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A comparison of the microphysics dependency on the reproducibility of the MJO under different resolutions using NICAM

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Simulation of the Madden-Julian Oscillation (MJO) has been notoriously difficult in atmospheric models. This is partly due to the fact that the reproducibility of the MJO is highly sensitive to parameters that are difficult to fix from observation or theory, and require empirical tuning based on model behaviors. Parameters regards to the cloud-microphysics are some of such parameters that simulations of the MJO are especially sensitive to.

To address this problem, we conducted a set of cloud-microphysics parameter-sweep experiments on a convection-permitting model, NICAM (Nonhydrostatic ICosahedral Atmospheric Model) at 14 km horizontal resolution to seek for a setting which best represents the MJO (MJO-tuned). We then compared the performance of the NICAM in reproducing the MJO using MJO-tuned setting with the standard NICAM setting employed for high resolution model intercomparison project (High Res MIP)-type experiments. The comparison was conducted for 14 km resolution, and for 3.5 km resolution experiments using DYAMOND (DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains) data, which is based on the MJO-tuned setting.

The comparison indicated that in the 14 km resolutions, the MJO-tuned setting reduces the excessive development of convection over the Maritime Continents which was apparent in the High Res MIP-setting. However, for the 3.5 km experiments convective activities of the MJO appeared to successfully reach the dateline for both the MJO-tuned setting and the High Res MIP-setting. The results of this study implies that a sufficient increase in the horizontal resolution has the potential to reduce the dependency of the microphysics setting on the reproducibility of the MJO, at least in the first few weeks of the simulations on NICAM.