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The effects of explicit versus parameterized convection on the MJO in a large-domain high-resolution tropical case study: moist processes leading to differences in MJO development

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High-resolution simulations over a large tropical domain (∼20[U+25E6]S–20[U+25E6]N and 42[U+25E6]E–180[U+25E6]E) using both explicit and parameterized convection are analyzed during a 10-day case study of an active Madden-Julian Oscillation (MJO) event. Here, the moisture budgets and moist entropy budgets are analyzed. Vertical subgrid diabatic heating profiles and vertical velocity profiles are also compared; these are related to the horizontal and vertical advective components of the moist entropy budget which contribute to gross moist stability, GMS, and normalized GMS (NGMS). The 4-km model with explicit convection and good MJO performance has a vertical heating structure that increases more rapidly with height in the lower troposphere within the propagating MJO convective signal, whereas the 12 km model with parameterized convection and a poor MJO does not show this relationship. The 4-km explicit-convection model also has a more top-heavy heating profile for the troposphere as a whole near and to the west of the active MJO-related convection, unlike the 12-km parameterized-convection model. The dependence of entropy advection components on moisture convergence is fairly weak in all models, and differences between models are not always related to MJO performance, making comparisons to previous work somewhat inconclusive. However, models with relatively good MJO strength and propagation have a slightly larger increase of the vertical advective component with increasing moisture convergence, and their NGMS vertical terms have more variability in time and longitude, with total NGMS that is comparatively larger to the west and smaller to the east.