Identifying the Relative Roles of Precursors Associated with Observed versus Modeled MJO Propagation across the Maritime Continent

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Tropical intraseasonal oscillations are key sources of sub-seasonal to seasonal predictive skill of the atmosphere, which represents a critical timescale for better preparing for potential weather-related risks. The Maritime Continent (MC) plays a critical role in sub-seasonal to seasonal predictive skill because intraseasonal tropical convection and the midlatitude jet stream interact strongly in this region, influencing subsequent weather downstream. This predictive skill is currently not fully realized because models struggle to accurately forecast and simulate tropical intraseasonal convective activity. One lingering model deficiency is that the MC tends to act as an unrealistically strong barrier for the eastward propagation of the Madden and Julian Oscillation (MJO) whereas, in reality, some developing MJO events propagate across the MC reaching the west Pacific basin.

While several phenomena have been proposed to influence MC propagation of intraseasonal oscillations, their relative significance, interplay and precise mechanisms have not been examined in detail using observations, which is an essential step for model verification purposes. The proposed research will first examine observed MC propagation characteristics of the MJO such as speed, intensity, and how it is disrupted. Then, atmospheric and oceanic precursor signals that distinguish those characteristics will be investigated using multiple metrics to test the robustness of the results. The proposed research will also examine processes that control the occurrence of these precursor signals associated with MJO propagation and the mechanisms by which such precursors affect it, using global historical observational and reanalysis datasets along with in-situ observations from the Year of Maritime Continent (YMC) field campaign. The observational and reanalysis results will then be compared with the sub-seasonal to seasonal (S2S) project reforecast dataset to examine the fidelity of precursors signals associated with MJO propagation in the forecast models. Using the perturbed ensemble reforecast data, the final component of this research will investigate sources of forecast error and spread associated with MJO propagation.

Along with the objectives of the Climate Variability Program competition, "*Observing and Understanding Processes Affecting the Propagation of Intraseasonal Oscillations in the Maritime Continent Region*", the proposed project aims to identify the propagation characteristics of intraseasonal tropical convection across the MC and examine the processes controlling them using observational, reanalysis, and reforecast data. Tropical intraseasonal variability is known to influence frequency and location of extreme weather events. Therefore, improved understanding of intraseasonal tropical convection will ultimately help advance long-range forecast skill of extreme weather and climate projection skill of the frequency of extreme weather, which are important for achieving NOAA's long-term goals of informing society to anticipate and respond to climate and weather impacts.