The Value of Large Ensembles in Distinguishing between Internal Variance and Systematic Biases in Extreme Precipitation

Naomi Goldenson, Alex Hall, Chad Thackeray, Daniel Swain, Neil Berg

UCLA Center for Climate Science
Institute of the Environment and Sustainability
University of California, Los Angeles

Using a diagnostic to evaluate GCM performance in the upper tail of the precipitation distribution, we use initial-condition ensembles to explore the role of internal variance in explaining some of the spread in model performance compared to GPCP.

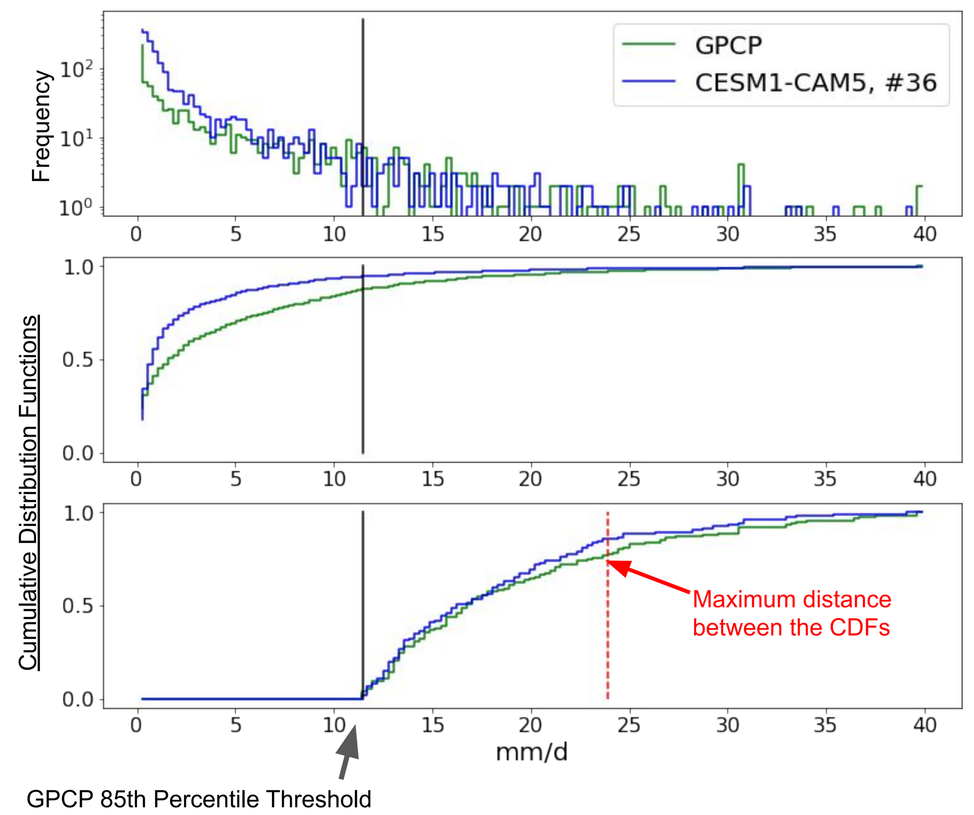
The Kolmogorov-Smirnov test is based on the maximum difference between the CDFs of two distributions.

It's bound to fail in comparisons of GCM precipitation with satellite products because of the excess of drizzle produced by the models.

We apply the test only above a threshold, to isolate the upper tail of the distribution while retaining enough samples.

The 21-year period from 1997-2017 is an concatenation of the historical (through 2005) and early years of the RCP8.5 simulations for the GCMs.

Precipitation Distribution for Example Gridcell (33˚N, 326˚E)

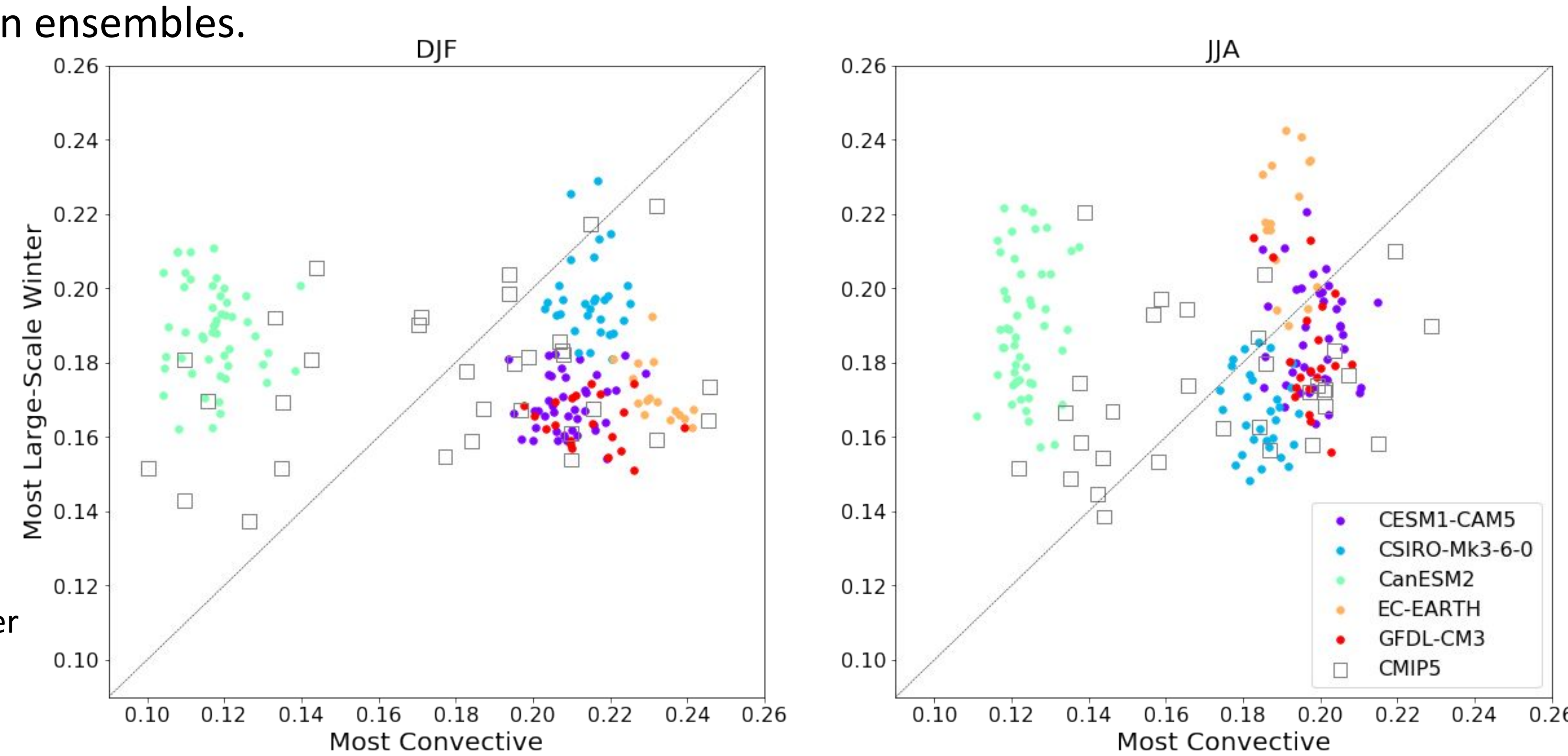


We average across dynamically-defined regions based on model agreement on the dominant processes. Then we compare the CMIP5 ensemble spread with that of five single-model initial-condition ensembles.

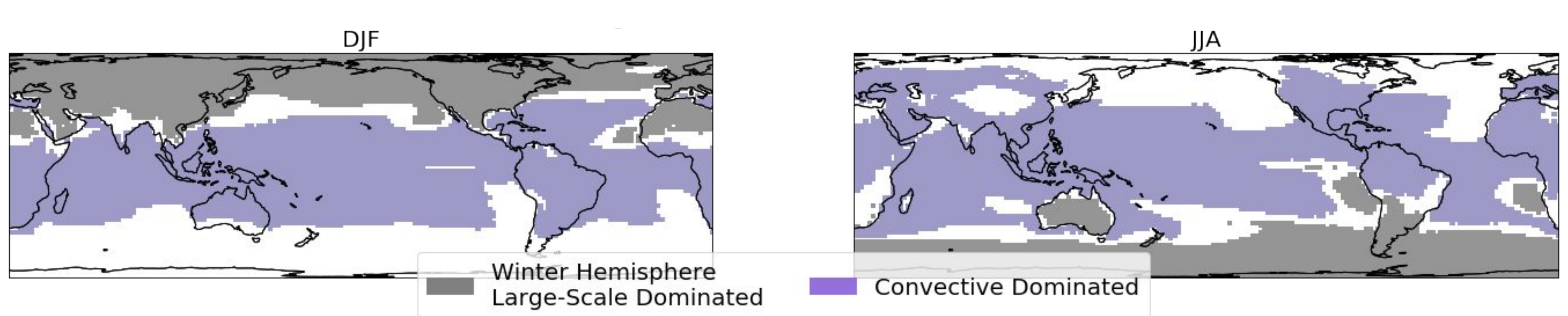
Area-weighted Mean P-Value

(Over the regions defined below)

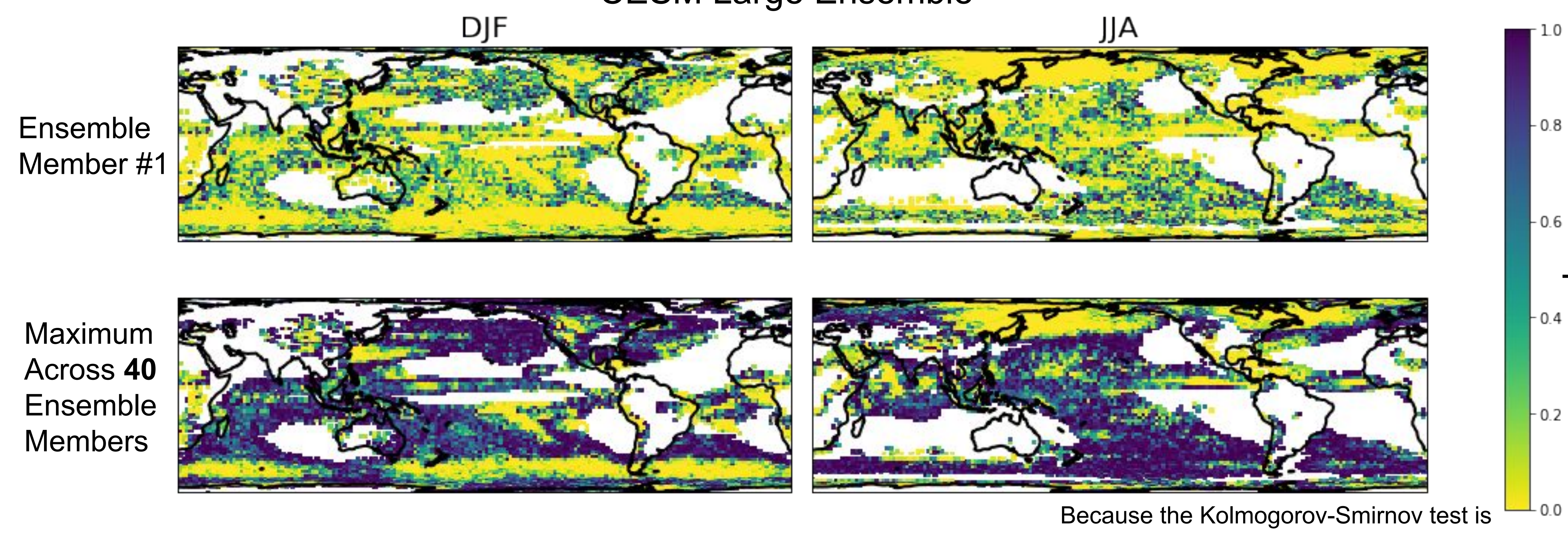
The higher the P-Value, the more likely the two distributions could have been drawn from the same larger distribution.



Where ⅔ of CMIP5 models agree on whether there is more large-scale or convective precipitation.

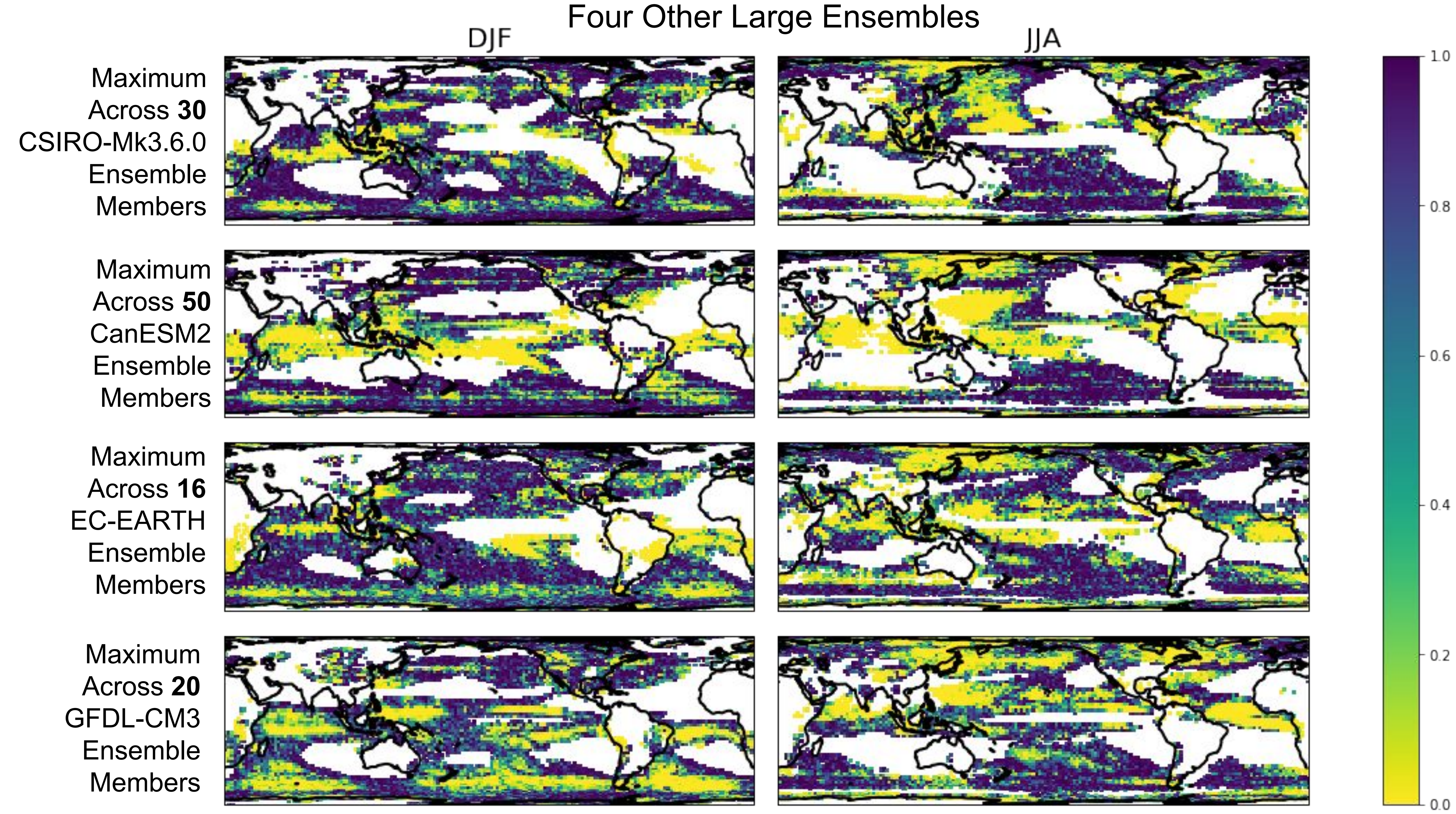


CESM Large Ensemble



Because the Kolmogorov-Smirnov test is vulnerable to being underpowered, it is not performed in locations that lack at least 60 samples from a given ensemble member.

Maximum P-Value Across Four Other Large Ensembles



Conclusions:

- Variation across ensemble members represents a substantial fraction of the CMIP5 inter-model spread.
- The large ensembles distinguish locations that are systematically different than GPCP regardless of ensemble member.