# Climate outlook & risk management

## Hayman SARDI climate applications

SOUTH AUSTRALIAN RESEARCH & DEVELOPMENT INSTITUTE
PIRSA

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia

SARDI
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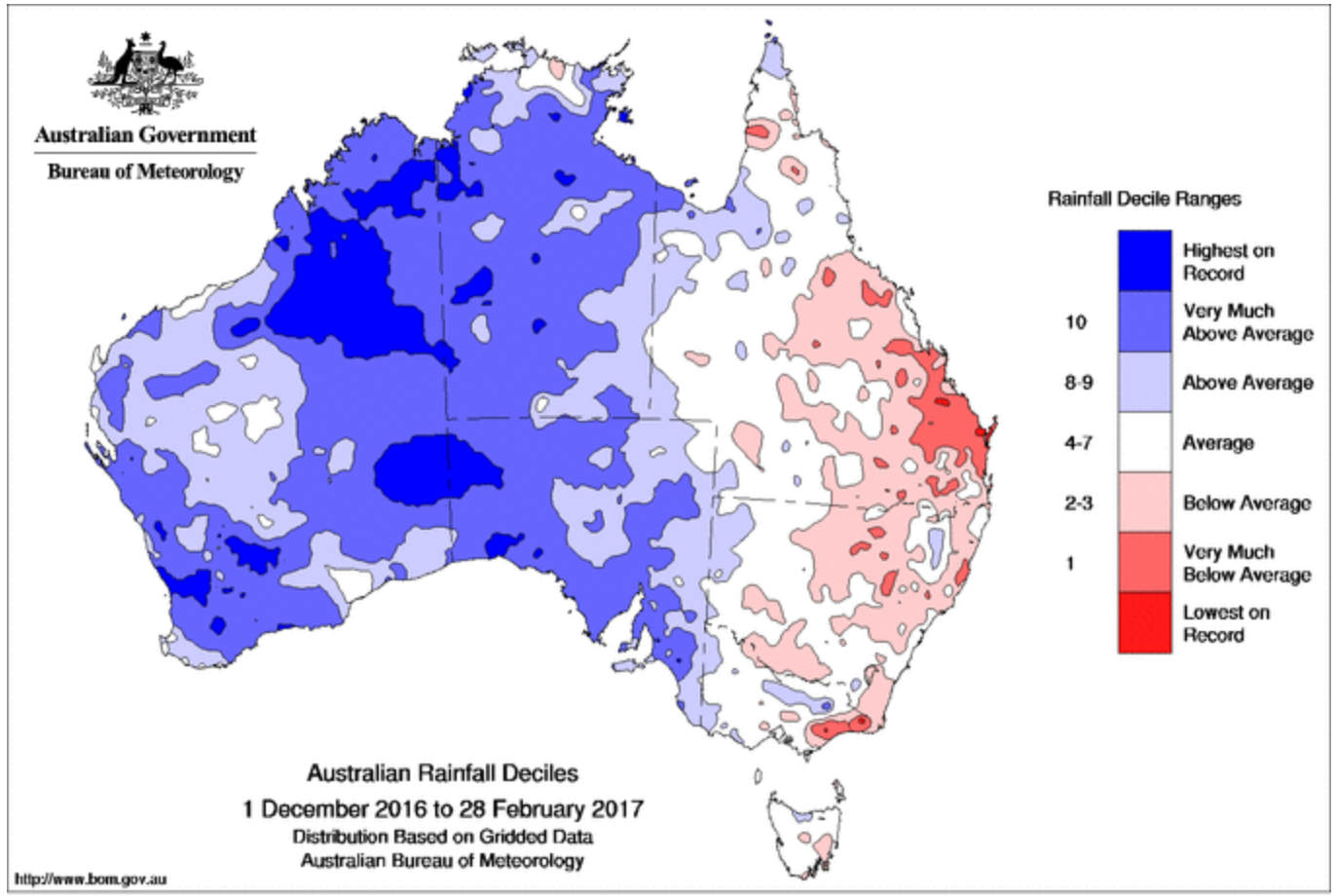


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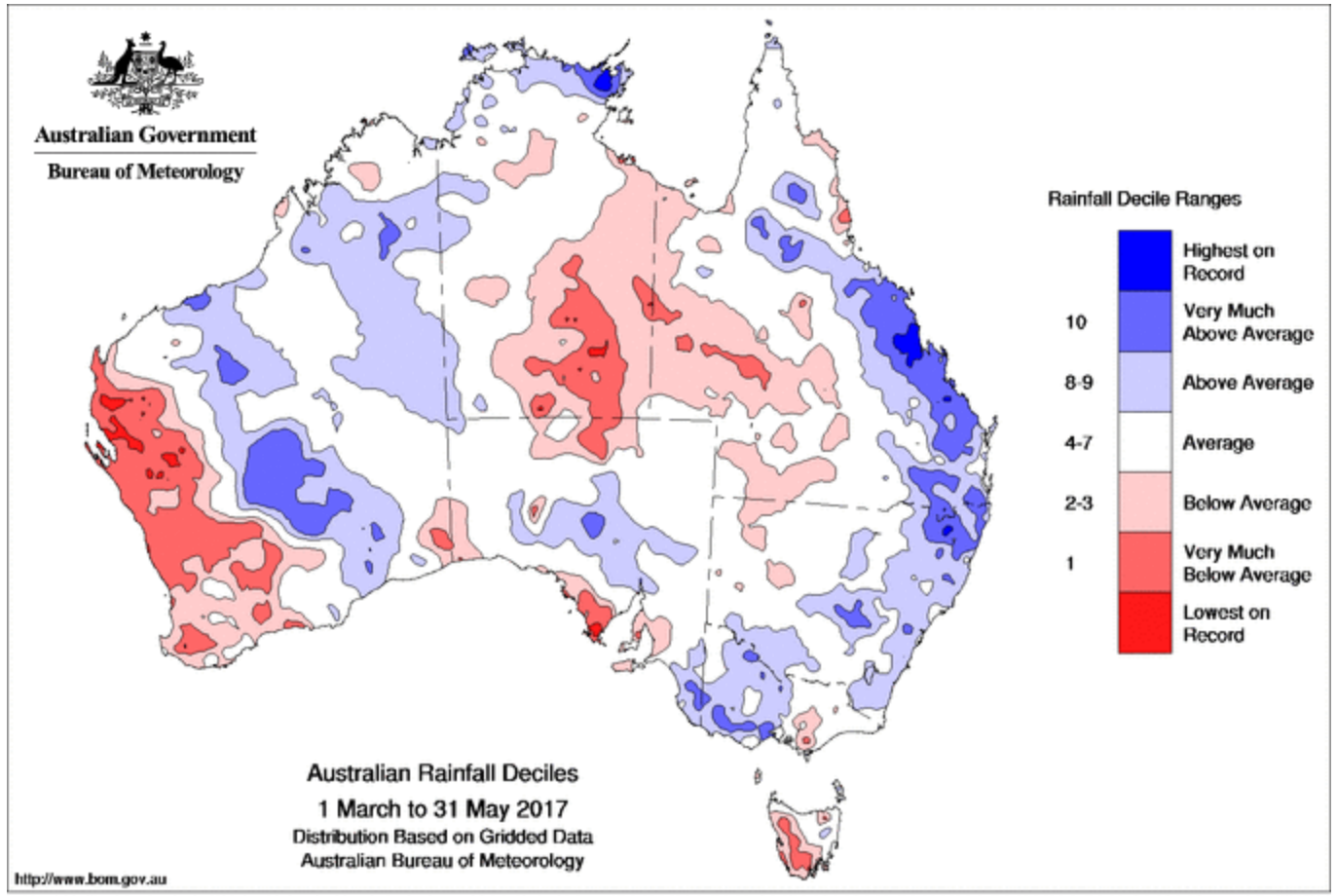
Issued: 21/03/2017

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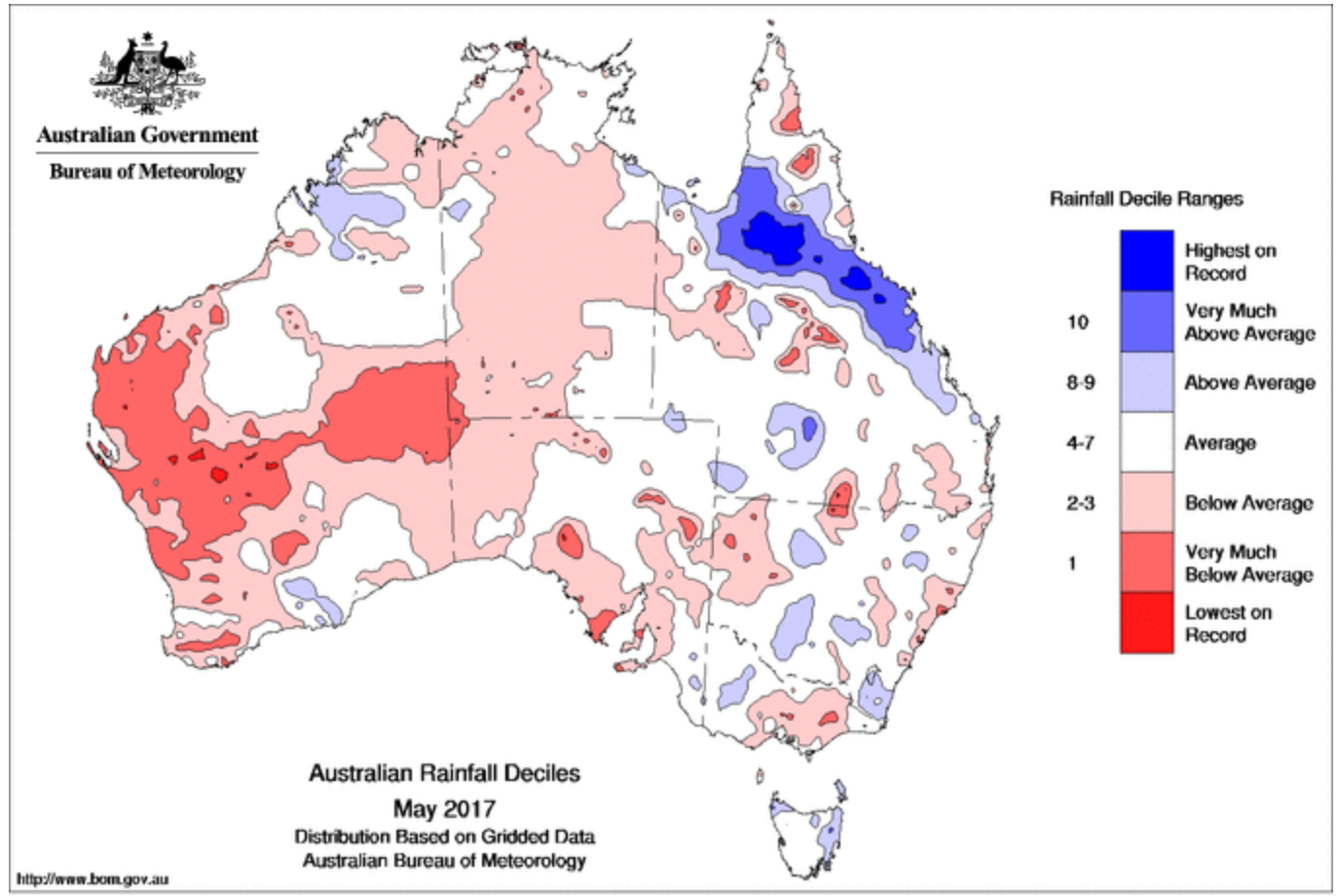


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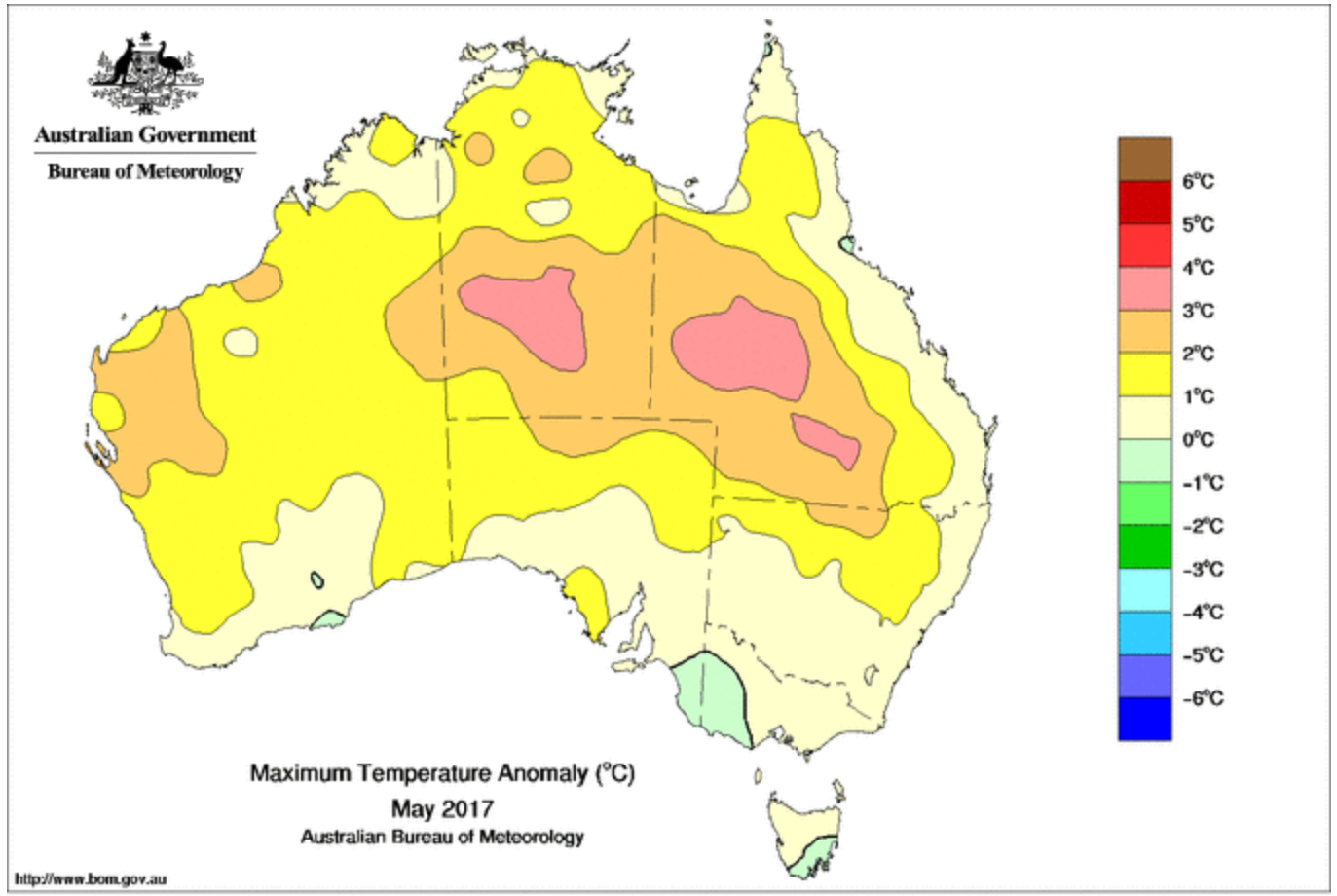


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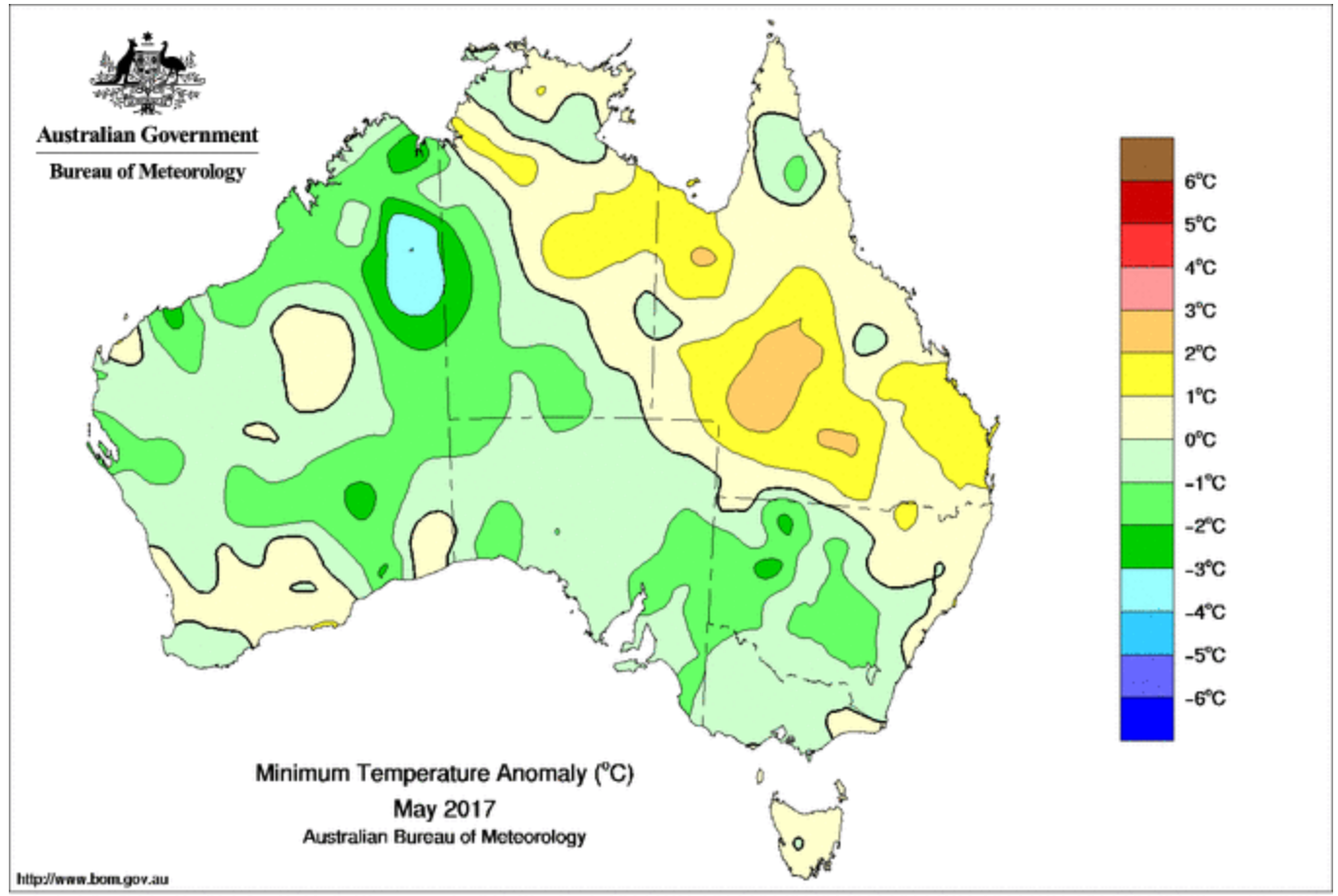


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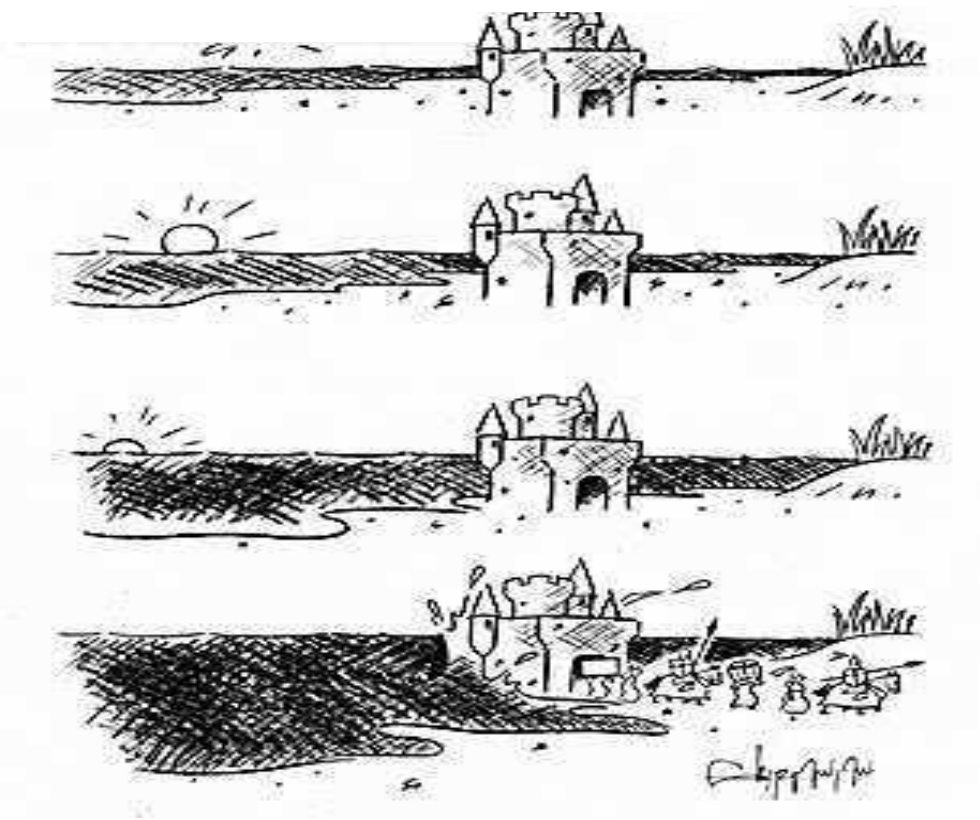
stash the cash WIN UP TO $20,000

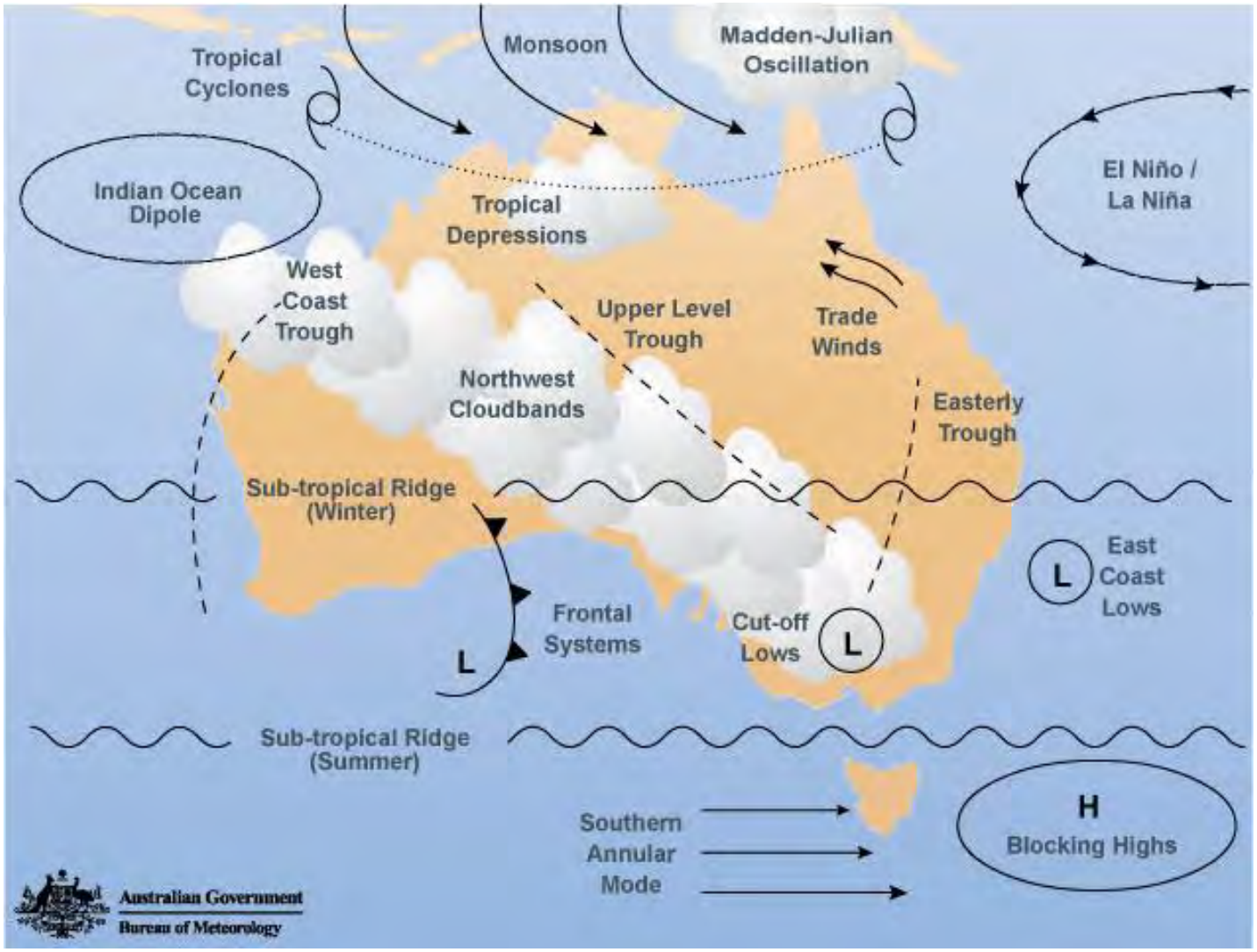
# The West Australian

## A TALE OF TWO WINTERS

As Perth laps up the winter warmth, farmers curse WA's big dry NEWS PG 7



What destroyed the sand castle ? The wave or tide ?


Tropical Cyclones
Monsoon
Madden-Julian Oscillation
Indian Ocean Dipole
Tropical Depressions
El Niño / La Niña
West Coast Trough
Upper Level Trough
Trade Winds
Northwest Cloudbands
Easterly Trough
Sub-tropical Ridge (Winter)
East Coast Lows
L
Frontal Systems
Cut-off Lows
L
L
Sub-tropical Ridge (Summer)
Southern Annular Mode
H
Blocking Highs
Australian Government
Bureau of Meteorology

Enso rounds up tropical moist air in the Equatorial Pacific Ocean

Eastie's deep low pressure systems can dominate annual rainfall in Gippsland

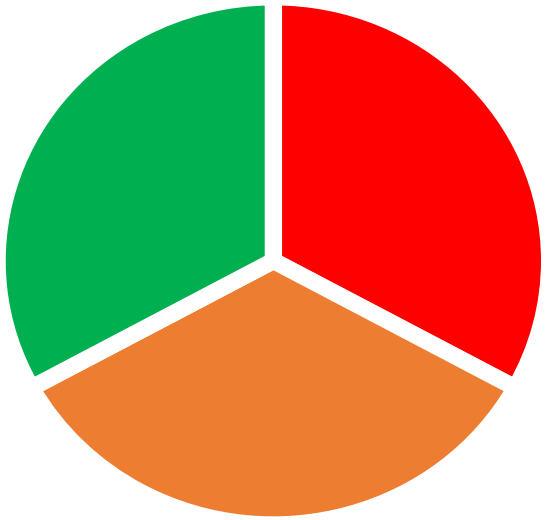
Indy delivers moisture from the Indian Ocean

Sam influences the strength and frequency of cold fronts over Victoria

Ridgy and high pressure systems can block rainfall in Victoria

GSR

All years

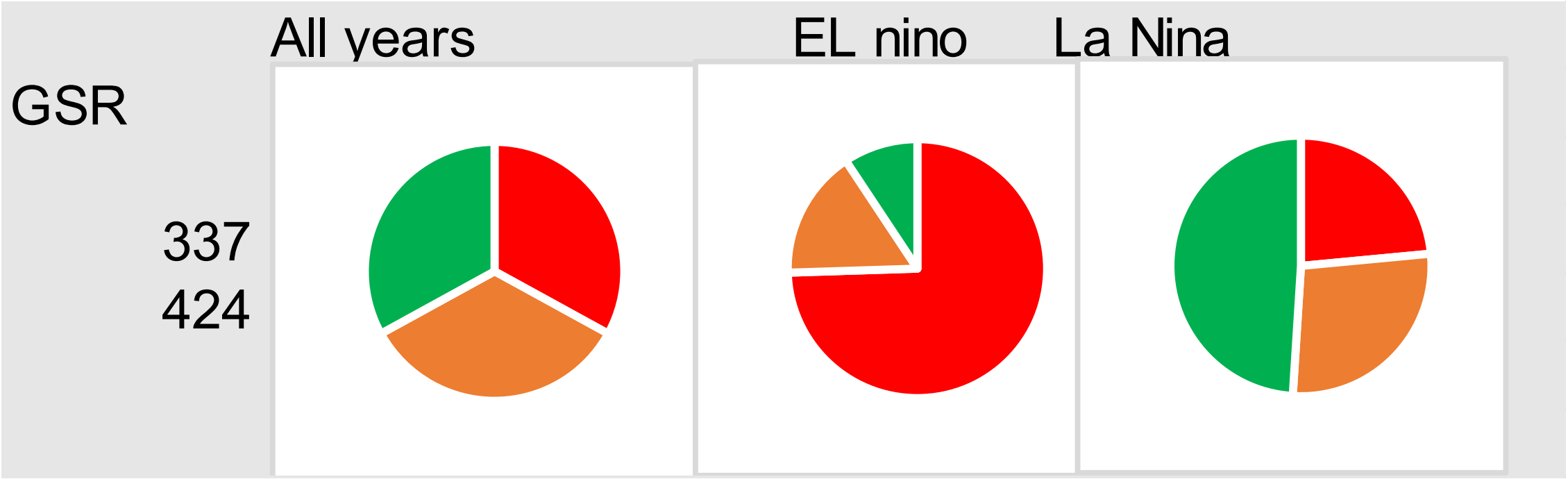


337

424

EL nino

La


All years
EL nino
La Nina
GSR
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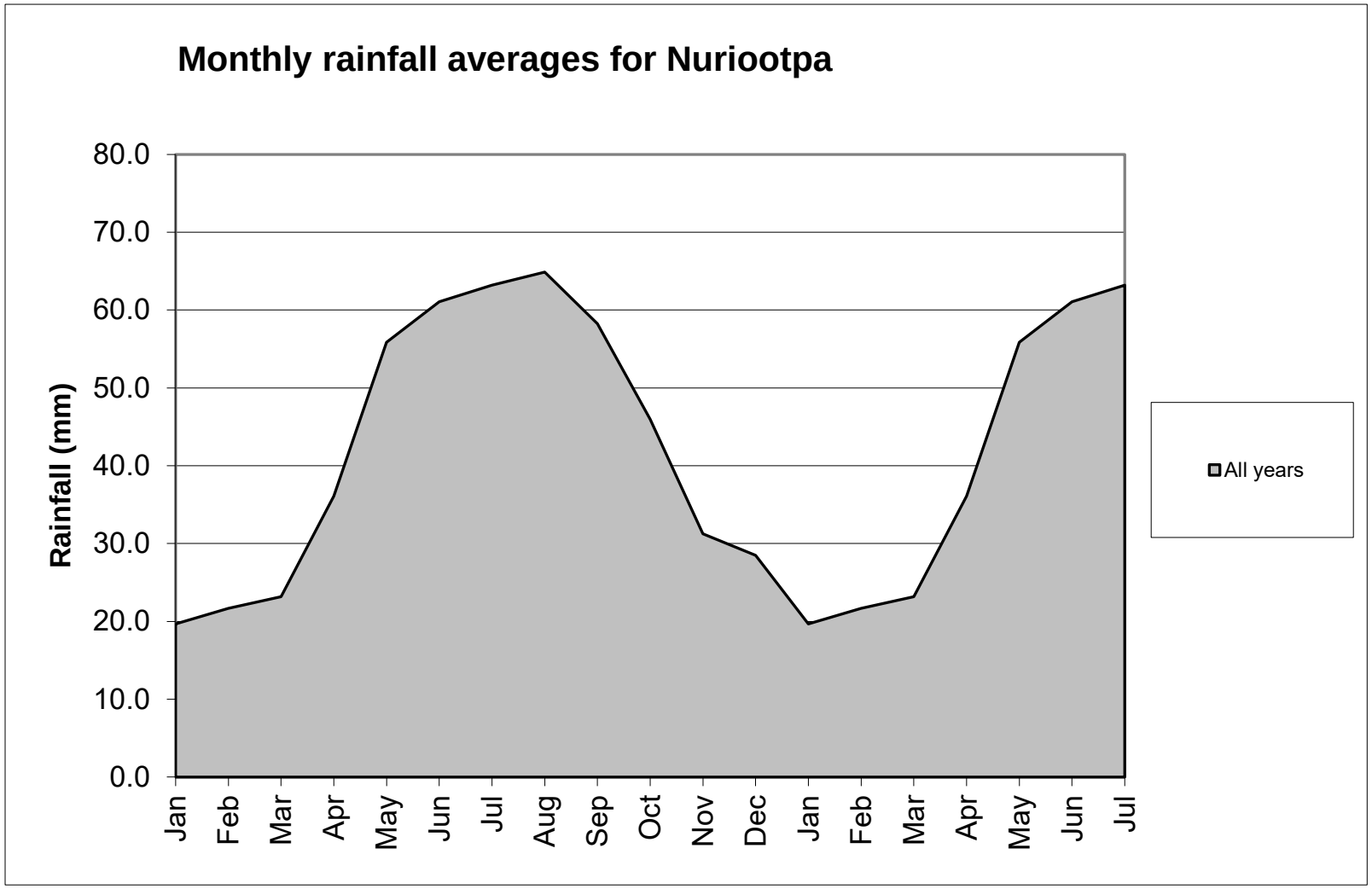
Monthly rainfall averages for Nuriootpa
Rainfall (mm)
80.0
70.0
60.0
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Jan
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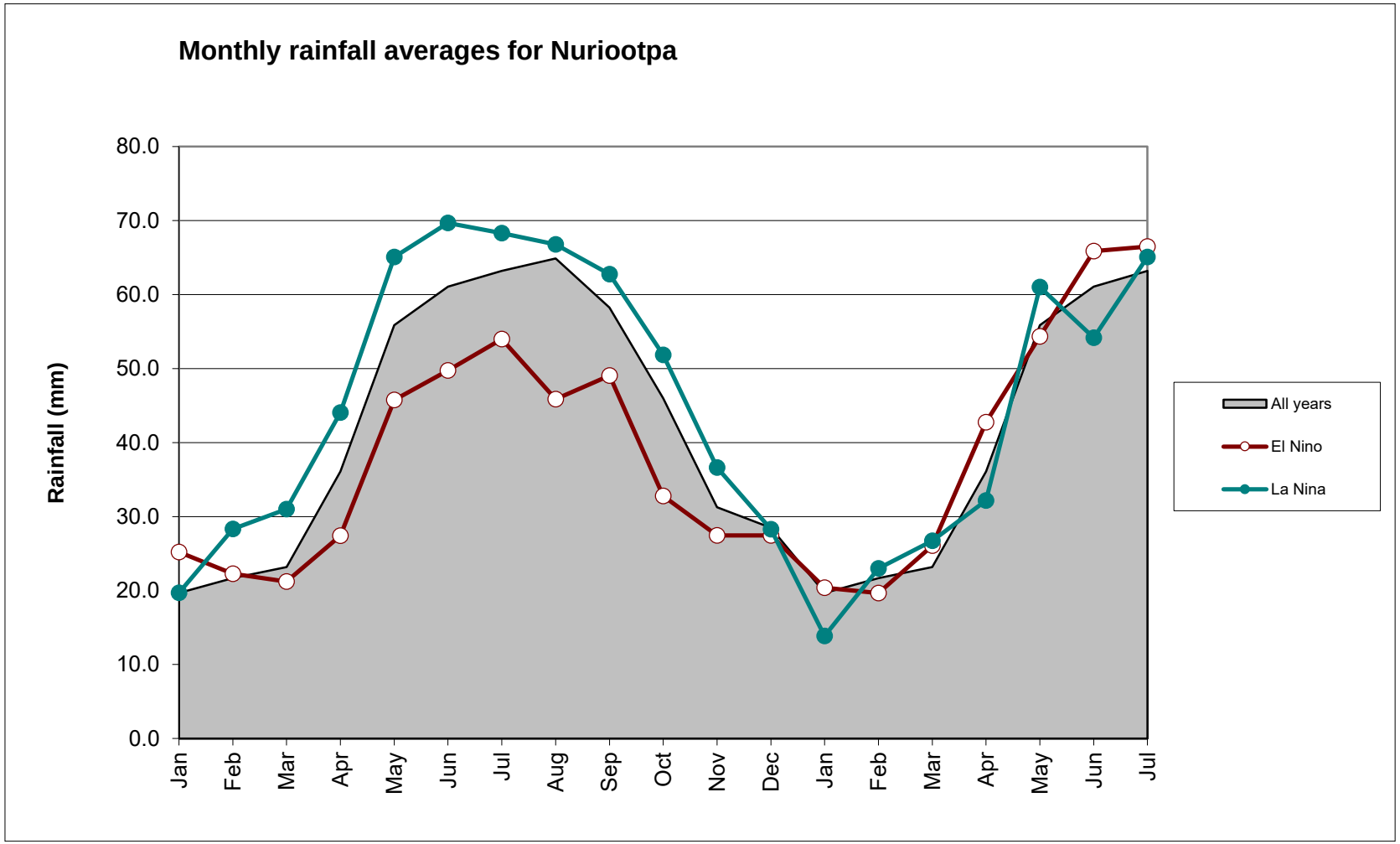
All years


Monthly rainfall averages for Nuriootpa
Rainfall (mm)
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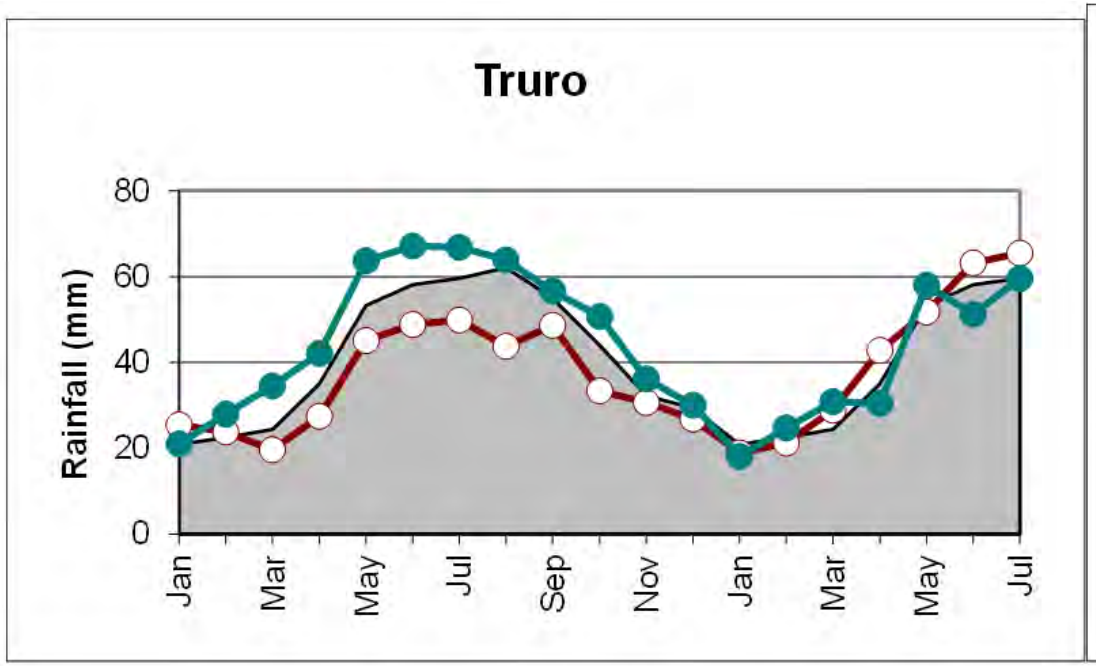
All years
El Nino
La Nina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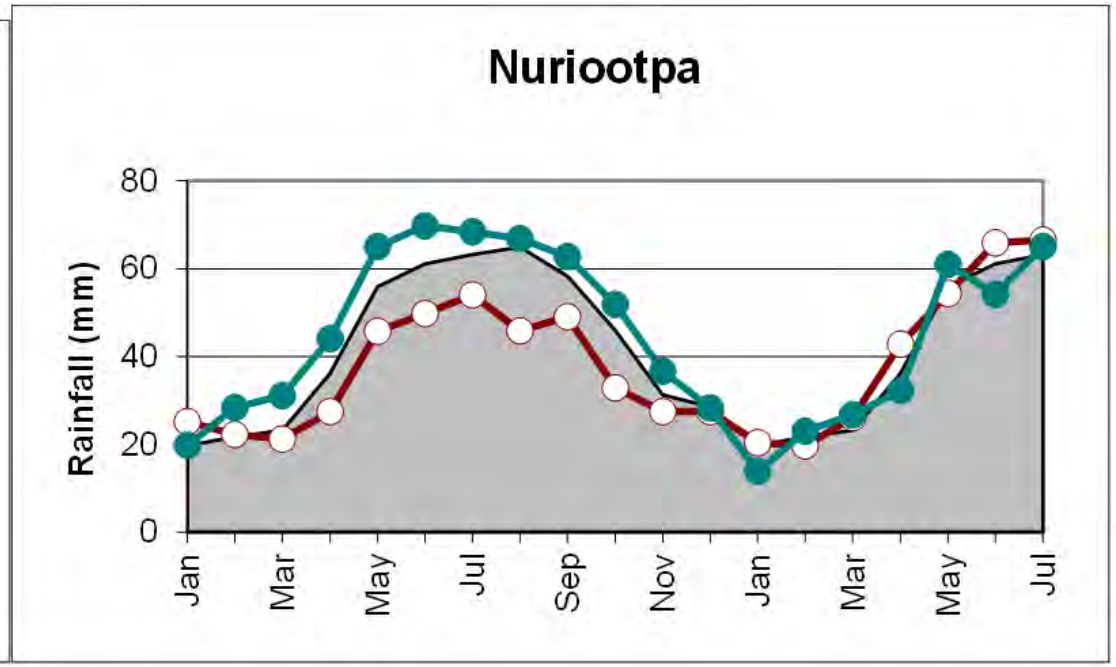
Nuriootpa
Rainfall (mm)
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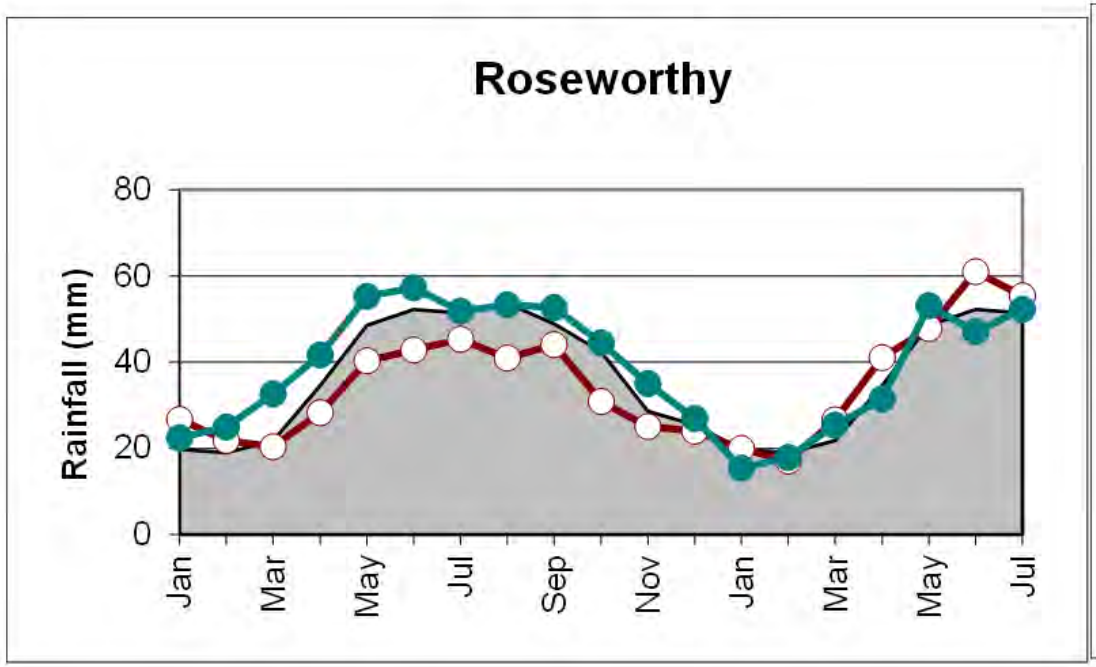
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Rainfall (mm)
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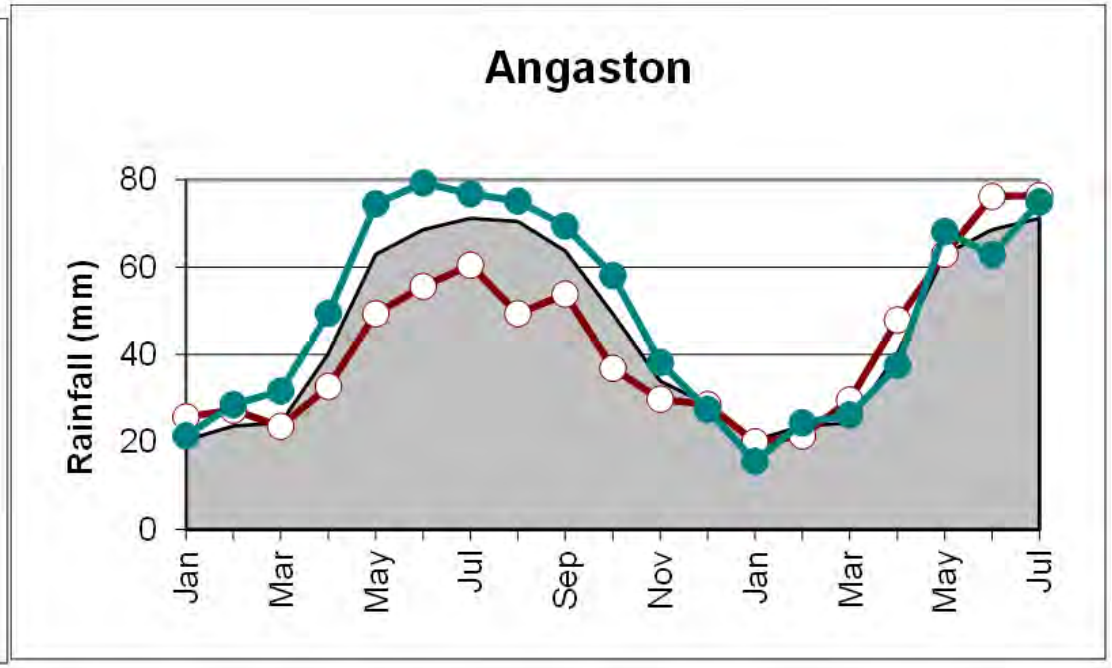
Angaston
Rainfall (mm)
0
20
40
60
80
Jan
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May
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Jan
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May
Jul

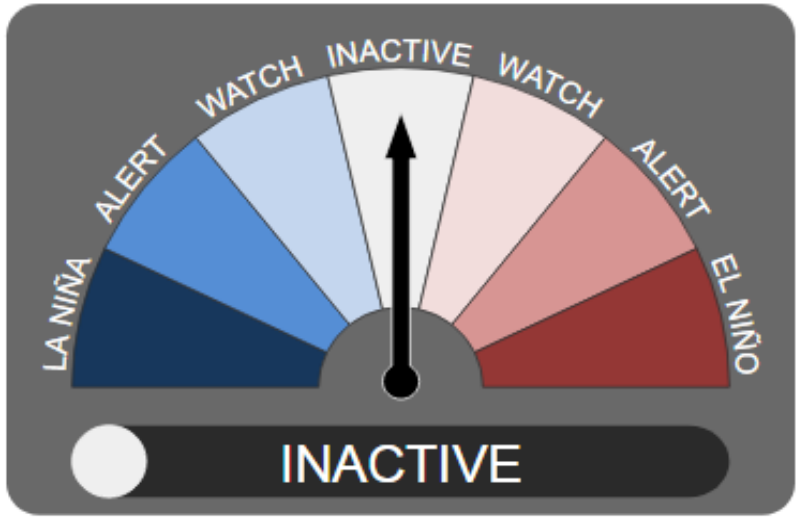
## El Niño WATCH remains in place


The ENSO Outlook remains at El Niño WATCH. El Niño WATCH means there is around a 50% chance of El Niño developing in 2017, which is approximately twice the normal likelihood.

ENSO is currently neutral, however a warming trend has been observed in the tropical Pacific Ocean since the start of the year. A majority of climate models suggest this warming is likely to continue with El Niño thresholds being met by spring 2017. All atmospheric indicators of ENSO remain neutral.

Further information on the current status of ENSO can be found in the ENSO Wrap-Up linked below.

## ENSO Outlook reset to INACTIVE

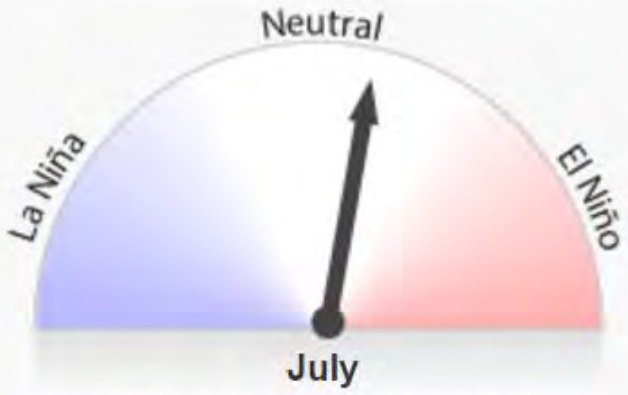



The ENSO Outlook has been downgraded from El Niño WATCH to INACTIVE. International climate models have continued to ease their outlooks for El Niño in recent weeks, with all models now suggesting the current ENSO-neutral state wil persist for the remainder of the year.

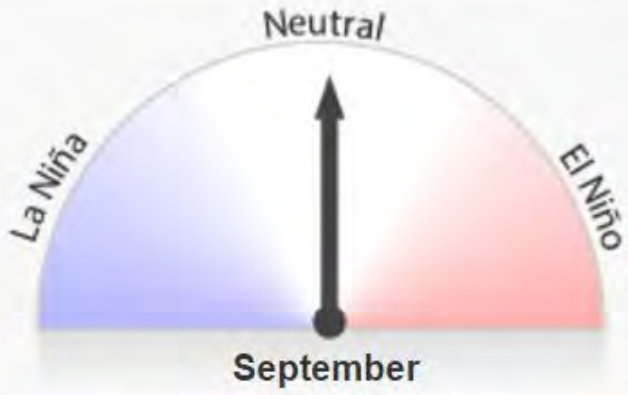
Model outlooks made earlier in the year showed high chances of El Niño development in 2017, with the majority of models suggesting an event would develop in the southern winter and persist through spring. While some very stron warming occurred in the far eastern tropical Pacific Ocean during March-April – which can herald a basin-wide El Niño event– the atmosphere and ocean didn't start reinforcing each other, and this warmth has now dissipated.

The ENSO Outlook will continue to be updated fortnightly. Further information on the current status of ENSO can be found in the ENSO Wrap-Up linked below.

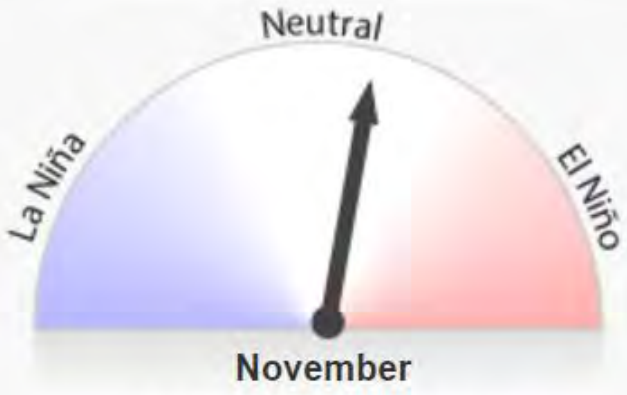
## Average of international model outlooks for NINO3.4




SST anomaly: +0.3 °C

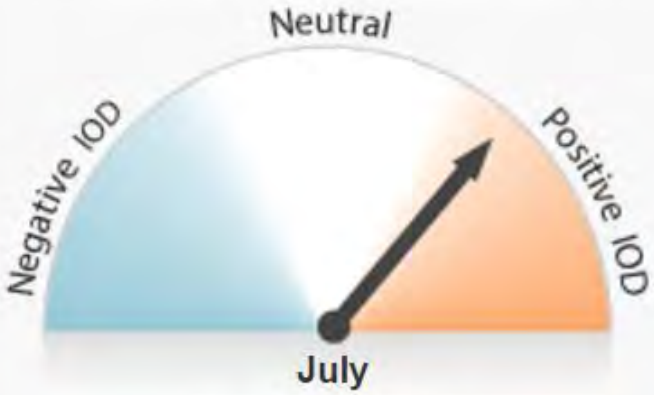



SST anomaly: +0.1 °C

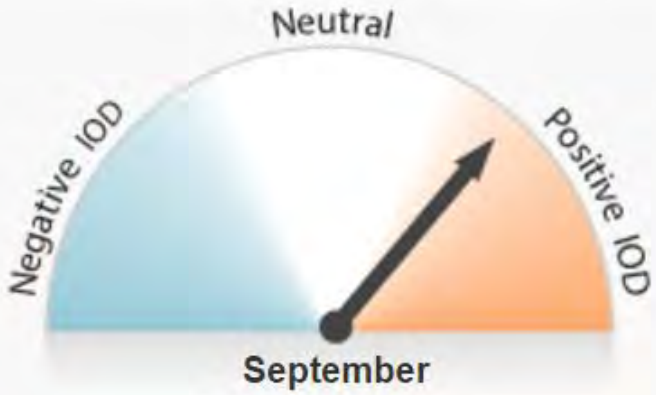



SST anomaly: +0.2 °C

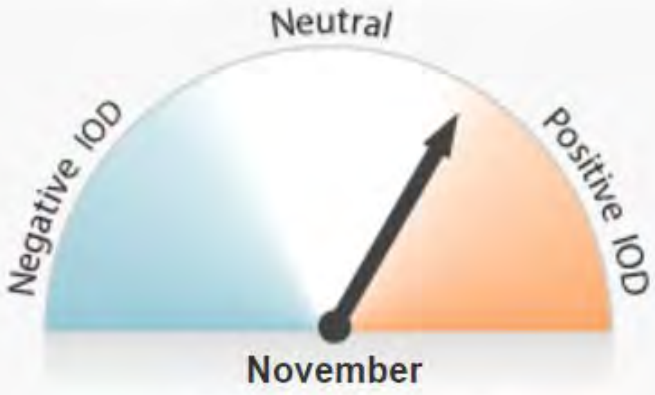
## Average of international model outlooks for the Indian Ocean Dipole (IOD)




IOD index: +0.4 °C




IOD index: +0.4 °C




IOD index: +0.3 °C

# INDIAN OCEAN DIPOLE IN AUSTRALIA

## POSITIVE PHASE

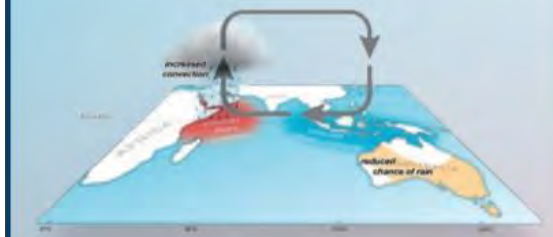
Average winter-spring rainfall
**RED** = DRIER THAN NORMAL

- **LESS RAINFALL** OVER CENTRAL AND SOUTHERN AUSTRALIA
- **WARMER DAYS** IN WEST AND SOUTH
- **WARMER NIGHTS** IN SOUTHWEST, **COOLER** IN NORTH
- **SHORTER SNOW SEASON,** LOWER SNOW DEPTHS
- **INCREASED FIRE RISK** IN SOUTHEAST

### POSITIVE PHASE MORE LIKELY TO COINCIDE WITH EL NIÑO

**1982** SOUTHEAST AUSTRALIA HAD ITS

**DRIEST** YEAR ON RECORD WHEN A **POSITIVE IOD** COINCIDED WITH **EL NIÑO**




## WHAT IS IT?

The Indian Ocean Dipole is the difference in ocean temperatures between the west and east tropical Indian Ocean, that can shift moisture towards or away from Australia.

## WHEN DO THEY OCCUR?

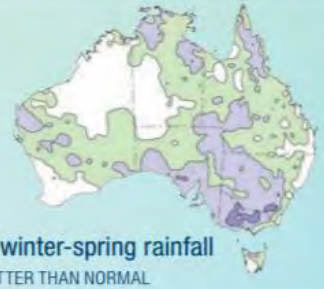
THE IOD CAN IMPACT FROM **MAY** TO **DECEMBER**

**AND LAST FOR**

**2 TO 7 MONTHS**

THE IOD DOESN'T FORM DURING SUMMER **DUE TO THE AUSTRALIAN MONSOON**

## NEGATIVE PHASE



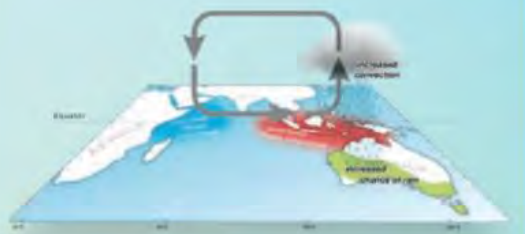
Average winter-spring rainfall
**BLUE** = WETTER THAN NORMAL

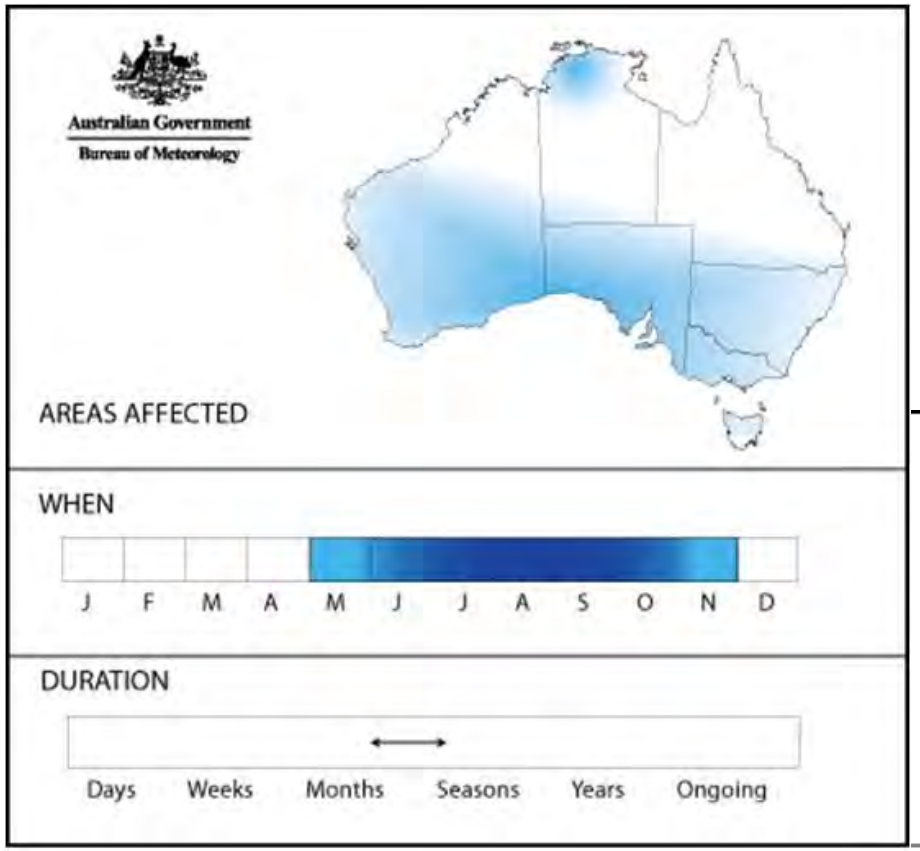
- **MORE RAINFALL** OVER EASTERN AND SOUTHERN AUSTRALIA
- **COOLER DAYS** IN SOUTH
- **WARMER NIGHTS** IN NORTH
- **INCREASED CHANCE** OF FLOODING
- **MORE** NORTHWEST CLOUD BANDS

### NEGATIVE PHASE MORE LIKELY TO COINCIDE WITH LA NIÑA

**1974** AUSTRALIA HAD ITS

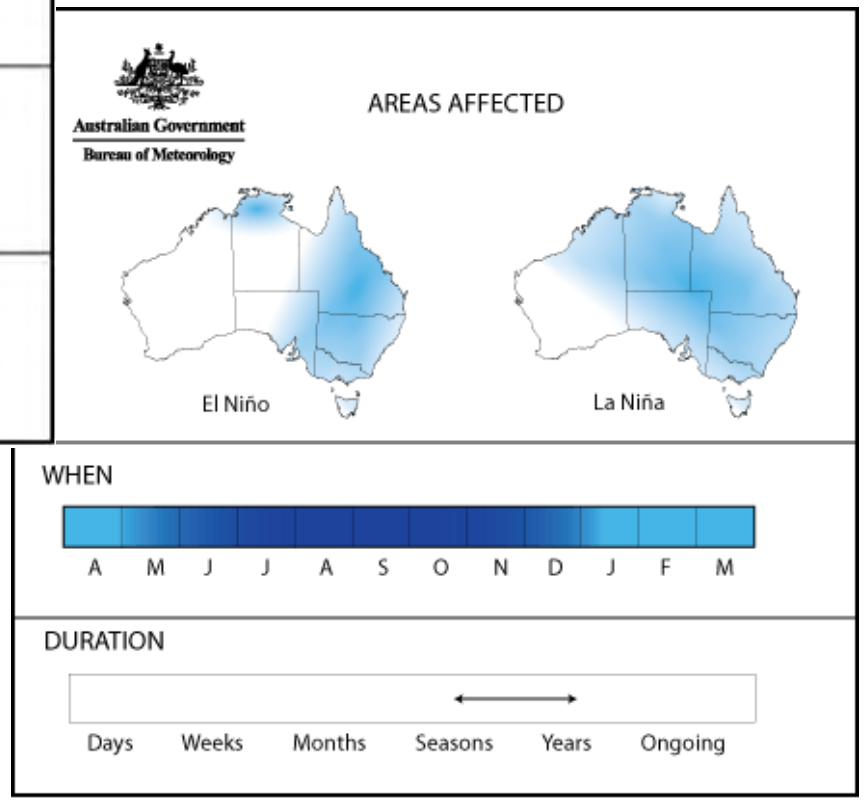
**WETTEST** YEAR ON RECORD WHEN A **NEGATIVE IOD** COINCIDED WITH **LA NIÑA**

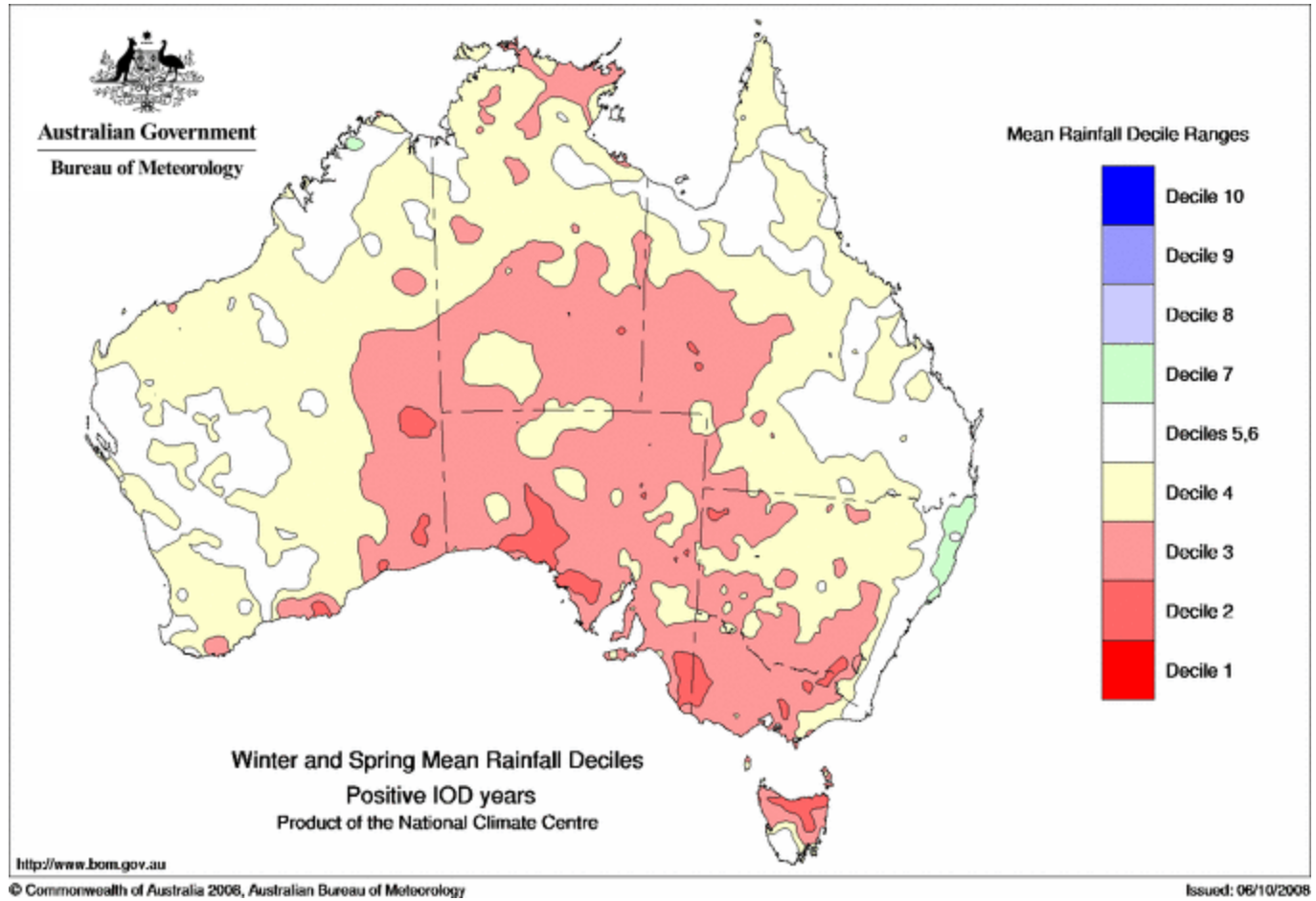



Australian Government
Bureau of Meteorology
AREAS AFFECTED
WHEN
J F M A M J J A S O N D
DURATION
Days Weeks Months Seasons Years Ongoing

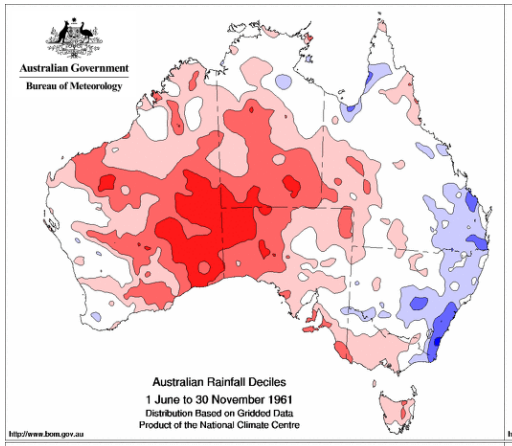
IOD

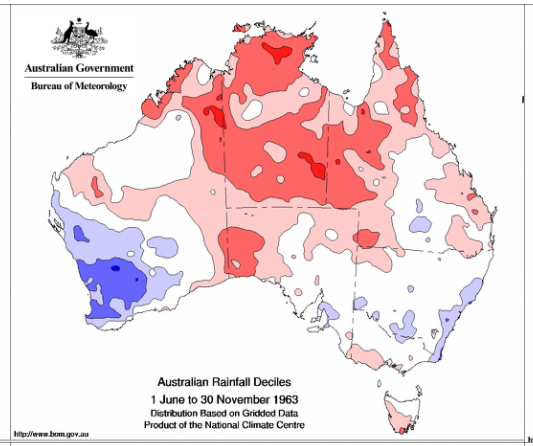
ENSO

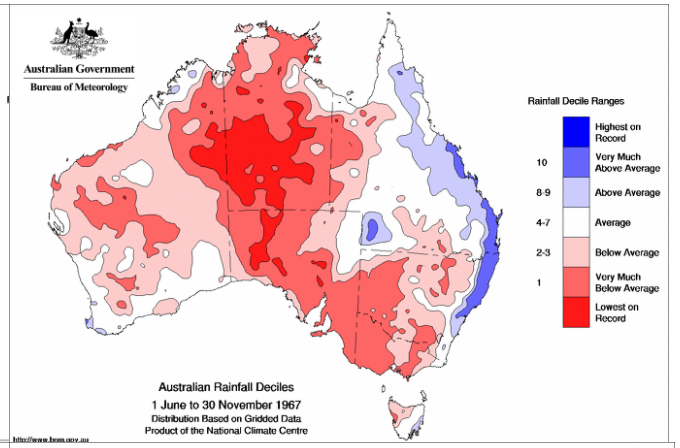

Australian Government
Bureau of Meteorology
AREAS AFFECTED
El Niño
La Niña
WHEN
A M J J A S O N D J F M
DURATION
Days Weeks Months Seasons Years Ongoing

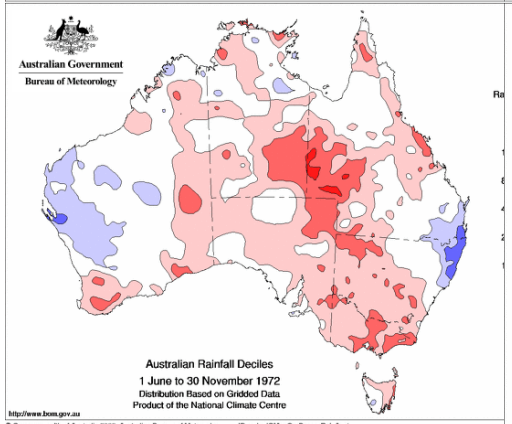



Map made up of 10 individual years

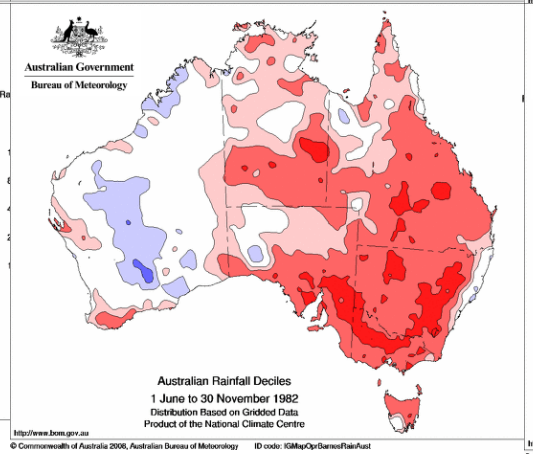


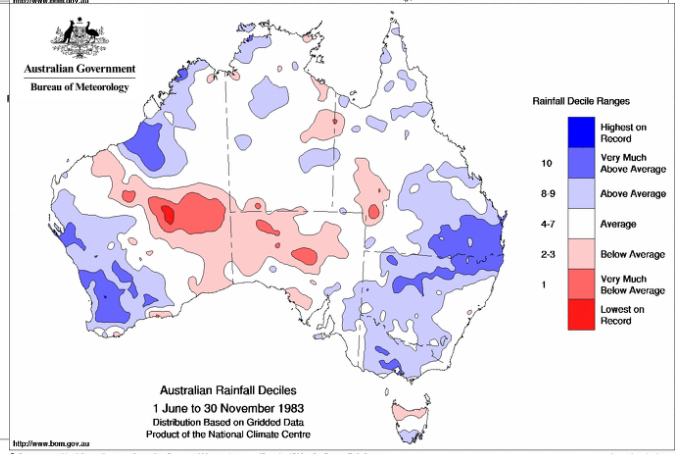







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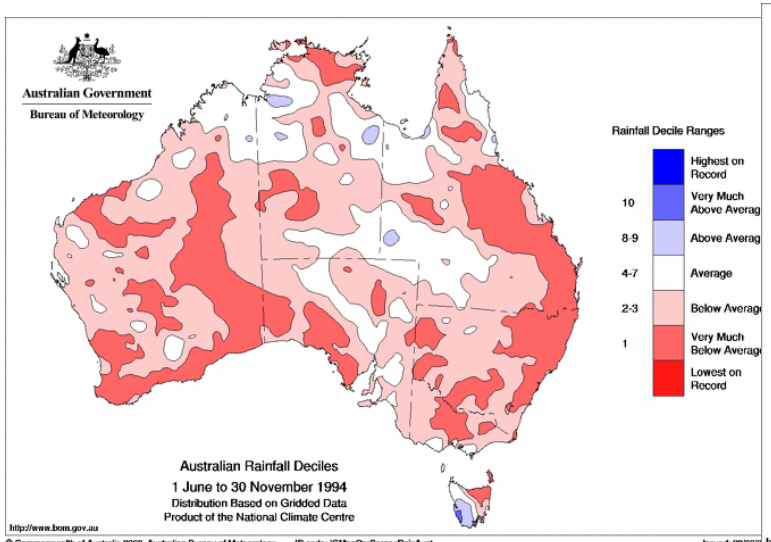
Australian Government
Bureau of Meteorology
Rainfall Decile Ranges
Highest on Record
10
Very Much Above Averag
8-9
Above Averag
4-7
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2-3
Below Averag
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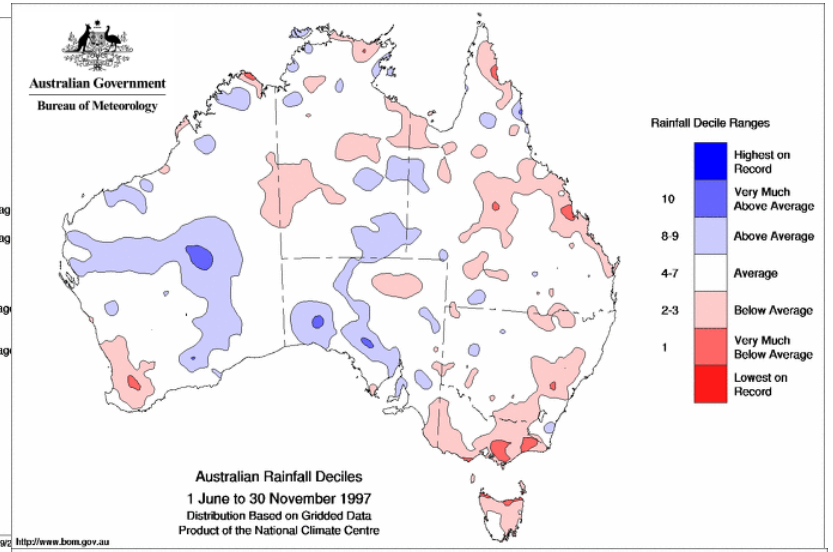
Very Much Below Averag
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 1994
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
© Commonwealth of Australia 2008, Australian Bureau of Meteorology
ID code: IGMapOprBarnesRainAust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Rainfall Decile Ranges
Highest on Record
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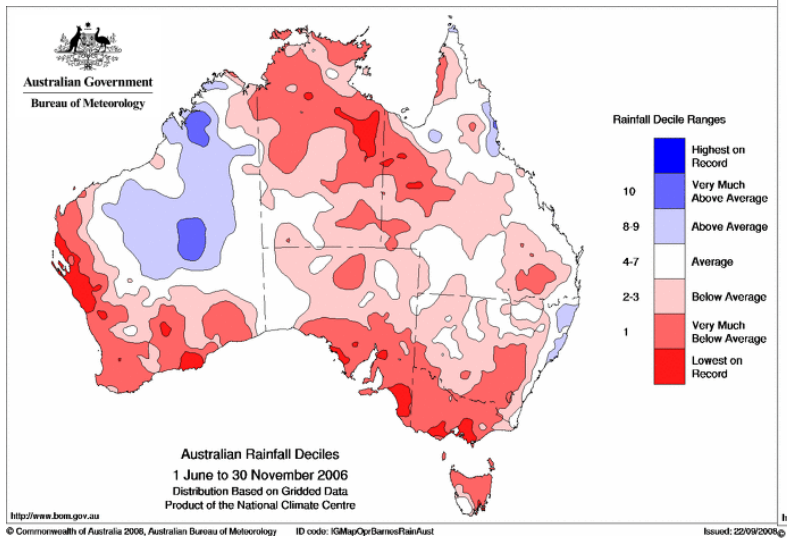
Below Average
1
Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 1997
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au


Australian Government
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Rainfall Decile Ranges
Highest on Record
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Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 2006
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
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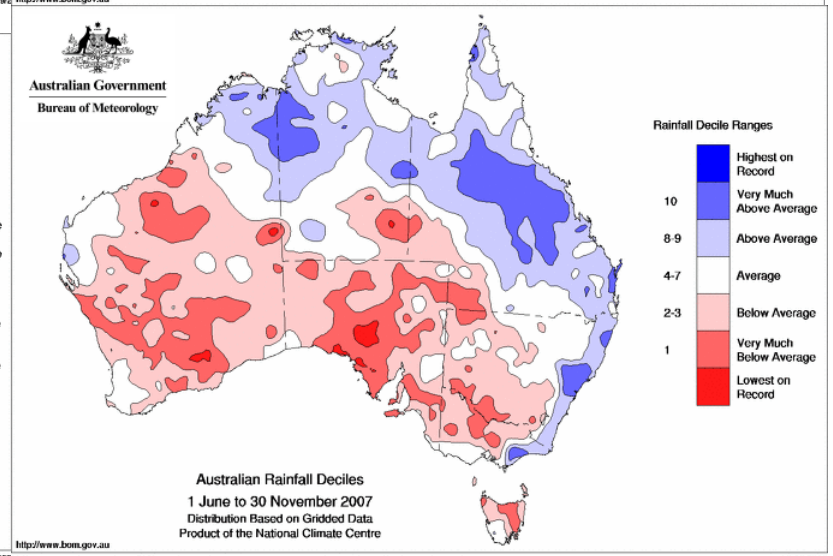
Australian Government
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Rainfall Decile Ranges
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4-7
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2-3
Below Average
1
Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 2007
Distribution Based on Gridded Data
Product of the National Climate Centre
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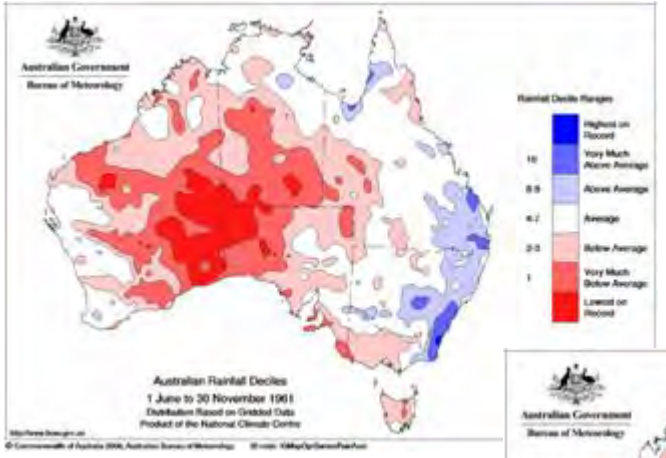
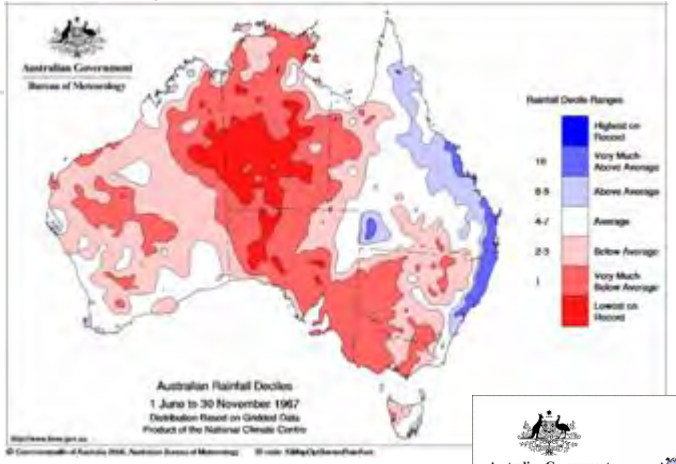
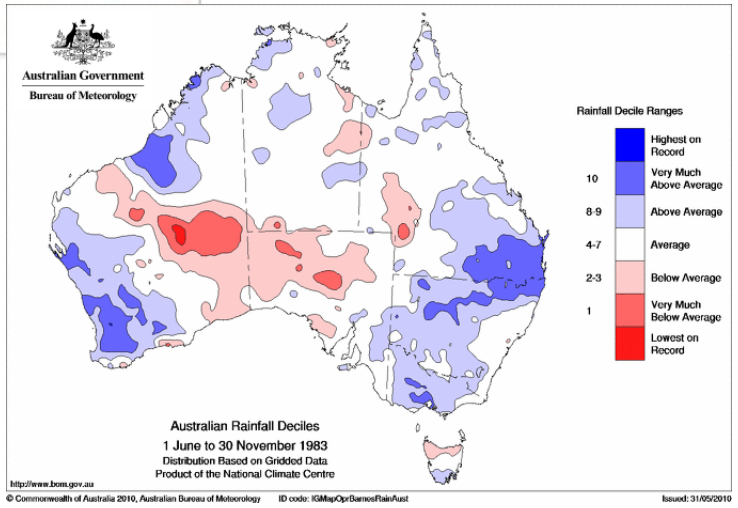
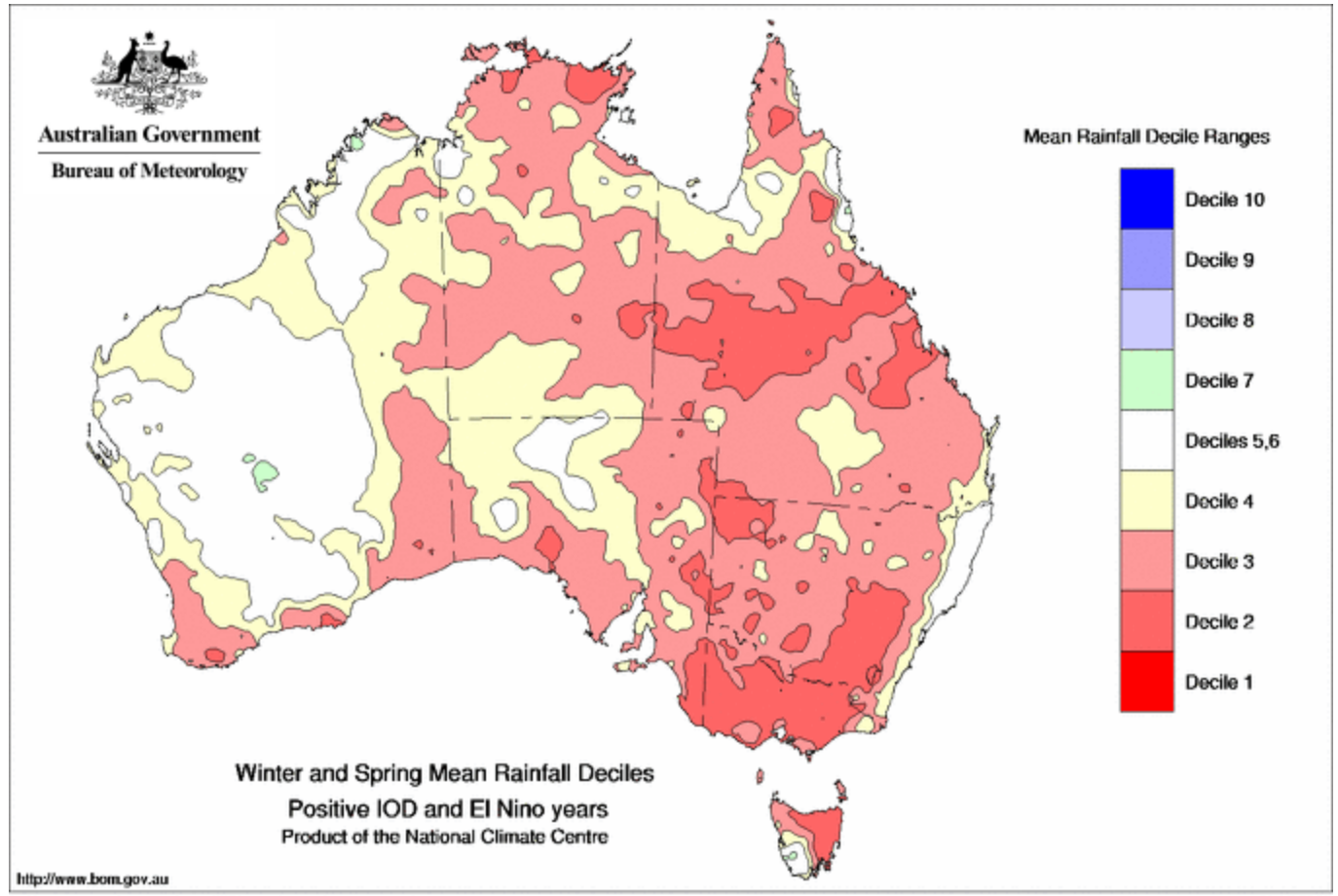



7 of the 10 IOD positive years were El Nino, 3 were neutral ENSO years – Look how SA compares with NSW & Qld



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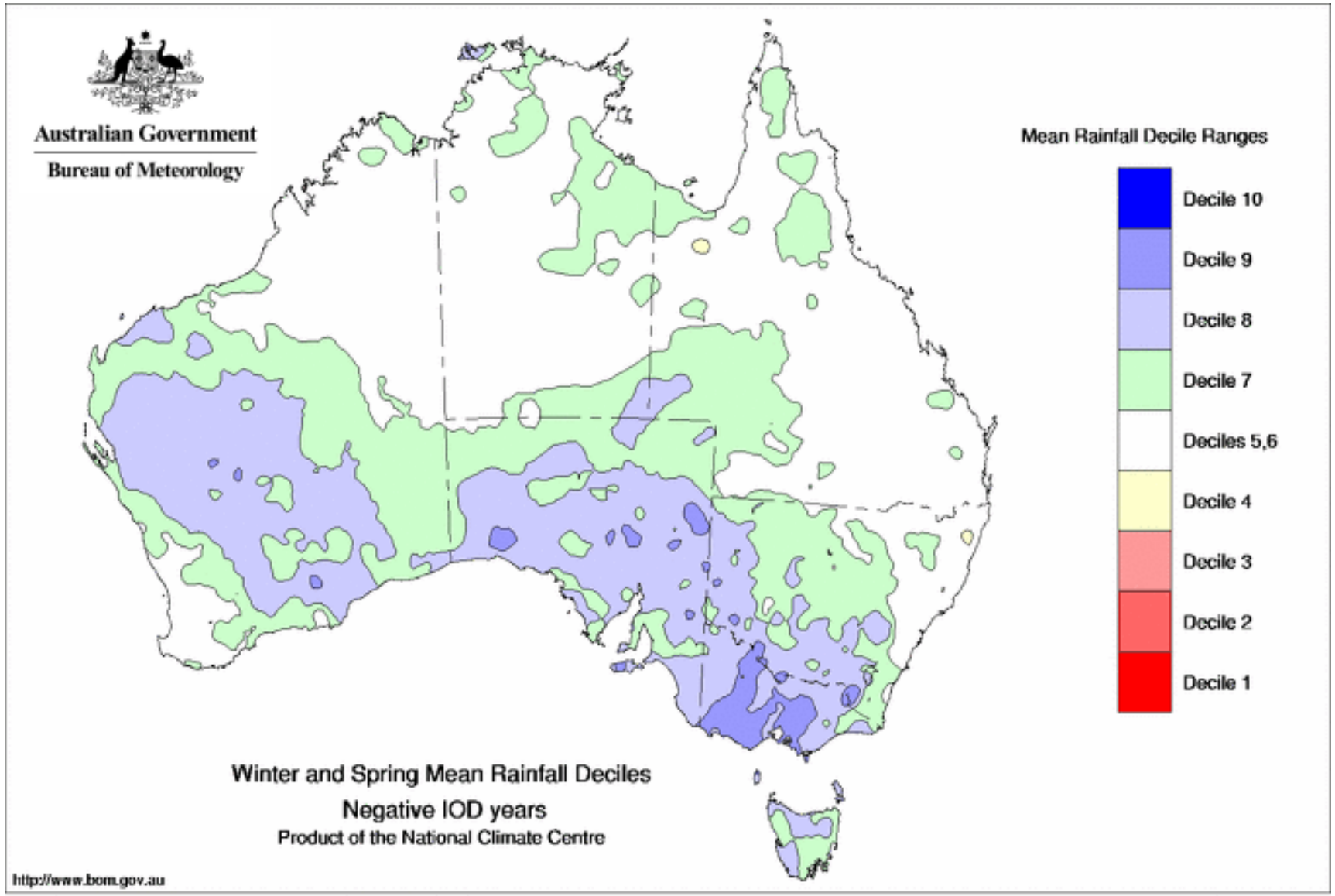
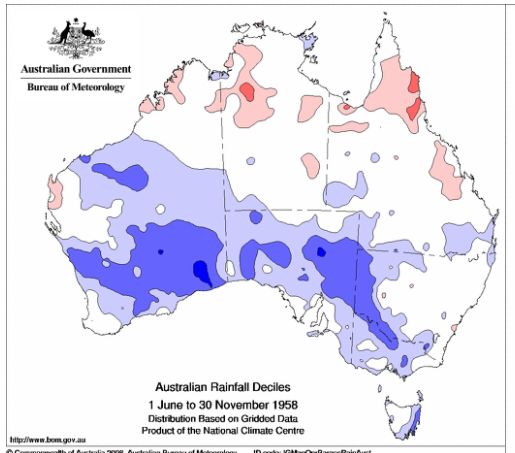
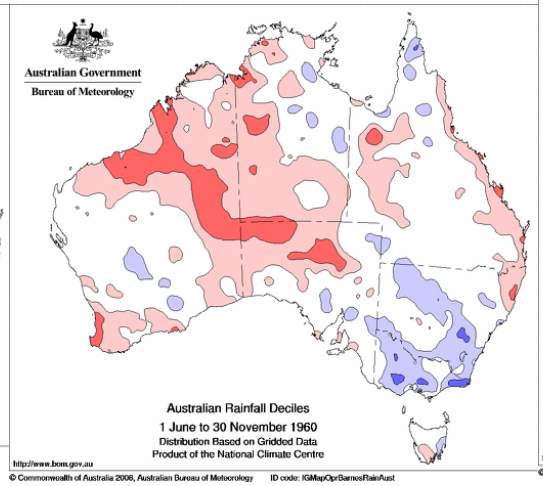





Issued: 06/10/2008


Australian Government
Bureau of Meteorology
Australian Rainfall Deciles
1 June to 30 November 1958
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
© Commonwealth of Australia 2008, Australian Bureau of Meteorology
ID code: IGMapOprBarnesRainAust


Australian Government
Bureau of Meteorology
Australian Rainfall Deciles
1 June to 30 November 1960
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
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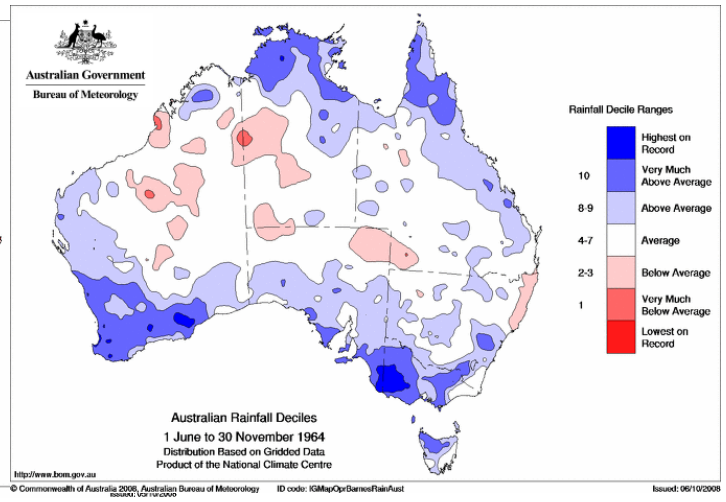
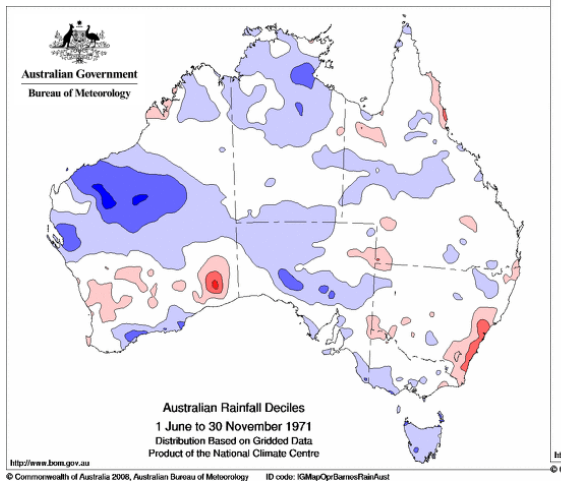
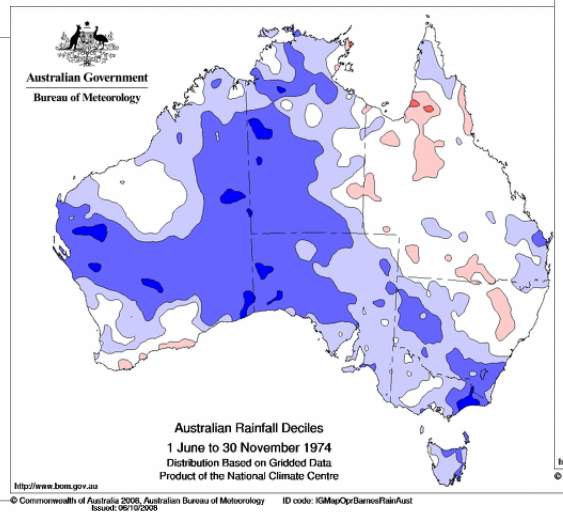
ID code: IGMapOprBarnesRainAust


Australian Government
Bureau of Meteorology
Rainfall Decile Ranges
10
8-9
4-7
2-3
1
Highest on Record
Very Much Above Average
Above Average
Average
Below Average
Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 1964
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
© Commonwealth of Australia 2008, Australian Bureau of Meteorology
ID code: IGMapOprBarnesRainAust
Issued: 06/10/2008


Australian Government
Bureau of Meteorology
Australian Rainfall Deciles
1 June to 30 November 1971
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
© Commonwealth of Australia 2008, Australian Bureau of Meteorology
ID code: IGMapOprBarnesRainAust


Australian Government
Bureau of Meteorology
Australian Rainfall Deciles
1 June to 30 November 1974
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
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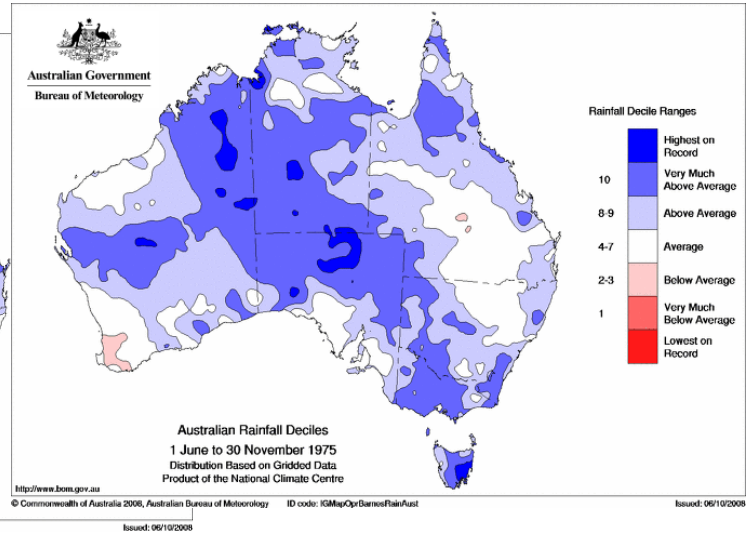
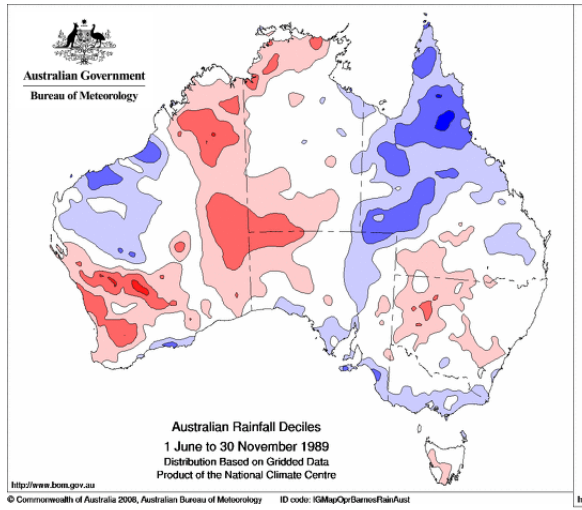
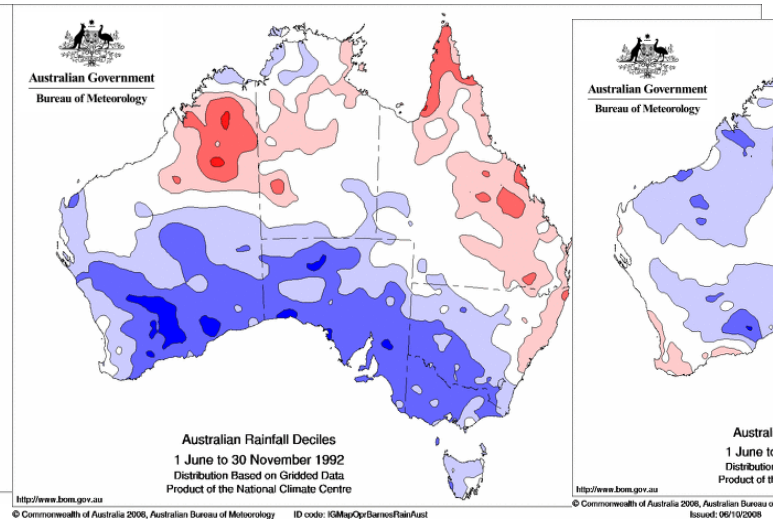
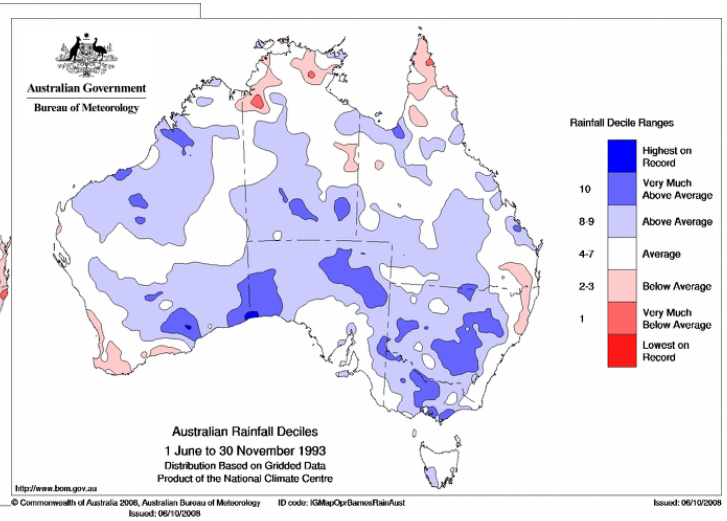
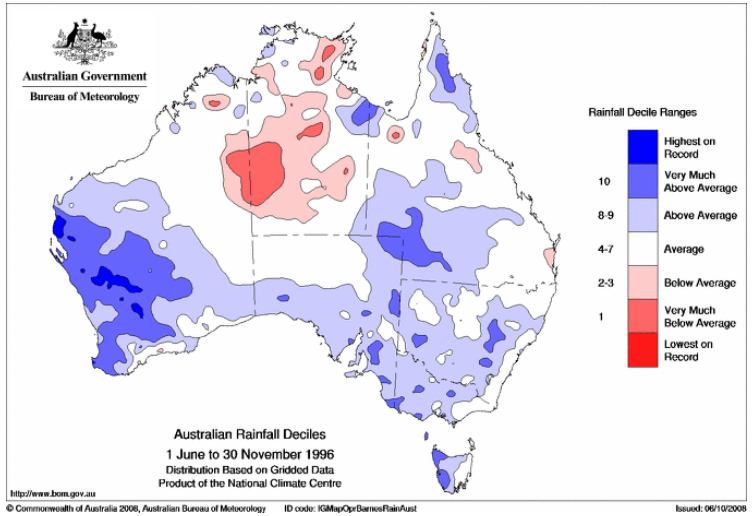
Issued: 06/10/2008


Australian Government
Bureau of Meteorology
Rainfall Decile Ranges
10
8-9
4-7
2-3
1
Highest on Record
Very Much Above Average
Above Average
Average
Below Average
Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 June to 30 November 1975
Distribution Based on Gridded Data
Product of the National Climate Centre
http://www.bom.gov.au
© Commonwealth of Australia 2008, Australian Bureau of Meteorology
ID code: IGMapOprBarnesRainAust
Issued: 06/10/2008



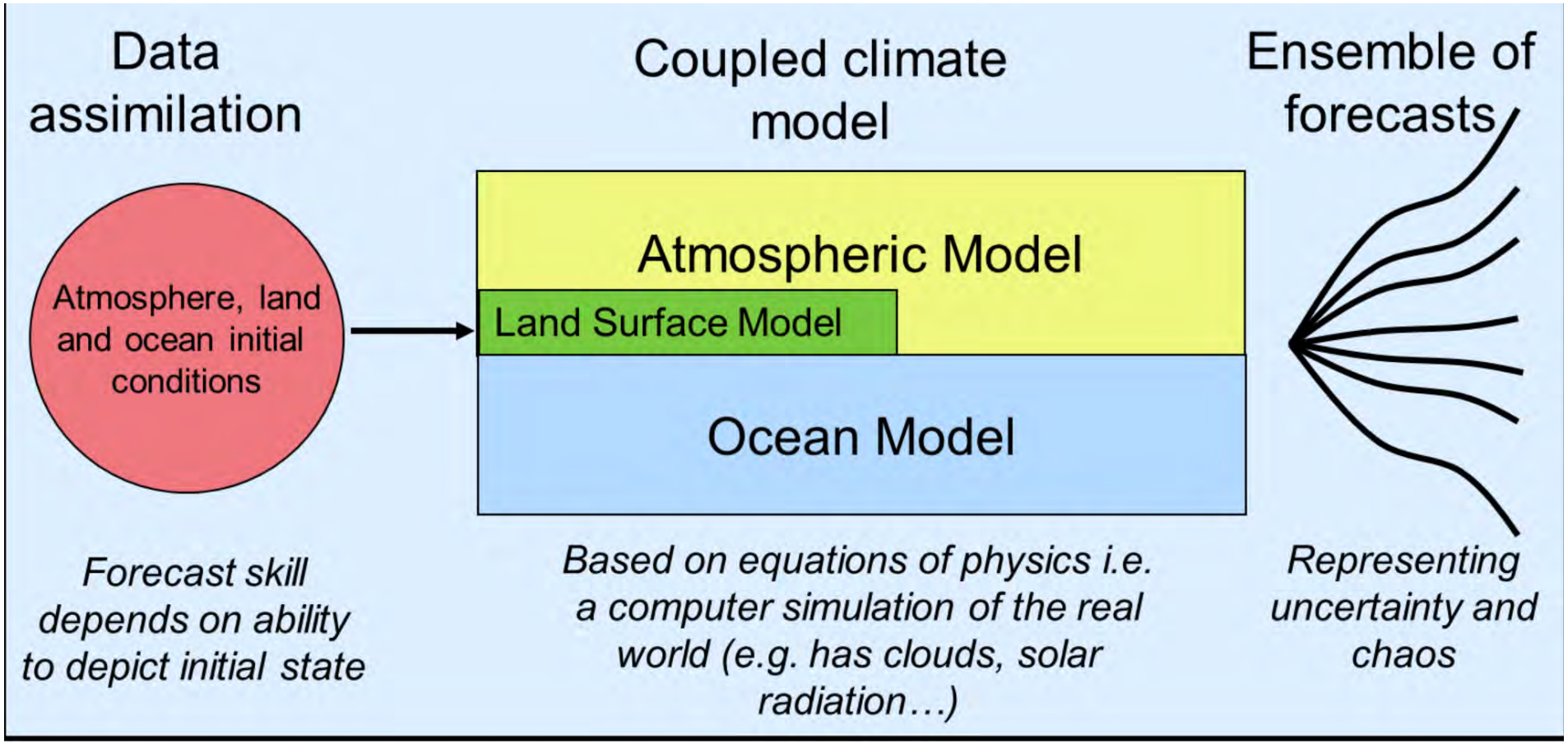



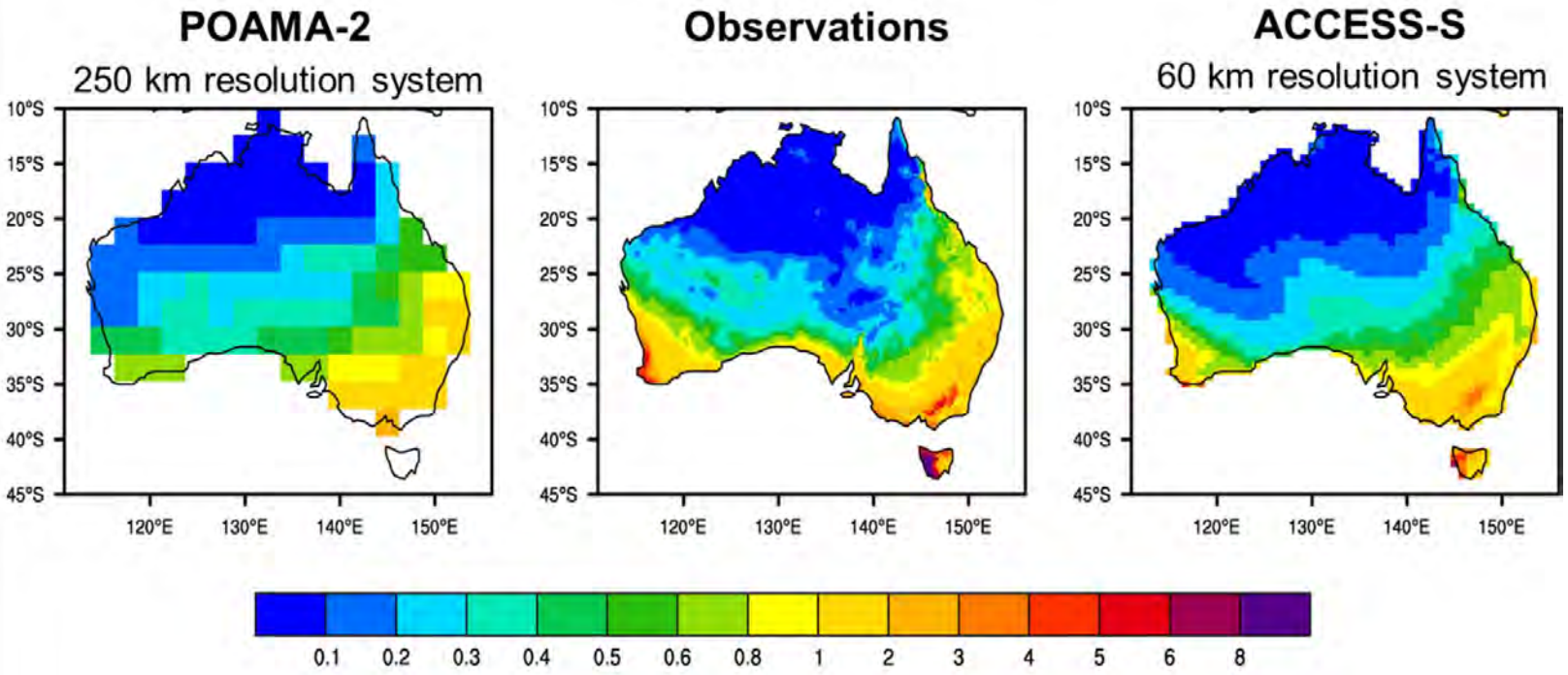

1964, 1971, 1974 and 1975

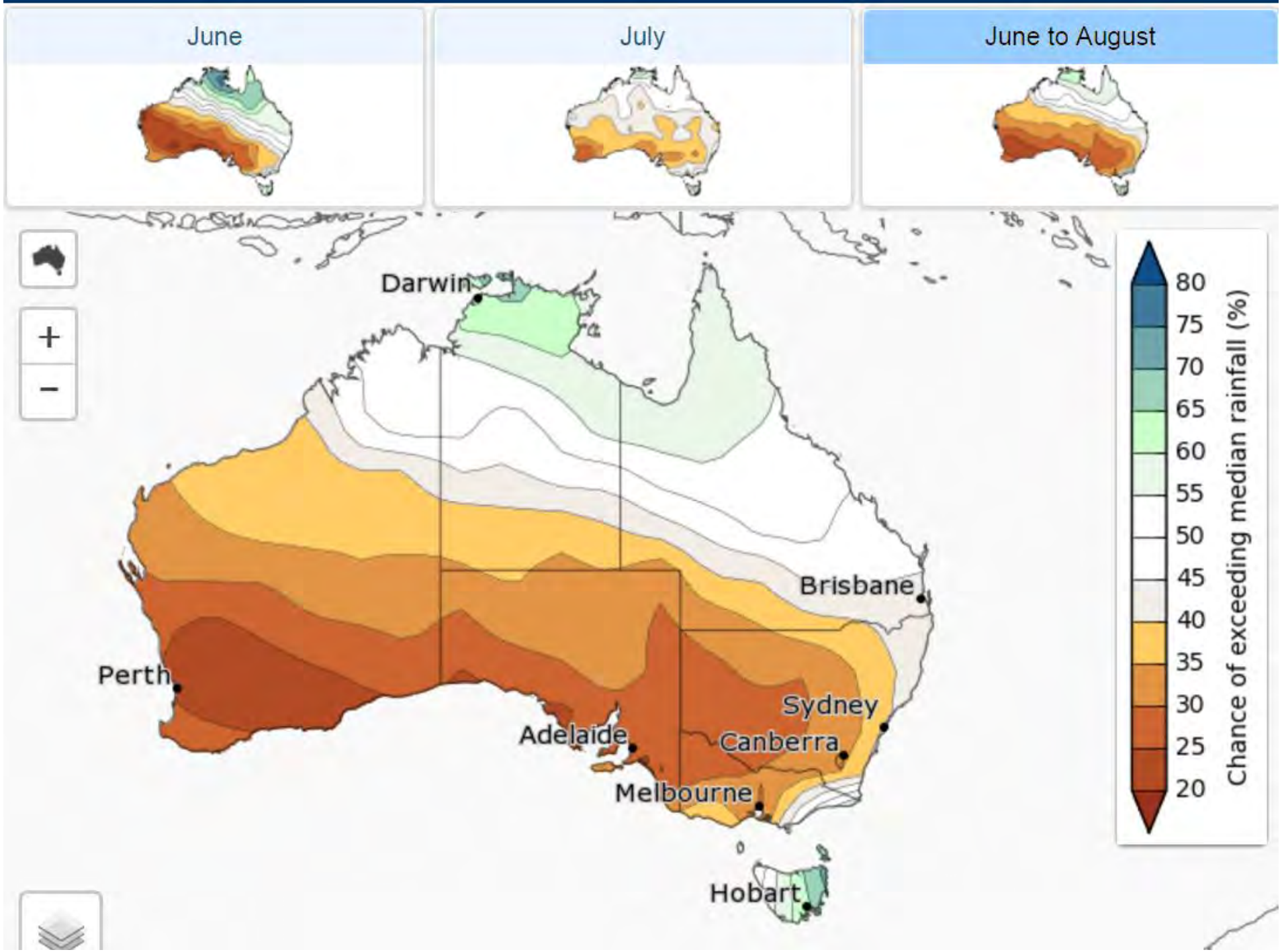
| | |
|---|---|
| POAMA-1 (2002-2006) | First Operational forecast of Nino indices |
| POAMA-1.5 (2007-2011) | Operational forecast of IOD and GBR indices/regional climate |
| POAMA-2 (2011- ) | Operational seasonal outlook (from 22 May 2013) |
| ACCESS-S (Under development) | Based on ACCESS |

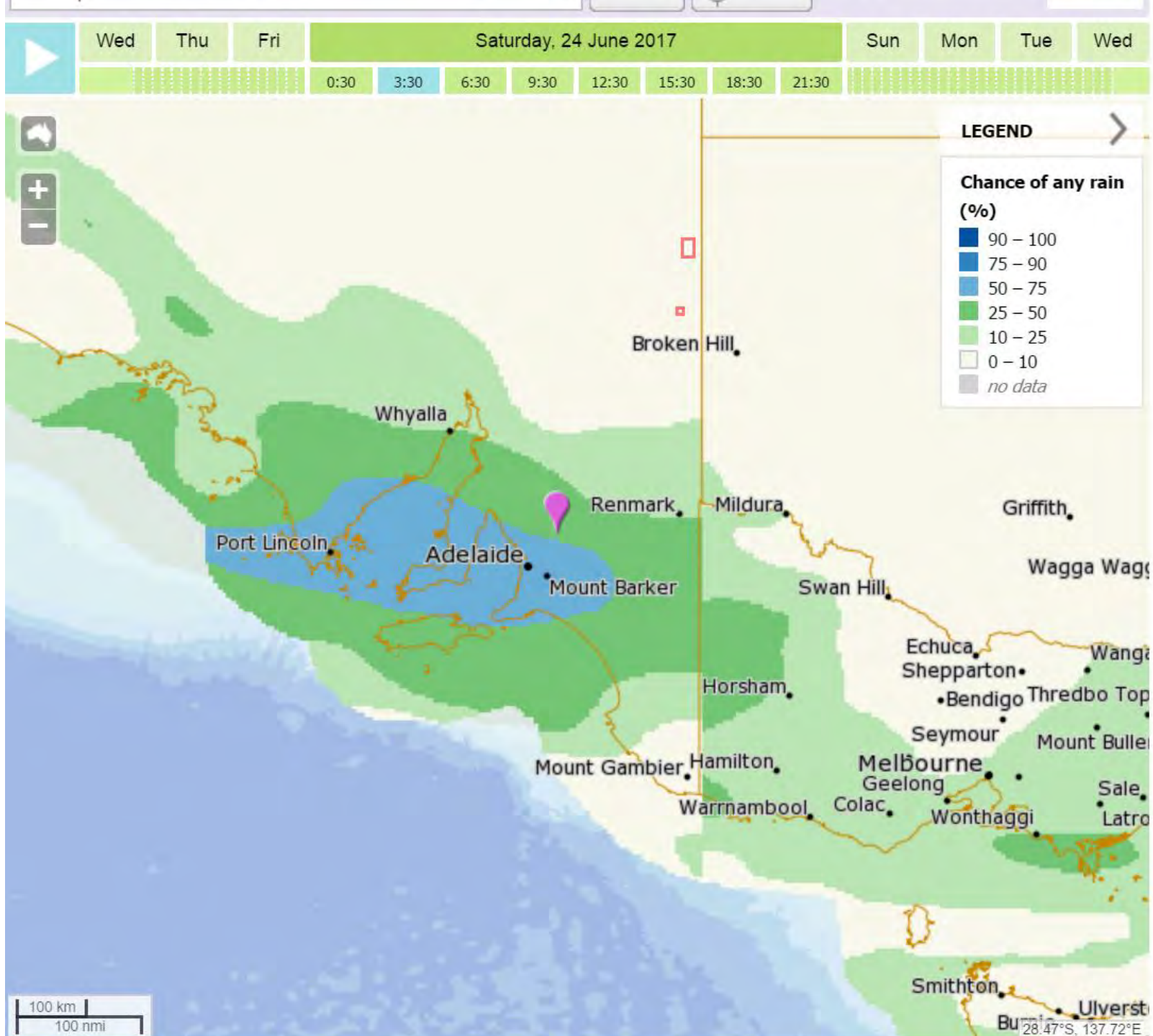

Data assimilation
Coupled climate model
Ensemble of forecasts
Atmosphere, land and ocean initial conditions
Atmospheric Model
Land Surface Model
Ocean Model
Forecast skill depends on ability to depict initial state
Based on equations of physics i.e. a computer simulation of the real world (e.g. has clouds, solar radiation…)
Representing uncertainty and chaos

# Mean Rainfall (mm/day) for August

Higher resolution greatly improves the depiction of mean rainfall




June
July
June to August
Darwin
Brisbane
Perth
Sydney
Adelaide
Canberra
Melbourne
Hobart
80
75
70
65
60
55
50
45
40
35
30
25
20
Chance of exceeding median rainfall (%)


Wed
Thu
Fri
Saturday, 24 June 2017
Sun
Mon
Tue
Wed
0:30
3:30
6:30
9:30
12:30
15:30
18:30
21:30
LEGEND
Chance of any rain (%)
90 – 100
75 – 90
50 – 75
25 – 50
10 – 25
0 – 10
no data
Broken Hill
Whyalla
Renmark
Mildura
Griffith
Port Lincoln
Adelaide
Mount Barker
Swan Hill
Wagga Wagg
Echuca
Shepparton
Wanga
Horsham
Bendigo
Thredbo Top
Seymour
Mount Bulle
Mount Gambier
Hamilton
Melbourne
Geelong
Sale
Warrnambool
Colac
Wonthaggi
Latro
Smithton
Ulverst
100 km
100 nmi
28.47°S, 137.72°E

Nuriootpa, SA | Locate | Find me | Time zone ACST

Thursday | Friday | Saturday | Sunday | Monday | Tuesday

**Forecast for Nuriootpa** — **See text views for location**

| Save location | Wed. 21 Jun | Thu. 22 Jun | Fri. 23 Jun | Sat. 24 Jun | Sun. 25 Jun | Mon. 26 Jun | Tue. 27 Jun |
|---|---|---|---|---|---|---|---|
| Max (°C) | – | 16 | 17 | 15 | 14 | 14 | 13 |
| Min (°C) | – | 1 | 0 | 4 | 4 | 3 | 1 |
| Chance of rain (%) | – | 0 | 20 | 70 | 50 | 30 | 20 |
| Rainfall range (mm) | – | 0 | 0 | 0 to 4 | 0 to 2 | 0 to 0.2 | 0 |
| Issued 21 Jun 2017 | Detail | Detail | Detail | Detail | Detail | Detail | Detail |

# Prepare *AND* Predict

The future is uncertain

Risk is putting numbers on uncertainty

Risk assessment and risk management

# The bookie and the punter

- As humans we are poor intuitive statisticians
- Natural lawyers rather than scientists

- Robust vs twitchy farming systems