Assessment of Multi-Model Hindcast Skill for the Southeast United States

Lydia Stefanova, Vasu Misra, James O’Brien, Eric Chassignet
Center for Ocean-Atmospheric Prediction Studies, Florida State University

**QUESTION:** How predictable is the climate of the Southeast US on seasonal time scales from the point of view of existing global circulation numerical models?

**APPROACH:**
Models: Seasonal hindcasts for 1982-2001 from several global models’ ensembles hosted by the Asia Pacific Economic Cooperation Climate Center (APCC).

<table>
<thead>
<tr>
<th>Model (Interpolated to 2x52x33)</th>
<th>APRC, non-interactive observed SST</th>
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**Verification:** The Climate Prediction Center (CPC) Merged Analysis of Precipitation (CMAP). The European Centre for Medium-Range Weather Forecasts (ECMWF) 40-Year Reanalysis (ERA-40).

**Metrics:** Potential predictability, anomaly correlation, equitable threat score, Brier skill score.

**PREDICTABILITY AND DETERMINISTIC SKILL:** Predictability and anomaly correlation for precipitation

- The largest predictability (signal to noise ratio) of precipitation anywhere in the US is found in the Southeast in winter.
- The strongest anomaly correlations of precipitation anywhere in the US are found in the Southeast in winter.

**DETERMINISTIC SKILL:** Temporal anomaly correlations

- High skill in winter both for models using observed SSTs and for coupled models - coupled models’ skillful in resolving the winter ENSO phase, atmospheric components able to generate the proper circulation in response to ENSO SSTs.
- Poor skill in summer and fall – hurricanes and convection poorly resolved, ENSO influence weak.

**2-meter temperature:**

- High skill for models using observed SSTs; poor skill for coupled models – surface air temperature more sensitive to local SSTs (Gulf of Mexico, Atlantic) than to ENSO SSTs and associated circulation.

**PROBABILISTIC SKILL:** Reliability Diagram and Brier Skill Score (Precipitation)

- BSS measures probabilistic hindcast skill compared to climatological probability hindcast.
- Skill present in winter, absent in summer.
- When present, skill is both in the reliability and the resolution terms.
- Low probability forecasts tend to be overestimates, high probability forecasts tend to be underestimates.

**OPEN QUESTIONS:**

- Why is the 2-meter temperature forecast least skillful in winter when the precipitation forecast is most skillful?
- How does the skill stratify with ENSO phase?
- What is the relationship between predictability and skill?
- How much can downscaling help?

**ANSWER:**

1. Model hindcast skill has considerable variation within the Southeastern U.S. domain; the skill tends to be larger for coastal areas.
2. For precipitation: winter hindcasts are most skillful. Most of this skill seems driven by ENSO. Of all the US regions, the Southeast has the highest predictability of precipitation, occurring in spring and winter;
   - Both models with observed SST and with coupled SST forcing have very high skill in winter and no skill in summer
   - In winter, forecasts of low probability tend to be overestimates, and forecasts of high probability tend to be underestimates.
3. For 2-meter temperatures: winter hindcasts are least skillful. Local effects seem more important than ENSO.
   - Models with observed SST forcing have largest skill in spring and summer, smaller skill in autumn and winter;
   - Models with coupled SST or imposed non-observed SST forcing have almost no skill.

**PROBABILISTIC SKILL:** Gerrity skill score (ETS for multi-category forecast)

- Categories: below normal, normal, above normal
- Sample contingency tables:

**GSS summary table:**

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