Evaluation of precipitation characteristics in global convection permitting models

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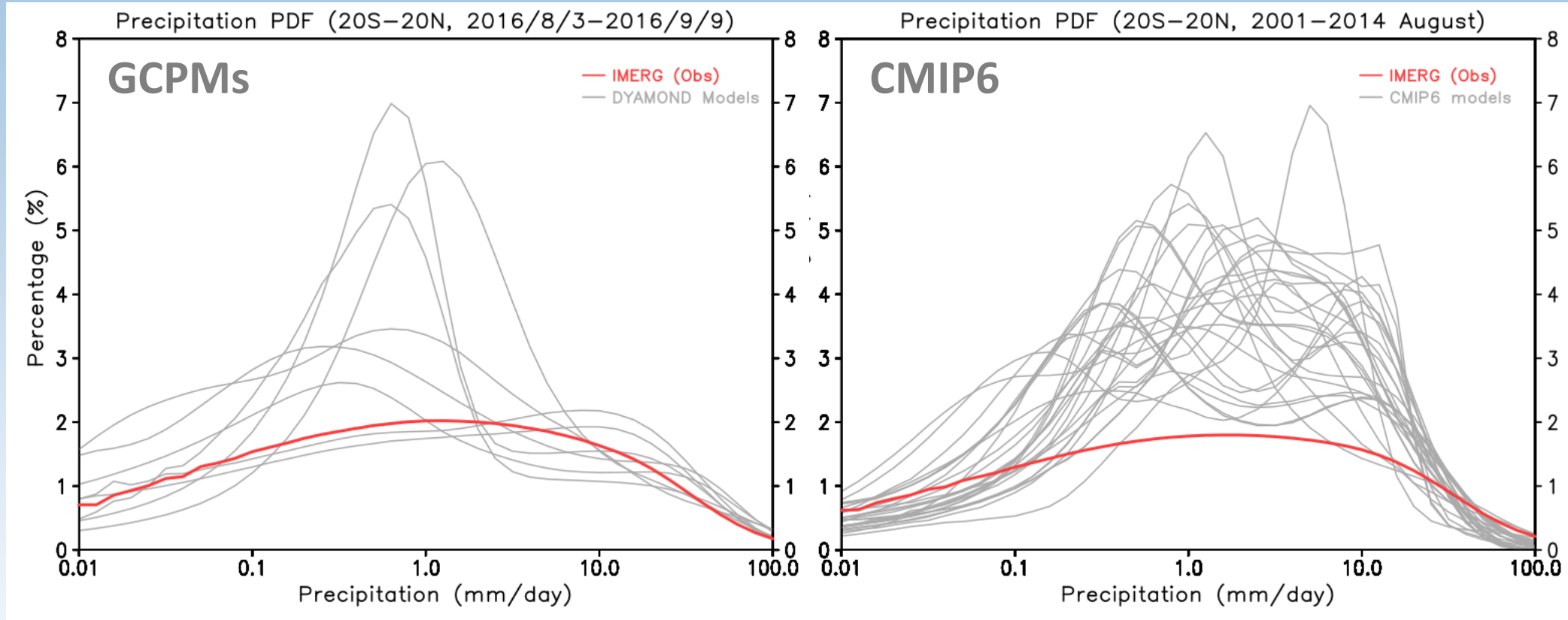
Motivation: Contemporary global climate models suffer from many systematic errors in precipitation simulations. This is usually due to the deficiency in parameterizations (e.g., convection) and coarse model resolutions.

Question: How well are the global convection permitting models (GCPMs, 2-5km horizontal resolutions) in simulating precipitation?

- We examine precipitation simulations from the DYAMOND* project and CMIP6/AMIP

* The DYAMOND (DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains) project is the first intercomparison project of GCPM simulations (A single 40 day simulation started from 1 August 2016).

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Daily Precipitation PDF over the tropics

Precipitation PDF (20S–20N, 2016/8/3–2016/9/9) — GCPMs; Precipitation PDF (20S–20N, 2001–2014 August) — CMIP6

- GCPMs generally simulate better PDF for deep convection (>4 mm/day) than CMIP6 models, especially for intense precipitation.

- Bias in the light precipitation in the PDF.

Propagation of convection over the central U.S.

- Some of the GCPMs can simulate the nocturnal propagating convection, which usually initiates over the lee of the Rockies, and propagates into the Great Plains.
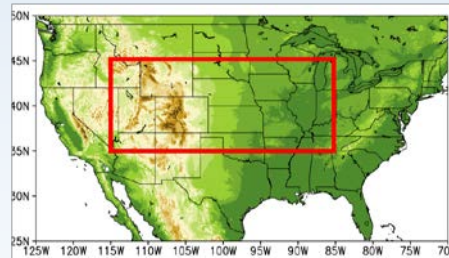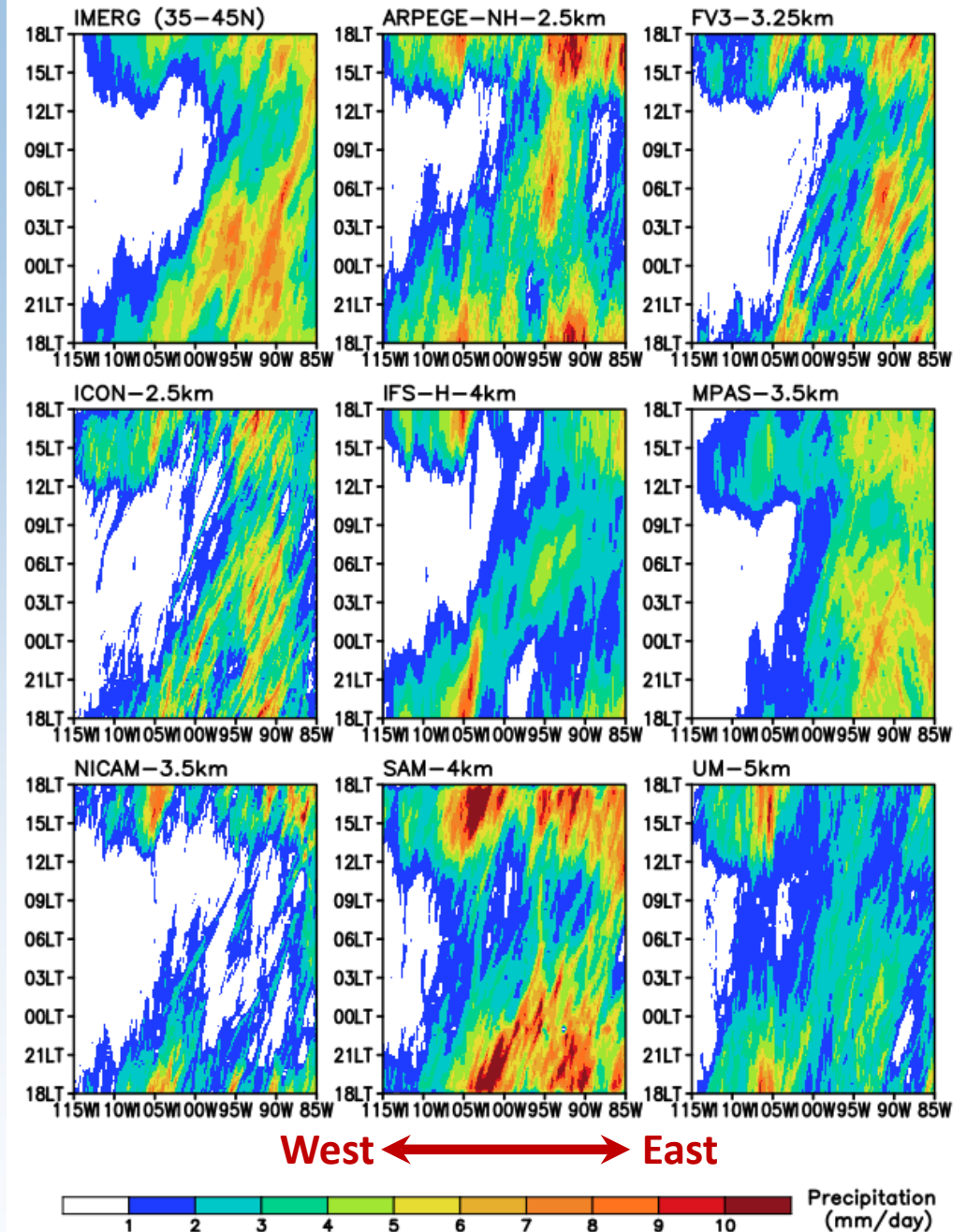
Research Opportunities

- Compared to low-resolution GCMs, GCPMs can simulate better precipitation PDF, especially for intense and extreme precipitation. GCPMs can also simulate better phase of diurnal cycles (not shown) and propagating convective systems (in some models). However, some biases remain in these GCPMs.

- There are still many aspects that GCPMs have superior performance than low-resolution GCMs. We can better study GCPM simulations (including the DOE's SCREAM) to better understand the key processes relevant to convection and precipitation biases and provide guidance for model development for both GCMs and GCPMs.

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