



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

Background:

Mesoscale convective systems (MCSs) contribute more than half of total rainfall in most tropical regions. However, traditional climate models do not have adequate parameterizations to represent MCSs. It is also important to validate simulated MCSs within a Multi-scale Modeling Framework (MMF) wherein cloud parameterizations are replaced with cloud-resolving models (CRMs) in a global model.

Significance:

The impact of CRM domain size and horizontal resolution on the realistic simulation of MCSs in an MMF is investigated, and the non-linear feedback process on global precipitation are also examined. The surface precipitation is in good agreement with observations when MCSs are simulated.

Analysis:

Two-year (2007-2008) hourly precipitation rates, cloud properties, surface fluxes and other atmospheric fields from four Goddard MMF runs using different CRM domain and grid spacing were analyzed and compared with observations.

Findings:

The Goddard MMF can realistically simulate MCSs with larger CRM domains (256 or 512 km) and higher resolutions (1 or 2 km) compared to a typical MMF configuration of 128-km domain size and 4-km grid spacing. Large-scale non-linear feedback between surface evaporation and wind also play important roles in determining global rainfall amount.

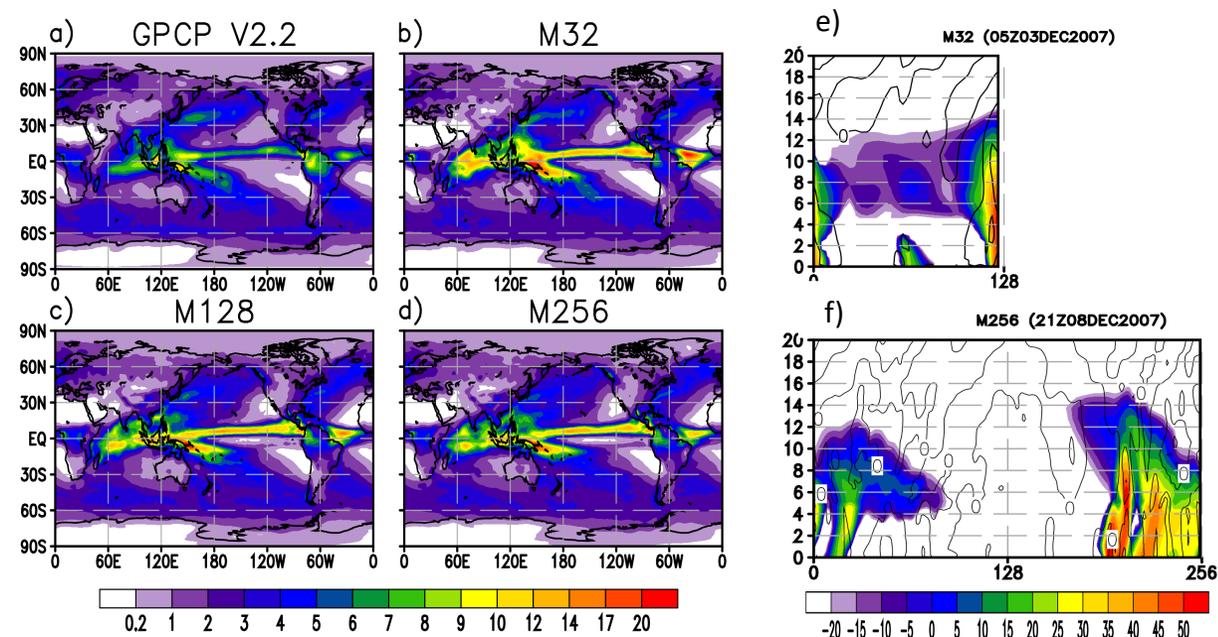


Figure. Two-year (2007-2008) annual mean precipitation rates (mm/day) from a) GPCP observations and Goddard MMF simulations for b) M32 (128-km domain size and 4-km grid spacing), c) M128 (256-km domain size and 2-km grid spacing), and d) M256 (256-km domain size and 1-km grid spacing) experiments. MMF-simulated radar reflectivity (dBZ, color shading) and vertical velocity (m/s, contours) at the maximum precipitation time for a GCM grid point near the DYNAMO field campaign site (76°E, 2°N) in December 2007 are also depicted for the e) M32 and f) M256 experiments.

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