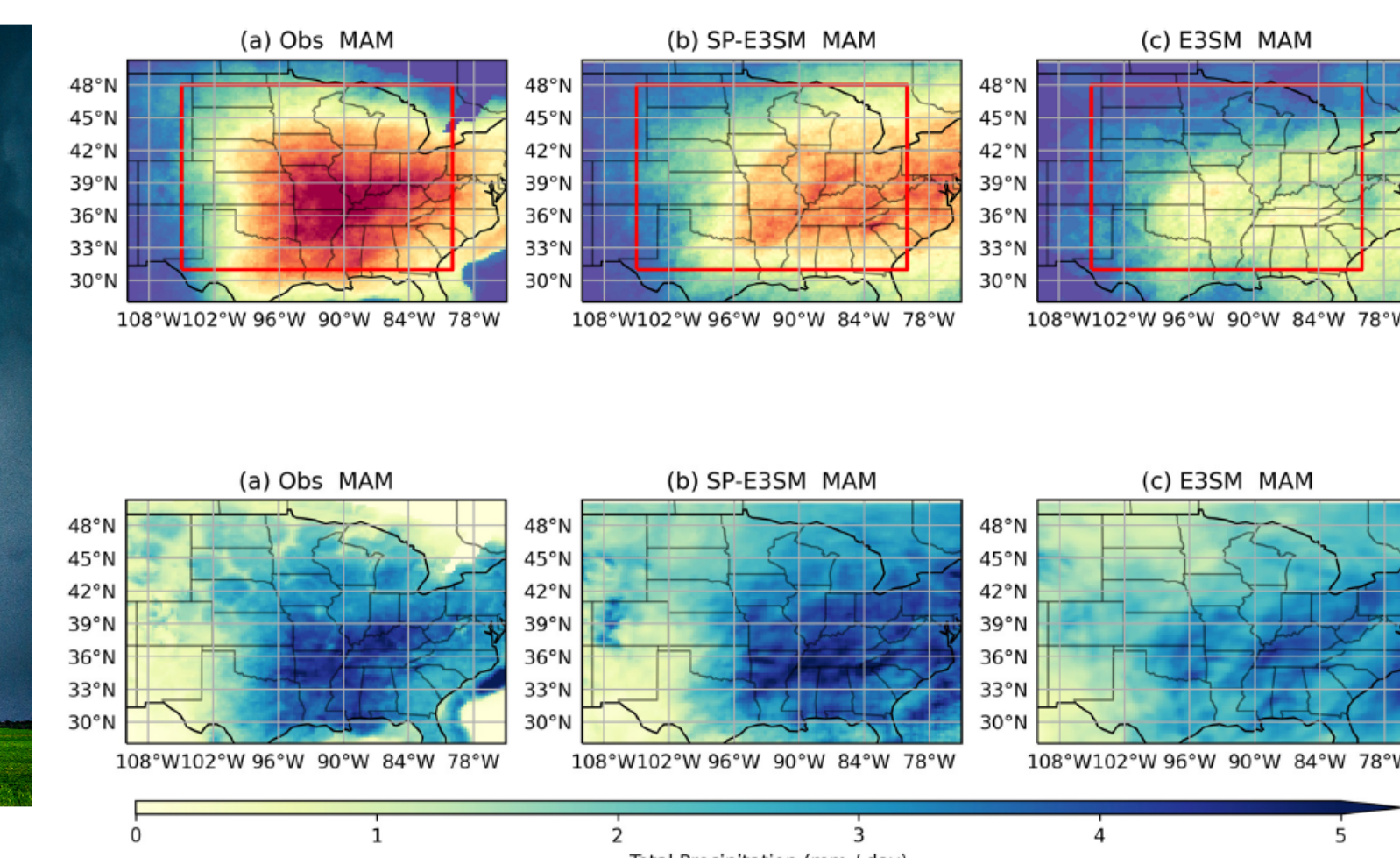


# Exascale Challenge Problem

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- Develop an Earth system model with a fully weather resolving atmosphere and cloud-resolving super-parameterization, an eddy resolving ocean and ice components, all while obtaining the necessary throughput to run 10-100 member ensembles of 100-year simulations.
- Definitions:
  - Cloud-resolving: 1km grid spacing in both horizontal and vertical directions.
  - Weather resolving: 50-25km horizontal resolution, ~1km vertical (the resolution of today's global operational forecast models).
  - Eddy resolving ocean/ice: minimum 18 km resolution in equatorial regions, decreasing to 6 km in polar regions to capture the reduction in eddy size with decreasing Rossby radius of deformation, with  $O(100)$  levels in the vertical.
  - Necessary throughput: 5 simulated-years-per-day.

## GPU Acceleration of Ice and Ocean



**Figure 1: I/O read throughput of ADIOS**

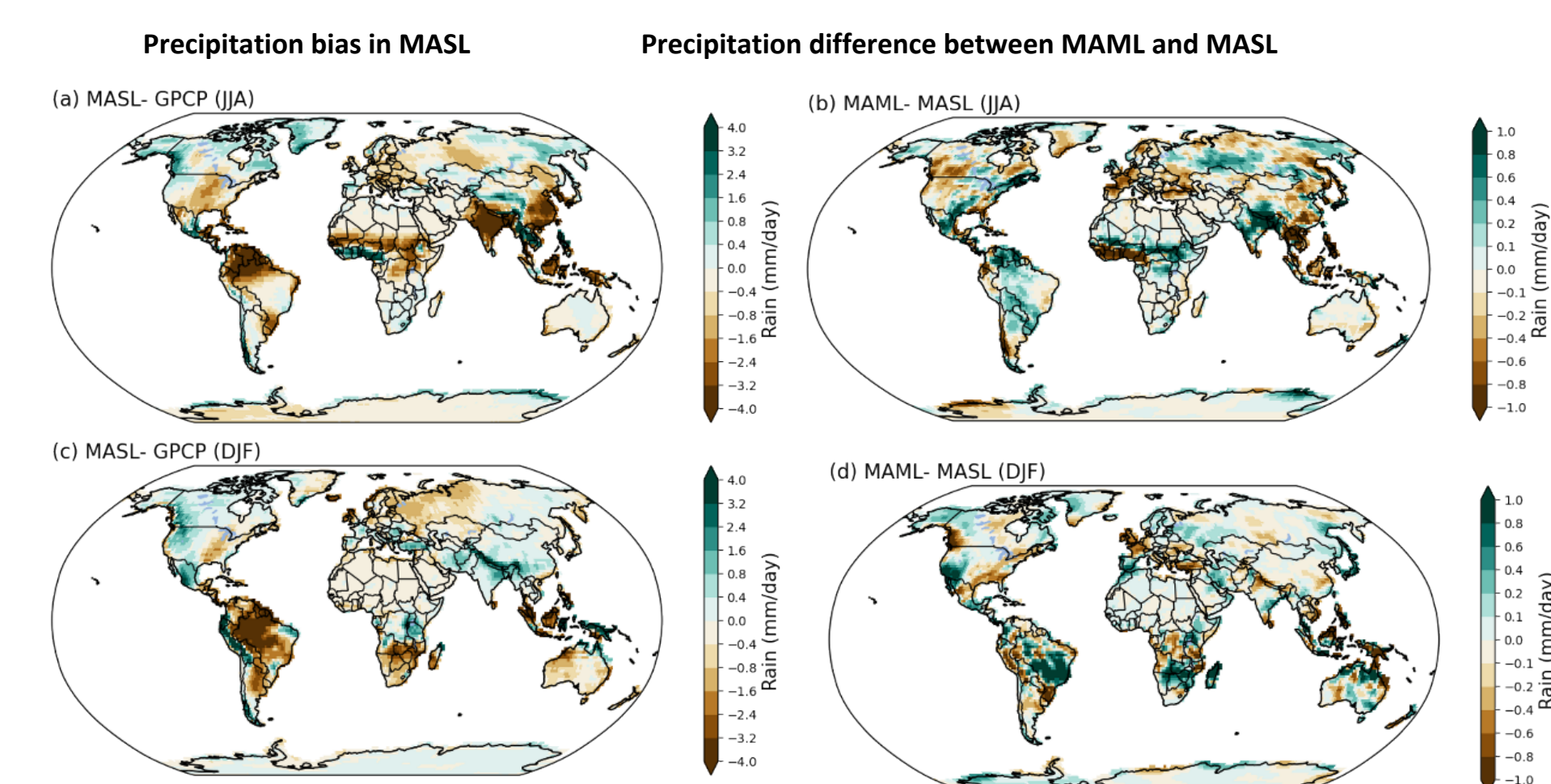
**Top Chart: I/O read throughput of ADIOS (Chrysalis, LGF)**

Case	ADIOS (MB/s)
ref F case	~8
n30 F case	~130

**Bottom Chart: I/O read throughput of small EISM cases using ADIOS (Chrysalis, LGF)**

Case	ADIOS (MB/s)
F case	~18
G case	~32
L case	~48

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- Multiple Atmosphere Single Land (MASL) → Multiple Atmosphere Multiple Land (MAML)



- PRECIP improvements: 2D vs 3D CRM, with and without momentum transfer.

