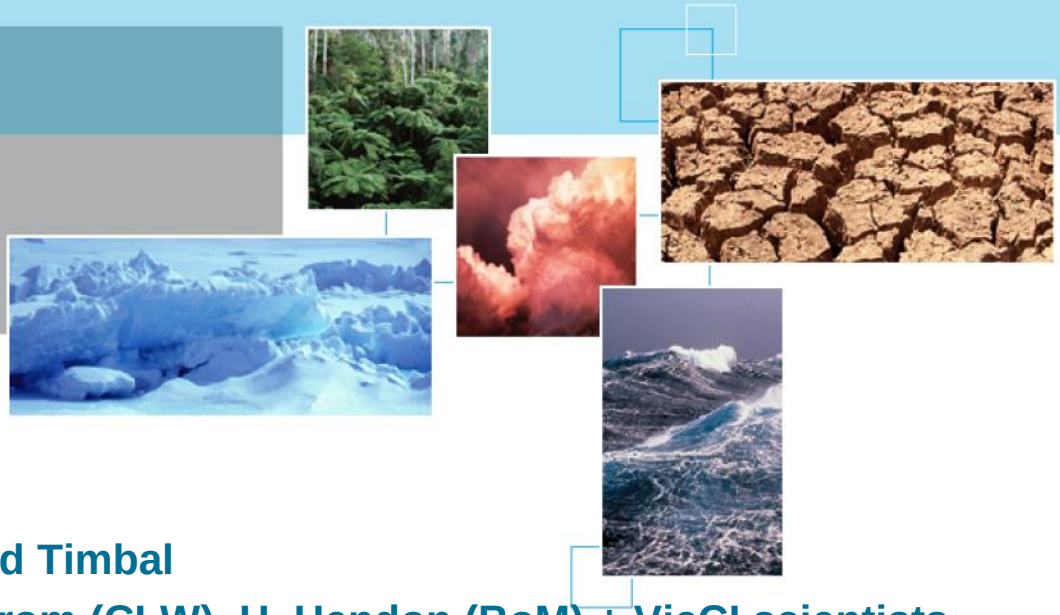
The Victorian Climate Initiative: VicCI



Bertrand Timbal
M. Ekstrom (CLW), H. Hendon (BoM) + VicCI scientists
S. Fiddes (Melb. Uni.), M. Griffiths (BoM)

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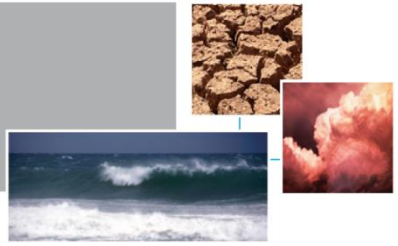
Relevance to today session



What new water and climate information should we be developing?

- Do we understand the most important water and climate process well enough ?
- Basic hydrological processes are still poorly understood
- Are we too focus on future projections not enough on understanding the story so far?
- We need better and faster access to information and data

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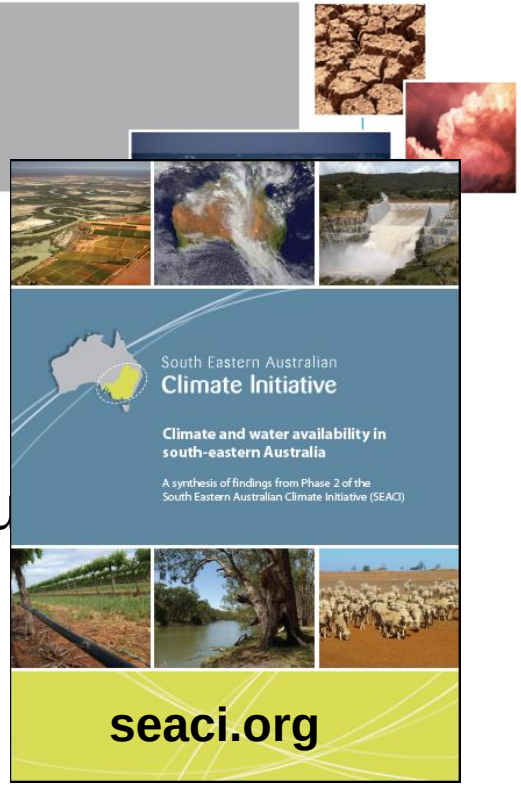
Overview of VicCI: rationale



Program Rationale:

- Restart where SEACI ended: continuing a su
- Smaller program: more targeted focus
- Interface of climate and hydrology
- Driven by user needs (water planning)
- Physical understanding, Predictability, Models assessment
- Prediction (year to multi-year), Projection (decadal to secular)
- Climate variability on multi-time scales

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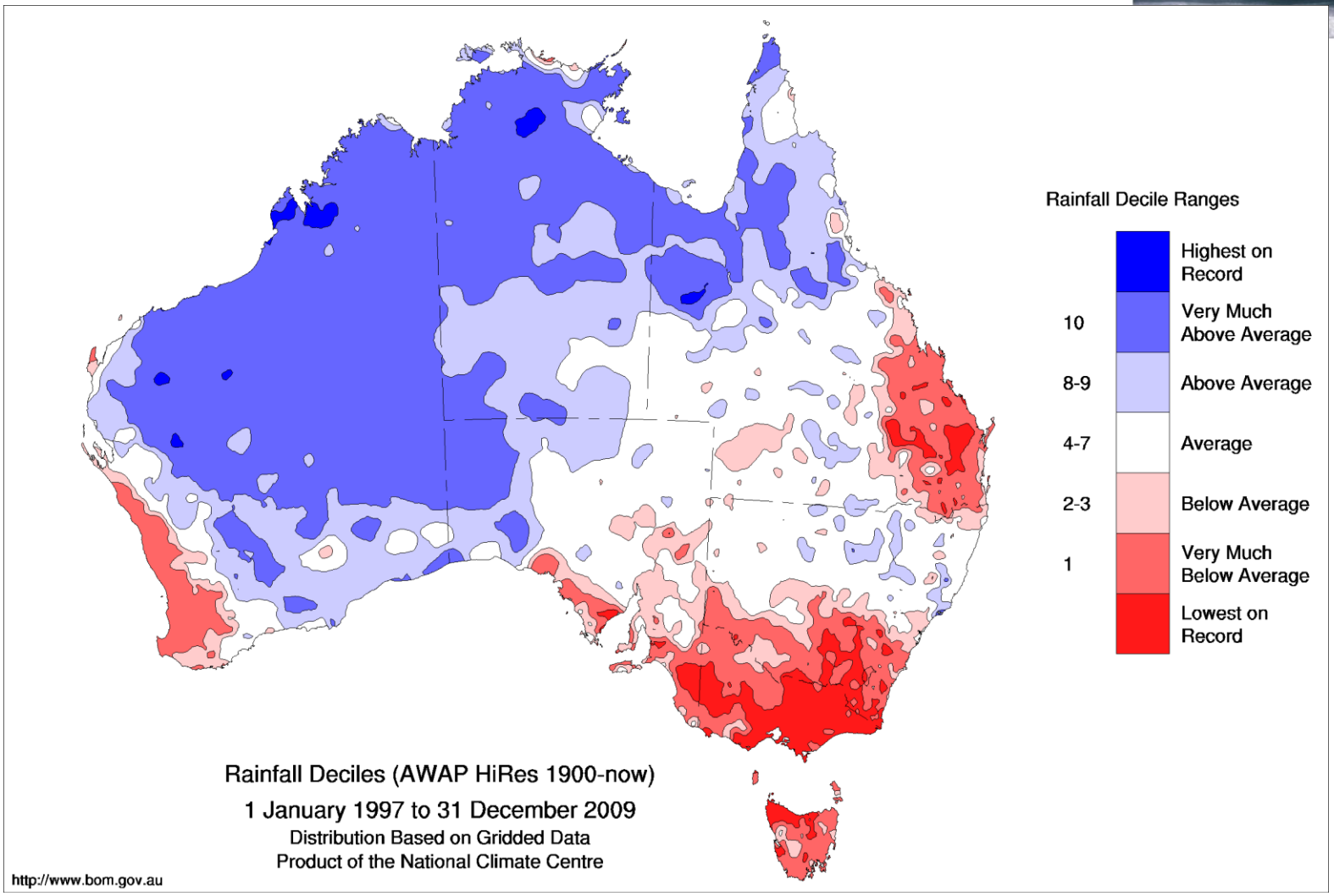
The Millennium Drought (1997-2009)



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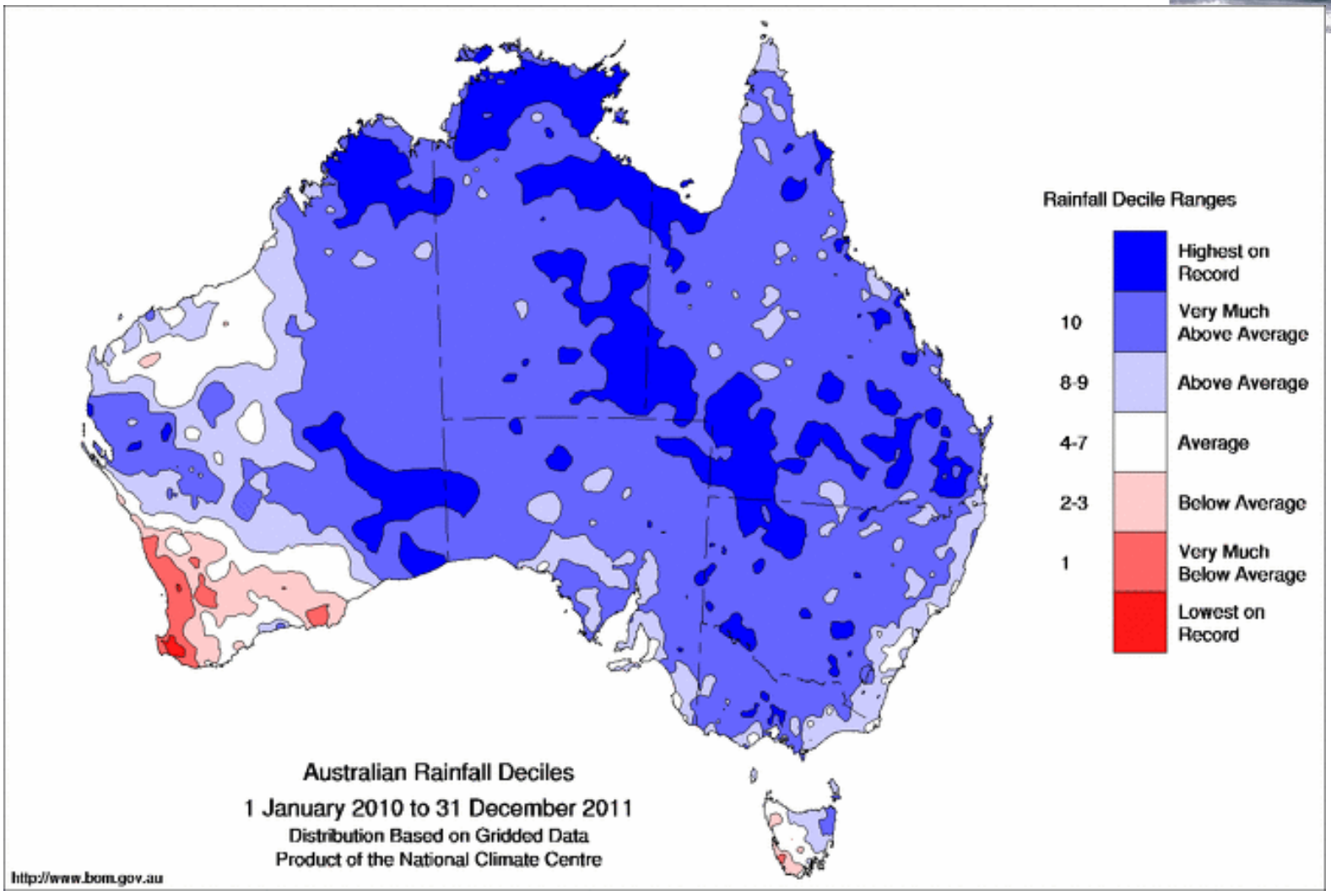
La Niñas of 2010-11 and 2011-12



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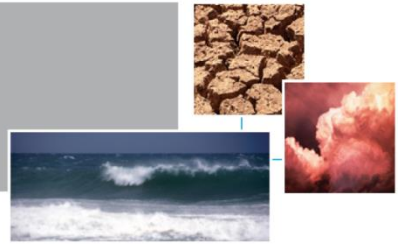
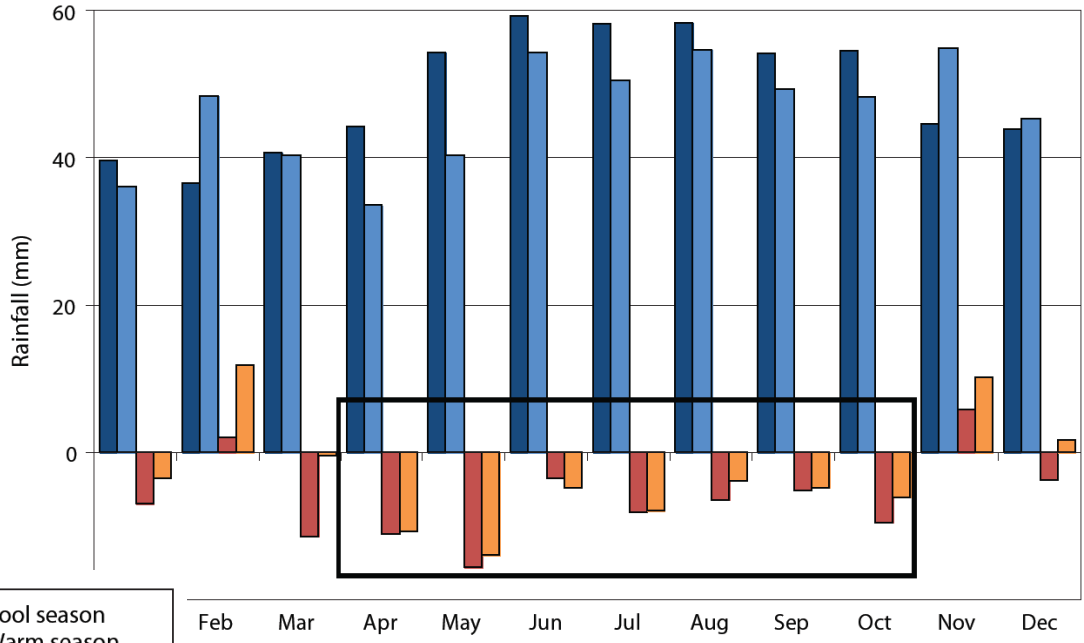
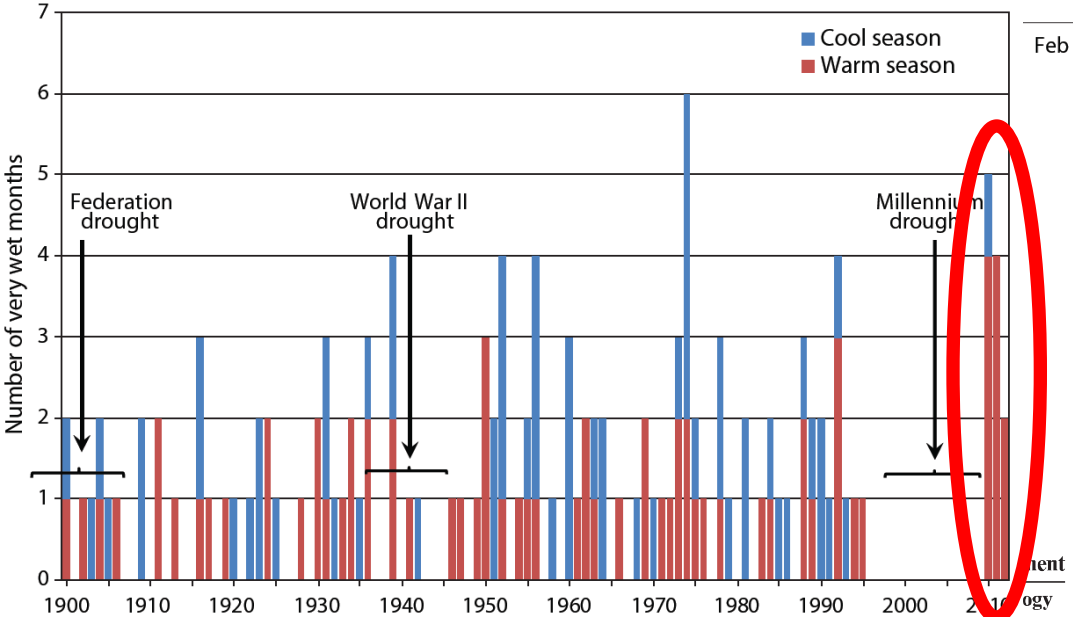
La Niñas of 2010-11 and 2011-12



- One extreme to the other!
- Largest number of very wet months
- Warm half of the year
- 10 out of 12 possible months





- 2010-11 are the wettest 2 years on record across Australia
- "Only" 4th wettest in SEA
- Due to on-going cool season rainfall deficiency unchanged in 2010 and 2011

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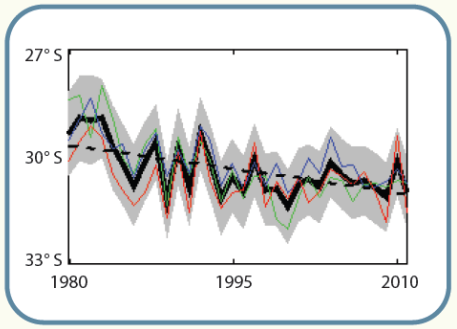
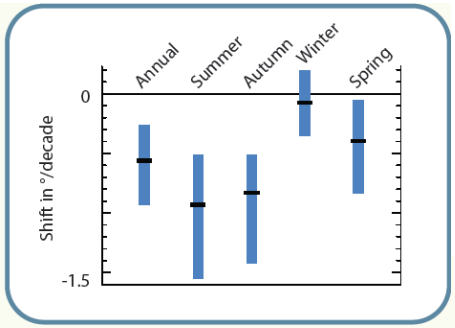
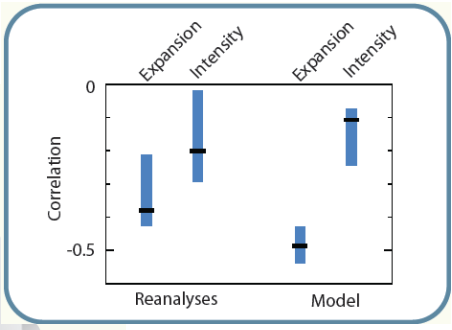
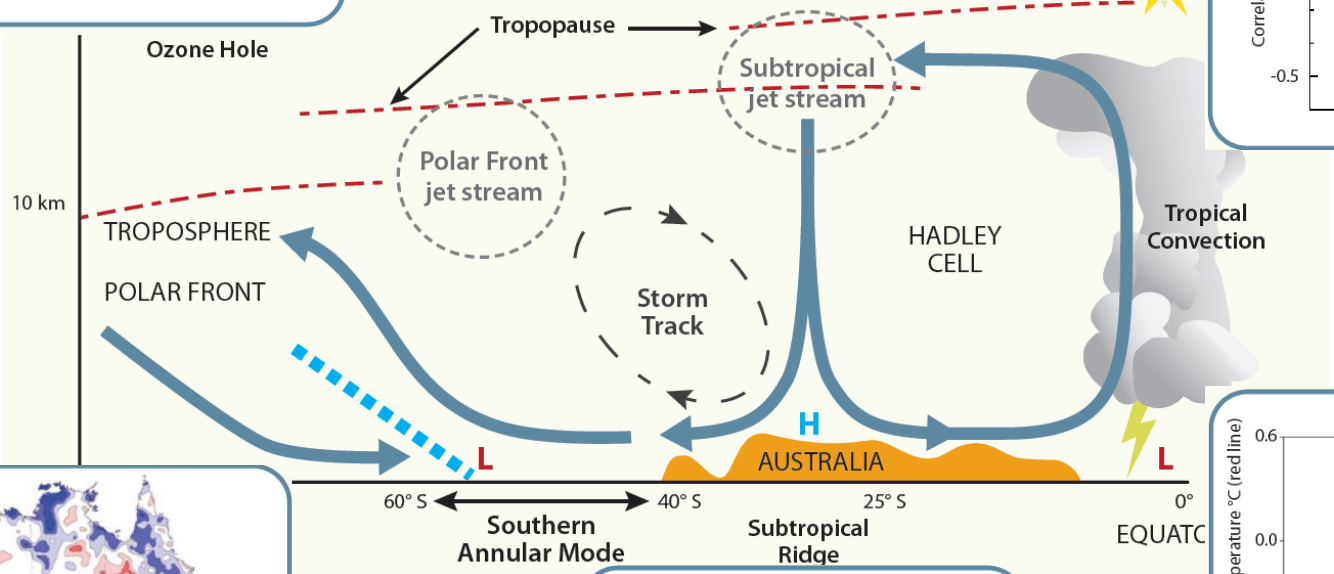
Mean Meridional Changes and their impacts

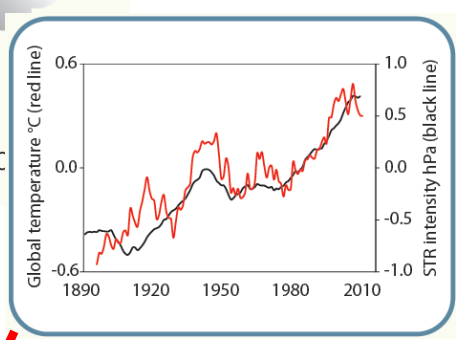


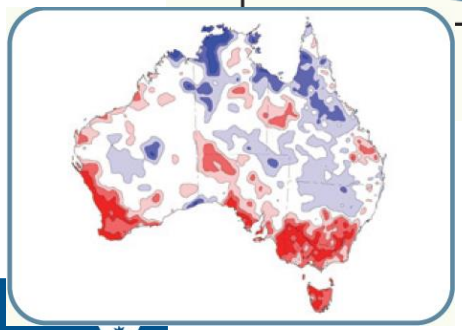
Ozone Hole

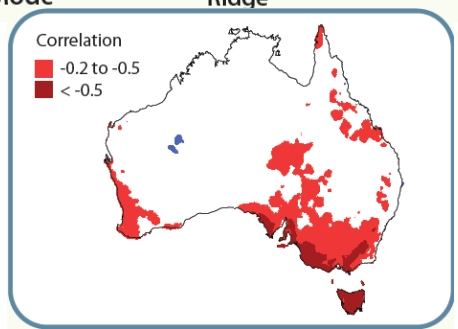












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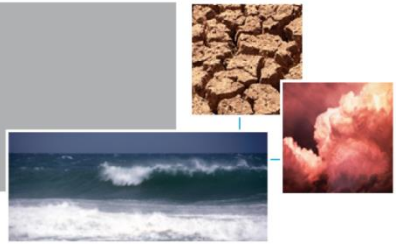
Overview of VicCI: 7 projects



Knowledge scale

Physical understanding

GCMs

Downscaling

Hydrological applications

Relevance scale

Tropical and extra-tropical interactions

Understanding Mean Meridional Circulation

Multi year predictability & predictions

Attribution of observed changes

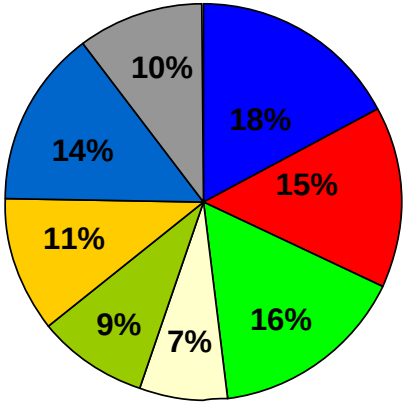
Inter-pretation of the GCM projec-tions

High resolution modelling of extremes

Downscaling and hydrological applications

Day | Season | Multi year | Decade | Century

Time scale



- P1: Multi year predictability & predictions
- P2: Changes in Mean Meridional Circulation
- P3: Tropical-extratropical interactions
- P4: Attribution of recent observed changes
- P5: Interpretation of GCMs' future projections
- P6: High resolution modelling of extremes
- P7: Downscaling & Hydrological applications
- Governance - Management - Communication

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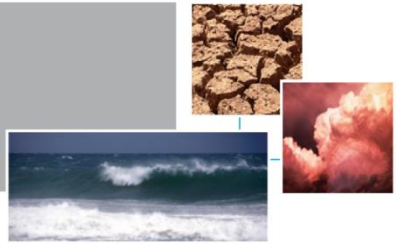
Project 7



Downscaling & Hydrological applications:

Team: Jin Teng (CSIRO), Bertrand Timbal (BoM),
Sonya Fiddes (Melbourne Uni)

- Investigate simple rainfall-runoff relationship in high yield catchment using high resolution gridded observations
- Review of possible bias corrections techniques needed to applied to downscaled rainfall series
- Generated future projections of streamflow

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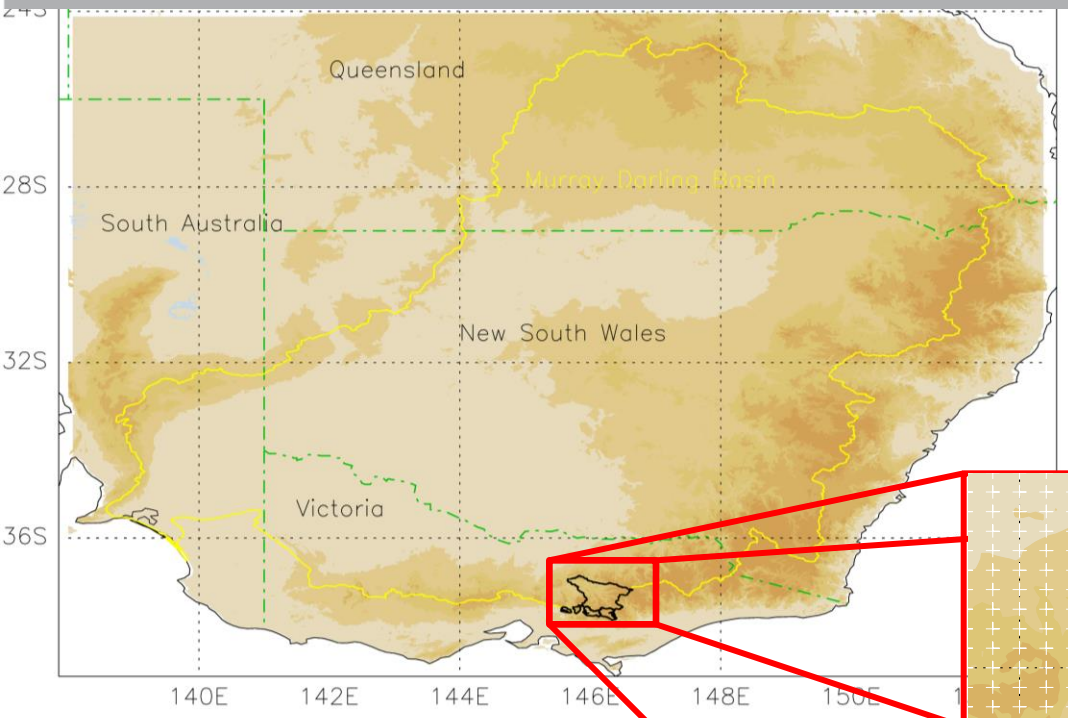
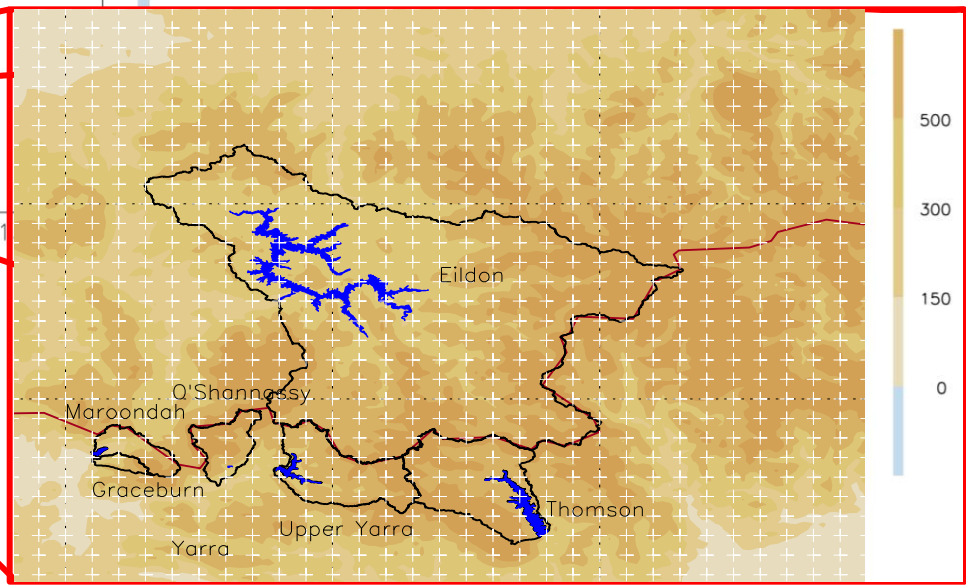
Focus on greater Melbourne Catchment area





Focusing on:

- Eildon (north of the GDR)
- Thomson catchment
- Yarra catchments (aggregated)
- Broader region (SEA, MDB)

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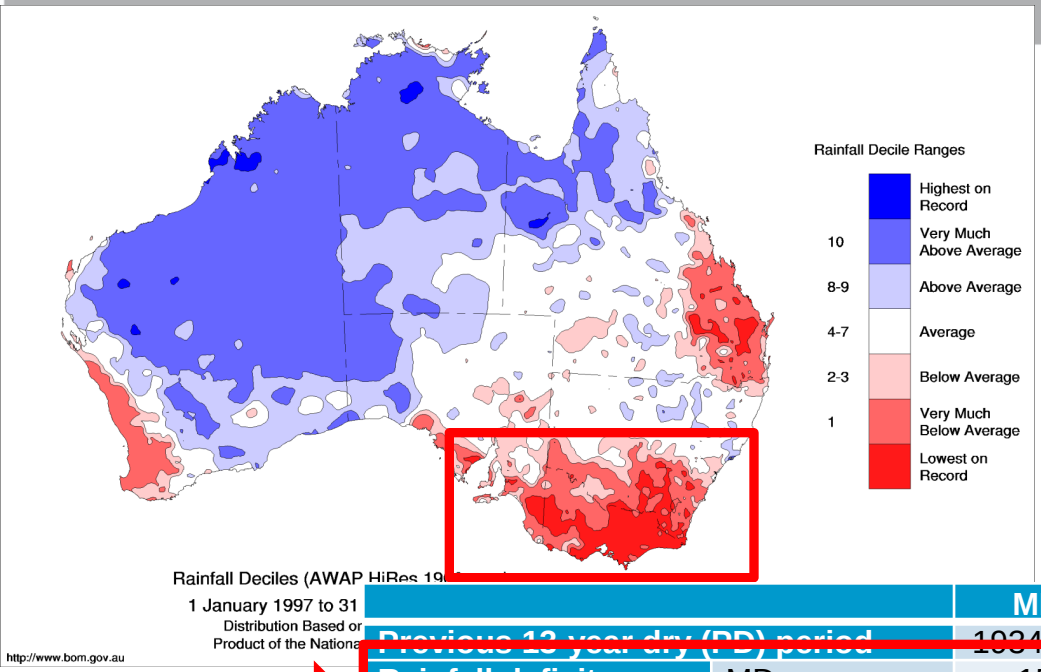
The Millennium Drought (1997-2009)



		MDB	Eildon	Yarra	Thomson	SEA
~~Previous 13 year dry (PD) period~~		~~1934-1946~~	~~1902-1914~~	~~1902-1914~~	~~1902-1914~~	~~1937-1949~~
Rainfall deficit	MD	-15 %	- 18 %	- 17 %	- 15 %	**-12%**
	~~PD~~	~~13 %~~	~~8 %~~	~~4 %~~	~~5%~~	~~8%~~
Wettest year	MD	577	1090	1476	1420	**611**
	Rank	(15)	(62)	(61)	(49)	**(44)**
	Anomaly	23%	2%	2%	2%	**5%**
	PD	543	1284	1735	1566	**697**
	Rank	(25)	(23)	(19)	(22)	**(13)**
	Anomaly	16%	15%	15%	13%	**20%**
Summer anomaly	MD	-6%	-8%	-8%	-8%	**-6%**
	PD	11%	-10%	-8%	-9%	**+8%**
Autumn anomaly	MD	-24%	-29%	-25%	-24%	**-26%**
	PD	-16%	-1%	+1%	-4%	**-5%**
Winter anomaly	MD	-4%	-16%	-13%	-12%	**-9%**
	PD	-7%	+1%	2%	+1%	**-11%**
Spring anomaly	MD	+3%	-12%	-14%	-13%	**-6%**
	PD	**-26%**	**-5%**	**-5%**	**-3%**	**-13%**

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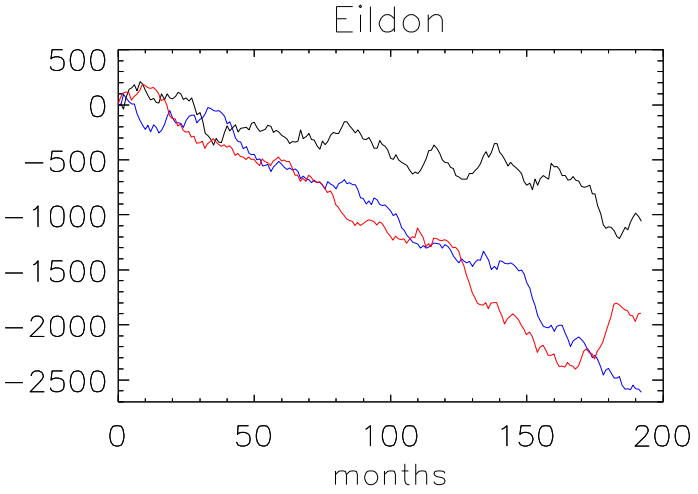
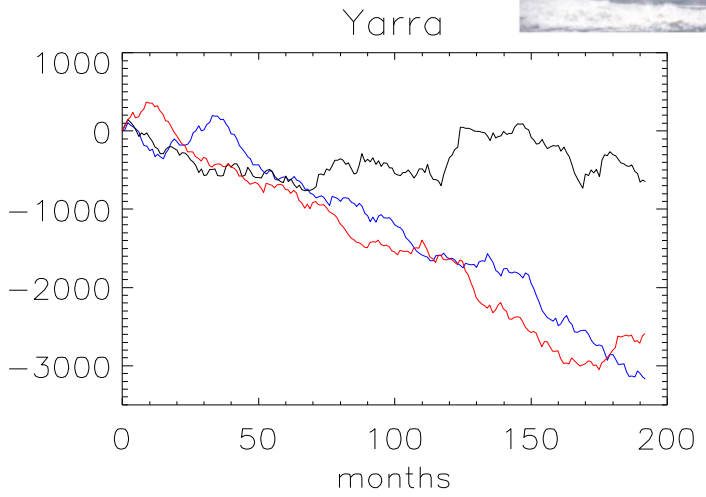
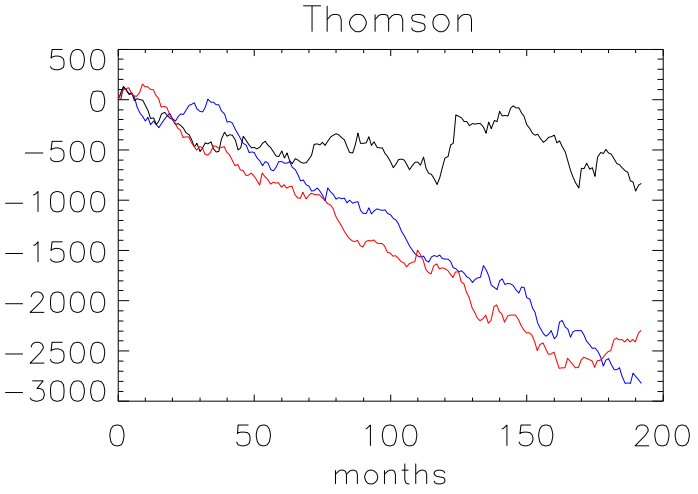
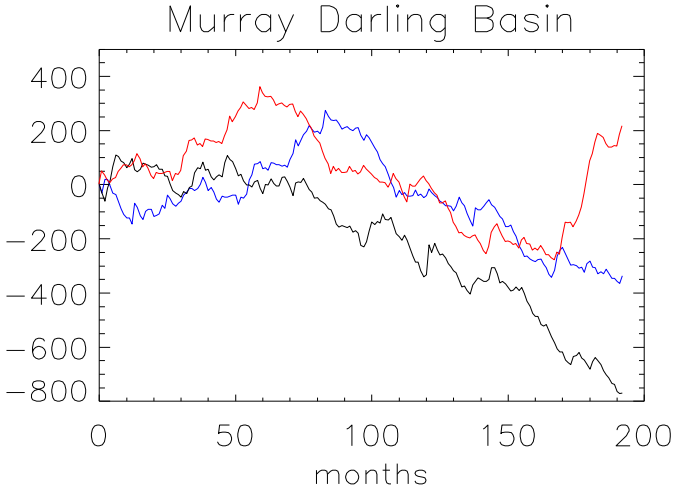
Historical Perspective: Millennium Drought + 2010-11 recovery









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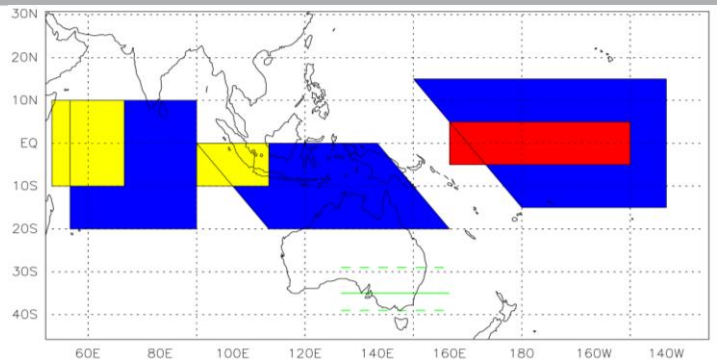
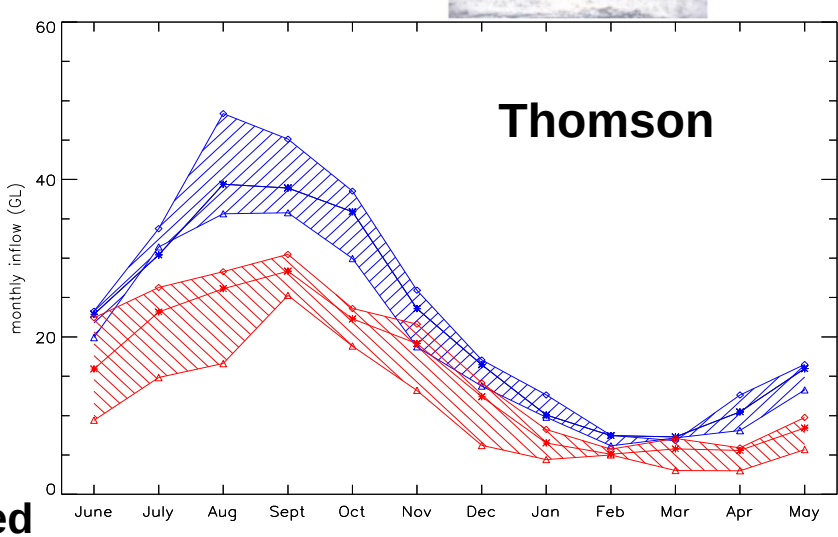
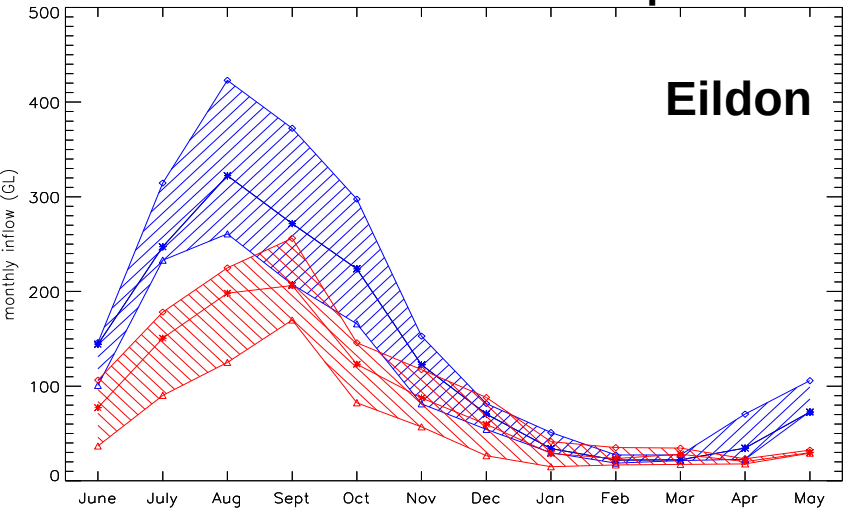
Has the influence changed in the last 20 years?

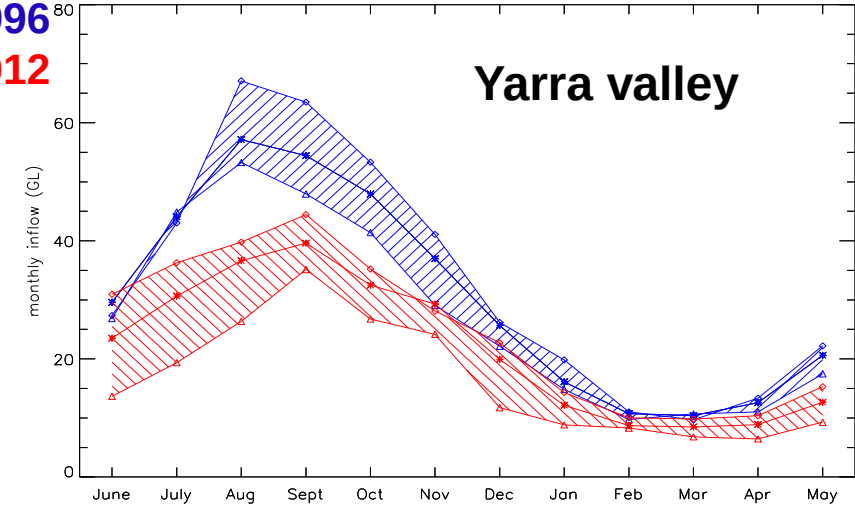


Composite inflow years
Based on the sign of the tripole
(positive = la Nina or Negative IOD)
Two distinct periods are considered

1910 to 1996
1997 to 2012







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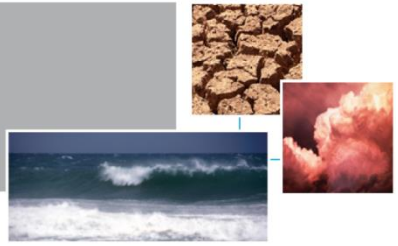
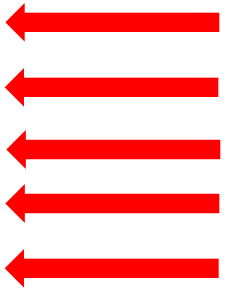
Reconstructing measured inflows



- Difficulty in understanding the inflow response during the Millennium Drought:
  - Increase in the elasticity factor: rainfall > inflow
  - Role of Temperature (obvious or non existent??)
  - Role of seasonality of the rainfall decline
  - Role of lack of very wet years
- Possible non-stationarity of hydrological process:
  - Is the current hydrological modelling coping with this?
  - Is there a way to by-pass this and simply rely on atmospheric variables?
  - Test a series of simple linear models:

$$Inflow_{Month} = f(Rain_{Month}) + f(Rain_{Month-1}) + f(Rain_{Year}) + f(Rain_{10\,Years}) + f(Tmax_{Month})$$



Far from sufficient
Important
Needed for MD depth
Marginal improvement
No impact

How are the MD and linear trends captured?

		Eildon	Yarra	Thomson
1913 to 2012 linear trend (as a percentage of mean) (mm/decade)	Rainfall	-6	-8	-8
	Inflow	-34	-34	-36
	With T_{max}	-17	-16	-15
	Without	-17	-16	-15
1980 to 2012 linear trend As percentage of 1980-2012 mean	Rainfall	-13	-11	-7
	Inflow	-38	-23	-18
	With T_{max}	-50	-29	-19
	Without	-49	-29	-17
1997 – 2009 anomaly (% from long term mean)	Rainfall	-18	-17	-16
	Inflow	-42	-36	-37
	With T_{max}	-40	-35	-30
	Without	-40	-34	-30

Hydrologic Reference Stations

Introduction | Feature Stations | Selection Guidelines | FAQs | Glossary | Methods | Stakeholder | References and Papers | Feedback | Copyright

Station Selector

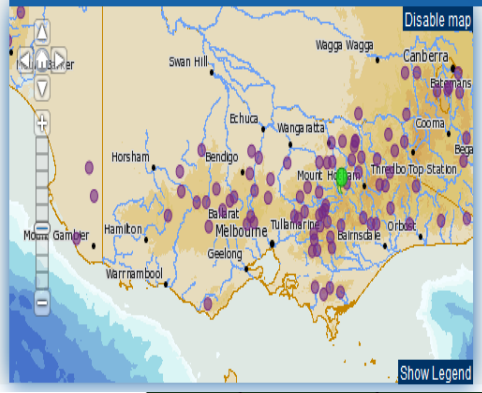
Region: Victoria

Basin: Ovens River

Station: Rose River at Matong North (403217)

Nearby stations
- Buffalo River at Abbeyard (403222)
- Boggy Creek at Angleside (403226)
- Happy Valley Creek at Rosewhite (403214)

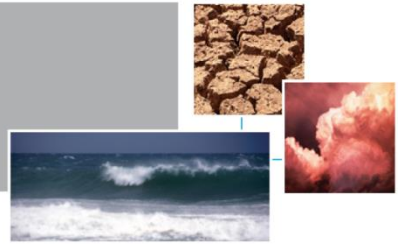
Rose River at Matong North (403217)



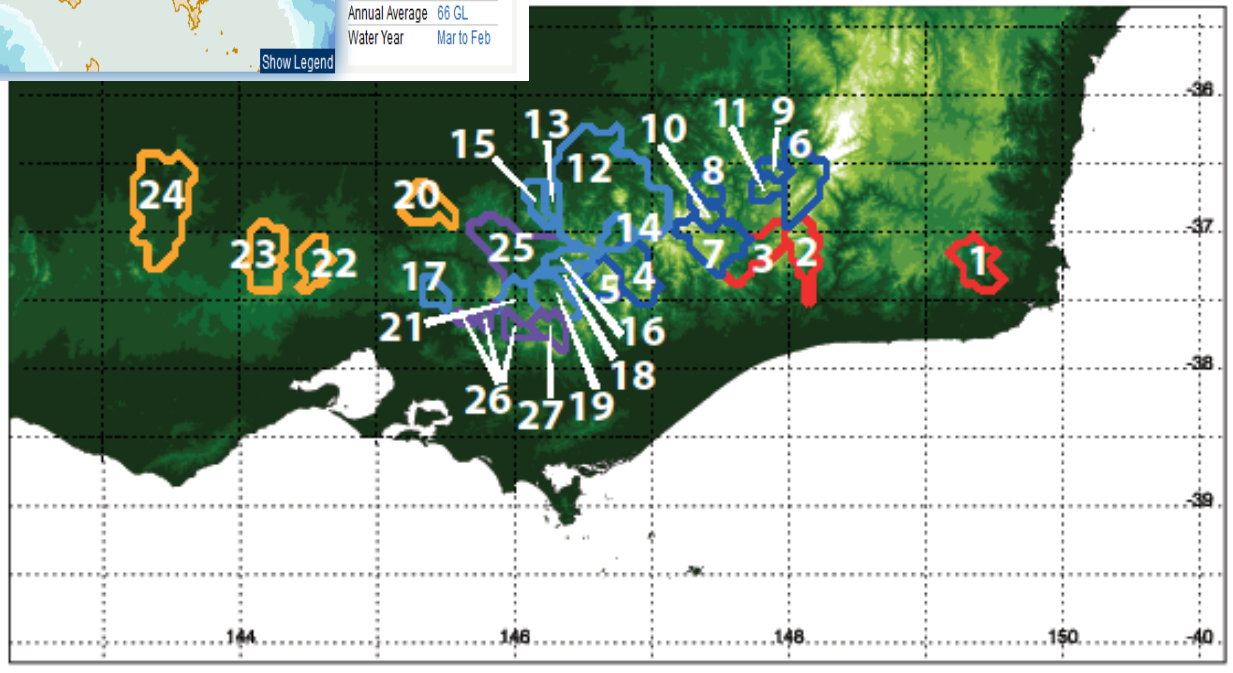
Quick Facts

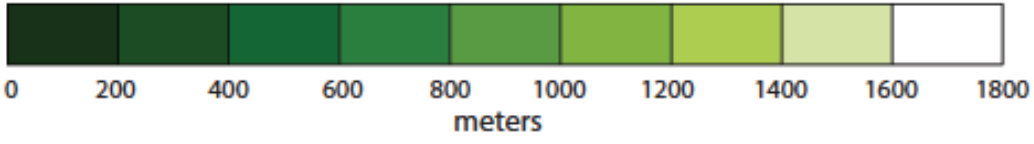
Catchment	
Area	180 km^2
Stream Length	151 km

Time series	
Start Date	24-06-1967
End Date	18-04-2007
Gap-filled	0.44 %
Daily Max	10929 ML
Daily Min	0 ML
Daily Average	178 ML
Annual Average	66 GL
Water Year	Mar to Feb



Catchment Areas





1: Genoa
2: Buchan
3: Tambo
4: Wonnangatta
5: Macalister
6: Murray
7: Mitta
8: Snowy
9: Nariel
10: Jokers
11: Gibbo
12: Reedy
13: 15 Mile
14: Buffalo
15: Holland
16: Howqua
17: Yea
18: Jamieson
19: Goulburn
20: Pranjip
21: Big
22: Campaspe
23: Loddon
24: Avoca
25: Eildon
26: Yarra
27: Thomson

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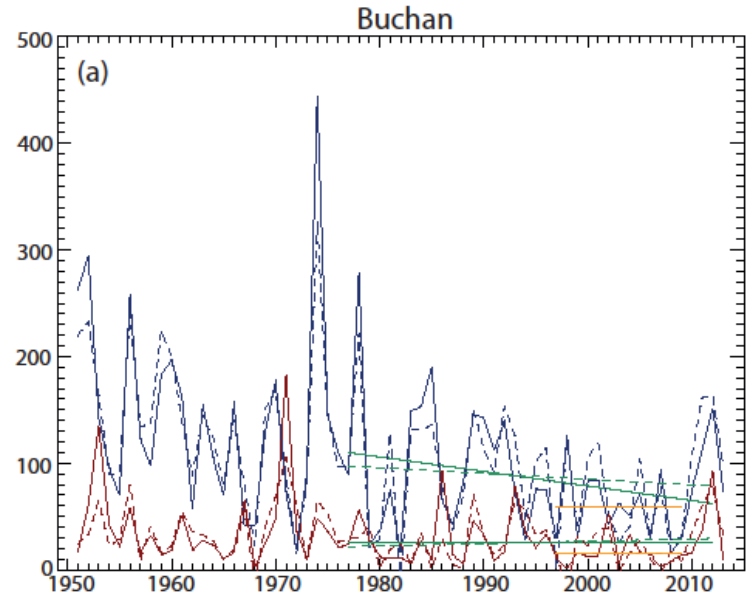
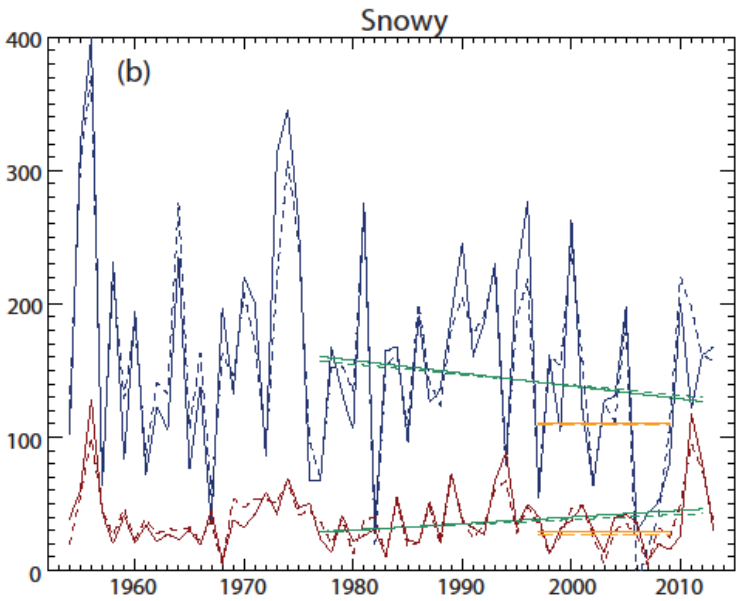
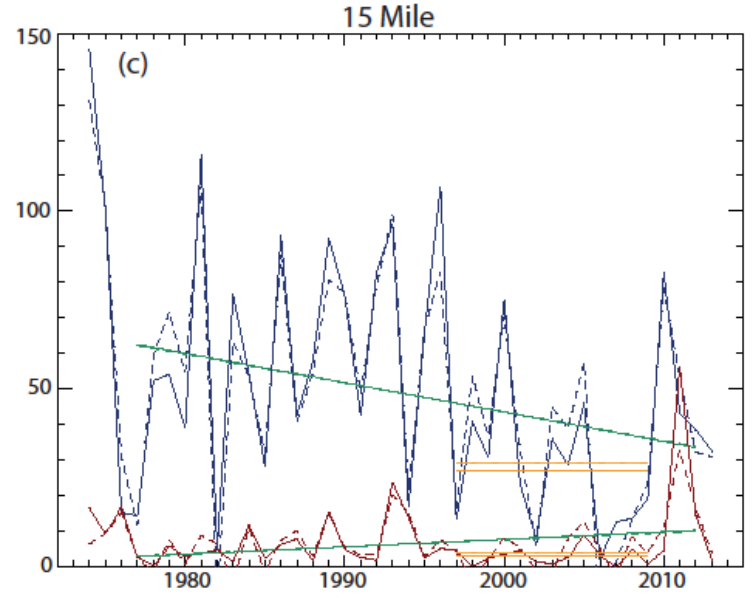
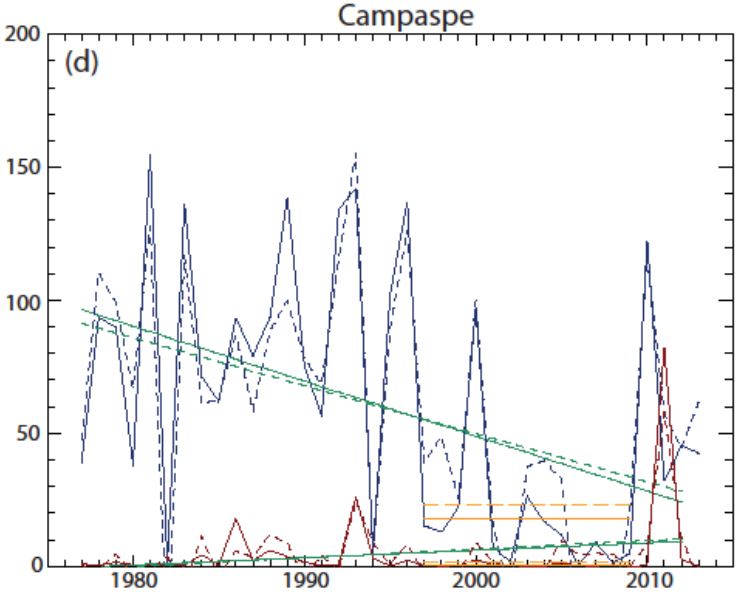
Seasonal Inflow (GL)









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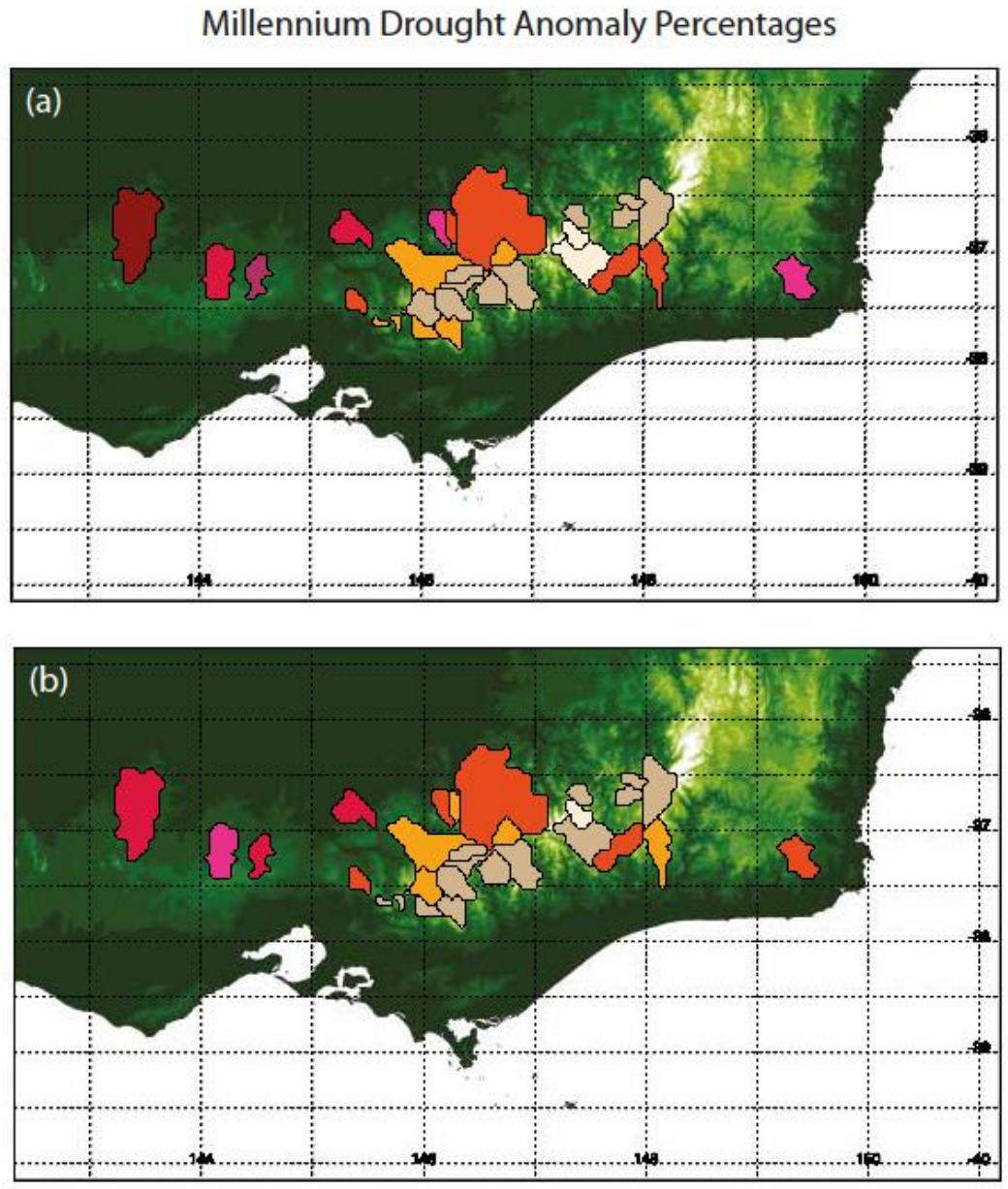
Observed

Reconstructed



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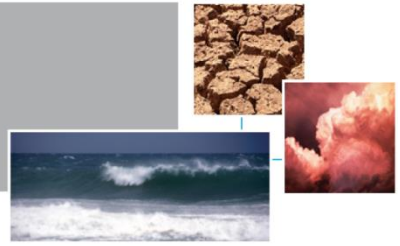
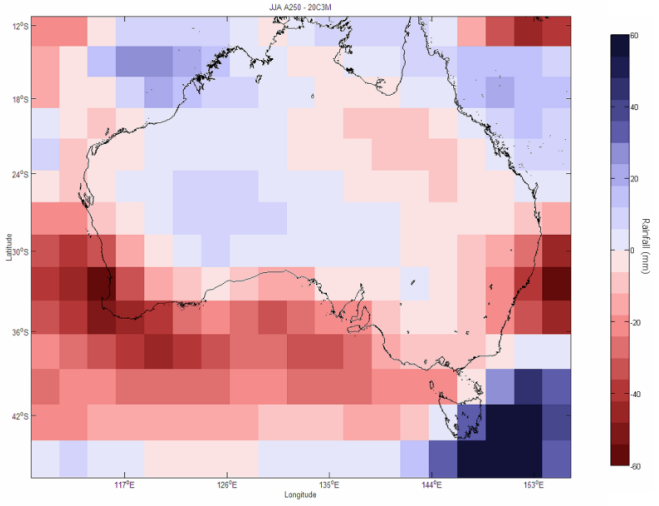
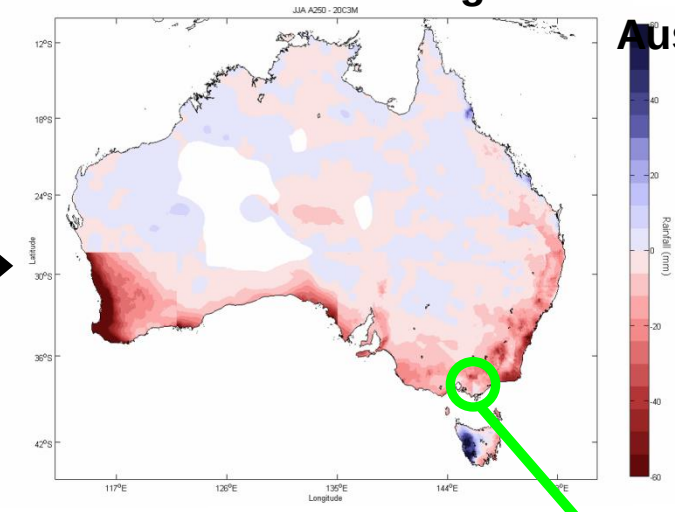


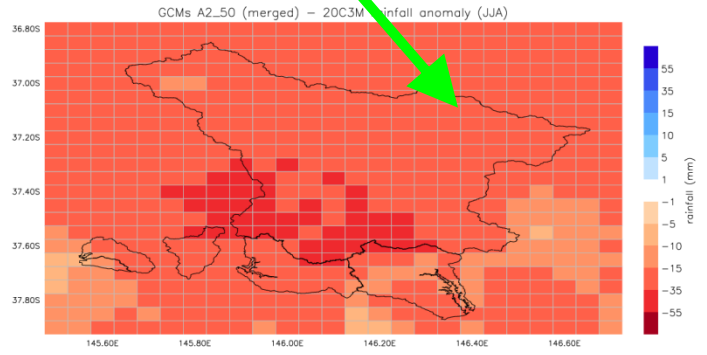
- Downscaling to a 5*5 km grid (same than BoM operational gridded observation)
- 22 CMIP5 models used, RCP 4.5 and 8.5, daily outputs from 2005 to 2100
- Currently available variables: Rain, T_{max} , T_{min}

Host CMIP5 GCM (any one of them)



Statistical Downscaling of the CMIP5 model: Australia-wide





Possible to apply for adaptation and impact studies: e.g. rainfall projections for Melbourne main catchment area

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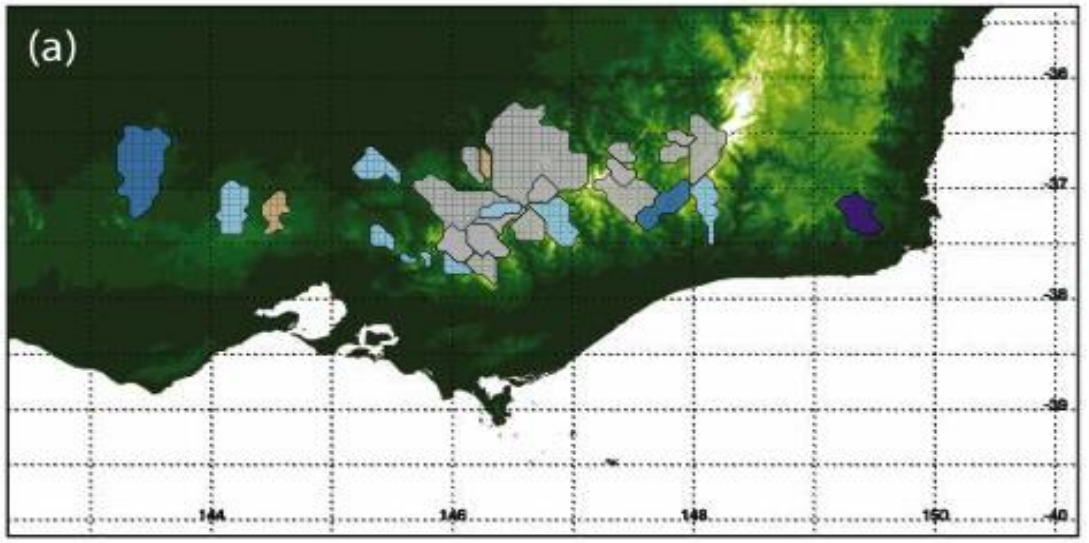
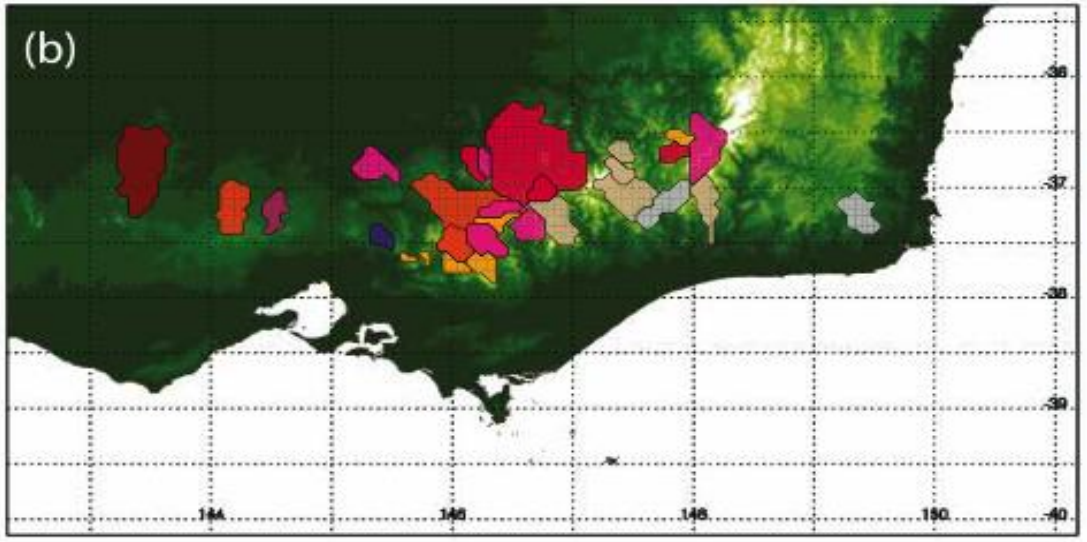
Model Performance



mean %
160 to 170
150 to 160
140 to 150
130 to 140
120 to 130
110 to 120
100 to 110
90 to 100



variance %
145 to 155
135 to 145
125 to 135
115 to 125
105 to 115
95 to 105
85 to 95
75 to 85
65 to 75
55 to 65
45 to 55
35 to 45
25 to 35

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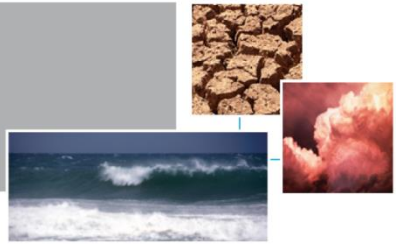
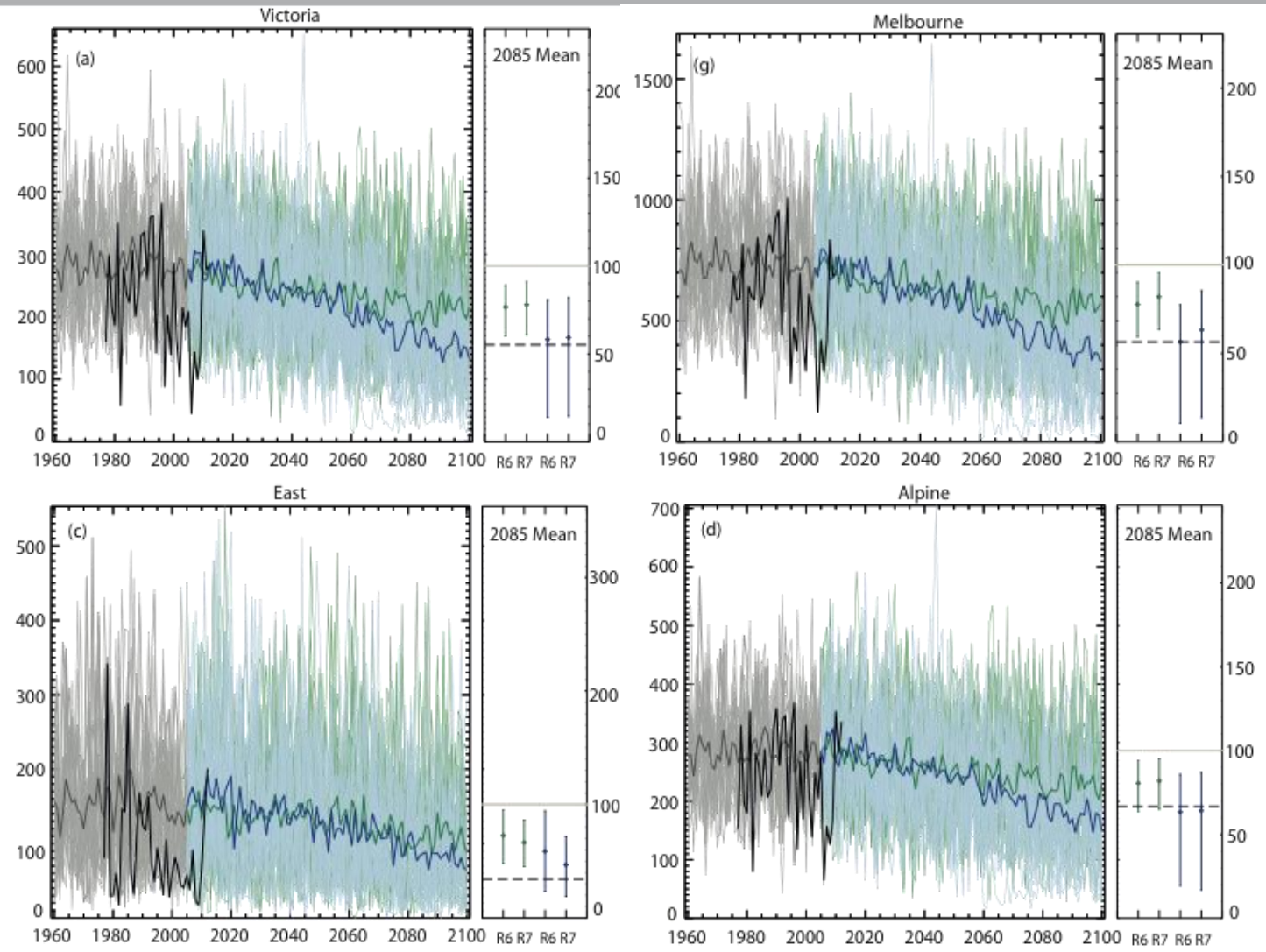
Projected inflow time series





- Observations
- Histrocal average
- R6 RCP 4.5 average
- R6 RCP 8.5 average
- Historical all models
- R6 RCP 4.5 all models
- R6 RCP 8.5 all models
- 1990 Historical mean
- MD mean

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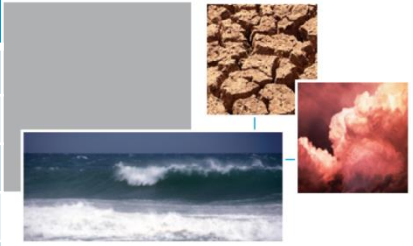
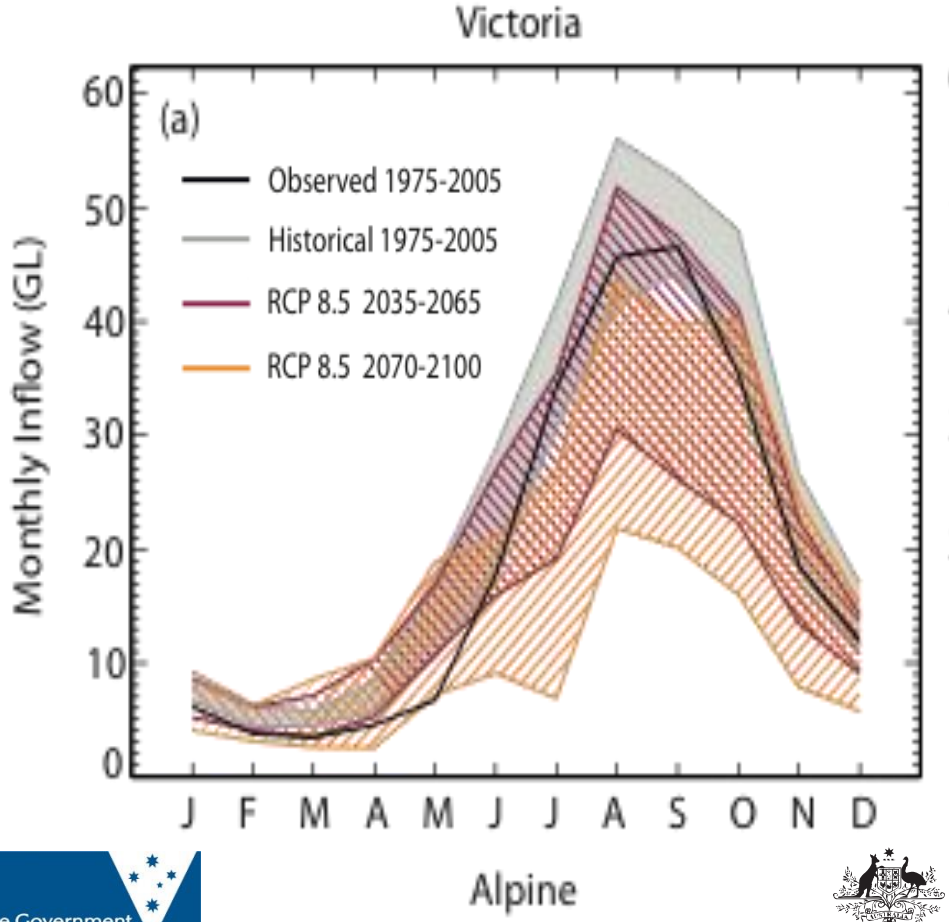
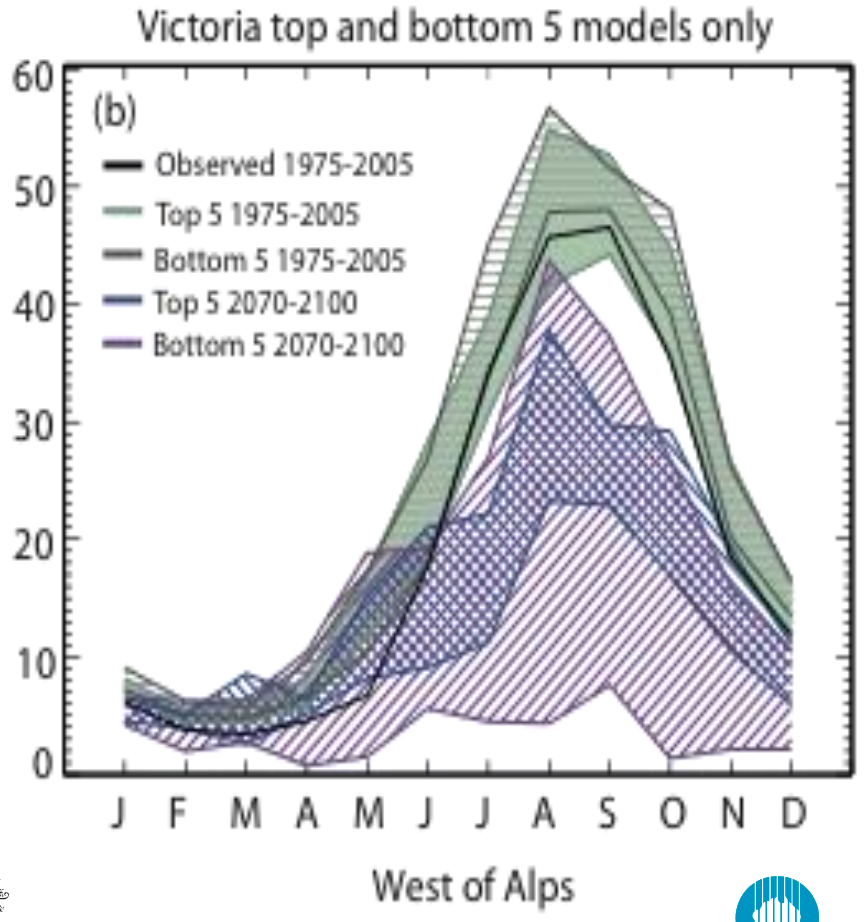
RCP 8.5						
	Annual		Dry Season		Wet Season	
Catchment	2050	2085	2050	2085	2050	2085
East	-16.0	-46.7	3.8	-21.3	-23.3	-48.0
Alpine	-15.9	-36.0	-6.3	-16.8	-14.2	-34.3
West of Alps	-22.4	-42.3	-9.1	-21.0	-18.2	-39.5
Far West	-37.7	-53.8	-19.0	-14.8	-31.6	-44.6
Melbourne	-18.0	-35.7	-8.8	-28.1	-18.6	-43.3
Average	-21.6	-43.5	-8.3	-19.6	-19.6	-40.0







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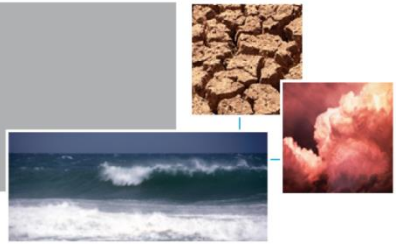
Relevance to today session



What new water and climate information should we be developing? **Streamflow future projections relying on downscaled rainfall**

- Do we understand the most important water and climate process well enough ? **The most important: yes**
- Basic hydrological processes are still p **She'll be right, love!**
- Are we too focus on future projections not enough on u **The past explains the present which leads you to the understand the future**
- **The week we generated the future streamflow projections we provided them to DEPI ……. And wish them good luck !!**

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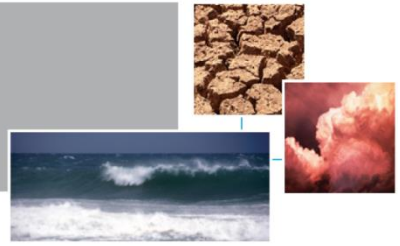

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- Bertrand Timbal: b.timbal@bom.gov.au
- VicCI web site: http://cawcr.gov.au/vicci/
- VicCI first annual report: CAWCR Tech. Rep. N°76:
  http://cawcr.gov.au/publications/technicalreports.php