



On the diurnal cycle of the tropical rainfall in the CMIP5 climate models

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Tropical rainfall manifests itself in different spatio-temporal scales. The interactions among these scales makes the simulation of tropical rainfall challenging and interesting. In this study we evaluate diurnal cycle of rainfall in tropics in 16 atmospheric and coupled models from the Coupled Model Intercomparison Project 5 (CMIP5). Three-hourly rainfall data from twentieth-century climate simulations are analyzed and compared with the merged Tropical Rainfall Measuring Mission (TRMM) observations. Diurnal harmonic of rainfall from the models show huge biases in both amplitude and phase. Phase errors in most models are very evident over western coasts and inland. A clear late afternoon rainfall seen in the observations over these regions is rather noisy in the models. Models with more phase bias over the ocean regions have less phase bias over the land regions and vice versa. Bias are somewhat reduced in the coupled models but the spatial patterns remain rather similar as their atmospheric counterparts. The primary goal of the study is to relate the observed large scale diurnal monsoonal flow due to the land-sea contrasts, to the diurnal cycle of rainfall. The divergent winds from the CMIP5 models show a noisy pattern similar to the noisy diurnal cycle of rainfall over the land, this is in contrast to the clear diurnal mode of divergent wind in the ECMWF reanalysis. This is likely due to underlying over-sensitivity of the model convection parameterizations to the sea surface temperature. A key question that remains to be explored is how the understanding from this study can be used to reduce the diurnal bias in models, and further explore interactions among other spatio-temporal scales.