Estimating the Subseasonal Forecast Skill in the NASA GEOS-5 System with a Focus on the Madden Julian Oscillation and the Land Surface Memory Feedback Processes

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Abstract

In this project, we will demonstrate the feasibility of using the NASA GMAO GEOS-5 coupled model forecasting system to conduct real-time subseasonal forecasts for inclusion in the NOAA subseasonal North American Multi-model Ensemble (NMME) project. As the main thrust of this work, we will perform 45-day reforecasts for each week of the period 1981-2015 and corresponding real-time forecasts for 1 year and deliver the forecast data to NCEP in real time as required by the subseasonal NMME protocol.

Prior to performing the forecasts, however, we will examine and potentially improve the subseasonal forecast skill of our system with a focused analysis on the Madden Julian Oscillation (MJO) and land surface memory feedback processes, two phenomena highly relevant to subseasonal prediction. The MJO, a critical link in bridging the gap between weather and climate prediction, is a large-scale spatially coherent quasi-periodic oscillation in convection and circulation that directly affects most of the tropics and indirectly modulates many weather and climate patterns in the midlatitudes. GEOS-5 already successfully forecasts an MJO when initialized with an observed signal; in this project we will adjust various aspects of its MJO simulation (particularly by adjusting the threshold minimum entrainment rate and the model time step) to improve even further, if possible, the realism of the simulated MJO. We will also provide an assessment of the MJO forecast skill as a function of the different stages in its convective initiation as well as longitudinal positioning of the convective anomaly along the equator, usually identified by the phase of the real-time multivariate MJO index. Land-atmosphere feedback in the GEOS-5 system will be addressed by examining land-atmosphere coupling strength and land surface state persistence using established techniques and then adjusting land model parameters to optimize their agreement with observations to the fullest extent possible. The land model being used for the reforecasts and real-time forecasts in this project will include a dynamic phenology component (capturing, for example, variations in the “leafiness” of the vegetation); thus our analysis will include a focus on how vegetation state influences land-atmosphere feedback.

This proposal is submitted in response to the NOAA MAPP Climate Test Bed call, “Accelerating Transition of Research into Operations”, (Competition 3a), as a potential contribution to the NOAA subseasonal NMME project.