NCCARF
Terrestrial Biodiversity workshop Tasmania, 7th June 2011

Aim of the day: *to try to identify the most significant local research needs and challenges and help put these into a national context*.

What are the key issues for Tasmania for climate change adaptation?

Defining adaptation

Adaptation

the decision-making process and the set of actions undertaken to maintain the capacity to deal with current or future predicted change*

"For biologists ... the evolutionary processes by which populations of organisms change over time in response to other organisms and the physical environment (Lamarck 1809, Mayr 1982). In the context of climate change planning ... generally refers to human activities intended to minimise the adverse effects of climate change on human infrastructure and sensitive aspects of the natural environment" (Mawdsley et al. 2009, p. 1081).

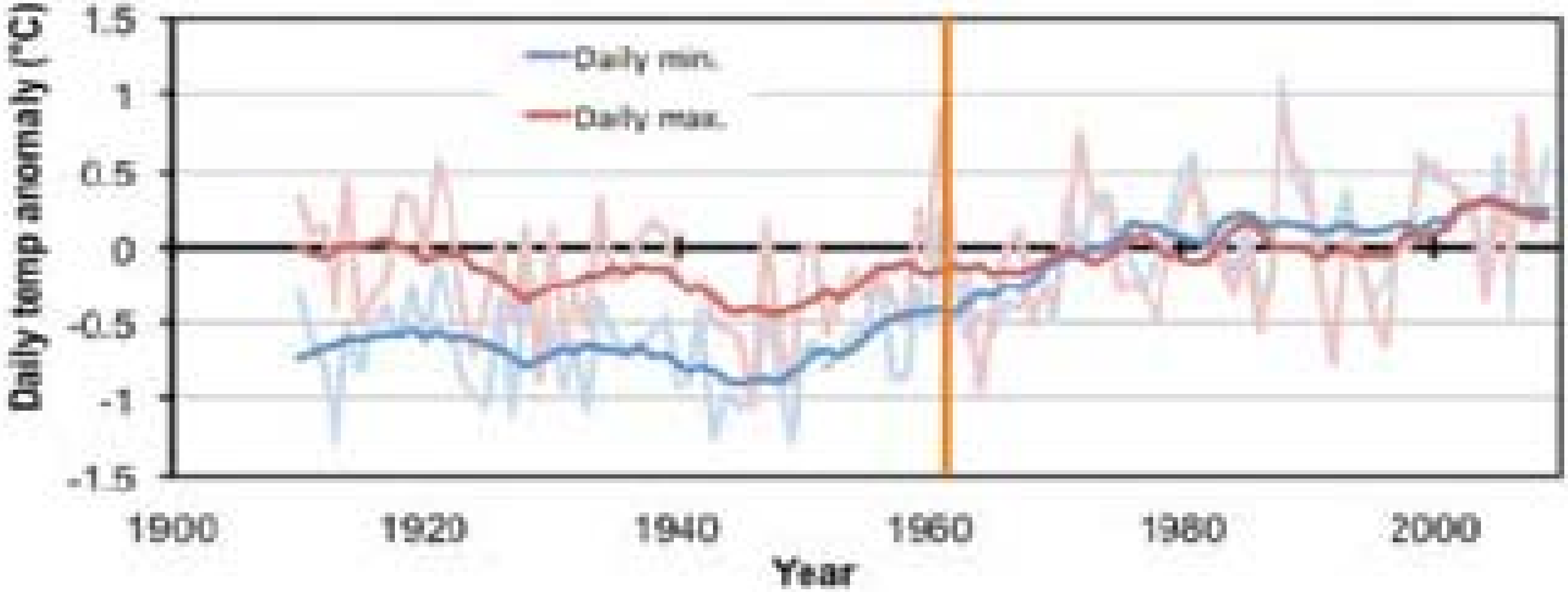
Adaptation research

Research that underpins management to minimise or avoid the negative impacts of climate change on biodiversity and ecosystem processes (Hughes)

Adaptive capacity

the preconditions necessary to enable adaptation, including social and physical elements, and the ability to mobilize these elements*

*Nelson, D. R., Adger, W. N., and Brown, K. (2007). Adaptation to environmental change contributions of a resilience framework. *Annual Review of Environment and Resources* **32**, 11.1-11.25.



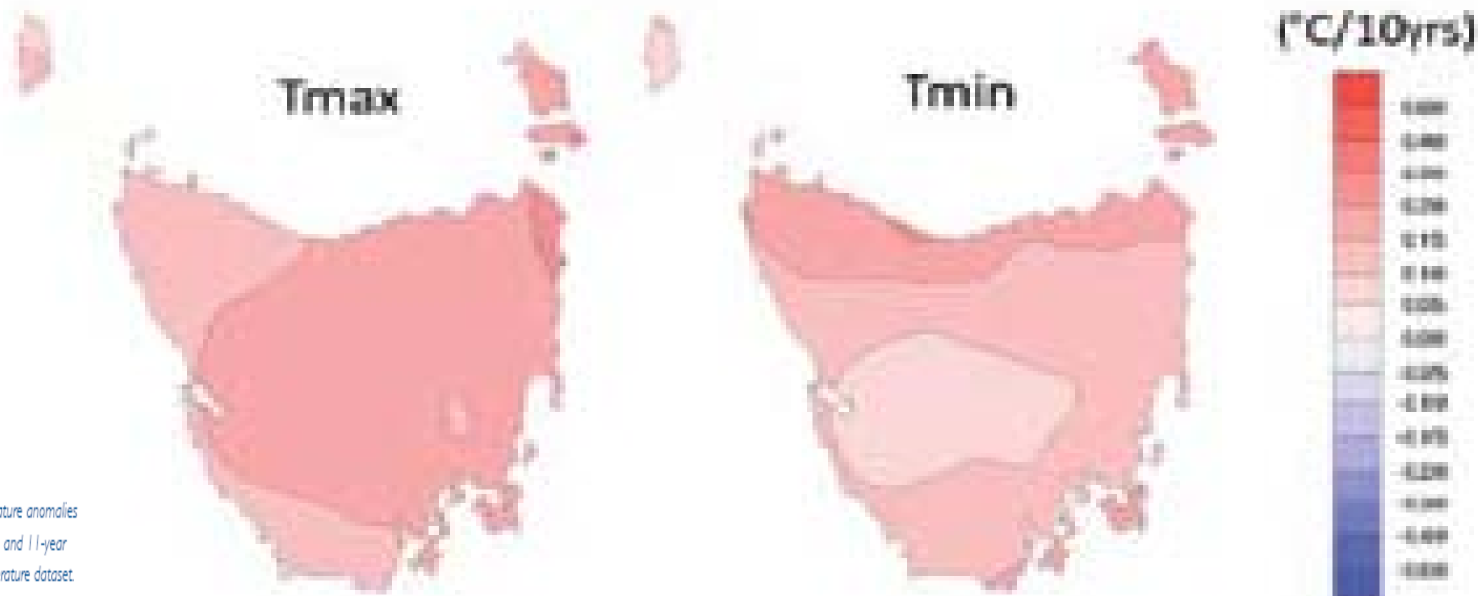
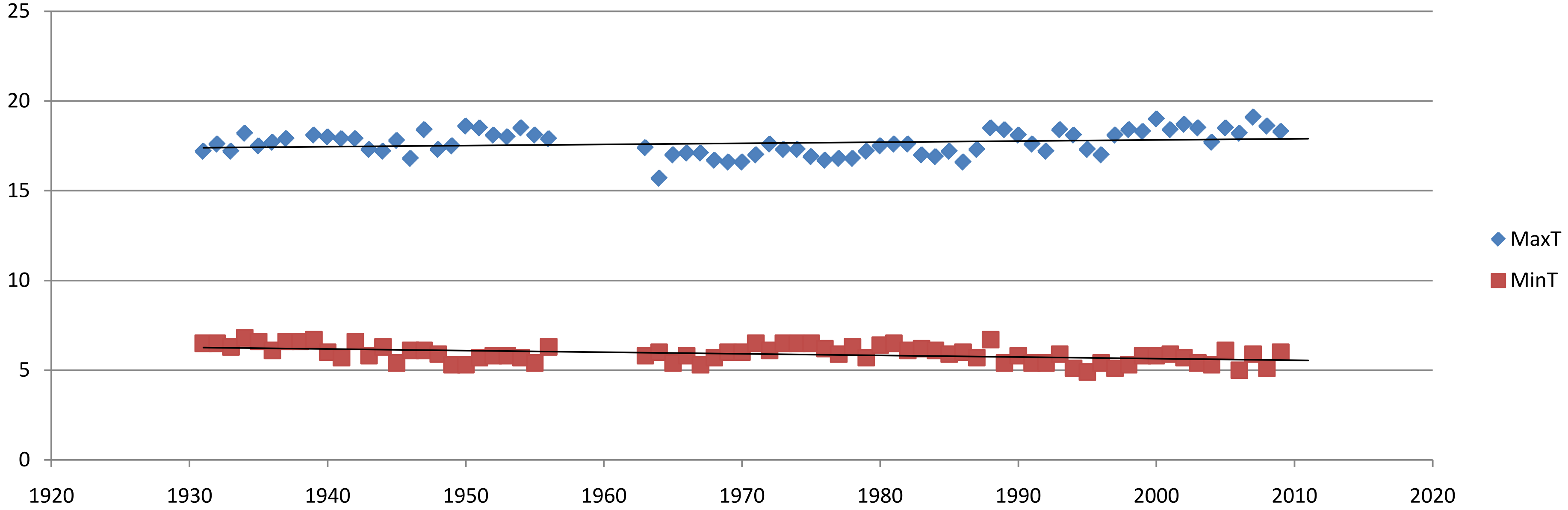


Figure 1.4 Annual mean daily minimum and daily maximum temperature anomalies from the 1961-1990 baseline period mean for Tasmania (faint lines) and 11-year moving averages (thick lines) from the Australian High Quality temperature dataset. The maps below the plot shows the linear trend in daily maximum and minimum temperatures between 1961 and 2007, the period after the orange line, using 0.05° gridded data (AWAP data cited in Grose et al. 2010).

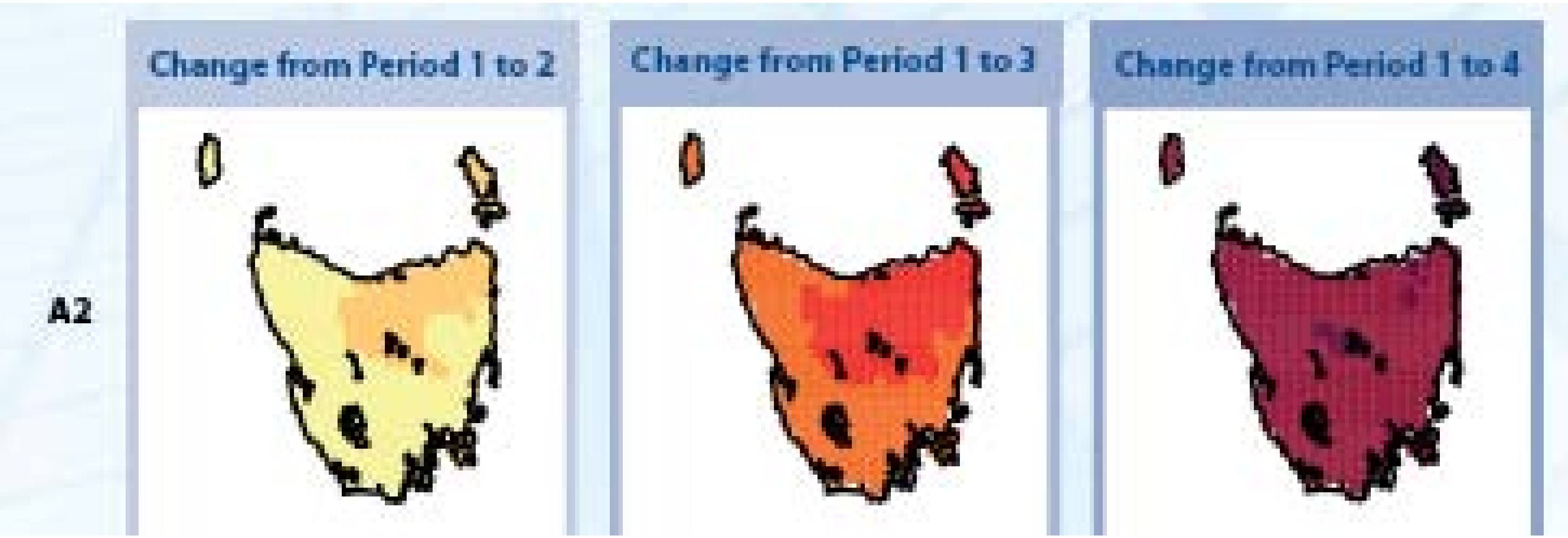
RMC (2010) Vulnerability of Tasmania's natural environment to climate change: an overview

Mean annual temperatures (max and min) for Bushy Park from 1931-2009

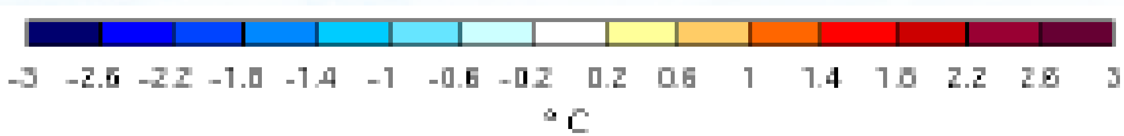


Source: BOM

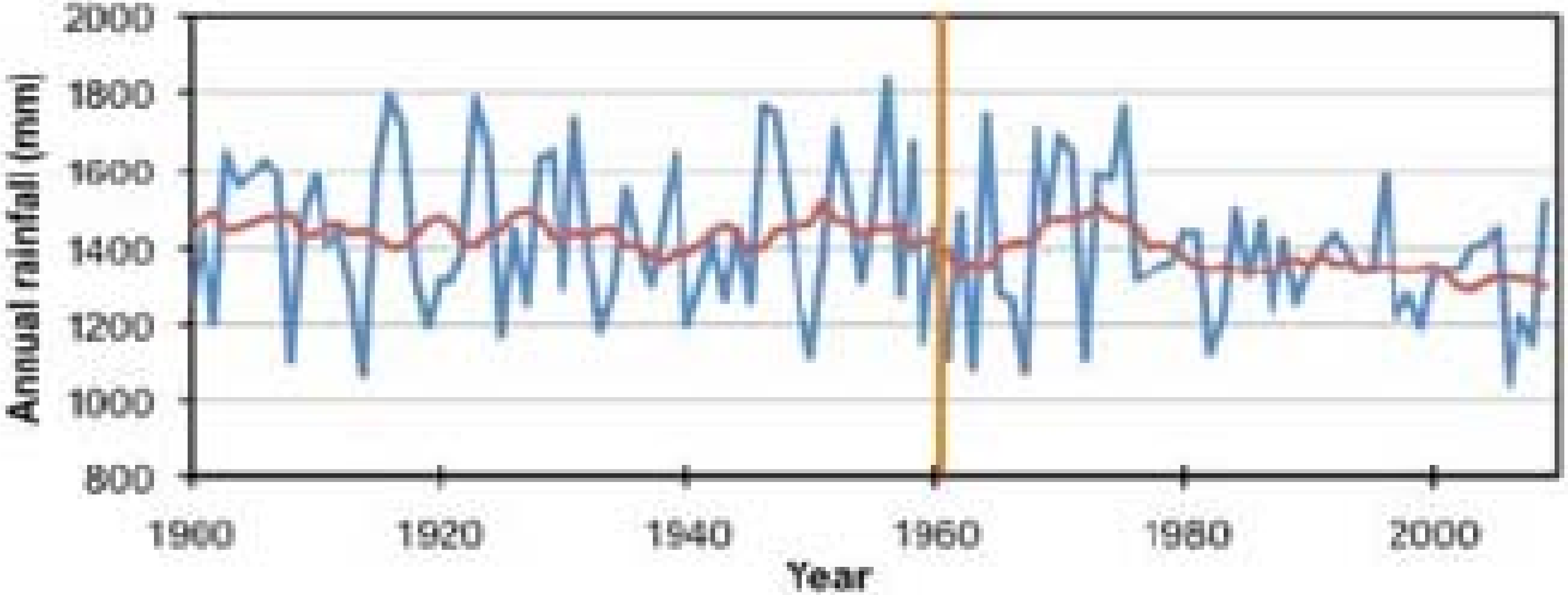
Projected change in temperature °C from 1978-2007 to 2070-2099



1978-2007 to 2010-2039 1978-2007 to 2040-2069 1978-2007 to 2070-2099



Source: CFT, ACE-CRC



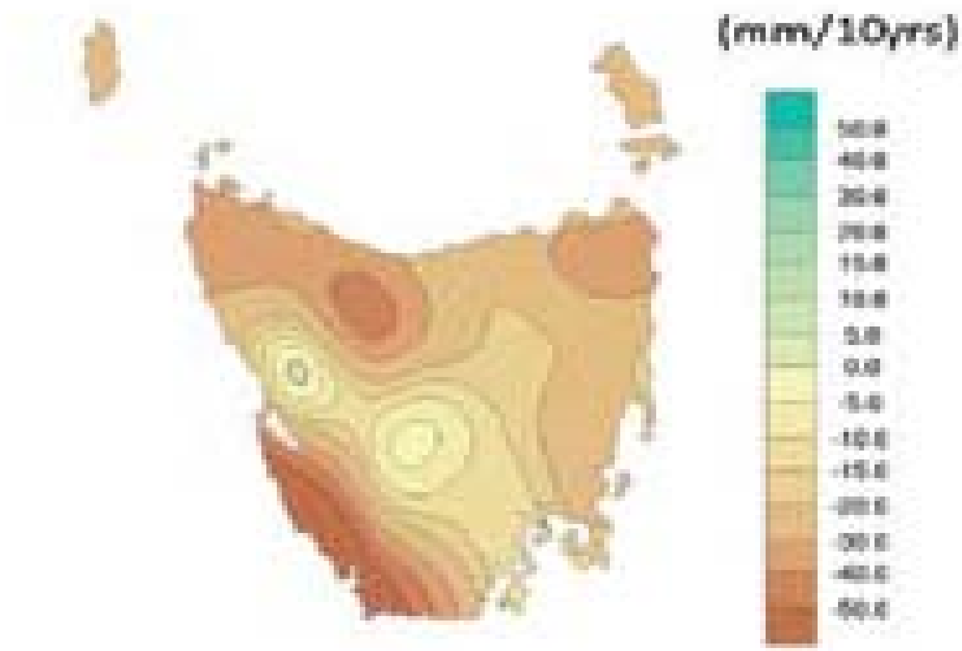


Figure 1.5 Statewide mean annual total rainfall for Tasmania (blue line) and 11-year moving average (red line) from the Australian High Quality rainfall dataset. The map below the plot shows the linear trend in total annual rainfall between 1961 and 2007, the period after the orange line, using 0.05 ° gridded data (AWAP data cited in Grose et al. 2010).

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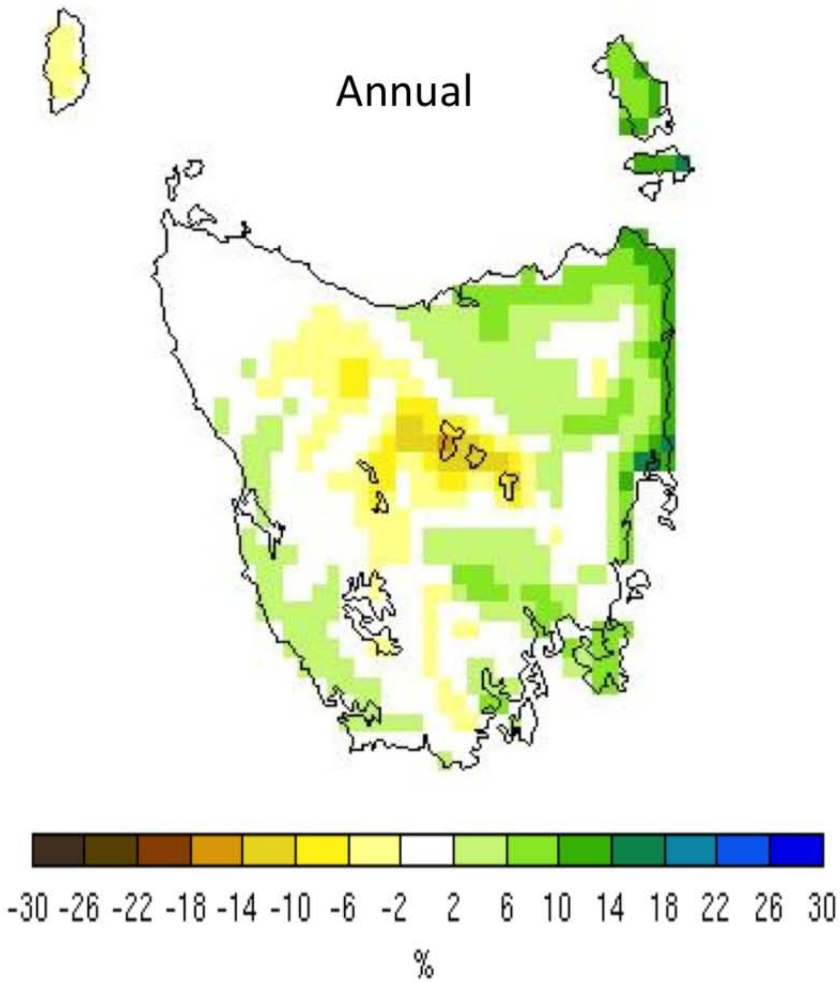
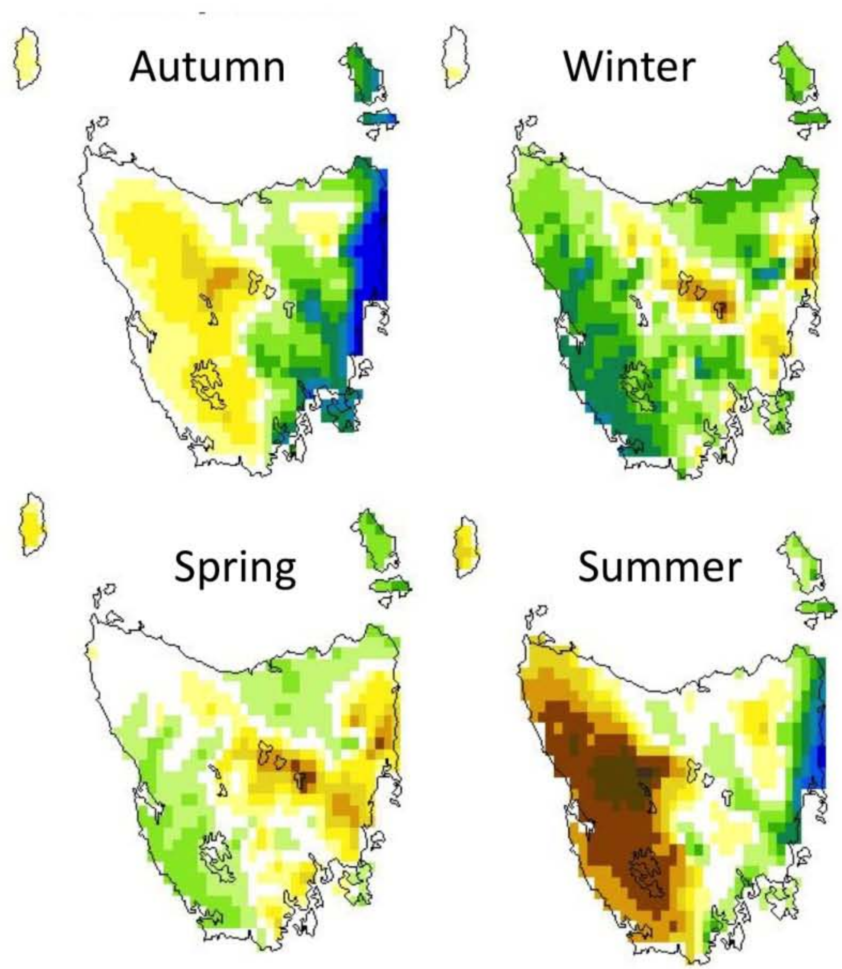
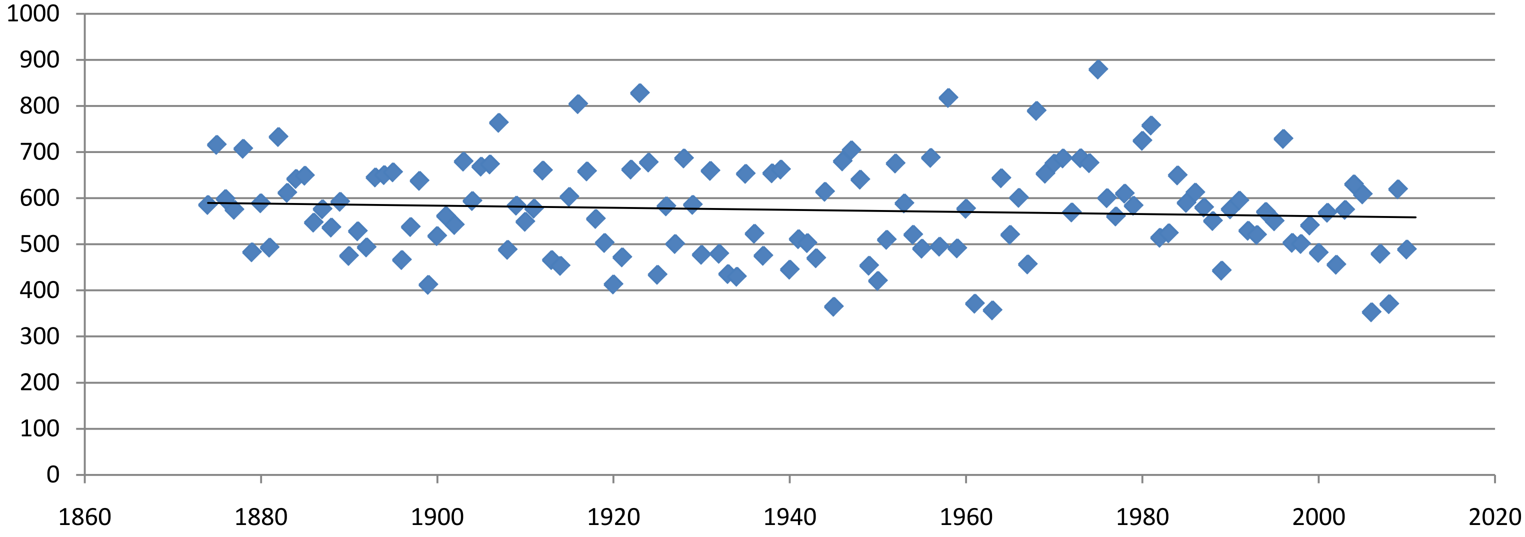
% change in annual and seasonal rainfall 1961-1990 to 2070-2099



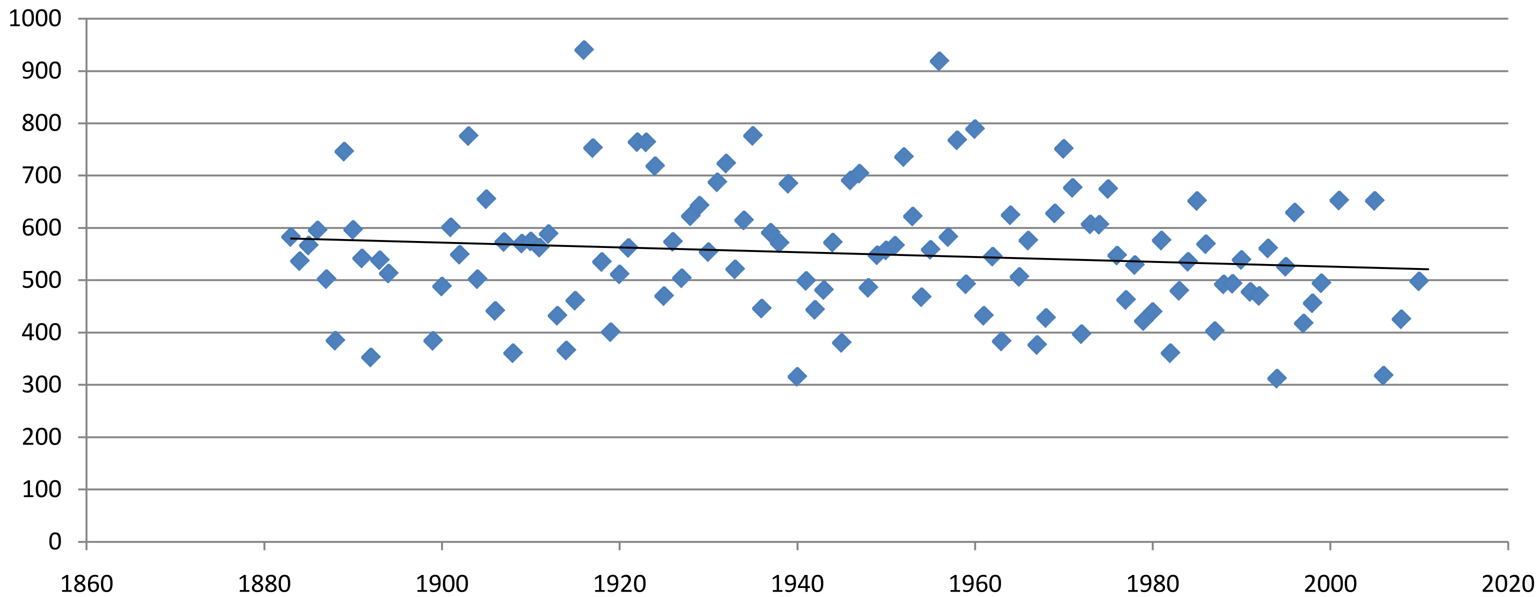


Source: CFT, ACE-CRC

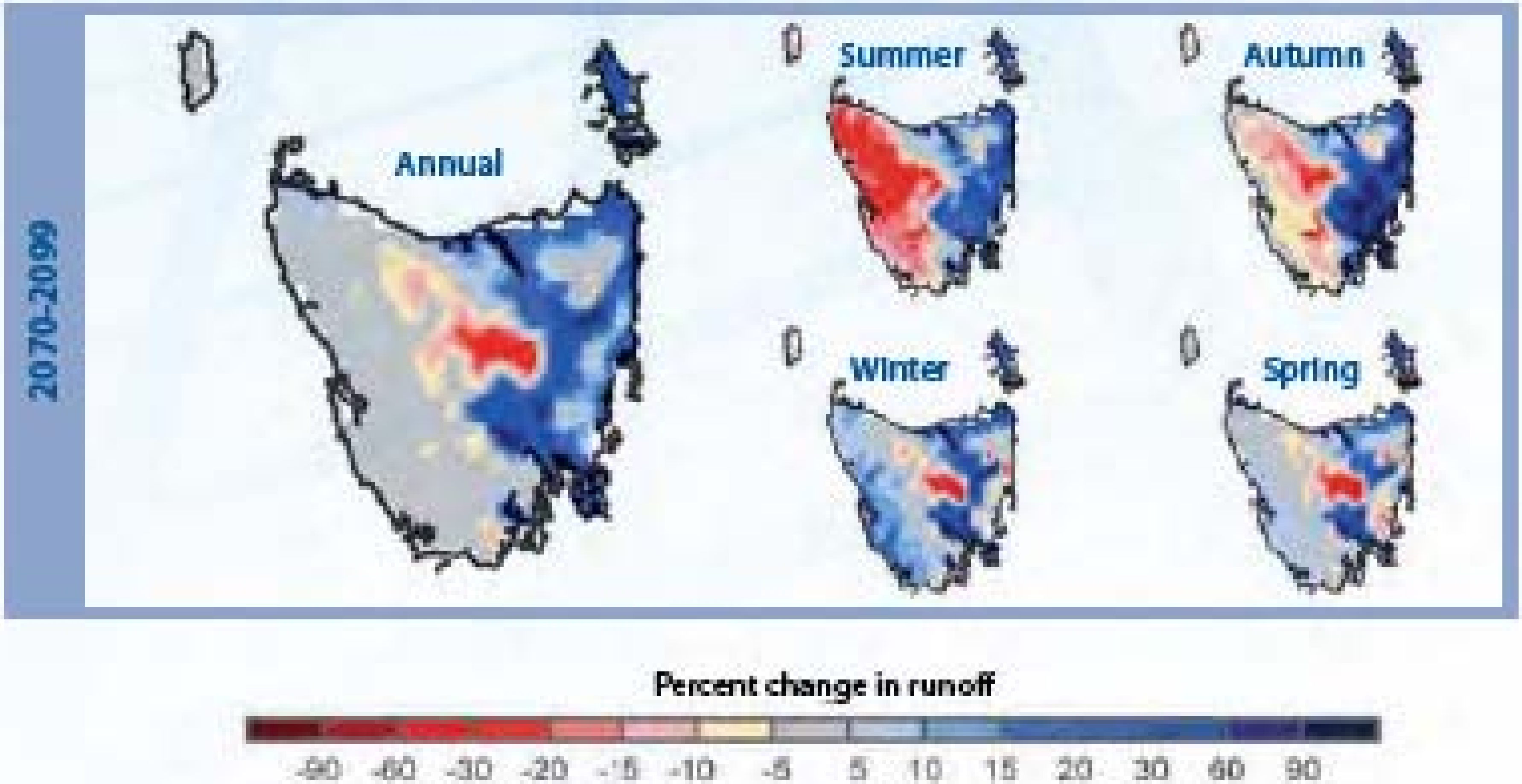
Annual rainfall (mm) for Bushy Park, 1874-2010



Annual rainfall (mm) for Oatlands 1883-2010



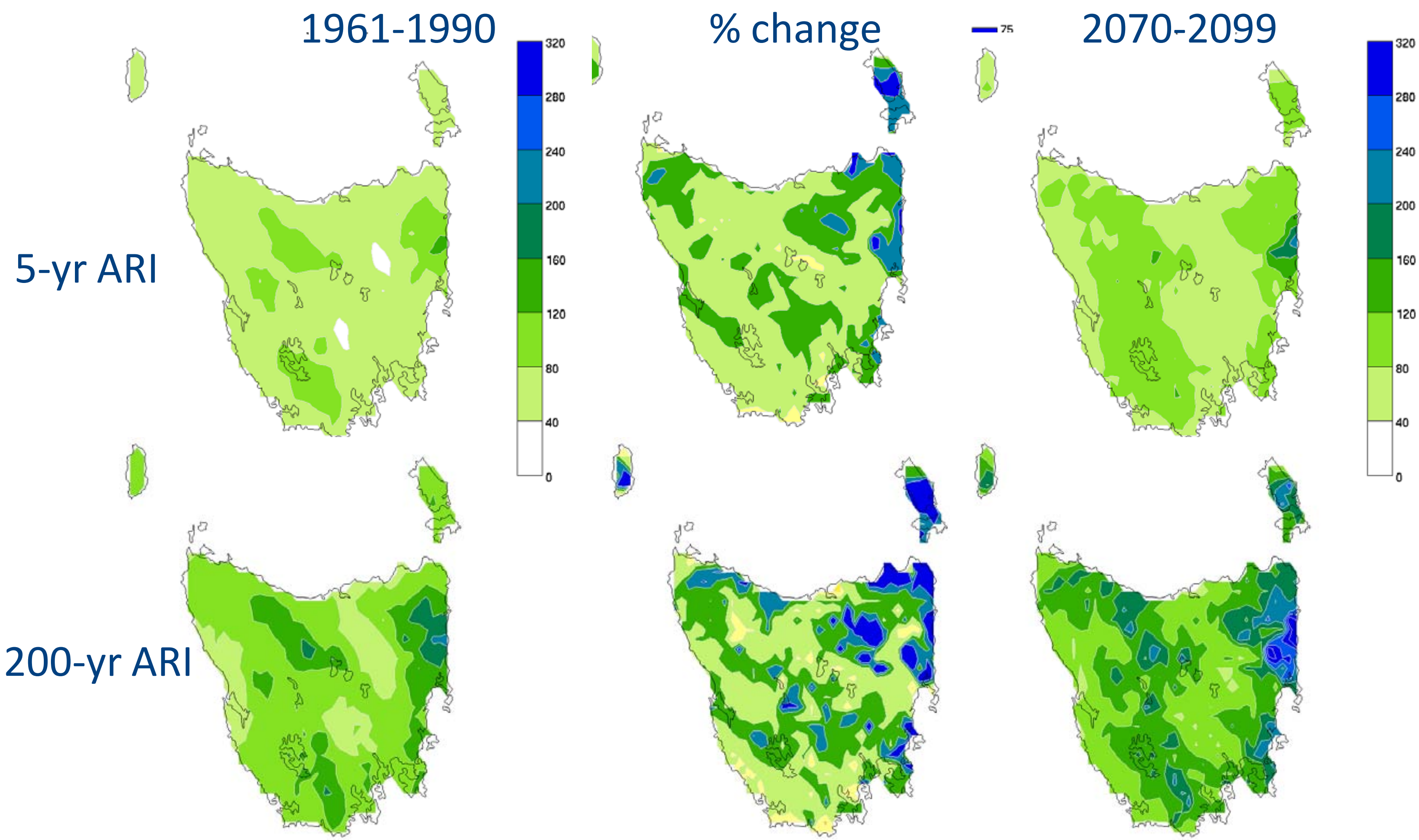
Source: BOM



Projected annual and seasonal changes to runoff from the reference period, 1961-1990, to 2070-2099

Source: CFT, ACE-CRC

Extremes Rainfall
Average Recurrence Intervals (ARI or return period)

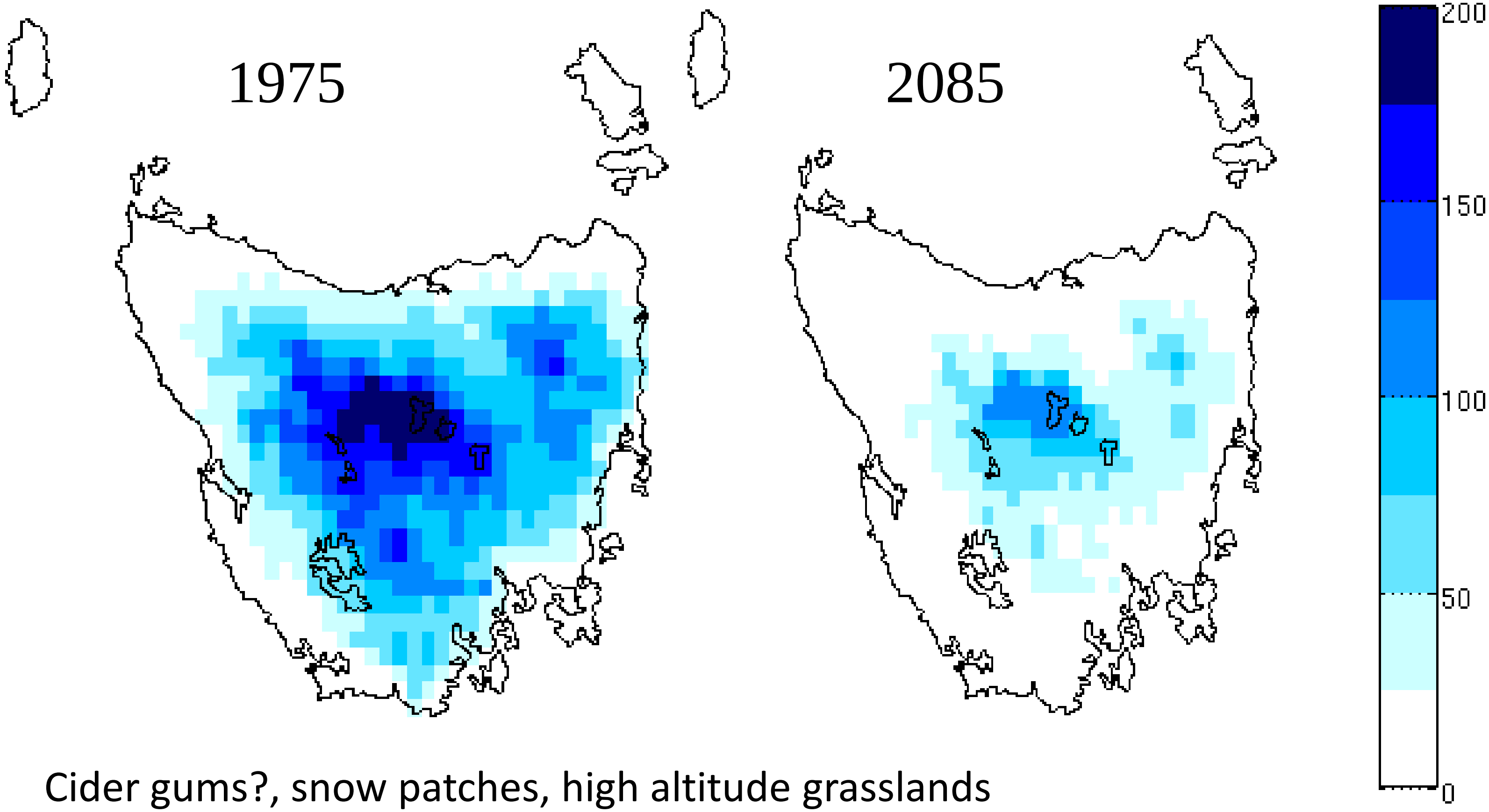


ARIs (or *return periods*) are used by engineers, emergency planners and scientists to assess the likely frequencies and magnitudes of high precipitation / flood events

Source: CFT, ACE-CRC

Climate projections

Frost (days <2°C)/year

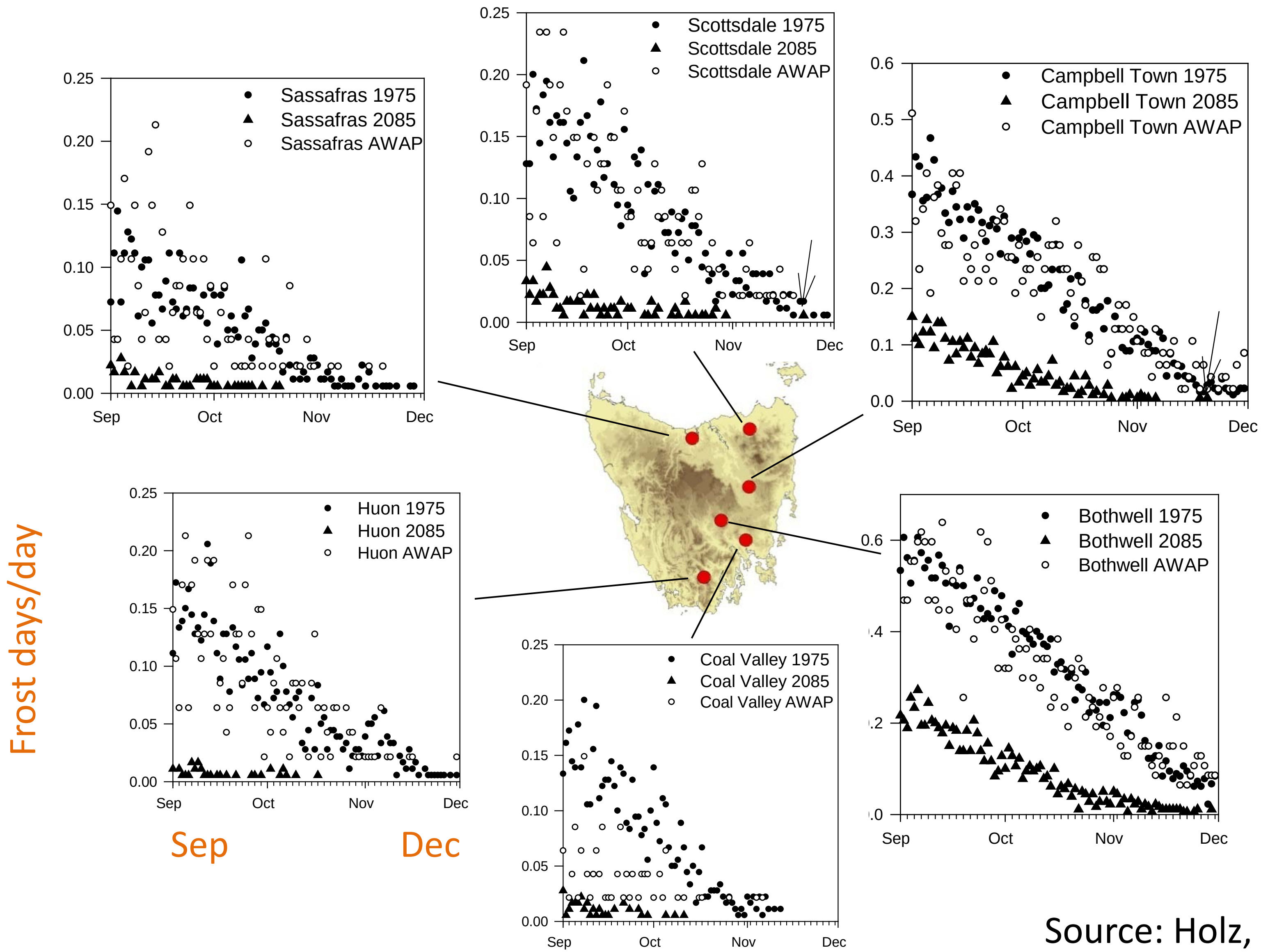


Cider gums?, snow patches, high altitude grasslands
Invertebrate activity
Vertebrate herbivory
Change to competitive ability of species

Source: CFT, ACE-CRC

Mean No. days < 2 C Sep-Nov

1961-90 and 2070-99 six GCMs SRES A2



Source: Holz, CFT, ACE-CRC

Implications for crop and sown pasture production from APSIM models using CFT data. (Lisson, Parsons, Holz - TIAR)

Crops	Earlier flowering and maturity	Lower evapo-transpiration, higher water use efficiency – reduced water stress	Increased biomass – faster growth rates	Change in yield depends on resource availability (N and water)	Decreased frost risk
Pasture (rye and clover)	Earlier autumn growth	Currently water limited in summer and temp limited in winter. Future –less limited by temp in winter and more limited in summer	Increased yield – spring/ autumn, decrease in summer	Modelled with unlimited resources	Slight decrease in digestibility, greater proportional decrease in protein

Current day
2050
2085

Table 5.1 Physical processes in major ecosystems likely to be impacted by climate change.

Physical climate change indicator	Potential impact
Increased temperature	Increases in minimum and maximum temperatures will affect physiology of some plant species
	Increase in altitudinal range of *Phytophthora cinnamomi*
	Many of the dominant *Eucalyptus* species in Tasmania's forests have a restricted climatic and geographic range and may be susceptible to increased temperatures
	May lead to an advance in the onset of spring, delay in autumn, and increased out-of-season events such as winter flowering
	May lead to increase in treeline
Reduced precipitation	Reduced flow in rivers, drying of wetlands
	Oxidisation of peatlands, reduction in rate of peat accumulation in buttongrass moorlands and *Sphagnum* peatlands
	Increased stress of species currently at the limits of climate tolerance, e.g. *Eucalyptus gunnii, Sphagnum* species
	Decreased regeneration rates in dry eucalypt forests
Reduced incidence of frosts	Loss of alpine plant species that require frost for germination
	Uphill movement of treeline
	Increase in woody species in frost hollows
	Loss of specialised fjaeldmark communities
Reduced snowlie	Loss of specialised snowpatch communities such as cushion moorlands
Changed seasonality of rainfall	Widespread dieback of eucalypt species
	Breeding seasons of some mammals that are related to spring rainfall may change if rainfall patterns change
	Changes in the ratio of C3 to C4 plant species
	Changes in the secondary metabolites such as tannins and phenolics will affect palatability and nutrient value of plants to browsers

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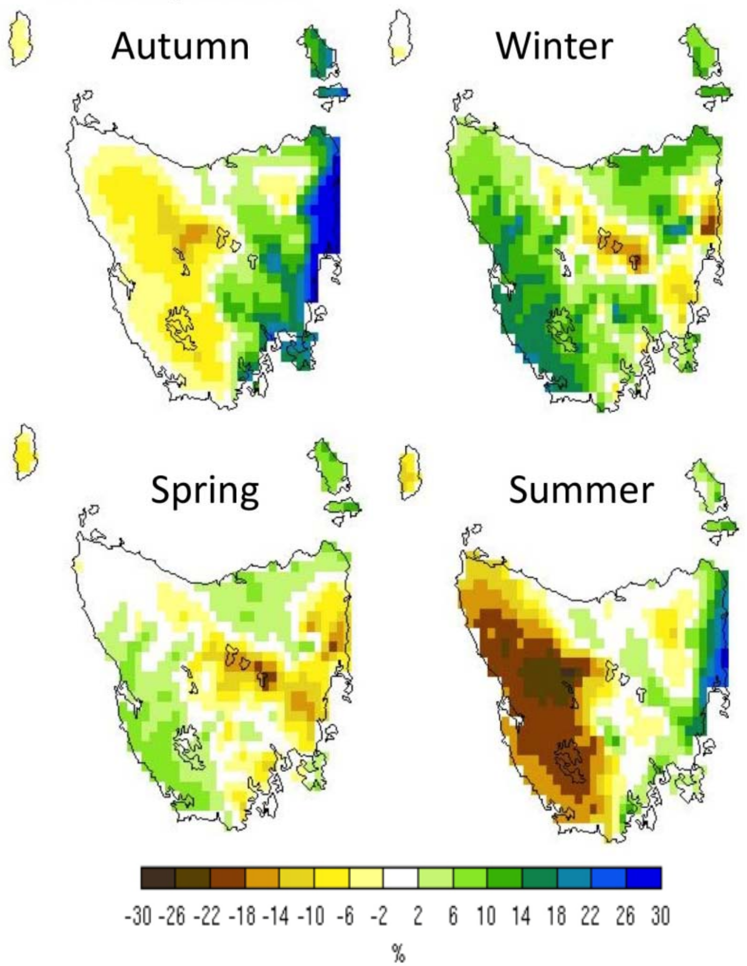
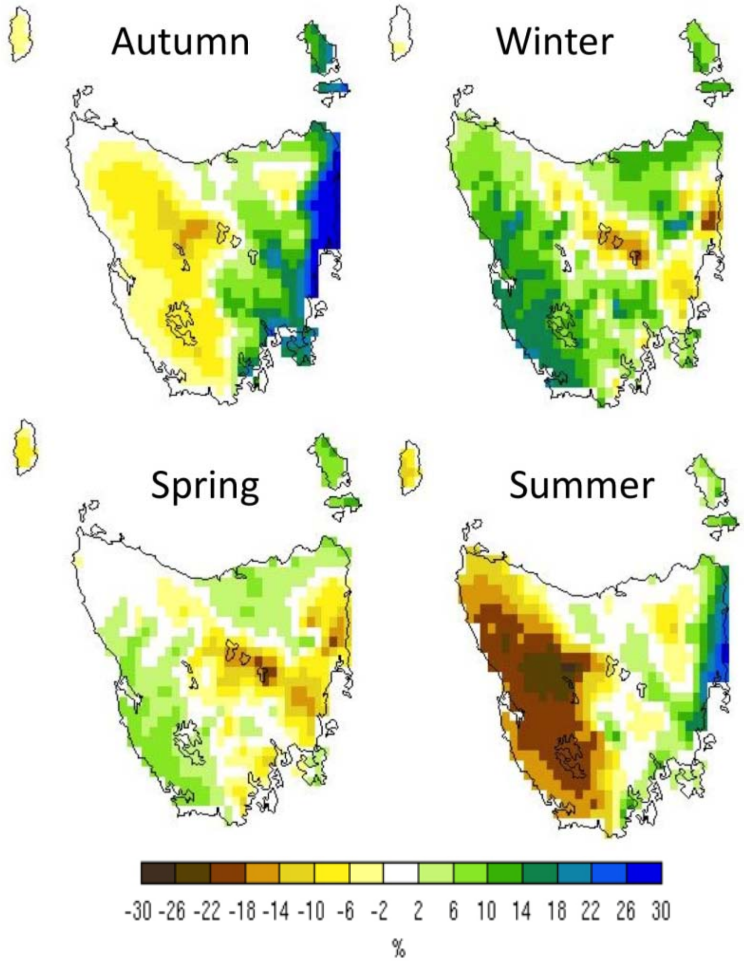


Climate projections are dire for western Tasmania and the Central Plateau i.e. the WHA

Increased summer drying of organosols, (buttongrass moorlands), sphagnum bogs, change in microbial activity - decomposition rates
Impact on burrowing crayfish, alpine vegetation – shrubs and trees (Cider gums)

Increased incidence of fire strike, increased intensity,

Potential increased rate of spread of pests, weeds and diseases (Phytophthora?)



South-eastern Tasmania
Shift in seasonality of rainfall from winter/spring to summer/autumn

Implications for grassland composition, use of pastures for livestock production – impact of irrigation developments to increase water security for agriculture.

What else?
Microbial activity, wetlands...

Prober and Dunlop 2011

- Shift focus from preserving species and current species composition to maintaining ecological and evolutionary processes = is pragmatic and offers primary direction for policy and implementation.

- Accept change and losses

- Hope that current biota will be replaced by functioning, diverse ecosystems that effectively capture limiting ecological resources and provide ecosystem services

- Once we have crossed the line from managing for what we know to managing for what might be, it is no longer straight forward to define objectives and targets for biodiversity conservation.

- Need discussions as to what these objectives might be – different scales - preference for Australian endemics, minimising species loss...

- Is managing biodiversity under climate change about facilitating nature's response?

The way we're going to win this is…

1) Landscape scale conservation (including generational and temporal scales)
2) Developing communications between groups (researchers, policy makers, planners, NGOs, private land holders, general public)

- What are the key issues for Tasmania for climate change adaptation? (addressed in RMC report)
- What management options do we have? (addressed in the literature)
- What actions/activities need to be planned for now to enable adaptation to take place?

Where are we and where do we want to be?

Recognise that climate change is one part (an overlay?) of land management in a sea of existing environmental issues.

Is the adaptation that is needed a 'mental' one, i.e. a shift in perception of conservation outcomes?

What are we managing at the moment and what for? Monitoring is important to track change – but has been poorly supported in the past.

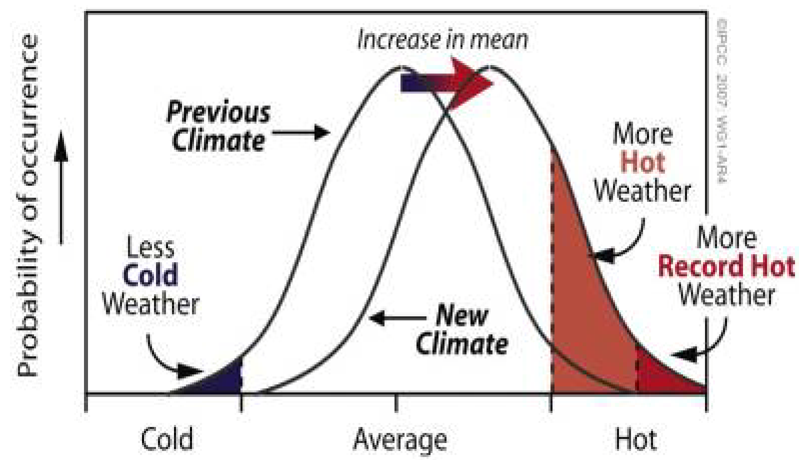
What land management interventions are occurring?

What stomach have we got for the spectrum of possibilities/actions?

It's not all negative! Be innovative, look for opportunities.
e.g. carbon farming, use of existing resources (water storages?) to boost/mitigate against prolonged drying.

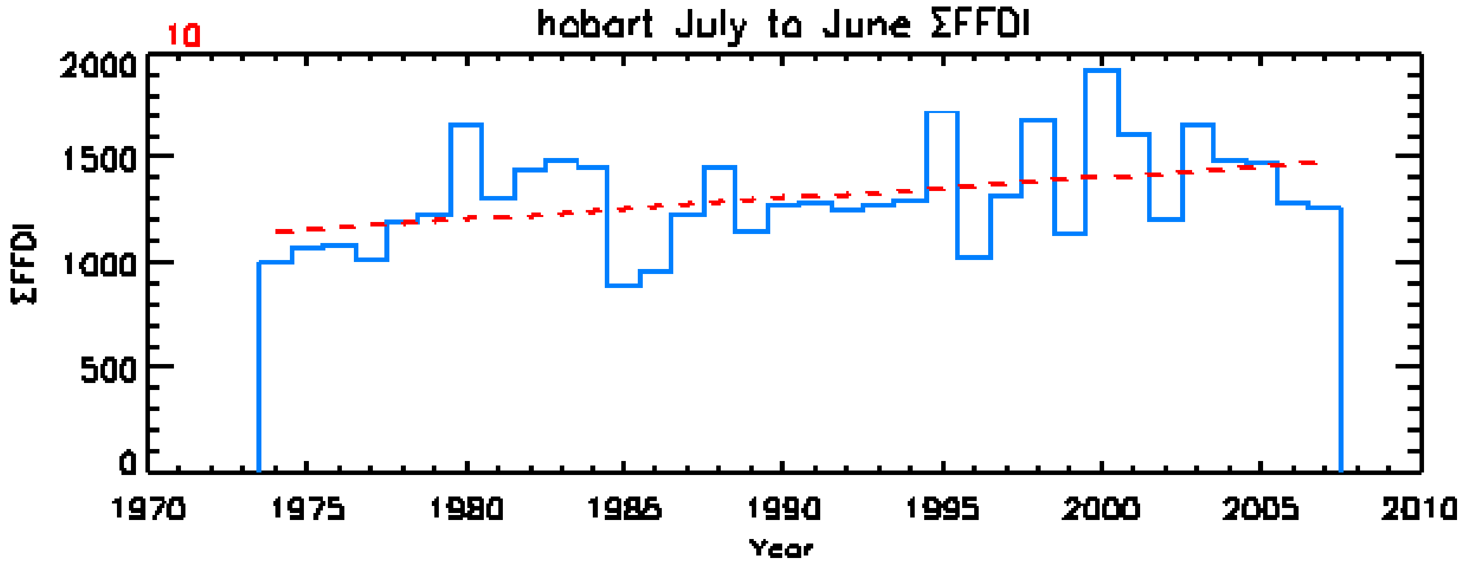
A new confounder for bushfire risk in SE Australia - climate change

- Warmer
- Drier
- More climatic extremes – e.g. heatwaves
- *Very high confidence* declining forest productivity and more bushfires in SE Australia



Intergovernmental Panel on Climate Change (IPCC) *Climate Change (2007) Impacts, Adaptation And Vulnerability – Summary for Policy Makers*

Trend for more severe fire seasons



ΣFFDI = annual (July to June) sum of daily Forest Fire Danger Index (FFDI)

FFDI mathematically combines soil dryness, air temperature, wind speed and relative humidity

Lucas, Hennessy, Mills and Bathols (2007) Consultancy Report prepared for *The Climate Institute of Australia*