Developing an NMME Probability Threshold Based Seasonal Forecast Tool

Mingyue Chen, Arun Kumar, and David DeWitt
Climate Prediction Center, NCEP, College Park, Maryland

Objective

In this study, we examine the feasibility of developing a seasonal forecast tool based on the North American Multi-Model Ensemble seasonal forecast system (NMME) for different probability thresholds.

Approach

- Assess the probabilistic seasonal forecast skill from NMME, including spatial maps and time series of skill over the Contiguous US (CONUS), and its seasonality;
- Assess the impact of the threshold probability used to define the region of forecasts with equal chance (EC) on (a) forecasts skills and (b) corresponding spatial coverage of region with non equal Chance (nonEC) forecasts;

Data

Forecast data:

– The probabilities of three categories (above, near, and below normal) seasonal forecasts from NMME provided by Dr. Emily Becker (Kirtman et al, 2014)

Verification data:

– Precipitation (PREC): the CMAP monthly precipitation analysis (Xie and Arkin, 1997);
– Temperature (TEMP): the GHCN-CAMS monthly land surface temperature analysis (Fan and van den Dool, 2008);
– Climatology based on 1981-2010;

Verification period:

– 0-month-lead seasonal forecasts for the target seasons in JFM1995-DJF2016;

Skill measurements:

– Heidke Skill Score (HSS);
– Ranked Probability Skill Score (RPSS);

Results

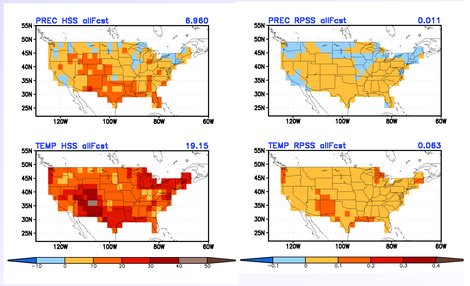

Fig. 1. Spatial maps of HSS (left panels) and RPSS (right panels) in all seasons 1995-2016 for PREC (upper panels) and TEMP (lower panels). Skills based on all forecasts.

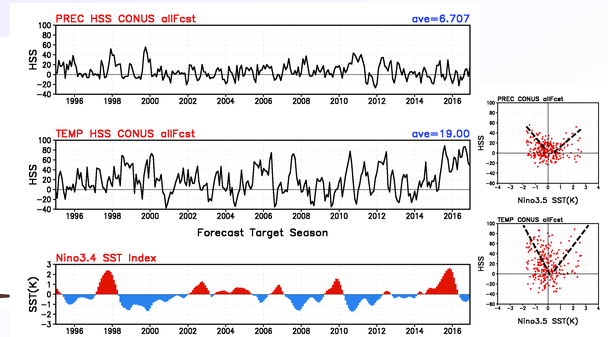

Fig. 2. Time series of HSS over the CONUS for PREC (upper panel) and TEMP (middle panel), and Nino3.4 SST index. The right panels are the scatter plot between HSS and Nino3.4 SST index. Skills based on all forecasts.

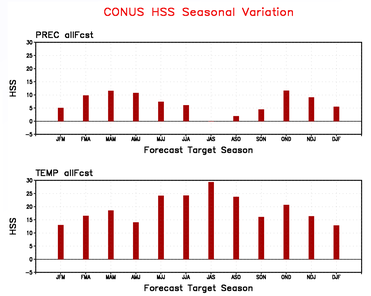

Fig. 3. HSS averaged over the CONUS for each forecast seasons. Skills based on all forecasts.

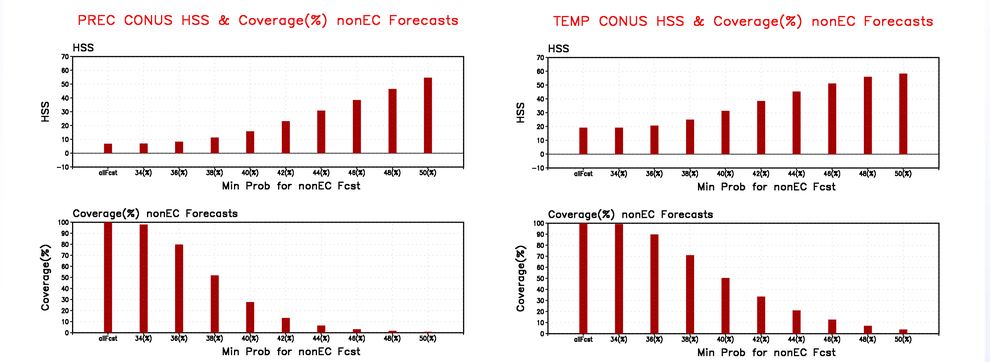

Fig. 4. HSS averaged over the CONUS for all forecasts and non-equal chance (nonEC) forecasts with different probability threshold used to define the nonEC forecasts (upper panels), and the corresponding coverage of the nonEC forecasts (lower panels).

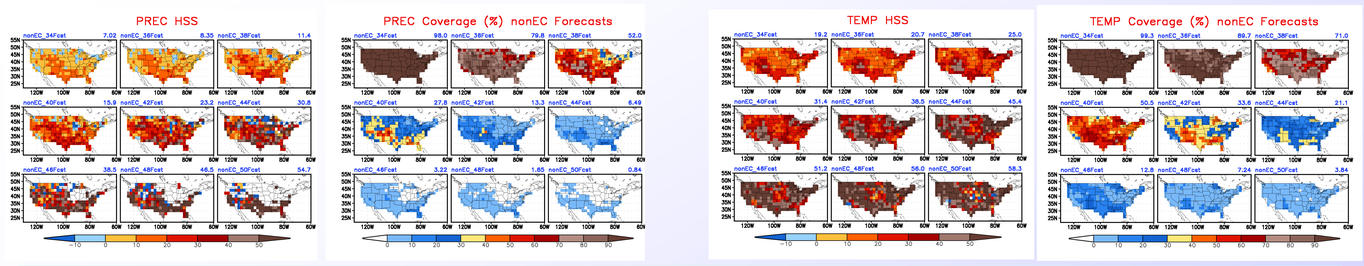

Fig. 5. Spatial maps of HSS and the coverage (%) of nonEC forecasts with different probability threshold used to define the nonEC forecast.

Summary

- Relative high forecast skills are located over the SW of the US;
- The locations with high (low) skills of HSS are consistent with high (low) skills of RPSS;
- In general, most high skills are related to ENSO episodes;
- PREC higher skills in spring and fall seasons; TEMP higher skills in summer season;
- nonEC forecast HSS increases as the probability threshold cutoff increases; and the areal coverage goes down. Increasing probability threshold cutoff is equivalent to higher confidence in forecasts, higher signal-to-noise ratio, large shift in the PDF from climatology, and therefore, should equate to higher skill.

Acknowledgments

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Reference

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Kirtman et al. (2014), The North American Multimodel Ensemble: Phase-1 seasonal-to-interannual prediction: phase-2 toward developing intraseasonal prediction. BAMS, 95, 585-601, doi:10.1175/BAMS-D-12-00050.1.

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