Increasing the utility of real-time IASI moisture and temperature soundings In very-short-range forecasting

Background and Purpose

Forecasters in the Alaska Region have requested that short-range NearCasting techniques (developed for using GOES soundings over the CONUS) be applied to hyper-spectral sounder products generated from the multiple Low Earth Orbiting (LEO) satellites that make frequent overpasses at high latitudes (e.g., CrIS and IASI). these data should help fill the space and time gaps between sparse RAOB reports available there.

This presentation demonstrates the potential of new short-range forecaster tools designed to use otherwise underutilized hyperspectral soundings in polar latitudes. Although these observations lack the special and temporal detail of GEO data, the increased vertical sounding resolution should be especially important both in areas with limited radar coverage or other asynoptic observations and when conventional NWP guidance is questioned.

Forecasters have also noted the need for short-range guidance using full resolution satellite observations in cloudy conditions (not included in IR-only satellite products) for a variety of problems, especially those related to heavy precipitation events and oceanic weather systems. To address this need, NearCasts generated using combined IR/microwave retrievals are also presented to illustrate how these data can add short-range forecast information in areas where IR instruments are 'blind'. These observationally driven short-range projections could also provide a unique LEO/GEO synergy by filling spatial gaps in future high-time frequency GOES-R IR products and displays. In this poster, we:

1. Study the accuracy of several POES retrieval systems over Alaska
2. Demonstrate the NearCast using IASI data over Europe, using 2 different retrieval candidates.
3. Show an example of a high-impact aviation event over Alaska.
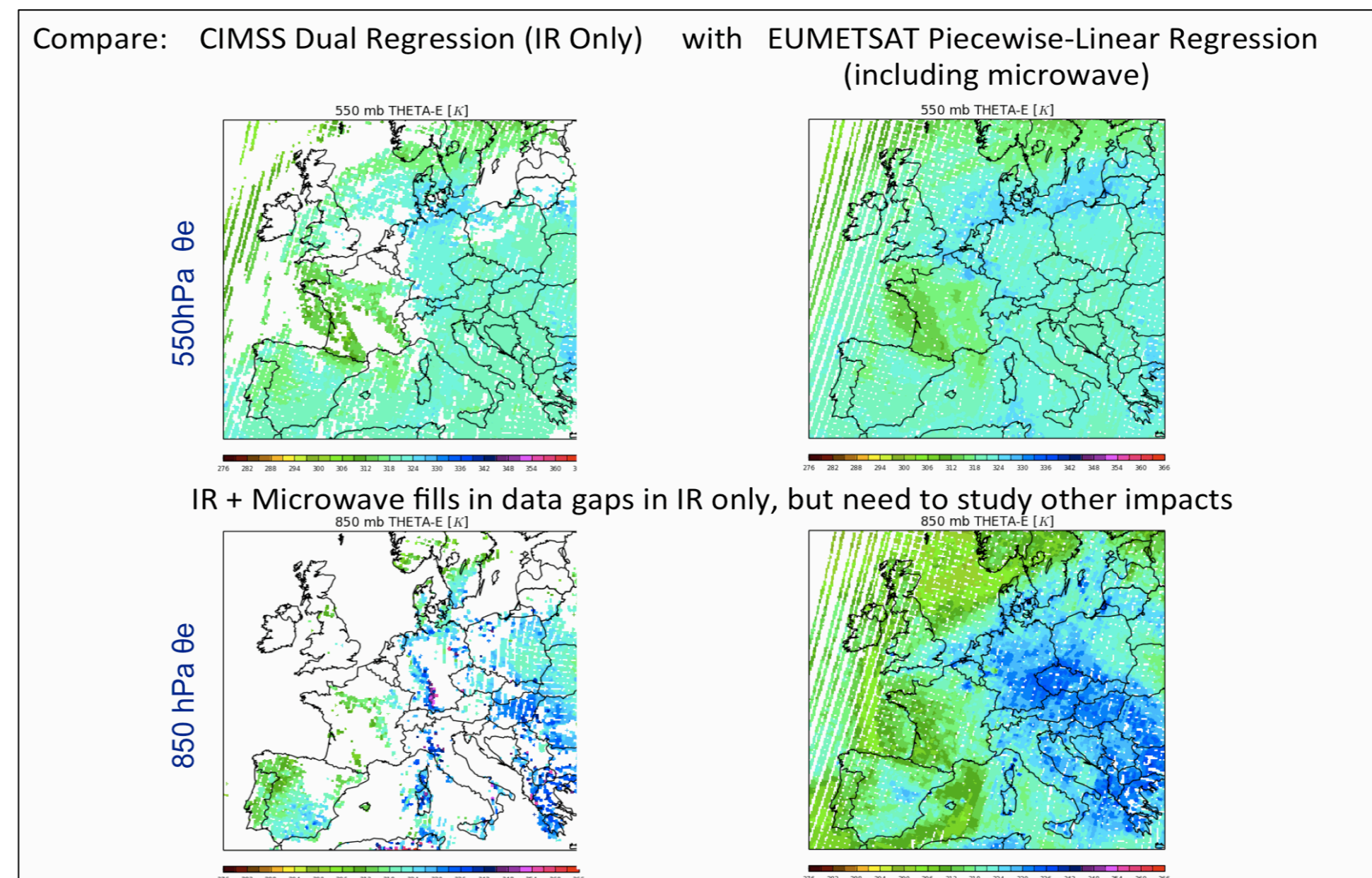4. Discuss several outstanding data access issues.

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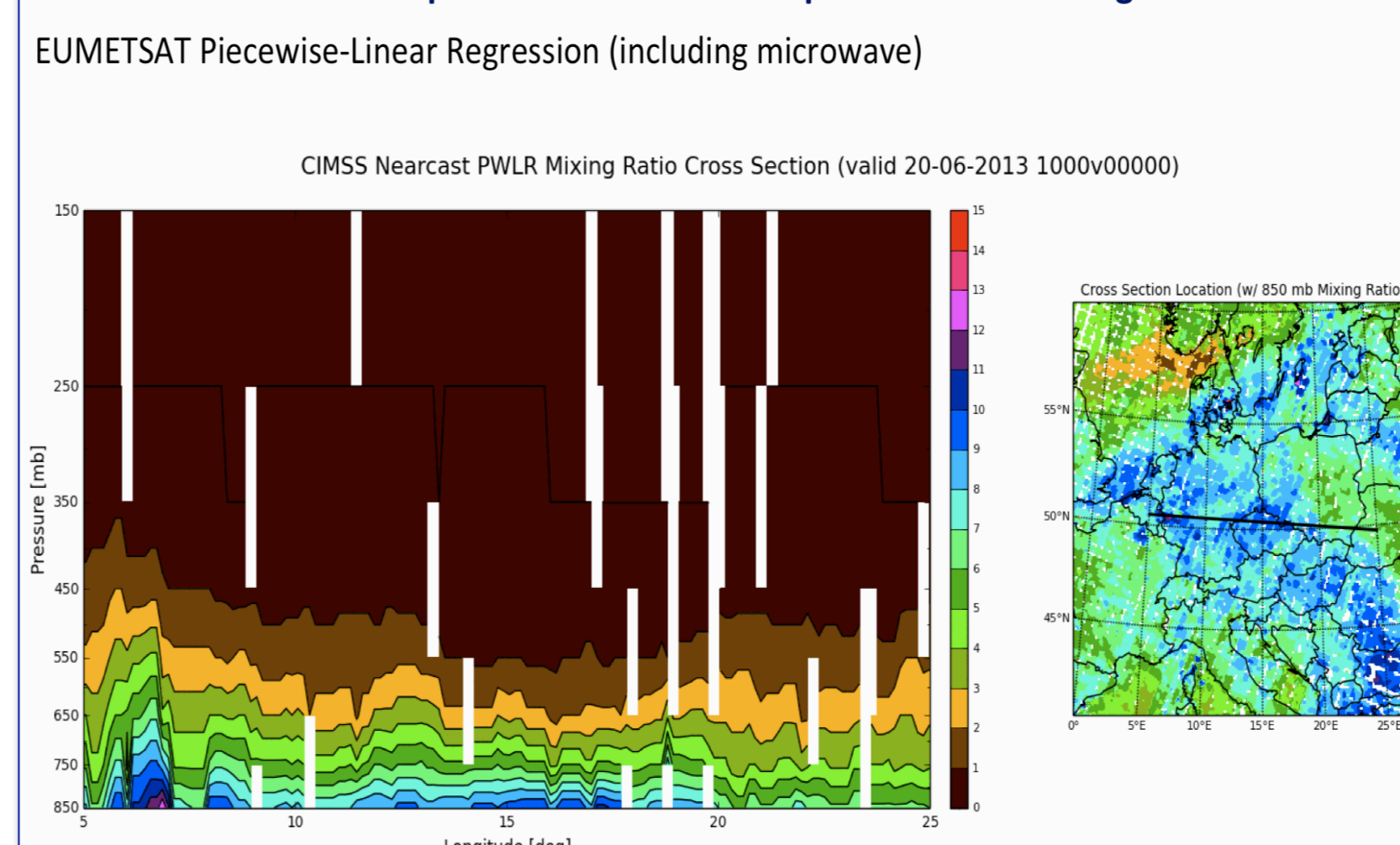[3] EUMETSAT, Darmstadt, Germany

Adapting GOES NearCasts to use asynchronous LEO Retrievals

Compare: CIMSS Dual Regression (IR Only) with EUMETSAT Piecewise-Linear Regression (including microwave)

IR + Microwave fills in data gaps in IR only, but need to study other impacts

←IR-only retrievals have more data gaps, especially at low-levels, but may have slightly stronger vertical gradients than combined IR+Microwave products – important for assessing pre-convective stability

An asset of IRS: Improvements in vertical resolution are clearly apparent in cross sections of Equivalent Potential Temperature and Mixing Ratio

EUMETSAT Piecewise-Linear Regression (including microwave)

CIMSS Nearcast PWLR Mixing Ratio Cross Section (valid 20-06-2013 1000v00000)

Independent of which retrieval system is used, *the combination of detailed low-level Equivalent Potential Temperature with updated information about vertical temperature structure (including tropopause) present in the CrIS/IASI retrievals allows more realistic computation of important diagnostic parameters, such as CAPE in CINH*

Determining Hyperspectral Moisture Retrieval Quality
Comparisons made at GPS receiver station in summer 2013.
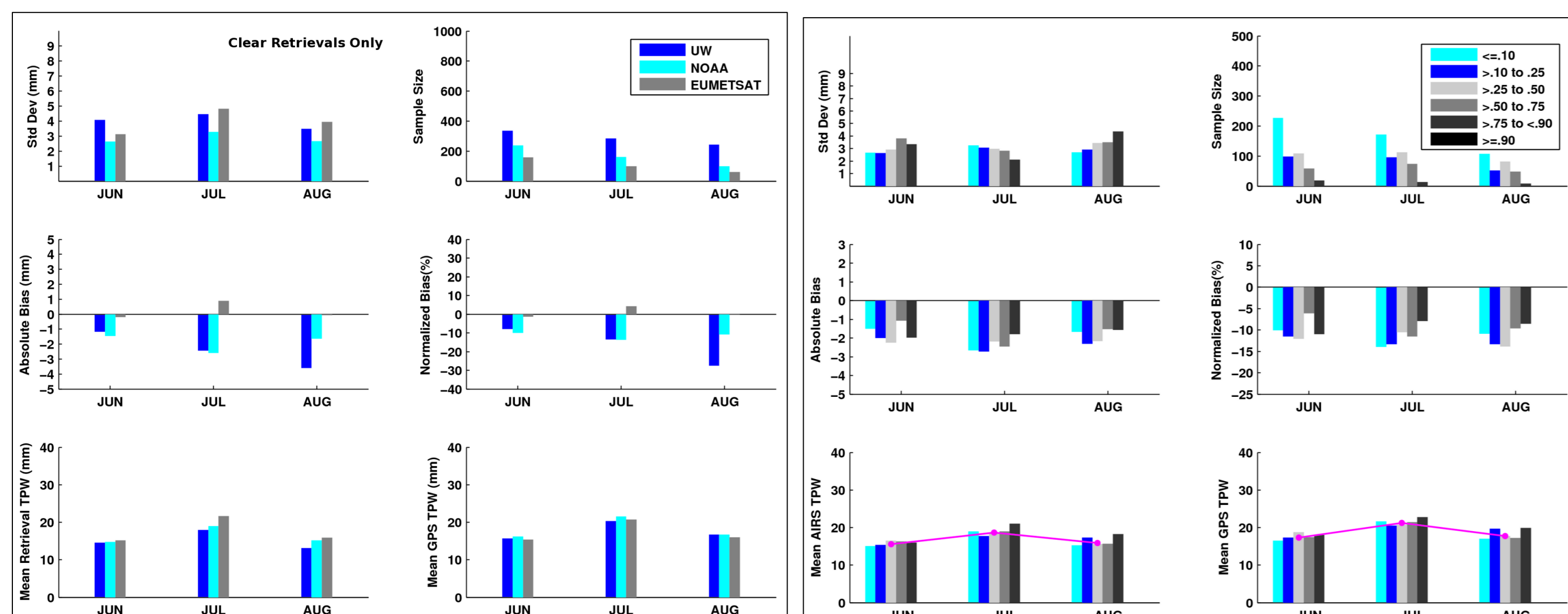
Comparisons based upon surface pressure difference between retrieval and GPS site.

TPW Bias v. Surface Pressure Difference

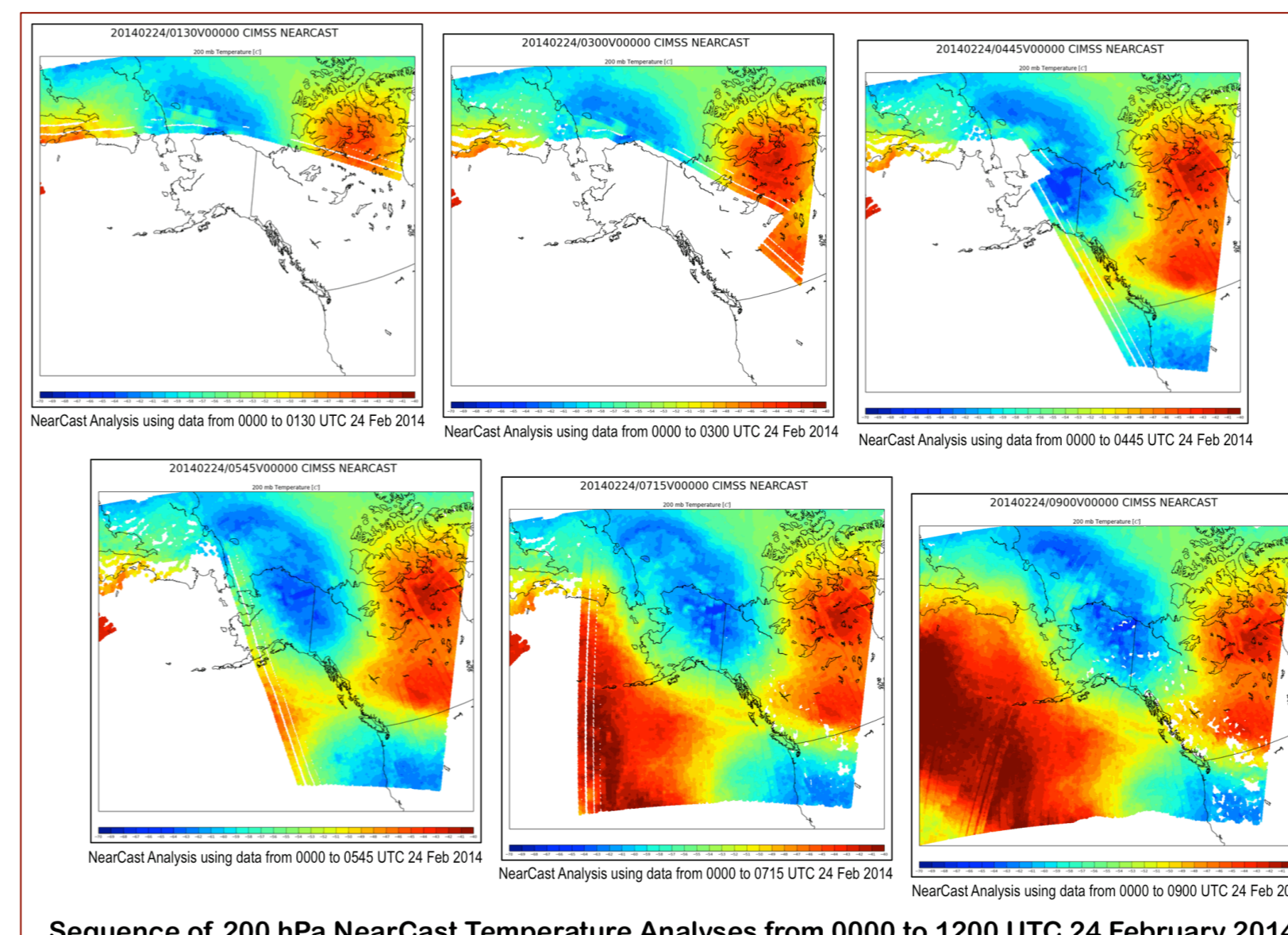Temperature QF <=1 and Clear ONLY Retrievals
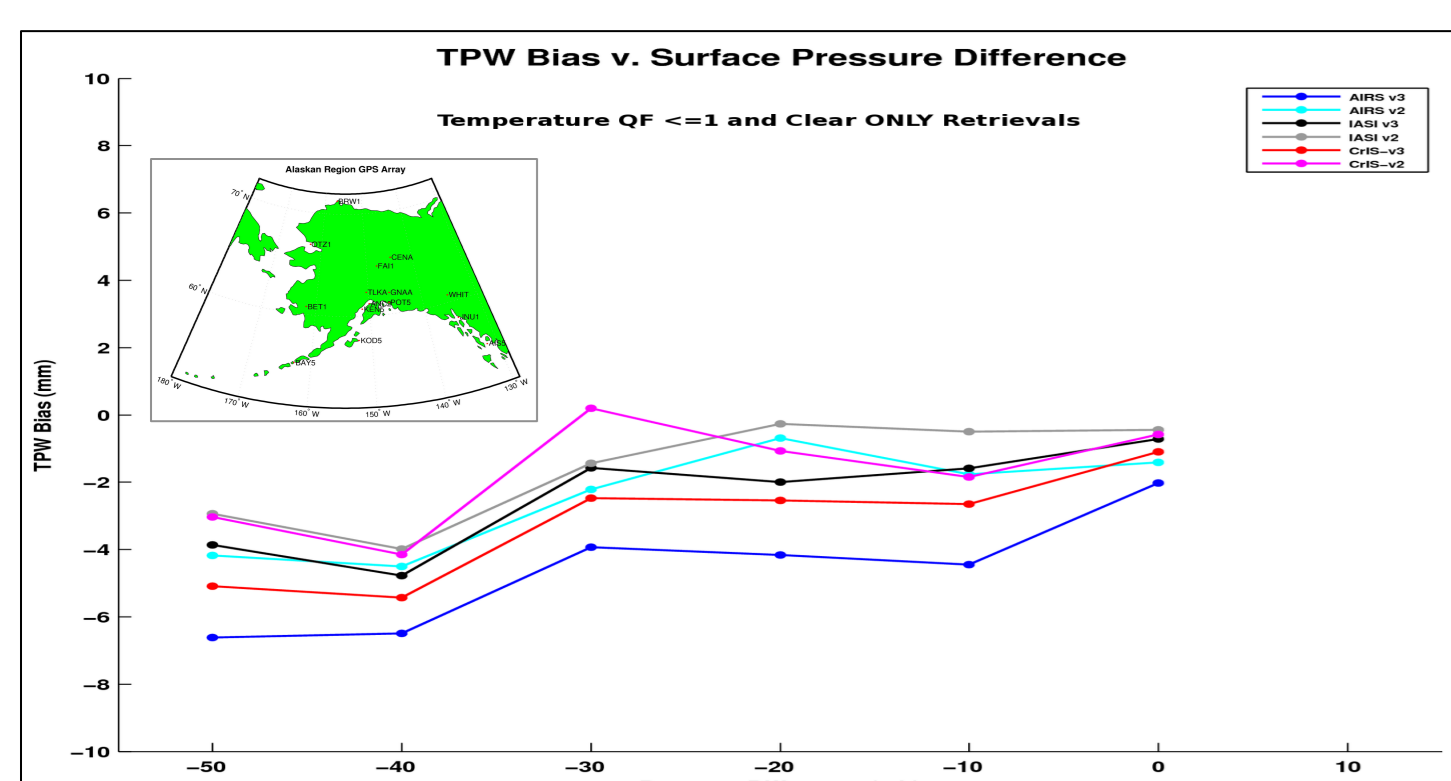
Comparisons based upon surface pressure difference between retrieval and GPS site.

Results Show:
- Consistent dry Bias in the majority of Dual-Regression (DR) retrievals
- Dry Bias increases through the summer (Jun-Aug) for DR.
- SD difference is higher for UW-DR, possibly due to higher spatial resolution.
- IASI DR data had the smallest bias and SD
  - NOAA IASI retrievals had the smallest SD
  - EUMETSAT IASI had the smallest Bias.
- Bias related in part to differences between retrieval surface pressures and GPS sites
  - Also affected by of cloud-clearing process

Data Acquisition Issues
Real-time access to CrIS and IASI Retrievals/Radiances is Problematic
✓ Currently, NOAA NUCAPS only processing CrIS retrievals in real-time
✓ NUCAPS IASI data expected to be available soon
✓ EUMETSAT retrievals difficult to obtain via GTS and only for IASI

Missing either morning and afternoon orbit data leaves detrimental gaps in analyses, even in polar areas.

Gaps can be easily filled through access to centralized reception and retrievals from *both* CrIS and IASI

36 Hr Sequence of NearCast Analyses of CrIS Low-Level Precipitable Water

Sample 36 h sequence of NearCast Analyses of lower-level Precipitable Water from 1200 UTC 10 March through 0000 UTC 14 March 2015 using all retrievals available locally in Alaska (CrIS only). Note large temporal and spatial data gaps that occur when no CrIS overpasses are available or when only partial granules are received.

Aviation Hazard caused by Extremely Cold Cruise Level Temps
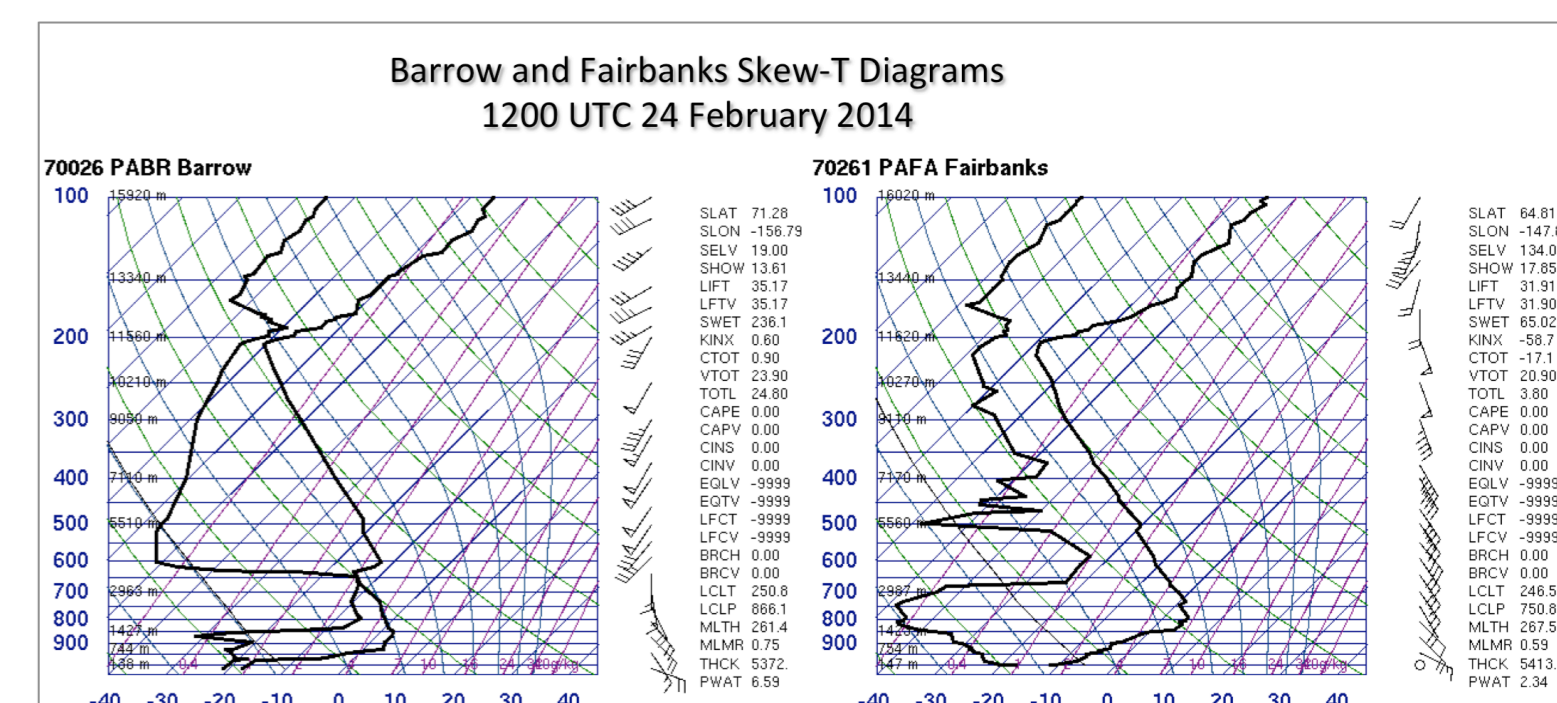### *- Can cause jet fuel to 'gel' -*

Sequence of 200 hPa NearCast Temperature Analyses from 0000 to 1200 UTC 24 February 2014
Using EUMETSAT IASI retrievals from METOP A and B
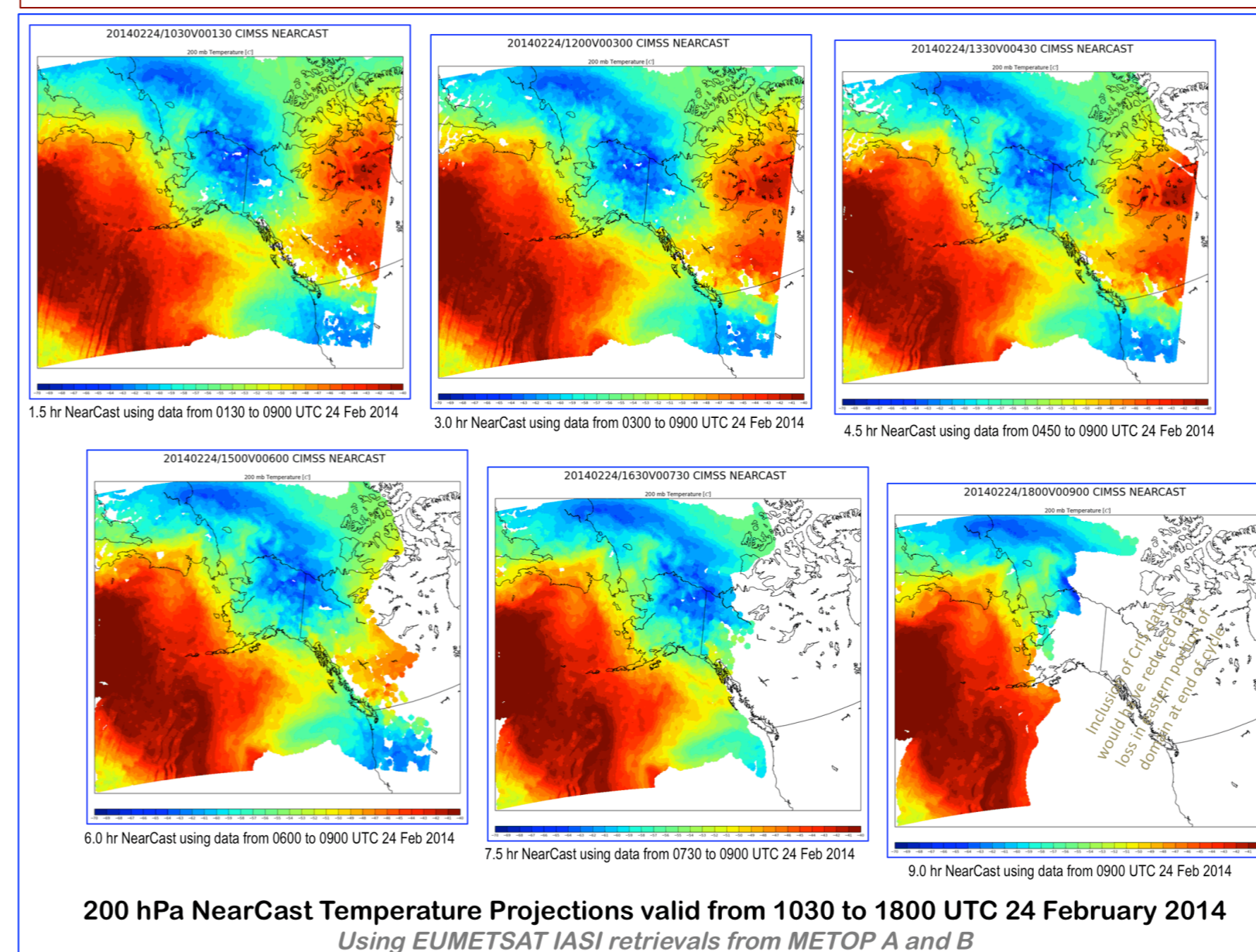
200 hPa NearCast Temperature Projections valid from 1030 to 1800 UTC 24 February 2014
Using EUMETSAT IASI retrievals from METOP A and B

← *NearCasts Analyses:*
✓ Detect area and show structure of extremely cold air (~ -70°C) near 200 hPa before 1200 UTC Barrow and Fairbanks RAOBS, including extension over Arctic Ocean
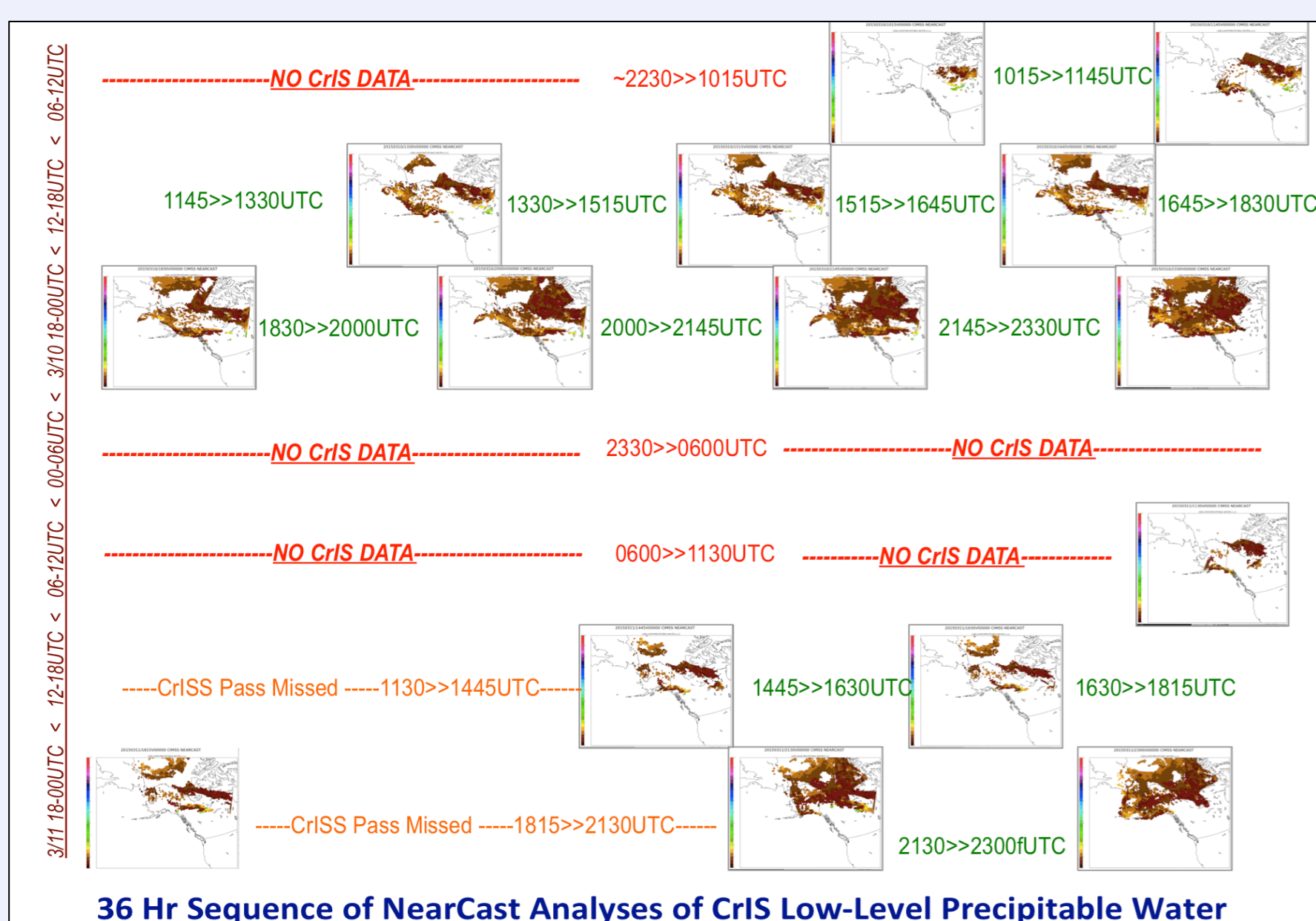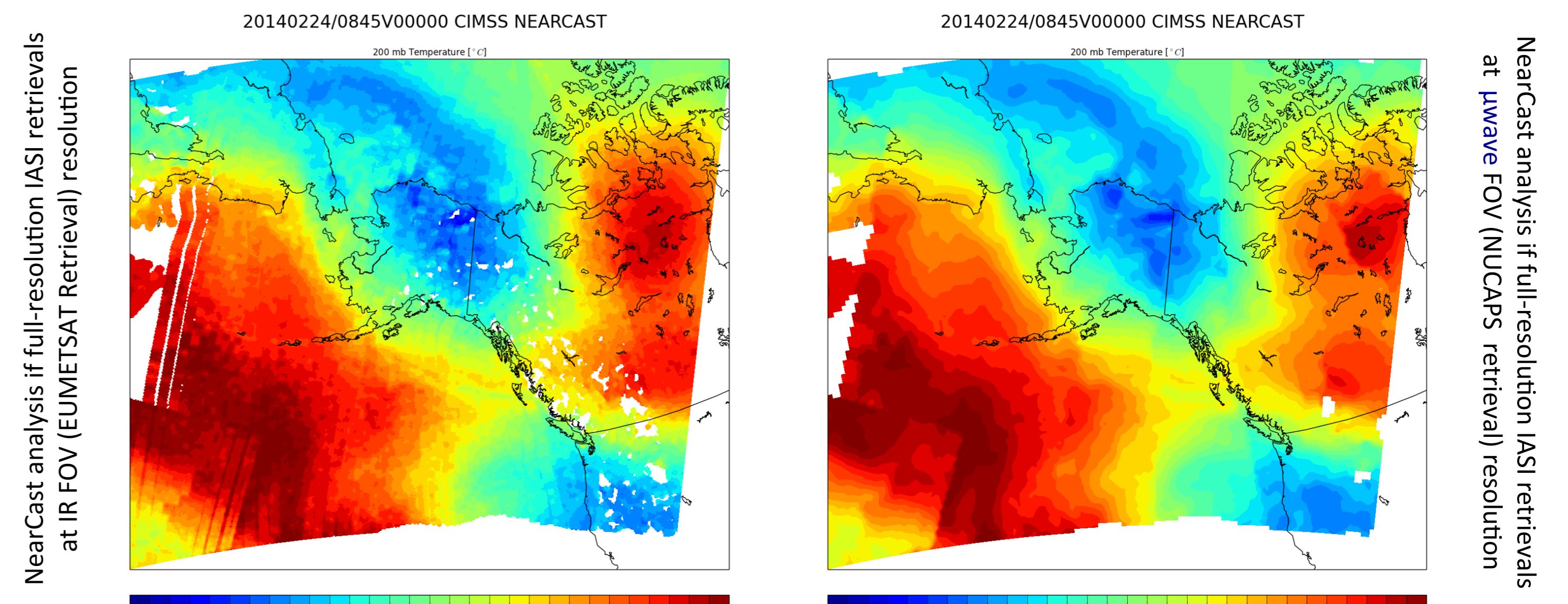✓ Indicate some inconsistency between nadir and limb retrievals – Feedback for satellite product developers

Barrow and Fairbanks Skew-T Diagrams 1200 UTC 24 February 2014

70026 PABR Barrow   70261 PAFA Fairbanks

← *NearCast Projections:*
✓ Agree well with 1200 UTC Barrow and Fairbanks RAOBS
✓ Show slow progression of cold pool to north and east
✓ Would have been useful in determining air routes to avoid

Impacts of EFOV Difference in CrIS/IASI Retrieval
Performing analysis at µwave or IR FOV size impacts detail in analyses/forecasts

NearCast analysis if full-resolution IASI retrievals at IR FOV (EUMETSAT Retrieval) resolution

NearCast analysis if full-resolution IASI retrievals at µwave FOV (NUCAPS retrieval) resolution

20140224/0845V00000 CIMSS NEARCAST   20140224/0845V00000 CIMSS NEARCAST

Summary:
✓ Input CrIS/IASI data show dry biases
✓ NearCast system adapted to use asynchronous LEO retrievals
✓ Successfully tested for Severe Weather and Aviation Hazard Events
✓ Data access issues are delaying real-time testing
✓ Access to underlined real-time retrievals from *BOTH* IASI and CrIS is critical for optimal forecaster use