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Plain Language Summary: Global non-hydrostatic simulations using cloud/cloud-system resolving horizontal meshes of 3.5-, 7-, and 14-km produce remarkably different amount of clouds in the tropics despite identical cloud-microphysics applied. The tropical mean upward motion, bounded by global scale radiative balance, is insensitive to the model resolution. However, it is realized by smaller and stronger updrafts in higher resolution models, resulting in a shorter residence time of air parcels within the updrafts, causing more cloud particles to survive without falling out as precipitation.

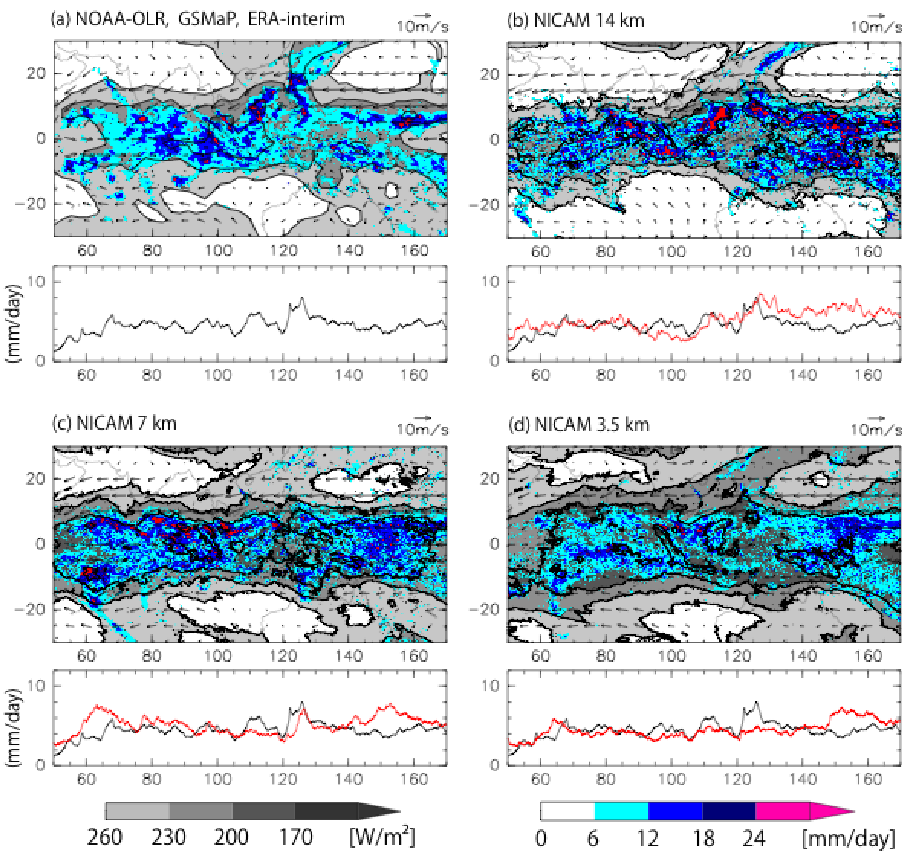

Figure 1. Horizontal maps of OLR (gray shade and contour), precipitation (color), and 850 hPa horizontal winds (vector), averaged during Nov 17 – Dec 16, 2011. (a) Observations/reanalysis, (b) NICAM 14-km, (c) NICAM 7-km, and (d) NICAM 3.5-km. The bottom panels show the meridionally averaged (20ºS–20ºN) precipitation (black: observation, red: simulation).

- Higher resolution simulations produce more high-clouds because shorter residence time of air parcels within updrafts allows more cloud-ice particles to survive without precipitating out.
- The increase of high-clouds is followed by a warming of the troposphere, which results in an increase in the column water vapor and an elevation of the freezing level.
- A Madden-Julian oscillation event was reproduced in the 3.5- and 14-km mesh simulations with as similar propagation speed, but with weaker associated circulation in the 3.5-km simulation.