Theory-Based MJO Diagnostics

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Abstract

Recent theoretical and modeling work suggest that two properties of atmospheric convection, the dependence of precipitation rate on saturation fraction or column relative humidity, and the gross moist stability (GMS) of convection are critical to the existence and strength of the Madden-Julian oscillation (MJO). The slope of the precipitation rate-saturation fraction curve sets the time scale for the response of precipitation to entropy forcing of the atmosphere by surface fluxes and radiative cooling, and the GMS determines how the convection feeds back on the atmosphere. The moisture mode hypothesis in particular stresses the importance of transient negative values of the GMS in the formation and intensification of the MJO. How the atmosphere determines the GMS of moist convection is thus critical to understanding the MJO and related phenomena in this picture. Cloud-resolving models and observation suggest that both saturation fraction and the vertical distribution of parcel buoyancy are important in determining the elevation of maximum vertical mass flux in deep convection. This parameter in turn influences the GMS, with lower-level mass flux maxima producing more negative values. This talk will review current results in this area and suggest corresponding diagnostics for both models and observations.