



Developments and applications of CBaM for post-processing seasonal climate forecasts

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LAND AND WATER
www.csiro.au



Talk outline

- Seasonal climate forecasting in Australia
- Introducing CBaM
- Applications and results
- Future development

Official seasonal climate forecasting in Australia is now GCM based

Australian Government
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Climate outlooks – monthly and seasonal

Issued: 27 August 2015 – Next issue: 24 September 2015

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Rainfall - Summary

- Overview
- Rainfall
 - Summary
 - Chance of above median
 - Outlook scenarios
 - Chance of at least
 - Medians
 - Past accuracy
- Temperature

Chance of above median

Outlook scenarios

Chance of at least

Wetter in the west and centre

- There is an increased chance of a wetter-than-average season over much of southern and central WA, the southern NT, SA and extending into parts of western NSW Victoria and Queensland. In far north Queensland, spring is likely to be drier than average. Most of eastern Australia has a roughly equal chance of a wetter or drier season.
- The current outlook reflects the record warm sea surface temperatures in the Indian Ocean, and a strengthening El Niño in the Pacific.
- Historical outlook accuracy for spring is moderate to high over most of Australia.

Water management and agriculture continue to use statistical forecasts

Seasonal Streamflow Forecasts

Date: September–November 2015

- Low streamflows more likely for September–November
- Low August streamflows observed at half of forecast locations
- El Niño strengthens but a warm Indian Ocean persists

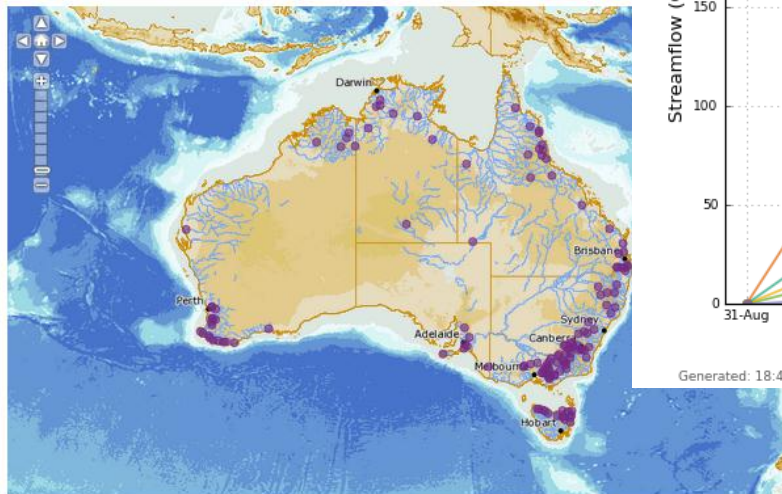
Streamflow forecast for September–November

For September to November, low streamflows are more likely at 98 locations across Australia. Near-median flows are more likely at 29 locations and high flows are more likely at five locations. There is generally high to moderate forecast skill across the country and in particular, across southern Australia.

Due to very low model skill or missing observations, forecasts have not been issued at eight locations. We suggest using the historical 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](#).



- Moderate to high skill
- Low skill or missing climate data
- Very low skill or missing antecedent condition data

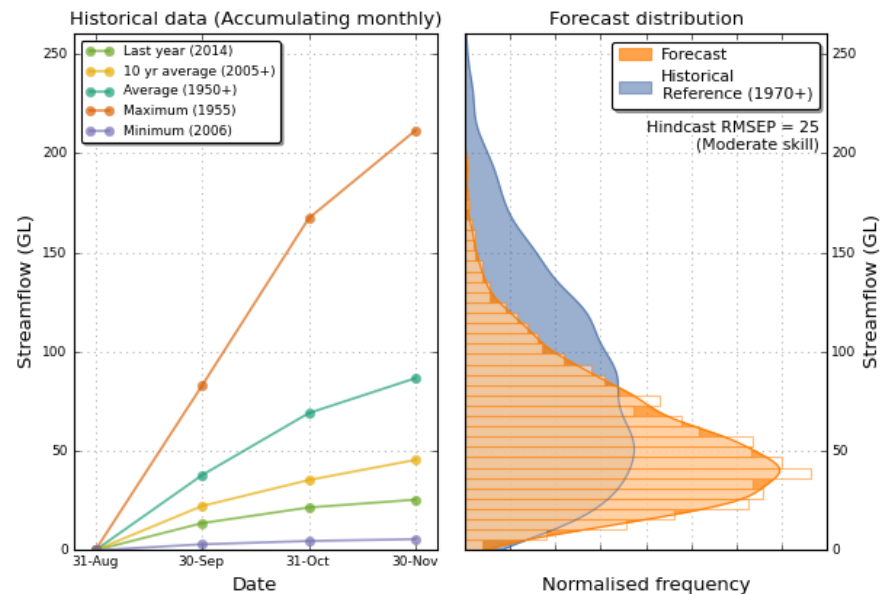
New information video

Trudy Wilson

September–November
Climate and Water

Australian Bureau of Meteorology

Ovens River at Bright (403205) Forecast period: Sep–Nov 2015



Generated: 18:44 04/09/2015 (ver. 1.8.4/1.1.6)

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Water management and agriculture continue to use statistical forecasts

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Rainfall and pasture growth

Australia

New South Wales

Northern Territory

Queensland

South Australia

Tasmania

Victoria

Western Australia

Home → Rainfall and pasture growth →

Rainfall and pasture growth

Raw data used in our rainfall maps is provided courtesy of the Department of Science, Information Technology and Innovation. Rainfall and rainfall percentile maps give us some idea over a particular period depends upon previous season temperatures, soil and pasture types, grazing pressure showing simulated pasture growth, which should provide a useful guide for pastoralists.

[Why monitor seasonal pastoral conditions?](#)

WARNING: These maps are designed to provide useful information when making decisions at specific locations.

[Australia](#) | [New South Wales](#) | [Northern Territory](#) | [Western Australia](#)

The rainfall maps on this site are produced using grid data from the Department of Science, Information Technology and Innovation. For more information, see [construct a comprehensive archive of Australian climate data 309-330](#). Stephen J. Jeffrey, John O. Carter, Keith B. Carter.

See also: [Bureau of Meteorology's official rainfall maps](#)

Last updated: 22 June 2010

Pasture Growth Outlook

www.LongPaddock.qld.gov.au

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Overcoming the disconnect - Introducing CBaM

- CBaM is a statistical post-processing method
 - Corrects biased and/or unreliable GCM forecasts and upskills
- Produces ensemble time series forecasts
- Adoption can benefit water management, agriculture, energy, mining



How does CBaM work?

- **Calibration**

- Eliminates bias and improves reliability

- **Bridging**

- Recovers skill through teleconnections
- Extends forecast lead times

- **Merging**

- Maximises skill for each location and time period
- Links ensemble members into time series

- Matches spatial scales

- Downscaling

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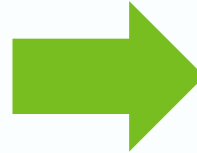
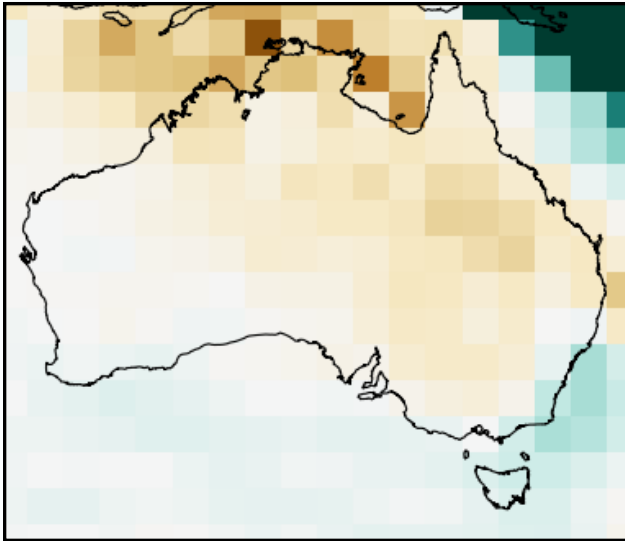
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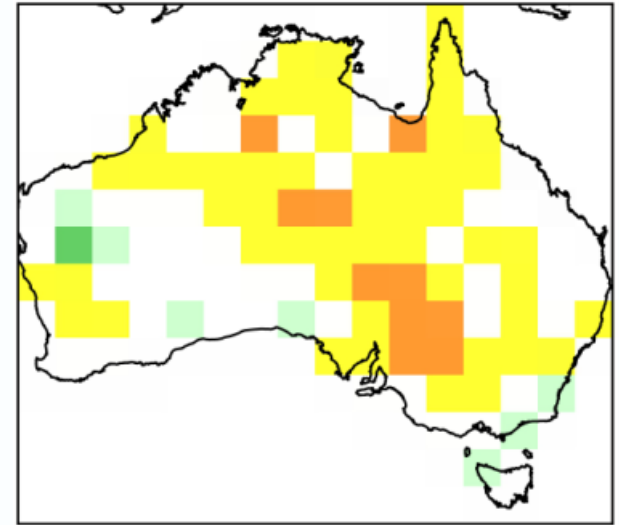
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Calibration

Raw GCM output



Calibration forecast



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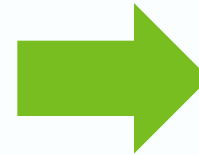
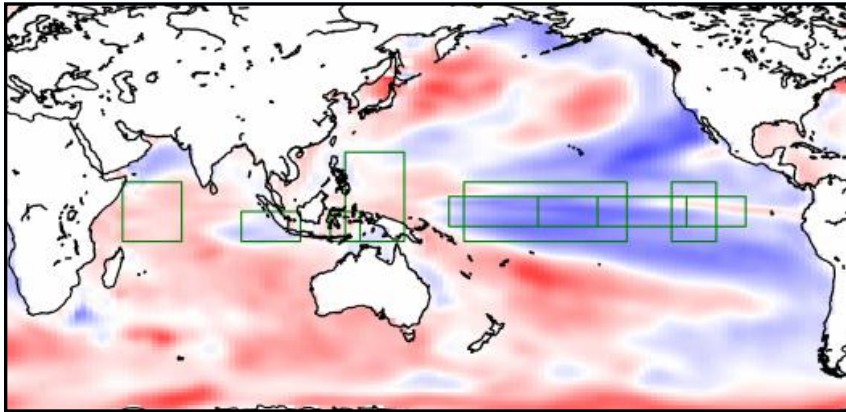
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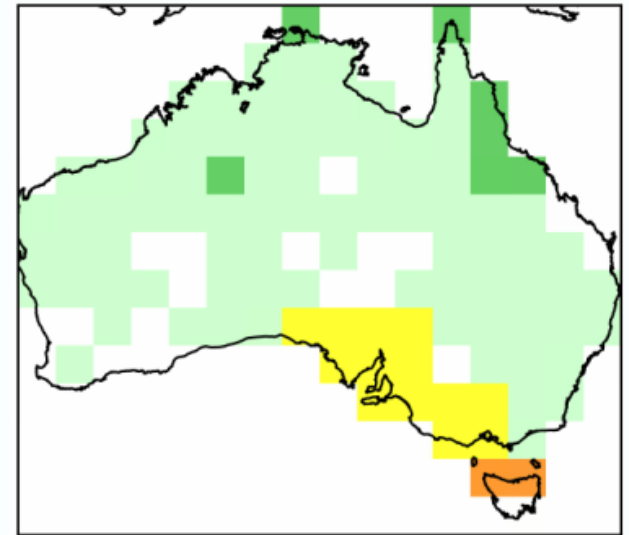
- Downscaling

Bridging

GCM SSTs



Bridging forecast



Predictors: Ensemble means of GCM climate indices

(e.g. NINO3, NINO3.4, NINO4, EMI, DMI, II)

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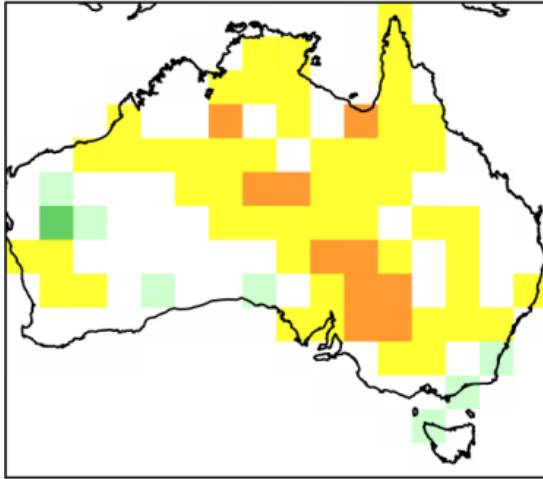
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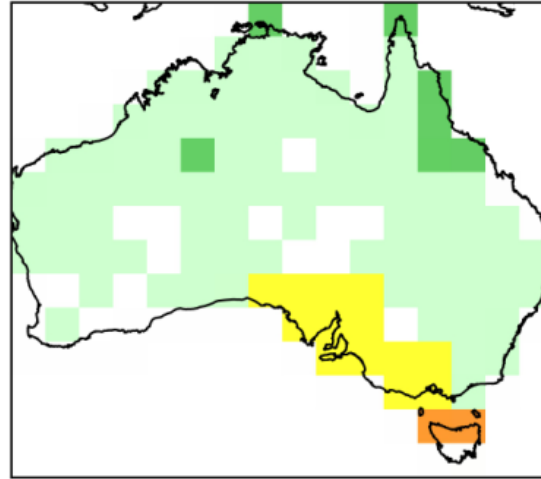
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Merging

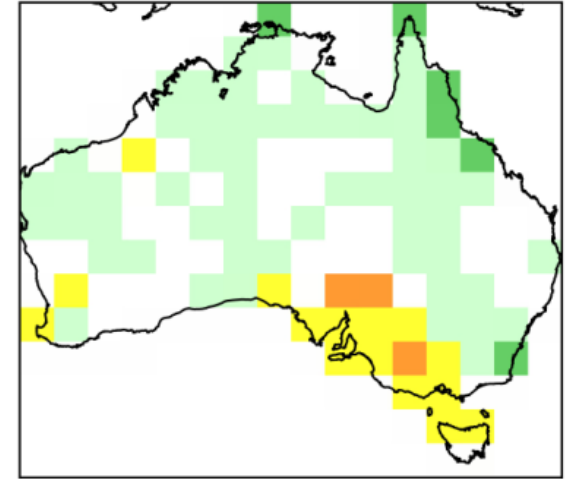
Calibration



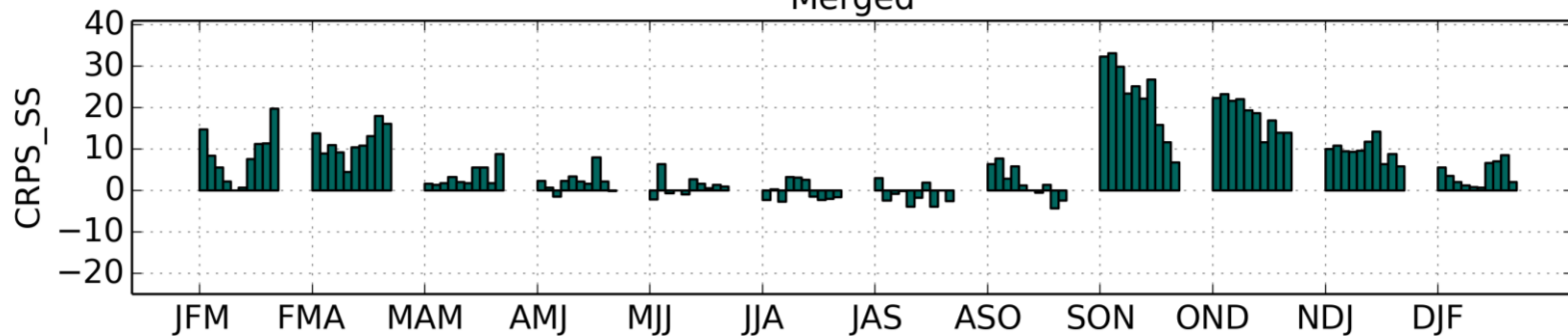
Bridging



Calibration & Bridging



Merged



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CBaM = BJP + BMA + Schaake Shuffle

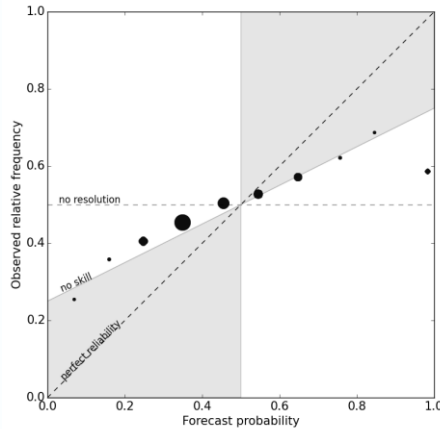
Recent applications

- POAMA, CFS2, System4
- Seasonal Rainfall, Tmin, Tmax
- 1983 – 2010 Cross-validation
- 2.5 degree grid across Australia

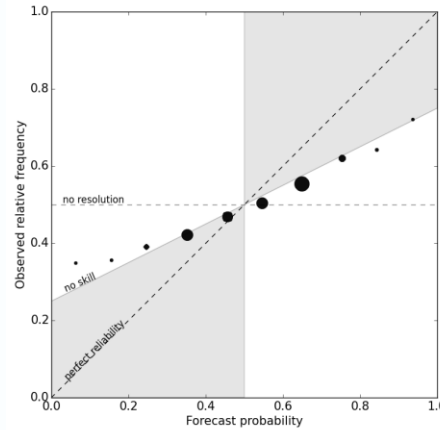
Improvement to reliability (e.g. POAMA2)

Raw
mean-
corrected

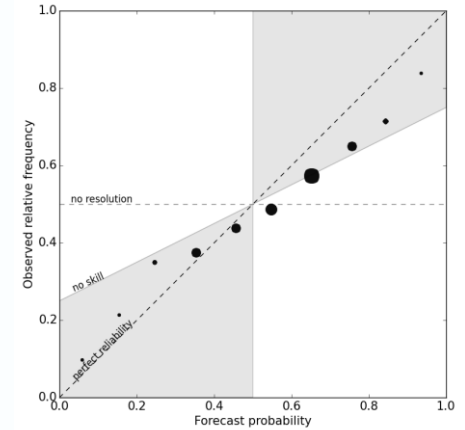
Rainfall



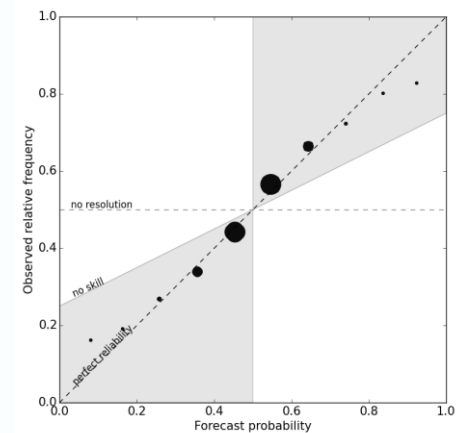
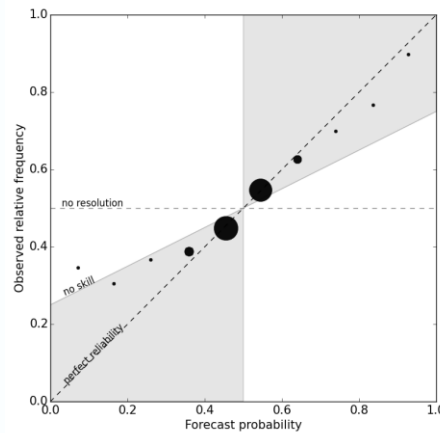
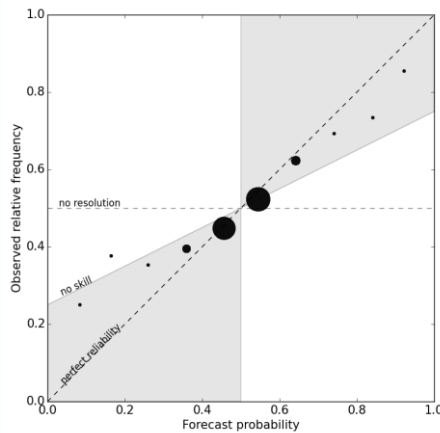
Tmin



Tmax

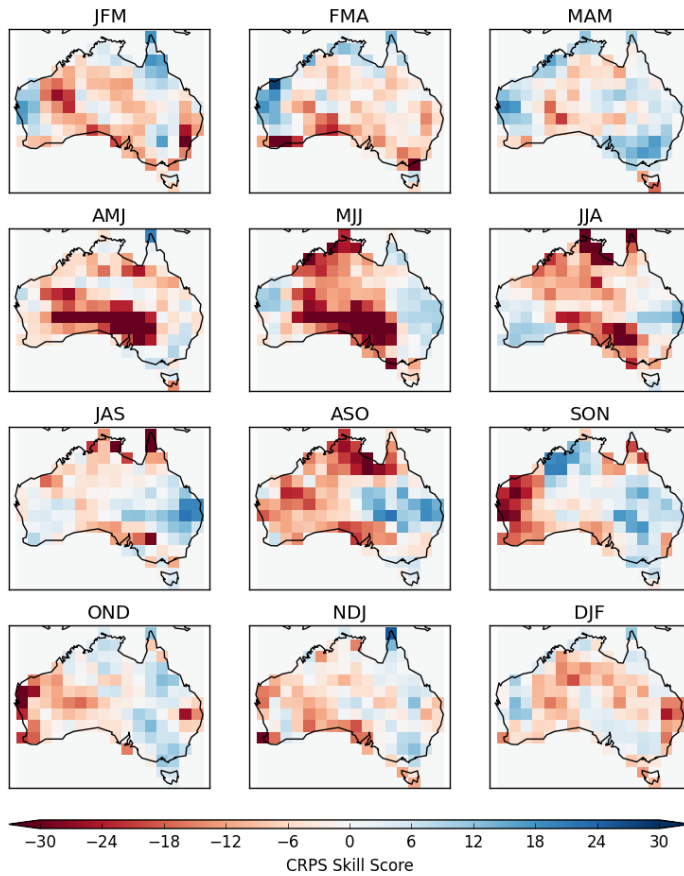


CBaM
post-
processed

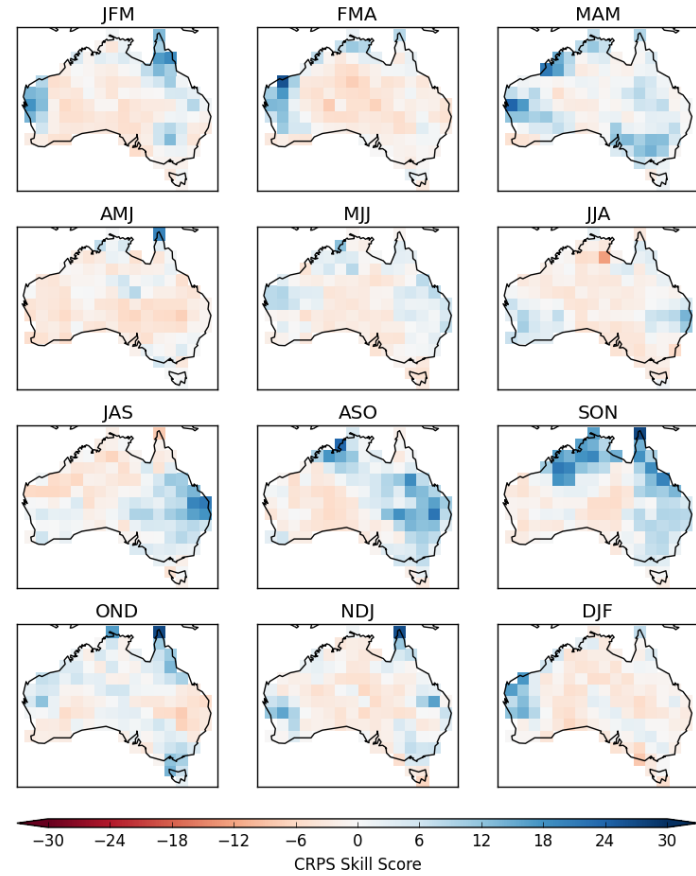


Skill of calibration (e.g. POAMA2 rainfall)

Mean-corrected (Raw)

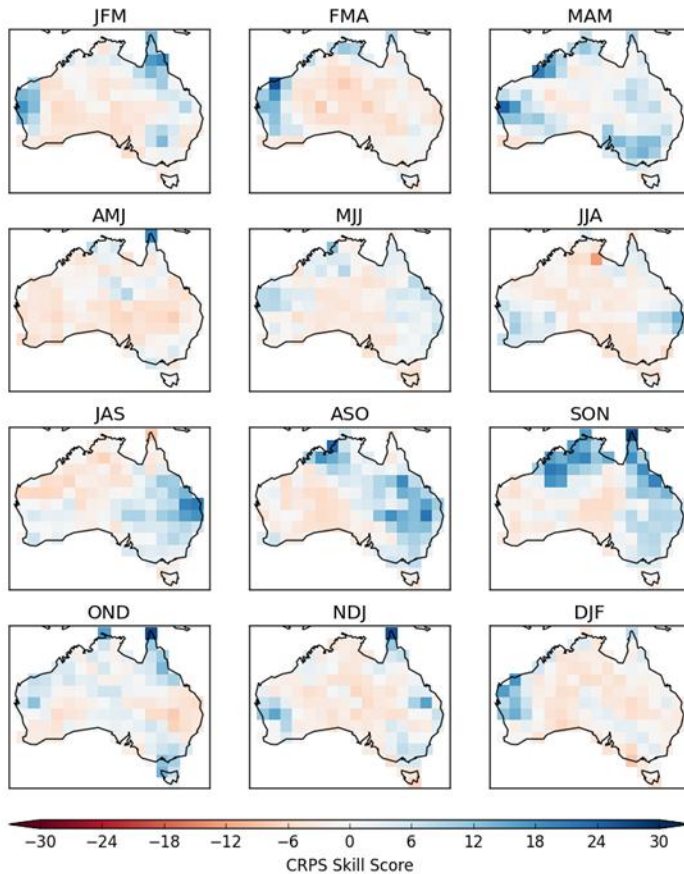


Calibration (CBaM)

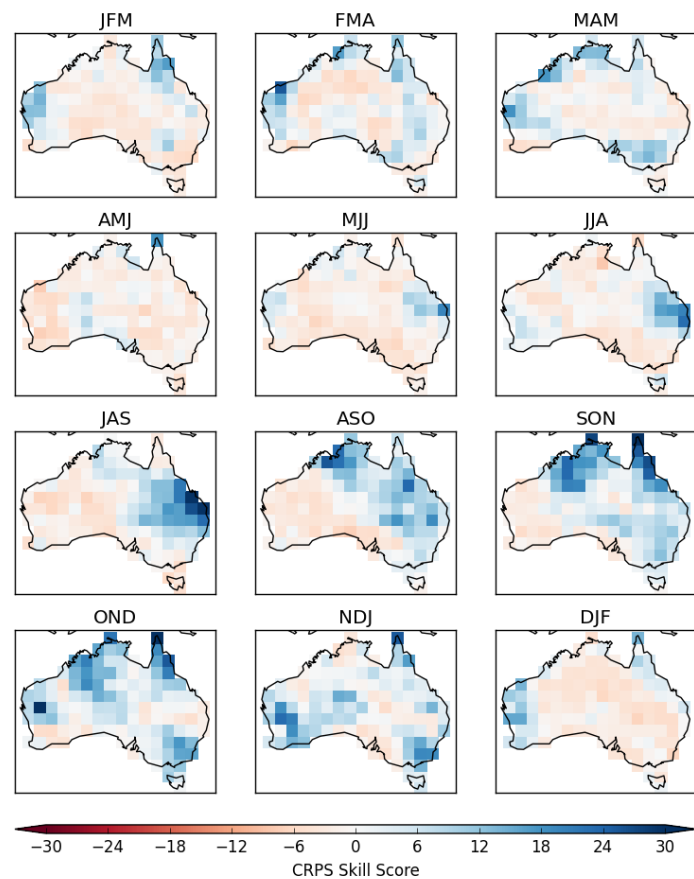


Skill improvement through bridging (e.g. POAMA2 rainfall)

Calibration

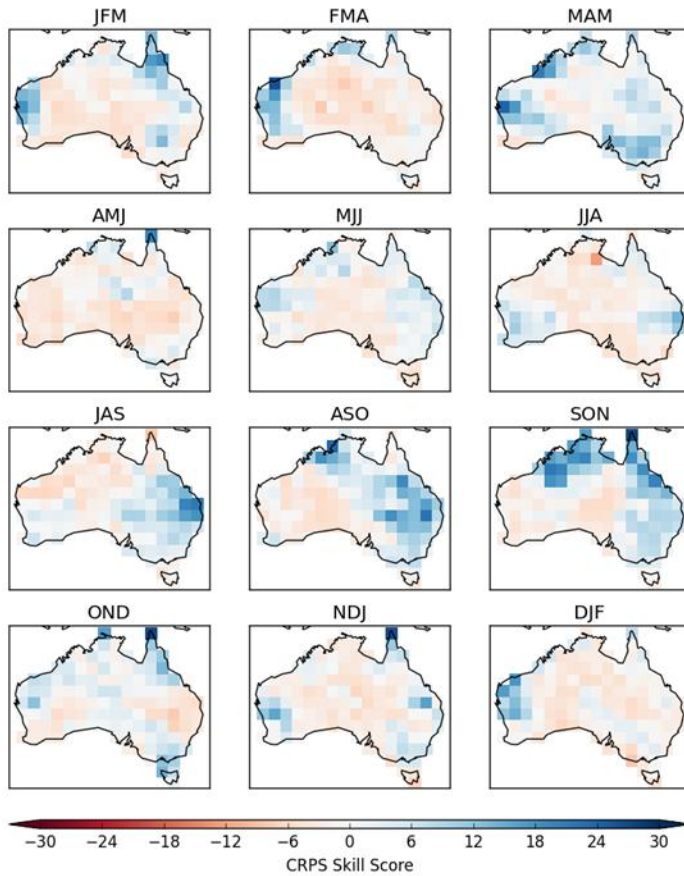


Merged

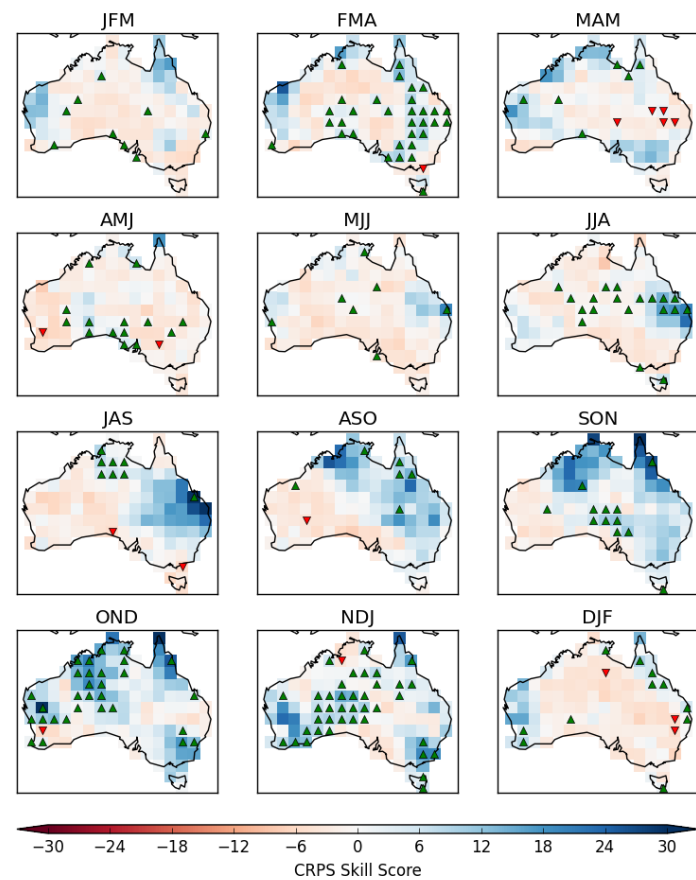


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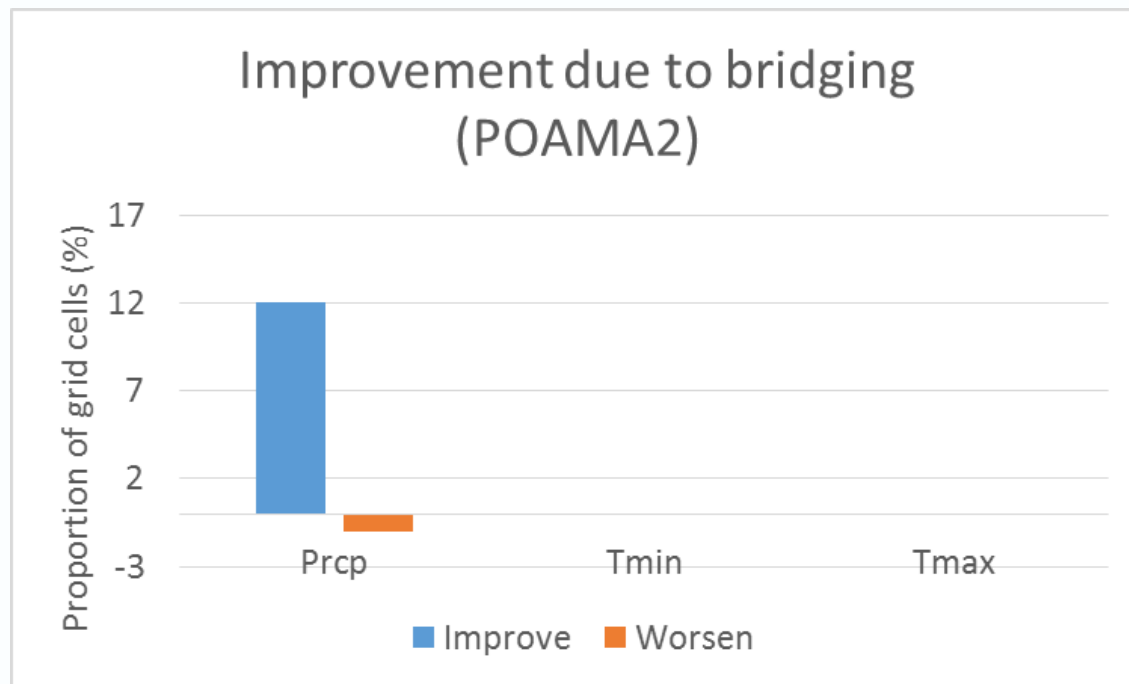
Calibration



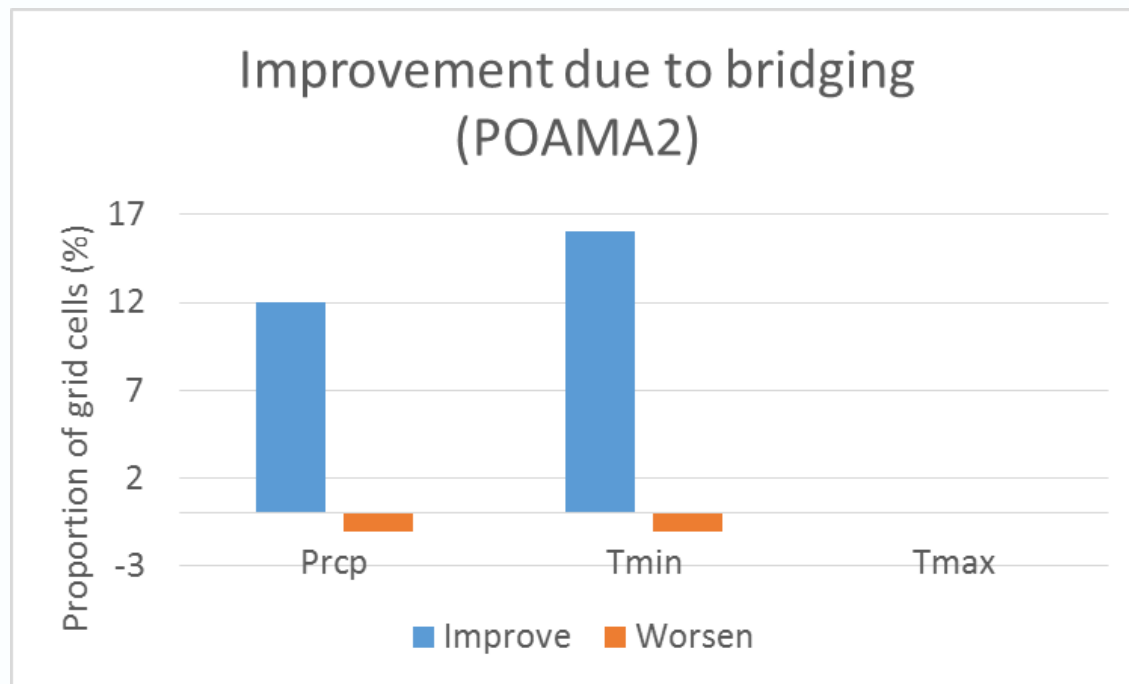
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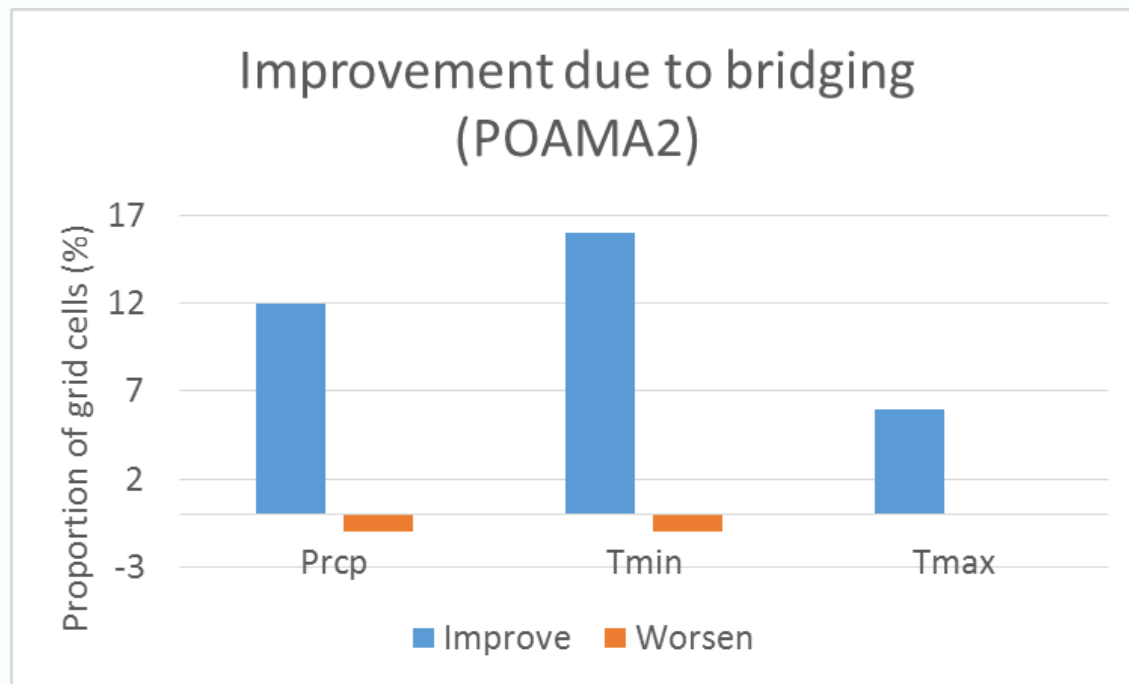
Contribution of bridging to improving skill (e.g. POAMA2)



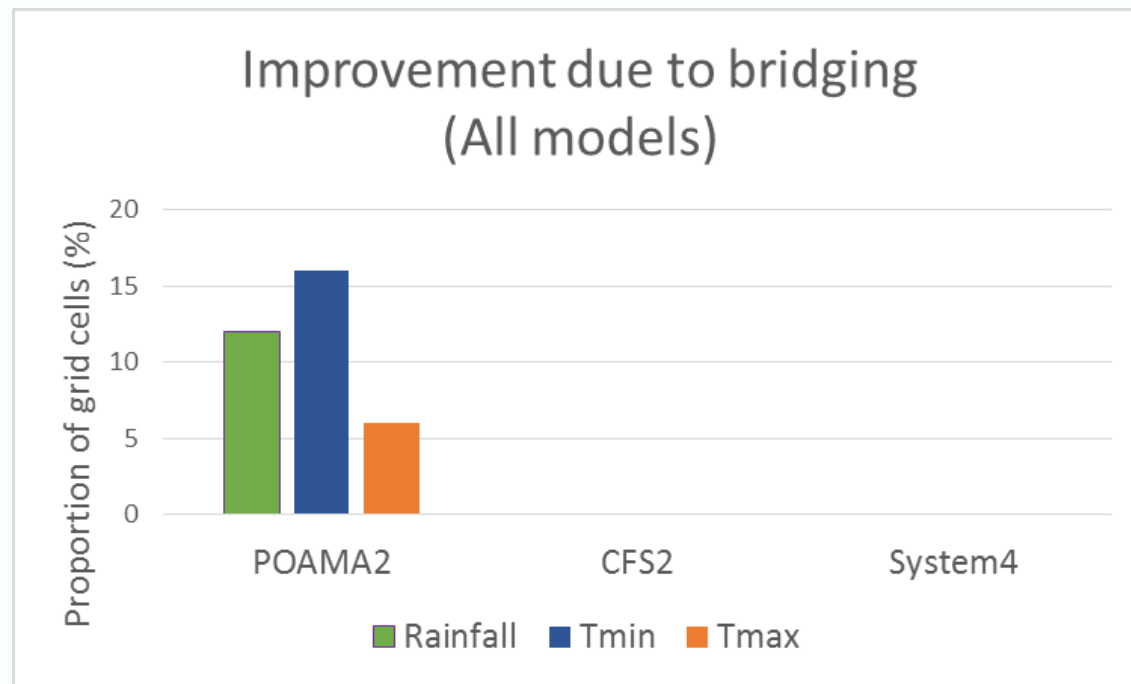
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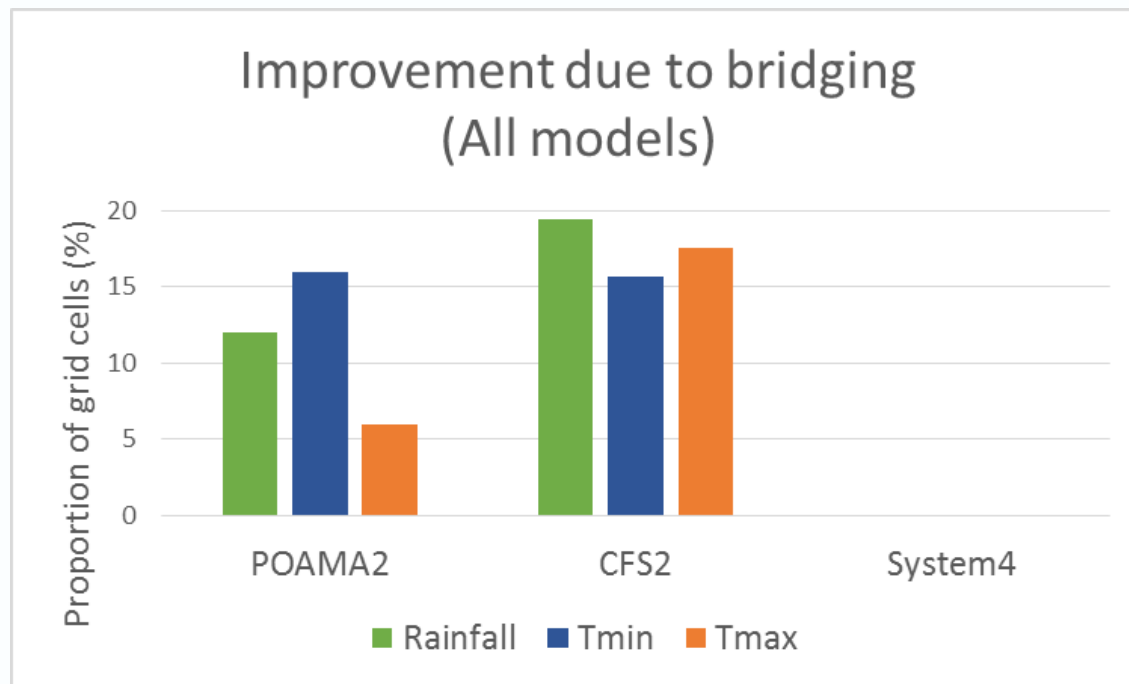
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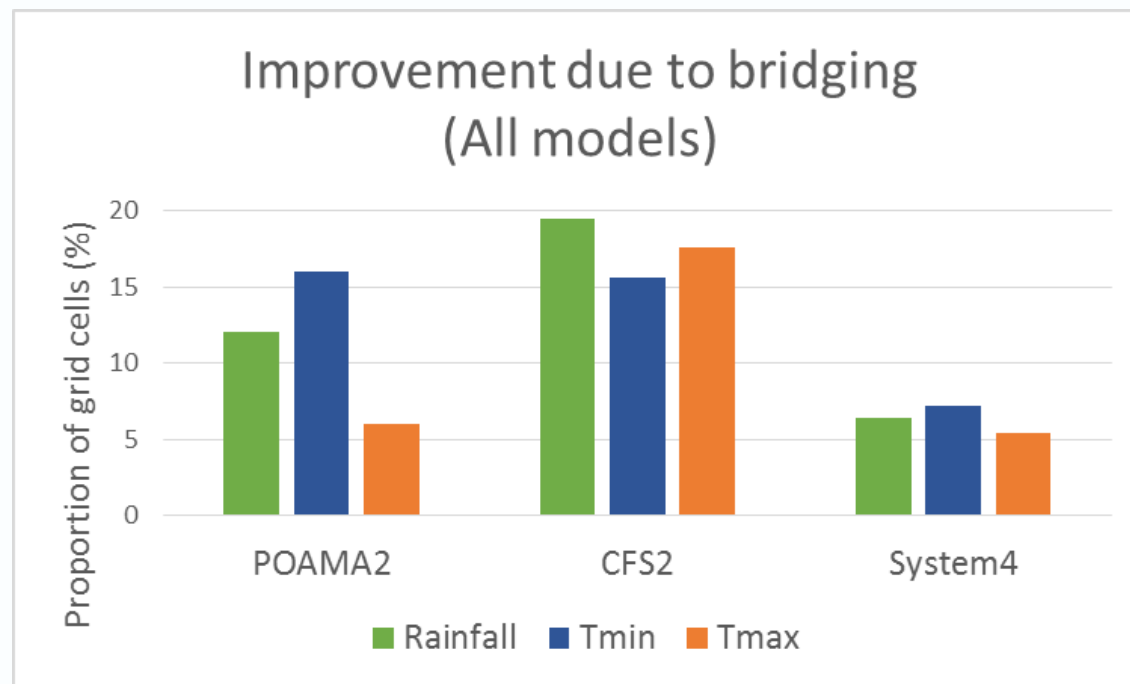
Bridging improves skill for multiple GCMs



Bridging improves skill for multiple GCMs



Bridging improves skill for multiple GCMs



Summary of results

- CBaM produces reliable ensemble forecasts
- Bridging produces additional skilful forecasts in many locations and time periods
- CBaM is effective for maximising skill across multiple GCMs

Much work to be done

- Transition to ACCESS-S
- Catering for different ensemble generation methods
- Linking to user models (e.g. crop)
- Quantifying the benefit of using GCM forecasts

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Questions?

Thank you.

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