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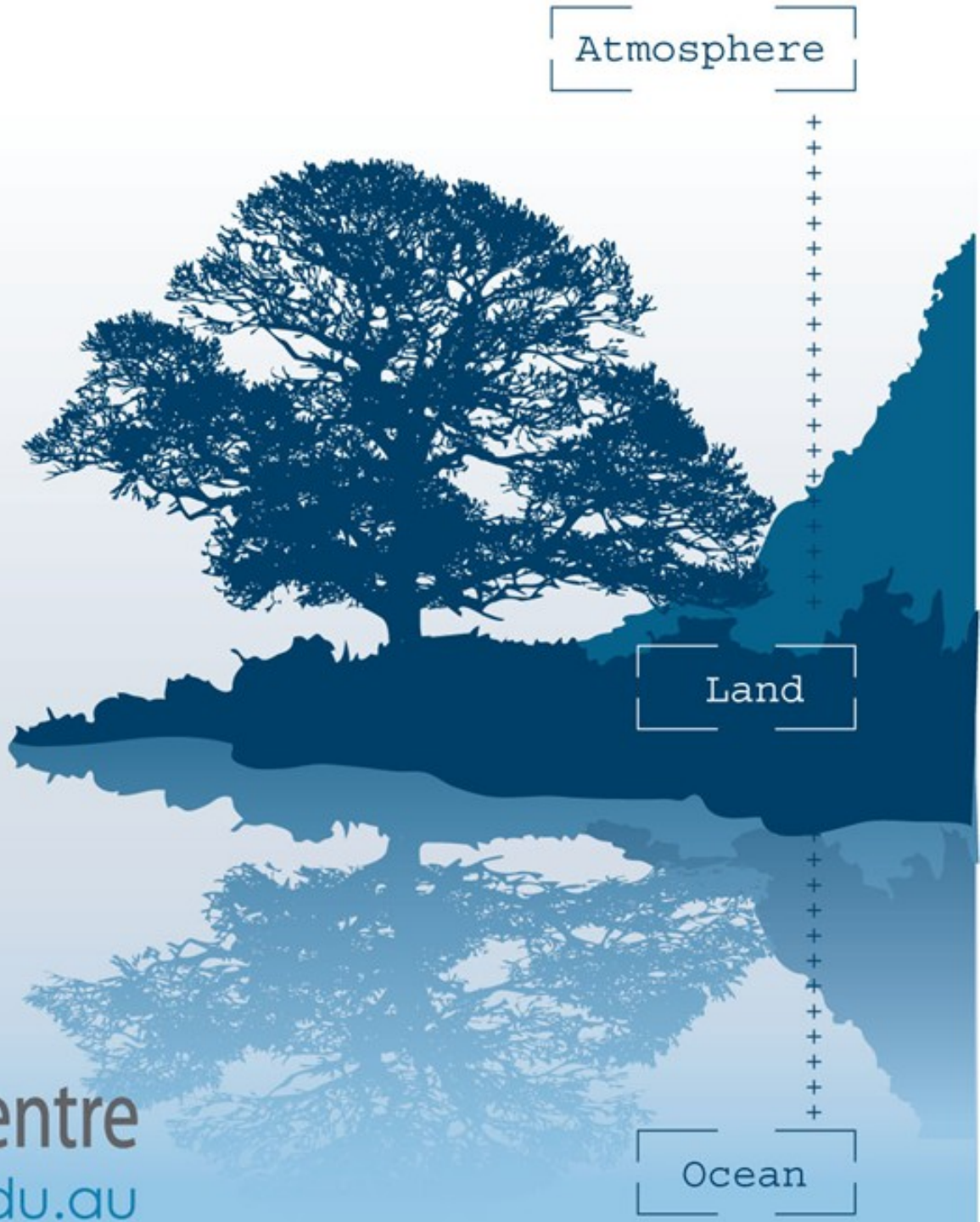
SYDNEY • AUSTRALIA

Regional climate projections for NSW

Dr Jason Evans

Jason.evans@unsw.edu.au



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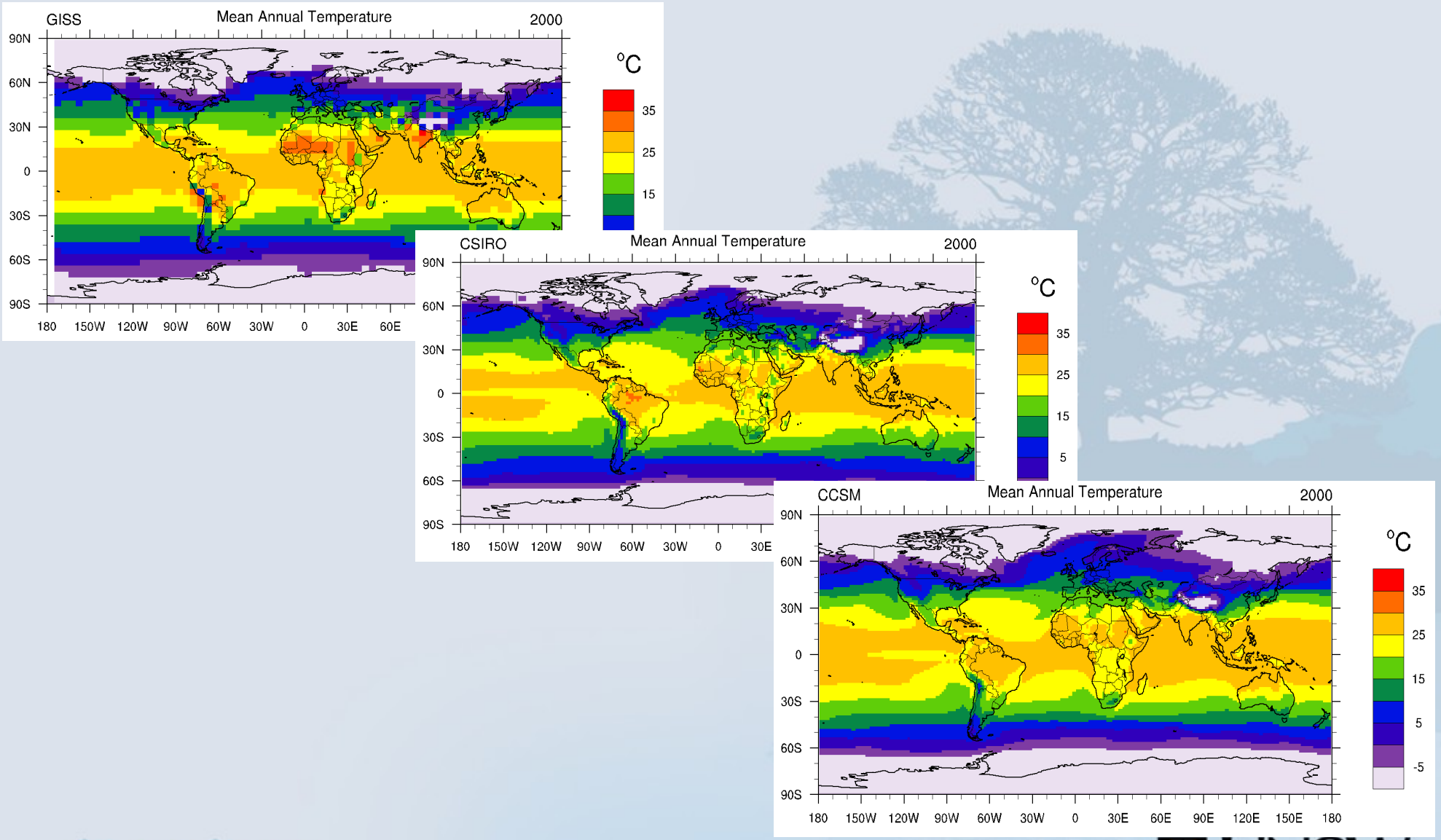
www.ccrc.unsw.edu.au

Climate Change Projections

- Global Climate Models (GCMs) are the primary tools to project future climate change
  - CSIROs Climate Change in Australia
  - UNSW/DECCW projections
- Do you need higher spatial resolution?
- Downscaled climate projections for NSW
  - Statistical downscaling
    - Analogue technique (Timbal et al)
    - Stochastic Weather Generator (Liu et al)
  - Dynamical downscaling
    - NARCliM project

GCM Projected Changes



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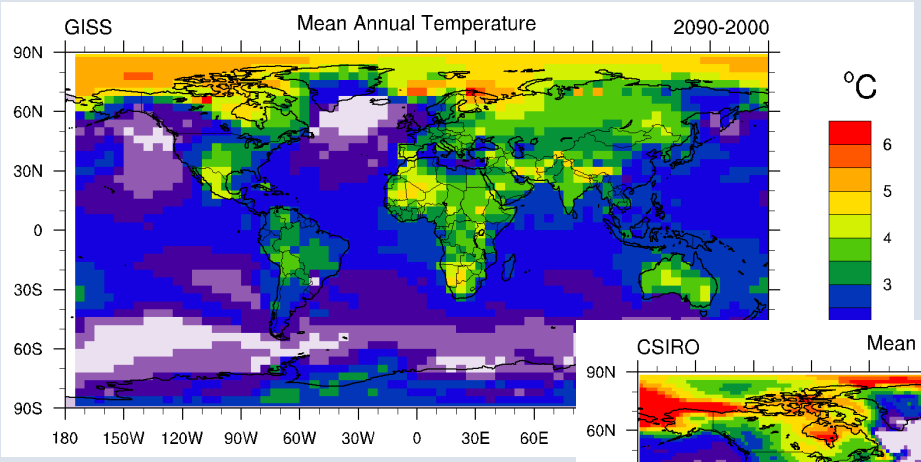
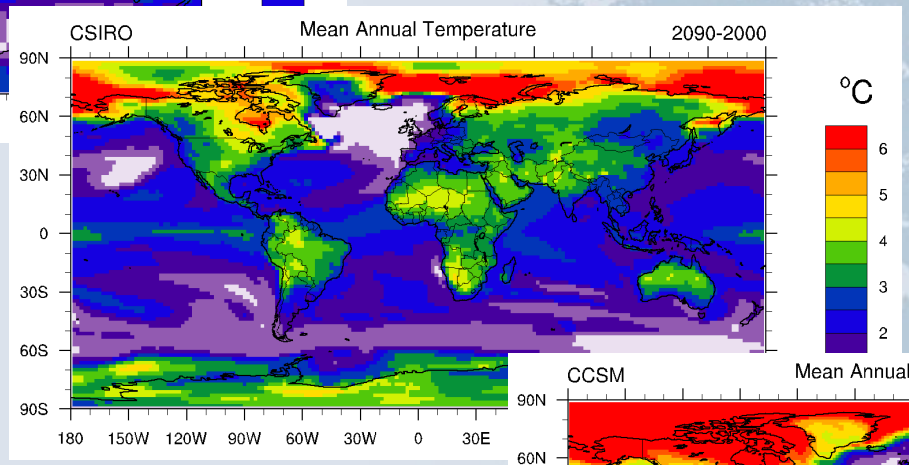
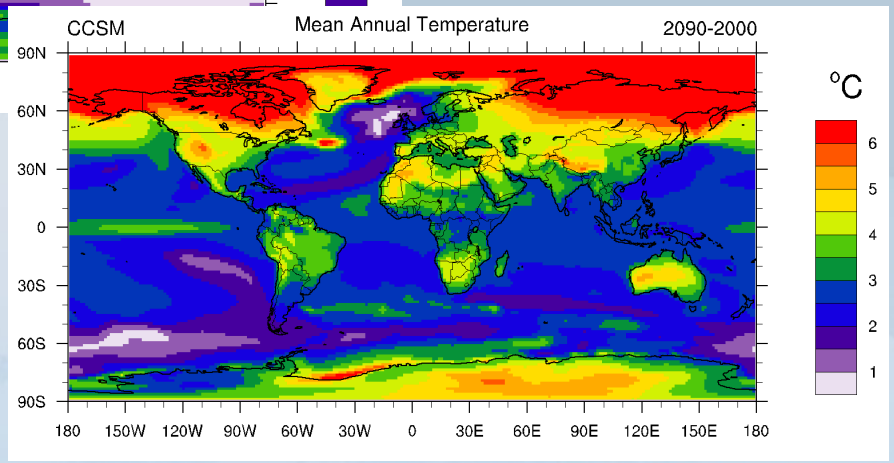
GCM Projected Changes







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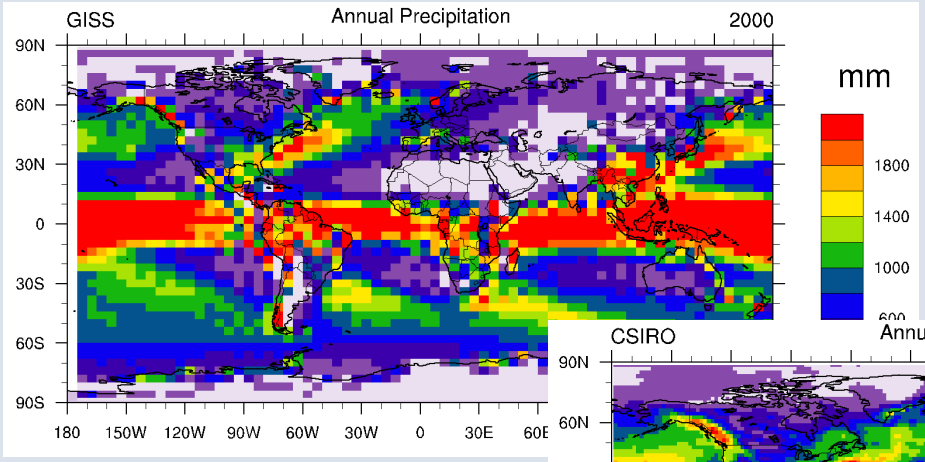
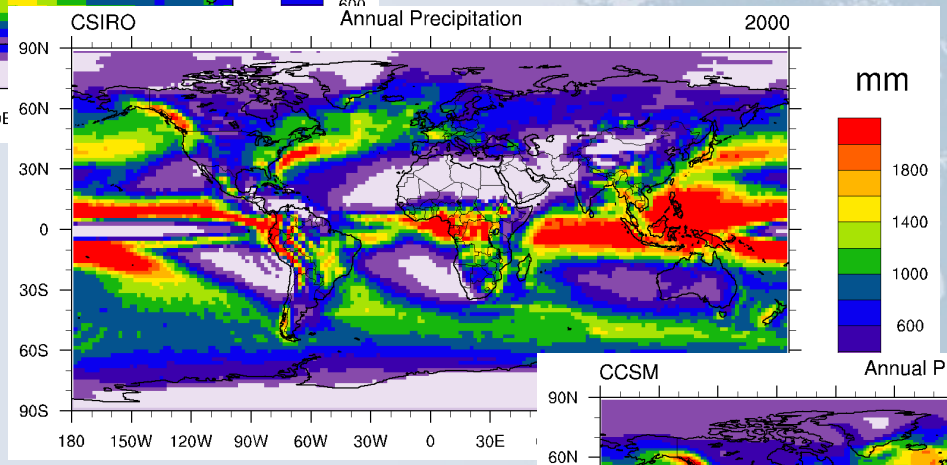
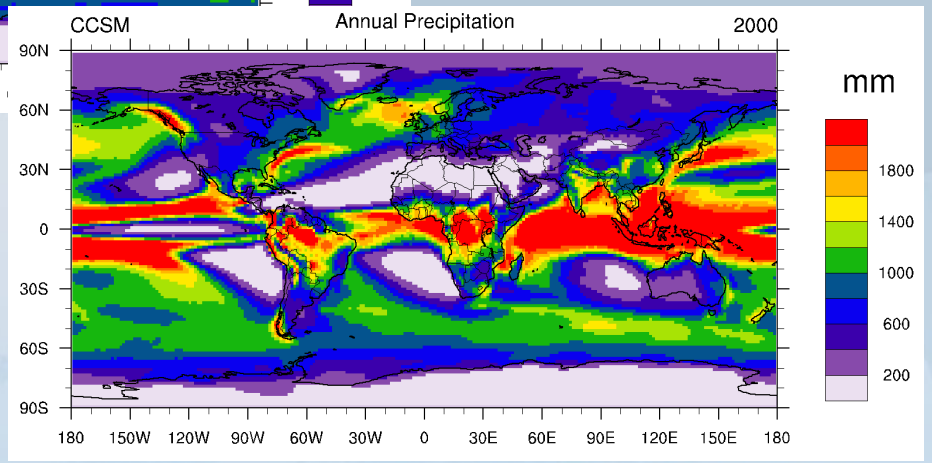
GCM Simulations







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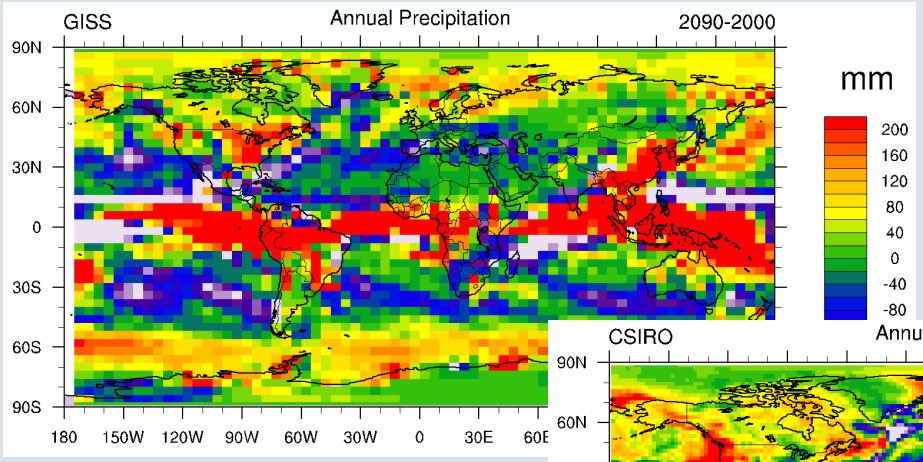

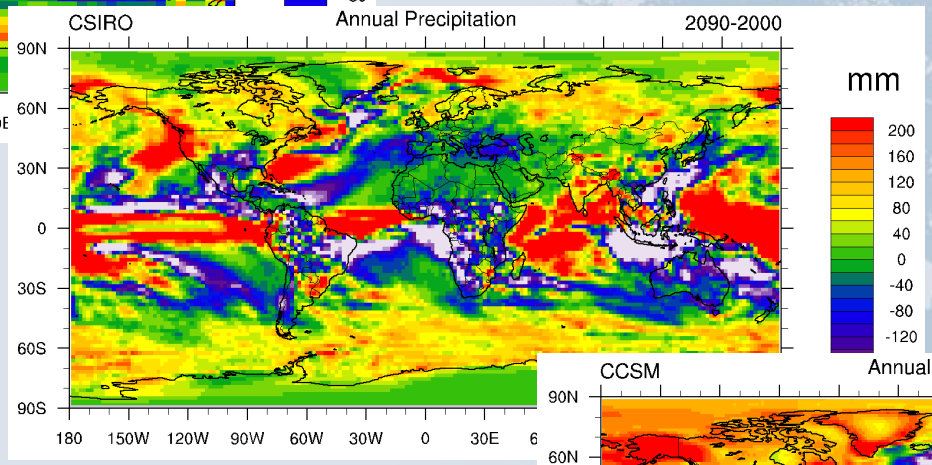

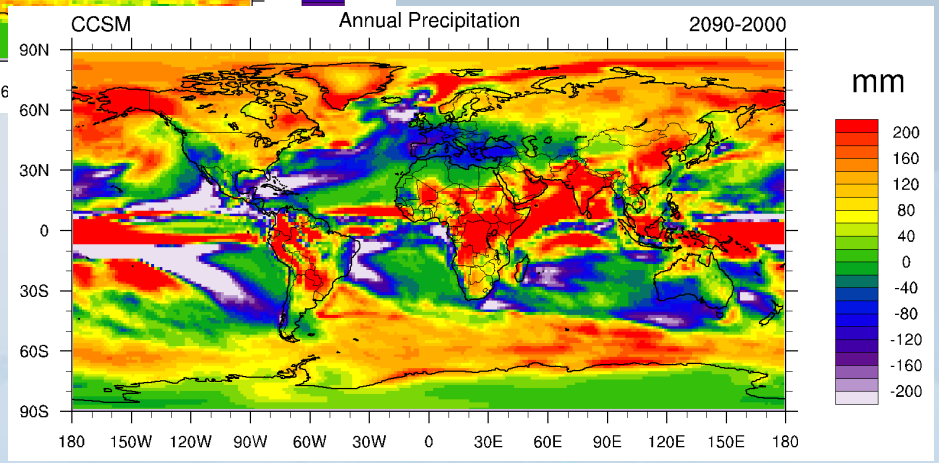

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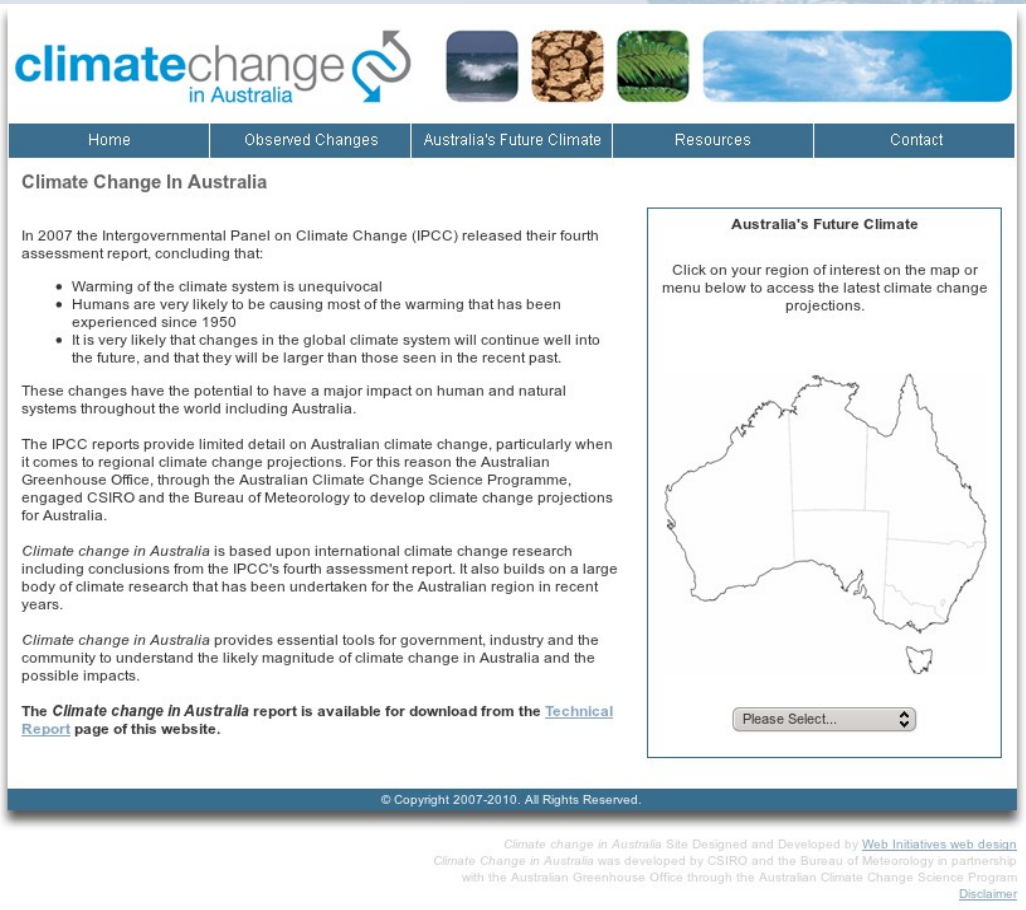
CSIROs Climate Change in Australia

http://climatechangeinaustralia.com.au/



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CSIROs Climate Change in Australia

climatechange in Australia

Home | Observed Changes | Australia's Future Climate | Resources | Contact

Australia's Future Climate >New South Wales / Australian Capital Territory Temperature Change

Region : New South Wales / ACT

Variable : Temperature change

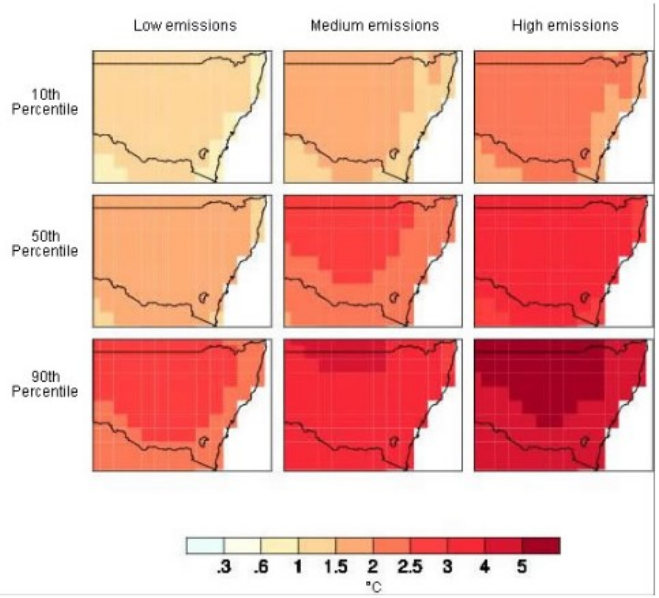
Year : 2070

Percentile : All*

Period : Summer

* You must select the 'All' option from one of Year, Percentile or Period. When you change your selection from 'All' in the current menu, the 'All' option will automatically move to the next menu.

New South Wales / ACT Temperature Change 2070 Summer



Click here for high resolution (300dpi) image of this projection.

Projections are given relative to the period 1980-1999 (referred to as the 1990 baseline for convenience). The projections give an estimate of the average climate around 2030, 2050 and 2070, taking into account consistency among climate models. Individual years will show variation from this average. The 50th percentile (the mid-point of the spread of model results) provides a best estimate result. The 10th and 90th percentiles (lowest 10% and highest 10% of the spread of model results) provide a range of uncertainty. Emissions scenarios are from the IPCC Special Report on Emission Scenarios. Low emissions is the B1 scenario, medium is A1B and high is A1FI.

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Australia's Future Climate >New South Wales / Australian Capital Territory Rainfall Change

Region :
New South Wales / ACT

Variable :
Rainfall change

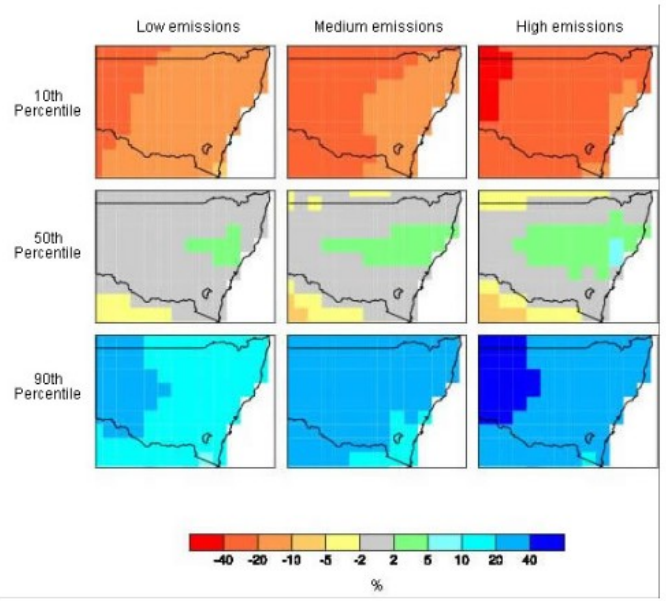
Year :
2070

Percentile :
All*

Period :
Summer

* You must select the 'All' option from one of Year, Percentile or Period. When you change your selection from 'All' in the current menu, the 'All' option will automatically move to the next menu.

New South Wales / ACT Rainfall Change 2070 Summer



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UNSW/DECCW projections

- Prof. Andy Pitman et al. Combined four GCMs to produce an ensemble projection of climate change for NSW
- Some GCMs are better than others at regional scales
- GCMs not spatially detailed enough to have confidence in changes occurring in areas smaller than ~1/4 of NSW

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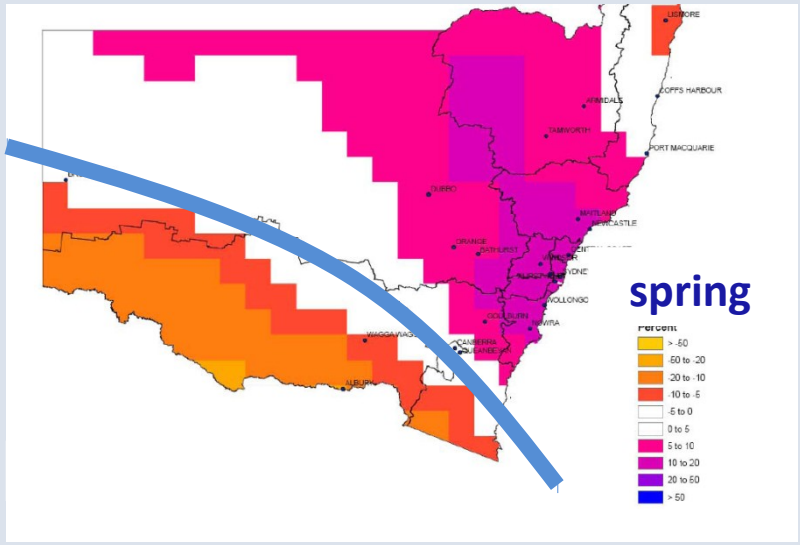
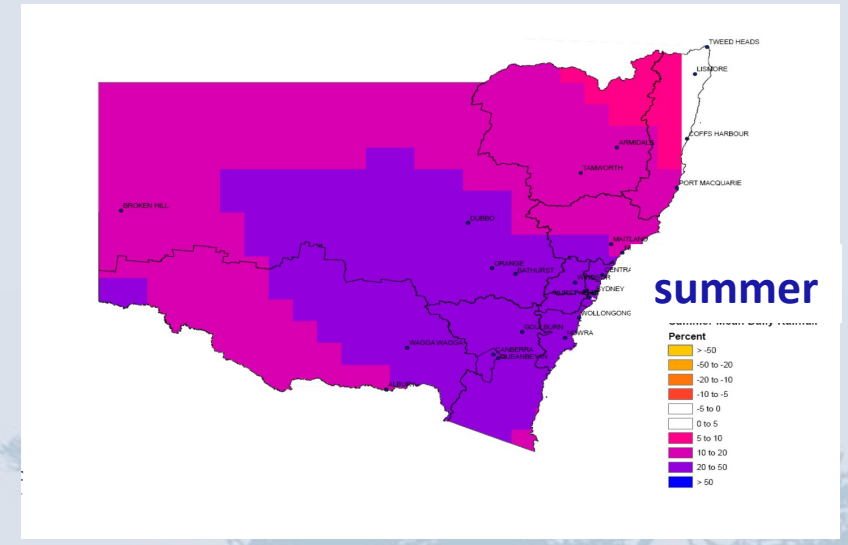
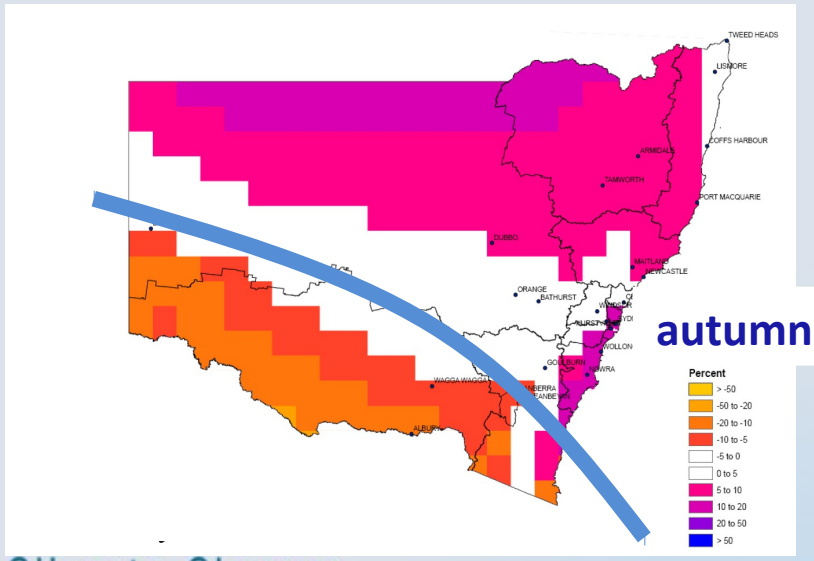
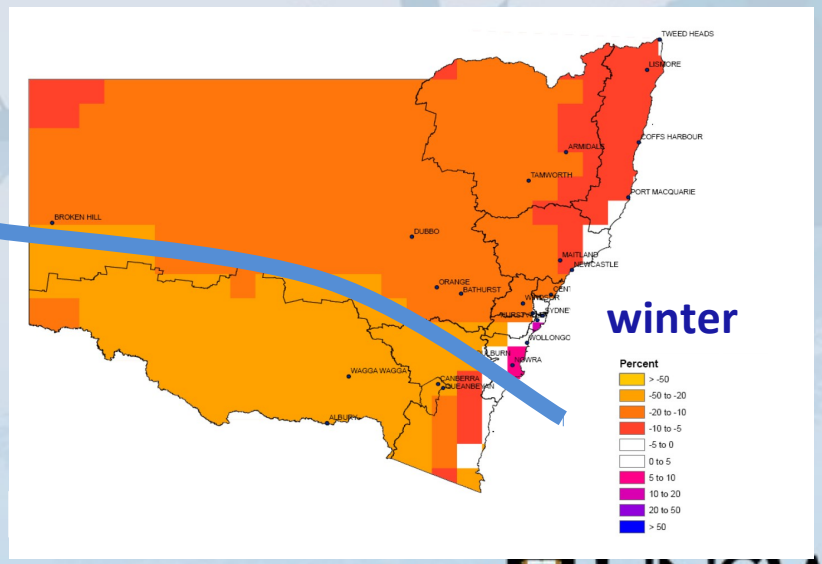
Rainfall – to 2050 [A2]









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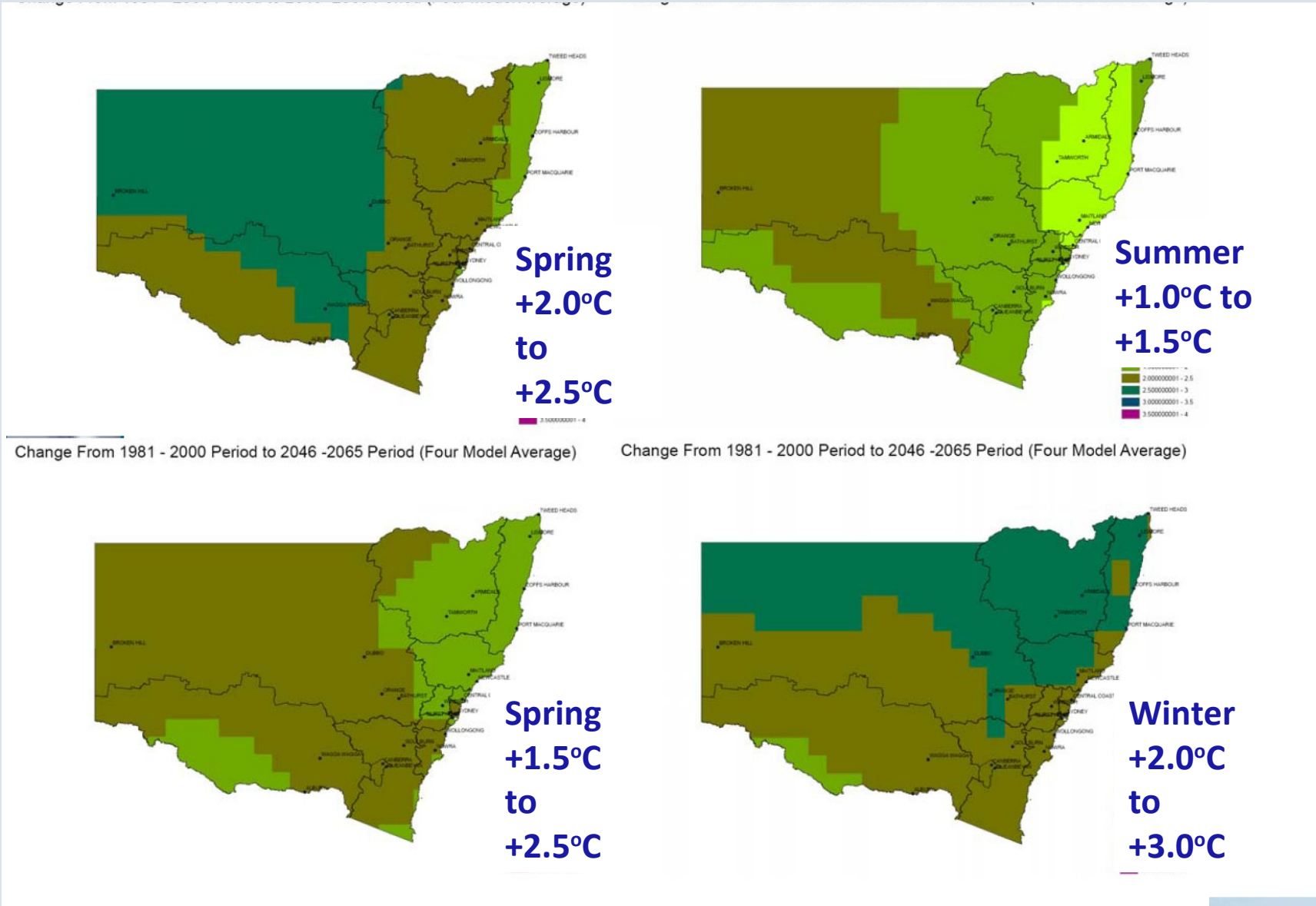
Temperature (to 2050, A2)



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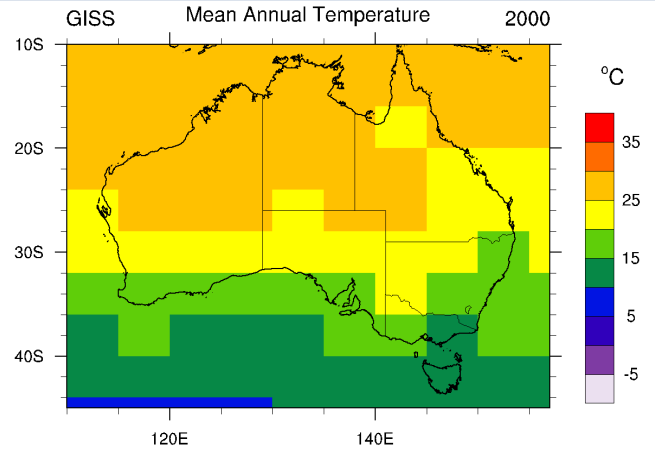
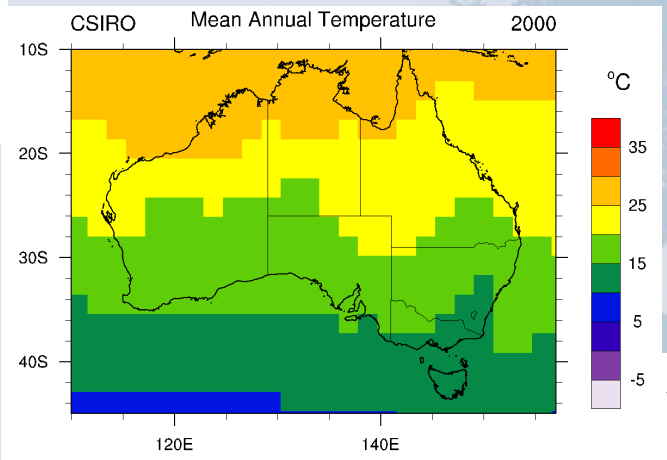
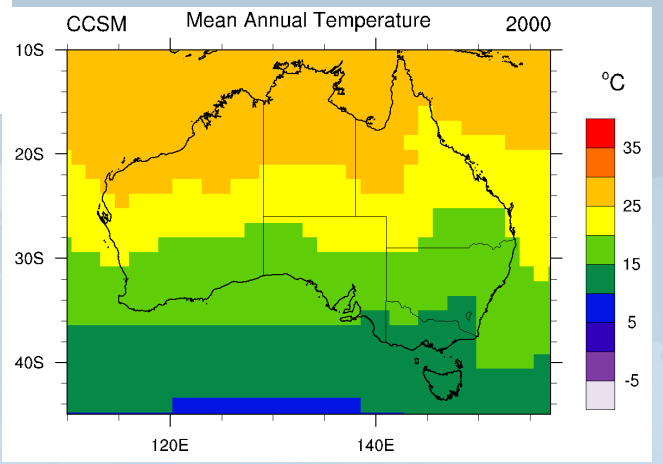
Do you need higher spatial resolution?

- Are surface variations important?
  - Coastlines
  - Mountains
  - Abrupt land-use changes
- Are regional scale atmospheric phenomena important?
  - Frontal rain systems
  - Mountain barrier jets
  - Sea-breezes
  - Tropical cyclones.....

GCM Simulations







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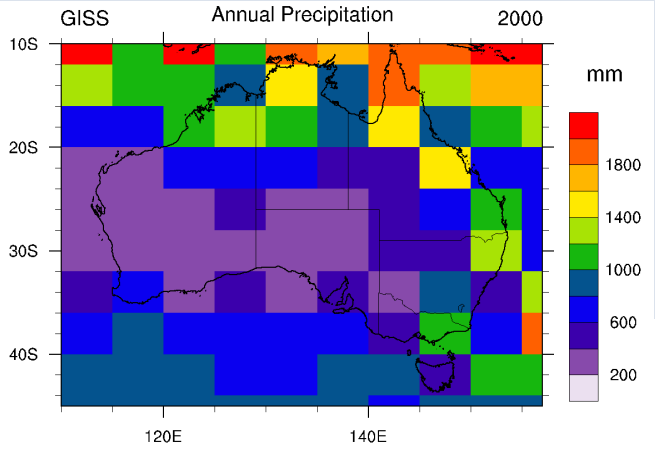

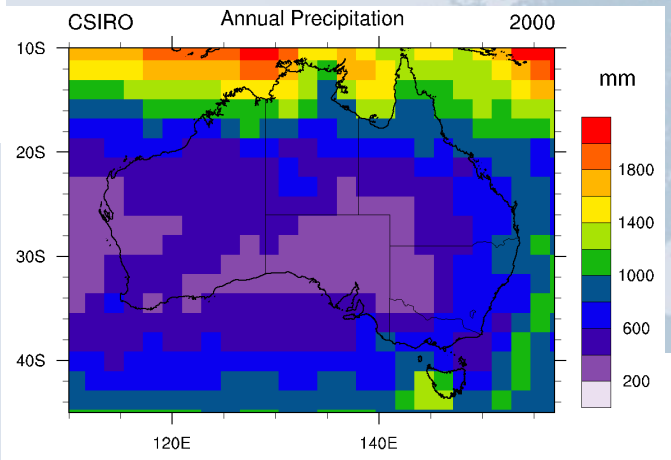

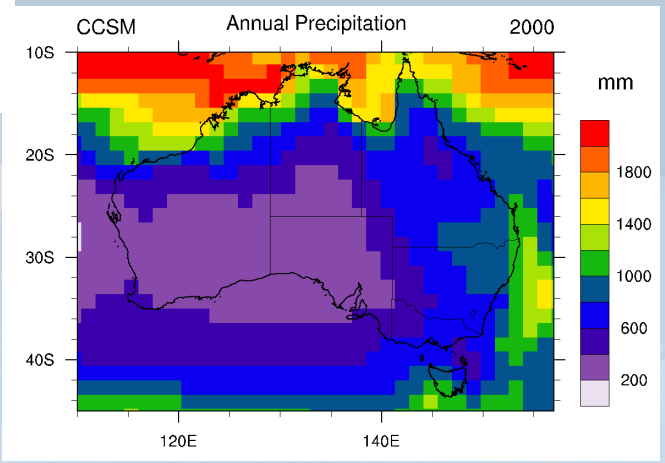

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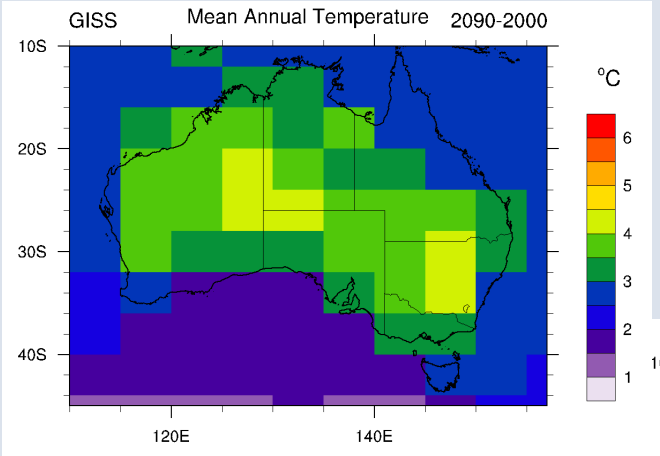
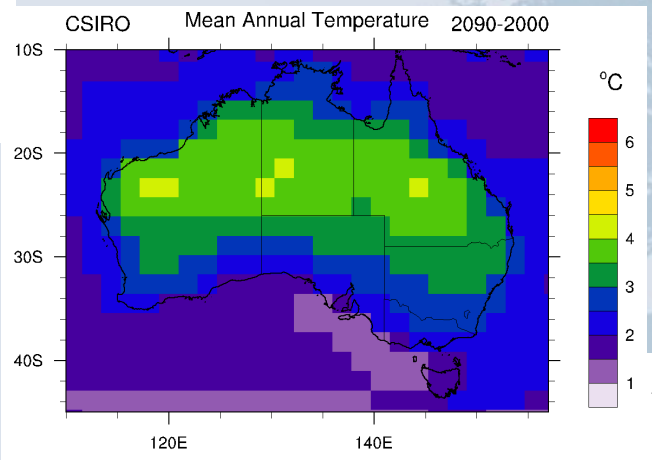
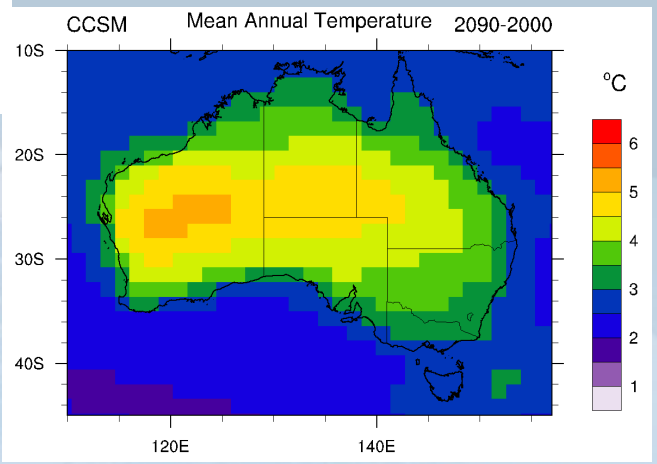
GCM Projected Changes







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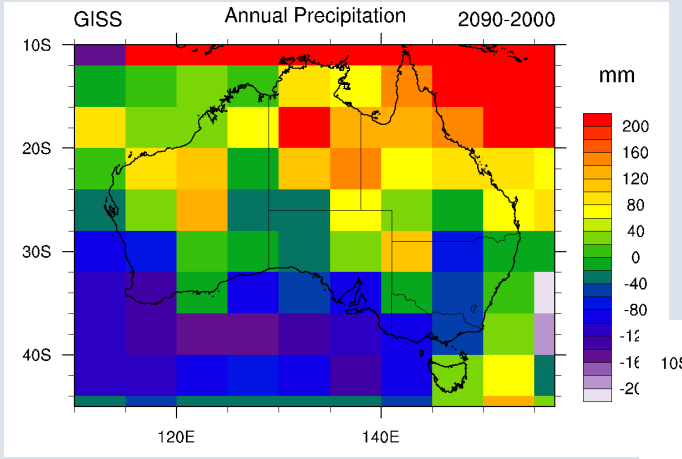

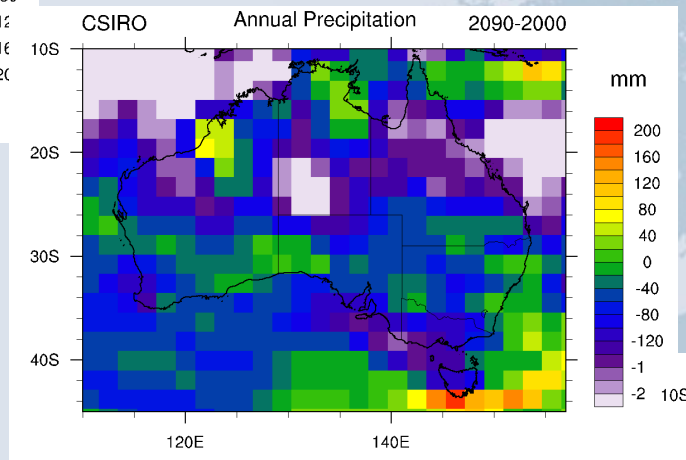

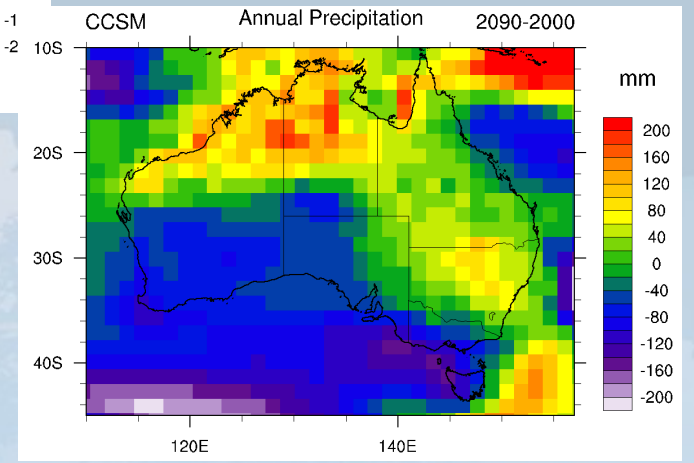

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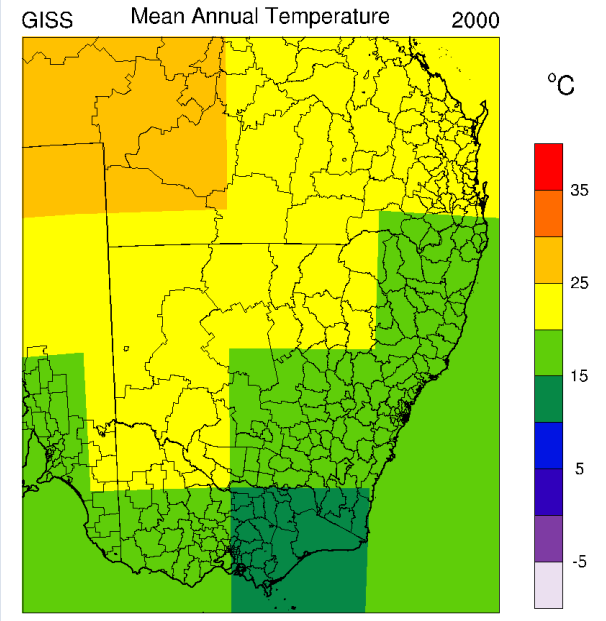
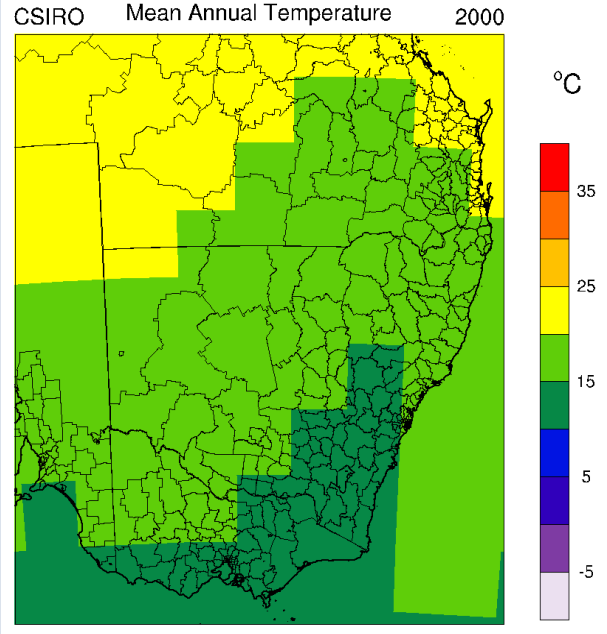
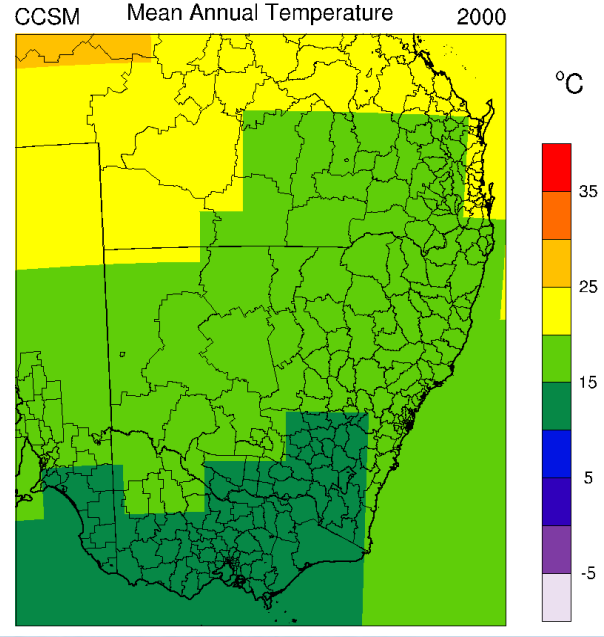
GCM Simulations







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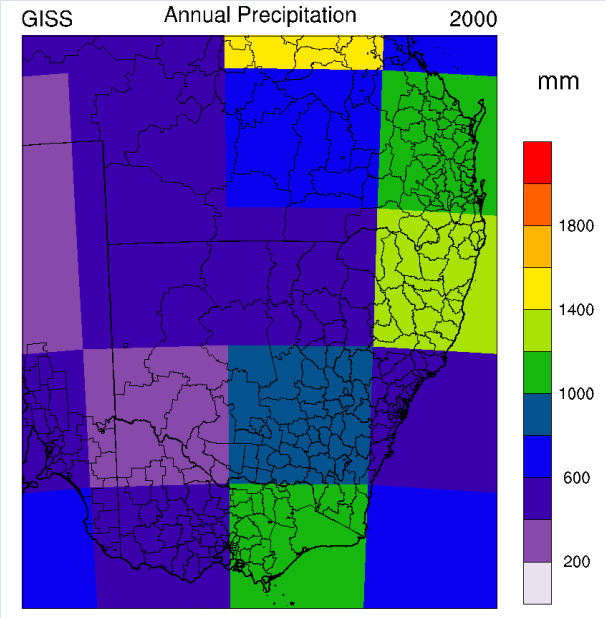

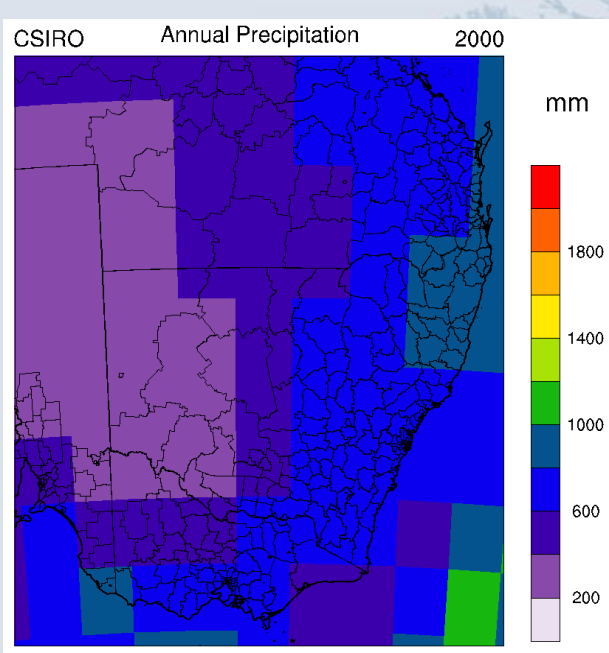

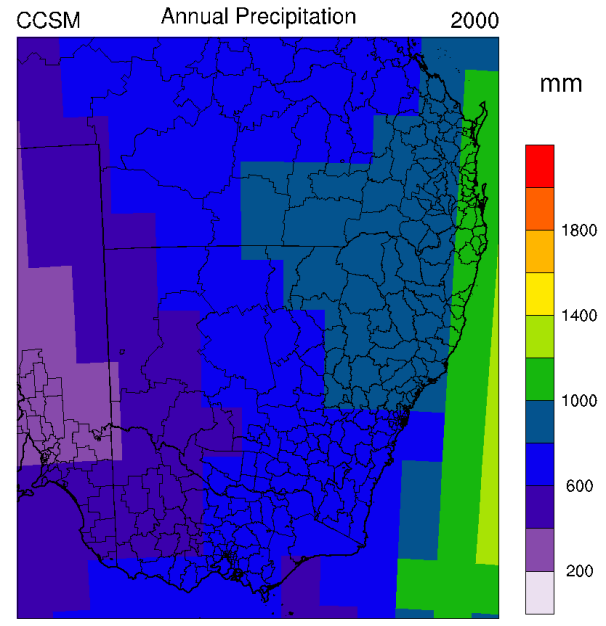

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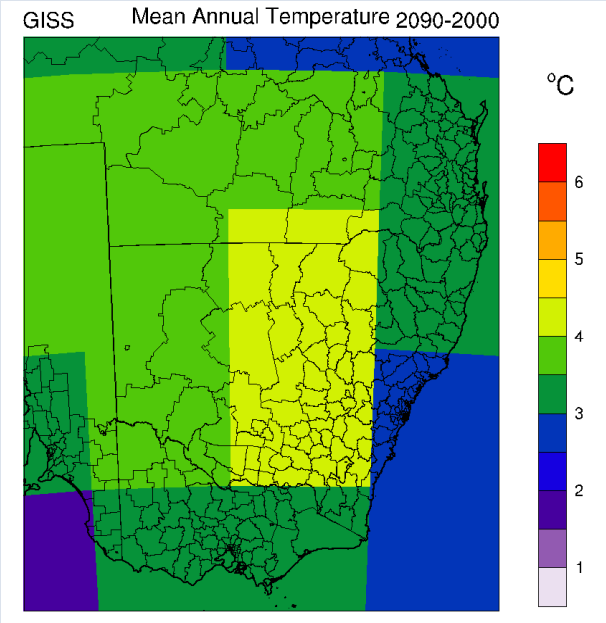
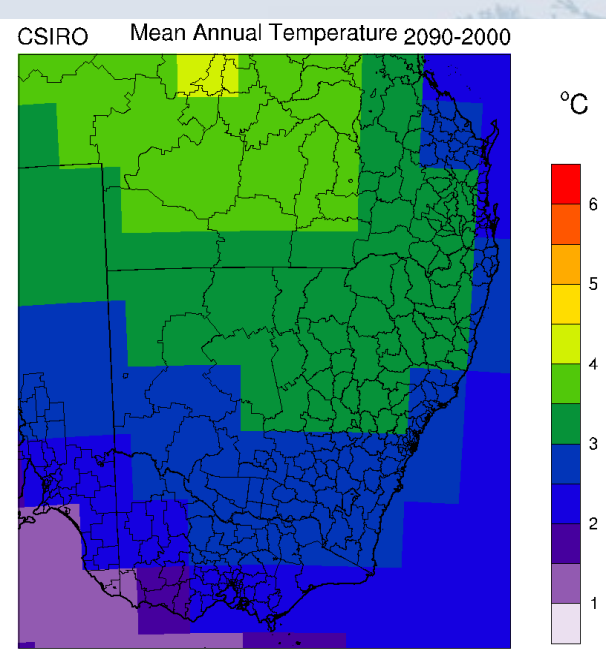
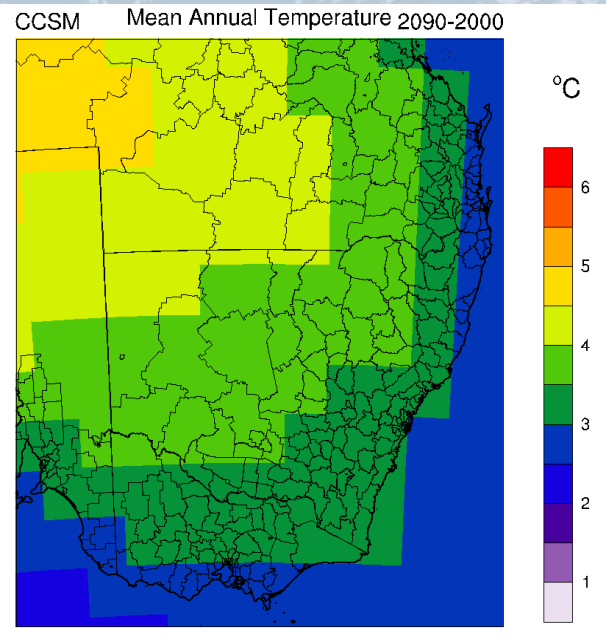
GCM Projected Changes







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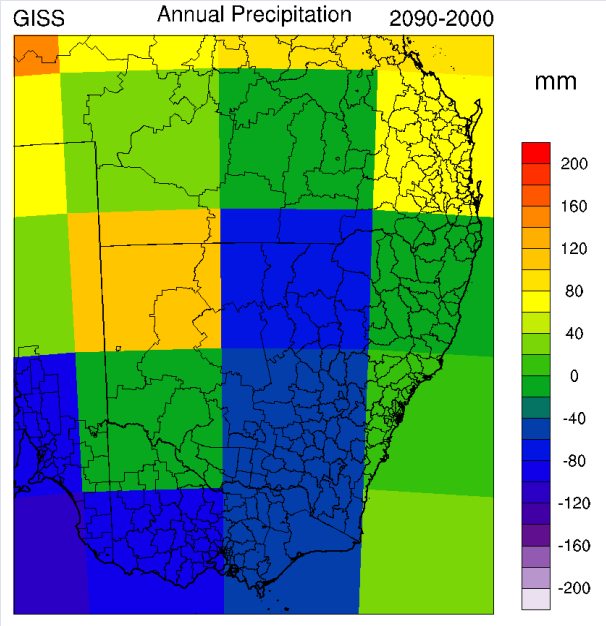

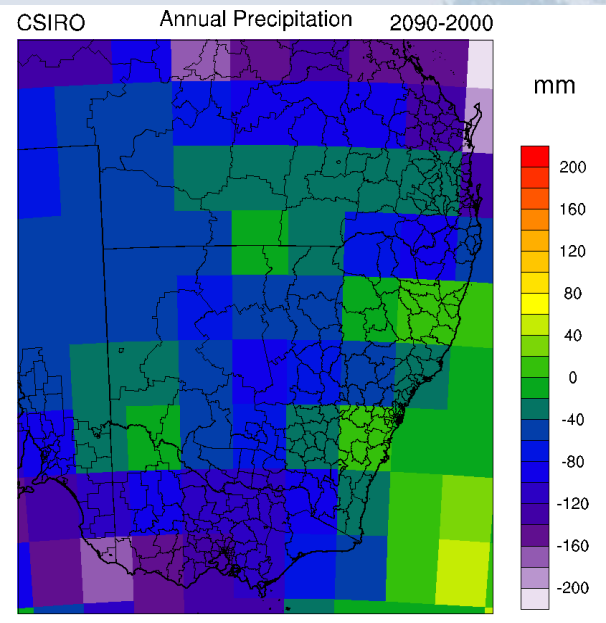

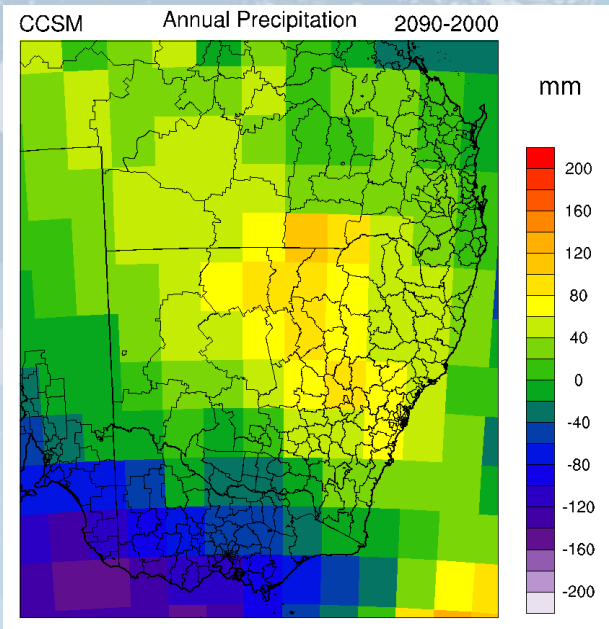

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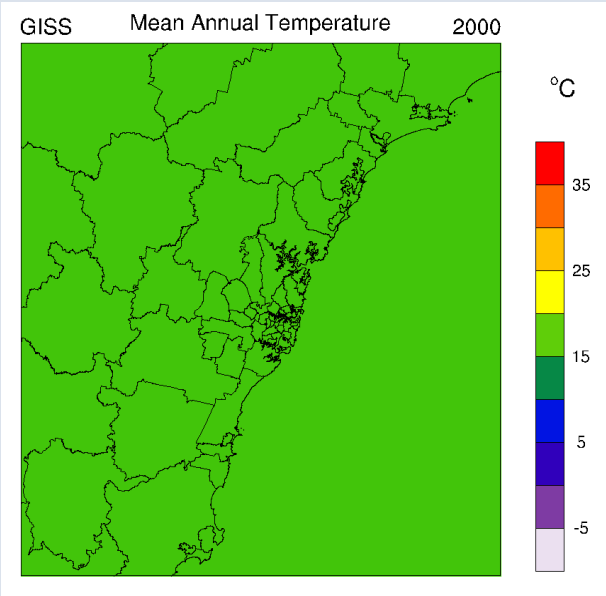

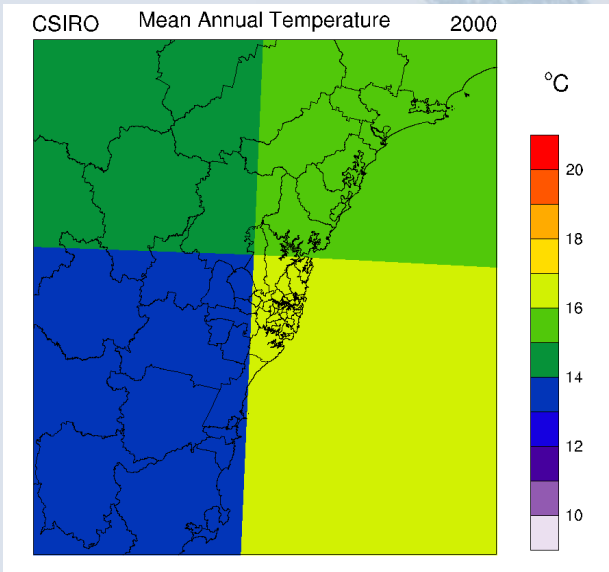

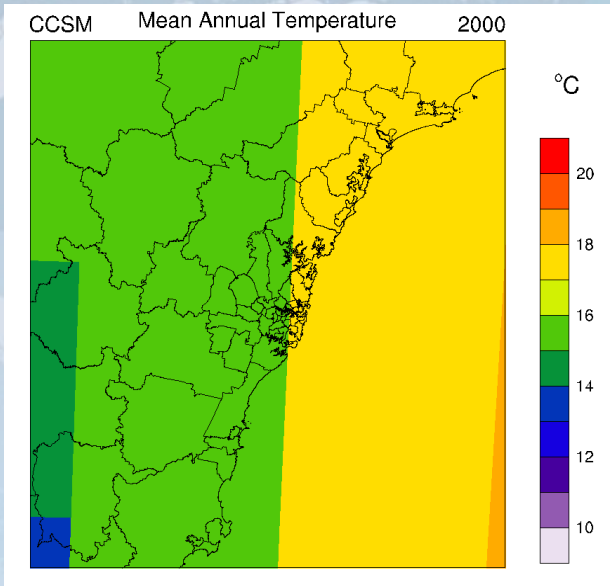

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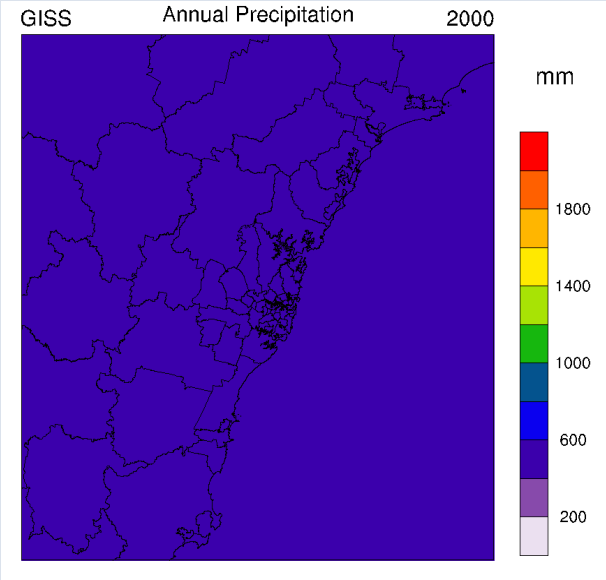

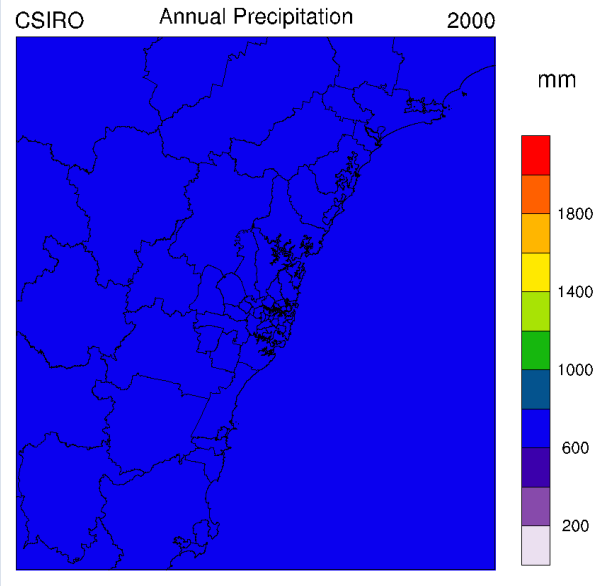

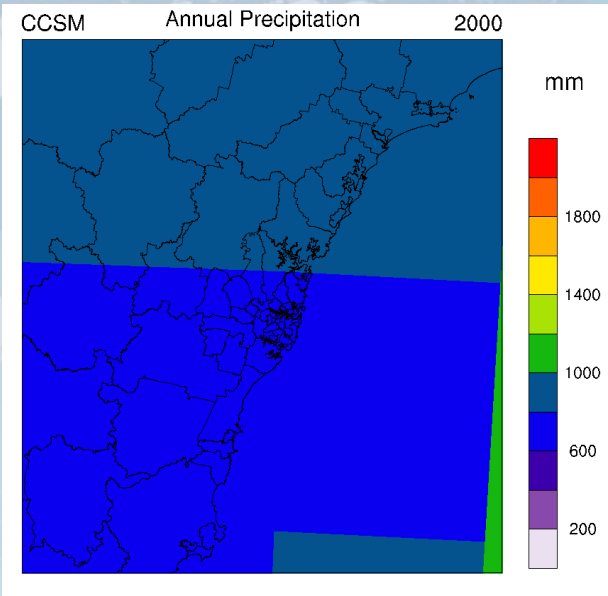

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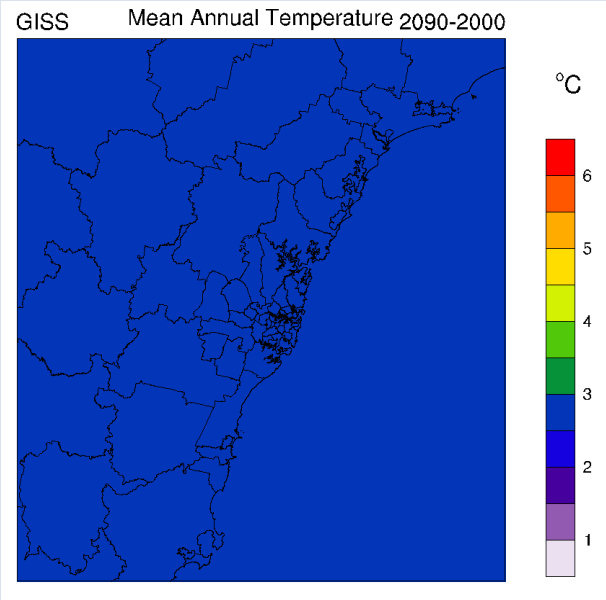
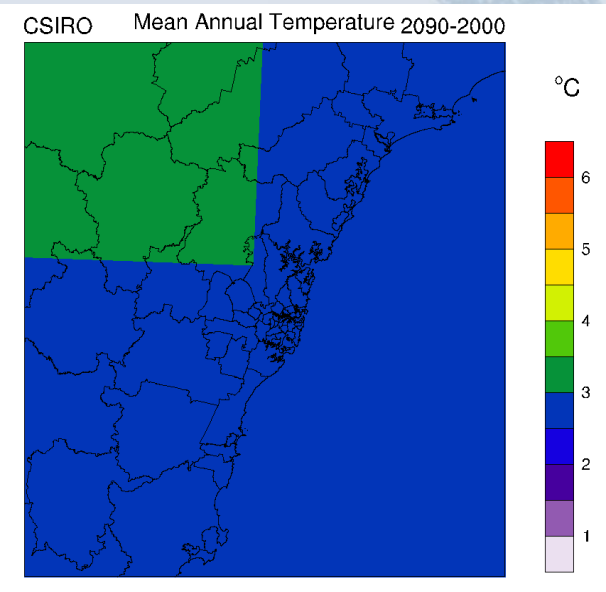
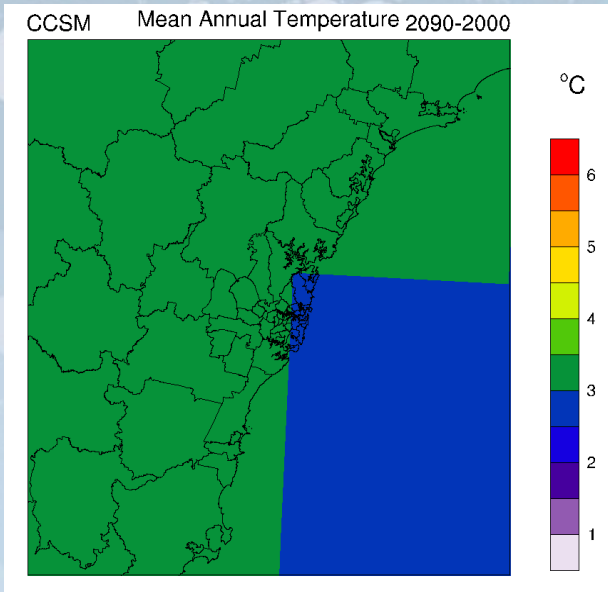
GCM Projected Changes







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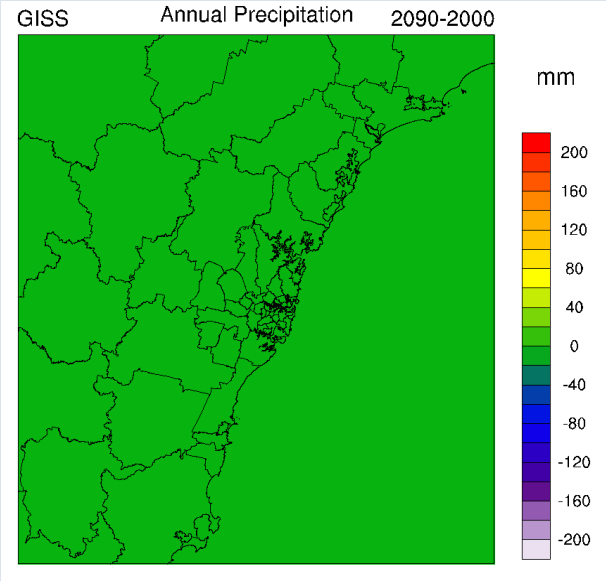
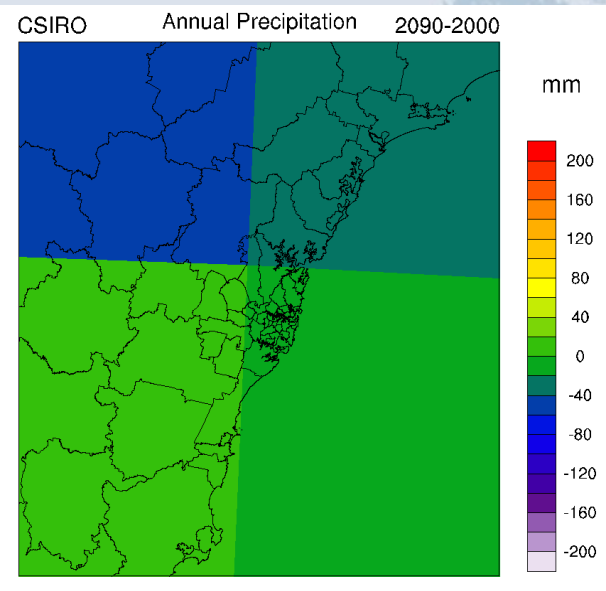
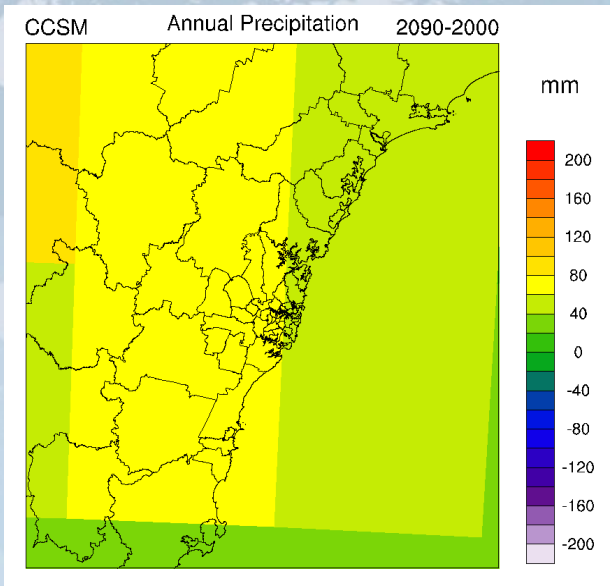
GCM Projected Changes







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Getting to smaller spatial scales

Downscaling

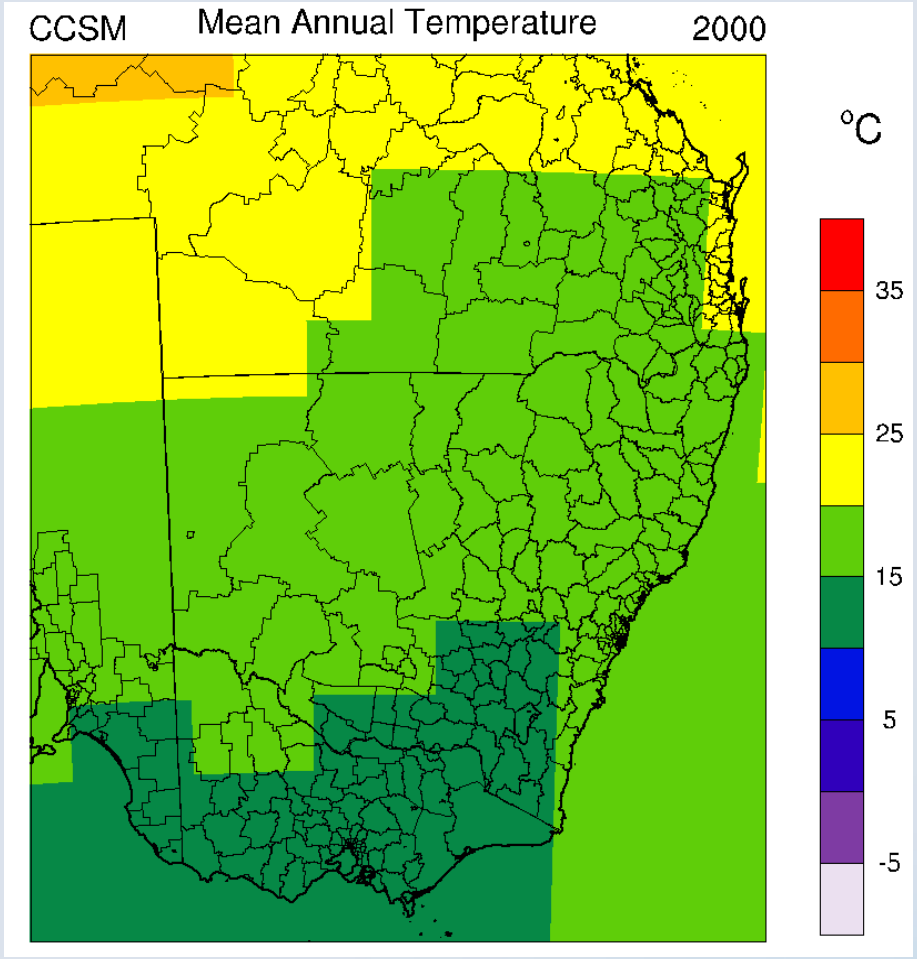
- Statistical
- Dynamical

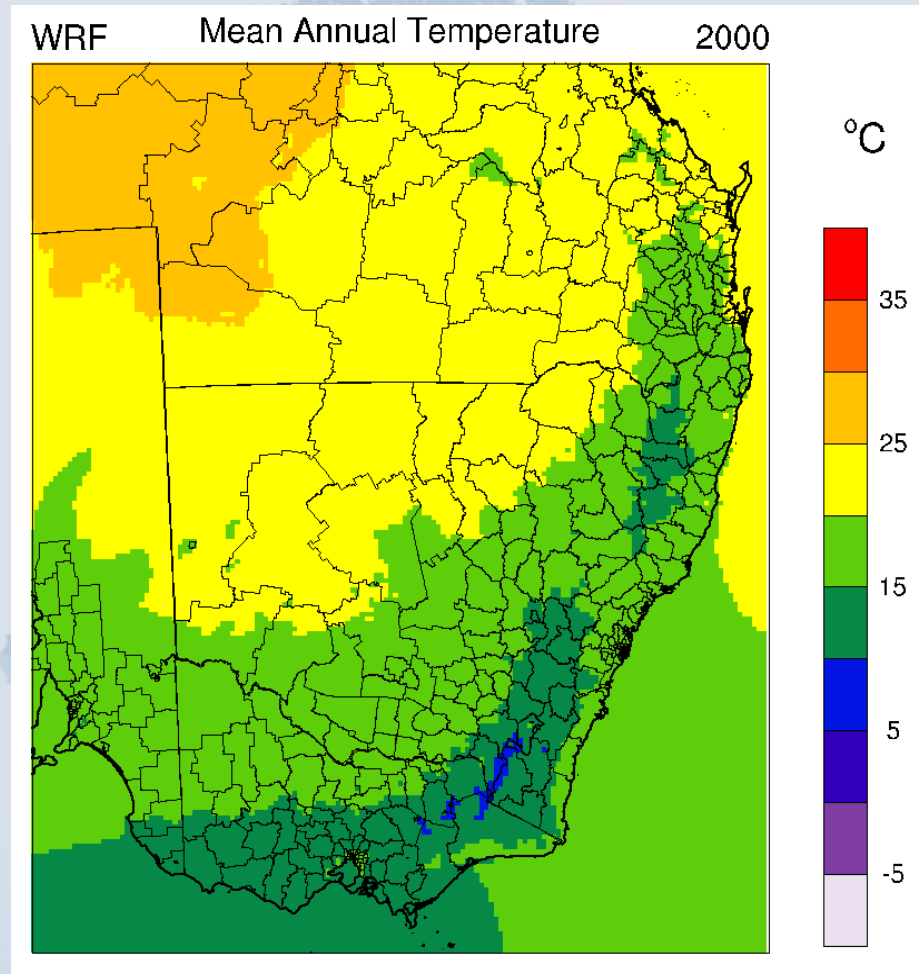
Regional Climate Models

Weather Research and Forecasting (WRF) model

10km horizontal resolution

GCM Simulations





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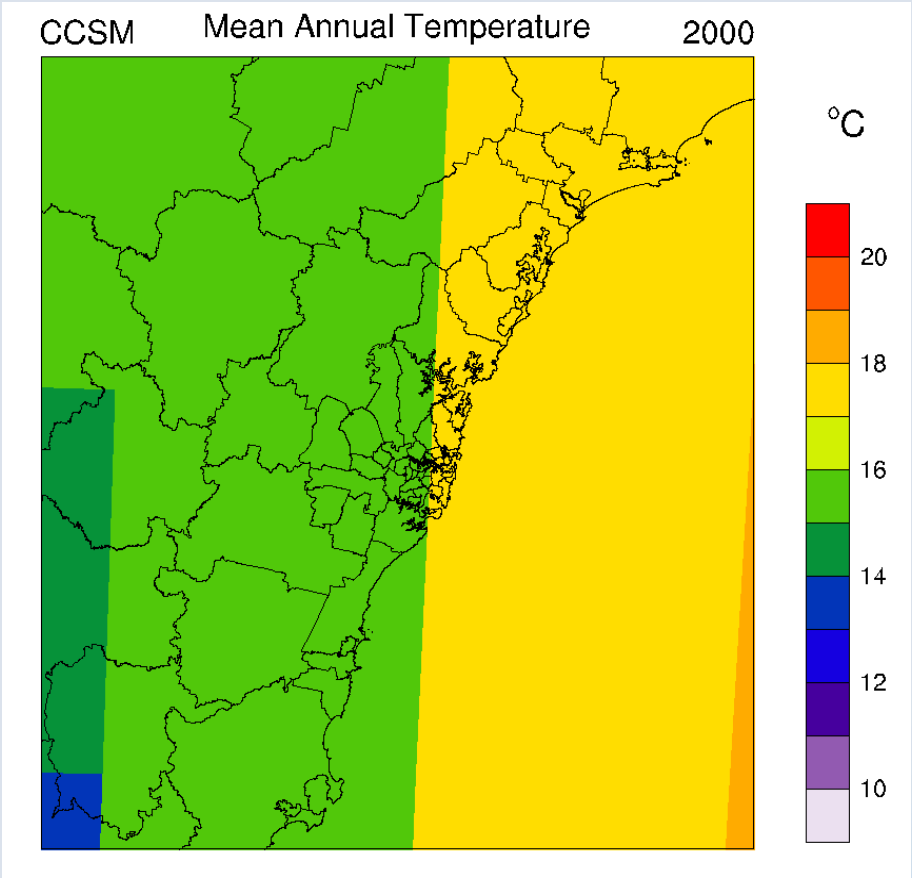
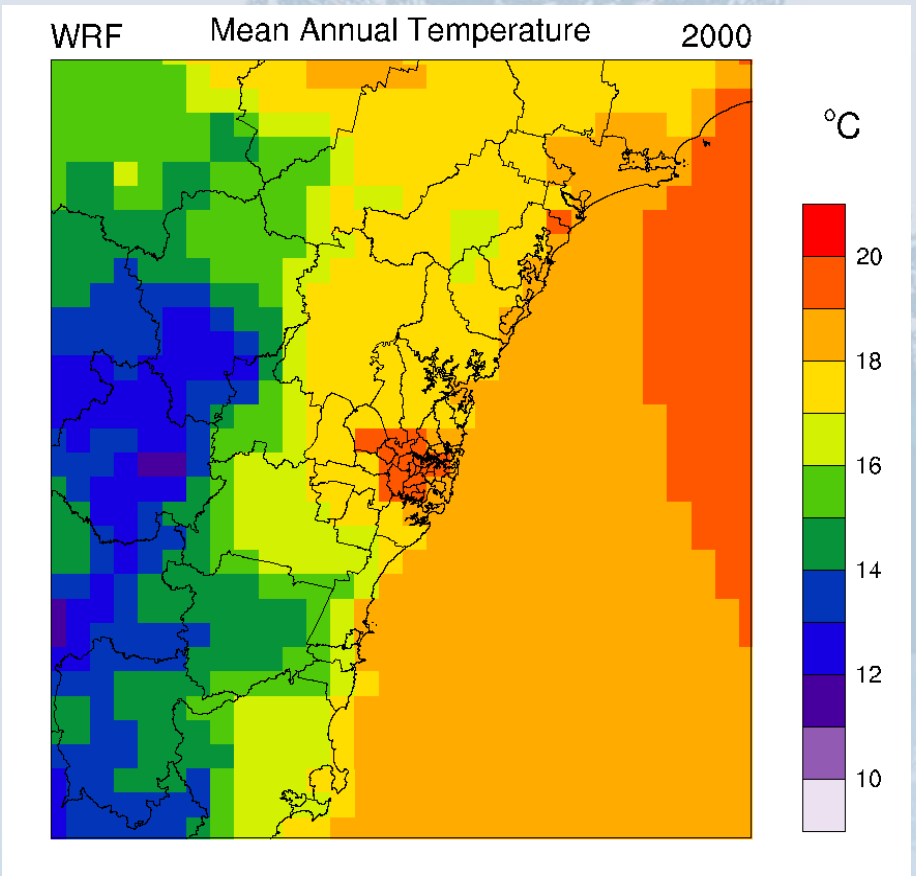
GCM Simulations





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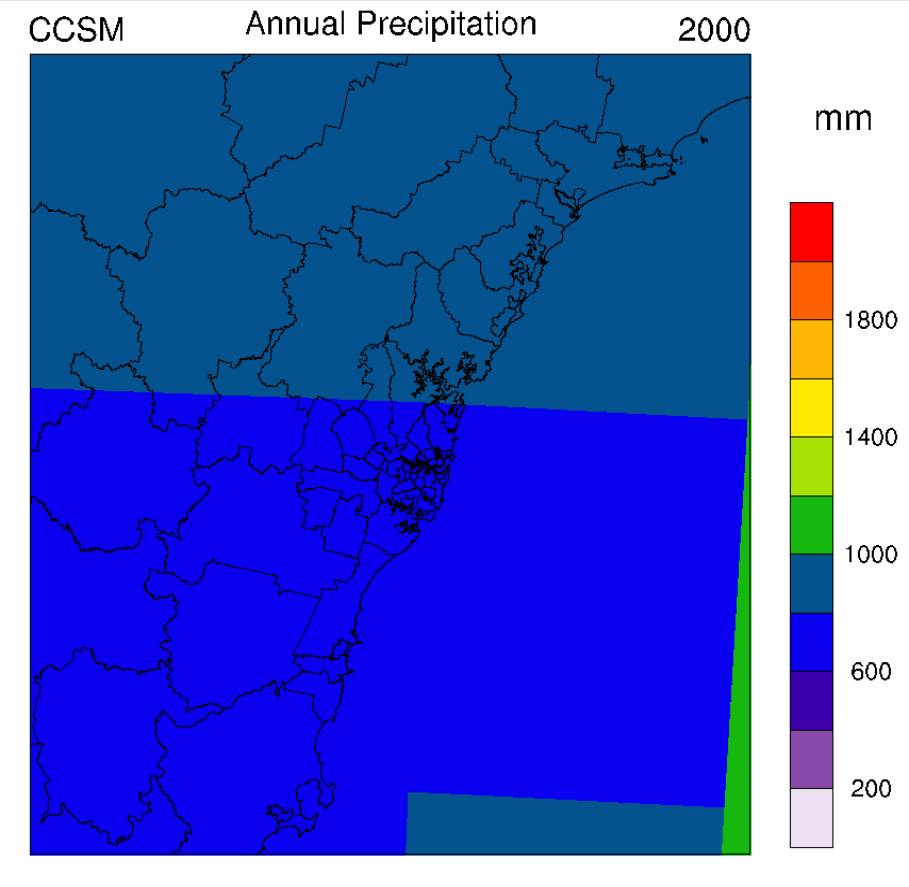
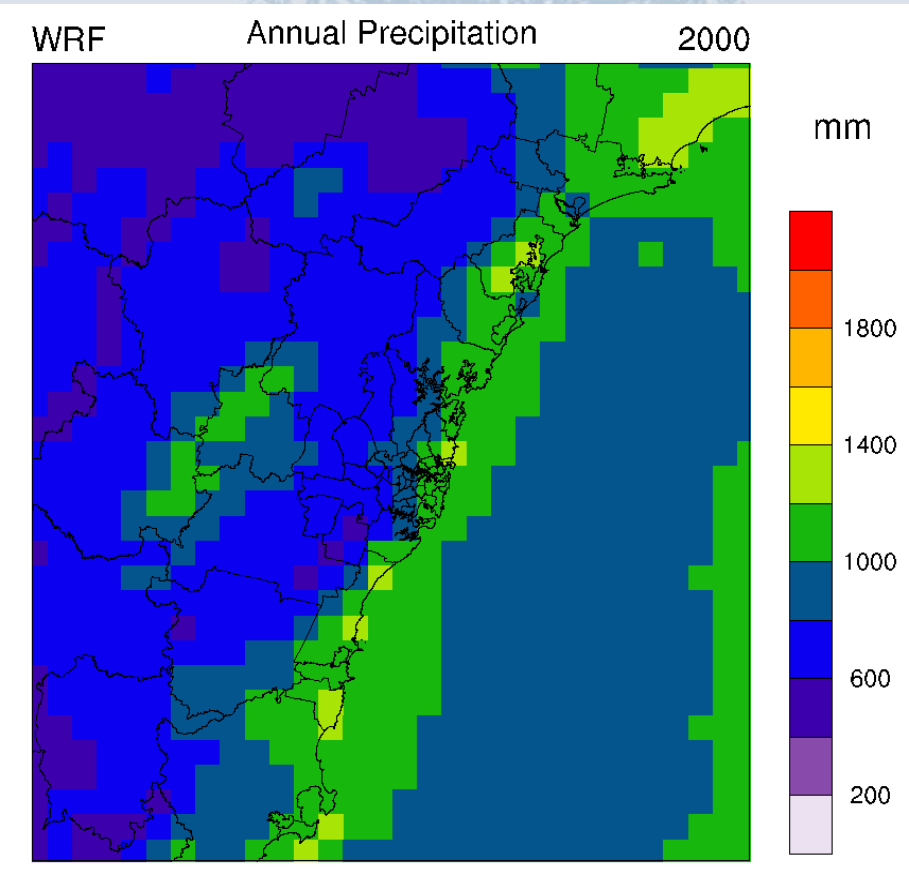
GCM Simulations





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Downscaled climate projections for NSW

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BoM "Analogue" statistically downscaled projections

Timbal, B., E. Fernandez and Z. Li. 2009: "Generalization of a statistical downscaling model to provide local climate change projections for Australia", Environmental Modelling and Software, 24, 341-358

Variables downscaled

- Daily precipitation, min & max temperature

To station locations & 0.05° grid

Contact: B.Timbal@bom.gov.au

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BoM "Analogue" statistically downscaled projections

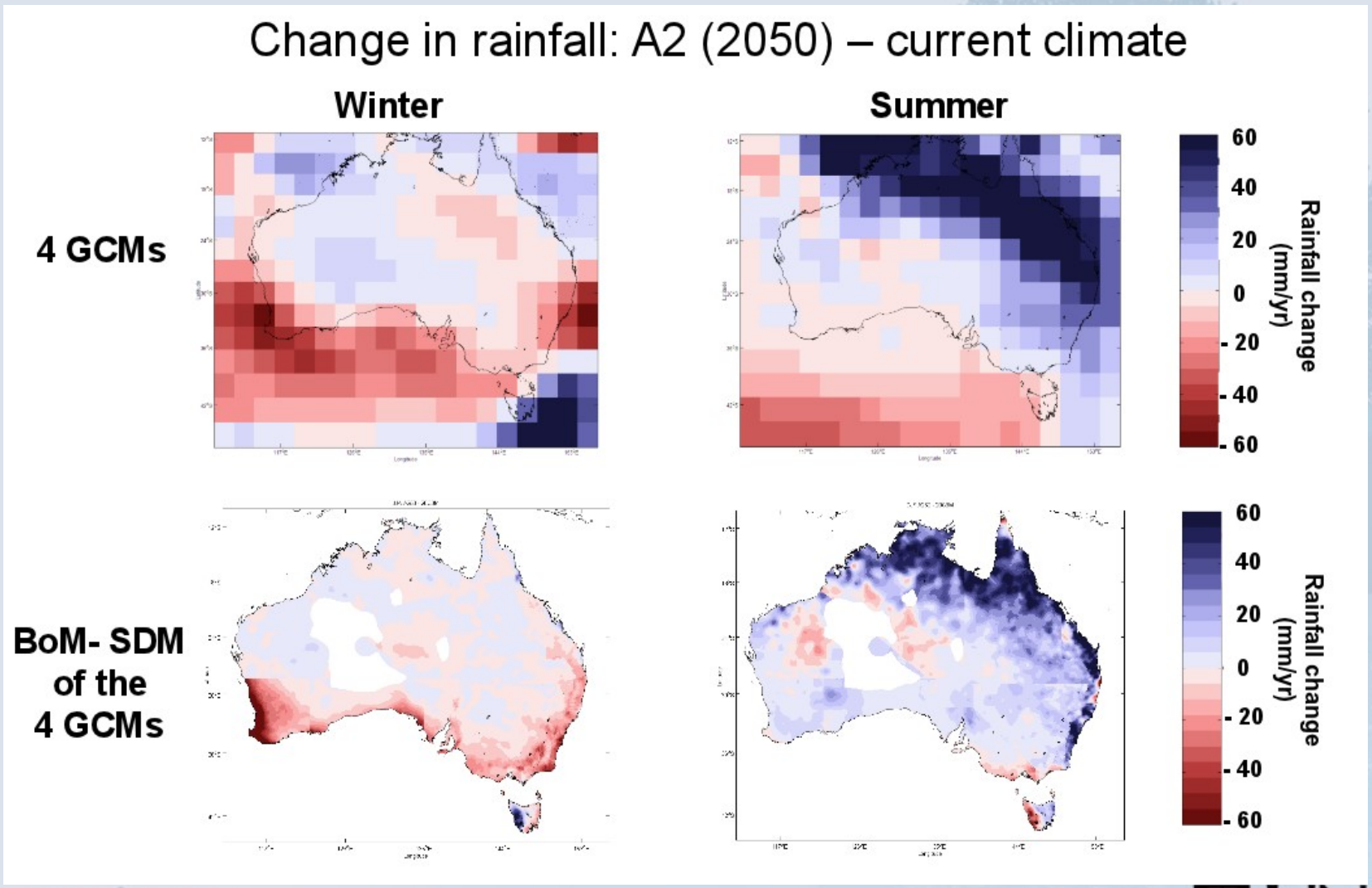
Methodology:

Find a historical analogue based on a small set of predictors

Predictors can include: Mean sea level pressure, temperature at 850 hPa, wind speed at 850 hPa,....

Limitation: cannot predict an event that has not occurred in the historical record.

BoM "Analogue" statistically downscaled projections



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NSW DPI "stochastic weather generator" statistically downscaled projections

Dr De Li Liu, NSW Department of Primary Industries,
Senior Research Scientist

Variables downscaled

- Daily precipitation, min & max temperature

To station locations

Contact: de.li.liu@industry.nsw.gov.au

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NSW DPI "stochastic weather generator" statistically downscaled projections

Methodology:

- Estimate statistical distributions of precipitation, min & max temperature from historical daily record
- Estimate changes to these distributions from GCM monthly projections
- Use stochastic weather generator to generate synthetic daily time series from these distributions

Limitation: How well do GCMs reproducing current statistical distributions? How are changes at the monthly time-scale reflected in daily distributions?

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NSW/ACT Regional Climate Modelling (NARCliM) Project

Dynamical downscaling project which is just starting. A collaboration between CCRC, UNSW & OEH. Due to complete in 3 years.

Variables downscaled

- More than 100 climate and related variables
- At least 3 hourly, daily and monthly times scales
- 10km resolution grid

Project contact: Graham.Turner@environment.nsw.gov.au

Research contact: jason.evans@unsw.edu.au

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NSW/ACT Regional Climate Modelling (NARCliM) Project

Methodology:

- Create lateral (& SST) boundary conditions from GCMs
- Drive RCMs with GCM boundary conditions

Limitations: Requires large amounts of computer time & data storage. (estimated at ~6 million CPU hours & 1PB)

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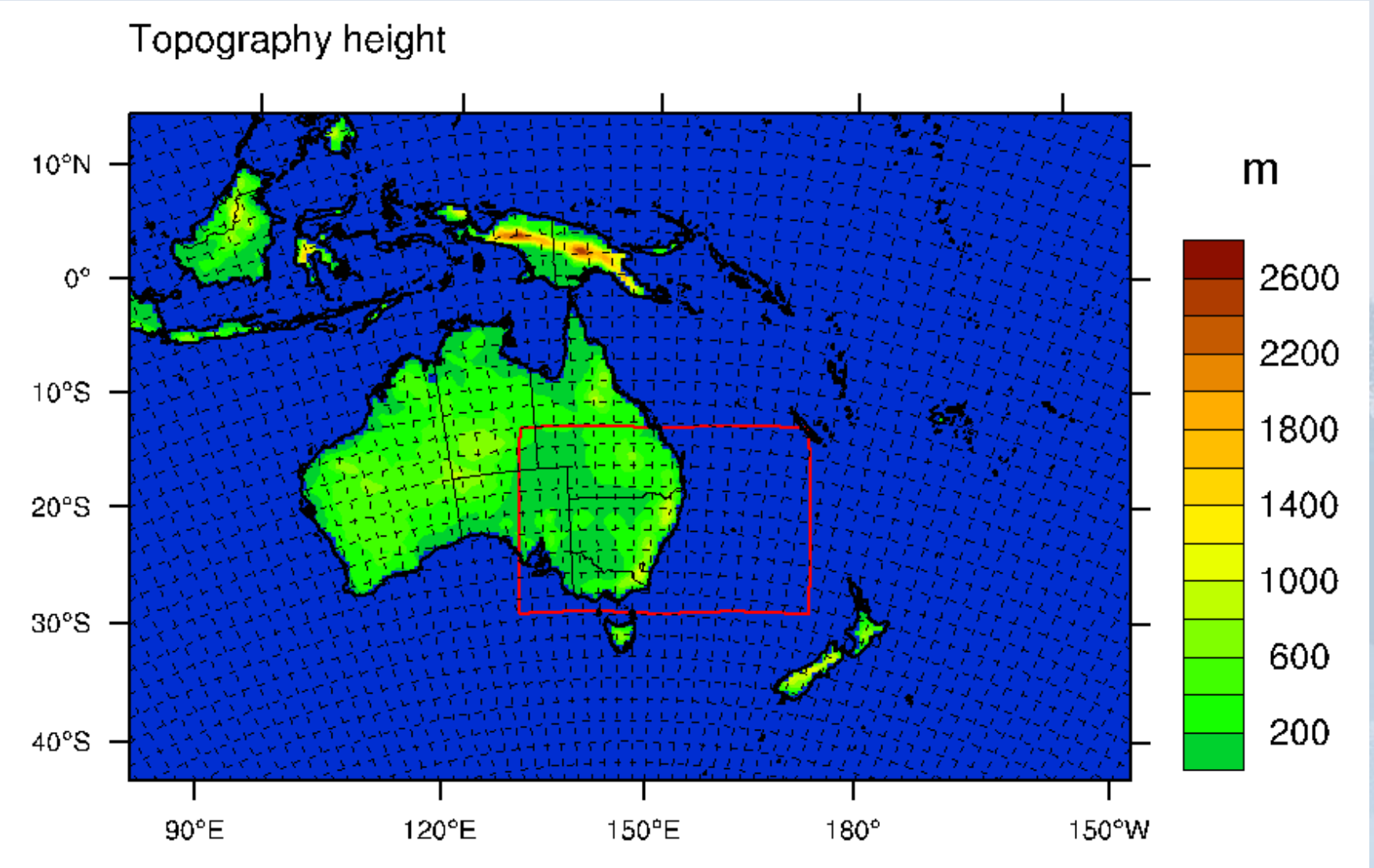
The NARCliM domain



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Currently available climate projections for NSW

Directly GCM based

- CSIRO – Climate Change in Australia
- UNSW / DECCW

Downscaled climate projections

- BoM "analogue" statistically downscaled projections
- NSW DPI "stochastic weather generator" statistically downscaled projections

In the future there will be NARCliM dynamically downscaled projections

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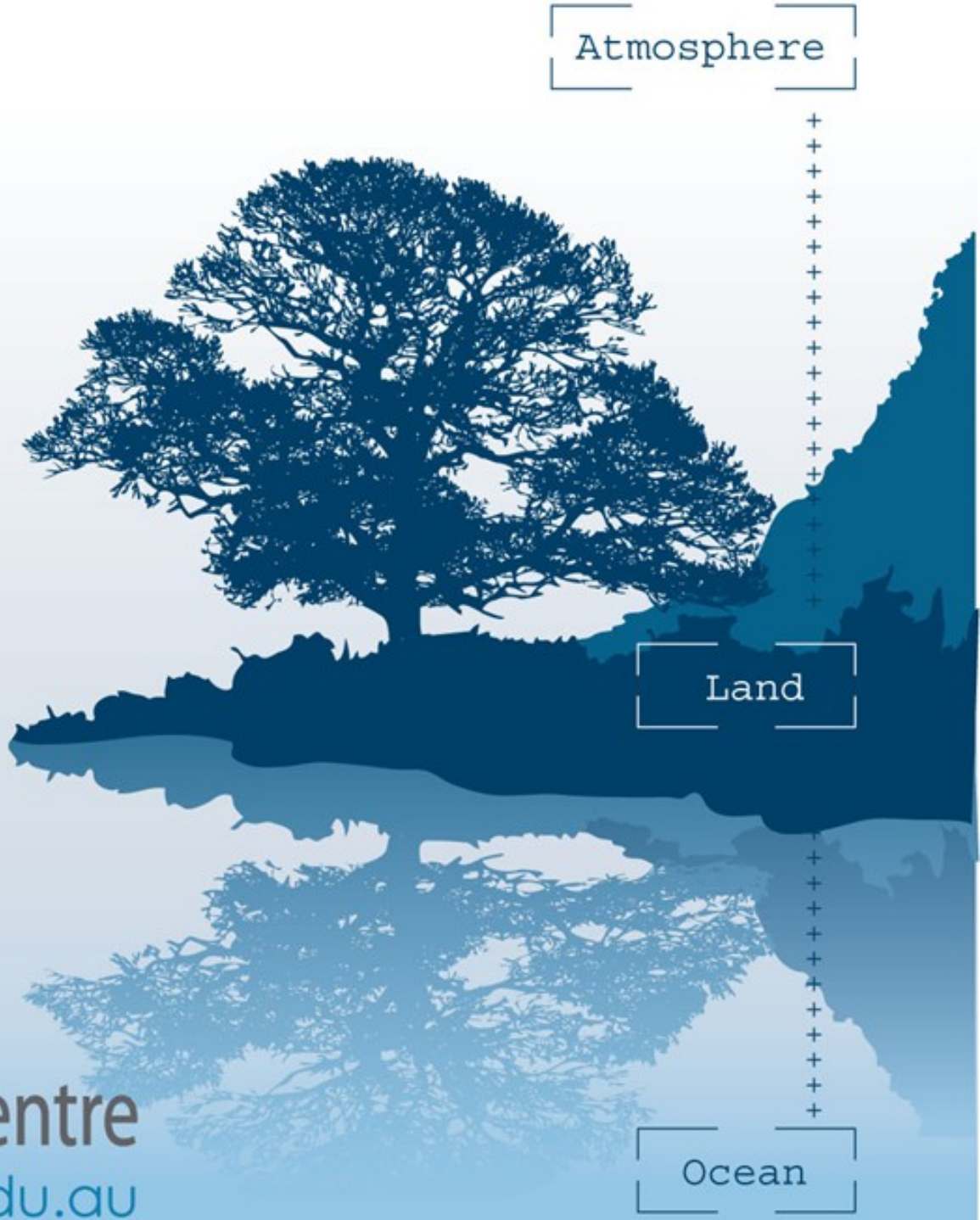
Regional climate projections for NSW

Dr Jason Evans

Jason.evans@unsw.edu.au



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