

Hydrological status and streamflow forecast services in Australia

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Bureau of Meteorology

26 September 2017



Governance and water services

Australian Government



- National Water Policy
- Commonwealth Environmental Water Holder
- Water market and charge rules for Murray-Darling Basin

Bureau of Meteorology

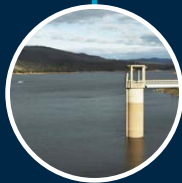
- Weather and flood forecasting
- Climate and water information



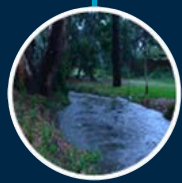
Murray-Darling Basin Authority

- Basin Plan
- River operations

State and Territory Governments



Water utilities



Catchment and river managers

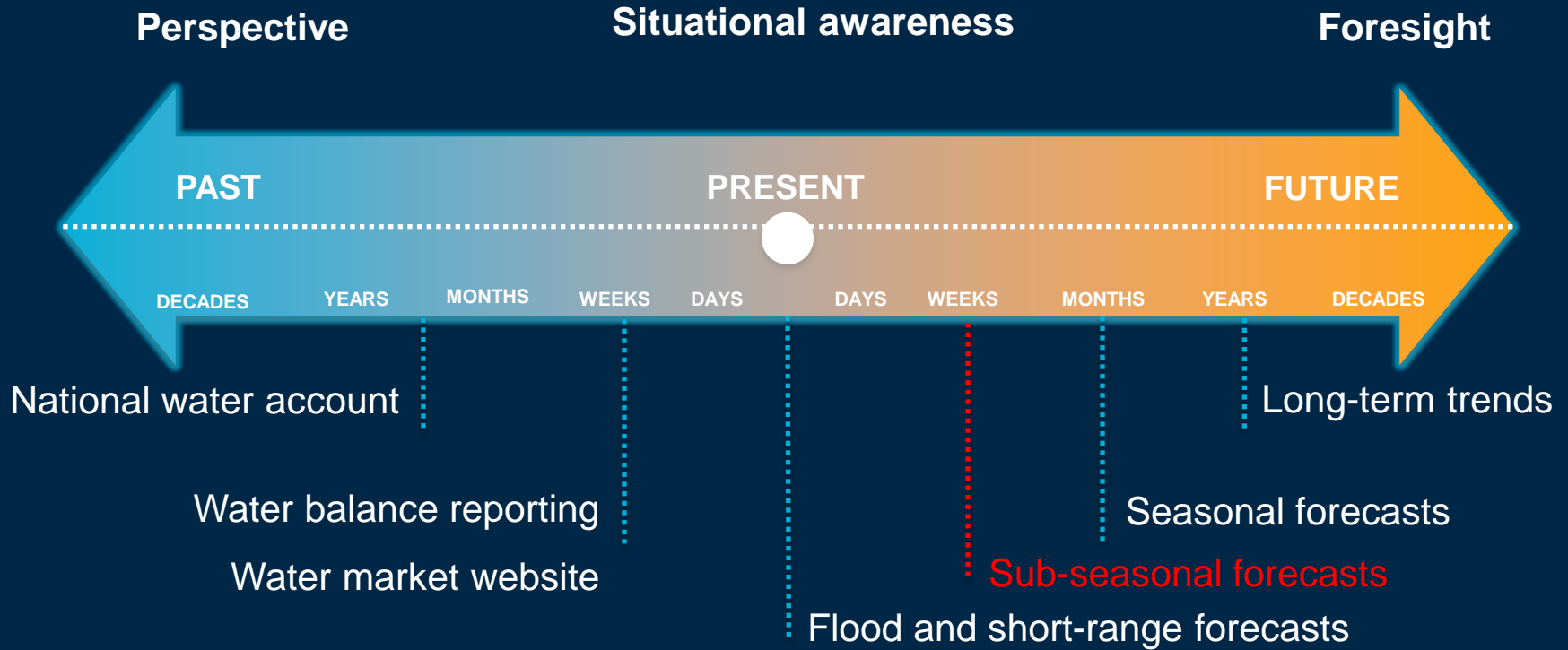


Water quality and price regulation



Environment protection

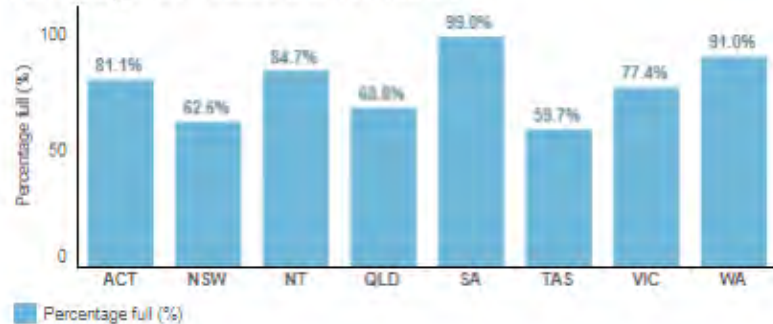
Water information products



Daily updates of Water Storage and Water Data Online

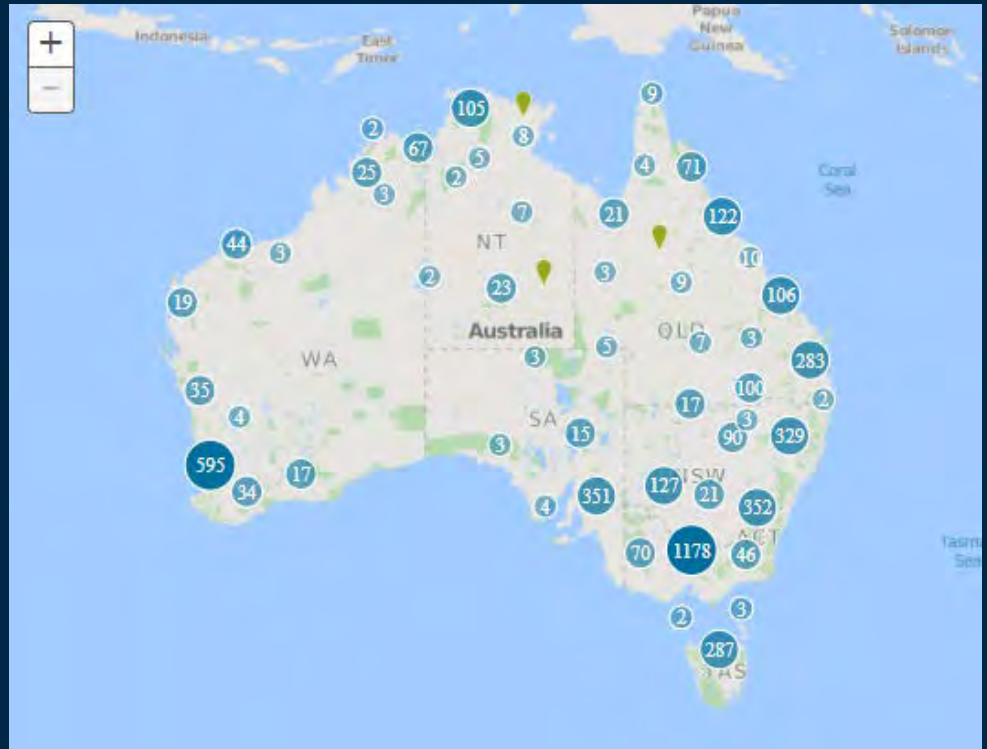
Australia
Percentage full (%): 70.1
Number of storages: 305
Accessible volume (ML): 56,686,020
Accessible capacity (ML): 80,849,055
Change since last year (%): +4.5
Reported date: 22 September 2017

Percentage full - States and Territories



Water Storage (70% full)

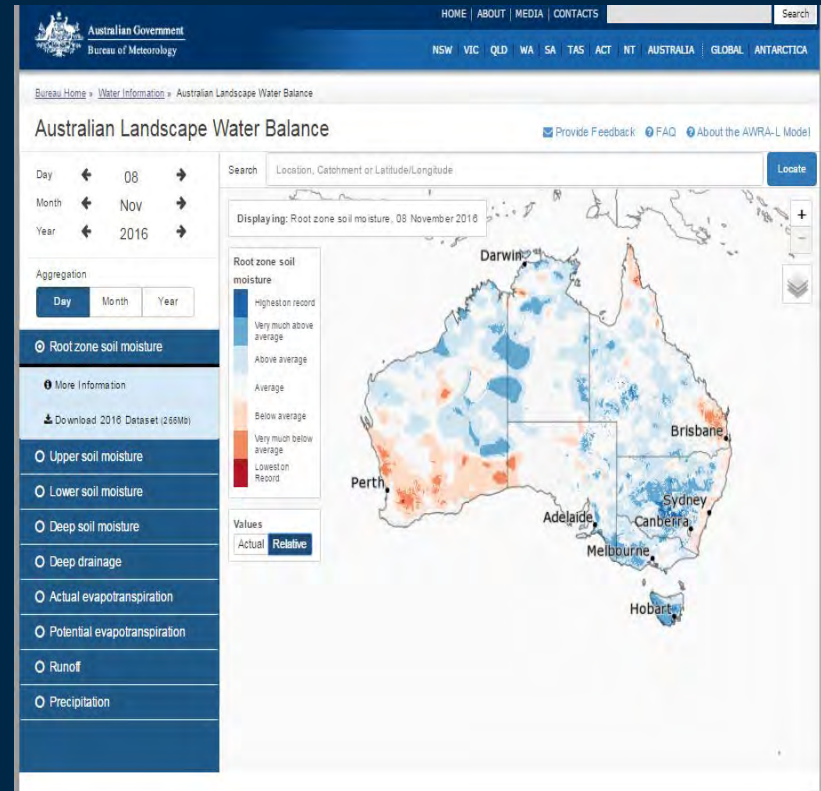
<http://www.bom.gov.au/water>



Water Data Online
(~5000 stations)

Landscape water availability service (AWRA)

- Provides seamless water balance information across Australia
- Uses observations where available, and modelling otherwise
- Provides reliable, timely and consistent information on landscape water availability
- Single, integrated modular modelling system



Operational website with outputs from 1911 until yesterday:

<http://www.bom.gov.au/water/landscape>

Water forecast services in Australia

Flood forecasts

7 Day forecasts

Seasonal forecasts (monthly updates)

National flood forecasting and warning service

The Bureau's flood forecasting and warning service uses rainfall and streamflow observations, numerical weather predictions and hydrologic models to forecast and warn for possible flood events across Australia. This information provides the basis for flood response by emergency services and other flood managers and is vital for water resource managers responding to large inflows of water into their dams and rivers.

The Bureau's national flood warning service is being enhanced to improve its accuracy and effectiveness. This will provide greater lead times for warnings and support more effective defence against flood damage.

Go to [National Flood Warning - Rainfall and River Information](#).

What to do before, during and after a flood

For those living in areas subject to flooding, the effects of being unprepared can range from slight discomfort to devastation.

Sadly, some people in our community perish in floods. Because floods are a part of Australian culture, it can be easy to become complacent. However, much has been done by experienced emergency preparedness workers to mitigate the effects of floods.

This [28 page guide \(PDF\)](#) has been prepared by experienced emergency workers to help people understand what to do before, during and after a flood.

It is the responsibility of all of us to see that where there is a risk of flood affecting life and property, we are well prepared before an event occurs. So take up the challenge that this booklet promotes - ask, learn, plan and prepare.

Your local State Emergency Service can provide additional information specific to your region and your needs.

(24/7/365 during extreme events)

7-day Streamflow Forecasts

Station Selector: Kiewa River at Bandiana (402205)

State: Victoria
Basin: Kiewa
Station: Kiewa R at Bandiana (402205)

Quick facts:
Upstream Catchment Area: 1004 km²
Longest stream: 131 km
Climate type: Temperate

Streamflow Analysis:
Start date: 01-01-1950
End date: 31-12-2014
Daily max: 42600 ML
Daily average: 1542 ML

No flood warnings current for the river system.

Daily forecasts | Hourly forecasts | Forecast evaluation

Forecast for Kiewa River at Bandiana (402205)
07 December 2016 to 13 December 2016
Cattinon average rainfall: observed (blue), forecast (red)

Date	Observed Rainfall (mm/day)	Forecast Rainfall (mm/day)
03 Dec 2016	~1.0	~1.0
04 Dec 2016	~1.0	~1.0
05 Dec 2016	~1.0	~1.0
06 Dec 2016	~1.0	~1.0
07 Dec 2016	~1.0	~1.0
08 Dec 2016	~1.0	~1.0
09 Dec 2016	~1.0	~1.0
10 Dec 2016	~1.0	~1.0
11 Dec 2016	~1.0	~1.0
12 Dec 2016	~1.0	~1.0
13 Dec 2016	~1.0	~1.0

Streamflow (ML/day): observed (blue), forecast (red)

Legend: Streamflow, No data, Observed, Forecast, Historical 25-75%ile, Historical 5-95%ile

(daily updates)

Seasonal Streamflow Forecasts
Period: March - May 2015

Quick facts:
Upstream Catchment Area: 1004 km²
Longest stream: 131 km
Climate type: Temperate

Streamflow Analysis:
Start date: 01-01-1950
End date: 31-12-2014
Daily max: 42600 ML
Daily average: 1542 ML

Seasonal Streamflow Forecasts - About

Seasonal Streamflow Forecasts
Period: March - May 2015

- Low streamflows more likely
- Low streamflows recorded in February
- The El Niño Southern Oscillation tracker raised to El Niño WATCH

Streamflow forecast - March to May

An additional 27 locations have been added to this month, taking the number of forecast locations to 101. The majority of these new locations are in Western Australia (8) and in South Australia (5). There are also new locations in Victoria (4), the Northern Territory (4), Queensland (3), New South Wales (2) and the Australian Capital Territory (1).

For the March to May 2015 forecast period, low streamflows are more likely at 22 of the 63 locations at which skill is acceptable. Median and high flows are more likely at 19 and 12 locations respectively. Forecast [skill scores](#) for the March - May period are low to moderate for most of these locations. Due to very low skill scores, the forecast has not been issued at 39 locations. The monthly [Climate and Water Outlook video](#) covers rainfall, streamflow and temperature for the next three months and beyond.

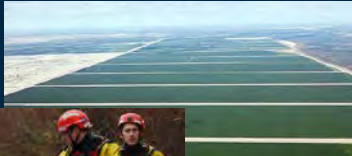
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Use the map below to zoom and pan to view the forecast locations. Then click on a pie chart to go directly to the latest forecast.

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

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

User needs analysis



Irrigators



Emergency
Services



Environmental
flows

Water data provision is backed by legislation

Water data

Irrigators

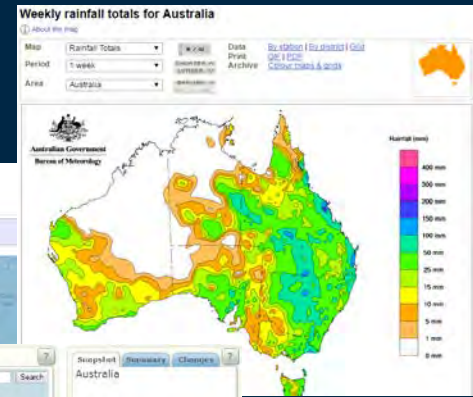
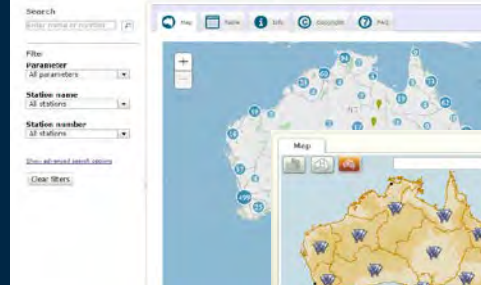


Emergency Services

Environmental flows



Water Data Online



Climate data



Storage

Statistical and dynamic models

Irrigators



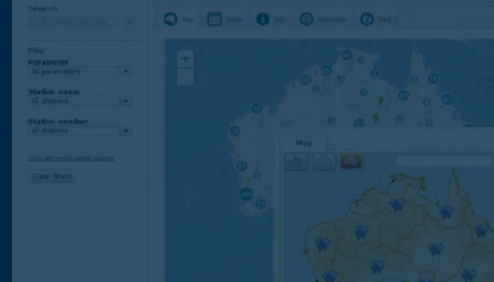
Emergency Services

Environmental flows

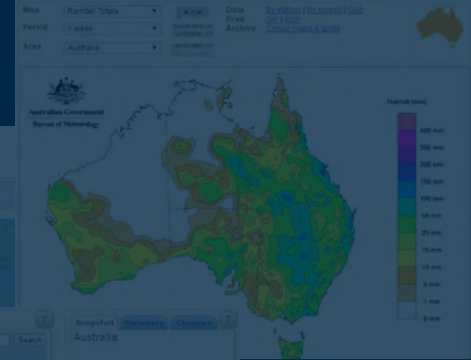


Water data

Water Data Online



Weekly rainfall totals for Australia

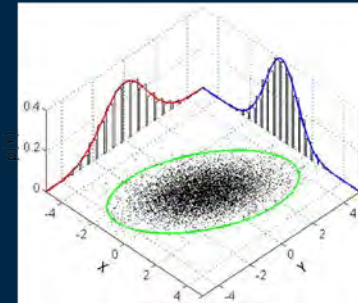


Climate data

Storage



Numerical Weather Prediction Models



Statistical Models

Web based products and communications



Irrigators

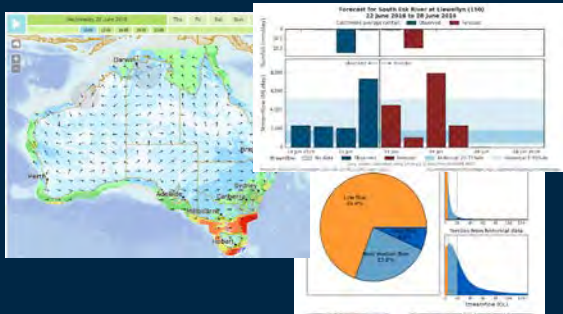


Emergency Services

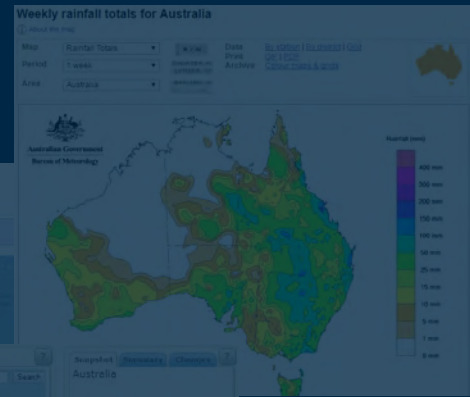
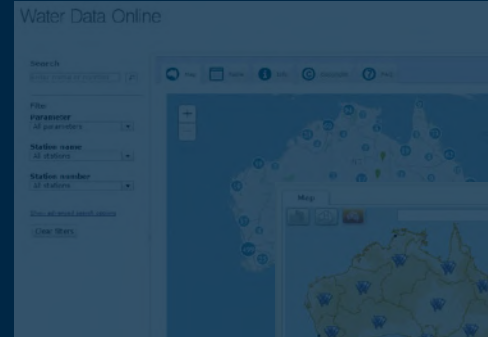


Environmental flows

Forecasts products



Water data

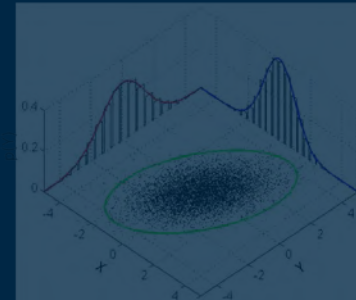


Climate data

Storage



Numerical Weather Prediction Models



Statistical Models

Water forecasting in Australia

User needs

Data sharing

Communication

Systems

Research

Climate data

Storage

Statistical Models

Numerical Prediction Models

Forecasts products



Emergency Services

Environment flow

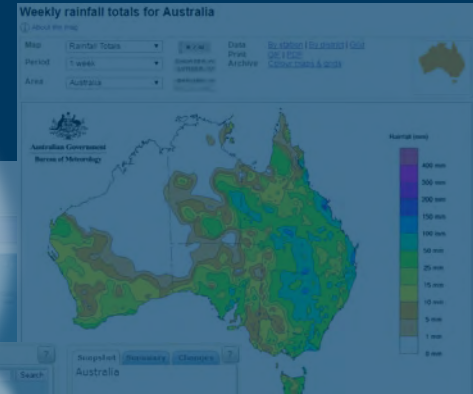


Water data

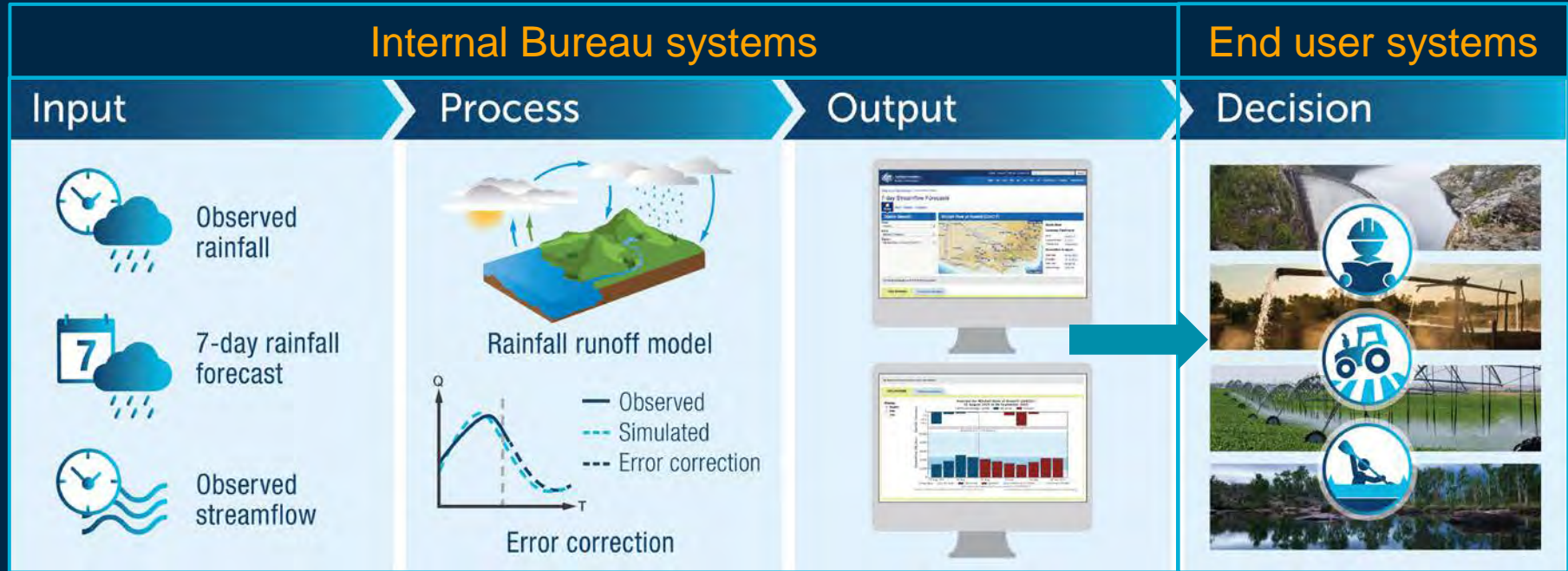
Water Data Cr

Station name
Station number
Date of most recent update
New filters

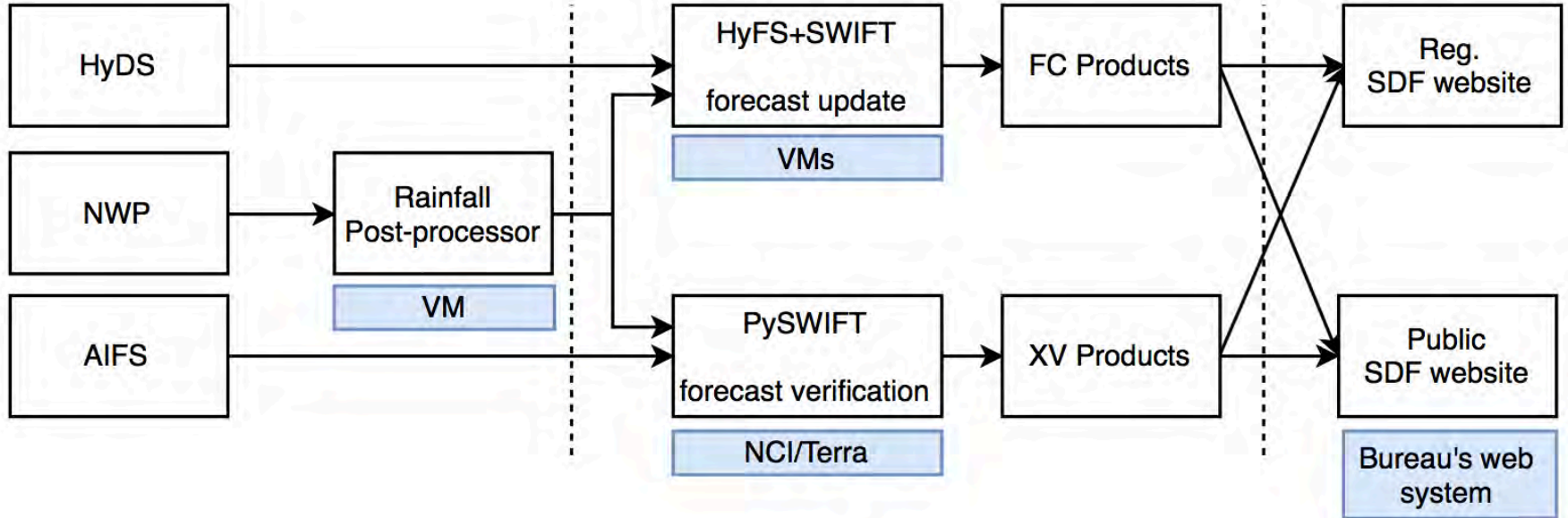
Numerical Prediction Models



How do we make 7-day forecasts?



7-Day streamflow forecasting system



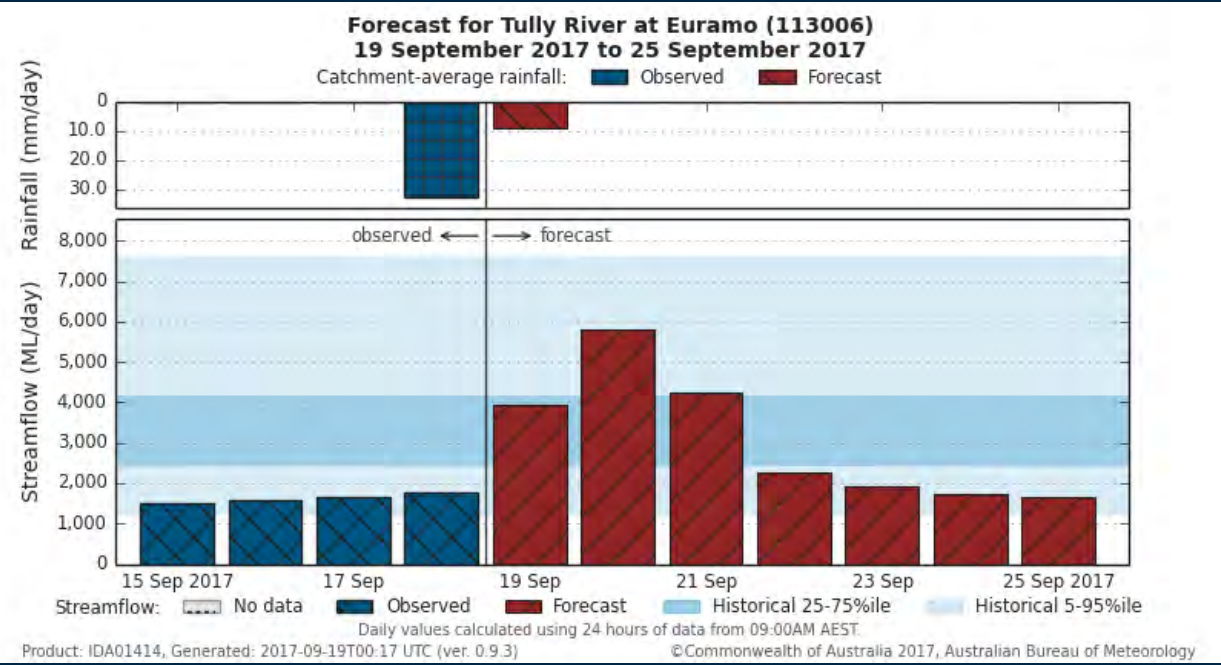
Observations and forecasts

Real time forecasts and verification

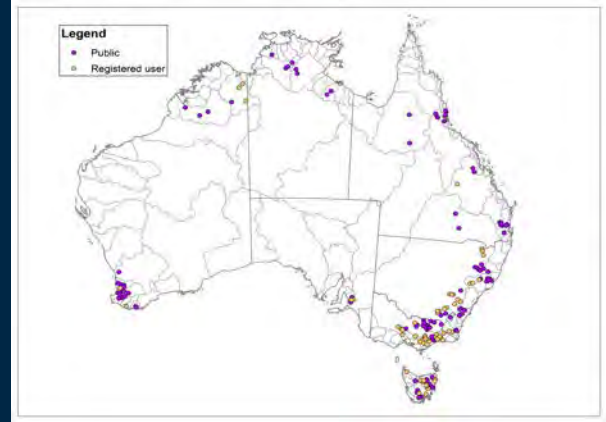
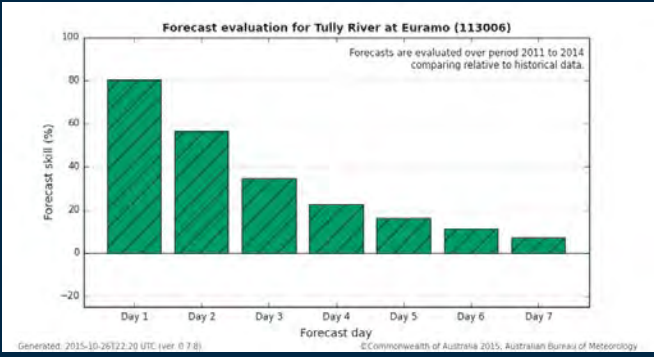
Web products

Streamflow forecast for Tully at Euramo

National service: 7 day forecasts



Forecast performance

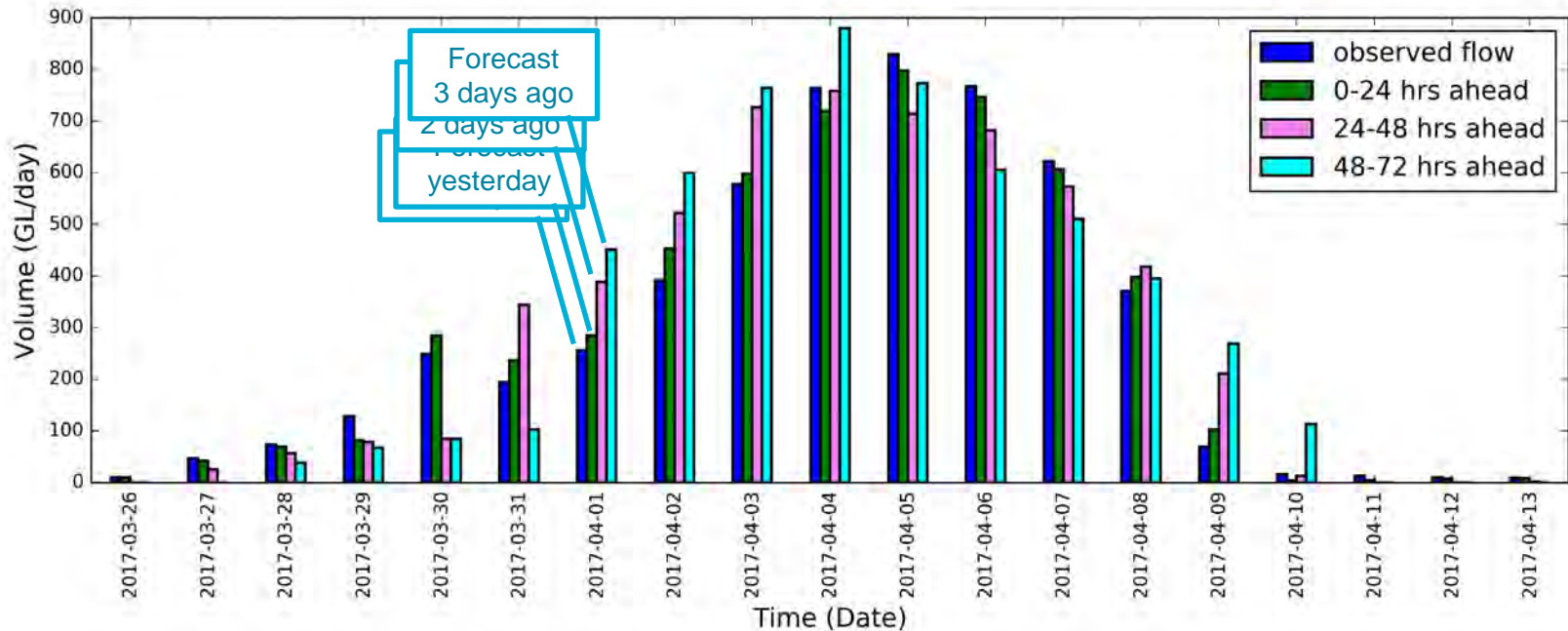


<http://www.bom.gov.au/water/7daystreamflow/>

National service coverage (daily updates)

Daily streamflow volume

Daily Volume for Fitzroy River at The Gap (130005A ~ 33285)



Seasonal streamflow forecast service

- 160 forecast locations to public and 300 to registered users
- 1-month & 3-month streamflow
- Issued every month
- Forecasts based upon BJP (statistical) and POAMA (dynamic)
- High uptake of the service

Forecast summary

Educational video

Outlook video

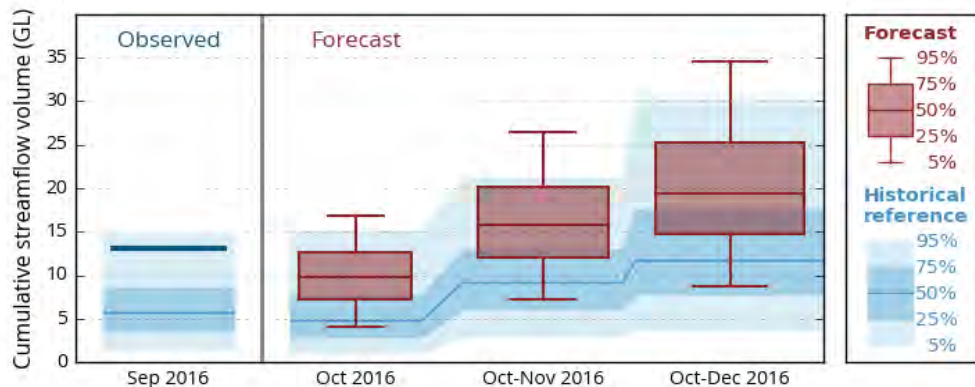
Dynamic Map of Forecast sites

<http://www.bom.gov.au/water/ssf/forecasts.shtml>

Forecast products

Cotter River at Gingera (ID: 410730)

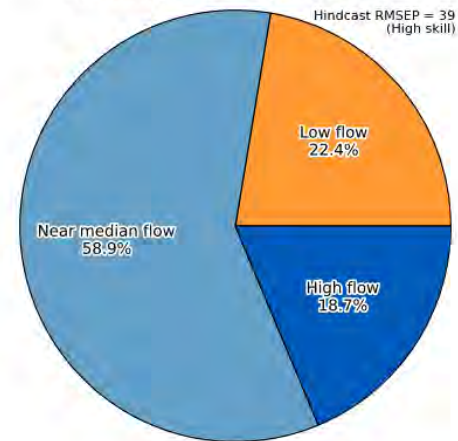
Oct 2016 - Dec 2016



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(Ver. 2.6.1rc2+70_g628a9332_dirty/1.1.11)

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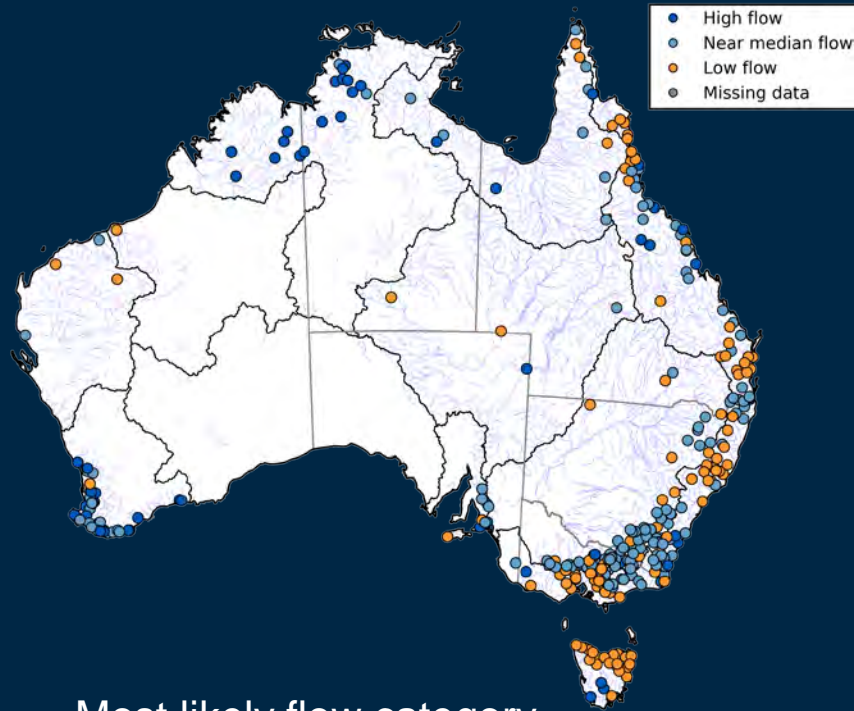
Unregulated inflow to Hume Dam Forecast period: Sep-Nov 2017



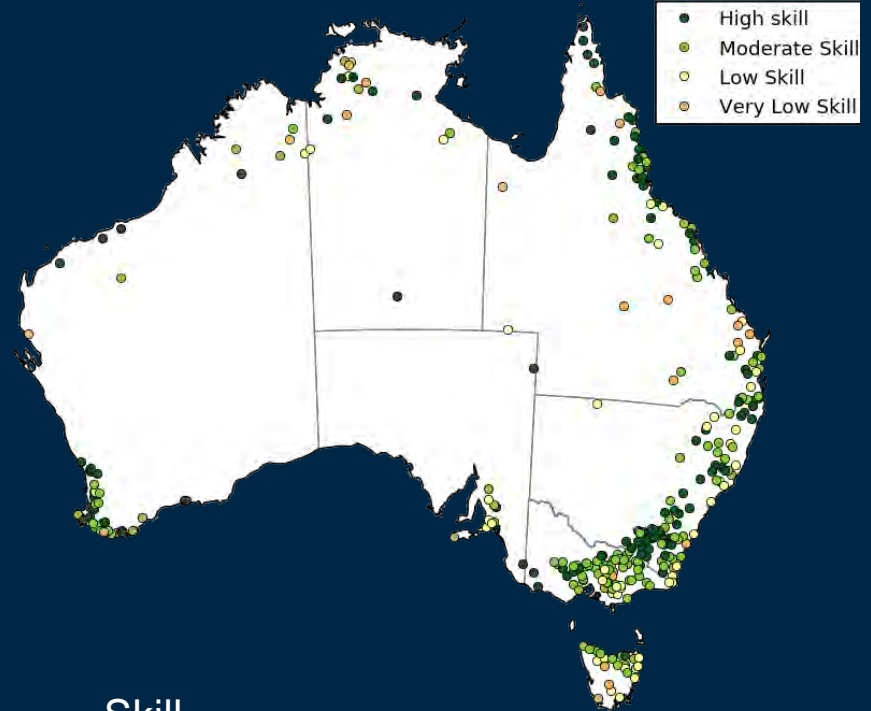
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Seasonal streamflow forecast September-November 2017



Most likely flow category



Skill

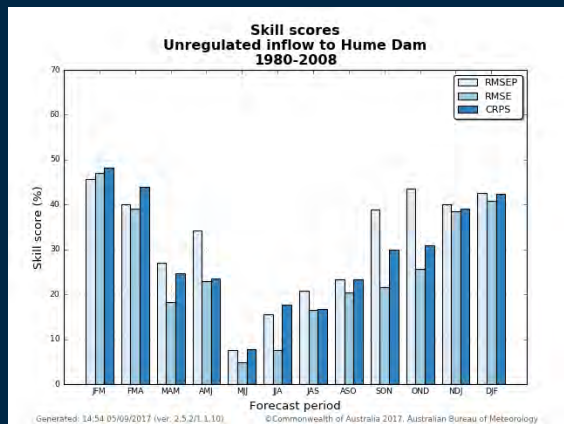
Seasonal streamflow forecast September-November 2017



Seasonal streamflow forecast performance

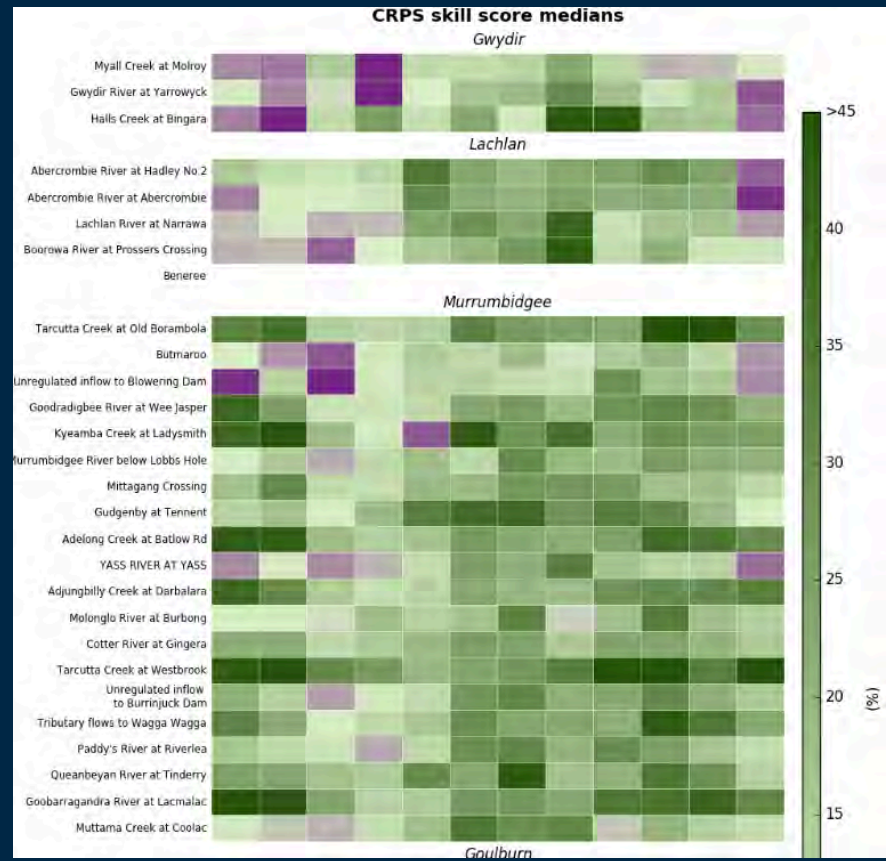
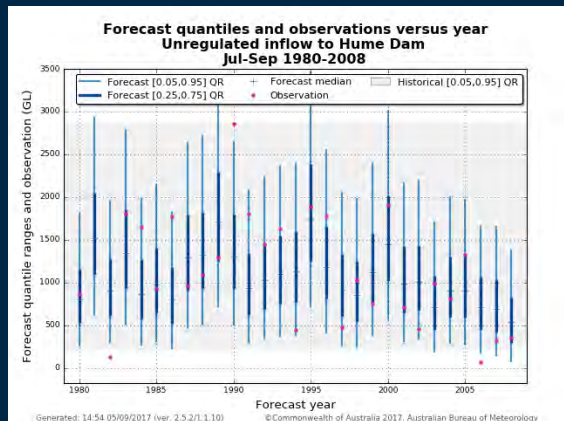
Skill scores:

- CRPS
- RMSE
- RMSEP



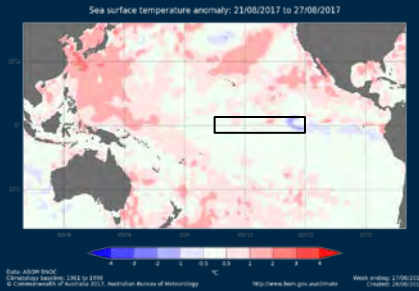
Inter quartile range (IQR):

- 5%
- 95%



Seasonal forecasting – **statistical** modelling system

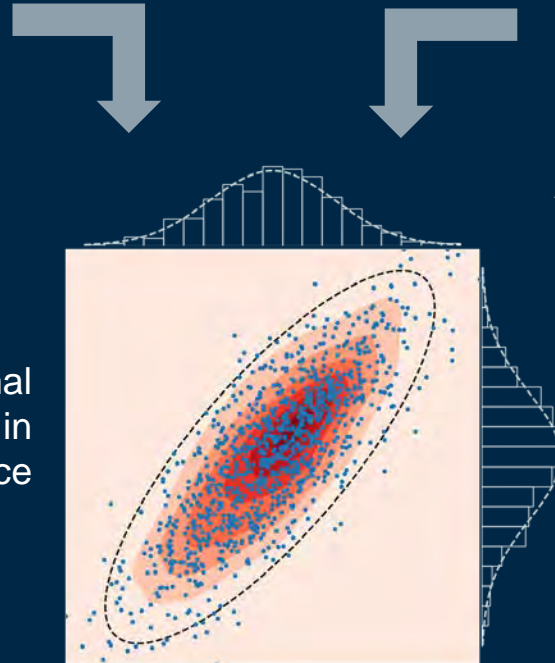
- Statistical modelling - current



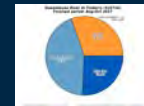
Climate indices

Multivariate normal distribution in transformed space

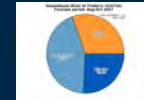
BJP model (Wang et al.; Robertson et al.)



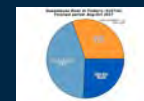
Antecedent streamflow conditions



Forecast month 1



Forecast month 2



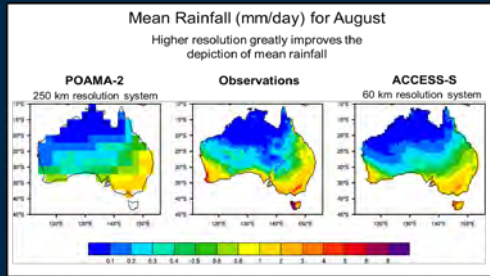
Forecast month 3

Seasonal forecasting – dynamic modelling system

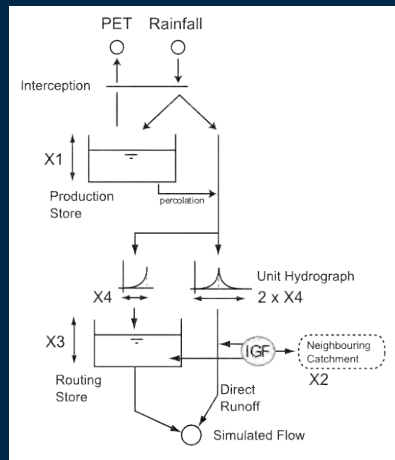
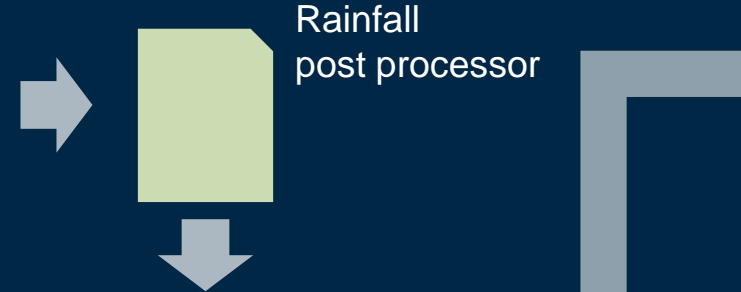
- Dynamic system – Monthly split (June 2018)



Antecedent streamflow conditions

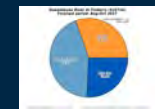
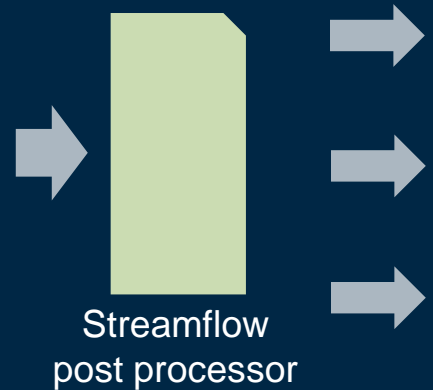


ACCESS-S
Rainfall Forecast

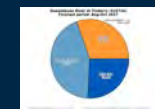


GR4J Rainfall
runoff model

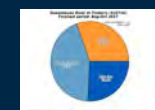
BATEA calibration engine
Embedded in wafari system



Forecast
month 1

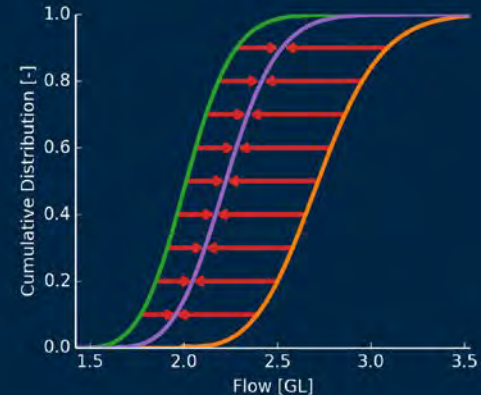
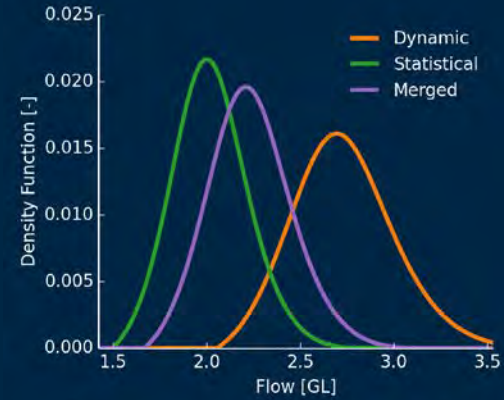
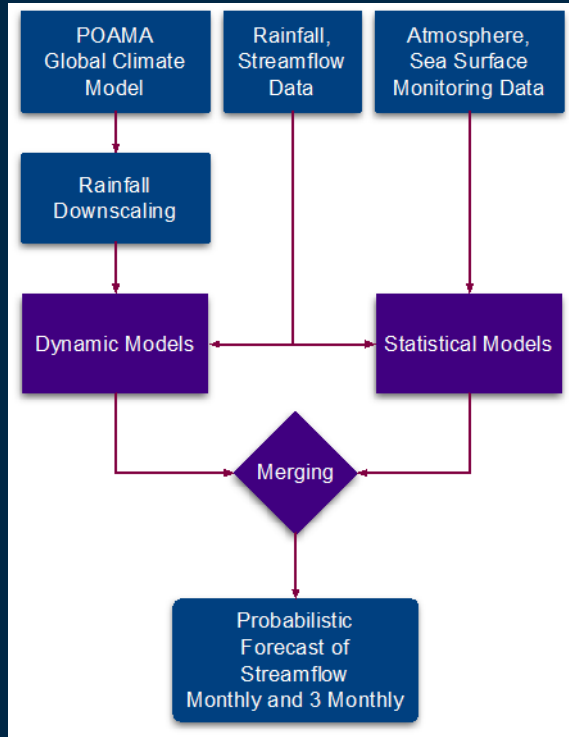


Forecast
month 2



Forecast
month 3

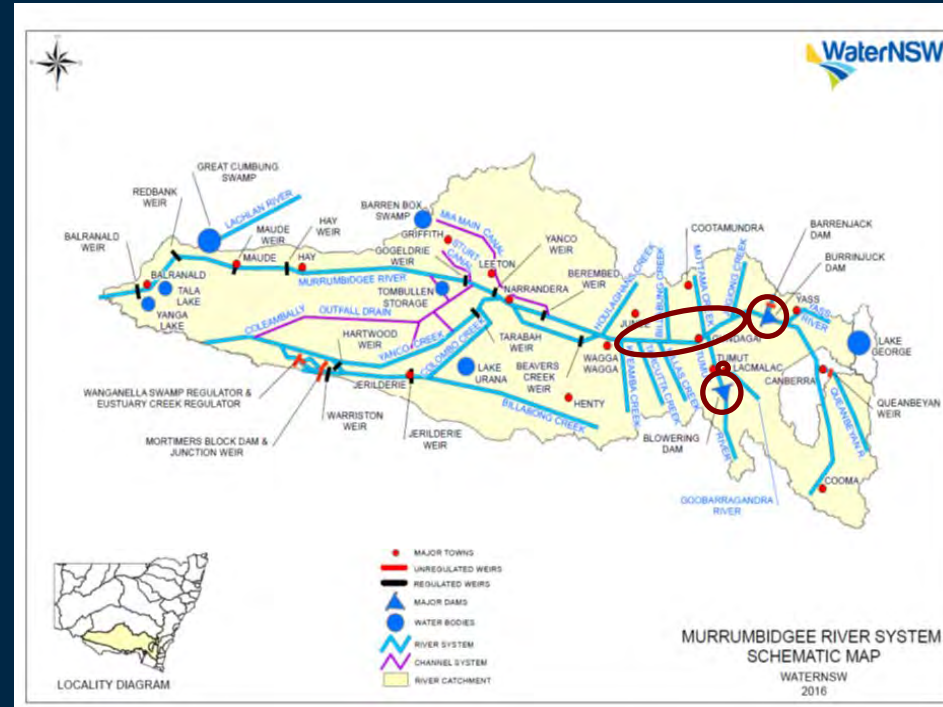
Merged statistical and dynamic forecasts



Schepen, Andrew, and Q. J. Wang. "Model averaging methods to merge operational statistical and dynamic seasonal streamflow forecasts in Australia." *Water Resources Research* 51.3 (2015): 1797-1812.

Murrumbidgee case study (significant agricultural resource)

- 3-month and 1-month forecasts for:
 - Burrinjuck Dam
 - Blowering Dam
 - Unregulated tributaries to Wagga Wagga
- Provide updated guidance of likely inflows into major storages and streams
- Forecasts improve sound decision making
 - Storage releases, irrigation allocations, safeguarding domestic water supplies



Key storages and streams - Murrumbidgee River Basin

○ Key SSF forecast locations

Looking forward to learning from experts globally and share
the Australian experience through HydroSOS

Thank you

www.bom.gov.au/water

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