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Role of Vertical Heating Structure in MJO Simulation in NCAR CAM5

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Observational studies suggest that the vertical structure of diabatic heating is important to MJO development. In particular, the lack of top-heavy heating profile was believed to be responsible for poor MJO simulations in global climate models. In this work, we investigate the role of vertical profile of convective heating in MJO simulation by modifying the heating profile to different shapes, from top-heavy heating to bottom cooling, in the NCAR CAM5. Results suggest that incorporating a mesoscale stratiform heating structure can improve the MJO simulation, with the lower-level cooling profile improving MJO simulation the most. In the lower-level cooling experiment, many observed features of MJO are reproduced, including clear eastward propagation, a westward tilt vertical structure of MJO-scale anomalies of dynamic and thermodynamic fields and strong 20-80 day spectral power. Further analysis shows an abundance of shallow convection ahead of MJO deep convection, confirming the role of shallow convection in preconditioning the atmosphere by moistening the lower troposphere ahead of deep convection during MJO life cycle. All these features are lacking in the control simulation, suggesting that lower-level cooling is more important than upper-level heating to MJO simulation. Our results suggest that the ability of simulating mesoscale convection in the convective parameterization is important to MJO simulation.