V2.8 RTMA/URMA/RTMA-RU Science Brief

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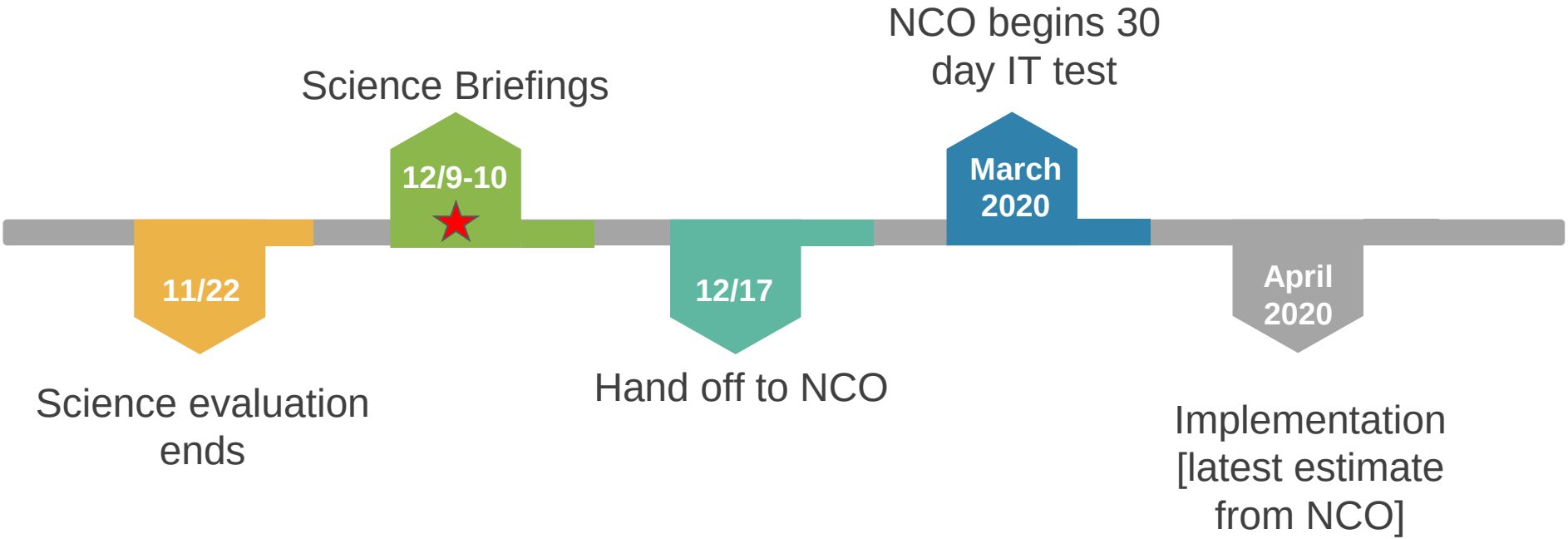
And many other excellent folks from ESRL/GSD, NWS WFOs and Regions, MDL + the NBM team, and NCEP Centers

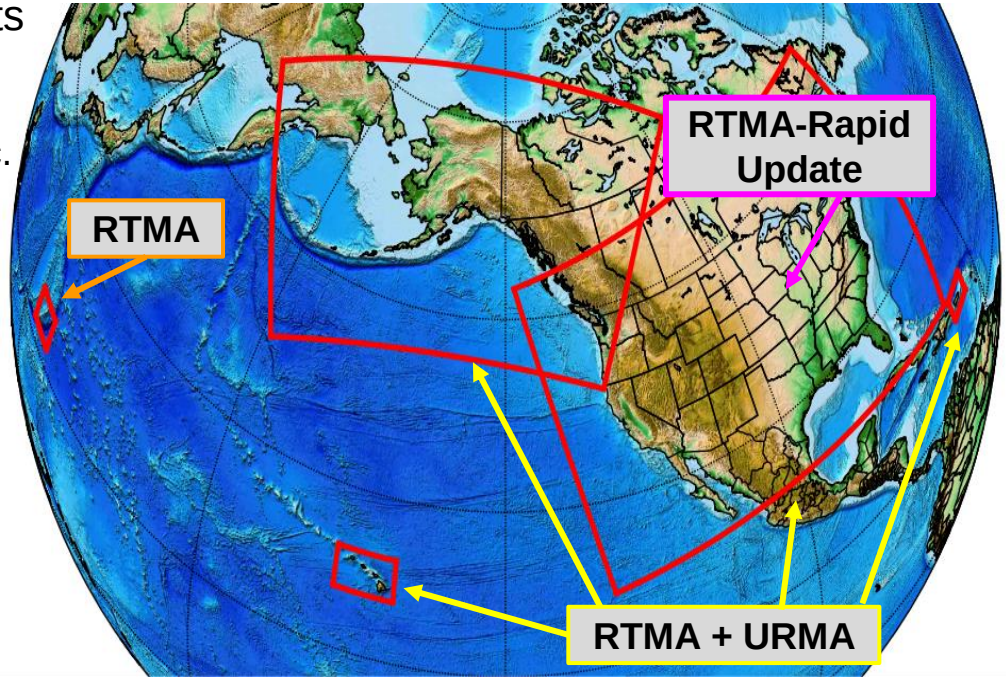
[1]NCEP/EMC/Modeling and Data Assimilation Branch
[2]IM Systems Group
[3]Systems Research Group

V2.8 RTMA/URMA/RTMA-RU Timeline



RTMA/URMA/RTMA-RU

- 2D, *2.5km** analysis of sensible wx elements
  - 2DVar system
  - 2m T and moisture, 10m wind and gust, ceiling, visibility, sky cover, wave height, etc.
- **R**eal **T**ime **M**esoscale **A**nalysis (RTMA)
  - Hourly
  - Real time system for nowcasting and situational awareness
- **U**n**R**estricted **M**esoscale **A**nalysis (URMA)
  - Runs 6 hours after RTMA to capture late arriving obs
  - Verification, calibration, analysis of record
  - Calibration in National Blend of Models
- RTMA-**R**apid **U**pdate
  - 15-min updates, low-latency
  - Nowcasting, aviation, + situational awareness



*AK domains are currently at 3 km
**PR now at 1.25 km*

v2.8 RTMA/URMA Upgrade: Highlights

- Downscaling/background field improvements [All stakeholders]
  - 2.5 km → 1.25 km for PR, consistent with NDFD [NBM, Puerto Rico]
- Improved wind analysis with reduced low bias [All stakeholders]
- Significant wave height for Guam and Great Lakes [NBM, Guam, Great Lakes]
- Moisture/dew point analysis enhancements [NBM, W. Region, WFO Missoula]
- Re-tuned sky cover analysis with enhanced QC [NBM, CONUS, AWC]
- Consistent ceiling and sky analysis [All stakeholders, esp. AWC]
- Precipitation enhancements [CONUS and coastal CONUS, WPC]
- NOHRSC snow analysis [CONUS, WPC]
- Expansion of upgrade for better fit to observations for OCONUS (already in CONUS) [NBM, OCONUS]

Many improvements continue to be motivated via collaboration with highly engaged stakeholder community

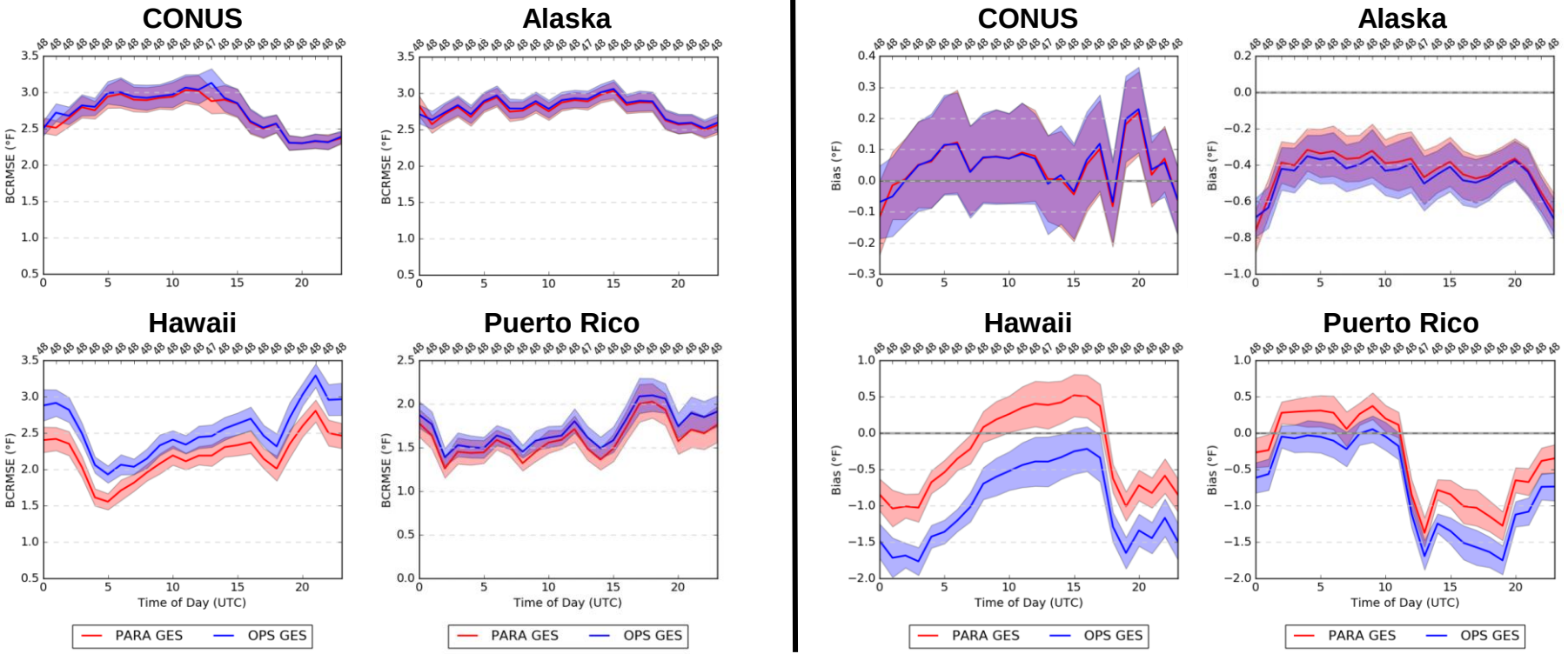
Downscaling updates for v2.8

Background/first guess in RTMA/URMA

- HRRR Smartinit (sent to AWIPS)
  - Winds
    - Where the NDFD terrain > model terrain.
      - Maximum of the 10-m winds (instead of model level 1 winds) and vertically interpolated winds multiplied by 0.7 (to account for surface friction)
    - When NDFD terrain <= model terrain
      - The 10-m winds are used.
- RAP Smartinit (not sent to AWIPS)
  - Use land sea mask for coastline adjustment instead of vegetation type
- NAM Hawaii and Puerto Rico, HiresW Guam and RAP Smartinit (sent to AWIPS)
  - New temperature downscaling, consistent with HRRR approach
    - If NDFD terrain != model terrain
      - Use the local lapse rate, constrained between dry adiabatic and isothermal, to adjust the temperature
- Puerto Rico grid change from 2.5 km to 1.25 km to be consistent with NDFD

Temperature Time Series - Background

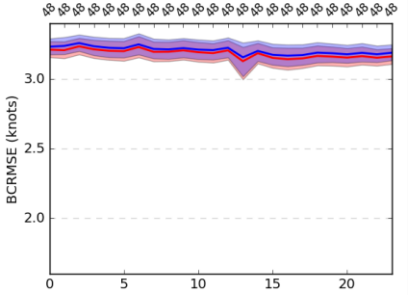
BCRMSE **OLD SYSTEM** **NEW SYSTEM** **Bias**



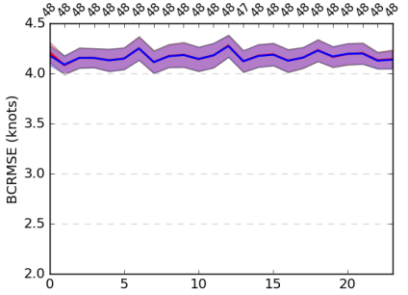
Wind Speed Time Series - Background

BCRMSE **OLD SYSTEM** **NEW SYSTEM** **Bias**

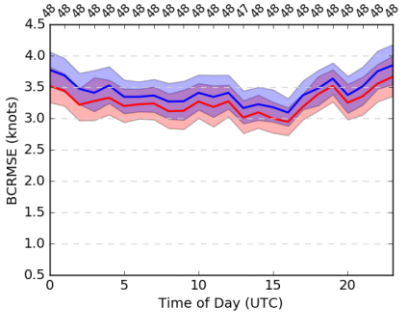
CONUS



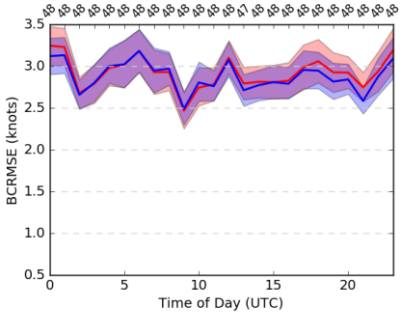
Alaska



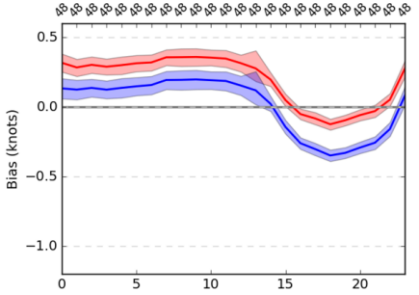
Hawaii



Puerto Rico



CONUS



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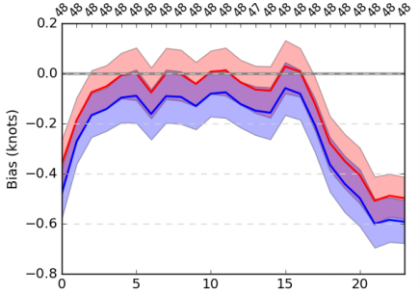

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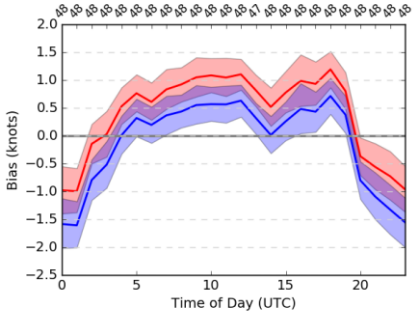
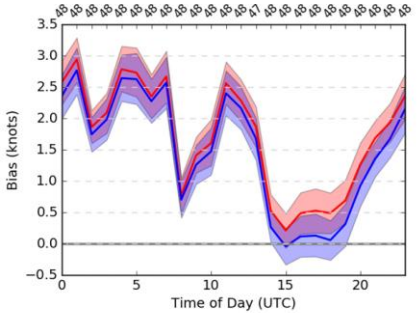


Puerto Rico



stats are relative to METARs, buoys, and ships

Wind Changes: Similarity Theory Adjustment

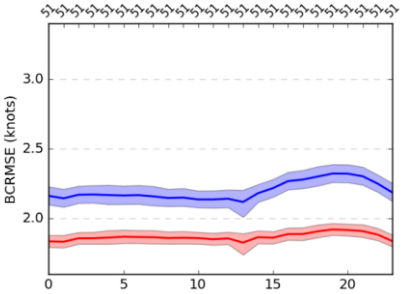
- Has been assumed that all wind obs are taken at 10 m AGL
  - We know from looking at station photos that this is not true
- For mesonets: wind sensor height will now be a function of provider/network
  - Current list of providers/heights
- Background wind is adjusted via similarity theory to the same height as the observed wind
- Observation is be compared against this adjusted background wind value
- Similar adjustments made to gust analysis

Station photo from weather.gladstonefamily.net

Wind Speed Time Series - Analysis

BCRMSE **OLD SYSTEM** **NEW SYSTEM** **Bias**

CONUS



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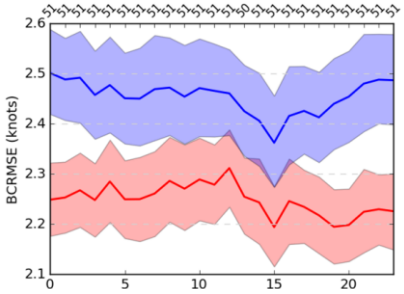

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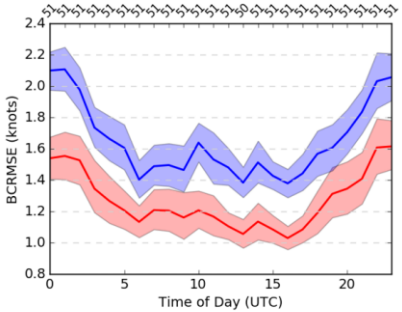
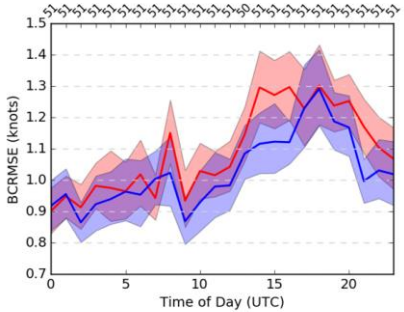
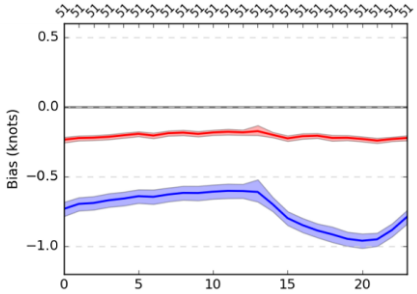


Puerto Rico



CONUS



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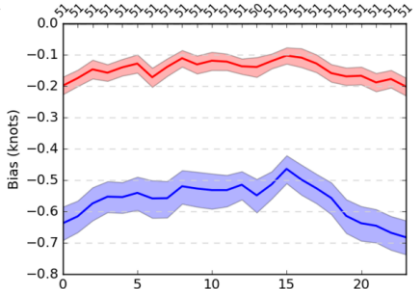

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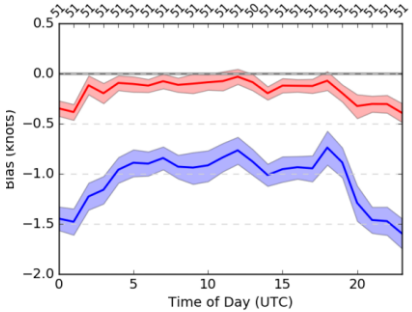
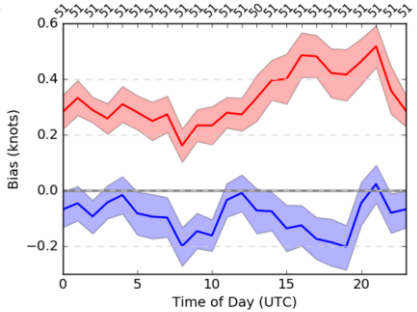


Puerto Rico



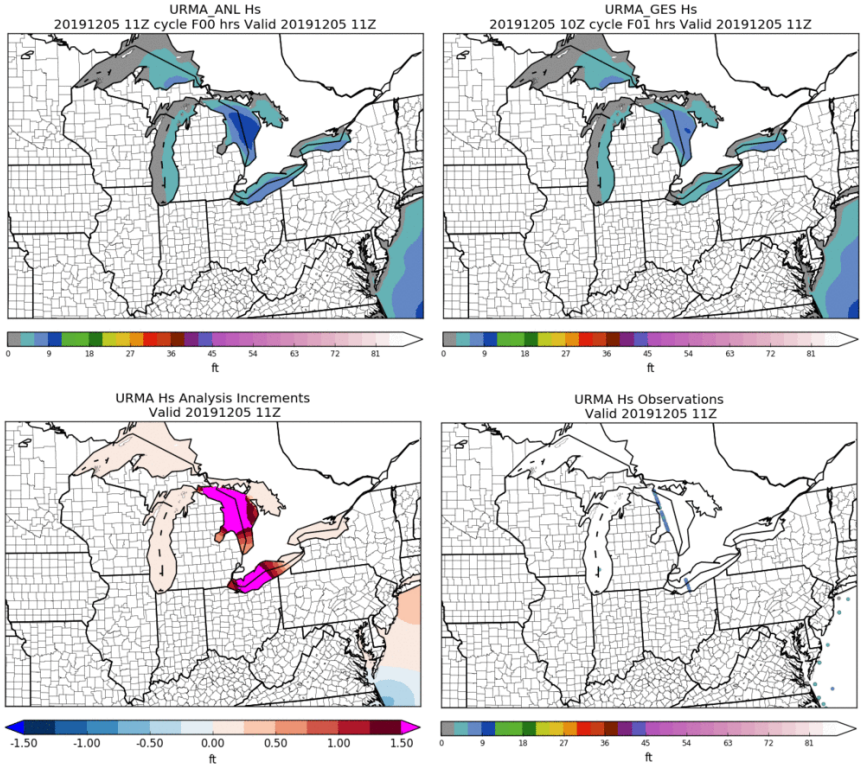
stats are relative to METARs, buoys, and ships

Significant Wave Height Upgrades

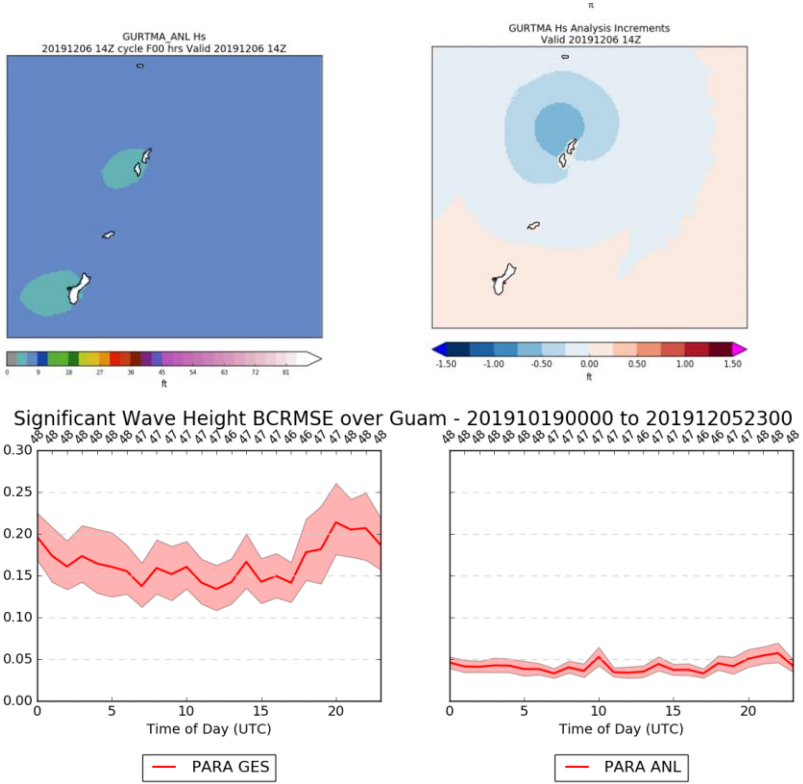
- Preprocessing, downscaling and merging the multi-grid output, of the SWH background:
  - Adding the sea land mask → erroneous values from the background have been eliminated
  - Background can now be produced by an infinite number of background grids
    - e.g. for CONUS, waves from 6 grids are merged
- Analysis for the Great Lakes is added, based on the GL forecasting system.
- Sea/ice mask is applied (CONUS and AK), based on the NCEP operational ice coverage retrieval.
- Significant Wave Height analysis is now provided for Guam (RTMA).

Wave Height v2.8

Great Lakes

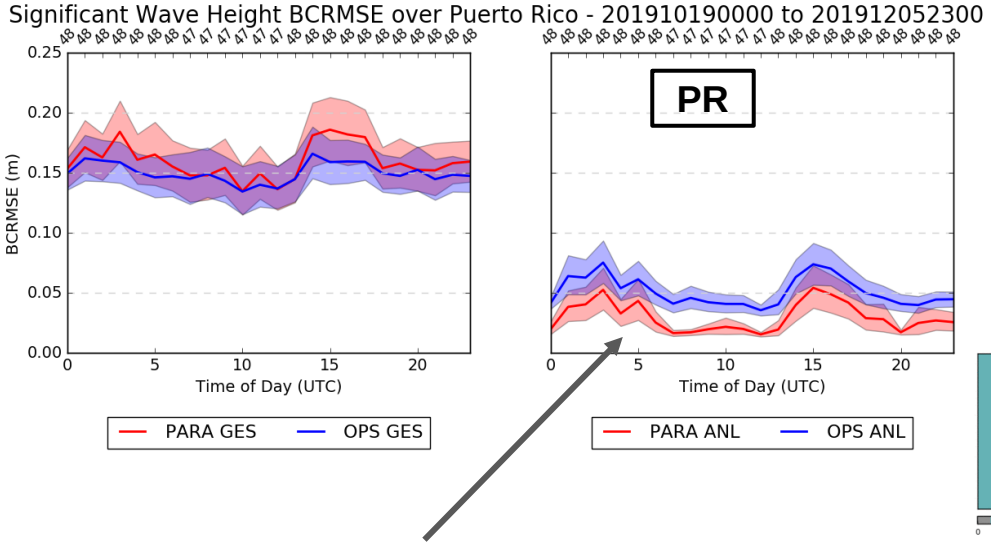


Guam



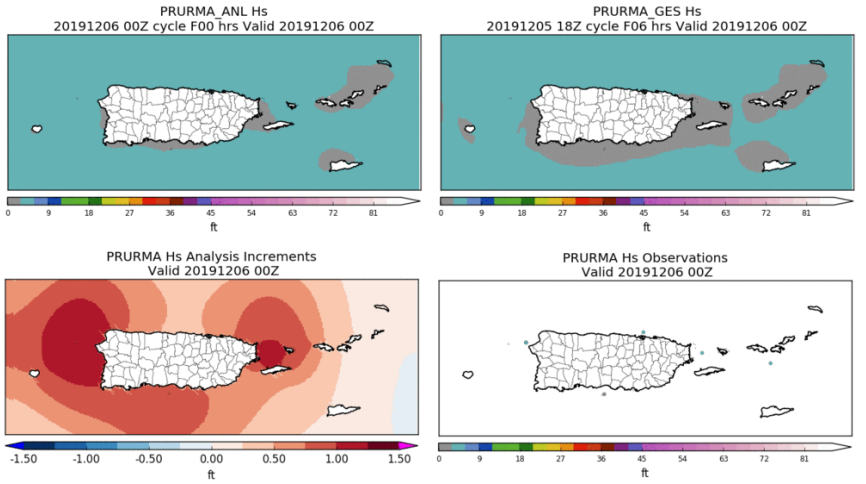
stats are relative to METARs, buoys, and ships

Puerto Rico Wave Height Stats



New grid and higher resolution + new background error = closer fit to obs

- The spatial resolution of PR was doubled (from 2.5km to 1.25km):
  - The system's parameters were recalibrated
  - *PR URMA is now the wave analysis system with the highest spatial resolution globally*

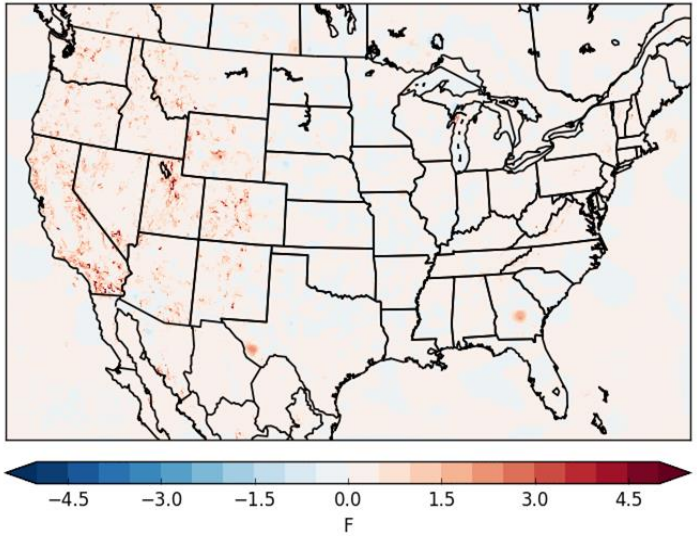


stats are relative to METARs, buoys, and ships

Dew Point Analysis Updates

- Moist bias causing issues with FireWx
  - First noticed by WFO Missoula, MT
- Operational Dew Point Product:
  - Q and surface press. analysis is used to derive Td
  - Analysis increments between the computed Td fields is smoothed via a “1-2-1” filter and added to the downscaled Td to generate the final analysis
- The “1-2-1” smoothing filter has been switched off**
- Impacts closely tied to steep terrain
  - Coordinated and approved with Western Region and WFO Missoula

22Z on 29 June 2019



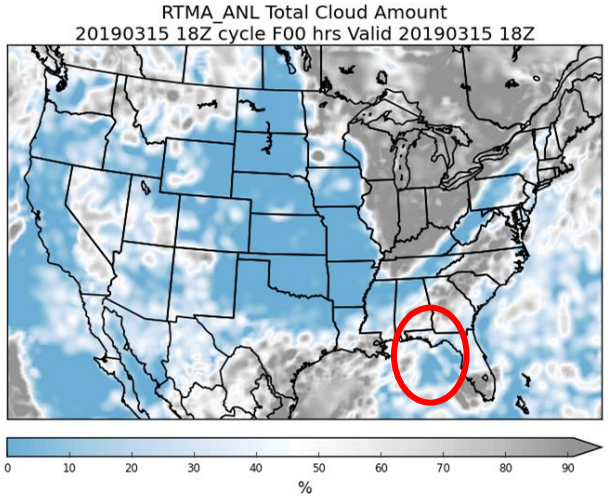
Operational - Retrospective

**Very early RTMA (>10yrs ago) had serious issues with localized areas of unrealistically low dew points

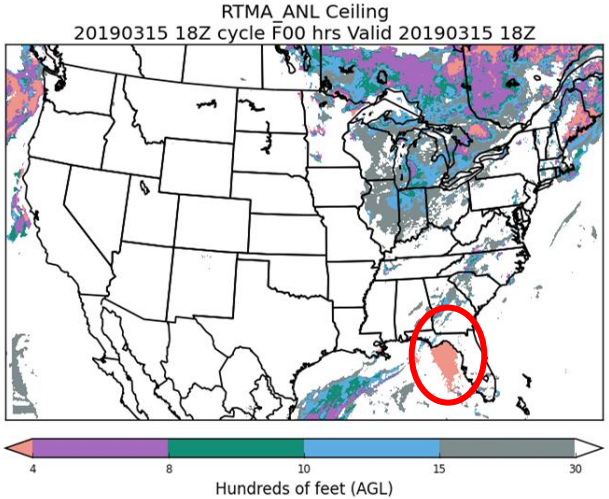
Ceiling and Sky Cover Updates for v2.8

- Ceiling is cleared (i.e., set to maximum ceiling value) when the analyzed sky cover is < 50%
  - Ensuring product consistency
- Reject GOES Imager sky cover observations when:
  - The observation is < 30% and over water; and
  - Solar zenith angle is > 80° (i.e., late evening, overnight, or early morning)
  - Based upon feedback and consultation with GOES product developer and stakeholders
- Reduced thinning of GOES sky cover observations (by half) and tripled the decorrelation length to address feedback of a “splotchy” sky cover analysis
- Add sky cover analysis to RTMA-RU
  - Updates every 15 minutes

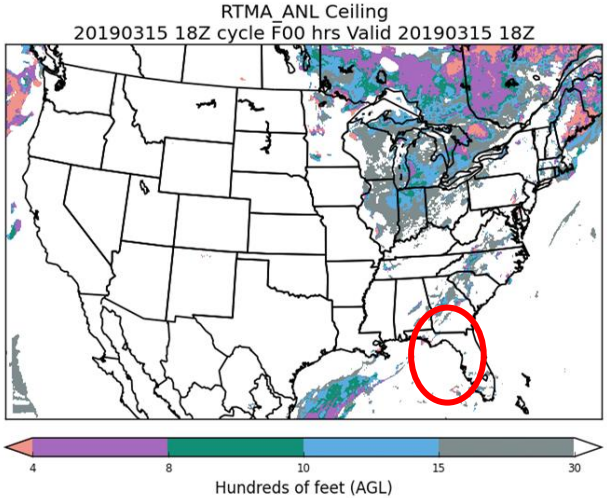
Example: Ceiling clearing



Sky Cover



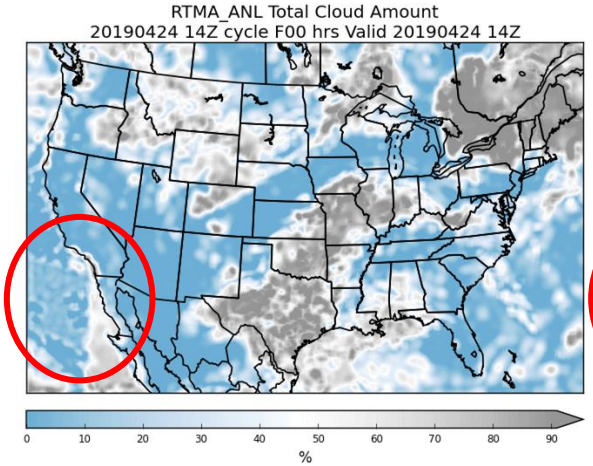
Original Ceiling

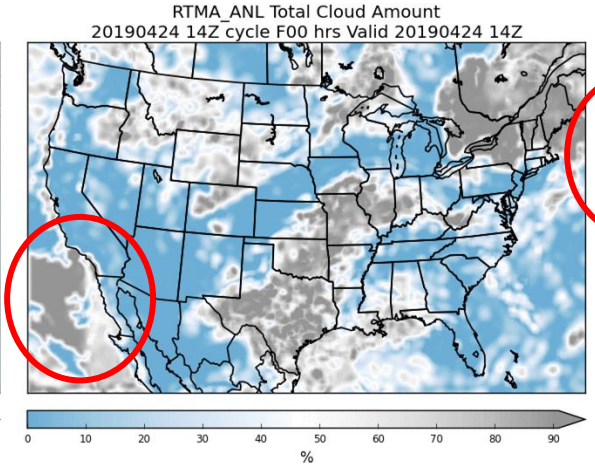


Modified Ceiling

18Z on 15 March 2019

Example: Sky Cover QC

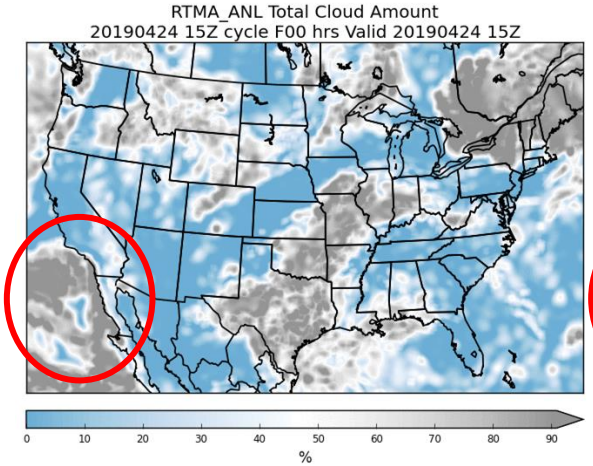


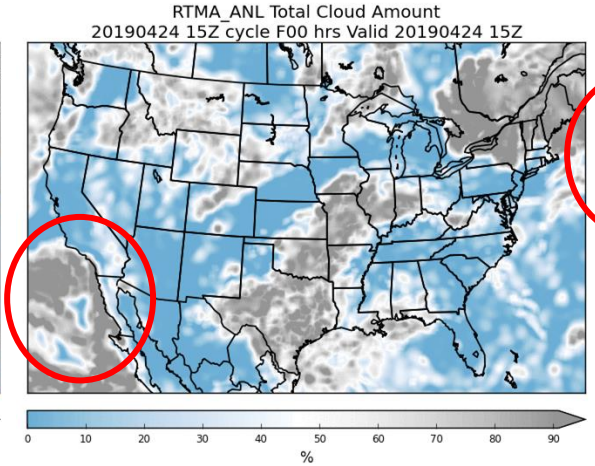


Original Sky Cover | **Modified Sky Cover (QC)** | **VIS**

14Z on 24 April 2019

Example: Sky Cover QC

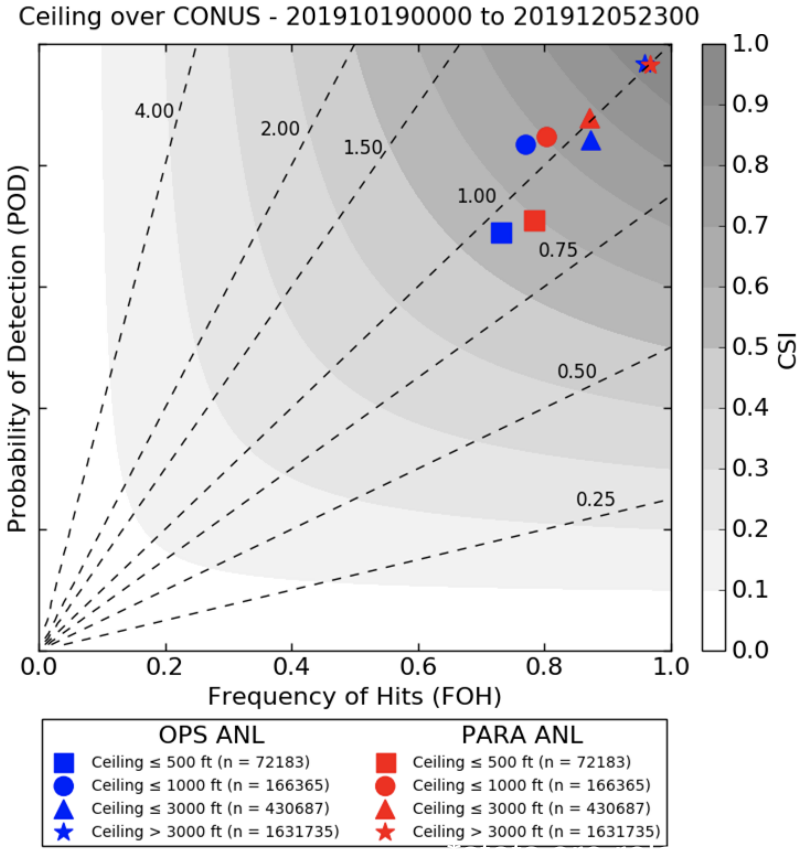


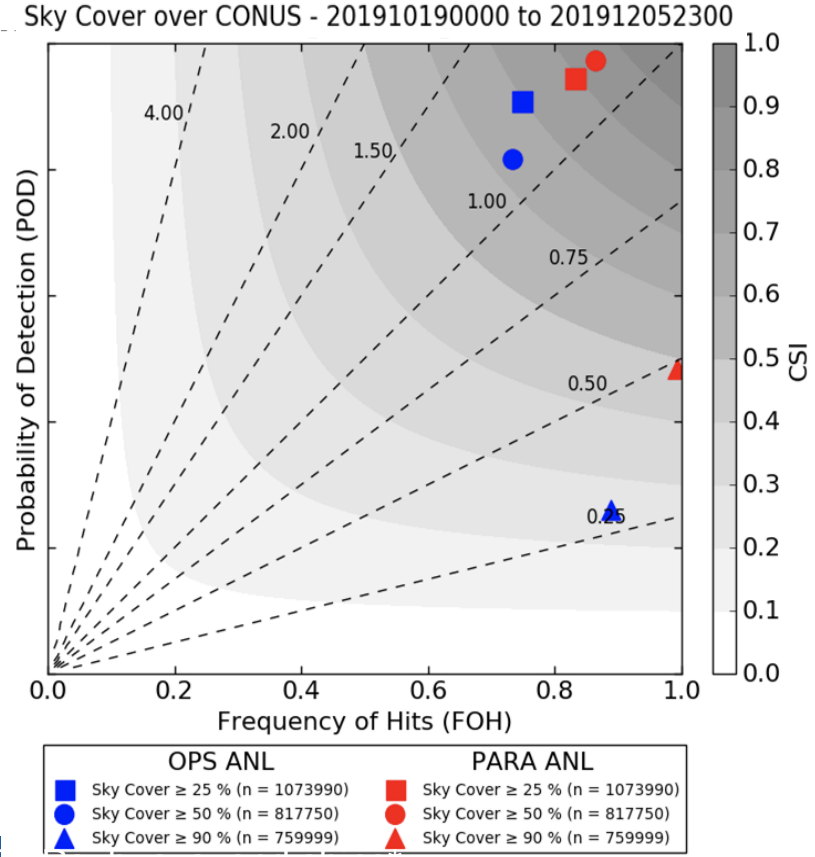


Original Sky Cover | **Modified Sky Cover (QC)** | **VIS**

15Z on 24 April 2019

Ceiling and Sky Cover Stats





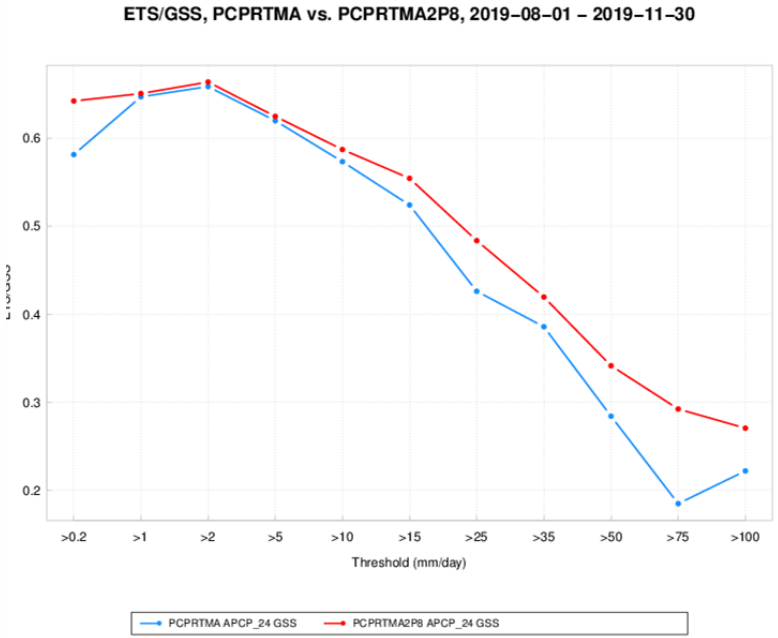
Stats are relative to METARs, buoys, and ships

QPE RTMA/URMA Changes for v2.8

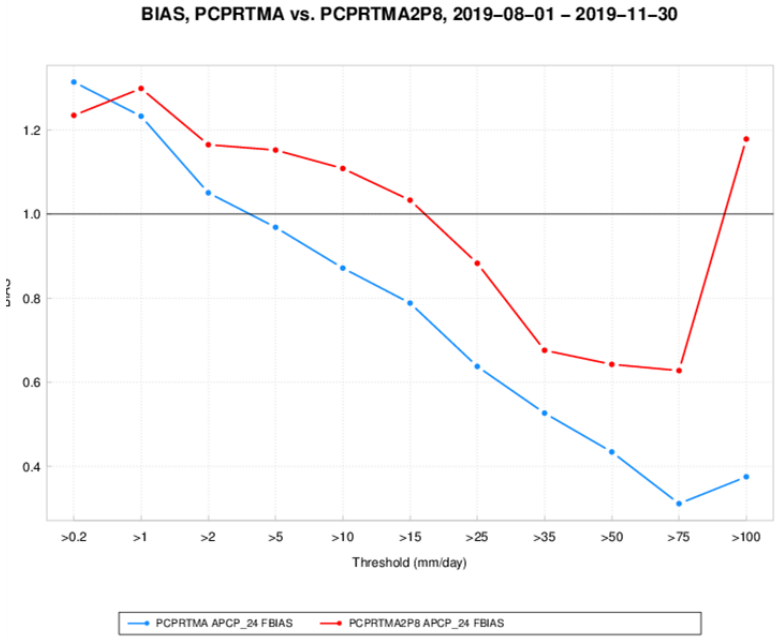
- Precip *RTMA*
  - Real time, low-latency QPE → currently from Stage II/IV (+33 min)
  - **v2.8:** Replace with radar-only MRMS; change hourly run schedule from hh:33 to hh:15
    - Improve latency
    - Situational awareness
- Precip *URMA*
  - Backbone is Stage IV and is rerun regularly ~1 week after valid time to refine/enhance as RFCs transmit revised data (what the NBM uses)
  - **v2.8:** Add NOHRSC snowfall analysis
  - **v2.8:** Add a blending for a smoother offshore filling with MRMS and CMORPH QPE
  - **v2.8:** Change hourly run schedule for PCPANL/pcpURMA from hh:33 to hh:55
    - Request by OWP, RFCs for RIDGE II, so more RFC QPEs can be included for current hour
    - More complete coverage, earlier
- PCPANL v4.0 (upstream job of RTMA/URMA):
  - Discontinue Stage II analysis - prod suite simplification
  - Add another 30h rerun of Stage IV 24h mosaic (for water.weather.gov/precip
    - Supplements the current ~daily rerun schedule and gives chance for updated RFC QPE's to get out to public (e.g. water.weather.gov/precip)

pcpRTMA using MRMS: validation

Prod *vs.* **v2.8** pcpRTMA: 24 QPE validation vs. daily gauges (1 Aug - 30 Nov 2019)



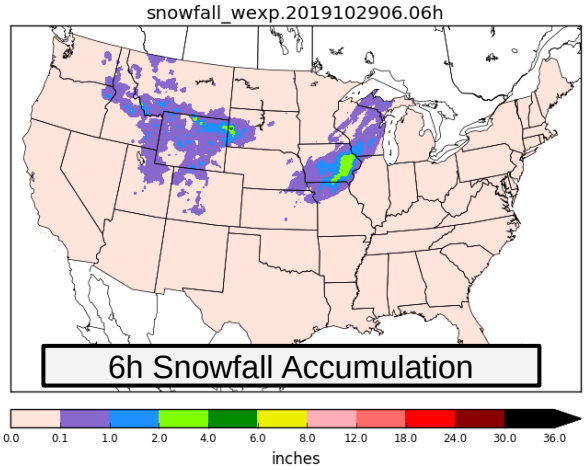
ETS *vs*. threshold

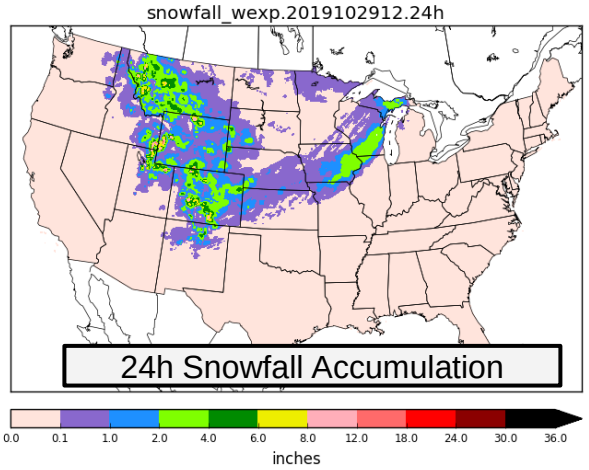


Bias *vs.* threshold

NOHRSC Snowfall Analysis for URMA

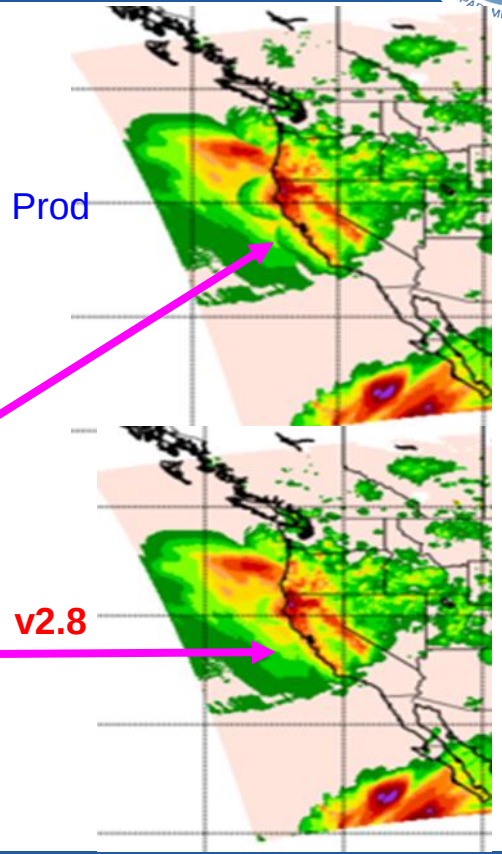
- Add NOHRSC 6h/24h snowfall analysis to the precipitation URMA suite
- At the 18Z cycle (run at 18:55Z), process NOHRSC data for current day AND the past 7 days to continually refine snow product
  - Data mapped from NOHRSC's g184 to the expanded ConUS grid (WEXP) for NBM
  - g184 data sent out to AWIPS





Improved Offshore Filling of pcpURMA

- The primary source of ConUS pcpURMA is the NCEP Stage IV
  - mosaicked RFC QPEs → which is limited to RFC domains
- V2.7 introduced offshore filling of ConUS PCPURMA with
  - Gauge-corrected MRMS (where RQI ≥ 0.1)
  - CMORPH
  - Sharp discontinuities can exist between these products
- Solution → apply Whittaker blending function for a smoother pcpURMA offshore filling
  - Approach already used in RTMA/URMA to fill edges around domain



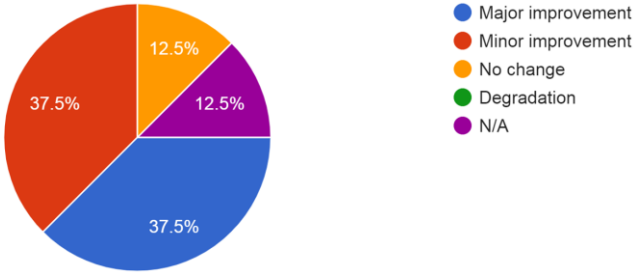
Evaluation Survey and Feedback

- Evaluation completed via Google Form survey
- Responses requested from all NWS regions, WPC, AWC and MDL
  - Survey was also sent to the field at large via MEG-maintained website
  - Website also linked to viewers and stats for the parallel, all previous relevant presentations
  - Much feedback also received via VLab community website and forum
- Responses asking for implementation:
  - Eastern Region, Western Region, Southern Region, AK Region, WPC, MDL and 1 WFO
- Response asking for changes
  - AWC detected a bug in the sky cover analysis at the end of the evaluation period
  - This bug has been corrected and AWC now recommends implementation

Evaluation Survey Results

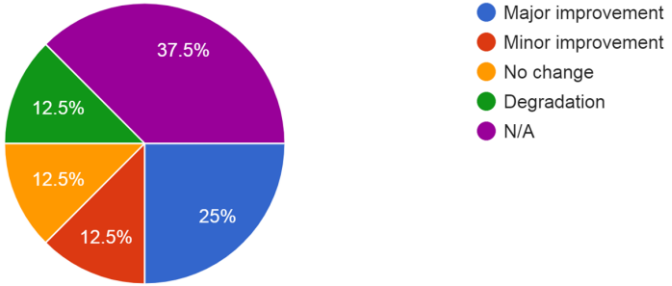
Are there improvements in the winds?

8 responses



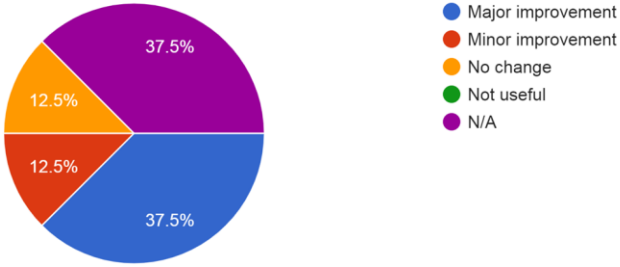
Are there improvements in RTMA-precip?

8 responses



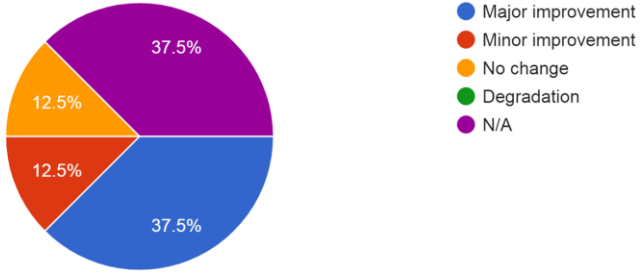
In this upgrade the snowfall analysis from NOHRSC has been added as a new product for the URMA. Do you find this snowfall analysis product useful?

8 responses



Are there improvements in the URMA-precip?

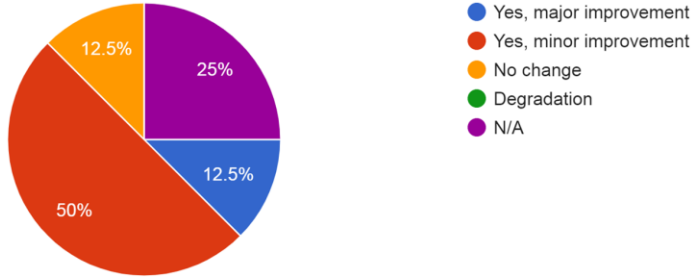
responses



Evaluation Survey Results

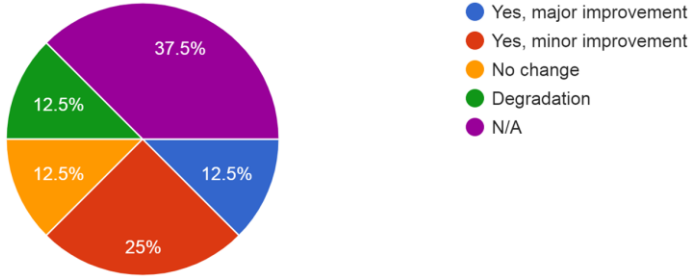
Are there improvements in the ceiling?

8 responses



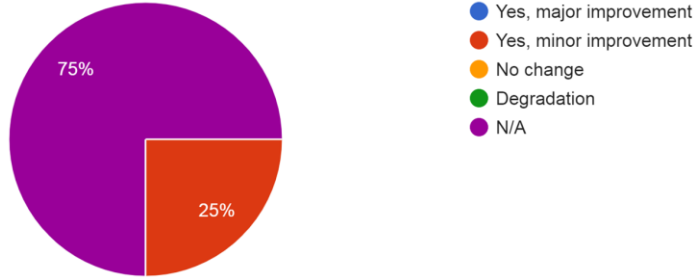
Are there improvements in the sky cover?

8 responses



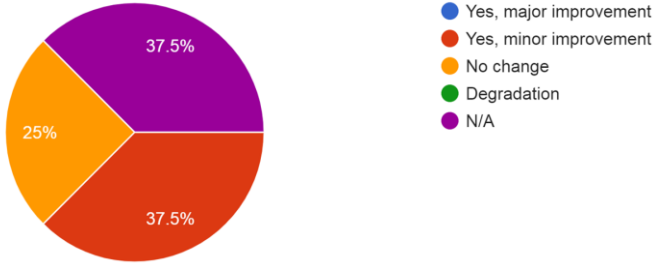
Is the OCONUS selection algorithm an improvement?

8 responses



Are there improvements in the dew point?

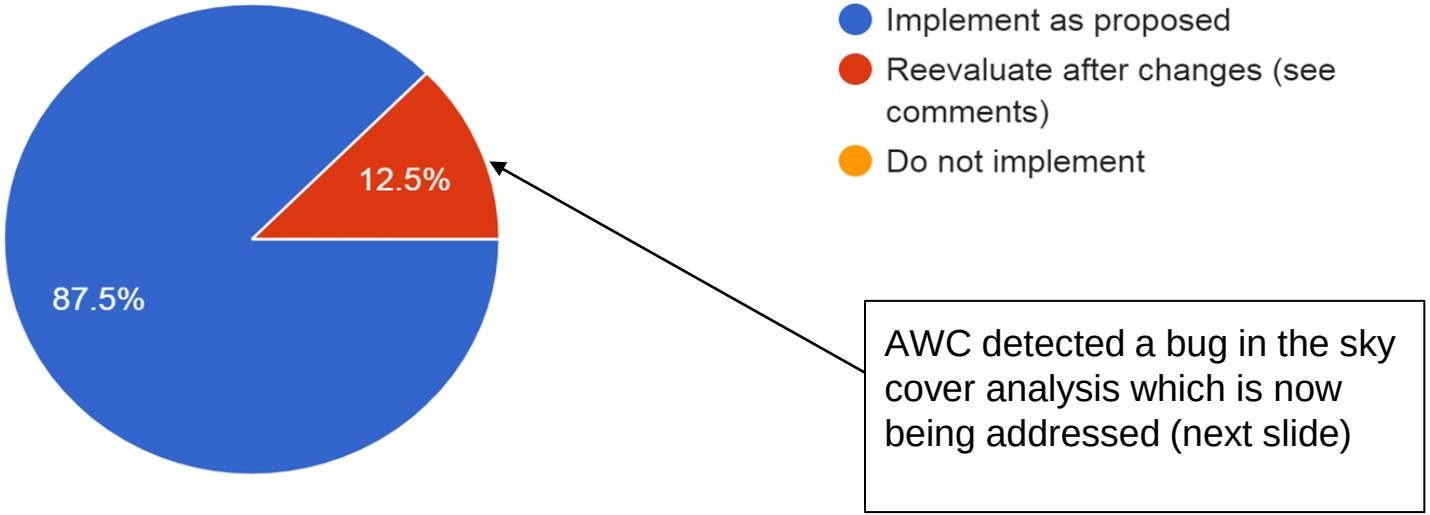
8 responses



Evaluation Survey Results

Should RTMA/URMA be implemented into operations?

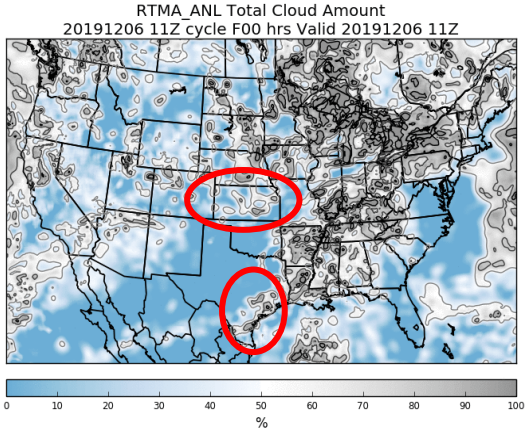
8 responses



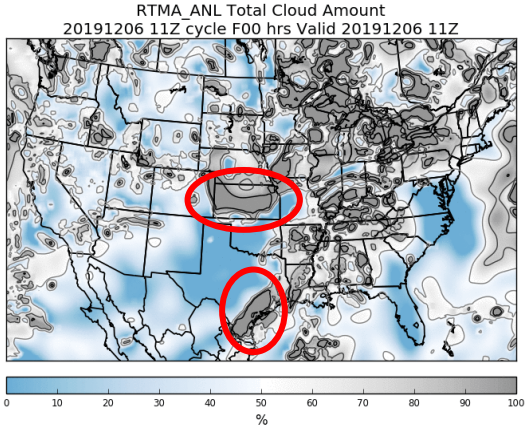
AWC detected a bug in the sky cover analysis which is now being addressed (next slide)

Sky Cover QC Additions

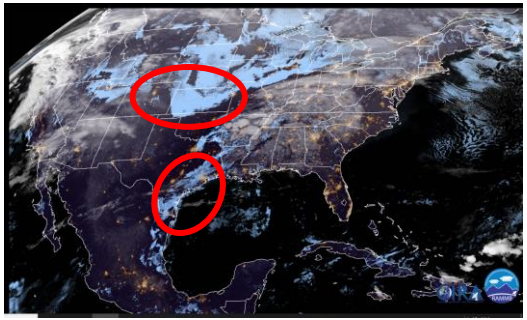
- AWC evaluation noted cases during low sun angles where low ceilings were erroneously cleared by the ceiling consistency check owing to low analyzed values of sky cover.
- GOES Imager sky cover QC was expanded to cover land areas beginning with the 14z (20z) URMA (RTMA) cycle on 5 December



Production



Parallel

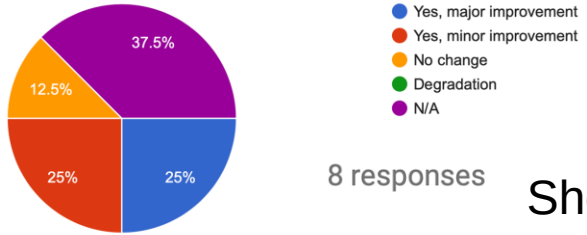


*Thanks to AWC's Jeremiah Pyle for identifying this issue and working with us!

Evaluation Survey Results

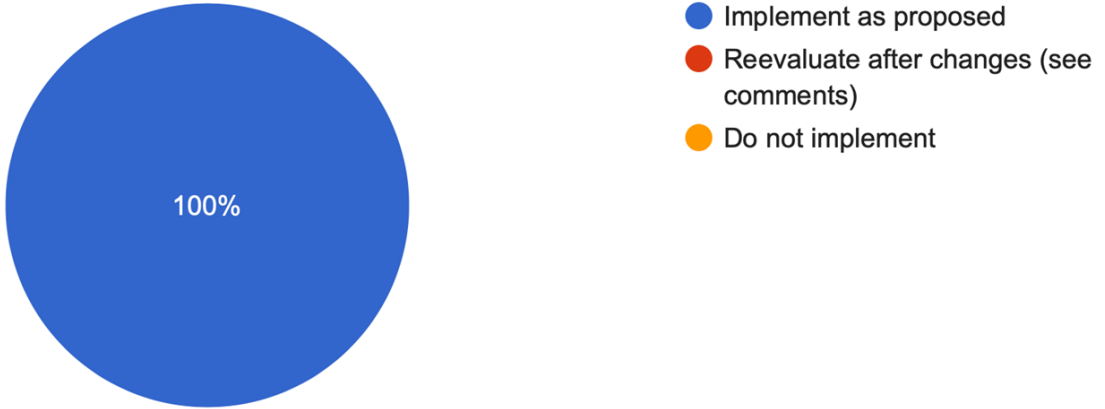
Are there improvements in the sky cover?

8 responses



8 responses

Should RTMA/URMA be implemented into operations?



Link to all responses

Summary

- Improved wind analysis through improved assimilation algorithm
- Expanded support for waves to Great Lakes and Guam
- Improved sky cover analysis and consistent with ceiling
- A number of improvements/updates for precipitation
  - Offshore blending, NOHRSC snowfall, additional re-runs for better quality URMA QPE, MRMS
- Much more → full evaluation page with complete stats
- Schedule:
  - Code hand off to NCO: Dec. 17th
  - Implementation expected: Mid April, 2020
- Final notes
  - This is the final 2D RTMA/URMA/RTMA-RU upgrade
  - 3D-RTMA is coming in the FY23 timeframe!
- RTMA/URMA/RTMA-RU/Precip benefits tremendously from an active and engaged user community → thank you!

Resources

Up/Downstream Changes

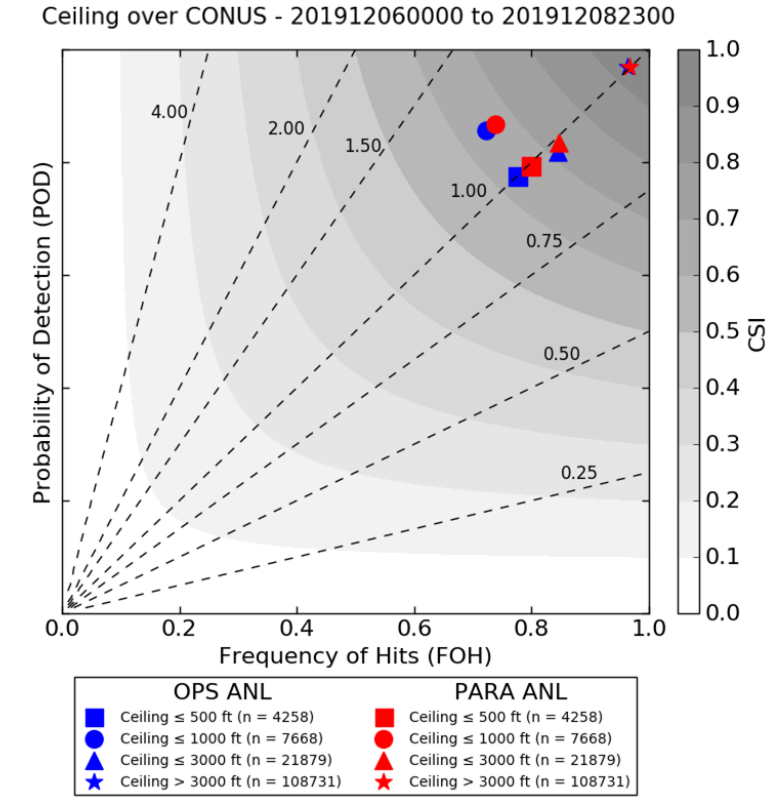
- Upstream dependency changes
  - PCPANL v4.0 (upstream job of RTMA/URMA):
    - Discontinue Stage II analysis
    - Stage IV: change from GRIB1 to GRIB2
  - Obsproc upgrade
    - Adding GOES Imager for RTMA-RU
  - SmartInit Changes for RAP, HRRR, NAM
  - HiRes wave background
- Product additions
  - NOHRSC snow
- SBN changes for AWIPS
  - New PR grids (tentative approval)
  - NOHRSC (tentative approval)

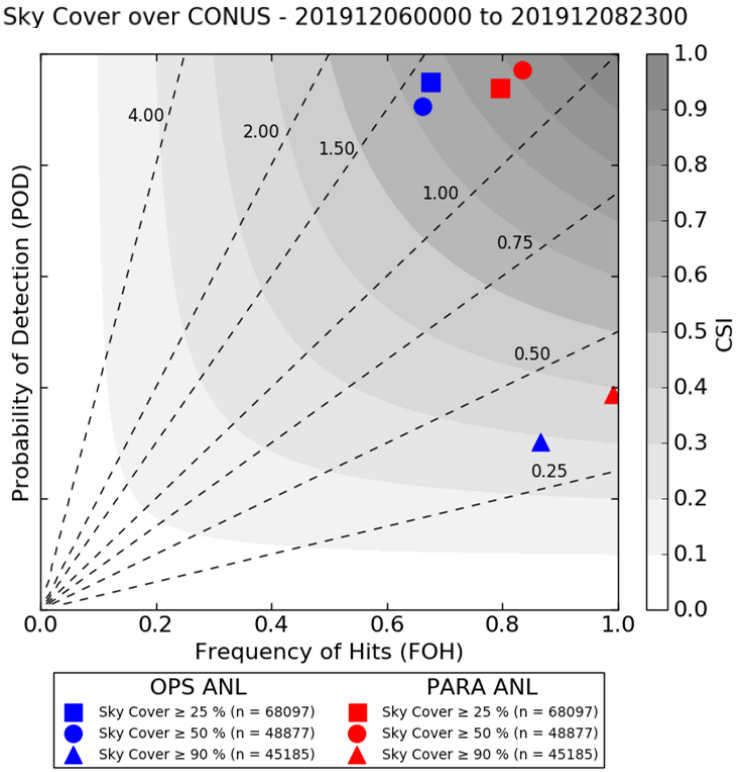
Resource Changes

- Minimal node use changes
- Minor (>10%, ~100 GB/day) increase in disc space
    - New variable (sky cover) for RTMA-RU increased from ~180 GB/day to ~220 GB/day
    - New fields needed in smartinit files for enhanced wind assimilation - small increase locally
        - HRRR Smartinit has increased from ~13 GB/day to ~26 GB/day
        - RAP Smartinit has increased from ~7 GB/day to ~10 GB/day
        - HIRESW Guam Smartinit has increased from ~250 MB/day to ~280 MB/day
        - NAM Smartinit has increased from ~8 GB/day to ~14 GB/day (00-12 hours)
        - PR RTMA/URMA increased from ~15GB/day to ~30GB/day
            - Also includes impact of resolution change
    - WW3 background has increased from ~25 GB/day to ~50GB/day (temp space only)

Supplemental Slides

Ceiling and Sky Cover Stats - following QC extension



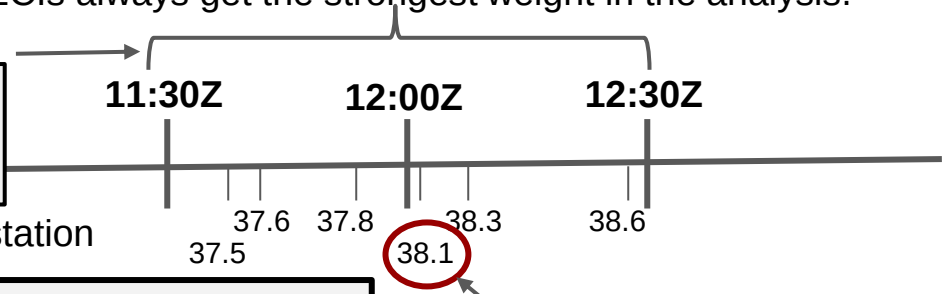


stats are relative to METARs, buoys, and ships

OCONUS: Updated Observation Selection Algorithm

- Already in place over CONUS **and** Alaska, being expanded to other domains
- Assimilate only the observation reported closest to the analysis time at each site
- This adjustment allows for a closer fit to observations in each analysis as well as the improved use of special (SPECI) reports (ceiling and visibility).
  - The modified algorithm ensures the SPECIs always get the strongest weight in the analysis.

12Z Ops OCONUS RTMA/URMA considers all obs in the window and interpolates among them



T Obs from hypothetical station

Largest impacts:
- Situations where the element in question may change rapidly
- Frontal passages, valley drainage, etc.
- Closer fit to observations

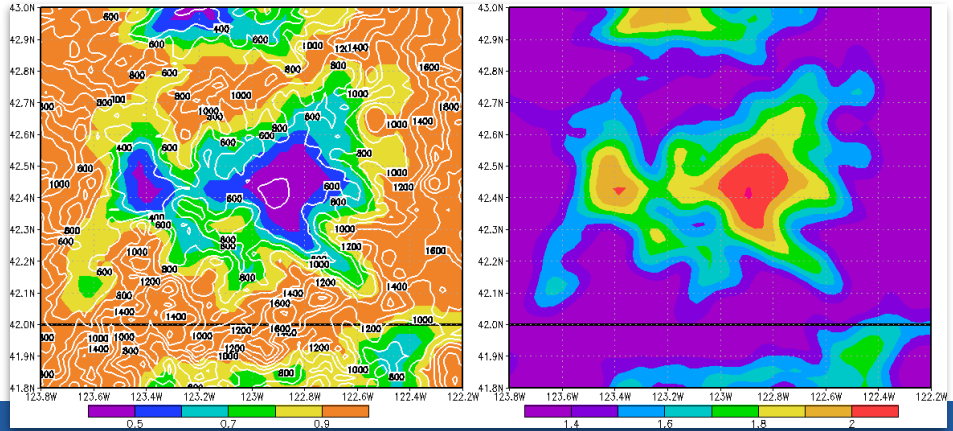
12Z v2.8 OCONUS RTMA/URMA
Only considers report closest to analysis time

OCONUS: Revised 2m T Background Error Covariance

- Analysis is a statistical combination of the observations and background, weighted by their respective errors
- The background 2m T field can struggle in/around complex terrain (i.e. *an error in the background*)
- Incorporate a valley map into the background error to inflate the errors in complex terrain
  - Fit observations more closely where the OCONUS RTMA/URMA background struggles - valley cold pools

Valley-map and Terrain (m)

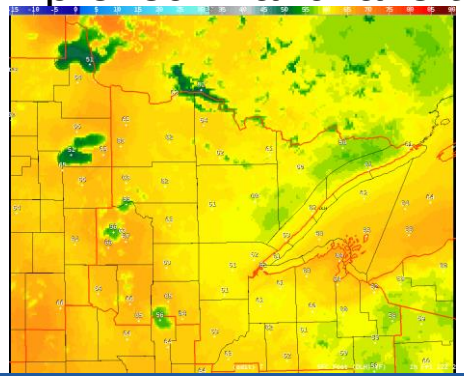
Temperature Background Error Stdev (K)



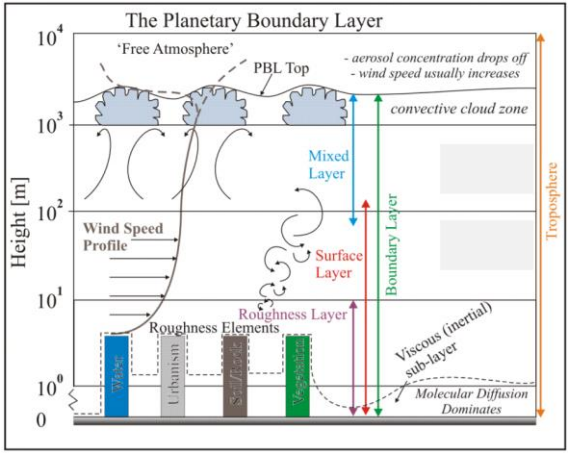
Implemented for CONUS in v2.7

NOT Included Here: New RAP/HRRR

- Our science evaluation does NOT include any data from the RAP/HRRR evaluation
- Timing of evals and lack of CONUS HRRR availability prevented full testing
- RTMA/URMA will likely be implemented before RAP/HRRR
- We will likely run another parallel, at some point, when CONUS RAP/HRRR fields are available
- Largest improvement in new RAP/HRRR: improved inland lake temperatures
  - Water temperature have been too cold before
  - New SST algorithm in HRRR



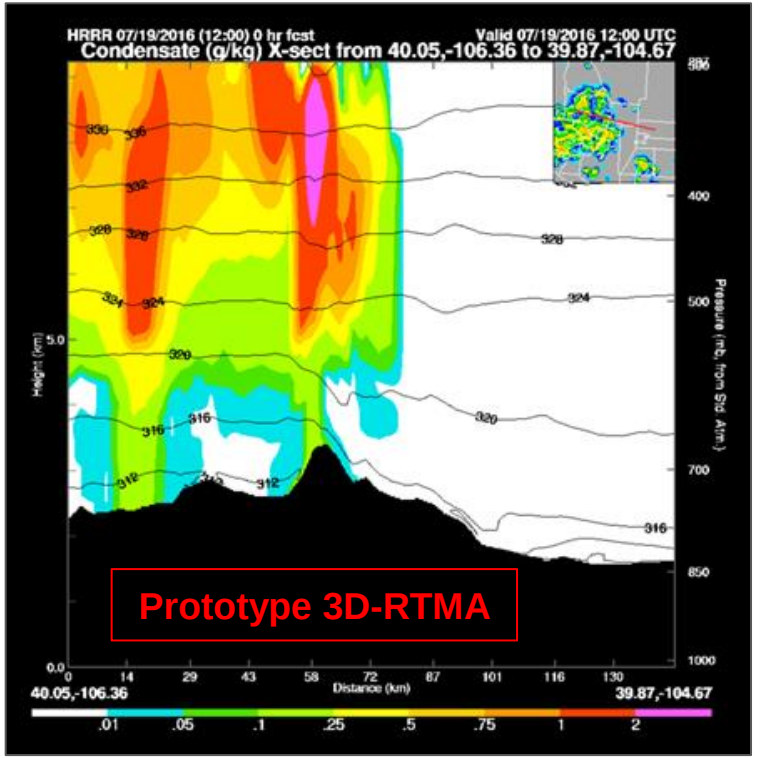
Wind Adjustment Procedure



- Inputs
  - Lowest two sigma levels of background model
  - Background skin temperature
  - Land/sea mask value
- Similarity Theory Adjustment
  - 10 m wind factor is calculated based on local stability
  - Background winds are then multiplied by this factor
  - 'Adjusted' background is then compared to observation to generate innovation and increment
- Results in higher wind speeds in the analysis
  - Closer to METAR observed wind speed
  - Many mesonet wind obs will still not be used at all; more may need to be flagged (info here)
  - If background under forecasts wind speed, analysis winds will still be too light.

The Move to Three Dimensions

- 3D-RTMA/URMA
  - With sub-hourly updates
  - CONUS + Alaska to start
- Joint development effort between EMC + ESRL/GSD
- Real time, rapid updated analysis of 3D atmospheric fields
  - Severe and aviation weather parameters
  - Analysis of hydrometeor and cloud fields
  - Assimilation of radar observations
  - Heavy rainfall, etc.



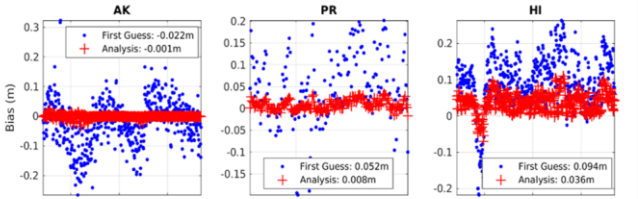
Thanks to ESRL/GSD for this figure

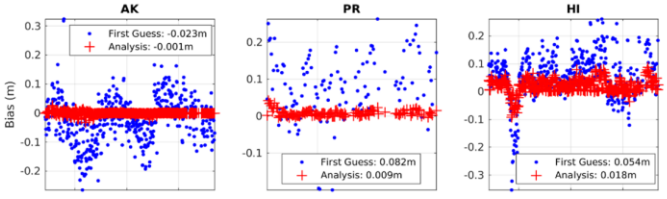
SWH OCONUS 2.8

URMA v2.7

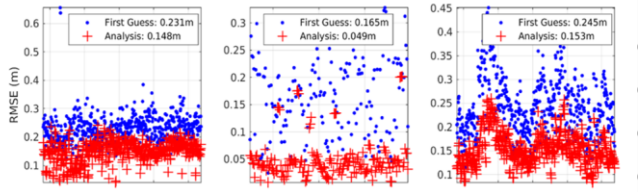
URMA v2.8

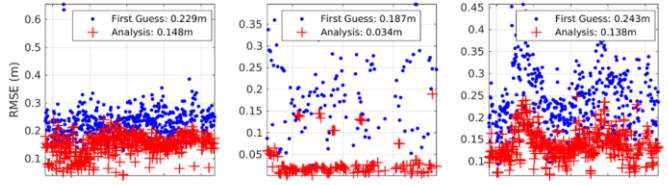
Bias (m)



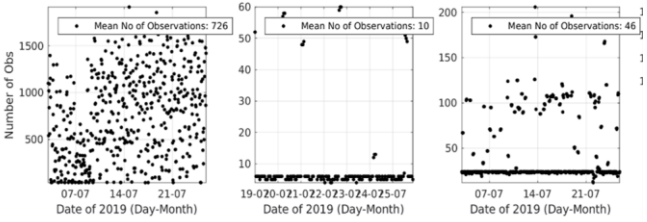


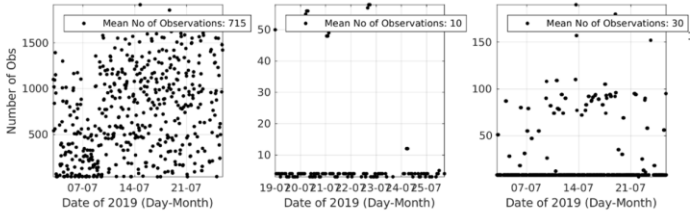
RMSE (m)





Obs





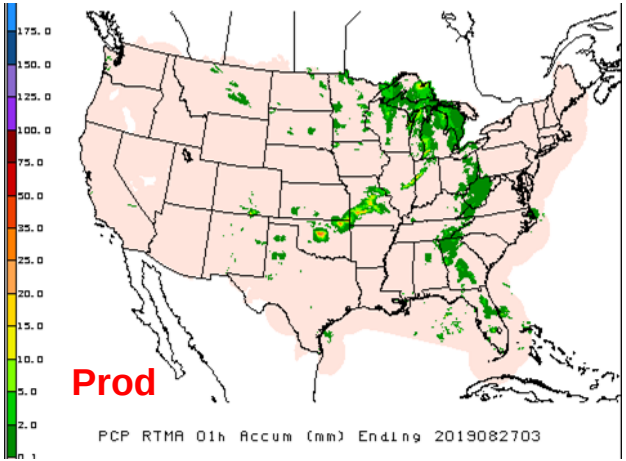
The 2.8 upgrades had positive or neutral effect on the analysis of SWH.

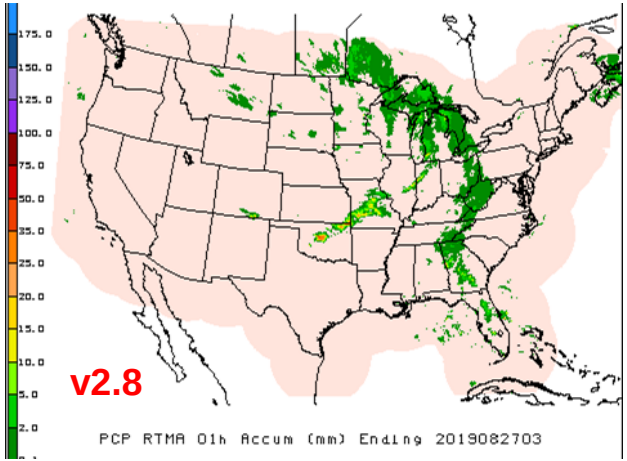
Supplemental Material

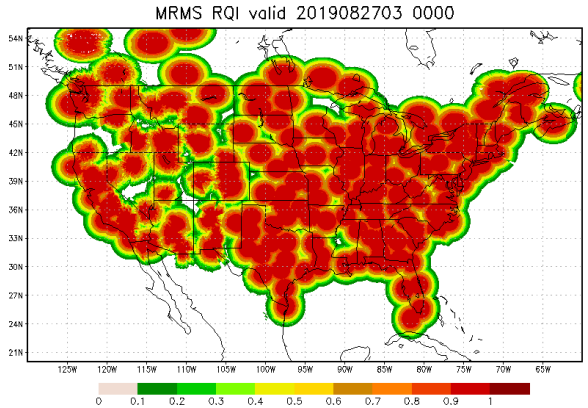
Supplemental material for precipitation

pcpRTMA using MRMS

- Use radar-only MRMS QPE
  - Lower latency
  - Less affected by data outages than gauge-corrected MRMS QPE
- Radar quality index (RQI) added as companion to each hour's pcpRTMA array
  - Provide users with info about quality of the QPE
  - RQI arrays will be available on NOMADS (not AWIPS)

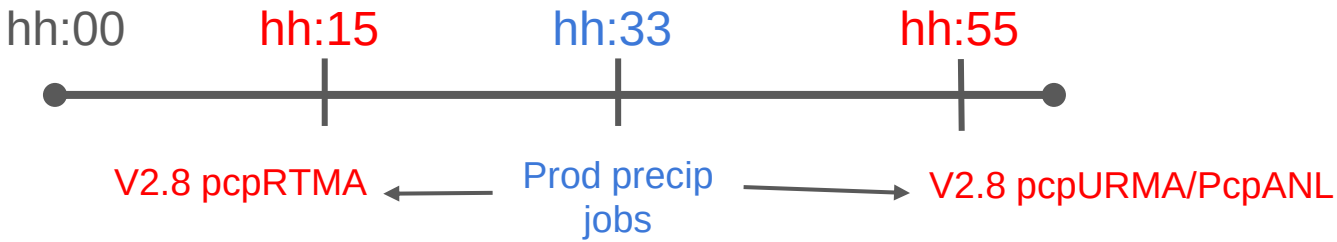






Request Changing Precip Run Schedule

- Current production PCPANL/pcpRTMA/pcpURMA run at hh:33
- Request:
  - *Advance* pcpRTMA by 18 minutes (to hh:15)
  - *Postpone* PCPANL/pcpURMA by 22 min (to hh:55)

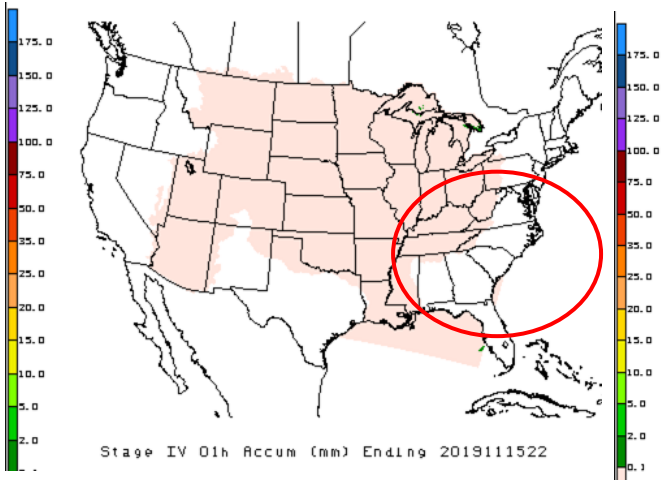


- Prod precip suite currently runs at hh:33 due to Stage II/pcpRTMA dependency on METAR gauges, available at ~hh:30
  - Using MRMS as source for pcpRTMA removes this dependency → *simpler*
  - Running pcpRTMA at hh:15 (instead of even earlier) allows use of MRMS data within a ±10 min window in case of an outage near hh:00 → *Reliability*
- Postponing PCPANL(Stage IV), pcpURMA to hh:55 → *more current-hour's RFC QPEs included*
  - Per request by OWP - plans to use Stage IV hourly mosaic for RIDGE II beginning in Q3 FY20)

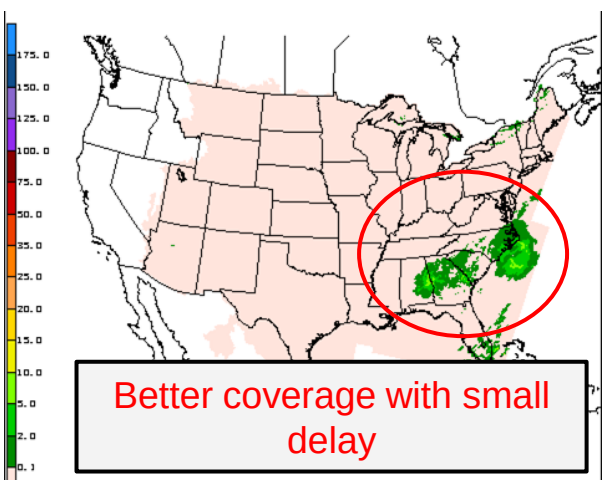
Delaying Stage IV from hh:33 to hh:55

- 22:33Z, some RFCs have not sent their QPEs for that hour yet.
- 22:55Z: All RFCs that produce 1h QPEs have sent them.
  - CNRFC/NWRFC do not have 1h QPEs;
  - Stage IV provide coverage for that area using the RFCs' 6h QPEs (received at 14:06/14:30 in this case) time-disaggregated using 1h MRMS data as weights.
    - QPE appears next day (3rd panel)

prod, made at 22:33Z

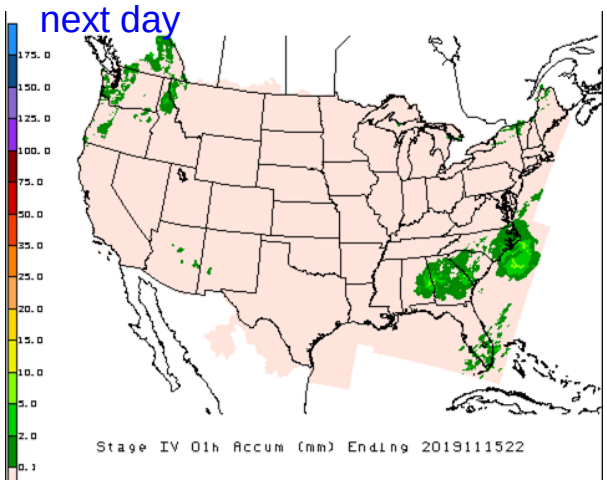


para, made at 22:55Z



Better coverage with small delay

prod/para at 14:33/14:55Z next day



Benefit of the 30h ConUS re-mosaic for 24h Stage IV

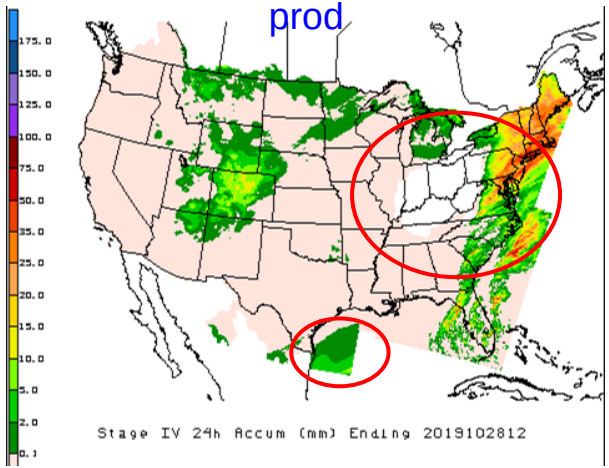
For the 24h ending at 12Z 28 Oct, several hourly OHRFC QPEs were missing. Data received at 14:32Z 29th. There was also a problem with earlier QPEs from WGRFC that was corrected at 17:47Z 30th.

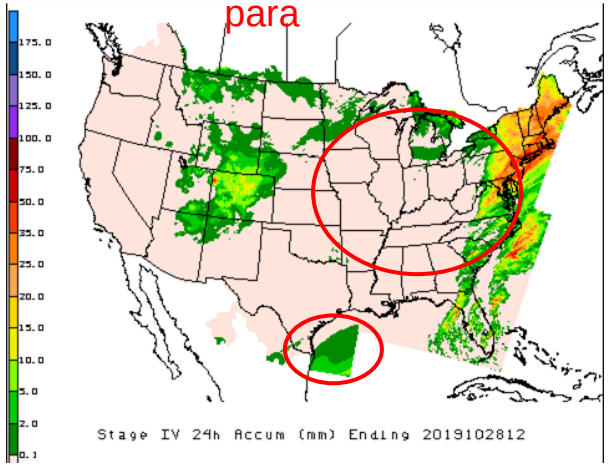
——————— after 18:33Z 29th ———————

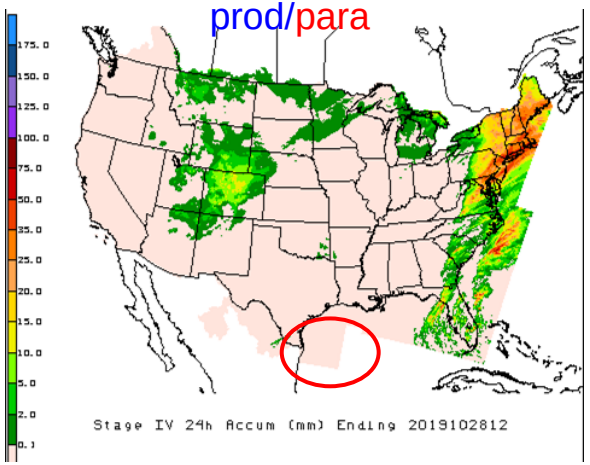
Para has complete coverage from the 30-h rerun. Prod still missing OHRFC area - had to wait until next day (12:33Z 30th) for complete coverage

——— after 12:33Z 31st ———

Corrected WGRFC QPE was used in the 3-day rerun in both prod/para







Radar-Only *vs.* Gauge-Corrected MRMS QPE

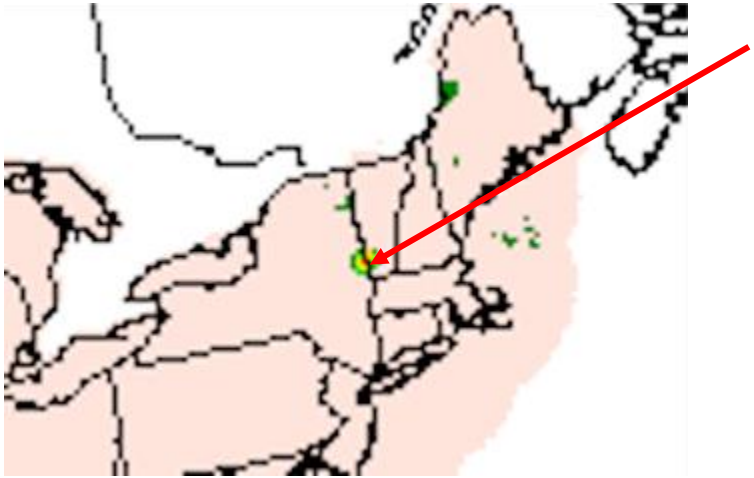
- Radar-only QPE
  - More timely!
  - A 2-minute lag *vs.* ~58min for gauge-corrected QPE
- Radar-only QPE is available every 2 minutes
  - In case of a data outage at the top of the hour, QPE valid closest to the top of the hour (within ±10 min of hh:00:00) can be used for pcpRTMA.
- *E.g.* on 26 Nov, gauge-corrected MRMS QPE was missing for 01/02/04Z. Radar-only QPE also had gaps: no data between 00:58:00 - 02:08:00Z and 03:58:00 - 04:10:00Z. No missing v2.8 pcpRTMA:

pcpRTMA valid at	From radar-only MRMS valid at
01Z	00:58:00
02Z	02:08:00
03Z	03:00:00
04Z	03:58:00

pcpRTMA Source

Current prod uses first run Stage IV supplemented by first run Stage II.

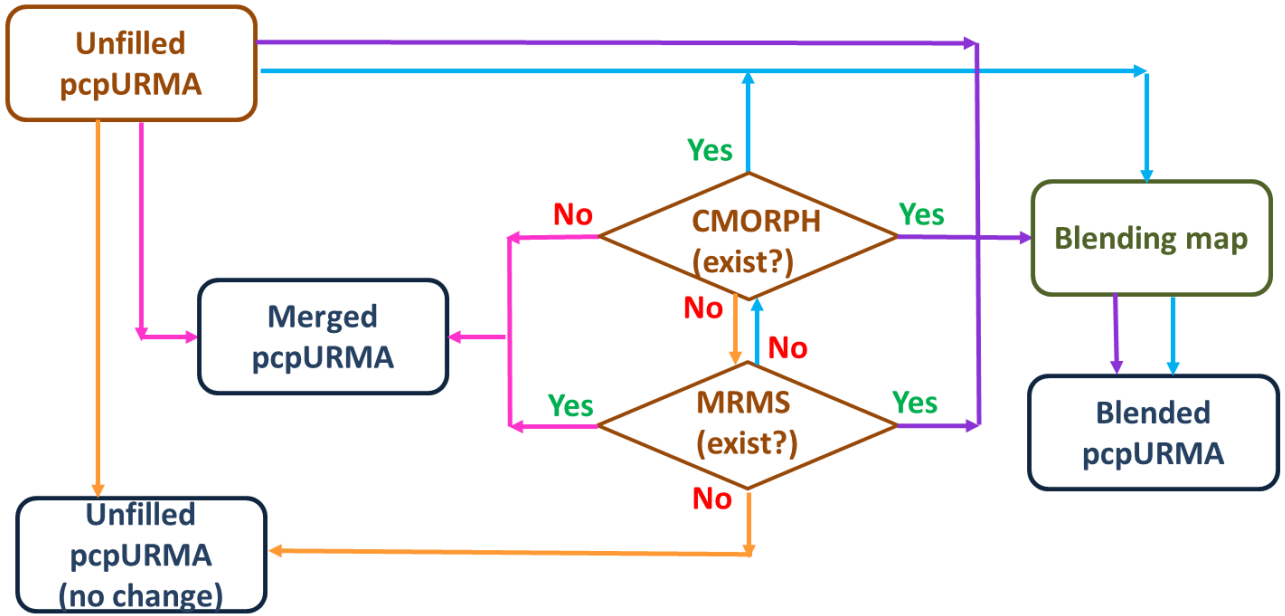
At the time of the pcpRTMA run (33 min past the top of the hour), the RFC QPEs (basis for Stage IV) generally do not yet have the benefit of human oversight/QC:



02Z 17 Dec 2017 (Saturday evening ET): bad gauge included in the first-run RFC QPE/pcpRTMA. NERFC removed the bad gauge within hours and pcpURMA was updated accordingly in the following hour's rerun. pcpRTMA was only run once ("Real Time") and the bull's eye stayed in the RTMA.

pcpURMA Offshore Blending (Yan Luo)

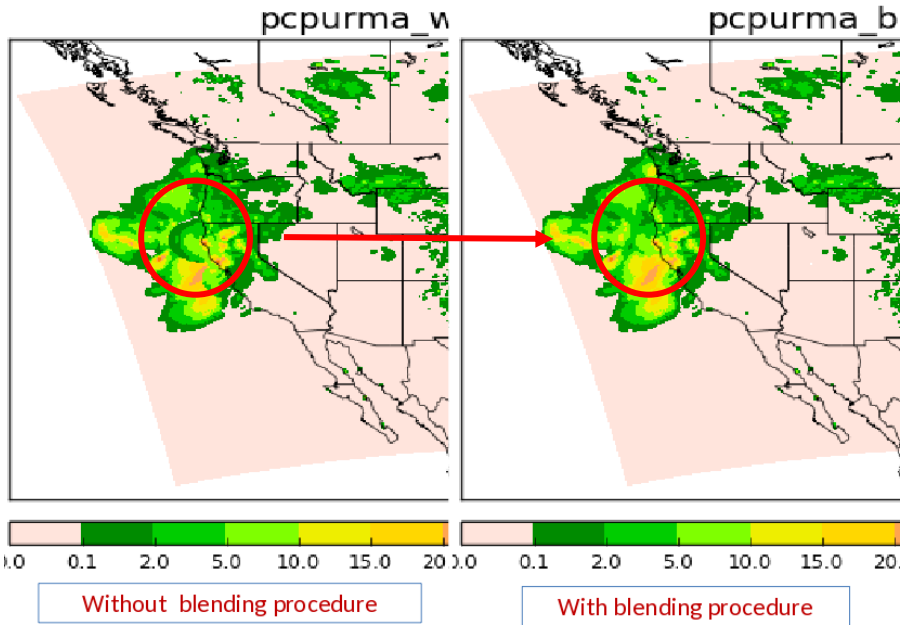
PCPURMA Blending Flow Chart v2.8.0



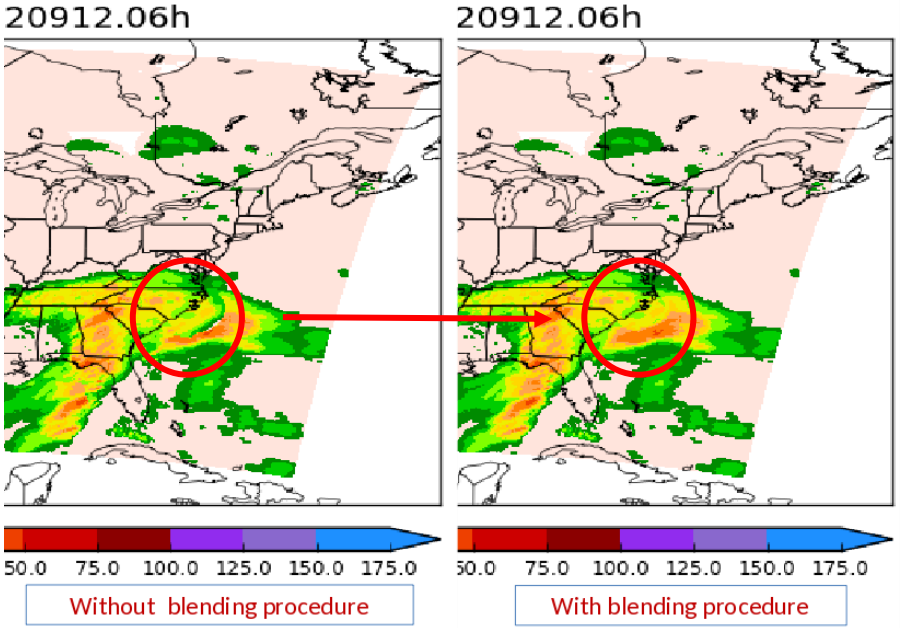
Examples of Blended Offshore PCPURMA

From Yan Luo:

Warm Season Case (2019051600.06h)



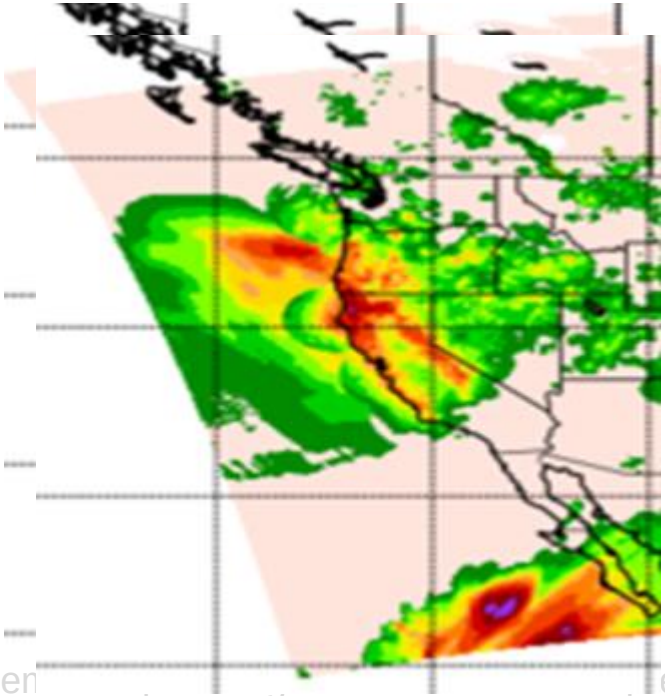
Cold Season Case (2018120912.06h) – East Coast



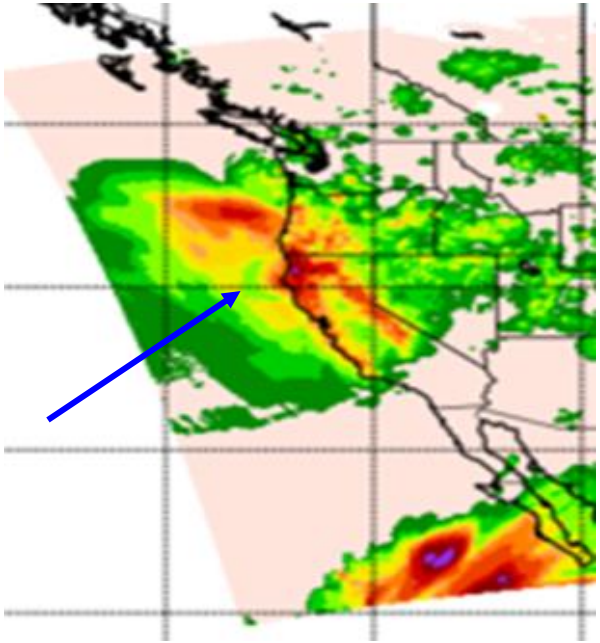
Offshore pcpURMA Blending

Recent example: 24h ending at 12Z 27 Nov

Prod



v2.8

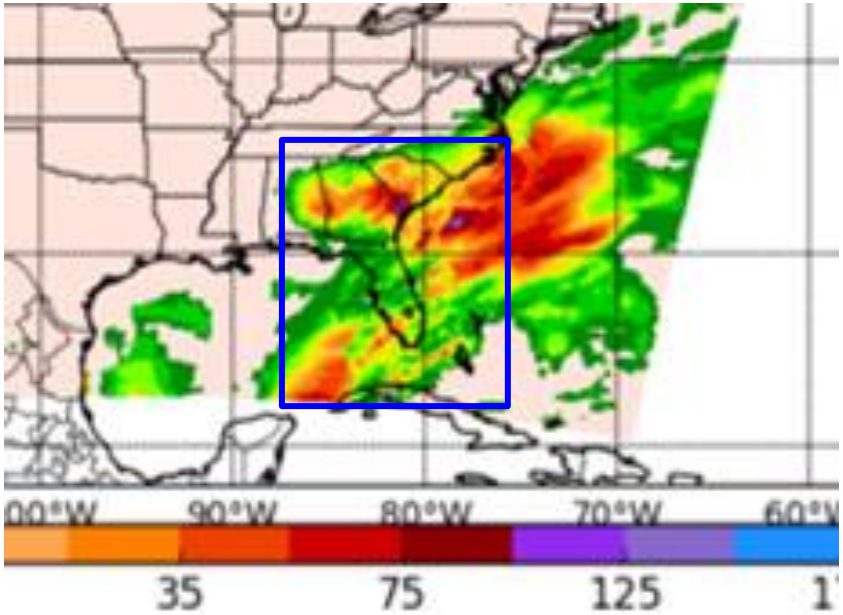


https://www.en ecip/rtma-urma/v2p8/daily/plots/urma/pcpurma2.20191127.png

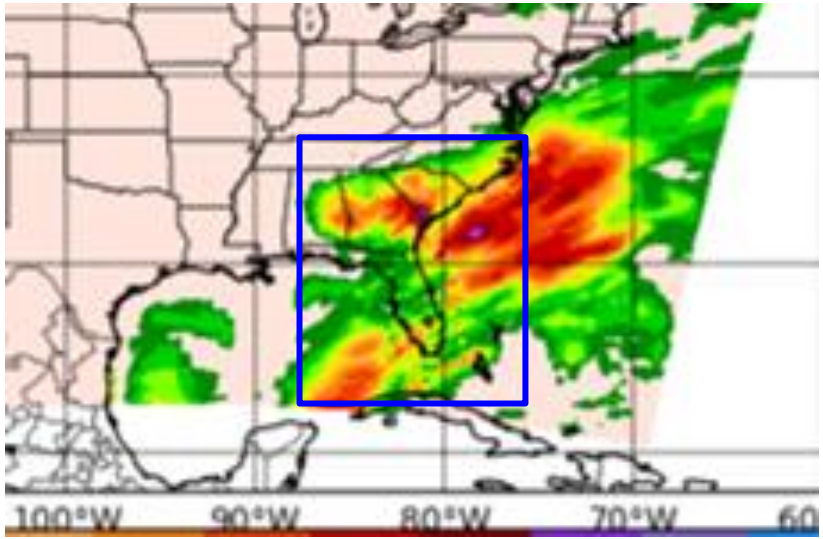
Offshore pcpURMA Blending

Recent example: 24h ending at 12Z 16 Nov

Prod



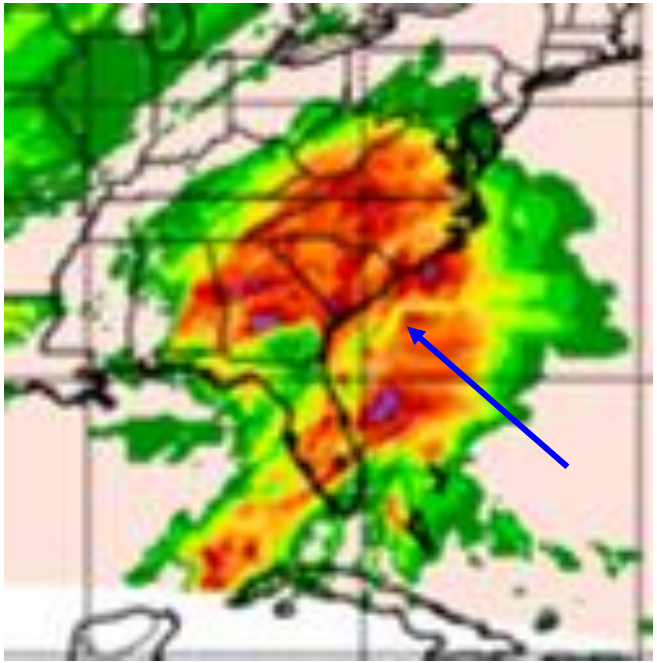
v2.8



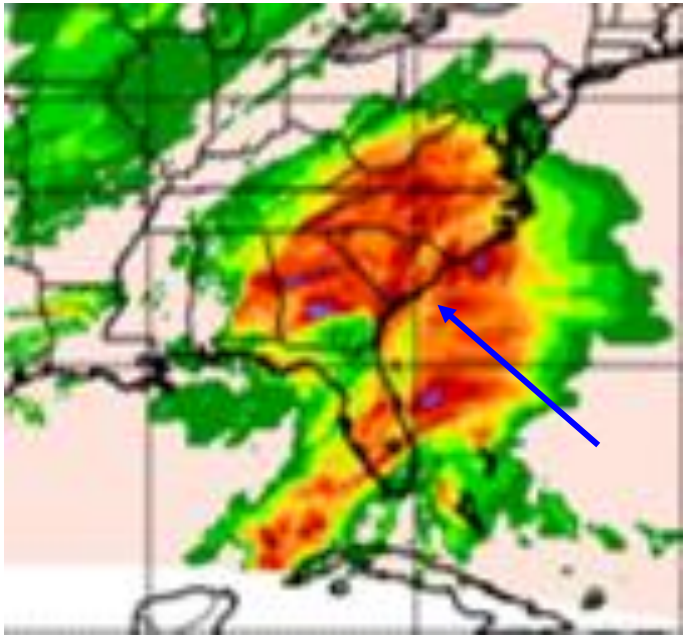
Offshore pcpURMA Blending

Recent example: 24h ending at 12Z 20 Oct

Prod



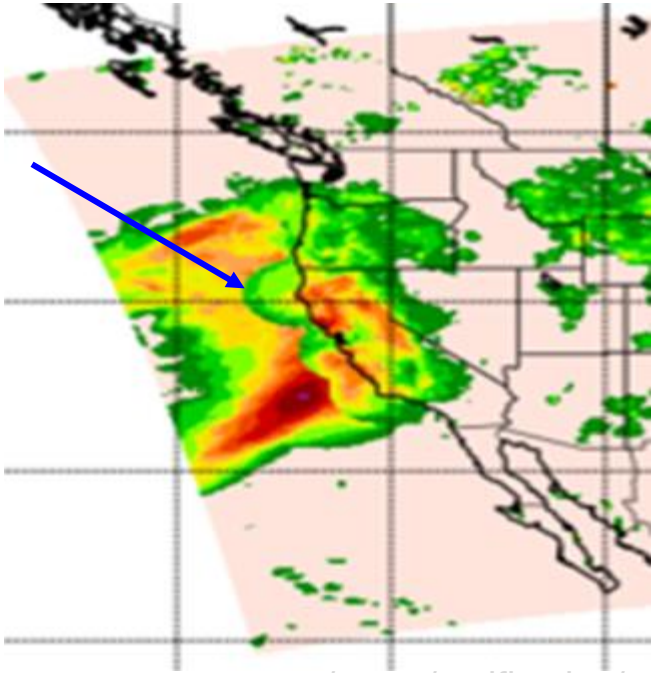
v2.8



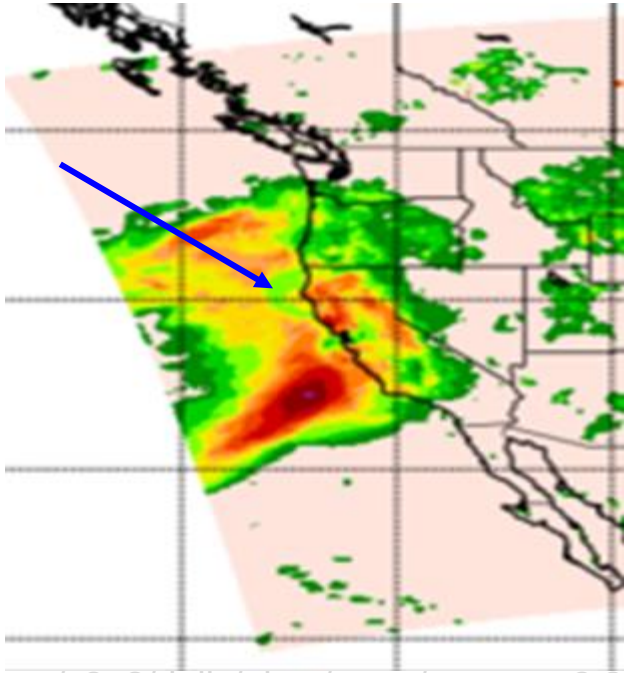
Offshore pcpURMA Blending

Recent example: 24h ending at 12Z 01 Dec

Prod



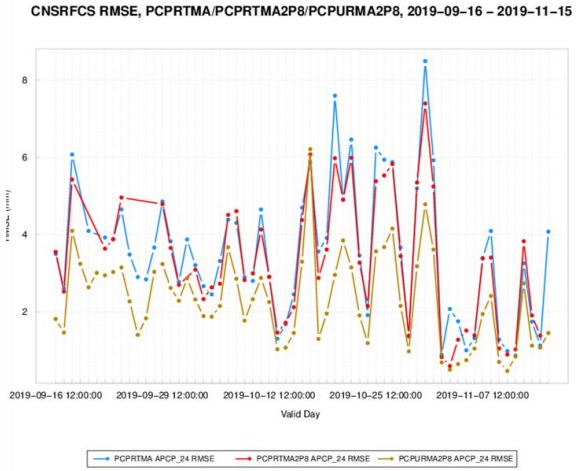
v2.8



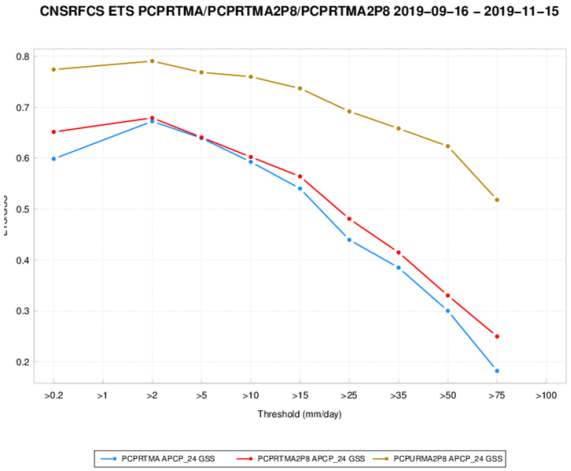
https://www.emc.ncep.noaa.gov/users/verification/precip/rtma-urma/v2p8/daily/plots/urma/pcpurma2.20191201.png

pcpRTMA/RTMA2.8/URMA2.8

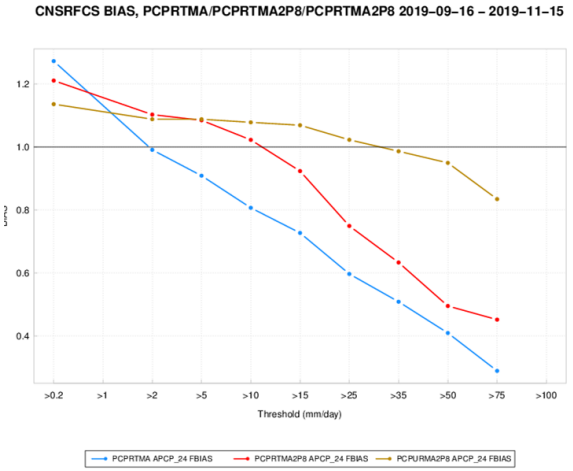
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, ConUS



Time series of RMSE



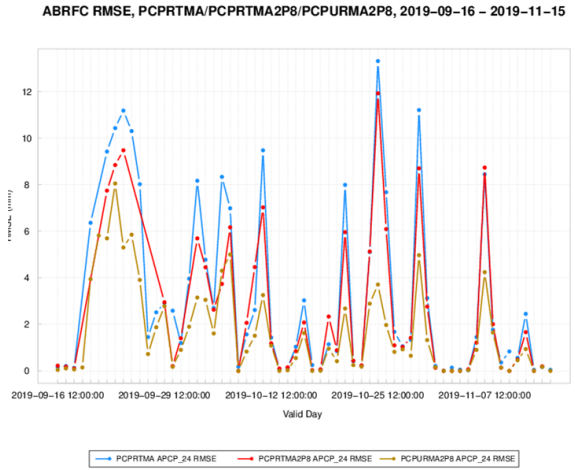
ETS *vs.* threshold



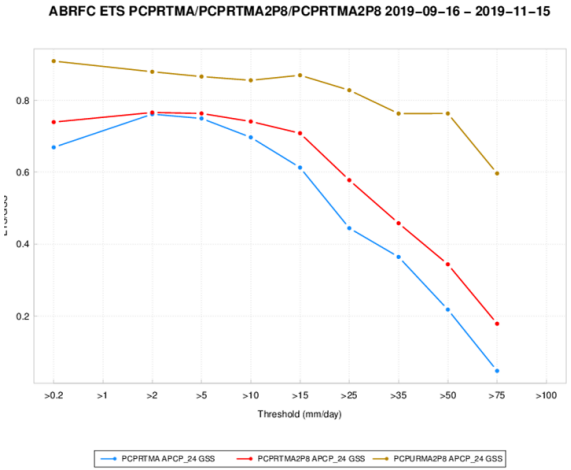
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

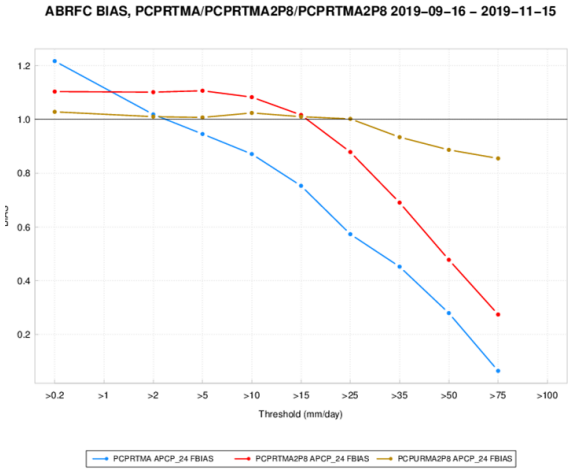
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, ABRFC



Time series of RMSE



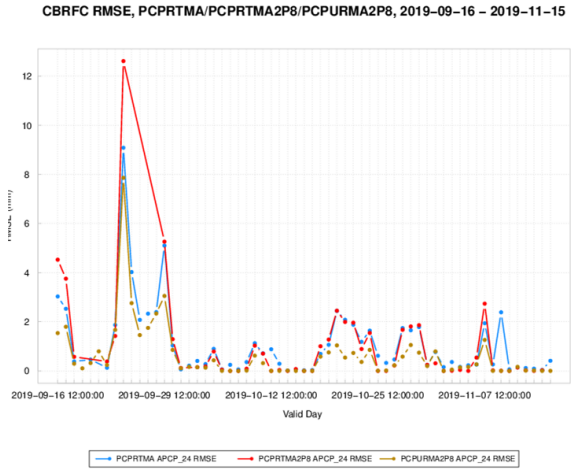
ETS *vs.* threshold



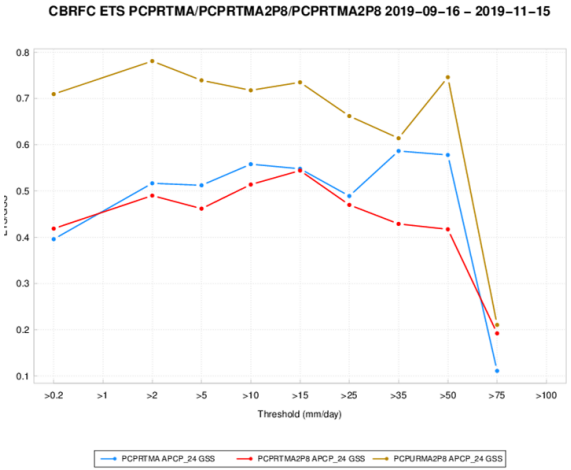
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

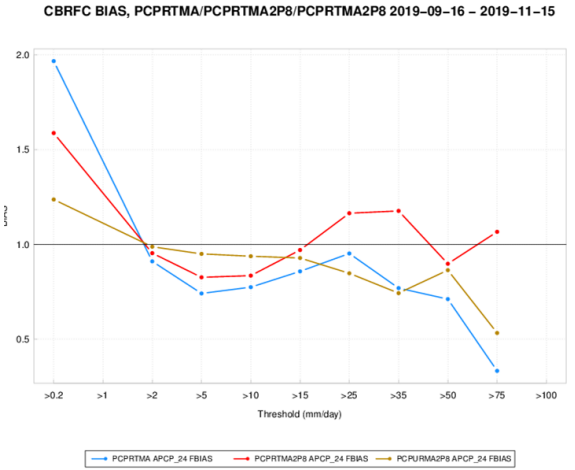
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, CBRFC



Time series of RMSE



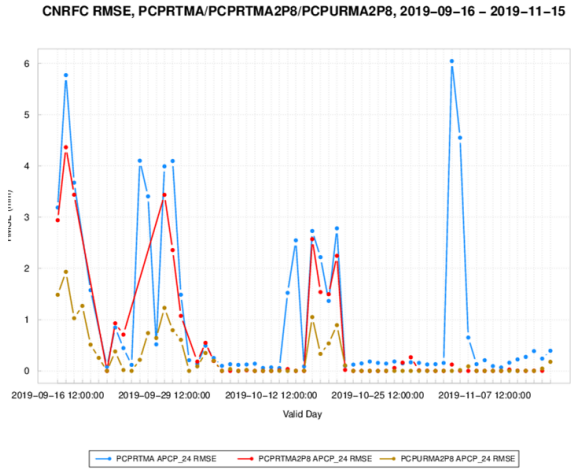
ETS *vs.* threshold



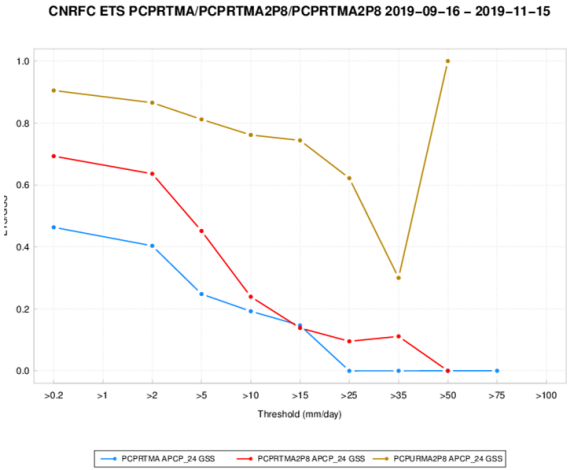
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

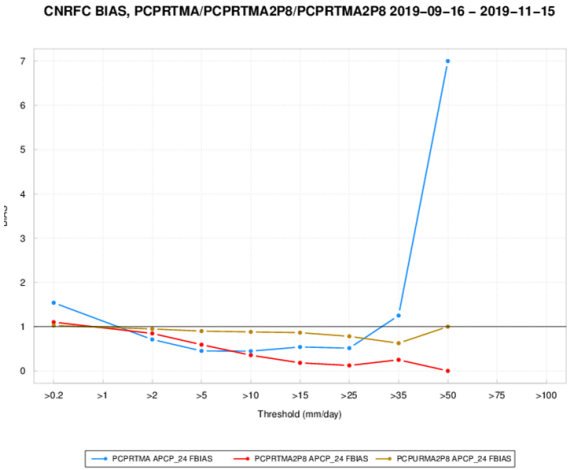
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, CNRFC



Time series of RMSE



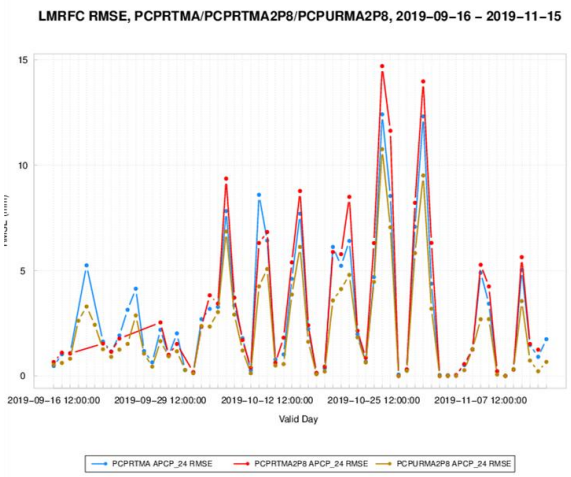
ETS *vs.* threshold



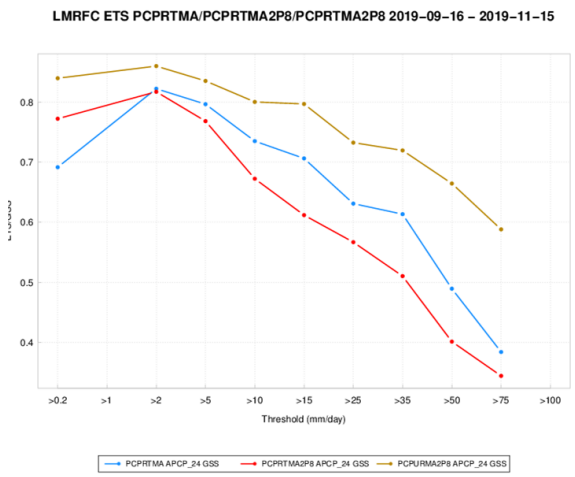
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

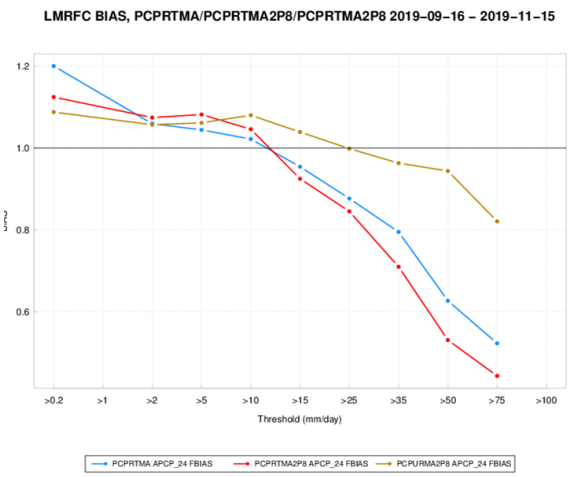
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, LMRFC



Time series of RMSE



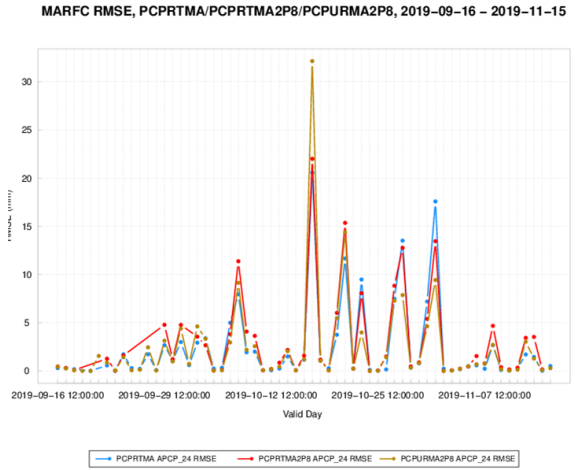
ETS *vs.* threshold



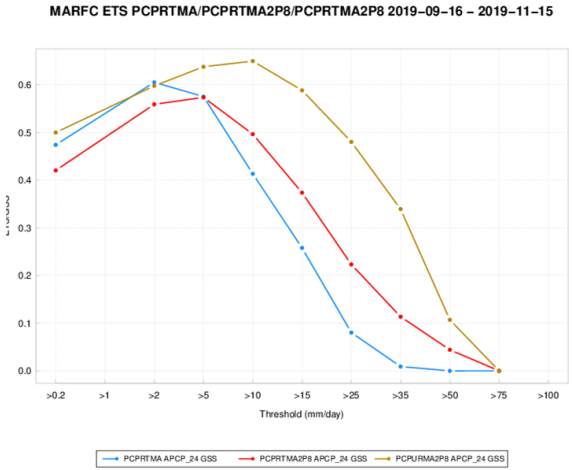
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

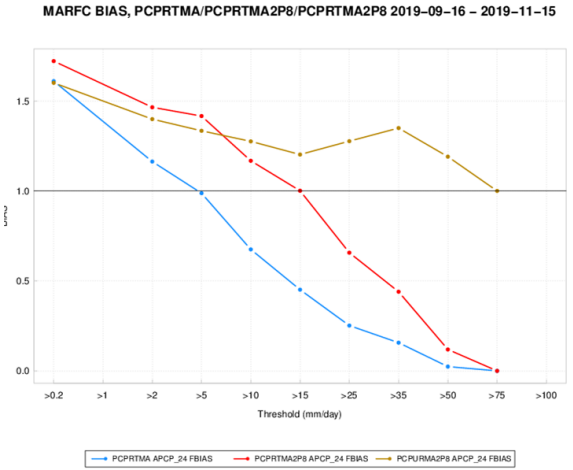
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, MARFC



Time series of RMSE



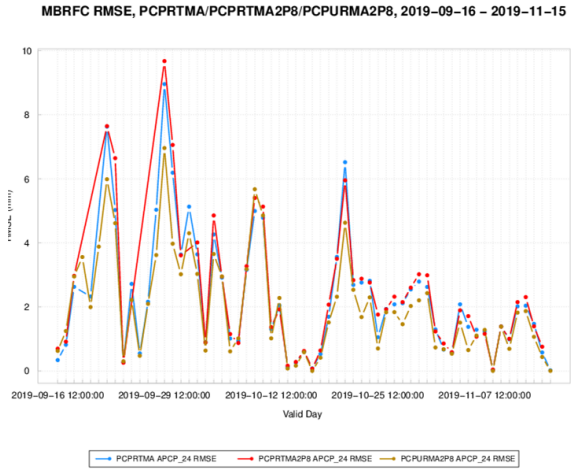
ETS *vs.* threshold



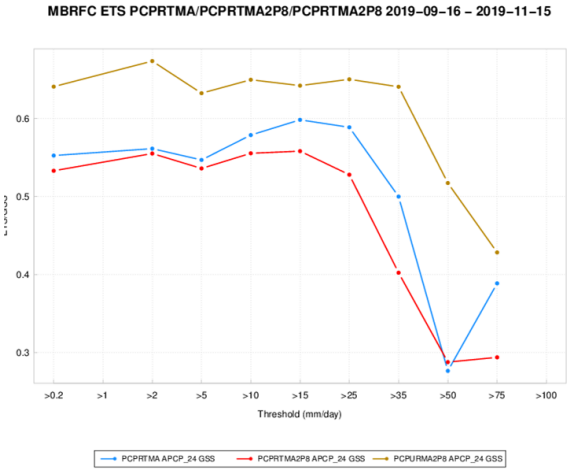
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

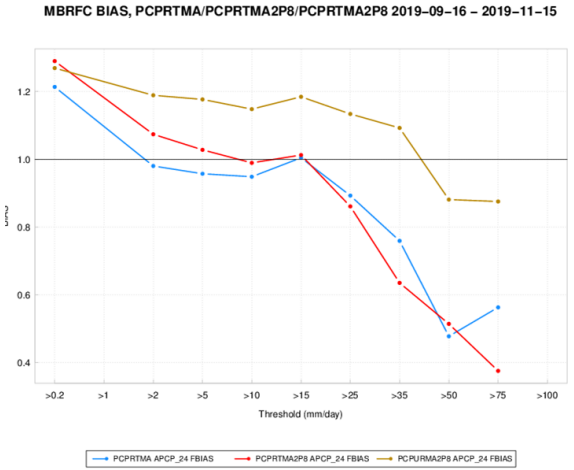
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, MBRFC



Time series of RMSE



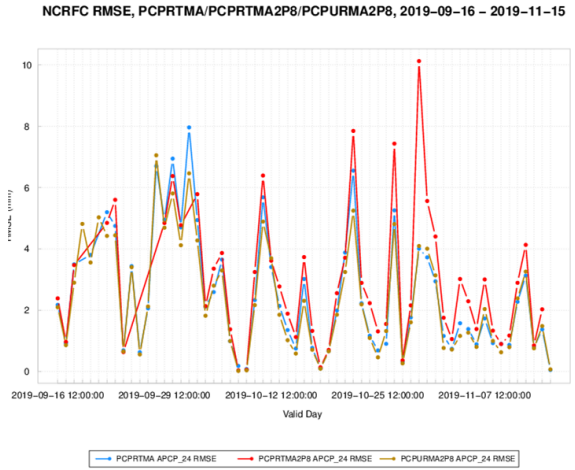
ETS *vs.* threshold



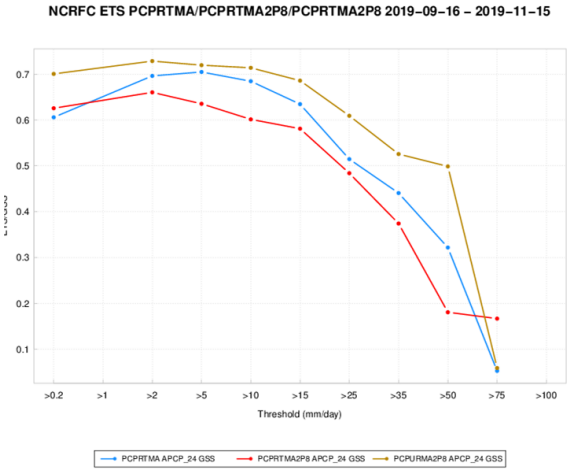
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

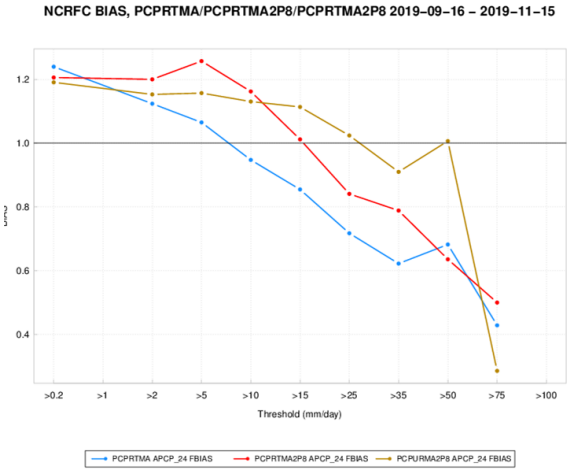
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, NCRFC



Time series of RMSE



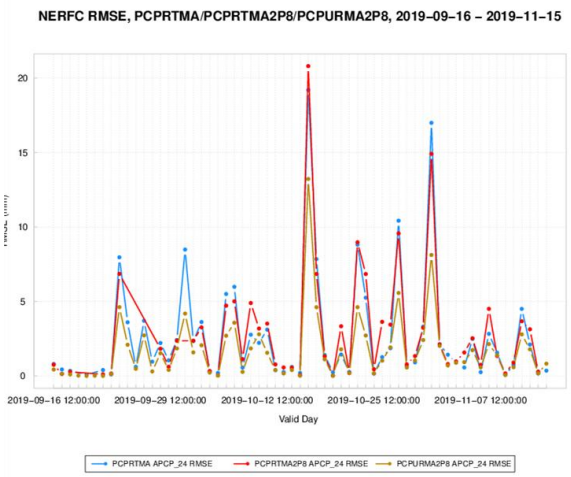
ETS *vs.* threshold



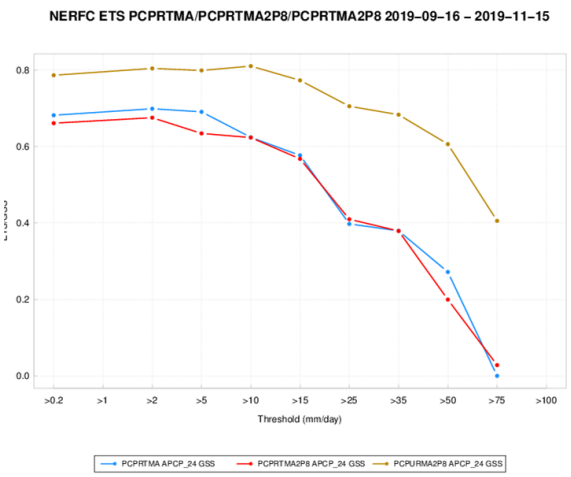
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

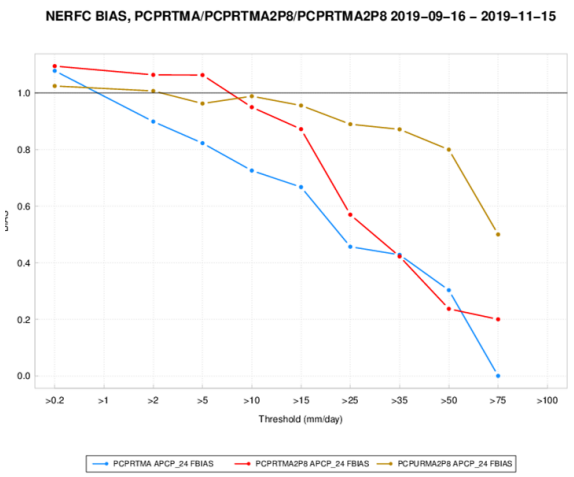
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, NERFC



Time series of RMSE



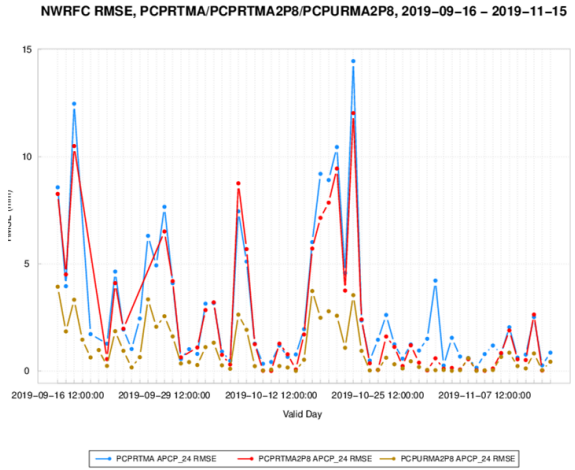
ETS *vs.* threshold



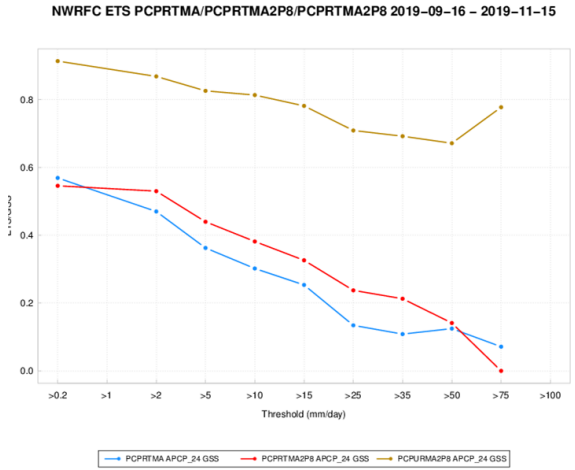
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

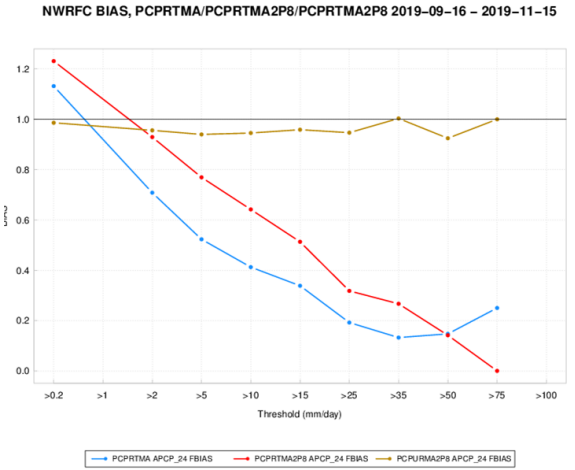
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, NWRFC



Time series of RMSE



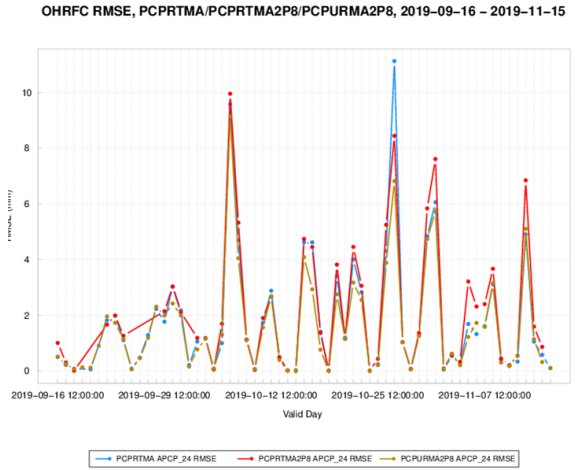
ETS *vs.* threshold



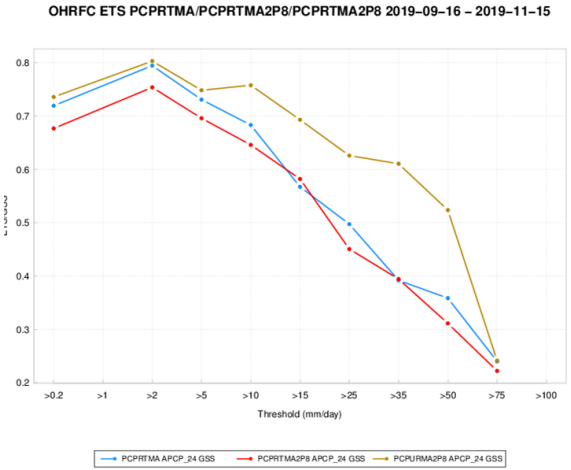
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

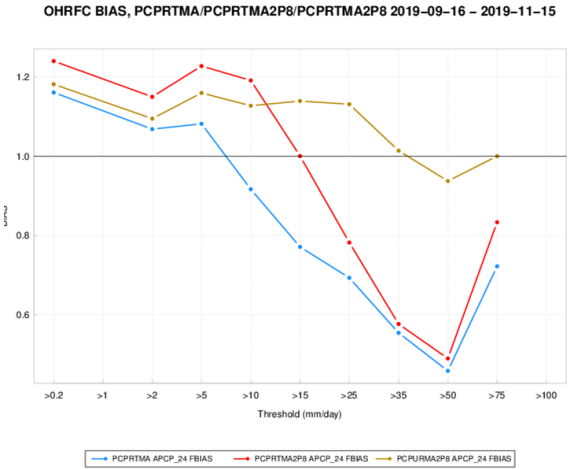
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, OHRFC



Time series of RMSE



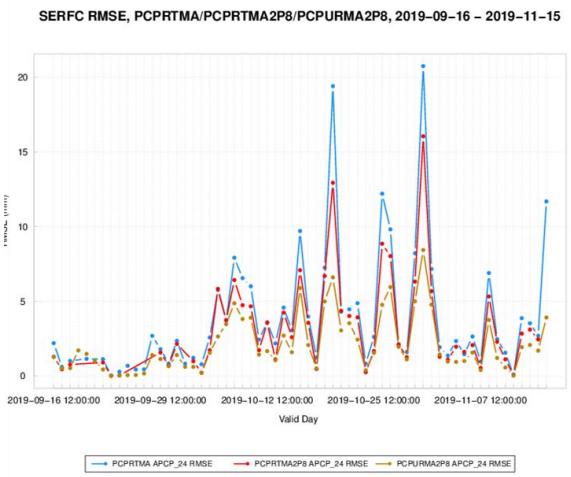
ETS *vs.* threshold



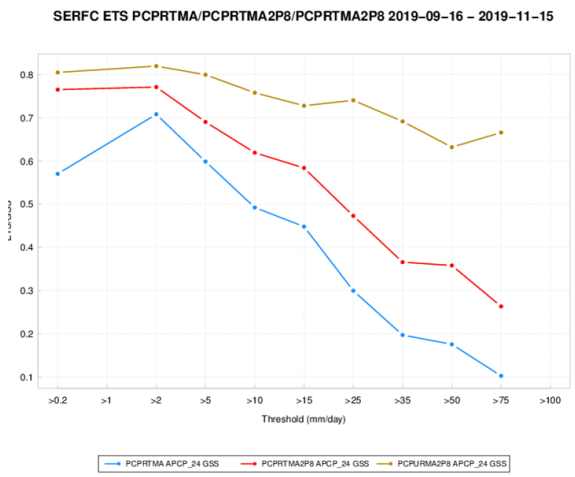
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

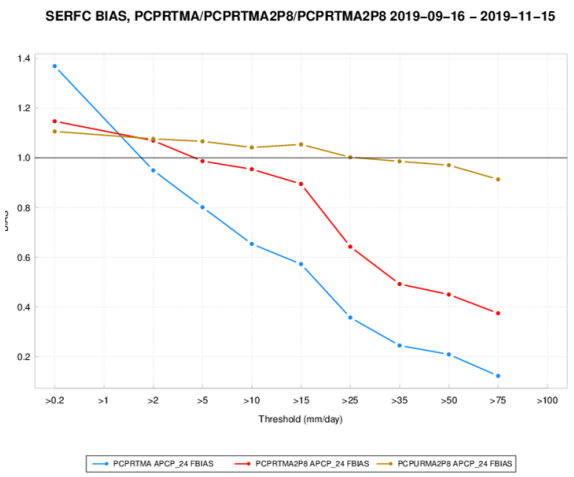
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, SERFC



Time series of RMSE



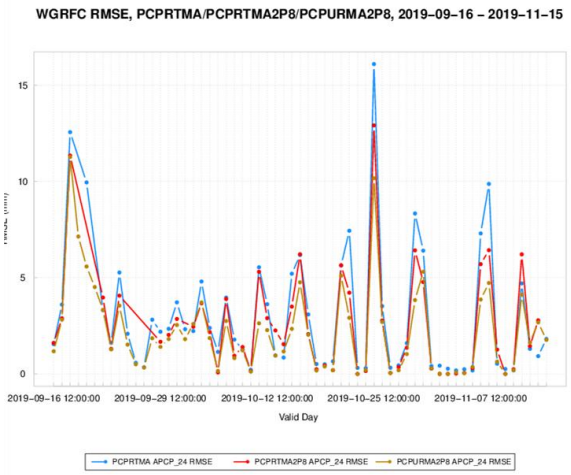
ETS *vs.* threshold



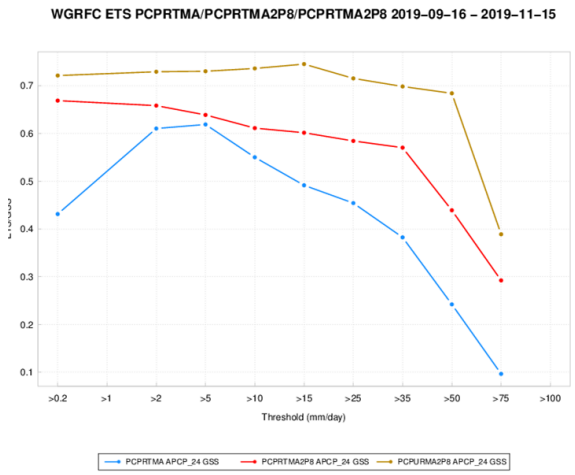
Bias *vs.* threshold

pcpRTMA/RTMA2.8/URMA2.8

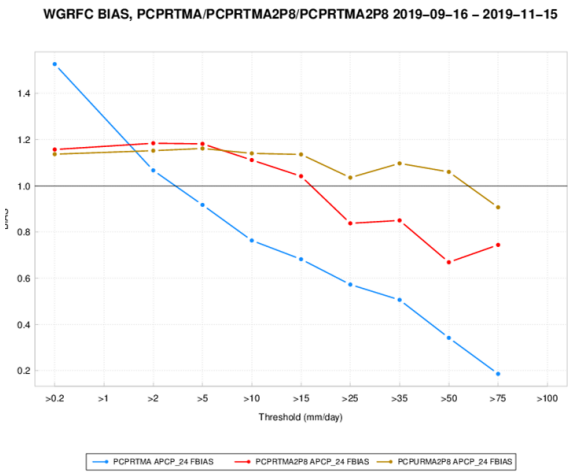
RTMA *vs.* **RTMAv2.8** *vs.* **URMAv2.8**, 16 Sept - 15 Nov, WGRFC



Time series of RMSE



ETS *vs.* threshold



Bias *vs.* threshold

For Users of PCPANL Output

Summary of changes for users of PCPANL (Stage II/IV) data planned for March 2020 with RTMA/URMA v2.8 implementation (https://www.emc.ncep.noaa.gov/users/meg/rtma_urma_v2p8/):

- Stage II will be discontinued with the RTMA/URMA v2.8 implementation (scheduled for Mar 2020)
- Stage IV will be in GRIB2 format, instead of GRIB1
- Stage IV mosaicking will be done at hh:55 instead of hh:33 (per request by OWP, RFCs for RIDGE II, so that more RFC QPEs can be included for the current hour)
- There is an additional re-run for 24h ConUS mosaic done at 30h after valid time (at the 18:55Z cycle), to supplement the current 1/2/3/5/7-day rerun schedule, done at 12:55Z, to give RFCs a better chance to have their re-sent or updated QPEs included in AHPS's water.weather.gov/precip w/o waiting for the 2-day rerun the next day

Add'l info about the upcoming precip change for RTMA/URMA v2.8:
https://docs.google.com/presentation/d/1GUjHKmD56AR1fxzgF-LexBsJTfs0KNEG4O7xonZpJ7g/edit?usp=sharing