Examination of the Experimental High-Resolution Rapid Refresh – Alaska

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Experimental HRRR-AK

The Model

- Run every 3 hours out to 36 hours. Output available hourly at 3 km resolution
  - Via ftp from NOAA ESRL

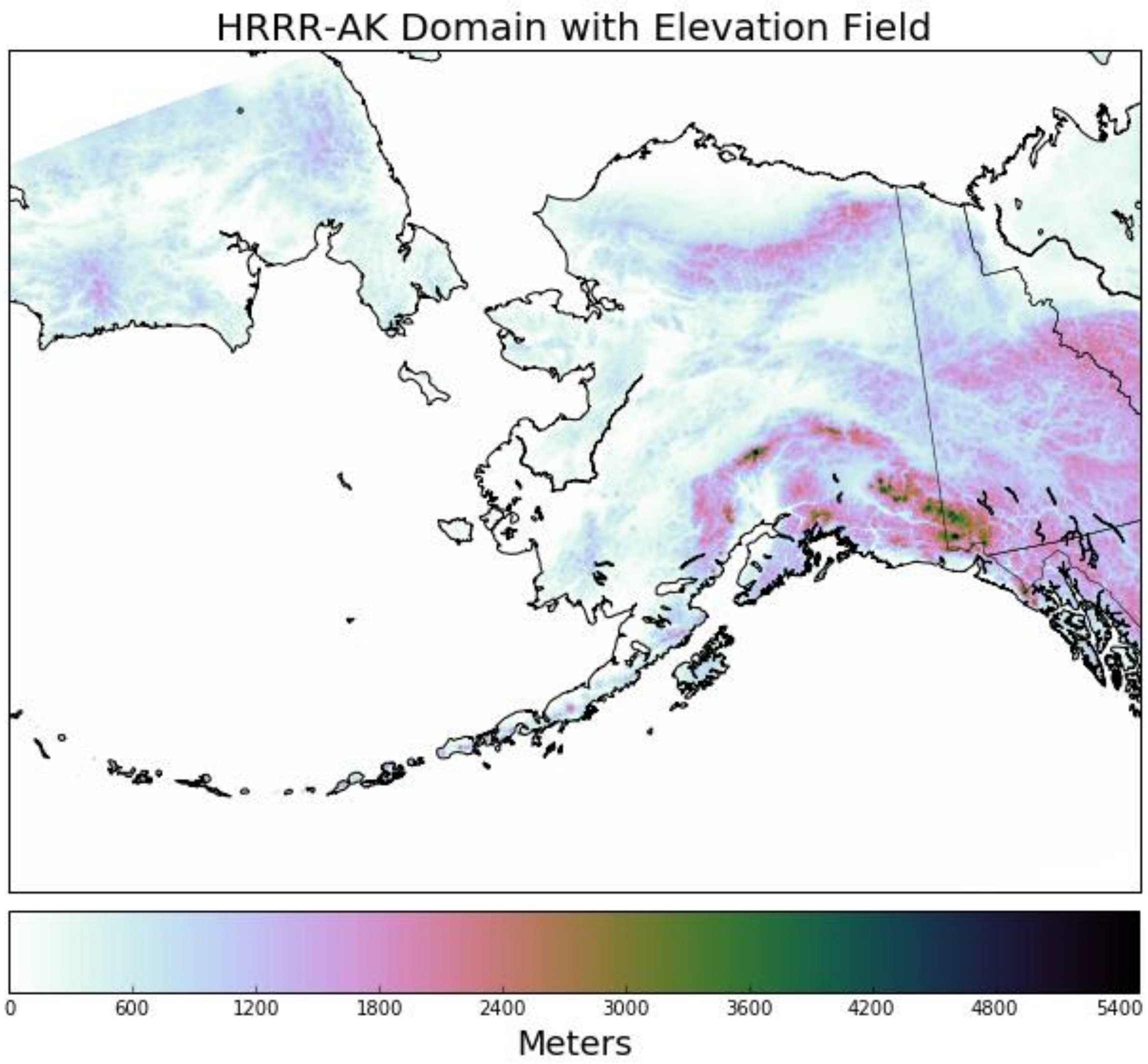
- Graphics available: https://rapidrefresh.noaa.gov/hrrr/ALASKA/

Data Examined

- October 2016 – present; Focusing on period after 1 Dec 2016 due to model configuration change

- Surface fields ~3GB/day; 430GB total stored in S3 archive

HRRR archive courtesy of Brian Blaylock, U of Utah



Objectives

- Examine the performance of the experimental HRRR-AK at hourly intervals for high-impact weather events, as well as cumulatively over the 2016-17 winter

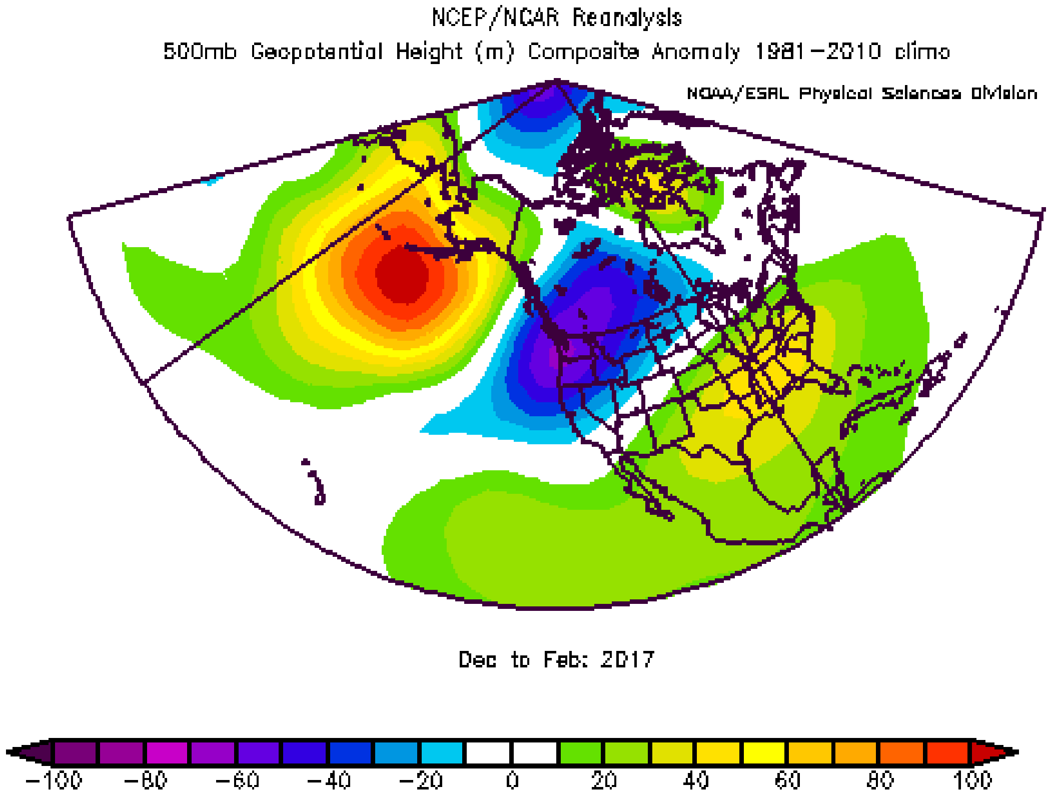
- Transition this summer towards examining fire weather applications of HRRR-AK analysis and forecast products

Analysis Approach

- Use many cases to evaluate the ability of the HRRR to forecast the progression of high-impact winter storms at high (hourly) temporal resolution
  - Are errors apparent in amplitude and/or phasing of synoptic and mesoscale systems?
  - Bulk error statistics calculated over portions of the winter

- *However, extended ridging dominated 2016-2017 winter; Affected number of systems available to examine*

- Attention shifted after 12-14 February 2017 to the downslope windstorm near Ft. Greely as an example of the type of high-impact weather event that can affect fire weather
  - +35º C Warm-up in 36 hours, winds gusted to 30 m/s (60 kts)



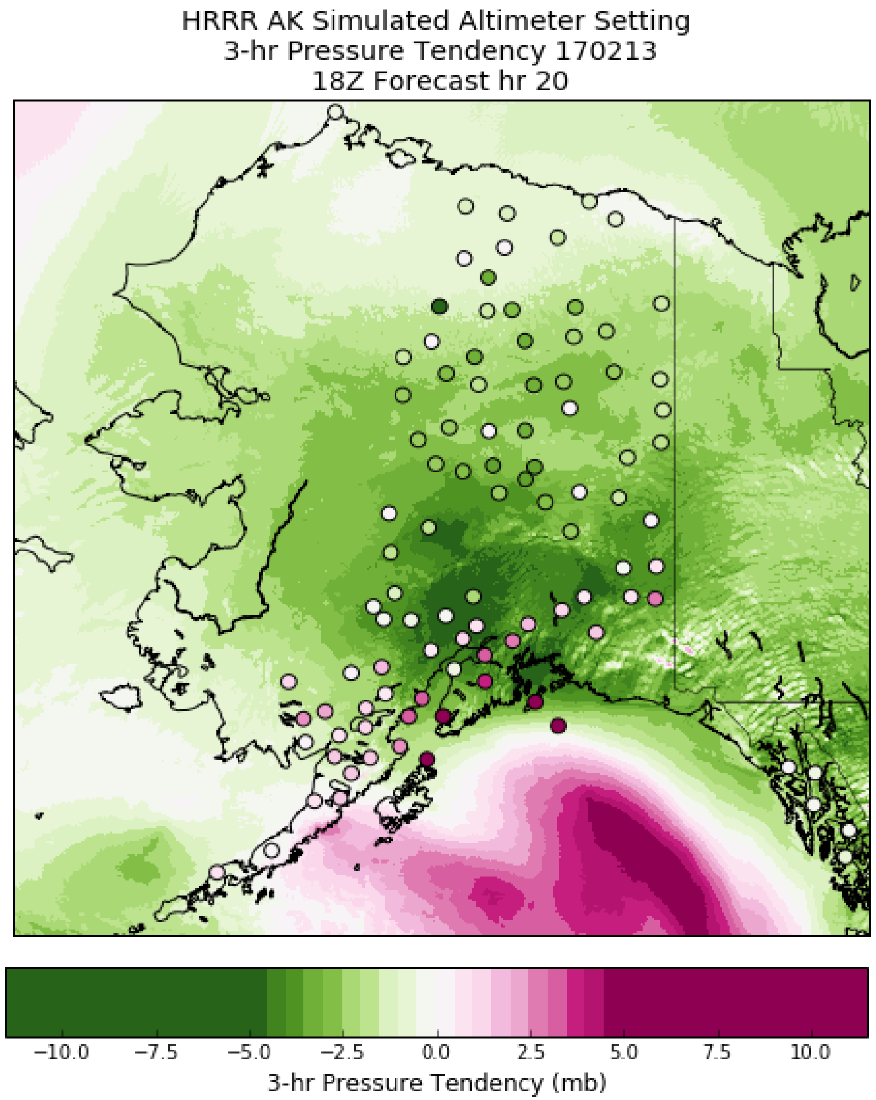
Examining High Temporal and Spatial Output from AK-HRRR

- Initial focus on examining the pressure field over long periods to examine how well the model handles the structure (intensity, phasing, timing) of weather systems

- Pressure adjusted for elevation (altimeter) has a higher degree of spatial homogeneity than variables like temperature and wind speed

- Examine 3-h pressure tendencies to focus on evolution of systems

- For case study, using all available data including wind, temperature, and satellite-derived soundings

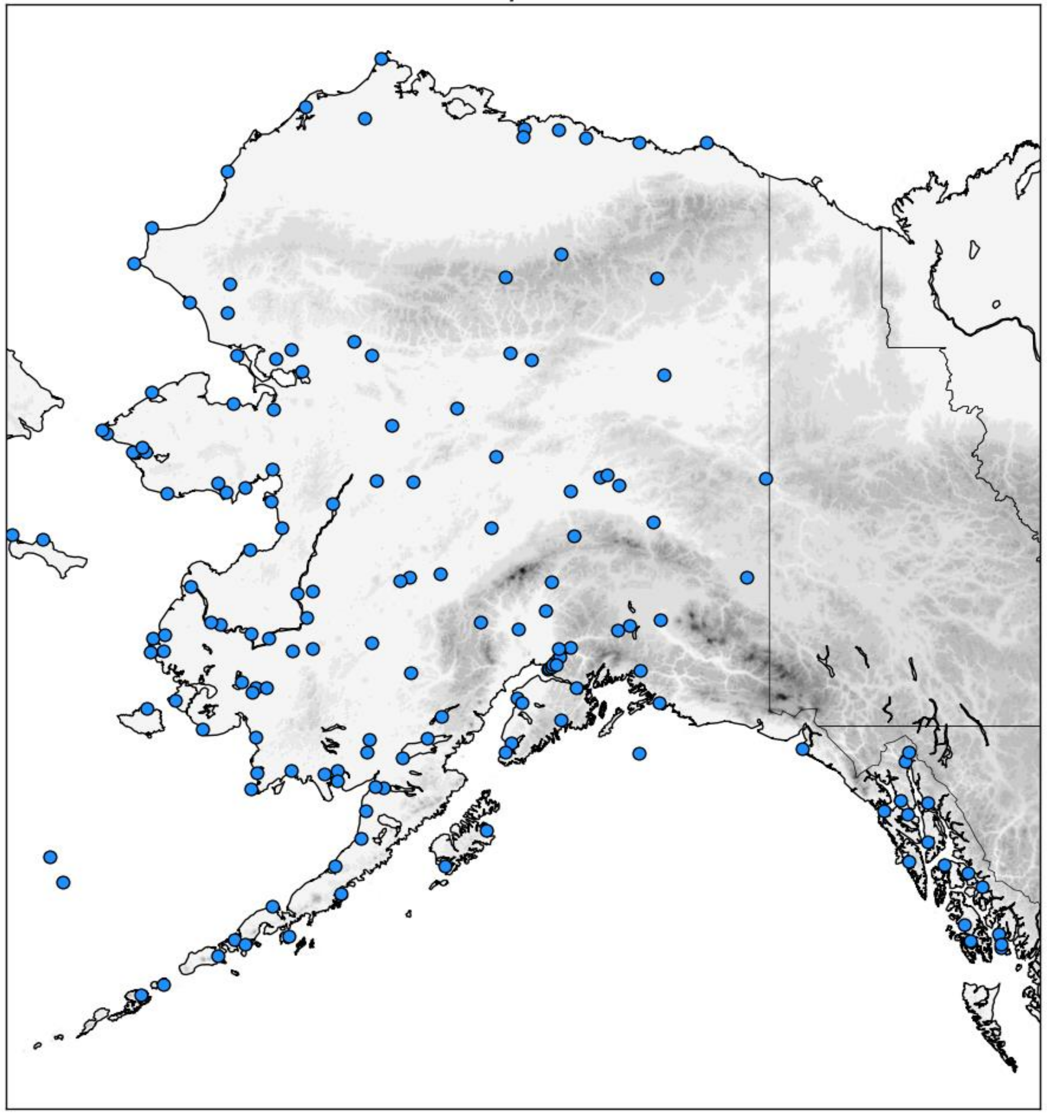


Resources for Evaluating AK-HRRR

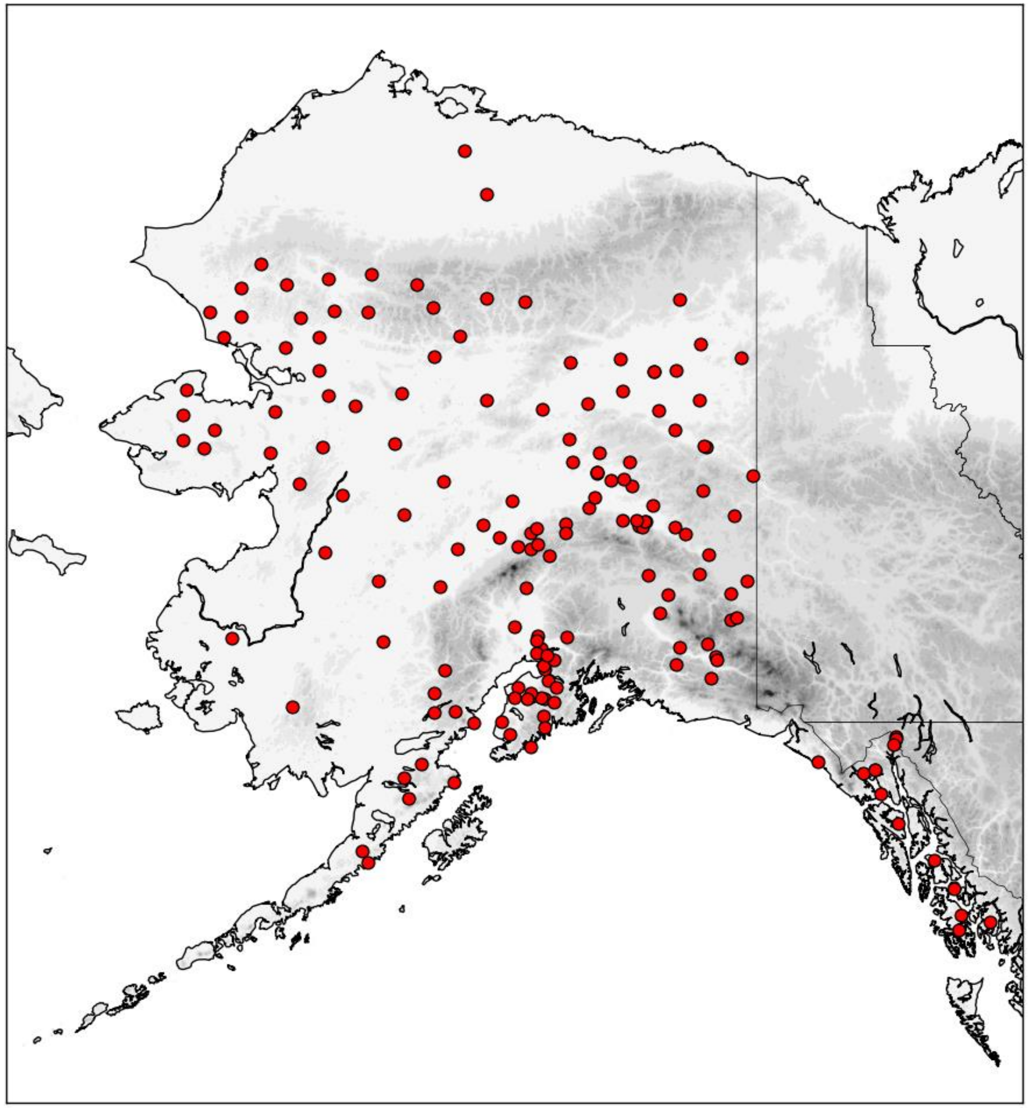
- In Situ observations archived by MesoWest (mesowest.org)
  - National Weather Service (NWS)/Federal Aviation Administration (FAA) station data
  - Remote Automated Weather Stations (RAWS)
  - Surface mesonets (AK DOT, Fort Greely)
  - USArray Seismic Network

- Remote Sensing: NOAA-Unique Cross-Track Infrared Sounder (CrIS)/ Advanced Technology Microwave Sounder (ATMS) Processing System (**NUCAPS**) Soundings

NWS/FAA



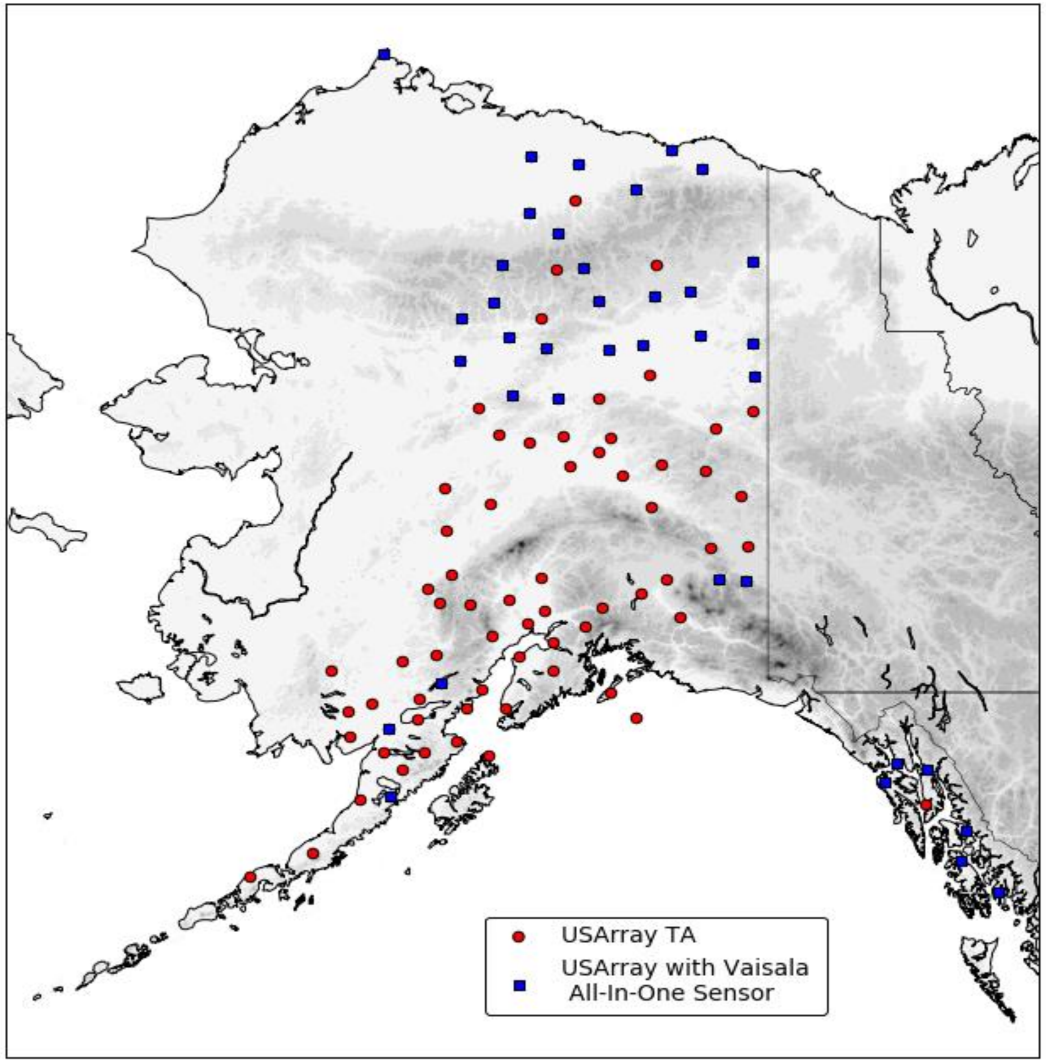
RAWS



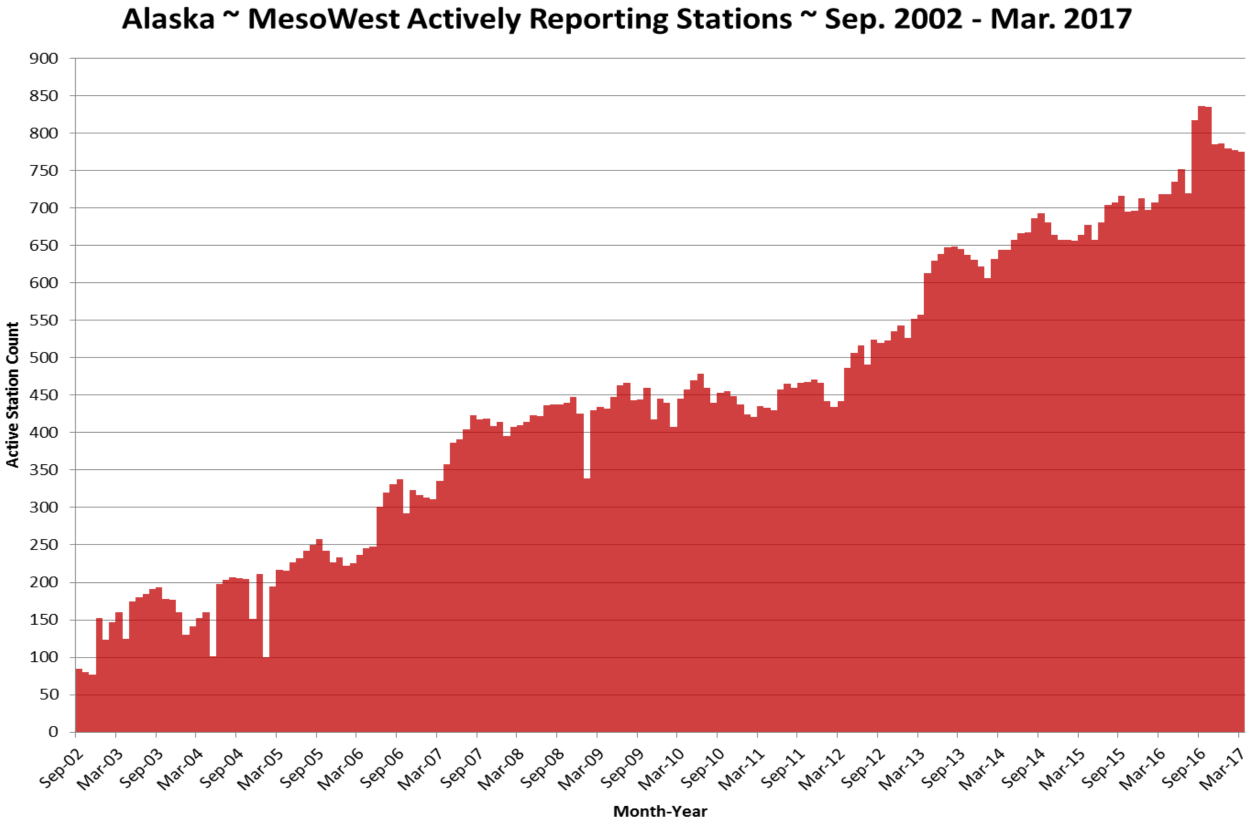
EarthScope USArray Transportable Array

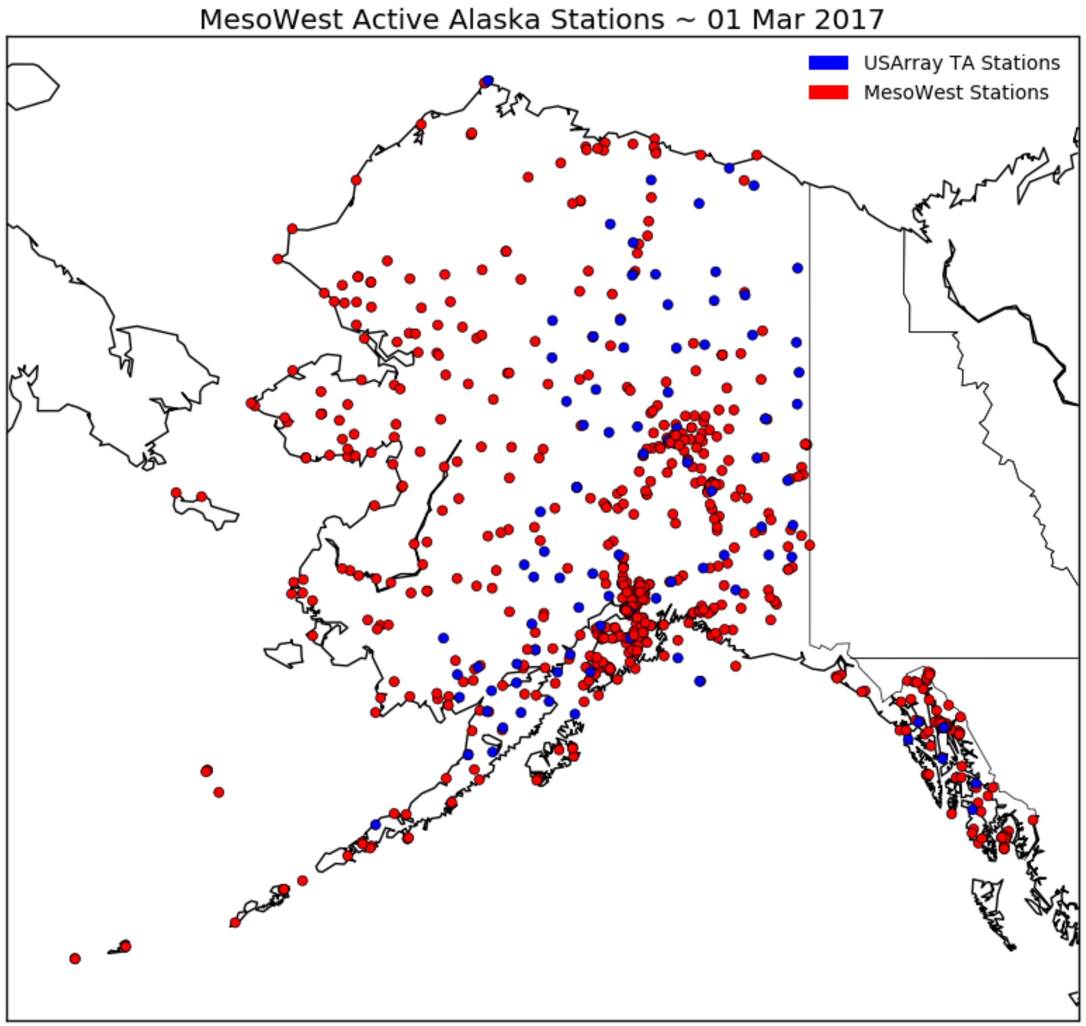
- Hi-res seismic stations, originally deployed in CONUS from 2004-2015 (Jacques et al. 2016)
- Implemented microbarographs in 2009; Sample barometric pressure at 1 Hz
- 275 stations with pressure sensors being redeployed in AK through 2019 in 85 km quasi-grid
- 37 stations with Vaisala all-in-one sensors deployed so far

Real-time and archived USArray TA data
http://meso1.chpc.utah.edu/usarray/



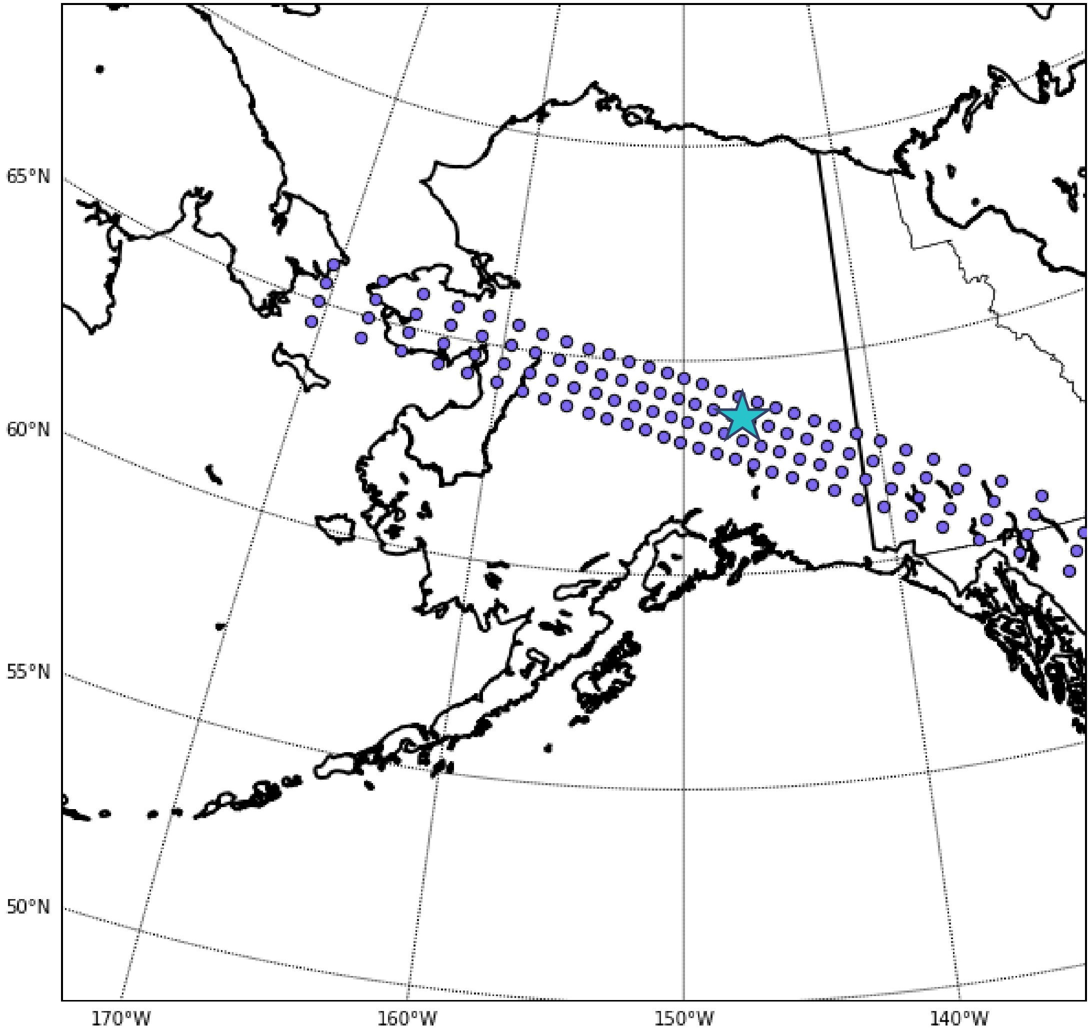
MesoWest (mesowest.org)





Images courtesy of Alex Jacques

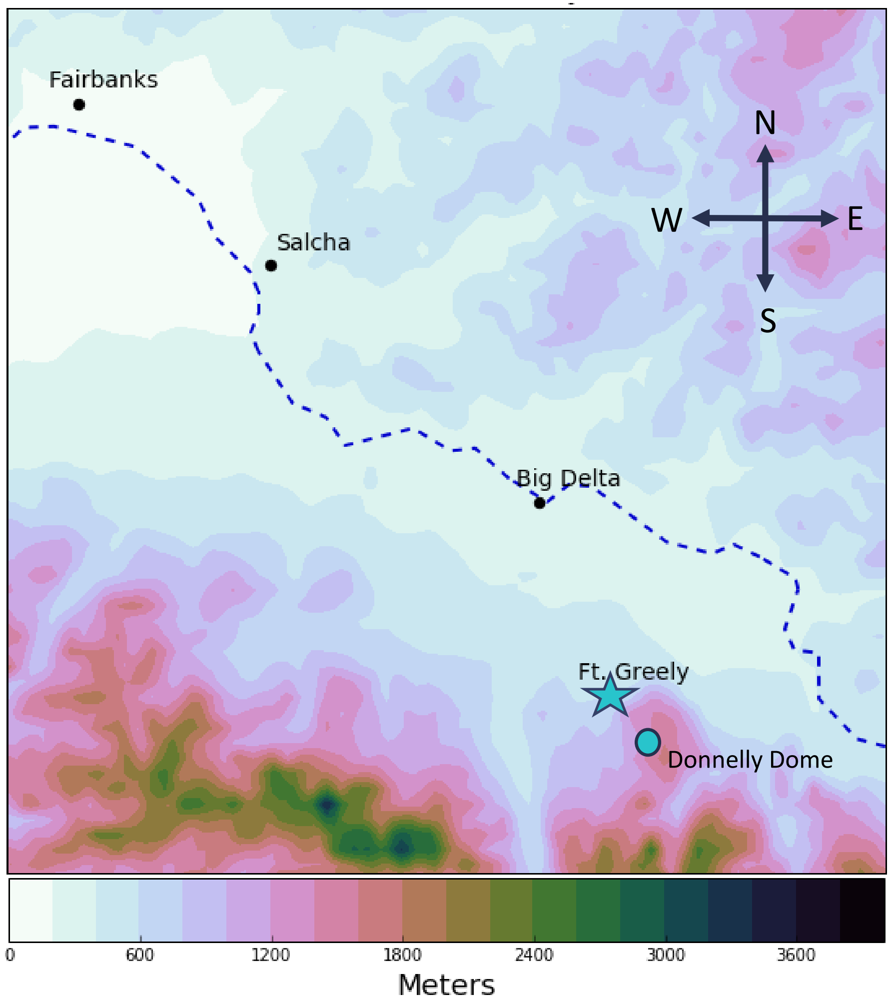
NUCAPS Sounding Products



- From the Joint Polar Satellite System (JPSS) Suomi National Polar-orbiting Partnership (S-NPP)
- The JPSS is a NOAA satellite mission in collaboration with NASA
- CrIS and ATMS suite (CrIMSS) designed to measure infrared and microwave radiances in order to produce vertical profiles of environmental data such as temperature, moisture, and pressure (*Nalli et al. 2013*)

NUCAPS Data available at
http://www.class.ncdc.noaa.gov/
Or via ftp at
ftp://ftp-npp.class.ngdc.noaa.gov/

HRRR-AK Evaluation: Case Study: 12-14 Feb 2017

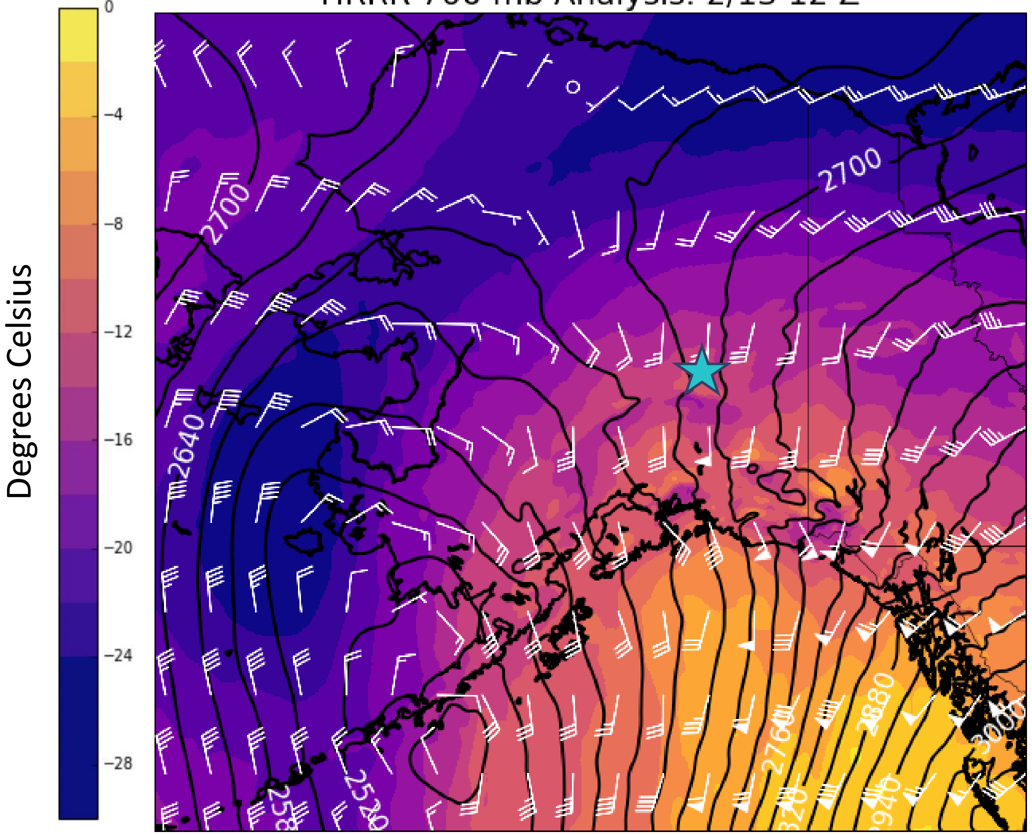


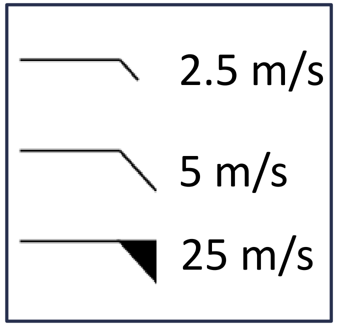
- Rapid Warm-up (+35º C in 36 hr)
  - Strong downslope (Chinook) wind at Ft. Greely
  - Downslope winds common in region (Nance and Colman 2000)

Chinook Wind: *Flow modified by orography where air descends a mountain slope, rapidly drying and warming as it approaches the surface*

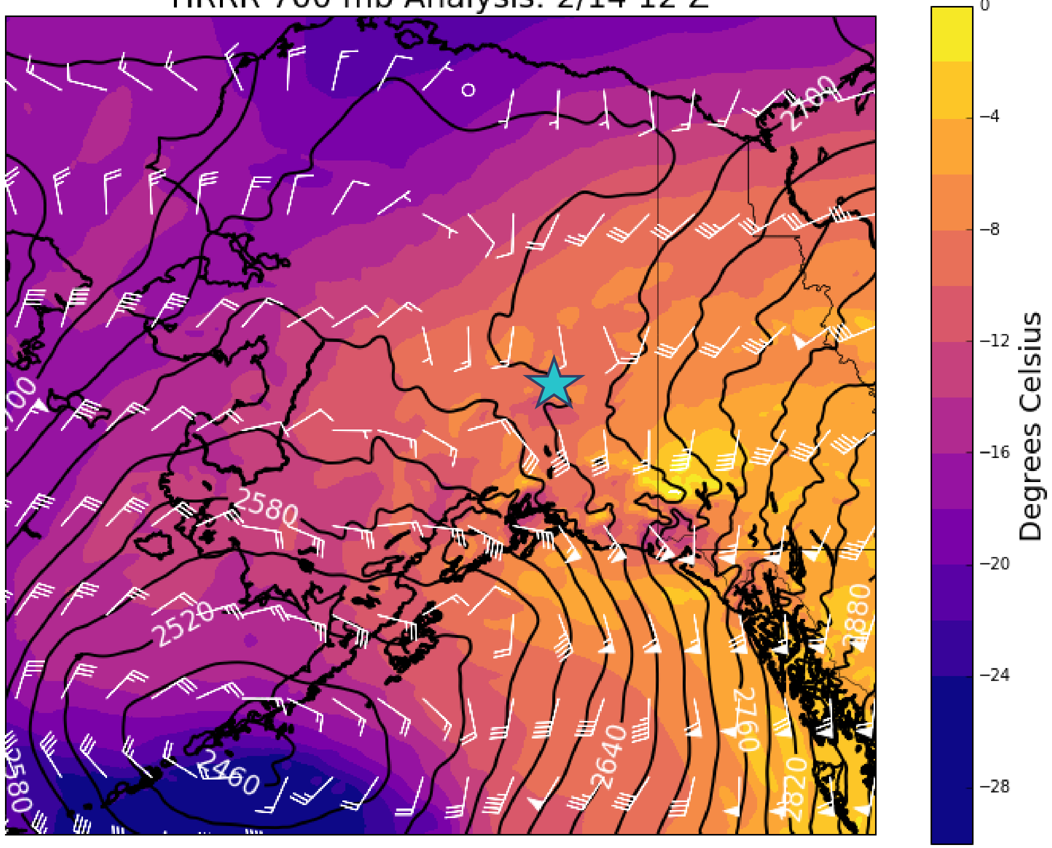
Synoptic Setting:
HRRR-AK Analyses – 2/13 & 2/14 12Z

HRRR 700 mb Analysis: 2/13 12 Z

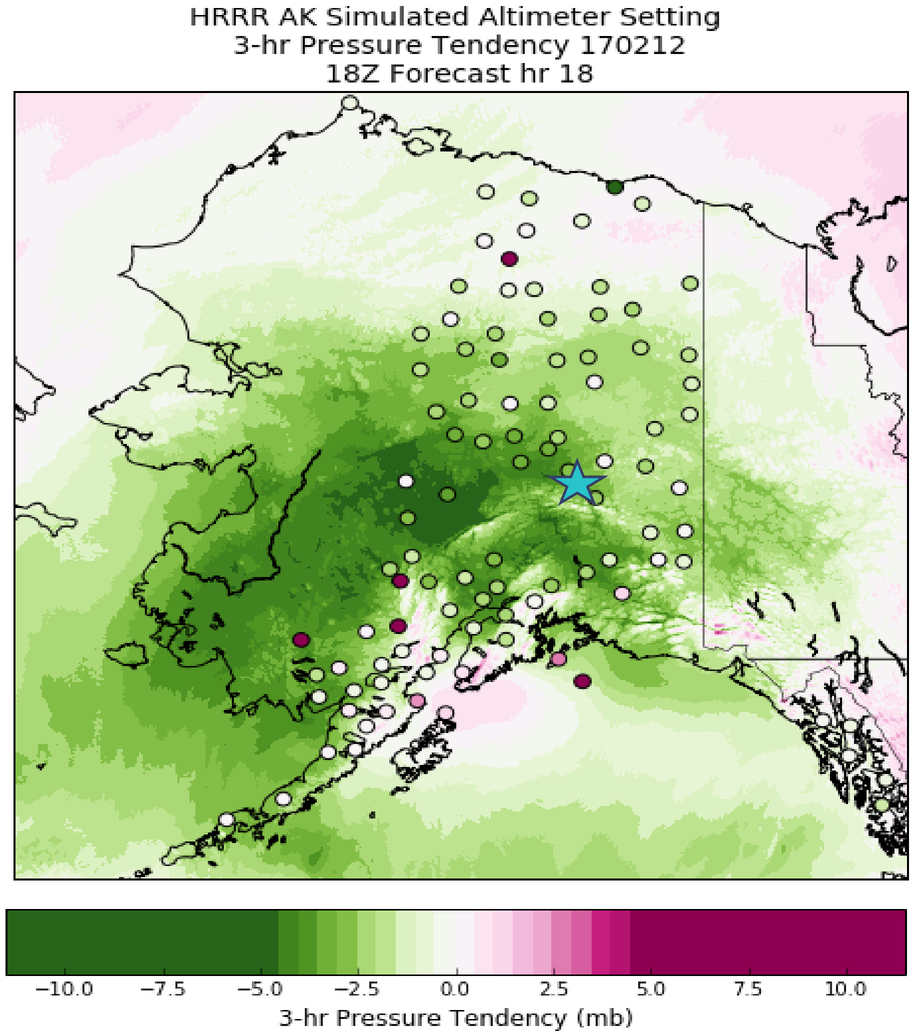


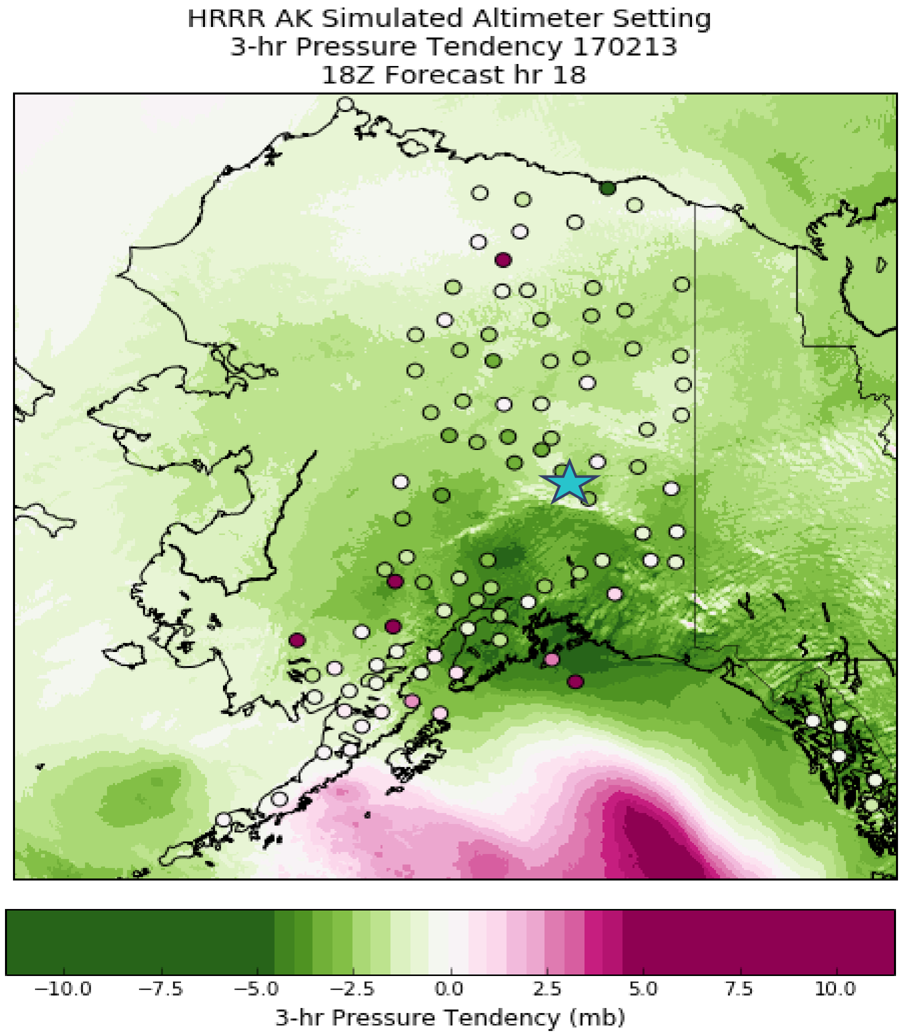


HRRR 700 mb Analysis: 2/14 12 Z

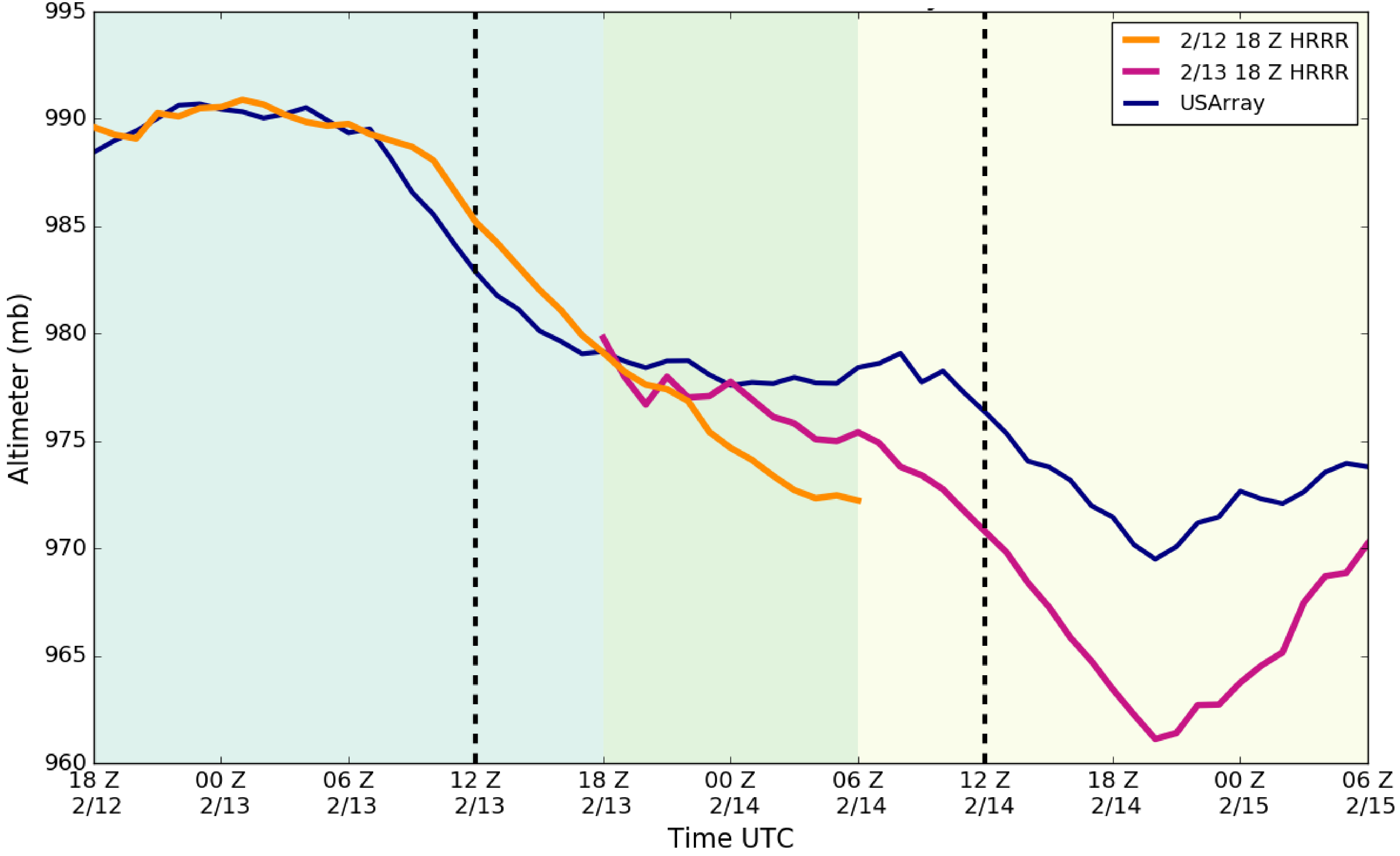


18 h Forecast Pressure Tendencies
Valid at 2/13 12Z and 2/14 12Z

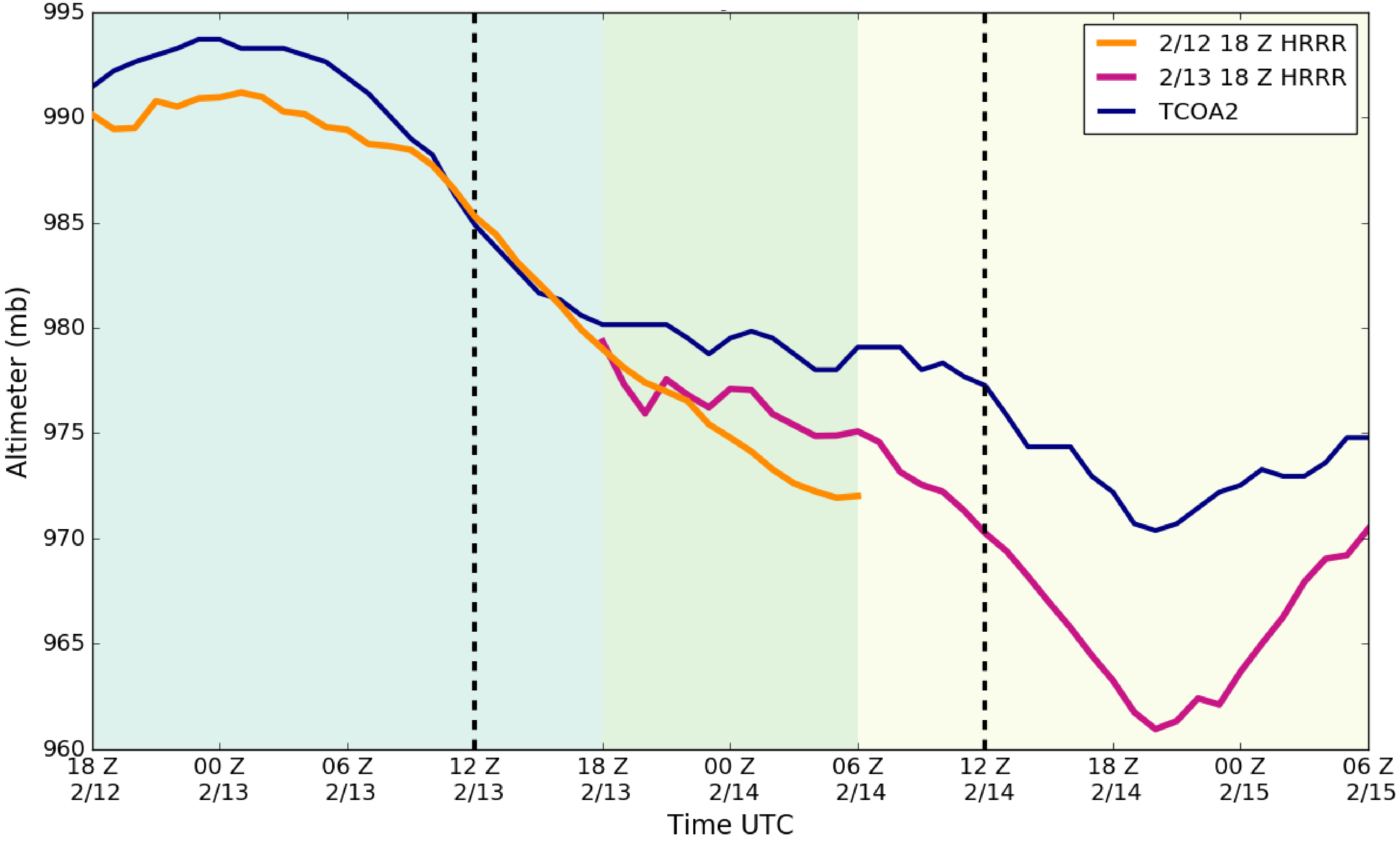


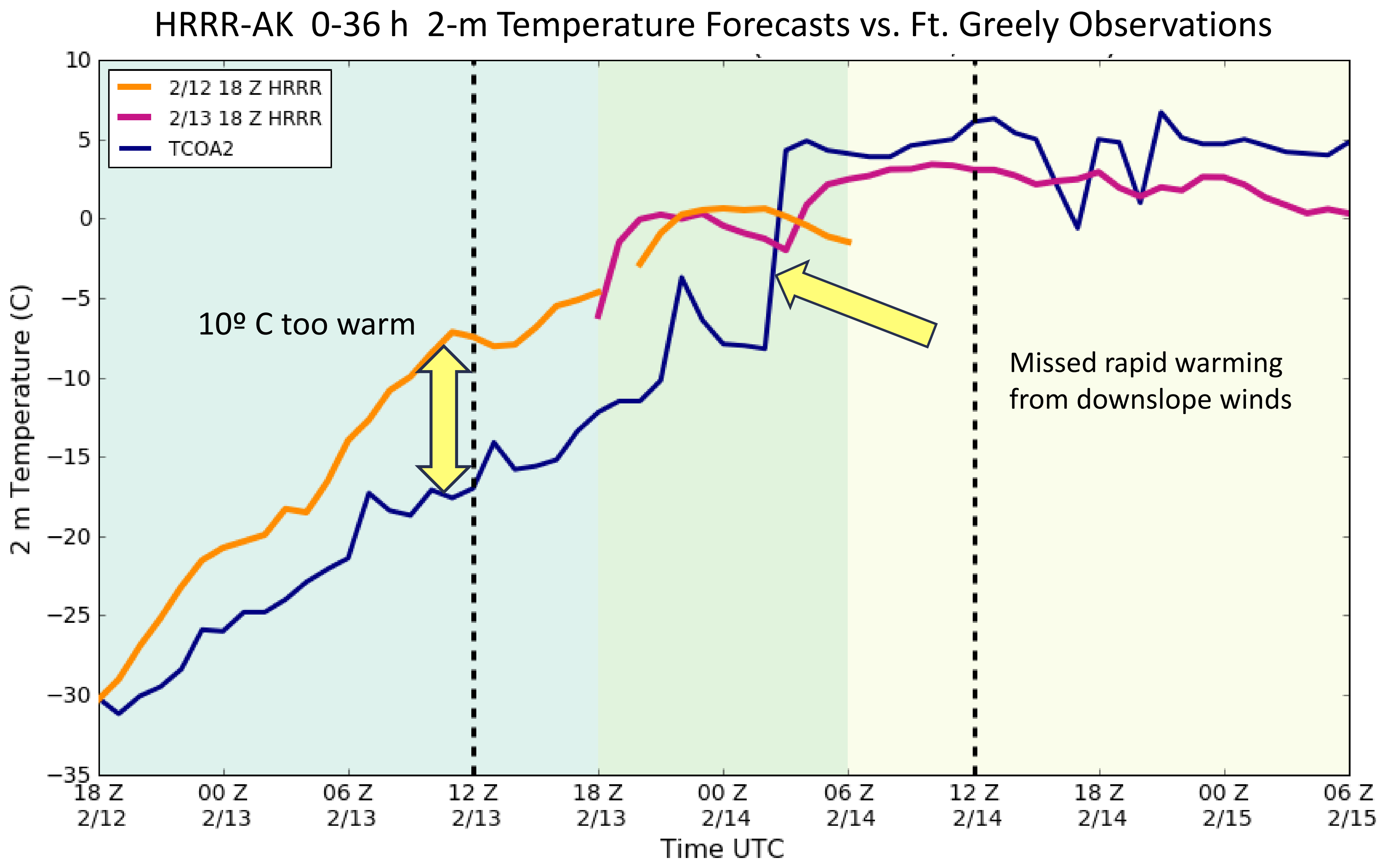


HRRR-AK Altimeter 0-36 h Forecasts vs. USArray Donnelly Dome Observations



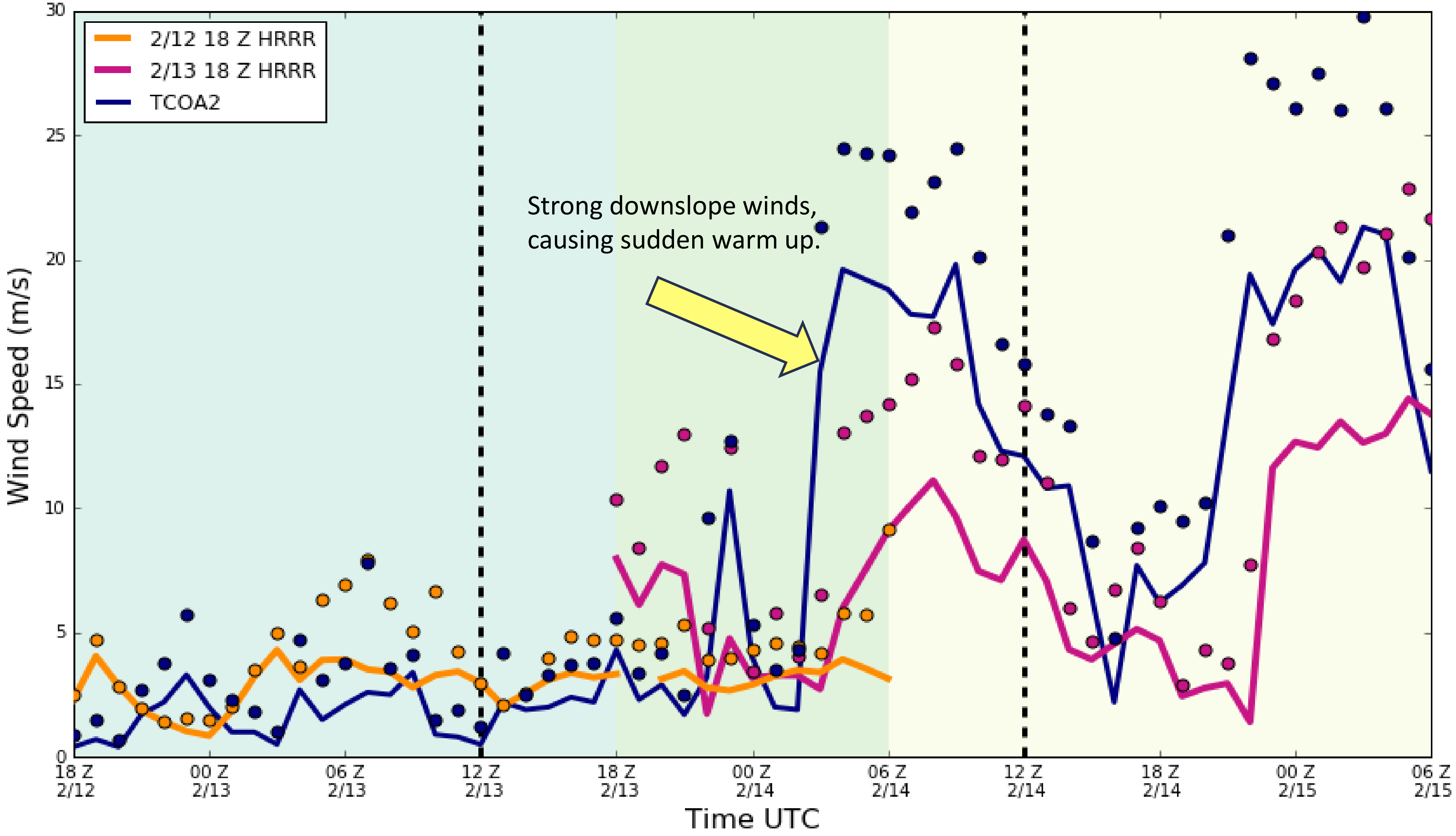
HRRR-AK Altimeter 0-36 h Forecasts vs. Ft. Greely Observations



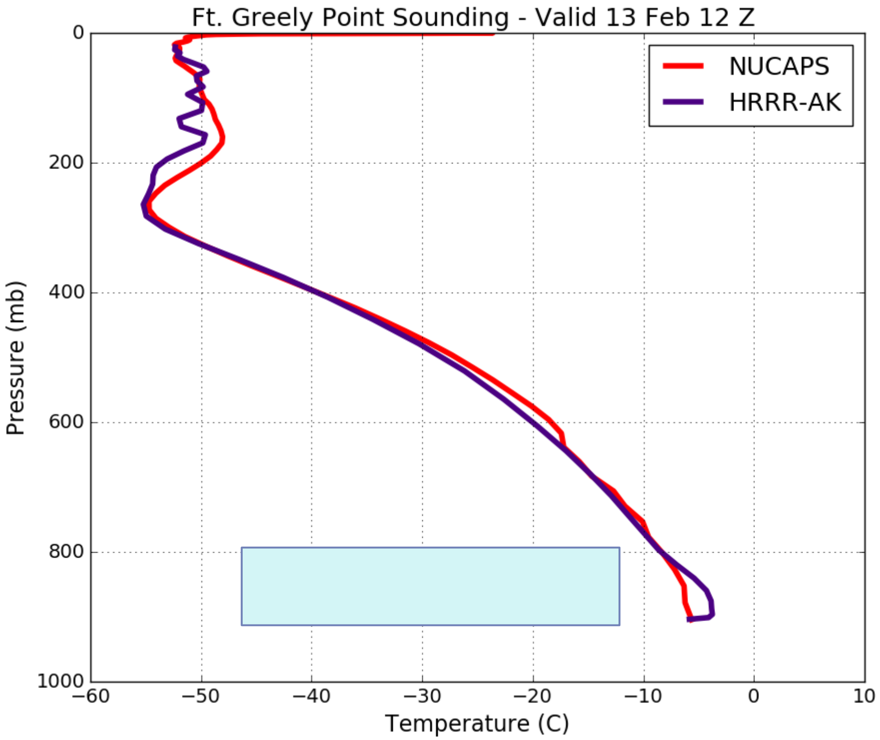


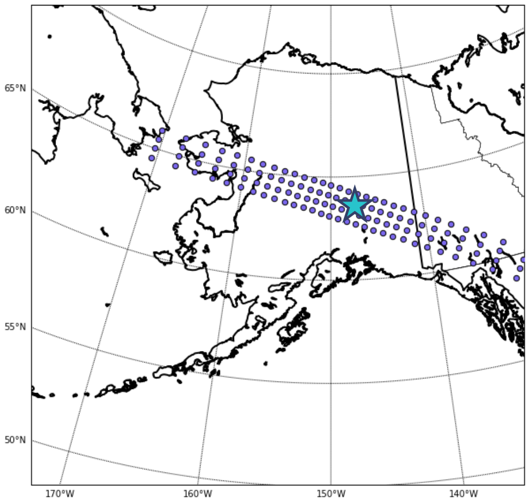
HRRR-AK 0-36 h 2-m Temperature Forecasts vs. Ft. Greely Observations
2/12 18 Z HRRR
2/13 18 Z HRRR
TCOA2
10º C too warm
Missed rapid warming
from downslope winds
2 m Temperature (C)
10
5
0
−5
−10
−15
−20
−25
−30
−35
18 Z 2/12
00 Z 2/13
06 Z 2/13
12 Z 2/13
18 Z 2/13
00 Z 2/14
06 Z 2/14
12 Z 2/14
18 Z 2/14
00 Z 2/15
06 Z 2/15
Time UTC

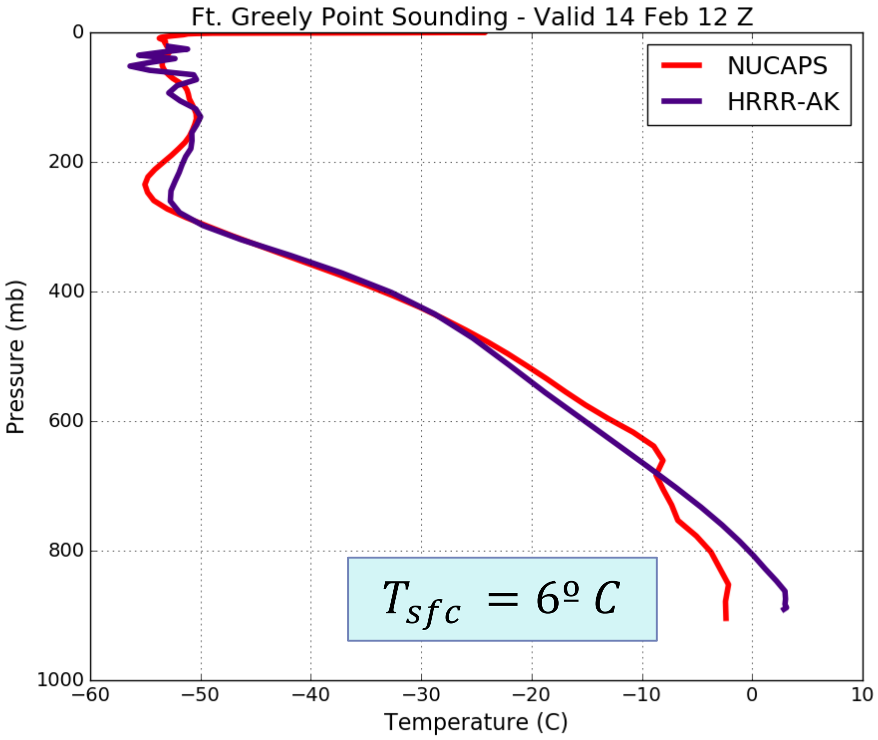
HRRR-AK 0-36 h 10 m Wind Speed & Gust Forecasts vs. Ft. Greely Observations



Soundings: 2/13 & 2/14 at 12Z







HRRR-AK Forecast Hr 18 from 2/12 and 2/13 18z runs

Summary & Future Work

- Developing archive of experimental HRRR-AK products at high temporal (1h) and spatial (3km) resolution
- Downslope wind storm near Ft. Greely highlights how the HRRR-AK products can be evaluated relative to surface observations & satellite vertical profiles
- Have proposed to evaluate the HRRR-AK's performance for fire weather cases during summer 2017 using available surface observations (RAWS, USArray, etc.) and satellite sounding products such as from NUCAPS with a focus on the model's ability to capture convective outflows in the vicinity of major fires

We appreciate feedback and suggestions, particularly for other potential surface-based or remote sensing observations appropriate for model validation

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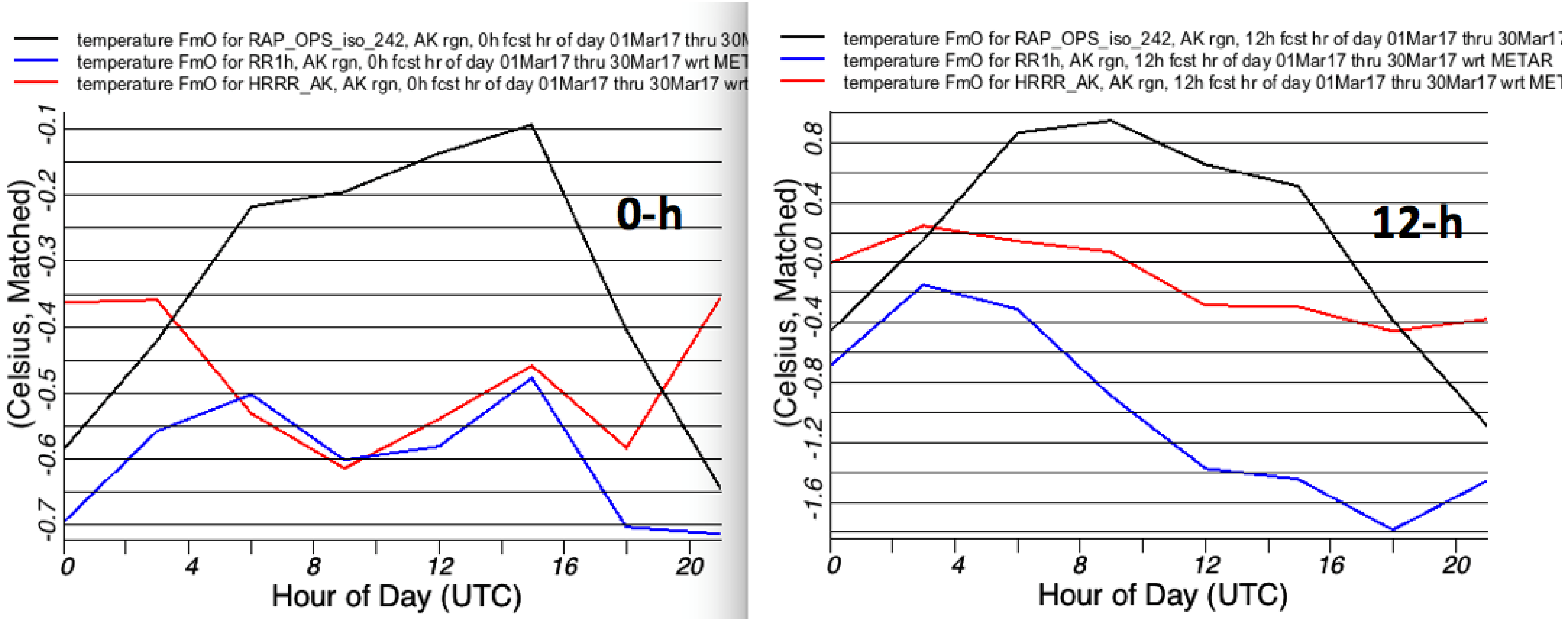
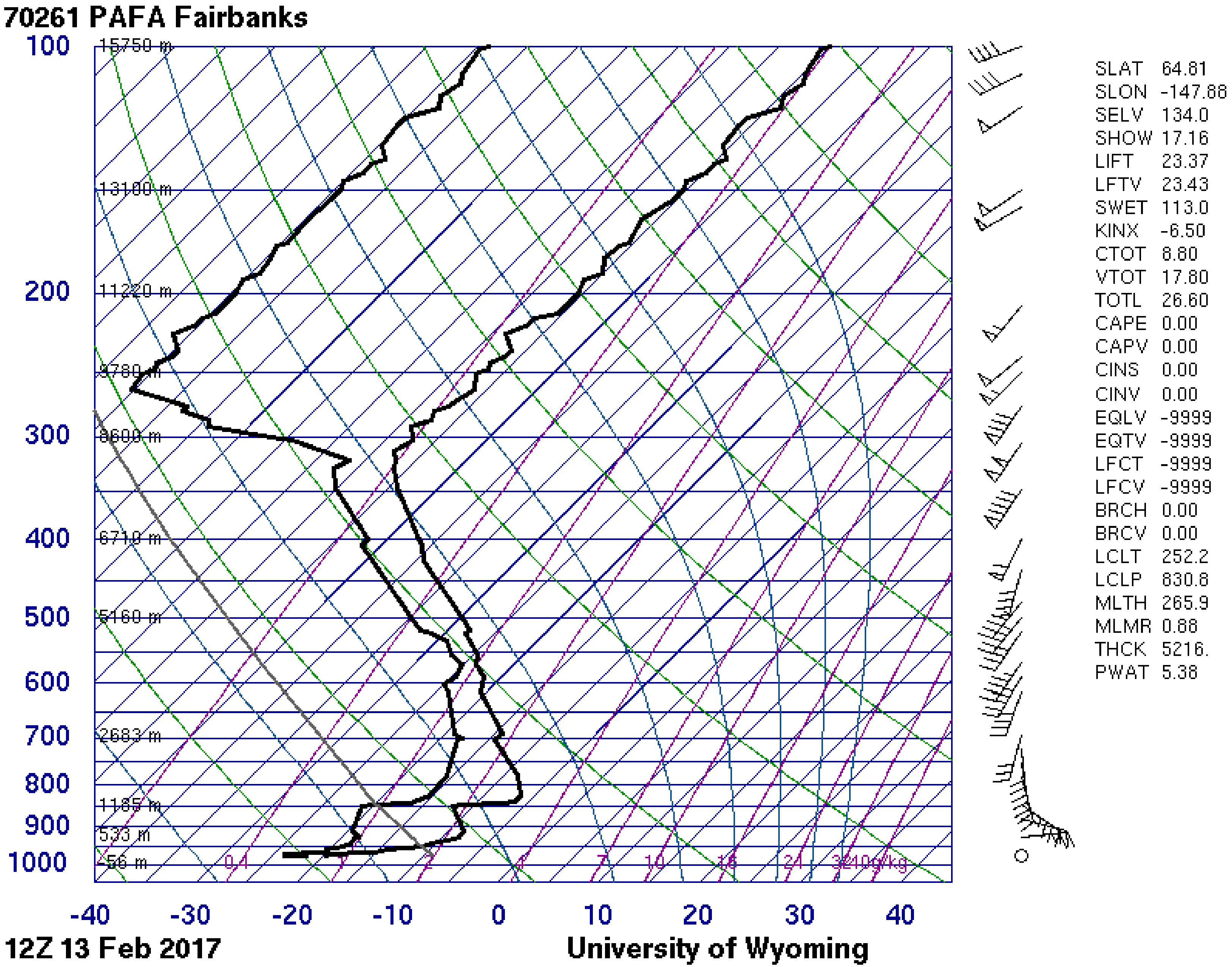
Bias



Images courtesy of Trevor Alcott


70261 PAFA Fairbanks
100
15750 m
13100 m
200
11220 m
9780 m
300
8600 m
400
6710 m
500
5160 m
600
700
2683 m
800
1185 m
900
533 m
1000
-56 m
0.4
1
2
4
7
10
16
24
32 40 g/kg
-40
-30
-20
-10
0
10
20
30
40
12Z 13 Feb 2017
University of Wyoming
SLAT 64.81
SLON -147.88
SELV 134.0
SHOW 17.16
LIFT 23.37
LFTV 23.43
SWET 113.0
KINX -6.50
CTOT 8.80
VTOT 17.80
TOTL 26.60
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
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MLTH 265.9
MLMR 0.88
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