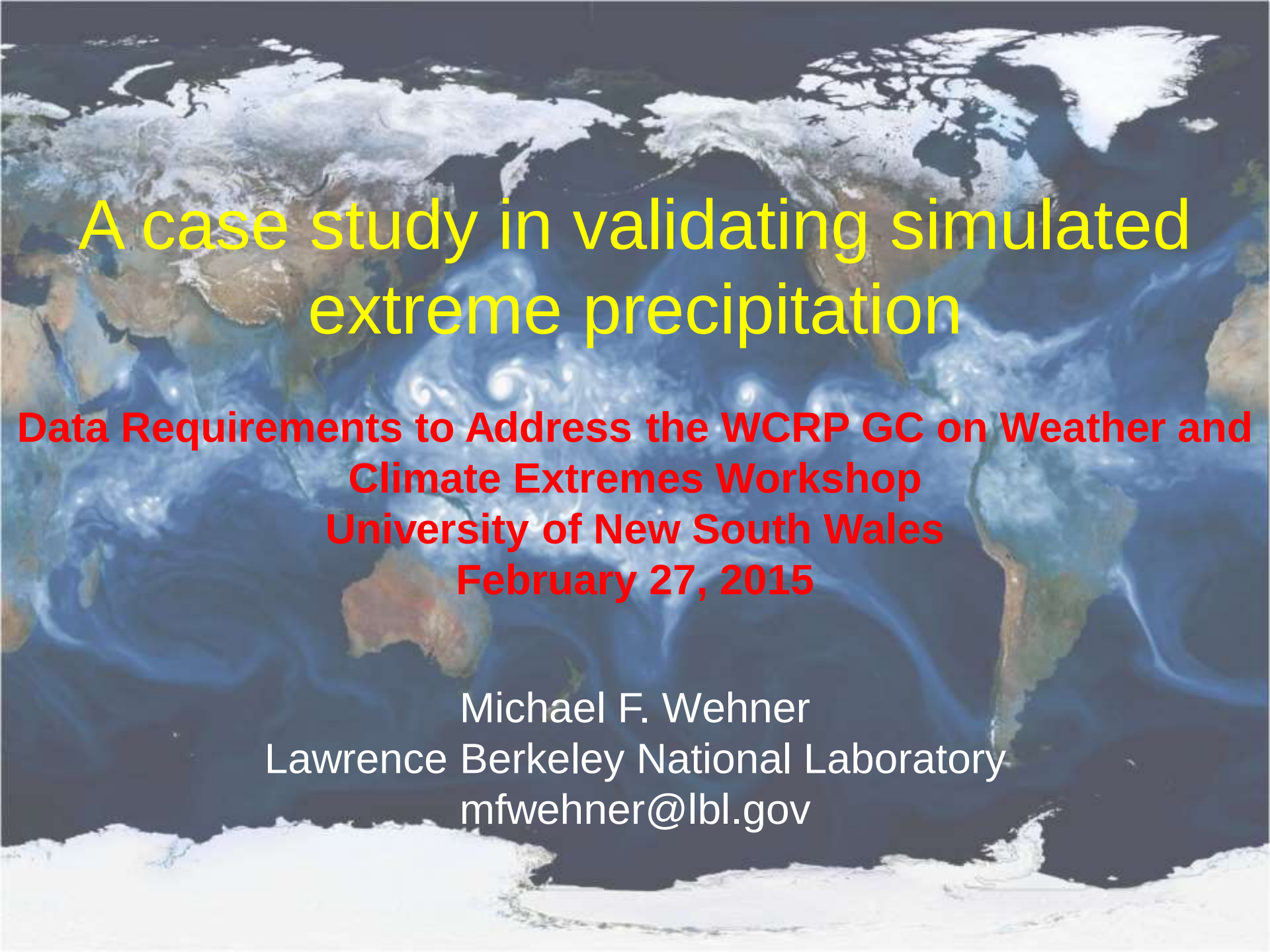

A case study in validating simulated extreme precipitation

Data Requirements to Address the WCRP GC on Weather and Climate Extremes Workshop
University of New South Wales
February 27, 2015

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CAM5 hi-resolution simulations (0.25°, prescribed aerosols)

Michael Wehner, Prabhat, Chris Algieri, Fuyu Li, Bill Collins
Lawrence Berkeley National Laboratory

Kevin Reed, University of Michigan

Andrew Gettelman, Julio Bacmeister, Richard Neale
National Center for Atmospheric Research

June 1, 2011

Data: http://esg01.nersc.gov/esgf-web-fe/ search for c20c
Video: https://www.youtube.com/watch?v=cNyftYdjt-Q

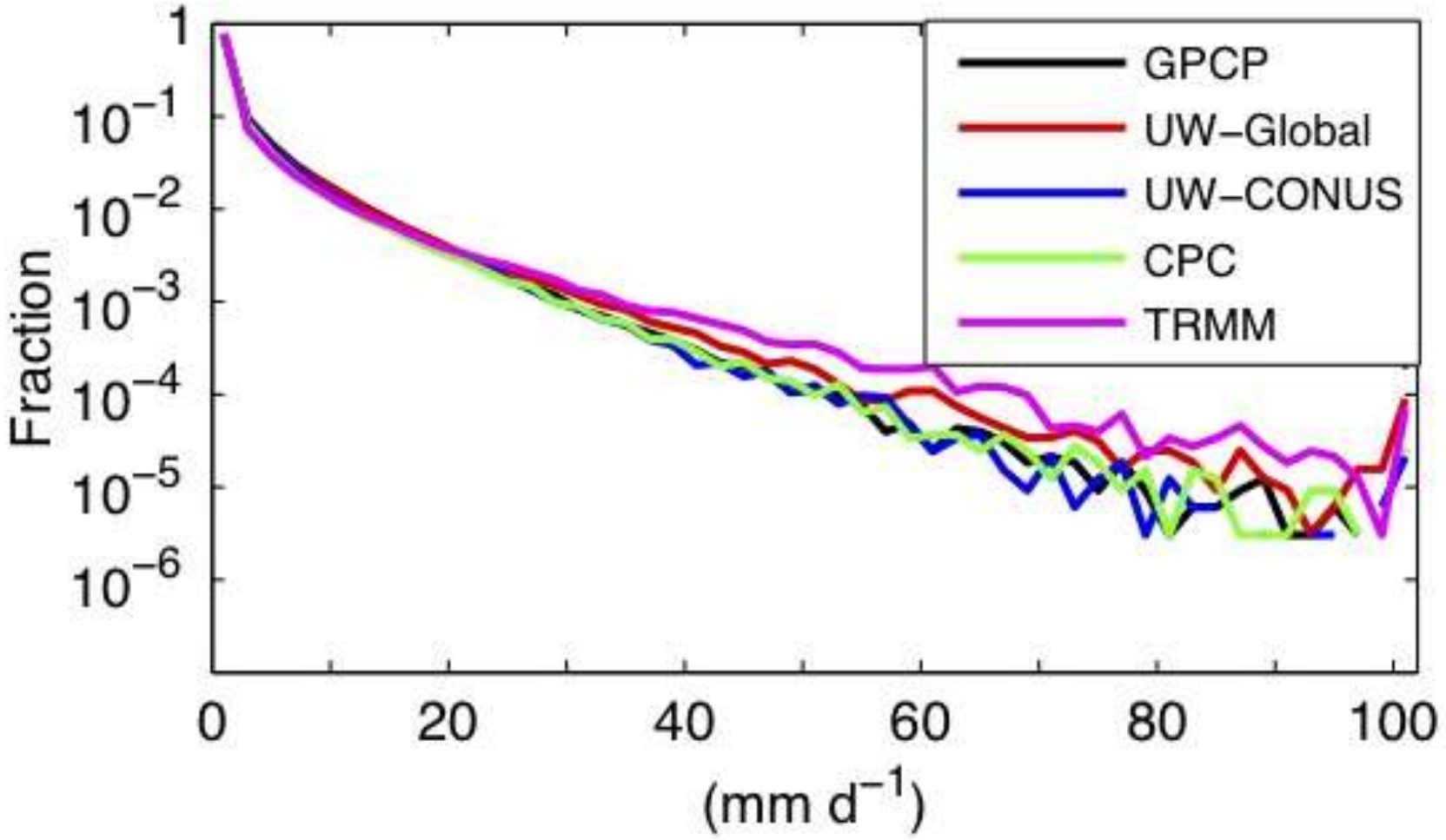
Extreme daily precipitation

- Gridded Observed daily precipitation
  - At least 8 different daily data sets:
    - GPCP: Global ocean and land 1º
    - UW Global: Land only. 0.5º
    - TRMM: 50S-50N 0.25º
    - CPC: CONUS: 0.25º
    - UW CONUS: 0.125º
    - E-obs: Europe 0.25º
    - APHRODITE: Asia 0.25º
    - PERSIANN: 60S-60N 0.25º

Michael F. Wehner, Kevin Reed, Fuyu Li, Prabhat, Julio Bacmeister, Cheng-Ta Chen, Chris Paciorek, Peter Gleckler, Ken Sperber, William D. Collins, Andrew Gettelman, Christiane Jablonowski (2014) The effect of horizontal resolution on simulation quality in the Community Atmospheric Model, CAM5.1. Early online release: *Journal of Modeling the Earth System* 06, doi:10.1002/2013MS000276

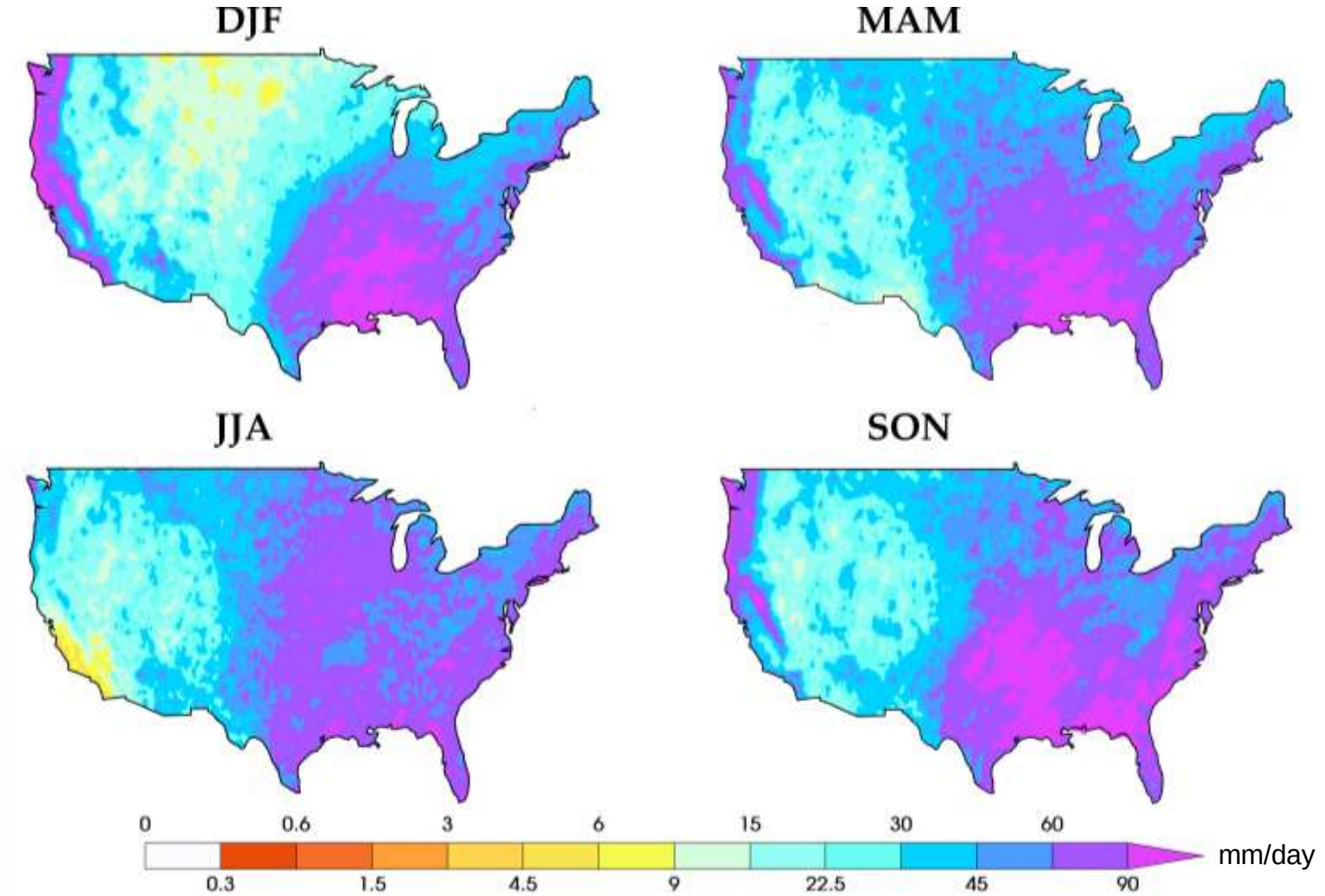
Contiguous United States (CONUS)

- Differences in mean precipitation are small when averaged over the CONUS.
- Differences in the tail of the distribution are not.
- Local details in the 20 year RV are large in the mountainous Western US.



20 year return value of seasonal maximum daily precipitation

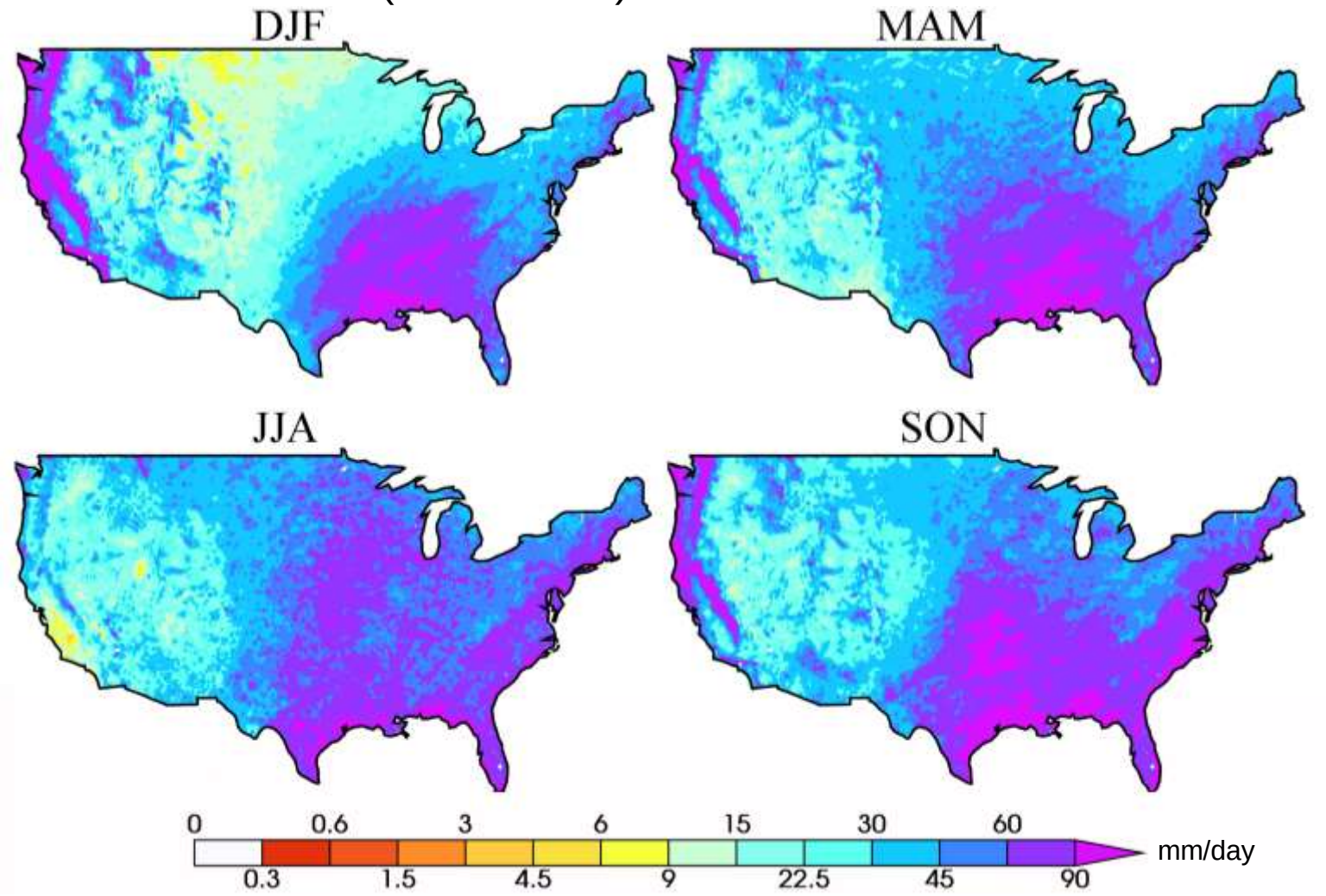
Observation: NOAA CPC



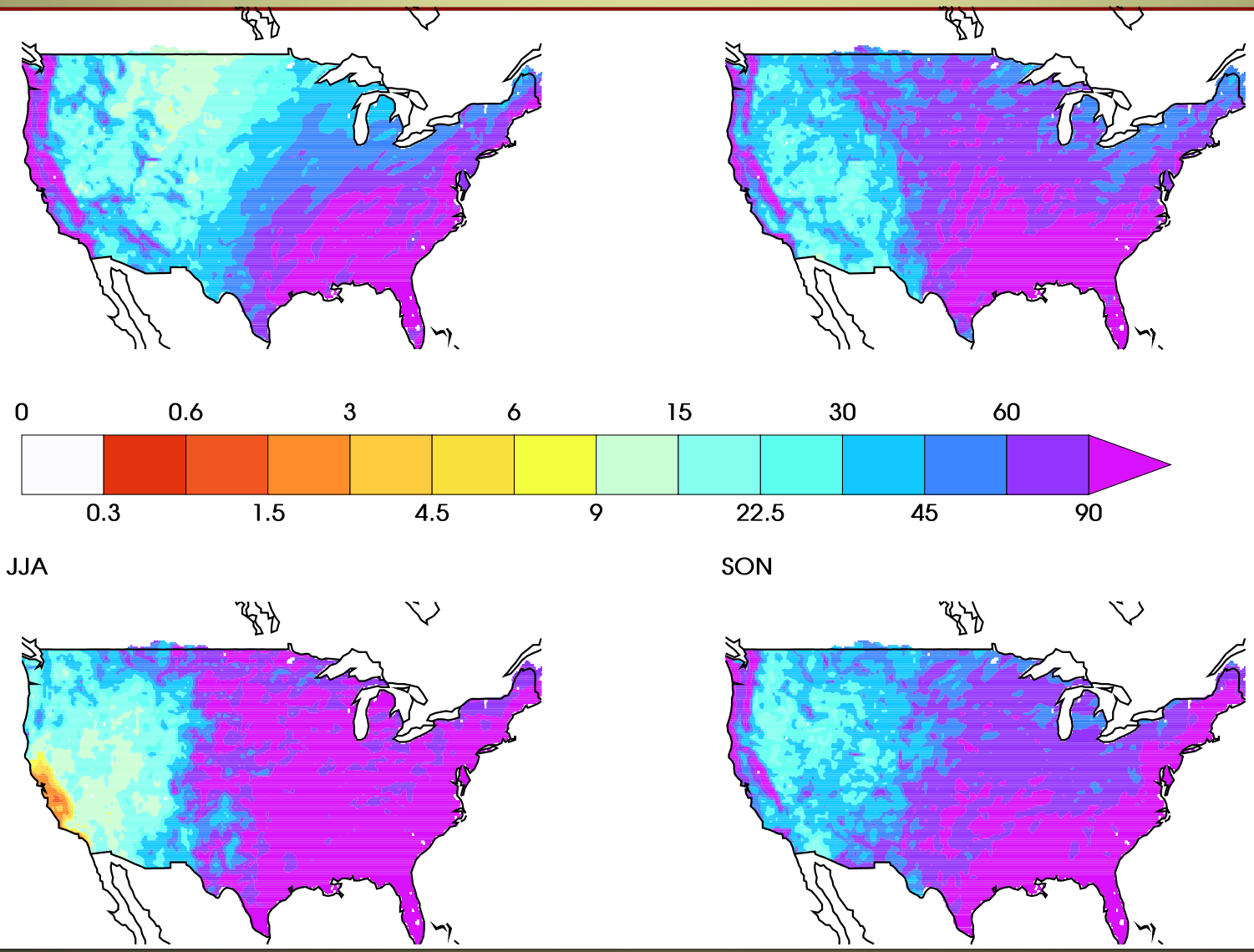
Michael F. Wehner (2013) Very extreme seasonal precipitation in the NARCCAP ensemble: Model performance and projections. *Climate Dynamics* **40**, 59-80. DOI: 10.1007/s00382-012-1393-1

20 year return value of seasonal maximum daily precipitation

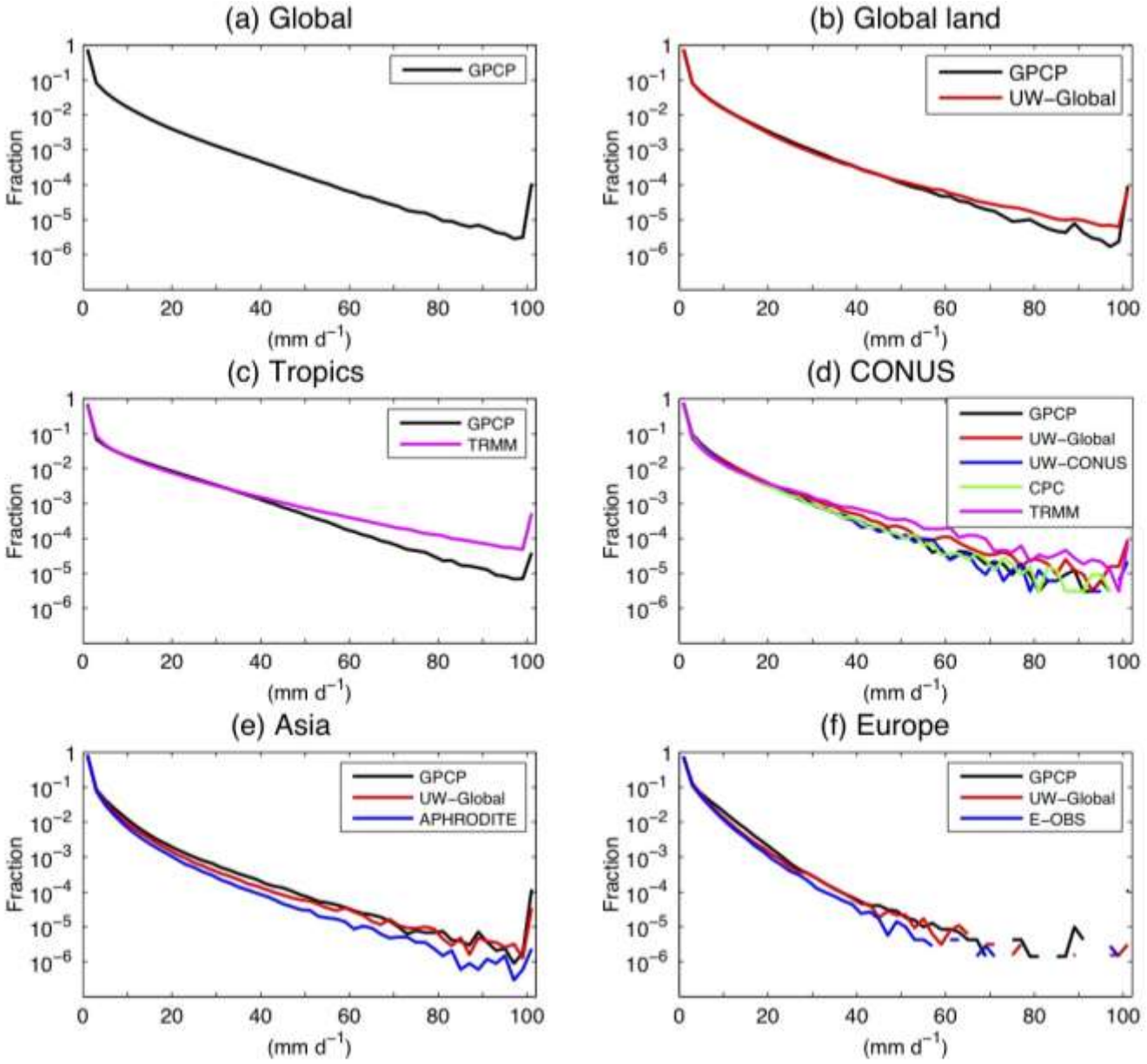
Observation: UW CONUS (Maurer et al)



20 year seaonal RV: 0.25º fvCAM5.1



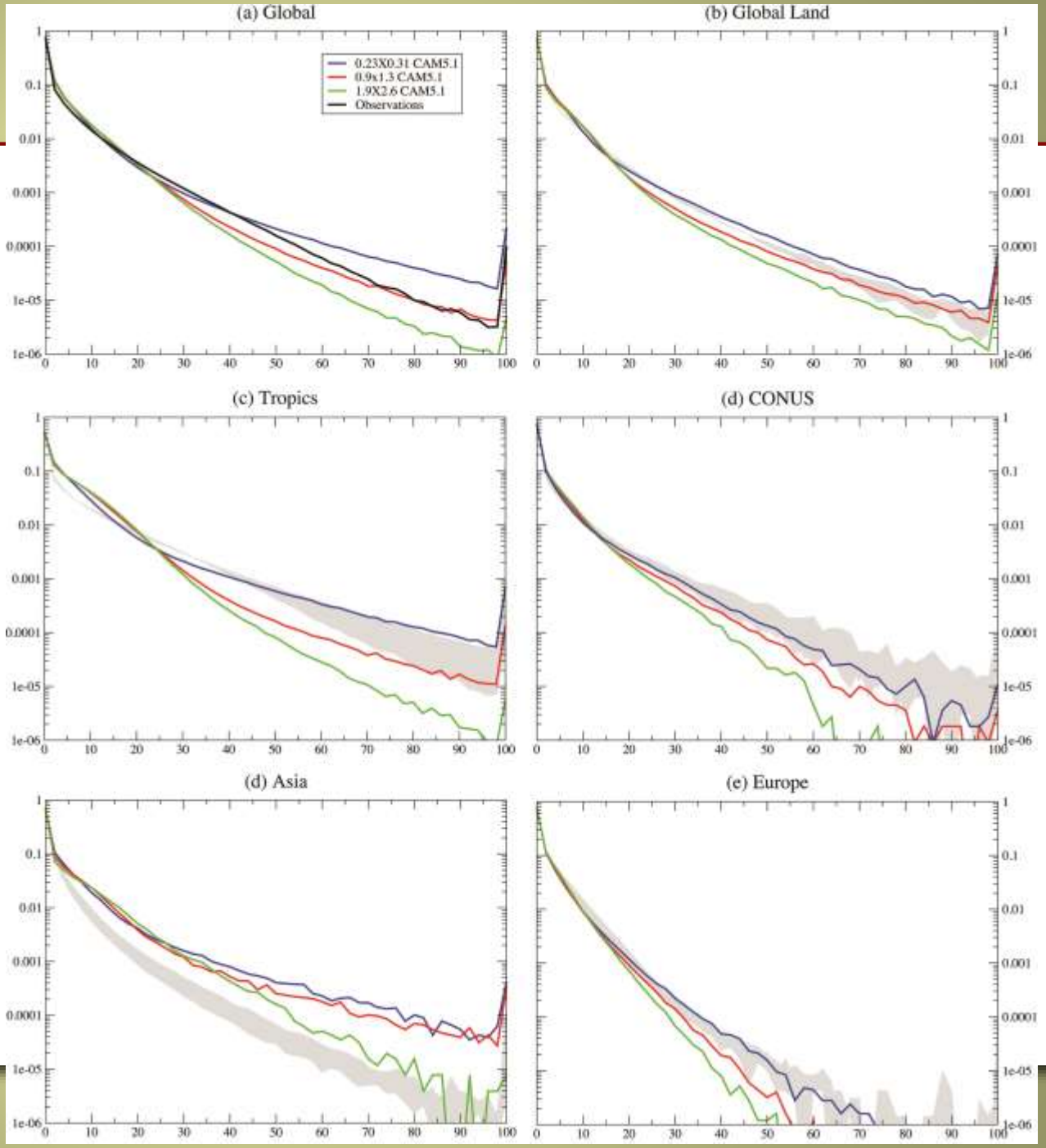
Normalized PDF of observed daily precipitation (mm/day)

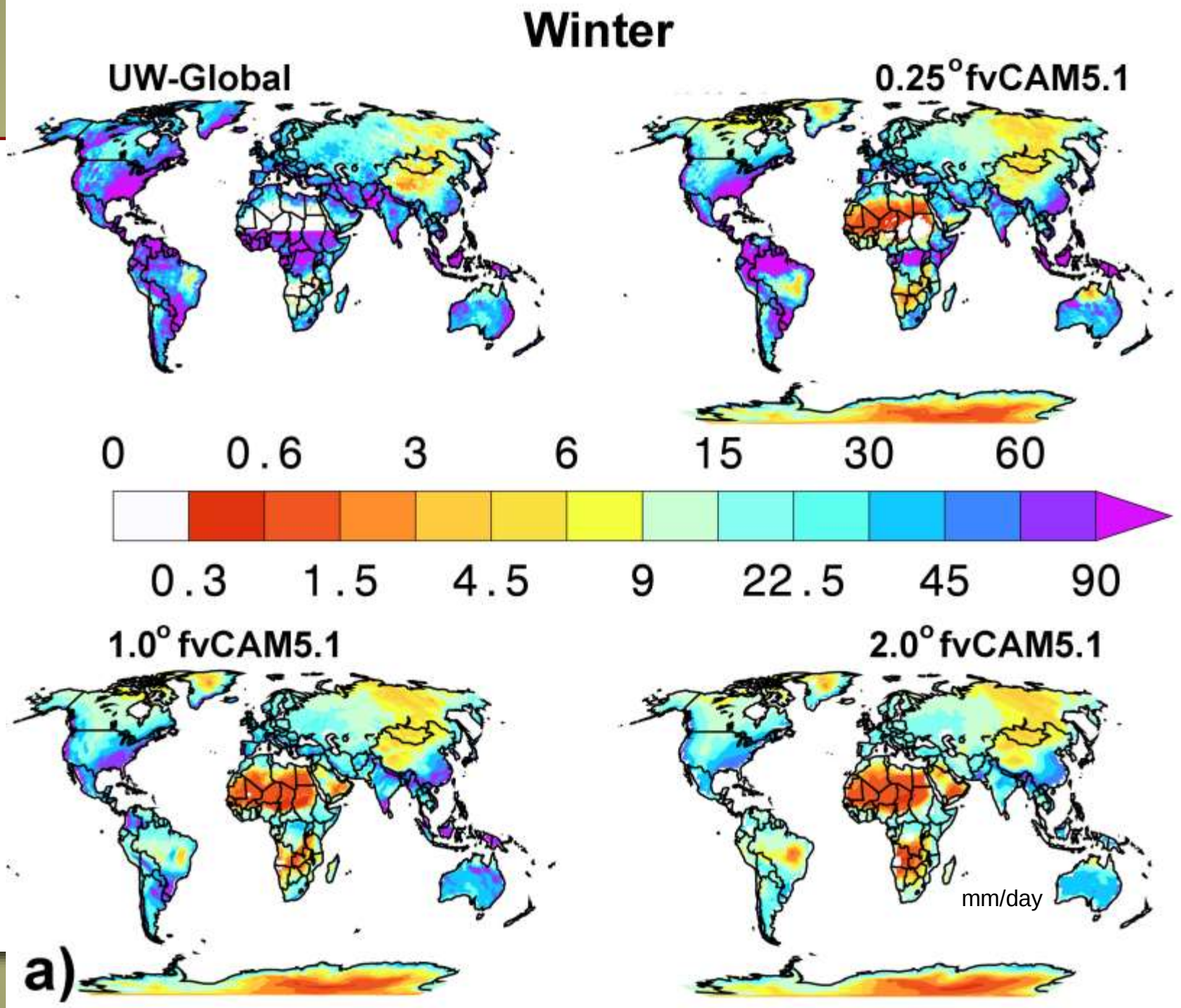


Precipitation

Daily Precipitation
fvCAM5 vs. obs.

Observational range is shown as gray.
A crude measure of Observational uncertainty.




Winter
UW-Global
0.25°fvCAM5.1
0
0.6
3
6
15
30
60
0.3
1.5
4.5
9
22.5
45
90
1.0° fvCAM5.1
2.0° fvCAM5.1
mm/day
a)

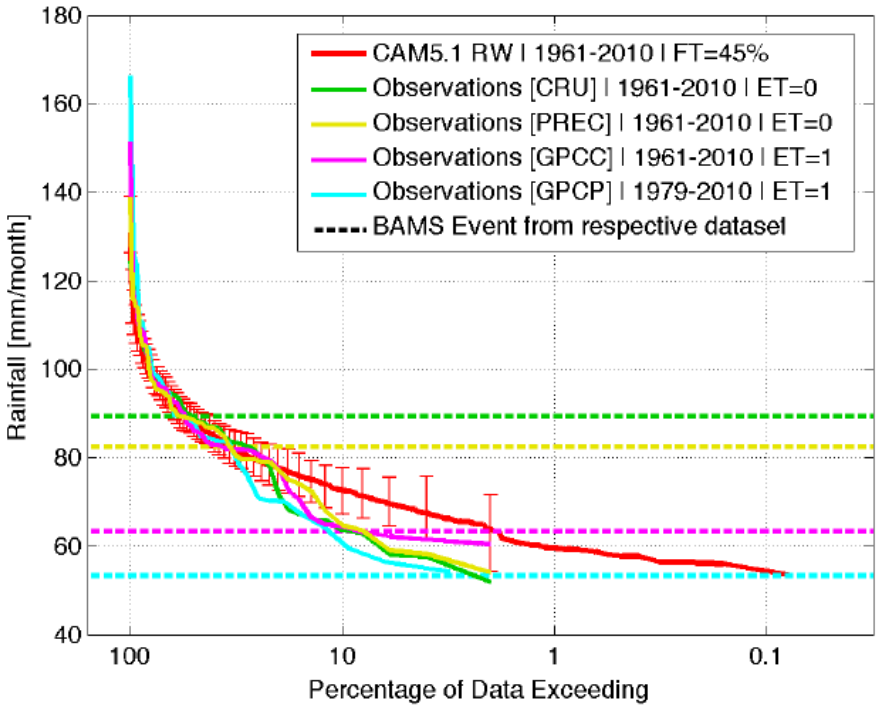
Some conclusions.

- The differences in gridded daily precipitation products is significant.
  - This limits the usefulness of model evaluation.
  - Guidance from experts in observations is in order.

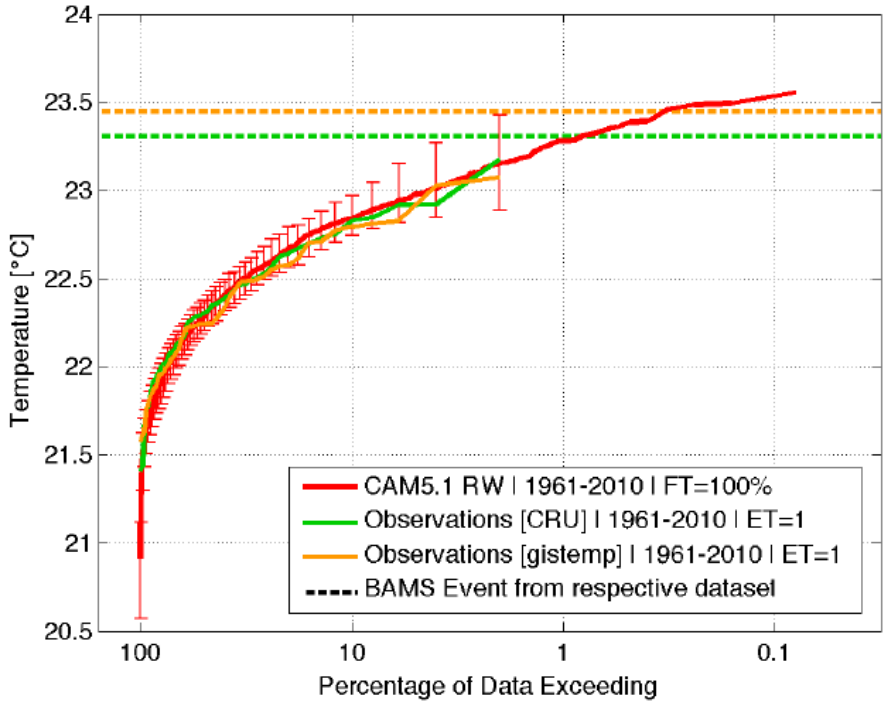
- Uncertainty in the tail of the observed distribution of daily precipitation leads to uncertainty in the assessment of the actual rarity of a given event.
  - CMIP5-class models systematically simulate low extreme precipitation rates.
  - High resolution models can do better, but it is still difficult.
  - CMIP5 models may not be fit to purpose for attributions or projections of extreme precipitation.
    - But we do it anyways.

- Tropical Cyclones
  - Current high resolution models can have a remarkably good TC climatology.
    - But this is the subject of another story.

Implications for extreme event attribution



(h) Item 3 | Low MAMJ Rainfall



(cq) Item 44 & 45 | High ANN Temperature

2011 East Africa

2013 Australia

What is the true rarity of these very rare extremes?

Sensitivity of Recent Event Attribution to Methodology Oliver Angelil, Chris Paciorek, Daithi Stone, and Michael Wehner (in preparation)

Thank you!

mfwehner@lbl.gov