v2.6 RTMA/URMA and Rapid Update RTMA CCB

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Quick update on “Good enough” items

Task Tracking Document Here

- Developed in consultation with EMC management
- This goes over the issues described by the ‘RTMA Good Enough Group’ led by Dave Bernhardt et al.
- Entries are highlighted based on when they are expected to go into operations (or have gone in)
- Note that some entries are being dealt with in V2.6 (see following slides)
- ***Plan is to keep this doc refreshed/updated to help us all keep track of progress. If you’ve suggestions on how to do this better, let us know.***

v2.6 Bundle: Timeline

- Note* This is the first RTMA/URMA upgrade under the new procedures, means the evaluation occurs before hand off to NCO for their 30 IT day test
  - EMC devs conduct and run all pre-implementation testing.
  - Plan to have future discussions with user community to consider other ways to facilitate evals (e.g. retrospectives). Time and details are TBD.
- Implementation briefing is scheduled for June 26th, 2017.
- Implementation scheduled for October.

v2.6 Bundle: Contents + Outline

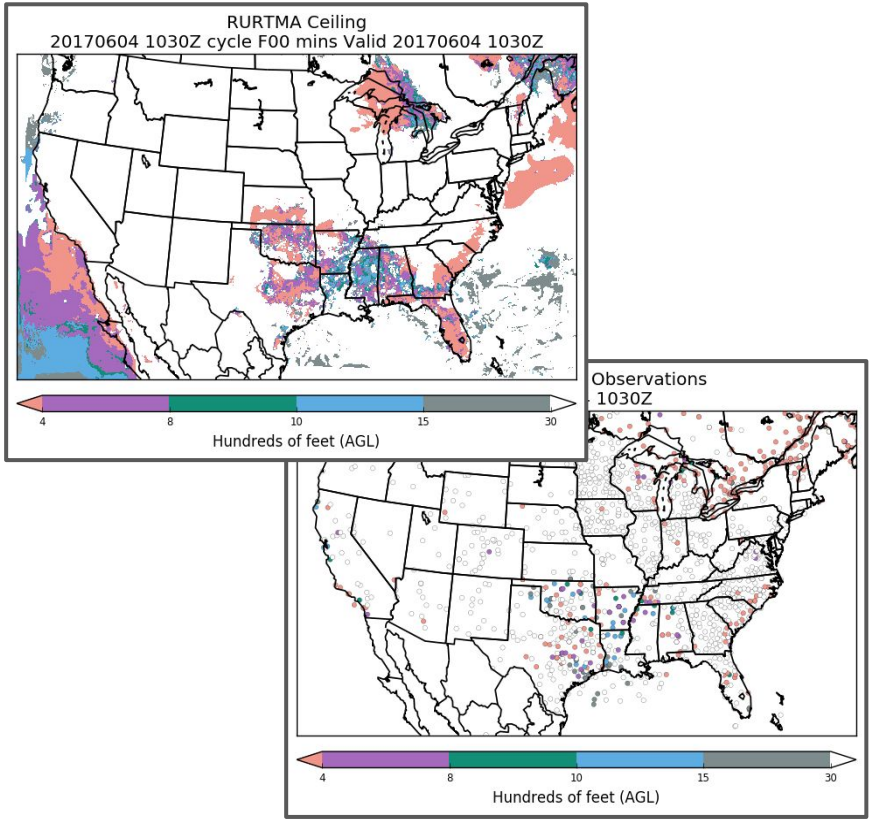
- Rapid Update RTMA (15-minute cycle) - support AWC, HEMS, and aviation users
- Hourly precip URMA for ConUS and Puerto Rico - support NBM
- New terrain and land/sea mask in use for CONUS/PR/HI
    - AK files to come in 2.7
- New output fields:
    - min/max RH product (URMA) - support NBM
    - Significant wave height analysis (URMA) - support NBM and coastal WFOs
    - AK: Ceiling - support aviation and NBM

v2.6 Bundle: Contents + Outline

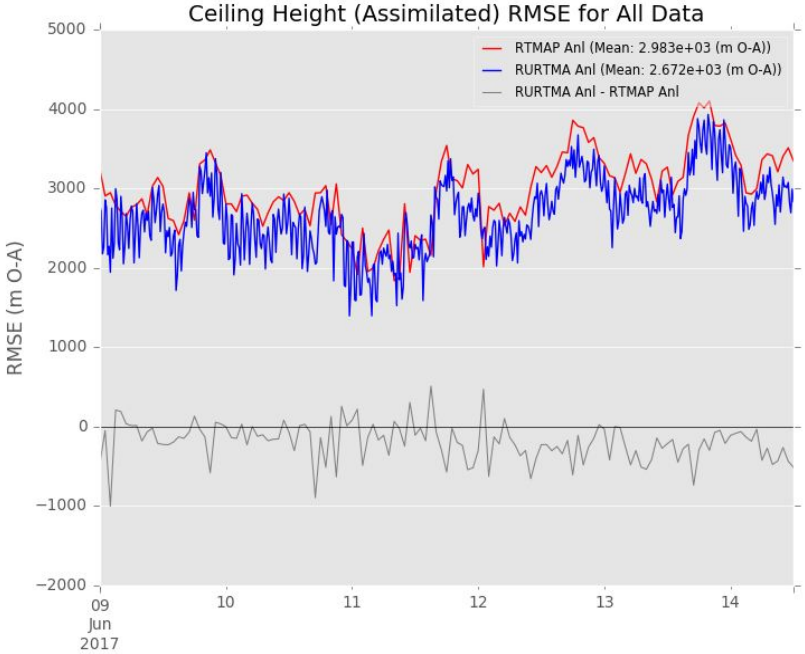
- Relax QC criteria to increase use of mesonet temperature and moisture data
  - Assists with good enough item 2e
- New obs for URMA
  - Pseudo obs over Great Lakes via GLERL adjustment (long awaited item)
  - New data from UrbaNet and COOP
- Bug fix: Ceiling background from downscaled RAP/HRRR
- Reduce steepening in background error model along land/water boundaries based upon forecaster feedback

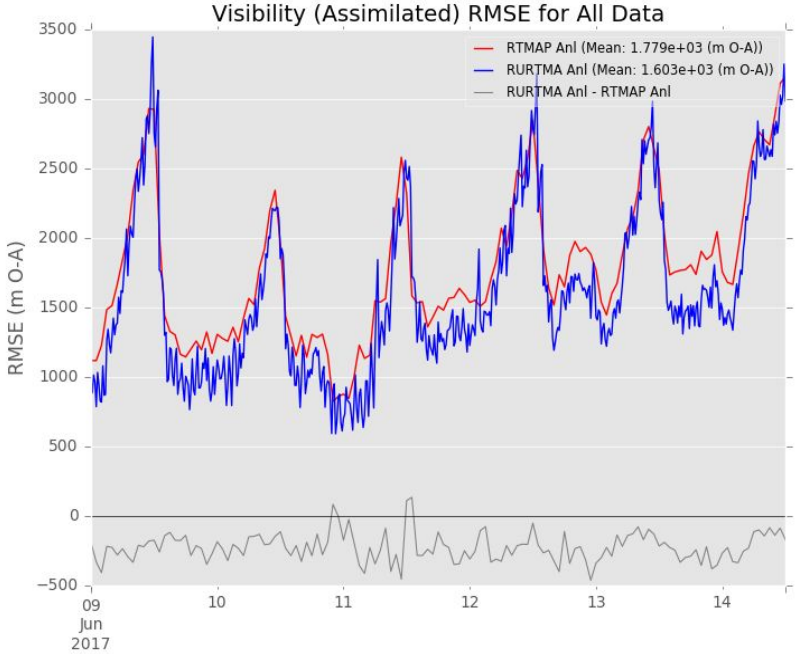
v2.6 Bundle: Rapid Update RTMA

- RTMA system with updates every 15 minutes instead of every hour
- Focus is aviation applications
  - Helicopter Emergency Med. Services tool
  - Collaborative FAA AWRP project with AWC
- Uses closest in time available data for C&V
  - No time interpolation among a window of observations
  - Closer fit to data
  - Uses 15 min output from HRRR
- Available at T+20 mins.
  - For v2.7, plan to go to T+15 mins.



v2.6 Bundle: Rapid Update RTMA

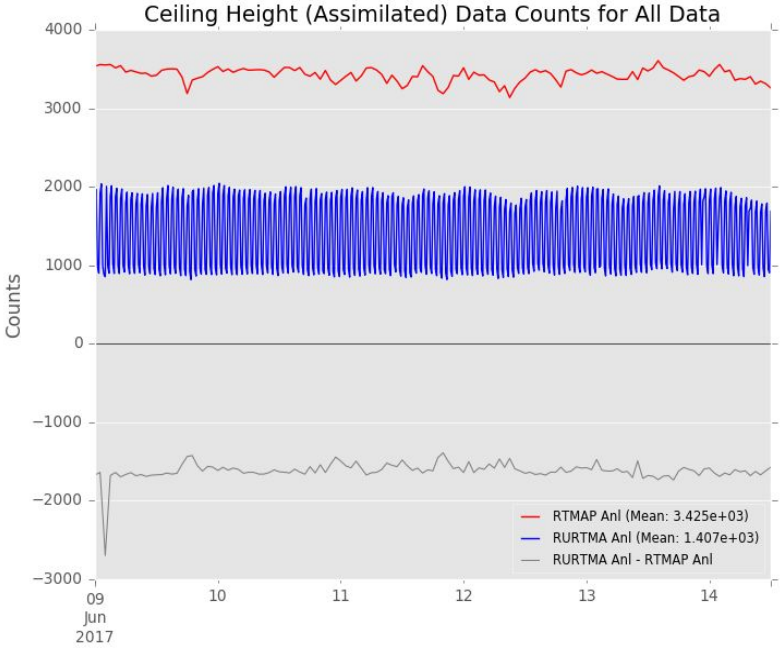


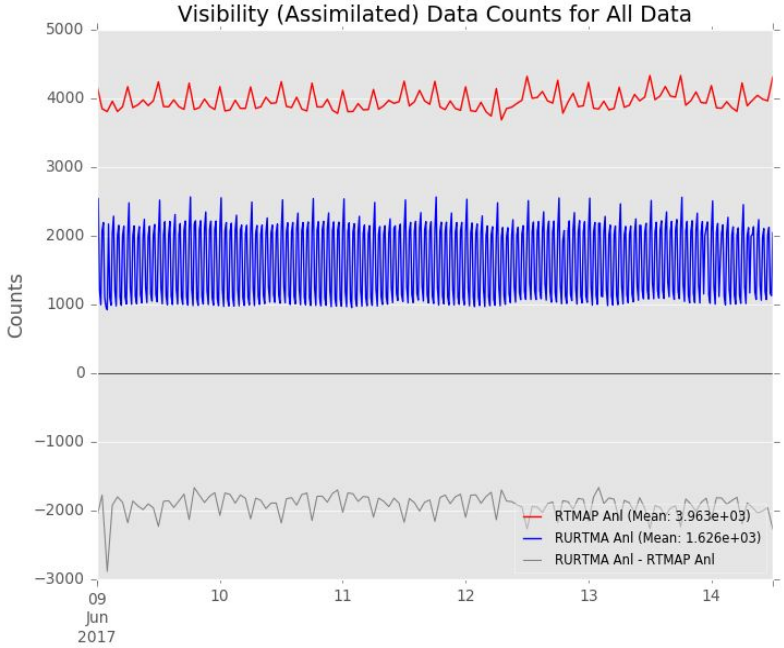


RURTMA (blue) fits ceiling and vis data more closely than hourly v2.6 RTMA (red)

- For C&V RU-RTMA only uses the observation closest to the analysis time

v2.6 Bundle: Rapid Update RTMA





RURTMA (blue) uses less data *per cycle* than hourly v2.6 RTMA (red)

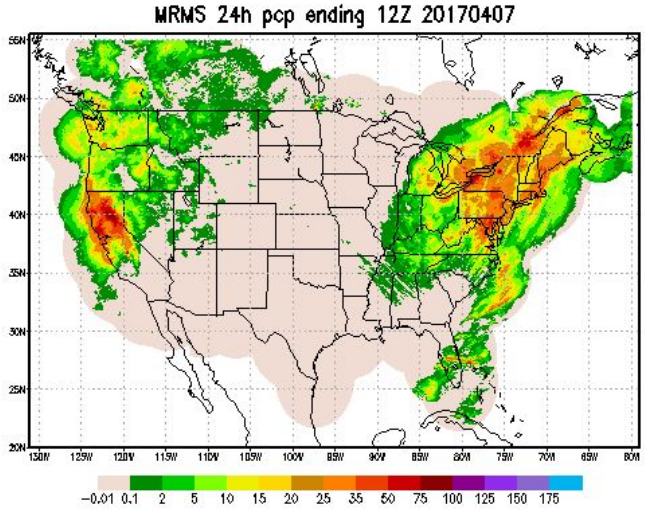
- The number of assimilated obs for each 15-min window is less than hourly v2.6 RTMA.
- BUT the sum of assimilated obs in RURTMA in one hour is, on average, more than that in the hourly v2.6 RTMA

v2.6 Bundle: Precipitation URMA

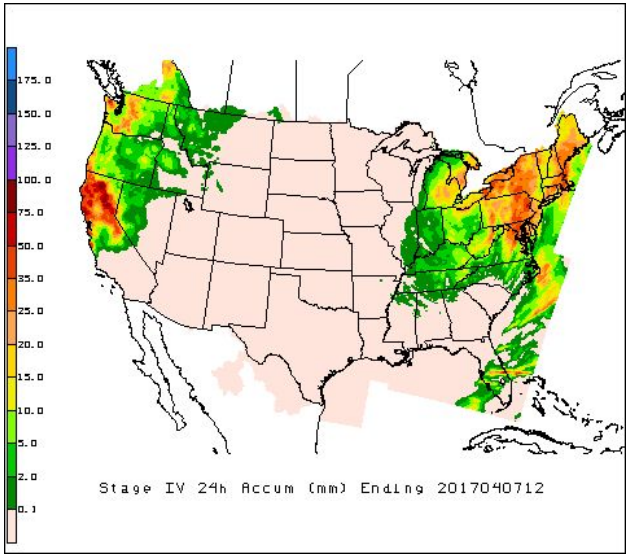
- **Currently in operation:** 6-hourly URMA for ConUS, Alaska and Puerto Rico (from hourly/6h RFC QPEs)
- **v2.6:** add hourly ConUS and PR URMA - supports the NBM
  - **PR:** SERFC produces hourly and 6h QPEs for Puerto Rico
  - **Issue for ConUS hourly:** NWRFC and CNRFC only have 6h QPEs, the other 10 ConUS RFCs produce hourly QPEs. MRMS has hourly QPEs, but in the complex terrain out West the gauge-based RFC QPEs often has an advantage over the MRMS.
  - **Solution:** time-disaggregate 6h QPEs from NWRFC/CNRFC into hourly QPEs using hourly gauge-corrected MRMS as weights (if MRMS is missing or has zero precip in an area for the entire 6h, weight for each hour is assumed to be ⅙), and combine these with the hourly QPEs from the 10 other RFCs for a ConUS mosaic.

v2.6 Bundle: Precipitation URMA

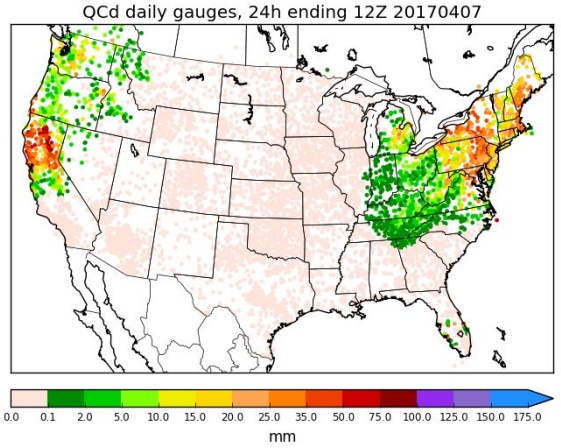
24h totals ending 12Z 7 Apr 2017



MRMS



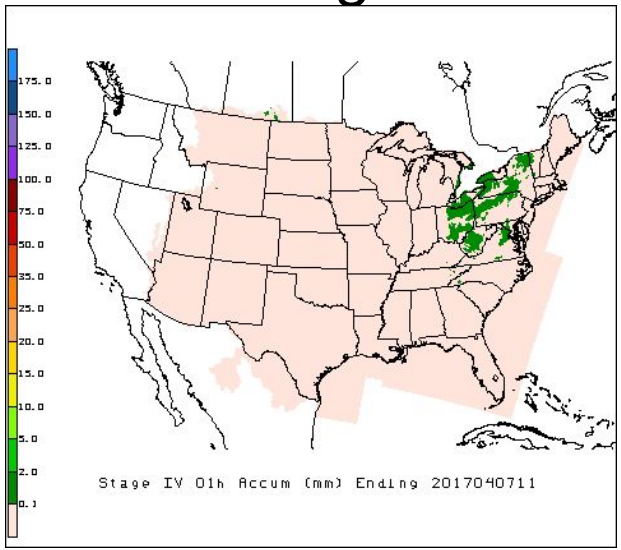
Stage IV

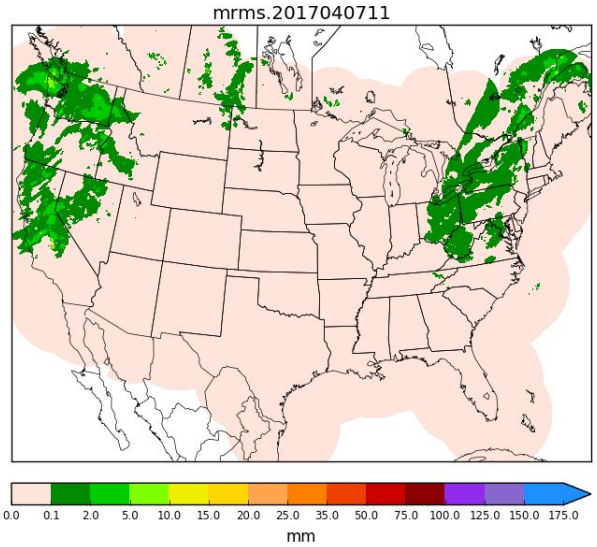


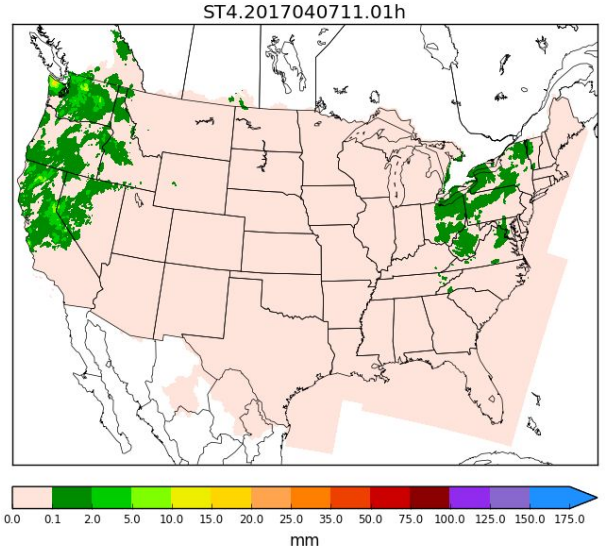
QC’d Daily Gauges

v2.6 Bundle: Precipitation URMA

1h ending 07Z 20140411







Current Hourly Stage IV (mosaic of RFC QPE): no coverage in NWRFC and CNRFC areas

Hourly MRMS

V2.6: hourly Stage IV/URMA

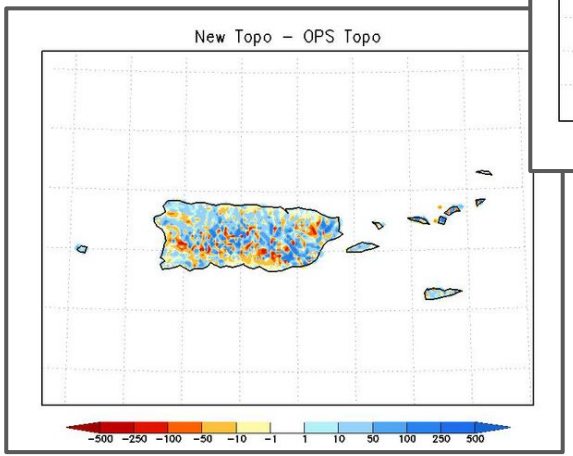
** Note: NWRFC/CNRFC have no offshore coverage

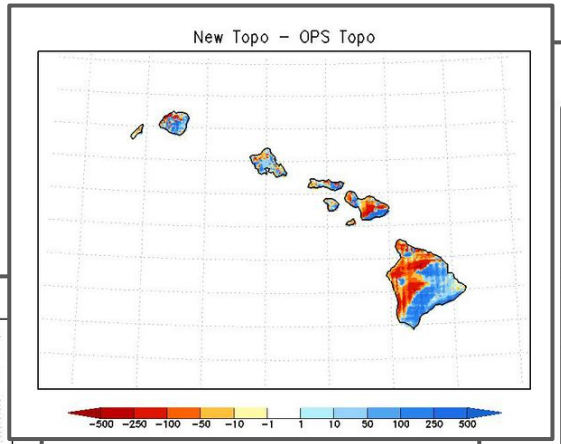
➔ Plan to fill in gaps with MRMS and/or satellite data in RTMA/URMA v2.7.

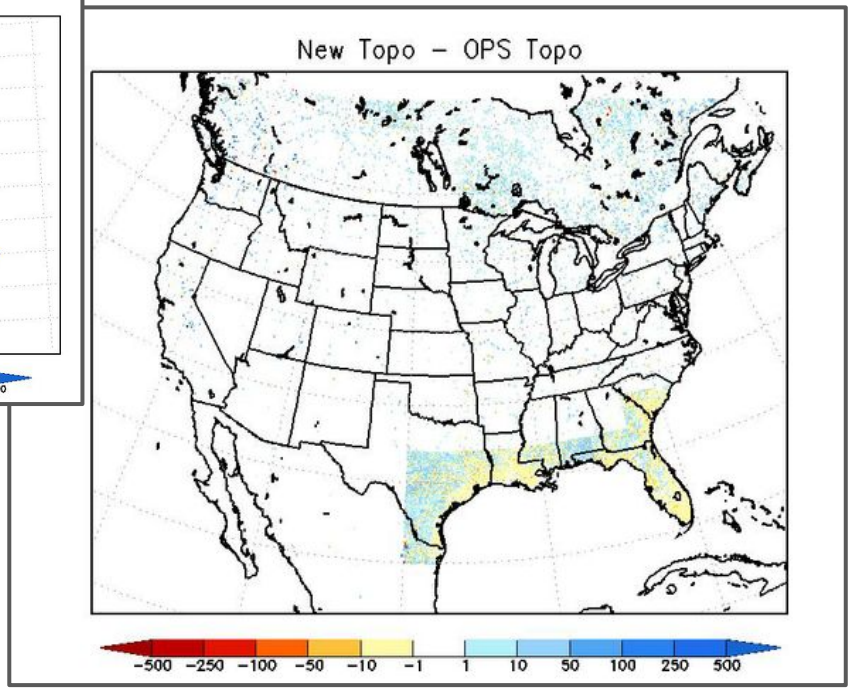
v2.6 Bundle: New terrain and land/sea mask

For CONUS/PR/HI

- AK files to come in 2.7



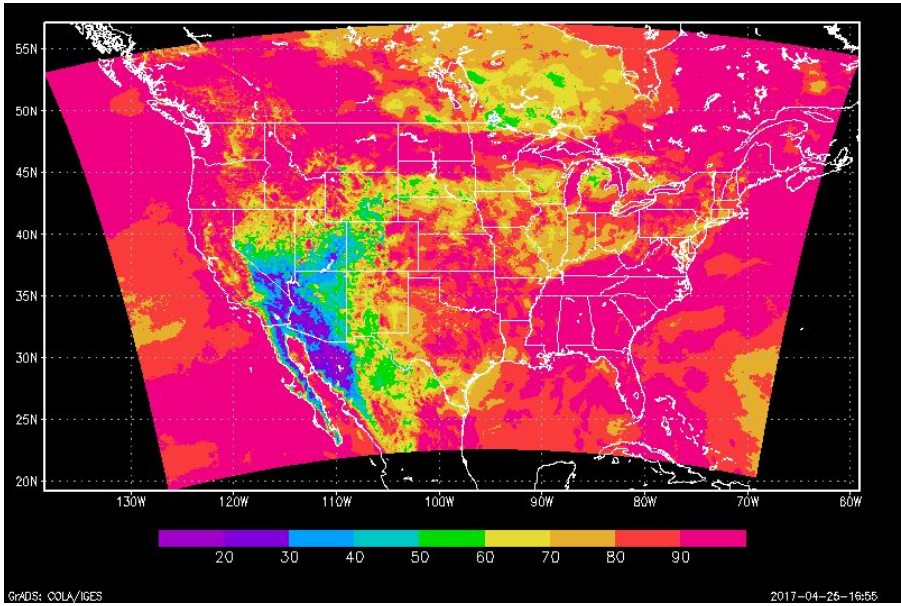




Thanks to Geoff Wagner, Brian Miretzky, George Gayno, WFOs, Regions, and others for all the help!

v2.6 Bundle: Min/Max RH

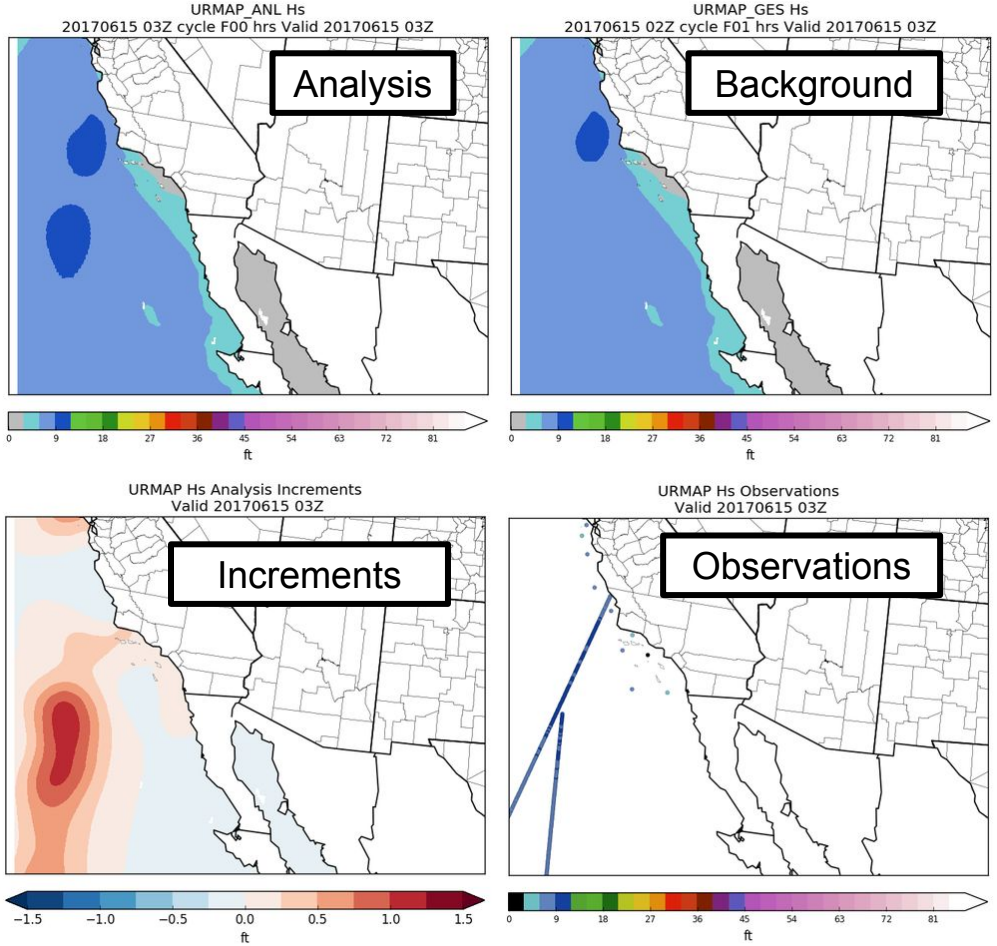
- Requested by NBM/MDL
- Maximum of hourly RH values from previous 12 hourly URMAs
  - RH derived from temperature and dew point analyses
- MaxRH: 06-18Z, minRH: 18-06Z
  - For CONUS, AK, HI and PR domains
  - No local time zone adjustment
  - Co-indices with min/max T analyses



CONUS maxRH (%) valid 4/24/17

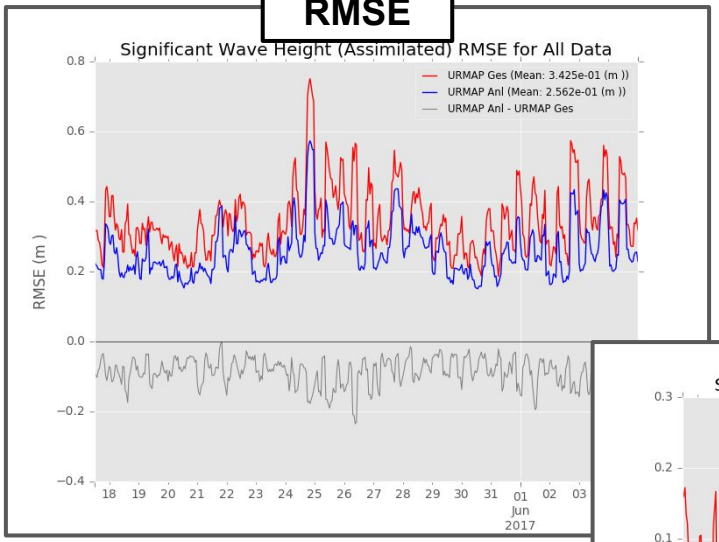
V2.6 Bundle: URMA Significant Wave Height

- Background is from Global WW3
- Assimilates buoy and satellite altimeter observations
  - Satellite data:
    - ~770 Obs per hour
    - Jason-2 & 3, Saral/Altika and CryoSat-2
  - In-situ buoy data:
    - ~70 obs per hour



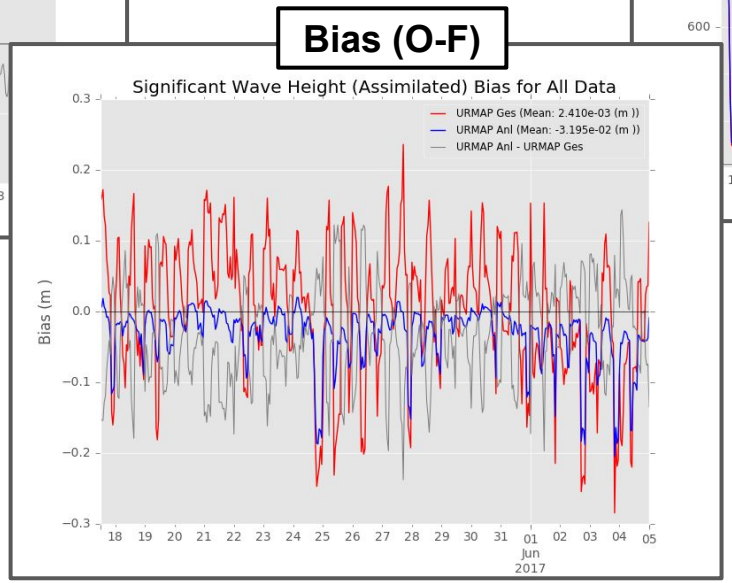
v2.6 Bundle: Significant Wave Height Analysis

RMSE

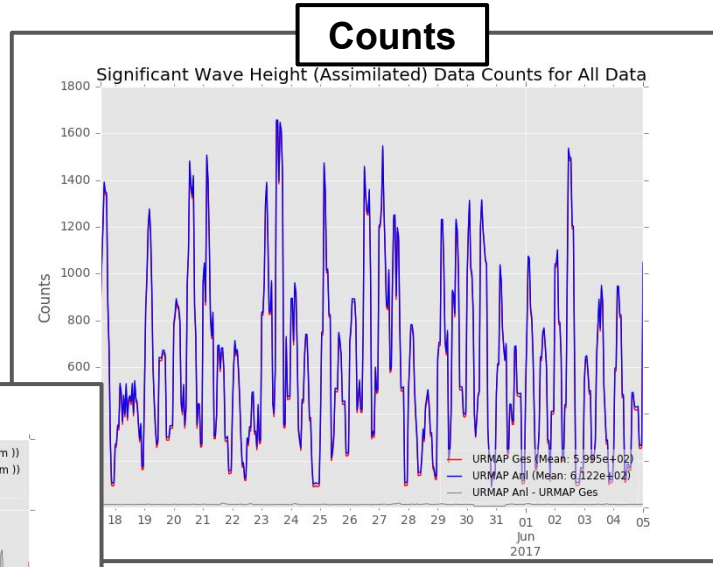


URMA Guess
URMA Analysis

Bias (O-F)

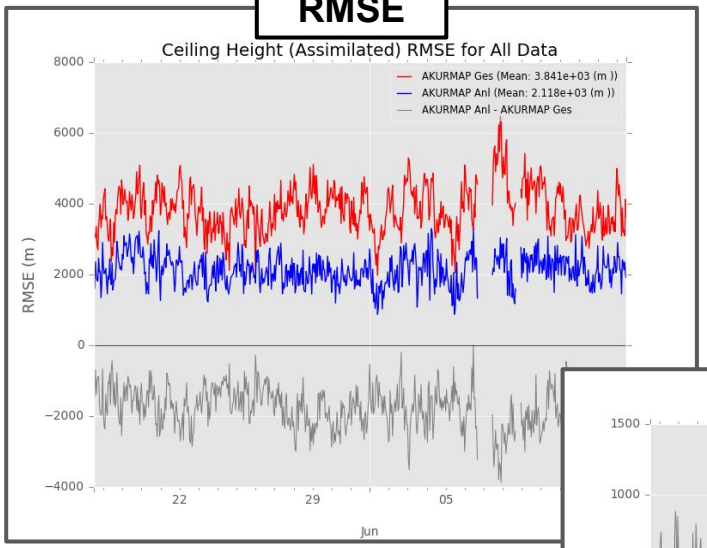


Counts



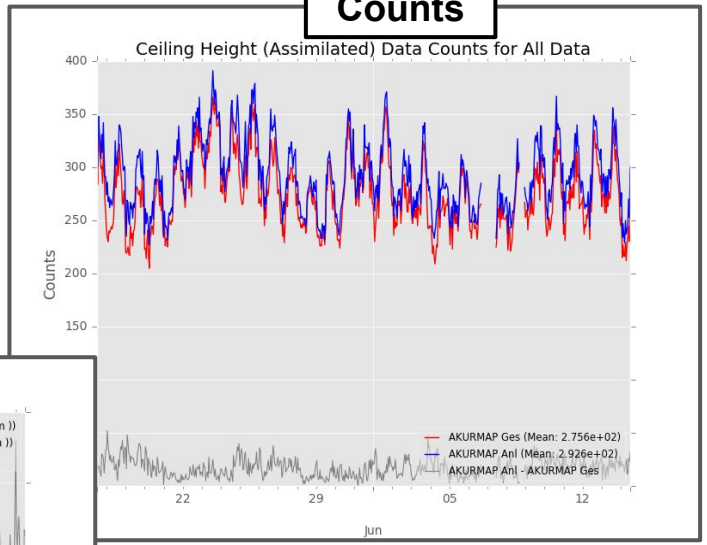
v2.6 Bundle: Adding ceiling to Alaska

RMSE

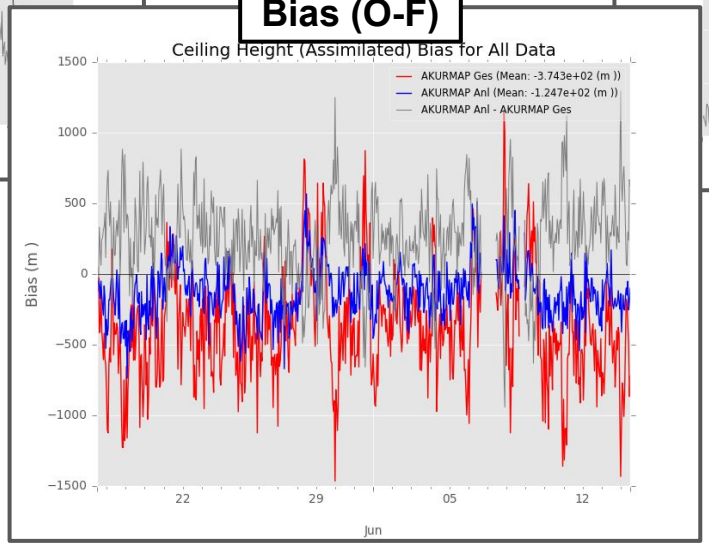


URMA Guess
URMA Analysis

Counts



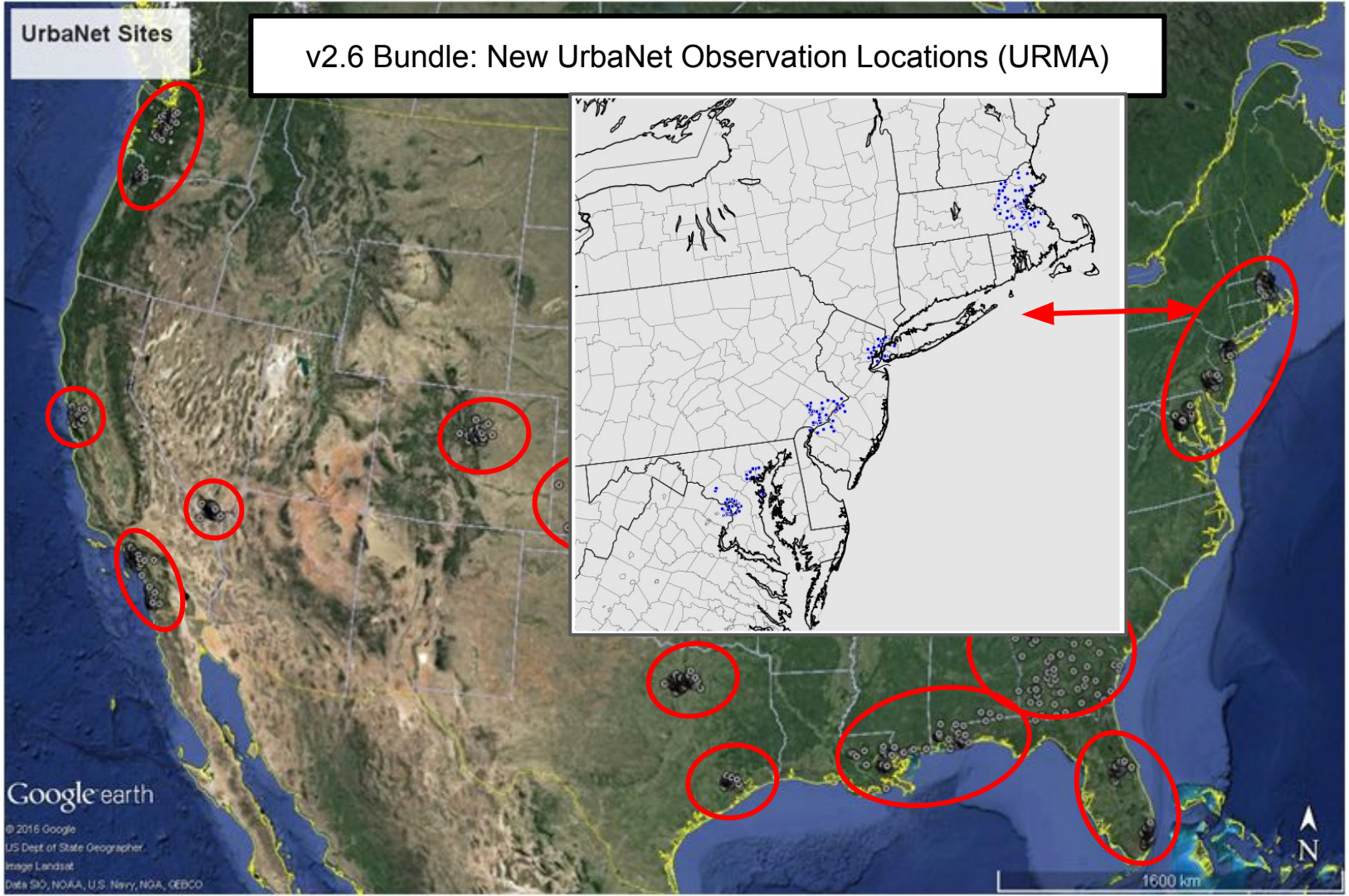
Bias (O-F)



250-300 obs per analysis

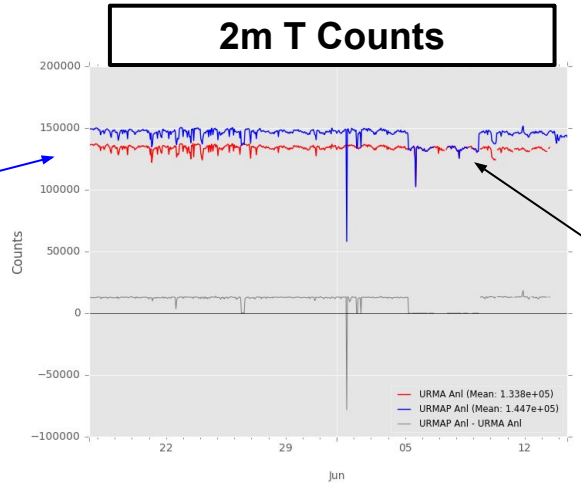
v2.6: Relax Gross Error QC for Mesonet T and Q data

- Relaxed by 10%
  - Help address ‘Good Enough’ item 2e
  - Why?
    - During the iterative analysis procedure more mesonet T and Q observations would trickle in as the background adjusted to the analysis
    - Implies we are too strict with the gross error QC for these ob types
  - What does this mean?
    - We assimilate more observations
    - Those additional observations have a larger deviation from the background
      - As a result, bulk stats will show a slightly larger RMSE
  - For CONUS RTMA:
    - About 200-300 additional T and Q obs per analysis
  - Applied to all domains

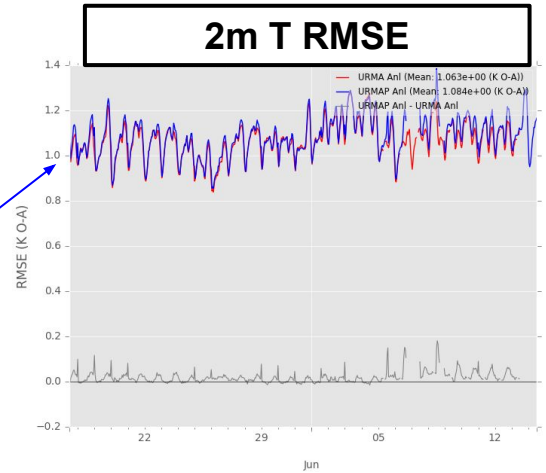

UrbaNet Sites
v2.6 Bundle: New UrbaNet Observation Locations (URMA)
Google earth
© 2016 Google
US Dept of State Geographer
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
1600 km
N

v2.6: New data and relaxed gross error QC impacts

- ~11 thousand new T and Q obs per URMA analysis
- ~ 5 thousand new wind obs per analysis
- Very small increase in analysis RMSE due to relaxed gross error QC
  - Larger O-Fs allowed into analysis translates to having larger O-As in the analysis
  - ~0.02 K for T and and Min/Max T
  - ~0.04 g/kg for specific humidity



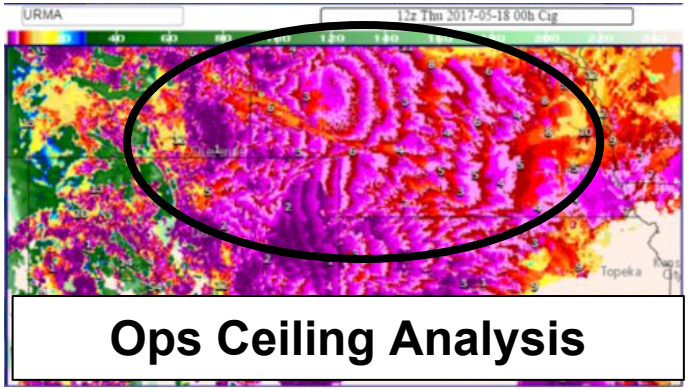
WCOSS prod switches/downtime - used prod data



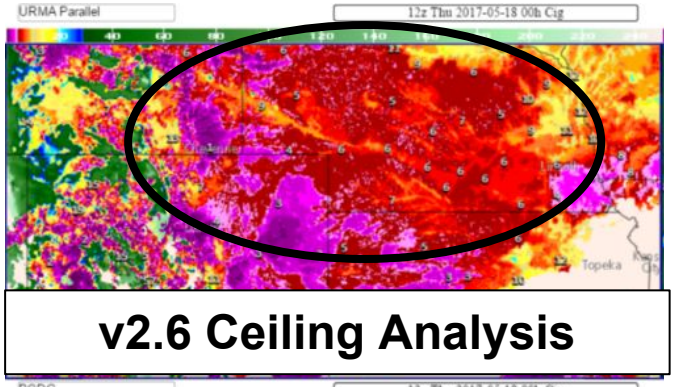
Ops URMA Analysis
v2.6 URMA Analysis

v2.6 Bundle: Bugfix for ceiling background

- Bug fix in RAP/HRRR SmartInit code for Ceiling
- GRIB2 Precision issue
- Will be fixed in RAP/HRRR SmartInit implemented along with v2.6 RTMA/URMA upgrade



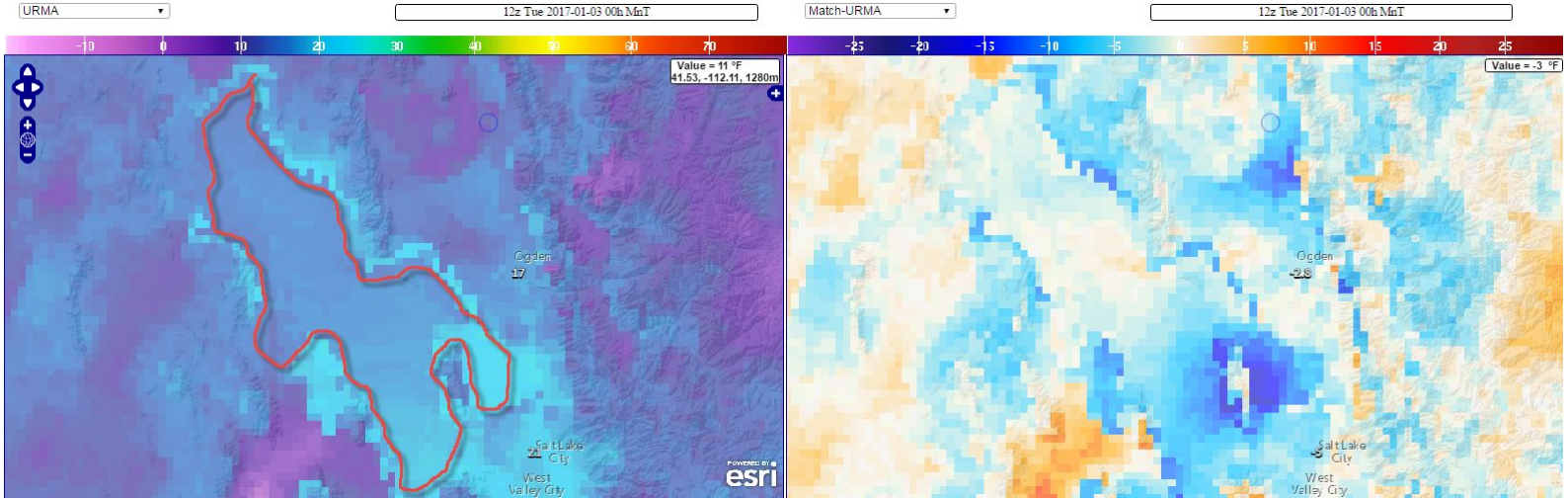
Ops Ceiling Analysis



v2.6 Ceiling Analysis

V2.6 Bundle: Coastline background error change

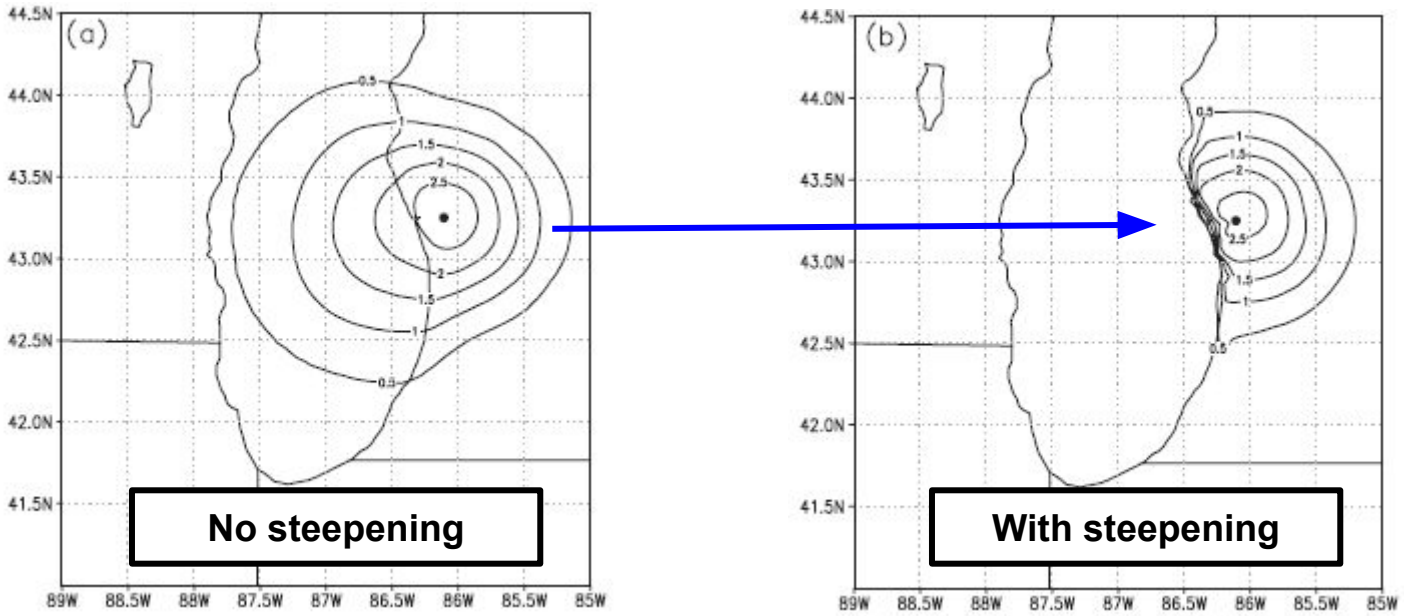
- Artifacts noted around Great Salt Lake (provided by Darren Van Cleave on Jan. 9)
- Refresher:



- Initial impression: Likely a mismatch between terrain and land/sea mask data sets
- After getting the terrain updates for v2.6 we re-checked the issue - but it remained!

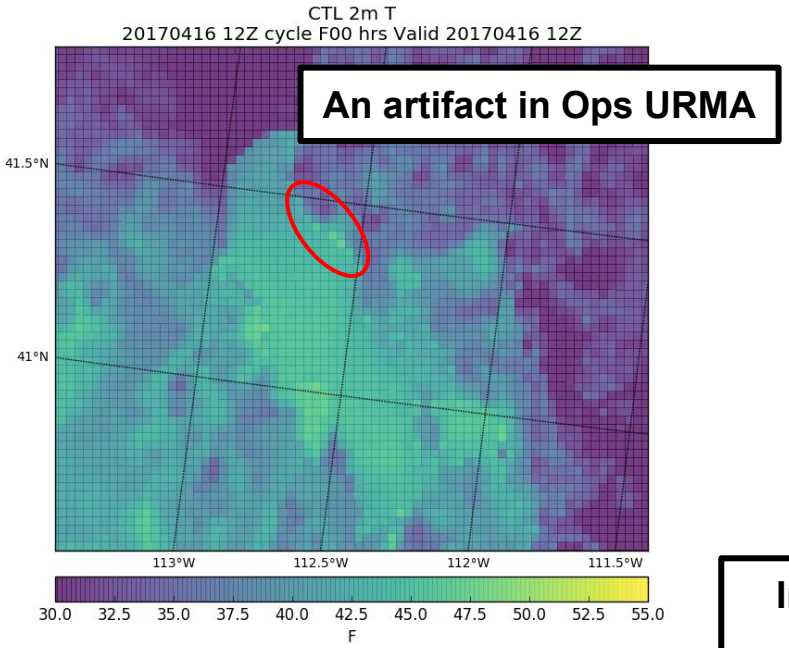
v2.6 Bundle: Coastline background error change

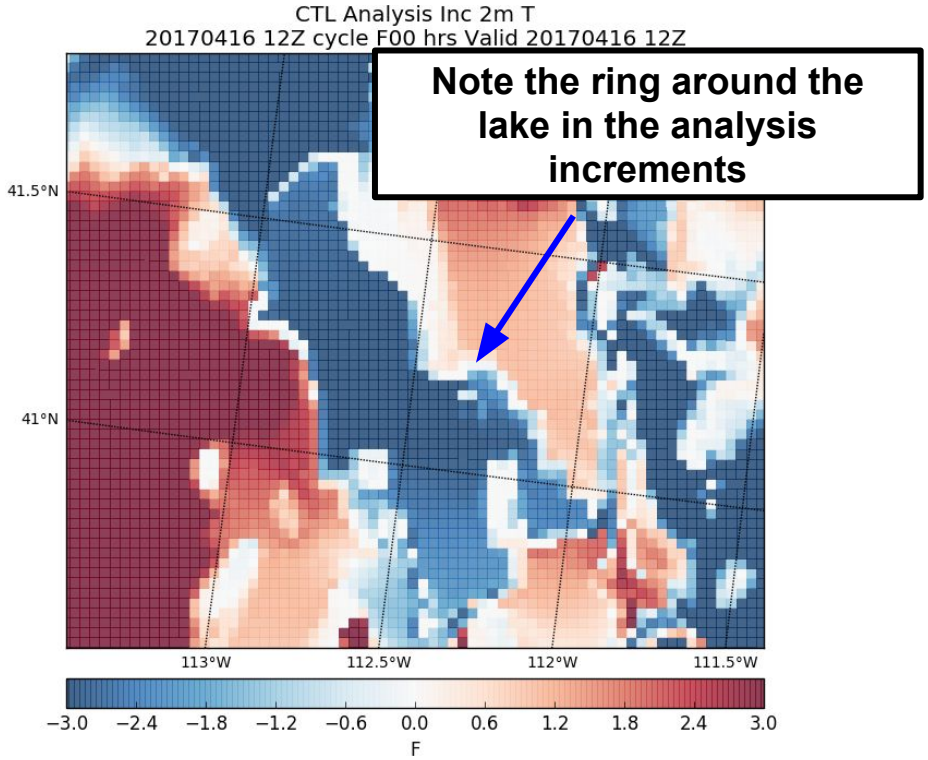
- Further investigation revealed it is an issue with how we analyze temperature across water and land boundaries
  - RTMA/URMA steepens the coastlines to retain land/water contrasts
    - Effectively sharpens the background error covariance



v2.6 Bundle: Coastline background error change

- This steepening is overdone and leading to artifacts

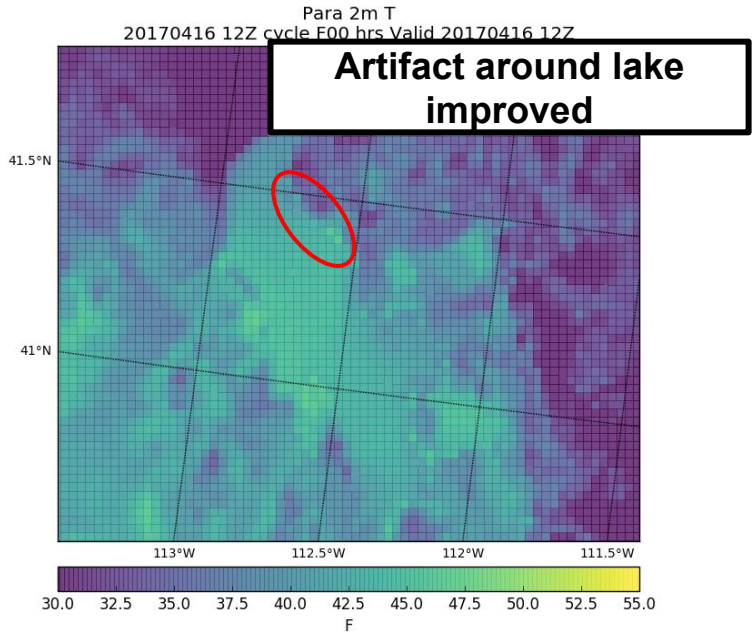


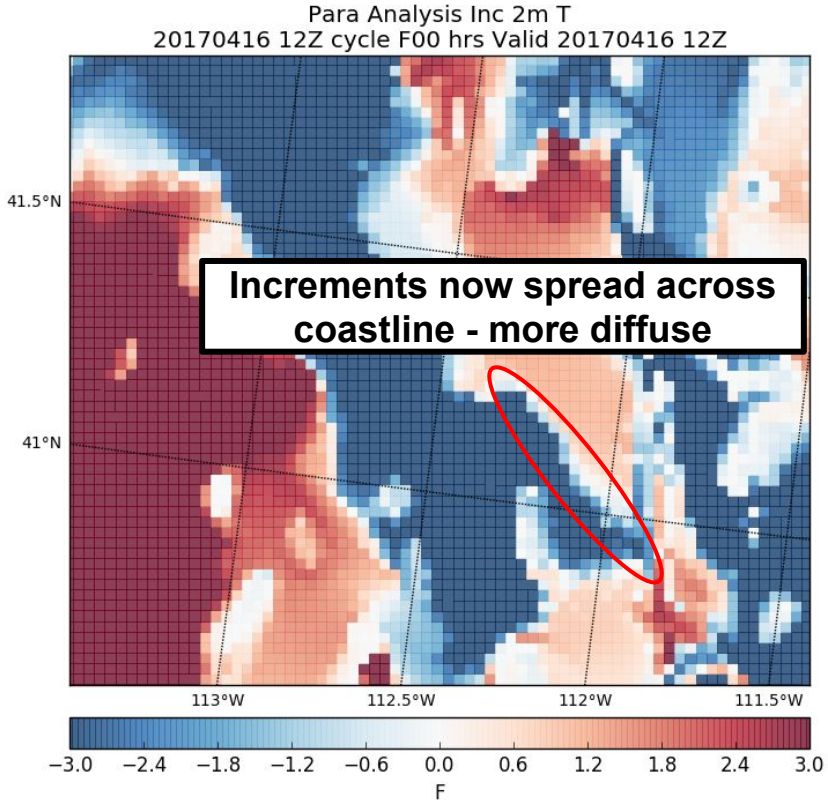


In this “ring” the background is not being updated - which leads to the artifacts

v2.6 Bundle: Coastline background error change

- Solution is to reduce the steepening

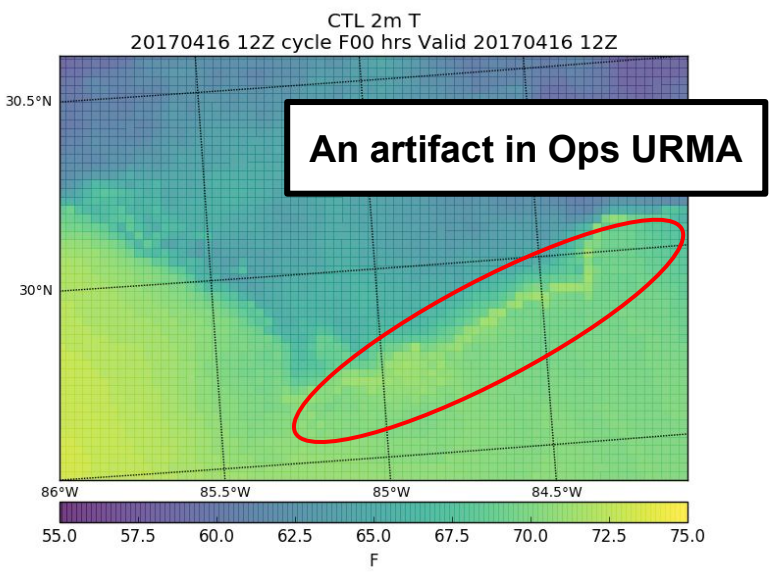


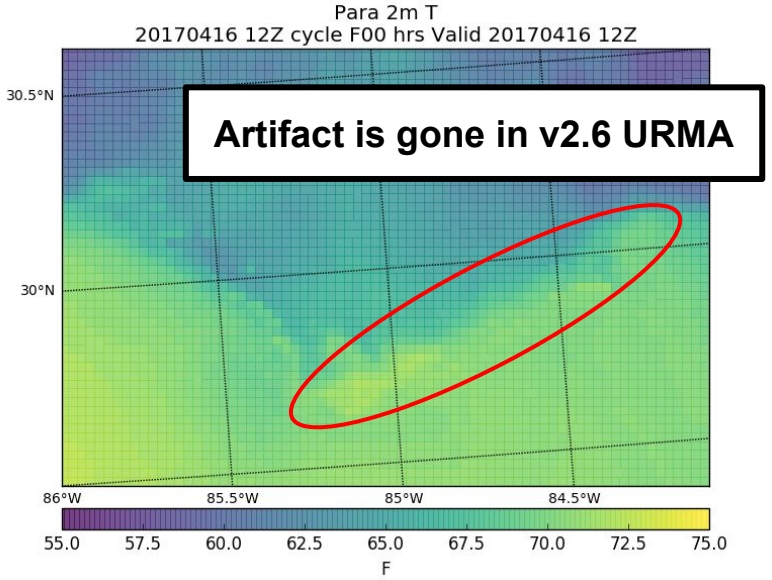


v2.6 Bundle: Coastline background error change

- Further investigation showed RTMA/URMA had this issue around many coastlines.

Example: Central Florida Panhandle



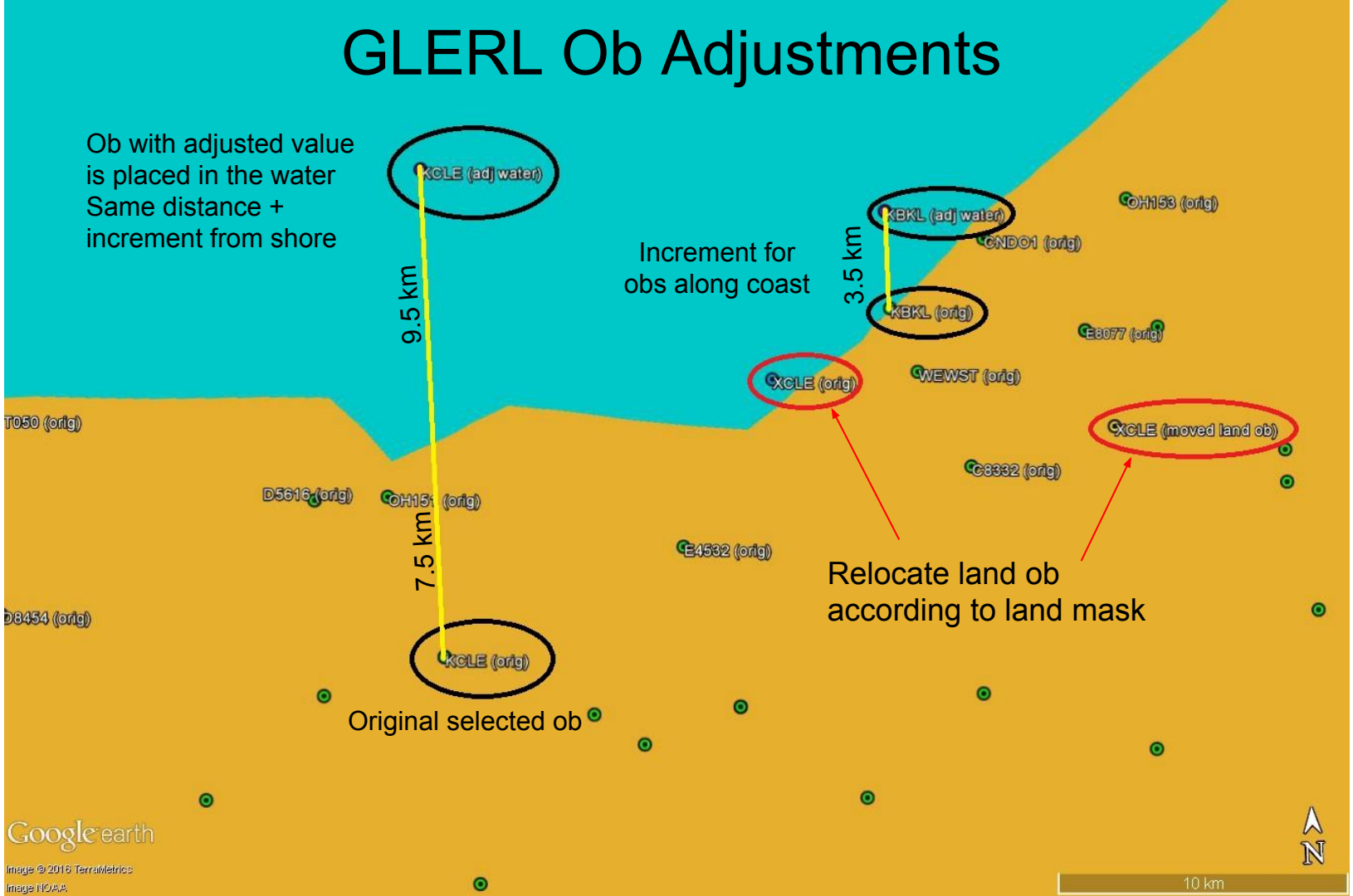


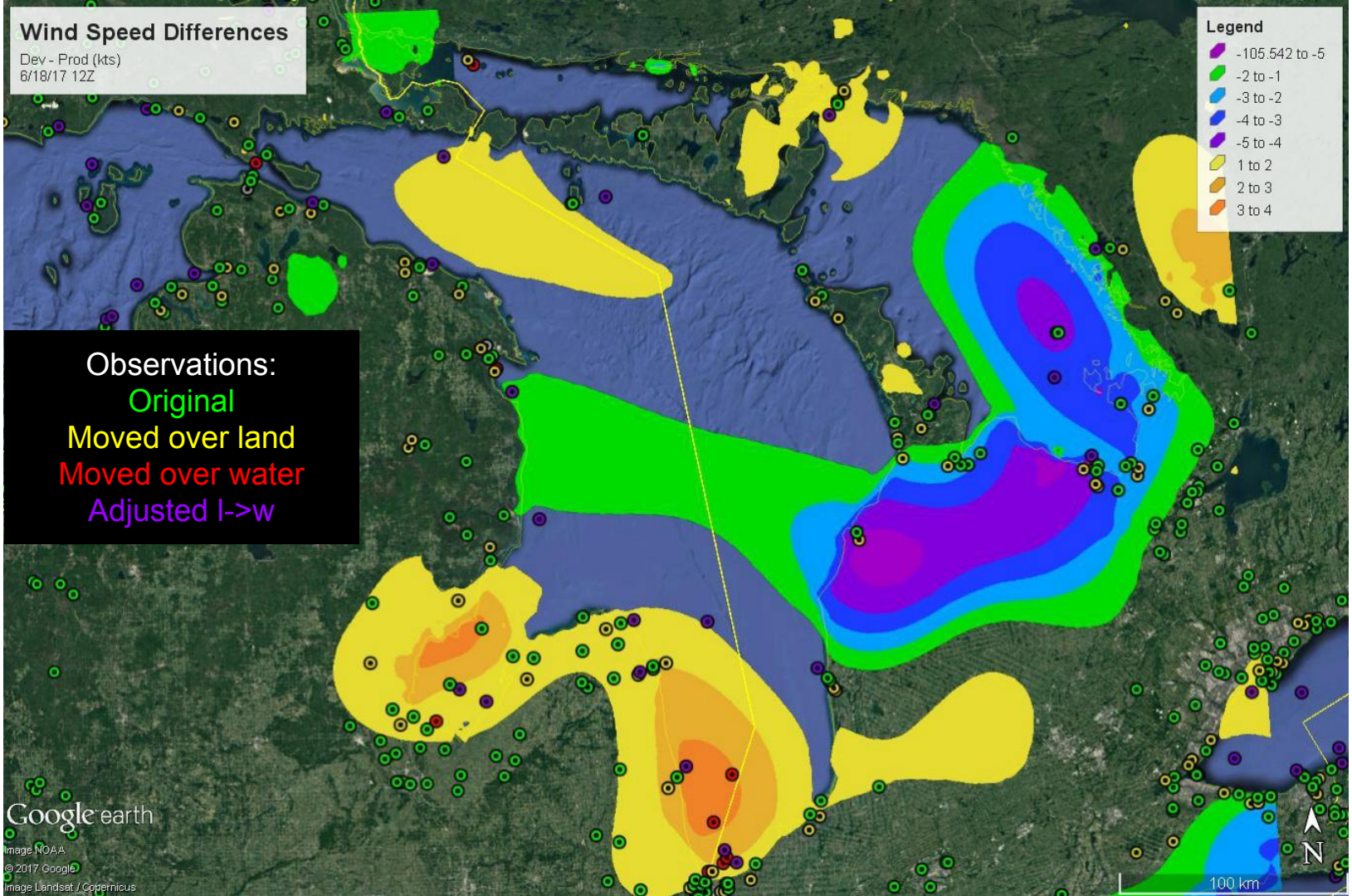
Thanks to Darren Van Cleave for bringing this (tricky!) issue to our attention!

v2.6 Bundle: GLERL Method over Great Lakes

- Goal: Create a smooth wind analysis over the Great Lakes that can be used to initialize Great Lakes Wave model
- MMAB (Henrique Alves) suggested that URMA try to mimic analysis produced at GLERL.
- Analysis relies on additional ‘adjusted’ observations.
  - Selected land-based sites used
  - Formula developed at GLERL to adjust observations to represent over-water conditions
  - Adjusted obs are then placed over the lake, terrain escarpment prevents cross-contamination
  - Original ob remains at original site
  - Additional ob sites were relocated so their location was consistent with land/sea mask
- Adjustments are made in a new subroutine in observation file
  - Due to runtime, process runs in URMA only
- Increase correlation length scales for winds over Great Lakes by 50% for a smoother analysis

GLERL Ob Adjustments




Wind Speed Differences
Dev - Prod (kts)
6/18/17 12Z
Legend
-105.542 to -5
-2 to -1
-3 to -2
-4 to -3
-5 to -4
1 to 2
2 to 3
3 to 4
Observations:
Original
Moved over land
Moved over water
Adjusted l->w
Google earth
Image NOAA
© 2017 Google
Image Landsat / Copernicus
N
100 km

Evaluations - Part 1

- OPC: Provided informal feedback - No recommendation
  - Prefer more extensive coverage of the wave height analysis beyond CONUS
    - We do have OCONUS coverage planned for v2.8
    - Major, oceanic domain coverage is outside the current scope of RTMA/URMA
  - Would like an RTMA version of the wave height analysis
    - Investigating now, however observation latency may limit quality (~70 obs per analysis)
- WPC: Recommends implementation
  - Mostly evaluated temperature and moisture
  - Temps over Great Lakes were sometimes 2-4 F warmer (coastline steepening change + GLERL obs)
- Southern Region: Recommends implementation
  - Like the RU-RTMA, some forecasters have noted analyses improvements at and near the coast, URMA significant wave height will help with verification and validation of some marine forecasts, hourly precipitation fields will provide beneficial record for post-event studies of excessive rainfall events.

Evaluations - Part 2

- WFO Salt Lake City
  - “happy with the fix for the issue of "rings" around lakes, namely the Great Salt Lake. We're looking forward to having that fix in the operational version in September.”
- FAA: Provided informal feedback and recommends implementation
  - Differences noticed in cloud amount and ceiling
  - Parallel had less restrictive ceilings and more gradual transition between flight categories

Parallel Issues

- Dependent on 5 upstream parallels: NAM smartinit, RAP smarintit, HRRR smartinit, obs processing and wave model
  - Wave model was briefly run on production machine, better availability but we had to move files
- With bias correction, it's much better to run consecutively than to miss a cycle or two
- AWC unable to evaluate the 'Rapid Update' part of RU-RTMA do to delays associated with dev environment
- How should parallel be maintained going forward?
  - 30-day IT won't be available until September
  - Development for v2.7 must begin now
  - Add on to existing parallel, knowing parts won't be implemented in October?

Thanks! Questions about v2.6, future developments, etc.?:
rtma.feedback.vlab@noaa.gov

BACKUP SLIDES

v2.6 Bundle: Data Access

RTMA/URMA and RURTMA:

ftp://ftp.emc.ncep.noaa.gov/mmb/rtma/v2.6.0/${NET}/para/${RUN}.${YYYYMMDD}

where

NET=RTMA ; RUN=rtma2p5, akrtma, hirtma, prrtma, gurtma, rurtma2p5

NET=URMA ; RUN=urma2p5, akurma, hiurma, prurma

Precip data and images:

ftp://ftp.emc.ncep.noaa.gov/mmb/precip/pcpanl.v3.0.0/

Web Graphics:

Parallel RTMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/RTMAP

Parallel URMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/URMAP

Operational RTMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/RTMA

Operational URMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/URMA

Parallel vs. Ops RTMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/RTMAP-RTMA

Parallel vs. Ops URMA:

http://www.emc.ncep.noaa.gov/mmb/jcarley/rtma_urma/URMAP-URMA

Looking Ahead to v2.7

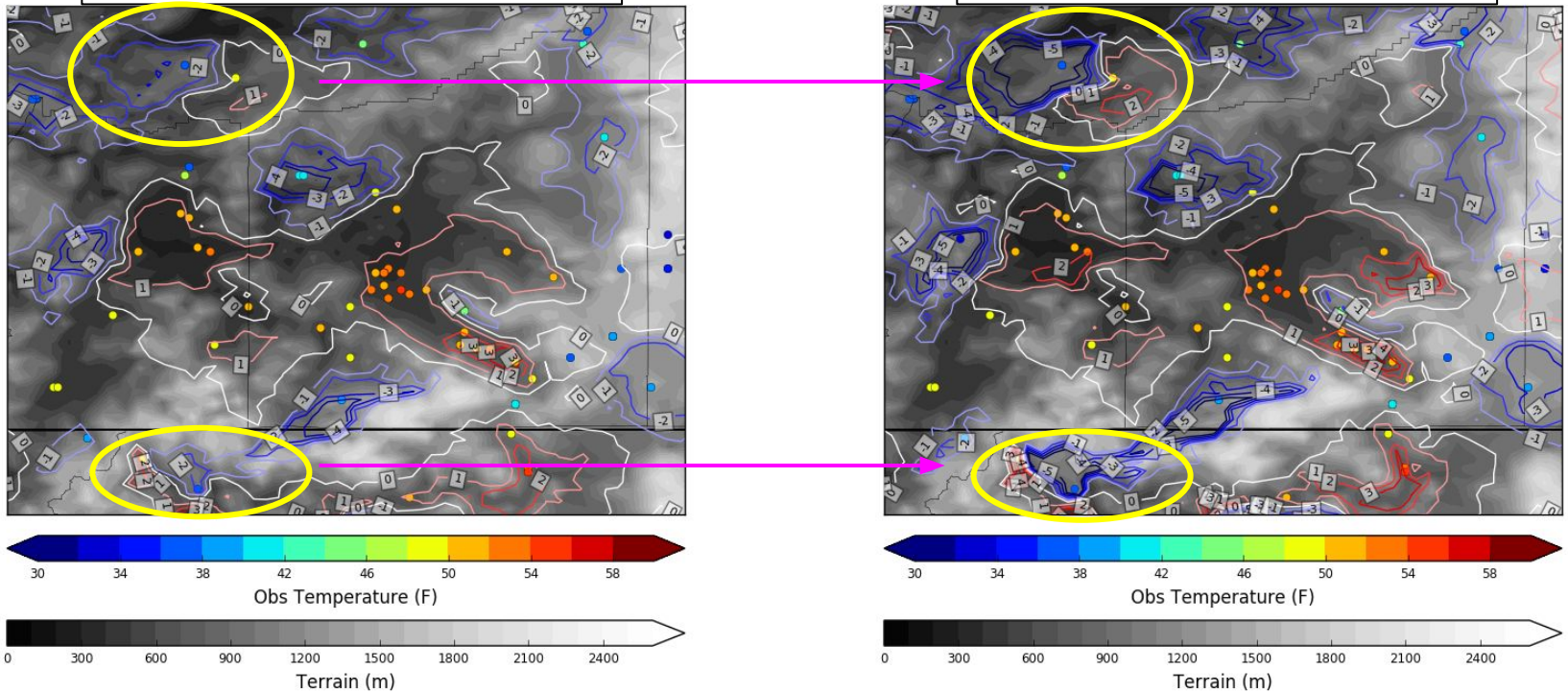
- Improve background error covariance model
  - Will fit data closer, **good enough item 3a**
  - Testing is in progress *now.* Will broadcast a test parallel to the field as soon as possible.
  - When the background deviates considerably from an observation the analysis struggles to fit the observation well
    - Decreasing the observation error can help - but it's not the observation that is in error
    - *Increasing* the background error will guide the analysis to fit the data more closely

Looking Ahead to v2.7: Updated background error

Medford, Oregon

Control: Temperature Analysis Increments

Experiment: Temperature Analysis Increments



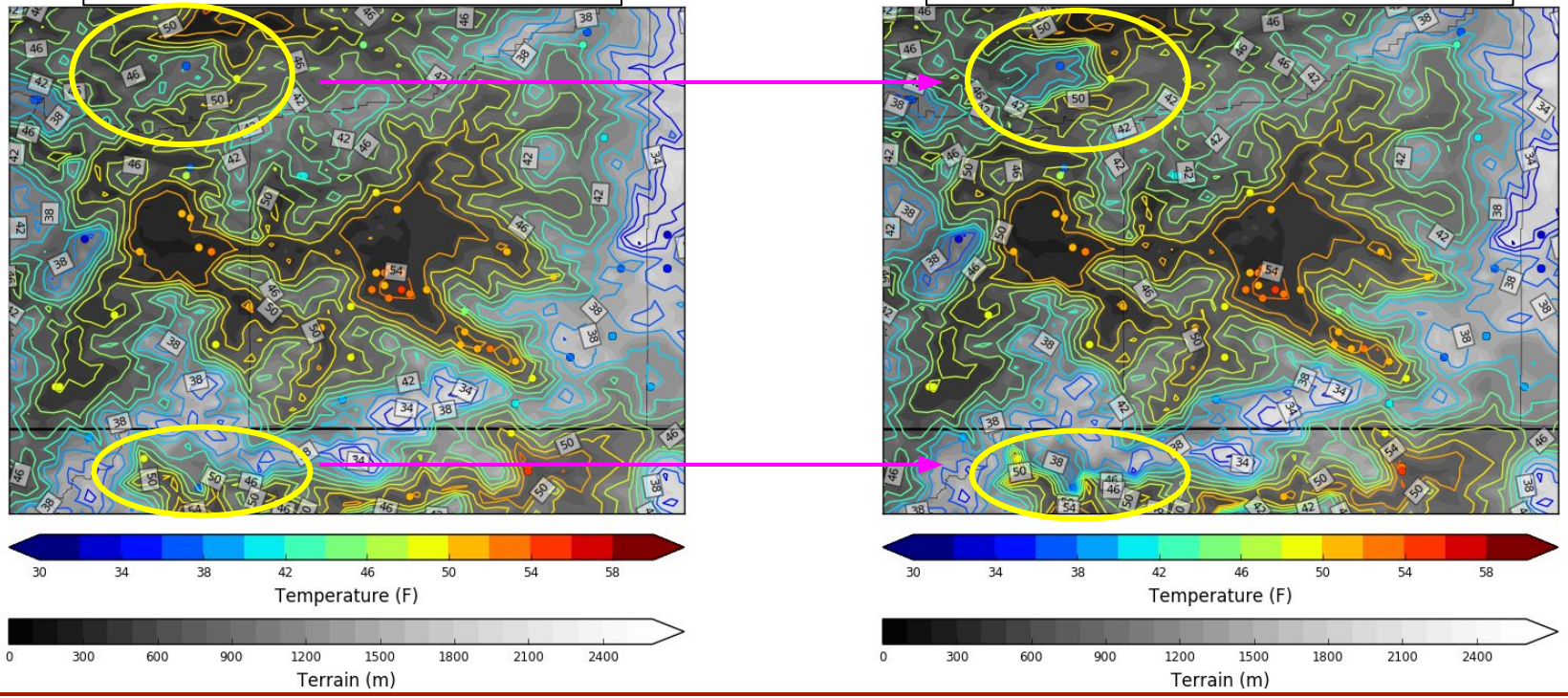
With updated background error covariance model EXP is able to more closely fit the observations

Looking Ahead to v2.7: Updated background error

Medford, Oregon

Control Temperature Analysis

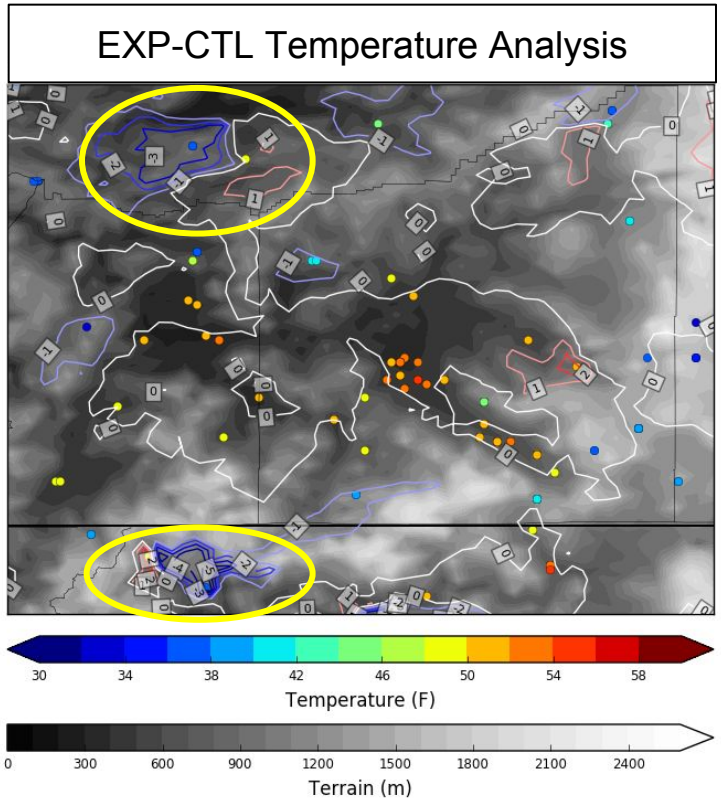
Experiment Temperature Analysis



With updated background error covariance model EXP is able to more closely fit the observations

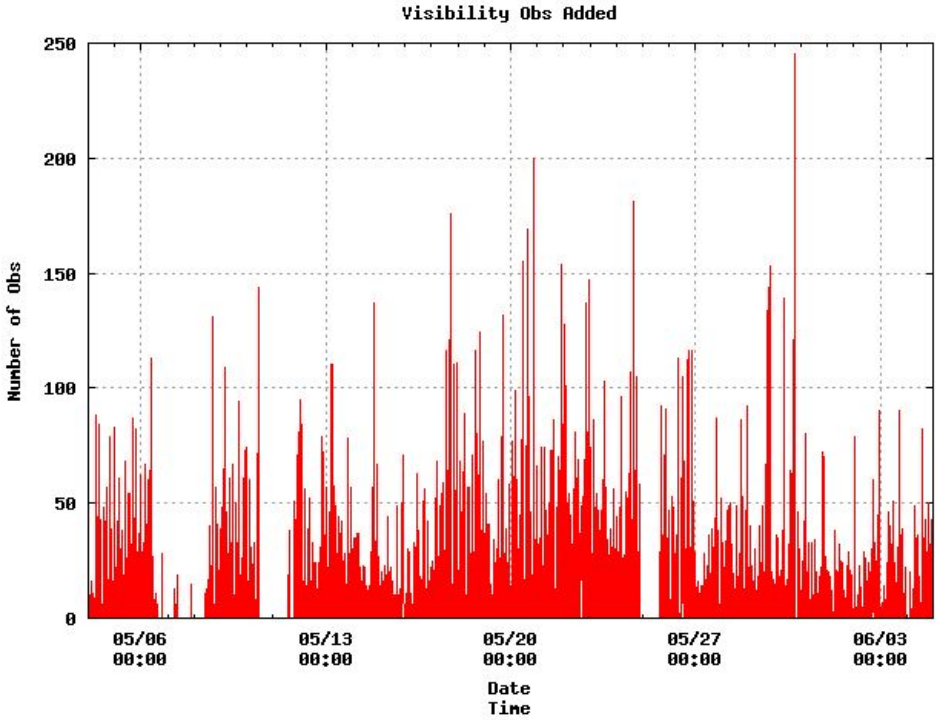
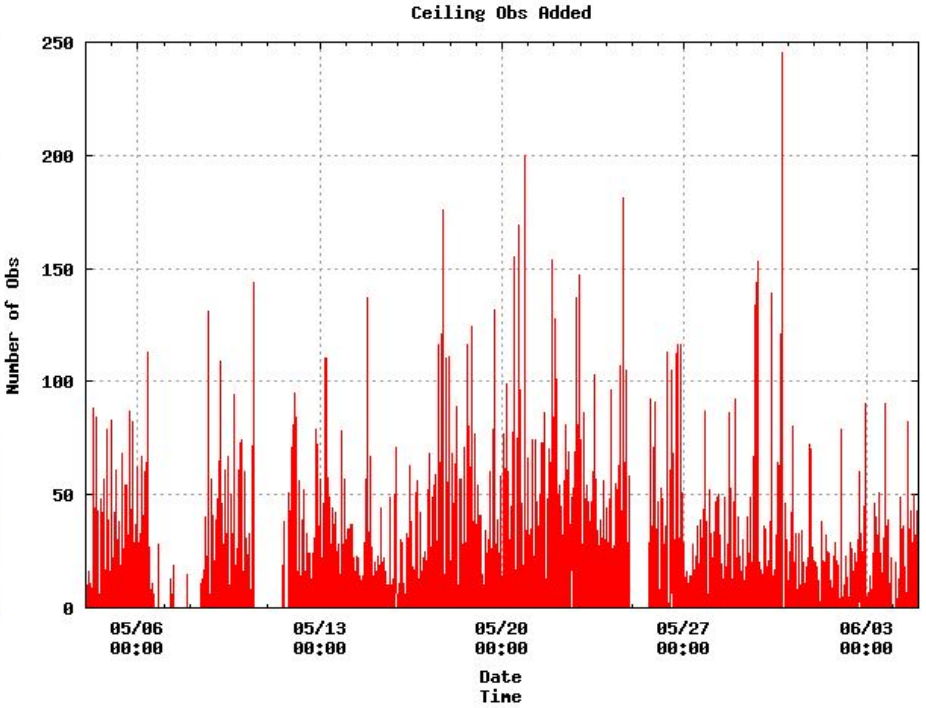
Looking Ahead to v2.7

- EXP shows closer fit to observations over CTL
- Current test revises the background error based upon terrain variability in a neighborhood of a gridpoint
- Expandable to the variability in the field of interest
  - May improve utility of estimate of analysis error by providing some flow-dependence
- More testing is needed - field input will be critical
  - e.g., valley cold pool case studies



Mesonet QC Enhancements

- Enhanced QC requested in ‘good enough’ document (item 2B)
- Meeting with stakeholders (interested WR SOOs and ERH) held in April
- Created form that SOO/DOH/center can use to identify bad stations
  - Finding was that SOOs and DOHs should control this, not individual forecasters.
  - List of stations is entered on sharable spreadsheet for easy tracking
  - Form also approved by NCO (Carissa Klemmer/Patrick O’Reilly)
- We will investigate and flag via SDM’s desk as needed
- Requires decoder RFC (BUFR table change to mesonets) to process SDM edit marks
  - Has been submitted but no date for implementation yet

Improving Data Latency

Max Possible Additional Obs From Updating Tanks Every Minute vs. Two Minutes (current)