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The operational seasonal streamflow forecasting service for Australia: Assessment and communication of forecast quality at the national scale

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Water Forecasting Services

Bureau of Meteorology

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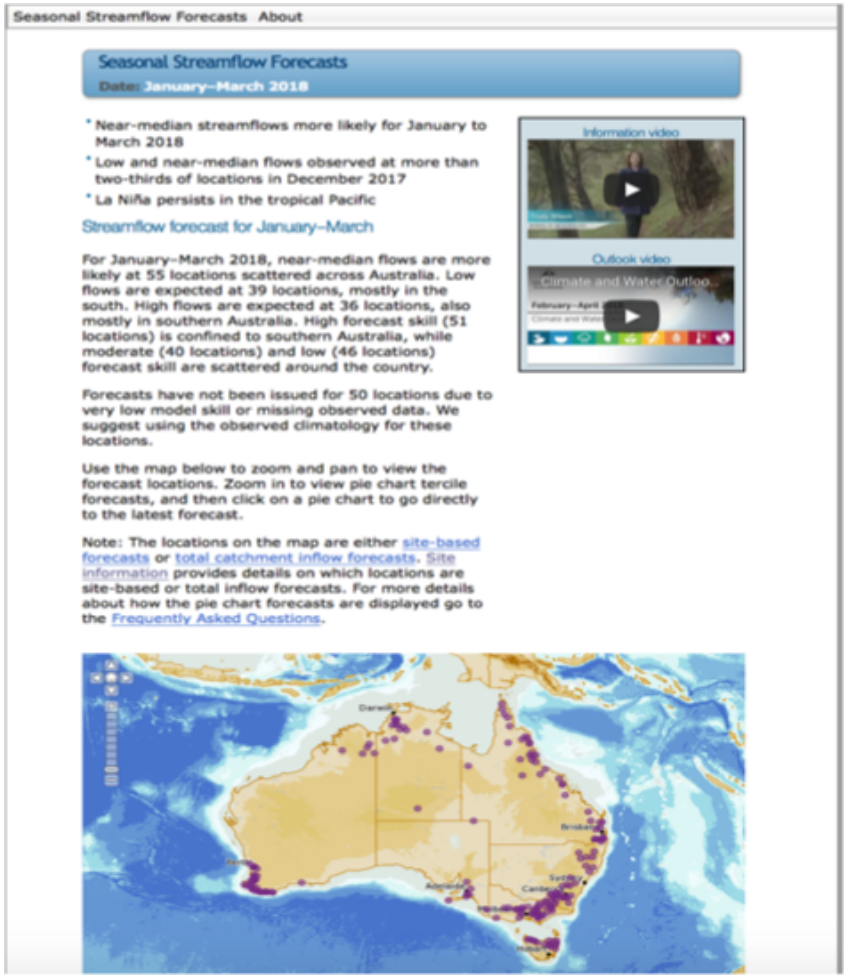
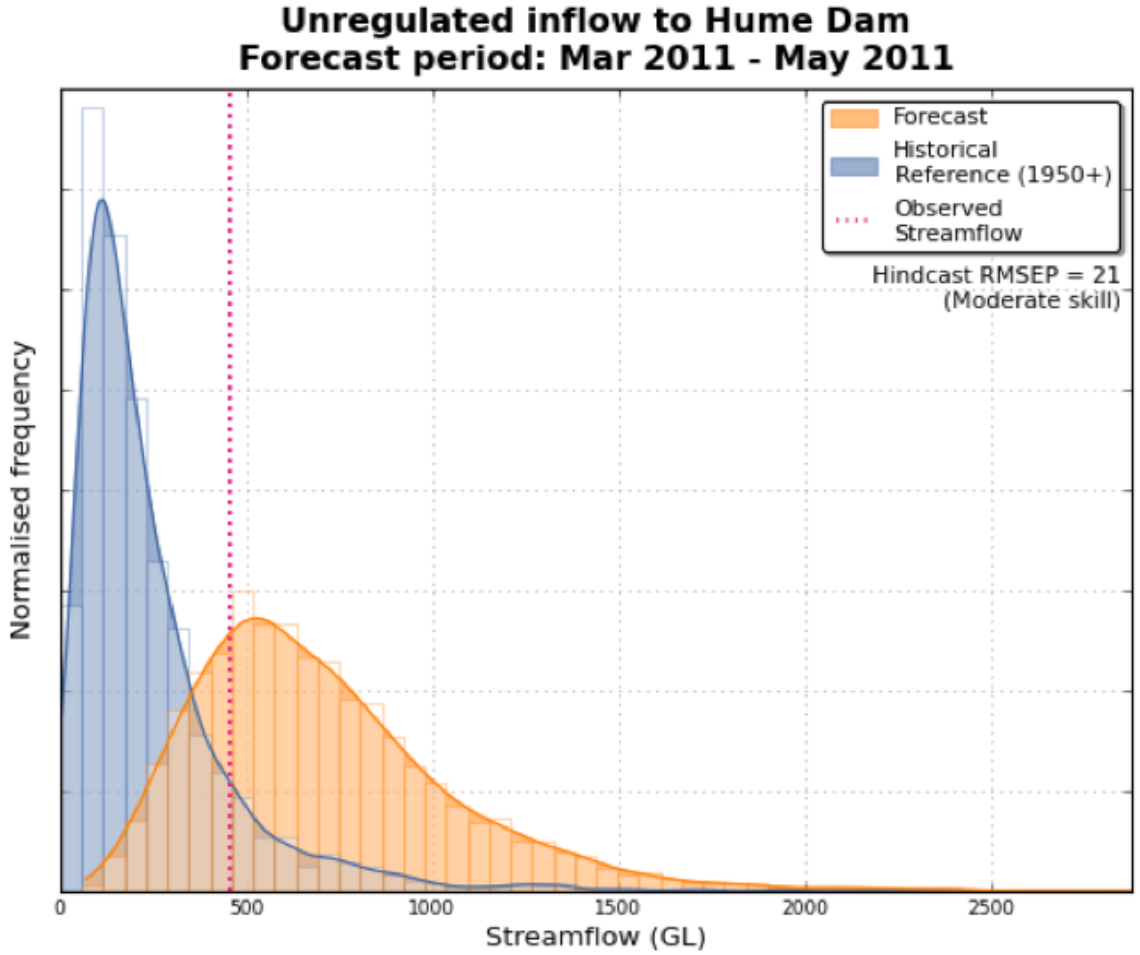
Seasonal streamflow forecasting service for Australia since 2010

- 3-month ahead streamflow volume forecasts
- Updated every month
- 5000 ensemble members using BJP method
- Currently ~180 sites to the public
- Drought onset, duration and recovery



Probabilistic forecasts since 2010



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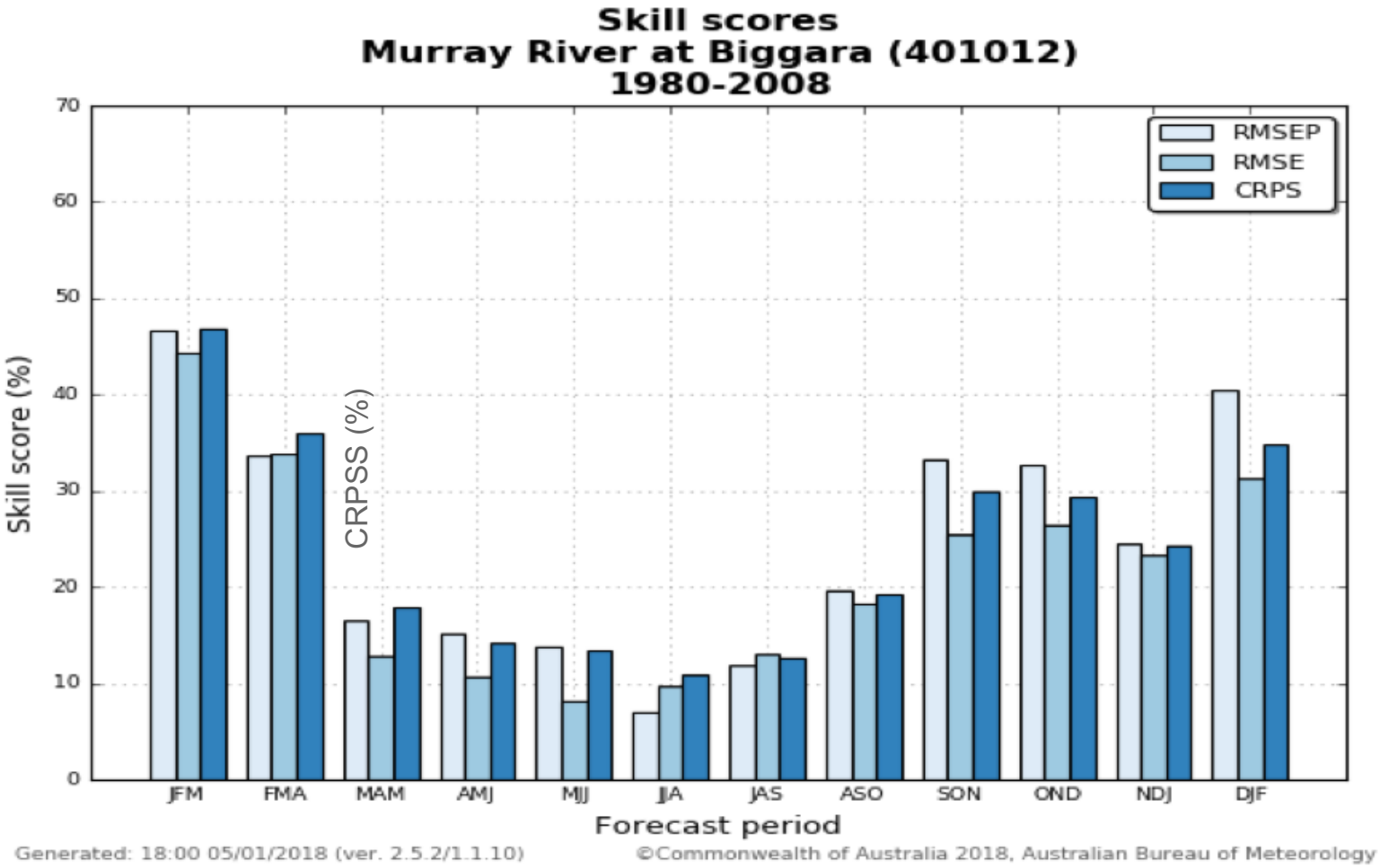
But still deterministic skill scores



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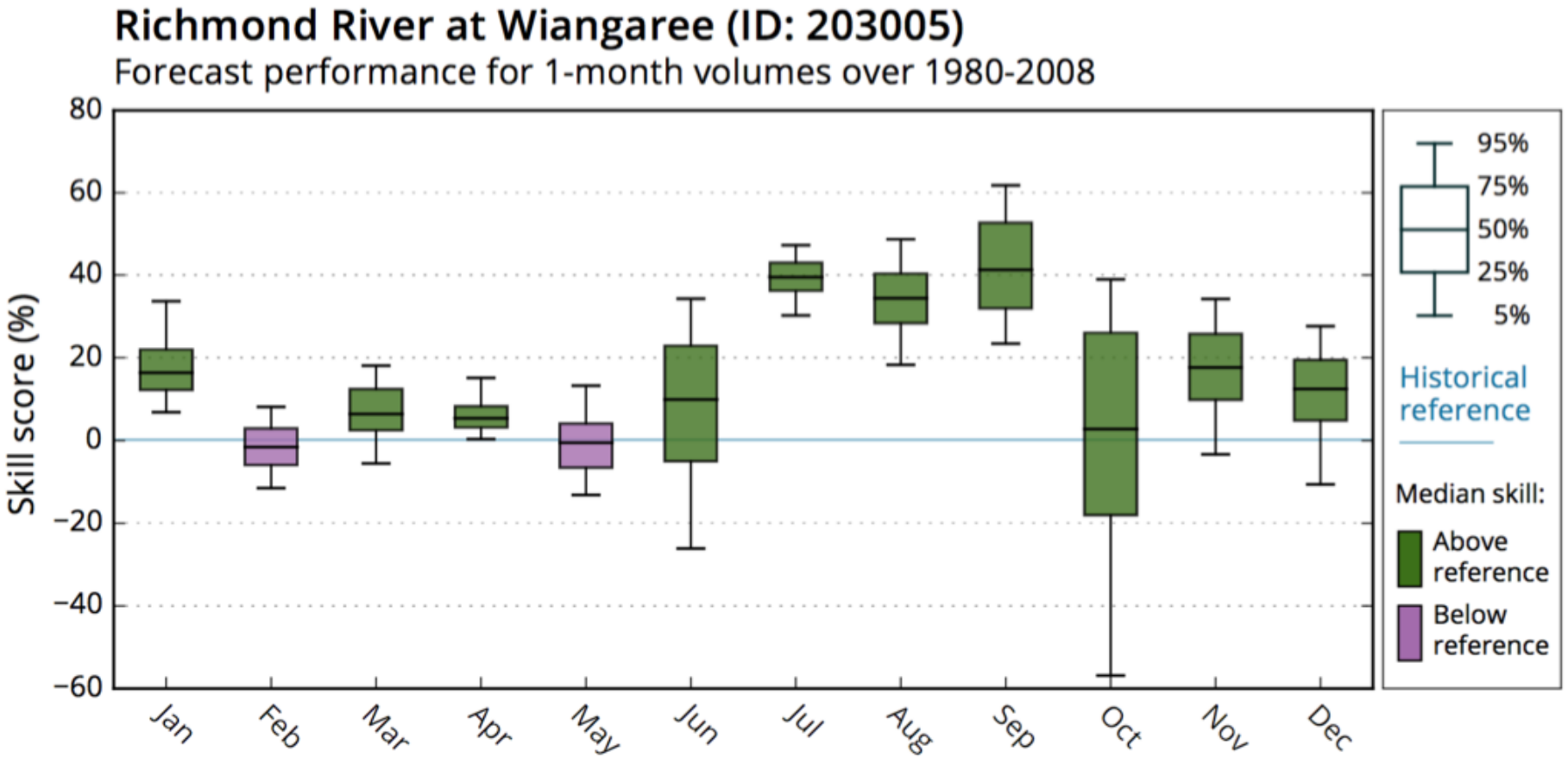
Going to release probabilistic skill scores to users



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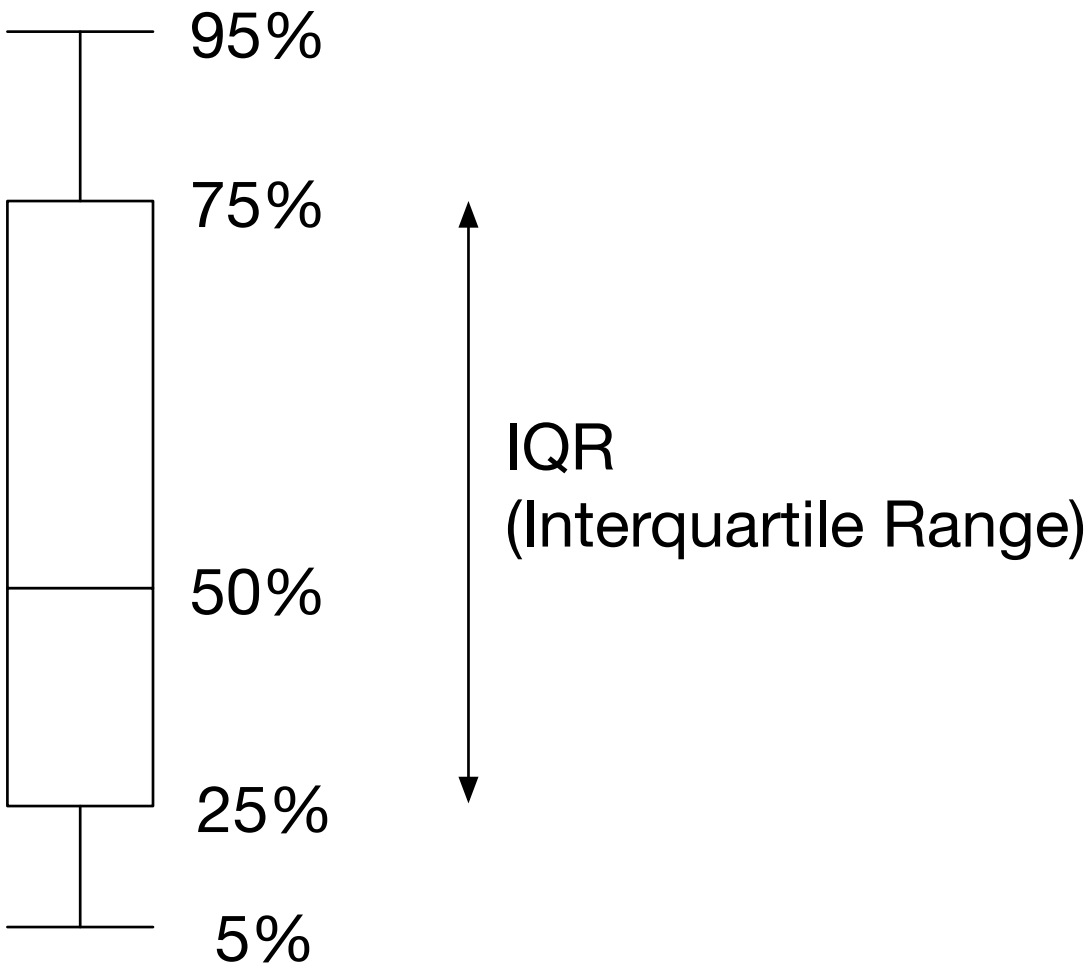
Boxplot we are using...



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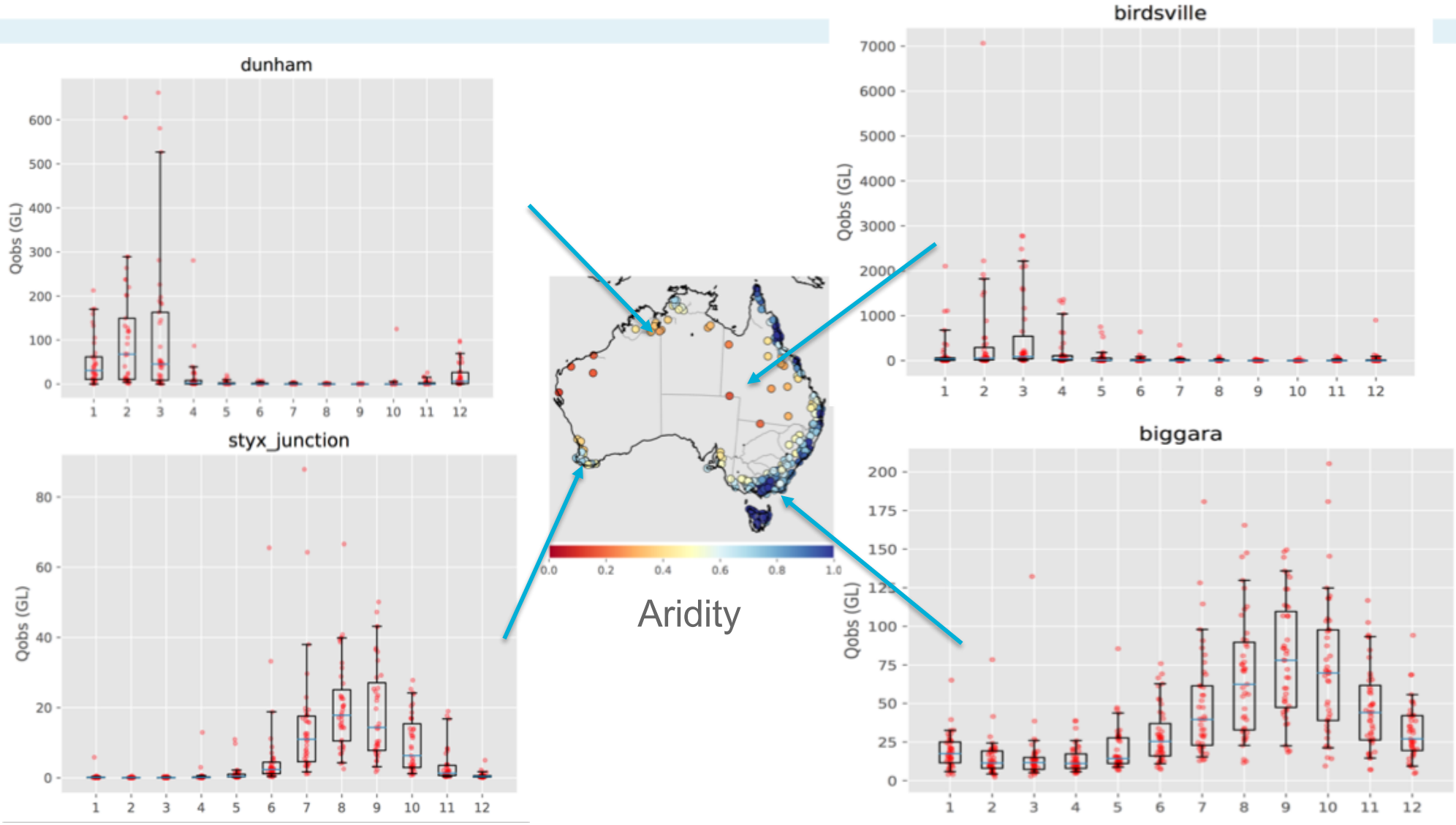
It is challenging to establish a robust forecast verification for streamflow forecasts in Australia.



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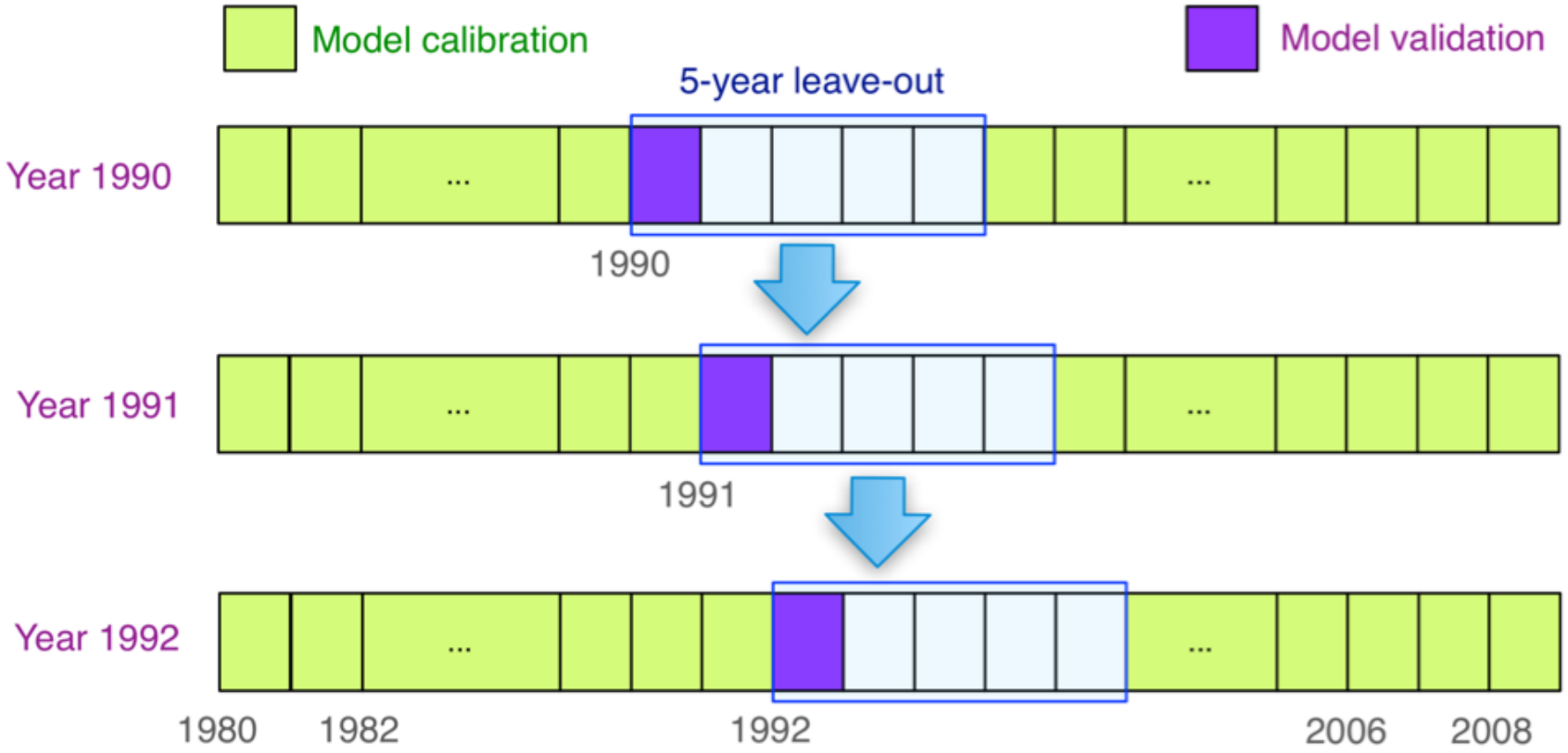
Cross-validation with 5-year leave-out moving window



- Re-calibrate, forecast and calculate an error iteratively over year 1980-2008, the hindcast period of POAMA 2.4.
- Historical reference period: 1970-2013

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Uncertainty assessment in skill scores using bootstrapping method

1. Sample observations, historical reference and cross-validated forecasts with replacement.
2. Calculate a CRPS skill scores for each month over the entire verification period.
3. Calculate a mean of the skill scores.
4. Repeat from step 1 until we have 500 replicates of mean CRPS skill scores.

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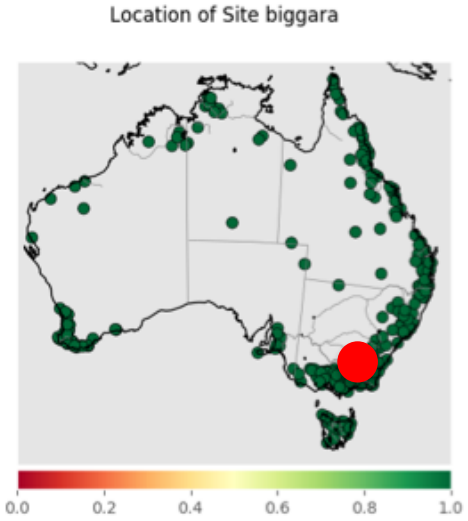
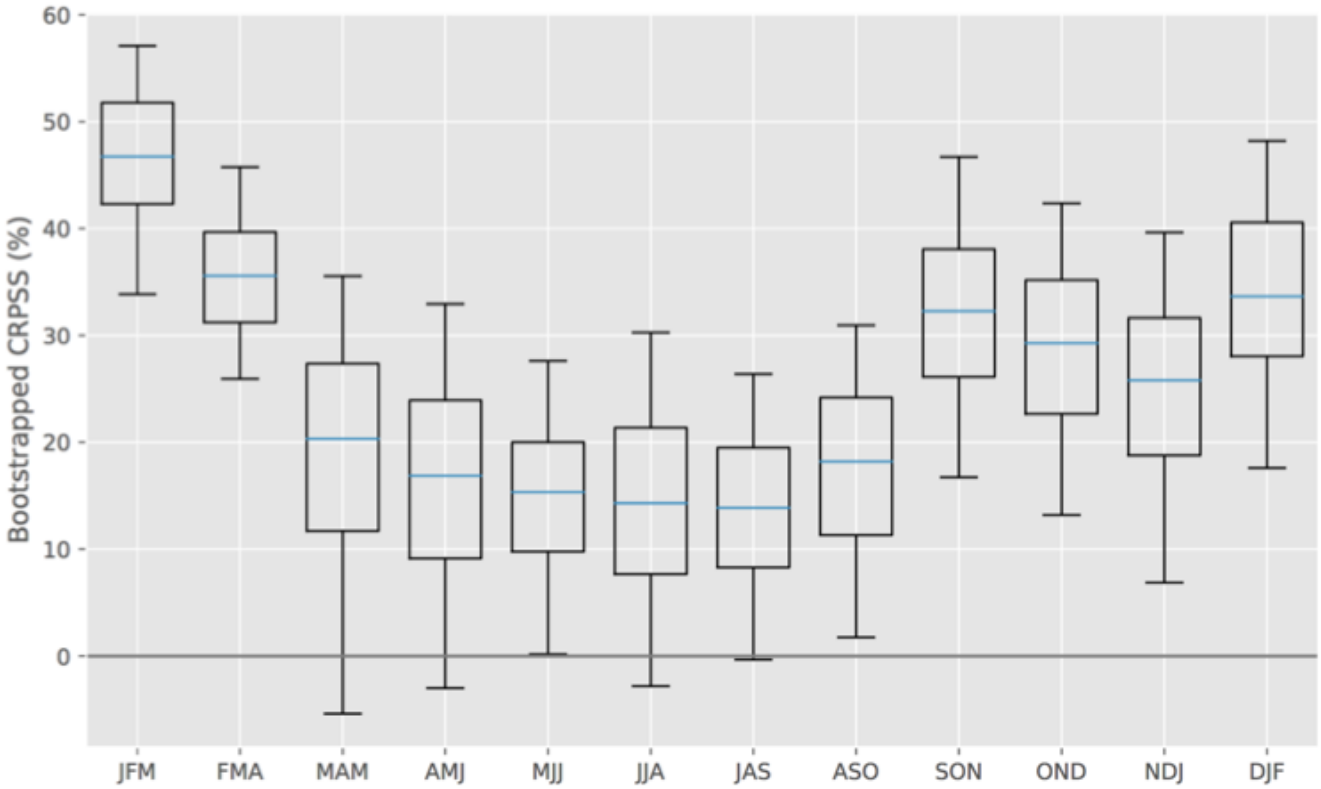
Biggara, Upper Murray





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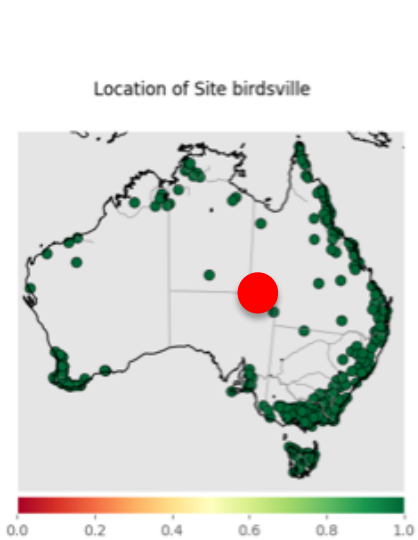
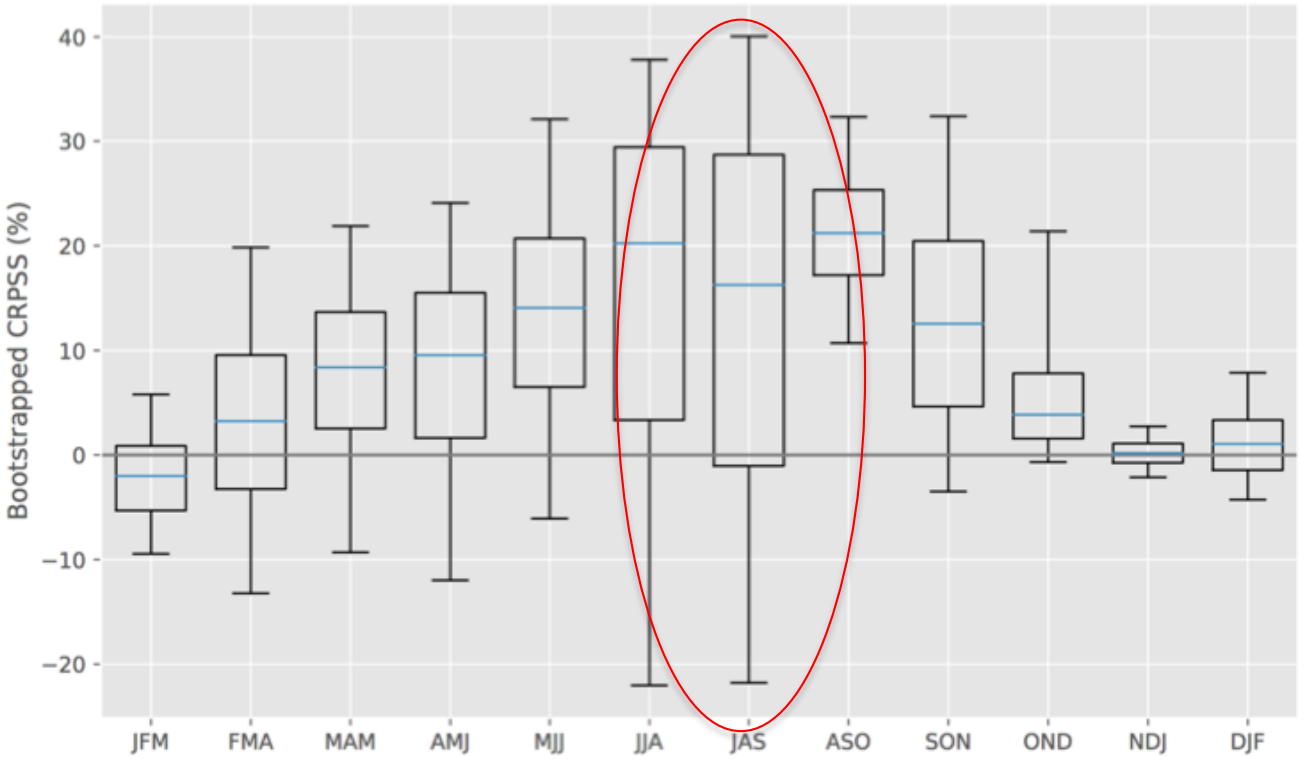
Birdsville, Lake Eyre Basin





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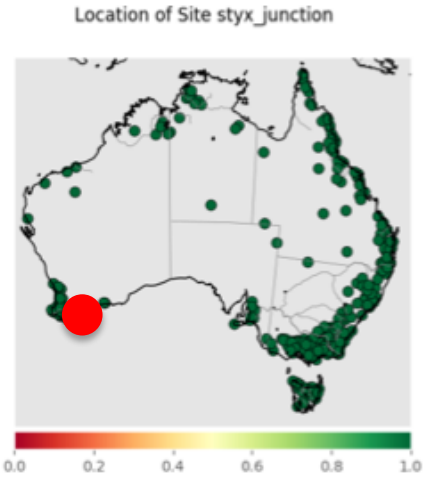
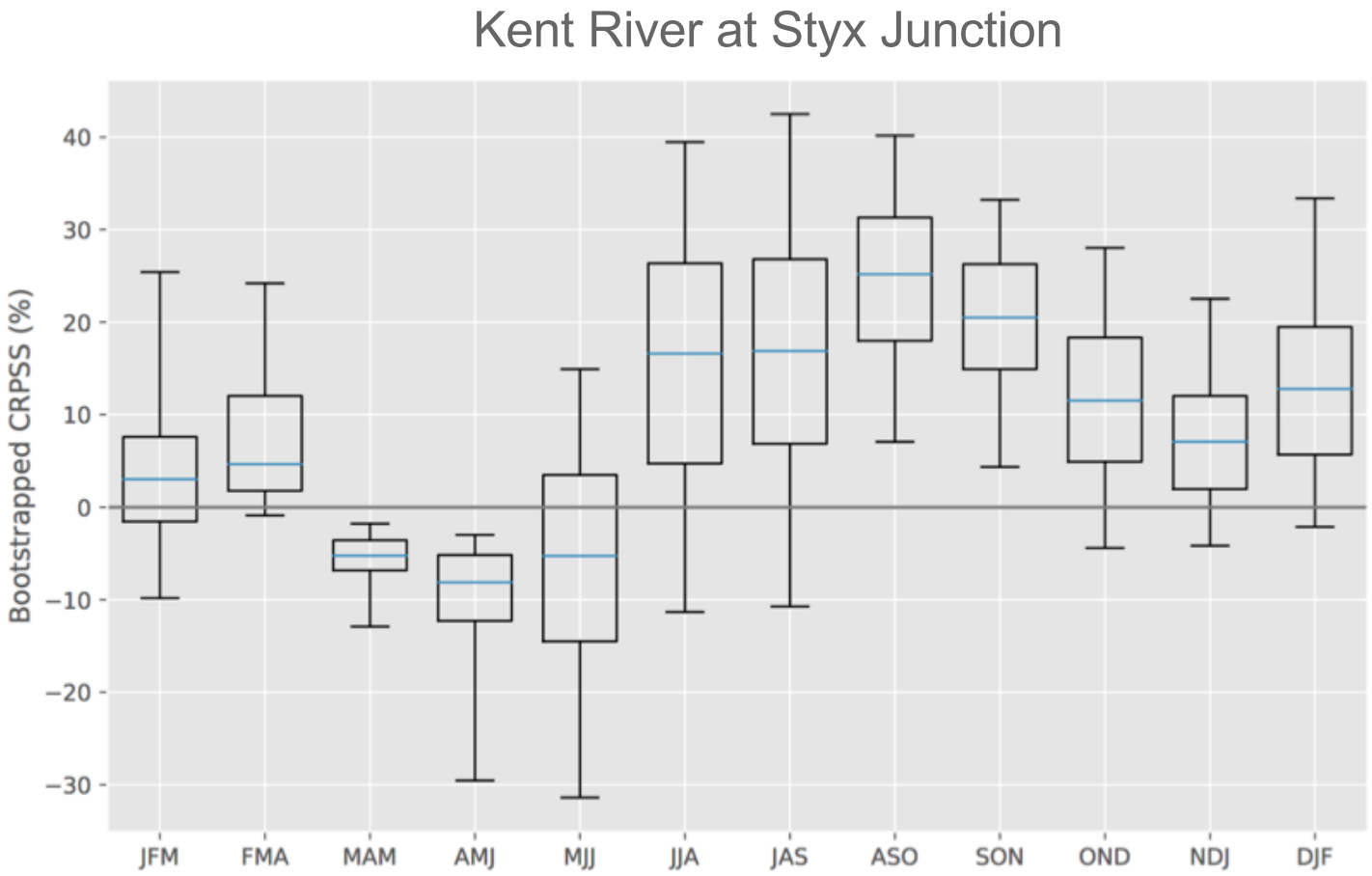
Kent River at Styx Junction





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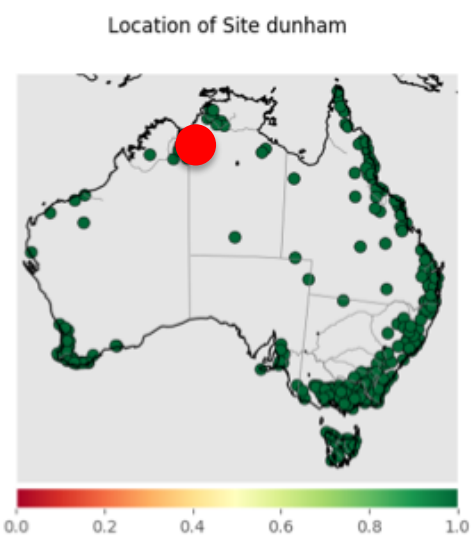
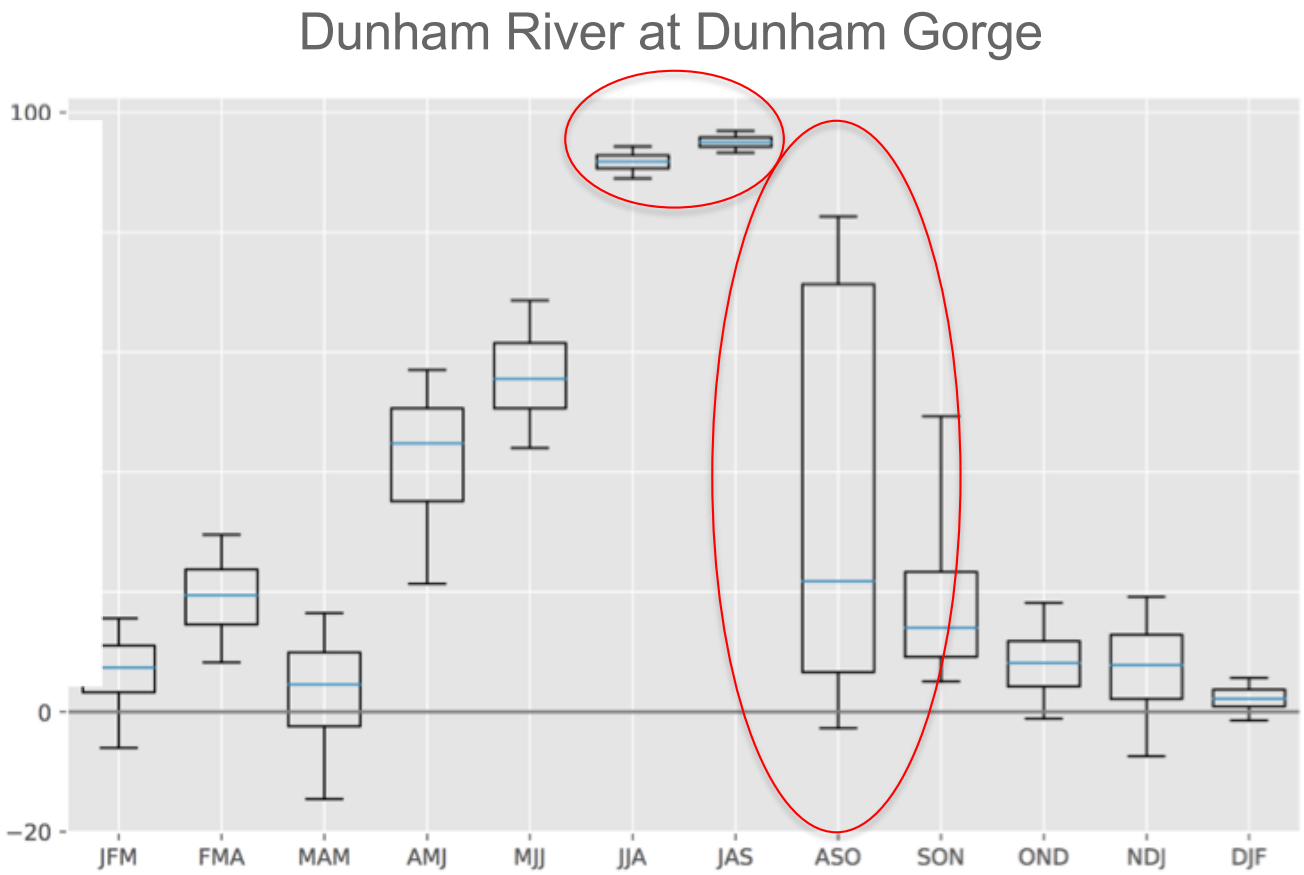
Dunham River at Dunham Gorge





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Why do we have significant uncertainty in the SSF's skill scores?

First, limited number of streamflow samples
e.g. < 30 observations from 30 years

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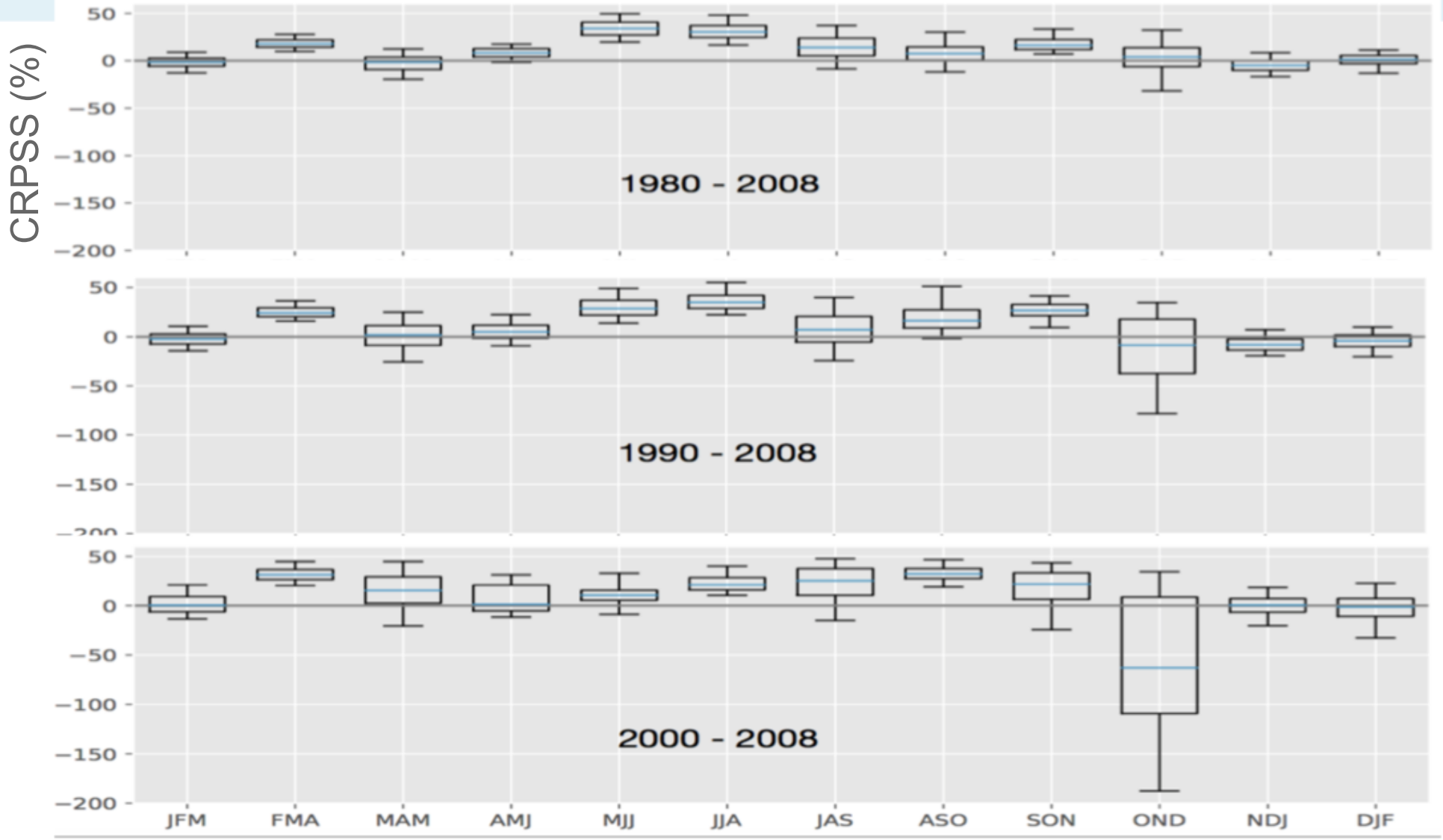
Impact of sample size on skill score uncertainty

Burdekin River at Sellheim, QLD



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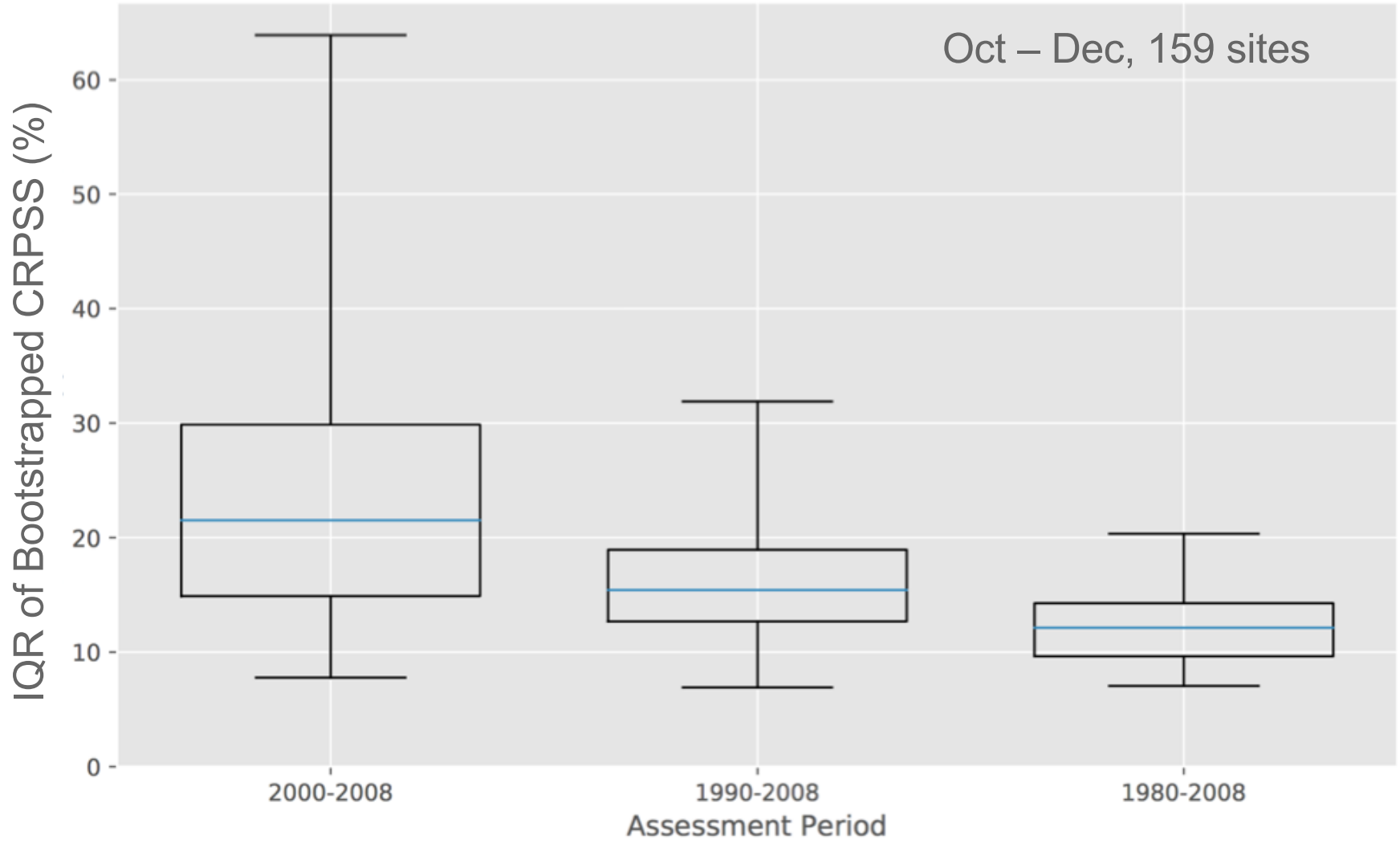
Impact of sample size on skill score uncertainty



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Sensitivity of skill score to forecast score variation

$$SS = 1 - \frac{S_{fc}}{S_{ref}}$$

$$\frac{\delta SS}{\delta S_{fc}} = \frac{1}{S_{ref}}$$

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Sensitivity of skill score to forecast score variation

$$CRPS = Reliability + Resolution + Uncertainty$$

$$CRPS(clim) = Uncertainty$$

$$\frac{\delta SS}{\delta S_{fc}} = \frac{1}{Uncertainty_{clim}}$$

H. Hersbach. Decomposition of the Continuous Ranked Probability Score for Ensemble Prediction Systems. Weather and Forecasting, 15(5):559–570, oct 2000.

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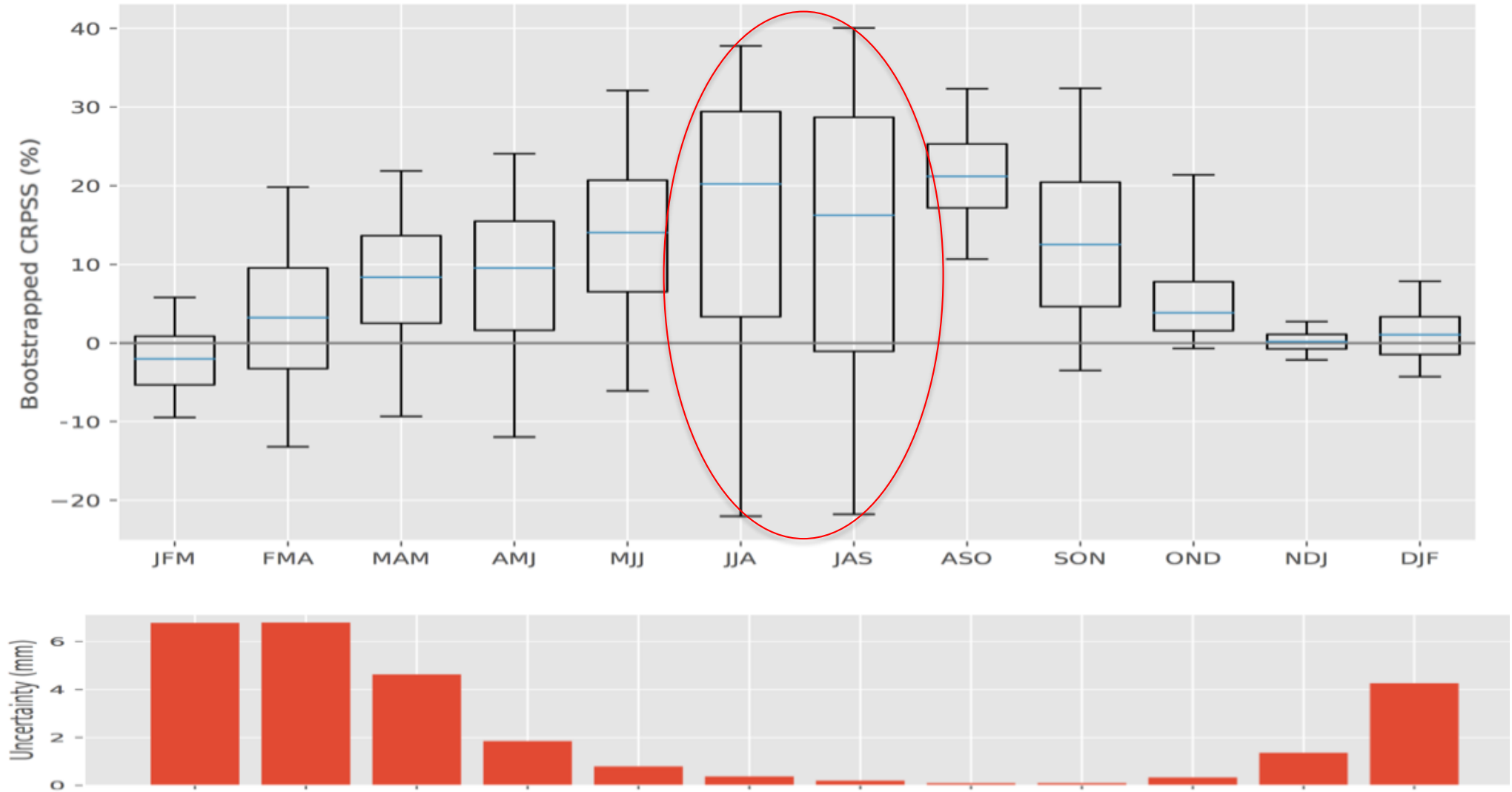
Skill score uncertainty vs. streamflow uncertainty: Birdsville, QLD



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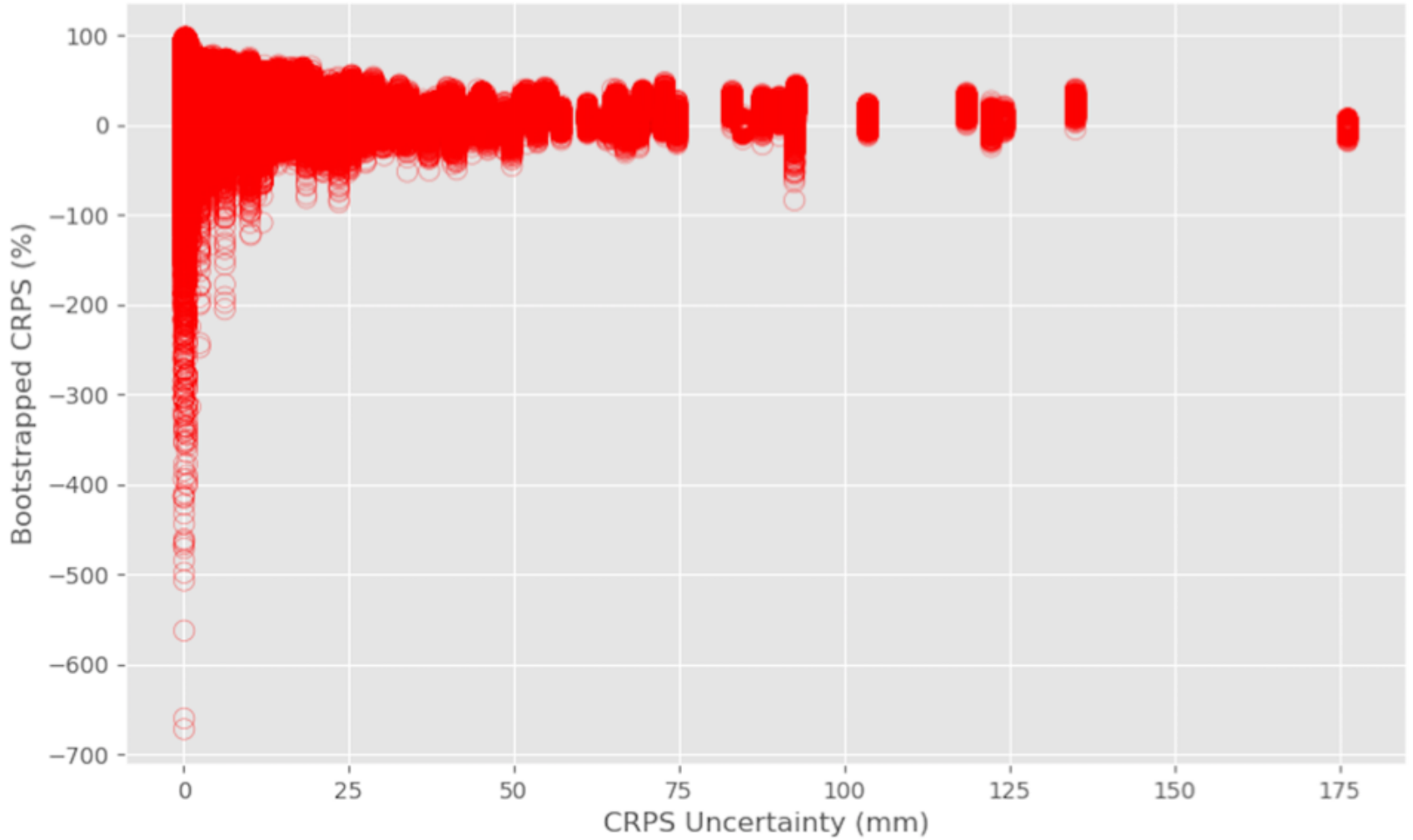
All bootstrapped skill scores vs. streamflow uncertainty: 159 sites



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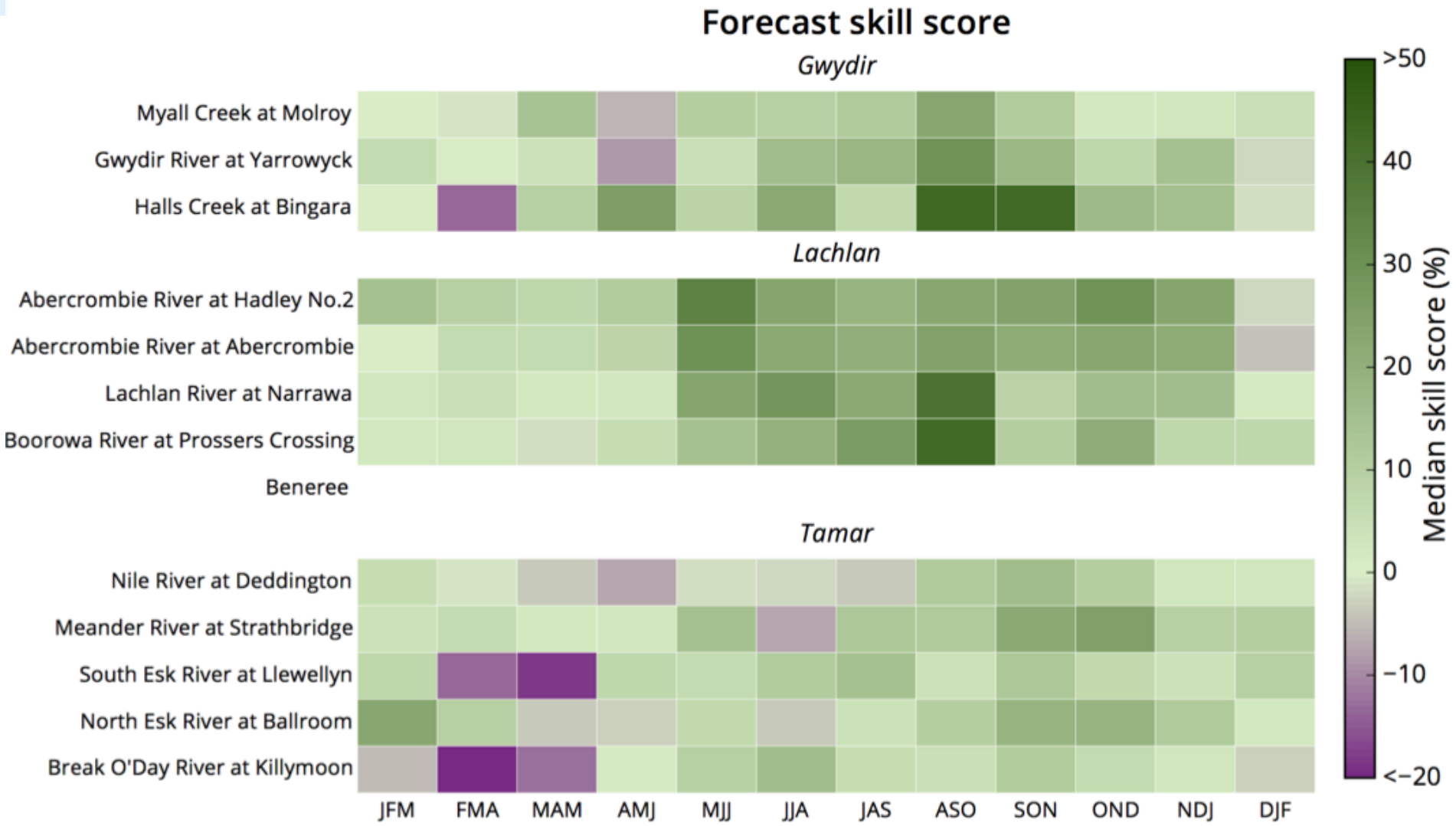
Skill score summary chart: Synoptic view on spatial and temporal pattern of forecast skills



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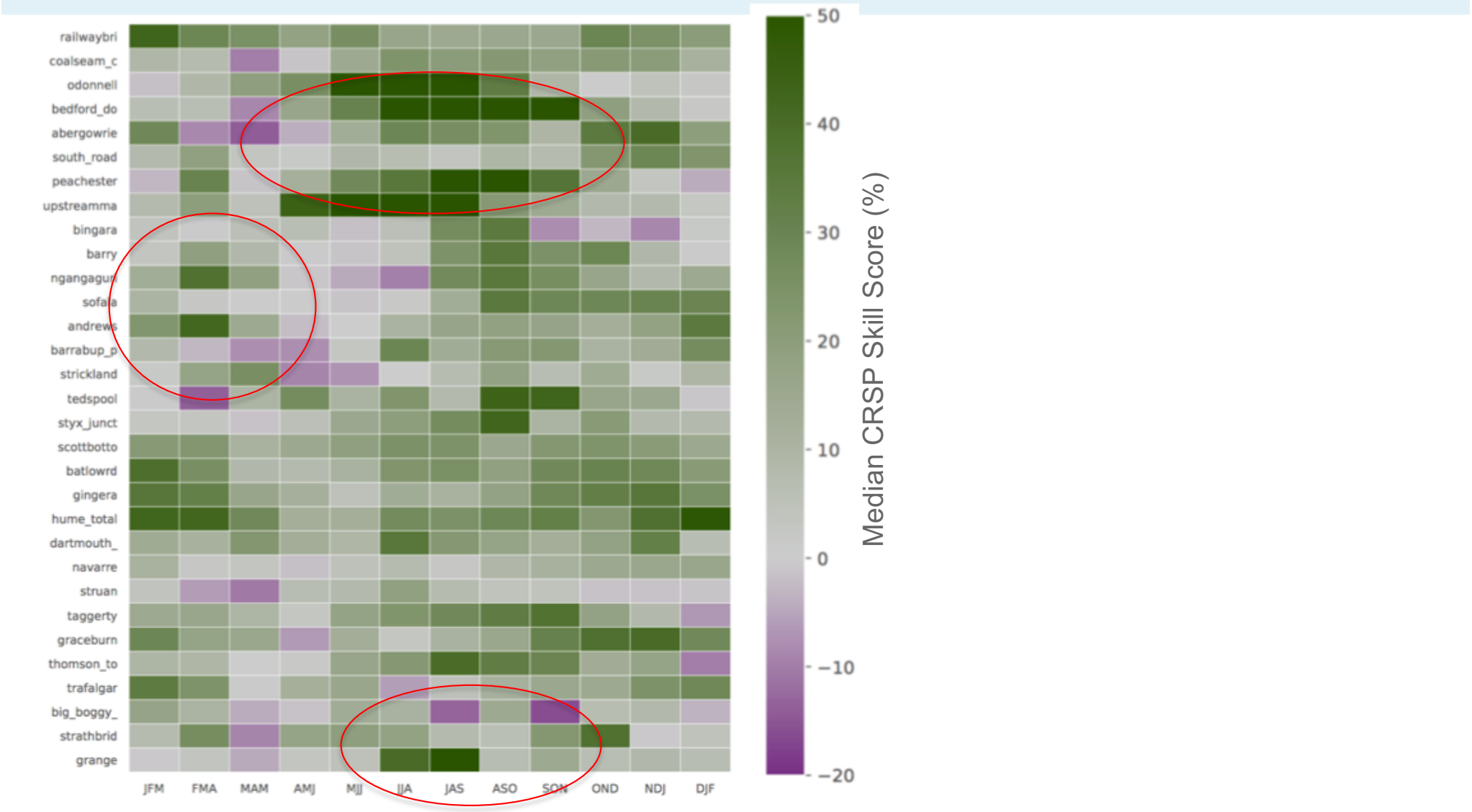
Impact on interpretation of skill score summary chart



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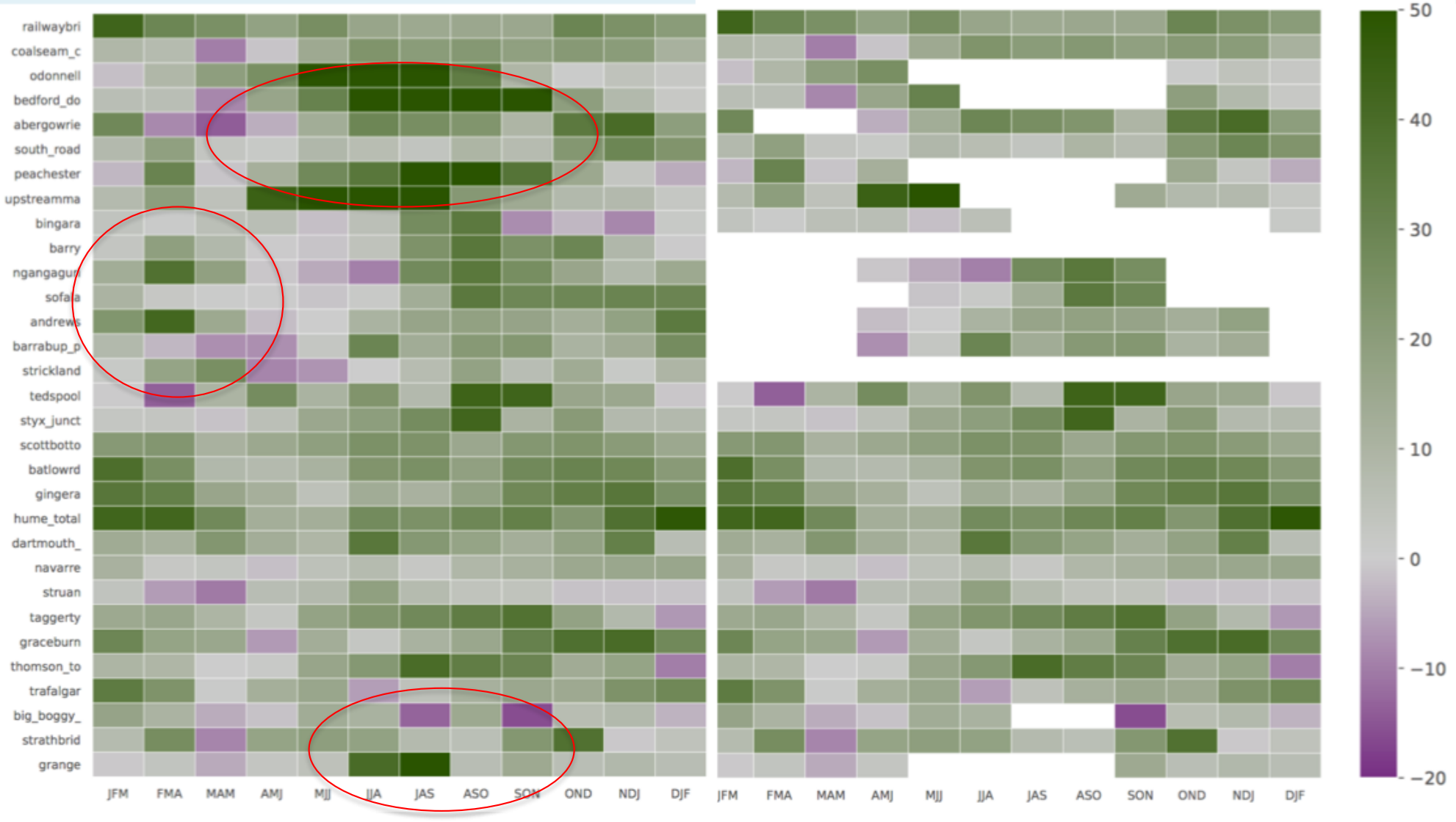
Impact on interpretation of skill score summary chart

Dropped if uncertainty < 2 (mm)



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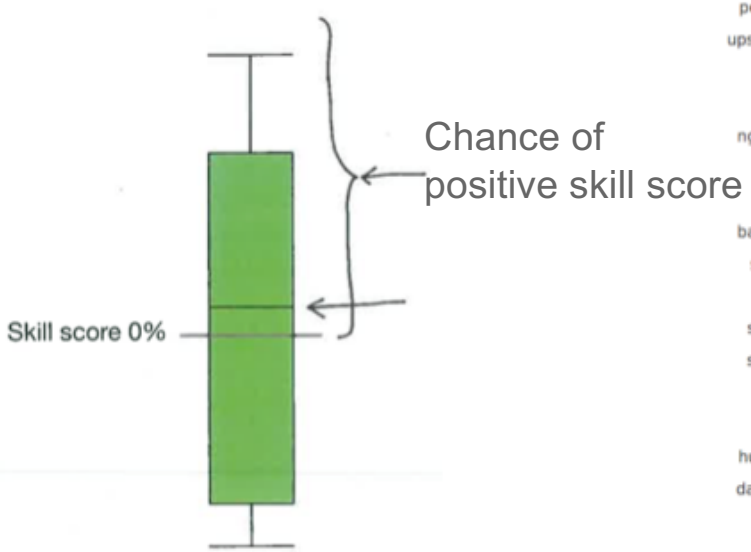
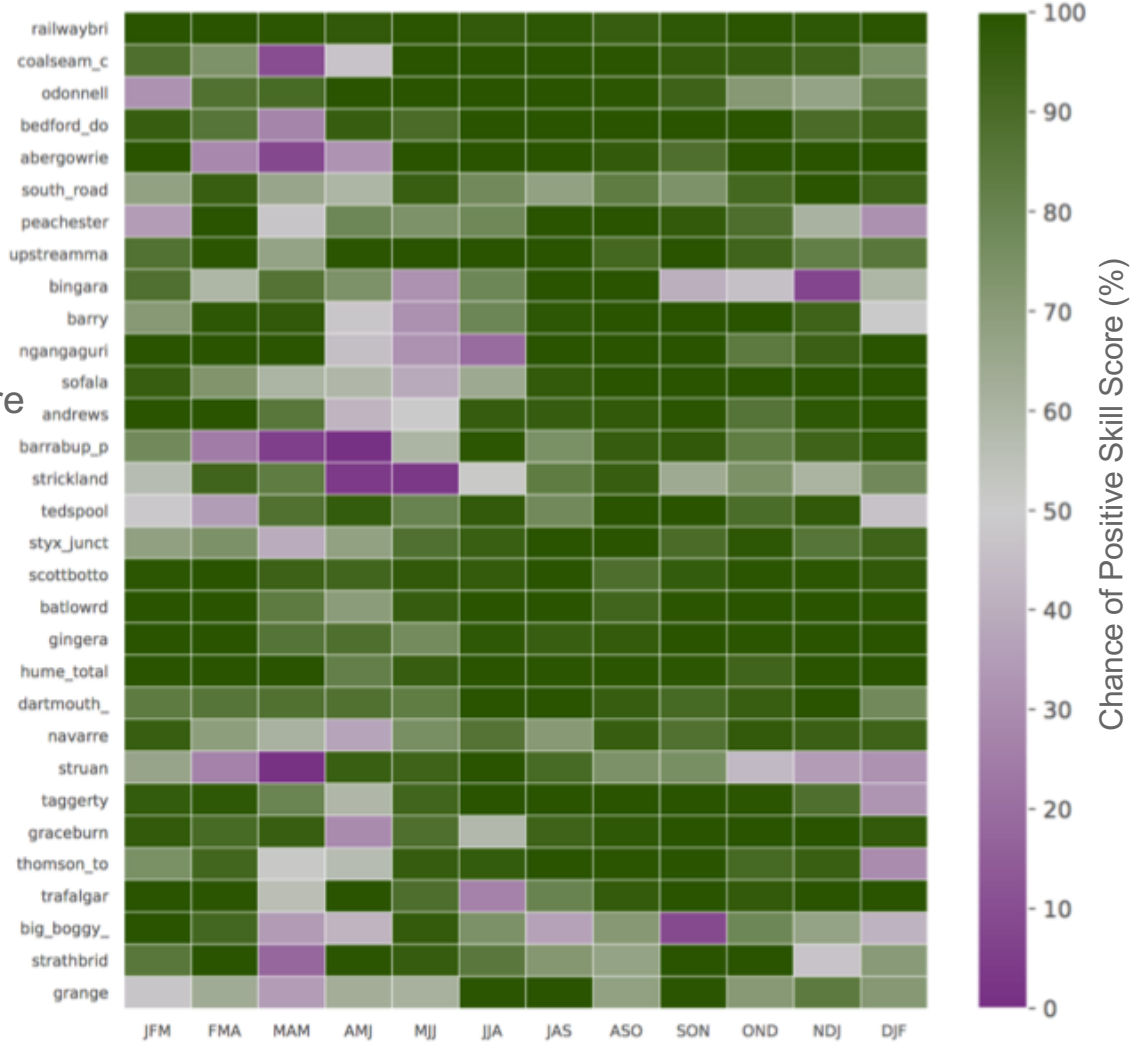
Another way to view forecast skills: Chance of positive skill score





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Change in messages to users about forecast quality

Our forecast is 20% better than just using historical reference (streamflow climatology).

There is 70% chance that our forecast is better than just using historical reference.

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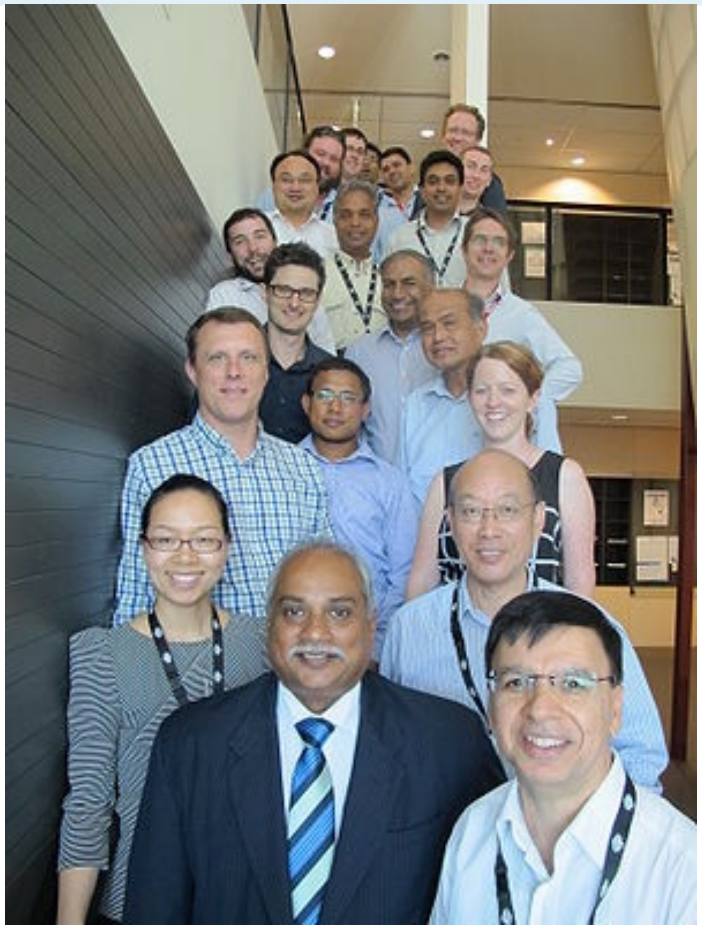
Acknowledgement



Please contact Daehyok Shin at d.shin@bom.gov.au for further questions.

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Another way to view forecast skills: Chance of positive skill score