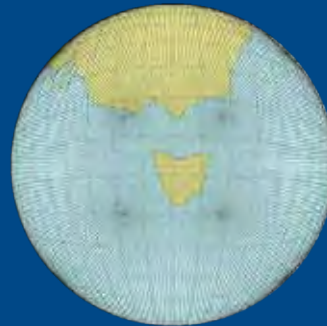


Coupling regional climate models and hydrological models to produce fine-scale runoff projections



James Bennett^{1,2}, Fiona Ling², Bryce Graham³, Michael R Grose¹, Stuart Corney¹
Greg K Holz¹, Christopher J White¹, and Nathaniel L Bindoff^{1,4}

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²Entura

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⁴Centre for Australian Weather and Climate Research (CAWCR)

Water in Tasmania



Irrigation/Agriculture

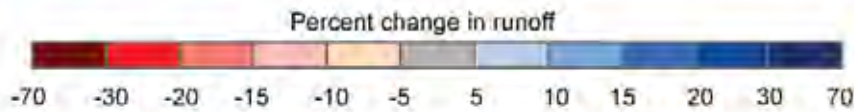
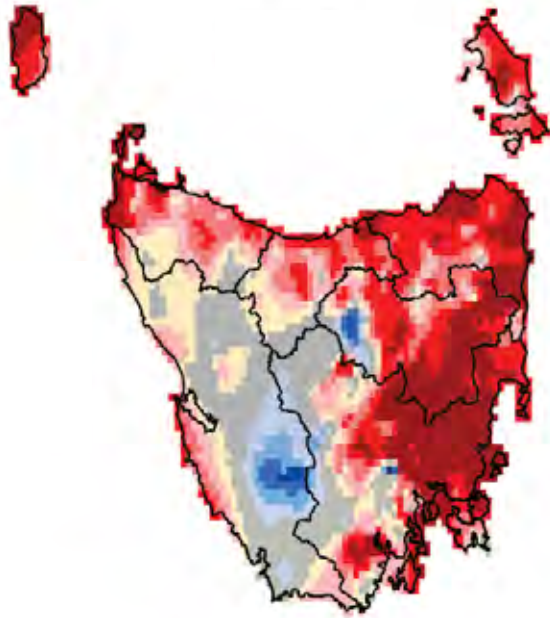


Hydropower



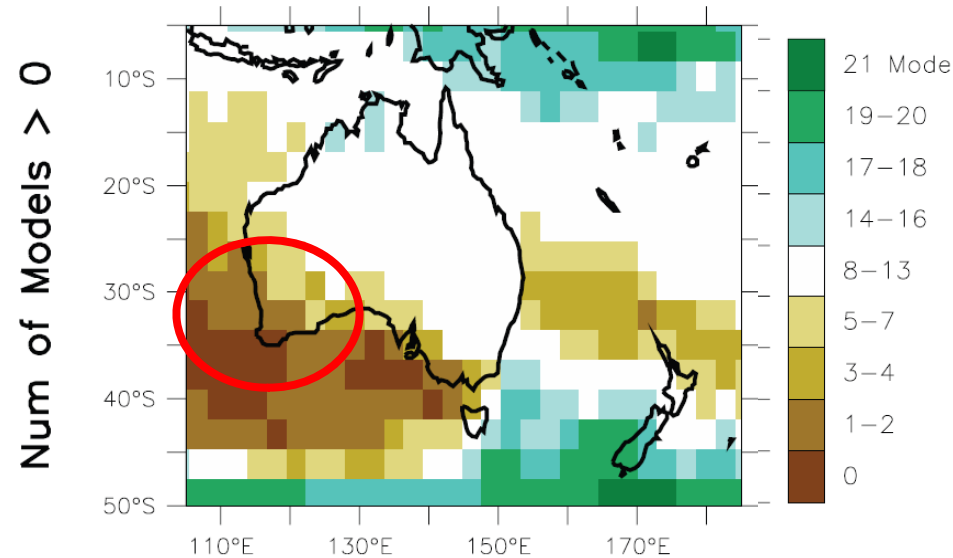
Environment

Tas Runoff Change 1997-2008 vs 1924-2008

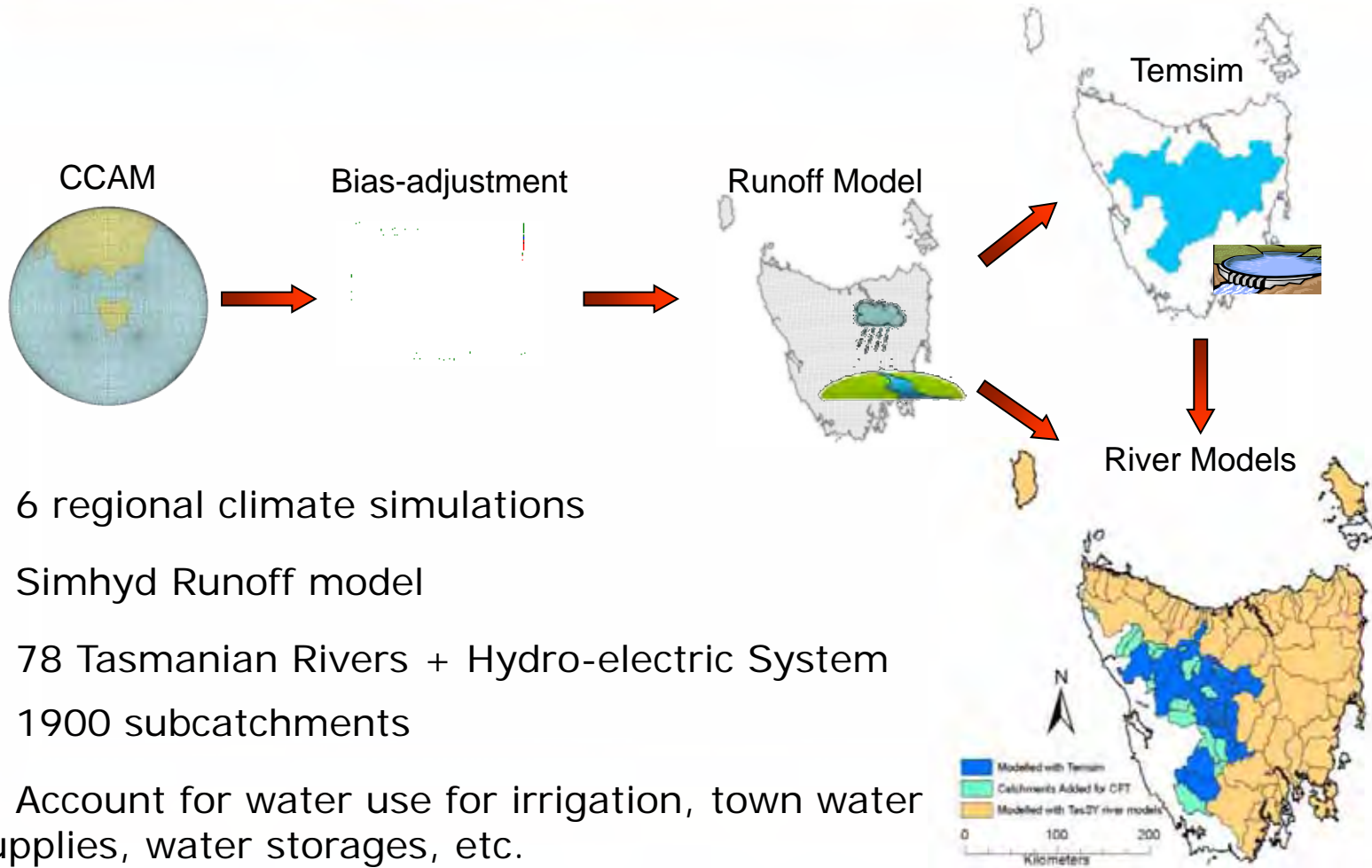


Source: Viney et al (2009)

Regional Rainfall change 1980-2000 vs 2080-2100

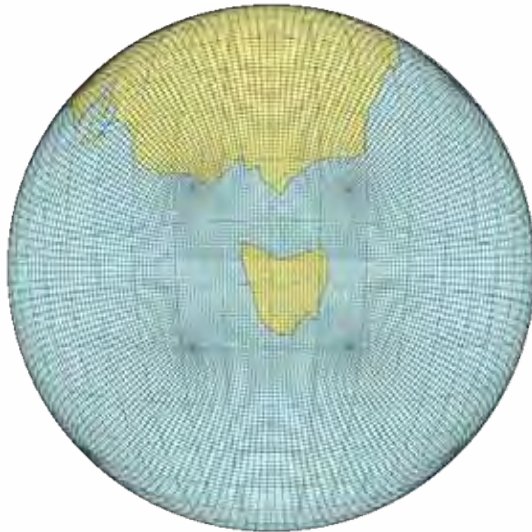


Source: IPCC (2007)

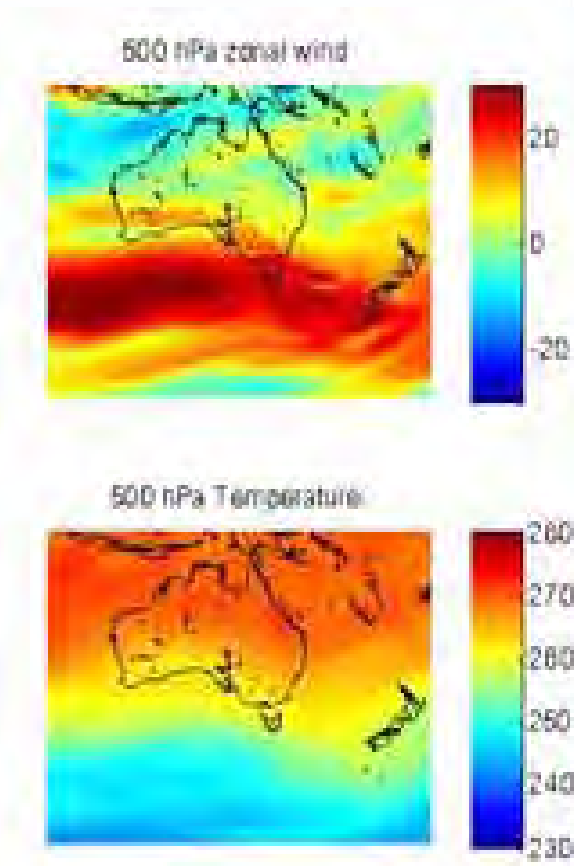


- 6 regional climate simulations
- Simhyd Runoff model
- 78 Tasmanian Rivers + Hydro-electric System
- 1900 subcatchments
- Account for water use for irrigation, town water supplies, water storages, etc.

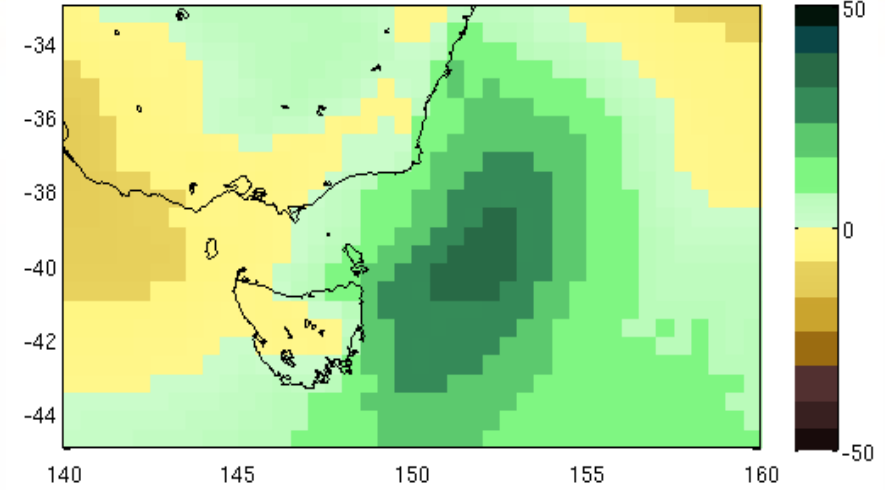
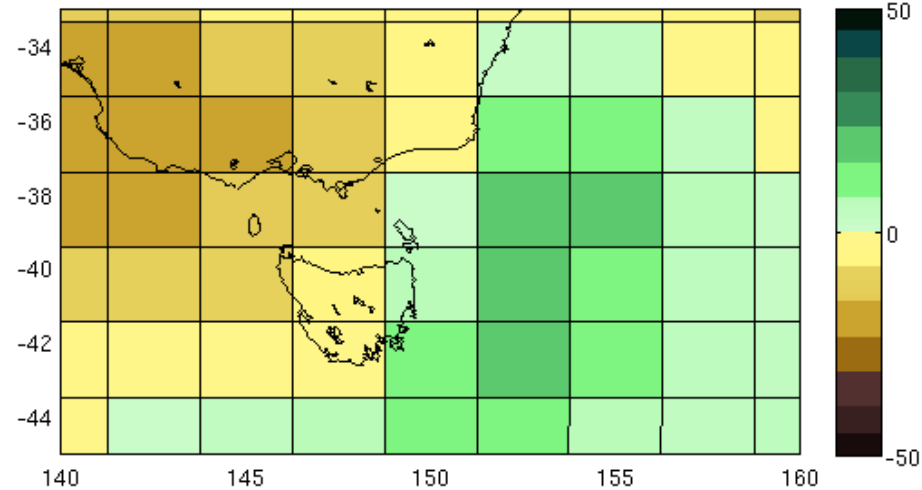
CSIRO Conformal Cubic Atmospheric Model (CCAM)



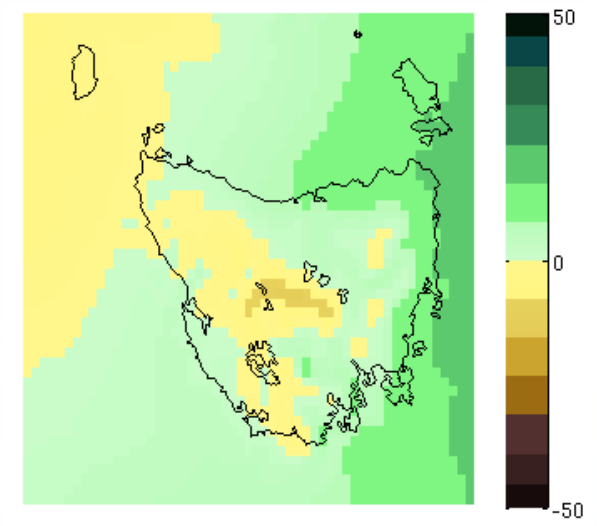
Stretched grid
Global coverage
= several advantages



GCM Downscaling: Adding value to GCMs

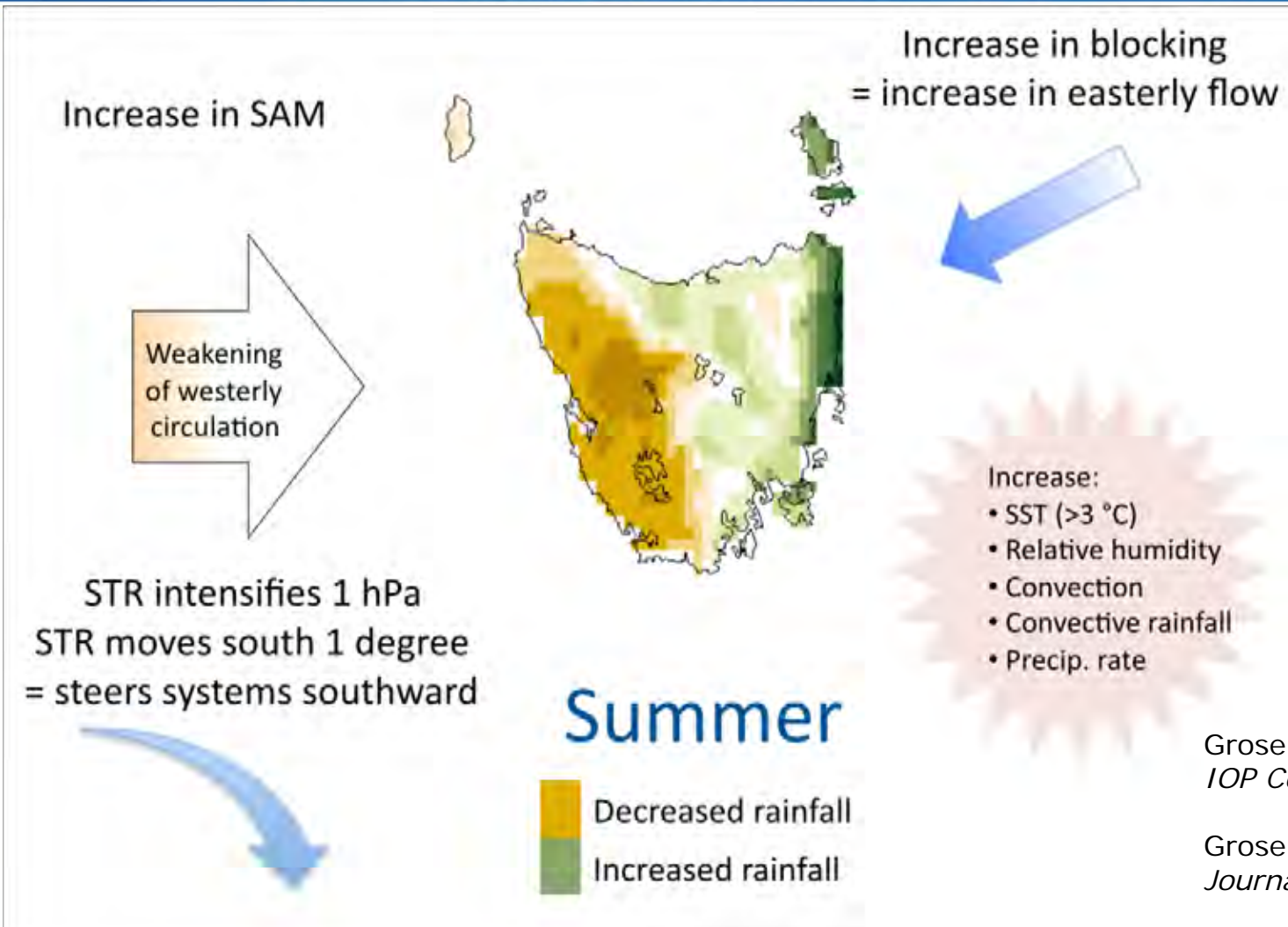


- 2 stages: 50 km resolution, 10 km resolution
- Processes accounted for at regional scale:
 - Topography
 - Synoptic climatology
 - Convection
 - Atmospheric response to surface



A2 (high) emissions scenario

Confidence in Regional Detail: Understanding Climate Processes



Grose *et al.* (2010)
IOP Conference Series

Grose *et al.* Submitted
Journal of Climate

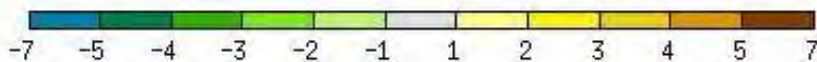
Grose *et al.* Submitted
Climate Dynamics

Rainfall intensity and evaporation

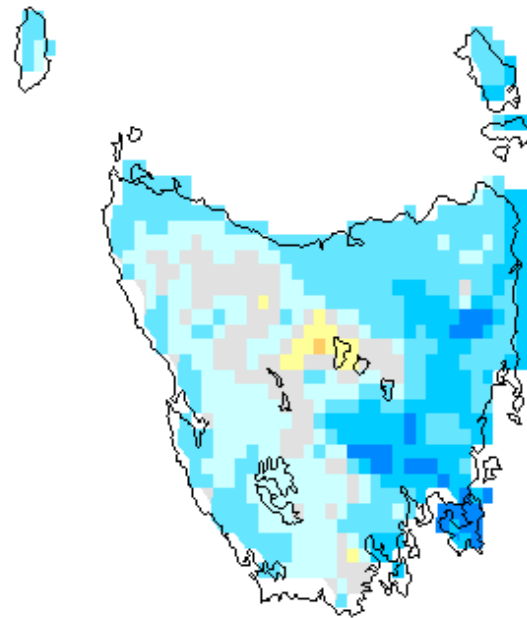
Mean Annual Areal Potential
Evapotranspiration
1961-1990 vs 2070-2099



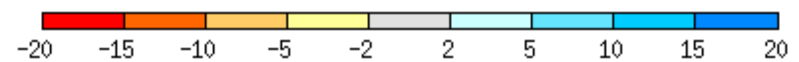
Percent change in mean annual APET



Mean Daily rainfall intensity
1961-1990 vs 2070-2099



Percent change in mean daily Rf intensity



The need for bias-adjustment

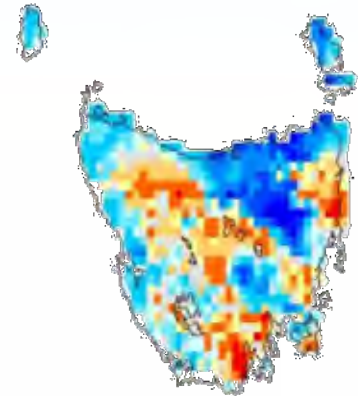
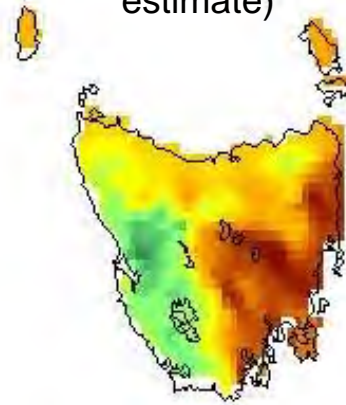
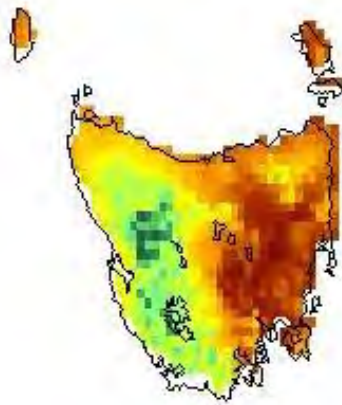
Rainfall
1961-2007

Unadjusted
10 km

Observed (SILO)

Modelled (Central
estimate)

Bias



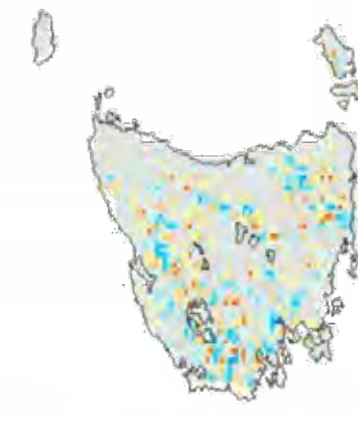
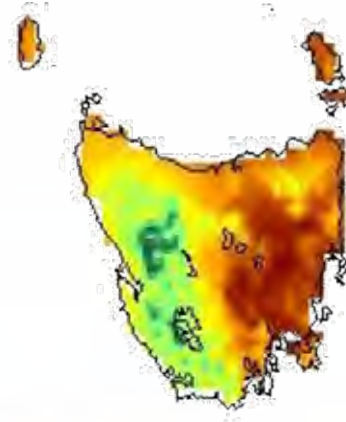
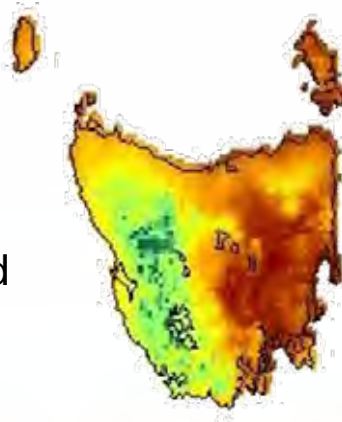
Mean annual rainfall (mm)



Percent Difference

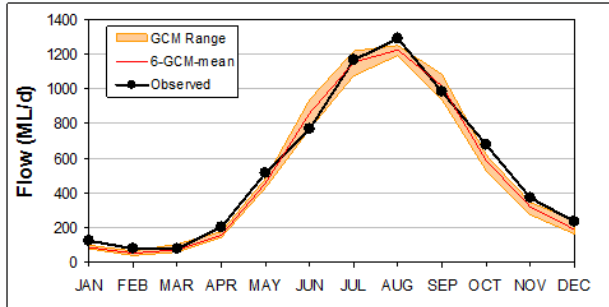


Bias-adjusted
5 km

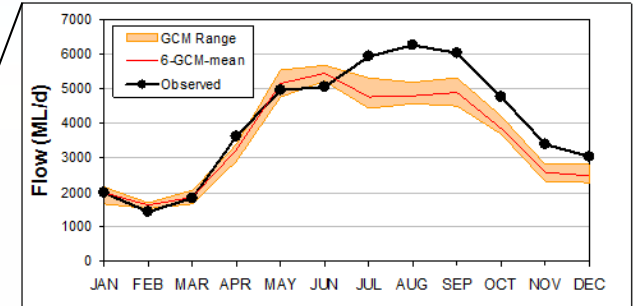


How do the CCAM inputs behave in hydrological models?

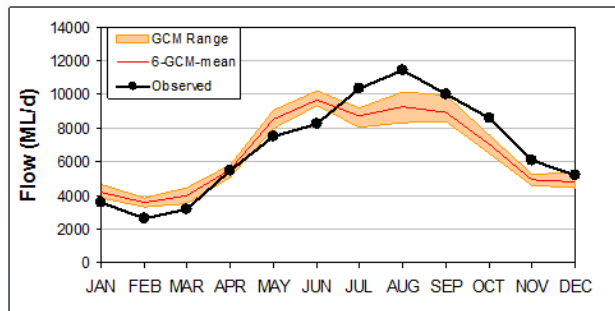
Black River



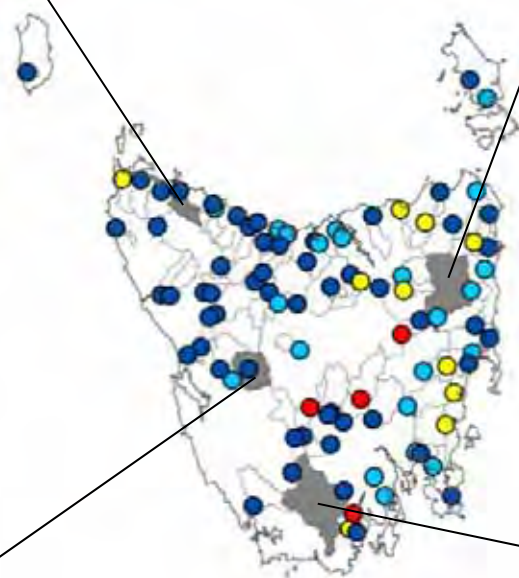
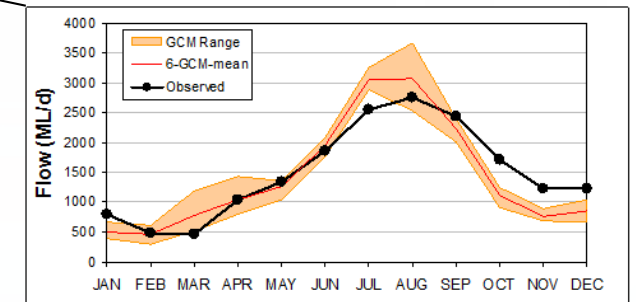
South Esk River



Franklin River



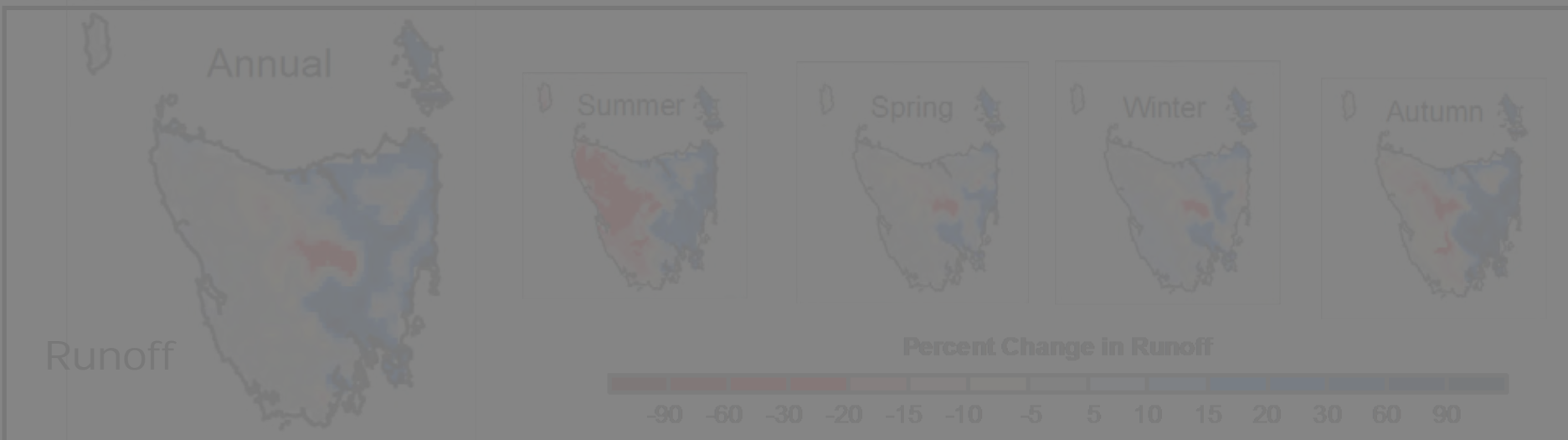
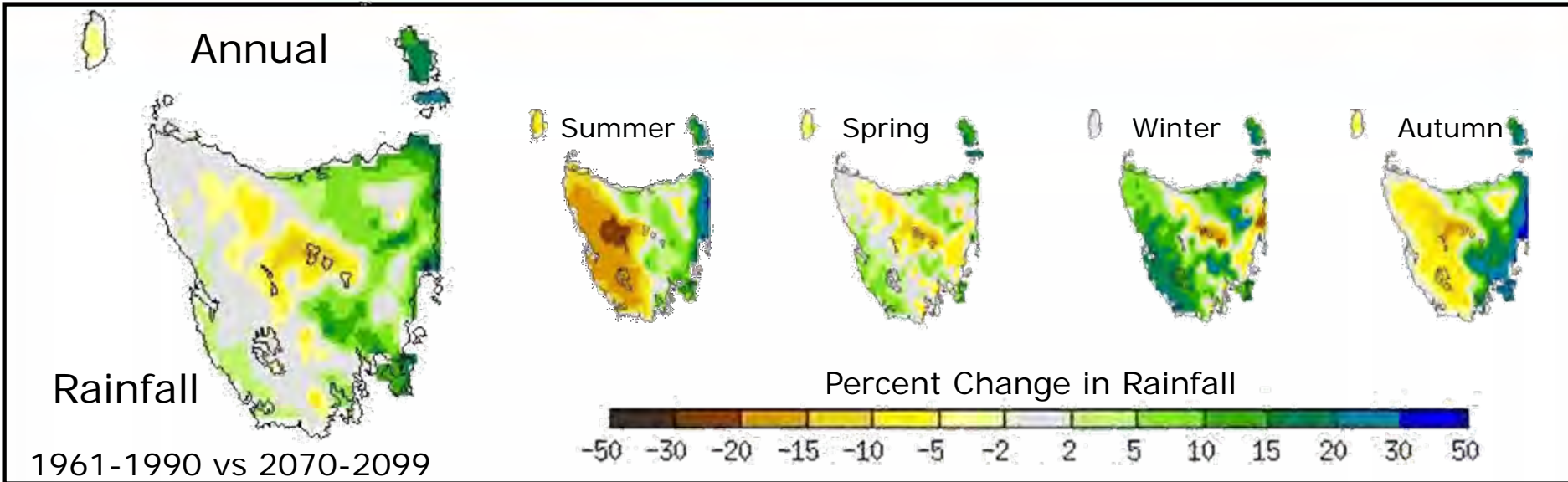
Huon River



Abs Vol Diff

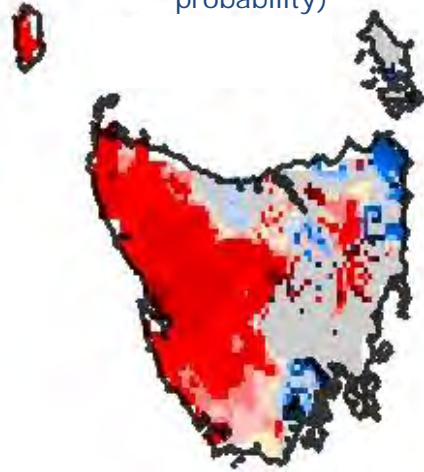
- 0 - 10 %
- 10 - 20 %
- 20 - 40 %
- > 40 %

Runoff changes amplify rainfall changes

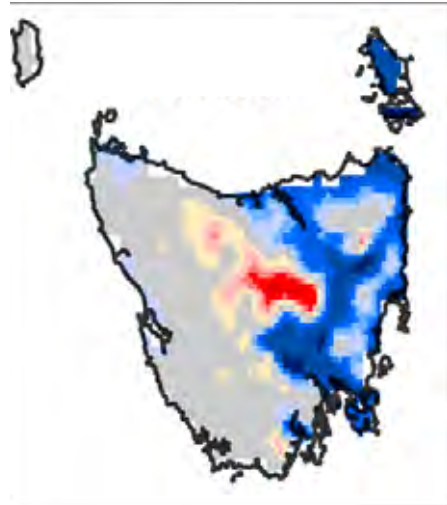


Changes to runoff from 1961-1990 to 2070-2100

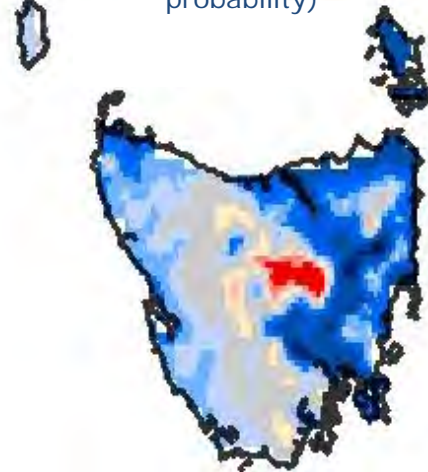
Low runoff
(95 % exceedance probability)



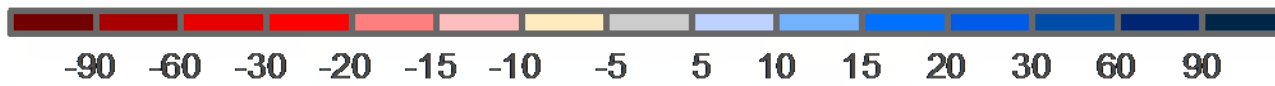
Average runoff



High runoff
(2 % exceedance probability)

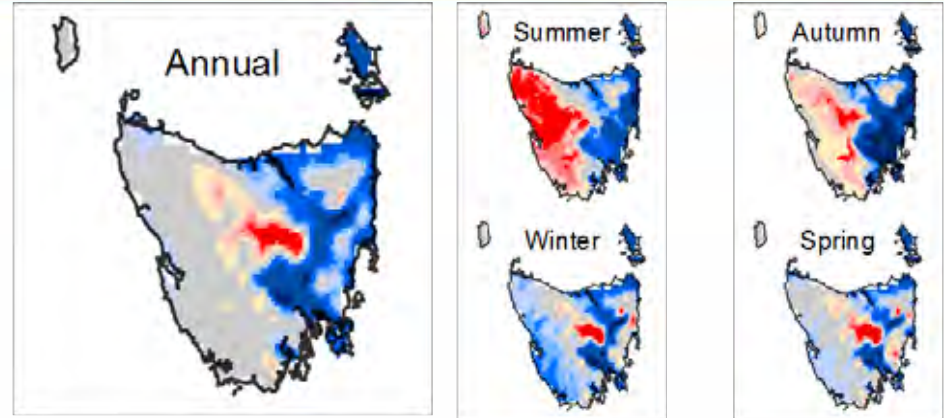


Percent Change in Runoff



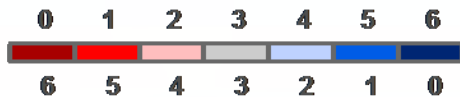
Showing the certainty in projections

Change in runoff
1961-1990 vs 2070-2099

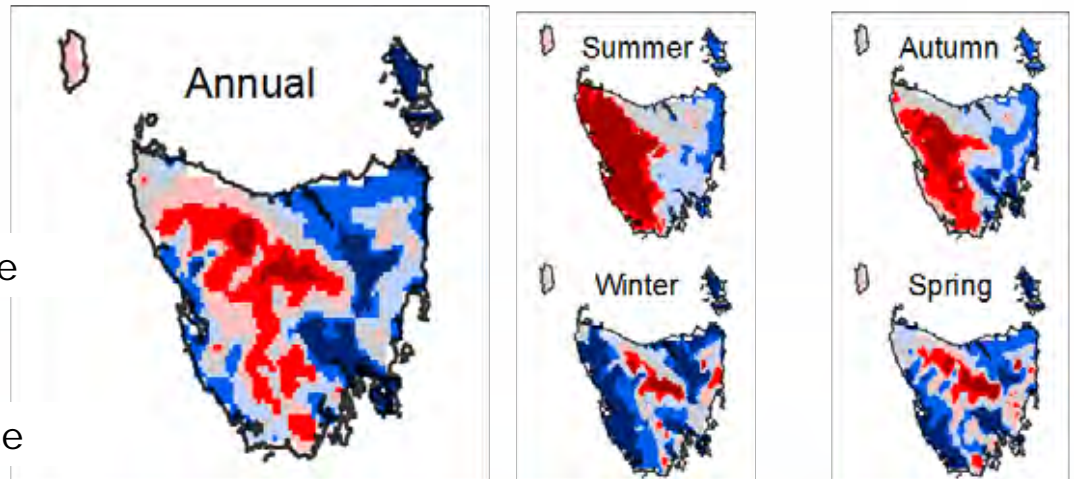


RCM agreement

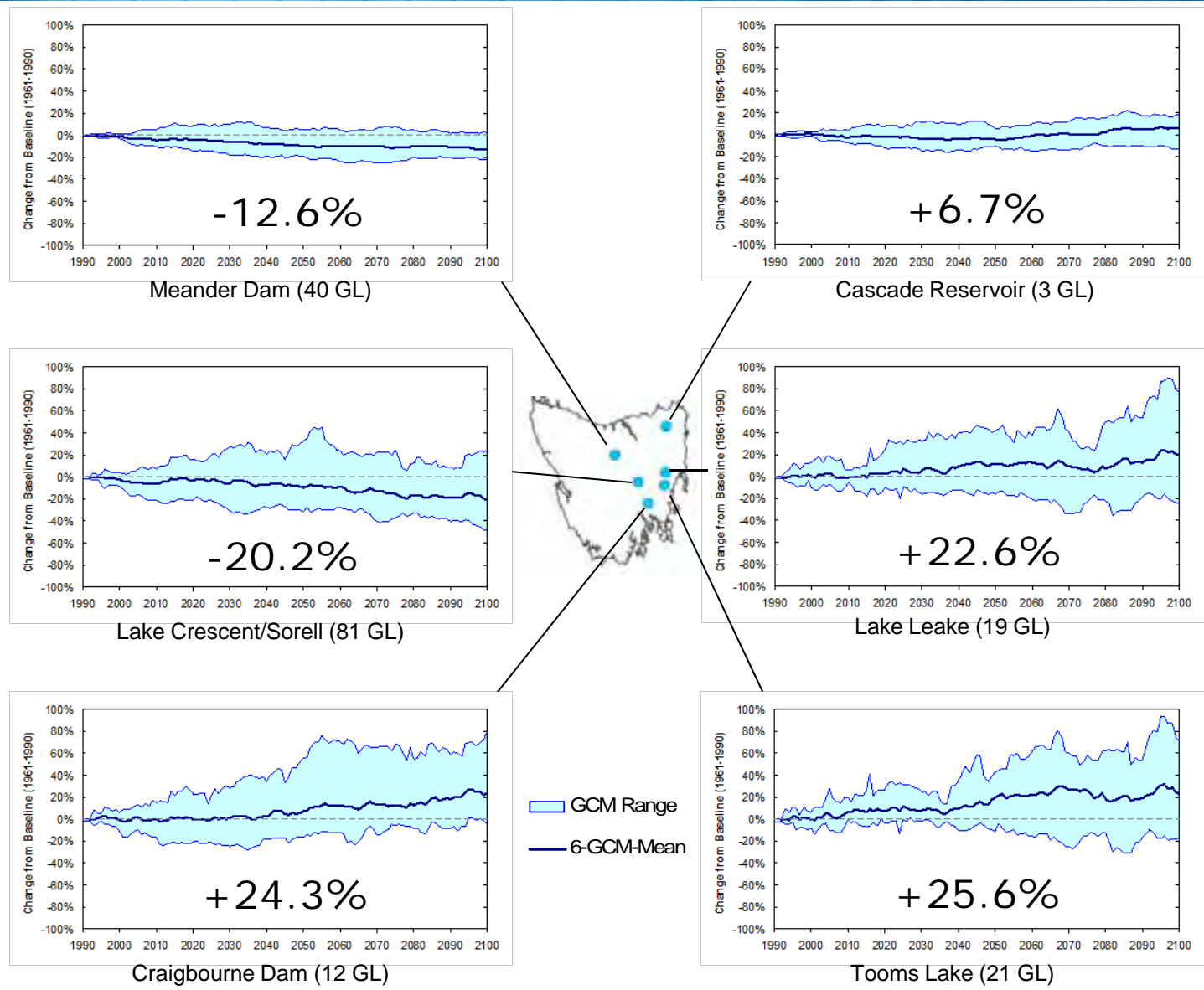
No. RCMs showing increase



No. RCMs showing decrease



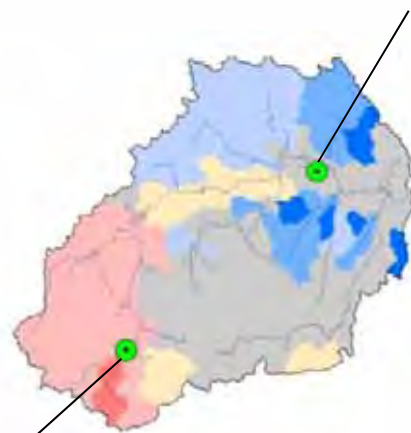
Inflows to irrigation storages



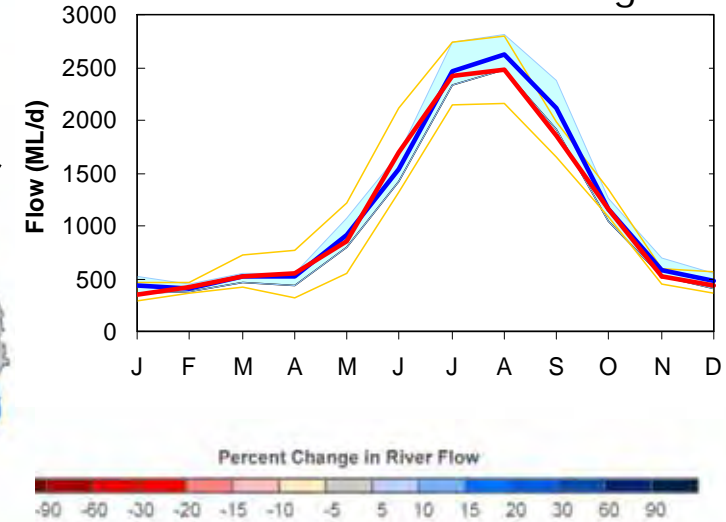
Changes to river flows: Meander River



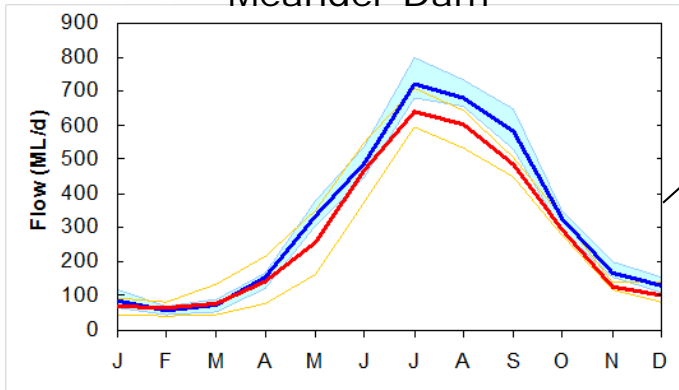
Flow change from
1961-1990 to 2070-2099



Meander at Strathbridge



Meander Dam

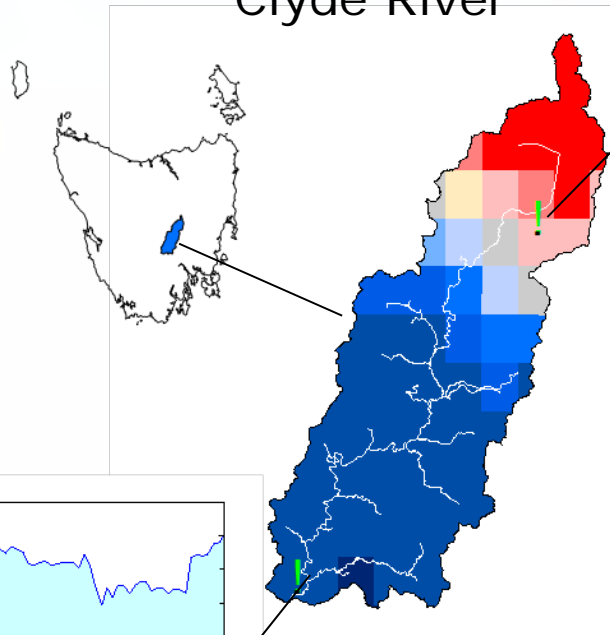


Site	Annual	Nov-Apr	May-Oct
Dam	-12.6%	-12.9%	-12.6%
Strathbridge	-3.7%	-5.5%	-3.2%

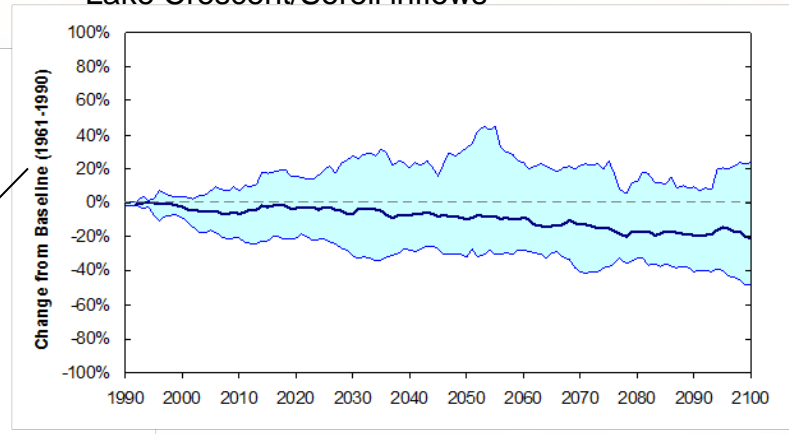
The value of fine-scale climate modelling for hydrological impact studies



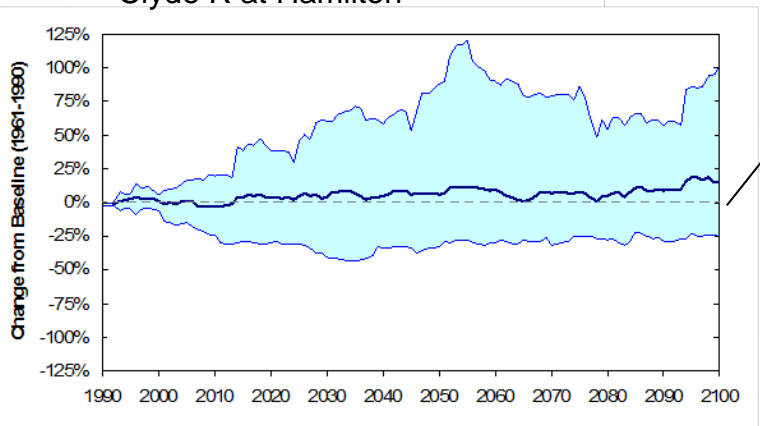
Clyde River



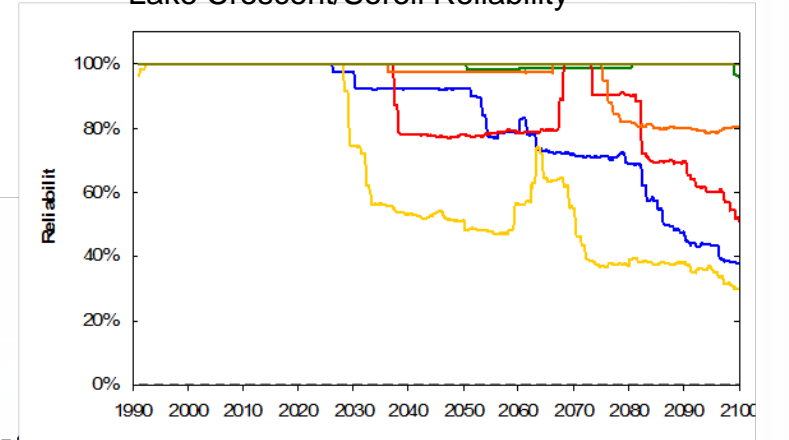
Lake Crescent/Sorell inflows



Clyde R at Hamilton



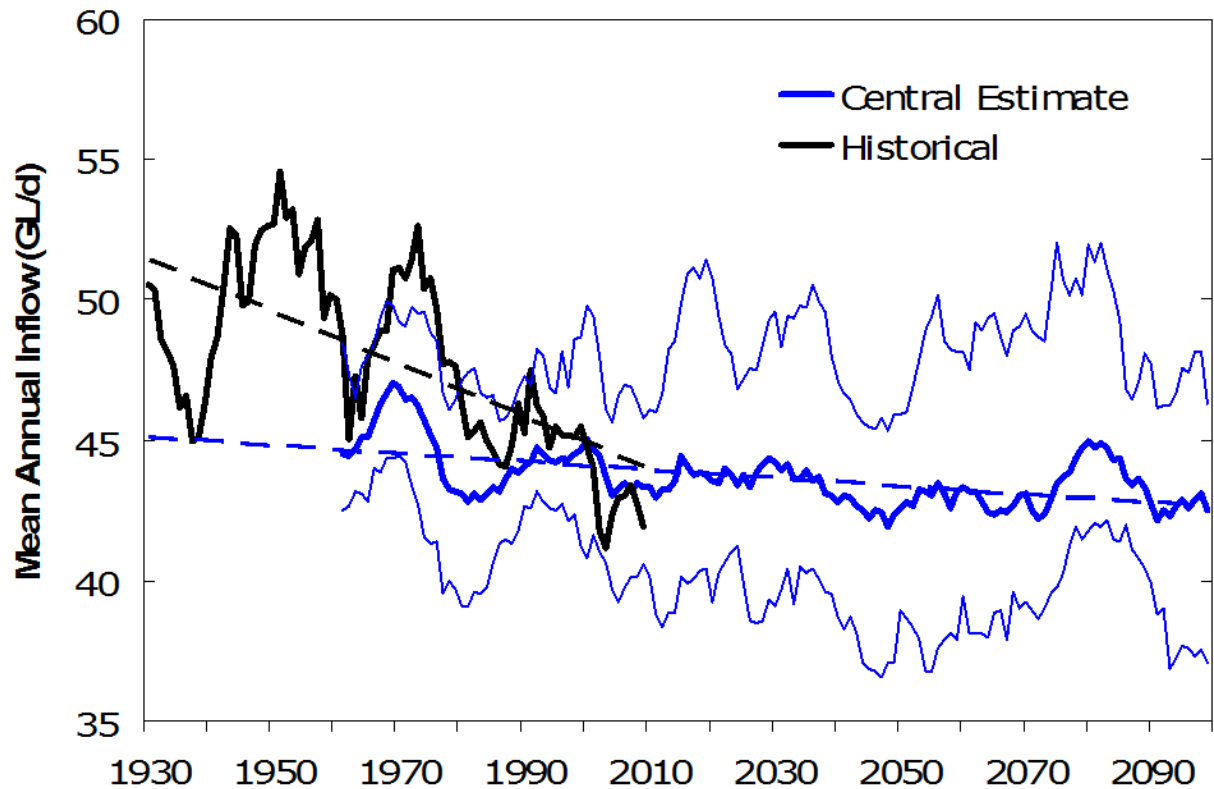
Lake Crescent/Sorell Reliability



Percent Change in Runoff



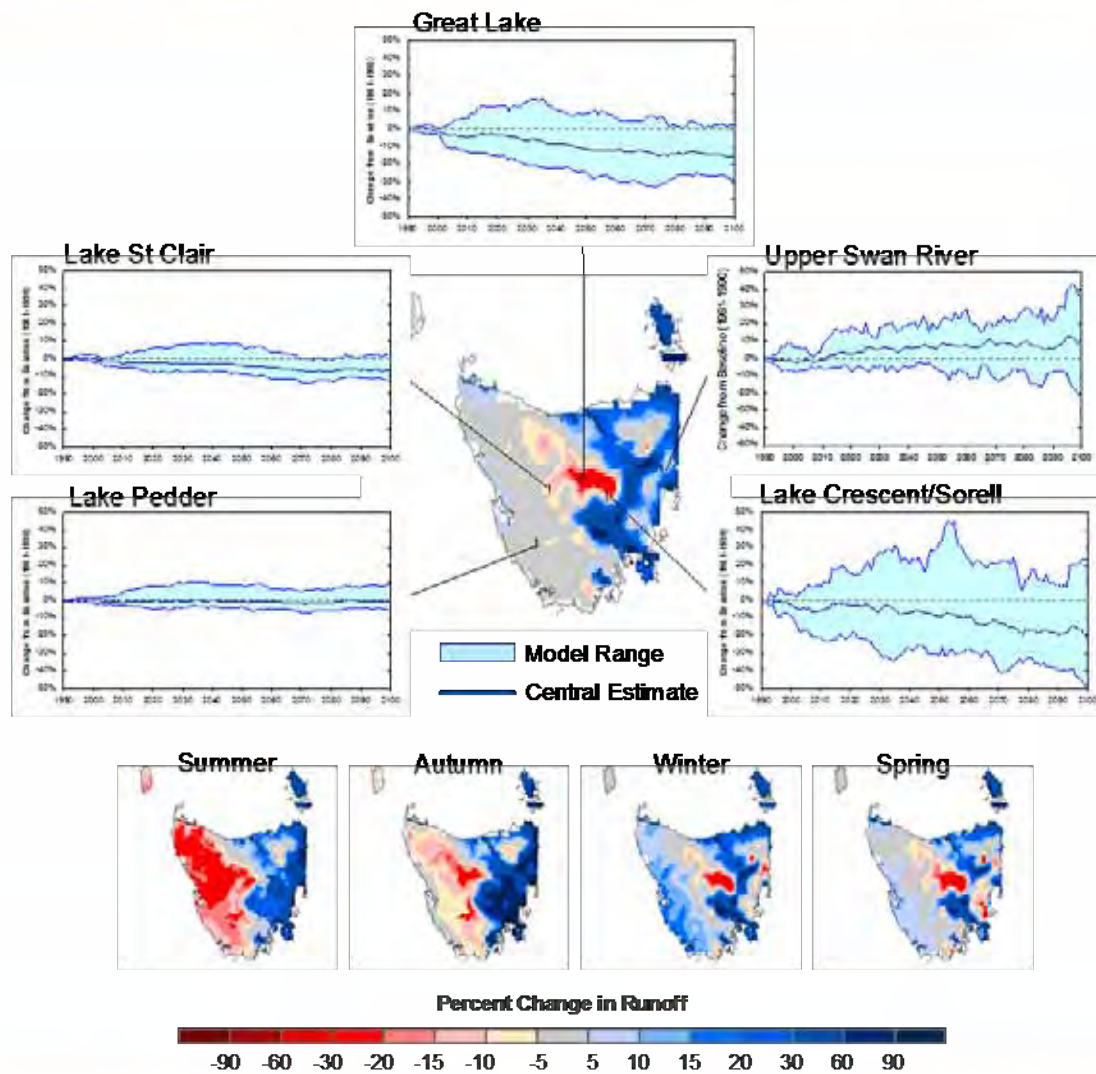
Hydro-electric power generation: Inflows by 2100



Bennett et al (2010)

Endemic fish species

Morrongiello et al
(2010) *accepted*





- To adapt, we need to understand what we are adapting to – downscaling climate models can help.
- Using RCM outputs directly in hydrological models worked well.
- High resolution hydrometeorological modelling produced outputs that are now being used by water management organisations.

Impact of project

While there has not been a major update to the set of climate modelling experiments used in the regional projection work upon which the Review's modelling was based, there have been significant developments in our understanding of how the climate is likely to change regionally in Australia. Recent work has provided more detail on projected climate change through the application of high resolution downscaling techniques⁴. It has also provided further insight into changes to climatic extremes

⁴ For example, Grose M.R, Barnes-Keoghan, I., Corney, S. P., White, C. J., Holz, G. K., Bennett, J. B., Gaynor, S. M. and Bindoff, N. L., 2010, *Climate Futures for Tasmania: General Climate Impacts Technical Report*, Antarctic Climate & Ecosystems Cooperative Research Centre Hobart, Tasmania.



ANTARCTIC CLIMATE & ECOSYSTEMS CRC

Publications



http://www.climatechange.tas.gov.au/government_action/climate_futures

