Multiscale Organization of Equatorial Waves

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This talk will discuss some observational aspects of the organization of equatorial rainfall systems. It is well-known that convective disturbances in the tropics occur over a very broad spectrum of scales, ranging from individual cumulus cells to planetary scale features such as the Madden-Julian Oscillation (MJO). It is also observed that the larger scale features are composed of smaller scale equatorial waves, so that for example the "envelope" of the MJO is often comprised of eastward propagating Kelvin, and westward inertio-gravity waves. The envelopes of these smaller waves are in turn are comprised of a broad spectrum of mesoscale features, which are predominantly westward propagating. While it is certainly evident that the larger envelopes must be creating a favorable environment for the higher frequency activity within them, the precise mechanisms for this modulation are still a subject of debate, as is the inverse role of the mesoscale disturbances in the upscale transfer of energy.

For example, a census of a large number of individual MJOs shows that they are comprised of a wide variety of smaller scale disturbance types from case to case, suggesting that parameterization of their upscale impacts of might be feasible. A potential aid to the understanding of scale interactions within the tropical atmosphere, and their simulation in models, is the fact that there is a certain degree of "self similarity" in observed gross features of the dynamical structures of organized tropical convection. In general these disturbances display a warm moist lower troposphere ahead of the wave, with cooling and drying behind, and a warm moist mid-troposphere within the convective region. These dynamical signals are consistent with the observation that the waves show a progression from a dominance of shallow to congestus, then deep convection, and finally stratiform precipitation, regardless of their size or propagation direction.