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Characterizing the vertical diabatic heating profile of the MJO - A Joint MJO Task Force and GEWEX GCSS Model Experimentation and Intercomparison Project

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While the Madden-Julian Oscillation (MJO) exerts pronounced influences on global climate and weather systems, current general circulation models (GCMs) exhibit limited capability in representing this prominent tropical variability mode. Meanwhile, the fundamental physics of the MJO are still elusive. Since diabatic heating lies at the heart of prevailing MJO theories, a composite analysis of vertical anomalous heating structures associated with the MJO is conducted by utilizing recently released reanalysis datasets and diabatic heating estimates based on Tropical Rainfall Measuring Mission (TRMM). However, some discrepancies in the composite vertical MJO heating profiles are noted among these datasets, particularly, between three reanalyses and three TRMM estimates. A transition from a shallow to deep heating structure during the MJO evolution is clearly evident in a pressure-time plot over both the eastern equatorial Indian Ocean and western Pacific in three reanalysis datasets. While this vertical heating structure transition is detectable over the western Pacific in two TRMM products, it is weakly defined in the other TRMM dataset over the western Pacific and in all three TRMM datasets over the eastern Indian Ocean. We will further introduce an undergoing model inter-comparison project on vertical MJO diabatic heating profiles jointly proposed by MJO Task Force and GEWEX GCSS. The evolution of the heating structures along with cloud features during the MJO evolution will be examined based on these multi-model simulations in three experimental components, i.e., (i) climatological simulation; ii) long-term hindcasts; iii) short-term detailed-"physics" hindcasts. The purposes of this model inter-comparison project are multi-fold, namely, to determine how different the model simulated heating structures are relative to the spread of observational (reanalysis and TRMM) values, to substantiate important roles of various heating components for the MJO, and to elucidate key model deficiencies in depicting the MJO heating structures.