



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



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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:

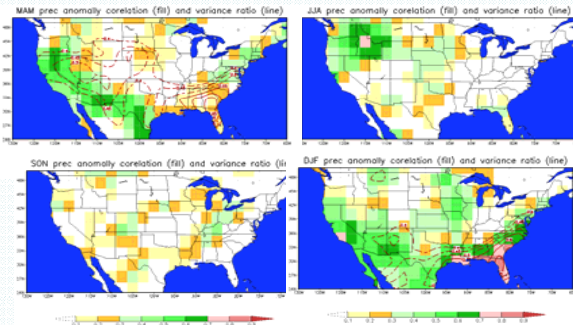
Models: Seasonal hindcasts for 1982-2001 from several global models' ensembles hosted by the Asia Pacific Economic Cooperation Climate Center (APCC).

Model (interpolated to 2.5x2.5)	1982-2001 Hindcast Type				Ensemble members (L234)
	AMIP continuous run, observed SST	SMIP-2 seasonal run, observed SST	SMIP/HFP 2-tier imposed forecast SST	SMIP/HFP 1-tier interactive SST	
COLA T63/L18 (USA)	Observed SST				10
CWB T42/L18 (Taiwan)			Statistical SST		10
HMC 1.1x1.4/L28 (Russia)			Persistent SST anomalies		10
MGO T42/L14 (Russia)		Observed SST			6
NCEP/CFS T62/L64 (USA)				Coupled SST	15
POAMA T47/L17 (Australia)				Coupled SST	10

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 spring and winter**.
- The **strongest anomaly correlations** of precipitation anywhere in the US are found in the **Southeast in winter**.

DETERMINISTIC SKILL: Temporal anomaly correlations

a) Precipitation:



➤ **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.

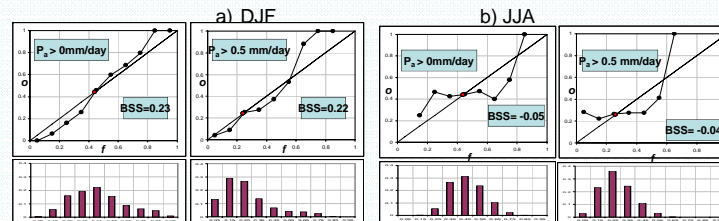
➤ **Poor skill in summer and fall** - hurricanes and convection poorly resolved, ENSO influence weak.

b) 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.

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

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

Obs	Below	Normal	Above
Fcst			
Below	23	10	5
Normal	10	11	9
Above	3	12	18

Obs	Below	Normal	Above
Fcst			
Below	15	12	8
Normal	14	11	7
Above	9	10	15

➤ GSS summary table:

	Precipitation				2m Temperature			
	ALL	OBS SST	Tier2	Tier1	ALL	OBS SST	Tier2	Tier1
MAM	0.06	0.07	0.01	0.06	0.17	0.35	-0.01	0.05
JJA	0.01	-0.04	0.06	-0.03	0.16	0.28	0.06	0.01
SON	0.01	0.01	0.06	0.04	0.17	0.15	0.01	0.12
DJF	0.37	0.30	0.35	0.30	0.00	0.15	-0.07	-0.02

- All models have high skill in categorical hindcasts for winter precipitation;
- Models using observed SSTs have high skill for spring and summer 2m temperature.
- Models without observed SSTs have no skill in categorical hindcasts for 2m temperatures in any season.

ANSWER

- Model hindcast skill has **considerable variation** within the Southeastern U.S. domain; the skill tends to be larger for coastal areas.
- 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.
- 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**.

OPEN QUESTIONS

- Why is the 2-m 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?