Convective multi-scale interactions over the Maritime Continent during the propagation of the MJO

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Models have difficulty in simulating and predicting the evolution of the MJO as it crosses over the Maritime Continent (MC) because of the intricate convective-environmental interactions over the complex geography of the region. Land and ocean differences in the region lead to a strong diurnal cycle in rainfall over land that varies in character during the propagation of the Madden-Julian Oscillation (MJO). The motivating hypothesis of this work is that the diurnal cycle over land disrupts the convective evolution in the MJO envelope and that the MJO has to overcome this strong diurnal signal to make it through the MC unscathed.

The Indonesia Meteorological, Climatological and Geophysical Agency (BMKG) operational radar network consists of more than 30 single-polarization, Doppler C-band radars spread across the Indonesian islands. We will work with BMKG to collect and analyze high-resolution reflectivity and radial velocity observations from this network from mid 2018 to mid 2019 to study storm structure variations across the MC during different phases of the MJO. In particular, we will determine whether there are variations in diurnal cycle rain intensity and organization before, during, and after the passage of the MJO convective envelope and how the MJO convective envelope responds to strong versus weak diurnal cycles over land. While these relationships have been studied with radars at individual sites, the tremendous extent of the BMKG radar network allows a much more comprehensive analysis of diurnal-intraseasonal interactions. In addition, results from satellite studies of these relationships are highly dependent on the limited sampling (e.g., once per day swaths) and/or proxy nature (e.g., outgoing longwave radiation) of measurements made from space.

Rain mosaics from the radar network will further be used to assess large-scale model output, such as rain statistics throughout the diurnal cycle and over complex topography, both of which vex coarser resolution models. The radar data can also be assimilated into high-resolution regional models for enhanced analysis of the atmosphere over the MC. This work will include science and technology exchange and capacity building with BMKG through interactions with their Division for Remote Sensing Imagery Management.

This work is highly relevant to the objective of the Competition *"Climate Variability and Predictability Program (CVP) – Observing and Understanding Processes Affecting the Propagation of Intraseasonal Oscillations in the Maritime Continent Region"* by providing detailed observations of the evolution of convection across the Indonesian islands, which will help understand the scale interactions at play as the MJO traverses the complex geography of the MC and the associated land-ocean variability in storm structure and circulations, including very complicated diurnal cycles. It will also provide upstream convective conditions over much of the MC during PISTON. This work supports NOAA's long-term climate goals by providing information on how detailed "scale-aware" parameterizations need to be to accurately model and predict the MJO propagation over the MC. Improvements in MJO model predictions and their subsequent impact on US circulation patterns can lead to improved prediction of US precipitation at sub-seasonal to seasonal (S2S) timescales.