Progress Report on Subseasonal NMME Forecasts: Skill, Predictability, and Multi-model Combinations

Timothy DelSole

George Mason University, Fairfax, Va and Center for Ocean-Land-Atmosphere Studies, Calverton, MD

November 9, 2015
Project

Goals

1. Develop statistically informed protocol for subseasonal prediction.
2. Rigorously compare multi-model skill to individual forecast skill.
3. Assess whether subseasonal forecasts capture linear impacts of MJO.
4. Rigorously quantify predictability and skill of subseasonal forecasts.

Personnel

**Investigators**
- Timothy DelSole  PI
- Michael Tippett  co-PI
- Kathleen Pegion  co-PI

**NOAA Contact:** Arun Kumar

**Post Doc:** Laurie Trenary
Lagged Ensemble Forecasts of the MJO

1. Forecasts are from CFSv2 45-day hindcasts 1990-2010
2. MJO diagnosed using Wheeler and Hendon’s RMM1/RMM2
3. Consider only daily means initialized on 0Z, Nov. - Feb.
4. Removed mean conditioned on initial condition and lead.

\[
\text{MSE} = \left< \left( \text{RMM1}_{CFSv2} - \text{RMM1}_{OBS} \right)^2 + \left( \text{RMM2}_{CFSv2} - \text{RMM2}_{OBS} \right)^2 \right>
\]
MSE of CSFV2 hindcast of MJO
November–February 1999–2010

Numbered Labels = Lead (Days)

Number of lagged ensemble members
Conclusions

1. Skill exists even at 20 days leads.
2. For leads $< 7$ days, one-member ensemble has most skill.
3. For leads $> 12$ days, five-member ensemble has near-maximum skill.
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Are differences in MSE statistically significant?
Comparing Forecast Skill

TIMOTHY DELSOLE
George Mason University, Fairfax, Virginia, and Center for Ocean–Land–Atmosphere Studies, Calverton, Maryland

MICHAEL K. TIPPETT
Department of Applied Physics and Applied Mathematics, Columbia University, New York, New York, and Center of Excellence for Climate Change Research, Department of Meteorology, King Abdulaziz University, Jeddah, Saudi Arabia

(Manuscript received 4 February 2014, in final form 12 August 2014)
Skill of Single Events

Identify Events When Forecast $H$ has more skill than Forecast $T$.

Null hypothesis: probability that $H$ has more skill than $T$ is 50/50.
Skill of Single Events

Identify Events When Forecast H has more skill than Forecast T.

Null hypothesis: probability that H has more skill than T is 50/50.

- No caveats about independence.
- No assumptions about distribution of forecast errors.
- No restrictions on the criterion for deciding skill.
Random Walk Test

Identify Events When Forecast H has more skill than Forecast T.

Null hypothesis: Counts follow a binomial distribution with $p=1/2$. 
Sign test results for CFSV2 hindcast of MJO

Lead 20 Days -- November–February 1999–2010

Net Count = # ModelA − # ModelB

Red means ModelA is more skillful

Insignificant values masked out (5% significance mask)
MSE of CSFV2 hindcast of MJO
November–February 1999–2010

Number of lagged ensemble members

Normalized MSE

MSE of CSFV2 hindcast of MJO
November–February 1999–2010
No Skill
Numbered Labels = Lead (Days)
Sign test results for CFSV2 hindcast of MJO
Lead 2 Days −− November−February 1999−2010

Net Count = # ModelA − # ModelB
Blue means ModelB is more skillful
Insignificant values masked out (5% significance mask)
1. Introduced new, rigorous methods for comparing skill over common periods (e.g., sign test).

   - Skill exists even at 20 days leads.
   - For leads < 7 days, 1-member ensemble has most skill.
   - For leads > 12 days, 5-member ensemble has near-max skill.


4. Not discussed: CFSv2 was able to predict features of a 2013 flooding event in Saudia Arabia up to 10 days in advance.