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Modeling of Mesoscale-Convective Systems Downstream of Mountain Regions

Andreas F. Prein
National Center for Atmospheric Research, Boulder, United States of America (prein@ucar.edu)

Mesoscale-Convective Systems (MCSs) are prolific rain-producers and are responsible for most flash flood events in mid-latitudes. Global hotspots of MCS occurrence are downstream of major mountain regions such as the Rocky Mountains, the Andes, and the Himalayas. This is because of the effects of mountain barriers on circulation patterns, moisture transport, and convective initiation. Realistically simulating MCSs in climate models is essential for representing the water and energy cycle and flood and severe convective weather assessments. However, state-of-the-art climate models have substantial biases in simulating MCSs and orographic impacts on downstream environments resulting in large uncertainties and errors in assessing climate change impacts on water availability and extreme events. Here we present that kilometer-scale models, which have an improved representation of orography and can represent deep convective processes explicitly, show a step improvement in simulating organized convective storms compared to coarser-resolution models. We will show examples of these improvements from kilometer-scale simulations over the Tibetan Plateau, North- and South America. We will also show sensitivities to the model setup and feedback processes and end with discussing remaining challenges and future prospects.