IMAGe Seminar

Institute for Mathematics Applied to Geosciences at NCAR

Multicloud models for convectively coupled tropical waves: MJO-like envelopes and congestus preconditioning mode

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Abstract:

Multicloud model convective parametrizations based on three cloud types (congestus, deep, and stratiform), introduced recently by the authors, where congestus heating and the induced low level moisture convergence play the major role of low level moistening and preconditioning prior to deep convection, have revealed to be very useful in representing key features of organized convection and convectively coupled waves. Here a new systematic version of the multicloud models is developed with separate upper and lower troposphere basis functions for the congestus and stratiform clouds. This formulation allows for asymmetry across the troposphere and has the consequence that a fraction of congestus and stratiform precipitation actually reach the surface. It also leads naturally to a new convective closure for the multicloud models enhancing the congestus heating in order to better pinpoint the congestus preconditioning and moistening mechanisms. The models are studied here for flows above the equator without rotation effects. Firstly, the new model results consist of the usual synoptic scale convectively coupled moist gravity wave packets moving at 15-20 m/s but in addition these packets have planetary scale envelopes moving in the opposite direction at about 6 m/s and have many of the self-similar features of convectively coupled waves, reminiscent of the Madden-Julian oscillation. Secondly, when a warmpool forcing is imposed, dry regions of roughly 250 km in extent form 'convective barriers" surrounding the warmpool region where only congestus heating survives. Deep convection and moist gravity waves propagating within the warmpool region are suppressed when they hit the convective barrier and become dry propagating first and second baroclinic gravity waves. Finally, linear analysis reveals that, for sufficiently dry mean states, in addition to the inherent synoptic scale moist gravity waves, the new model supports a planetary (wavenumber 1) standing congestus mode which in a non-linear simulation preconditions and moistens the environment within its congestus-active region where moist gravity waves evolve and propagate. This results in a Walker-like circulation over a uniform SST background.

Joint work with Andrew J. Majda

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1:30pm (Refreshments served at 1:15pm**)**

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