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Intraseasonal Variability of the Philippines Diurnal Cycle

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The diurnal cycle in tropical islands is critical for water supplies and agriculture, and potentially has important feedbacks onto longer timescale tropical disturbances. However, the conditions that regulate the diurnal cycle of rainfall on such islands remain poorly understood. Here, we use observations and a cloud resolving model to understand intraseasonal variability of the diurnal cycle in and near Luzon during boreal summer.

The boreal summer intraseasonal oscillation (BSISO) and quasi biweekly oscillation (QBWO) modulate the Luzon diurnal cycle in a similar manner during their lifecycles. In particular, the diurnal cycle of rainfall and offshore propagation of rainfall into the South China Sea are maximized during phases of the BSISO and QBWO characterized by increasing tropospheric moisture, sufficient insolation, and weak offshore easterly flow. These conditions occur in advance of the large-scale convective envelope of the BSISO and QBWO. Such a phase relationship suggests that enhanced diurnal rainfall may aid northward propagation of intraseasonal disturbances in the South China Sea.

The Cloud Model 1 (CM1) integrated at 1 km horizontal grid spacing is used to isolate the relative importance of background wind, humidity, and insolation for the diurnal cycle in and near an idealized tropical island resembling Luzon. By prescribing daily mean BSISO background wind variations through nudging, it is shown that the wind direction and speed are major regulators of offshore propagation of diurnal disturbances on the west side of the island. In particular, offshore propagation is maximized during periods of offshore easterly flow at low levels. Other experiments that test sensitivity to the vertical profile of wind are discussed. We also show that BSISO humidity and surface shortwave radiation variations are major contributors to diurnal cycle variability. These results not only have implications for the diurnal cycle in the Philippines, but also other tropical islands such as Sumatra with prominent diurnal cycles modulated by intraseasonal variability.