

A Standardized Benchmarking Framework to Assess Downscaled Precipitation Simulations

Rachael Ispording, Lisa Alexander, Margot Bador, Donna Green, Jason Evans, Scott Wales



Do you use rainfall data from Regional Climate Models (RCMs) and are unsure how best to assess model performance?

A how to guide to quantify the skill of RCM rainfall simulations.

There are many different climate model simulations, each producing a different plausible representation of our Earth System. However, not all simulations are skilled at simulating everything. Our framework guides users in identifying Regional Climate Models (RCMs) that are skillful in simulating different aspects of precipitation.

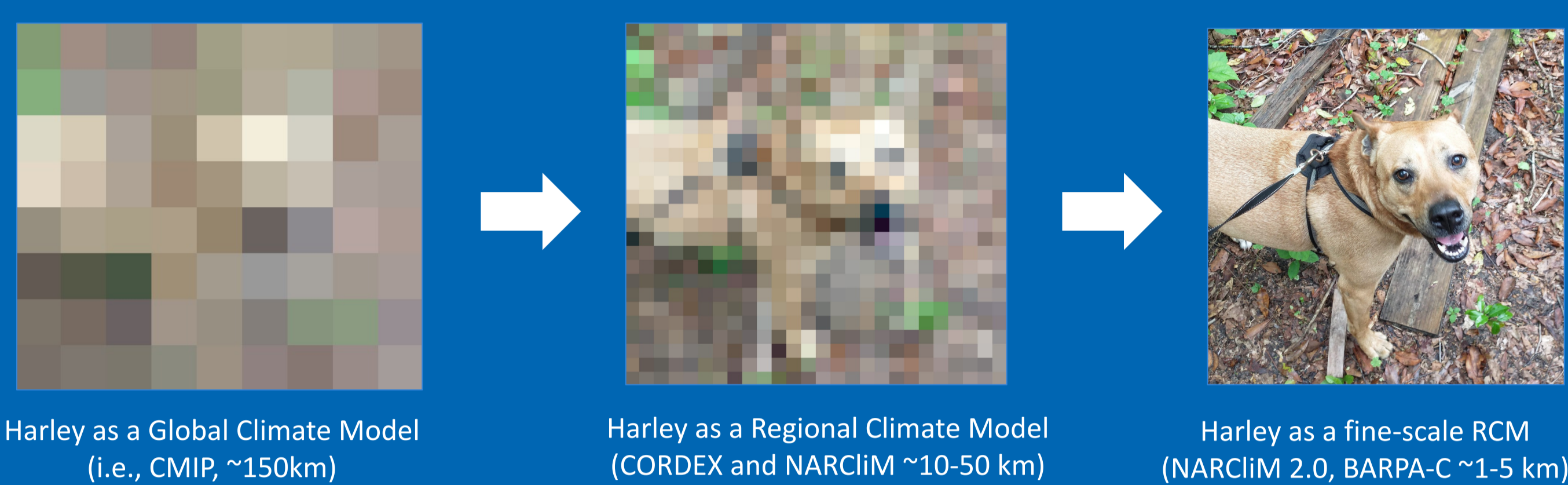
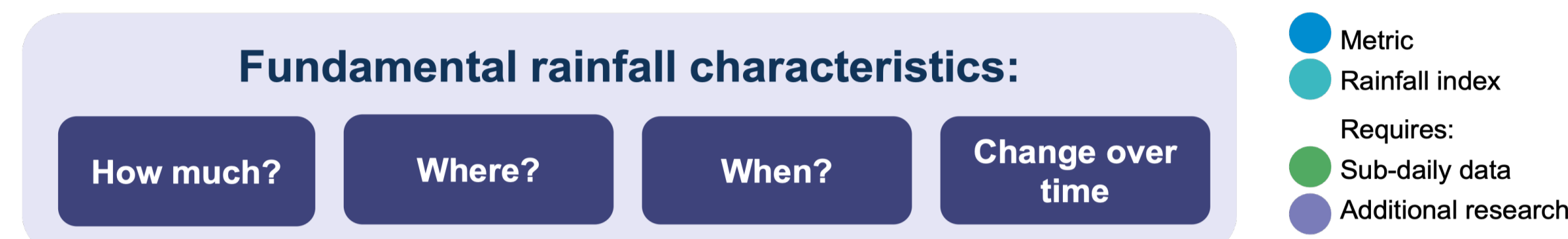


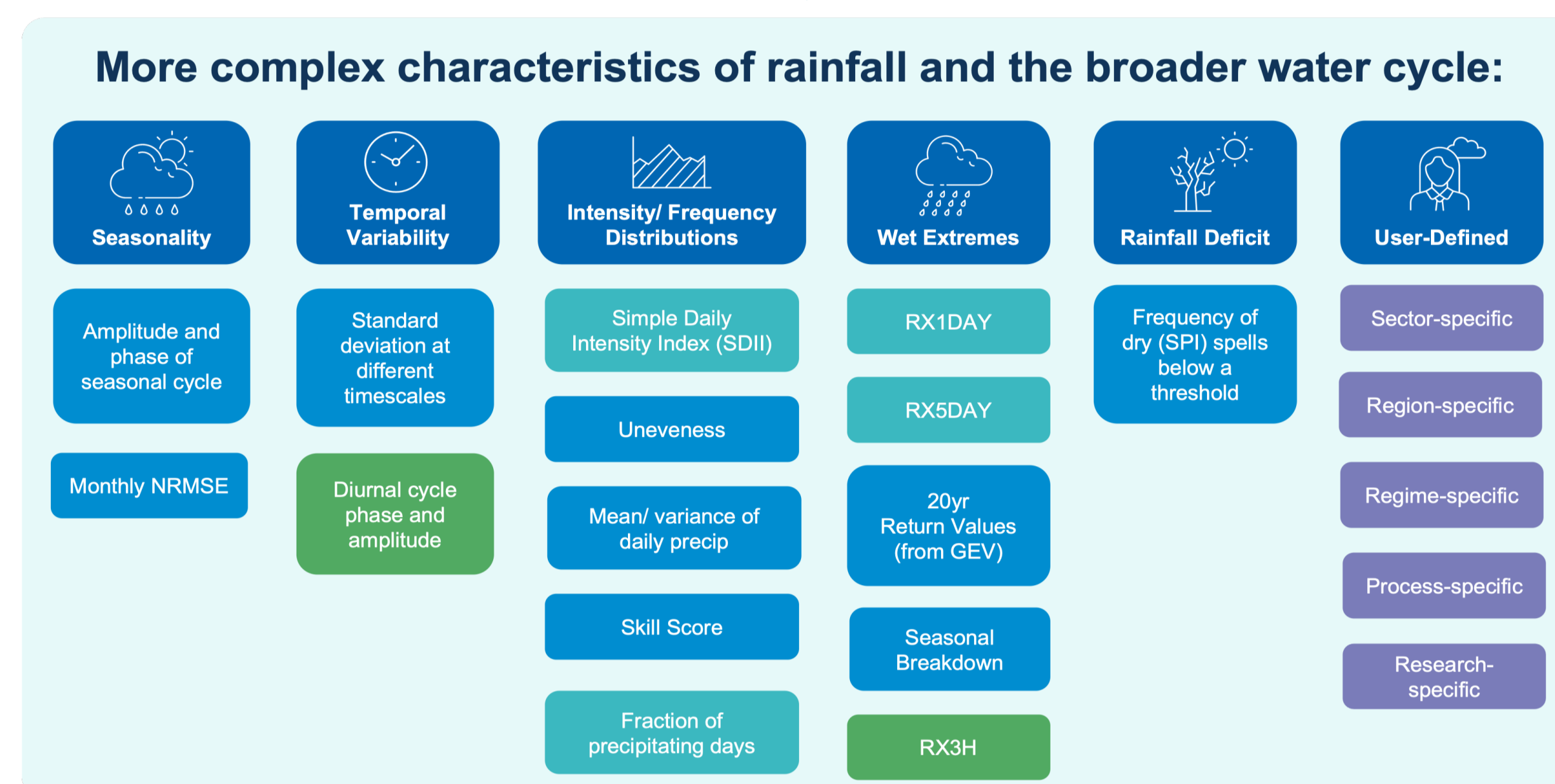
Fig 1: Harley becoming a high-resolution RCM through downscaling.

Regional climate models are high resolution simulations of the climate system at a regional scale. These models produce datasets at higher spatial and/or temporal resolutions and incorporate processes and details useful to local and regional scales.

1: Test basic rainfall characteristics based on your needs



2: What are you interested in?



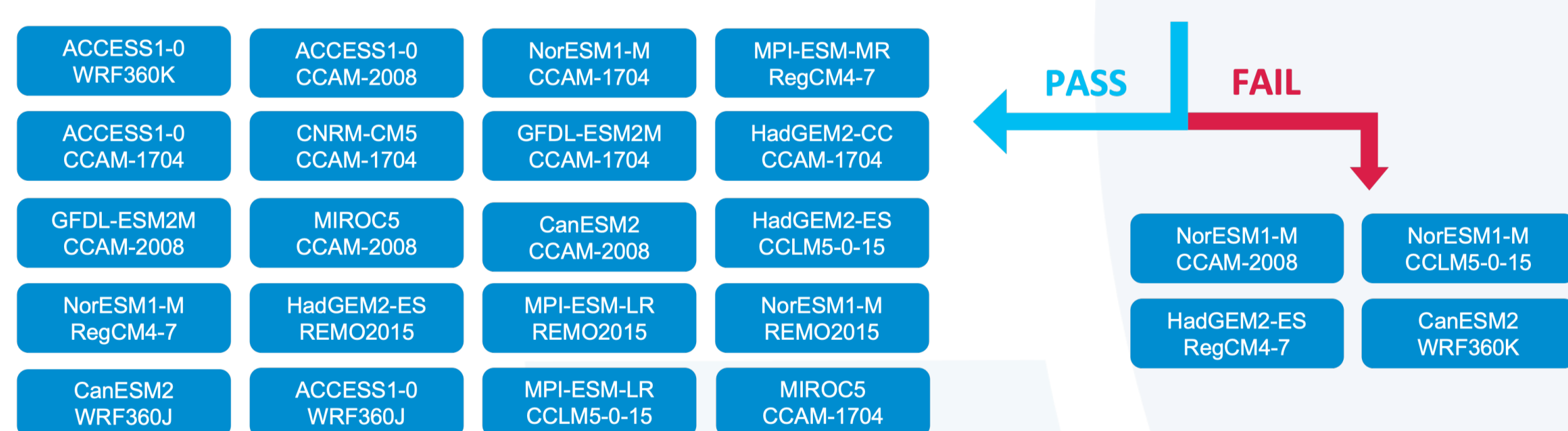
3: Fit for purpose models

Fig 2: Tiers of metrics for assessing model performance, underpinned by DOE (2020). The first tier quantifies basic characteristics of rainfall. The second-tier offers a non-exhaustive list of metrics to further assess more characteristics of rainfall that are relevant to the user (i.e. wet extremes for flood risk). We encourage users to incorporate other metrics.

Full ensemble of model simulations

ACCESS1-0 CCAM-1704	CNRM-CM5 CCAM-1704	GFDL-ESM2M CCAM-1704	HadGEM2-CC CCAM-1704	MIROC5 CCAM-1704	NorESM1-M CCAM-1704
GFDL-ESM2M CCAM-2008	MIROC5 CCAM-2008	NorESM1-M CCAM-2008	HadGEM2-ES CCLM5-0-15	MPI-ESM-LR CCLM5-0-15	NorESM1-M CCLM5-0-15
MPI-ESM-MR RegCM4-7	HadGEM2-ES REMO2015	MPI-ESM-LR REMO2015	NorESM1-M REMO2015	ACCESS1-0 WRF360J	CanESM2 WRF360J
ACCESS1-0 CCAM-2008	CanESM2 CCAM-2008	HadGEM2-ES RegCM4-7	MPI-ESM-MR RegCM4-7	ACCESS1-0 WRF360K	CanESM2 WRF360K

1. Test fundamental rainfall characteristics



2. What are you interested in?



3. Fit for purpose models

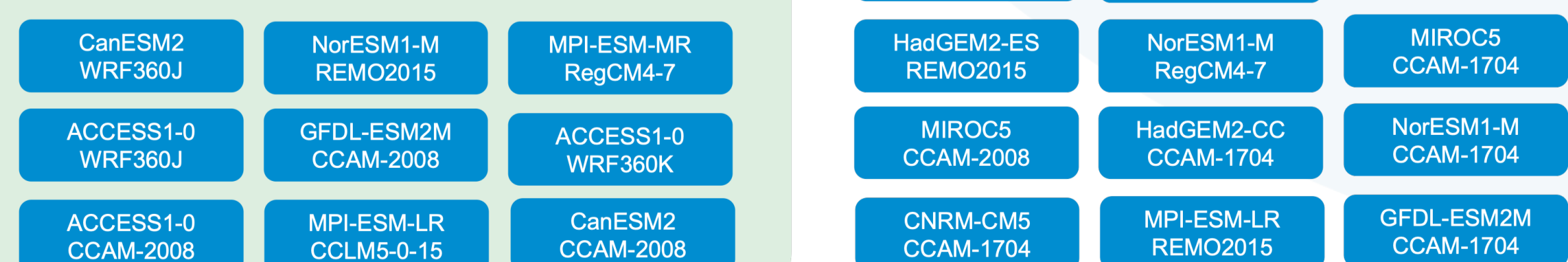


Fig 3: Schematic flowchart summarizing one hypothetical application of the framework for a user interested in identifying models most skilled in capturing the seasonality of rainfall across Australia. At each step in the application of the framework, the user defines model performance expectations and appropriate scientific analysis. Ultimately, the user distills a subset of fit for purpose models.

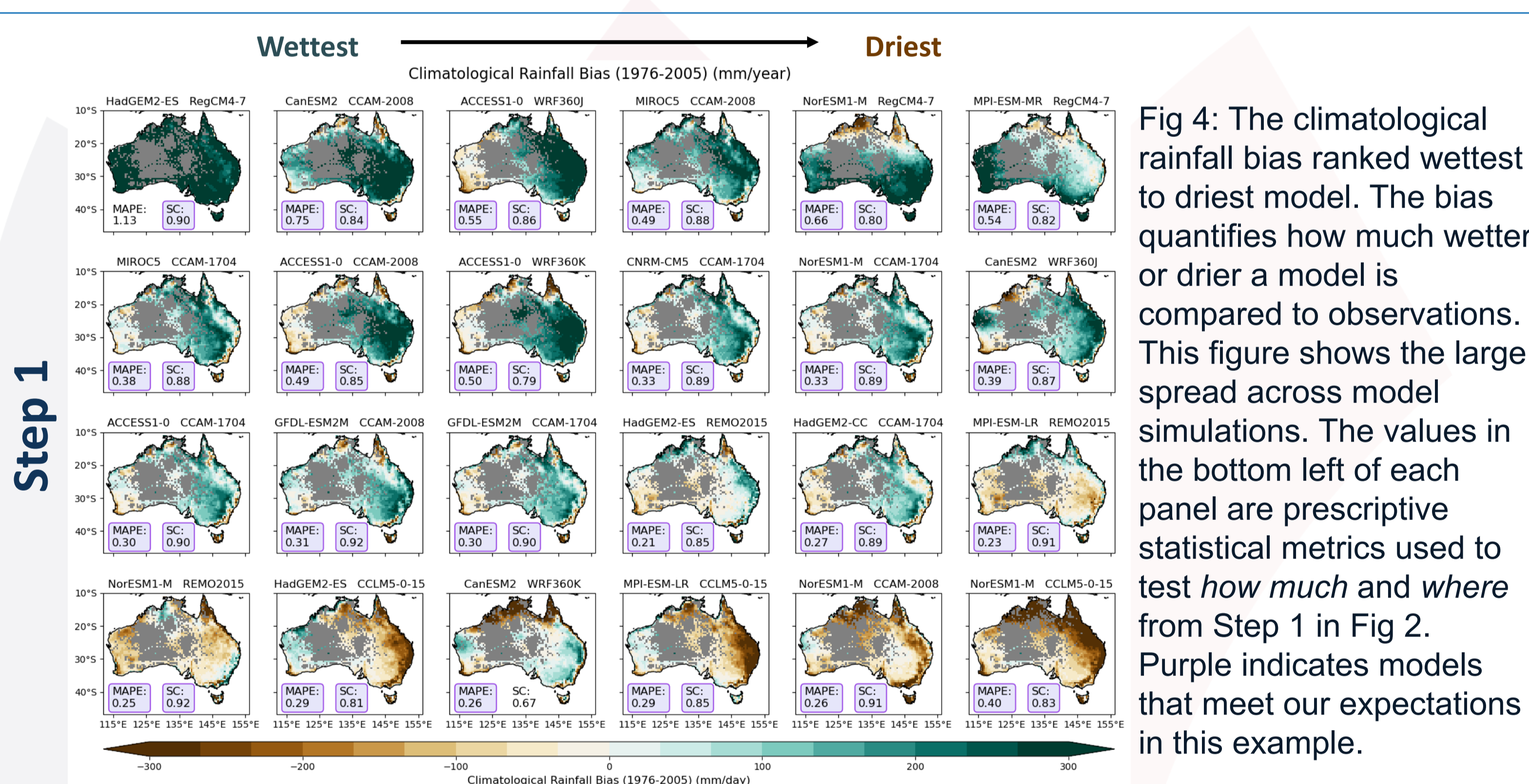


Fig 4: The climatological rainfall bias ranked wettest to driest model. The bias quantifies how much wetter or drier a model is compared to observations. This figure shows the large spread across model simulations. The values in the bottom left of each panel are prescriptive statistical metrics used to test how much and where from Step 1 in Fig 2. Purple indicates models that meet our expectations in this example.

Step 2 & 3

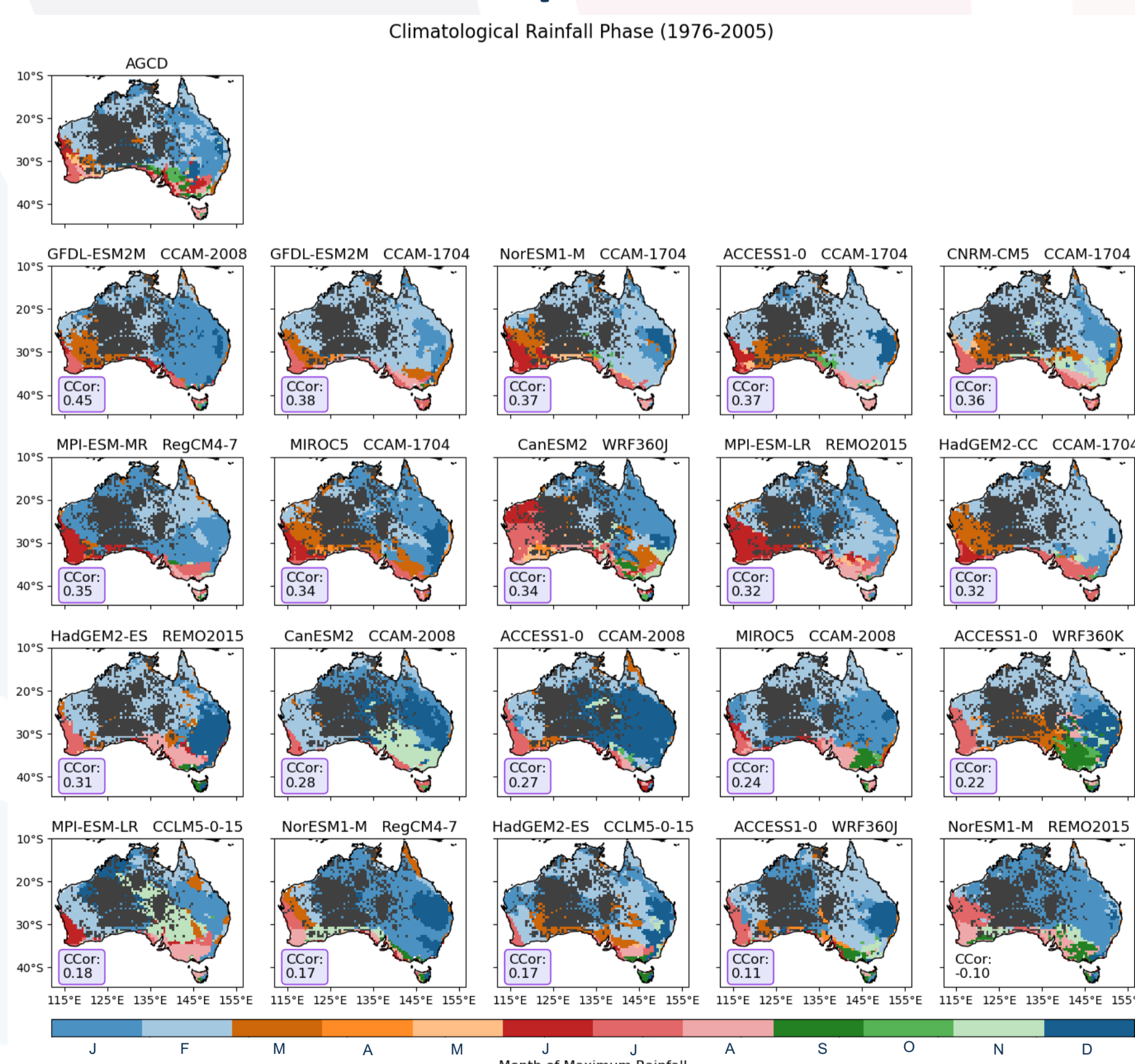


Fig 5: The climatological month of maximum rainfall (observations - top row). This is one way the Step 2 metrics can be applied to assess Seasonality. We show the wettest month across Australia to assess model skill in capturing the timing of rainfall for each model in our subset.

Examples of use:

- Identify fit for purpose models
- Optimize rainfall input data for impacts models (i.e. flood risk models)
- Objective, consistent model evaluation
- Inform model development priorities
- Guide added value studies
- Test new downscaling methods

Contact: r.isphording@unsw.edu.au

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Code: Ispording, R. N., 2023; https://doi.org/10.5281/zenodo.8365065

Datasets: Available at NCI



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