Global climate change:
How much, in what time frame?

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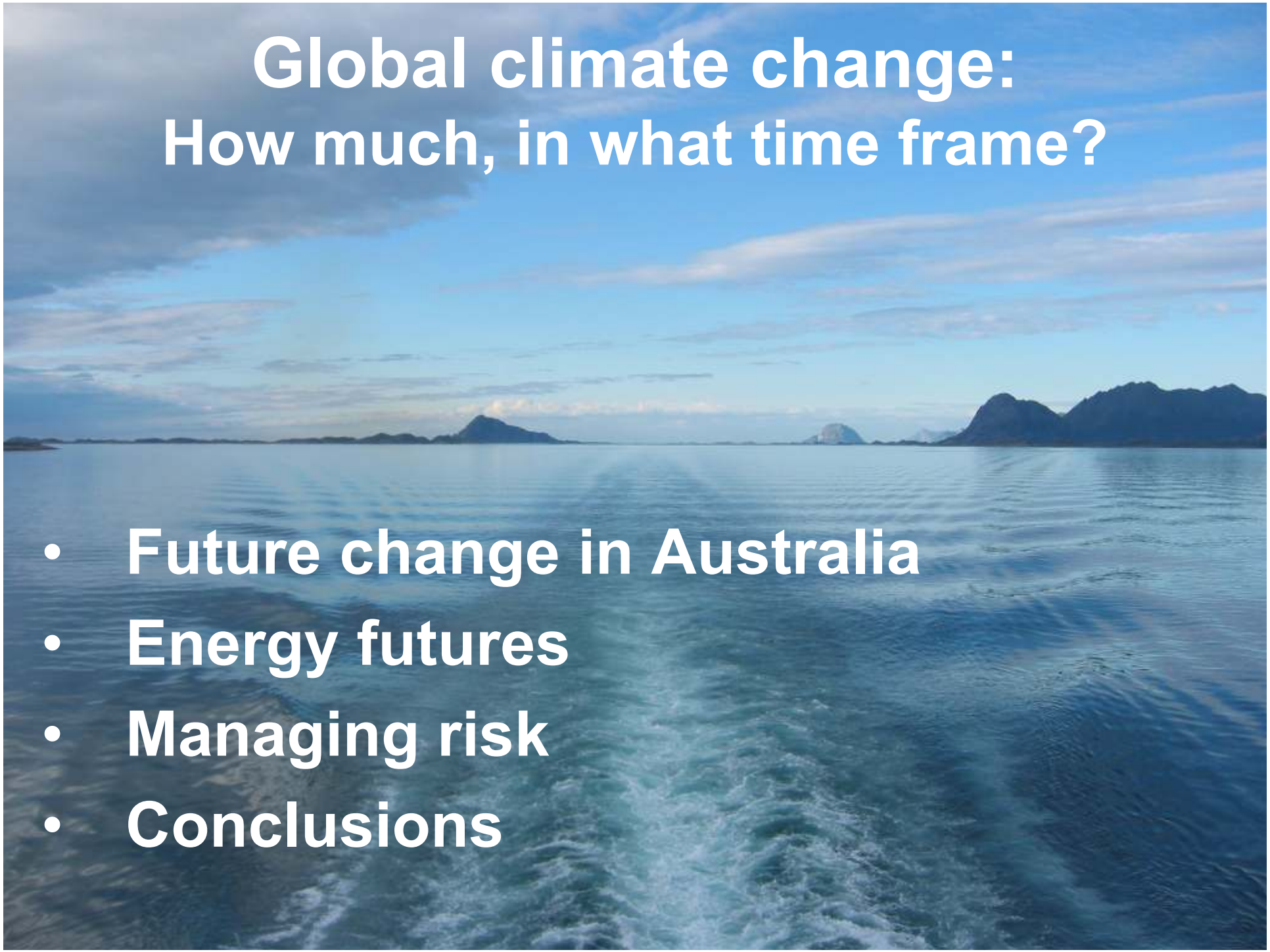

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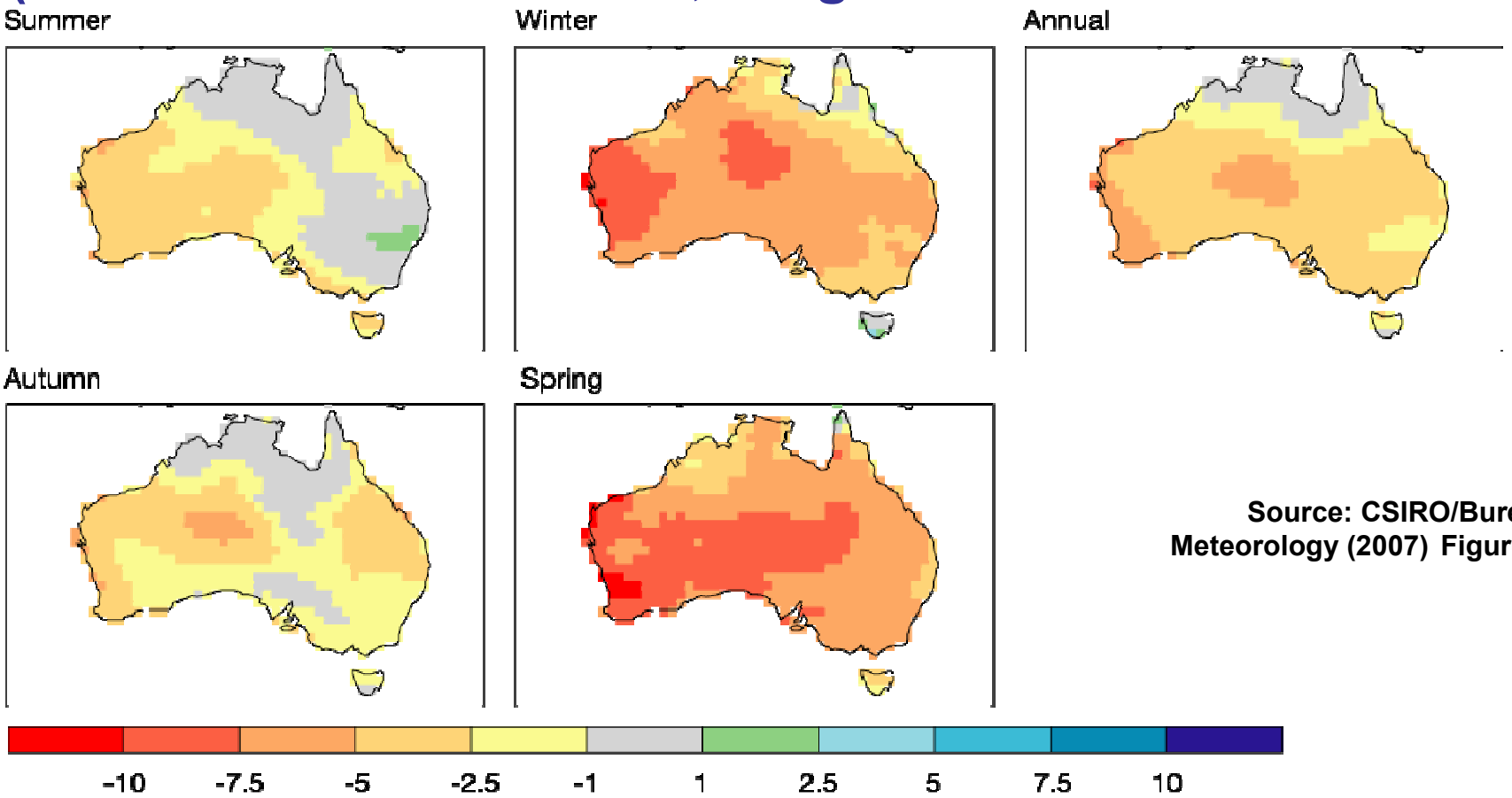
- Future change in Australia
- Energy futures
- Managing risk
- Conclusions

Best estimate (50th percentile) of change of rainfall by 2030 (% of 1961-1990)

(Emissions scenario A1B; weighted results of 23 models)

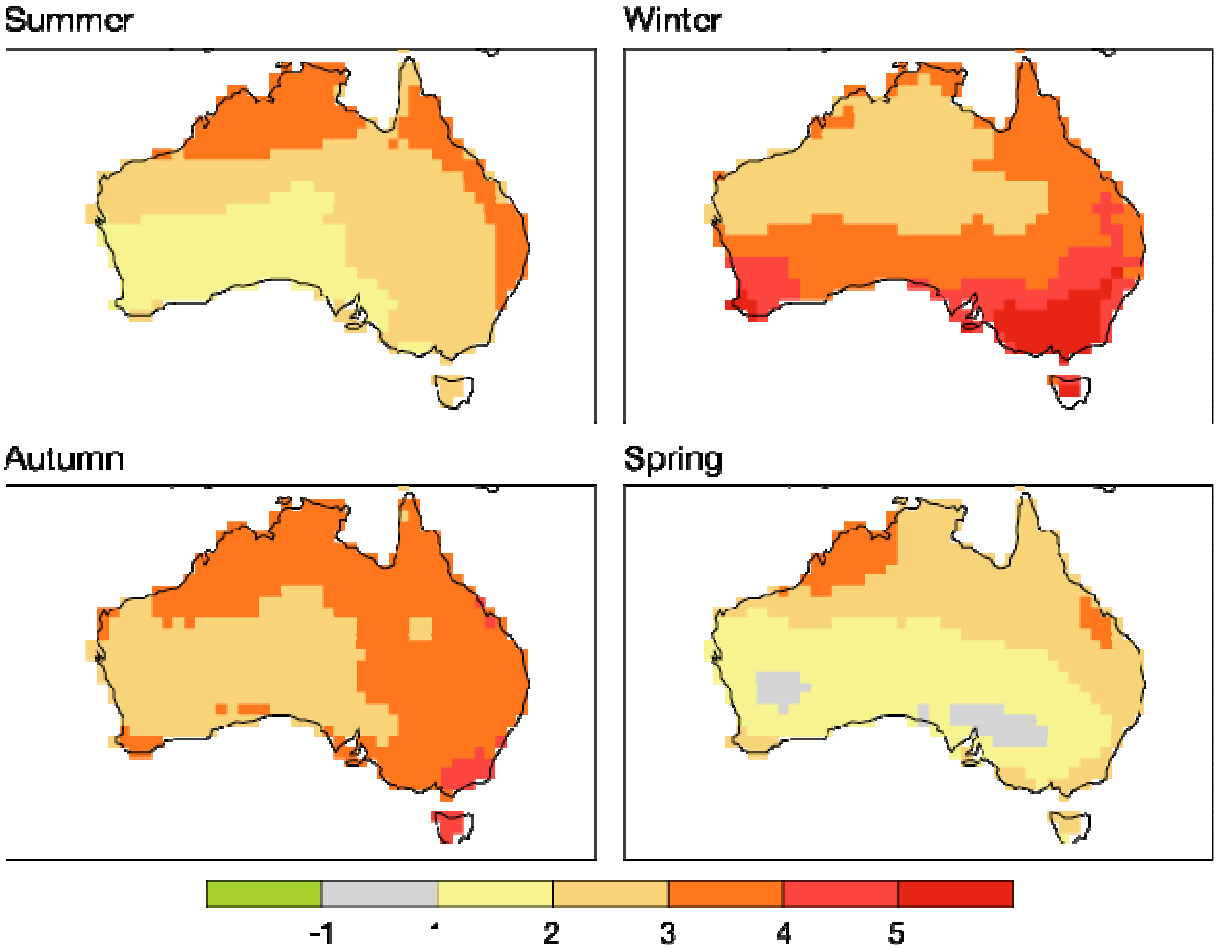


Source: CSIRO/Bureau of Meteorology (2007) Figure 5.18

- Annual loss of rain
- Possible small increase in north/east in summer/autumn
- Uncertainties relating to monsoons
- Annual loss of 3-7% in south

Best estimate (50th percentile) of change of evapotranspiration by 2030 (% relative to 1990)

(Emissions scenario A1B; weighted results of 14 models)

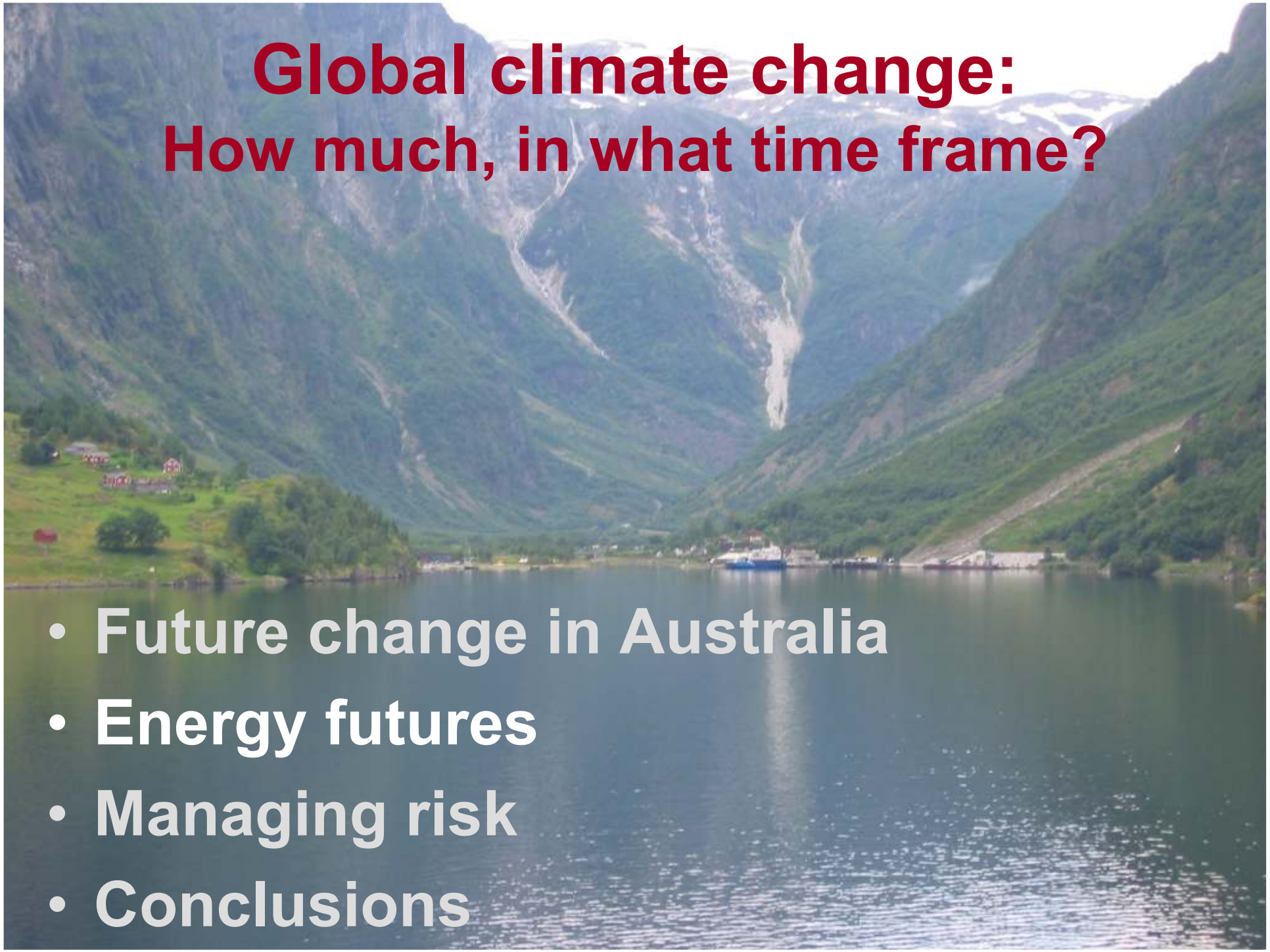


Source: CSIRO/Bureau of Meteorology (2007)
Figure 5.35

- Net available water related to both rainfall and evapotranspiration
- This suggests significant loss or water for soils, streams, dams

E.g. Risk arises for agriculture from:

- **Change in productive capacity of the land**
  - Tradeoffs: water, food, fibre, bio-fuels, ecosystems
- **Changes to available natural resources**
  - Ecosystem services, water, timber, tourism
- **Threats to infrastructure**
  - Storms, hail, inundation
- **Changing impacts globally**
  - Competitors, suppliers, markets, humanitarian aid, migration, security
- **Revolutionary changes to energy**
  - Sources, utilisation and costs



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Mitigation

- Without mitigation emissions will continue to grow (high agreement)
- Significant economic potential for mitigation for all sectors
  - Sufficient to offset growth or reduce emissions below current levels (high agreement)
- By 2030 macro-economic costs for mitigation are (high agreement):
  - Equivalent to an average reduction of 0.1% of annual GDP growth

Mitigation

IPCC results are supported by:

Stern Report

In Australia by:

AGL-WWF

Australian Business Roundtable

Australia21

CSIRO

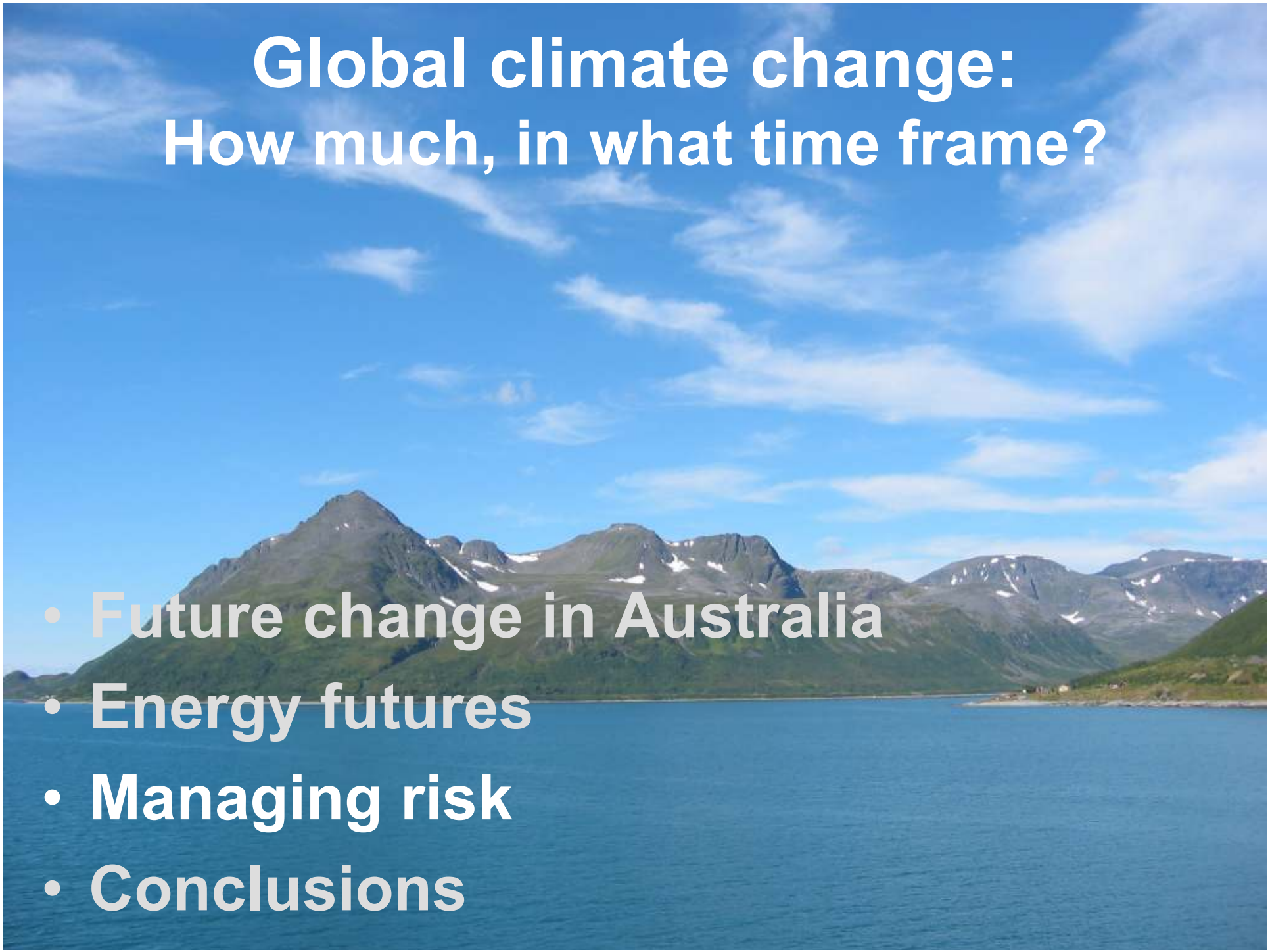
Monash Centre for Policy Studies

Sorting through the uncertainties of all technologies

- ***Cost***
  - **What are the costs now and when mainstream?**
- ***Technically feasibility***
  - **Is it proven or speculative?**
- ***Capacity to met demands on time***
  - **Can it deliver significant energy on time?**
- ***Capacity to deliver emissions reductions on time***
  - **Can it reduce emissions significantly in time?**
- ***Is it acceptable***
  - **Will the community accept?**
- ***Permanency of emissions reductions***
  - **Sequestration versus efficiency?**

Alcoa
Greenhouse Performance in Australia

- Refining operations - greenhouse intensity 9% below 1990 levels
- Smelting operations – greenhouse intensity 60% below 1990 levels
- Rolling operations – greenhouse intensity 5% below 1990 levels
- Aggregate CO_{2e} (direct & indirect) emissions down ~1% from 1990, despite production increasing by 57% (refining) and by 6% (smelting)



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Global stabilisation scenarios

Capacity	CO_2 concentration	CO_2 equivalent concentration	Peaking years for CO_2emsiions	CO_2 emissions change 2050 (% of 2000)	Temperature increase Above pre-industrial	Sea-level rise Above pre-industrial from thermal expansion
	ppm	ppm	year	percent	°C	metres
I	350-400	445-490	2000-2015	-85 - -50	2.0 - 2.4	0.4-1.4
II	400-440	490-535	2000-2020	-60 - -30	2.4 - 2.8	0.5-1.7
III	440-485	535-590	2010-2030	-30 - +5	2.8 - 3.2	0.6-1.9
IV	485-570	590-710	2020-2060	+10- + 60	3.2 - 4.0	0.6-2.4
V	570-860	710-855	2050-2080	+25 - +85	4.0 - 4.9	0.8-2.9
VI	860-790	855-1130	2080-2090	+ 90 - +140	4.9 - 6.1	1.0-3.7

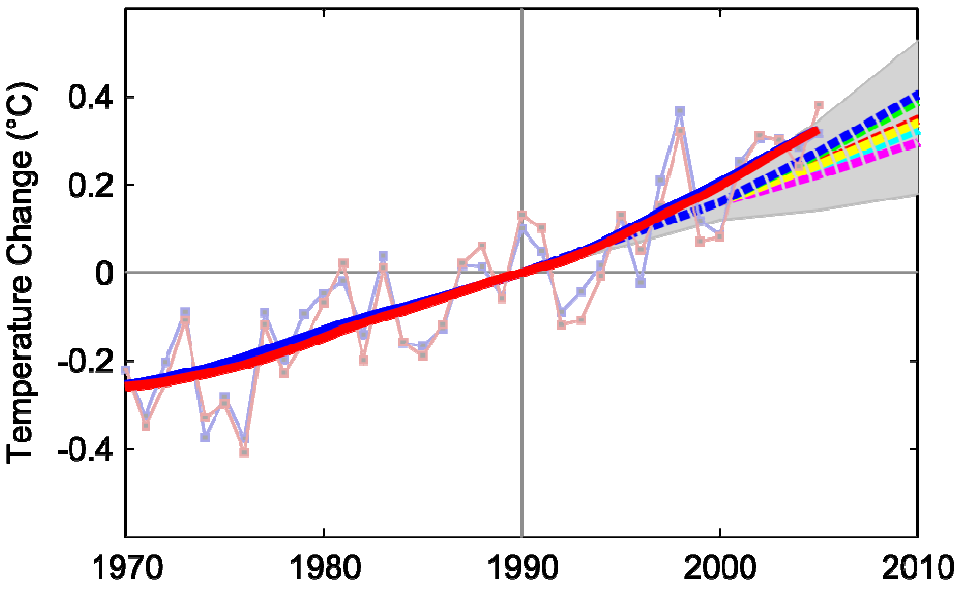
IPPC 4AR, Synthesis

Risk compounded by the rate of change

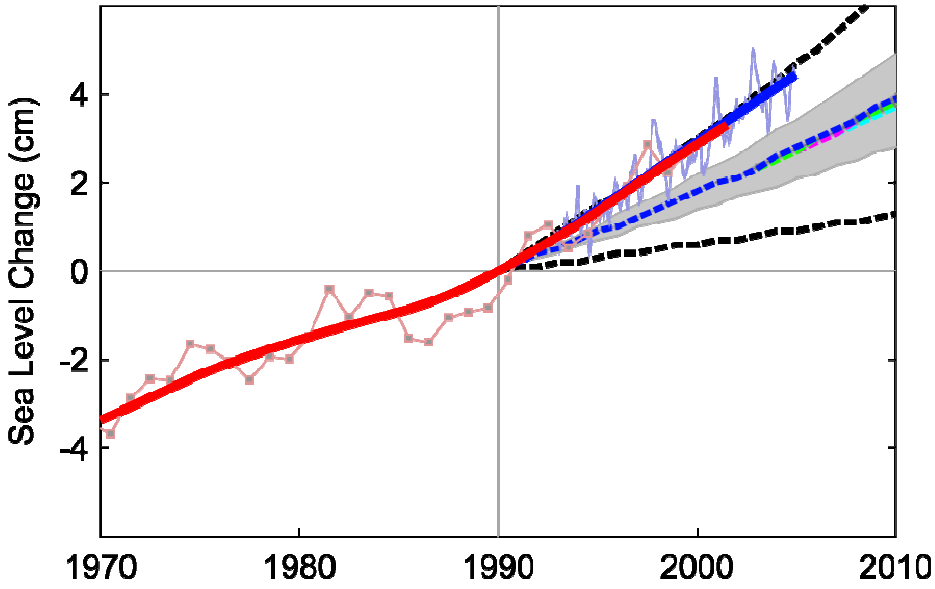
- We have underestimated how much change will occur
- What if we have underestimated what a "small" warming means?
- Are there wild cards – high-impact but unknown-probability events that could change perceptions?
- How will the issues of "equity" be handled globally and nationally?

Are IPCC projections too conservative?

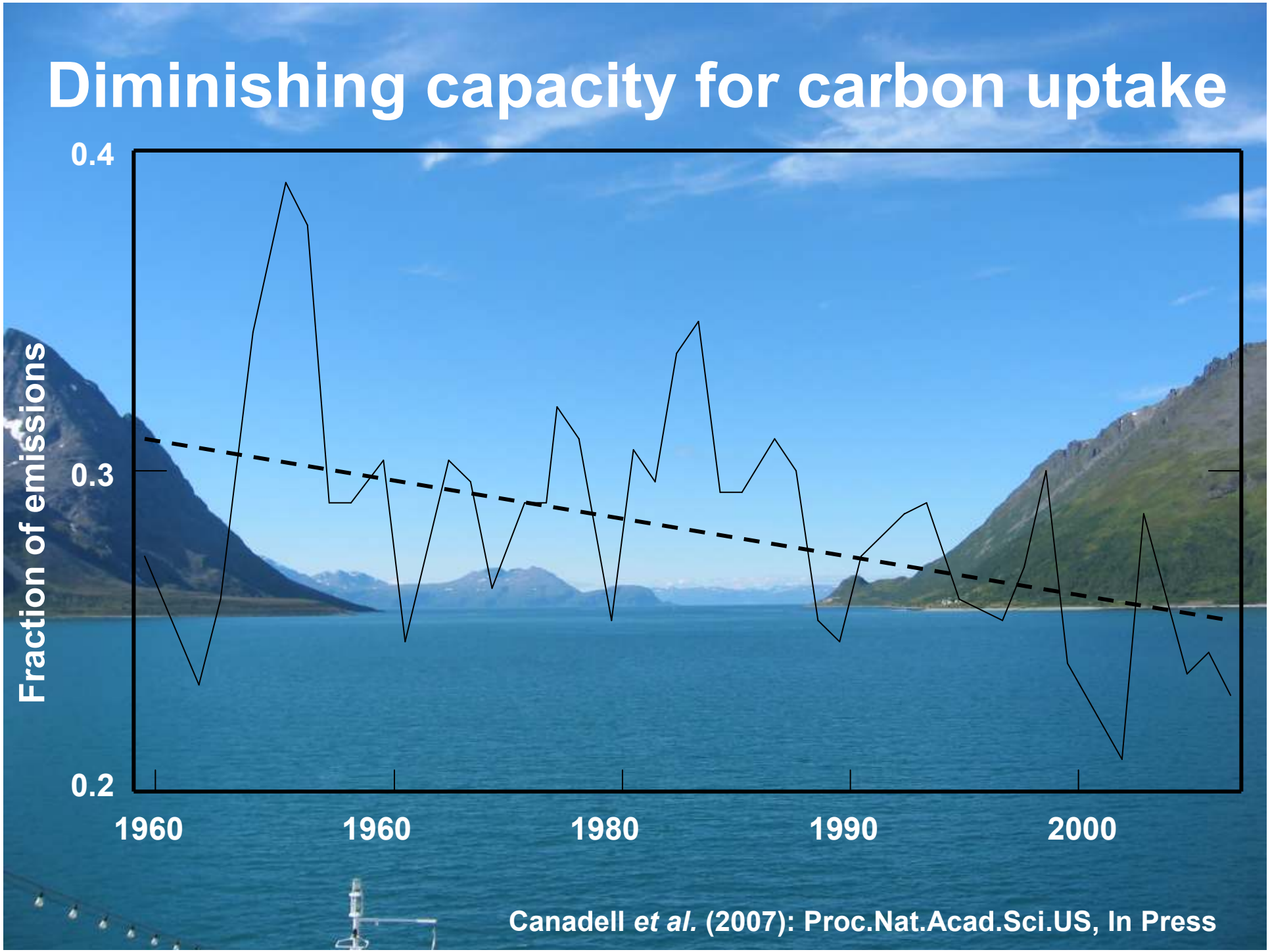
Temperature



Sea-level Rise



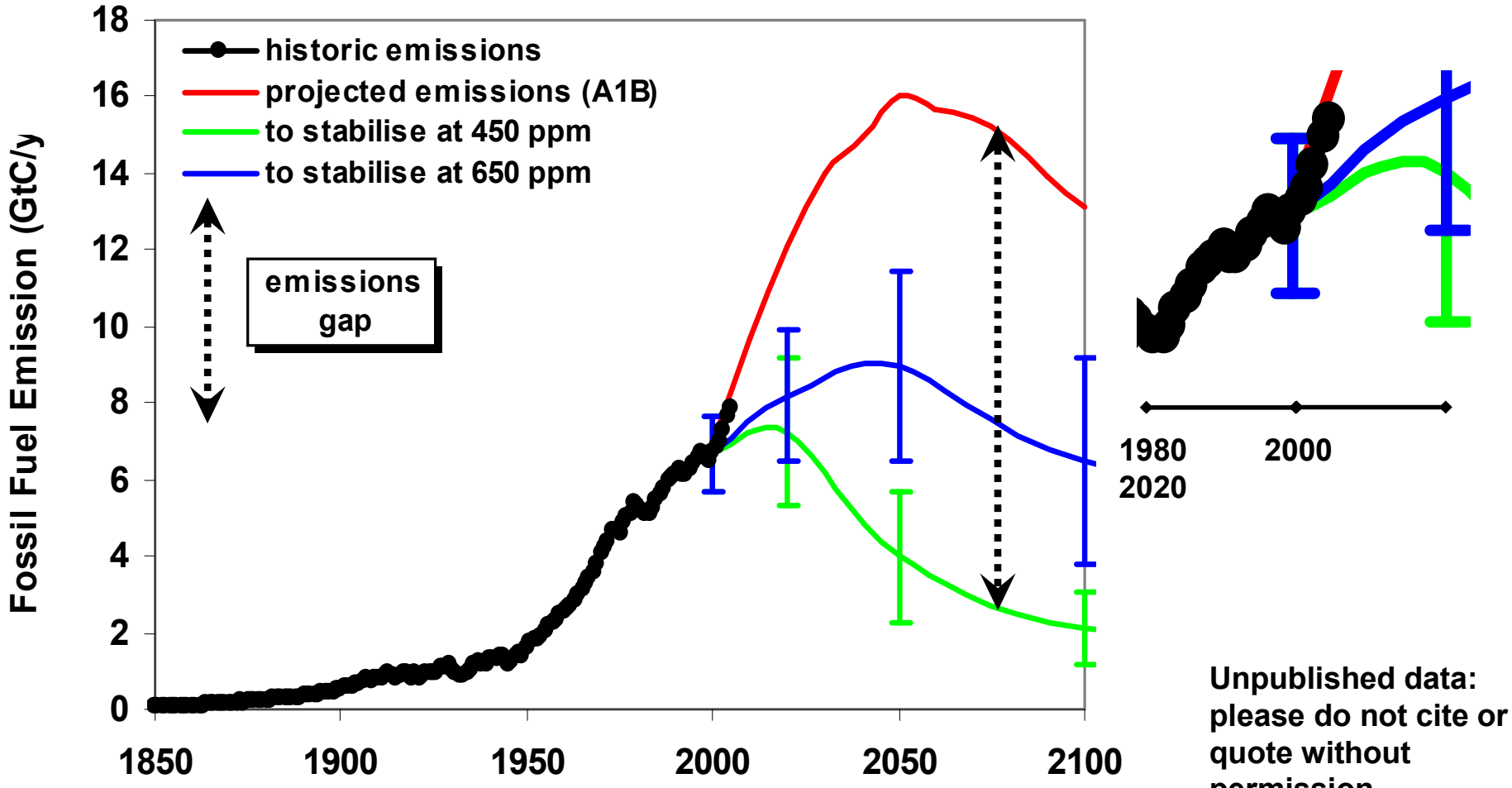
Diminishing capacity for carbon uptake



Canadell *et al.* (2007): Proc.Nat.Acad.Sci.US, In Press

Are IPCC projections too conservative? Emissions trajectory

- Emissions scenario (A1B): global development



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Climate change and water security

Year	Population (M)	Population water-stressed countries (M)	Number of people (millions) in water stressed countries with increase in water scarcity estimated by different climate models							
			HadCM2	HadCM3	ECHAM4	CGCM1	CSIRO	CCSR	GFDL	NCAR
2025	8055	5022	338-623	545	488	494	746	784	403	428
2050	9505	5915	2209-3195	1454	662	814	1291	1439	-	-

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Messages

- Climate change is not just on the radar
  - Its here, right now
- Recent science has strengthened concern that we may have underestimated the:
  - Rate of change
  - Potential for rapid change
- The window of opportunity to avoid "dangerous" climate change is now
  - We are in it, action can't wait
- Significant challenges related to
  - Uncertainly, complexity, time scales
  - Equity and adaptation