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Climate Change Overview

Climate Adaptation

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National Research
FLAGSHIPS



Presentation Outline

- **Background**
 - Previous IOCI findings
 - IOCI3
 - WAMSI Node 2
- **Observed climatic changes & trends**
- **Anthropogenic climate change**
 - projections
 - uncertainty 'issues'
 - GCM selection
 - scenario analysis
- **Concluding remarks**

AMOS WAMSI CSIRO Symposium March 2009

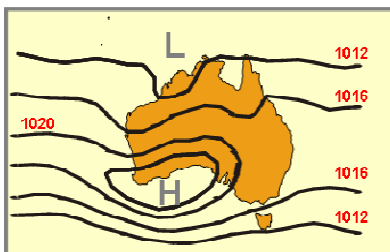
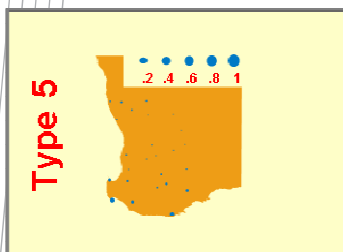
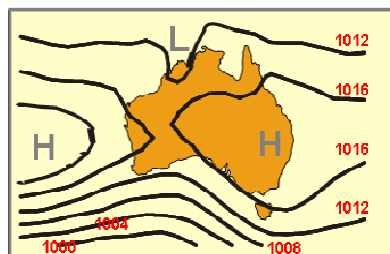
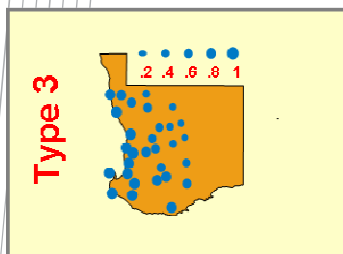


Previous IOCI Findings

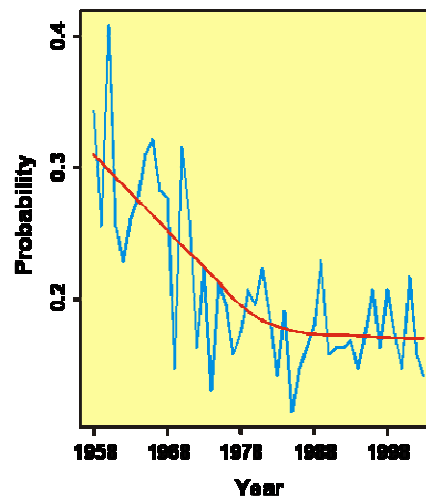


- Rainfall decline is statistically significant
- Declines in number of wet days & extreme amounts
- Most of the rainfall decline confined to MJJ
- Statistically significant inverse relationship between regional to near-global MSLP & winter rainfall
- Increase in MSLP in winter & decline in atmospheric moisture in winter & spring important in explaining rainfall decline
- Decline in intensity & number of troughs associated with regionally wet conditions since mid 1970s
- Reduction in intensity of cyclogenesis across southern Australia (SWA in particular)
- Precise attribution of rainfall decline remains elusive (natural versus several anthropogenic forcings)

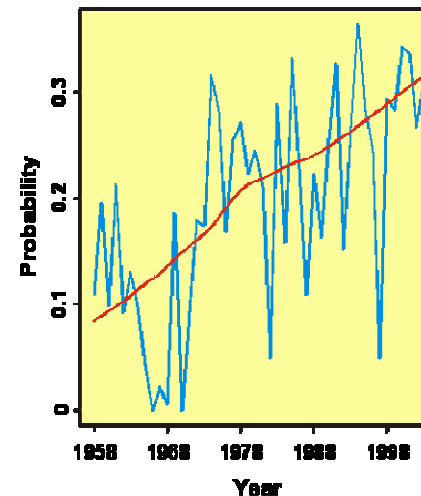
Changes in Synoptic Patterns



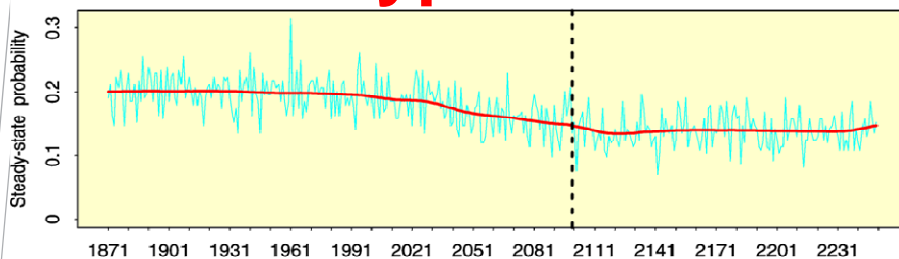
Type 3: Wet West & Central



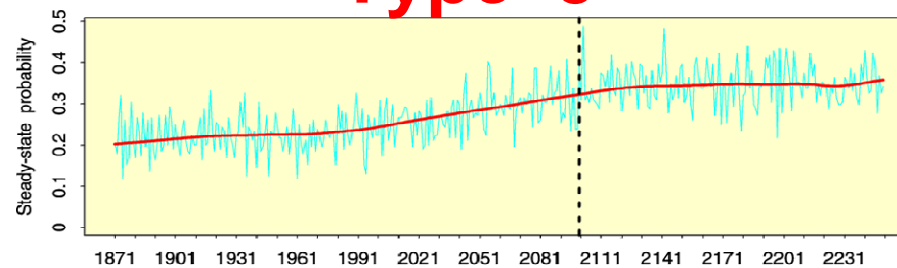
Type 5: Dry Everywhere



Type 3



Type 5



IOCI Stage 3



- **\$8M core climate science program over 4 years**
- **50:50 co-investment from State & CSIRO+BoM**
- **Three core-research themes:**
 - **Baselines, predictability of WA climate & attribution of climate change**
 - **Current & future climate of North-West including extreme events**
 - **Scenarios of climate change for sector impact & vulnerability studies**
- **\$4.65M "adaptation package"**

Study Areas for IOCI 3



Three Nested Projects

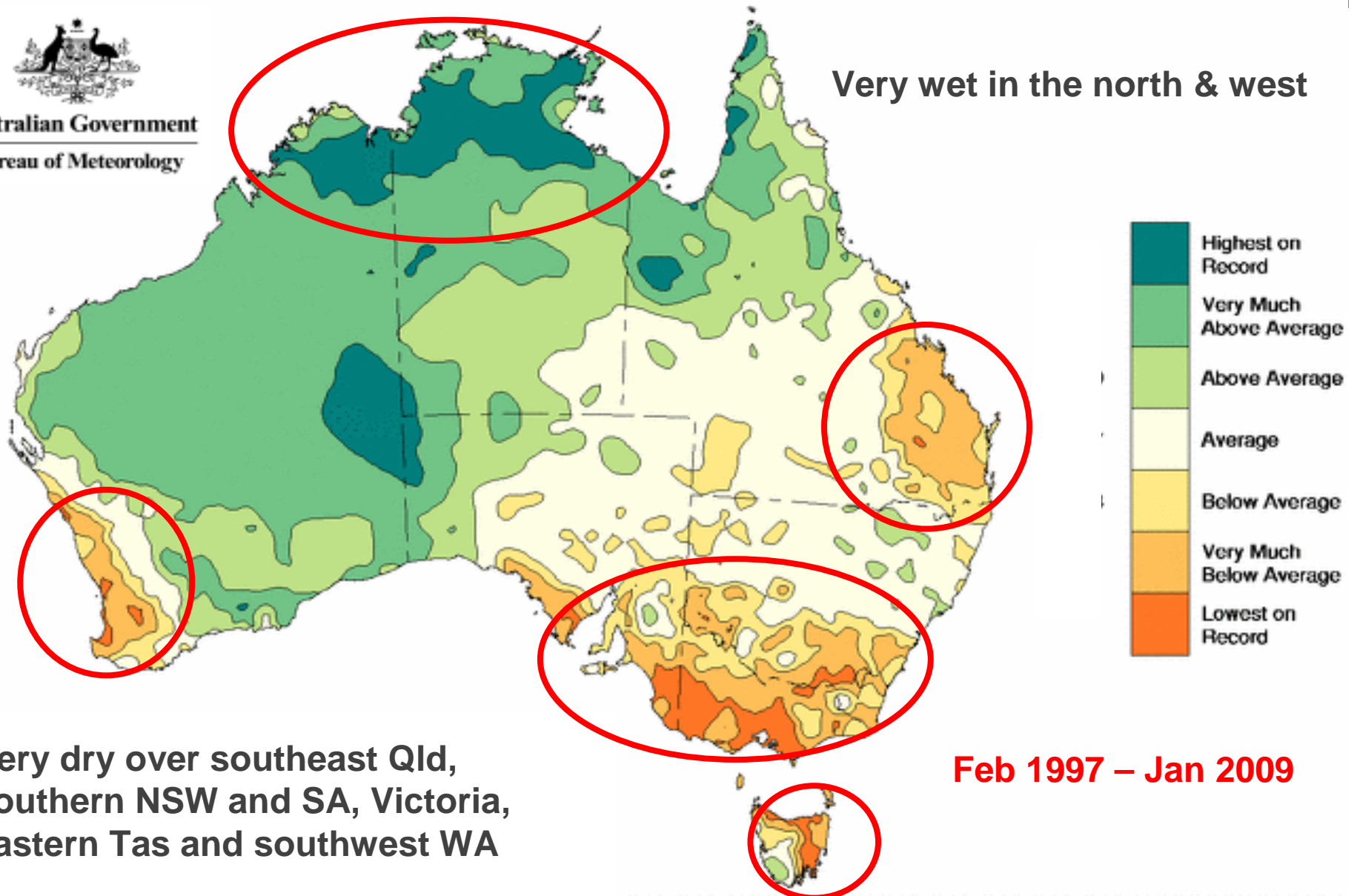


- **2.1** *Predictability of Indo-Pacific Ocean as a global condition on marine & terrestrial climate impacts in WA (BoM)*
- **2.2** *Dynamics & impact of Leeuwin Current on marine environment off WA (CSIRO)*
- **2.3** *Oceanic conditions at Ningaloo Reef – analysis of downscaling ocean climate into the Ningaloo Reef Tract (AIMS)*

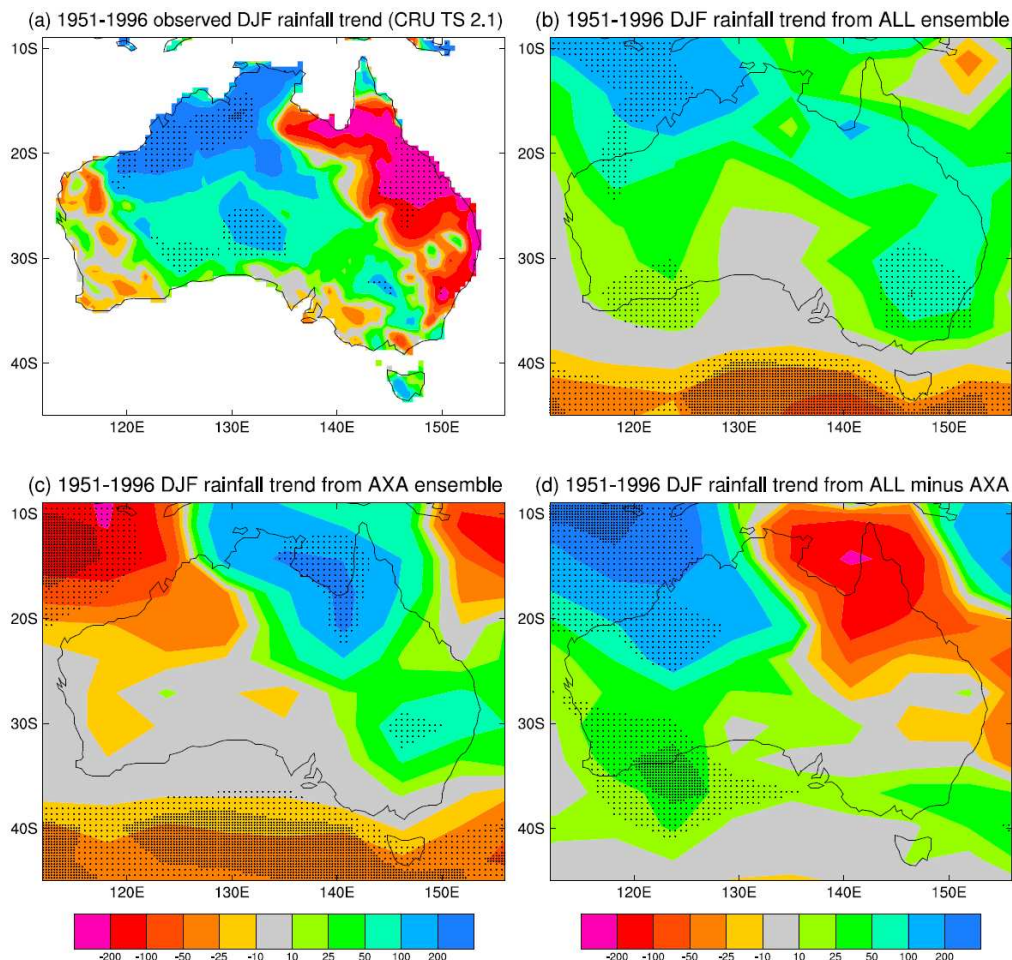
Past 12 Years Have Been Unusual



Australian Government
Bureau of Meteorology

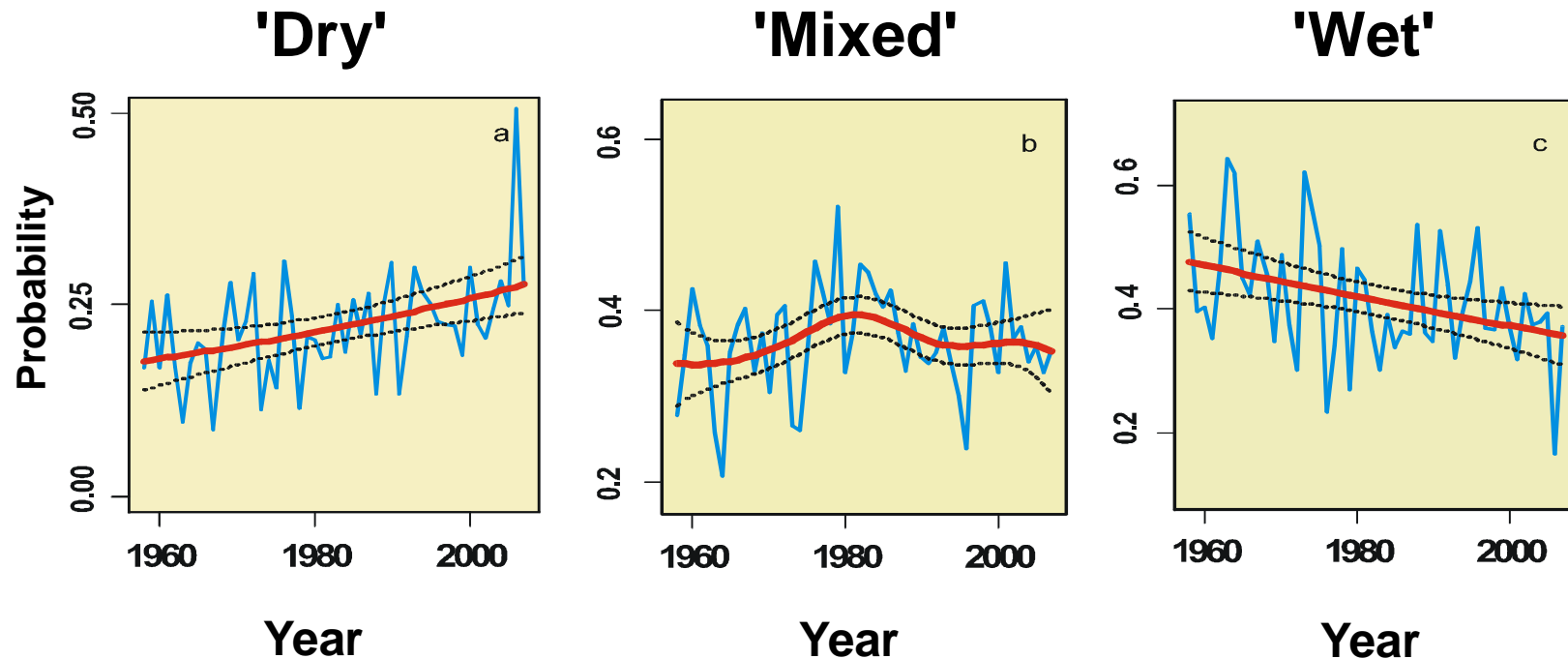


DJF Rainfall Trends



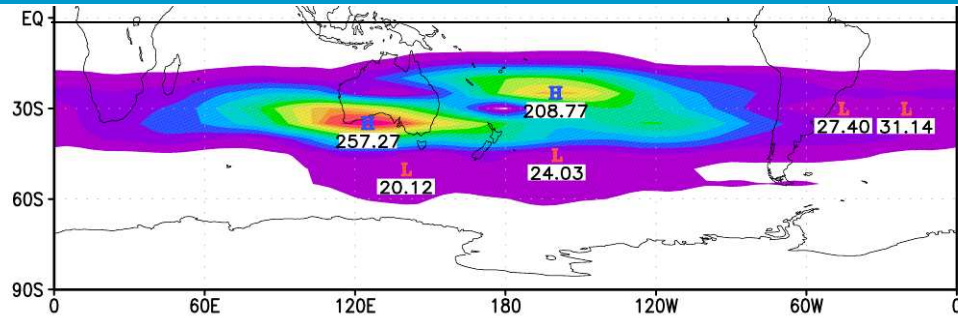
- **Most GHG-forced transient GCM runs**
 - do *not* capture increasing rainfall over NW Australia
 - indicate southward shift in tropical rainfall
- **Trend reversal possible if Asian aerosols reduced!**

Weather Type Probability Series (MJJ)

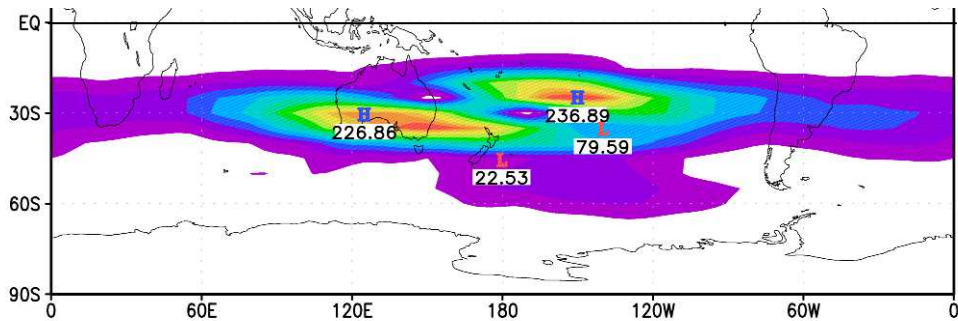


Little evidence of changes in persistence

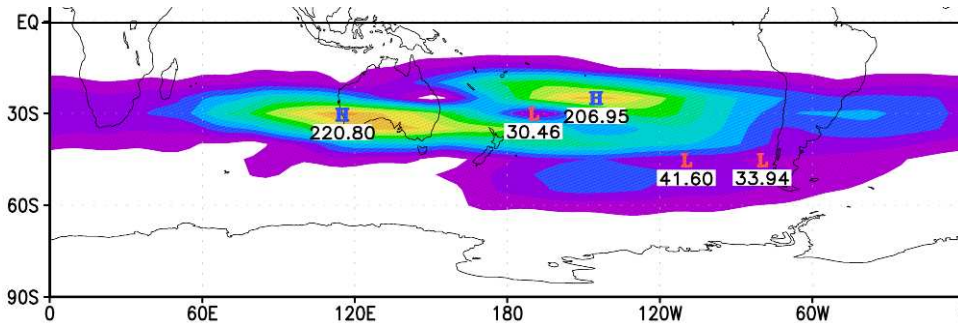
Leading SH Storm Track Modes Crossing Australia (July)



1949-68 NCEP



1975-94 NCEP

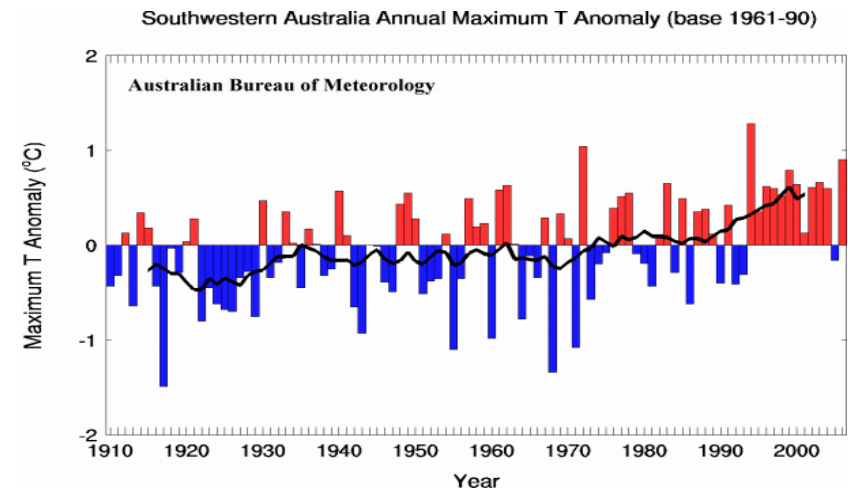
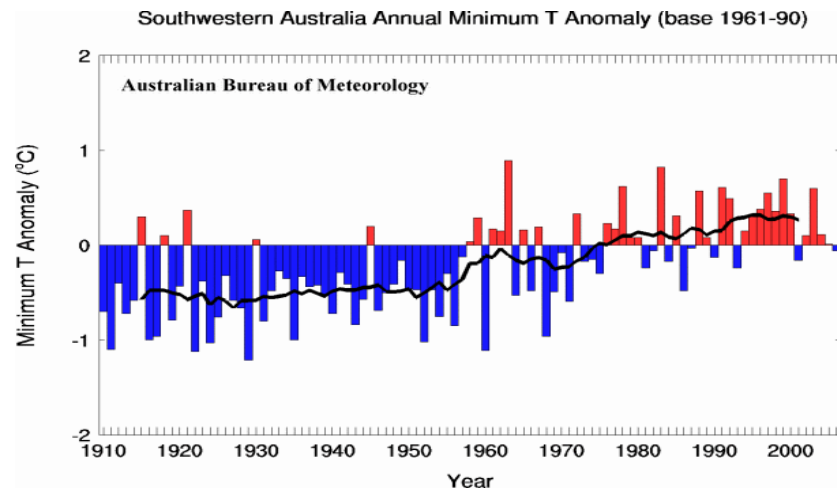
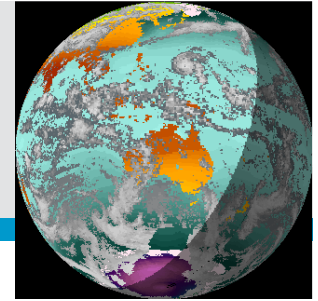


1997-2006 NCEP

300hPa Streamfunction Amplitude

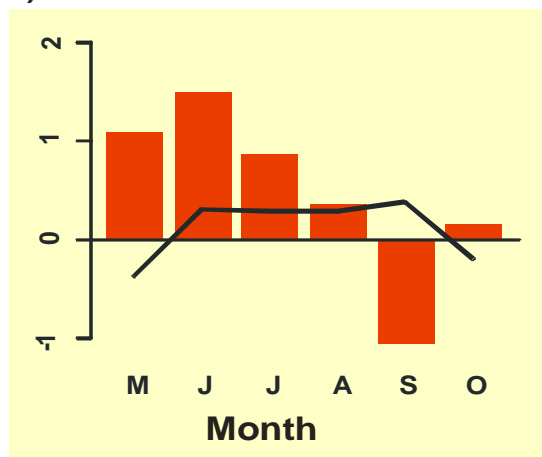
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Min & Max Temperatures

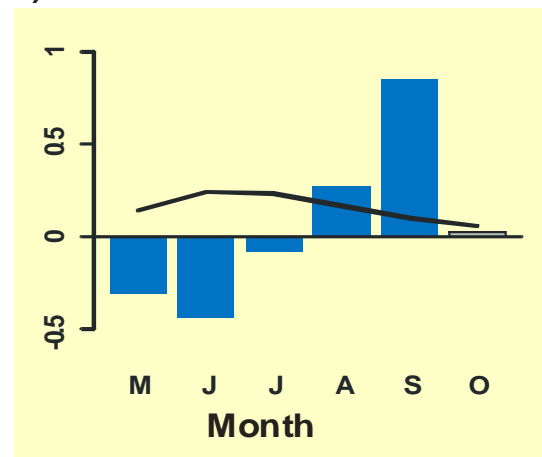


Changes in Atmos. Circulation

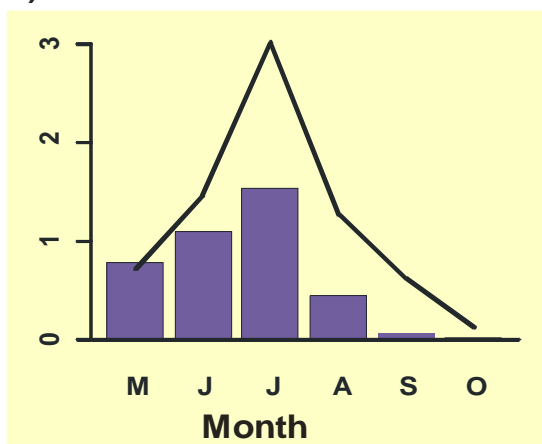
a) MSLP



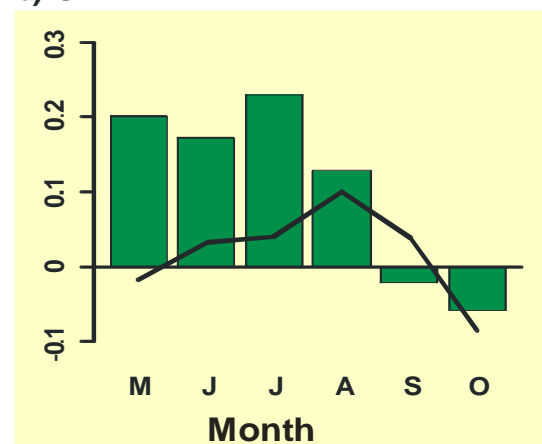
b) PG



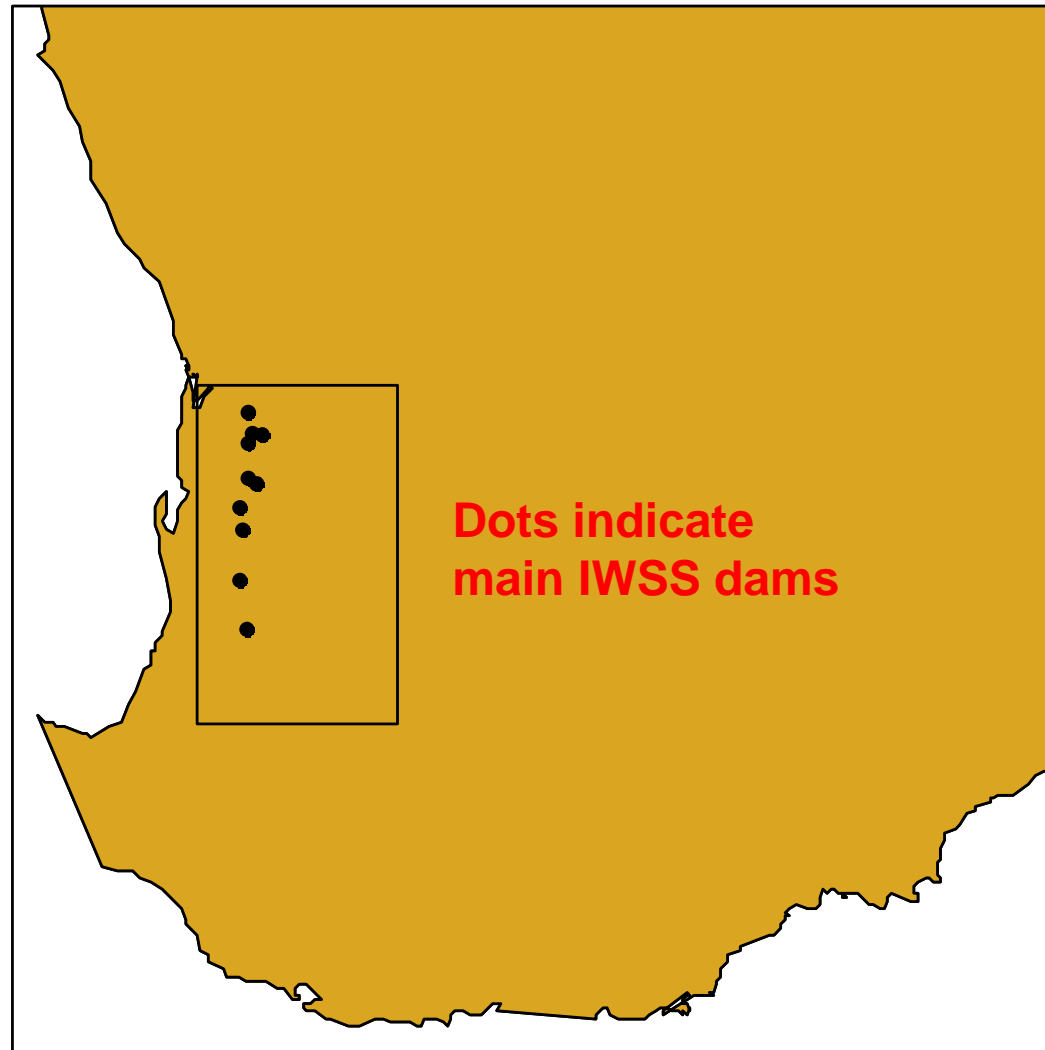
c) DTD



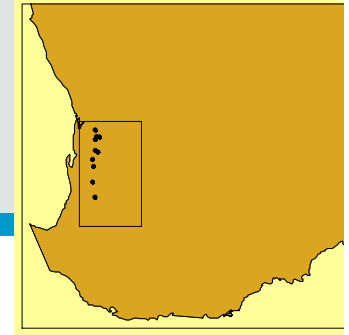
d) CV1



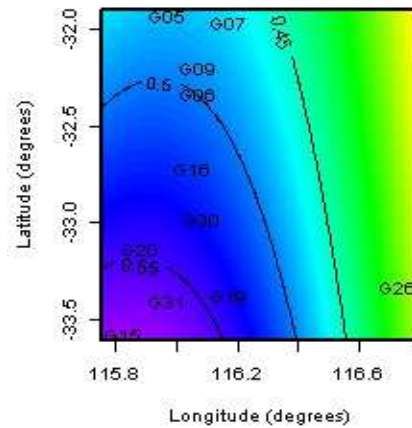
Sub-Region for At-Site Analysis



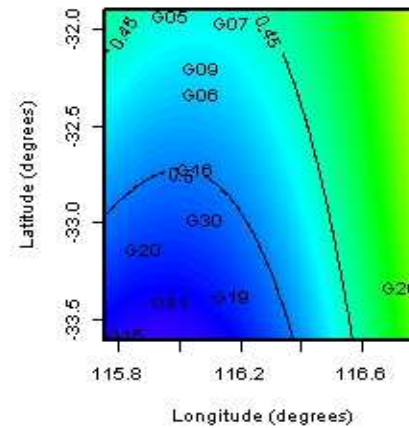
Rainfall Changes



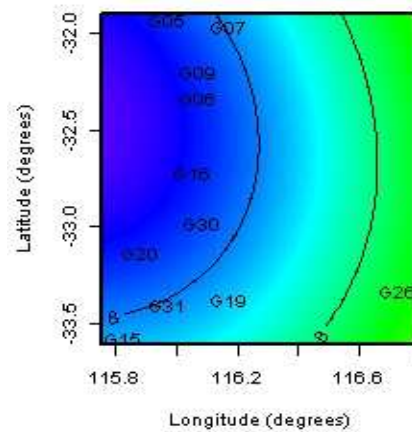
Occurrence: 1970



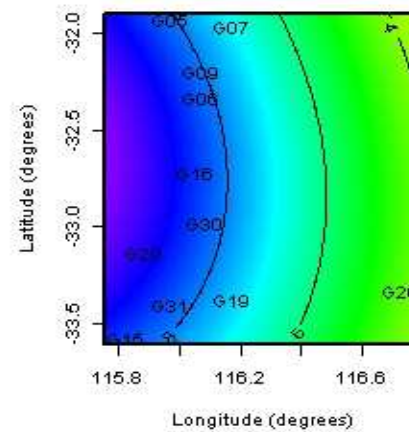
Occurrence: 2000



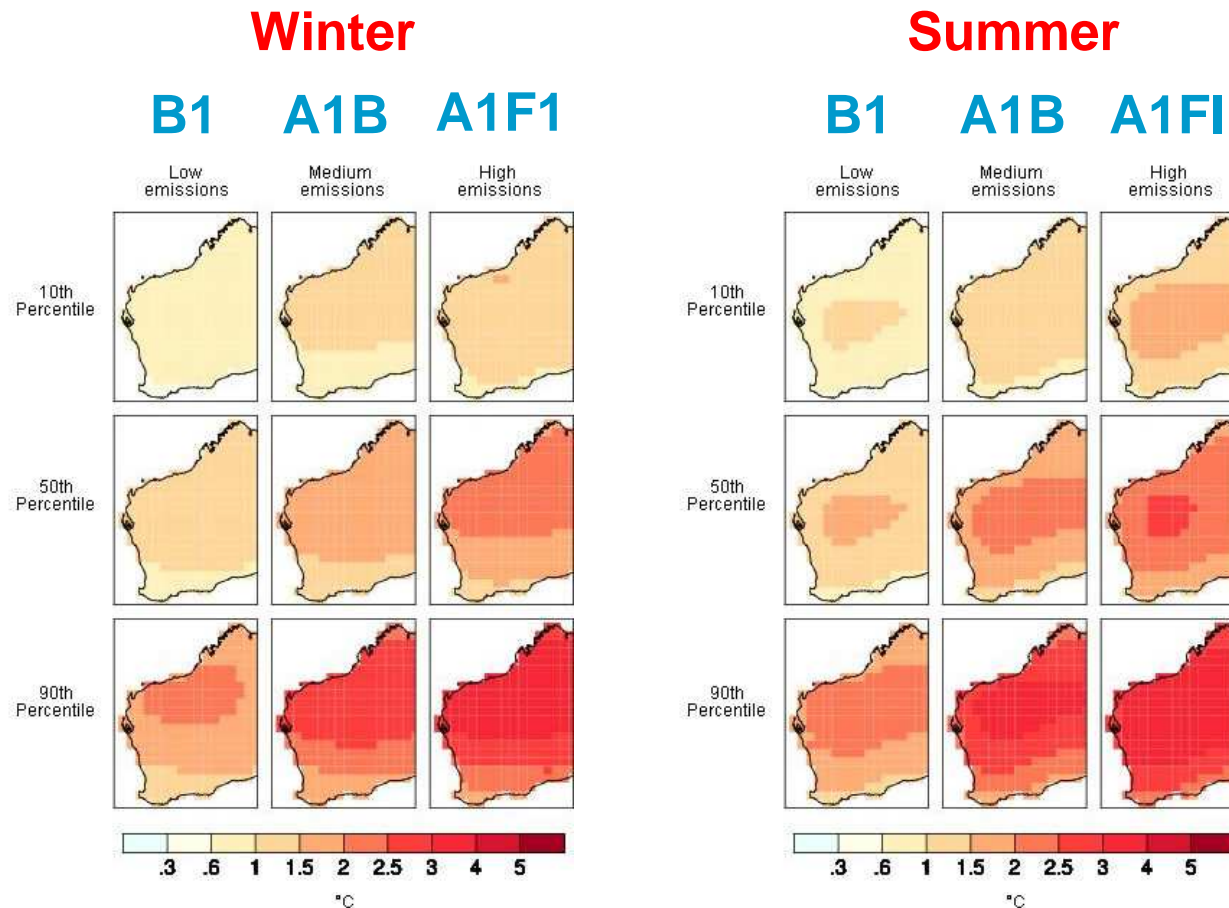
Amounts: 1970



Amounts: 2000



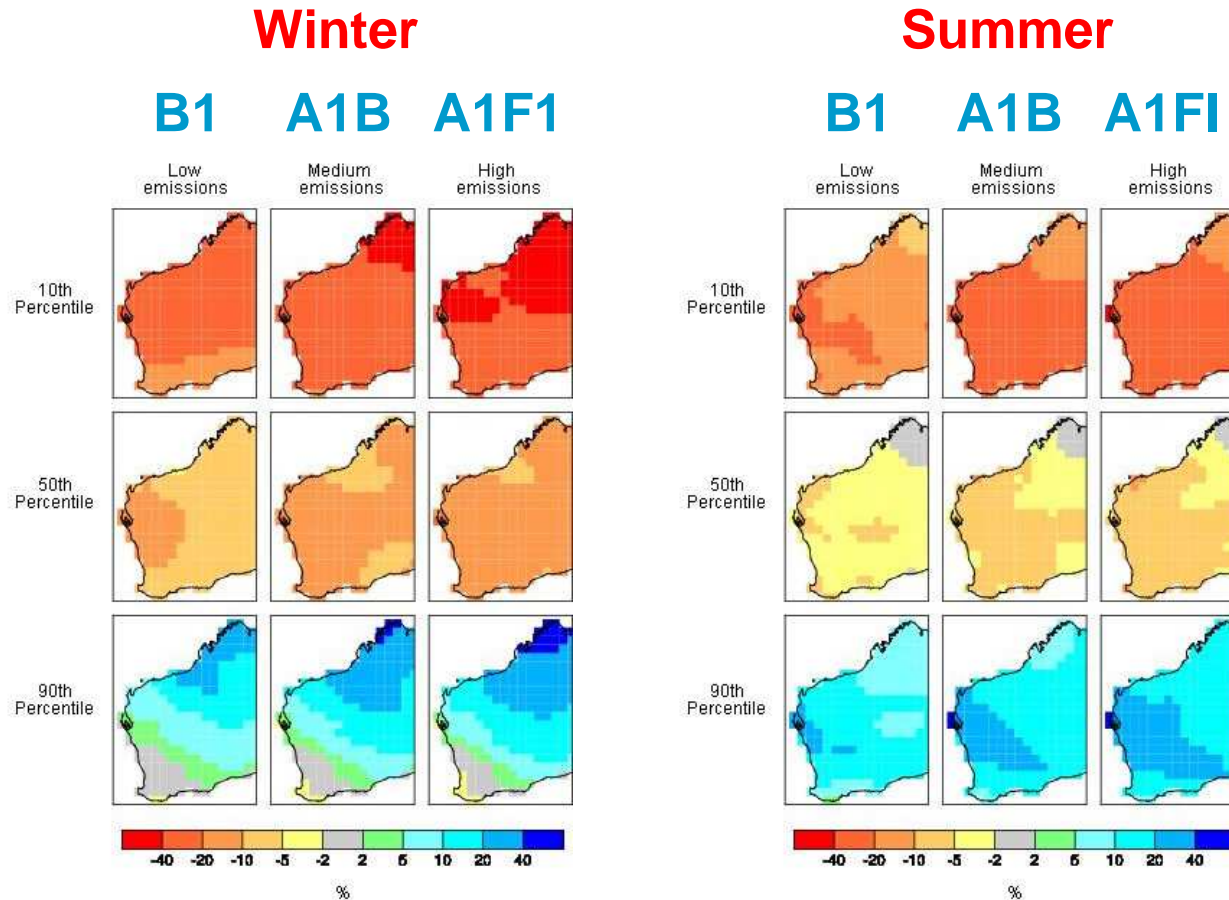
Temperature Projections (2050)



23 GCMs; 1980–1999 baseline

Source: <http://www.climatechangeinaustralia.gov.au/>

Rainfall Projections (2050)



23 GCMs; 1980–1999 baseline

Source: <http://www.climatechangeinaustralia.gov.au/>

Bates et al. (2008)

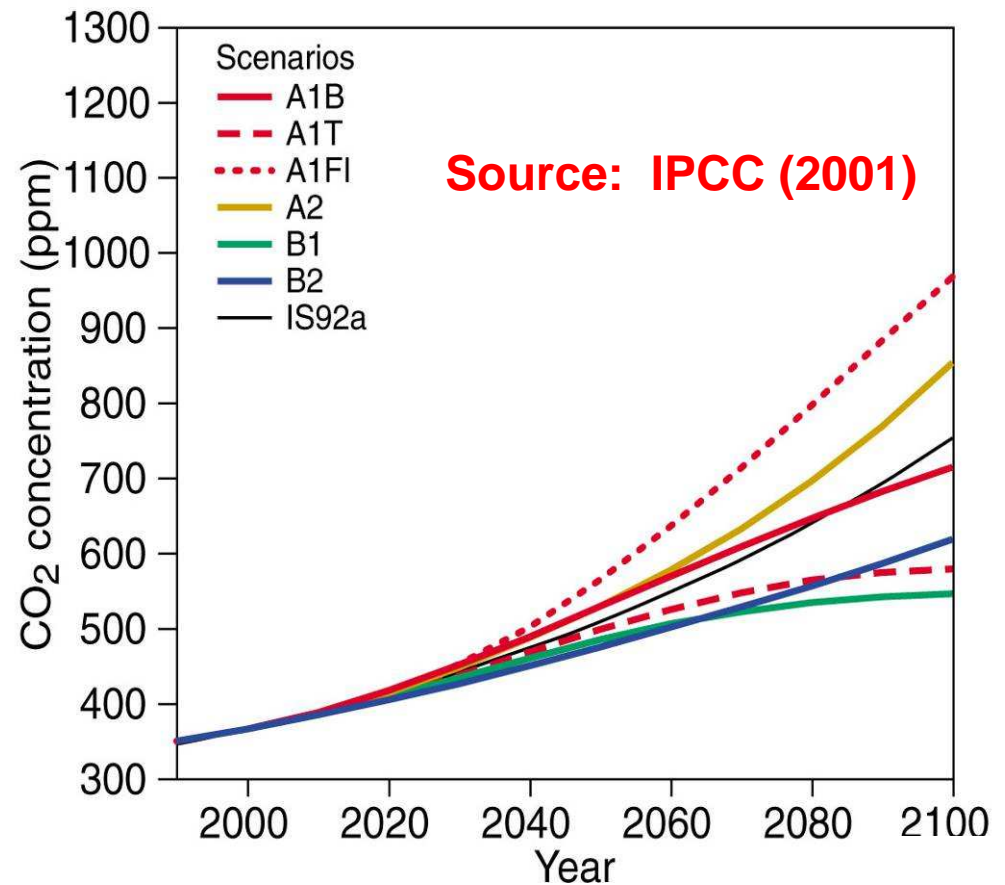


- **SW rainfall projected to decrease by 2 to 20% by 2030 & 5 to 60% by 2070**
- **SW summer temperatures projected to increase between 0.5 to 2.1 °C by 2030 & 1 to 6.5 °C by 2070**
- **SW winter temperatures projected to increase between 0.5 & 2 °C by 2030 & 1 & 5.5 °C by 2070**
- **SW potential evaporation projected to increase by 10% by 2030 & up to 40% by 2070**

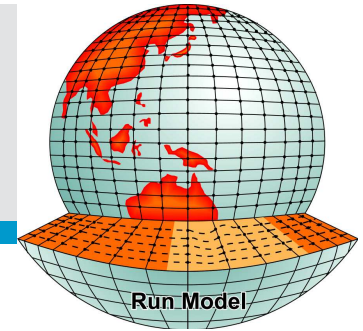
Sources of Uncertainty

- **Present to 2020s:**
uncertainties in climate models & initial conditions
- **2050s to 2100:**
uncertainties in GHG emissions & climate models dominate

CO₂ concentrations



GCM Selection



Climate Model		Perkins (Aust)	CMAR (Aust)		
GFDL2.0		Yes	Yes		
GFDL2.1		Yes	Yes		
ECHAM5		Yes	Yes		
GISS-ER		Yes	Yes		
CSIRO Mk3		Yes	No		
MRI-CGCM		No	No		
CGCM3.1		No	No		
IPSL-CM4		No	No		

Scenario Analysis



- Future GHG emissions likely to evolve **irregularly** in coming decades – use ‘scenarios’
- Scenario – series of events that **could** lead from present to **plausible** but **not assured** future situation
- Scenario **not** the same thing as a prediction or a forecast!
- Scenario analysis:
 - *Reveals vulnerabilities*
 - *Identifies need for contingency plans*
 - *Focuses attention on decision points*
 - *Builds adaptive capacity*

Concluding Remarks

- Our climate **will continue** to change
- Short-term prognosis for SW WA is bleak
- Long-term prognosis for SW WA is hotter & drier
- NW WA
 - new focus for IOCI research
 - Asian aerosols – another anthropogenic forcing?
- Future management strategies will need to be:
 - adaptive rather than static
 - based on a scenario management approach
- WA needs a well-coordinated & possibly integrated climate research effort

