

# Large scale convective organization in a simple multi-cloud model

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## Abstract

Despite the recent advances in super-computing, the current general circulation models (GCM) represent poorly the large scale variability associated with tropical convection. Multicloud model convective parametrizations with a crude vertical resolution reduced to the first two baroclinic modes and based on three cloud types (congestus, deep, and stratiform), introduced recently by K. and Majda (JAS, 2006), have revealed to be very useful in representing key features of organized convection and convectively coupled waves. The key instability mechanism is tied to a moisture switch function such that whenever CAPE is positive and the lower atmosphere is dry, deep convection is inhibited and congestus heating is favored. Congestus heating in turn induces low level moisture convergence through the second baroclinic mode which moistens and preconditioning the lower troposphere to sustain (deep) convection beyond the freezing level. Linear stability analysis reveals convectively coupled equatorial (Kelvin,  $n = 0$  inertio-gravity,  $n = 1$  westward inertio-gravity-2 day) waves which are unstable in wavenumber bands around the synoptic scale, as identified by Wheeler and Kiladis (1999). They also move at the right speed, i.e comparable to the observations of Wheeler and Kiladis. Moreover nonlinear simulations performed in the case without rotation exhibit moist gravity wave packets moving at about 17 m/s with planetary scale envelopes moving often in the opposite direction at about 6 m/s and having many of the self-similar features—including their vertical structure of convectively coupled waves, reminiscent of the Madden-Julian oscillation. It is also demonstrated that the congestus heating plays a crucial role in the non-linear dynamics of the moist gravity waves via a non-trivial planetary-scale standing congestus mode.

Joint work with Andrew J. Majda.