



Principal Component Analysis of observed and modelled diurnal rainfall in the Maritime Continent

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Principal Component Analysis (PCA) is able to diagnose the diurnal rain cycle in the Maritime Continent into two modes which explain most of the diurnal variability in the region. The first mode results from the differential variation in potential instability forced by surface heat flux, insolation, and long-wave radiative cooling on land and sea. The second mode is associated with intrinsic mesoscale dynamics of convective systems and its interactions with gravity waves, density currents and local circulations in coastal regions or mountainous terrain. The spatial phase relation between the two modes determines whether a diurnal signal is propagating or stationary. Thus, validating model simulations of diurnal rainfall using PCA provides insights on the representation of dynamics and physics. In this paper, the main modes of diurnal rain variability in the Maritime Continent from satellite observations are studied and compared to those from Weather Research and Forecasting (WRF) model simulations. Hovmoeller analyses of the reconstructed rainfall from the first two PCA modes clarify the impact of coastlines and mountains as sources of propagating signals. Wave cavities are identified in the Straits of Malacca, Malay Peninsula and North Sumatra where stationary signals are produced. WRF reproduces the first two modes but each with a phase lead of about 3 hours. The basic diurnal forcing in the model seems too strong and the model responds too strongly to small islands and small-scale topography. The phase speed of propagating signals over open sea is correctly modelled but that over land is too slow.