Title: Increasing Subseasonal-to-Seasonal (S2S) Forecast Skill through Climate Teleconnections: A Hybrid Statistical-Dynamical Prediction System
Proposal to Climate Program Office FY2016, MAPP Competition I: NOAA Climate Test Bed – Accelerating Transition of Research to Operations

Abstract:
We seek to enhance the prediction skill and probabilistic reliability of S2S forecasts derived from the output of individual ensemble prediction system (EPS) and multi-model ensemble (MME) systems available for operational seasonal and subseasonal forecasts, including the NCEP Global Ensemble Forecast System (GEFS) and Climate Forecast System (CFS), as well as the Environment Canada (EC) subseasonal EPS, and models of the North American Multi-Model Ensemble (NMME), through the use of advanced prediction methodologies developed by co-PIs to this proposal from CSIRO of Australia.

Application of an MME to S2S timescales and in particular extreme event prediction, requires evaluation and calibration of the model probabilistic distributions of surface air temperature and precipitation, utilization of knowledge of climate drivers, and optimized consolidation of multi-model systems, to assure forecasts are skillful in discriminating the potential for extreme events and reliable in conveying the uncertainty associated with the predictability of such events. To improve capacity to use MME for extremes, we will apply well-tested methodologies of model calibration and combination developed by co-PIs Wang and Schepen to seasonal and subseasonal MME forecasts.

We will use all operational subseasonal EPS and reforecasts currently available at the Climate Prediction Center: CFS, Japan Meteorological Agency and ECMWF. Using the non-operational S2S data (http://apps.ecmwf.int/datasets/data/s2s-reforecasts), we will demonstrate the robustness of methodologies for identification of changes in the potential for extremes in daily data at S2S timescales and use models of the Subseasonal NMME, including the extended GEFS and Environment Canada EPS, comprising the North American Ensemble Forecast System (NAEFS), which is to extend out to four weeks.

We hypothesize that models of the S2S and NMME simulate some of the climate phenomena and drivers of subseasonal timescale climate variability (e.g. AO, MJO, and ENSO), but may be inconsistent in representation of teleconnections between climate drivers and North American climate variability. Information on teleconnections derived from both the MME fields and reanalysis can be used to optimally combine predictions of the impacts of climate drivers on North American climate, as represented both within the GCMs and by statistical models. We further hypothesize that optimizing the calibration using methods of the co-PIs will improve the skill of the tails of the probability distribution and prediction of extreme events.

This project will apply the calibration, bridging and merging (CBaM) method (Schepen et al. 2014) to post-process available MME forecasts and produce hybrid statistical-dynamical forecasts. Bridging is used to indirectly forecast precipitation and temperature from model forecasts of climate indices (e.g. Nino 3.4). Merging (Wang et al. 2012, Schepen et al. 2015) optimally combines calibration and bridging forecasts from one or more climate models. The daily temporal resolution of S2S, NAEFS EPS models, Phase-II NMME, and subseasonal NMME will allow the application to and analysis of prediction of frequencies of high-impact events or daily extremes.
This project is relevant to NOAA’s Next Generation Strategic Plan (NGSP) (http://www.ppi.noaa.gov/ngsp/). The project addresses the NGSP core capability of understanding and modeling through evaluation of current capacity of climate models to represent the impacts of modes of climate variability such as ENSO. The need for this evaluation was also identified by the report of the NMME Review Panel. The project also addresses the NGSP core capability of prediction and projections and the NGSP call for progress in the provision of climate services including changes in extremes of weather and climate in support of the NWS Weather-Ready Nation.