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

Funding Opportunity Title: Climate Program Office FY 2014
Funding Opportunity Number: NOAA-OAR-CPO-2014-2003692

Investigators: Timothy DelSole (PI), Michael K. Tippett (co-PI), Kathleen Pegion (co-PI)
NOAA Contact: Arun Kumar

We propose to systematically diagnose predictability and skill on subseasonal time scales (14-60 days) of all North American Multi-Model Ensemble (NMME) models, and to develop a statistically informed protocol for generating multi-model, subseasonal predictions. The statistical methodology for these goals has been developed in previous research but not yet applied systematically to subseasonal forecasts. We will diagnose predictability and skill of all NMME models using the same objective criteria for all relevant lead times, target days, and models. Since predictability is a necessary condition for skill, this diagnosis will help forecasters decide when and where NMME forecast can be utilized beyond 14 days. We will rigorously identify significant differences in predictability and skill, which will help forecasters understand when and where model forecasts may be misleading due to unrealistically large signals or unrealistically small noises. We will rigorously assess whether the skill of a combination of subseasonal forecasts is significantly greater than that of a single forecast. This diagnosis will provide guidance on multi-model forecast protocols, especially whether resources should be spread across multiple models or concentrated on a single good model. We will objectively decide the number of lags that can be included in a lagged ensemble subseasonal forecast. This diagnosis will provide guidance on whether initialization on 5-day intervals is frequent enough to provide useful lagged ensembles. We will determine whether multi-model forecasts with different initialization frequencies can be combined to enhance skill; e.g., determine whether a forecast initialized every 5 days can be usefully combined with a forecast initialized every day. We will test whether forecasts capture linear impacts of the MJO, and if not, provide correction algorithms. Such corrections will allow forecasters to recognize shortcomings of the forecast during certain phases of the MJO. We will apply LASSO to combine forecasts to produce a single forecast with superior skill. LASSO has the attractive property of setting weights identically to zero, and therefore provides a natural way to identify models in a multi-model ensemble that should be dropped for that target day and lead time. The resulting LASSO multi-model regression will give predictions with optimized skill, and information regarding the models assigned to zero weight will help forecasters understand the relative performance of models.

The proposed research responds directly to the MAPP-CTB program call "to improve operational systems for climate prediction" and to NOAA's long term goal in Climate Adaptation and Mitigation "to produce accurate predictions" and "inform decision making" by establishing a rigorous basis for skillful subseasonal prediction.