



Climate Change and Variability: Observed trends for Australia, NSW and the Namoi

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NSW Climate Services Centre

Climate Change and Agriculture

21 & 22 March 2007



Australian Government

Bureau of Meteorology

Outline

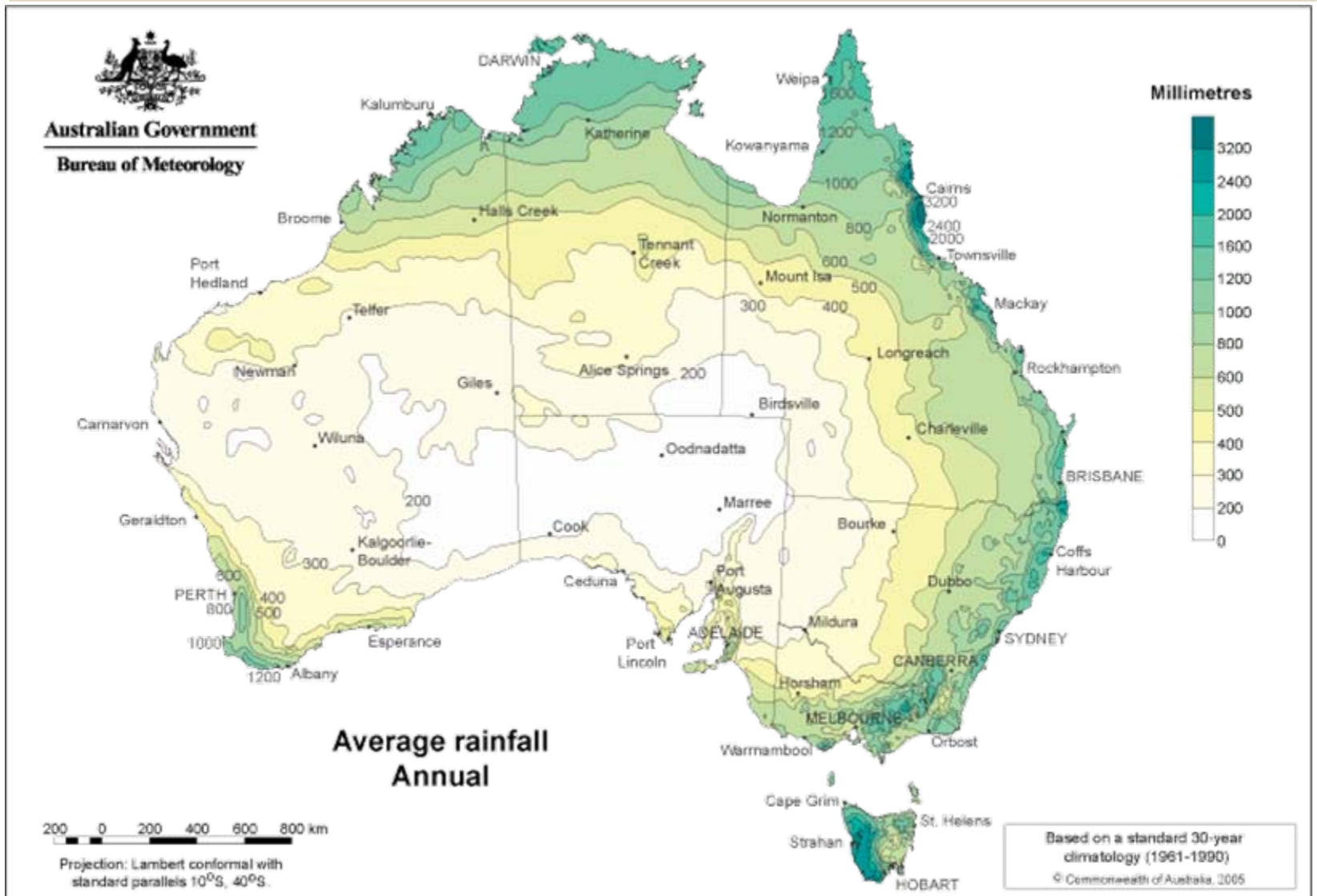
- Climate variability in Australia and NSW
- Observed temperature trends
- Observed rainfall trends

Australian climate variability

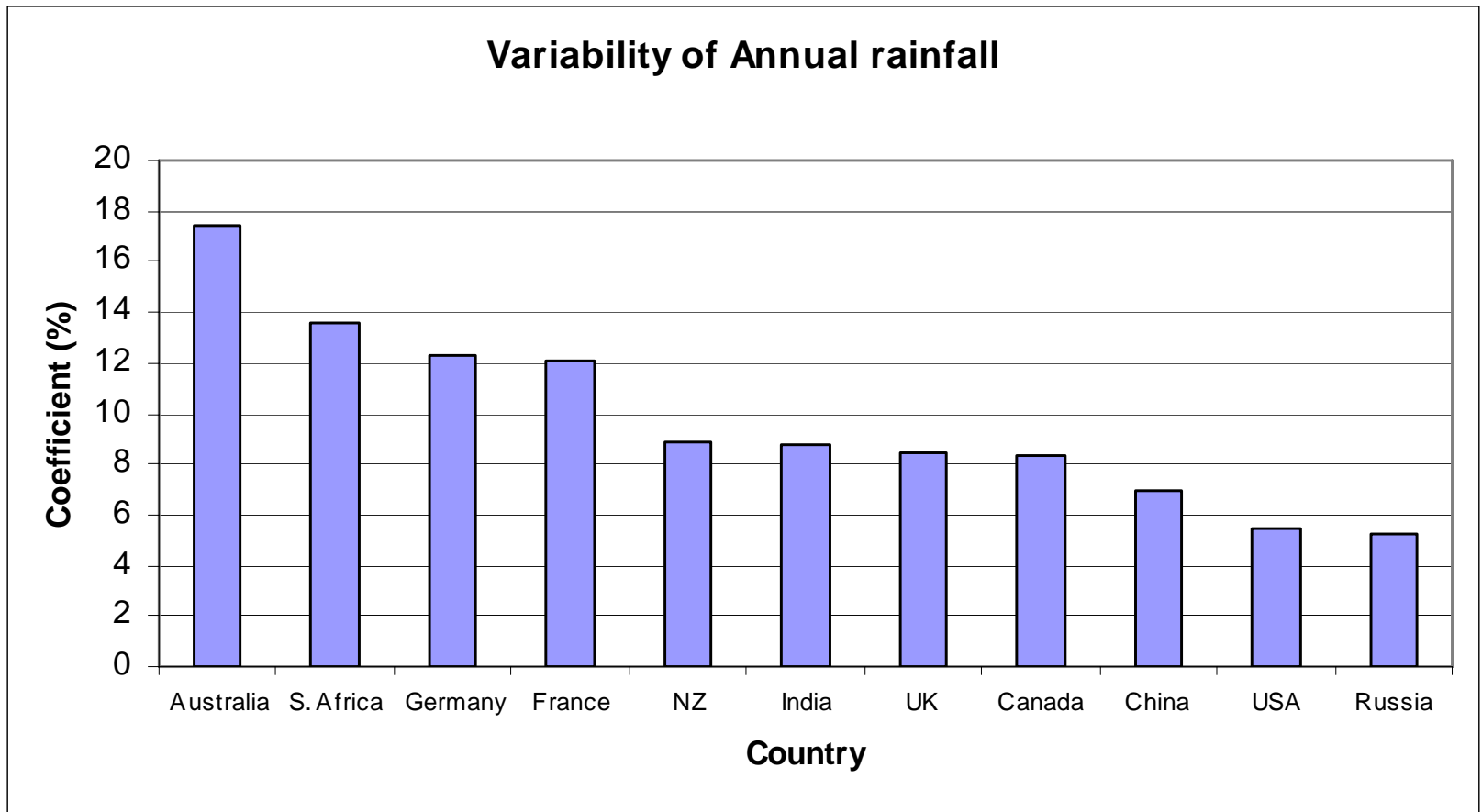


“...of droughts and flooding rains”

Driest inhabited continent



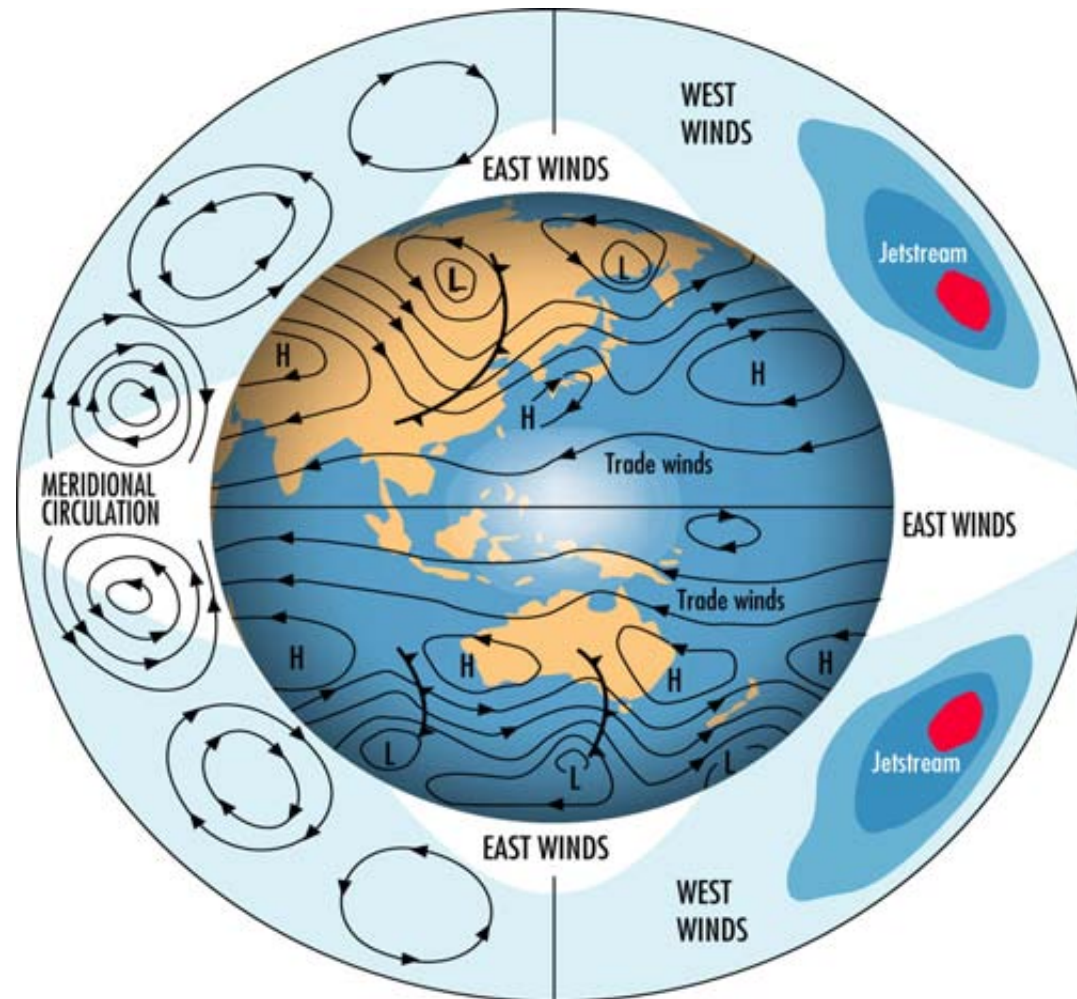
High annual rainfall variability



Seasonal rainfall zones



Global atmospheric circulation



Source: The Greenhouse Effect and Climate Change, Bureau of Meteorology

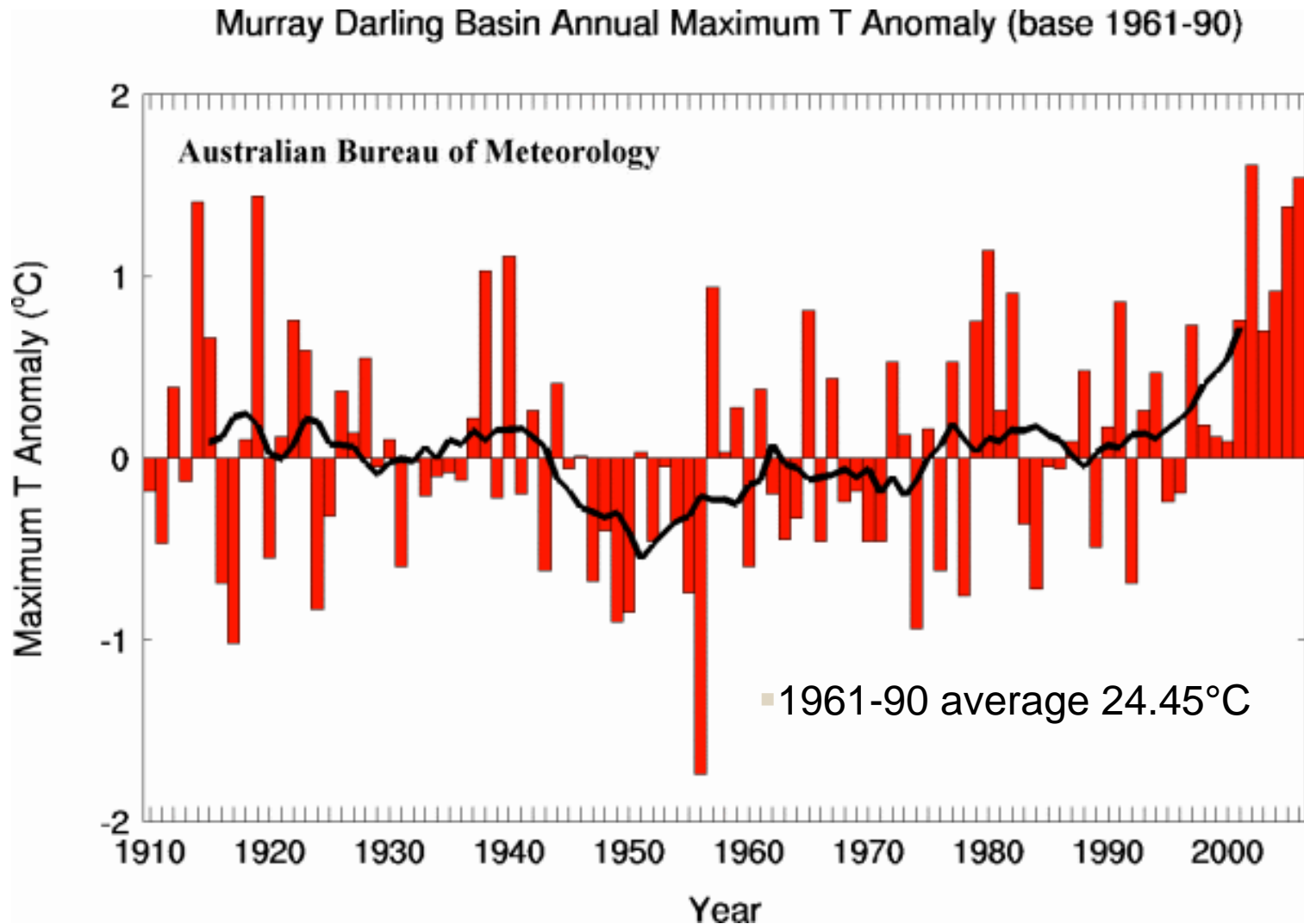
Some sources of rainfall variability

Known major causes	Approximate Time scale
Weather patterns	Day/week
Southern Annular Mode	Weeks
Madden-Julian Oscillation	Month/s
Seasonal shifts in circulations	Seasonal
El Niño (Southern Oscillation)	Inter-annual
Indian Ocean Dipole	Inter-annual
Inter-decadal Pacific Oscillation	Inter-decadal

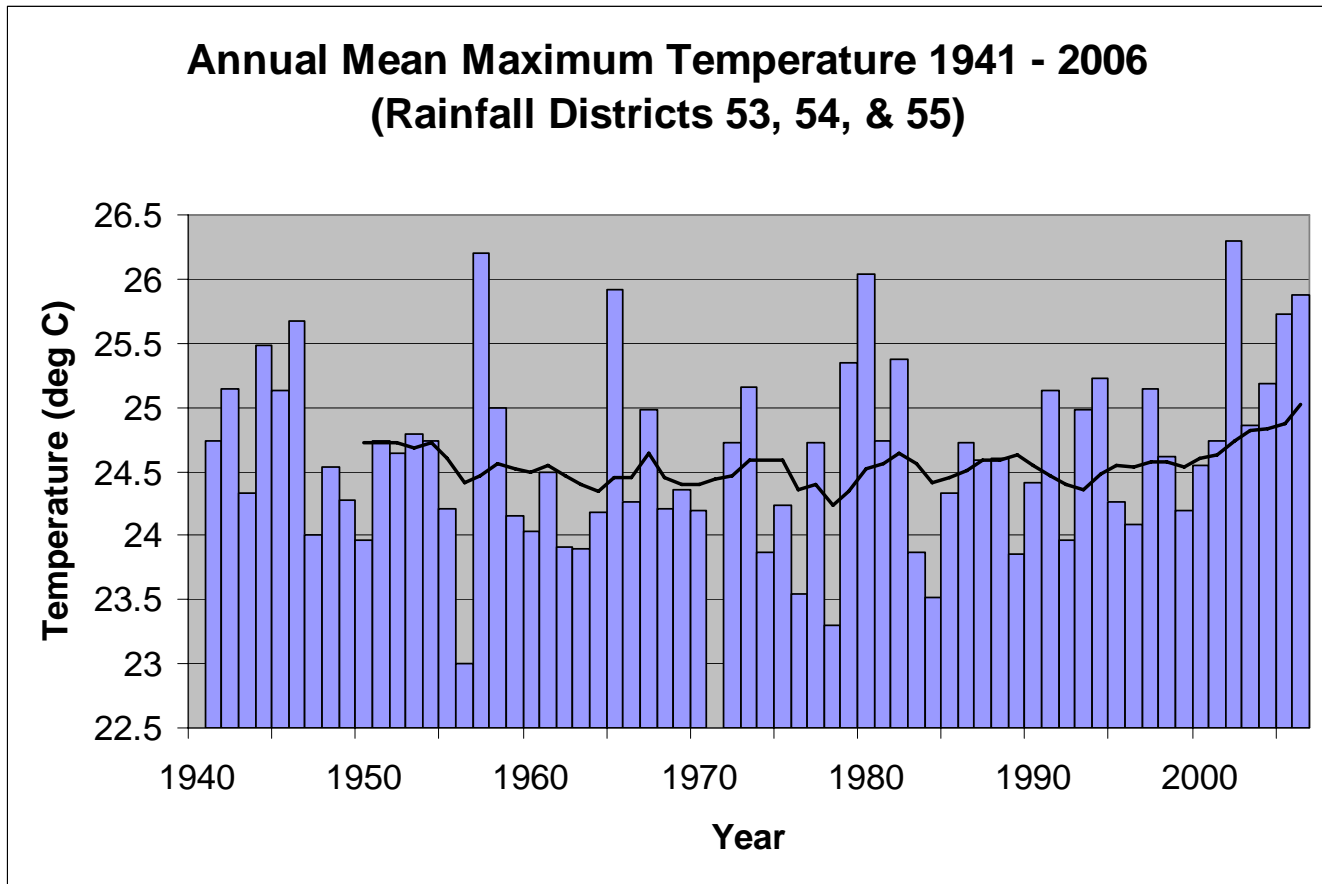


Observed Temperature Trends

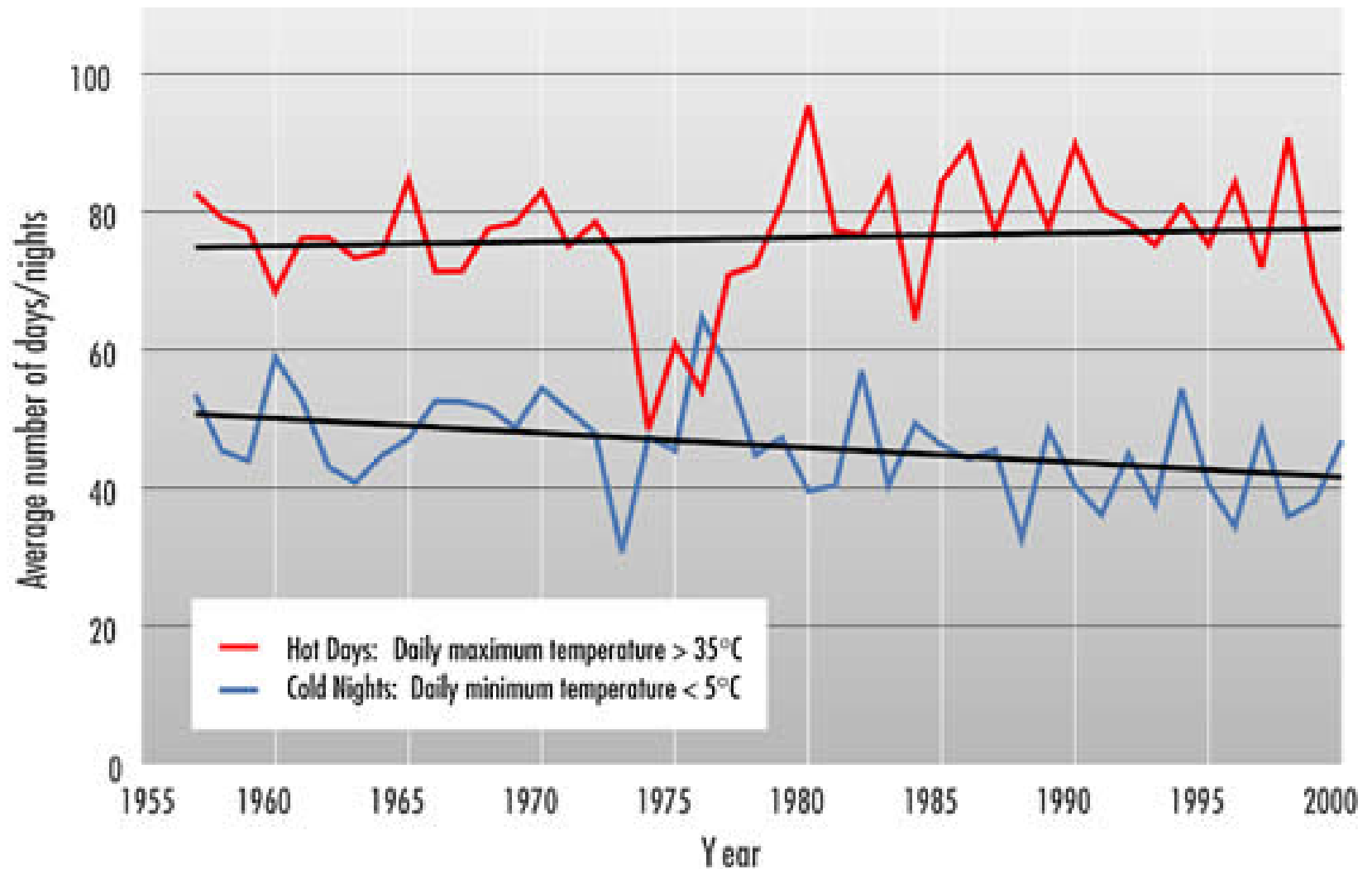
MDB Maximum Temperature Timeseries



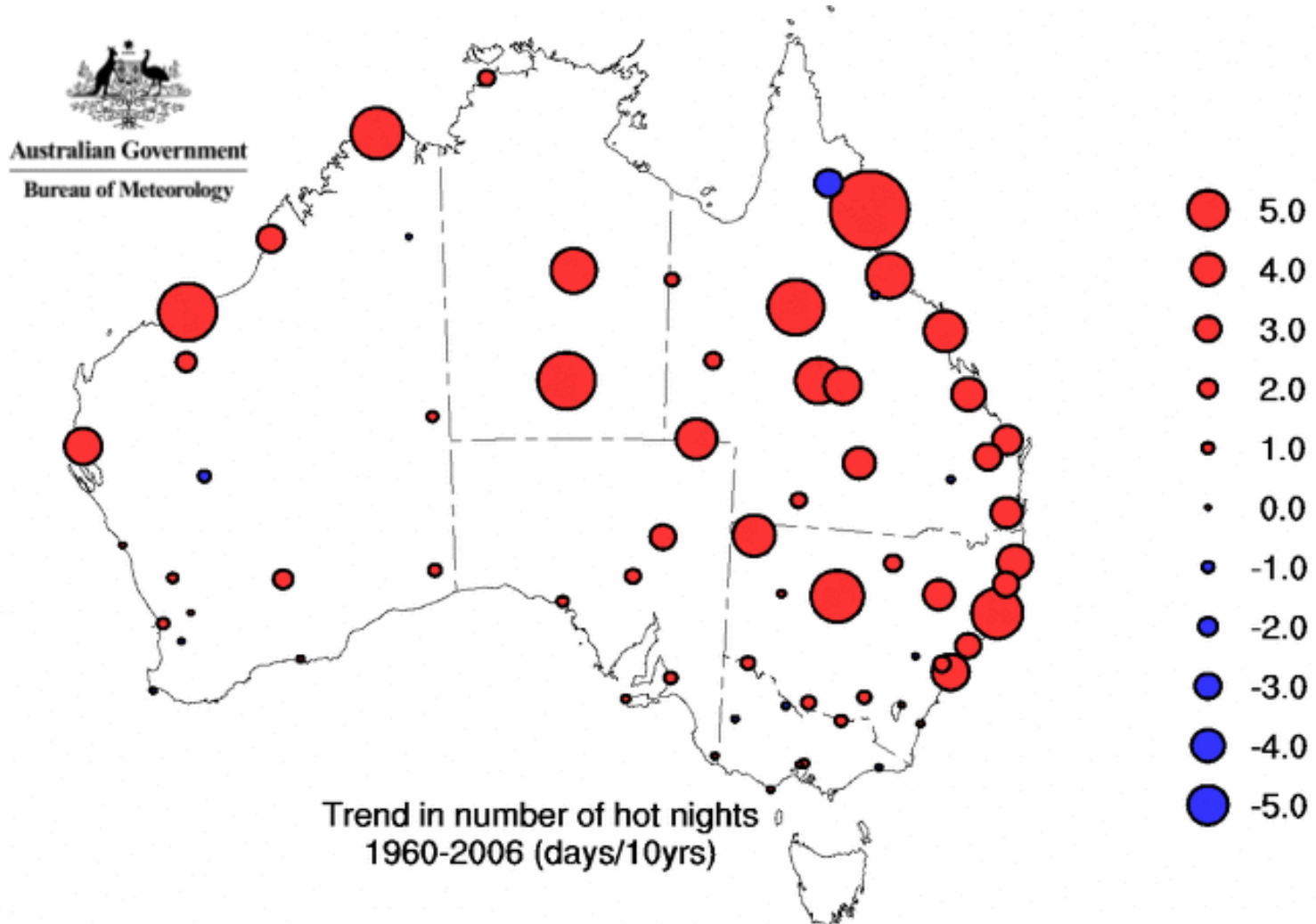
Local area maximum temperature trend



Australian Temperature Extremes



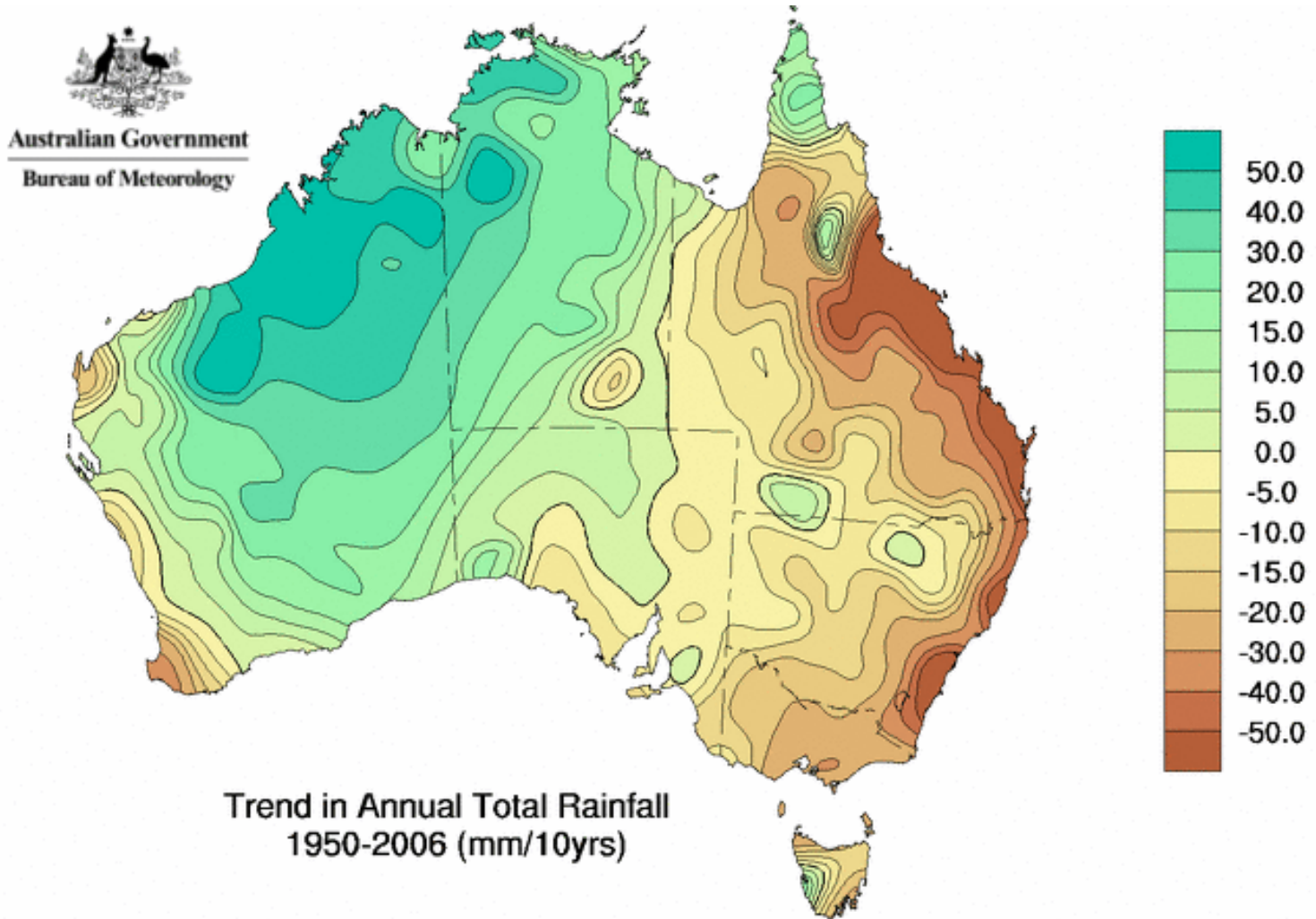
Australian Temperature Extremes





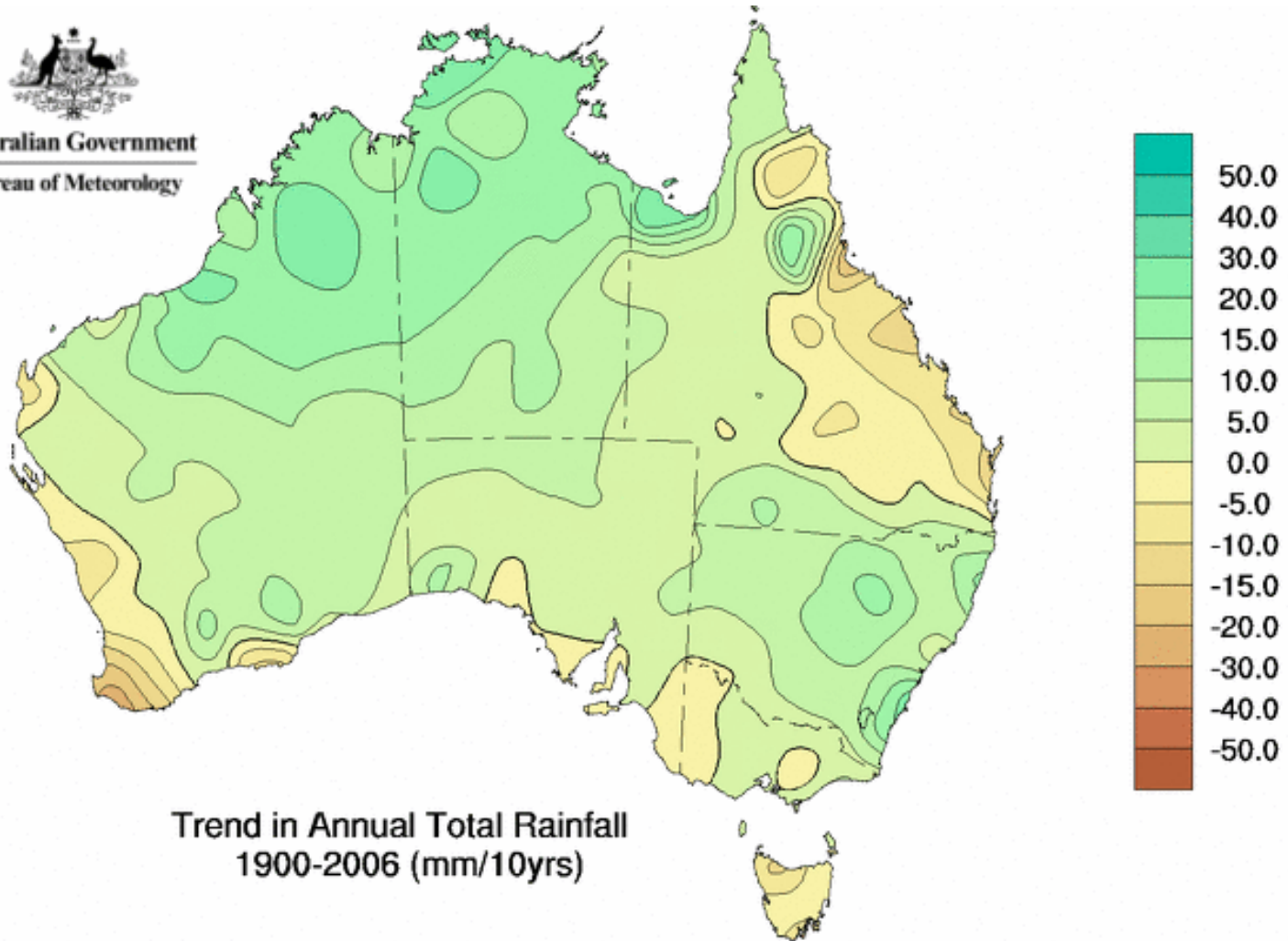
Observed Rainfall Trends

Australian rainfall trends since 1950



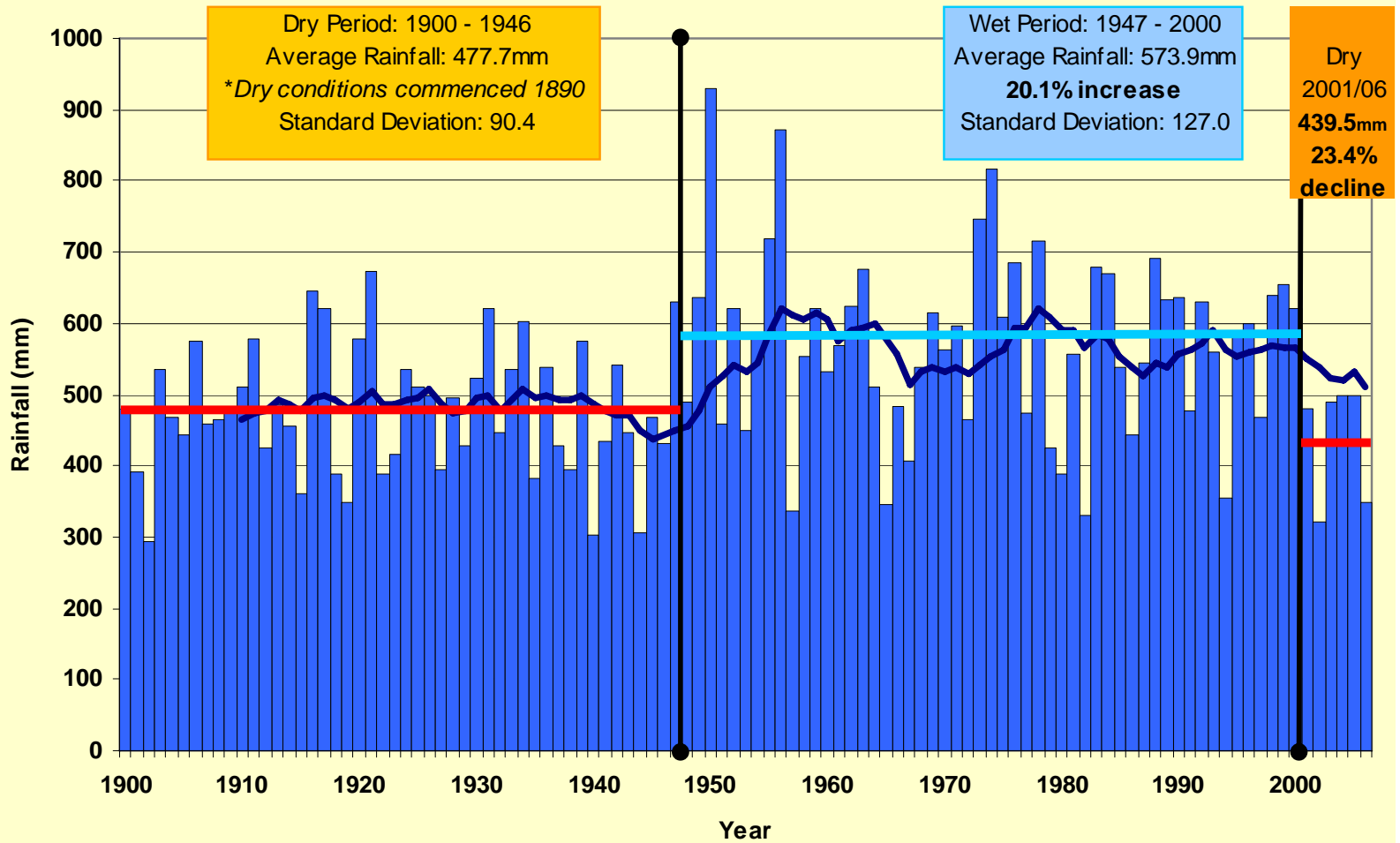
Australian rainfall trends since 1900


Australian Government
Bureau of Meteorology

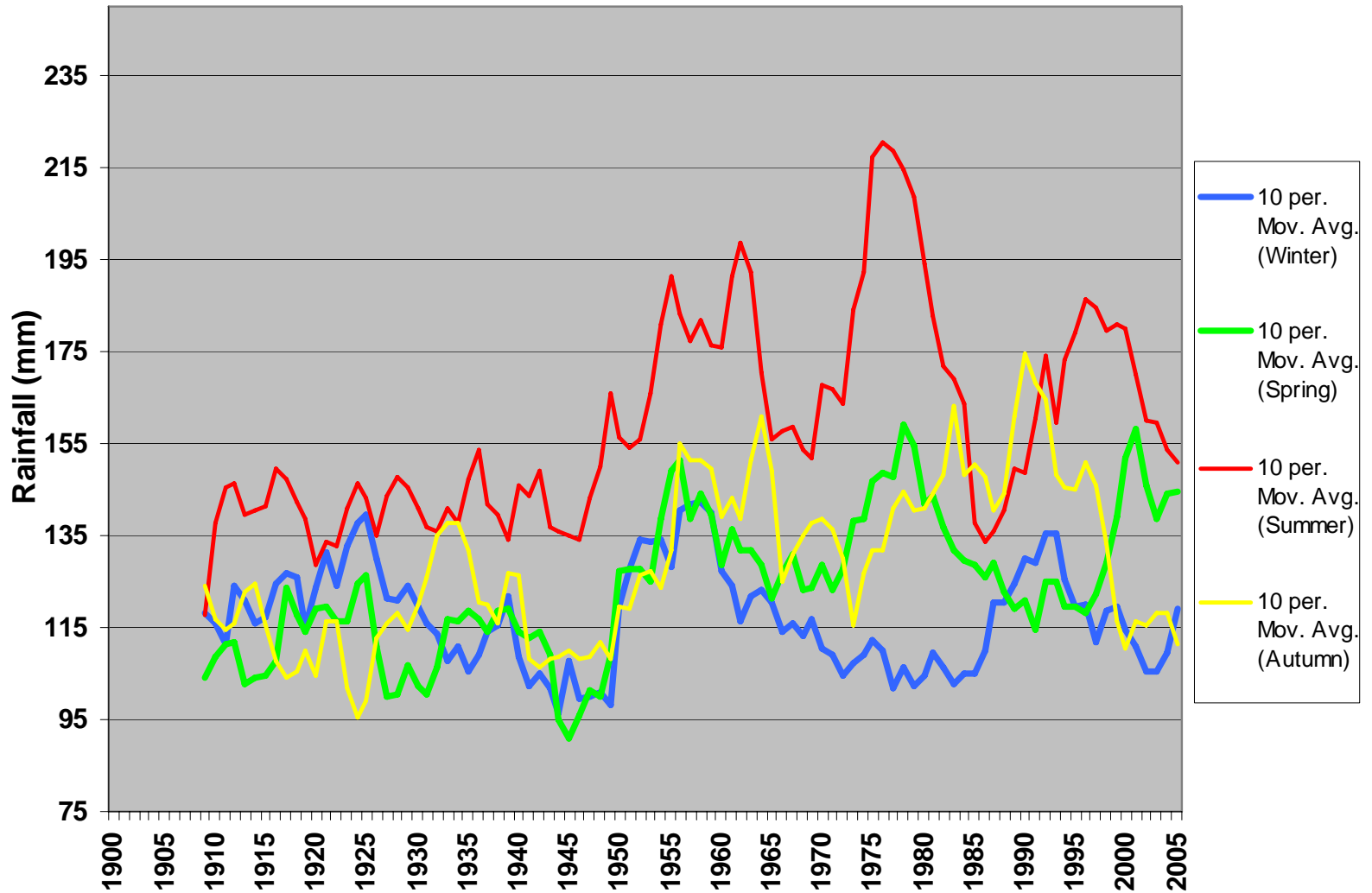


Trend in Annual Total Rainfall
1900-2006 (mm/10yrs)

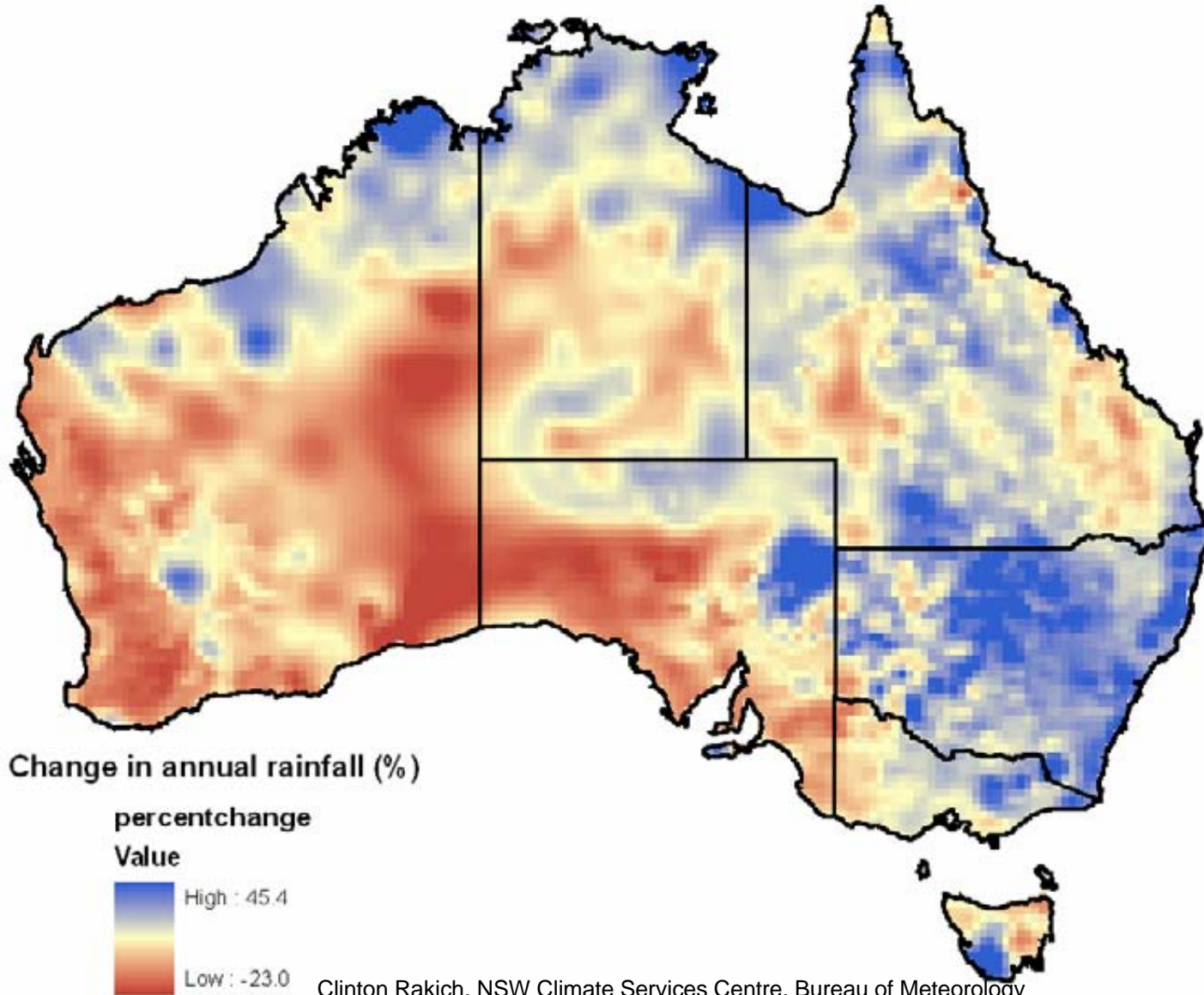
NSW annual rainfall time-series



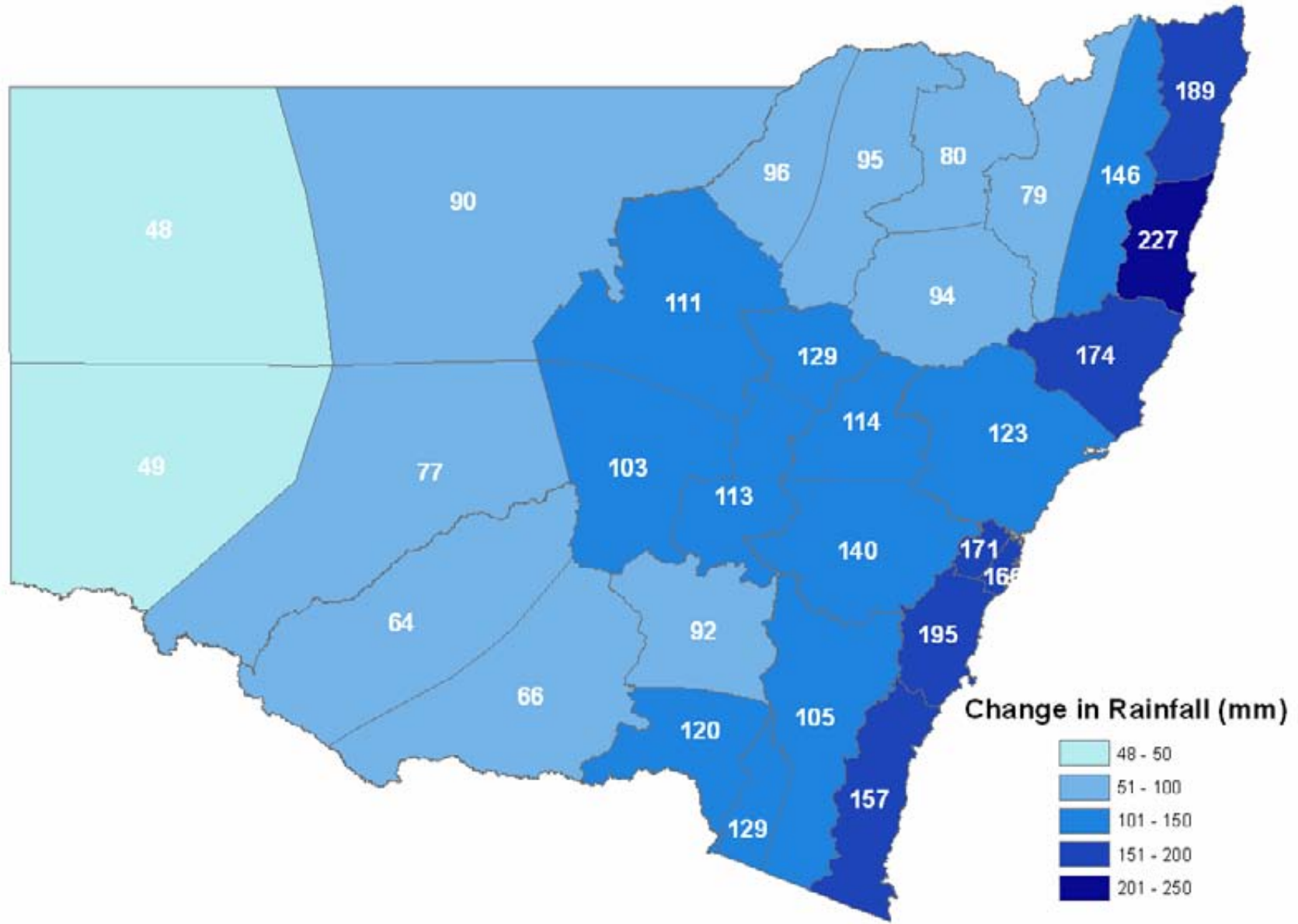
NSW seasonal rainfall trends



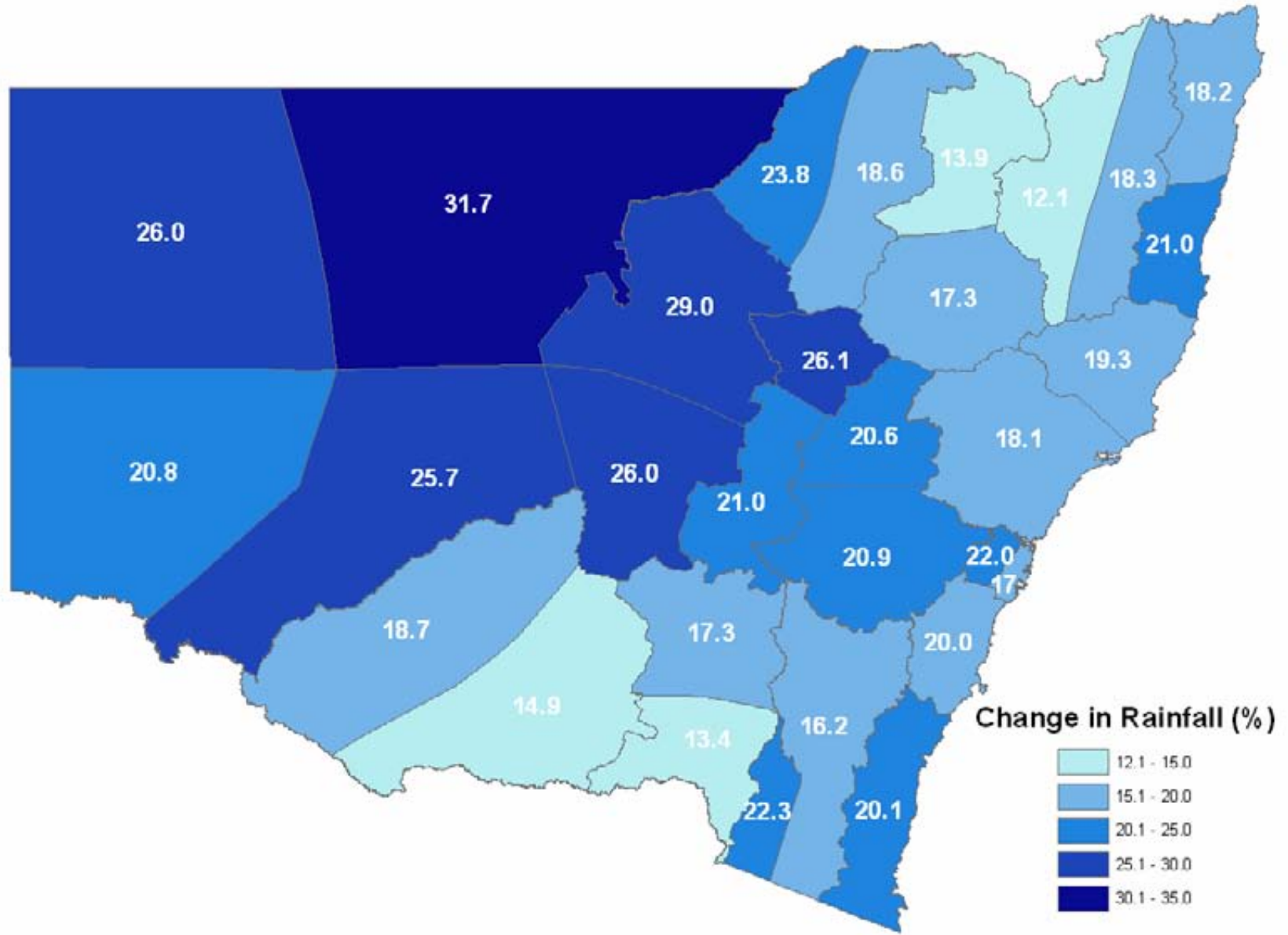
Change in annual average rainfall between the two periods 1900-1946 & 1947-2000 (%)



Change in annual average rainfall between the two periods 1900-1946 and 1947-2000

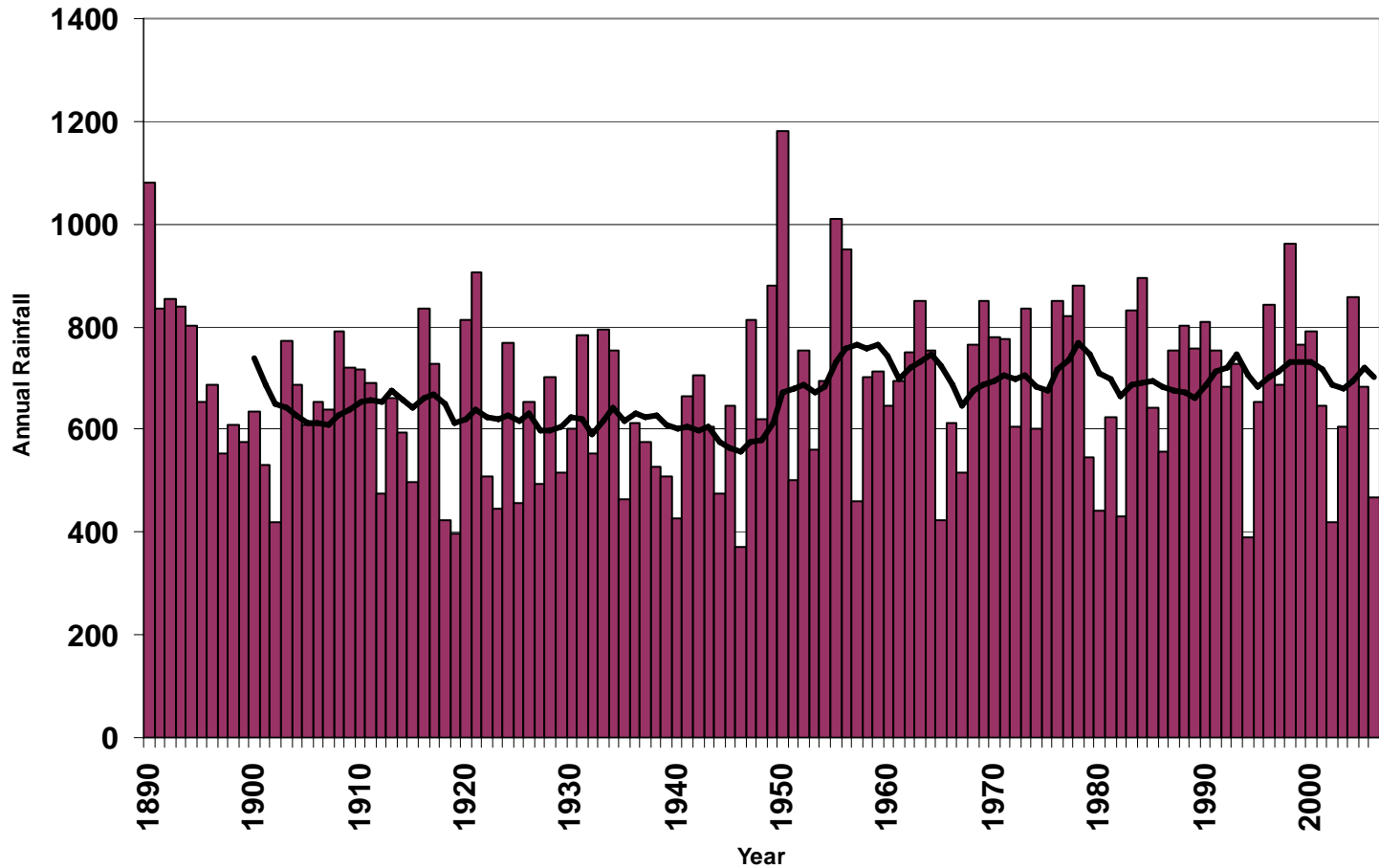


Change in annual average rainfall between the two periods 1900-1946 and 1947-2000



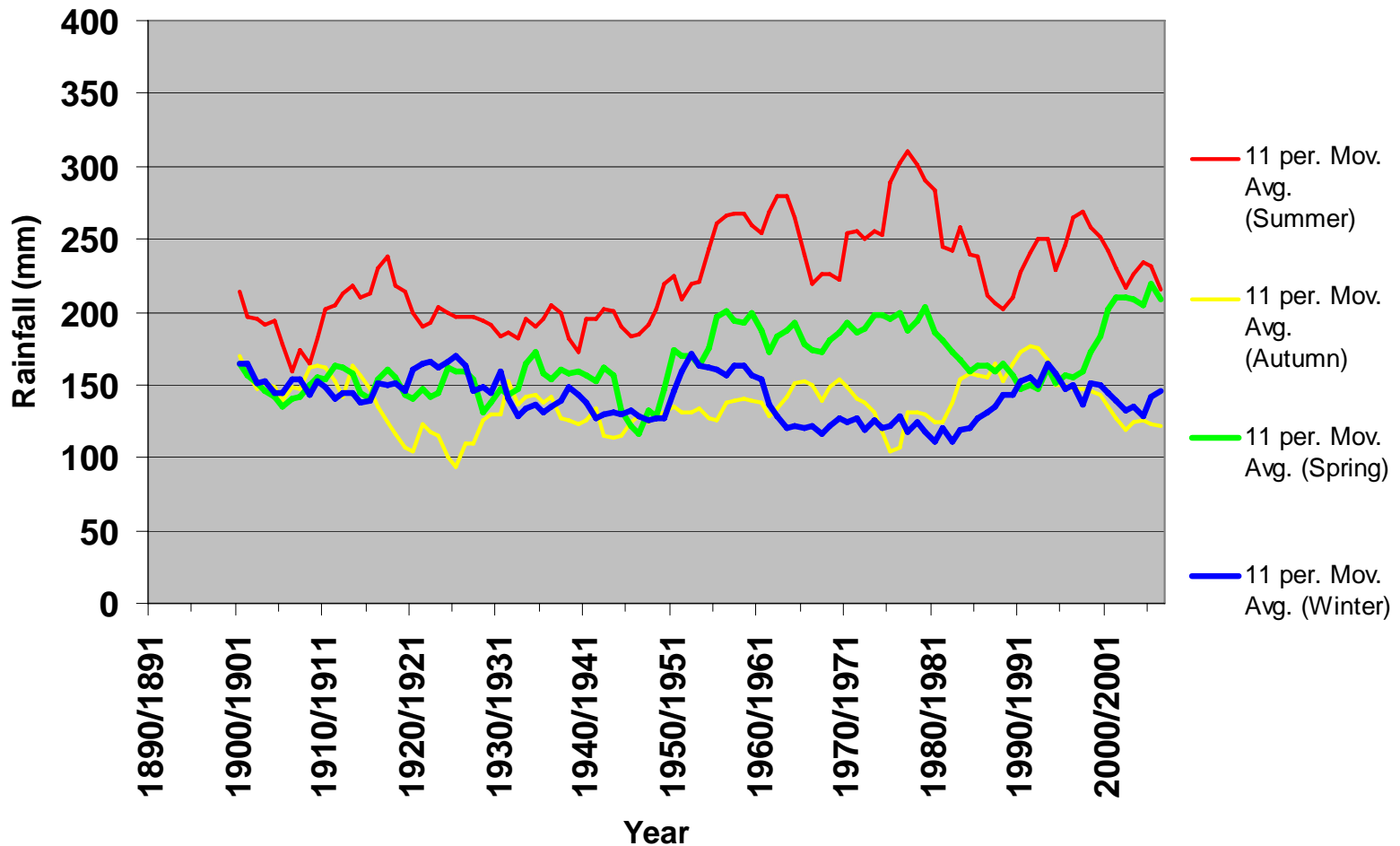
Local Rainfall Trends

Annual Rainfall Timeseries for District 55

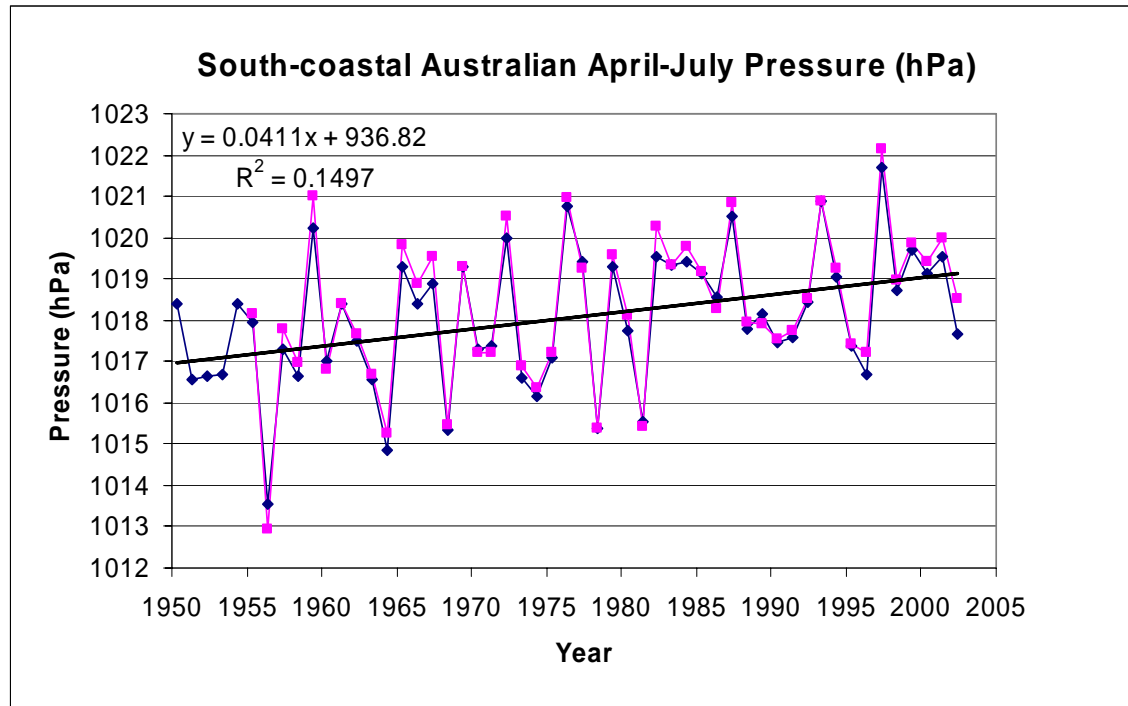


Local Area Seasonal Rainfall Trends

Seasonal Rainfall Timeseries for District 55

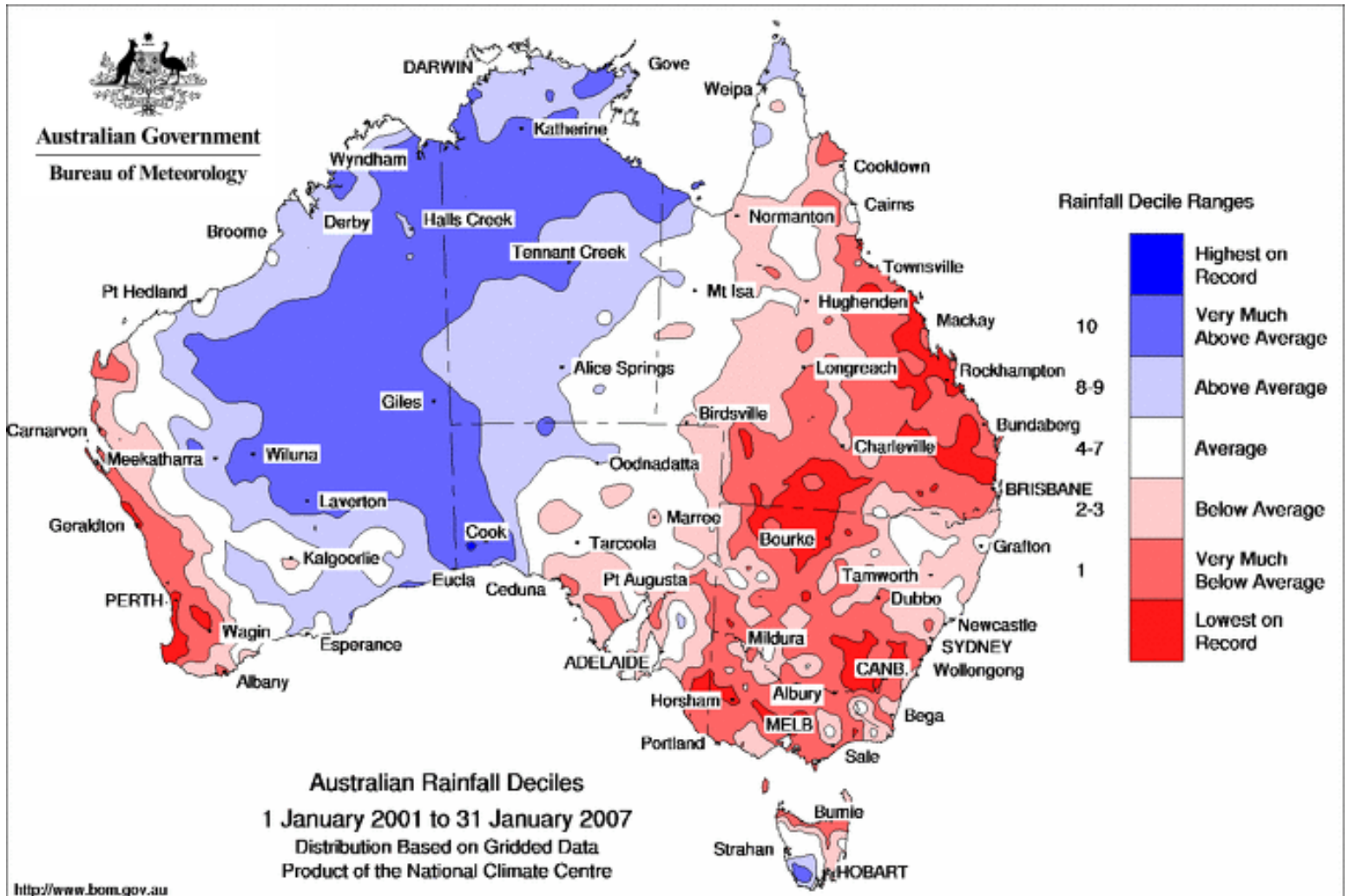


Observed changes in pressure/weather systems

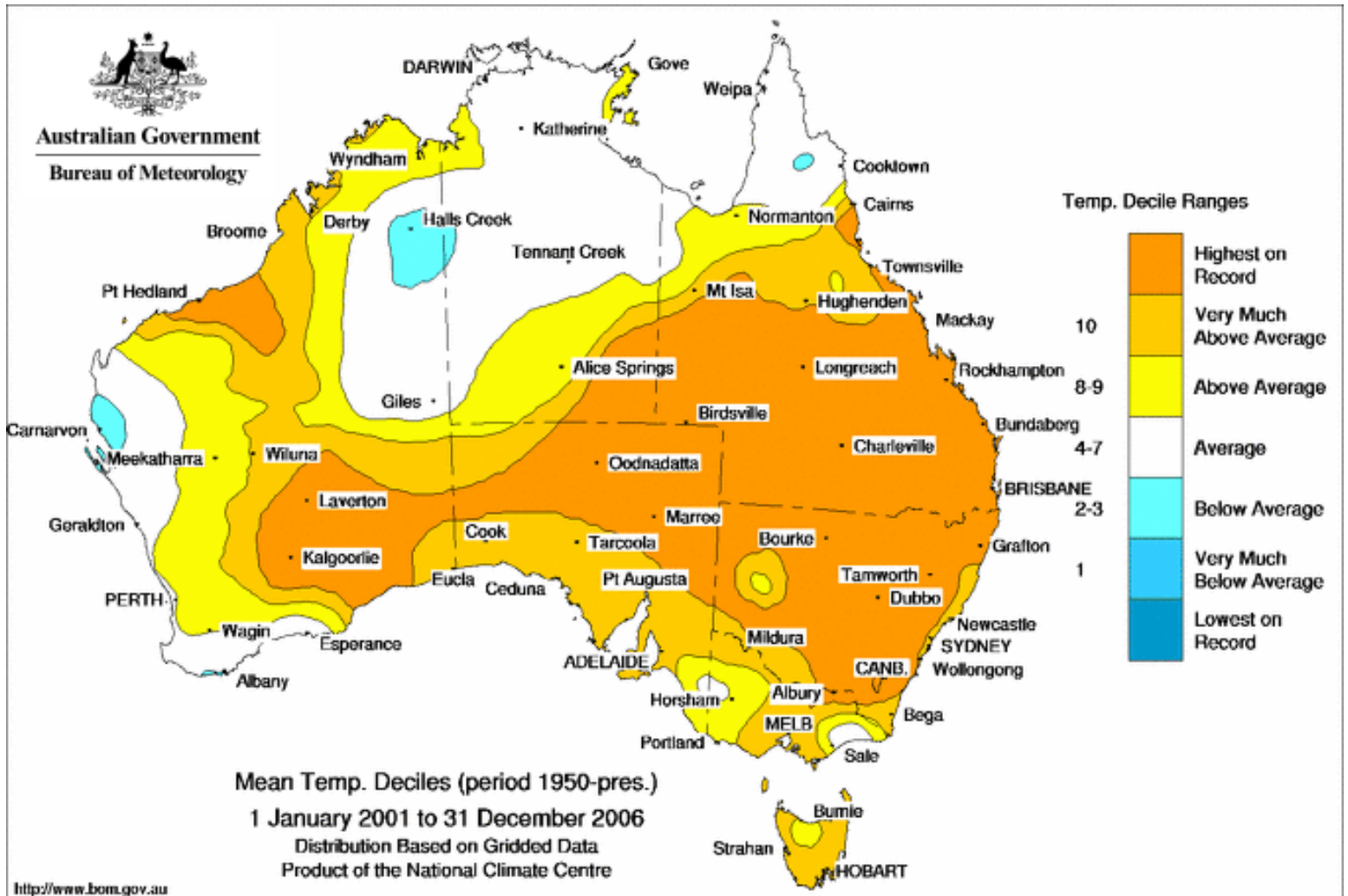


- Southern Australia has been experiencing increasing summer/autumn pressures since 1950, delaying the winter rainfall season.

The recent dry period : 2001-2006



The recent dry period : 2001-2006



Thank you!





Recipe for rain

- Moisture source
- Moisture transport
- Lifting mechanism
 - e.g. fronts, troughs, surface lows, convection, mountains
- Atmospheric instability
 - e.g. mid level troughs, cut off lows, cold pools
- Condensation nuclei

Rain is a complex phenomenon requiring several “ingredients” (most of which are interrelated) and each of which could, in principle, be impacted by global warming

Some sources of rainfall variability

Known major causes	Approximate Time scale
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Each of these sources of variability may also be impacted by global warming



Rainfall projections under climate change

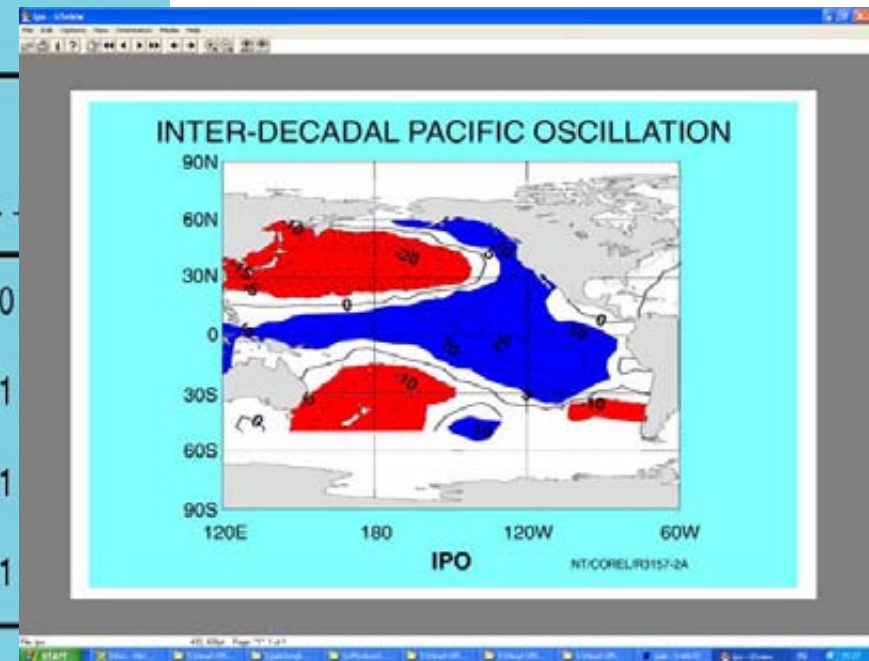
- Why rain is difficult
- Latest IPCC 4AR projections
- Plans for new Australian regional projections

Inter-decadal Pacific Oscillation

IPOI=INTER-DECADAL PACIFIC OSCILLATION INDEX
(t-series of UKMO SST EOF)

Correlation Coefficient

between the SOI &	IPOI < -0.5	IPOI >
Rainfall	0.7	0.0
Murray River flow	0.4	0.1
Temperature	-0.8	0.1
Crop yield	0.7	0.1



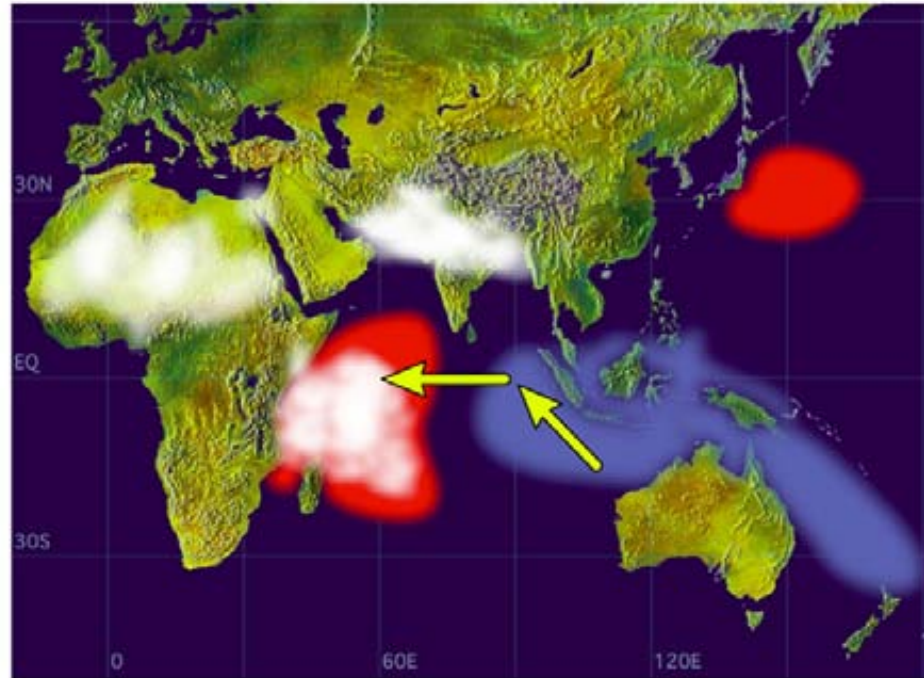
Power, Casey, Colman, Folland & Mehta, 1999
Climate Dynamics

NTCORELR0157-4

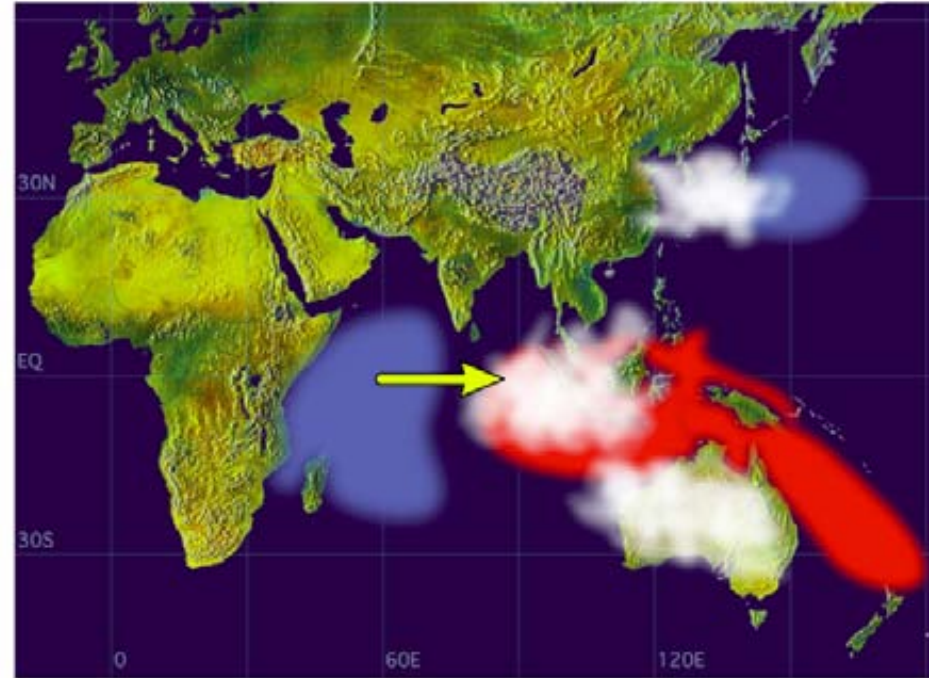
See recent BMRC Research Report: Power et al. (2005)

Indian Ocean Dipole

Positive Dipole Mode



Negative Dipole Mode

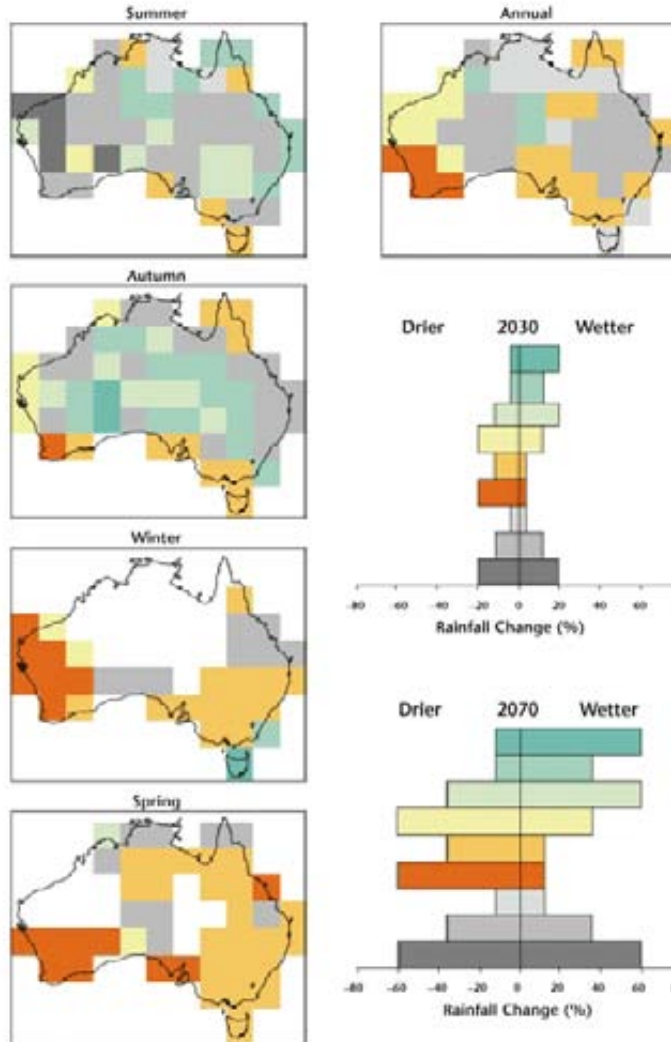


Images courtesy of A.Suryachandra Rao of the Institute for Global Change Research, Yokohama City, Japan

New Australian & Regional Projections

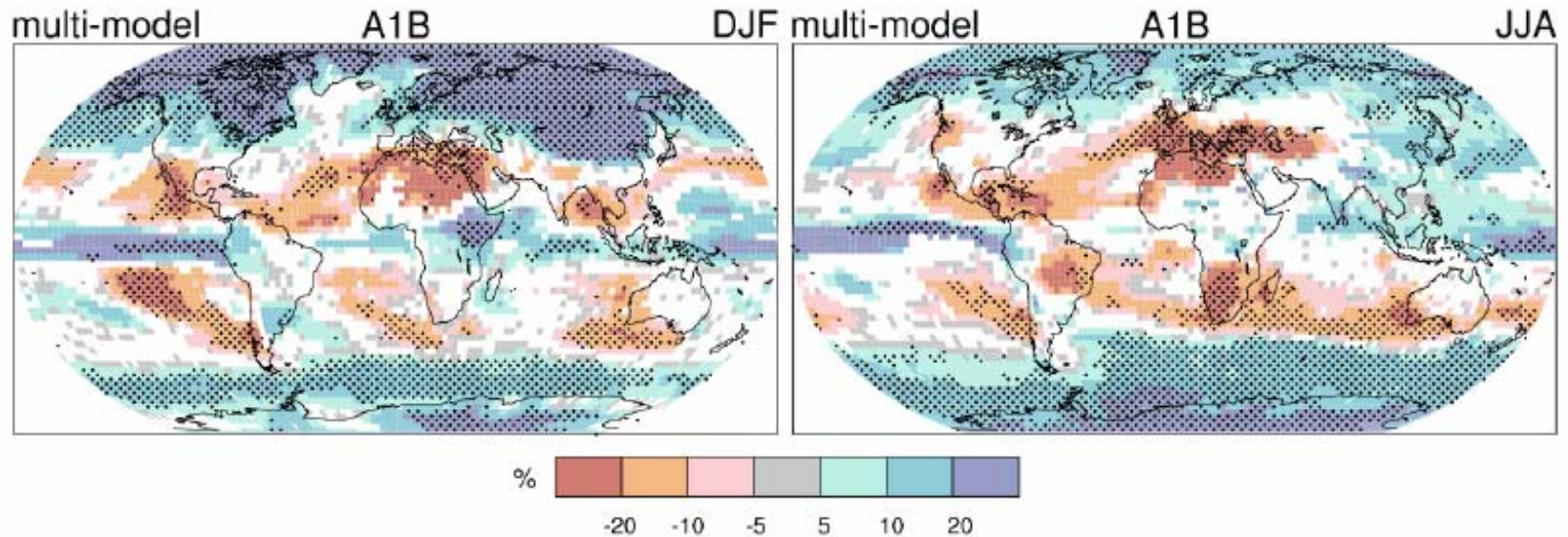
- New joint CSIRO/BoM regional projections due to be released at Greenhouse 2007, 2-5 October 2007
 - based on IPCC 4AR models and scenarios
 - will include probabilistic projections for rainfall and temperature
- Statistically downscaled localised regional projections are also being prepared by the Bureau of Meteorology Research Centre as part of the IOCI and SEACI projects (including the MDB)

Current CSIRO Australian Rainfall Projections



Emerging Consensus on Projected Global Rainfall Changes

PROJECTED PATTERNS OF PRECIPITATION CHANGES



Rainfall change for 2090-2099 relative to 1980-1999.