An evaluation of the Conditional Bias-Penalized Regression (CBPR)-aided Meteorological Ensemble Forecast Processor (MEFP) for Hydrologic Ensemble Forecast Service (HEFS) testbed locations

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Adding CBPR to Hydrologic Ensemble Forecast Service (HEFS)

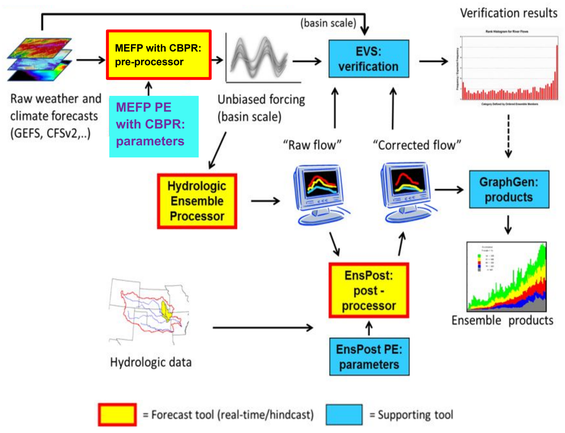


Figure 1. Addition of the CBPR to the Hydrologic Ensemble Forecast Service (HEFS).

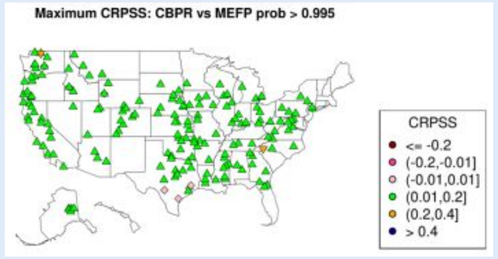
Introduction

- The Conditional Bias-Penalized Regression (CBPR; Kim et al., 2024) aims to improve the quality of Meteorological Ensemble Forecast Processor (MEFP; Wu et al., 2011) forecasts for heavy-to-extreme precipitation amounts used in Hydrologic Ensemble Forecast Service (HEFS; Demargne et al., 2014) of the US National Weather Service
- For this evaluation, the GEFSv12 mean precipitation forecasts were post-processed by MEFP with CBPR (hereafter "CBPR") and without CBPR (hereafter "MEFP"), and different metrics were computed compared to observed mean areal precipitation.
- The evaluation was done at 179 locations which were chosen to be representative of the gauged streamflow locations across the US.
- This poster describes the results from evaluating the performance of CBPR in comparison to MEFP and GEFSv12 ensemble mean

CBPR improves the performance of MEFP for heavy-to-extreme precipitation

Skill in precipitation ensembles from CBPR

CBPR vs MEFP



CBPR vs GEFSv12 ensemble mean

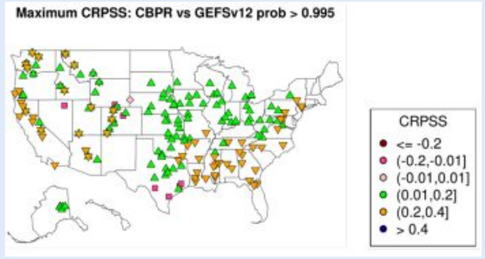
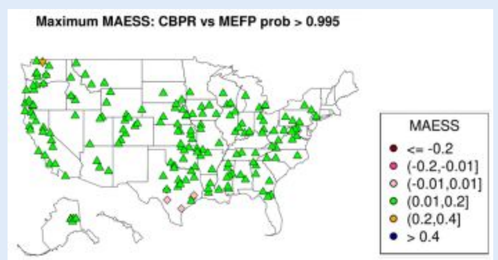


Figure 2. Maximum Continuous Ranked Probability Skill Score (**CRPSS**) of the CBPR for **179** study basins for the cases with the highest 0.5% of precipitation where maximum CRPSS is computed from 1 to 7 lead days on a daily time step. Here, CBPR is MEFP with CBPR. MEFP with CBPR has better maximum CRPSS than the MEFP alone (left) and the mean GEFSv12 (right).

Skill in precipitation ensemble mean from CBPR

CBPR vs MEFP



CBPR vs GEFSv12 ensemble mean

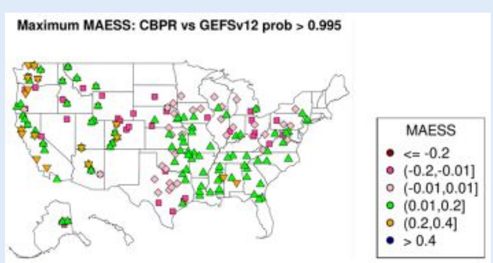
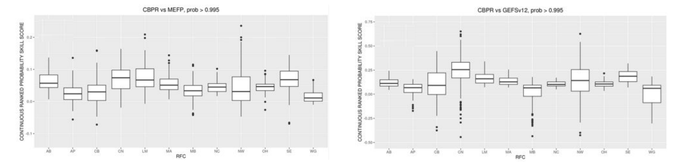


Figure 3. Same as Figure 2 but for Maximum Mean Absolute Error Skill Score (**MAESS**).

CBPR performance for each RFC

CRPSS

CBPR vs MEFP **CBPR vs GEFSv12 ensemble mean**

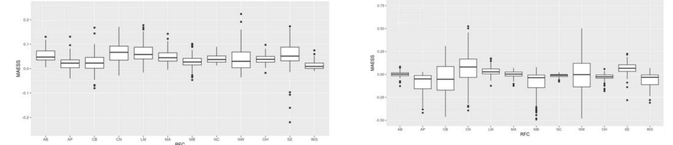


CBPR generally improves the quality of precipitation ensembles from the MEFP at all RFCs in terms of CRPSS

Figures 4. **CRPSS** of the CBPR for the cases with the highest 0.5% of precipitation at different RFCs where samples at each box plot are from different basins and lead times in the same RFC

MAESS

CBPR vs MEFP **CBPR vs GEFSv12 ensemble mean**



CBPR generally improves the quality of precipitation ensemble mean from the MEFP at all RFCs in terms of MAESS

Figures 5. Same as Figure 4 but for **MAESS**

Summary

- This study evaluates the performance of the CBPR for 179 US basins where the reference forecasts include the MEFP and the ensemble mean of the GEFSv12.
- CBPR generally improves upon the MEFP, particularly for heavy-to-extreme precipitation in terms of skill. Compared to the MEFP, the CBPR showed slightly reduced unconditional performance, but consistently positive performance at probability thresholds of equal to or greater than 0.9.
- The performance gain of using the CBPR is more pronounced when compared to the GEFSv12 ensemble mean forecasts. Compared to the GEFSv12, the CBPR generally outperforms at high probability thresholds and RFCs in terms of CRPSS, whereas an improvement in MAESS varies basin to basin

REFERENCES:
Kim, S., Jozaghi, A., Seo, D.-J., (2024) Improving ensemble forecast quality for heavy-to-extreme precipitation for the Meteorological Ensemble Forecast Processor via conditional bias-penalized regression, In preparation.
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Wu, L., Seo, D.-J., Demargne, J., Brown, J.D., Cong, S., Schaake, J. (2011) Generation of ensemble precipitation forecast from single-valued quantitative precipitation forecast for hydrologic ensemble prediction. Journal of Hydrology, 399, 281-298.

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