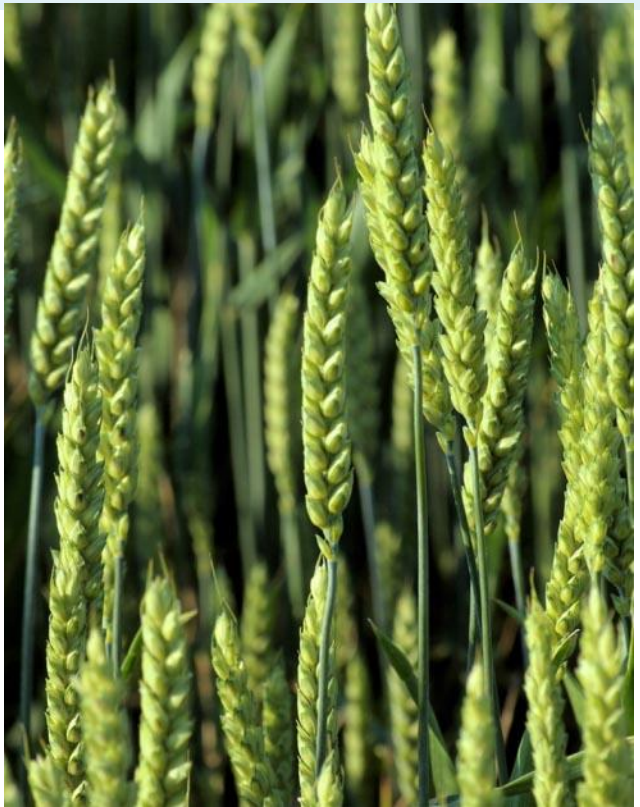
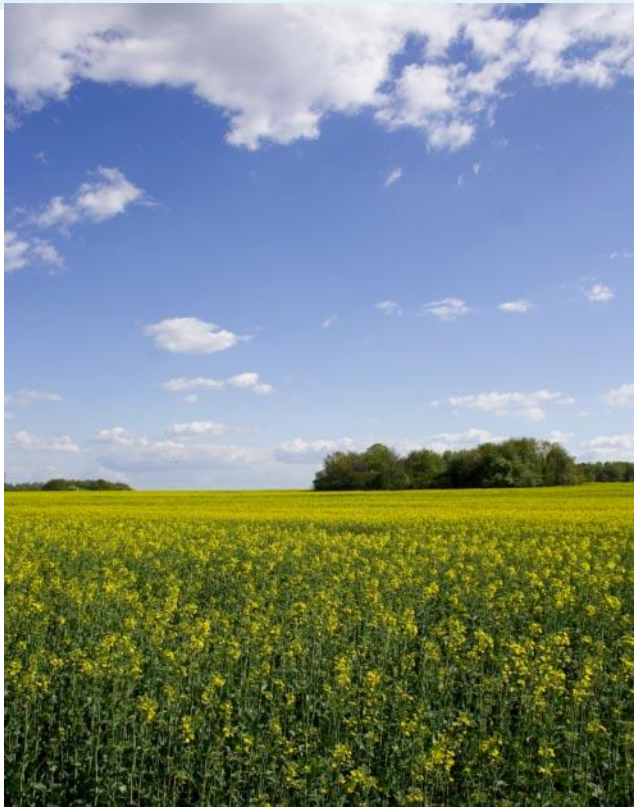
Australian Government
Bureau of Meteorology

Verification of probabilistic rainfall forecasts

Deryn Griffiths, Forecast Systems,

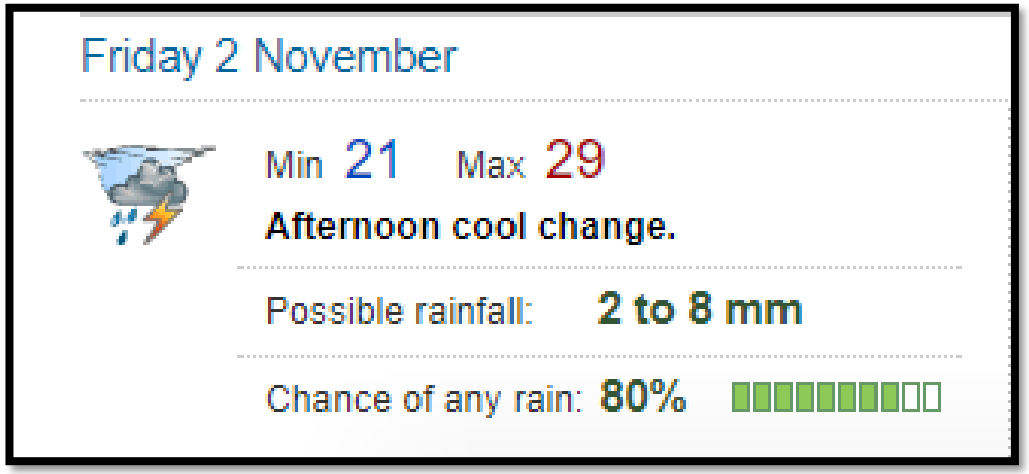
Bureau of Meteorology, Australia





Australian Government
Bureau of Meteorology

We issue Probabilistic Rainfall Forecasts



Chance of any rain:

80% chance of at least 0.2mm in the 24 hour period.

Possible rainfall:

50% chance of at least 2 mm

25% chance of at least 8 mm

Australian Government
Bureau of Meteorology

Australian Digital Forecast Database (ADFD)

For 24 hour periods, information is available for

- % chance of at least

  0.2 mm, 1 mm, 5 mm, 10 mm, 15 mm, 25 mm, 50 mm

- rainfall in mm for which there is

  75%, 50%, 25%, 10% chance of achieving

The forecast periods start at 15 UTC.

How good is the ADFD?
How good is an R&D alternative?

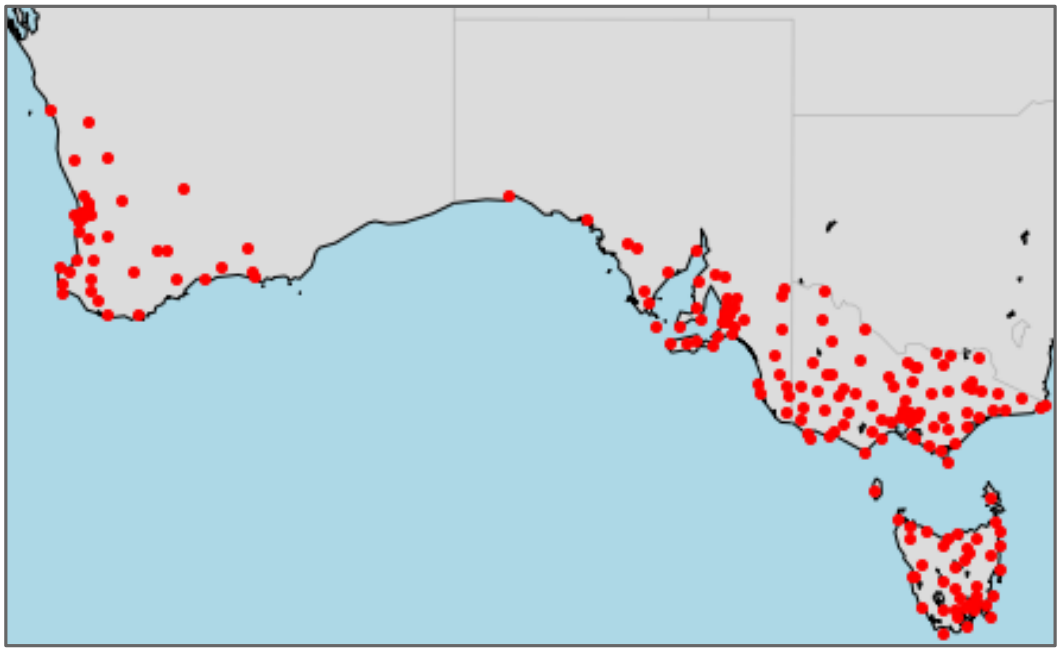
R&D alternative: OCF (also called PME)

- Ensemble of various models
- Uses mean Precipitation (mm) and number of models exceeding a threshold.
- Provides a pdf
- Designed to be well calibrated.

When and where can we use OCF to populate the ADFD directly (i.e. without manual editing)?

Australian Government
Bureau of Meteorology

Example Results Presented



Average over "Southern Australian" weather stations.

JJA (Winter) 2018

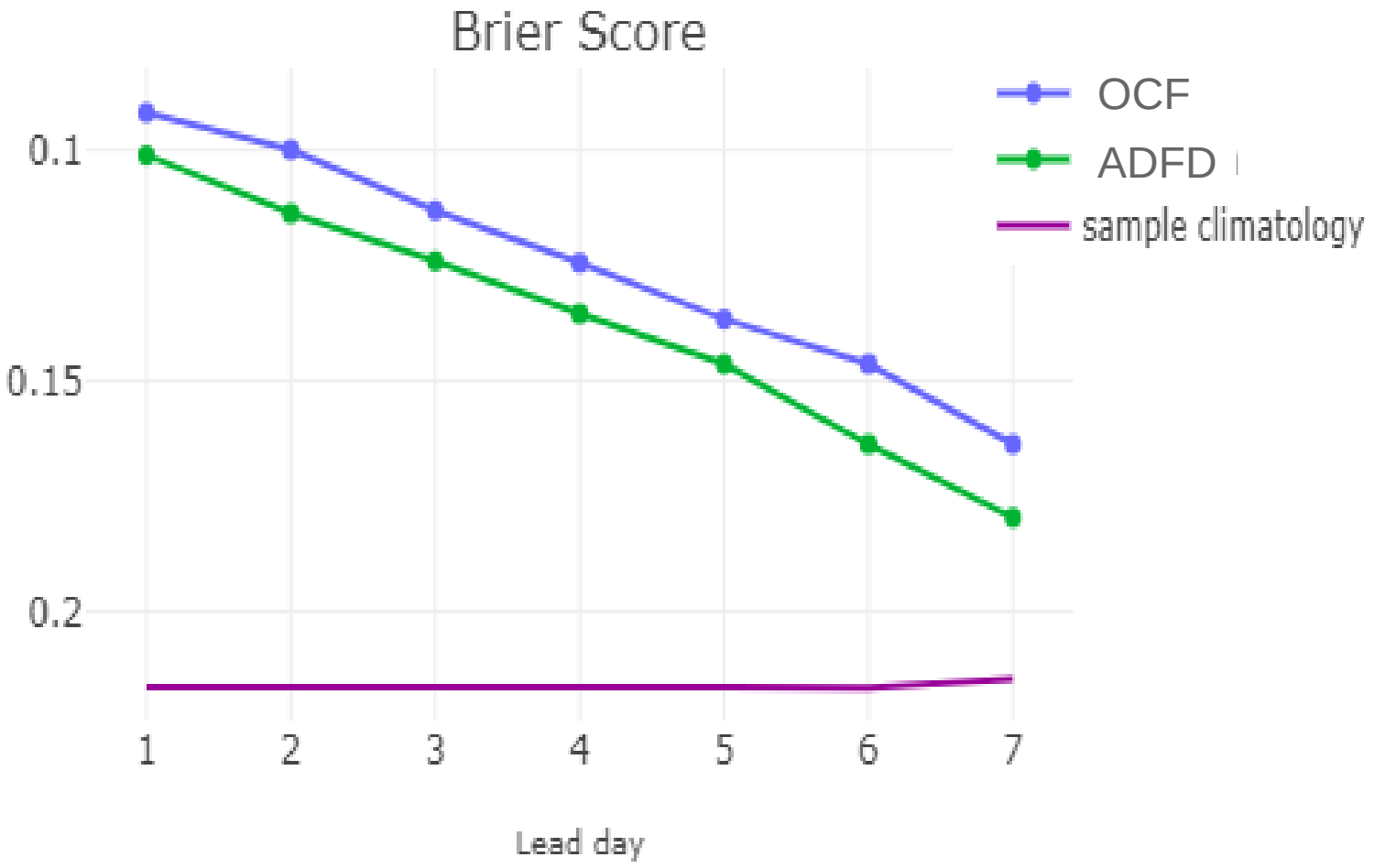
Other groups of stations and seasons available internally at

fiji.bom.gov.au/dashboards

Australian Government
Bureau of Meteorology

Brier Score for Chance of at least 1 mm in 24 h.

better



Australian Government
Bureau of Meteorology

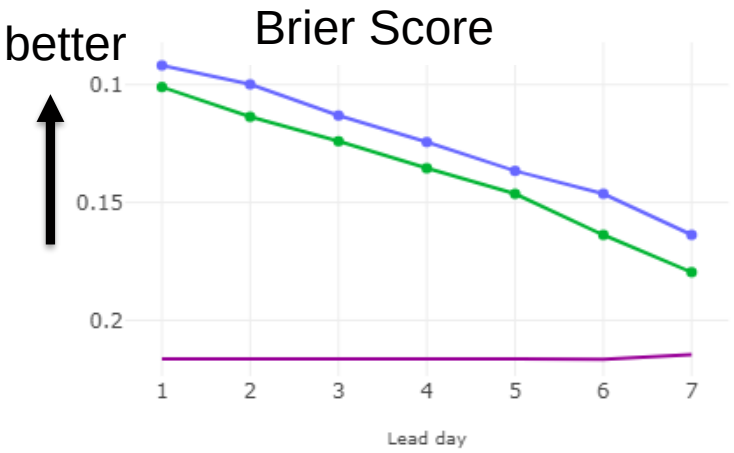
Brier Score

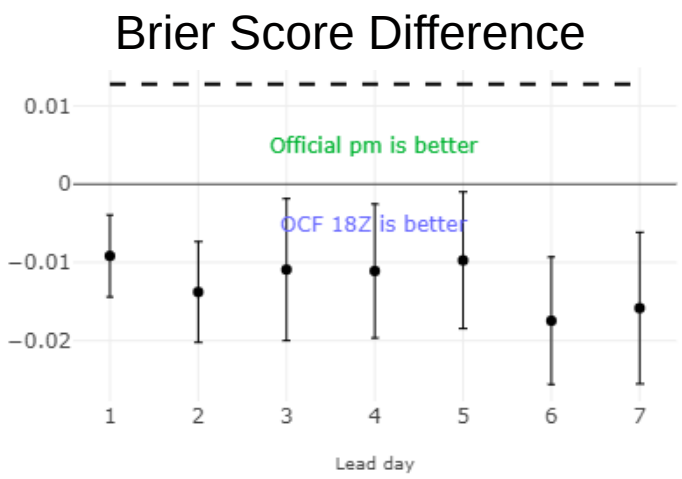
$$\frac{1}{n}\sum(f_i - o_i)^2$$

$\text{forecast} = f_i \in [0, 1]$
$\text{observation} = o_i \in \{0, 1\}$

- Mean Squared Error
- Proper (unhedgable)
- Rewards unbiased forecasts
- Rewards highly resolved forecasts

Brier Score Difference
Chance of at least 1 mm in 24 h.





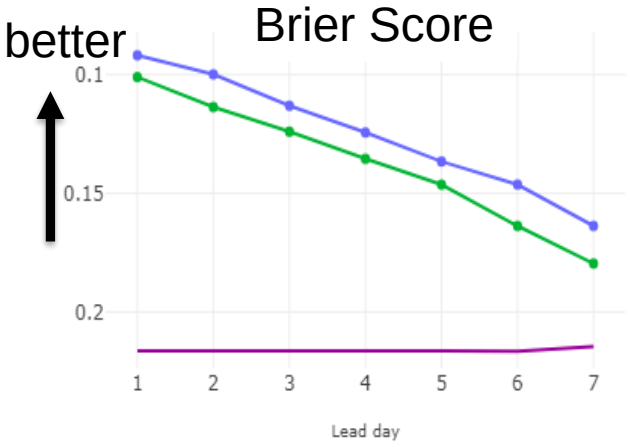
OCF
ADFD
sample climatology
OCF 18Z - Official pm
Skill per Lead day: Official pm

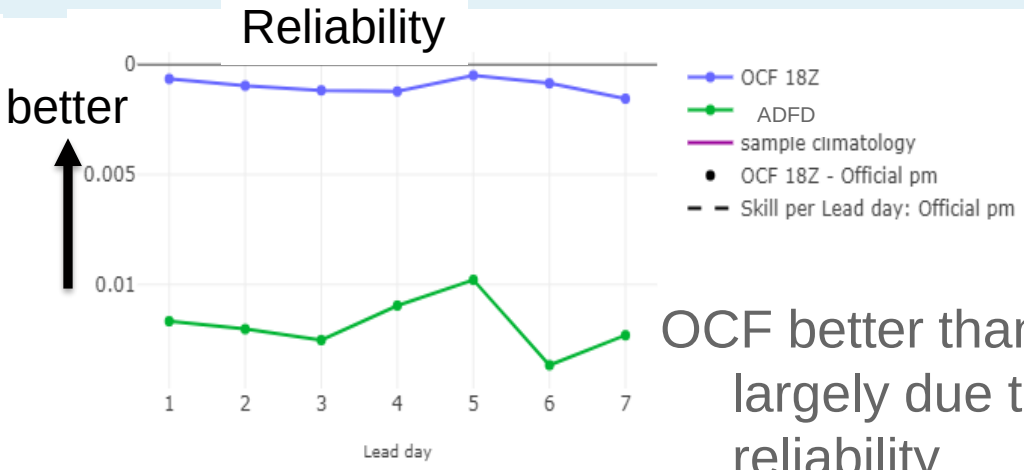
95% confidence interval on difference in Brier Scores.

Signal is statistically significant.

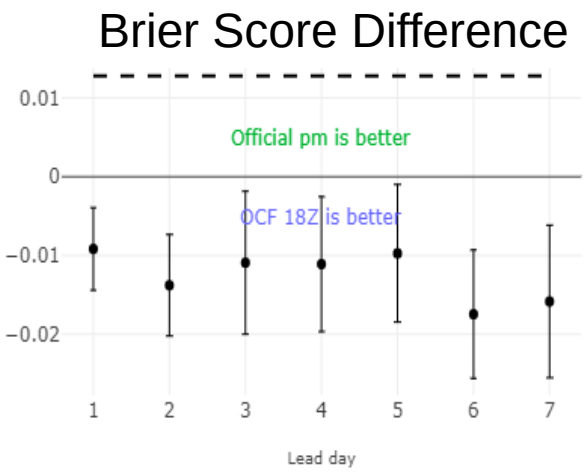
Australian Government
Bureau of Meteorology

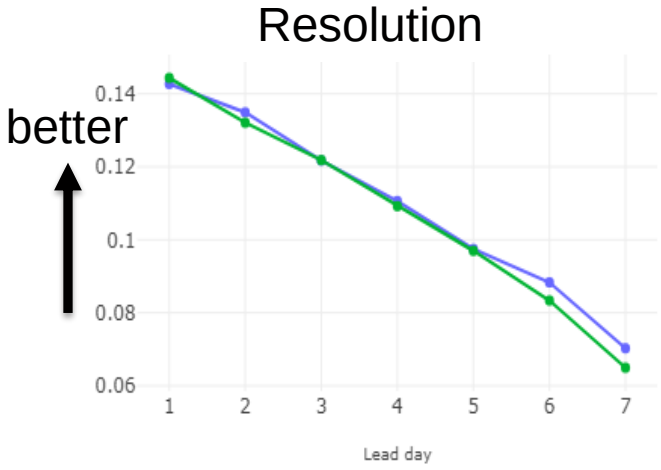
Brier Score Components
Chance of at least 1 mm in 24 h.





OCF better than ADFD largely due to better reliability



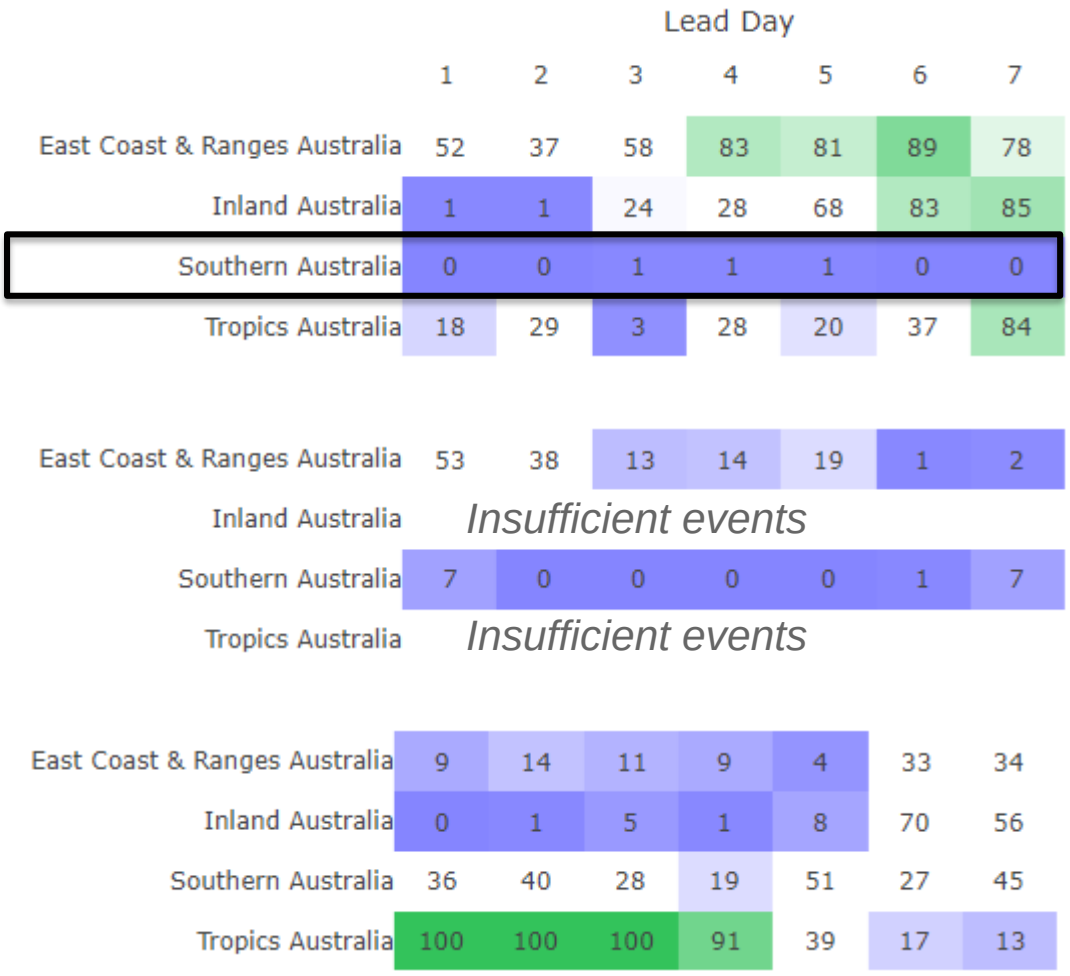


Reliability ~constant with lead day

Resolution decreases at longer lead days.

Australian Government
Bureau of Meteorology

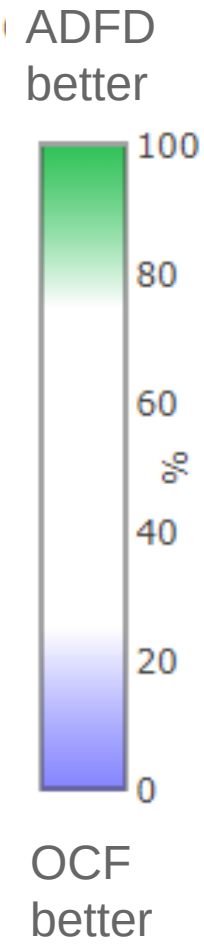
Summarised Confidence of Brier Score Difference showing ADFD Better than OCF



1mm threshold
Winter 2018

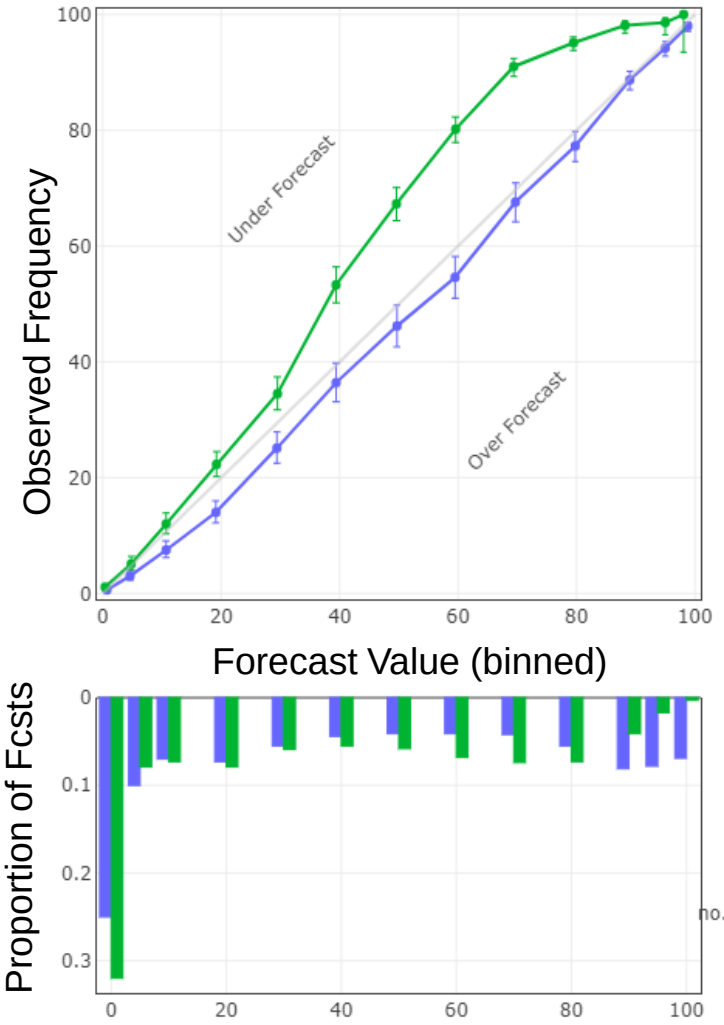
25mm threshold
Winter 2018

1mm threshold
Summer 2017-18



Australian Government
Bureau of Meteorology

Reliability Diagram – "Tomorrow"
Chance of at least 1 mm in 24 h



OCF

ADFD

Good OCF reliability shown by diagonal line

ADFD forecasts > 30% are under-forecast.

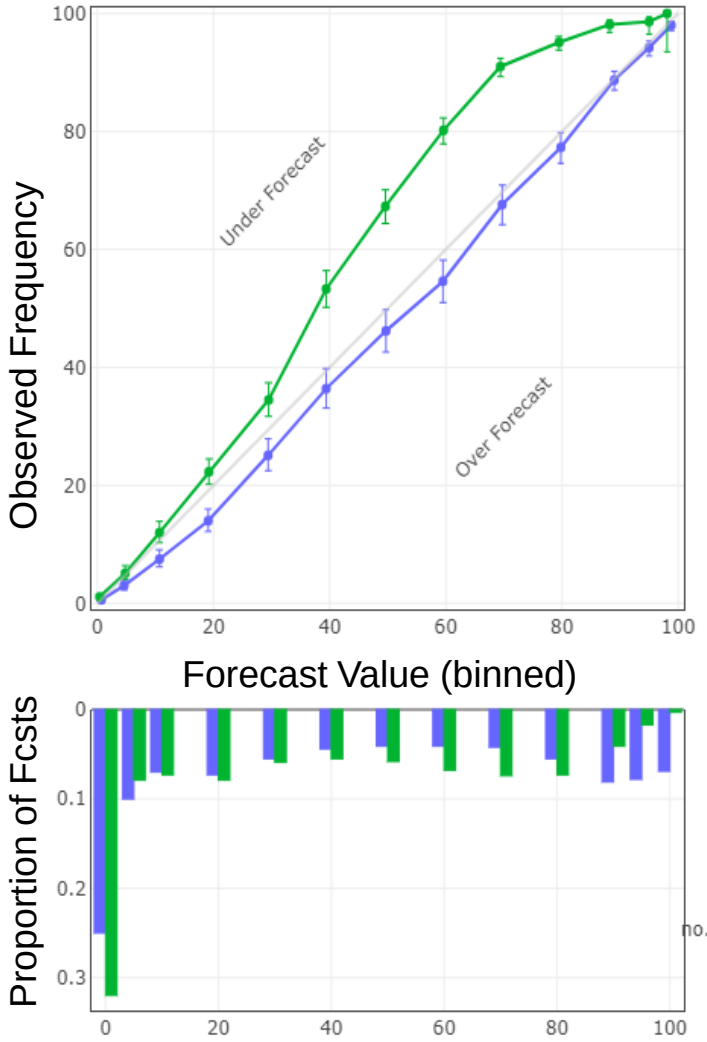
ADFD issues more forecasts near 0%.

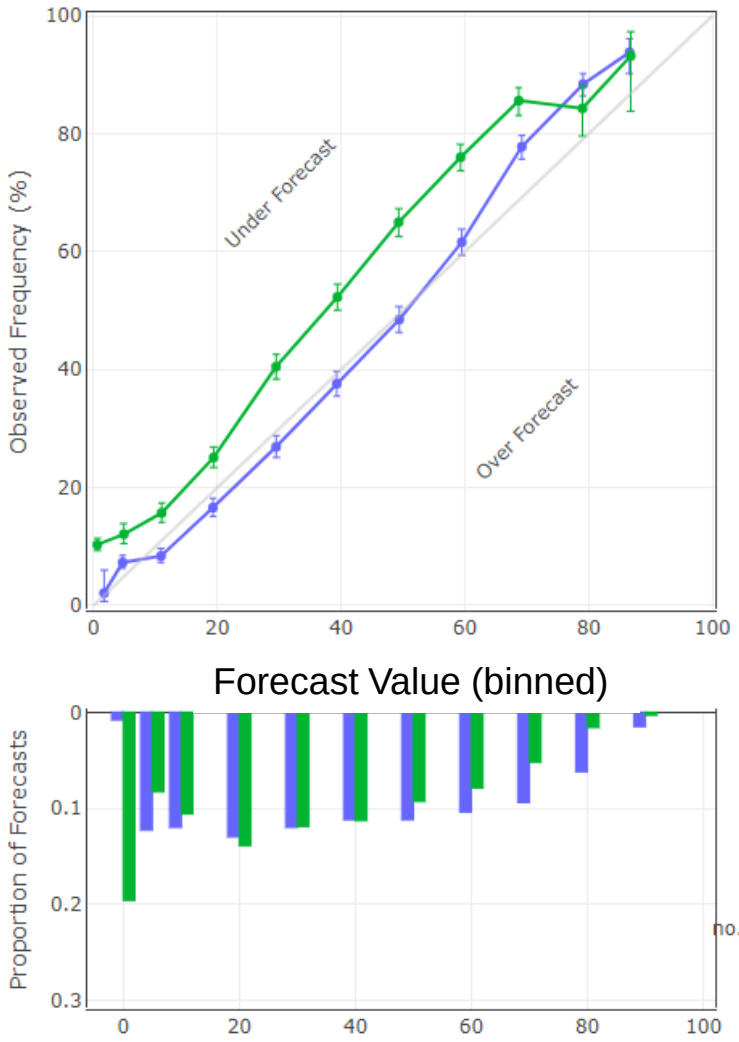
OCF issues more forecasts near 100%.

37.5% of days and stations got 1 mm.

Australian Government
Bureau of Meteorology

Tomorrow on the left
Day + 7 on the right

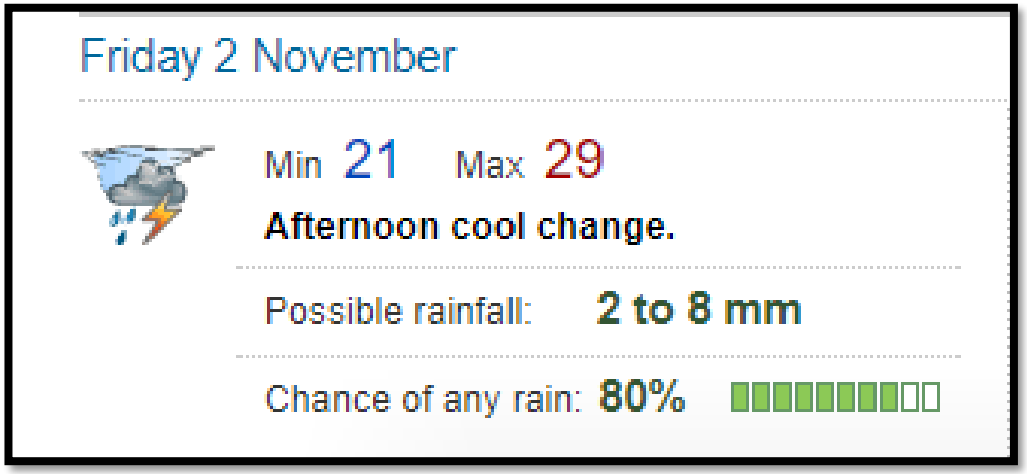




OCF
ADFD

Australian Government
Bureau of Meteorology

We issue Probabilistic Rainfall Forecasts



Chance of any rain:

80% chance of at least 0.2mm in the 24 hour period.

Possible rainfall:

50% chance of at least 2 mm

25% chance of at least 8 mm

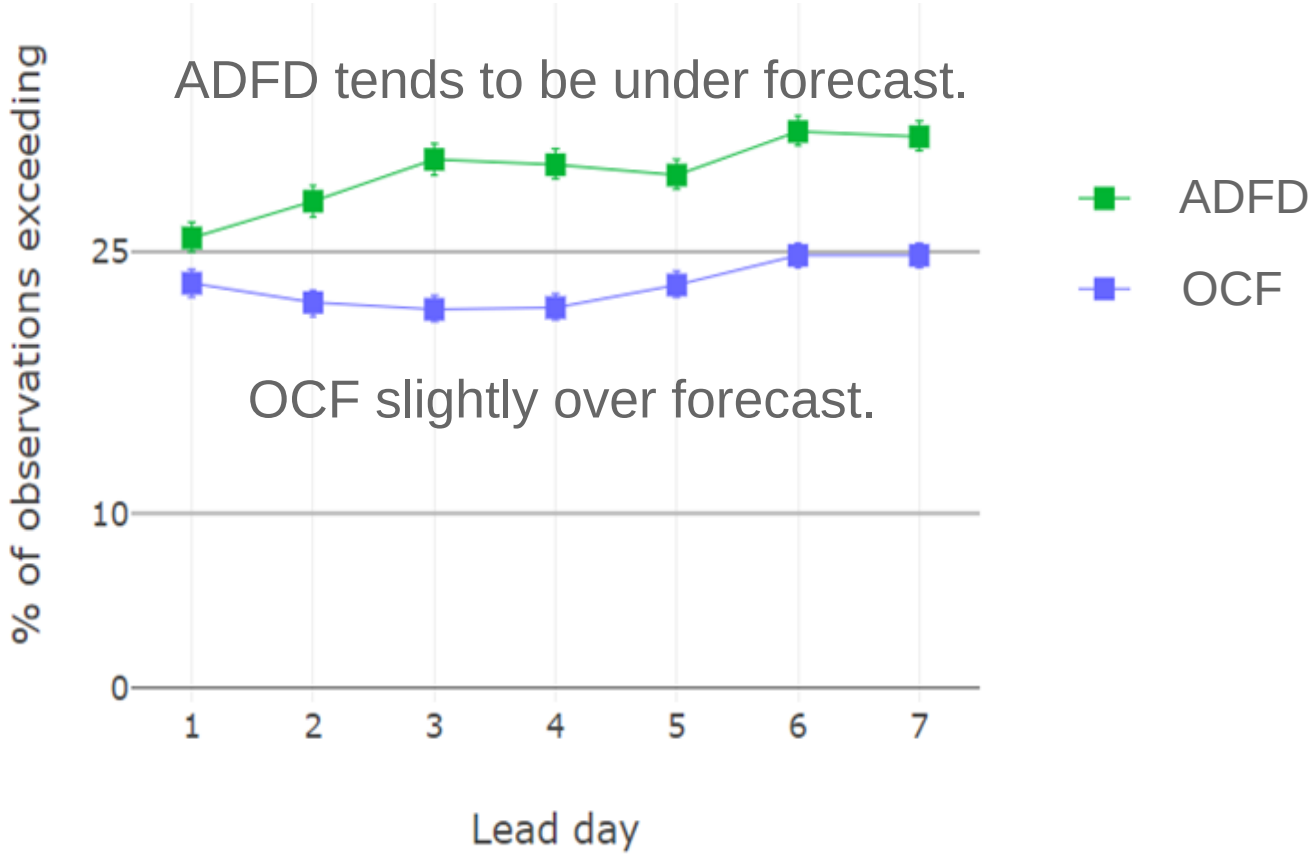
We want to report on Forecasts of "Rainfall in mm with a 25% chance of being exceeded"

Australian Government
Bureau of Meteorology

Analysis of Forecasts of "Rainfall in mm for which there is 25% chance of achieving"

(considering only forecasts ≥ 0.2 mm)

An unbiased forecast will be exceeded 25% of the time.



Australian Government
Bureau of Meteorology

Other analysis conducted

Relative Economic Value Curves

Flip-Flop Index

These are less special to probabilistic forecasts.

Not shown here.

Australian Government
Bureau of Meteorology

Analysis not conducted

(Continuous) Rank Probability Score

- considers whole pdf rather than cross-sections

Australian Government
Bureau of Meteorology

Things to Remember

We ***can*** verify probability forecasts.

One statistic cannot give you a full story.

Various analyses will expose various conditional biases.

Provide confidence intervals with your statistics.

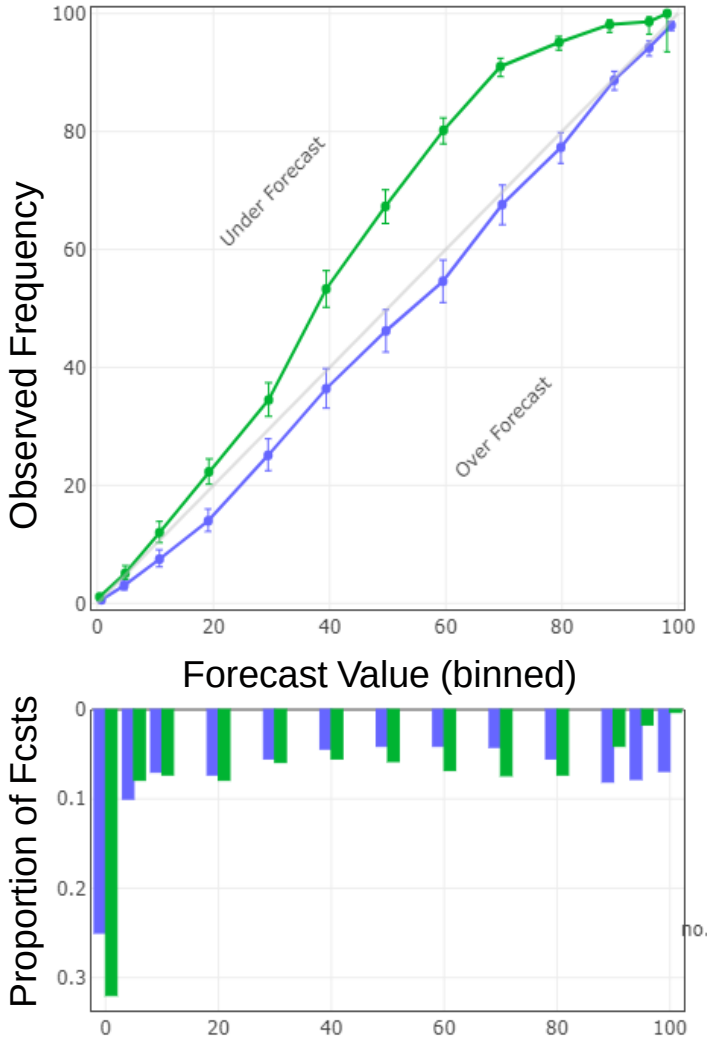
Australian Government
Bureau of Meteorology

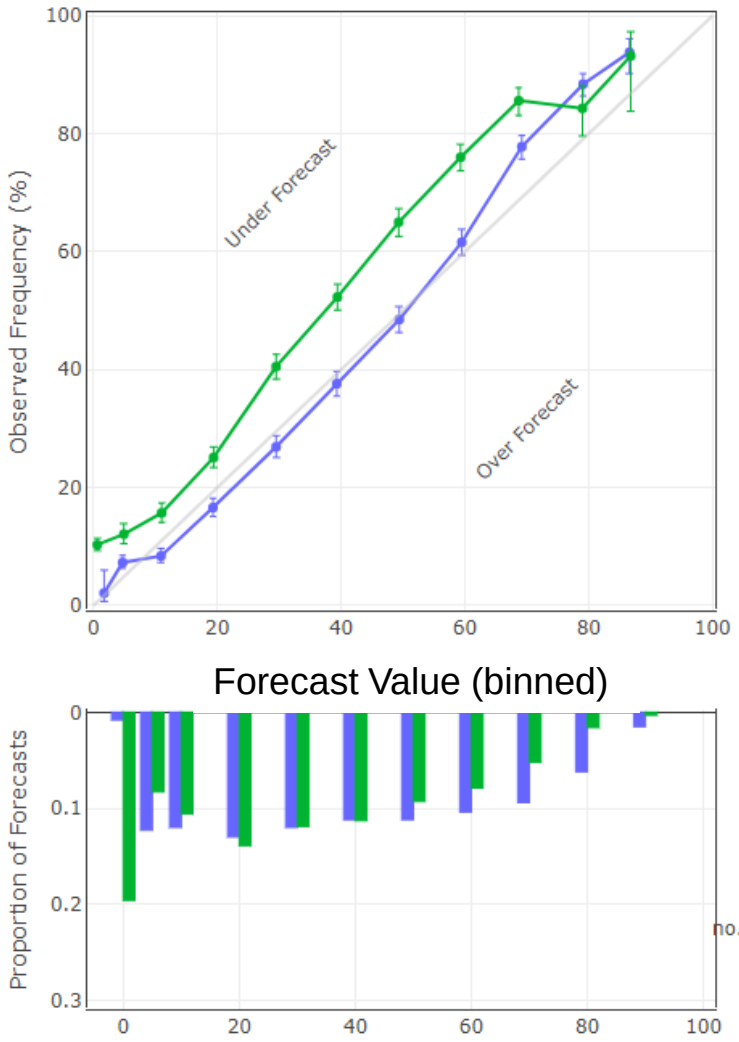
Thank you…

Deryn Griffiths
deryn.griffiths@bom.gov.au

Australian Government
Bureau of Meteorology

Day + 7 on the right





OCF
ADFD

Australian Government
Bureau of Meteorology

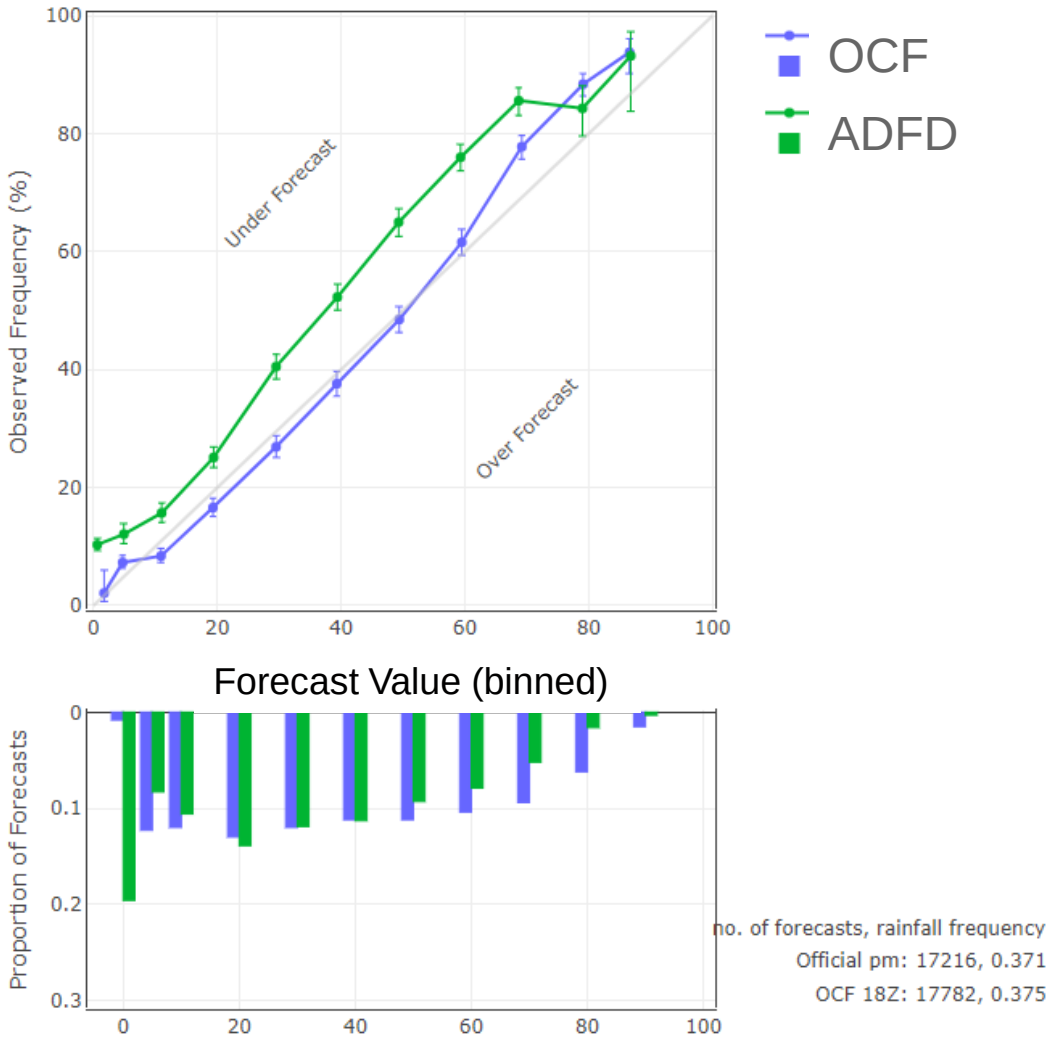
Day + 7 on the right

Similar Reliability overall

ADFD forecasts < 20% less reliable than at Day 1.

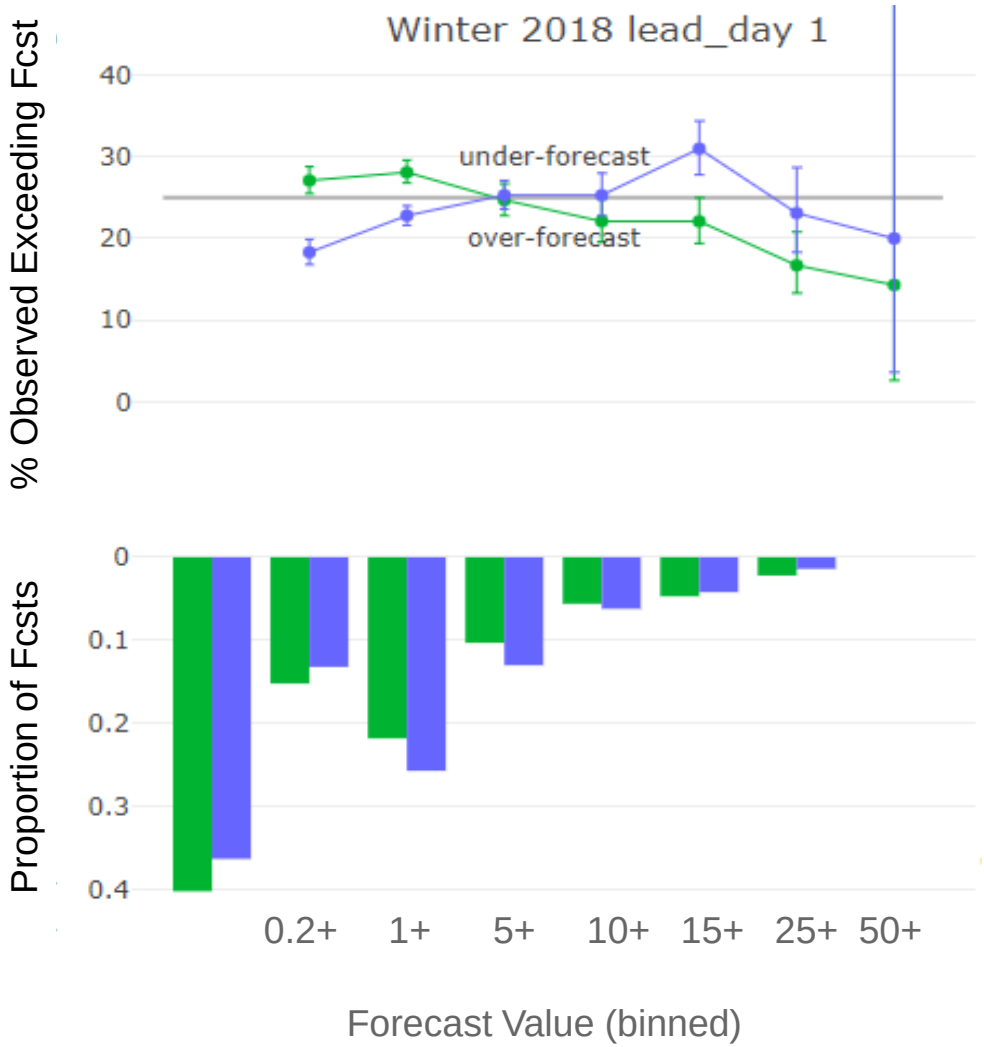
Fewer forecasts near 0% or 100%.

Corresponds to lower resolution.



Australian Government
Bureau of Meteorology

Day 1 25th percentile Forecasts. Analysis as a function of amount forecast.



ADFD becomes over-forecast at higher rainfall amounts

OCF over-forecast at low rainfall amounts.

The few forecasts of ≥ 50mm give very large error bars.