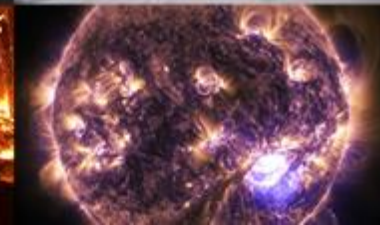
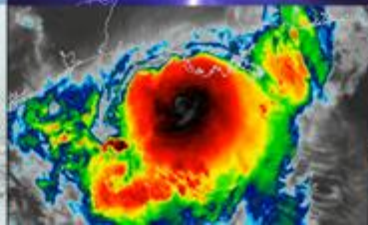




Monthly/Seasonal Prediction Tools Under Development at the Climate Prediction Center (CPC) for Sectoral Application Including Water Resources





Outline

- Background
- Assumptions
- North American Multi-Model Ensemble (NMME)-based precipitation prediction tool:
 - Overview
 - Hindcast verification
- Statistical precipitation prediction tool based on Switanek et al. (2020) and Wang et al. (1999) using sea surface temperature predictor:
 - Overview
 - Hindcast verification
- Summary



Background

- The Climate Prediction Center has developed monthly/seasonal prediction tools that can potentially be utilized by various sectors including water resources.
- These tools can provide prediction of monthly or seasonal mean (or other longer forecast length) temperature and precipitation. These can be disaggregated to daily data using statistical approaches.
- Work to date has focused on deterministic and tercile-class probabilistic predictions. Additional formats could be generated.
- The tools include cross-validated estimates of forecast skill that have at least 30 years of reforecasts available for testing in application models such as those used for water supply.



Assumptions

- USACE has adopted the NWS Hydrologic Ensemble Forecast System (HEFS) as the platform for implementing FIRO. Therefore, this presentation covers how CPC could fit into a HEFS-based approach.
- The current implementation of HEFS has the capability to utilize GEFS forecasts out to 28 days, i.e. the first month lead forecast. Therefore, we will focus on tools that could be used starting with the second month lead. CPC could also contribute to testing of post-processing techniques on GEFS data for the first 28 days.
- CPC can contribute explicit meteorological forecasts but would also be interested in exploring trace-weighting approaches that gives enhanced weight to previous years with similar climate forcing. Such an approach has previously been used by Werner et al., Wood et al., and Baker et al..



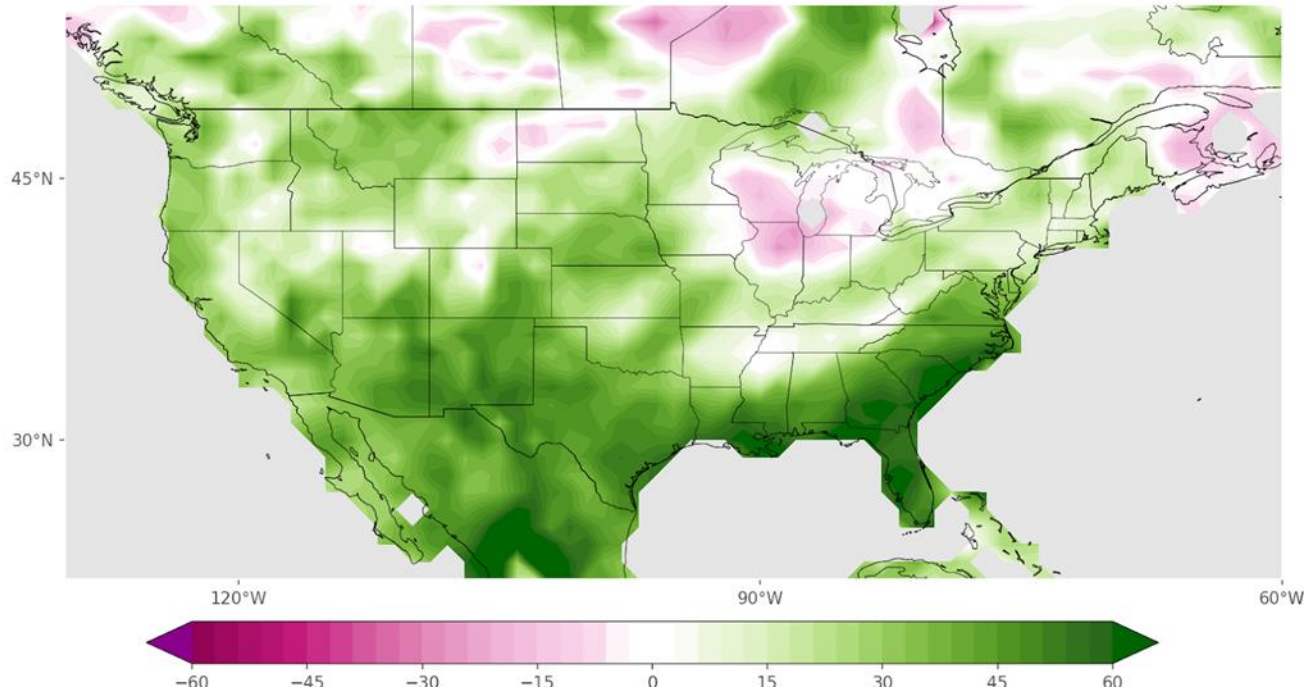
NMME-Based Precipitation Forecasts for Water Resources (E. LaJoie)

- CPC has developed three NMME-based forecasts for water resources. These are available for each calendar month. For example, October starts and leads out 6-months to estimate the sum total precipitation forecast for the target period.
 - **6-month outlook** initializing in October and running thru March → **ONDJFM**
 - **5-month outlook** initializing in the following month, November, and running thru March → **NDJFM**
 - **4-month outlook** initializing in December and running thru March → **DJFM**
- Monthly forecasts are also available for leads from 1 month to 6 months.
- Calibration uses the Ensemble Regression approach (Unger et al., 2009).
- Skill assessment is computed for the 1982 to 2020 period using the anomaly correlation coefficient (ACC). Cross-validation is handled using a **leave one year out procedure**.
- NMME Component Models:

• CFSv2	24 members
• GEM_NEMO	10 members
• NASA_GEOS5v2	4 members
• NCAR_CCSM4	10 members

NMME Anomaly Correlation Forecast Skill Retrospective Forecasts for 1982 to 2020

NMME Water Year Outlook Skill: ACC All Years 1982-2020





Statistical Precipitation Forecasts for Water Resources (H. Wang)

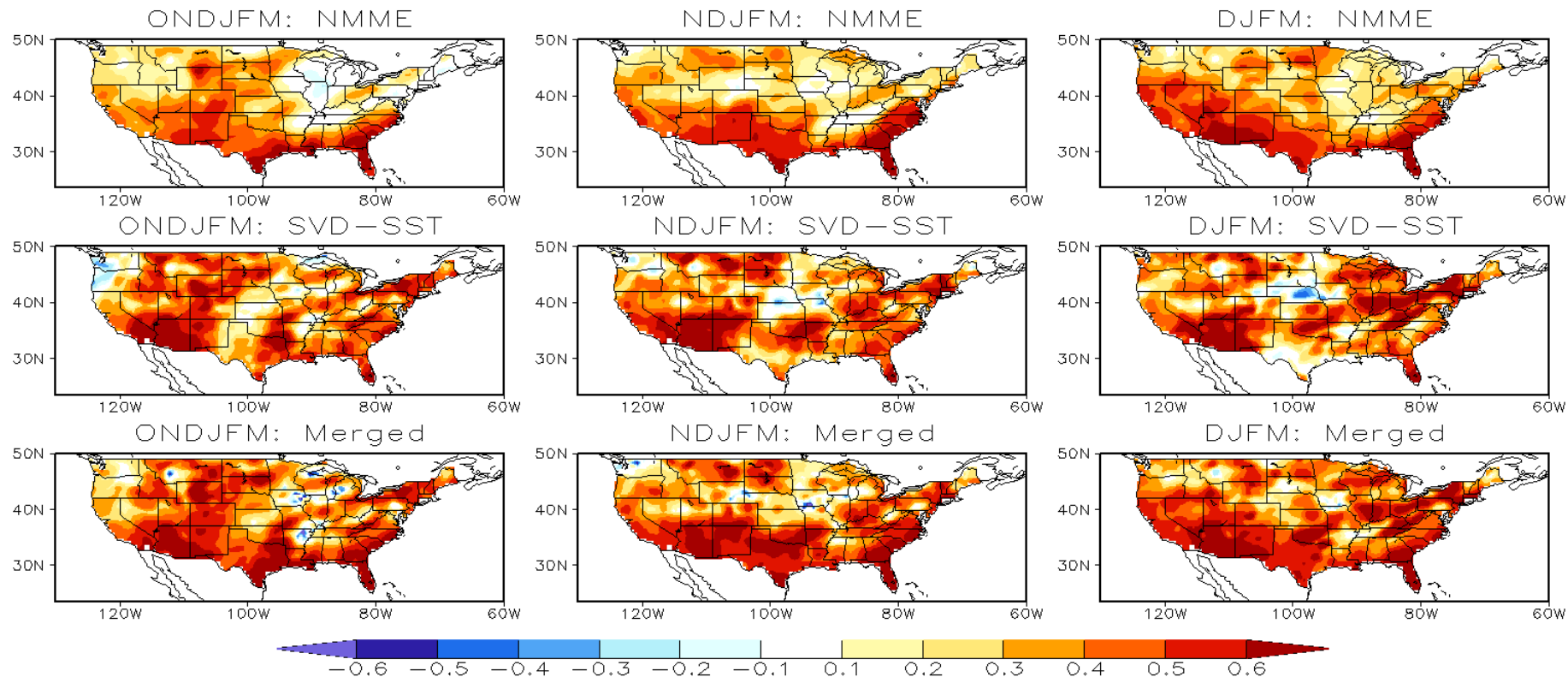


- The SVD-CLSST model is the mixed methods of Switanek et al. (2020, CLSST model) and Wang et al. (1999, SVD-based forecast).
- The statistical forecast is based on the lag relationships between SST (30°S–60°N, 1–18-month leads) and seasonal precipitation over CONUS.
- The lag relationships are objectively identified by the singular value decomposition (SVD) for each SST lead time.
- The skill values of anomaly correlation (AC) are used as weights for combining different SST-lead forecasts (if $AC < 0$, set $AC = 0$).
- Forecasts are cross-validated over 1982–2021 with the leave 5-year out approach and compared with the NMME forecasts.



AC Skill: Precipitation 1982/83 – 2021/22

0-Month Lead Forecast





Summary



- CPC is developing statistical and dynamical monthly/seasonal prediction tools for temperature and precipitation that can be used by sectoral models including potentially water resource models.
- The utility of these seasonal precipitation and temperature tools for any particular application will need to be evaluated through use of cross-validated reforecasts applied to specific sectoral models.
- We recommend evaluating the potential of trace-weighting approaches in HEFS in addition to using explicit meteorological forecasts.

