

AQPI Users Group Meeting – Oct 2019 – Hayward, CA

RAP/HRRR Model Forecasts of two AR events (22-Mar-2018 & 14-Feb-2019)

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Background

The backbone of atmospheric forecasting for AQPI is the NOAA High Resolution Rapid Refresh (HRRR) Model. The HRRR model was developed at NOAA Boulder and runs operationally at NOAA's Center for Environmental Prediction. The HRRR is NOAA's flagship model for high resolution, short term forecasting and is used by the National Weather Service to predict of all kinds of weather across the country. More information about the HRRR can be found [here](#). In AQPI, we are using the HRRR primarily for rainfall forecasting and for providing input forcing for the coastal forecast model and San Francisco Bay.

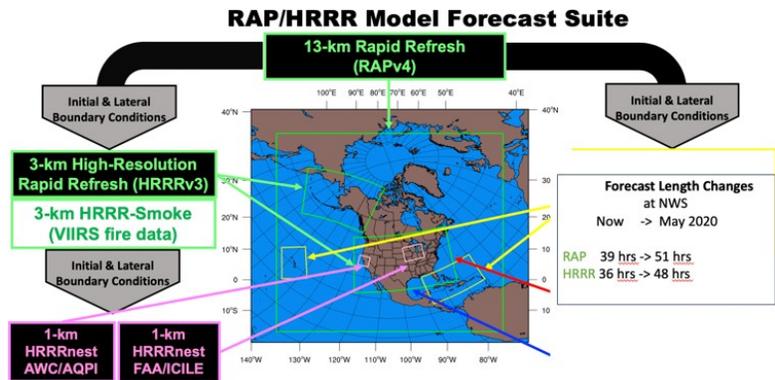
AQPI is providing an opportunity to look at the performance of the HRRR in the Bay area in a way that we have never been able to do before and identify ways to improve the model forecasts. Improvements to operational version of HRRR come through an experimental version of HRRR that is run at NOAA Boulder. The experimental HRRR has the latest and greatest science in it and these advances are eventually transitioned to the operational version of HRRR. Here, we take advantage of both the operational and experimental versions of HRRR to examine how well the HRRR model does at forecasting rainfall in the AQPI region.

Goals

- Evaluate Quantitative Precipitation Forecasts (QPF) from different model versions against multiple Quantitative Precipitation Estimates (QPE) for numerous Atmospheric River (AR) Events
- Improve QPF for future model versions and improve QPE maps

Approach

- Download RAP/HRRR operational/experimental model versions; run retrospective simulations with the latest developmental versions
- Evaluate numerous AR events
 - 21-23 Mar-2018 (shown here)
 - 12-17 Feb-2019 (shown here)
 - Other events (Feb & Mar 2019)
- Compare QPF to numerous QPE products
 - Stage-IV (6h spatial maps gauge+radar)
 - Mesonet network (1h accum of 500+ gauges)
 - Valley Water (SCWA) gauge network
 - Santa Clara X-band radar-derived precip
- Compare T, winds, RH, water vapor, etc

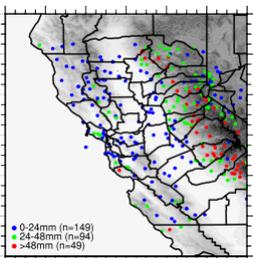


20-22 Mar 2018 Event

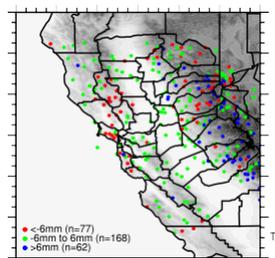
Heaviest rains fell on 22-Mar

HRRR generally predicts the spatial distribution of precip well compared to gauge products
 HRRR is too dry in the Bay Area/coast and too wet in the Sierras based on the limited gauge data
 Recent versions of the HRRR perform better than the old HRRR(v2)

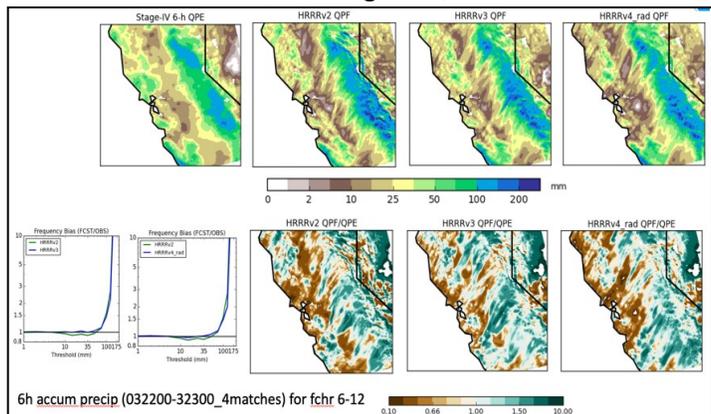
Mesonet 12h precip



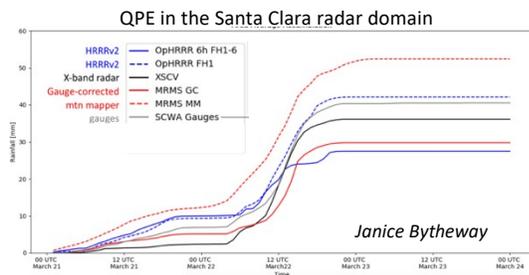
HRRRv3 bias (6h)



HRRR QPF vs Stage-IV QPF



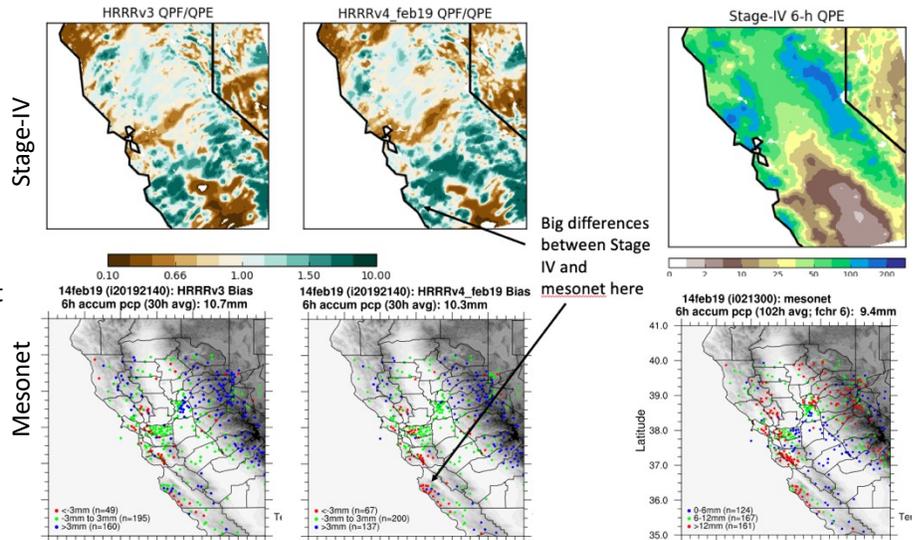
Precip contingency tables show similar skill across HRRR versions compared to Mesonet (not shown)
 Overall conclusions are similar comparing to Stage-IV or Mesonet, with some differences (more on p.2)



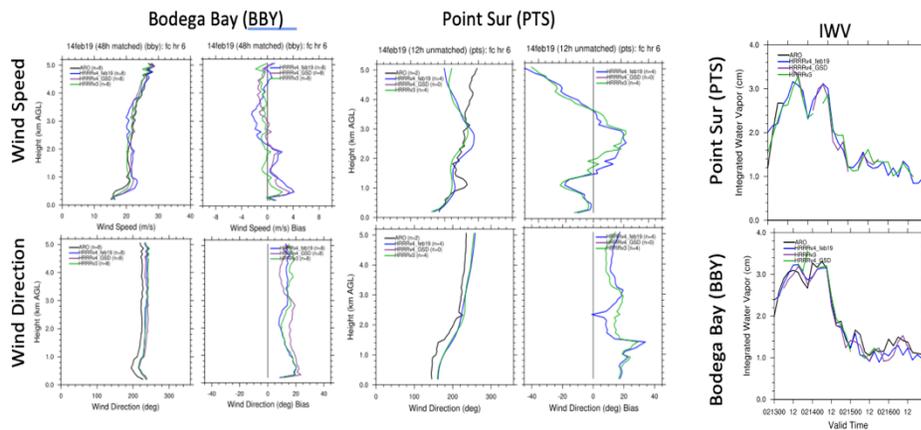
Comparing different precip measurements in the Santa Clara radar domain, QPE varies significantly indicating there is a lot of uncertainty in the “truth”. The HRRR forecasts generally falls within the range of the QPE

12-17 Feb-2019 Event

- Typical AR, similar to 20-22 Mar-2018 event, but lasted over five days! (12-17 Feb 2019)
- Compared QPF from HRRR operational (op), HRRR experimental (exp), to QPE from Stage-IV and Mesonet
- HRRR spatial biases have some similarities to 22-Mar-2018 event (too dry near the coast, too wet in the Sierras)
- Significant differences between QPE products in Southern AQPI domain make evaluation here a challenge



Big differences between Stage IV and mesonet here



Wind speed, wind direction, and integrated water vapor (IWV) do not vary much across HRRR model versions at two locations (Bodega Bay and Point Sur) HRRR wind speed and IWV compare well to measurements, but wind direction has an easterly bias. Need to explore the wind direction bias more, and whether it impacts QPF accuracy

Summary

- Multiple HRRR versions evaluated for two AR events (22-Mar-2018 and 14-Feb-2019)
- All HRRR versions generally predict precip well, but too dry in the Bay Area/coast and too wet in the Sierras according to the available gauge data. The ability of the gauges to accurately reflect the actual precipitation patterns in these regions in an active research topic.
- Huge spread amongst measurement products; the “truth” has much uncertainty
- X-band radar data is useful in providing a reliable QPE but the coverage range is limited
- More cases are needed to determine if these cases study results are robust
- Additional local network gauge data will help reduce the “truth” uncertainty

Next Steps

- Compare more AR events
- Run HRRR with X-band data for 14-Feb-2019 AR event – test if the radar data helps improve the forecast
- Compare additional network gauge data and refine QPE/QPF comparison techniques