How well can the Multiscale Modeling Framework (MMF) simulate MCS-associated precipitation over the Central United States?

*Guangxing Lin[1], Jiwen Fan[1], Zhe Feng[1]

1. Pacific Northwest National Laboratory

Mesoscale convective systems (MCSs) are a major source of precipitation in many regions of the world. Traditional global climate models (GCMs) do not have adequate parameterizations to represent MCSs. In contrast, the Multiscale Modeling Framework (MMF), which explicitly resolves convection within the cloud resolving model (CRM) embedded in each GCM column, has been shown to be a promising tool for simulating MCSs, particularly over the Tropics. In this work, we use ground-based radar-observed precipitation, North American Regional Reanalysis (NARR) data, and a high-resolution Weather Research and Forecasting (WRF) simulation to evaluate in detail the MCS-associated precipitation over the central United States predicted by a prototype MMF simulation that has a 2° host-GCM-grid. We show that the prototype MMF with nudged winds fails to capture the convective initiation in three out of four major MCS events during May 2011, and under-predicts the precipitation rates for the remaining event, because the model cannot resolve the mesoscale drylines/fronts that are important drivers for initiating convection over the Southern Great Plains (SGP) region. By reducing the host-GCM-grid spacing to 0.25° in the MMF and nudging the winds, the simulation is able to better capture the mesoscale dynamics, which drastically improves the model performance. We also show that the MMF model performs better than the traditional GCM in capturing the precipitation intensity. Our results suggest that increasing resolution plays a dominant role in improving the simulation of precipitation in the MMF, and the CRM embedded in each GCM column further helps to boost precipitation rate.

Keywords: Precipitation, Mesoscale convective system, Multiscale Modeling Framework (MMF)

©2020. Japan Geoscience Union. All Right Reserved.