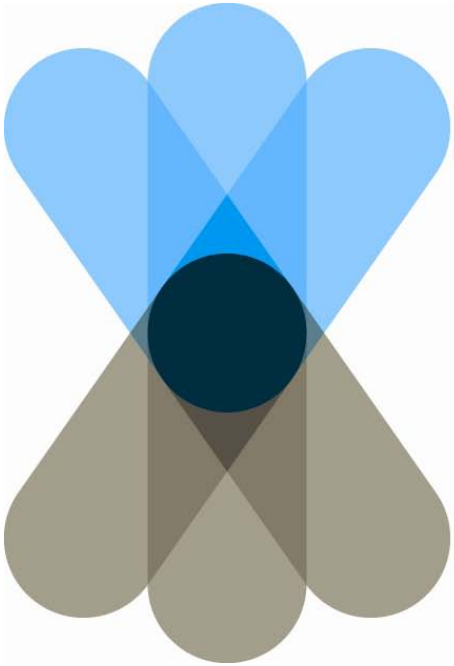

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National
Climate Change Adaptation
Research Facility

Adaptation Research Network
TERRESTRIAL BIODIVERSITY

Australian Government
Department of Climate Change

Queensland Government

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Today's agenda

9:00-9:30 National overview on Climate Change adaptation and terrestrial biodiversity– Lesley Hughes

9:30 - 9.40 Terrestrial Biodiversity network –what you can get out of it. – Yvette Williams, Network Co-ordinator

9:40 -10:00 Discussion

10:00- 10:30 Regional climate projections for NSW – Dr Jason Evans, UNSW

10:30-11:00 ***Morning Tea***

11:00-13:15 *Presentations by stakeholders*

- State Government – Dr Peter Smith and Gary Howling OEH -climate change science section
- Local Government – Amy Lovesey, Local Government and Shires Associations of NSW
- Involving local landholders – Dr John Gollan, Australian Museum
- Greening Australia-NSW - Pip Walsh- CEO
- Aquatic Landscape Planning – Michael Healey, Office of Water

13:15-14:00 ***Lunch***

14:00-16:30 Key themes & adaptation research priorities

Why have a Roadshow?

Why are we here?

- Roadshow across Australia in each state/node
- Scope of workshop:
  - What is adaptation?
  - Sector / State / Regional / Ecosystem priorities
  - Increase stakeholder involvement in network

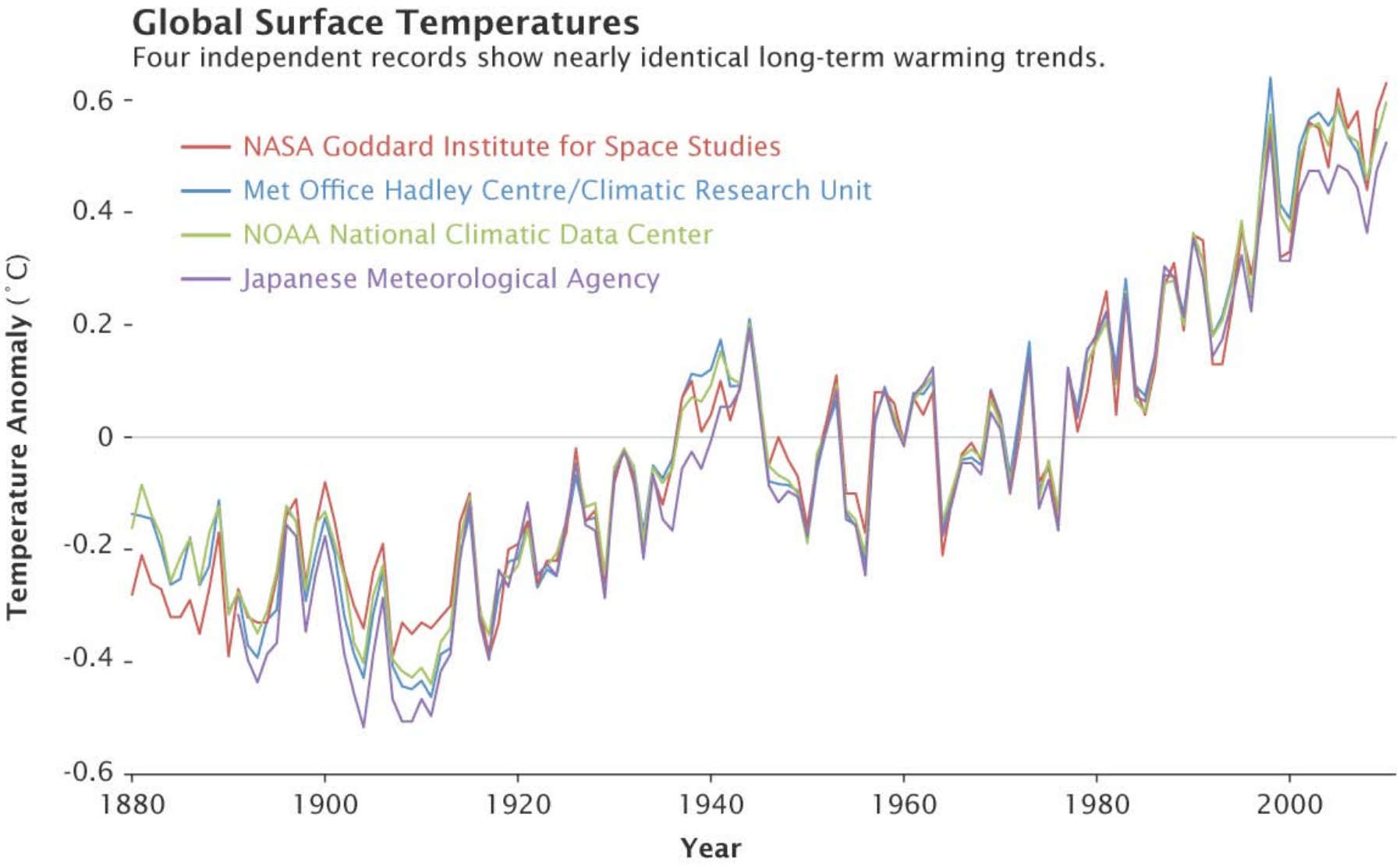
- How can involvement benefit everyone concerned?

- Outcomes:
  - Raising awareness and participation in NCCARF & the Terrestrial Biodiversity network
  - Increased networking/collaboration between research & stakeholder groups
  - Summary of each node workshop – network website / DCCEE
  - Report collating results across all nodes

How do YOU think the national priorities fit your ecosystem / region / sector?

- Are there any serious omissions?
- What are the priorities / challenges in your area of interest ?
- What research is needed to have the knowledge to make the best possible choices about adaptation?
- What are the main impediments?

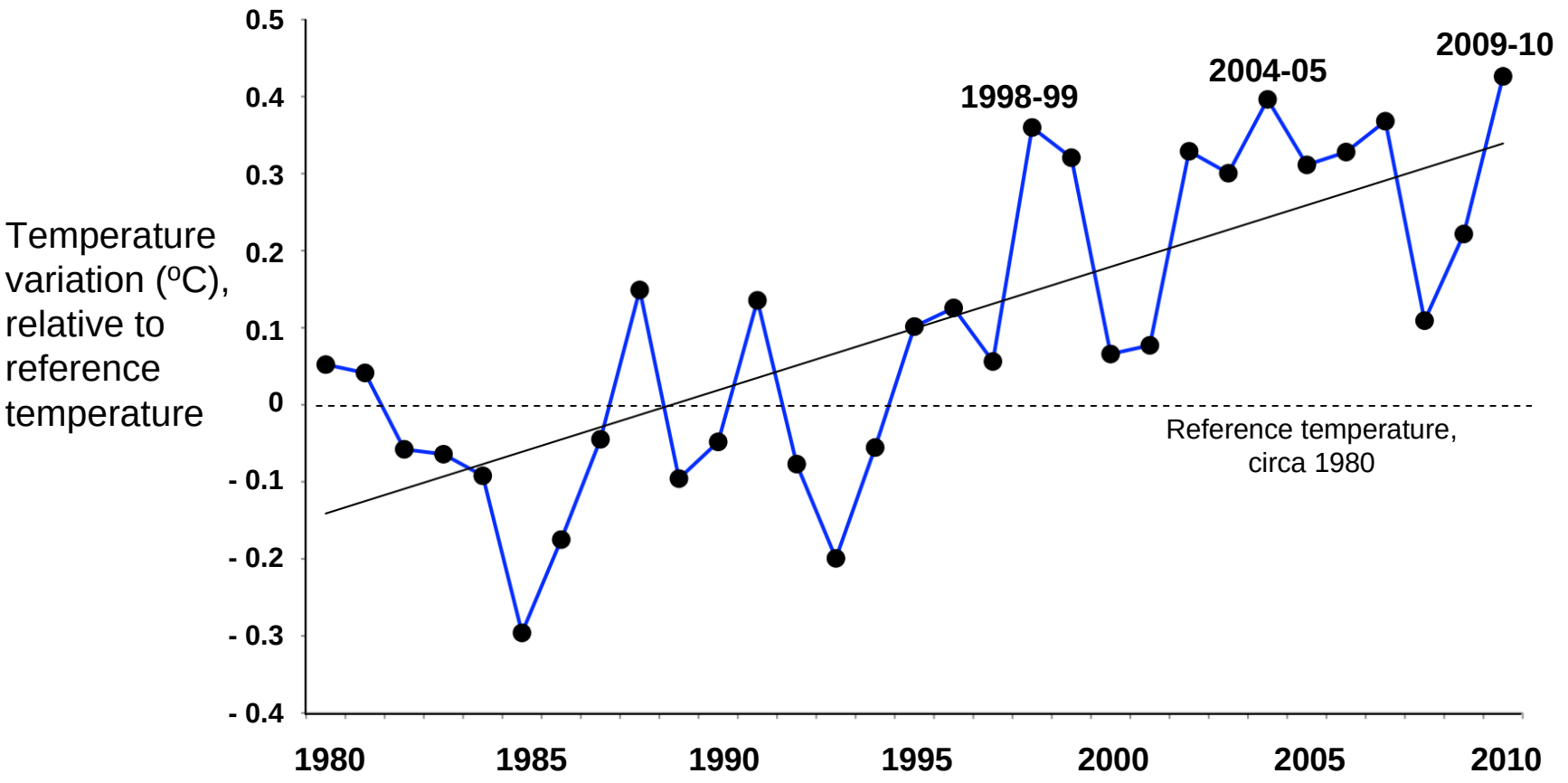
Climate Change & Terrestrial Biodiversity



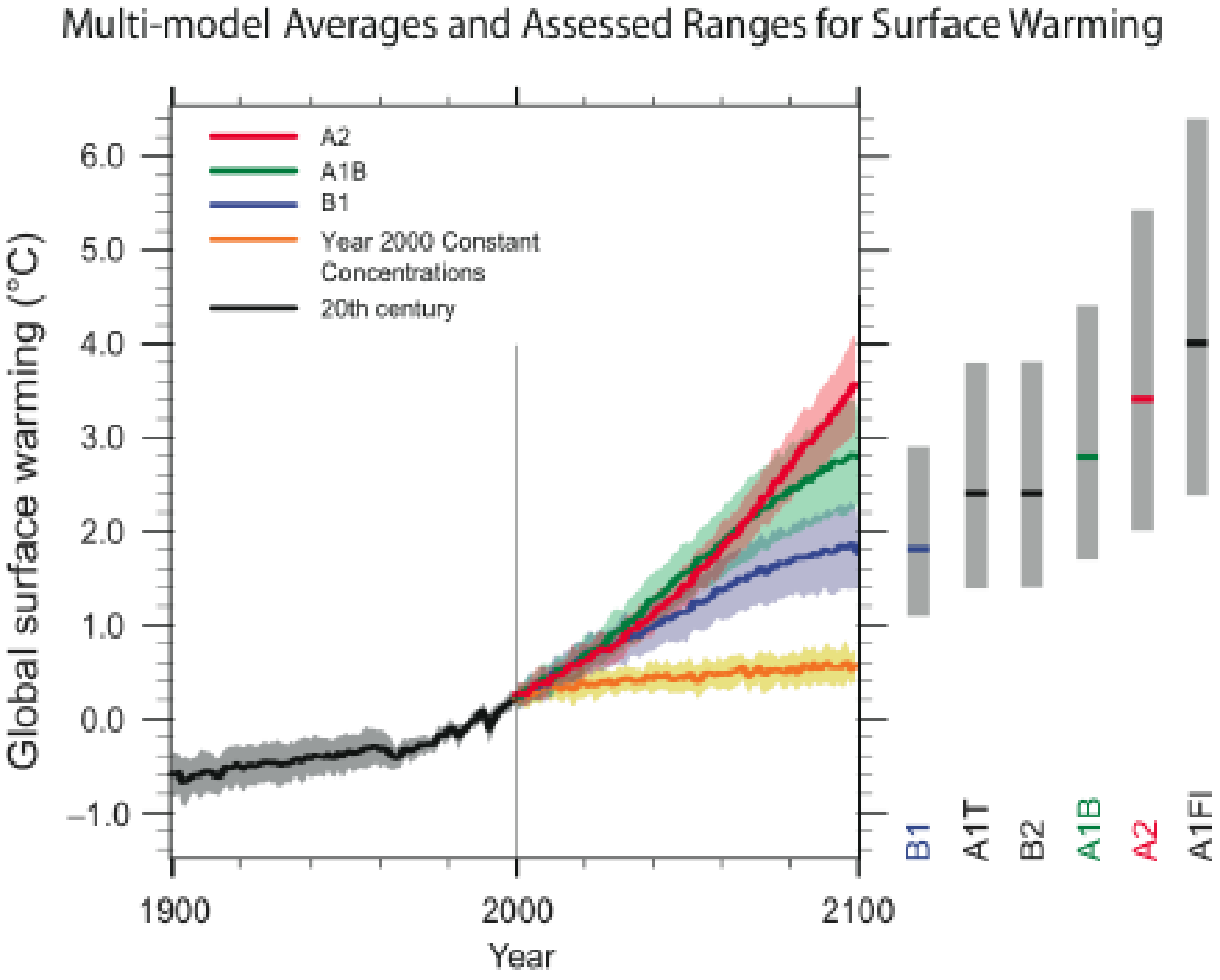
Credit: NASA Earth Observatory/Robert Simmon

Data Sources: NASA Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit, and the Japanese Meteorological Agency.

Satellite-based measures of average global temperature (near-surface lower atmosphere), by year (Sept-Feb period), 1979-2010



Global Temperature Projections



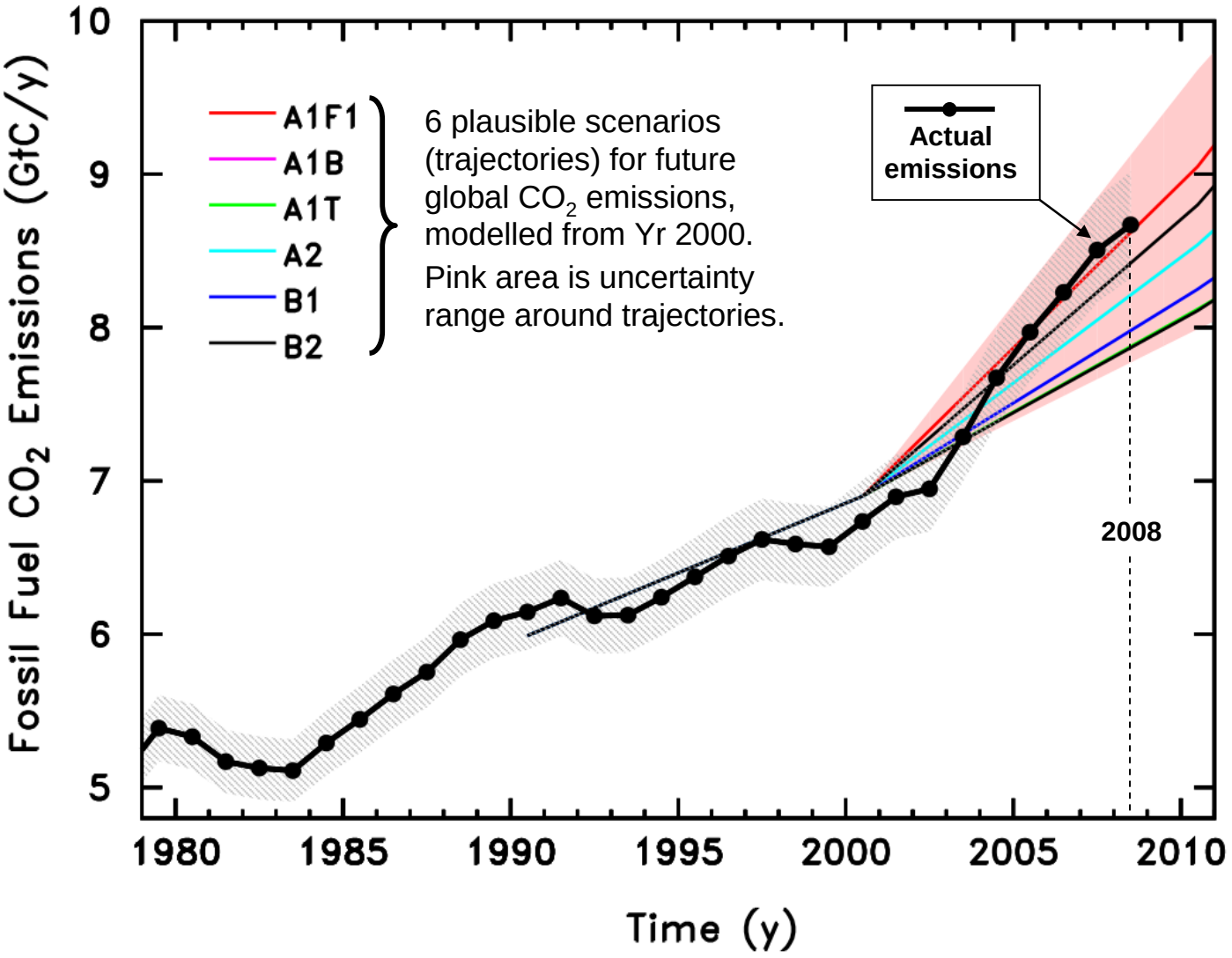
- 0.2°C per decade to end of 21st century
- 1.8-4.0°C warming (range 1.1-6.4°C)

(IPCC 2007)

But:

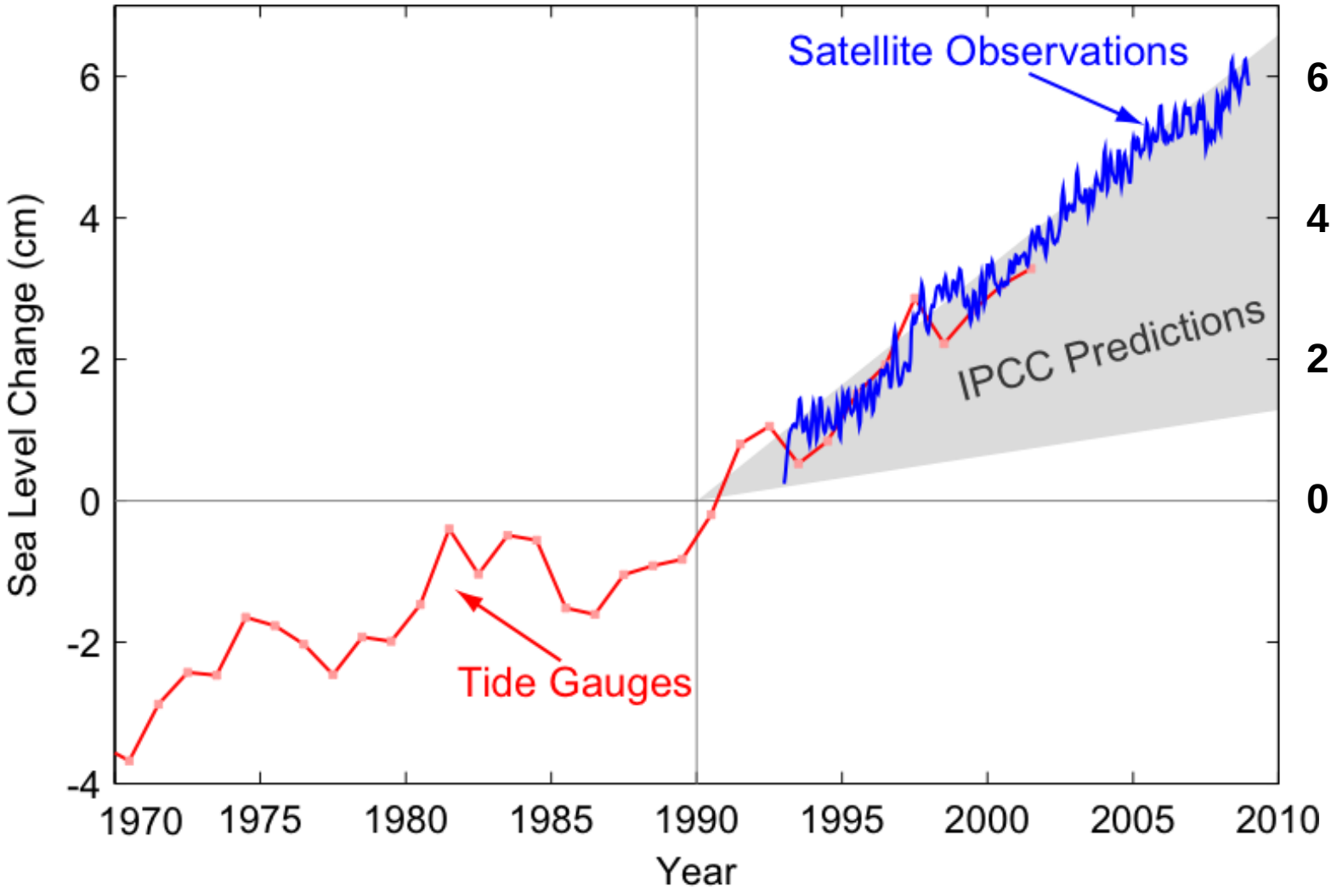
- CO_2 has almost tripled since the 1990s from 1.1% pa to 3.1% in the 2000s (Raupach *et al.* 2007)
- Sea levels also rising faster than IPCC projections
- Projections do not take melting of the West Antarctic Ice Shelf (WAIS) into account (Oppenheimer *et al.* 2007)

Actual emissions travelling at uppermost IPCC projection



www.copenhagendiagnosis.com

Global sea level



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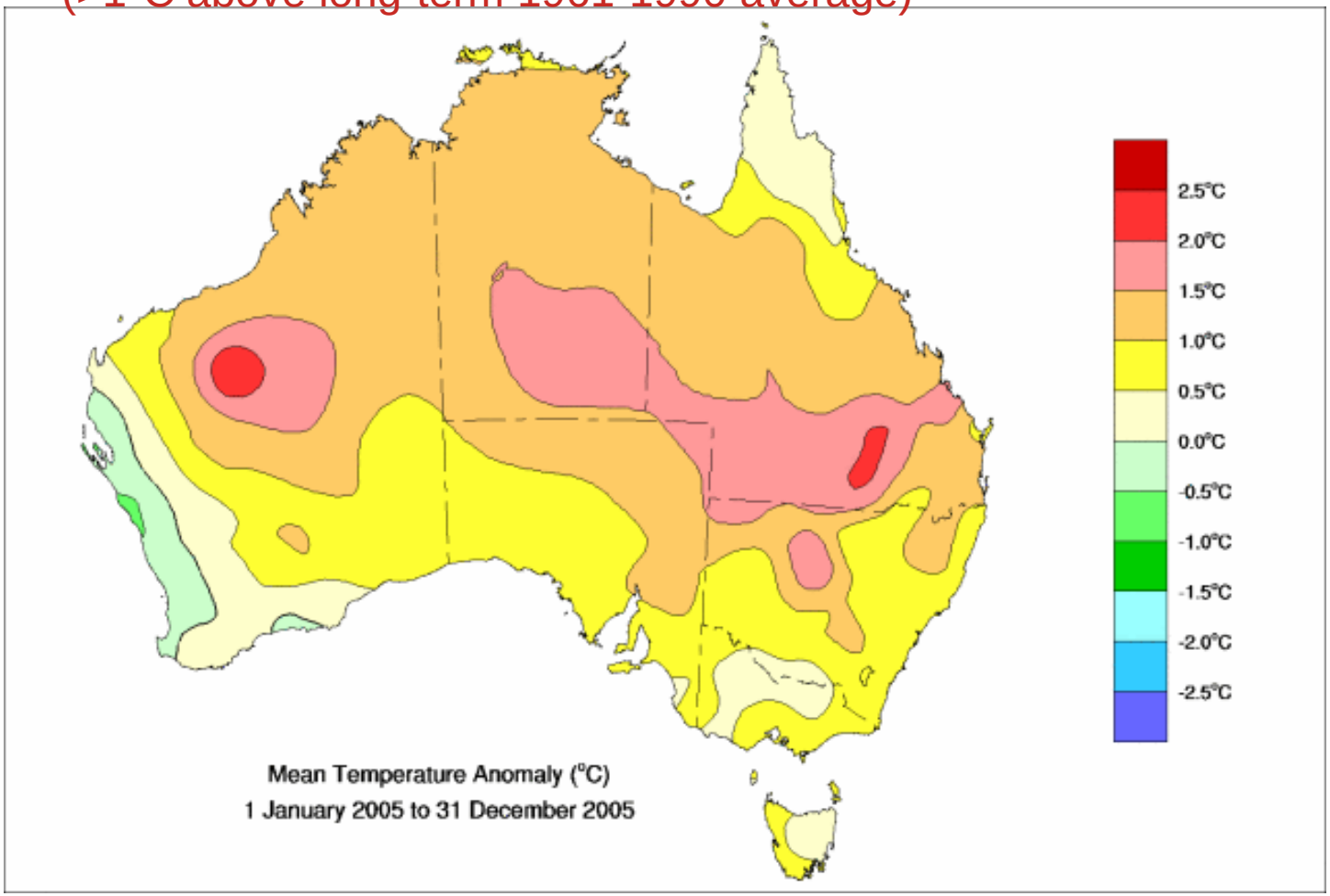
2005: Warmest year on record

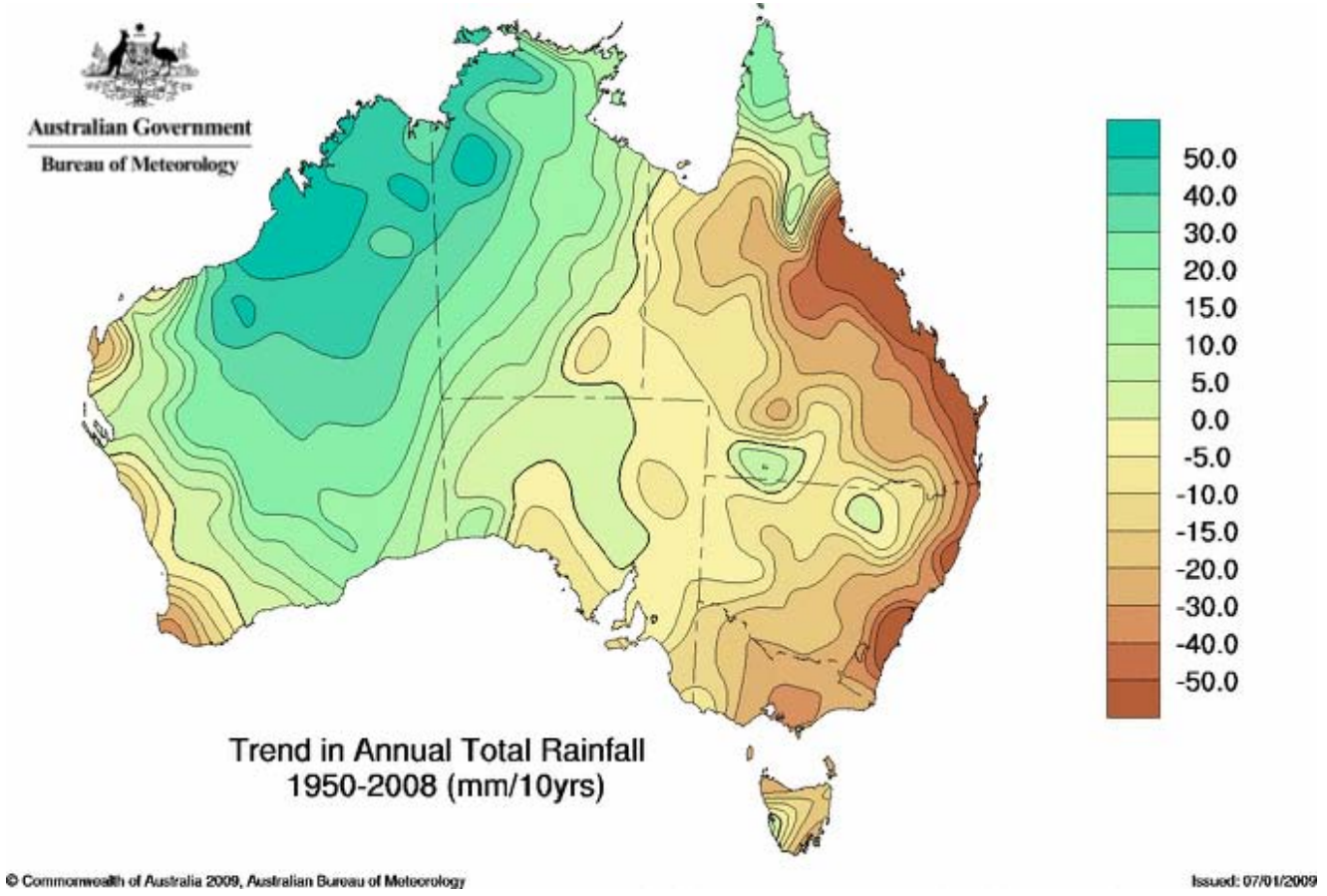
(>1°C above long-term 1961-1990 average)



2009: 2nd warmest year (0.09°C above average)

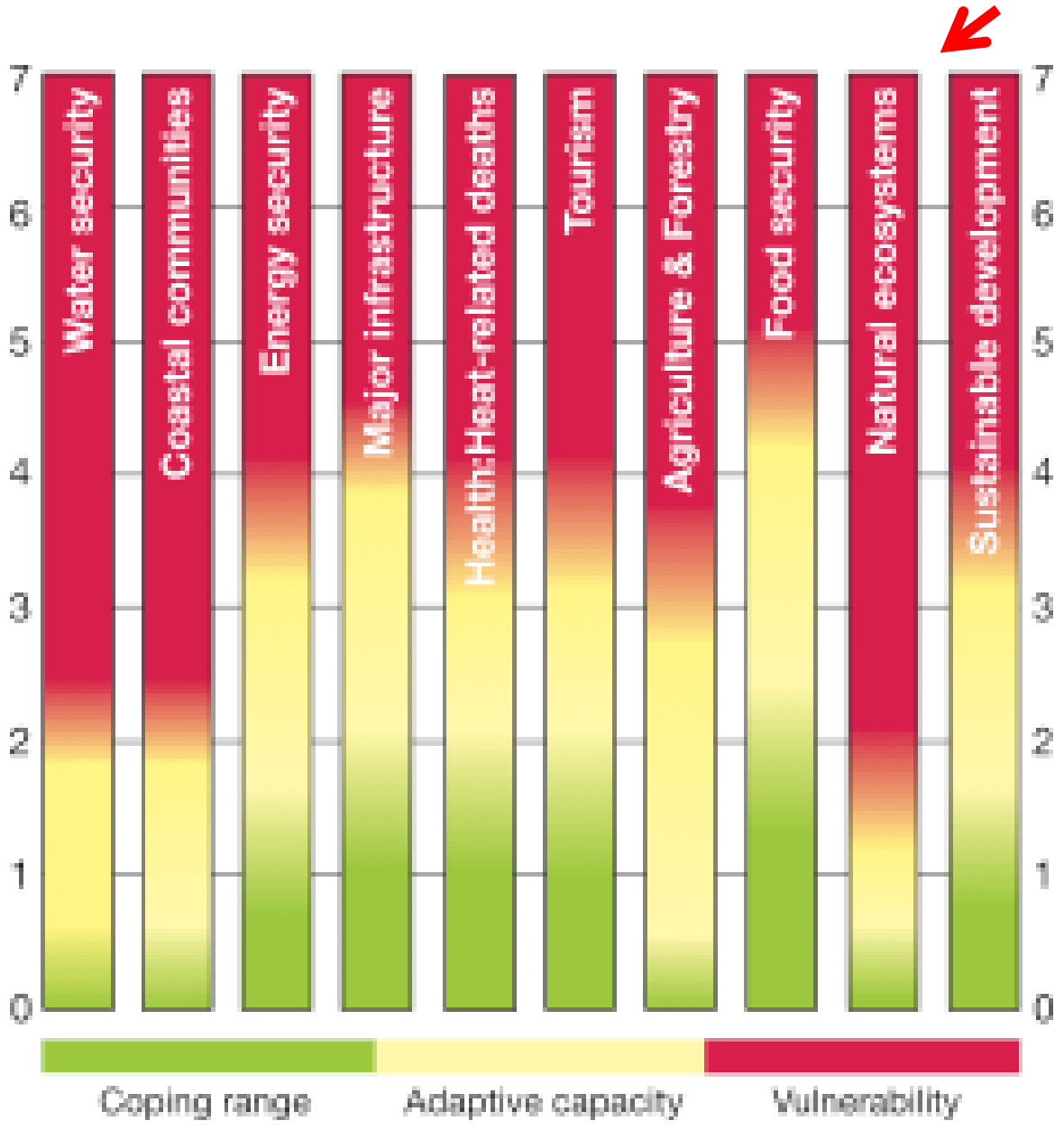
2010" equal warmest year globally

Rainfall



- General drying trend in east
- Rainfall decreased 14.3 mm/ decade since 1950 in NSW
- Heavy rainfall events increased, particularly since 1960s

Vulnerability of biodiversity cf other sectors



IPCC 2007

The scale of the problem for biodiversity

- Time for a species to evolve ~ 1 million years
- IPCC (2007): ~ 20-30% of species likely to be at increasingly high risk of extinction at 2-3^{o}C above pre-industrial levels
- Global warming already implicated in species declines across marine, terrestrial and freshwater ecosystems & at least one extinction
- **Climate change will be one of the major drivers of species extinctions in the 21st century.**

Impacts of climate change on species & communities already evident

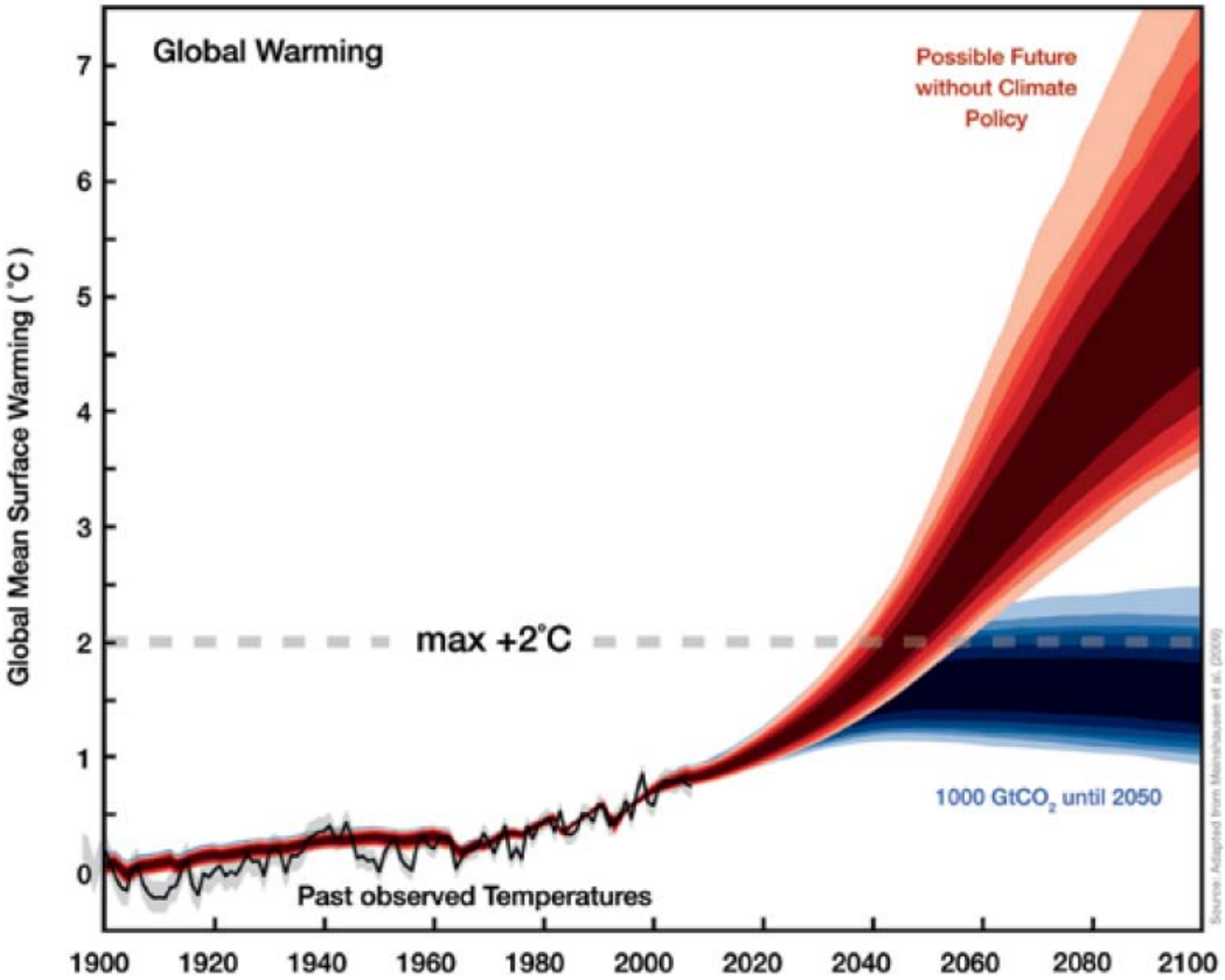
Examples include:

- Geographic range shifts (mainly south, some upwards)
- Life cycles (eg. advances in flowering, bird migration)
- Genetic change (heat shock proteins)
- Body size (latitudinal clines shifting)
- Proportions of warm-adapted species in communities increasing at expense of cool-adapted
- Increased frequency of coral bleaching
- Declining rates of calcification in corals
- Emergence of new diseases

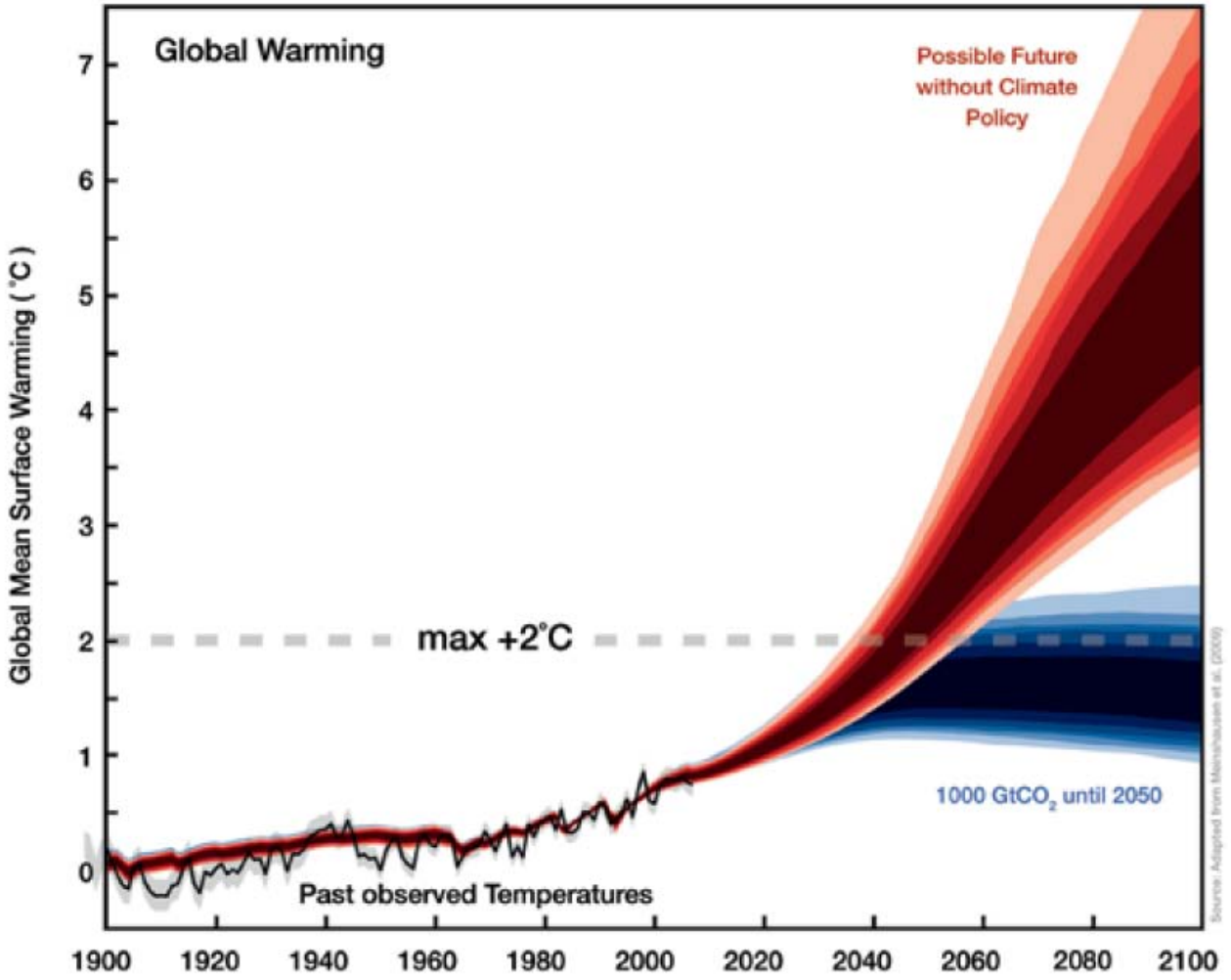



What can we do about minimising the impacts of global climate change on biodiversity?

Need for mitigation



Need for mitigation



No mitigation –
Adaptation not possible

Some mitigation –
Adaptation very important

Strong mitigation –
Adaptation not needed

Can biodiversity adapt autonomously?

1. Geographic change:
   - Possible for highly mobile taxa, but rate of change too rapid for most
   - Flat topography, fragmentation of landscape & lack of habitat presents substantial challenges

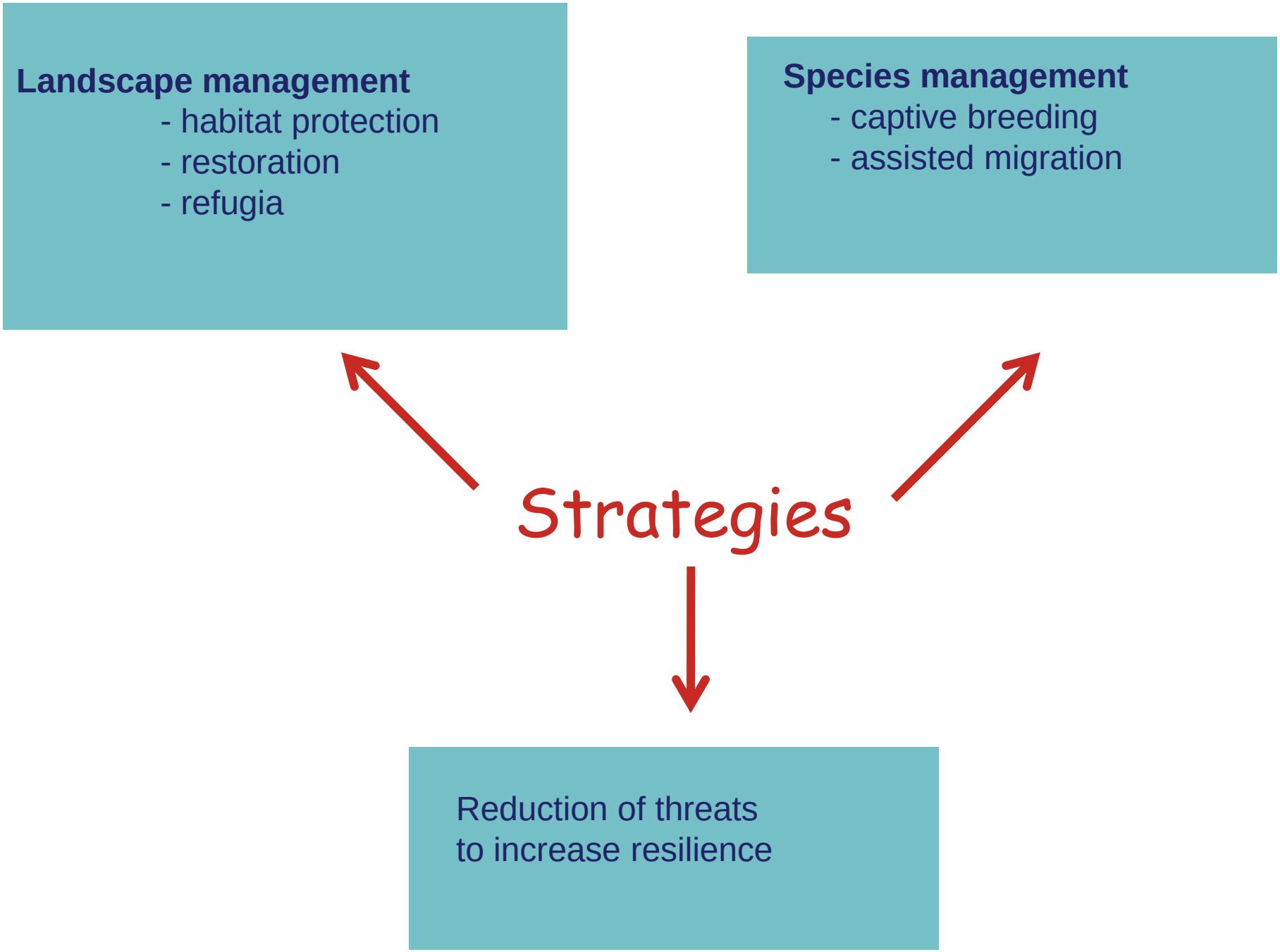
2. Phenotypic (including behavioural) plasticity:
   - Likely to be most common response
   - Changes in timing of life cycles likely to lead to significant changes in species interactions

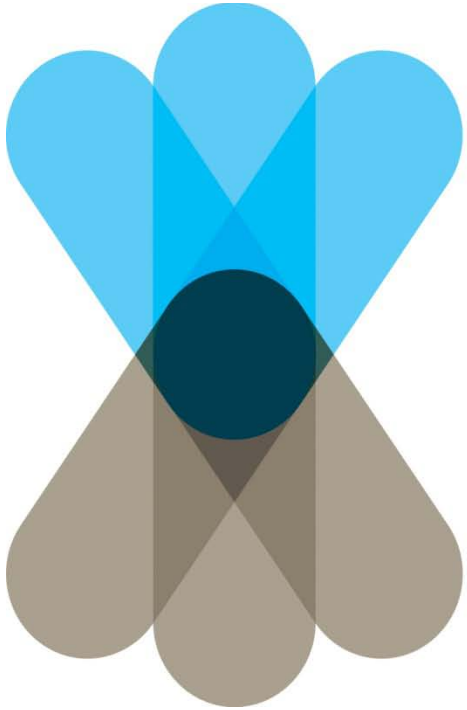
3. Genetic change:
   - Few species studied but limited evidence so far

→ Need for human-mediated adaptation

- Implementation of strategies that enhance the ability of species, communities or ecosystems to cope with climatic changes

Aim: to maximise adaptive ability and increase resilience


Landscape management
- habitat protection
- restoration
- refugia
Species management
- captive breeding
- assisted migration
Strategies
Reduction of threats
to increase resilience



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National Climate Change Adaptation Facility (NCCARF)

- An initiative of the Australian Government, based at Griffith University's Gold Coast Campus.

- ~$117 million (from 2008 to 2012) in climate change adaptation policies, programs and research through the Department of Climate Change
  - ~$10m NCCARF
  - ~$10m networks
  - ~$30m NARP research funding

The key roles of NCCARF include:

- developing National Adaptation Research Plans (NARP's) to identify critical gaps in information available to decision-makers
- synthesising existing and emerging national and international research on climate change impacts and adaptation, and developing targeted communication products
- undertaking a program of integrative research to address national priorities, and
- establishing and maintaining Adaptation Research Networks (ARN's) to link key researchers and assist them in focussing on national research priorities.

National Climate Change Adaptation Facility

Eight Adaptation Research Networks:

- **Terrestrial biodiversity**
- Water resources and freshwater biodiversity
- Marine biodiversity and resources
- Primary industries
- Human health
- Emergency management
- Settlements and infrastructure
- Social, economic and institutional dimensions.

Network Role – NCCARF Network Strategic Plan

Four key roles:

1. To promote and facilitate open exchange of information and sharing of resources.
2. To contribute to the work of NCCARF in synthesising existing and emerging research.
3. To contribute to the development and implementation of National Adaptation Research Plans.
4. To nurture the careers of young investigators and research students by promoting a sense of community, collaboration and strong, effective mentoring.

Terrestrial Biodiversity Adaptation Research Network

Providing decision makers with the information to develop and implement strategies that will promote adaptation to climate change in terrestrial ecosystems

Adaptation Research Network -Terrestrial Biodiversity

Convenors:

Prof Steve Williams (JCU, Nth QLD)

Prof Lesley Hughes (Macquarie, NSW)

- Co-ordinator: Dr Yvette Williams (JCU)

Steering committee (geographic, expertise, ecosystems):

Prof Andrew Lowe, Prof Barry Brook (SA)

Dr Dick Williams, Prof Stephen Garnett (NT)

Prof Ary Hoffmann, Dr Lynda Chambers (VIC)

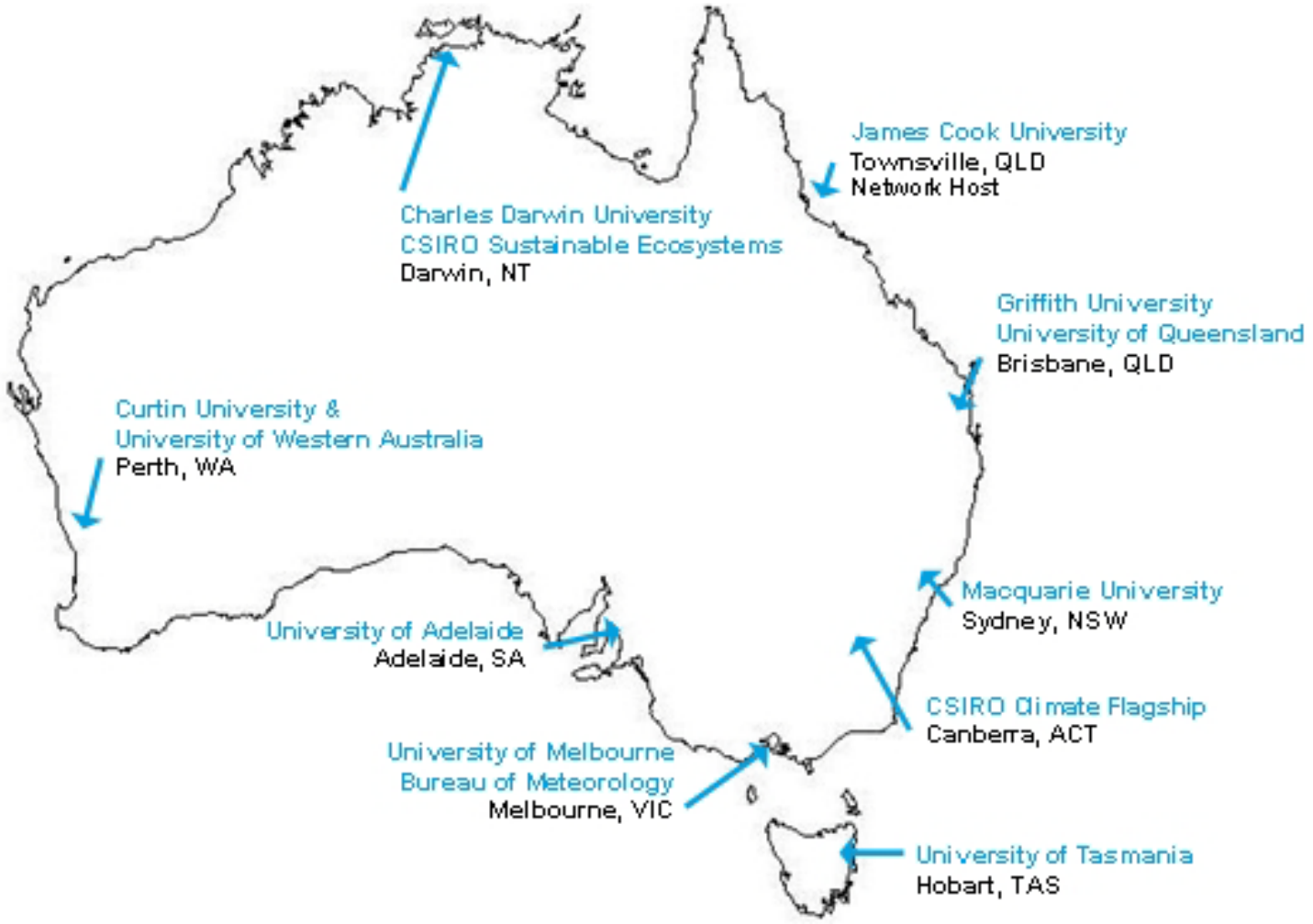
Prof Roger Kitching, Prof Hugh Possingham, Prof Bob Pressey, A/Prof Jean-Marc Hero (QLD)

Dr Trevor Booth, Dr Mark Stafford Smith (ACT; CSIRO CAF)

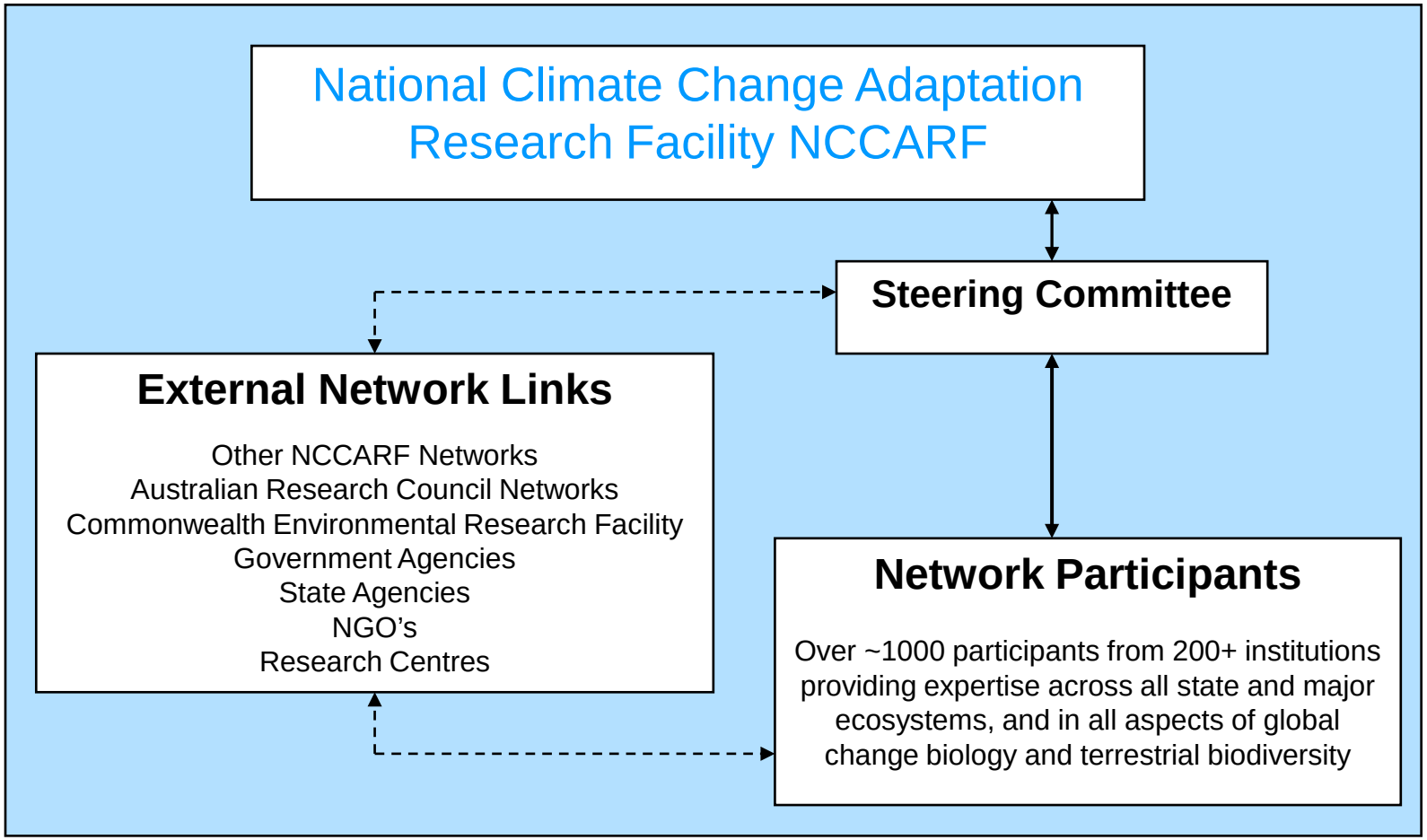
Prof David Bowman, Dr Kerry Bridle (TAS)

Prof Richard Hobbs, Dr Grant Wardell-Johnson, Dr Nicola Mitchell (WA)

Regional Nodes



Network Structure



Our Primary Goals

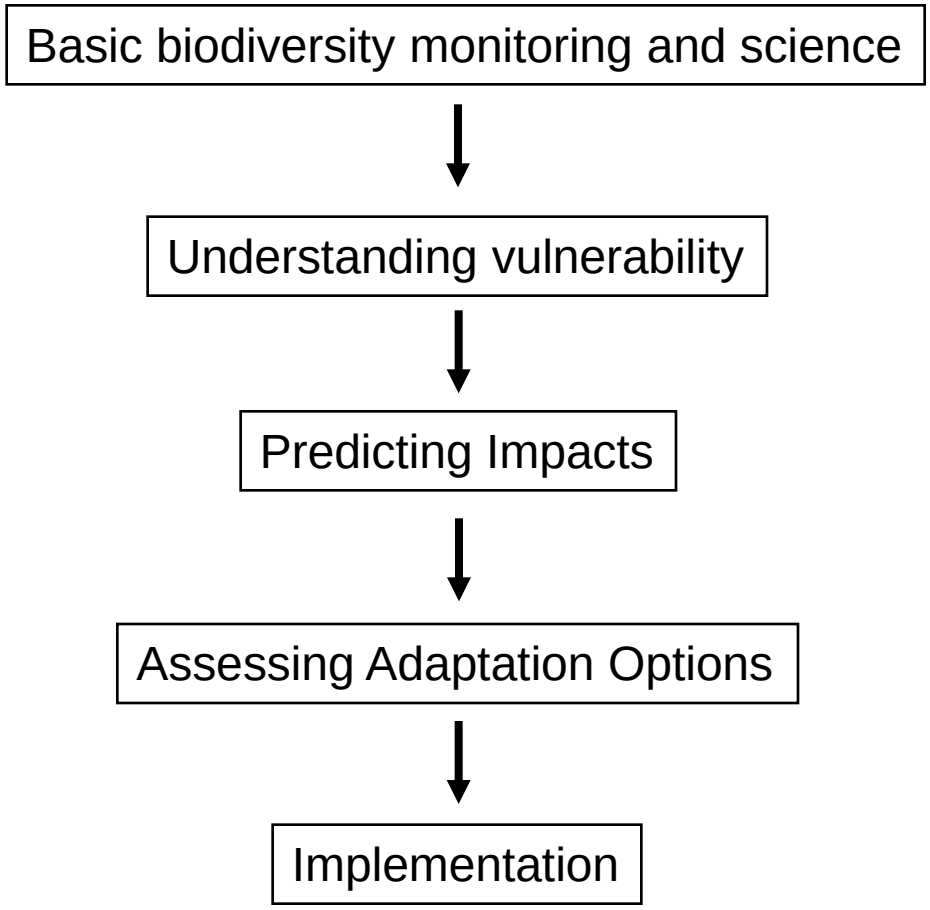
- Develop explicit and practical strategies to increase resilience in terrestrial ecosystems
- Maximise the adaptive potential of terrestrial ecosystems in the face of climate change
- Foster an inclusive collaborative research environment

In other words….

- Link expertise nationally
- Get people together
- Share information
- Foster collaboration
- Reduce duplication
- Facilitate exchange
- Encourage training and development
- Make a difference

Example:

Adaptation and protecting the biodiversity of Australian tropical rainforests



The rainforests of the Australian Wet Tropics

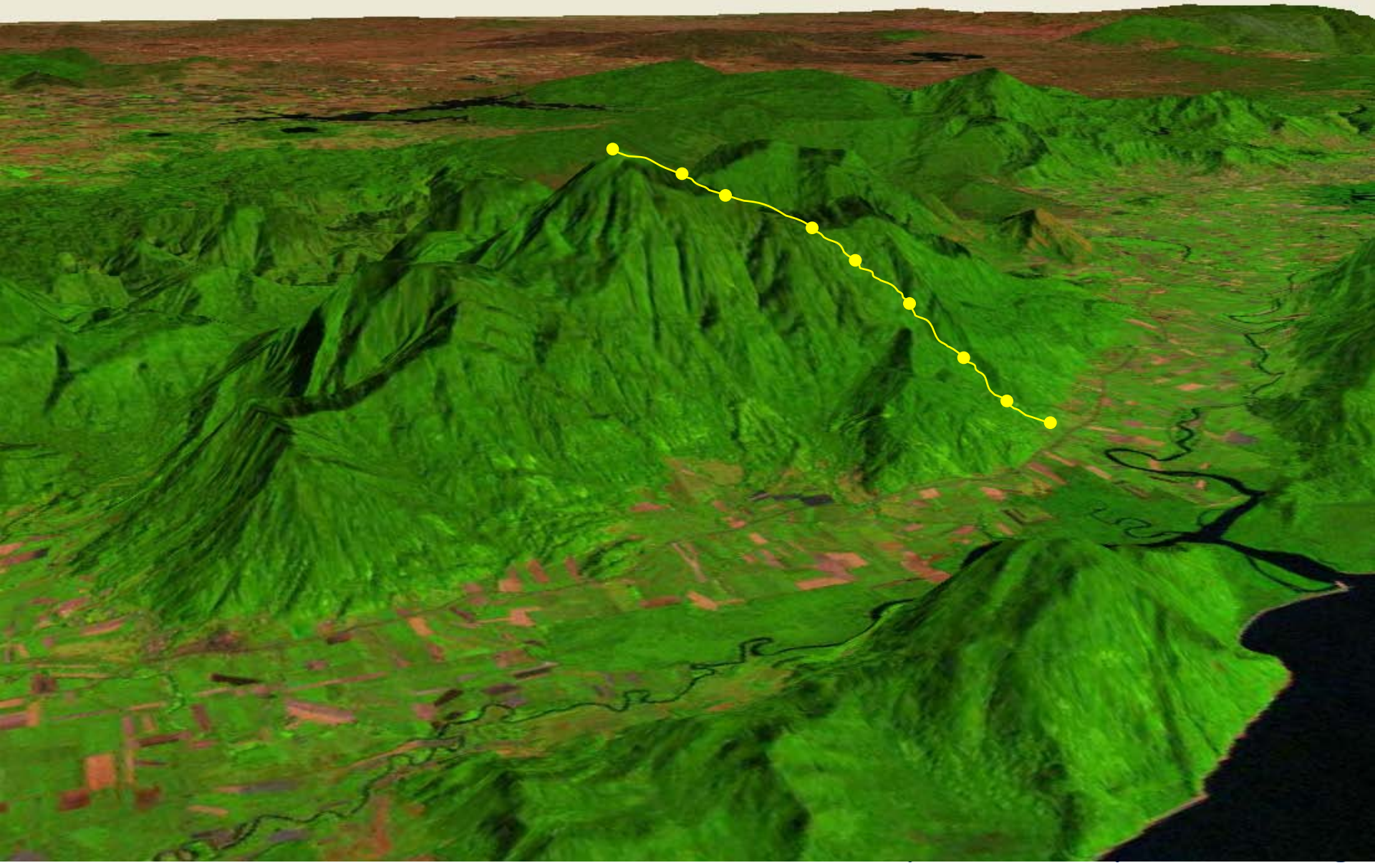
Most biologically rich area in Australia with many unique species

Mike Trenerry

~ 10,000 sq km rainforest


Cooktown
Cairns
Townsville

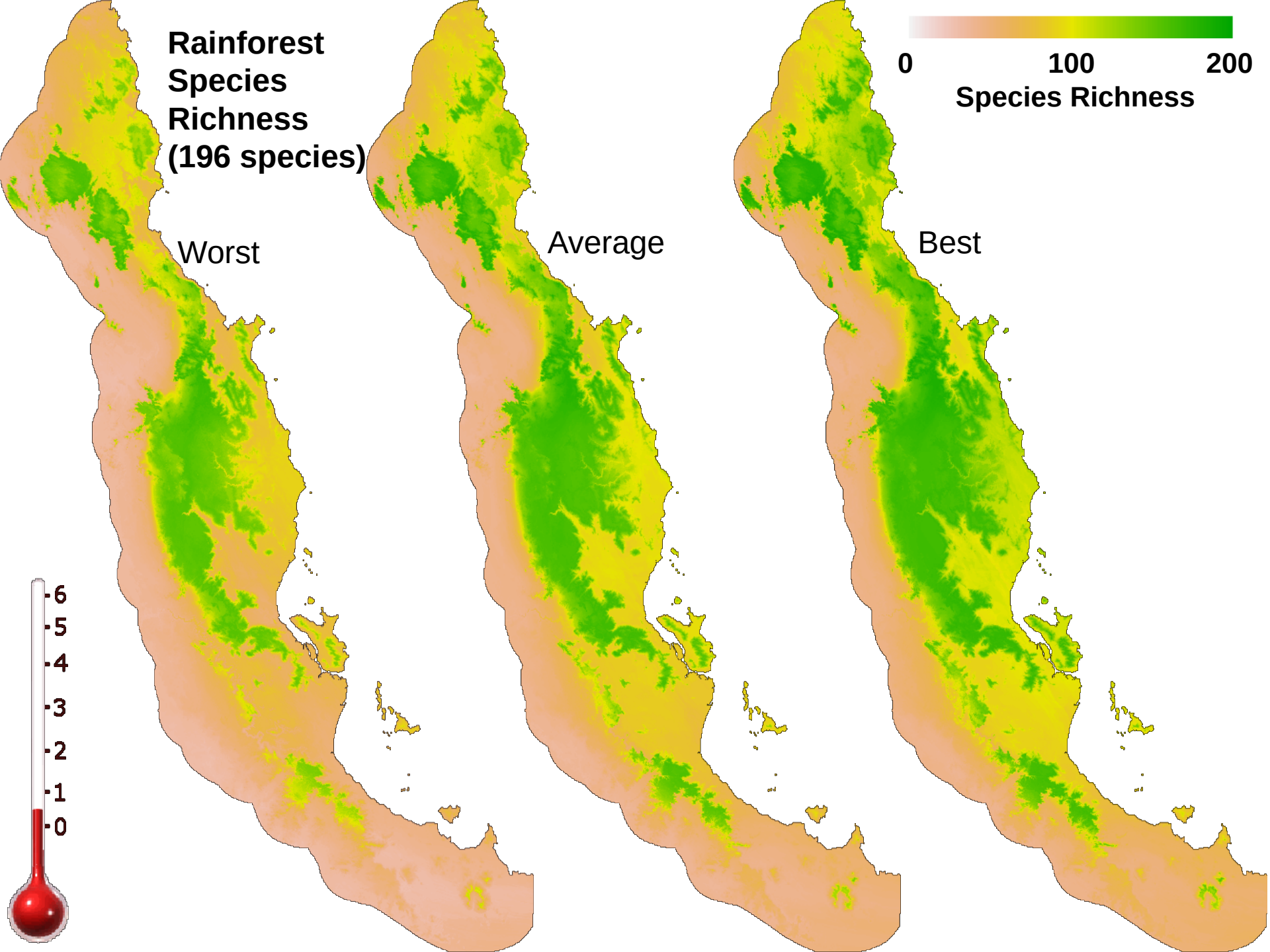
Elevational sampling at 200 m intervals



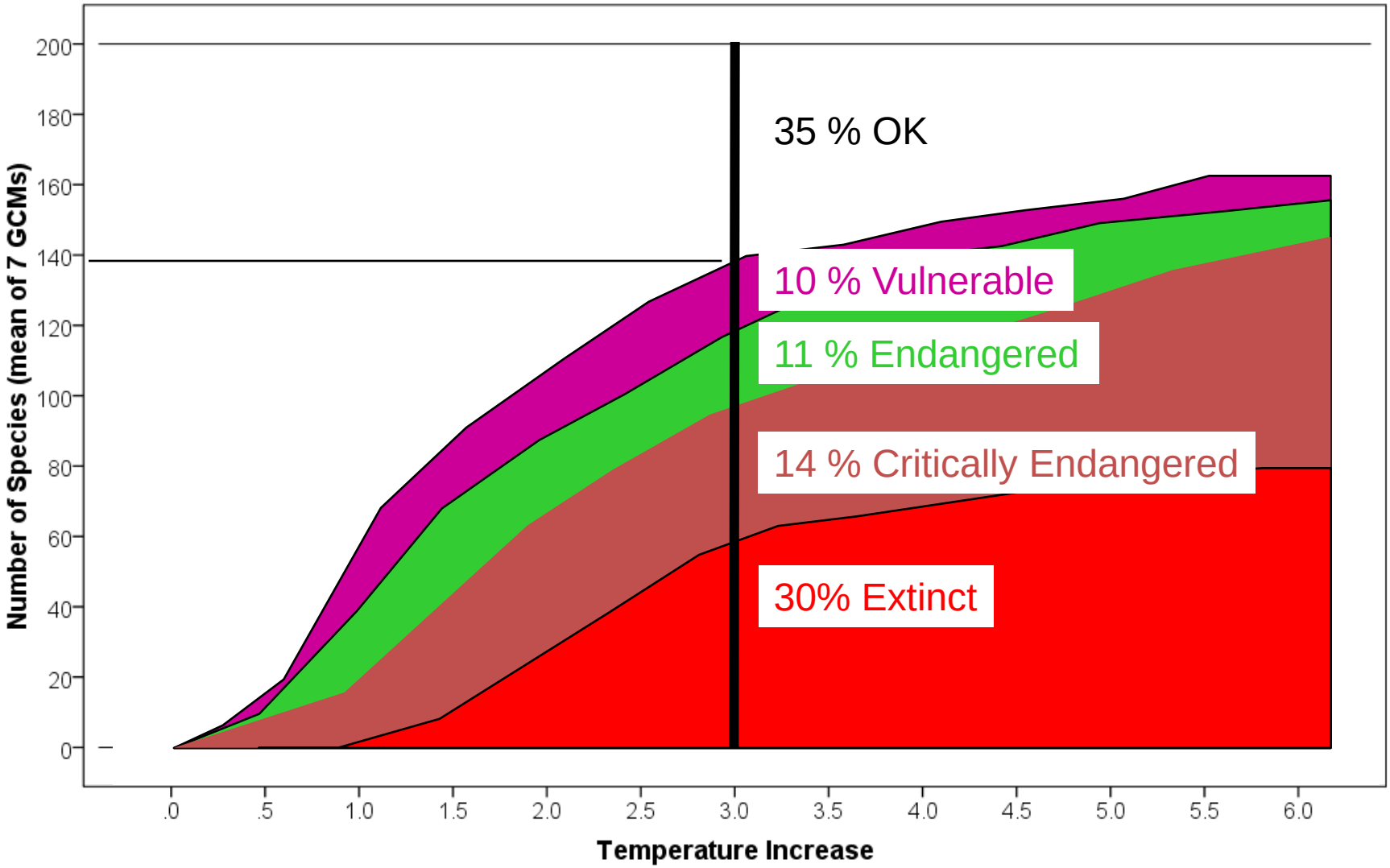
Standardized Data

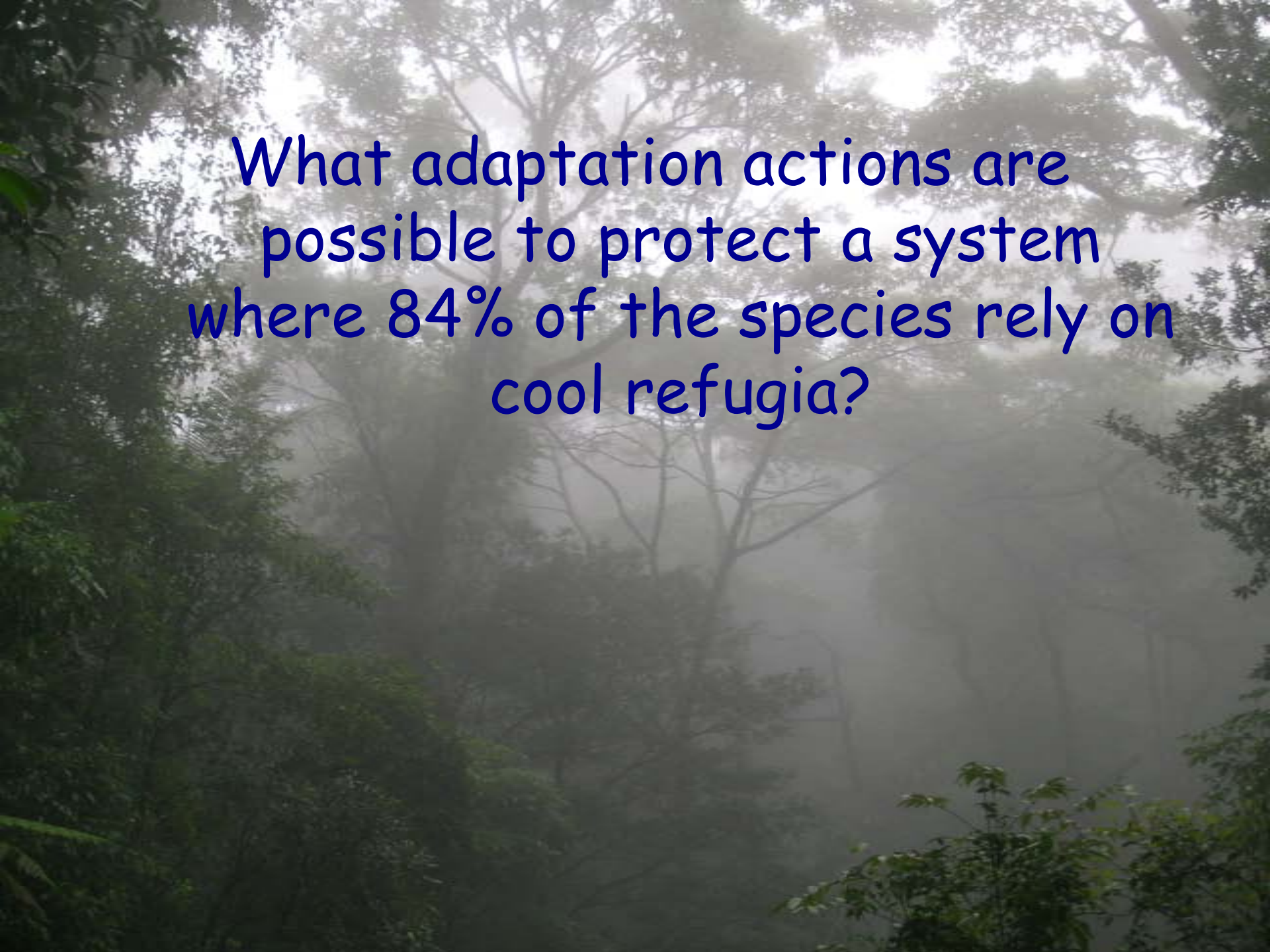
Total number of surveys:

- ~2000 Bird
- ~750 Reptile
- ~350 Spotlight
- 200 Stream Frog
- 400 Microhylid frog
- 6000 Malaise trap days
- ~250 leaf litter invertebrate
- Insect pit traps (>300000 trap days)


Rainforest
Species
Richness
(196 species)
Worst
Average
Best
0
100
200
Species Richness
6
5
4
3
2
1
0

Wet Tropics biodiversity is extremely vulnerable to climate change




What adaptation actions are possible to protect a system where 84% of the species rely on cool refugia?

Cool Refugia

Where will they be?

How big do they need to be to be effective?

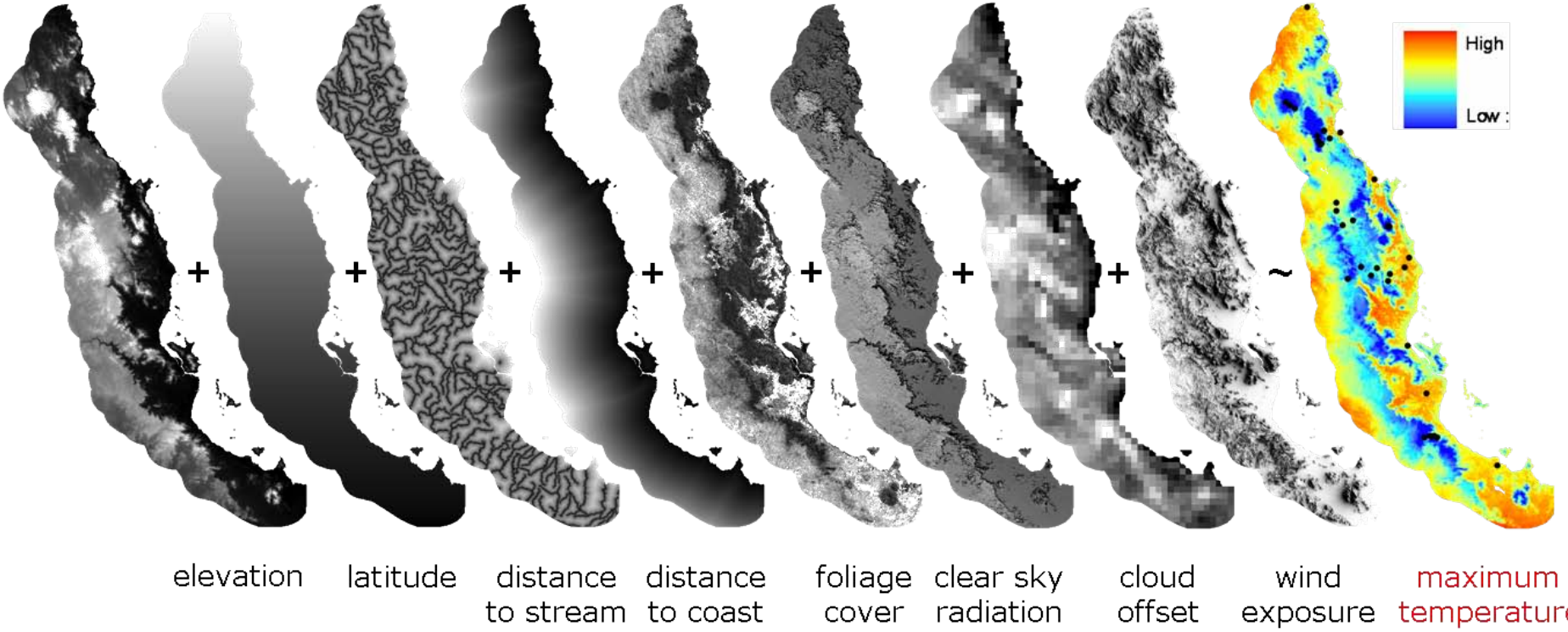
Which species will benefit?

What factors will threaten these refugia?

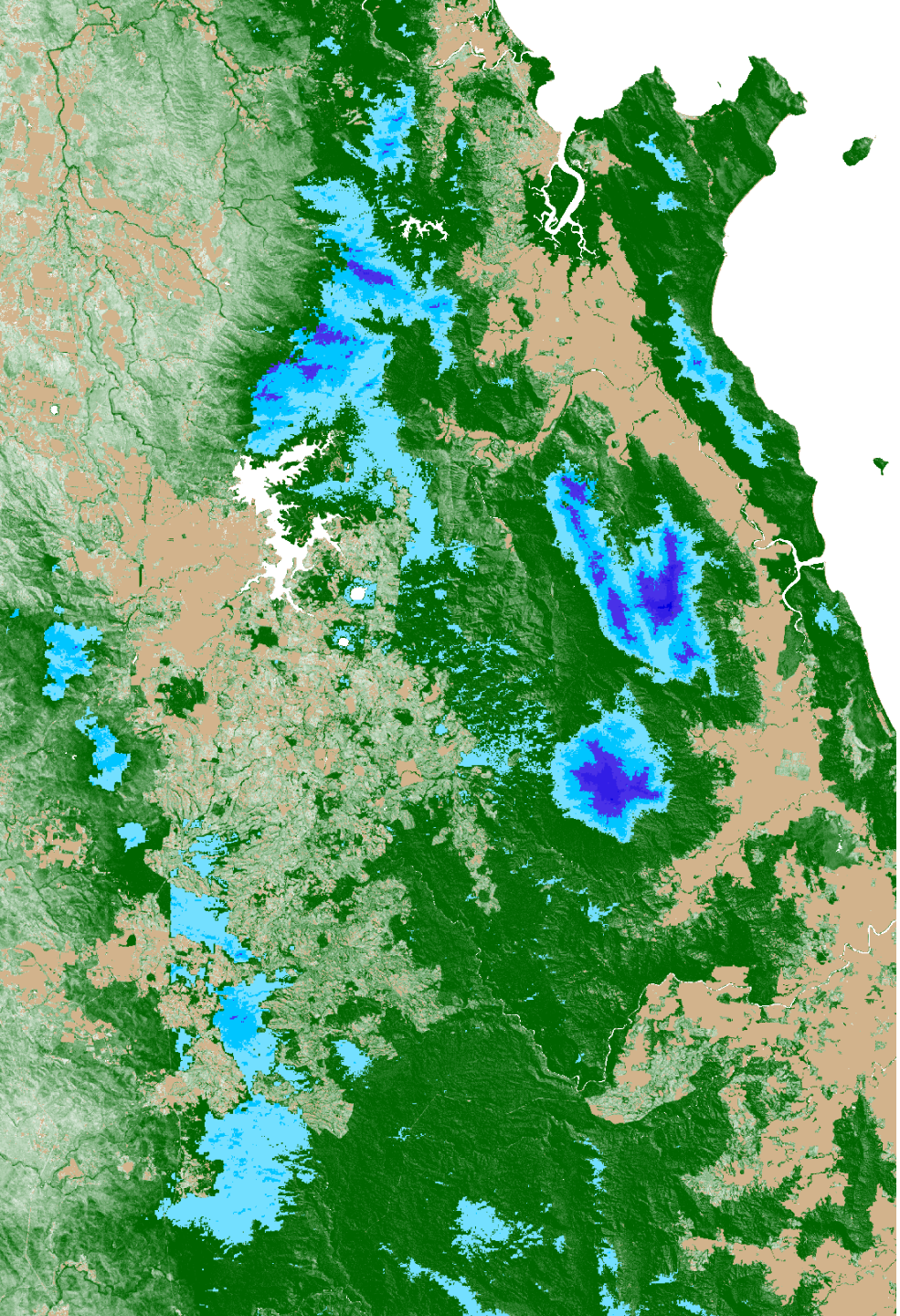
How do we protect, enhance and manage them?

Cool Refugia

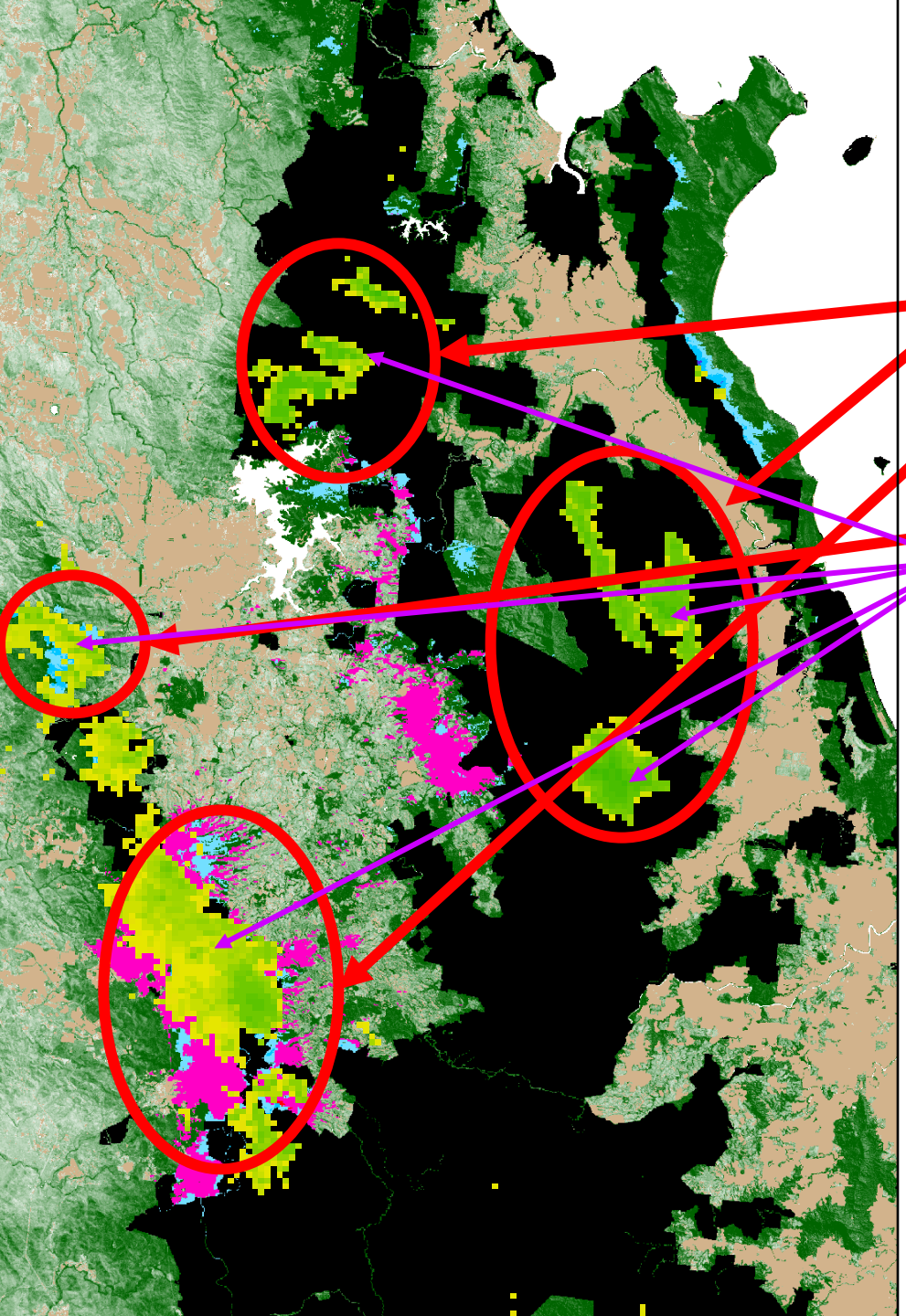
A map showing the maximum temperature actually experienced by an organism in any part of the region



Shoo, Vanderwal & Williams. *Glob Change Biol* 2010



Existing thermal refugia



Adaptation Options

High value refugia already in protected area:

- Land acquisition and/or off-reserve management agreements
- Habitat restoration
- Re-establish corridor for movement and gene flow

Biodiversity refugia based on overlayed distributions of all 200 rainforest vertebrates modelled using averaged Maxent future distributions of 7 GCMs at 4 deg C increase

Degraded landscape with potential to be high value refugia

- Maintain corridors to refugia

High value refugia connected to protected refugia:

- Potential for assisted translocation
- Off-reserve management agreements

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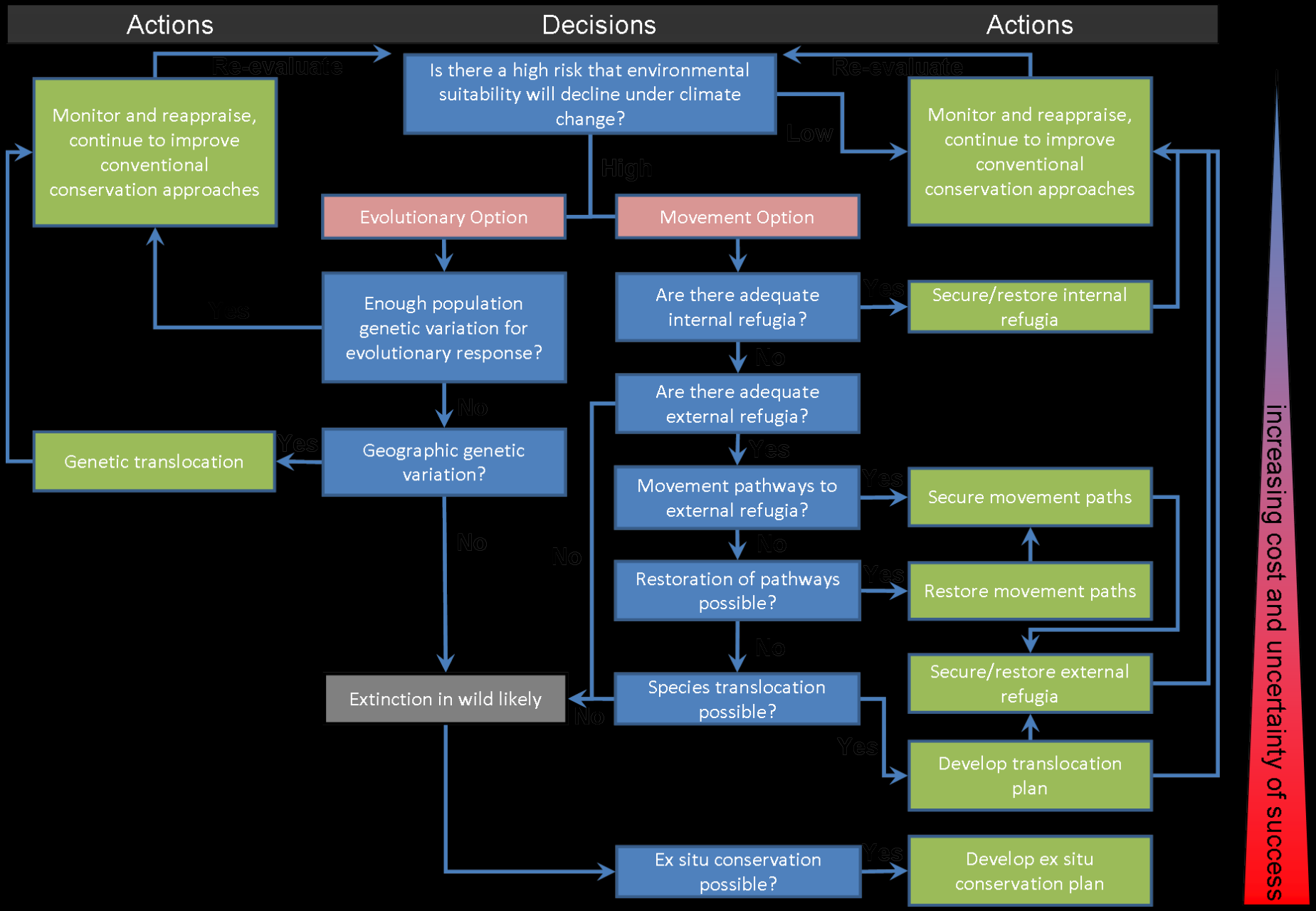
Adaptation Research Network
TERRESTRIAL BIODIVERSITY

Conservation Planning & Climate Change - workshop


Actions
Decisions
Actions
Re-evaluate
Re-evaluate
Is there a high risk that environmental suitability will decline under climate change?
Low
High
Monitor and reappraise, continue to improve conventional conservation approaches
Monitor and reappraise, continue to improve conventional conservation approaches
Evolutionary Option
Movement Option
Enough population genetic variation for evolutionary response?
Yes
Are there adequate internal refugia?
Yes
Secure/restore internal refugia
No
Are there adequate external refugia?
Yes
No
Genetic translocation
Yes
Geographic genetic variation?
Movement pathways to external refugia?
Yes
Secure movement paths
No
No
No
Restoration of pathways possible?
Yes
Restore movement paths
No
Secure/restore external refugia
Extinction in wild likely
Species translocation possible?
No
Yes
Develop translocation plan
Ex situ conservation possible?
Yes
Develop ex situ conservation plan
increasing cost and uncertainty of success

Will predicted future climate affect this species?

Is there sufficient ecological plasticity?

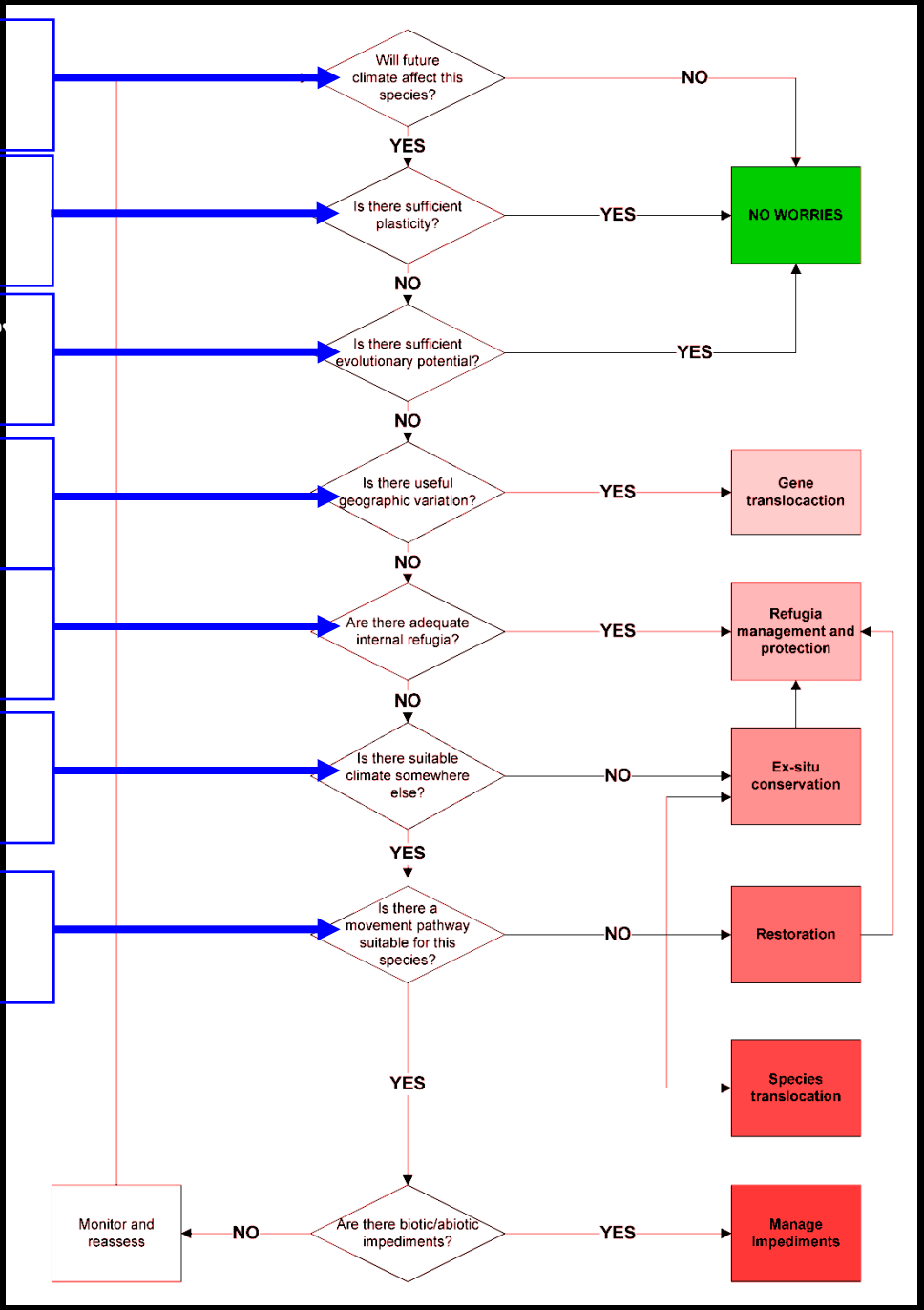
Is there sufficient evolutionar potential?

Is there useful geographic variation?

Are there adequate internal refugia?

Is there suitable climate elsewhere?

Is there a suitable movement pathway?



National Adaptation Research Plan - NARP

National Adaptation Research Plan (NARP) for Terrestrial Biodiversity identifies research required to assist managers of the terrestrial estate prepare for the consequences of climate change

National Adaptation Research Plan for Terrestrial Biodiversity

Authors:

Prof. Lesley Hughes	**(Macquarie University)**
Prof. Richard Hobbs	**(Murdoch University)**
Prof. Jan McDonald	**(Griffith University)**
Dr. Mark Stafford Smith	**(CSIRO - CAF)**
Prof. Will Steffen	**(ANU)**
Prof. Stephen Williams	**(James Cook University)**

National Adaptation Research Plan for Terrestrial Biodiversity

The aims of this Plan are to:

1) **Identify important gaps in the information needed by sectoral decision-makers to respond to climate change in ways that reduce the vulnerability of terrestrial ecosystems;**

2) **Set adaptation research priorities based on these gaps; and**

3) **Identify capacity that can be harnessed or that needs development to perform priority adaptation research.**

NARP – National Research Priorities

5.1 National/continental scale issues

- **5.1.1** How will climate change affect existing conservation goals and how should changed conservation goals be promoted and achieved?

- **5.1.2** How can the existing Australian legal, policy and institutional architecture for land management and biodiversity conservation respond to changes in conservation goals caused by climate change?

- **5.1.3** What conceptual models and long-term observation systems are needed to support the design, analysis and assessment of active adaptive management and policy experiments at regional and national scales under climate change?

NARP – Regional Research Priorities

5.2 Regional issues

- **5.2.1** What designs of landscapes in intensive and extensive land-use zones confer maximum resilience for biodiversity in the face of climate change, including the uncertainty associated with future climate scenarios?

- **5.2.2** How will climate change interact with other key stressors such as fire, invasive species, salinity, disease, water extraction, climate hydrology, grazing and clearing and what are the implications for ecosystem structure and functioning?

- **5.2.3** How can large-scale carbon mitigation initiatives such as revegetation and forest-related mitigation be designed to avoid adverse impacts on biodiversity and to maximise biodiversity conservation benefits?

- **5.2.4** How can major socio-economic trends occurring in many regions of Australia contribute to effective climate change biodiversity adaptation responses?

NARP – Local Research Priorities

5.3 Local land management issues

- **5.3.1** What are the costs and benefits of different climate change adaptation measures in key vulnerable communities and ecosystems?
- **5.3.2** How should fire management adapt to climate change?
- **5.3.3** How can management of local protected areas incorporate and adapt to climate change?
- **5.3.4** How can we better integrate conservation plans and actions across landscapes, incorporating protected area management, off-reserve conservation measures and other land-uses, to maximise biodiversity conservation benefits/outcomes under a changing climate?

NARP – Species Research Priorities

5.4 Managing key species

- **5.4.1** Which species should be the focus of investment in climate change adaptation?

- **5.4.2** How will climate change affect current management actions for protecting priority species and what management changes will be required?

- **5.4.3** How will climate change affect current or potential problem species and what management responses will be required?

Some common themes and priorities for biological research across NARP, BVA, Protected areas:

1) **Develop planning strategies and policy that recognise novel ecosystems, shifting climates and conservation paradigms**
2) **Understand, and predict, responses and vulnerability**
3) **Identify refugia – both internal and external**
4) **Understanding the influence of extreme events**
5) **Interactions between climate change and other stressors**
6) **Protect more habitat & greater environmental diversity**
7) **Manage habitat to reduce threats and maintain resilience**
8) **Manage landscape-scale issues such as connectivity**

How do YOU think the national priorities fit your ecosystem / region / sector?

- Are there any serious omissions?
- What are the priorities / challenges in your area of interest ?
- What research is needed to have the knowledge to make the best possible choices about adaptation?
- What are the main impediments?

Impacts:

What are the main impacts / challenges / problems of climate change on terrestrial biodiversity in YOUR area of interest / responsibility?

- Examples:
    - Direct temperature impacts
    - Biogeographic barriers to movement
    - Changing rainfall
    - Sea level rise
    - Extreme events:
        - Fire
        - Drought
        - Cyclones
        - Floods
        - Storm surges
    - Interactions
        - Invasive species
        - Habitat Fragmentation

Local / Regional / Sectoral

Sector	Area	Ecosystem	Impacts	Ideas to manage	Adaptation Research	Impediment
National Park	Bogong High Plains	Alpine/ subalpine	• increased fire risk	control burning	Which species most threatened •	Money Changing ideas and attitudes to Climate Change •skills
National Park	Bogong High Plains	Alpine/ subalpine	• increased incidence of drought	artificial structures to provide micro refugia / feeders	Would the animals use structures	
National Park	Bogong High Plains	Alpine/ subalpine	•increased threat of invasives	•Sterilize vehicles	When to act	