Pacific Northwest
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# Observational needs for the diversity of organized convection in global convection-permitting models

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2022 ASR PI Meeting Breakout –
Bridging ARM Data with Kilometer Grid Scale Models

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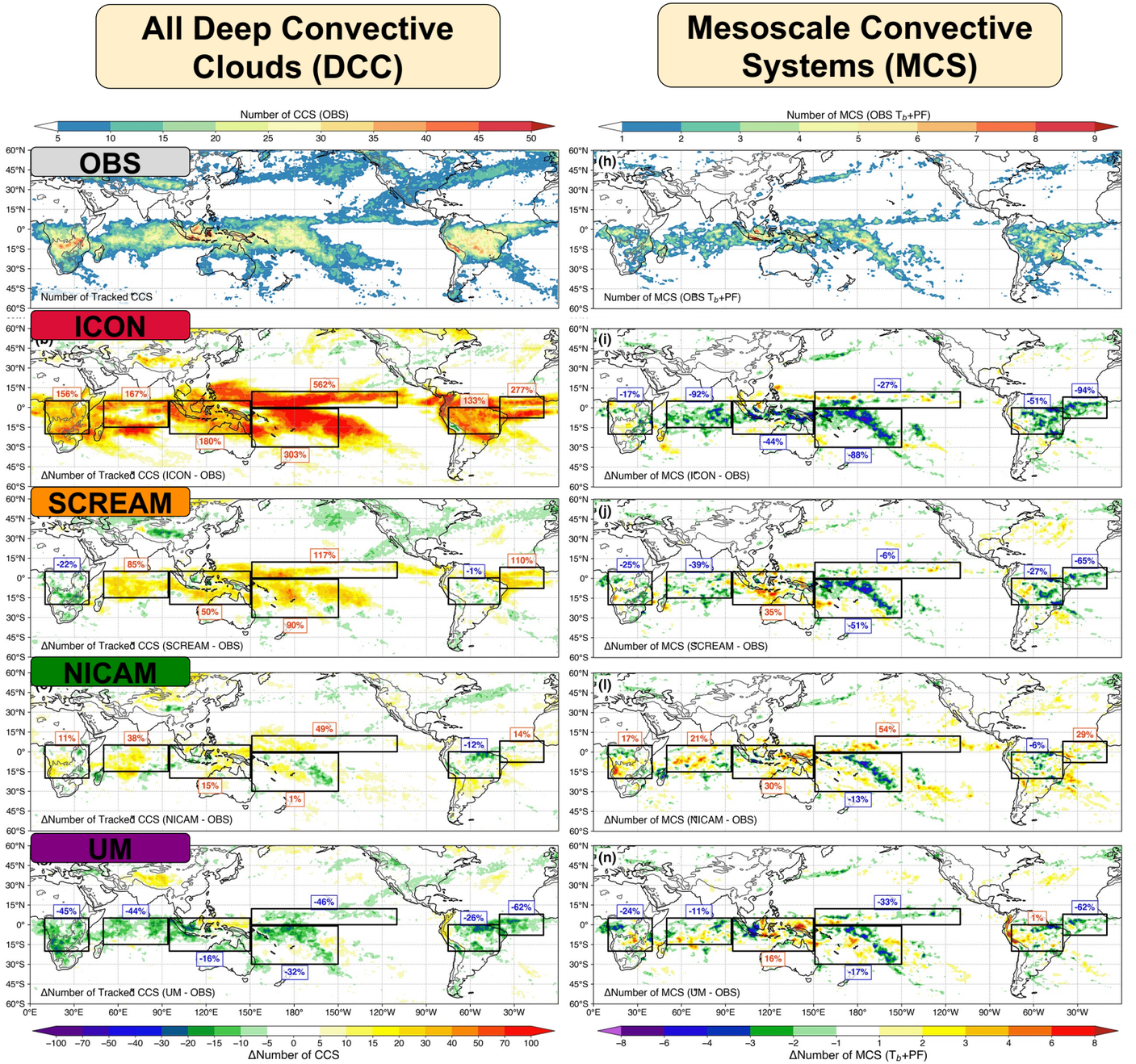
# Motivation

## Science questions:

1. Are deep convection populations and their associated precipitation realistic in GCPMs?
2. How well are mesoscale convective systems (MCSs) represented?

## Key findings:

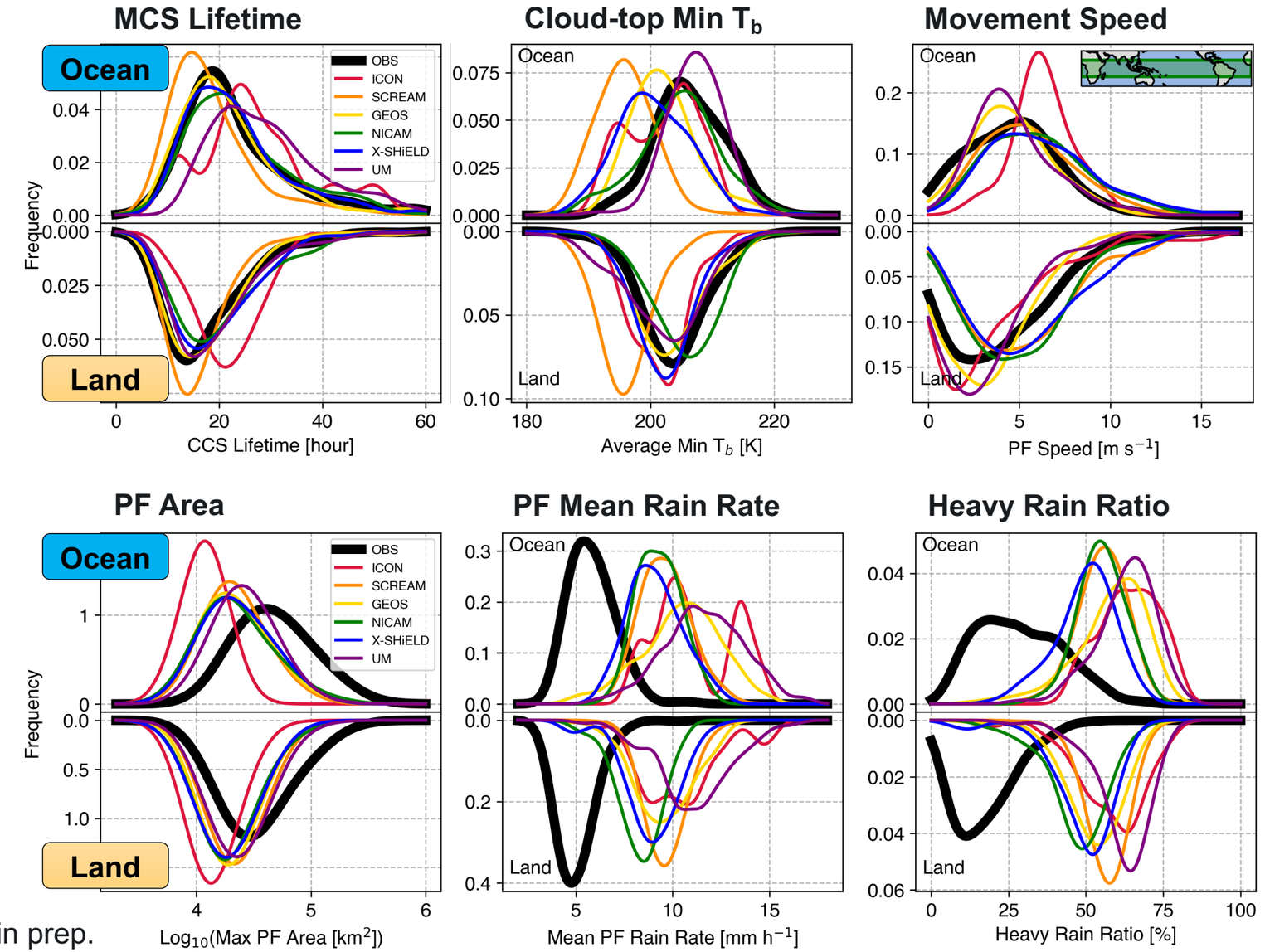
- Diverse range in simulating tropical DCC and MCS
- **Most models** overestimate DCC/MCS in Maritime Continents (MC), but underestimate tropical MCSs over continents, Indian/Atlantic Oceans, SPCZ
- **All models** overestimate MCS precipitation in MC, but most underestimate those in other tropical regions




Feng et al. (2022), in prep.

# Model MCS Properties and Interpretations

- **Most models** capture MCS lifetime, cloud-shield area and total volume rain quite well
- Widespread max cloud-top height (min $T_b$) but **generally deeper than obs.**, indicate updraft intensity may be too strong over ocean
- MCS movement speeds are generally faster over ocean, may be associated with stronger cold pools
- **All models** underestimate PF area (stratiform bias is common), overestimate rain intensity, heavy rain ratio (too much convective rain)

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# Observational Needs

- **Environments and upscale growth:**
  - What environments favor convection to aggregate and grow upscale? Why do some CPMs prefer unorganized convection while others produce more MCSs?
  - **Needed ARM observations:**
    - ✓ **Organized convective feature database** from collocated and **QCed** scanning radars, satellites that provide Lagrangian cloud/precipitation structure over ARM sites (we just released **PyFLEXTRKR** to help with this)
    - ✓ **Matched environmental conditions** from sounding, reanalysis that describes rapid temporal changes of local/large-scale meteorological conditions prior to initiation of convective features (see Varble's talk)
- **Properties of convection and impacts to environments:**
  - How do various environmental factors (e.g., moisture, instability, shear) and interactions among clouds influence convective updraft evolution that in turn modulates stratiform cloud and precipitation development?
  - **Needed ARM observations:**
    - ✓ **Temporally resolved updraft quantities/proxies** and associated stratiform area, rainfall amount
    - ✓ **Collocated environmental changes** from sounding, surface MET impacted by convection (need time/location context from tracked convective features)
- **A much-needed paradigm shift in model development and process studies:**
  - Co-design of model experiments between developers, process folks, and retrieval experts
  - Regional refinement, multi-resolution approach (e.g., LASSO-CACTI, check out the breakout session)