The impact of simulated mesoscale convective systems on global precipitation and its characteristics

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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 usually have horizontal scales of a few hundred kilometers (km); therefore, a large domain with several hundred km 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 may also lack the resolution (4 km grid spacing) and domain size (128 km) to realistically simulate MCSs.

In this study, the impact of MCSs on precipitation is examined by conducting model simulations using Goddard Cumulus Ensemble (GCE) model, 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 the strengths of the Hadley circulations, mean zonal and regional vertical velocities, surface evaporation, and amount of surface rainfall are 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. Sensitivity tests with sea surface temperatures (reduced or coupled with ocan model) will be presented at meeting.

Keywords: Global Precipitation, Cloud resolving model, Multi-scale modeling framework, Mesoscale convective system

