



The impact of mesoscale convective systems on global precipitation: A modeling study

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The importance of precipitating mesoscale convective systems (MCSs) has been quantified from TRMM precipitation radar and microwave imager retrievals. MCSs generate more than 50% of the rainfall in most tropical regions. Typical MCSs have horizontal scales of a few hundred kilometers (km); therefore, a large domain and high resolution are required for realistic simulations of MCSs in cloud-resolving models (CRMs). Almost all traditional global and climate models do not have adequate parameterizations to represent MCSs. Typical multi-scale modeling frameworks (MMFs) with 32 CRM grid points and 4 km grid spacing also might not have sufficient resolution and domain size for realistically simulating MCSs.

In this study, the impact of MCSs on precipitation processes is examined by conducting numerical model simulations using the Goddard Cumulus Ensemble model (GCE) and Goddard MMF (GMMF). The results indicate that both models can realistically simulate MCSs with more grid points (i.e. 128 and 256) and higher resolutions (1 or 2 km) compared to those simulations with less grid points (i.e. 32 and 64) and low resolution (4 km). The modeling results also show that the strengths of the Hadley circulations, mean zonal and regional vertical velocities, surface evaporation, and amount of surface rainfall are either weaker or reduced in the GMMF when using more CRM grid points and higher CRM resolution. In addition, the results indicate that large-scale surface evaporation and wind feed back are key processes for determining the surface rainfall amount in the GMMF. A sensitivity test with reduced sea surface temperatures (SSTs) is conducted and results in both reduced surface rainfall and evaporation.