

Assessment of Extreme Quantitative Precipitation Forecasts and Development of Regional Extreme Event Thresholds Using Data from HMT-2006 and COOP Observers

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Motivation

- Many key end-users of quantitative precipitation forecasts (QPF) are in need of accurate forecasts (e.g., location, timing, and amount of precipitation) of extreme events (e.g., > 3 in/24 h.)
- The current QPF evaluation method (i.e., > 1 in/24 h threat score) is sub-optimal for extreme events which tend to occur less frequently and over smaller areas than weaker precipitation events.

Objective

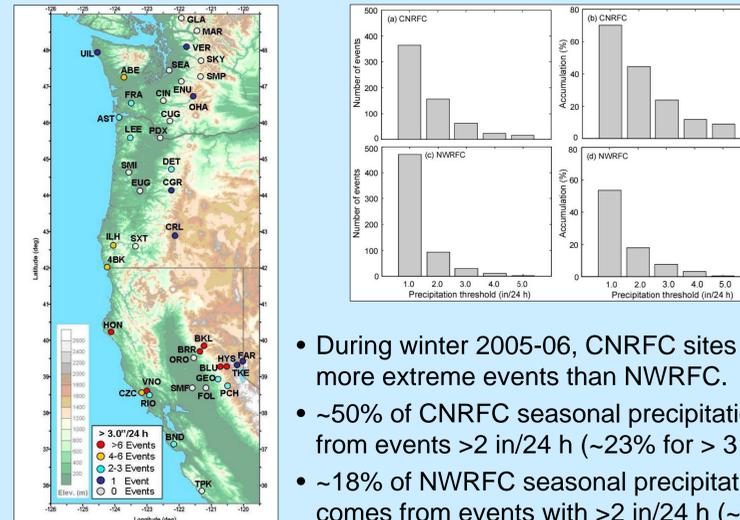
- To develop a QPF evaluation method that is effective for extreme precipitation events and that could be considered for use as a formal performance measure by NOAA.

Context

- The Hydrometeorology Testbed (HMT) has led to the development of the data sets used in this study.

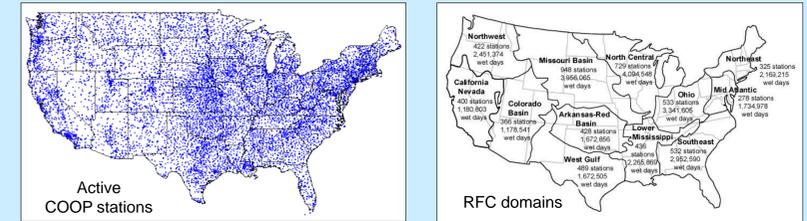
Extreme Precipitation Sampling

- An extreme precipitation event occurs at a verification site when the observed precipitation exceeds a predetermined threshold in 24 hours. (Here thresholds are > 3 in/24 h and > 5 in/24 h.)



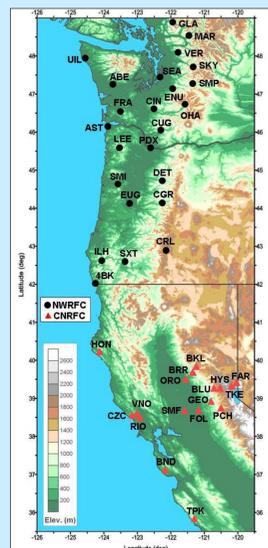
- During winter 2005-06, CNRFC sites had more extreme events than NWRFC.
- ~50% of CNRFC seasonal precipitation comes from events >2 in/24 h (~23% for > 3 in/24 h)
- ~18% of NWRFC seasonal precipitation comes from events with >2 in/24 h (~7% for > 3 in/24 h)

Cooperative Observer Program (COOP) Analysis



- 24-h accumulated precipitation totals were obtained from 6,088 stations from 1950-2007.
- All records from stations within the boundaries of an RFC region were analyzed together to assess large-area exceedence frequencies for daily precipitation.

Forecast & Verification Data



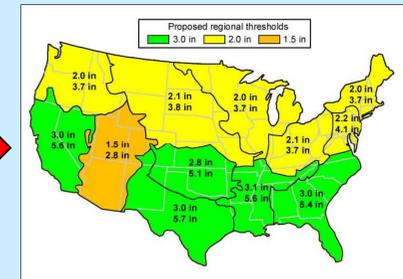
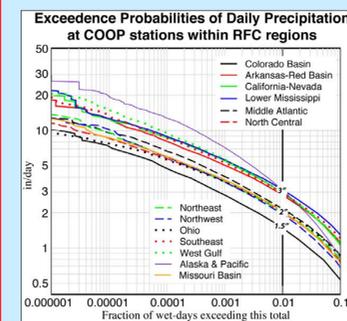
SITES

- Northwest river forecast center (NWRFC) – 24 sites in WA and OR utilized
- California-Nevada river forecast center (CNRFC) – 17 sites in CA utilized

DATA

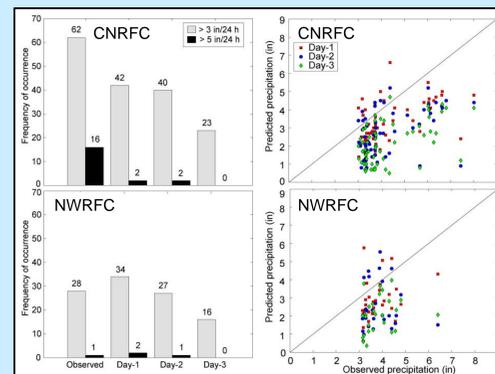
- Winter season: 5 Nov. 2005 to 25 Apr. 2006
- RFC QPFs
 - 24-h forecasts with lead times of 24 h (Day-1), 48 h (Day-2), and 72 h (Day-3)
 - Forecasts made from 12 Z to 12 Z
 - Grid resolution of 4 km
- RFC quantitative precipitation estimates (QPE)
 - Gage-based
 - 12 Z to 12 Z
 - Grid resolution of 4 km

Regional Extreme Precipitation Thresholds



- Proposed regional extreme precipitation event thresholds (in/24 h) for the 12 CONUS RFCs based upon 1% and 0.1% of largest precipitation events.
- Results show 3 tiers of thresholds for extreme events: northern CONUS (yellow), southern & southeastern CONUS plus California-Nevada (green), and the Colorado Basin (orange).

Extreme QPF Performance Analysis



- CNRFC had 16 observed site events > 5 in/24 h but only 2 events were predicted.
- NWRFC had only one observed site event > 5 in/24 h.
- CNRFC & NWRFC tend to under-forecast extreme events, especially with longer lead time.

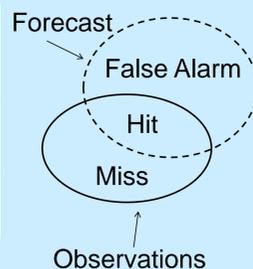
Conclusions

- A QPF evaluation method was developed for 24-h accumulated precipitation to assess forecast performance of extreme events.
- Five measures were determined to provide the most useful metrics of extreme QPF performance:
 - POD, FAR, CSI, bias and MAE
- Application of the QPF verification method to the CNRFC and NWRFC regions during HMT 2005/2006 for forecast lead times of 24 h, 48 h, and 72 h indicate:
 - Both RFCs generally under-predicted extreme events
 - POD, FAR, CSI, bias and MAE values became worse with lead time.
- COOP daily precipitation totals were examined to objectively determine regionally relevant thresholds of extreme precipitation events.

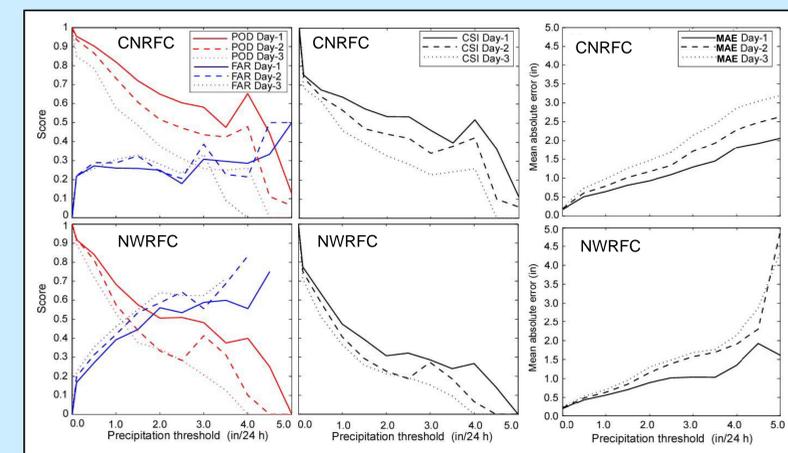
QPF Performance Measures

PRECIPITATION VERIFICATION FORECAST MATRIX

	Precipitation was measured	Precipitation was not measured
Precipitation was forecast	Hit	False Alarm
Precipitation was not forecast	Miss	Null



- **POD**
Probability of detection (Hit rate) = Hits/(Hits + Misses)
- **FAR**
False alarm rate = False alarms/(Hits + False Alarms)
- **CSI (aka Threat Score)**
Critical success index = Hits/(Hits + Misses + False Alarms)
- **MAE**
Mean absolute error = mean(abs(QPF-QPE))
- **Bias**
Bias = QPF/QPE



- CNRFC POD decreases and CNRFC FAR increases with lead time and threshold.
- CNRFC POD decreases with lead time faster than CNRFC FAR increases.
- NWRFC POD decreases and NWRFC FAR increases with lead time and threshold.
- MAE increases with lead time and threshold for both RFCs.

Future Work

- Evaluation method & regional thresholds will be applied to all CONUS RFCs retrospectively to establish a baseline for future extreme QPF performance.
- In collaboration with NCEP/HPC, method & regional thresholds will be applied to NCEP/HPC gridded QPF data.
- Method & thresholds will be applied to 6-h QPFs to quantify the timing of extreme precipitation within the 24-h accumulation period.