

Diagnosing MJO and convection behaviour in MMF and CAM simulation

Hongyan Zhu
Harry Hendon
Christian Jacob

BMRC, Bureau of Meteorology, Australia

MJO and convection behaviour are analysed in two versions of the Community Atmospheric Model (CAM), the standard model with Zhang and McFarlane (1995) convection parameterization scheme, CAM, and a "multiscale modelling framework", in which the cumulus parameterization has been replaced with a cloud-resolving model, MMF. Wavenumber-frequency spectrum analysis show that there is strong MJO power with a pronounced spectral peaks in both precipitation and U850 fields in the MMF, but MJO is completely absent in CAM simulation. In this paper, we compared the different convection behaviours in MMF and CAM simulations, aiming at understanding what aspect of moist convection in GCM are important to improve model MJO simulation.

We concluded that the following different features associated with convection in the two models contributes to the differences in MJO simulation:

- 1) In MMF, an exponential relationship is exhibited between precipitation and column integrated relative humidity, with more rainy events for high perceptible water in the atmospheric column, consistent with a slow "recharge" process. In CAM, the model tends to rain for low column relative humidity indicating that the model can't sustain high column humidity, and instead tends to rain prematurely, which is part of the limitation with CAPE closure.
- 2) There is relatively dry region in the low troposphere associated with deep convection with CAM simulation, while in MMF humidity increases substantially over an increasingly deep layer prior to the onset of rainfall. CAM simulation shows less adaptive to the low tropospheric moisture, which partially causes the more persistent precipitation.
- 3) In MMF, heavy precipitation is associated with top heavy (stratiform) heating profile, which should project onto slower modes, while in CAM simulation, convective-dominated heating profile should project onto fast modes. Unsaturated downdraft and mesoscale downdraft are the missing physics in CAM, which are responsible for the top heavy heating profile.
- 4) In MMF, the latent heat flux is in phase with deep convection and promotes sustained convection; while in CAM, the latent heat flux reduces sharply when deep convection starts, and acts to throttle deep convection.