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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

Seasonal Streamflow Forecasts About

Seasonal Streamflow Forecasts
Date: January–March 2018

- * Near-median streamflows more likely for January to March 2018
- * Low and near-median flows observed at more than two-thirds of locations in December 2017
- * La Niña persists in the tropical Pacific

Streamflow forecast for January–March

For January–March 2018, near-median flows are more likely at 55 locations scattered across Australia. Low flows are expected at 39 locations, mostly in the south. High flows are expected at 36 locations, also mostly in southern Australia. High forecast skill (51 locations) is confined to southern Australia, while moderate (40 locations) and low (46 locations) forecast skill are scattered around the country.

Forecasts have not been issued for 50 locations due to very low model skill or missing observed data. We suggest using the observed climatology for these locations.

Use the map below to zoom and pan to view the forecast locations. Zoom in to view pie chart tercile forecasts, and then click on a pie chart to go directly to the latest forecast.

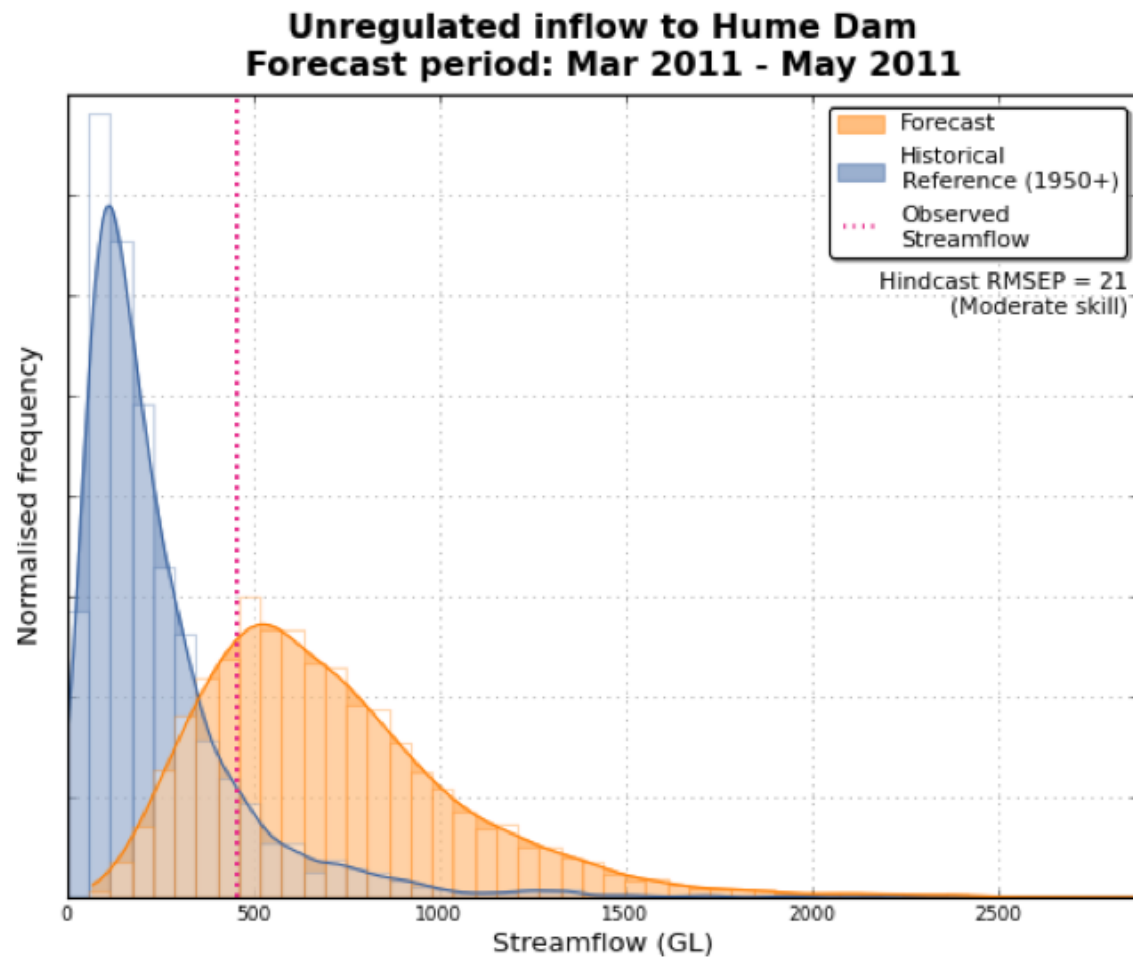
Note: The locations on the map are either [site-based forecasts](#) or [total catchment inflow forecasts](#). [Site information](#) provides details on which locations are site-based or total inflow forecasts. For more details about how the pie chart forecasts are displayed go to the [Frequently Asked Questions](#).



The screenshot shows a webpage titled 'Seasonal Streamflow Forecasts About'. It features a blue header with the title and date 'Date: January–March 2018'. Below the header, there are three bullet points providing context: 'Near-median streamflows more likely for January to March 2018', 'Low and near-median flows observed at more than two-thirds of locations in December 2017', and 'La Niña persists in the tropical Pacific'. A section titled 'Streamflow forecast for January–March' contains a paragraph of text detailing forecast skill and model performance. To the right of the text are two video thumbnails: 'Information video' and 'Outlook video'. At the bottom of the page is a map of Australia with numerous purple dots indicating forecast locations. The map includes state boundaries and labels for major cities like Darwin, Brisbane, Sydney, and Canberra.

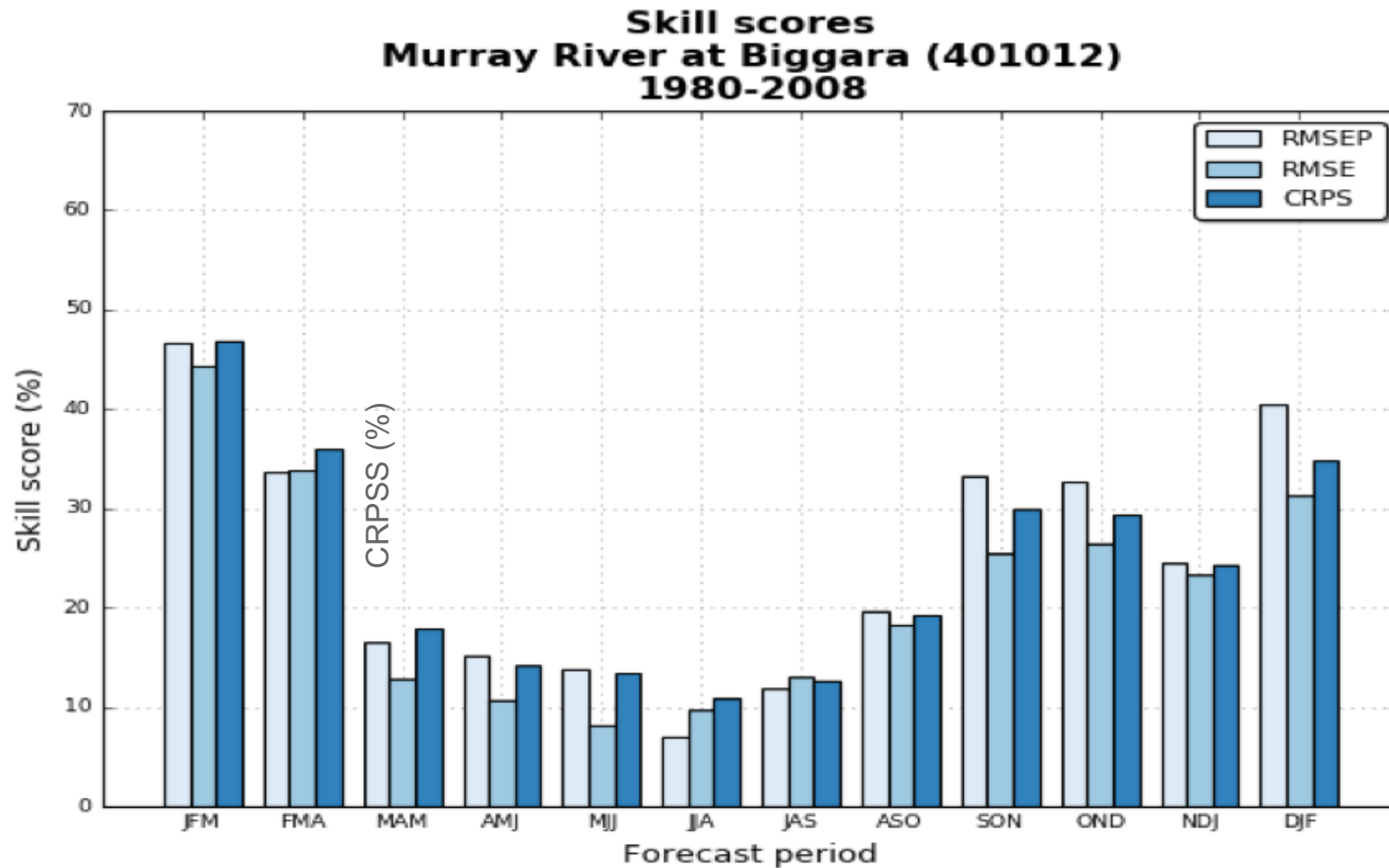


Probabilistic forecasts since 2010





But still deterministic skill scores



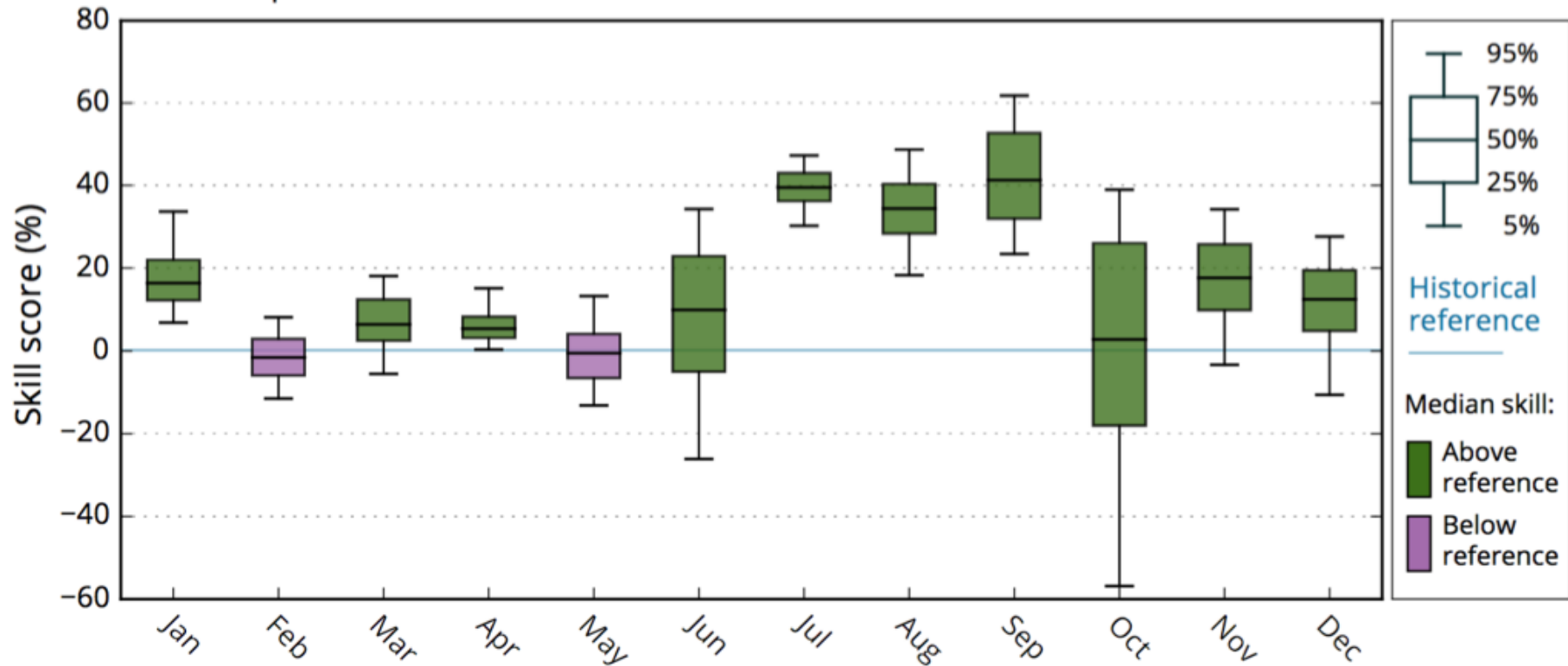


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Going to release probabilistic skill scores to users

Richmond River at Wiangaree (ID: 203005)

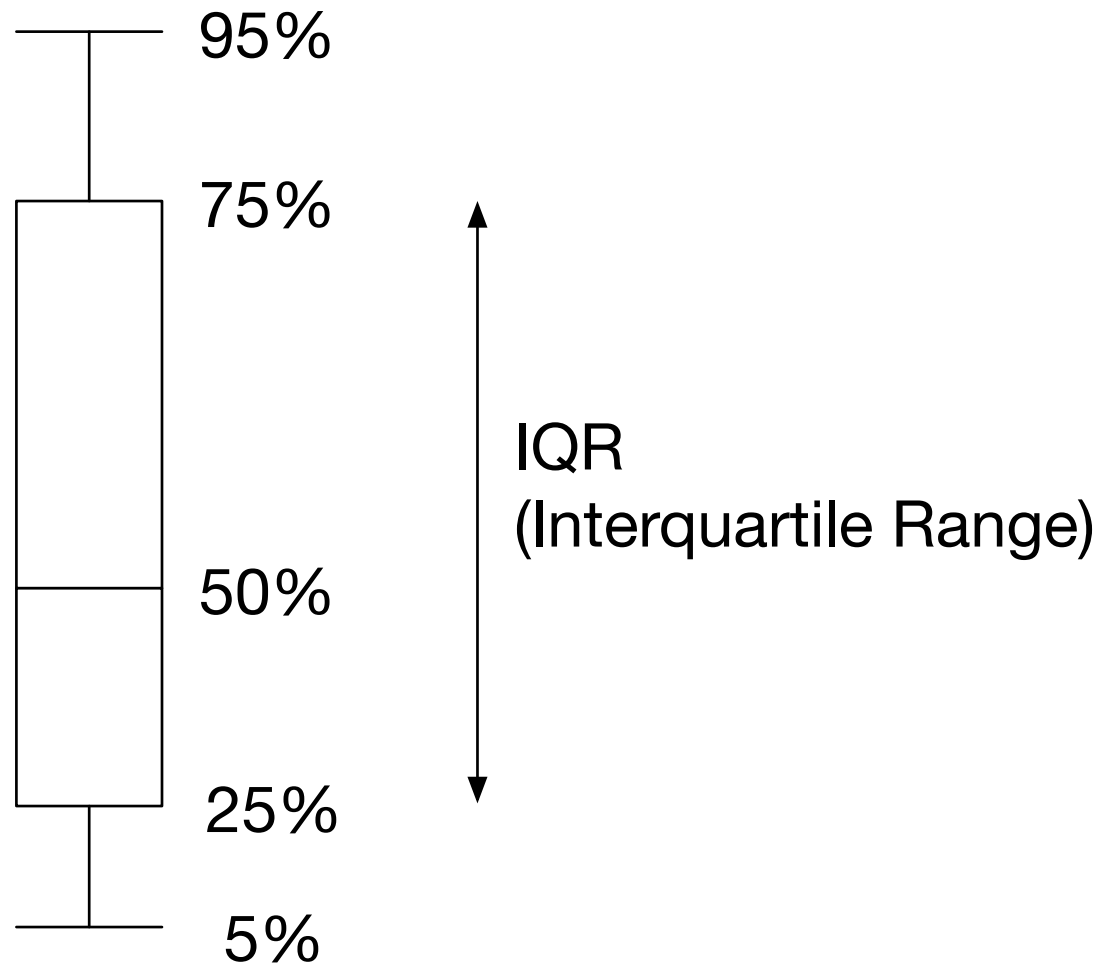
Forecast performance for 1-month volumes over 1980-2008





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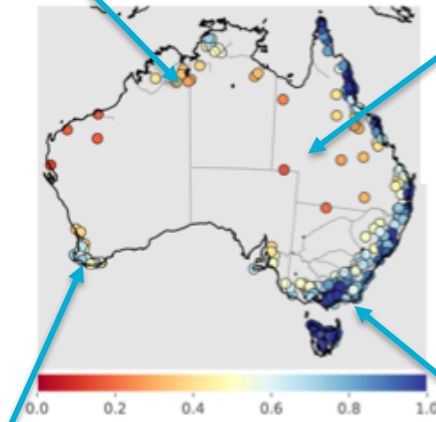
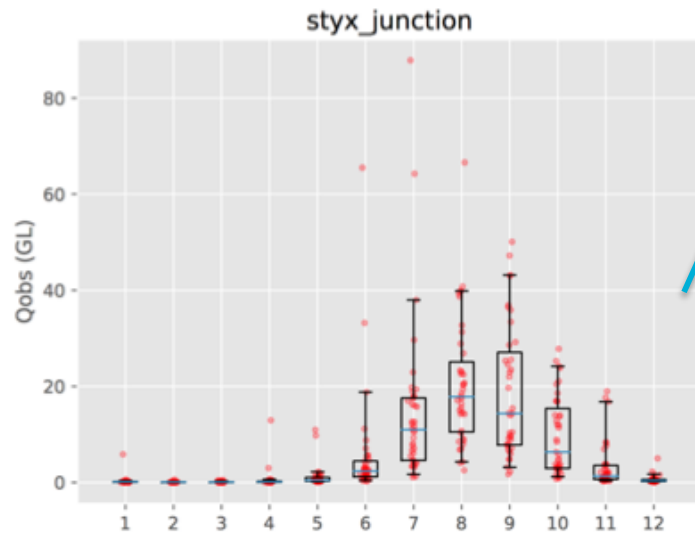
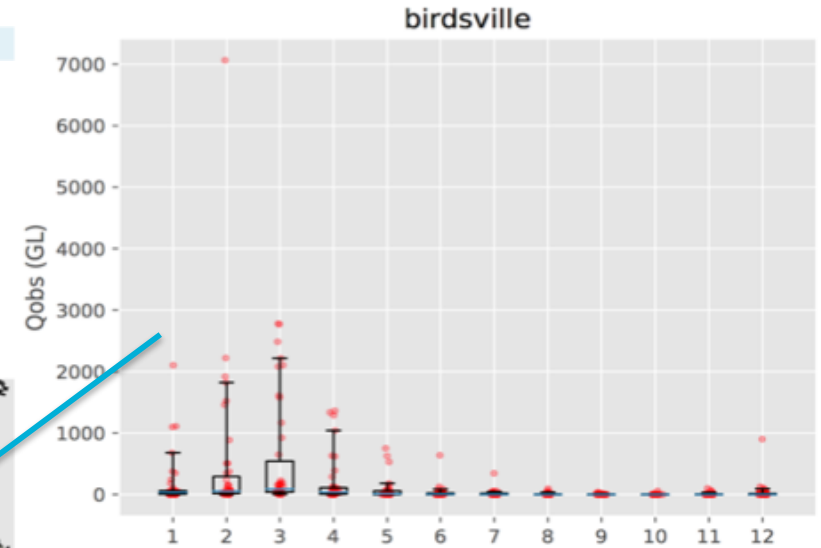
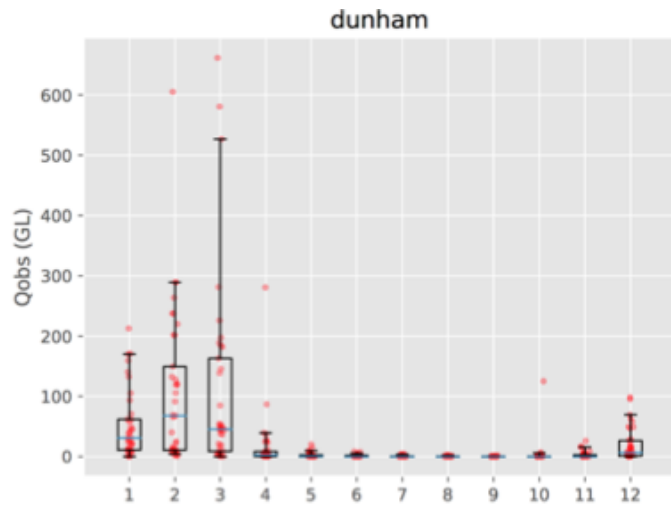
Boxplot we are using...



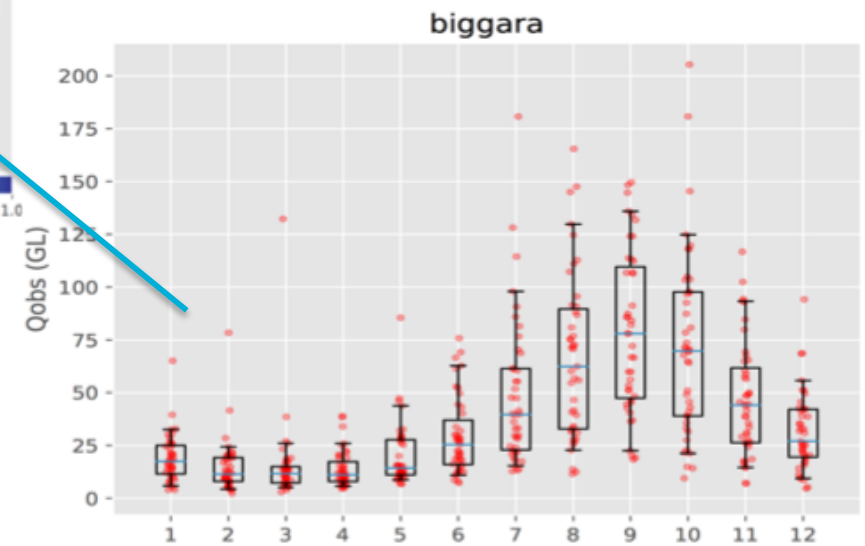


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It is challenging to establish a robust forecast verification for streamflow forecasts in Australia.

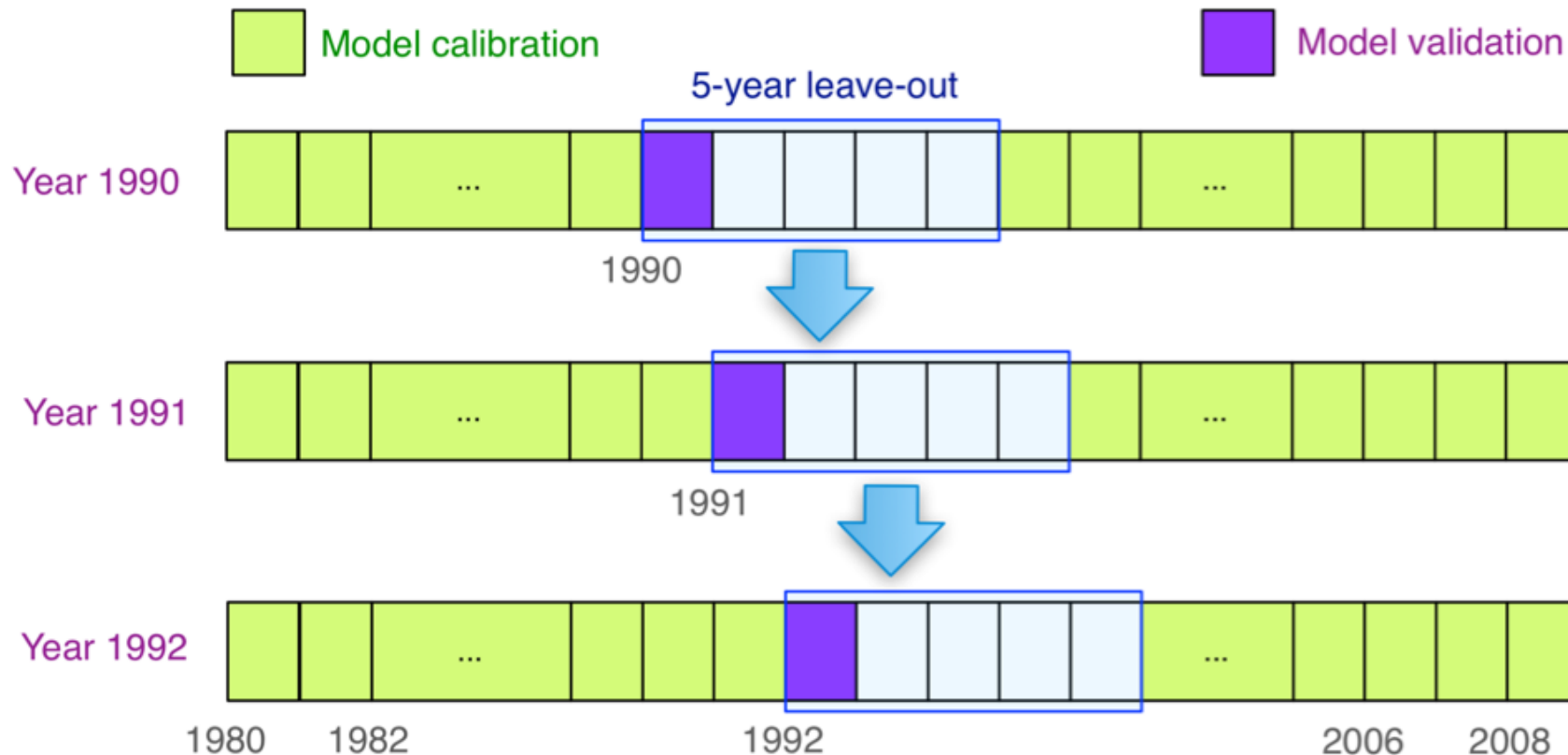


Aridity





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

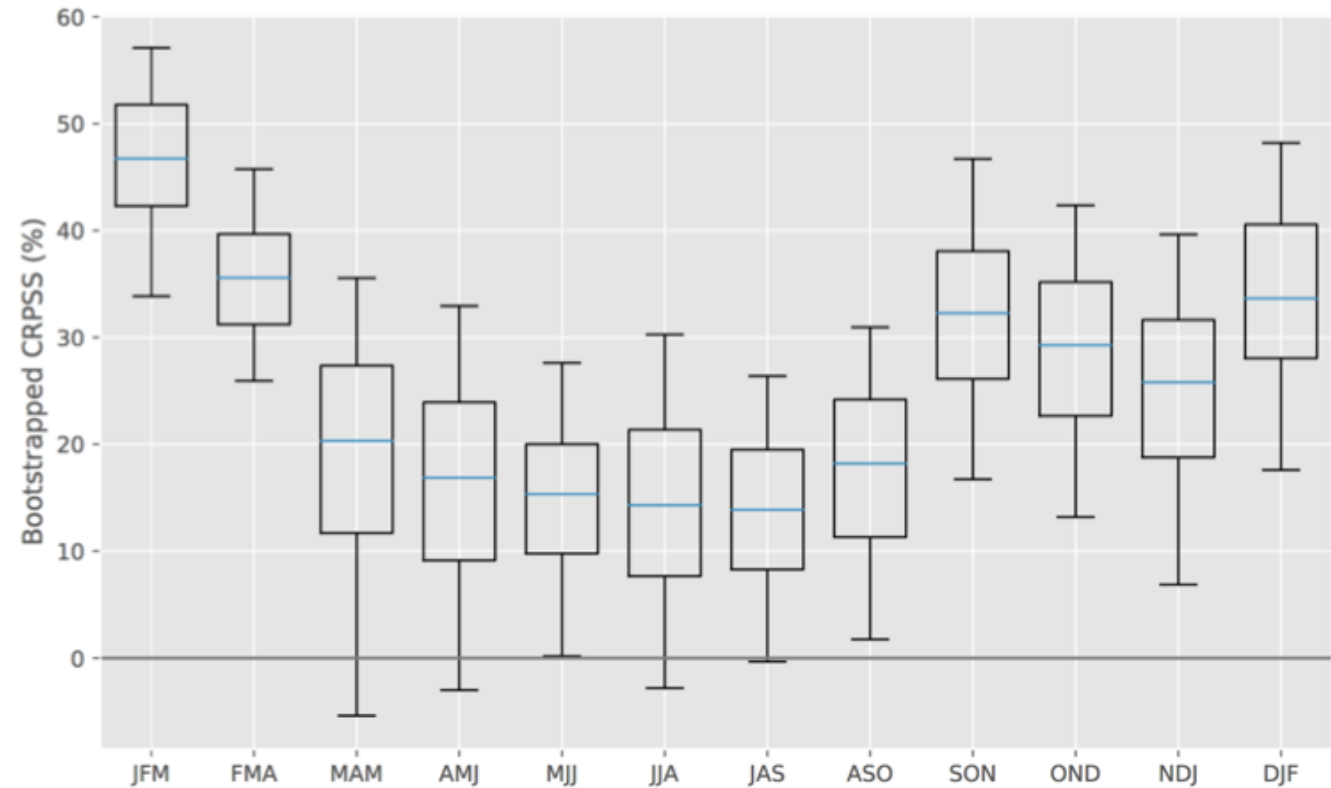
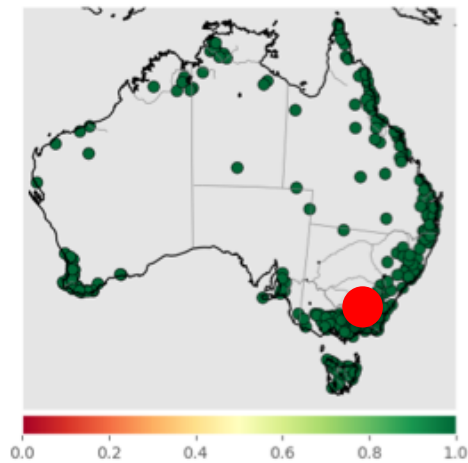
1. Sample observations, historical reference and cross-validated forecasts with replacement.
2. Calculate a CRPS skill scores for each month over the entire verification period.
3. Calculate a mean of the skill scores.
4. Repeat from step 1 until we have 500 replicates of mean CRPS skill scores.



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Biggara, Upper Murray

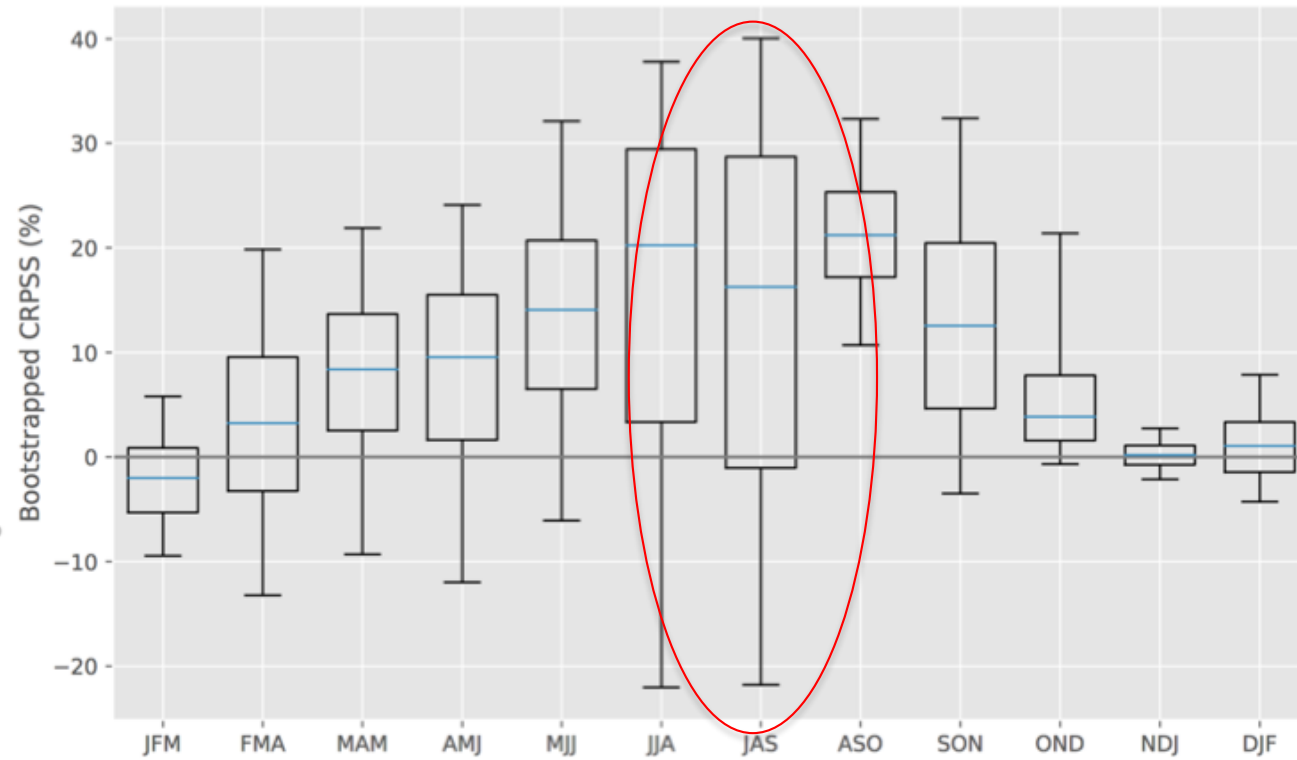
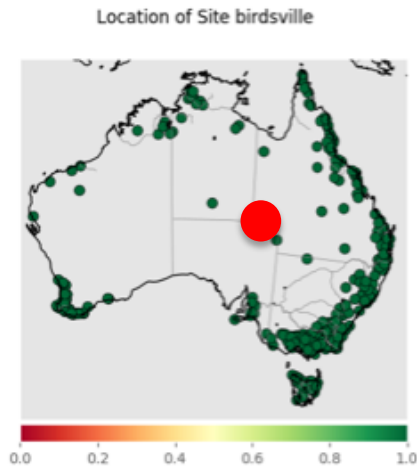
Location of Site biggara





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Birdsville, Lake Eyre Basin



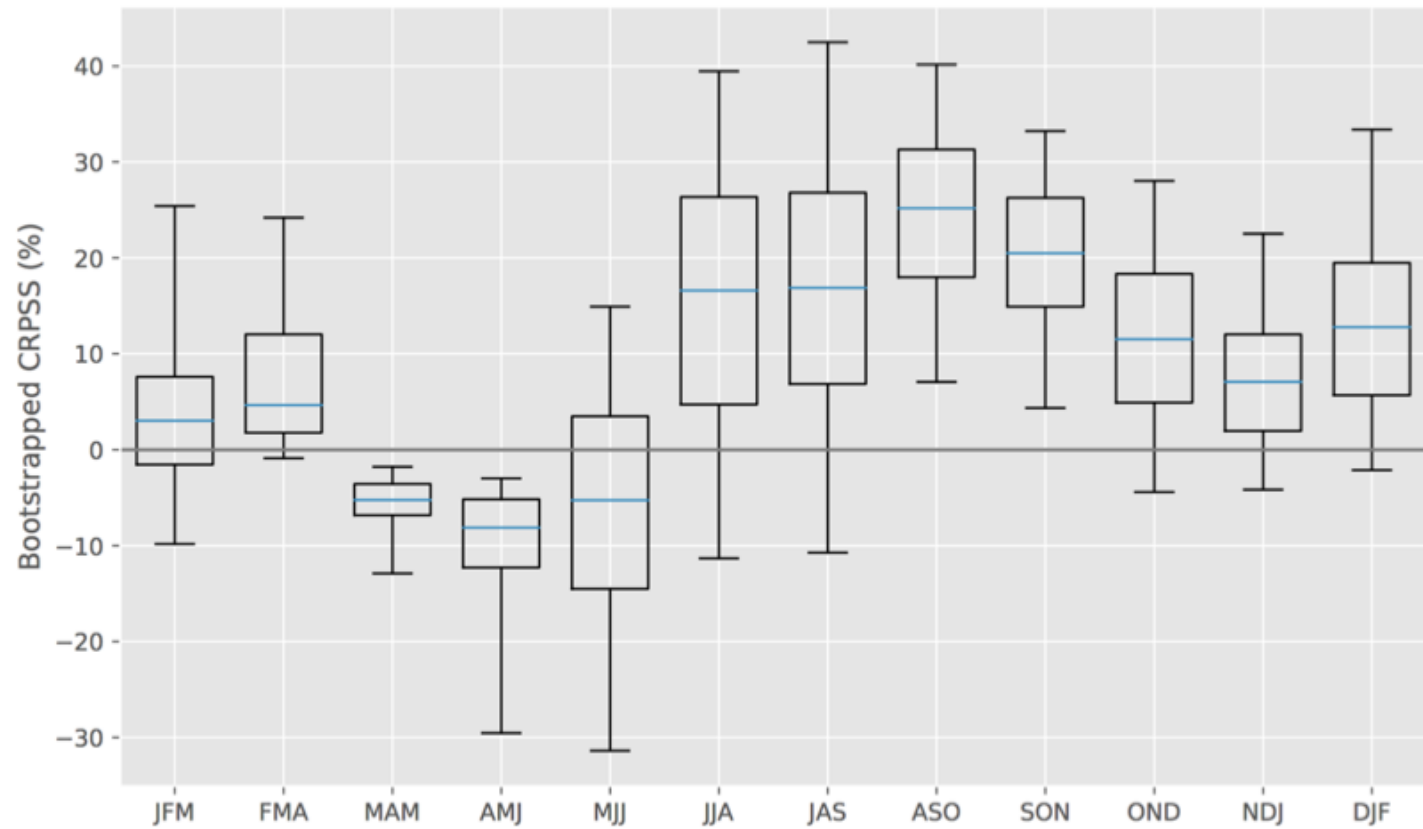
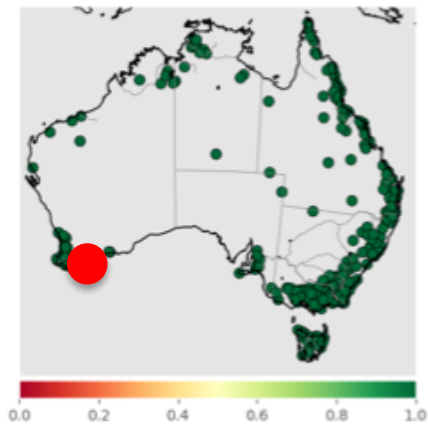


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Kent River at Styx Junction

Kent River at Styx Junction

Location of Site styx_junction

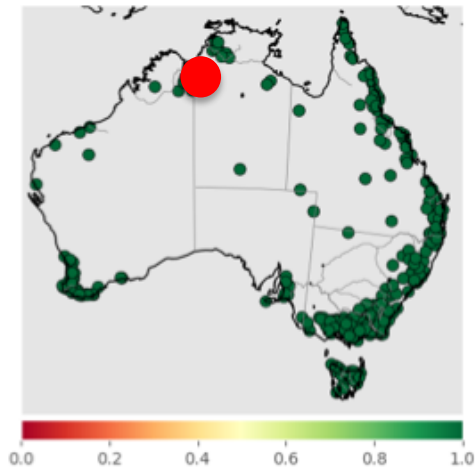




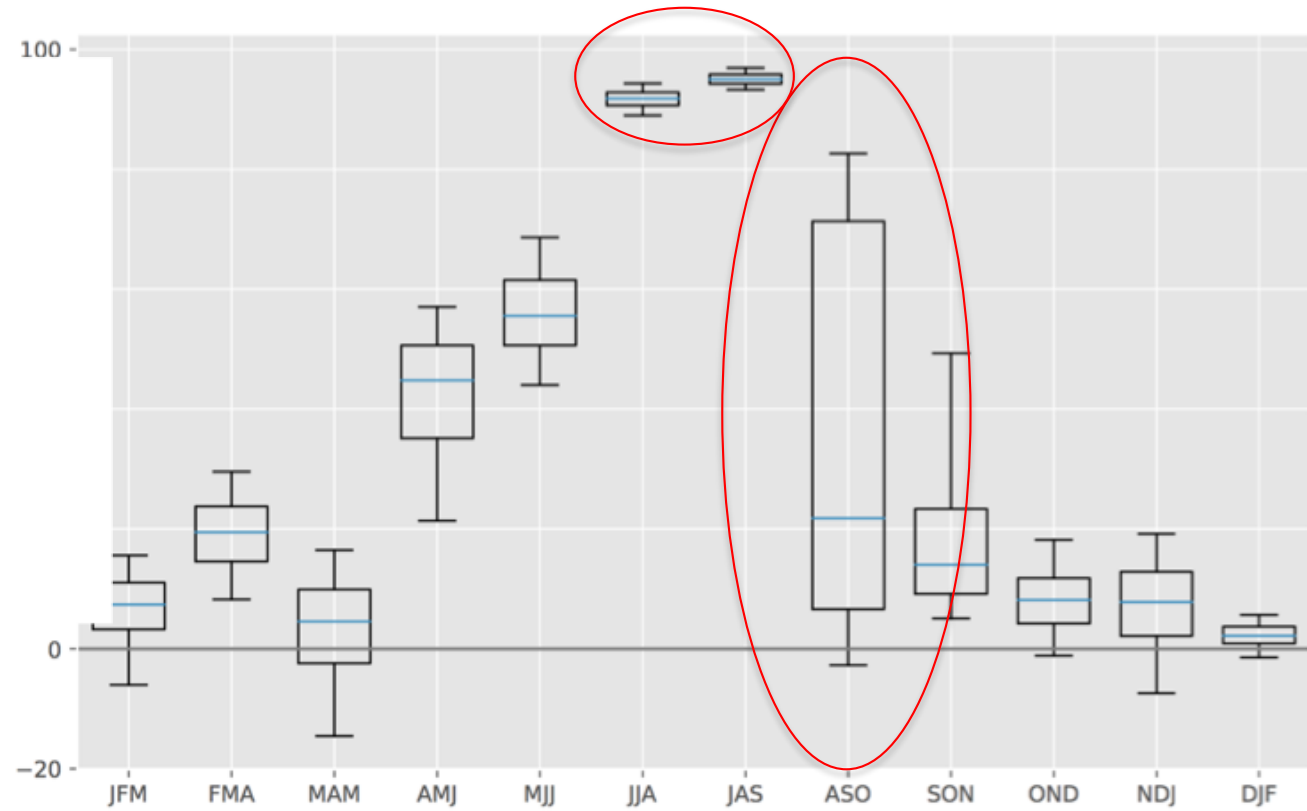
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Dunham River at Dunham Gorge

Location of Site dunham



Dunham River at Dunham Gorge





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

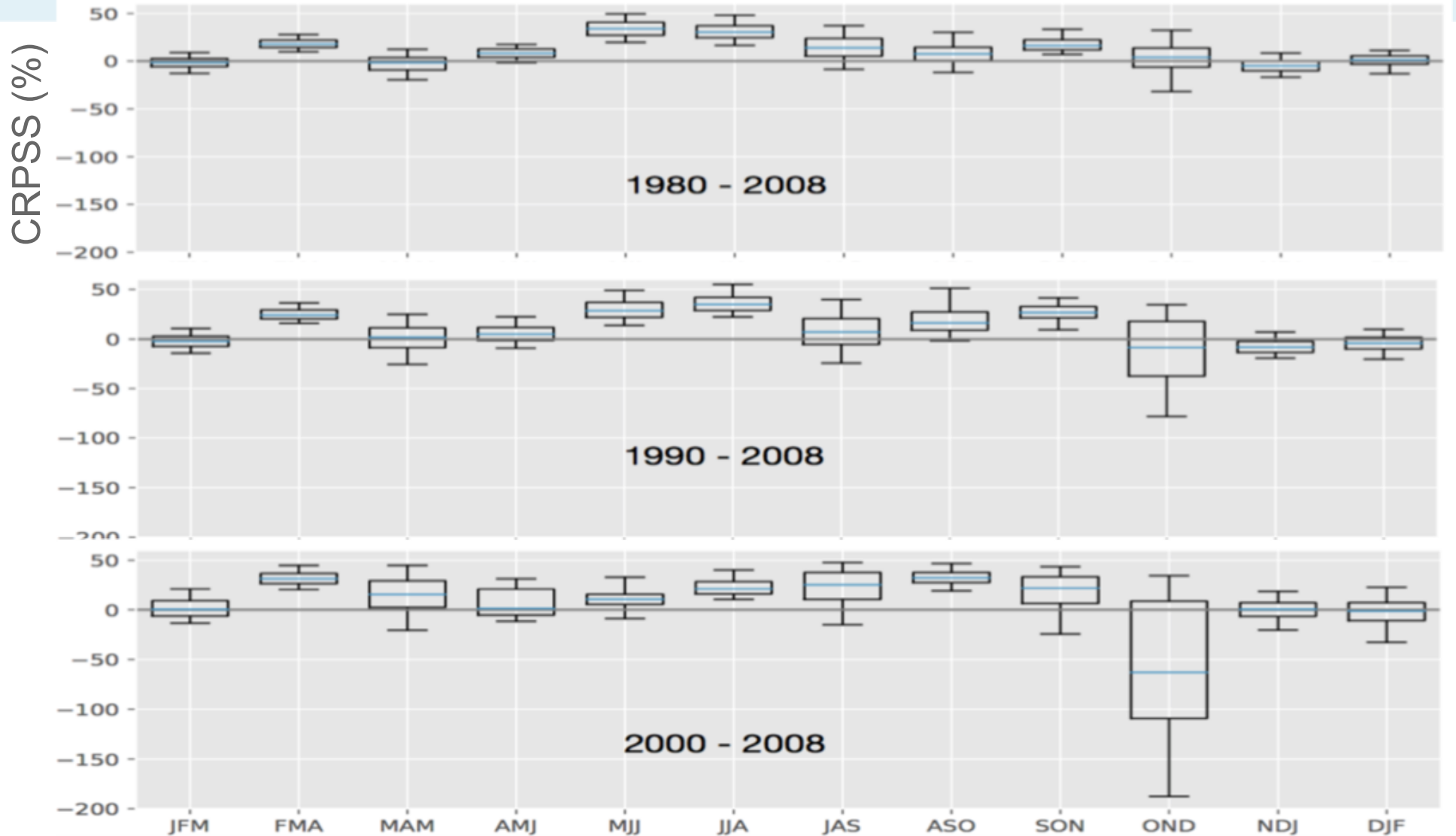
First, limited number of streamflow samples
e.g. < 30 observations from 30 years



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Impact of sample size on skill score uncertainty

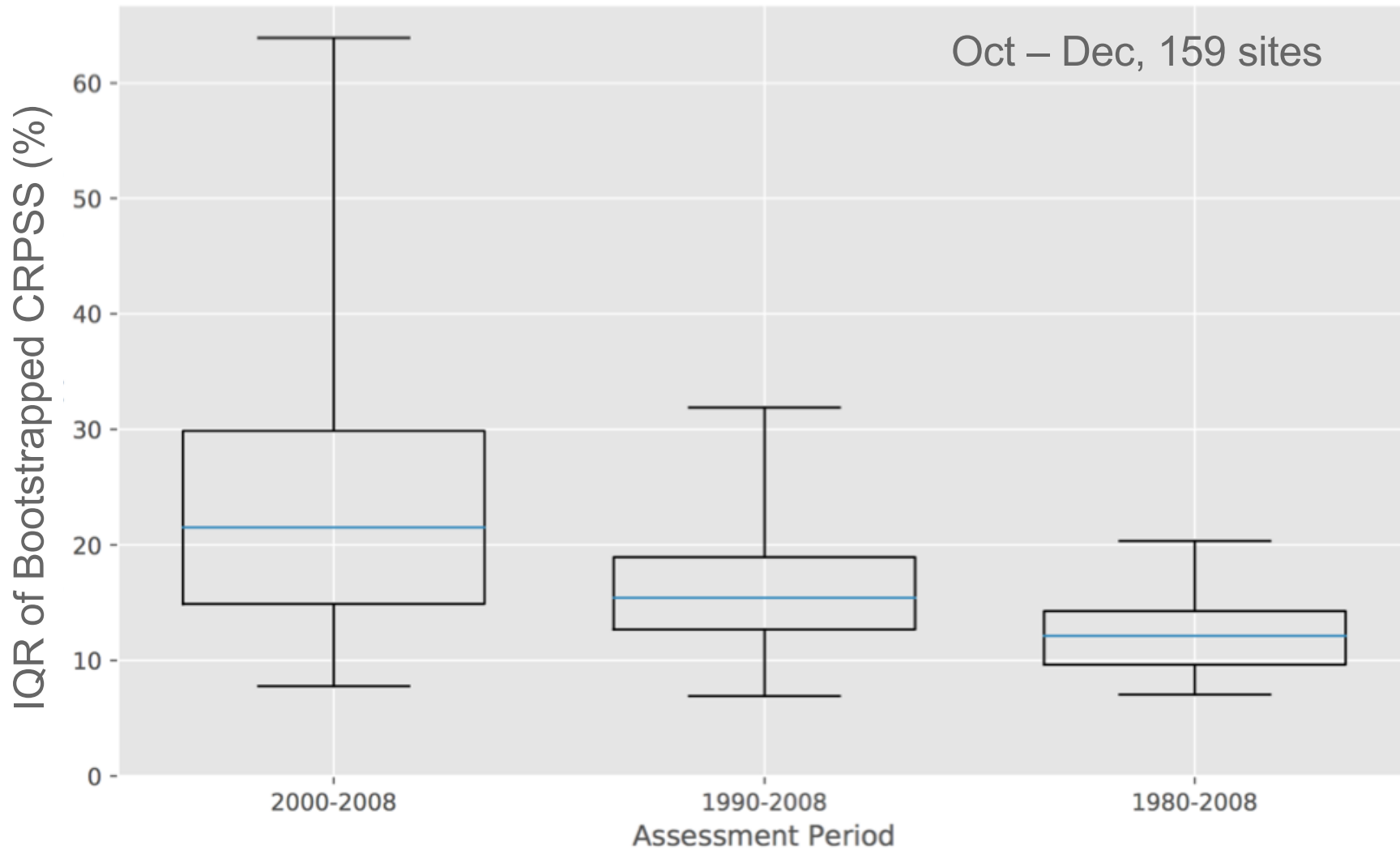
Burdekin River at Sellheim, QLD





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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

$$CRPS = Reliability + Resolution + Uncertainty$$

$$CRPS(clim) = Uncertainty$$

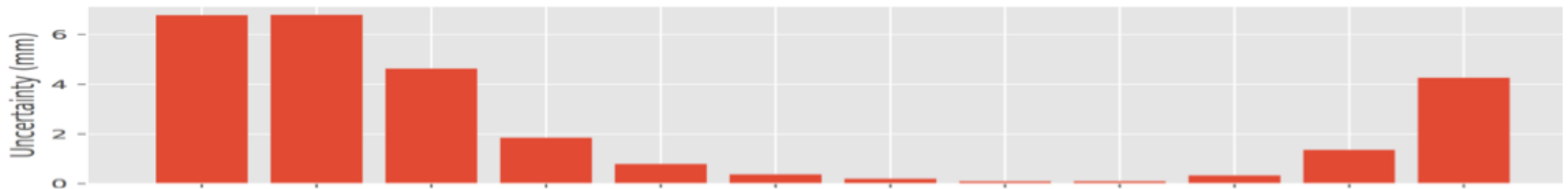
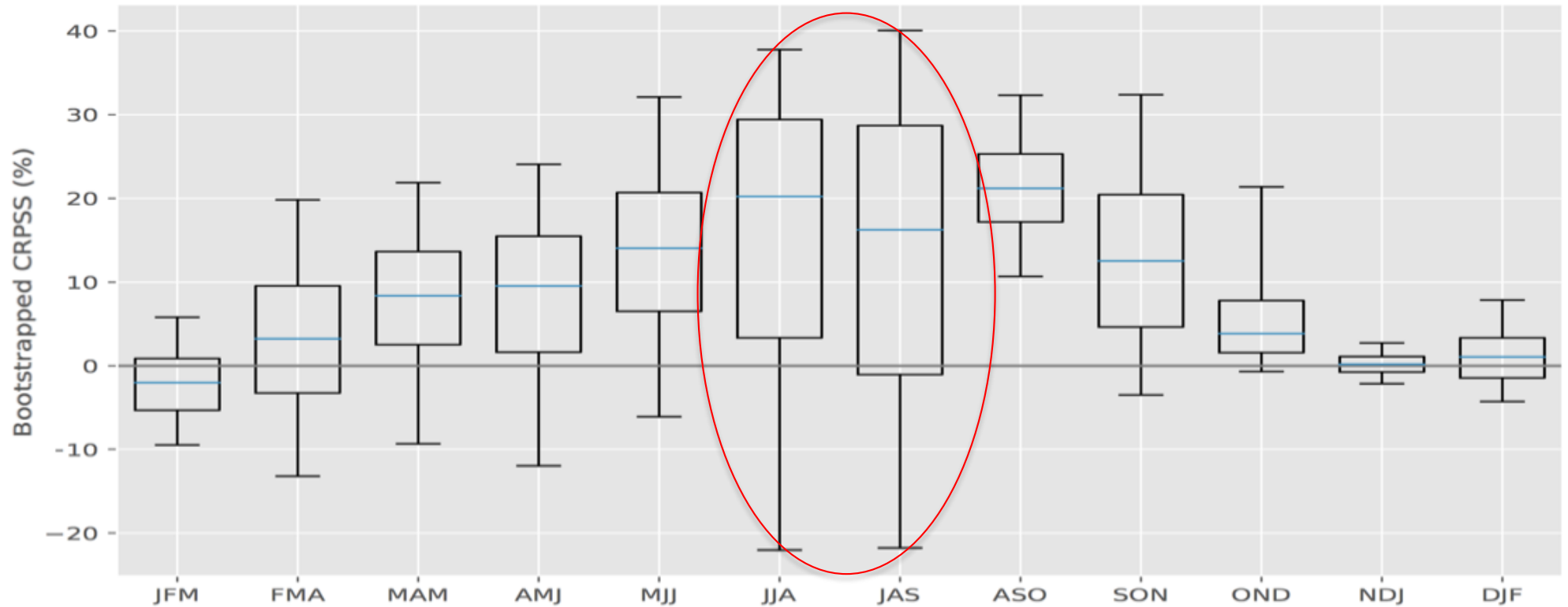
$$\frac{\delta SS}{\delta S_{fc}} = \frac{1}{Uncertainty_{clim}}$$

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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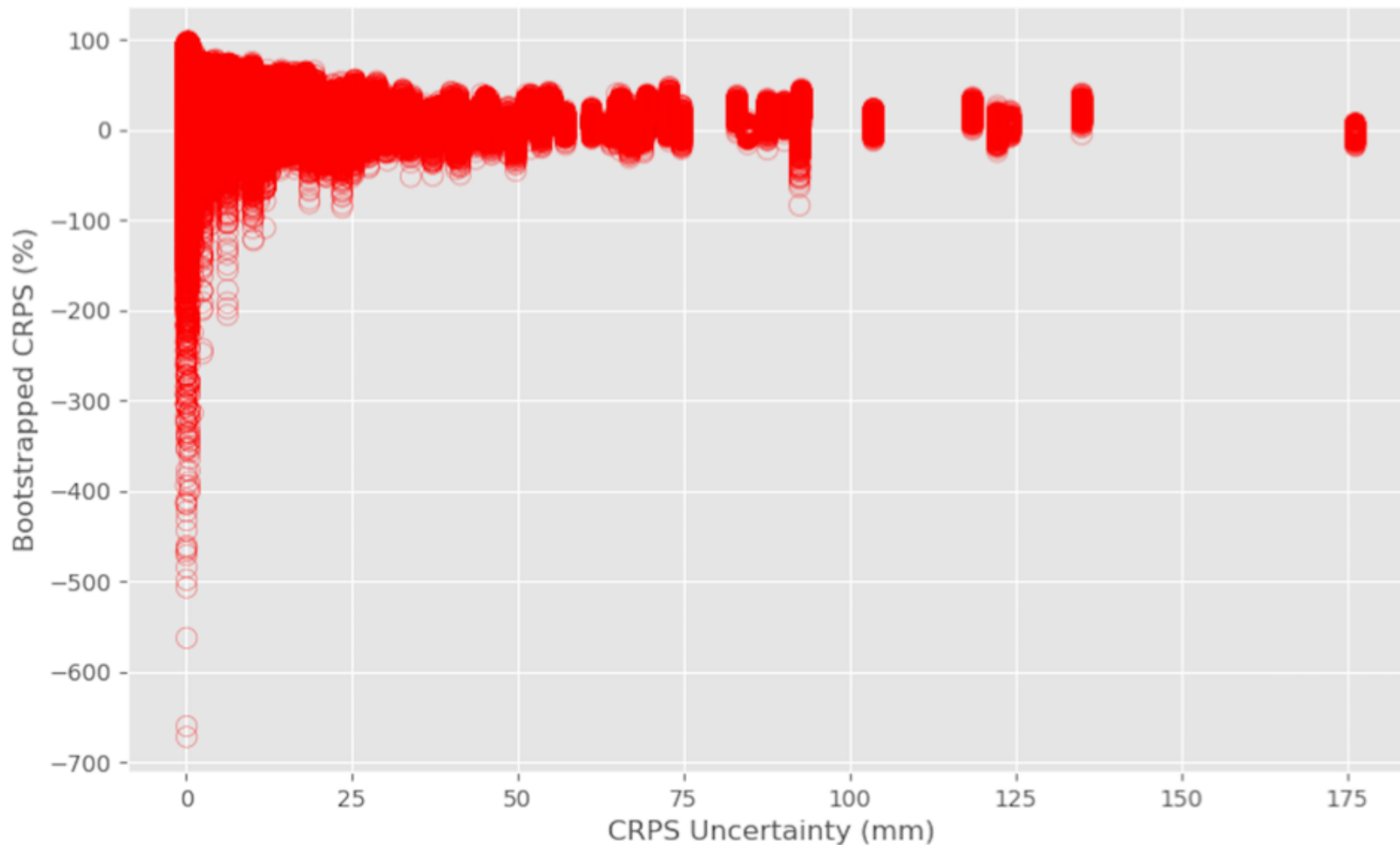
Skill score uncertainty vs. streamflow uncertainty: Birdsville, QLD





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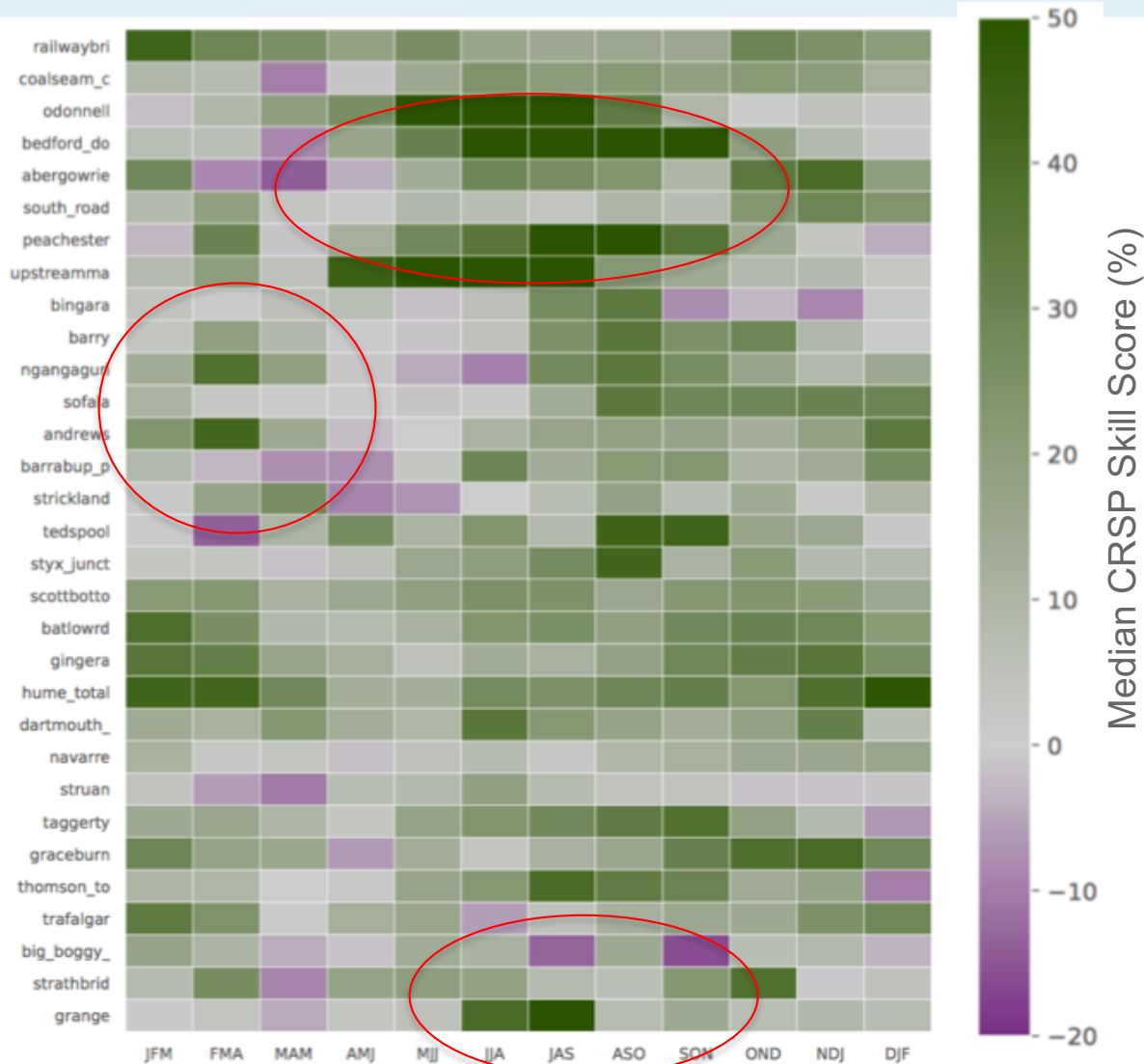
All bootstrapped skill scores vs. streamflow uncertainty: 159 sites





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Impact on interpretation of skill score summary chart



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.

