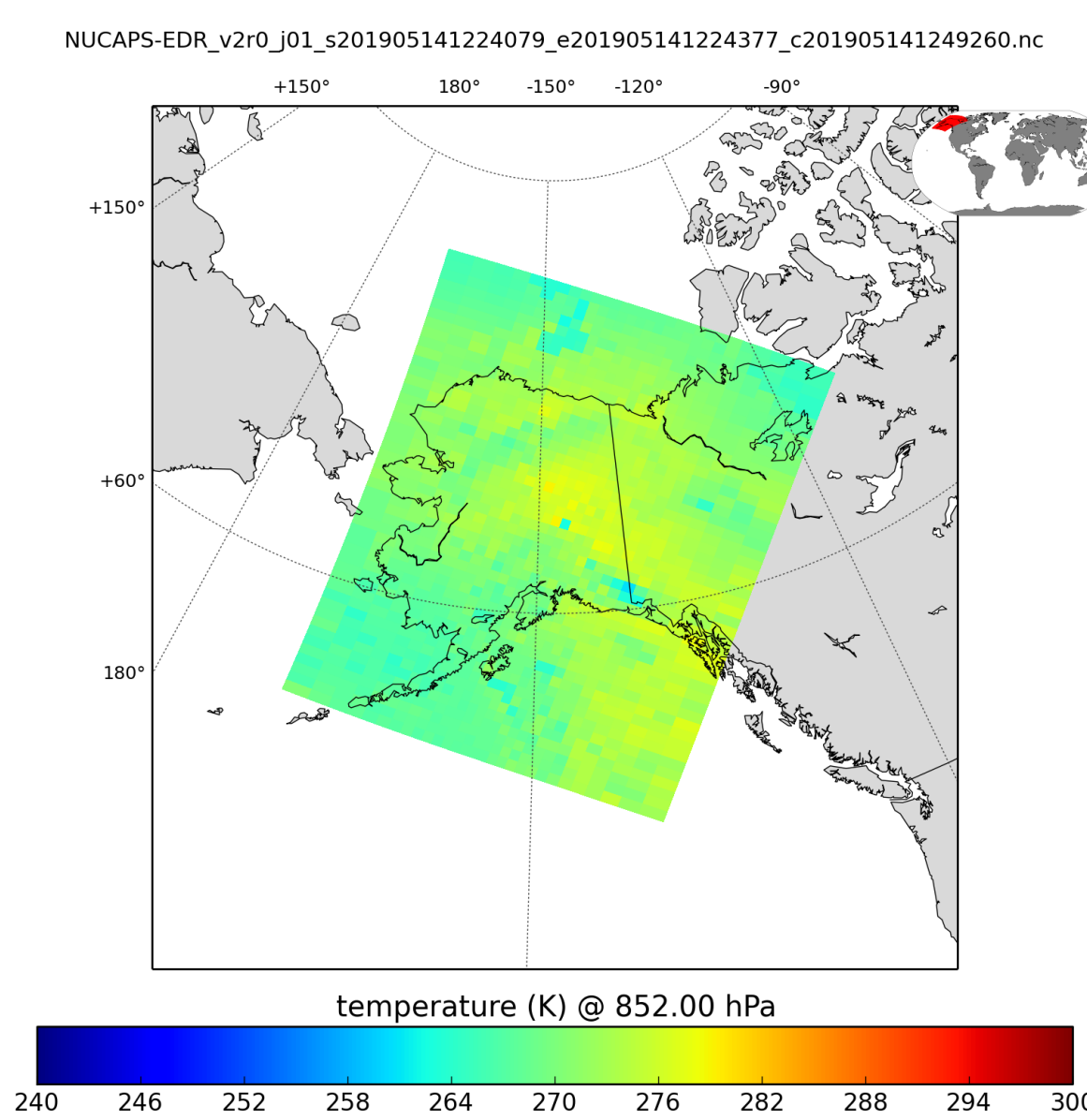
Aircraft data: Aircraft Meteorological DAta Relay (AMDAR)
- Used hourly AMDAR files for validation of NUCAPS

References and Contact

- Bloch, Callyn, et al. "Near-real time Surface-Based CAPE from Merged Hyperspectral IR Satellite Sounder and Surface Meteorological Station Data." *Journal of Applied Meteorology and Climatology* (2019).
- Feltz, Michelle, et al. "Towards Aiding Aviation Safety: Detection of Cold Air Aloft Using COSMIC RO and AIRS Hyperspectral IR Sounder." 96th American Meteorological Society Annual Meeting, New Orleans, Louisiana (2016).

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SSEC RealEarth
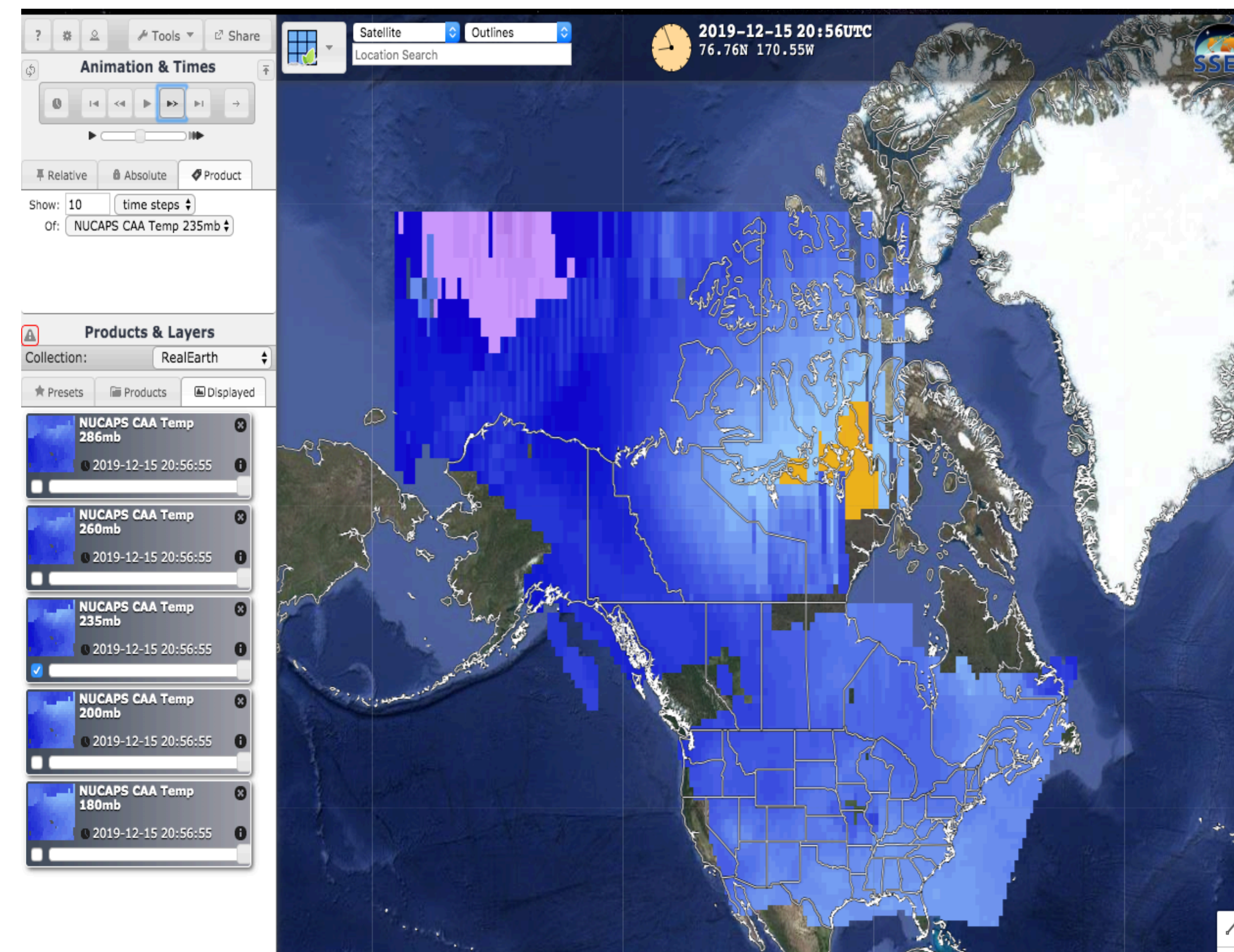
- RealEarth: currently being used to display the near-real time NUCAPS Cold Air Aloft product at 5 pressure levels: 180mb (41,000ft), 200mb (38,600ft), 235mb (35,270ft), 260mb (34,000ft), and 286mb (32,000ft).
- RealEarth is user friendly, easy to use.
- Example of NUCAPS CAA temperature at 235mb product that updates in near-real time after the satellite overpass
    - Available on the website and RealEarth™ app.
    - NUCAPS Cold Air Aloft products are displayed under the **'JPSS - NUCAPS' tab https://realearth.ssec.wisc.edu**

Direct Broadcast Sites

NUCAPS EDR software for retrieval of atmospheric profiles from input Suomi-NPP and NOAA-20 CrIS and ATMS SDRs.
- Software to process the data is available from the Community Satellite Processing Package (CSPP) available from SSEC at http://cimss.ssec.wisc.edu/cspp

- Currently merging data from 6 Direct broadcast systems for better coverage of CONUS, Alaska, and Canada
    - Space Science and Engineering Center (SSEC) – University of Wisconsin - Madison
    - NOAA CREST – The City College of New York
    - The Geographic Information Network of Alaska (3 sites)
    - Edmonton, Alberta, Canada

Validation

Case days: 28-31 January 2019
- During 2019 North American Polar Vortex
- Left: Two hourly examples of NUCAPS and AMDAR matchups

Hourly AMDAR temperature data matched with gridded/smoothed NUCAPS temperature data
- Matched at the 5 NUCAPS pressure levels used
- AMDAR data points matched within 100 km to the nearest NUCAPS gridpoint

NUCAPS and AMDAR - well correlated for this case study