

An overview of the pyLatte verification package and some preliminary results from the CAFÉ system

Dougie Squire, James Risbey and team

What is pyLatte?

A verification/diagnostics package for assessing and visualising the quality of forecast systems

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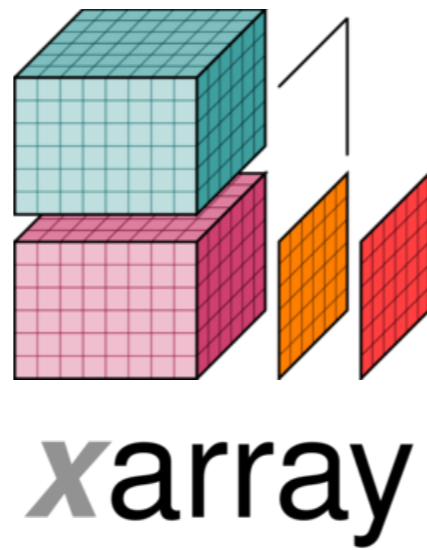
A verification/diagnostics package for assessing and visualising the quality of forecast systems



- Open source + community development
- Readability and user-friendliness
- Memory management/speed compromise

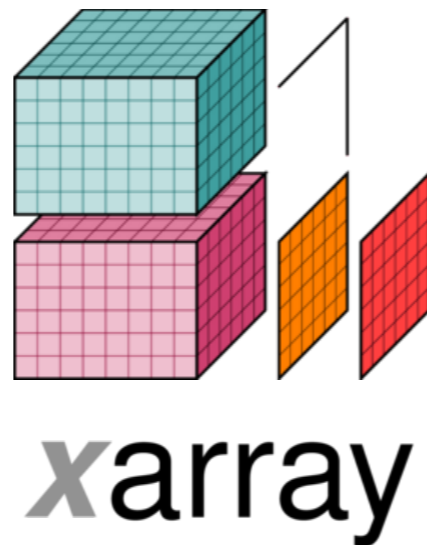
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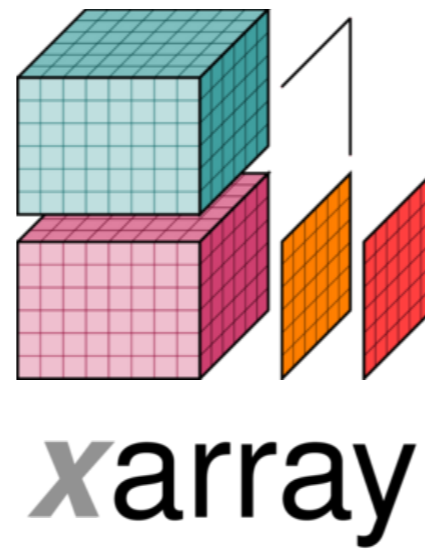
A verification/diagnostics package for assessing and visualising the quality of forecast systems



- Self-described, N-dimensional scientific data

What is pyLatte?

A verification/diagnostics package for assessing and visualising the quality of forecast systems



- Self-described, N-dimensional scientific data

Any N-dimensional array in xarray (`DataArray`) has several properties:

- `data`: the N-dimensional array
- `dims`: dimension names for each axis
- `coords`: the names and values of the coordinates on which the N-dimensional array is stored
- `attrs`: any arbitrary metadata (e.g. units, descriptions etc)

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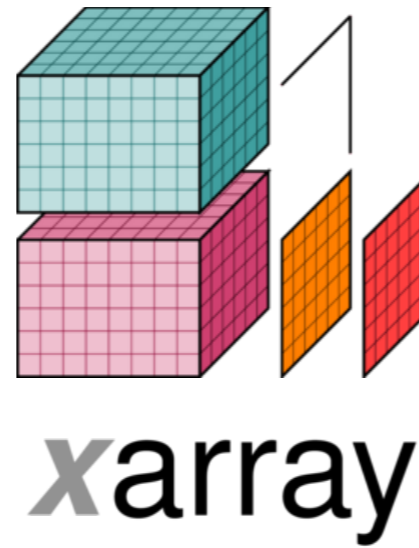


- Self-described, N-dimensional scientific data

```
<xarray.Dataset>
Dimensions:  (lat: 90, lon: 144, pfull: 24, time: 12)
Coordinates:
  * time      (time)      datetime64[ns]    2016-01-01 ...
  * lon       (lon)        float64           1.25 ...
  * lat       (lat)        float64           -89.49 ...
  * pfull     (pfull)       float64           3.65 ...
Data variables:
  temp       (time, pfull, lat, lon)  float64    266.4 ...
  precip     (time, lat, lon)          float32    1.90355e-05 ...
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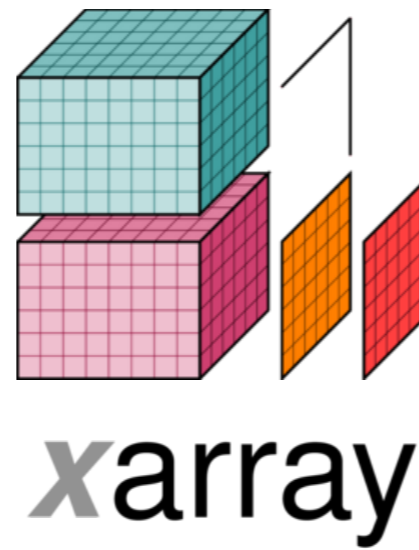
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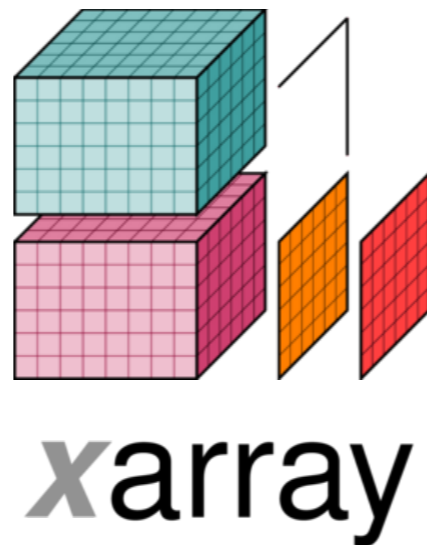
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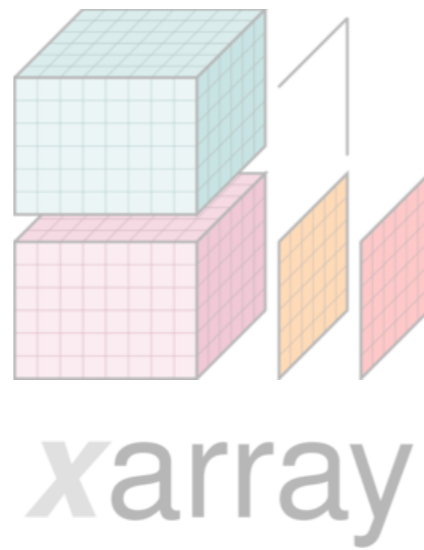
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- Self-described, N-dimensional scientific data
- Label-based indexing, arithmetic, aggregation, alignment, resampling, *split-apply-combine*

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A verification/diagnostics package for assessing and visualising the quality of forecast systems



- Self-described, N-dimensional scientific data
- Label-based indexing, arithmetic, aggregation, alignment, resampling, *split-apply-combine*
- Integrates with dask for *lazy, out-of-core, parallel* computation

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- Two primary functions:
- Abstract away difficulties with data querying



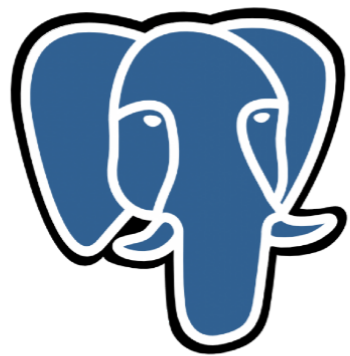
PostgreSQL

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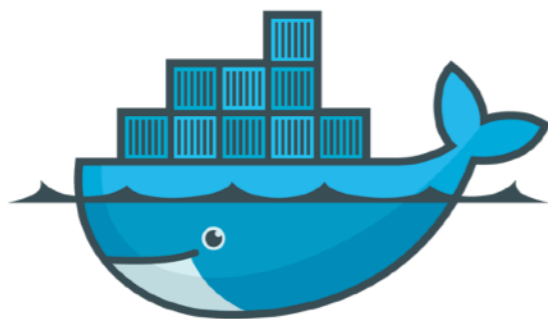
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PostgreSQL

- Provide a stable means for scaling workload across multiple nodes/machines

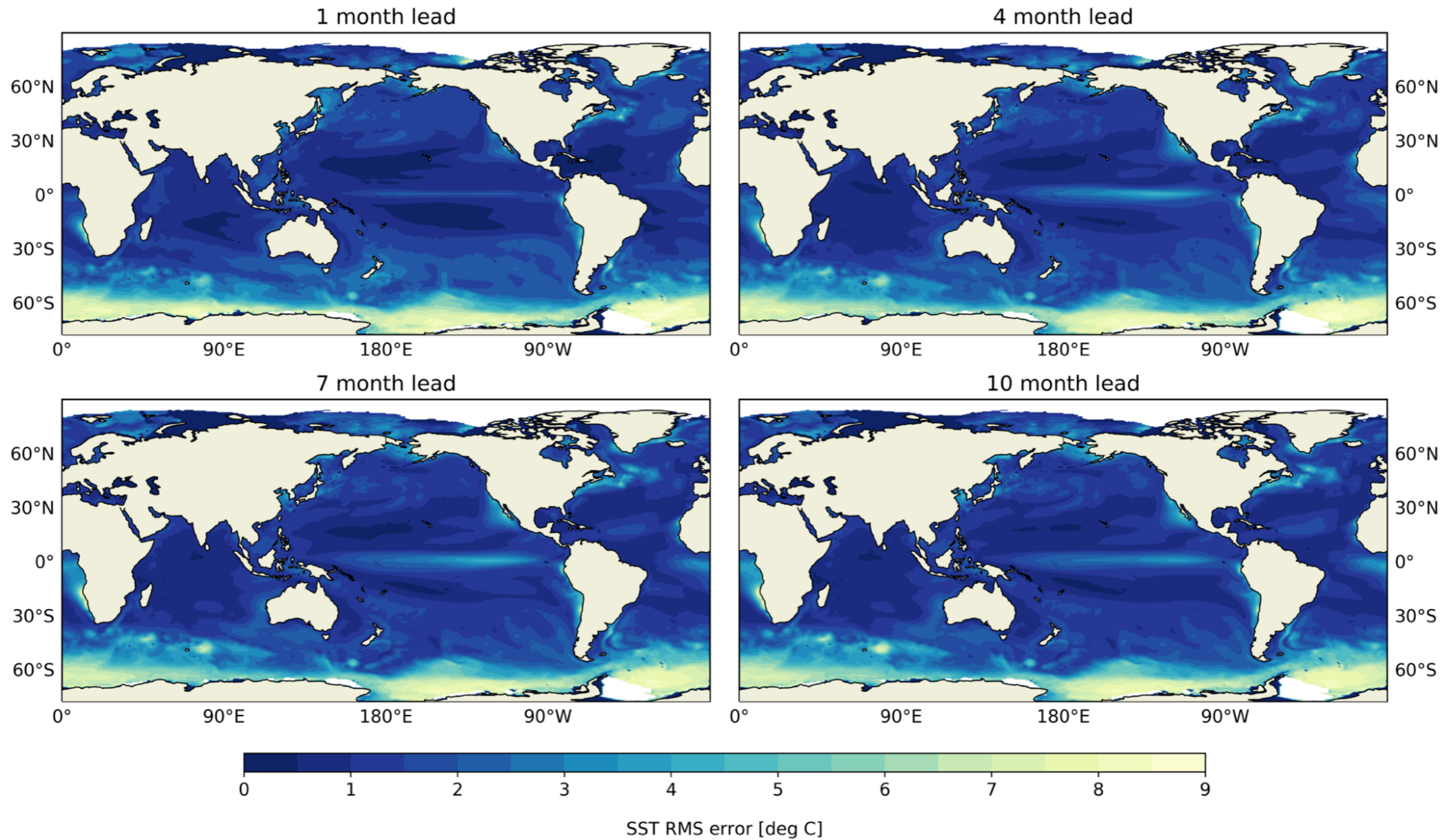


docker

Some example verification of the CAFÉ system

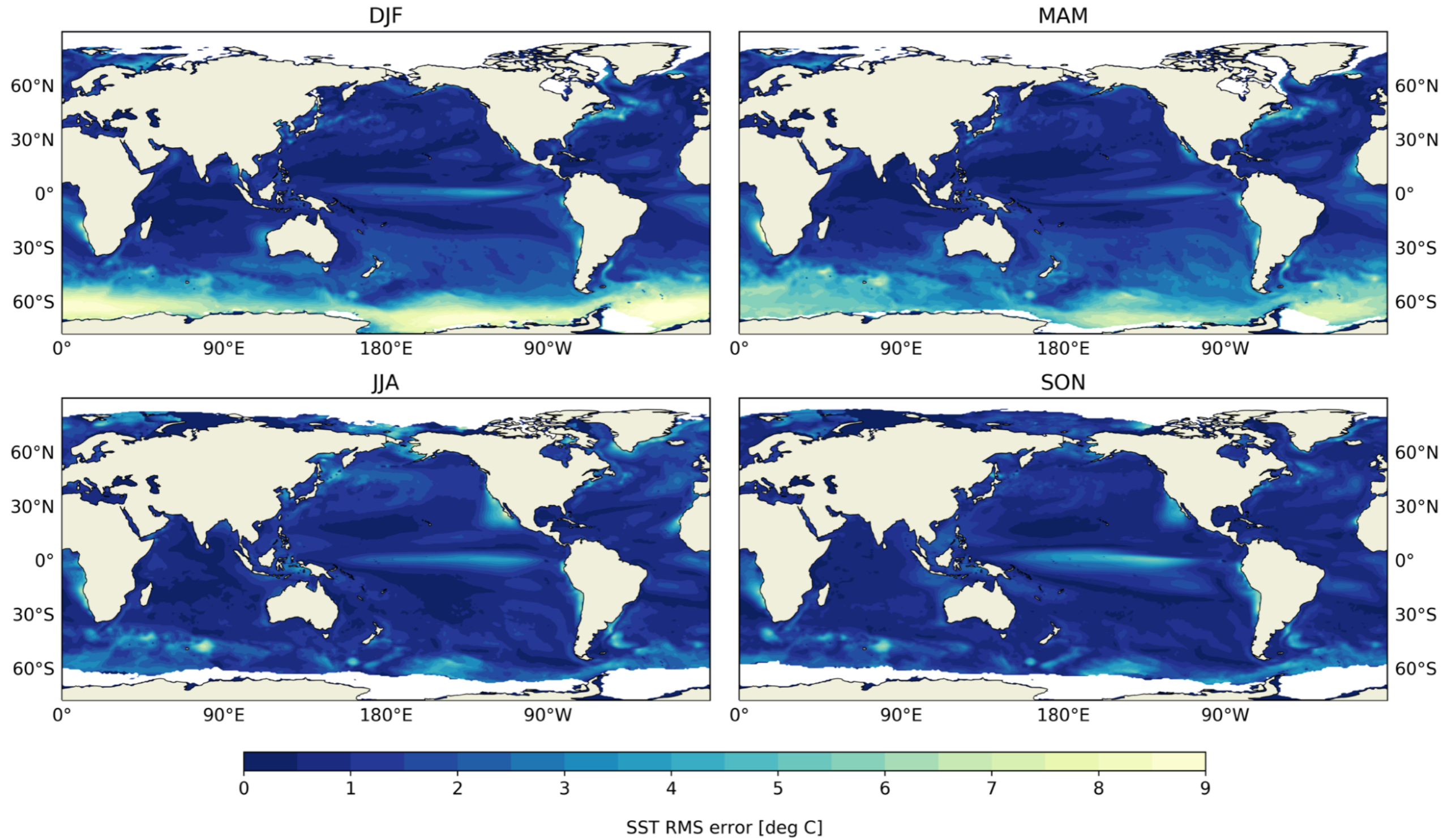
- v1 forecasts
 - 2-year forecasts (2002 - 2016)
 - 11 ensemble members
 - Only ocean observations assimilated
 - Bred vector initialised
- All monthly results
- Verified relative to JRA-55 reanalysis and REMSS

RMS error, SST

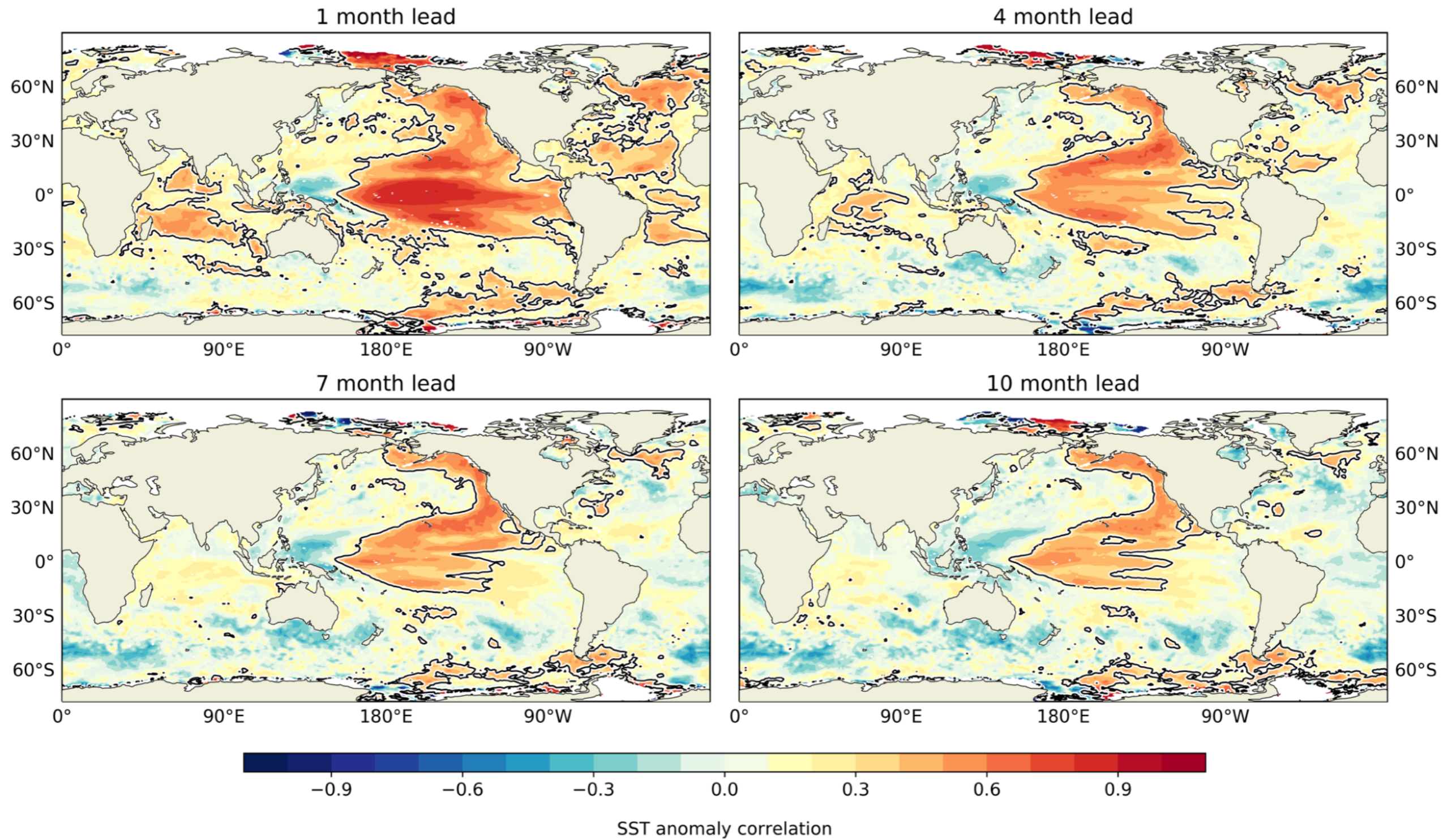


RMS error, SST

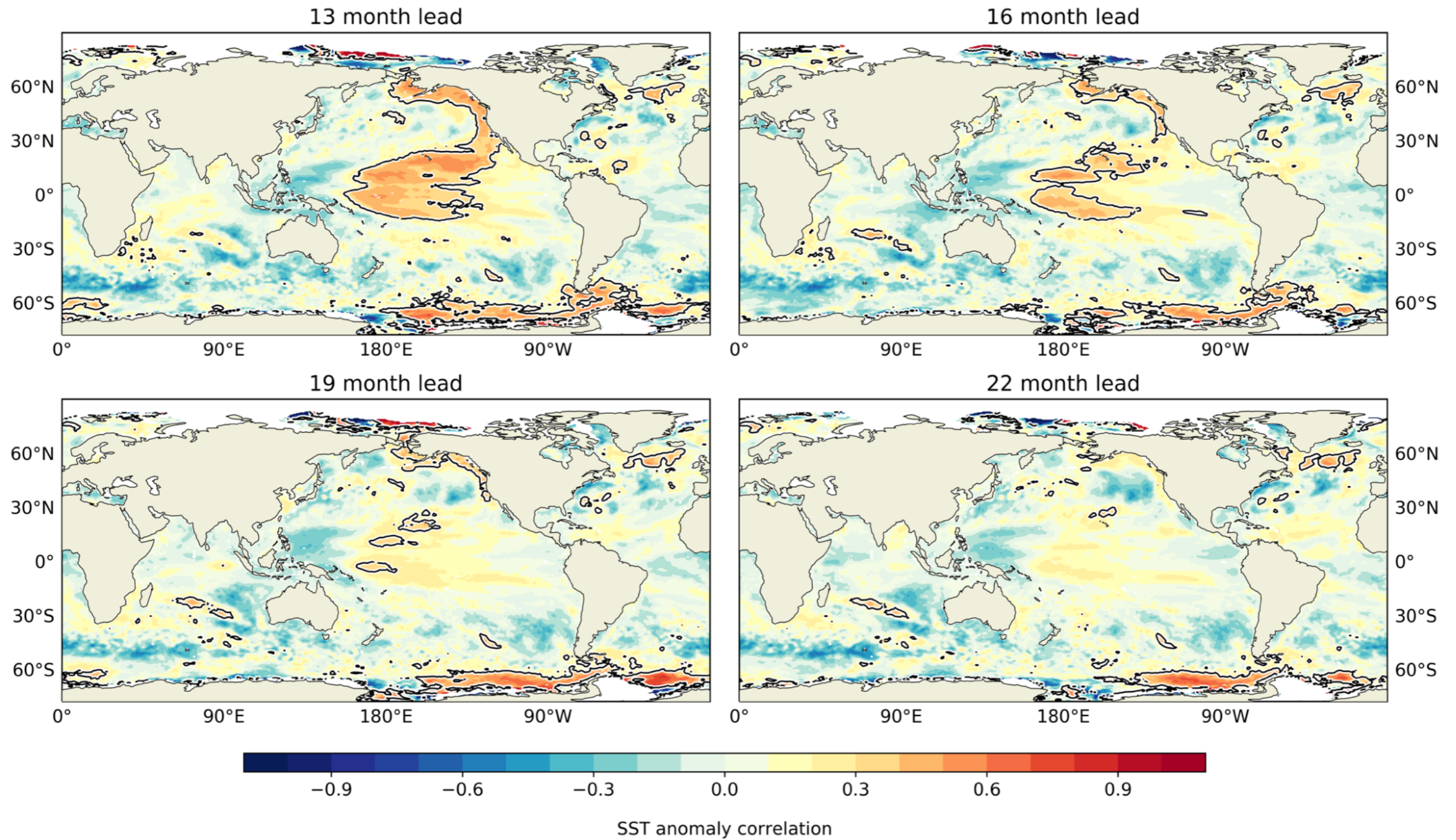
4 month lead



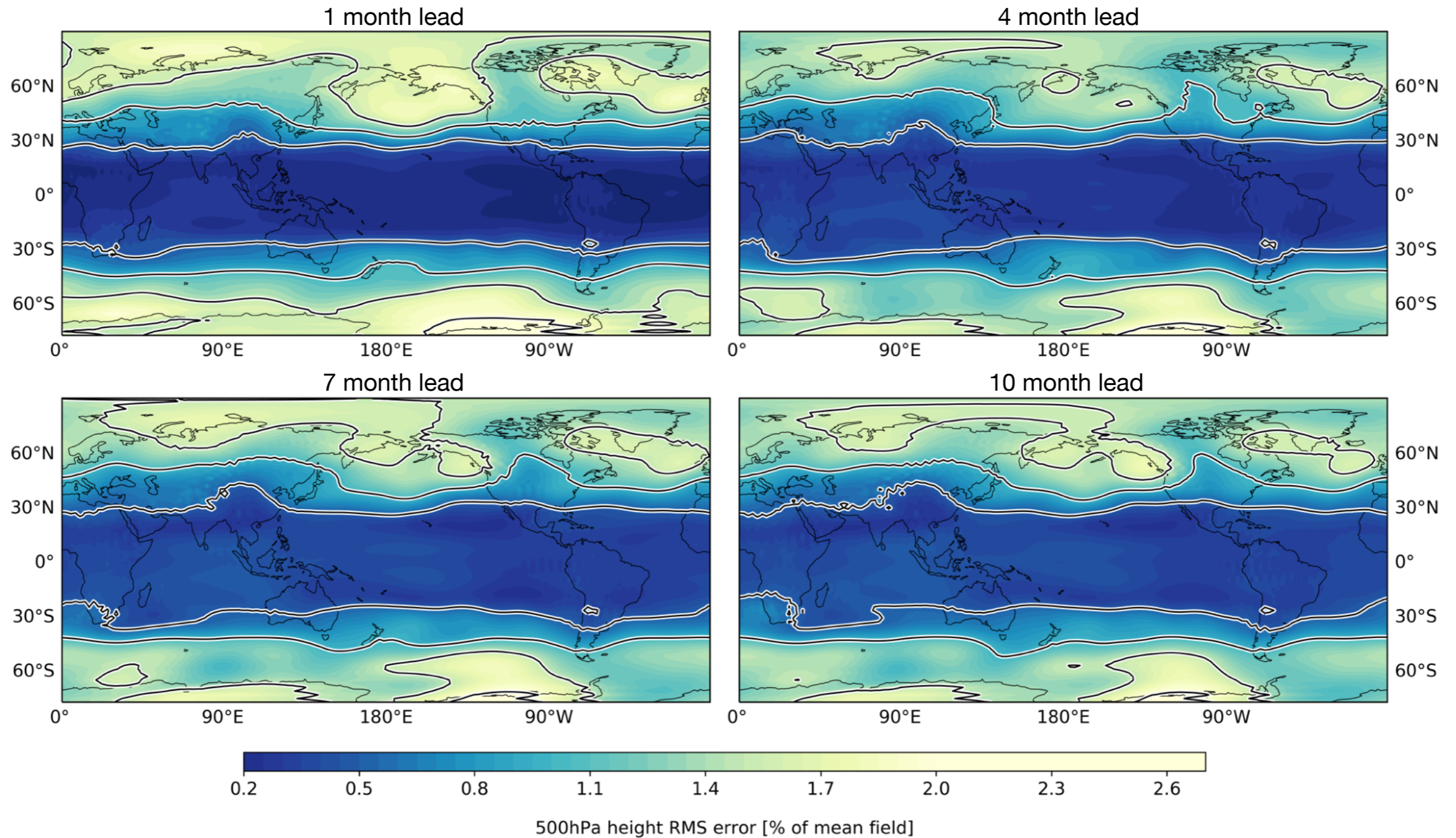
Anomaly correlation, SST



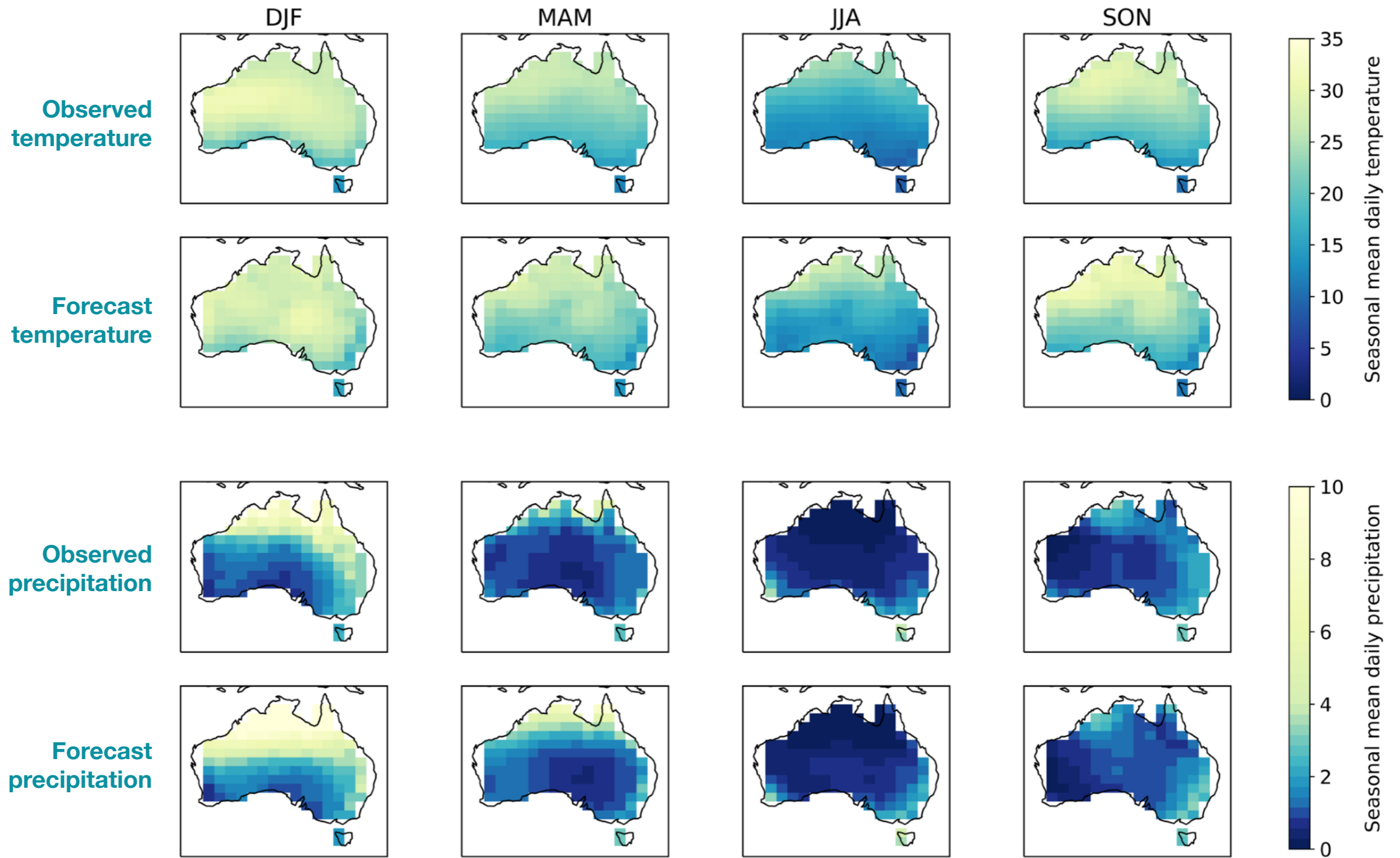
Anomaly correlation, SST



RMS error, 500hPa height



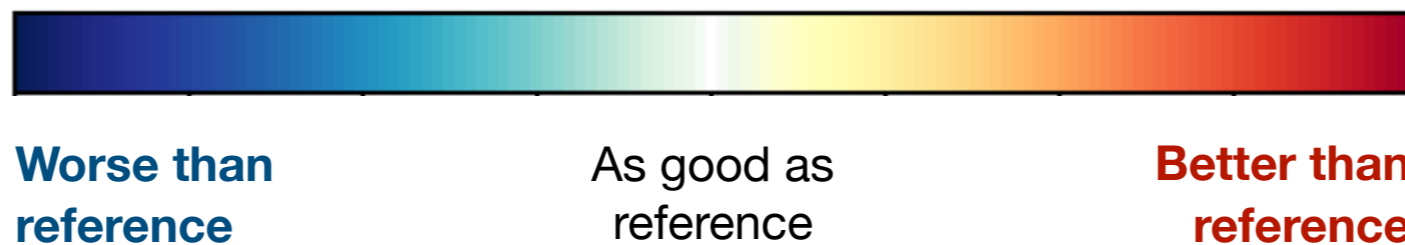
Seasonal mean, temp and rainfall



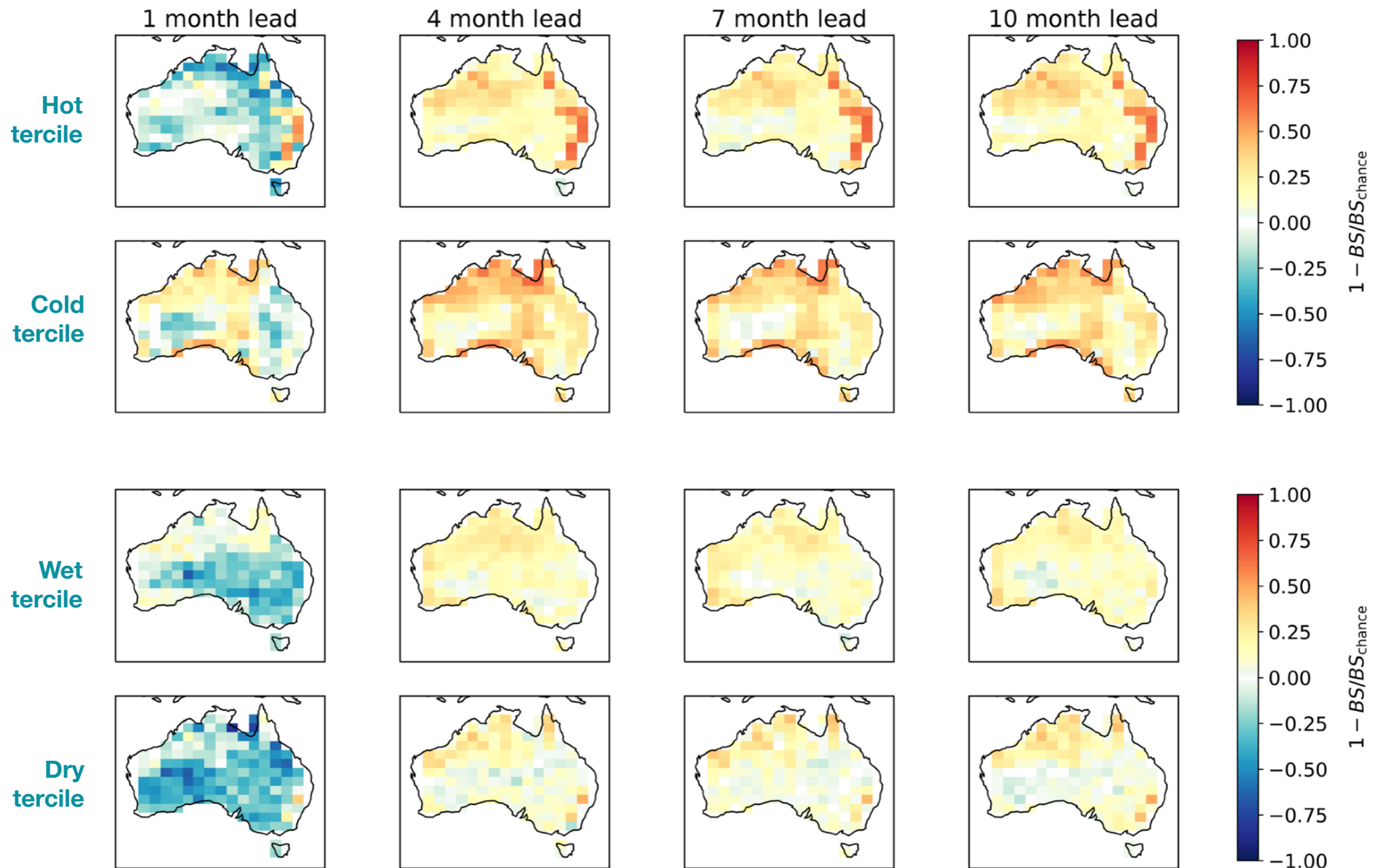
Brier skill

$$\text{Brier score} = BS = \frac{1}{N} \sum_{i=1}^N (p_i - o_i)^2$$

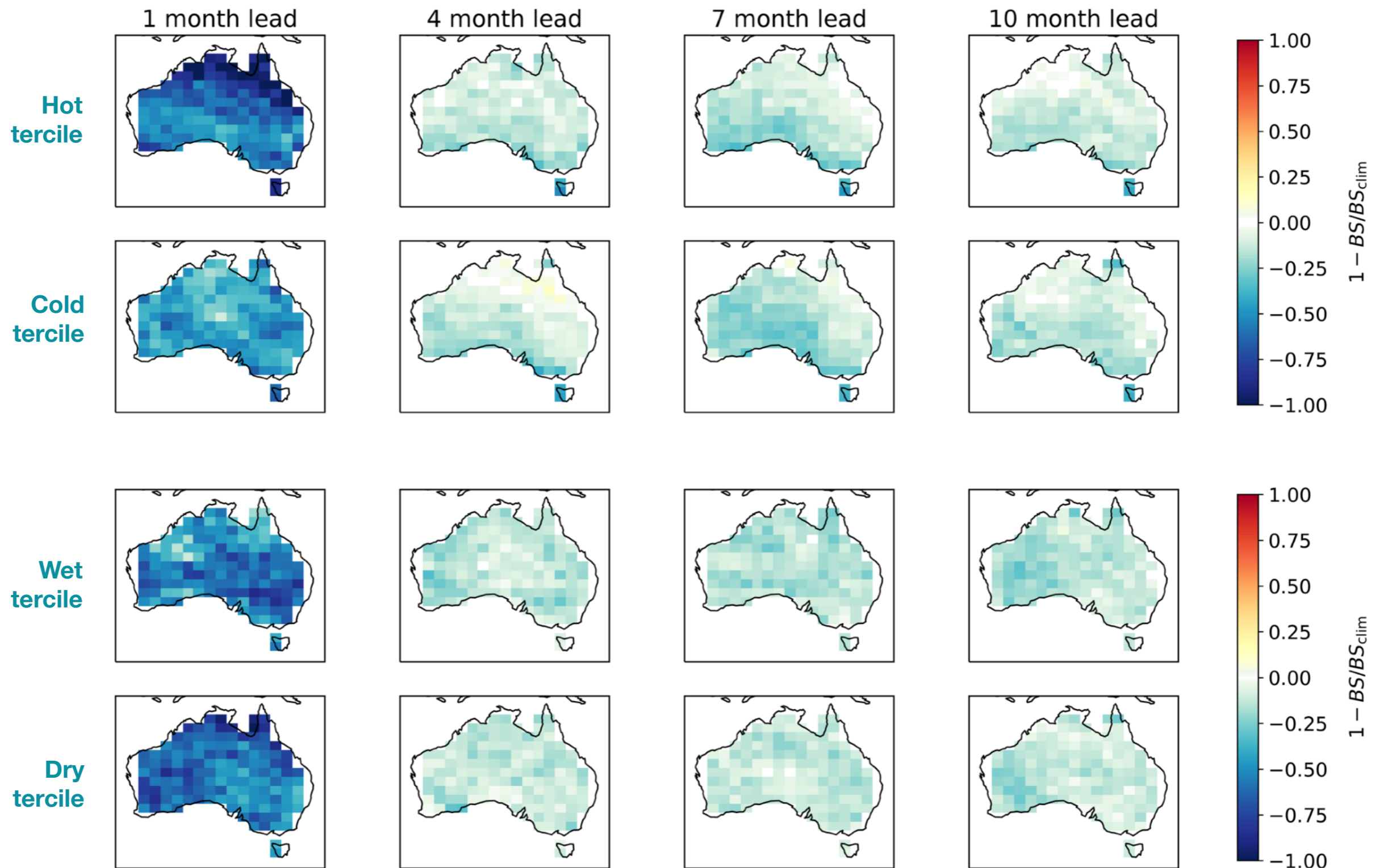
$$\text{Brier skill score} = BSS = 1 - \frac{BS}{BS_{\text{reference}}}$$

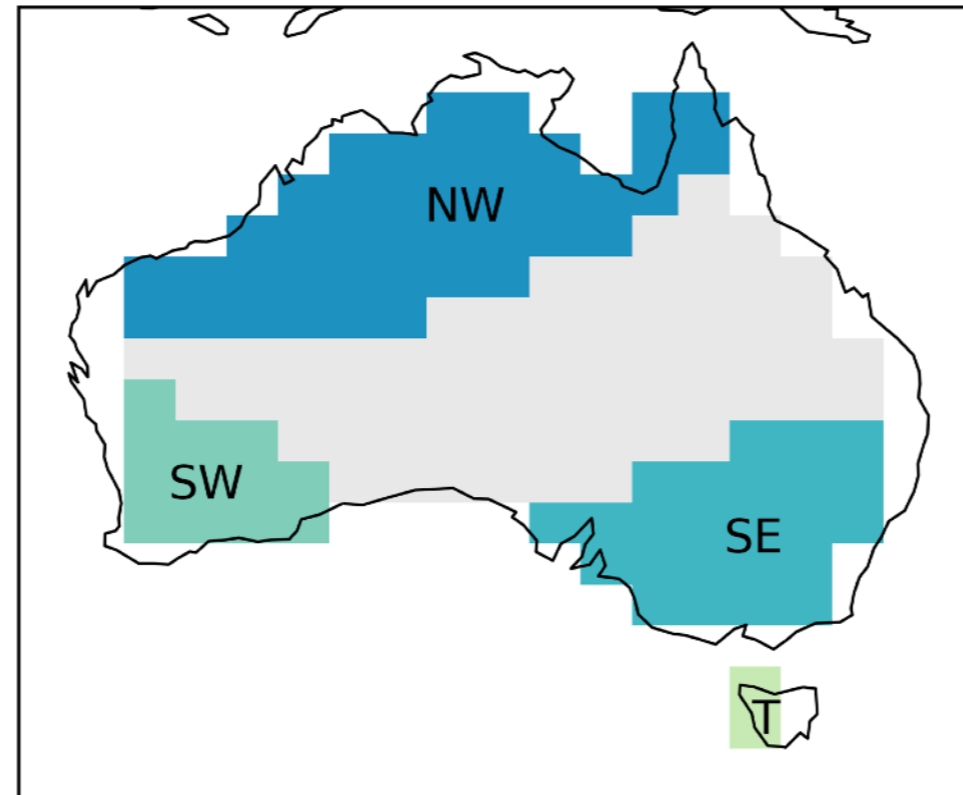


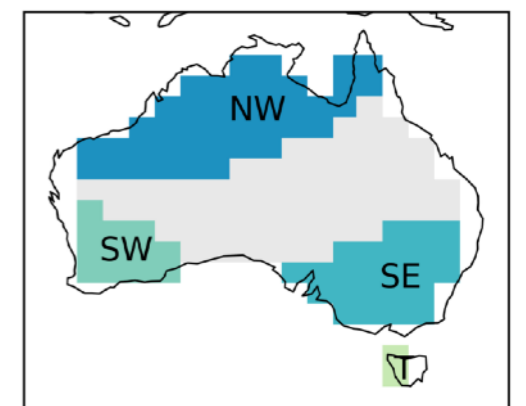
Brier skill relative to chance, temp and rainfall



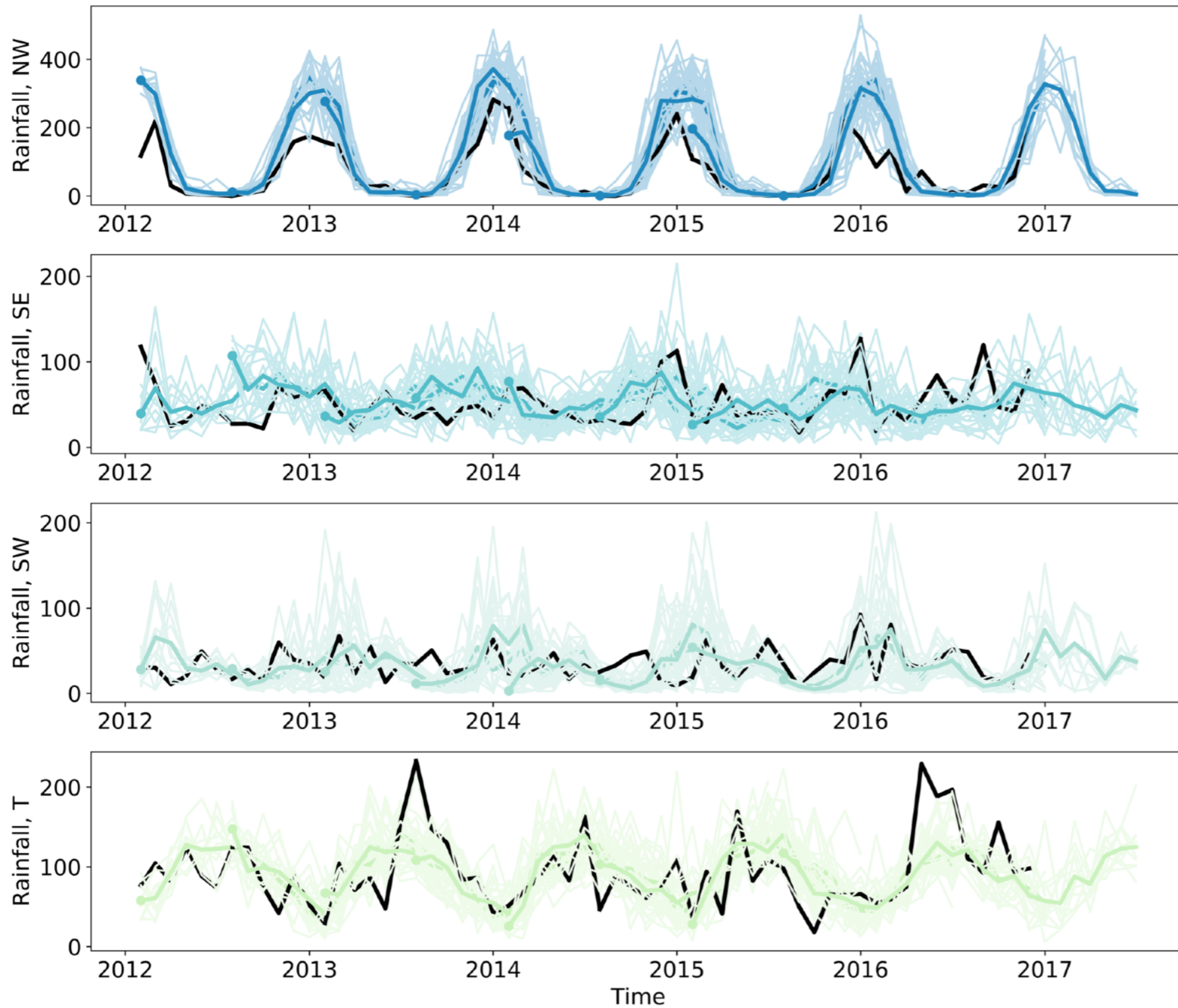
Brier skill relative to climatology, temp and rainfall



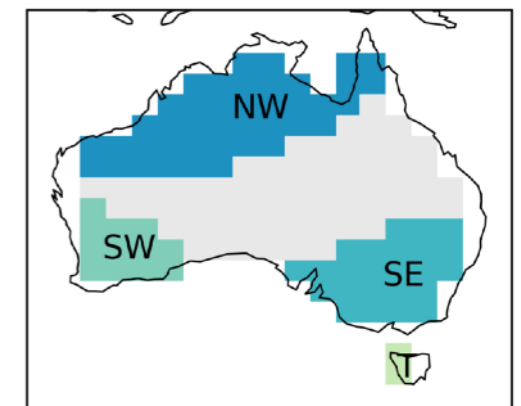




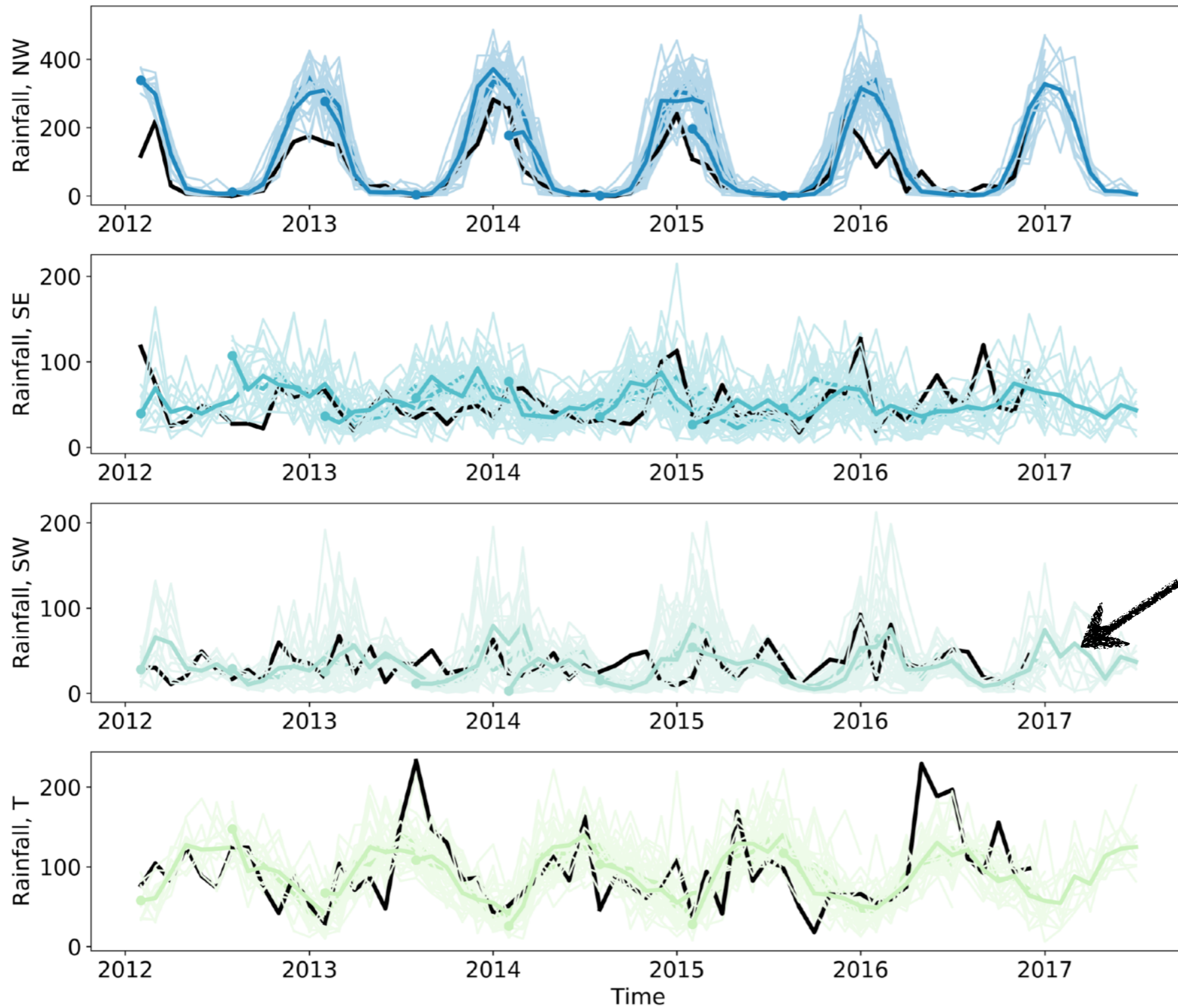
Time series, regional rainfall



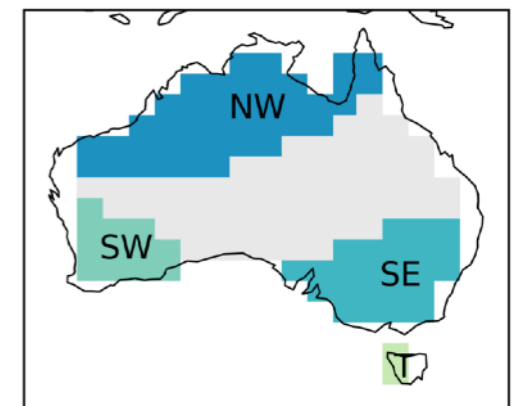
— ensemble member
● ensemble mean
- - observations



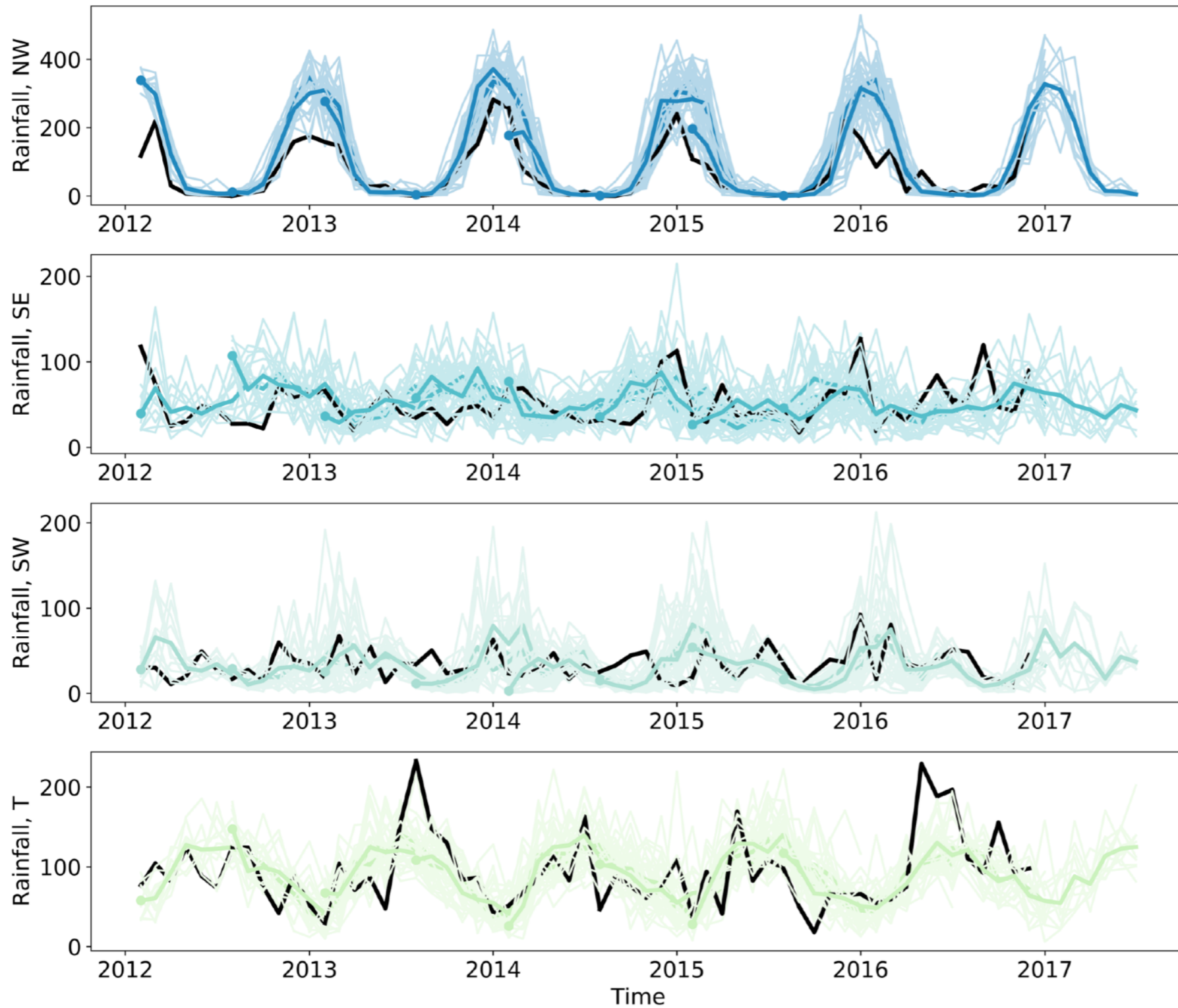
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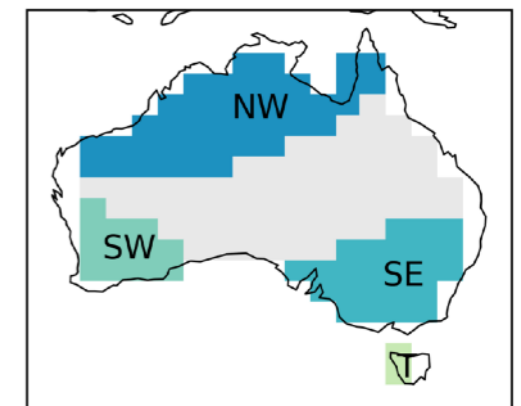
No seasonal cycle in the “observations” in south-west...



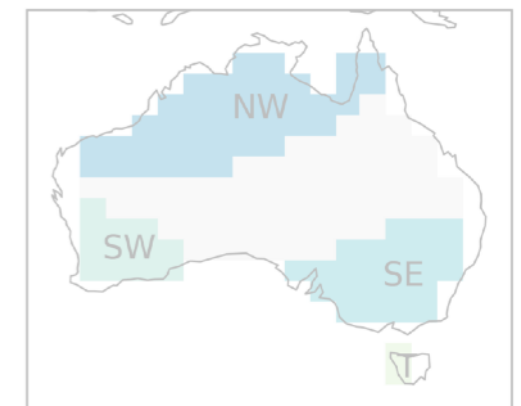
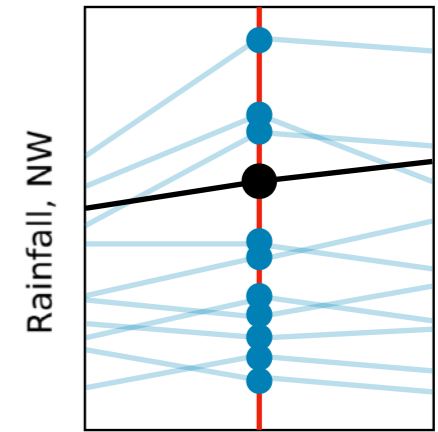
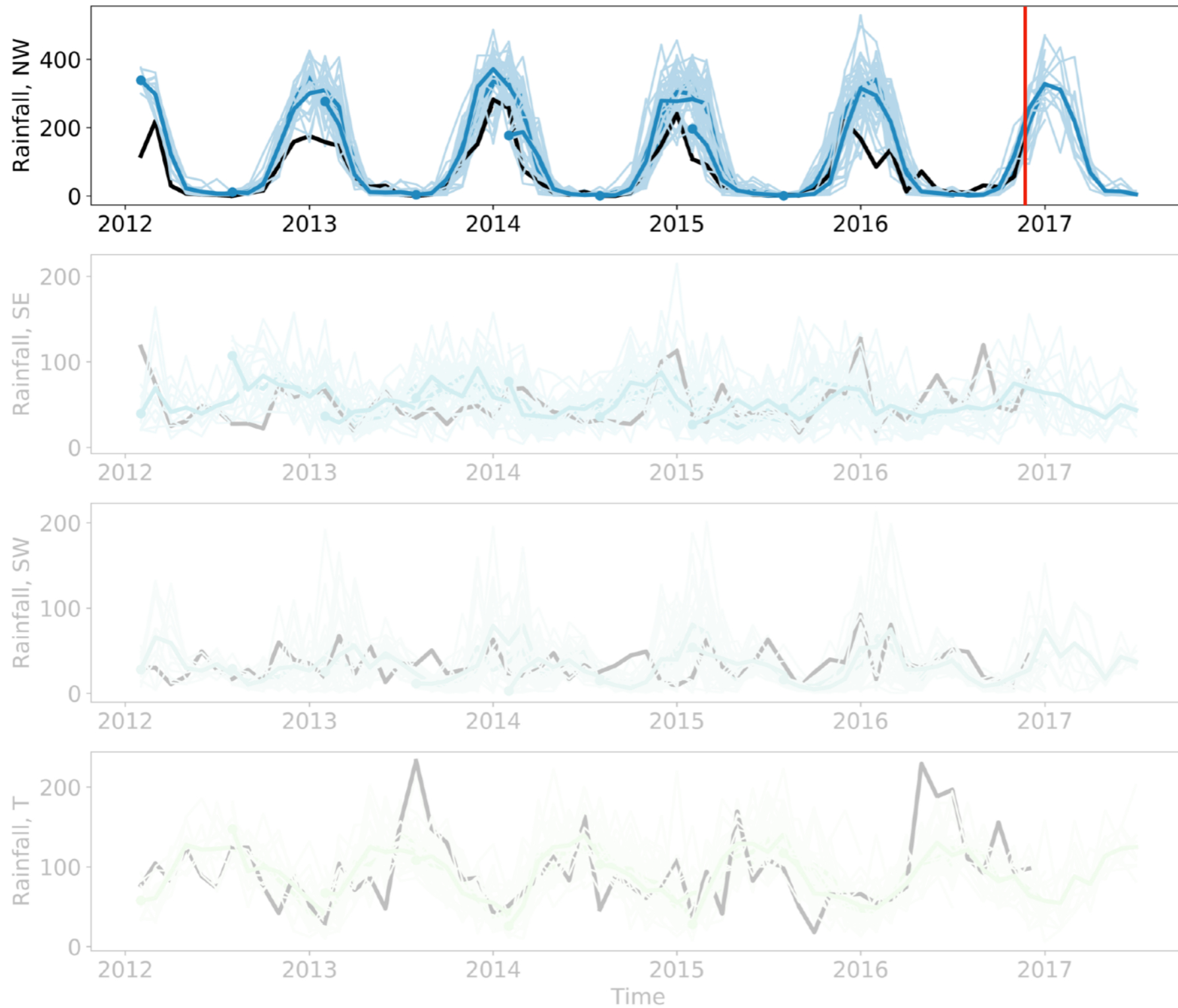
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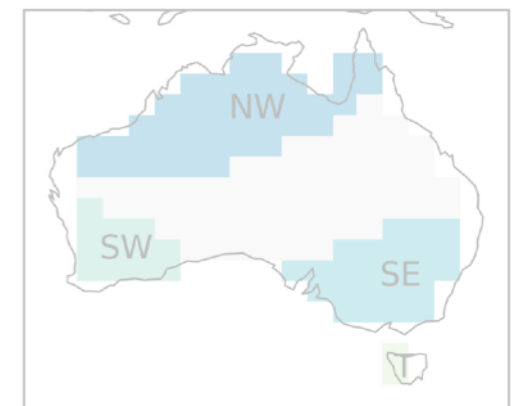
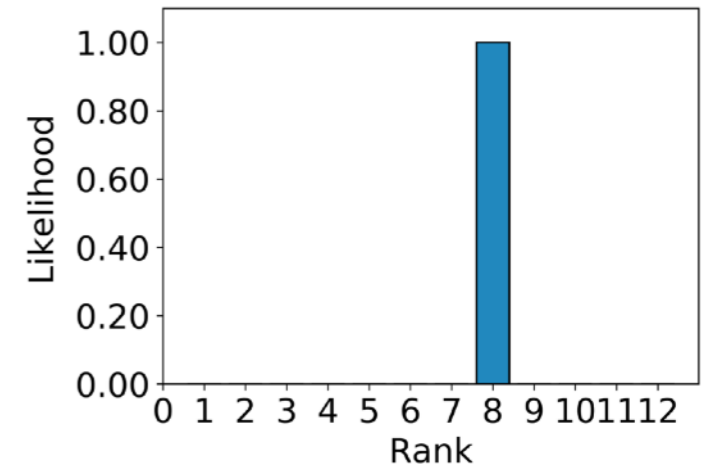
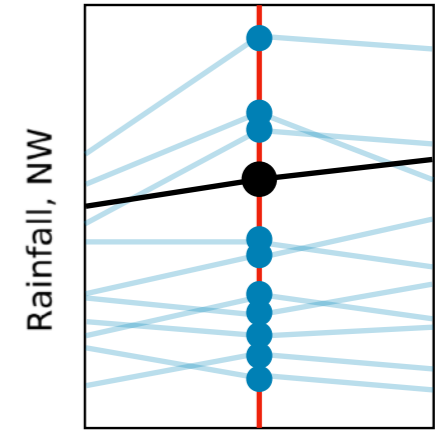
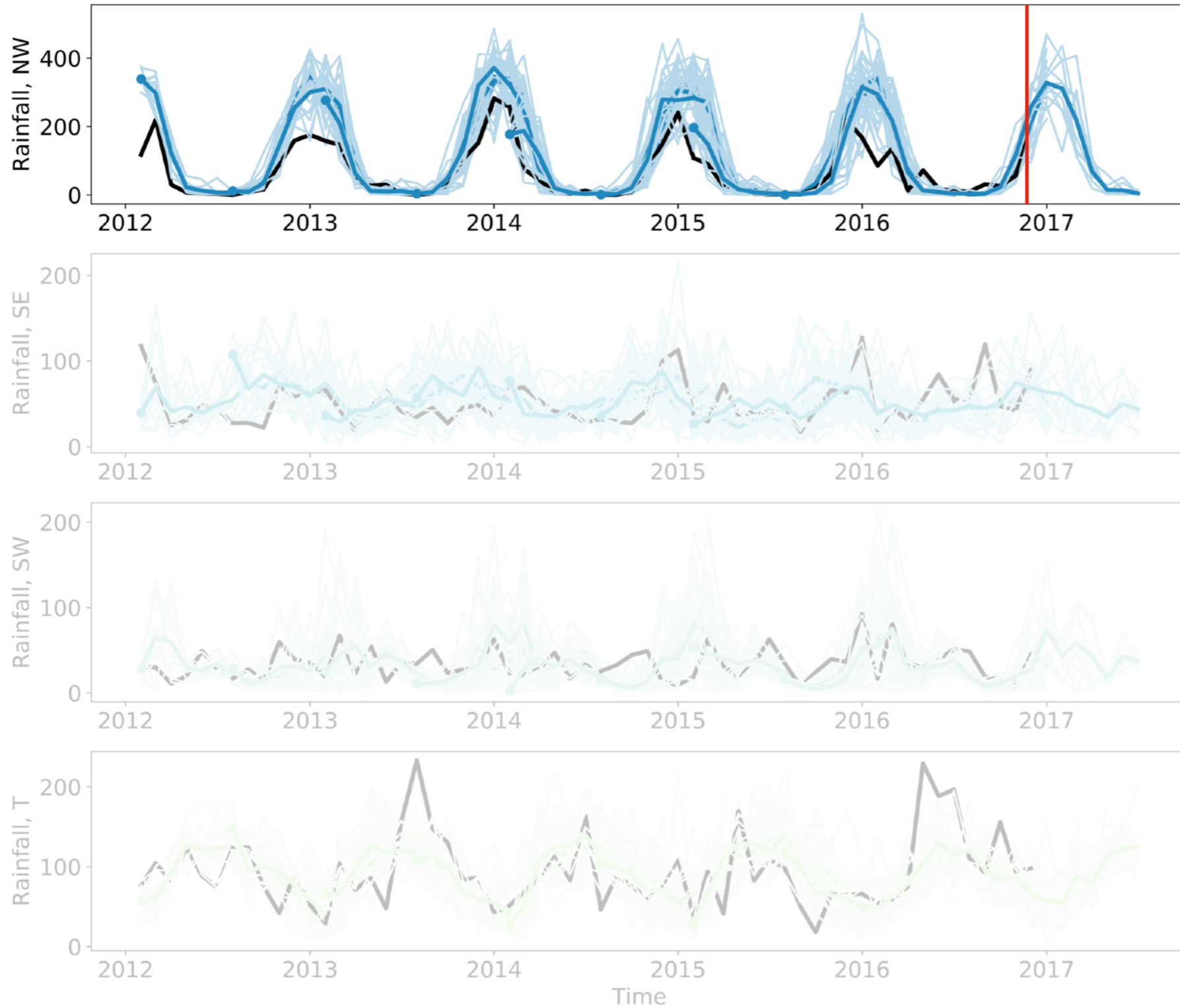
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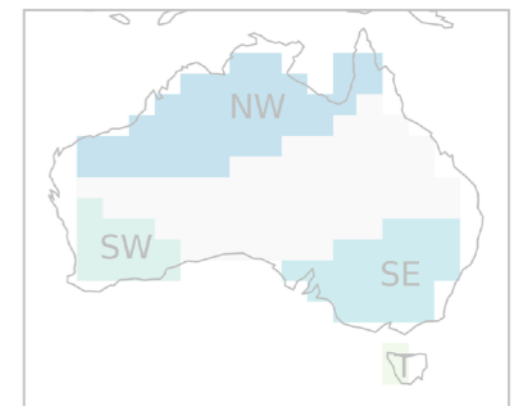
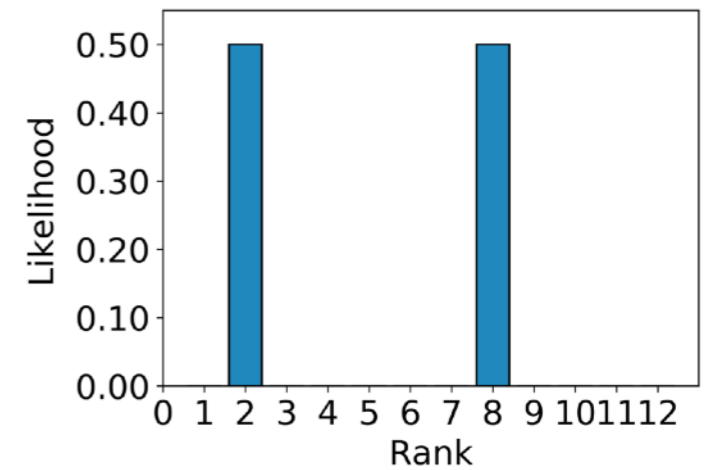
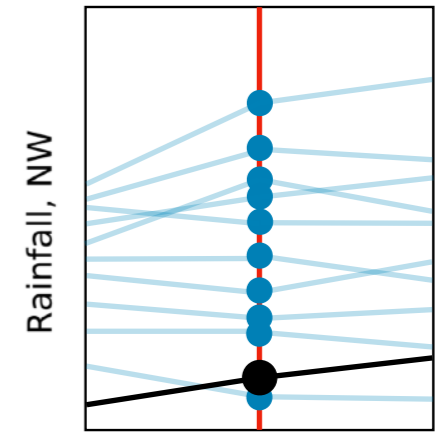
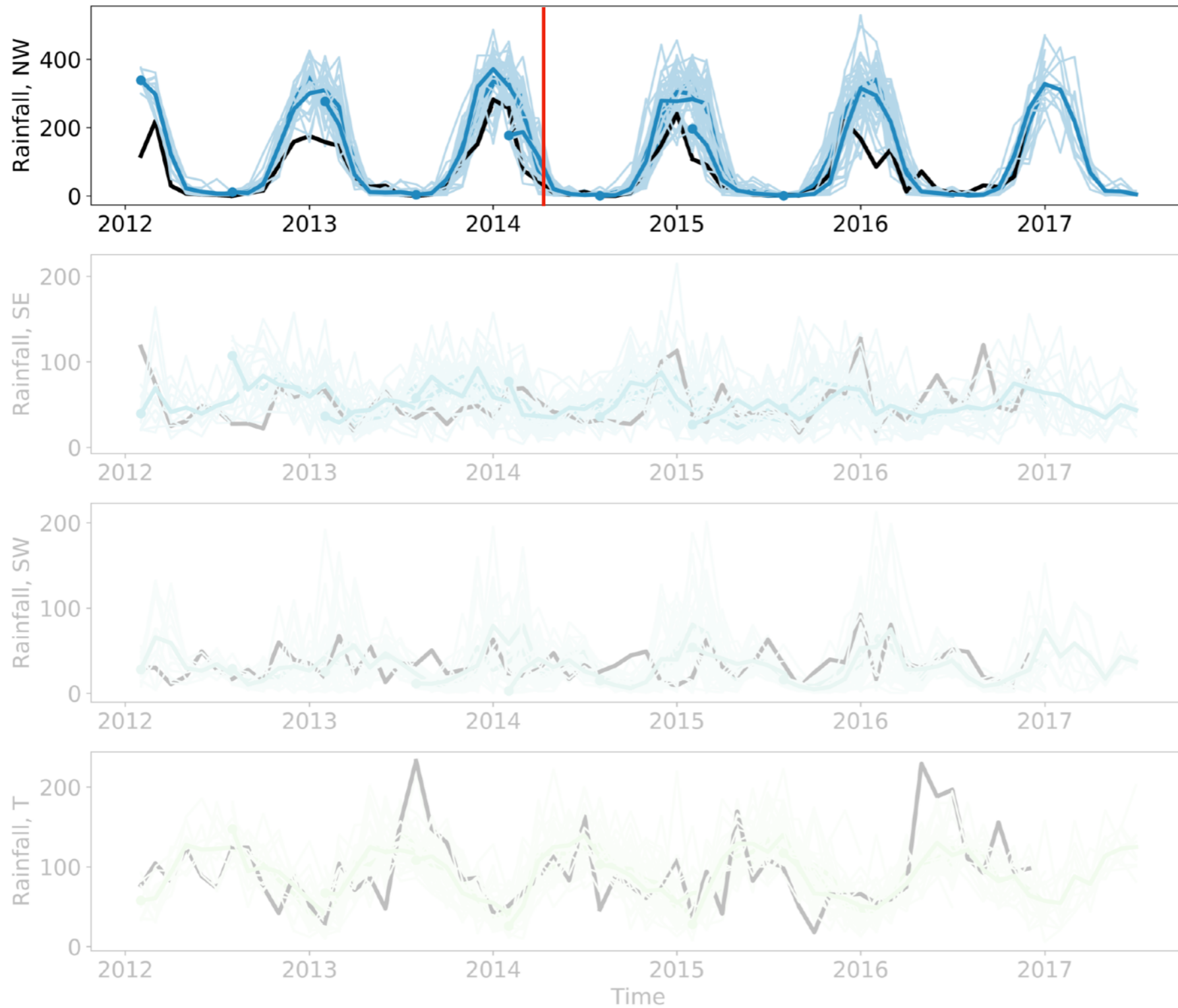
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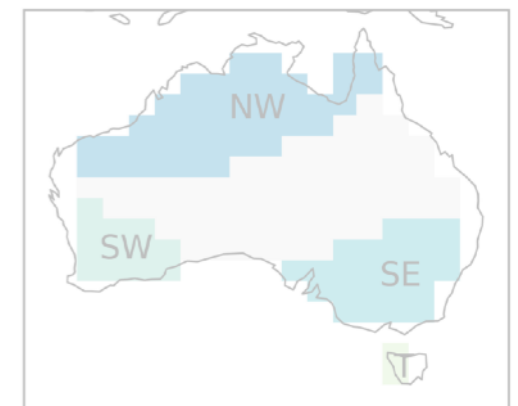
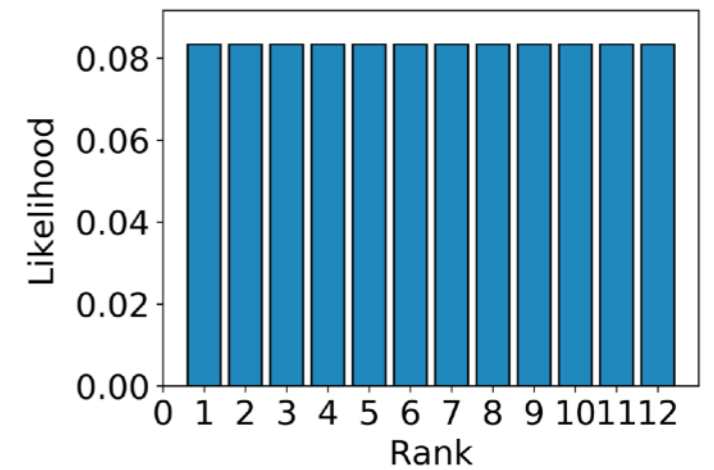
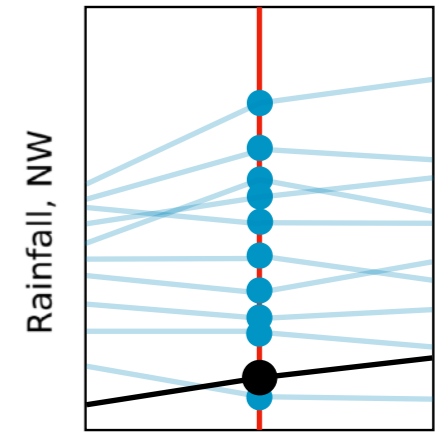
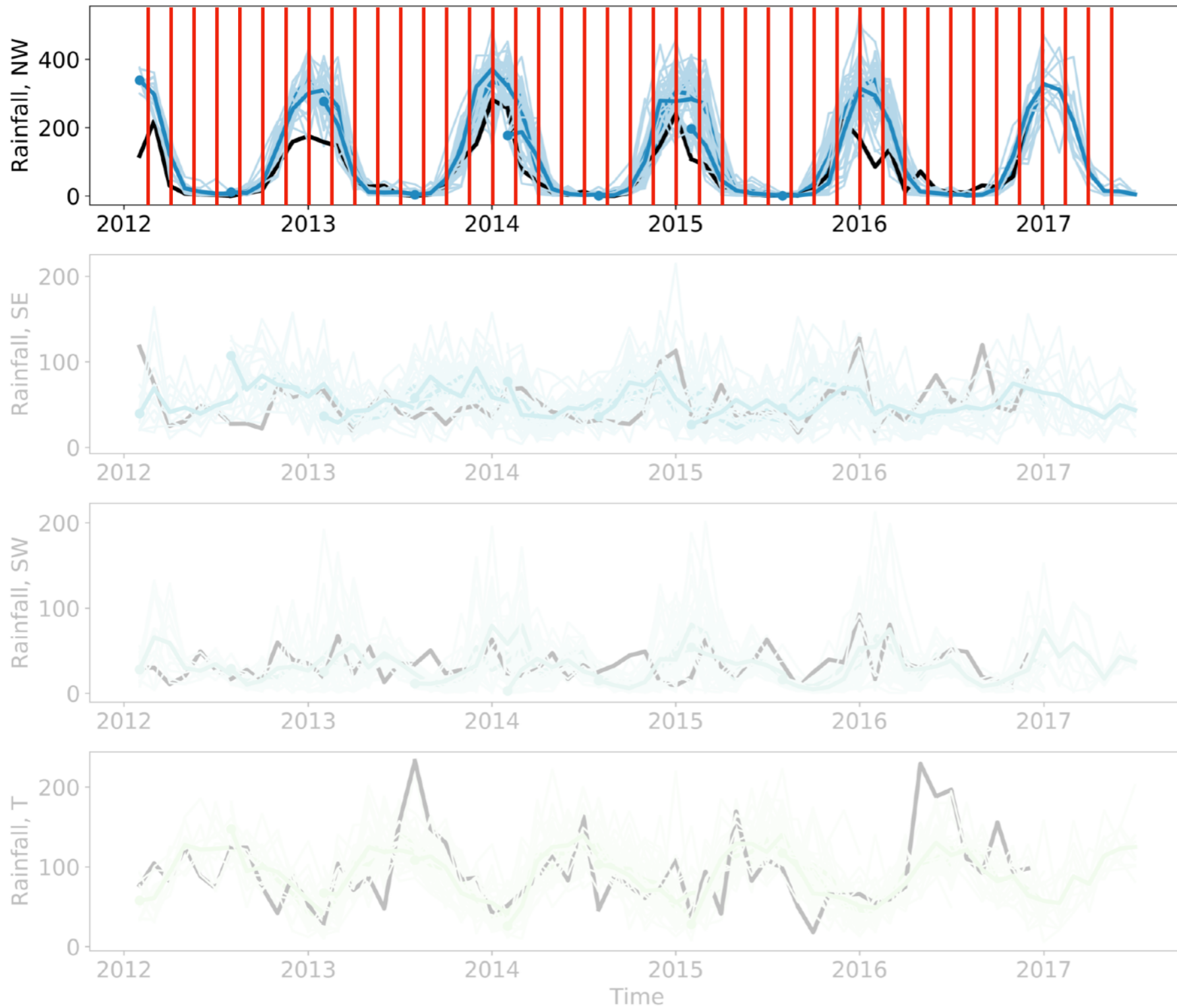
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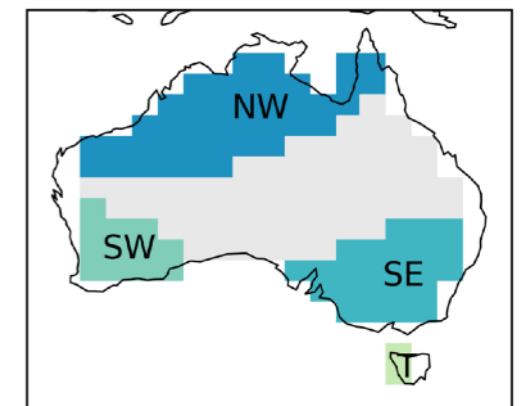
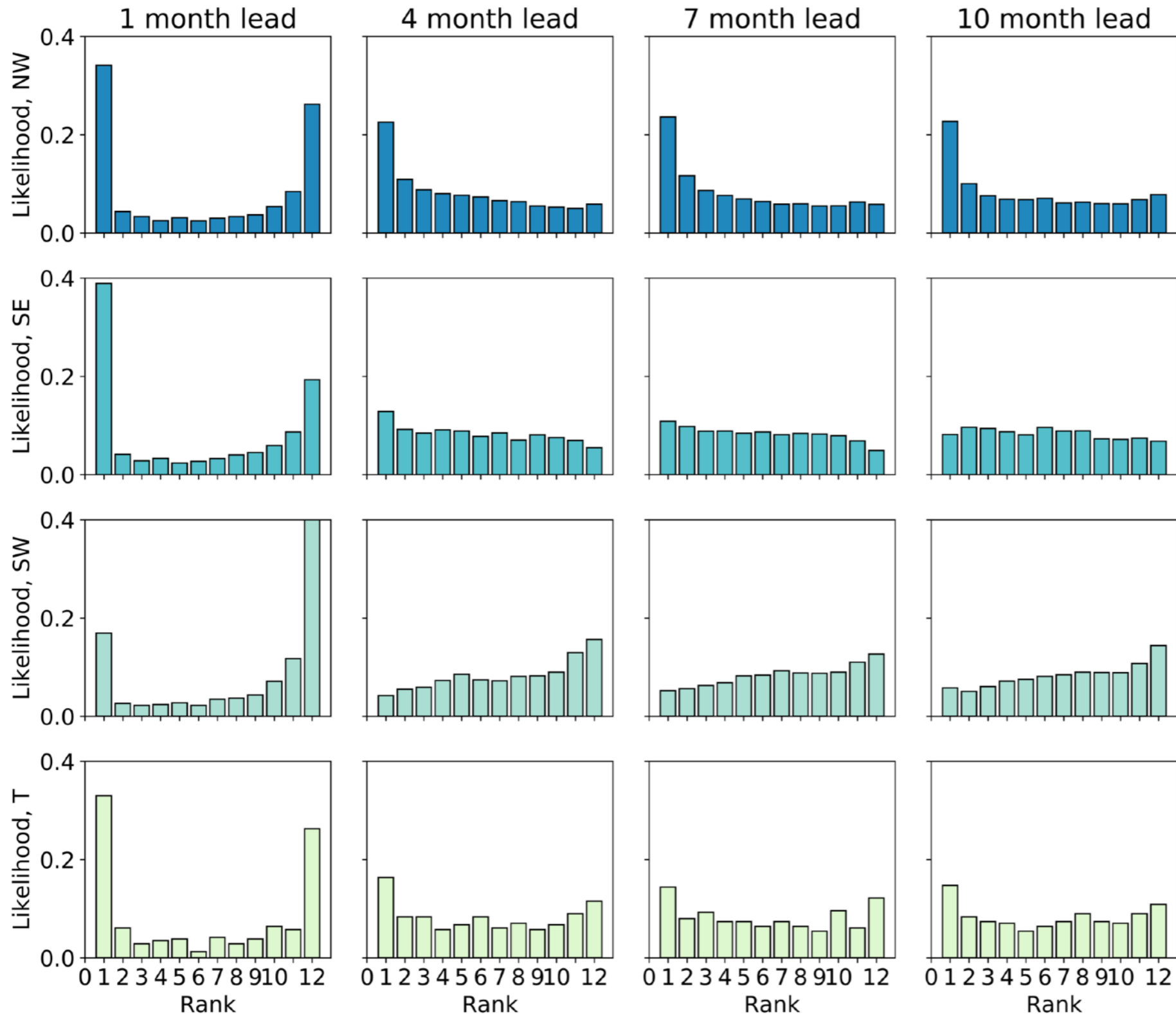
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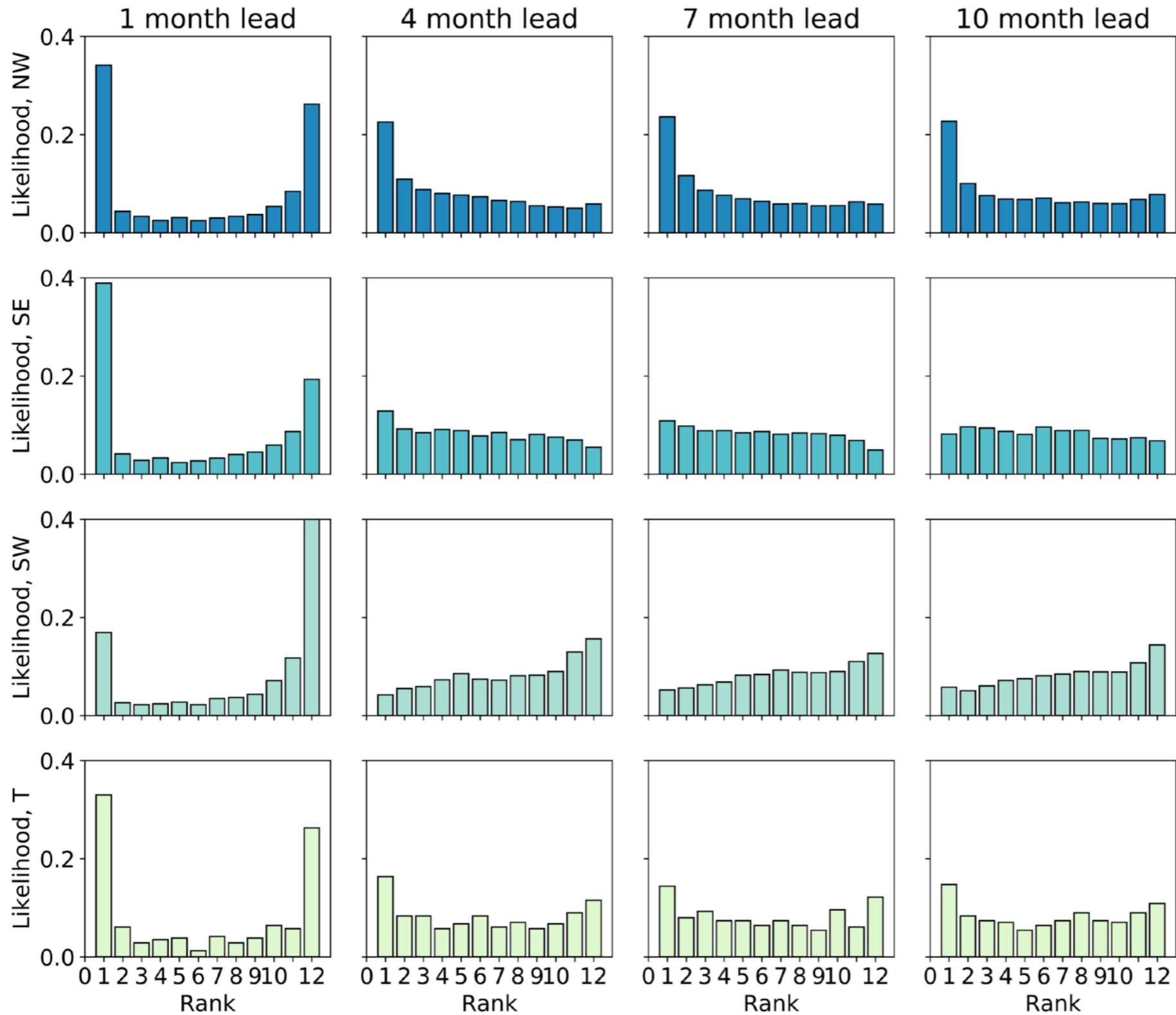
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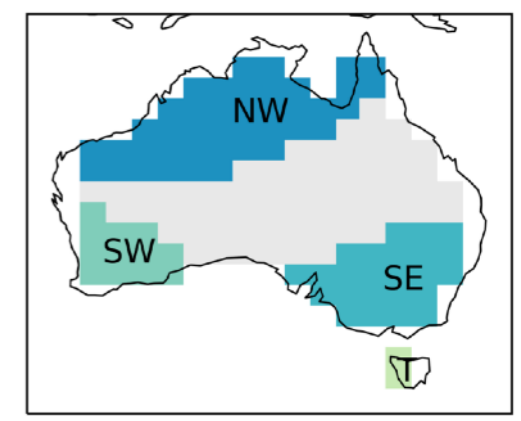
Rank histograms, regional rainfall



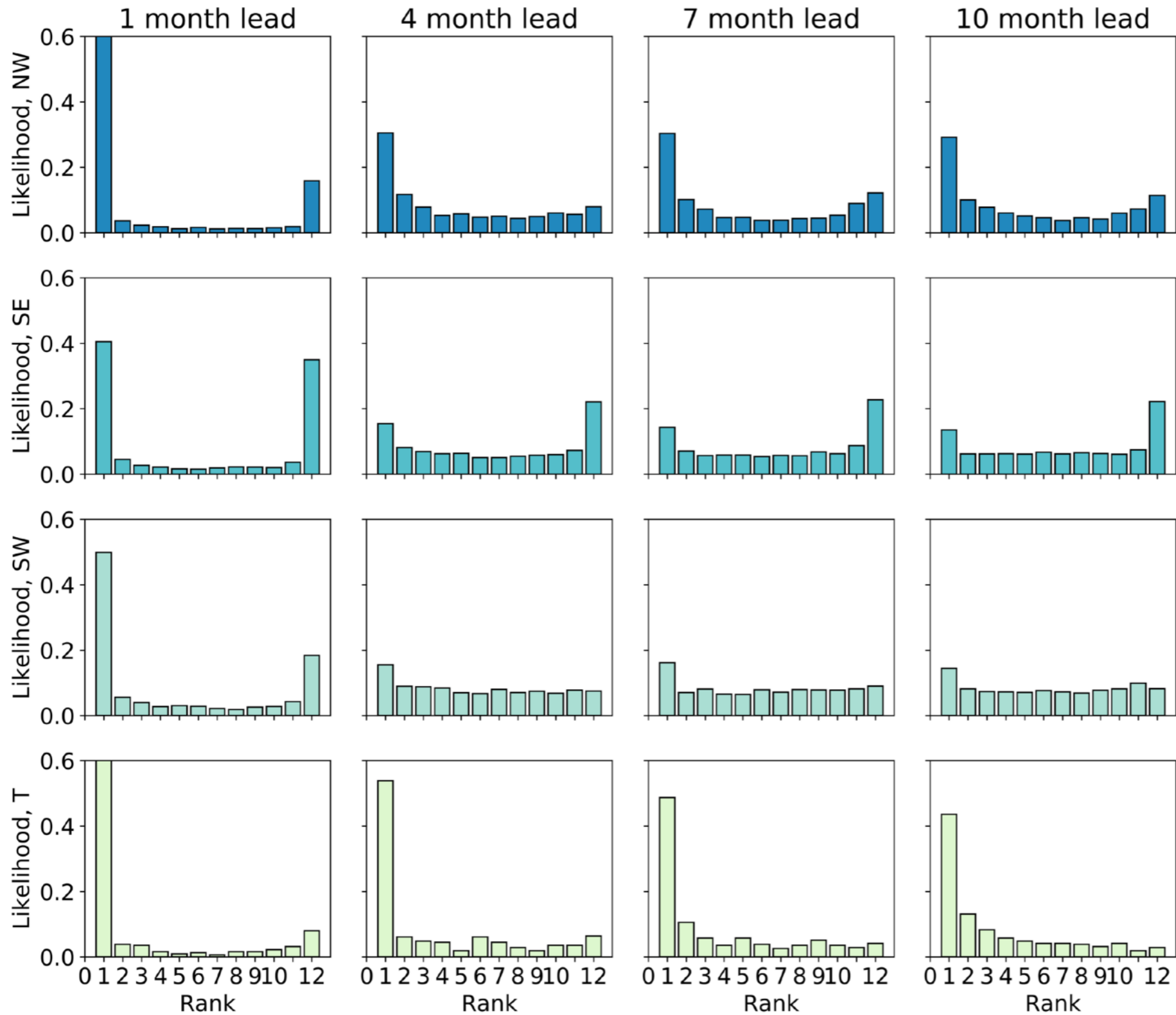
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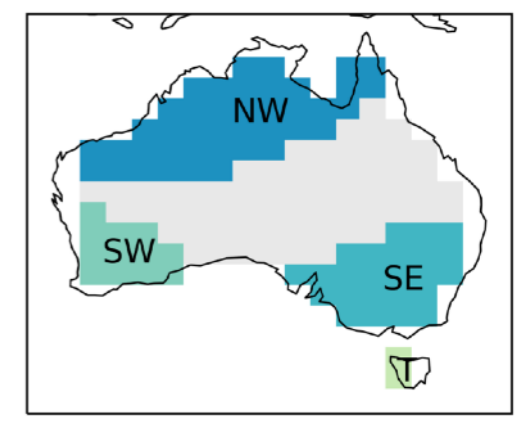
✓ Well constructed ensembles



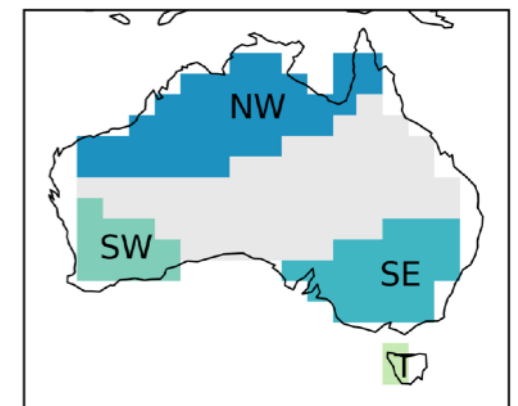
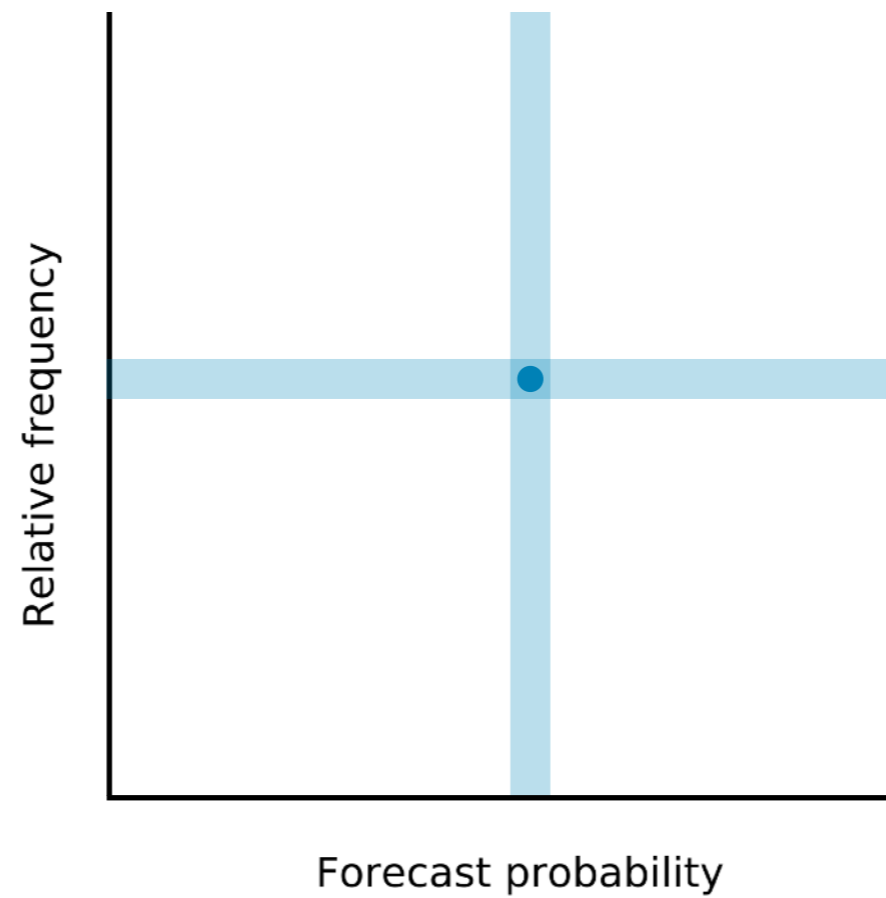
Rank histograms, regional temp



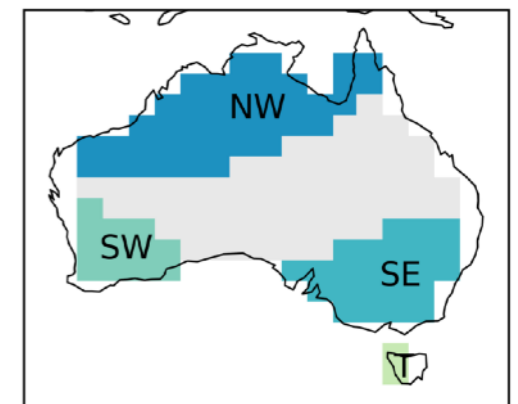
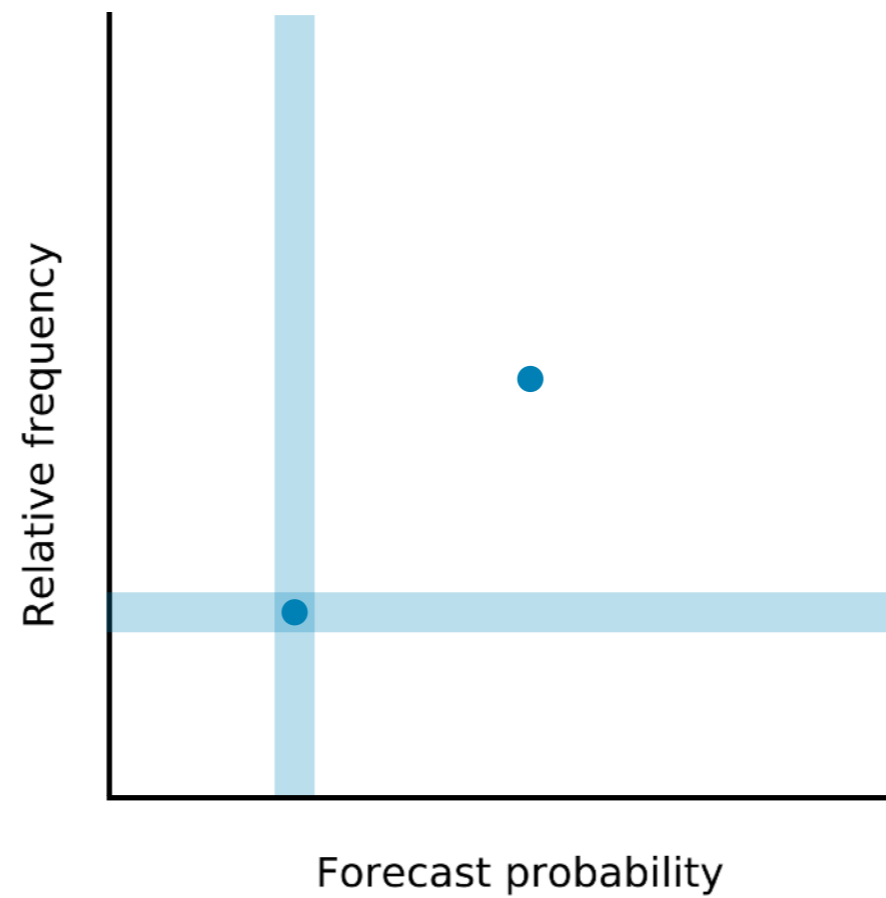
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Reliability diagrams

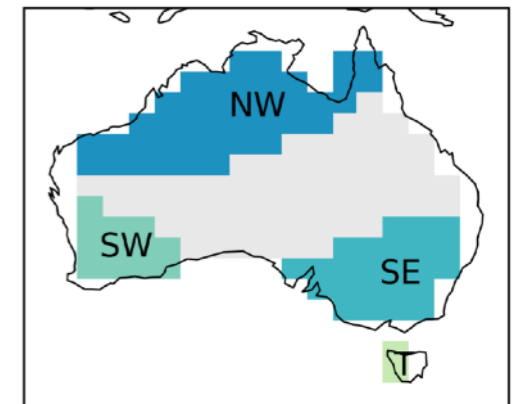
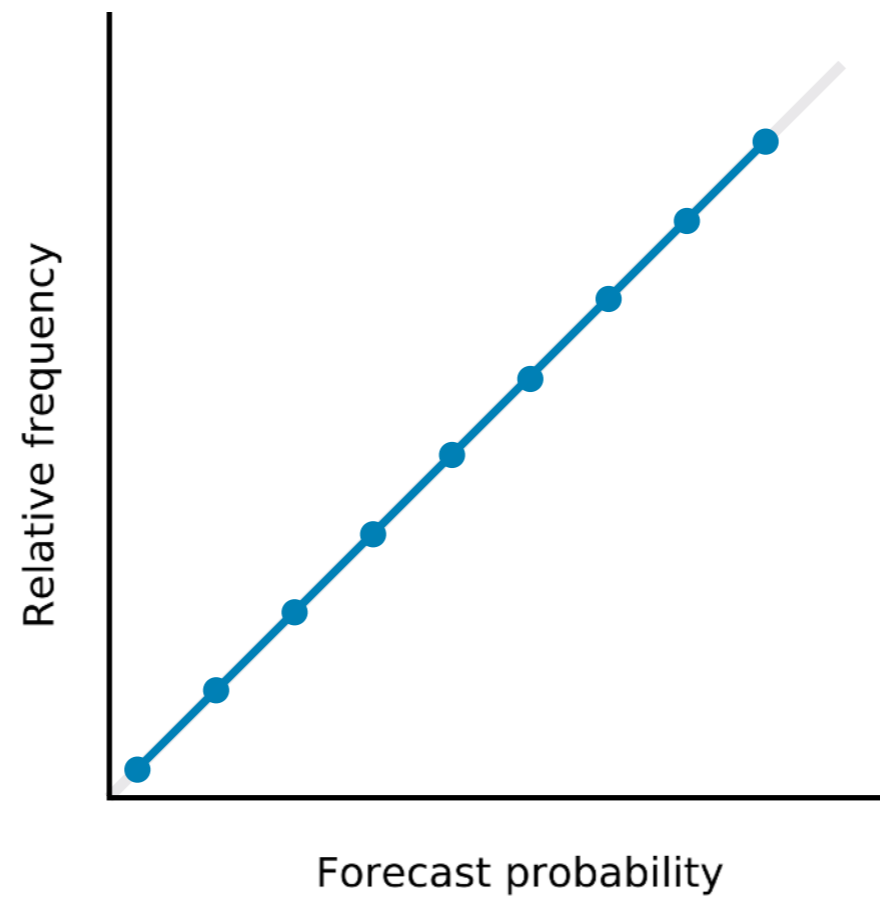


Reliability diagrams



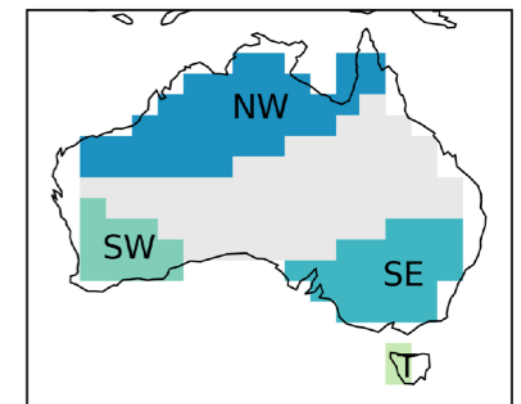
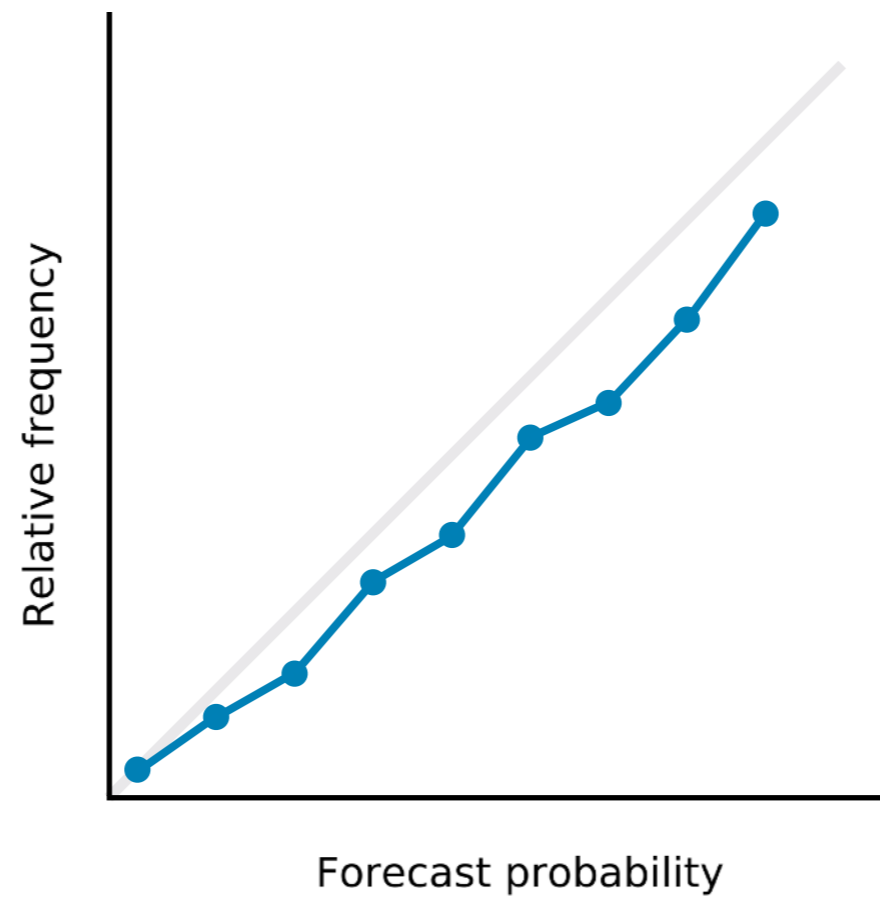
Reliability diagrams

Perfect skill



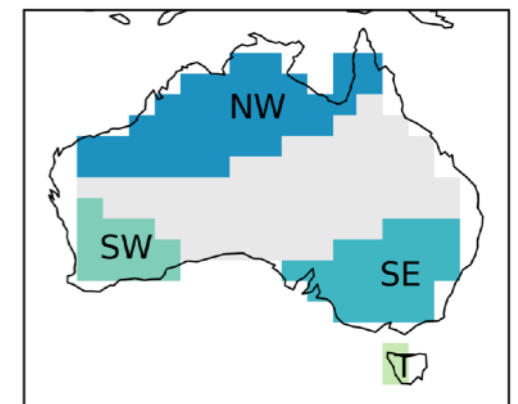
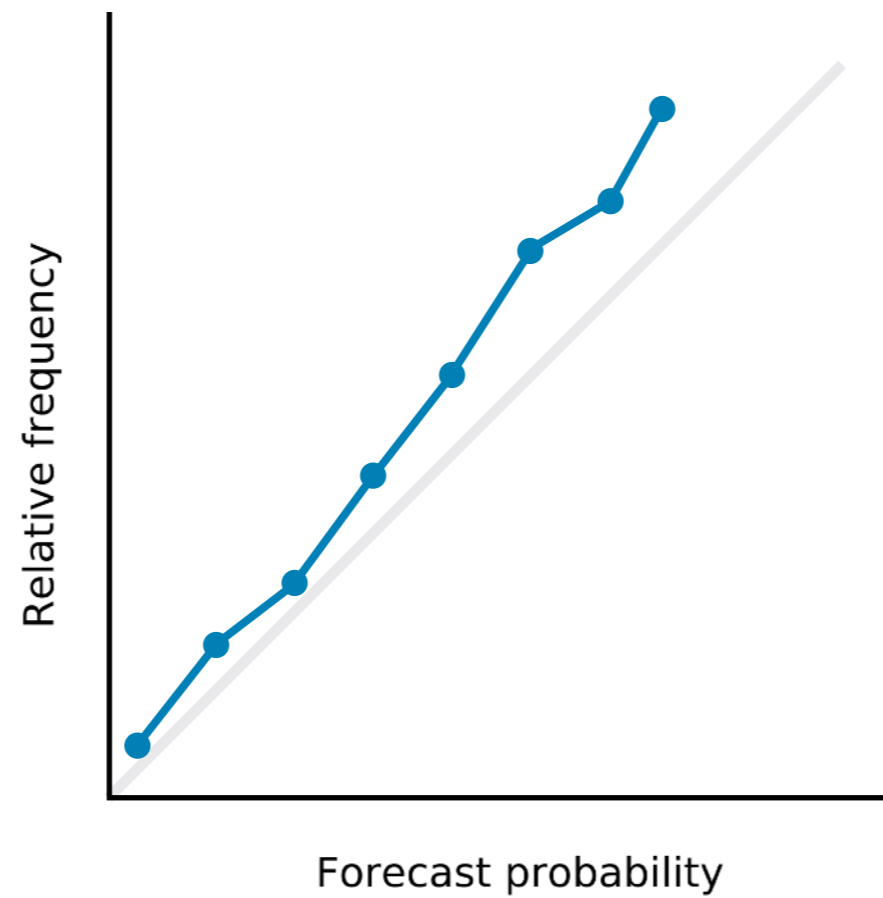
Reliability diagrams

Over confidence

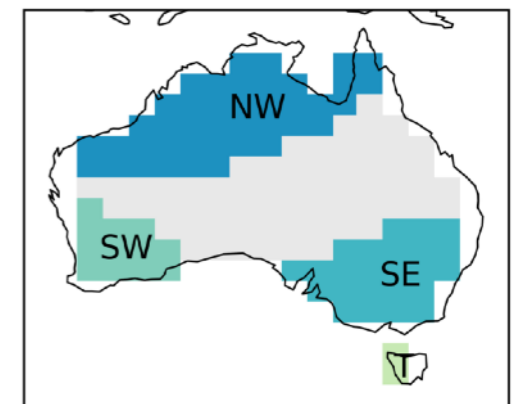
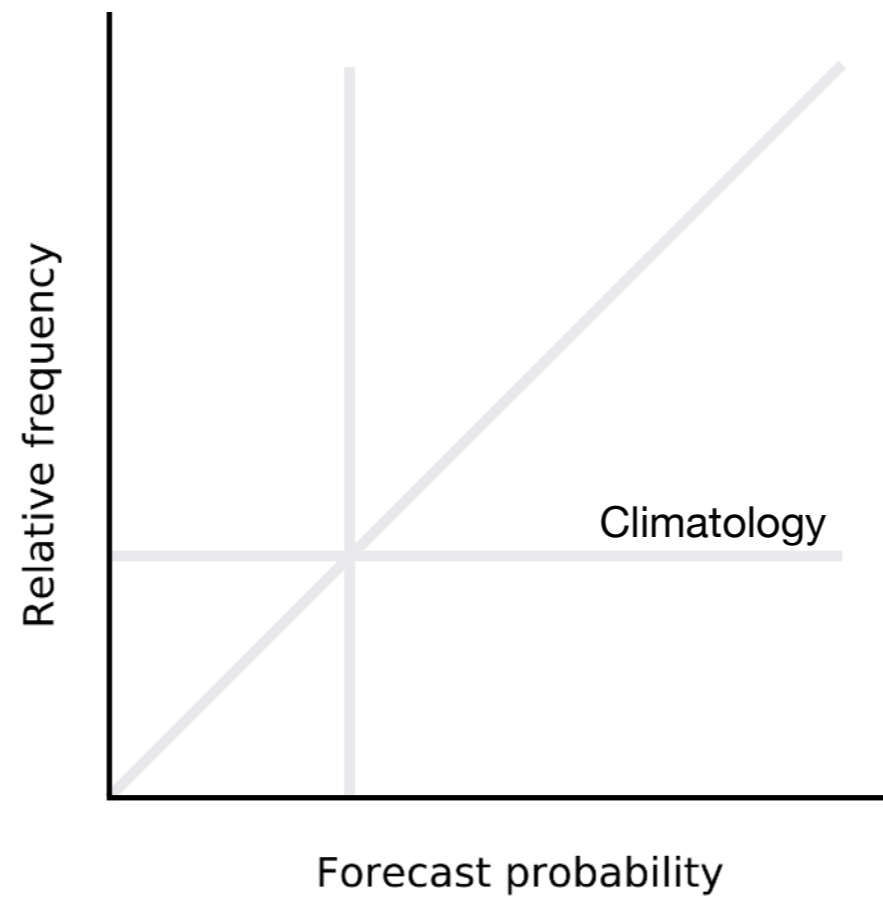


Reliability diagrams

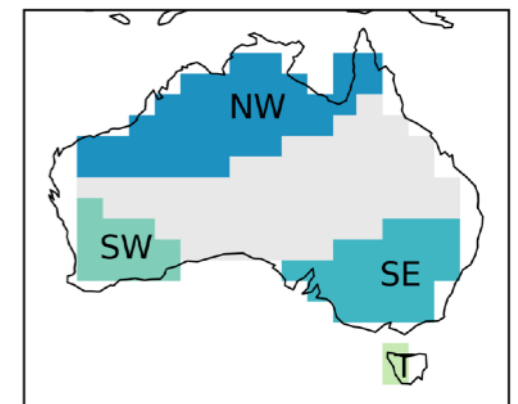
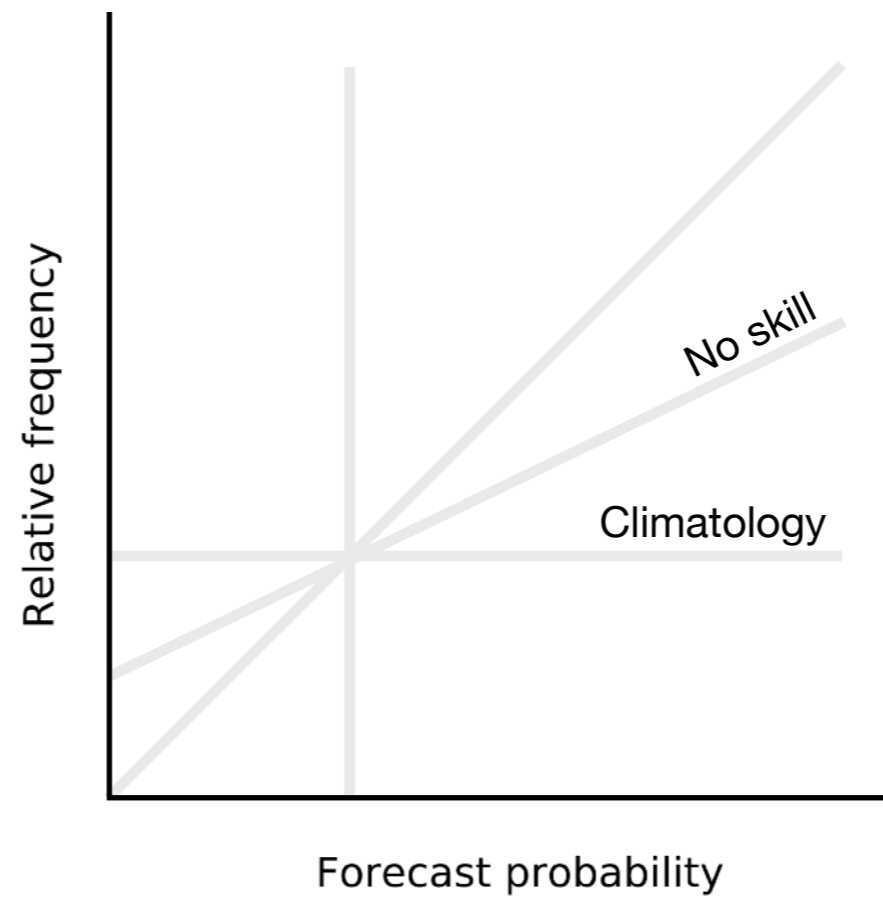
Under confidence



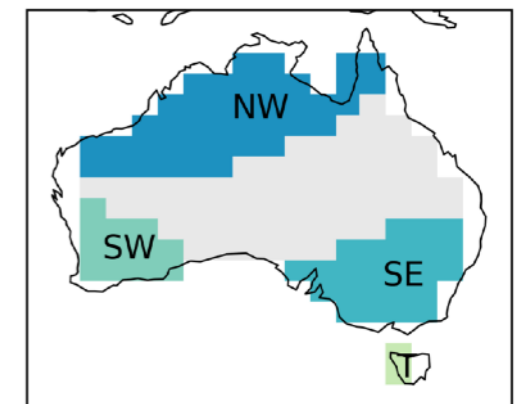
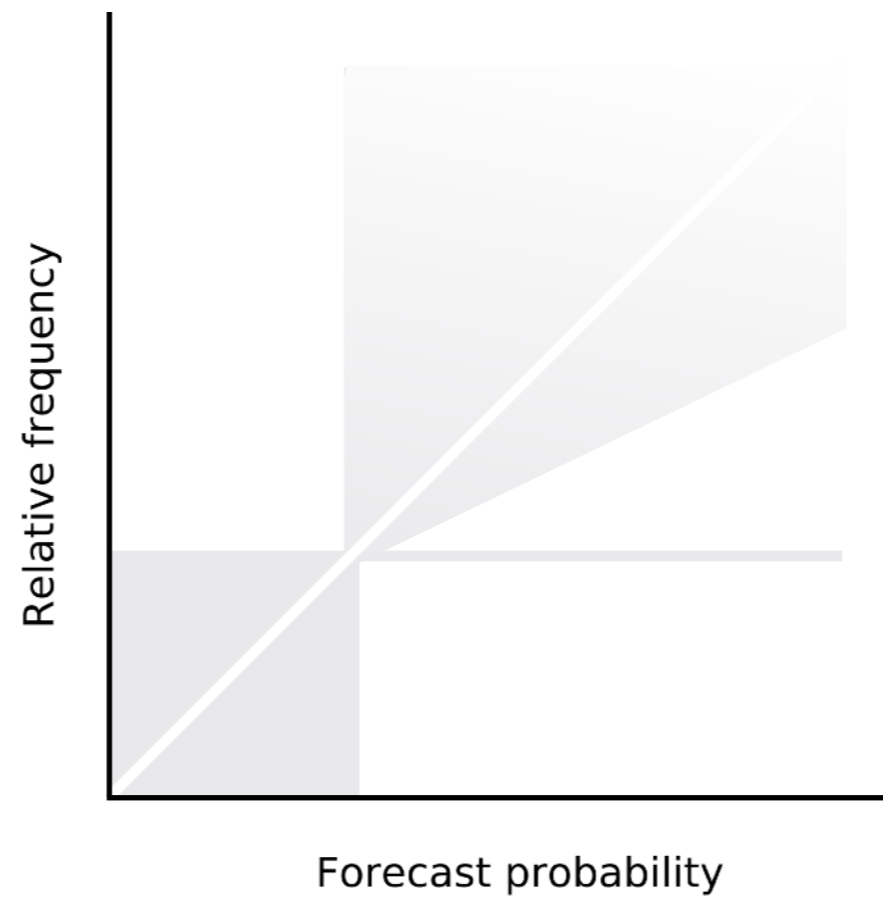
Reliability diagrams



Reliability diagrams



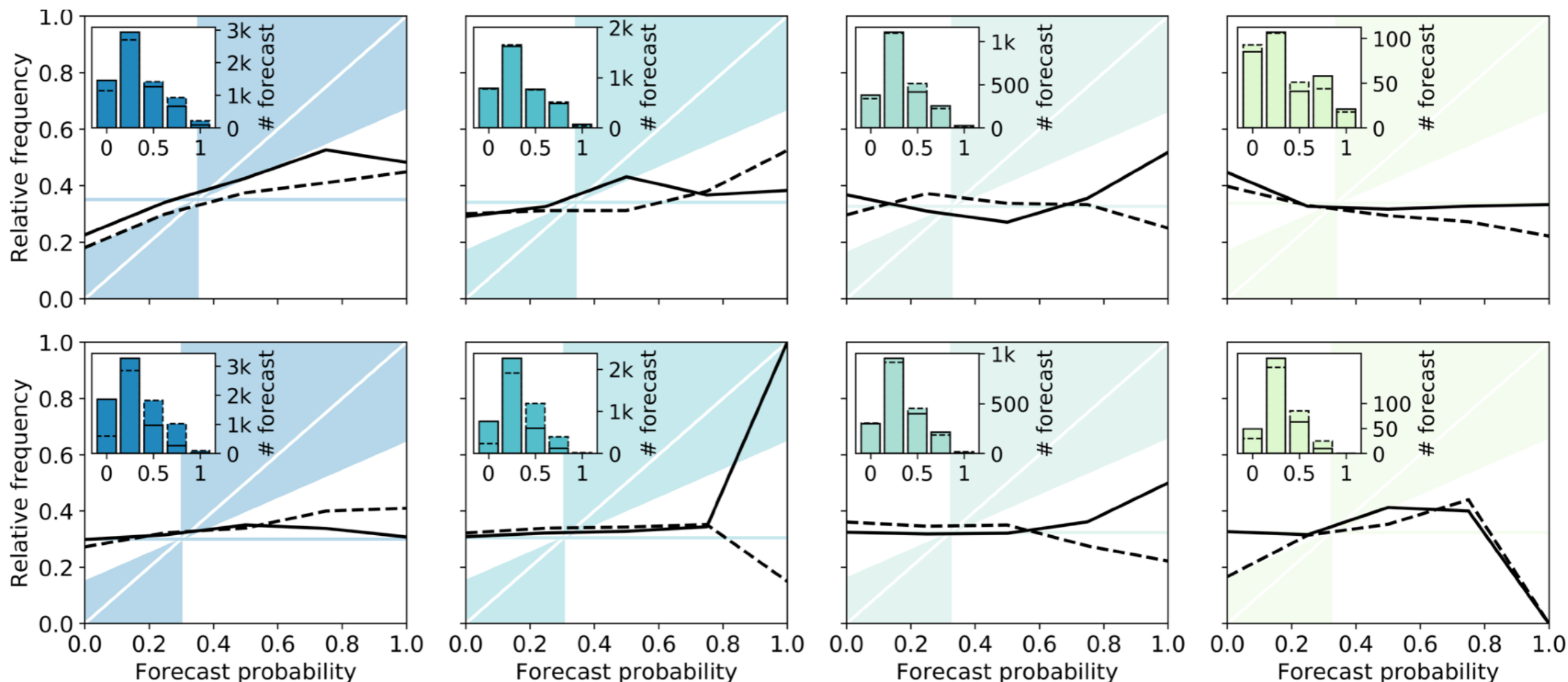
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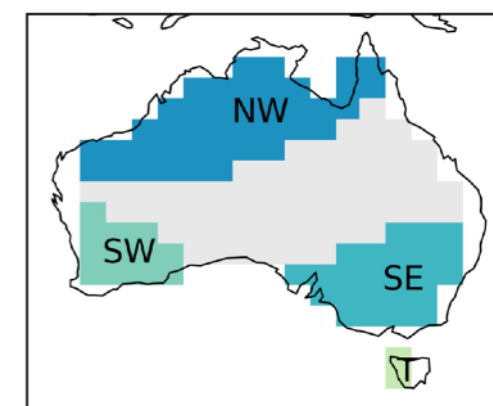
Reliability diagrams, regional temp and rainfall

4 month lead

Hot
Cold

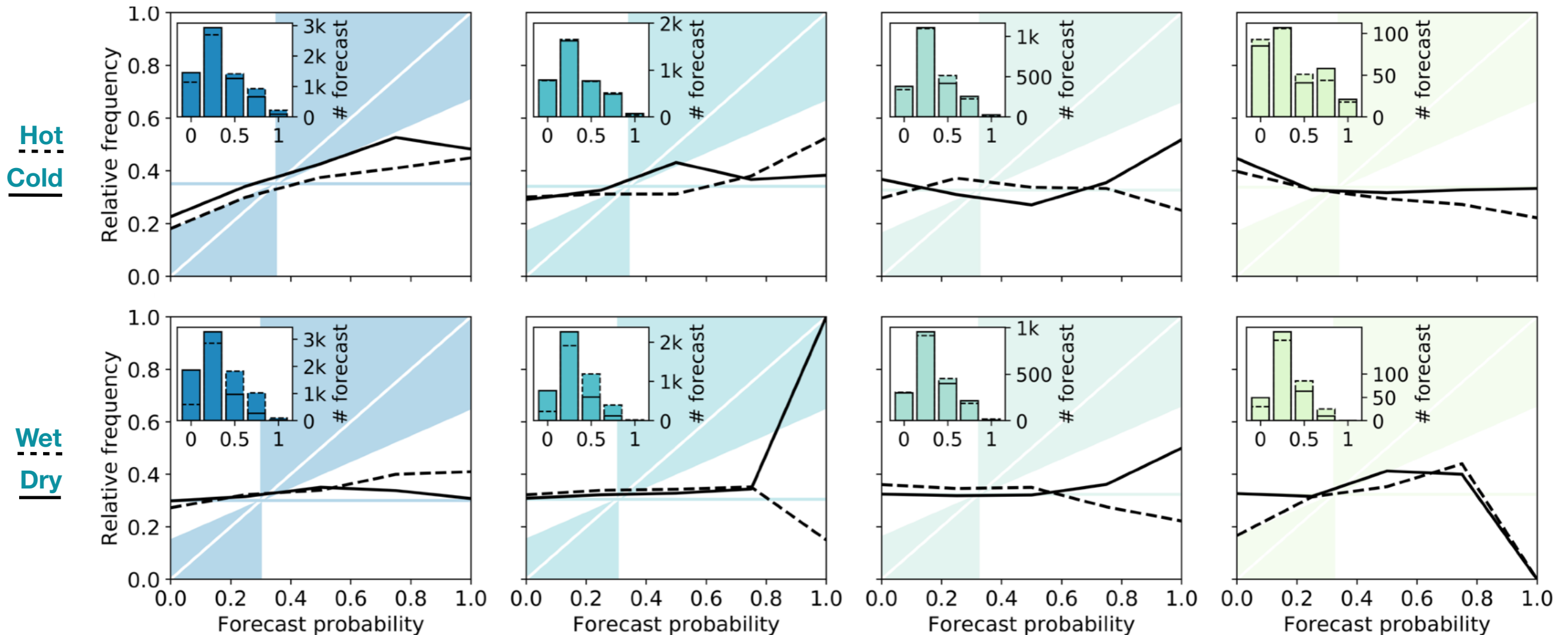


Wet
Dry

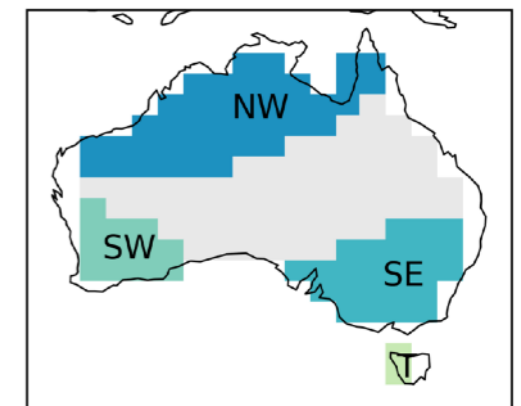


Reliability diagrams, regional temp and rainfall

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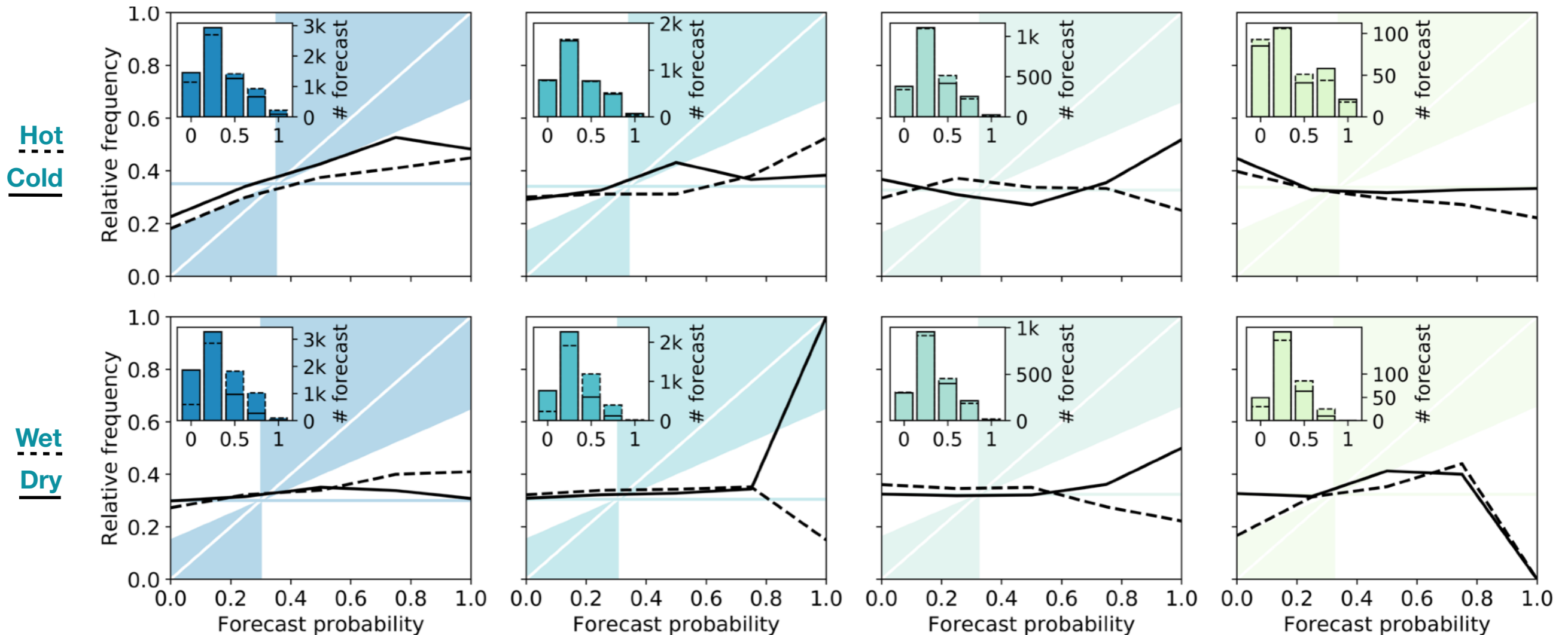


- Generally poor reliability and low resolution

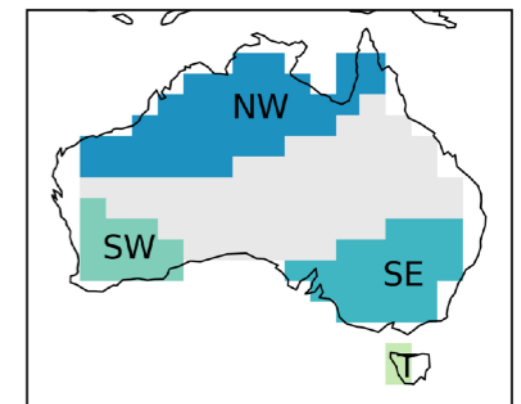


Reliability diagrams, regional temp and rainfall

4 month lead



- Generally poor reliability and low resolution
- Low sharpness

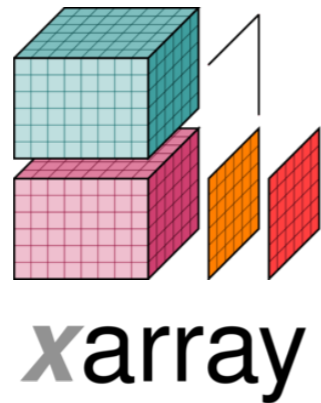


Conclusions

- pyLatte is a verification/diagnostics python package for assessing and visualising the quality of forecast systems

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- pyLatte is a verification/diagnostics python package for assessing and visualising the quality of forecast systems
→ Simple, intuitive and fast

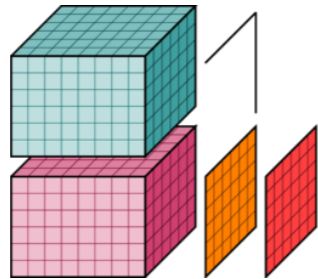


Conclusions

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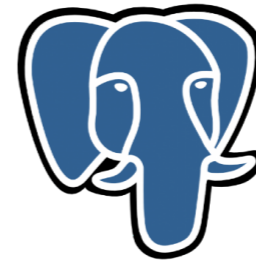
python



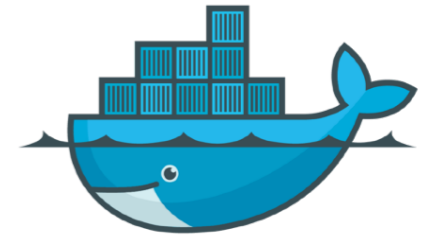
xarray



DASK



PostgreSQL



docker

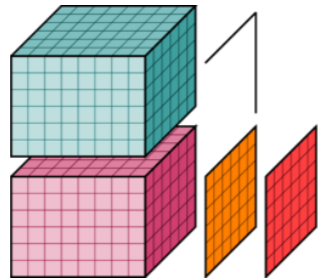
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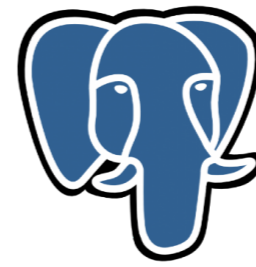
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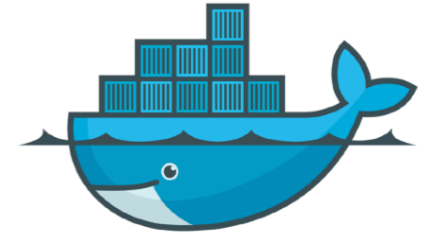
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DASK



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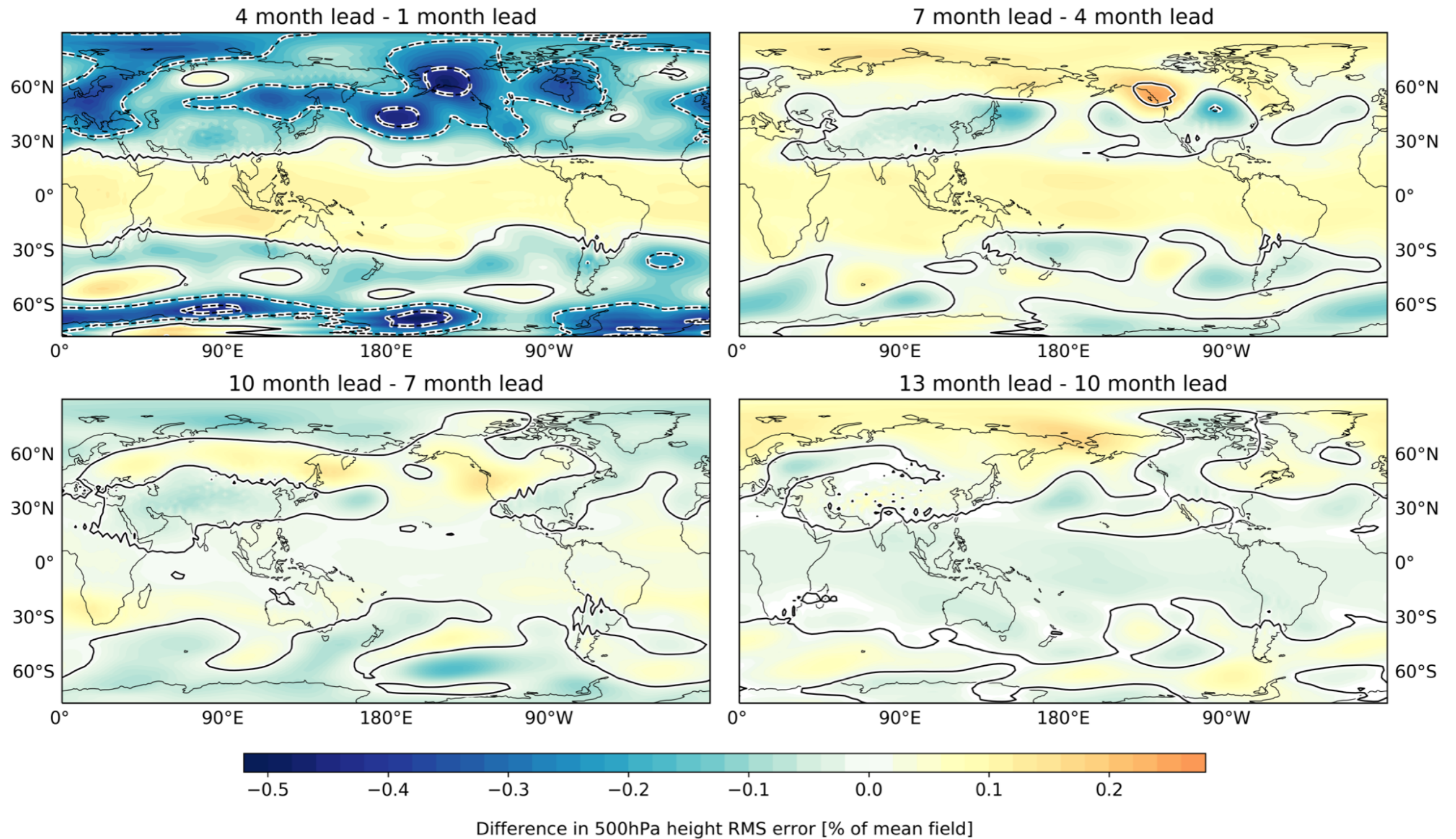


docker

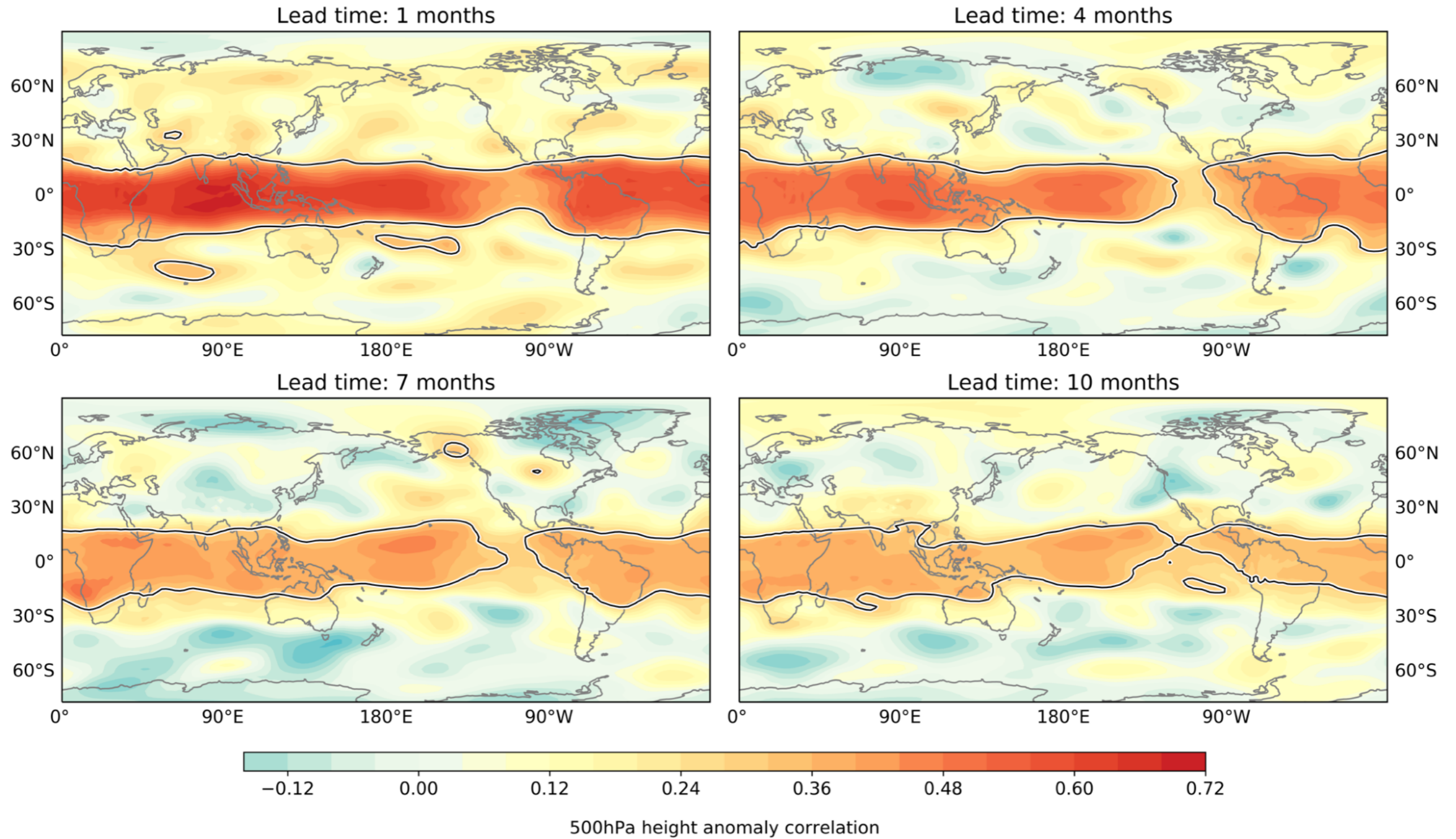
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Thank you

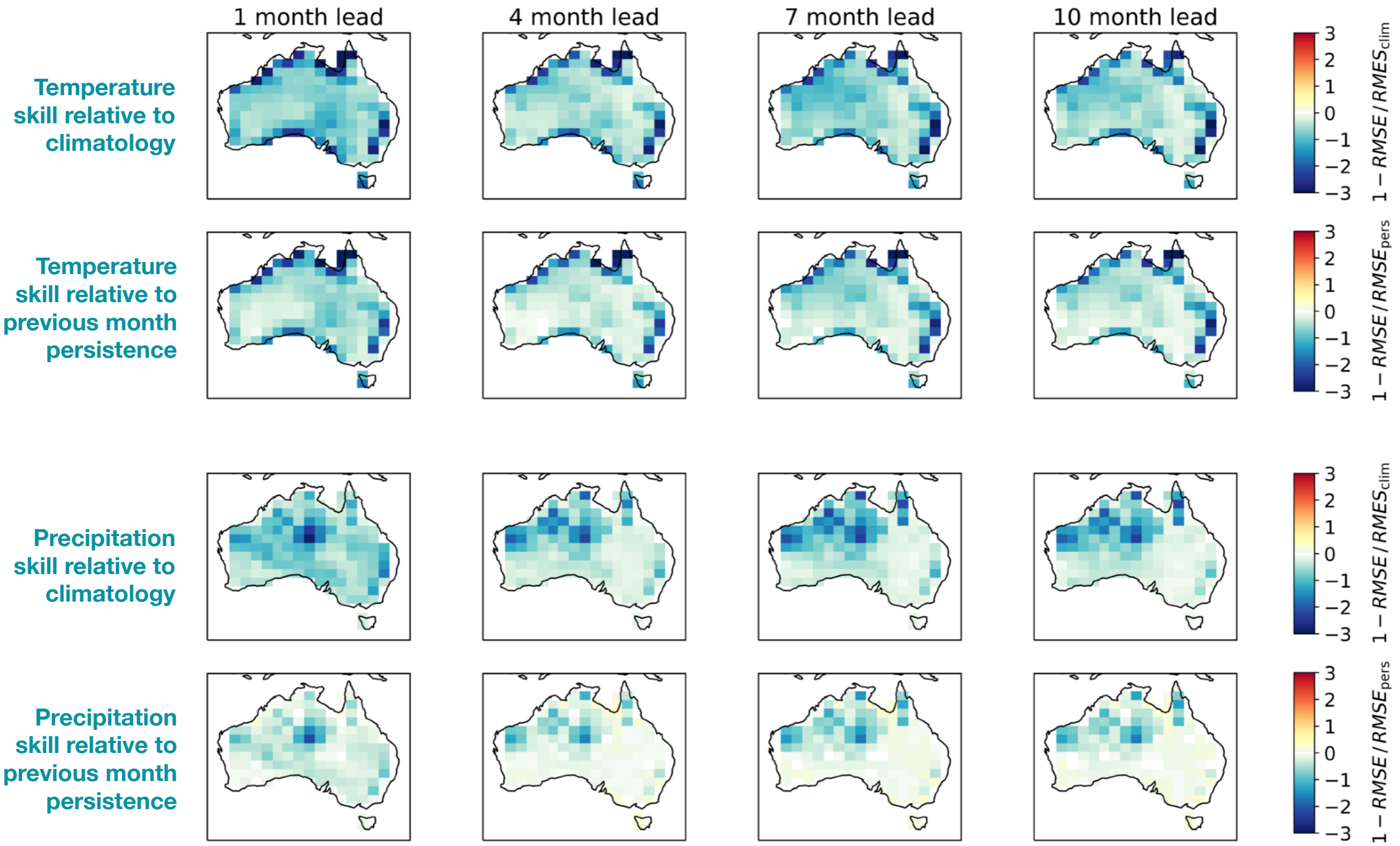
500hPa height rms error difference



500hPa height anomaly correlation



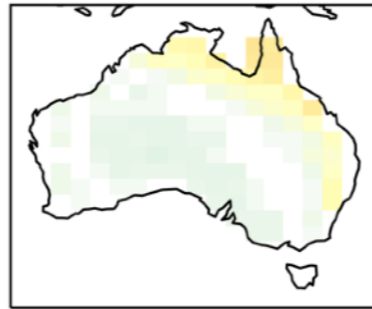
Rainfall and temp, RMSE skill



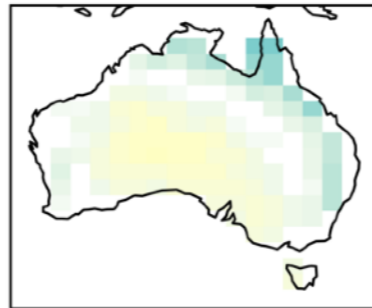
Rainfall and temp, probability anomalies

4 month lead

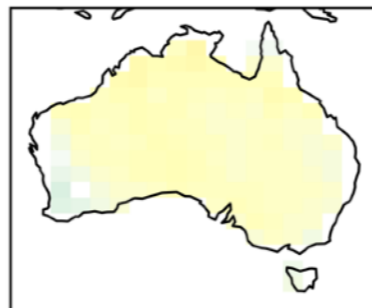
Hot
tercile



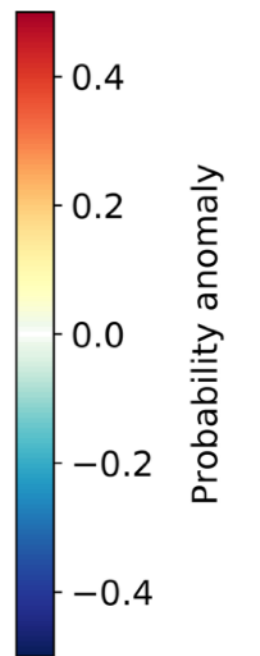
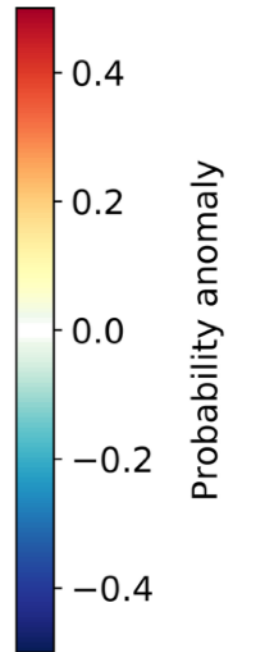
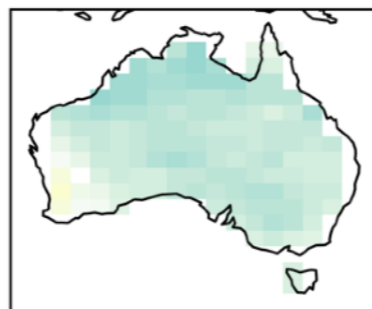
Cold
tercile



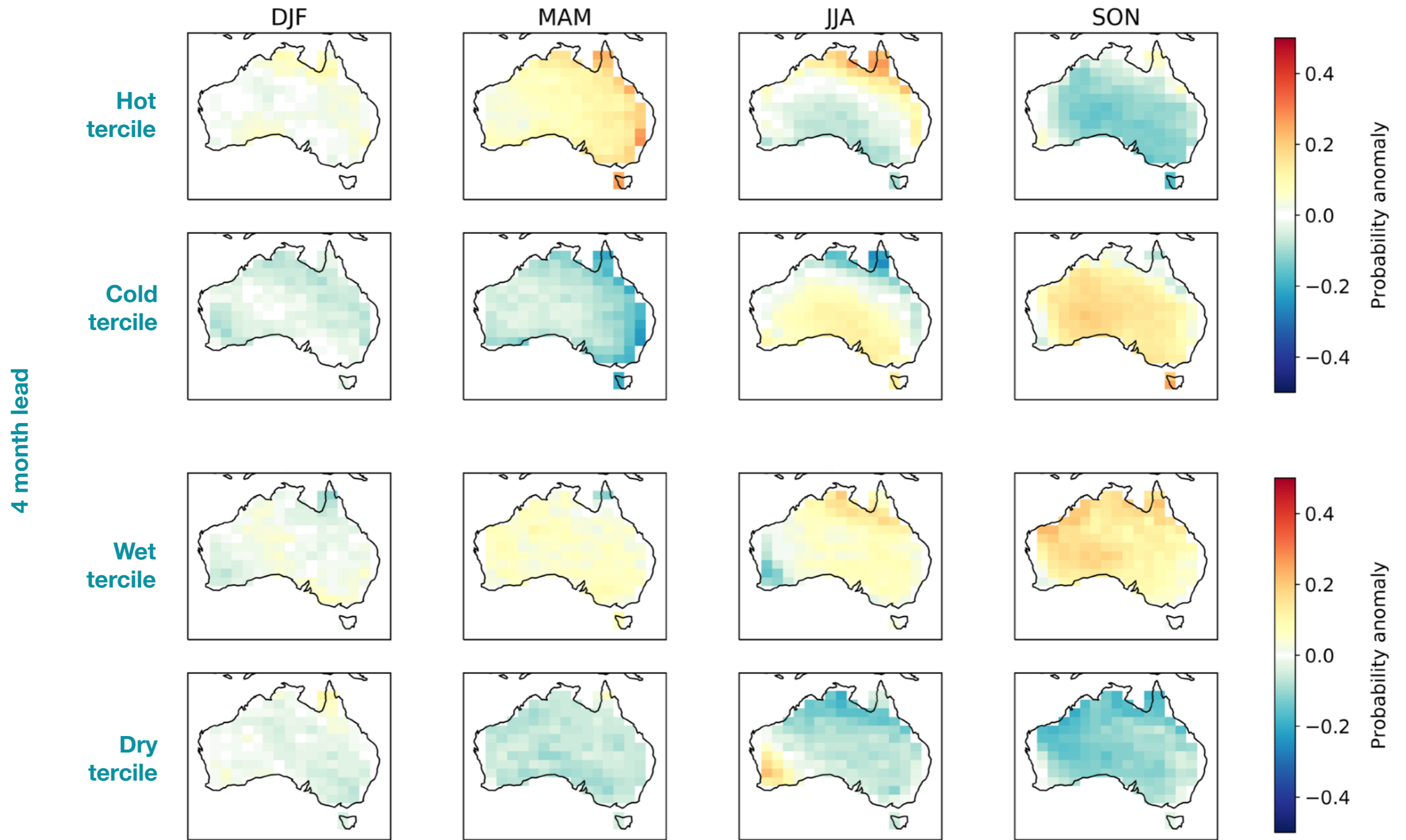
Wet
tercile



Dry
tercile



Rainfall and temp, seasonal probability anomalies



Regional temp rank histograms

