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Climate change: Loving an even more sunburnt country

Mark Howden, Steven Crimp, Rohan Nelson, Greg McKeon and many other colleagues

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National Research
FLAGSHIPS
Climate Adaptation



'My Country' - 1904

I love a sunburnt country,
A land of sweeping plains,
Of rugged mountain ranges,
Of droughts and flooding rains.

Dorothea Mackellar (1885-1968)



Climate is a major driver of agriculture & NRM

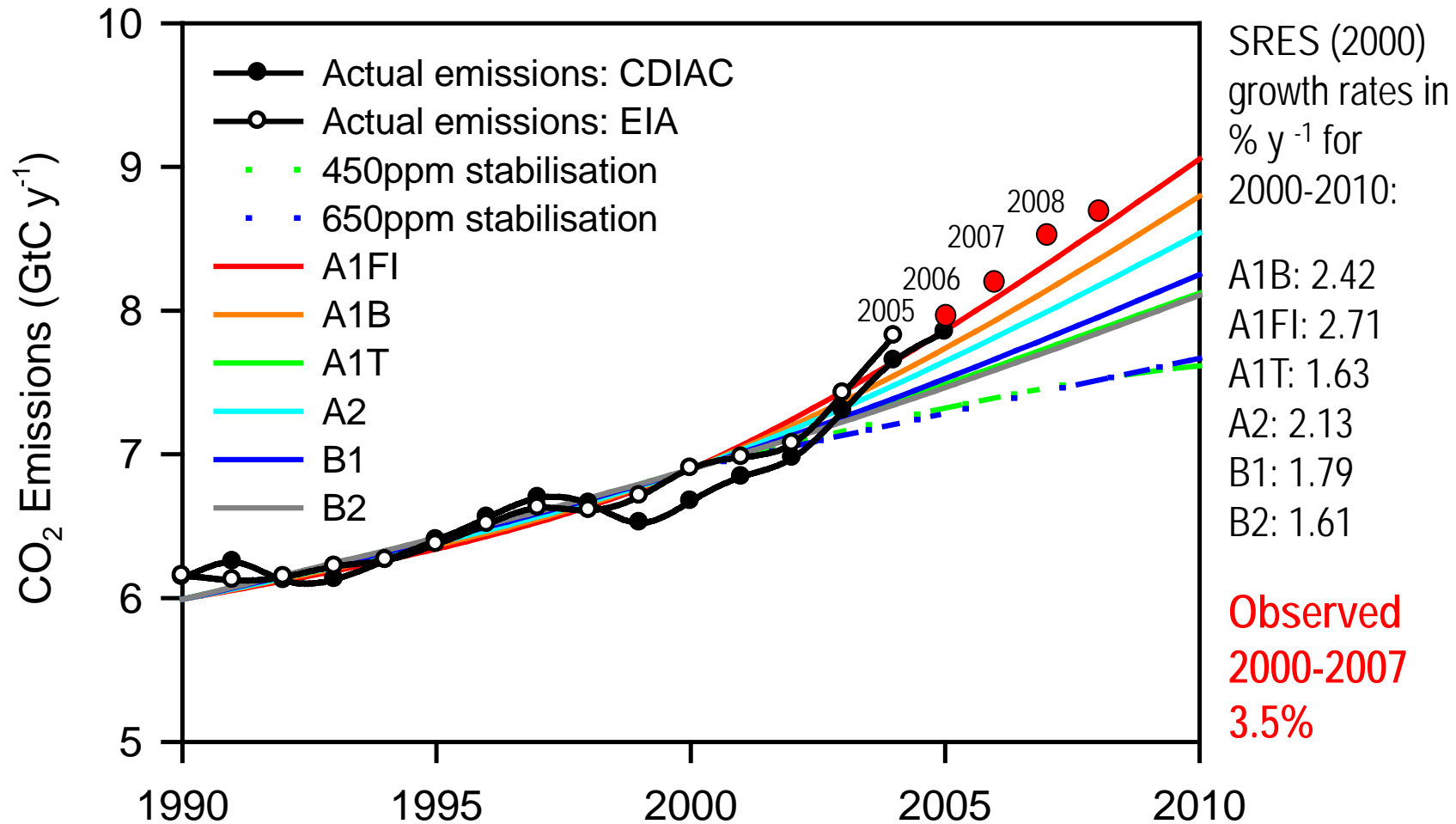
- choice of production system
- production potential and variability
- product quality
- areas planted and preferred soil types
- management systems and technologies
- input costs and product prices
- natural resource management
- biodiversity
- human health
- cultural and heritage values
- businesses along the supply chains
- regional economies and social fabric
-

Some steps in effective adaptation

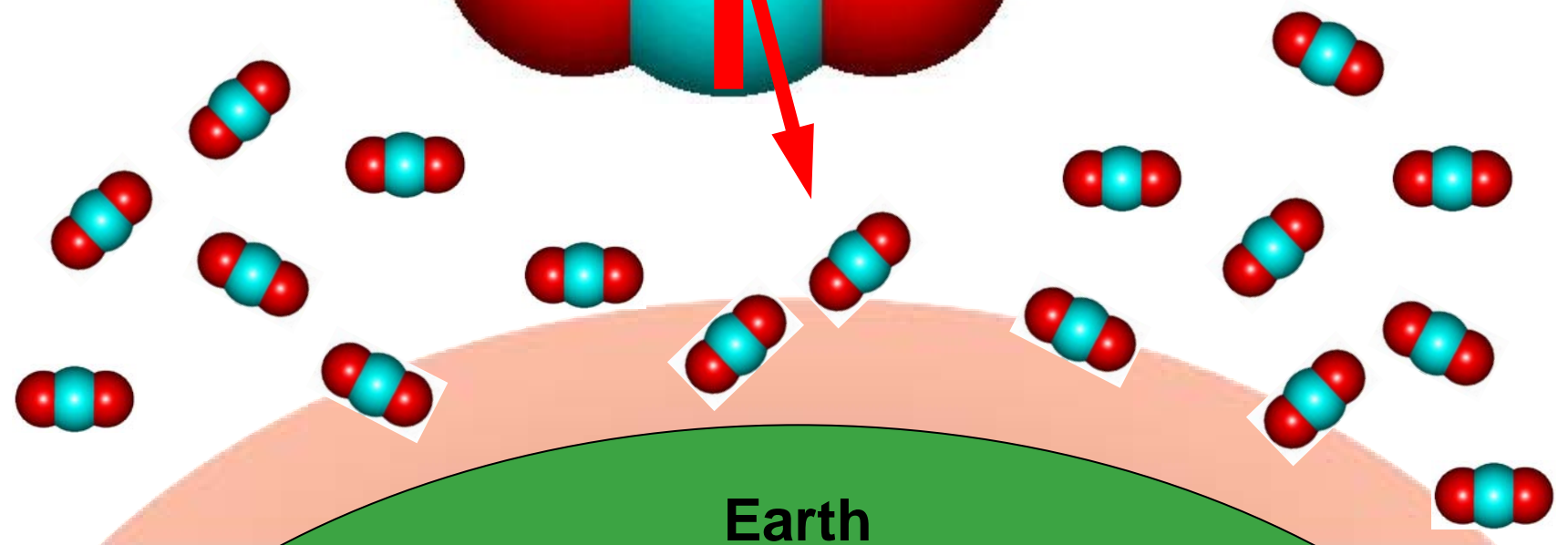
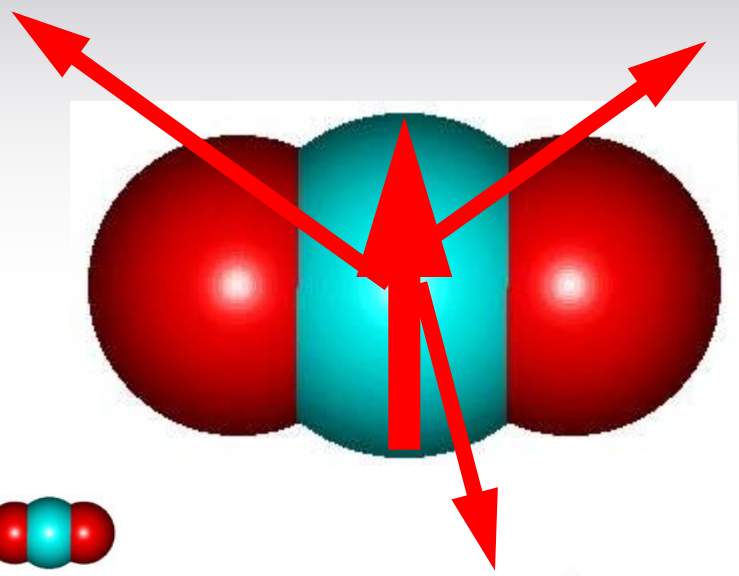
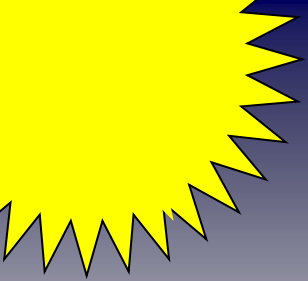
1. Acceptance that climate change is real and will continue
2. Confidence that the projected changes will significantly impact on the sector, region or community of concern
3. Technical and other management options available and targeted to specific regions, industries and communities
4. Early warning of likely major system changes to allow early policy intervention in supporting transitions and structural adjustment
5. 'Mainstreaming' climate adaptation into relevant policy, institutions and industries, building adaptive capacity
6. Monitoring for continuing improvements in adaptation (what is working, what is not and why)

(McKeon et al. 1993; Howden et al. 2007)

CO₂ emissions exceed all SF scenarios



Raupach et al. (2007), Canadell et al (2008), Myhre et al. (2009)

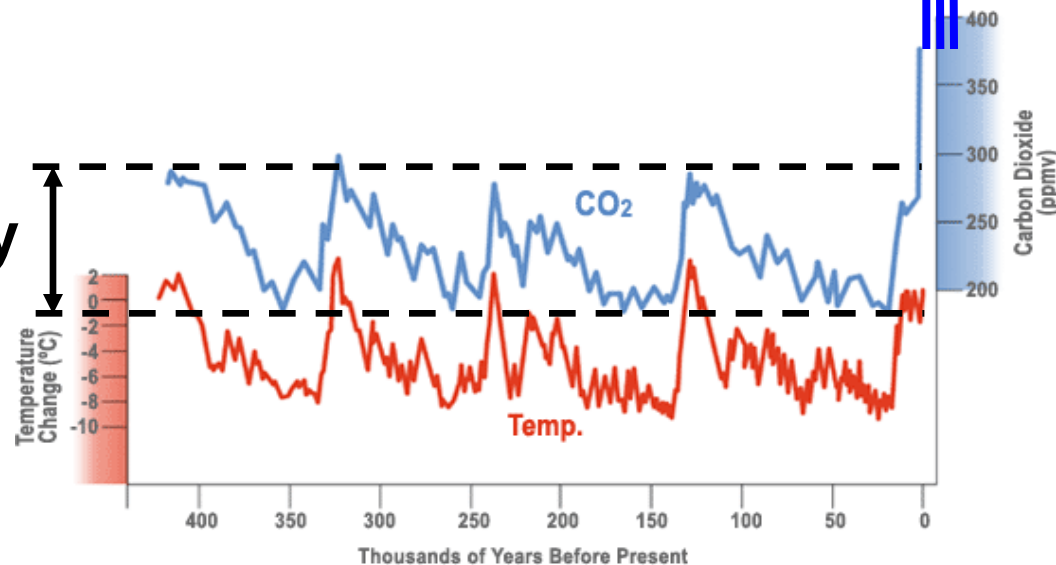


Earth

Carbon dioxide concentrations: future scenarios

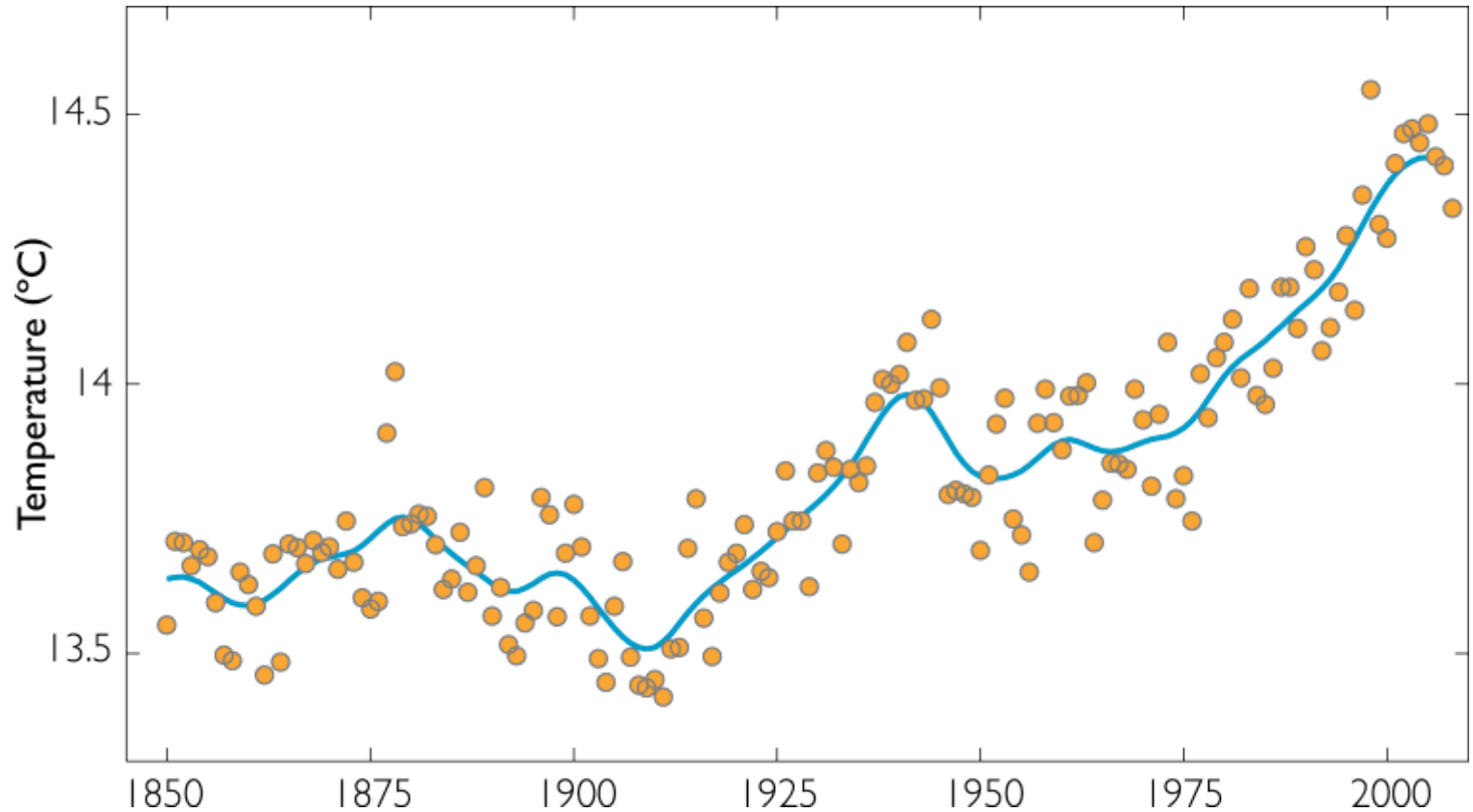
Between 520 to 1000 ppmv by
2100 with a mid-range of
~700ppm

Natural variability



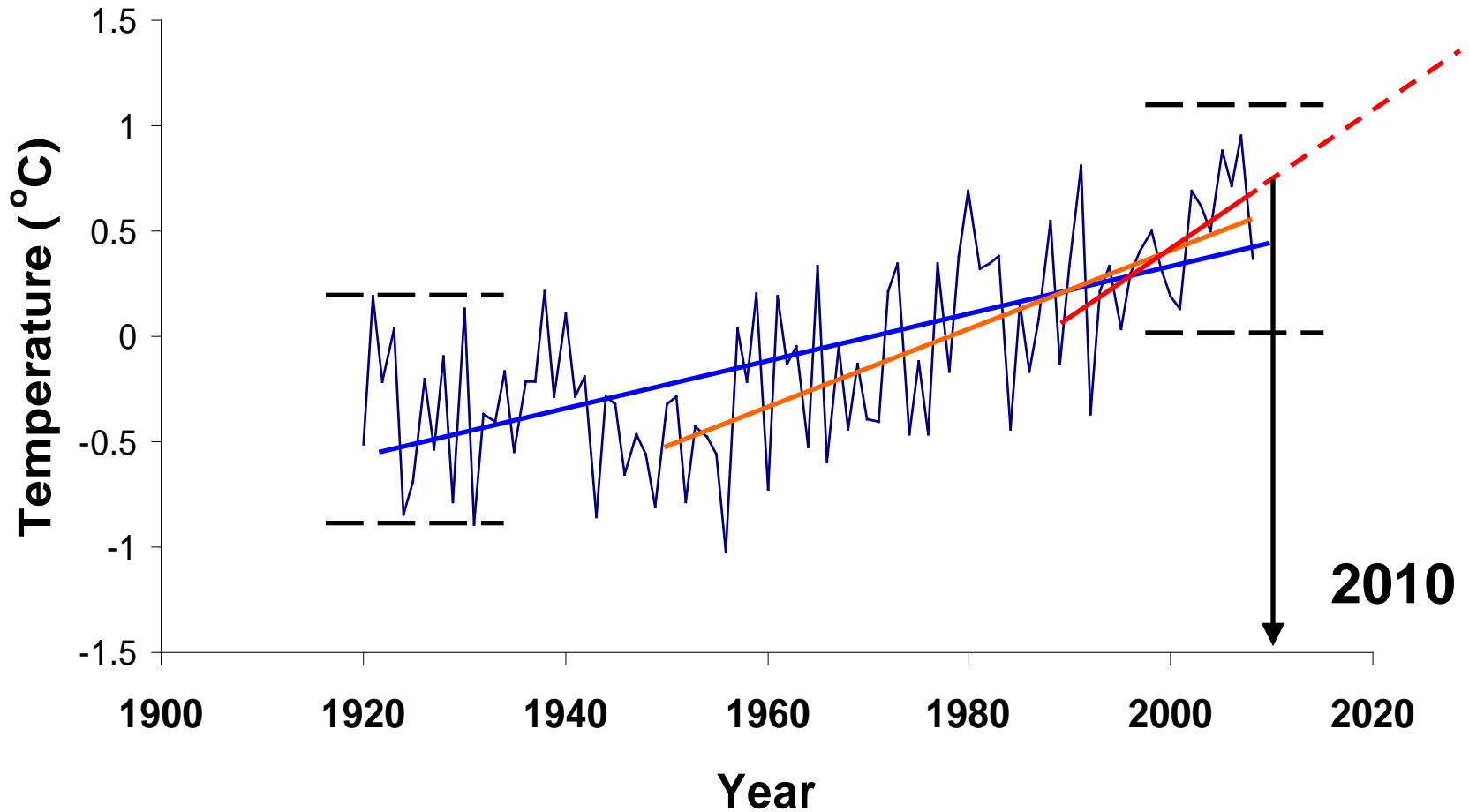
Source: IPCC 2007

Global average temperatures are rising



CRU, UEA

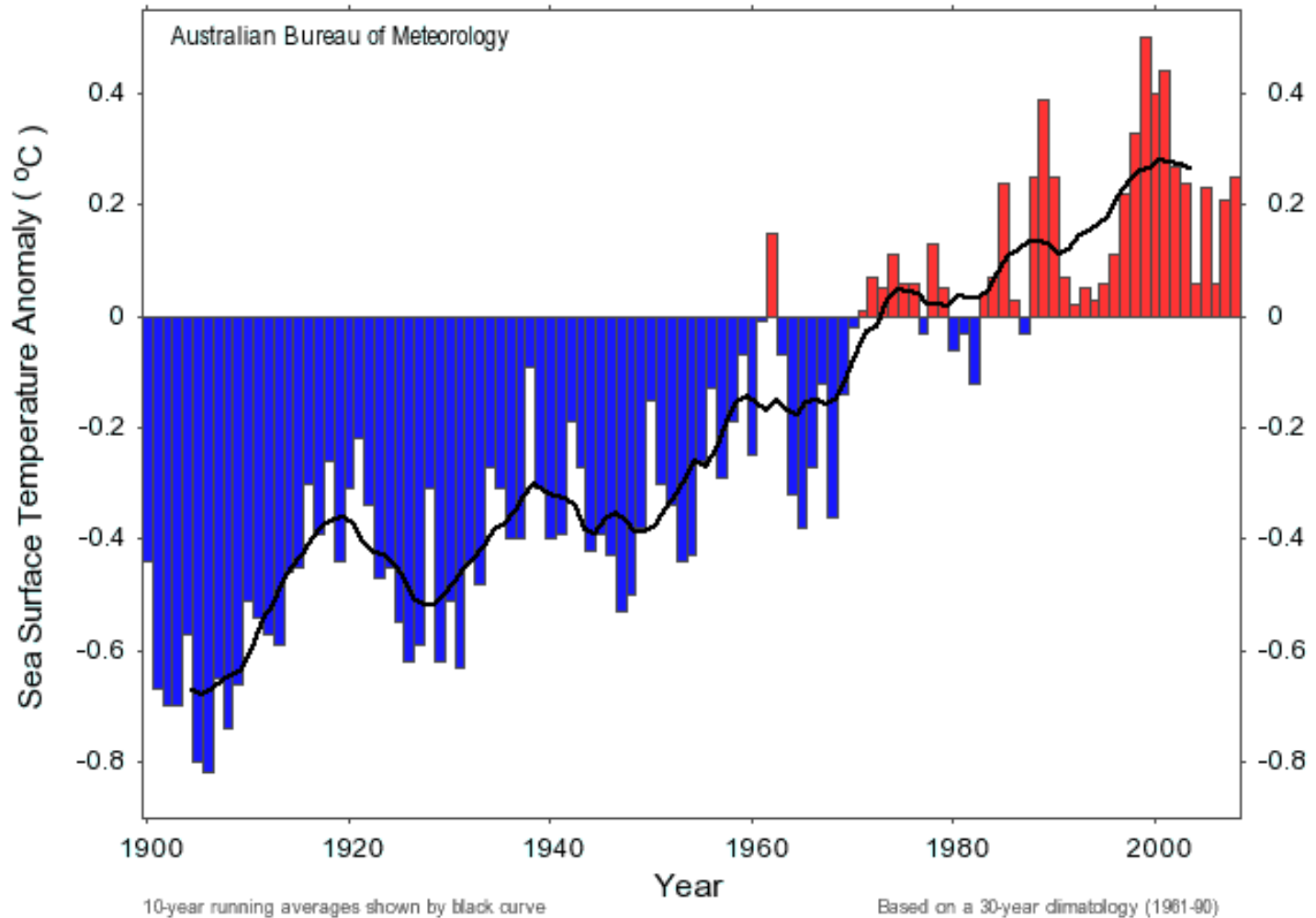
Southern Australian temperatures are already changing



(Data BoM; Analysis: Howden 2009, long term average 18.6°C)

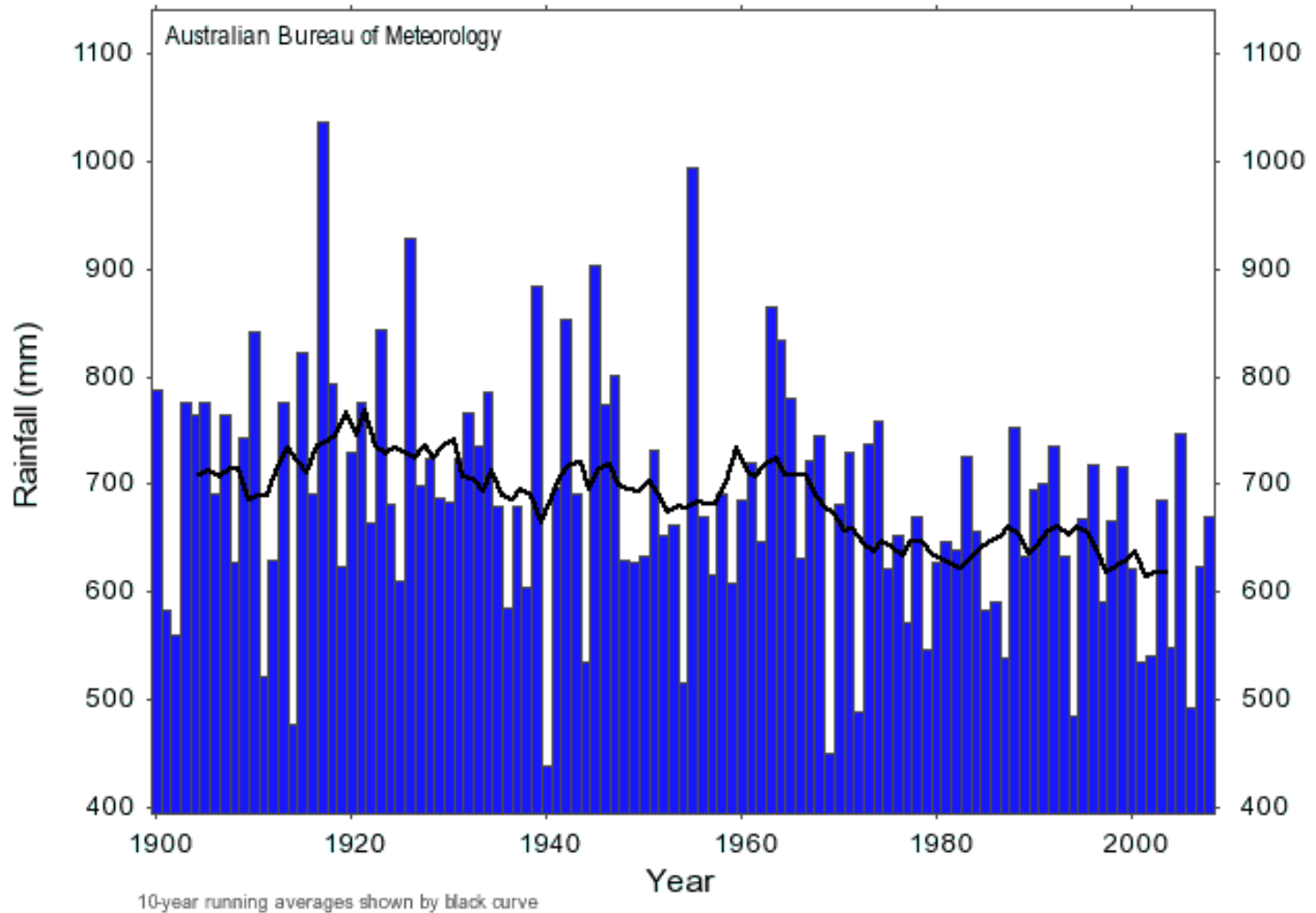
Sea surface temperatures are rising too

Annual Sea Surface Temperature Anomaly - Southern Region



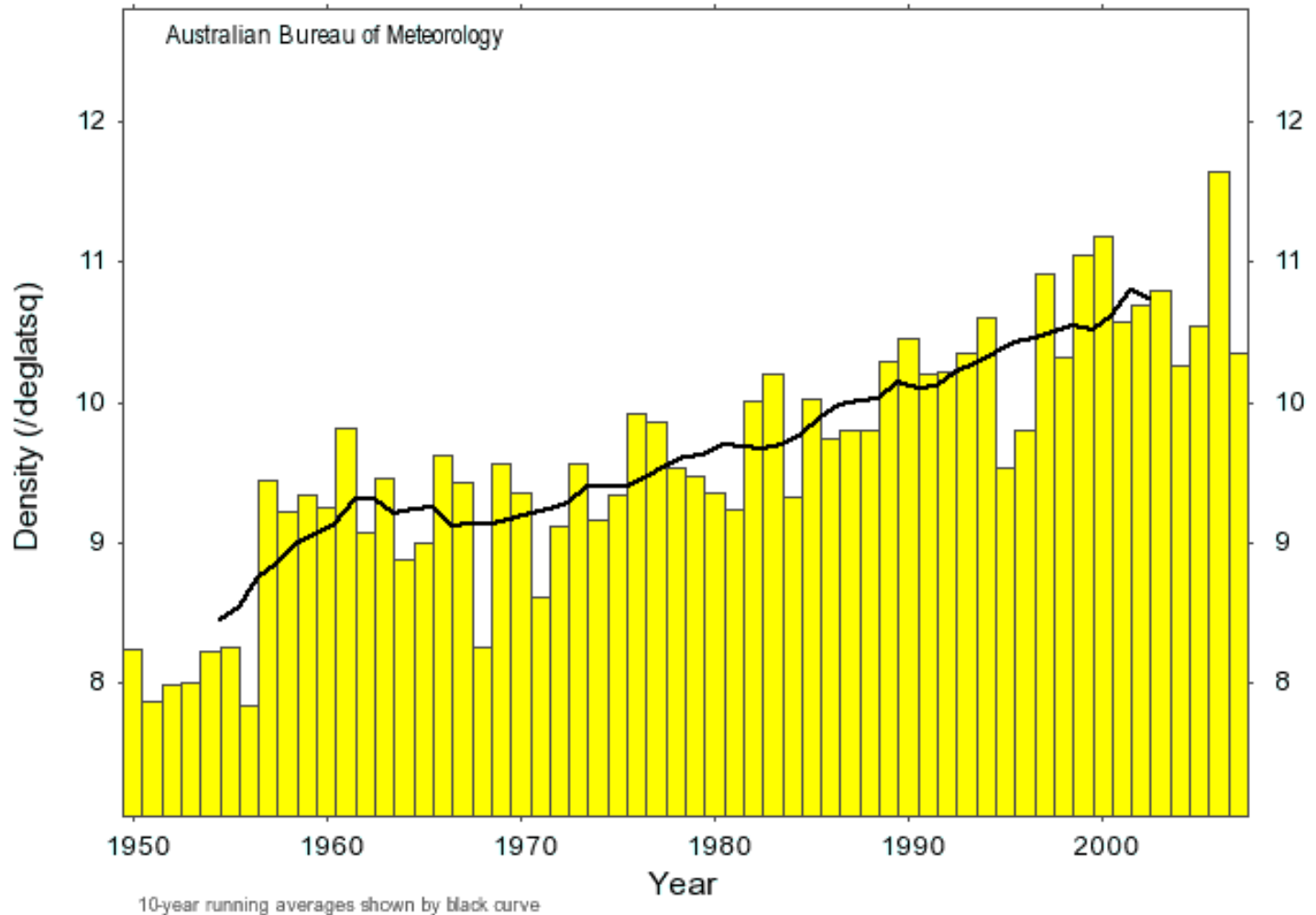
Rainfall is trending down

Annual Rainfall - Southwestern Australia



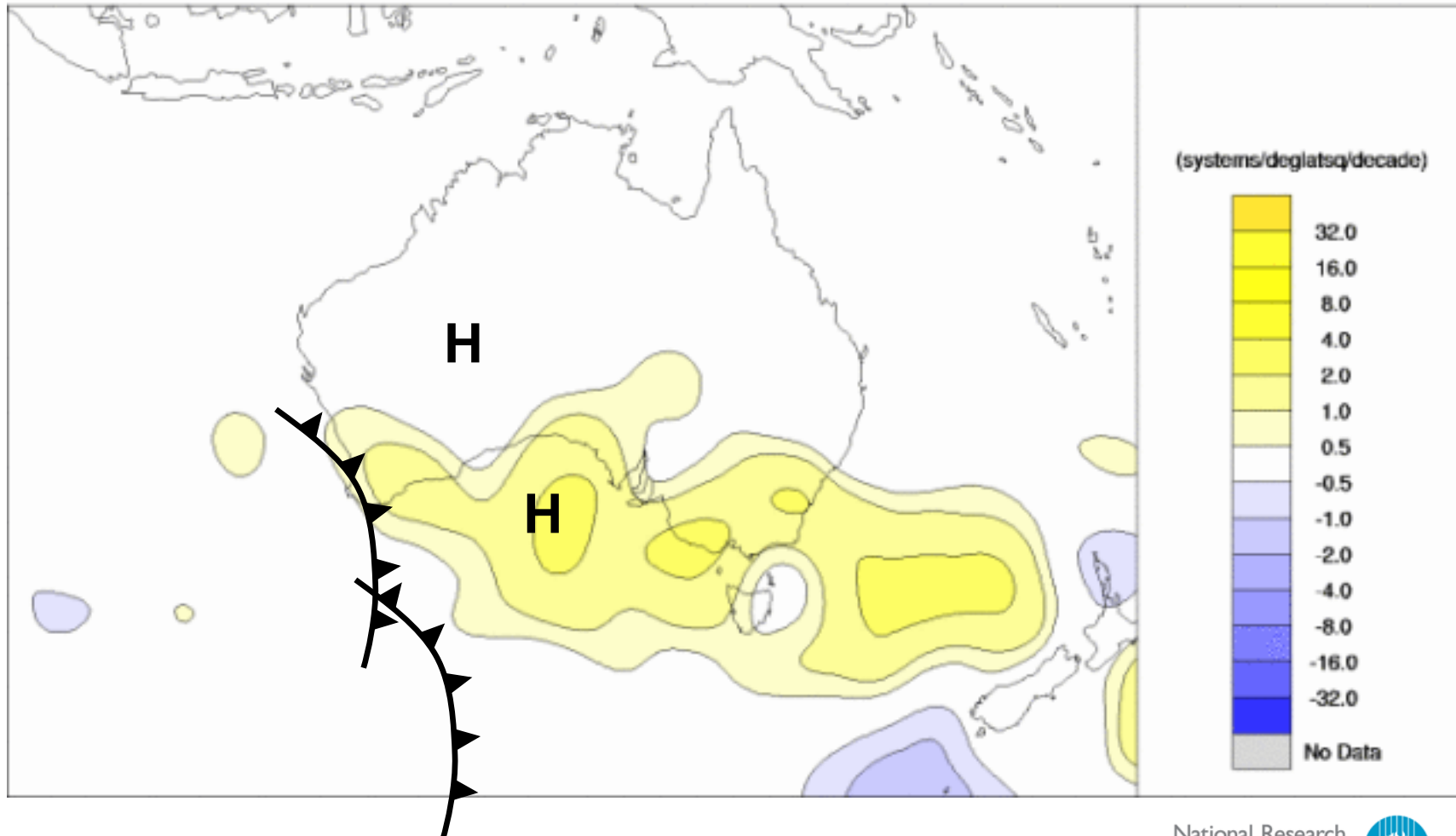
High pressure density – Southern region

Annual Mean Anti-Cyclone Density - Southern Region



High pressure density – Southern region

Trend in Annual Anti-Cyclone Density 1970-2007



In a nutshell...

‘Past performance is not a reliable indicator of future performance’

– *Aust Securities & Investment Commission*

‘The past climate is no longer a reliable indicator of the future climate’

– *message from scientific community*

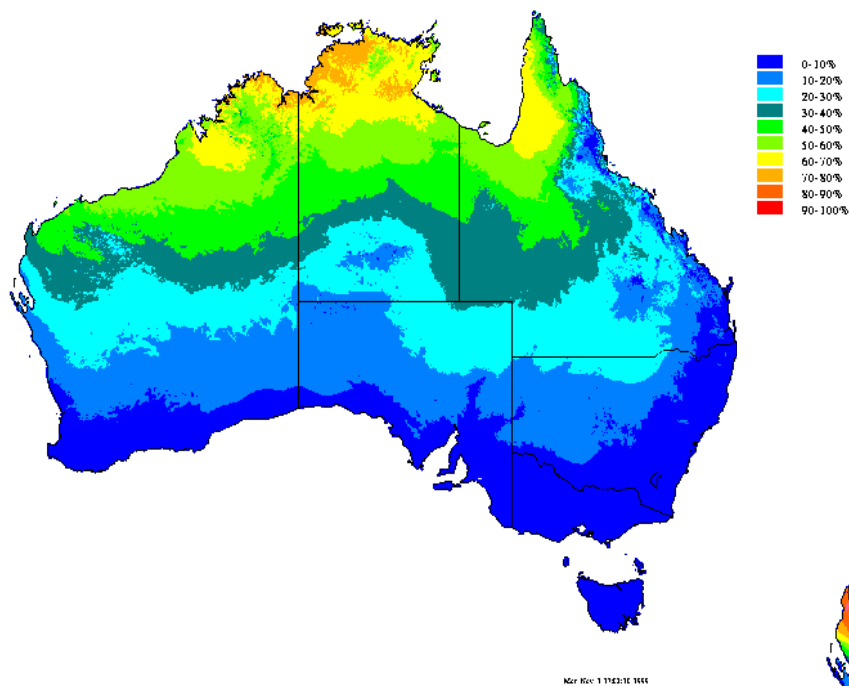


Projections of future climate

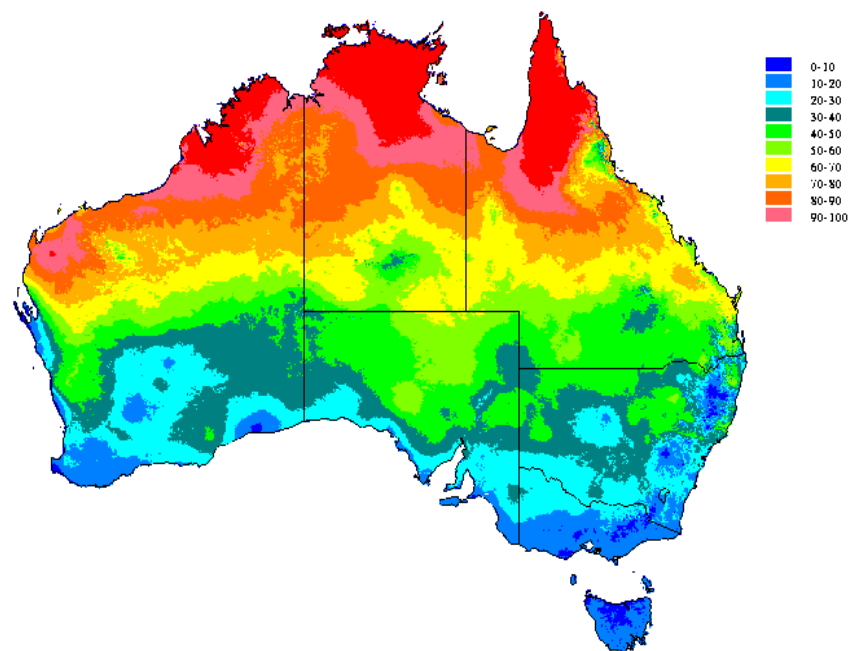
- Higher temperatures (1 to 6°C by 2070)
- Lower rainfall in the southwest and south-east (up to 60% reductions in some areas and some seasons)
 - possibly more monsoonal rain in the north
 - reduced soil moisture and river flow, water quality issues too
- Increased climate extremes
- Higher potential evaporation
- More fires
- Stronger tropical cyclones
- Sea level increases

Heat stress frequency

Current heat stress



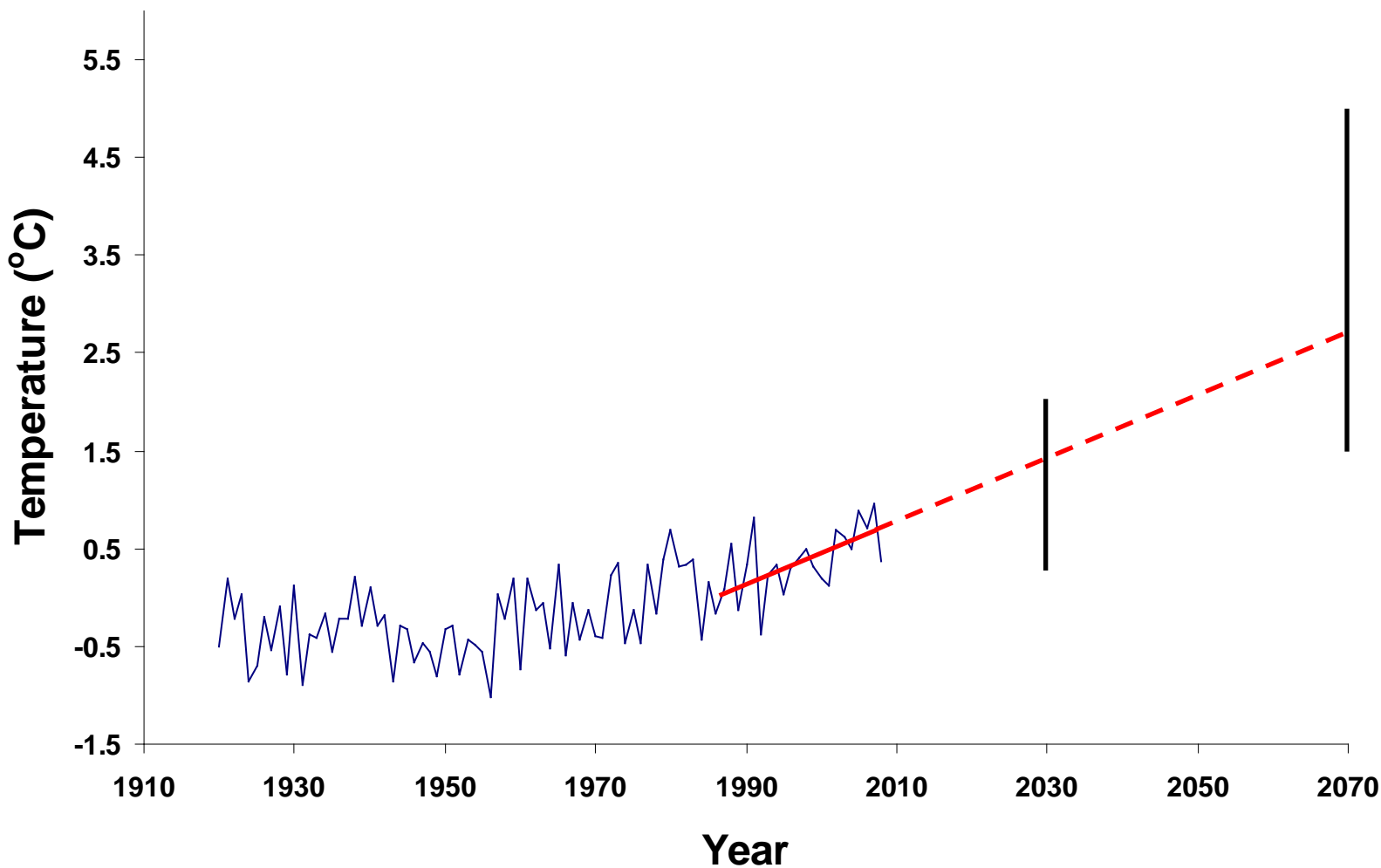
Heat stress 2.7°C warmer



Frequency of days when
THI > 82

Howden et al. (1999)

Past Southern Australian temperature changes are consistent with future projections



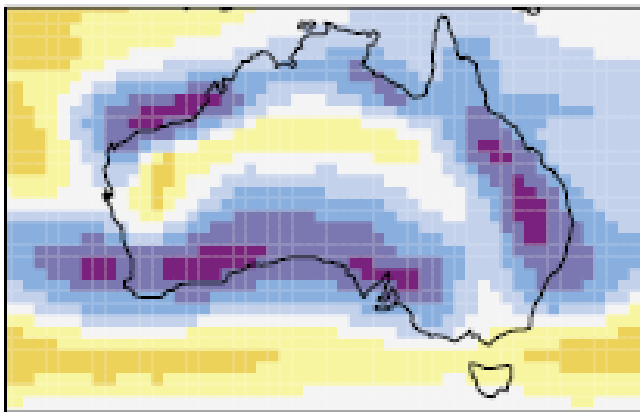
(Data BoM; Analysis: Howden 2009)

Projections of future climate

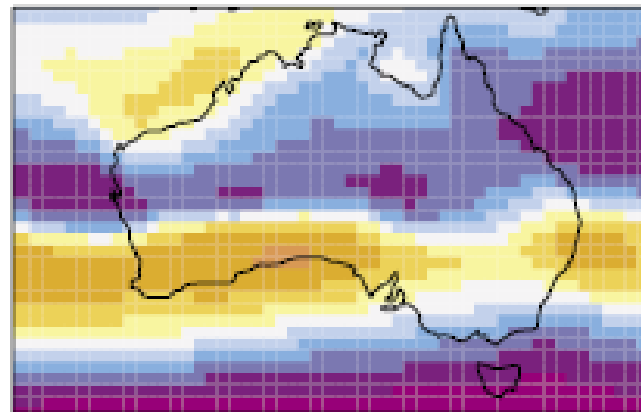
- Higher temperatures (1 to 6°C by 2070)
- Lower rainfall in the southwest and south-east (up to 60% reductions in some areas and some seasons)
 - unclear if reductions are in addition to the reductions already experienced
 - reduced soil moisture and river flow, water quality issues too
 - possibly more monsoonal rain in the north
- Increased climate extremes
- Higher potential evaporation
- More fires
- Stronger tropical cyclones
- Sea level increases

Probability of windspeed increase

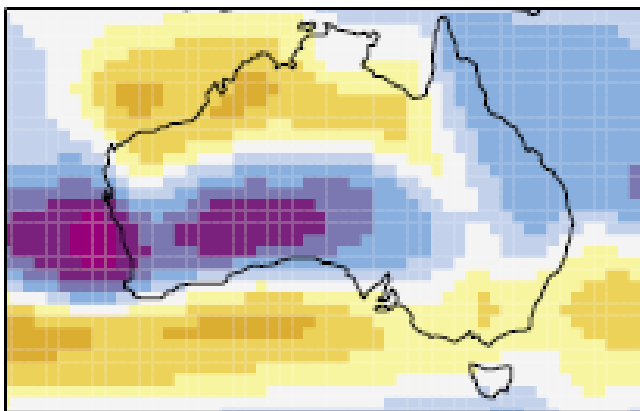
Summer



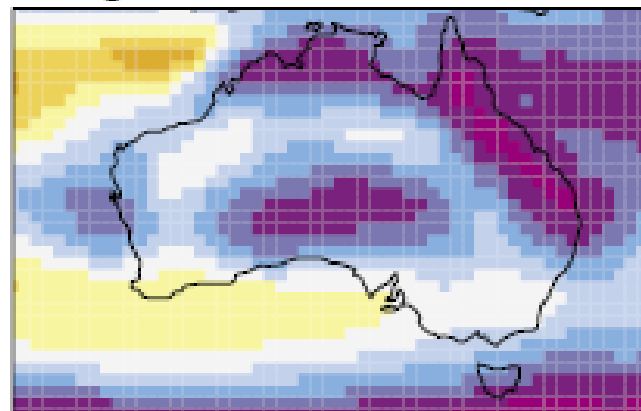
Winter



Autumn



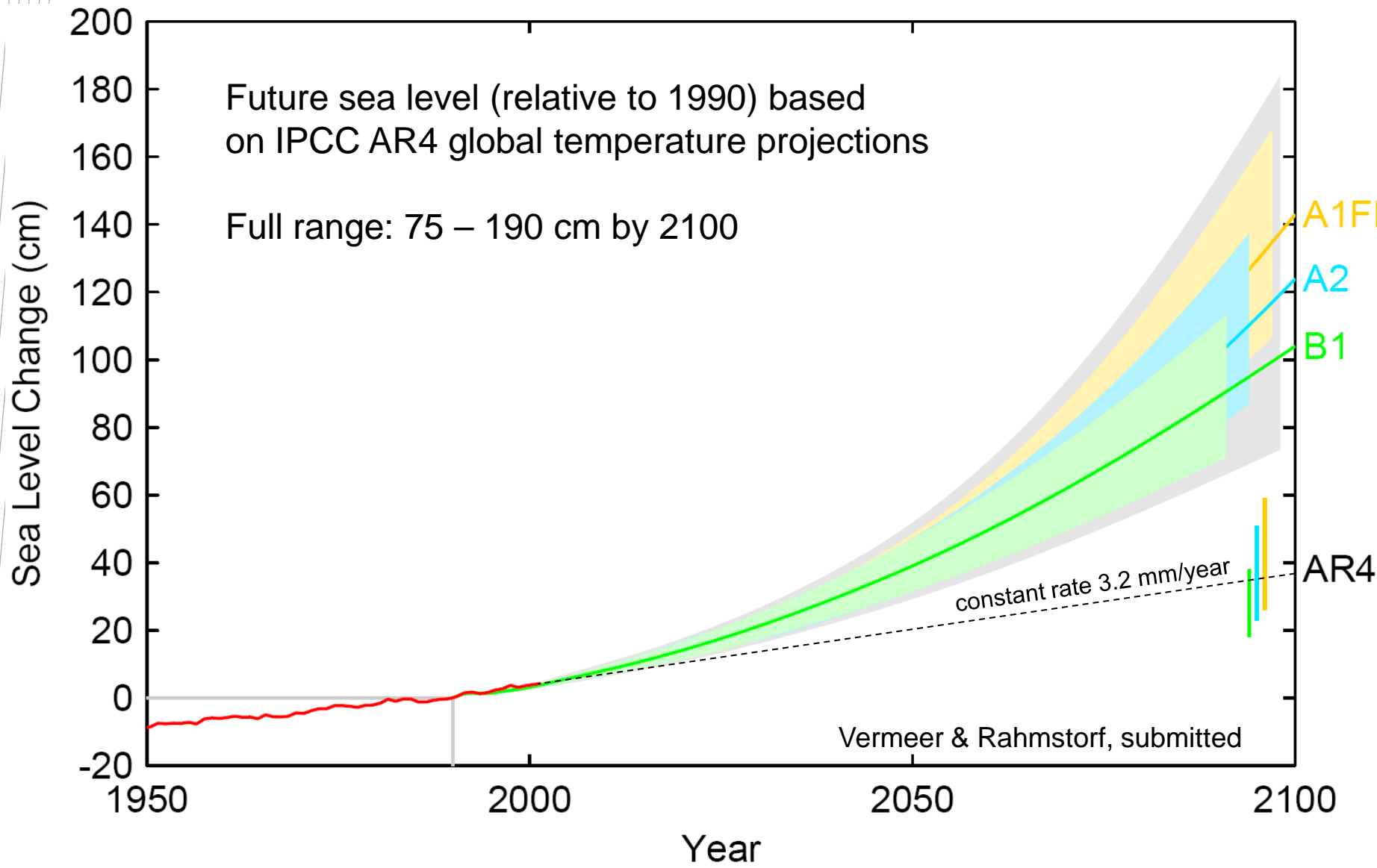
Spring



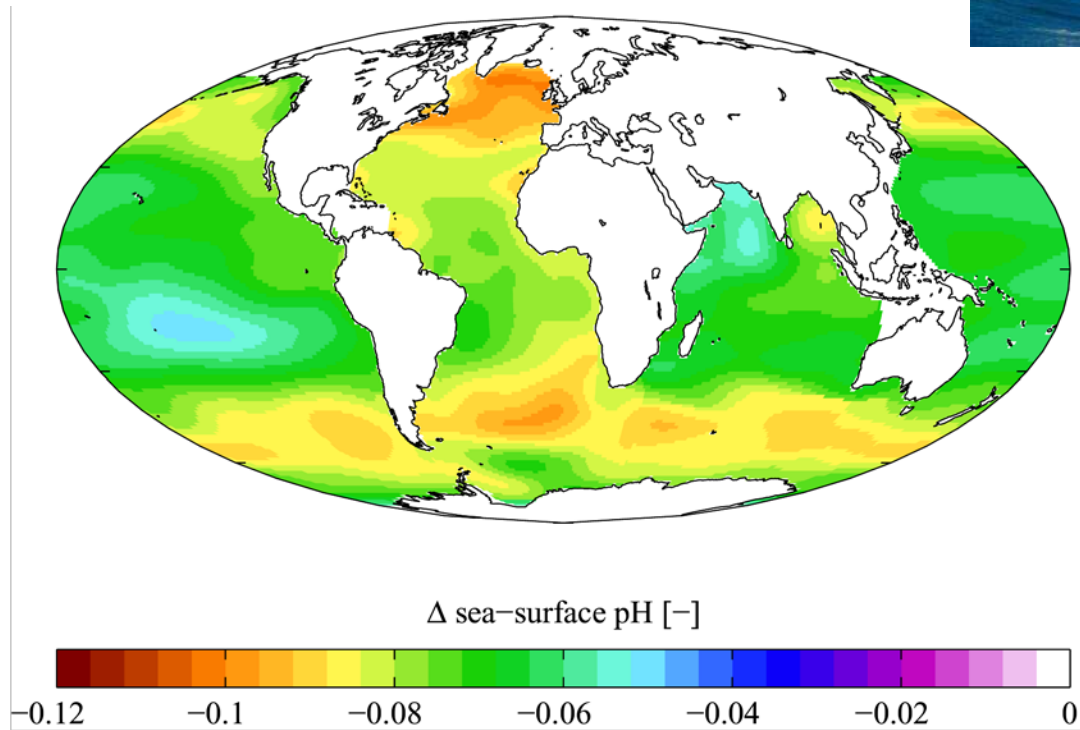
Projections of future climate

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- Increased climate extremes
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- More fires
- Stronger tropical cyclones
- Sea level increases and ocean acidification

Sea level projections



Ocean Acidification



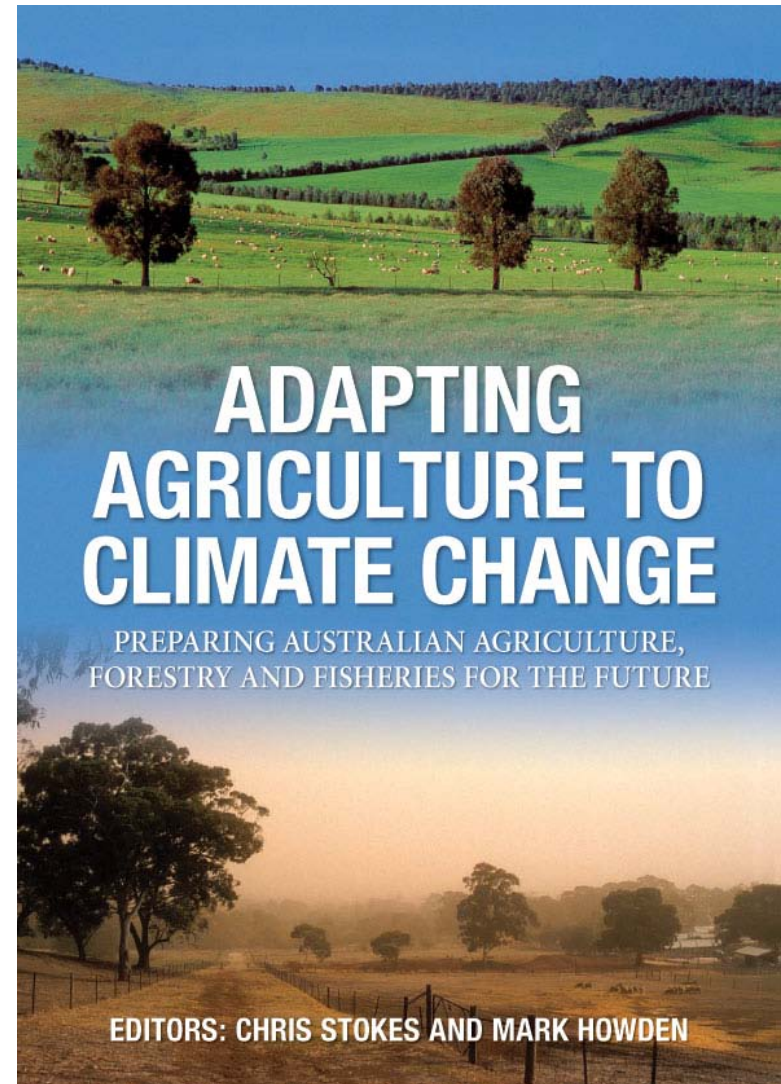
Change in pH between 1700s & 1990s

De-mystifying adaptation. We are adapting all the time

- Businesses re-position themselves in response to opportunities and risks
- Governments change policies and programs to better achieve broad societal goals
- These decisions are taken all the time – in the absence of complete information
- Climate change is no different
- Our aim is to help make adaptations more effective and efficient in the face of uncertain climate changes

Many adaptations are possible

- Varieties, species, planting times
- Residue and water management
- Nutrient management and rotations
- Seasonal climate forecasting
- Tools/training – dealing with uncertainty, transformation
- Regional development, drought, NRM policies etc
- Book out February 2010
 - maladaptation
 - adaptation and GHG emission reduction

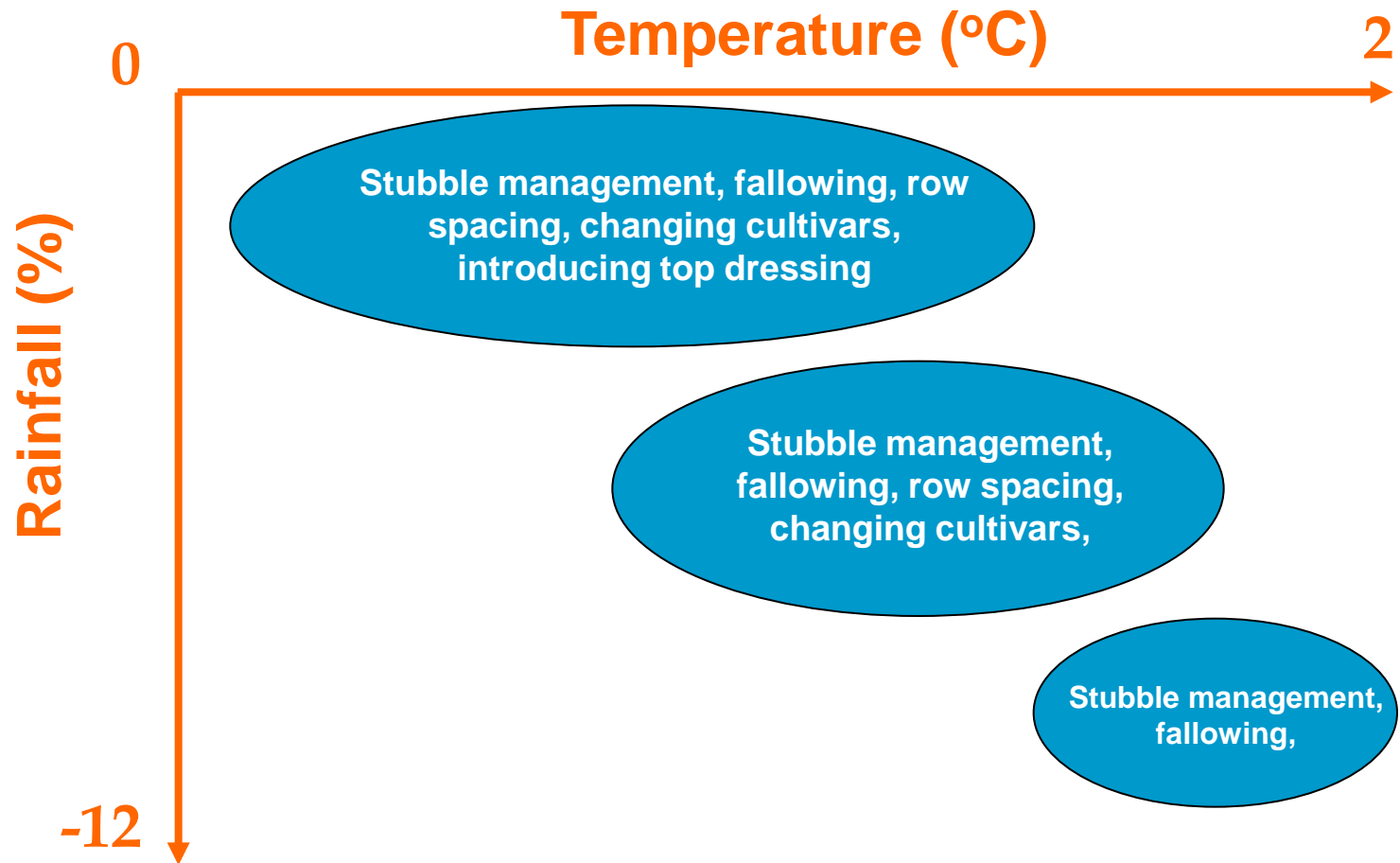


Combining local partner knowledge with systems modelling – farmer interviews

- Reduce the proportion of higher risk crops grown e.g. legumes
- **Fallow on a regular basis on heavier soils (crop less)**
- **Select for shorter season varieties and more heat tolerant crops**
- Lower stocking rates and **retain more stubble** to conserve soil moisture
- Consider growing more fodder crops and move out of wheat cropping

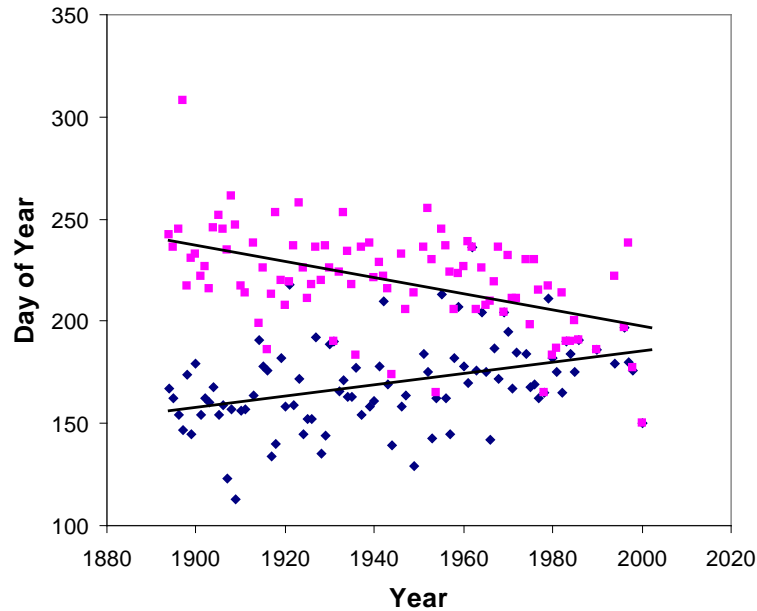


Combining local partner knowledge with systems modelling – menu of options



This provides a menu of options for implementation in appropriate contexts linked in to KASAP considerations

Adaptation to climate changes now



Frost risk strategy	Ignore	100-year	Adaptive
Mean gross margin	\$34	\$29	\$52

- Ignoring the trend meant extra frost risk early in the 100-year record and missed opportunities later

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(McKeon et al. 1993; Howden et al. 2007)

Social learning – a major facilitator

- Australian farming very well served by industry groups, farmer groups and Landcare
- Network for sharing experiences
- Potentially learning about climate management strategies from farming businesses in hotter, drier regions
- Integration of production with natural resource management
- Interface with scientists for two-way learning *via* action research

On the way ahead

- Focus on the things that we can change, together
 - acknowledging that climate is only one of multiple dimensions
- Update risk assessments, develop scenarios to deal with uncertainty
- Look at ways of building the adaptive capacity to a range of external factors (esp. those in common)
- Monitor and evaluate in an adaptive loop – inflexible, top down governance systems unlikely to help
- Change our science too so that it stays relevant

'My country': our future relationship ?

Core of my heart, my country!

Land of the rainbow gold

For flood and fire and famine

She pays us back ~~threefold.~~ twofold ?

Dorothea Mackellar (1885-1968)



Climate Adaptation Flagship

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Theme Leader

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Thank you

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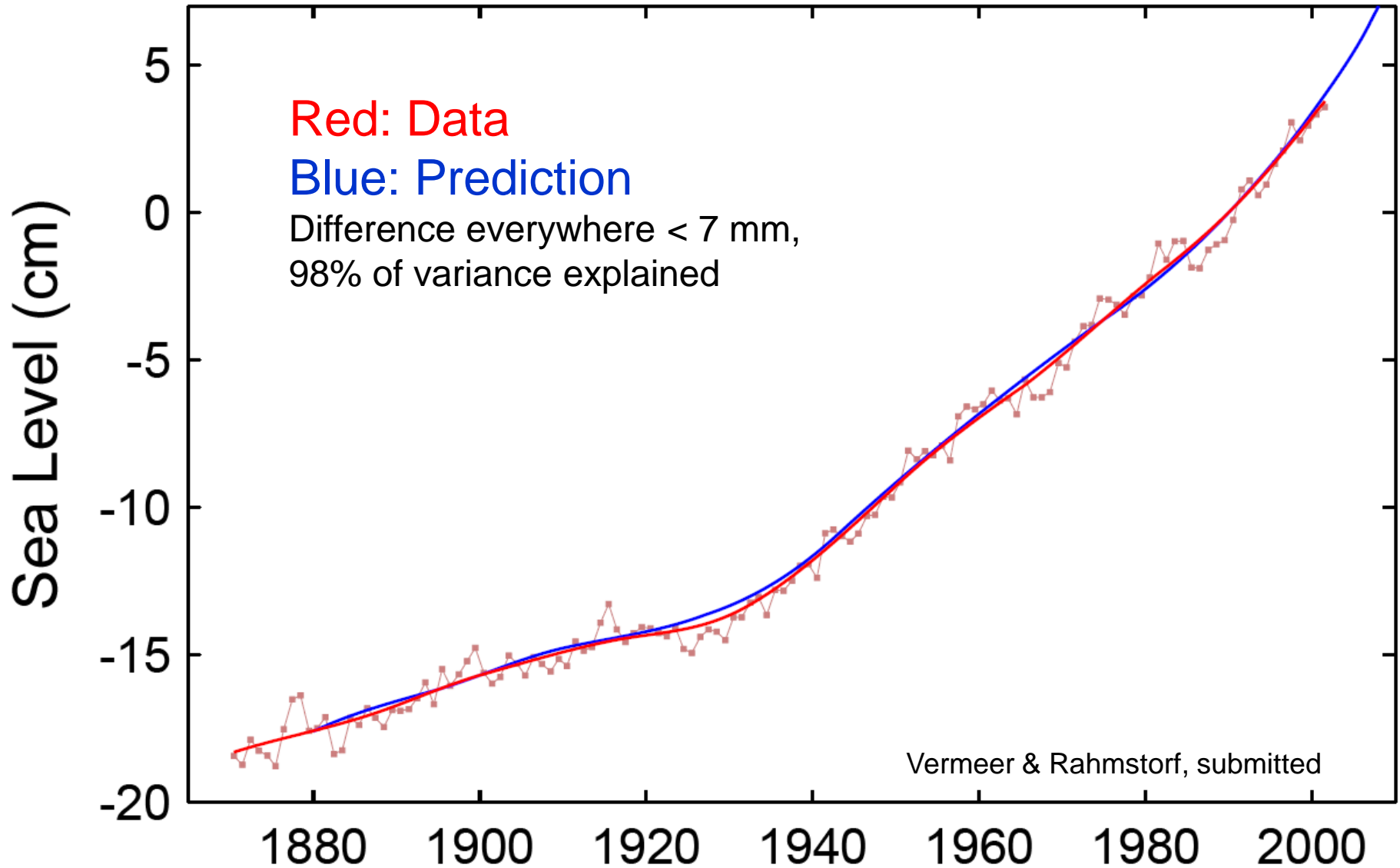
Email: Enquiries@csiro.au

Web: www.csiro.au

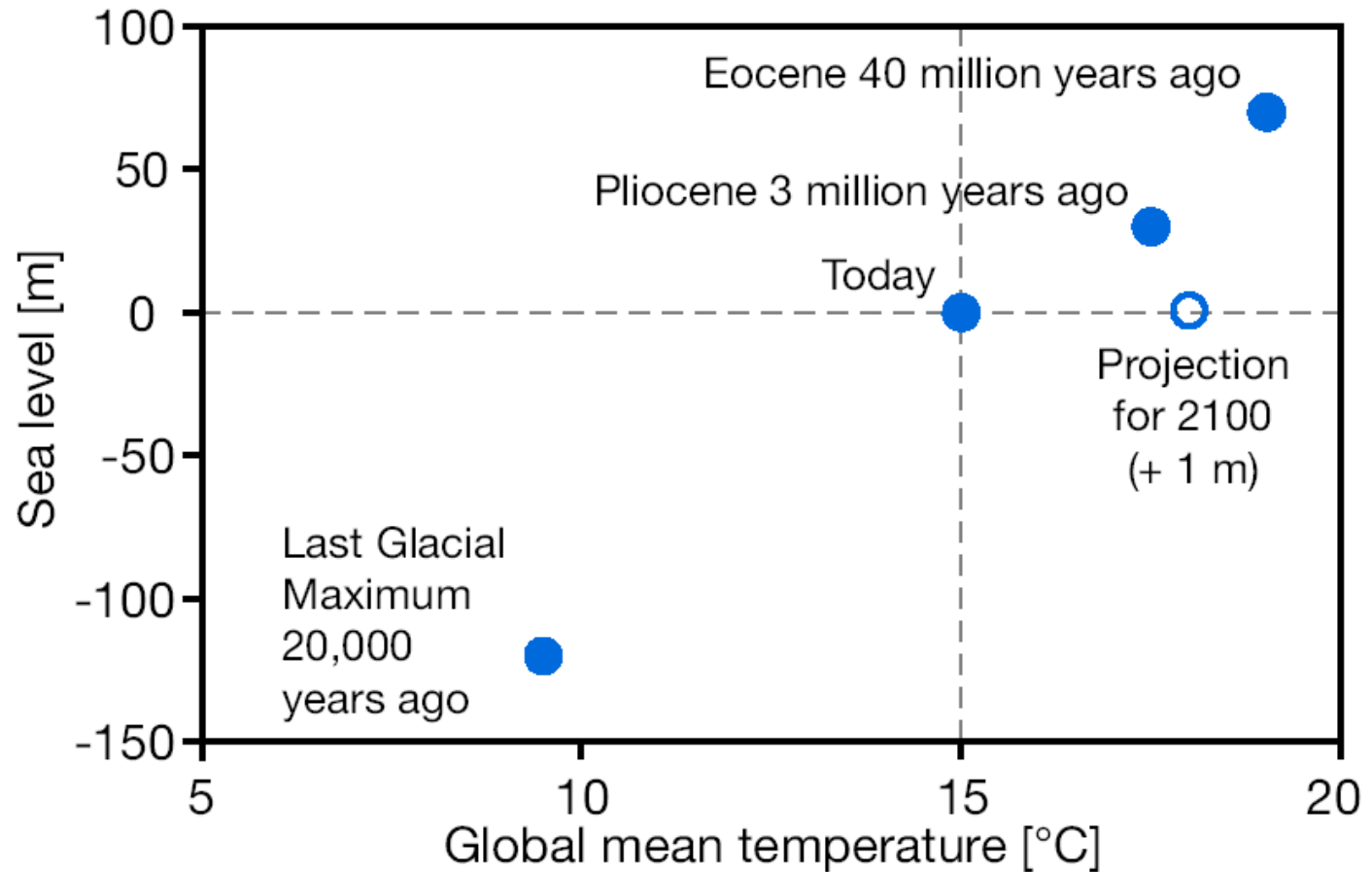
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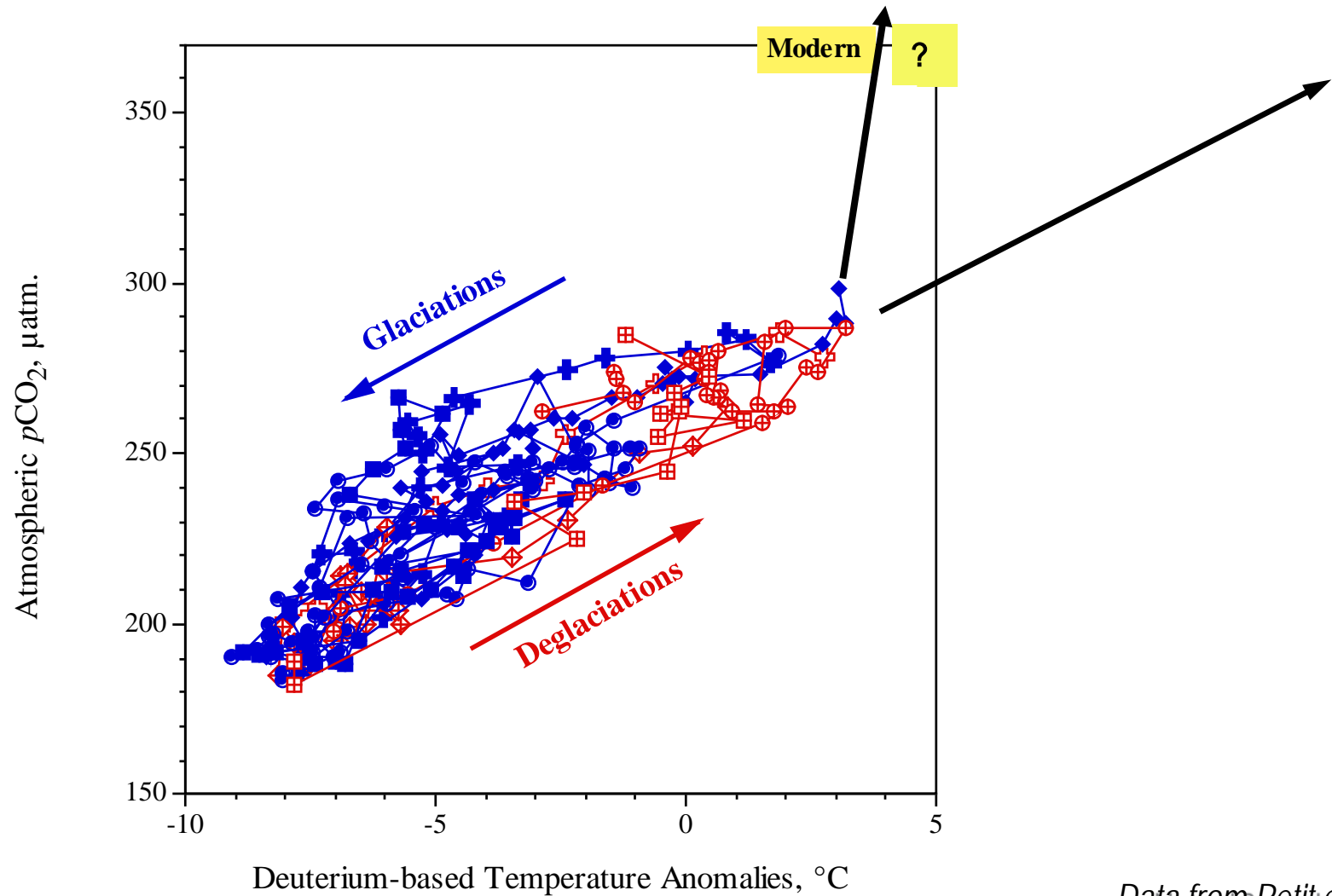
Sea level rises a function of temperature



Sea level and temperature: palaeo data

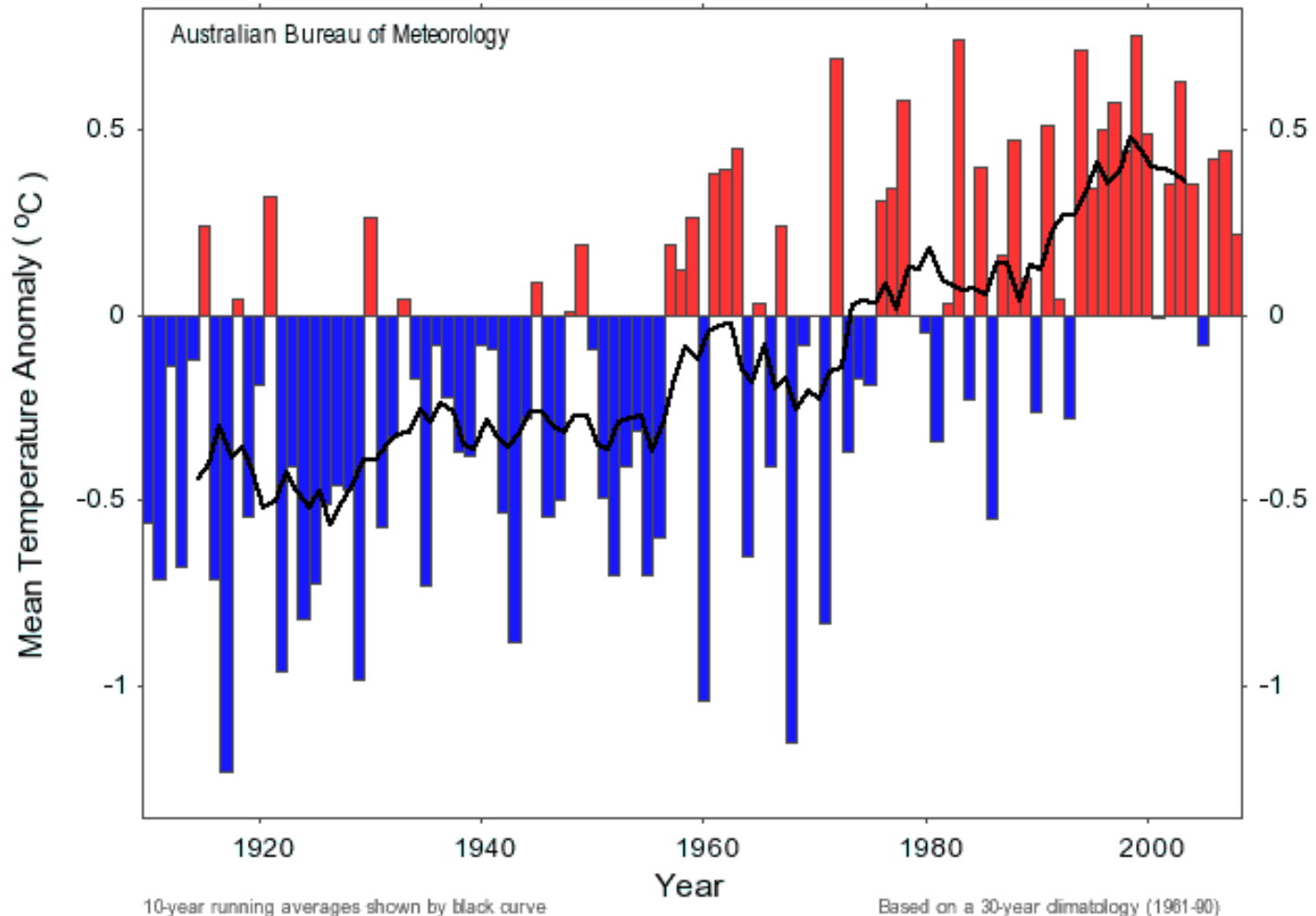


Atmospheric CO₂ and temperature anomalies from the Vostok ice core



Temperature is trending upwards

Annual Mean Temperature Anomaly - Southwestern Australia

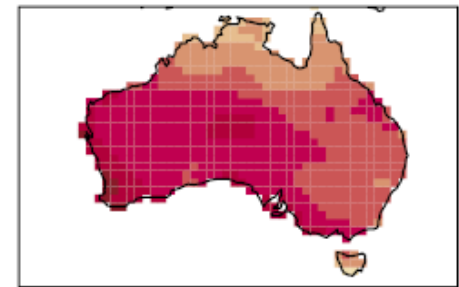


Chance of at least 10 or 20% less annual rainfall

Annual rainfall decrease > 10%

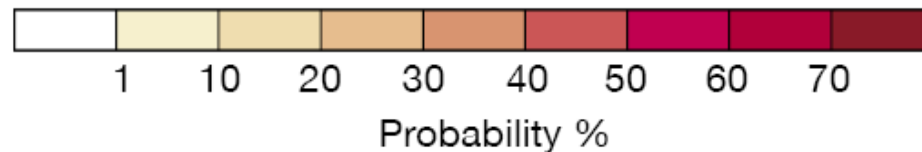
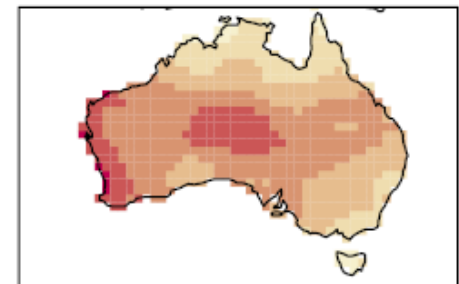
30 to 70% chance it will get quite a bit drier (10% less rain)

2070 High emissions

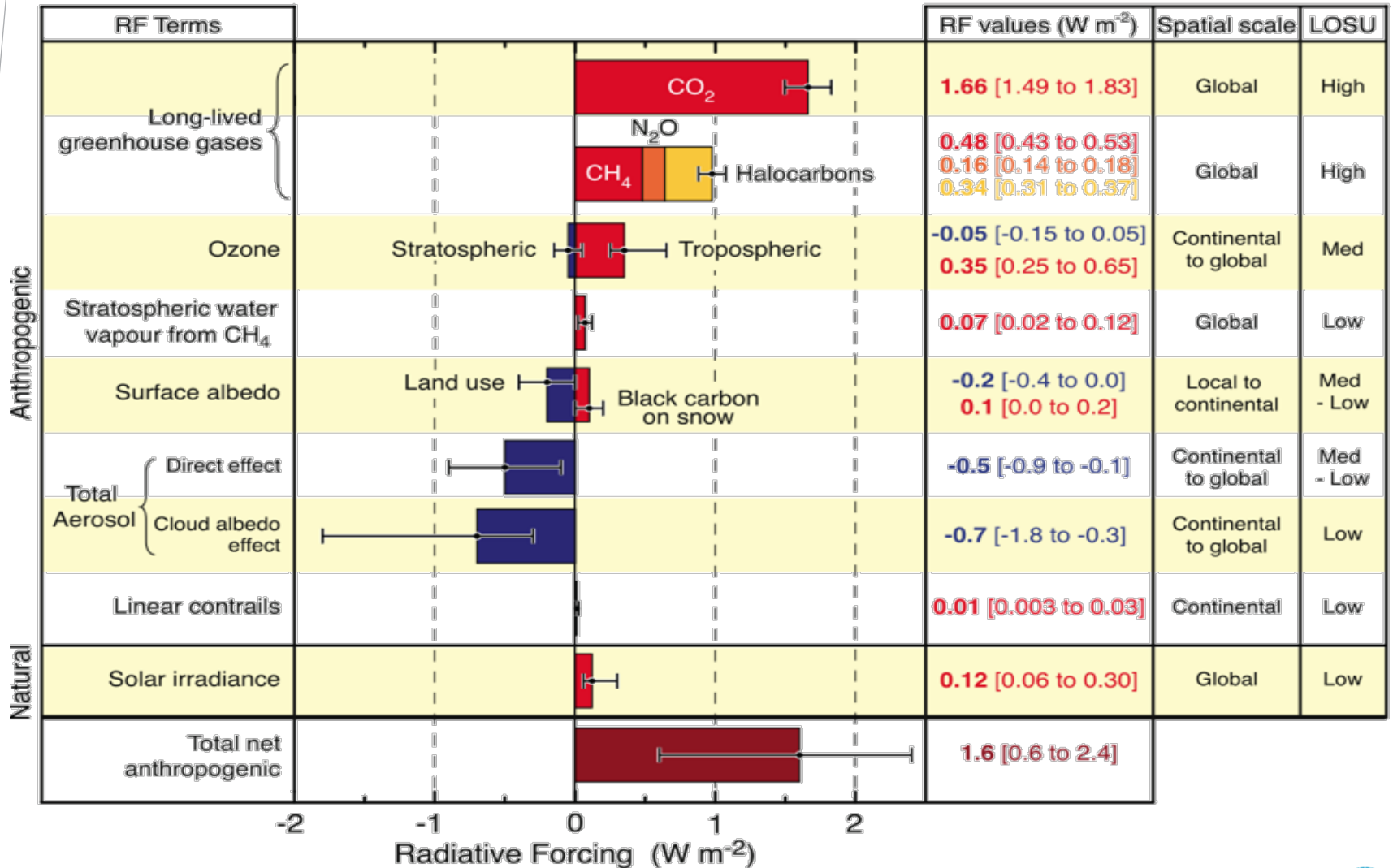


Annual rainfall decrease > 20%

10 to 40% chance it will get very much drier (20% less rain)



Radiative Forcing Components



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