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An Evaluation of Quantitative Precipitation Estimators over the Western United States

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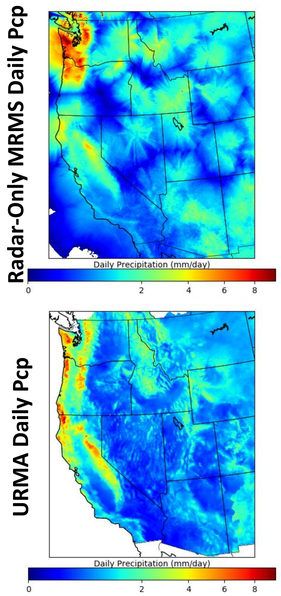
Introduction

Quantitative precipitation estimation (QPE) has long been challenging in the Western United States due to sparse surface stations, poor radar, coverage, and strong orographically-induced precipitation gradients.

For instance, mean daily precipitation from two different QPEs are shown to the right. **Radar-Only MRMS (upper right)** shows strong biases with regard to radar placement and huge deficits in wet locations relative to another product, **URMA QPE (lower right).**

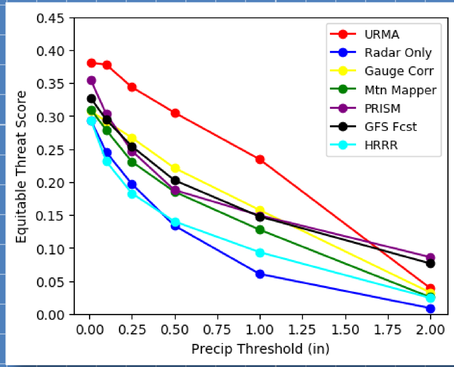
Accurate gridded QPE is critical for many hydrological forecast applications, for skillful post-processing of model output, and for model verification. In this work 5 QPE products are assessed to understand their relative skill for the purpose of improving the next generation of QPE analyses.



Datasets

Six-hourly intervals of five QPE products are being assessed: the Unrestricted Mesoscale Analysis (URMA, 2.5 km), PRISM QPE (4 km), MRMS Radar-Only (1 km), MRMS Gauge Corrected Radar (1 km), and MRMS Mountain Mapper (1 km). 0-6 hr forecasts from the 0.25 deg GFS and HRRR are included for comparison. **The period of record for each QPE is Apr 2016-Dec 2017.**

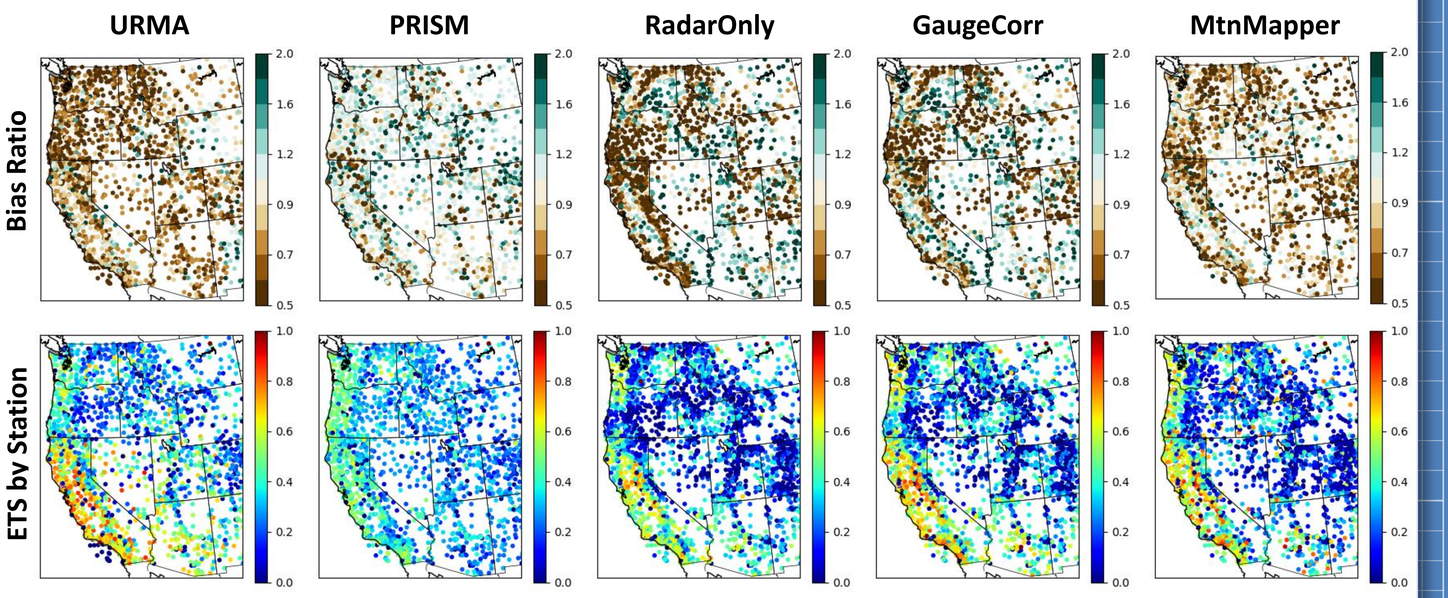
Approximately 1700 surface stations are used to verify QPE performance. This does not include SNOTEL. Ideally QPE skill would be assessed using data denial testing, but we do not have that capability. Instead , this research offers a relative comparison of QPE skill that can also illuminate shortcomings in each QPE for the purpose of improving the products.



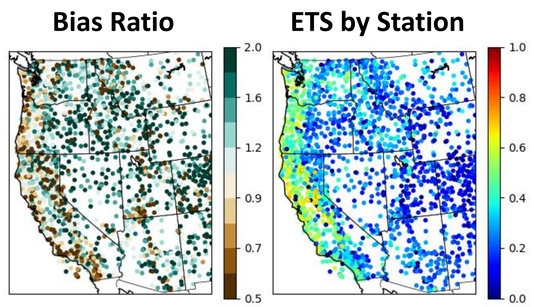
Using **Equitable Threat Score (ETS)** as the overall skill metric, URMA is the only QPE that clearly exceeds the skill of the GFS forecast West-wide.

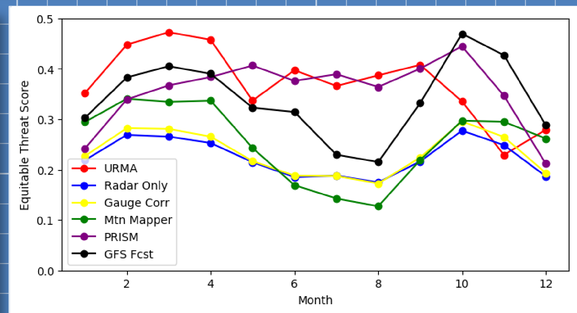
MRMS products fall below URMA and PRISM, although MRSM gauge-corrected radar is the best MRMS product.

Maps of ETS (> 0.00) and bias ratio by individual surface station are shown below for each QPE. Significant variations can be seen geographically. ETS is highest and bias tends to be low in the Central Valley of California, where significant radar coverage, plentiful gauges and strong synoptic forcing or precipitation combine.



How does the GFS forecast compare? The 0-12 hour forecasts from the GFS (to the right) corresponding to the above QPEs have a much higher bias than the QPEs but similar geographic distribution of ETS.





The **seasonal variation in ETS** varies by QPE, but early spring tends to have the highest values.

Discussion and Future Work

While URMA records the highest ETS overall for most precipitation thresholds and Radar-Only MRMS the lowest, considerable geographical variation of ETS exists for both products. Scores tend to be highest on the Pacific coast, particularly in California This result is true for all the QPEs. PRISM has the lowest bias scores overall, while MRMS bias is clearly influenced by the quality of the radar coverage. The seasonal variation of ETS is surprising, with a minima in February and maxima in October.

Considerable refinement of this work is possible, starting with a more in-depth quality control of the observed precipitation amounts and the inclusion of the QC-intensive SNOTEL data. Additional work will also include working with the developers of URMA and MRMS to improve the quality of their analyses by utilizing the results of this work.