Future shock: science for adapting forest management to climate change

Partner Universities

The University of Melbourne · Monash University · La Trobe University · RMIT University

Project Sponsor

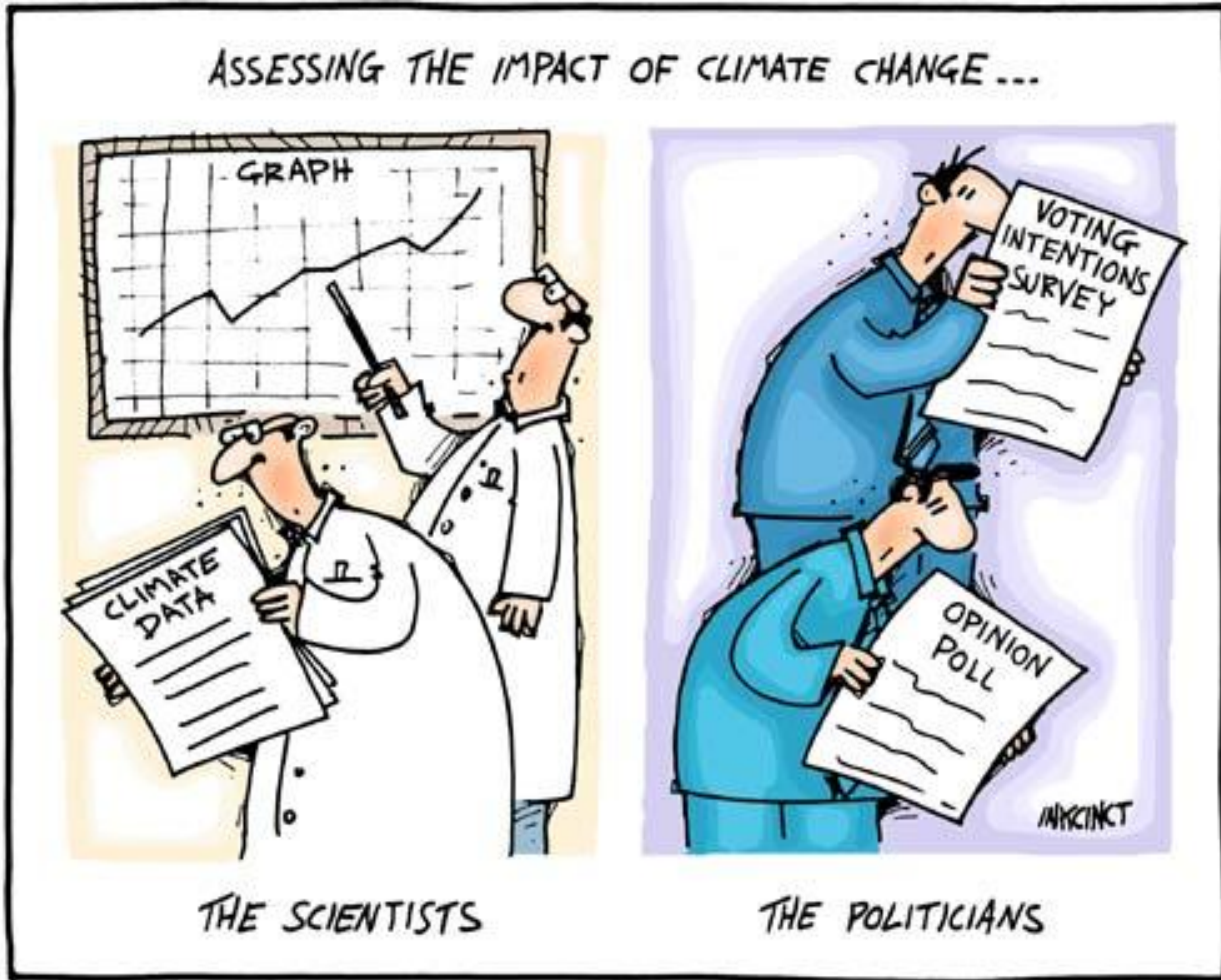
Victoria The Place To Be · Department of Sustainability and Environment

Rod Keenan, Director

www.vcccar.org.au

Outline

- What is adaptation?
- Objectives of adaptation
- Climate literacy in forest management
- Decision-led adaptation analysis
- Identifying and prioritising adaptation options
- Science-practice-policy partnerships


ASSESSING THE IMPACT OF CLIMATE CHANGE...
GRAPH
CLIMATE DATA
VOTING INTENTIONS SURVEY
OPINION POLL
INKCINCT
THE SCIENTISTS
THE POLITICIANS

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Current day impacts

The Economist

Adapt or Die

Sep 2008

Environmentalists have long said the world should concentrate on preventing climate change, not adapting to it. That is changing

Once upon a time. . .

- Adaptation to climate change was considered the "easy way out"

> *"[Adaptation is a] kind of laziness, an arrogant faith in our ability to react in time to save our skins"*
>
> Al Gore (1992)

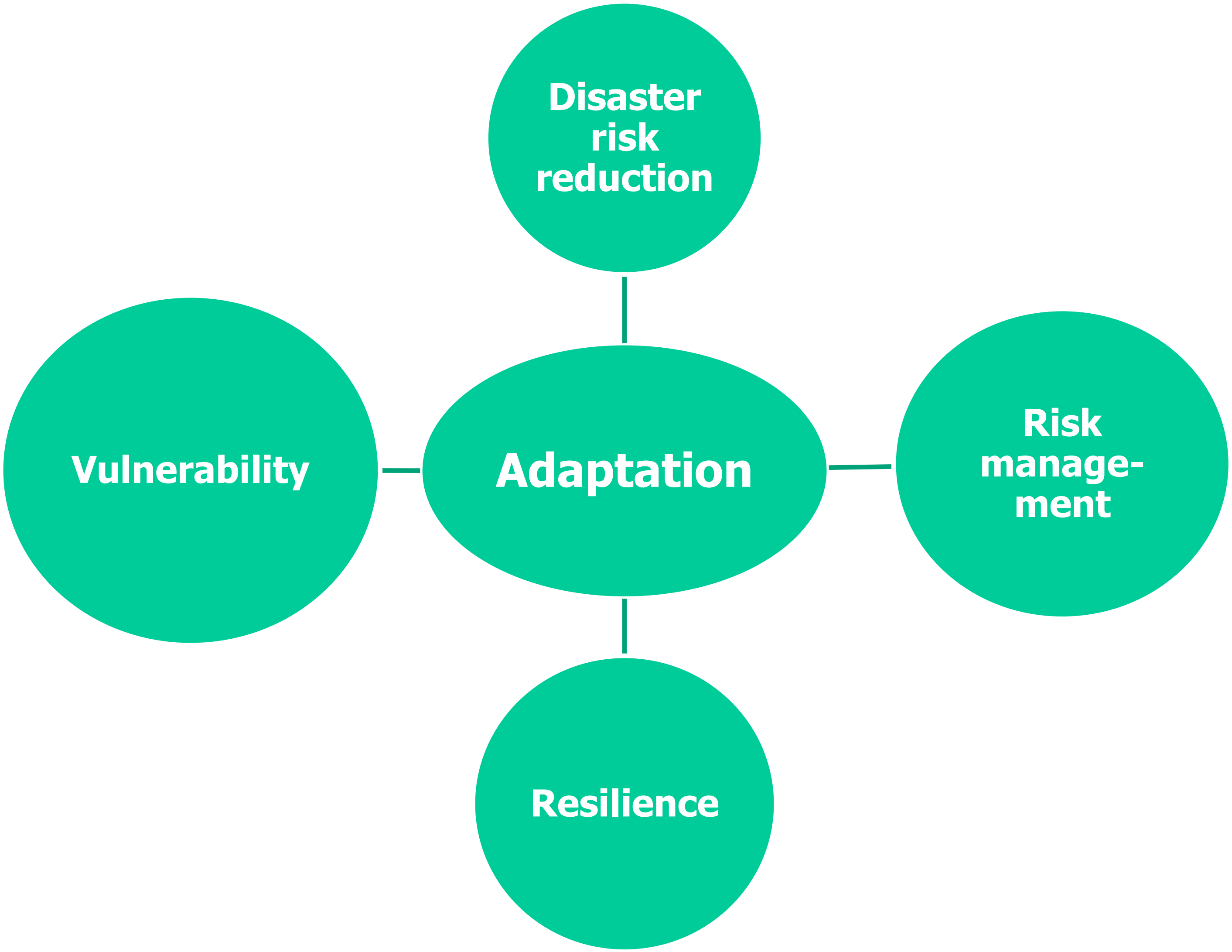
> *"Should we try to prevent the one possible risk of global warming? Or should we try to become smarter and wealthier so that we can adapt ourselves to whatever risks occur, whether it be warming or cooling, or drier or hotter, or maybe an asteroid or a disease, or many other risks that the world will certainly face in the 21st Century?"*
>
> Fred Smith, President, Competitive Enterprise Institute (1997)

- Adaptation is now accepted as a legitimate strategy for managing climate risk and improving social and ecological well-being

Ben Preston keynote address Greenhouse 2011 conference, Cairns

Framing adaptation

Fuenfgeld and McEvoy 2011 VCCCAR Working paper



Adaptation definitions

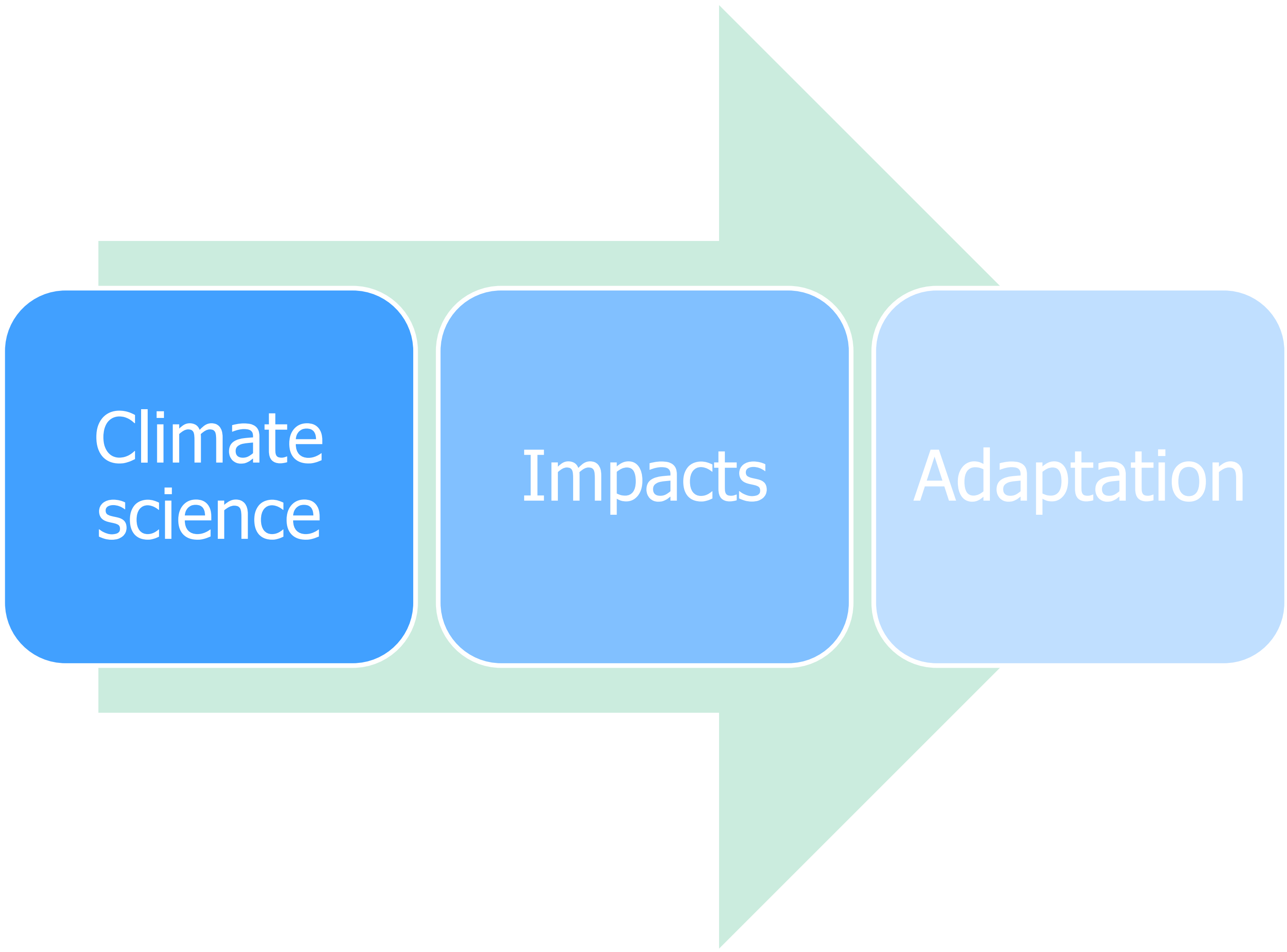
The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities – IPCC

A process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented -UNDP

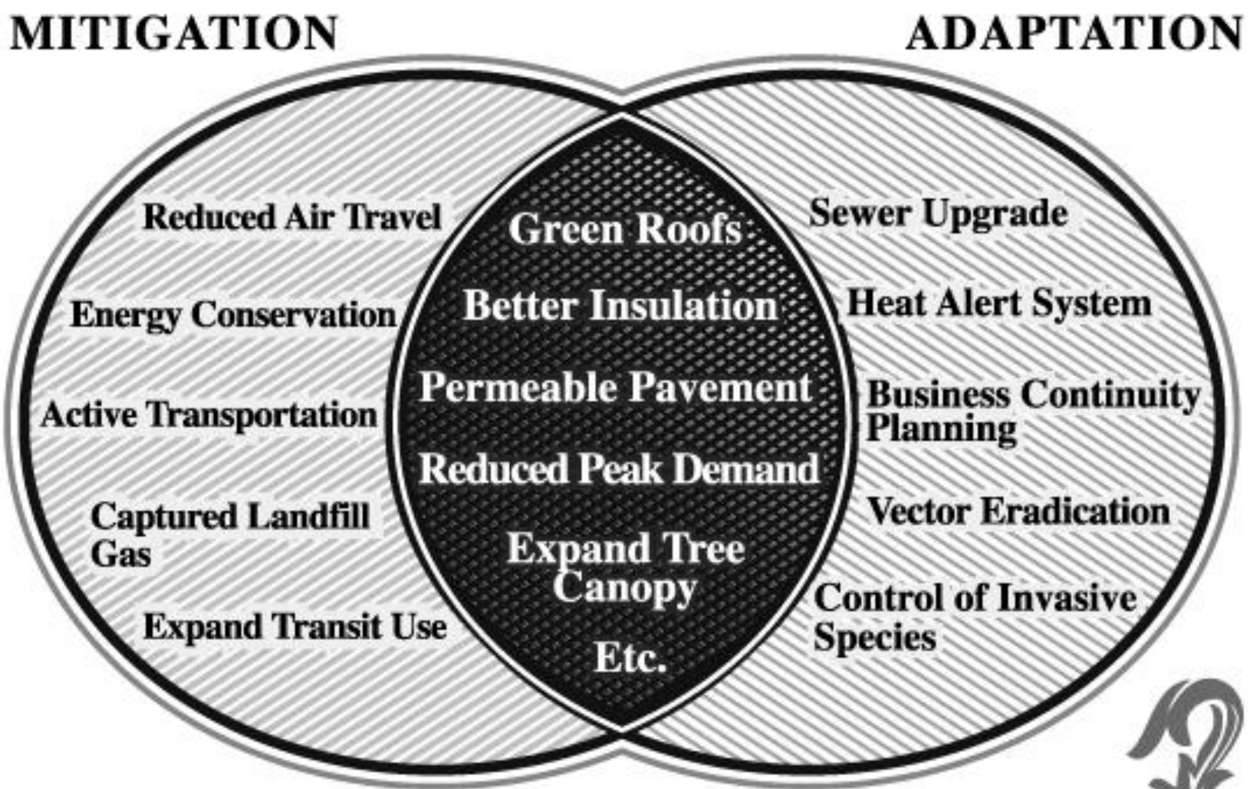
The process or outcome of a process that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change - UKCIP

Actions taken to help communities and ecosystems cope with changing climate condition (UNFCCC)

Making smart decisions - Keenan


Climate science
Impacts
Adaptation

Mitigation vs Adaptation



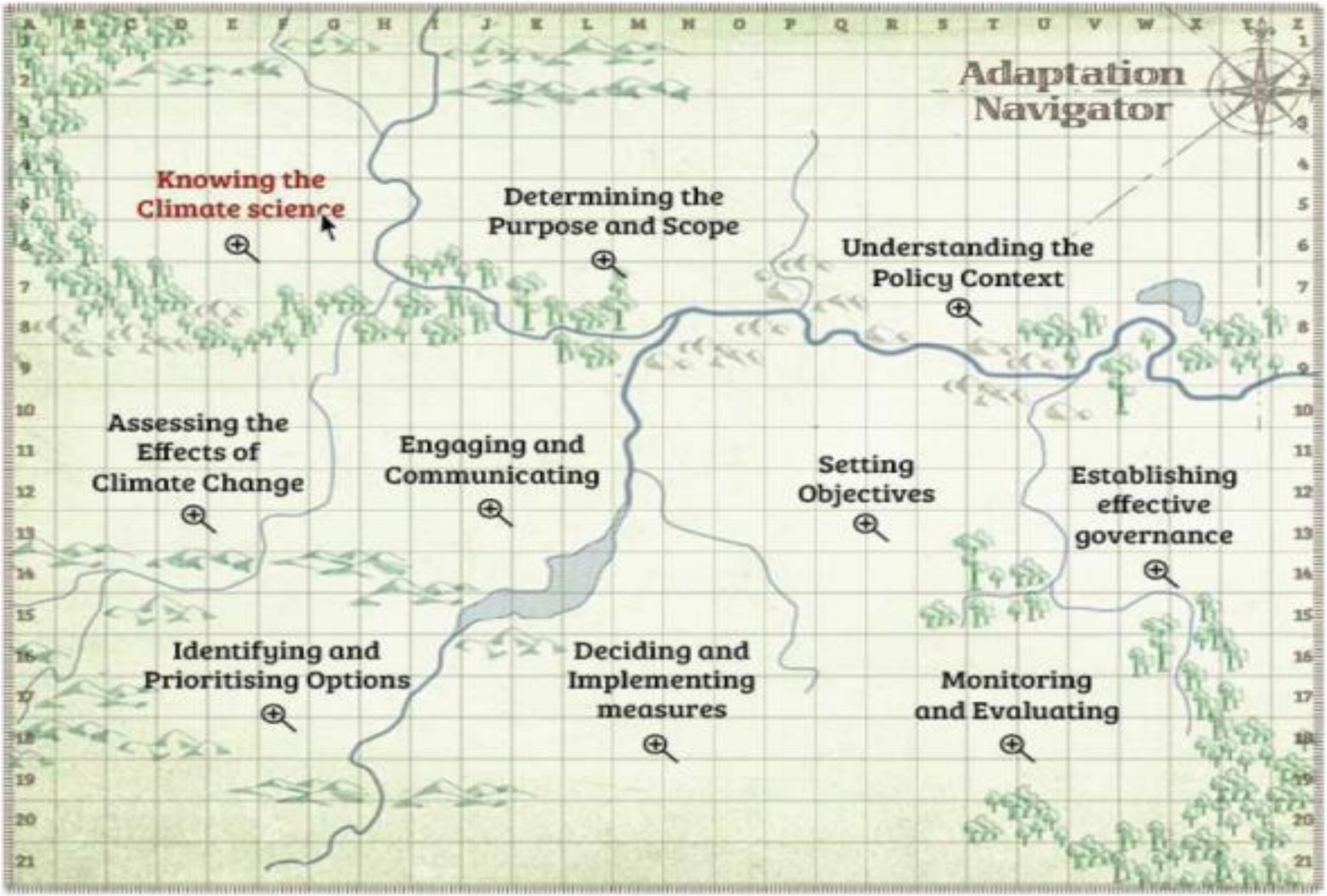
Source: Penney, J., 2008,
"Emerging Climate Change Adaption Strategies,"
Clean Air Partnership.

Ecosystem-based adaptation

- Greater use of woody vegetation in dryland farming systems
- Diversified production and market options
- Land-use planning systems that recognise ecosystem services
- Stewardship payment for provision of ecosystem services
- Use of vegetation in fire, flood erosion or coastal protection

The adaptation landscape

Fuenfgeld et al (in press)



Setting objectives

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Sustainable forest management

What are forests for?

The stewardship and use of forests in a way that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now AND IN THE FUTURE, relevant ecological, economic and social functions

Modified from MCPFE

Examples

- Maintaining wood supply to industry or water supply to users
- Enhancing the capacity of vulnerable people or places to cope with climate variability
- Supporting industry to harness new opportunities presented through a changing climate

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Forest sector policy change

- Industry consolidation and privatisation
- Competitive pricing of wood
- Commercialisation of native forest management
- Demonstrated 'sustainability' of timber production
- Changing social norms
- Biodiversity conservation
- Demand for protective functions and environmental and social services

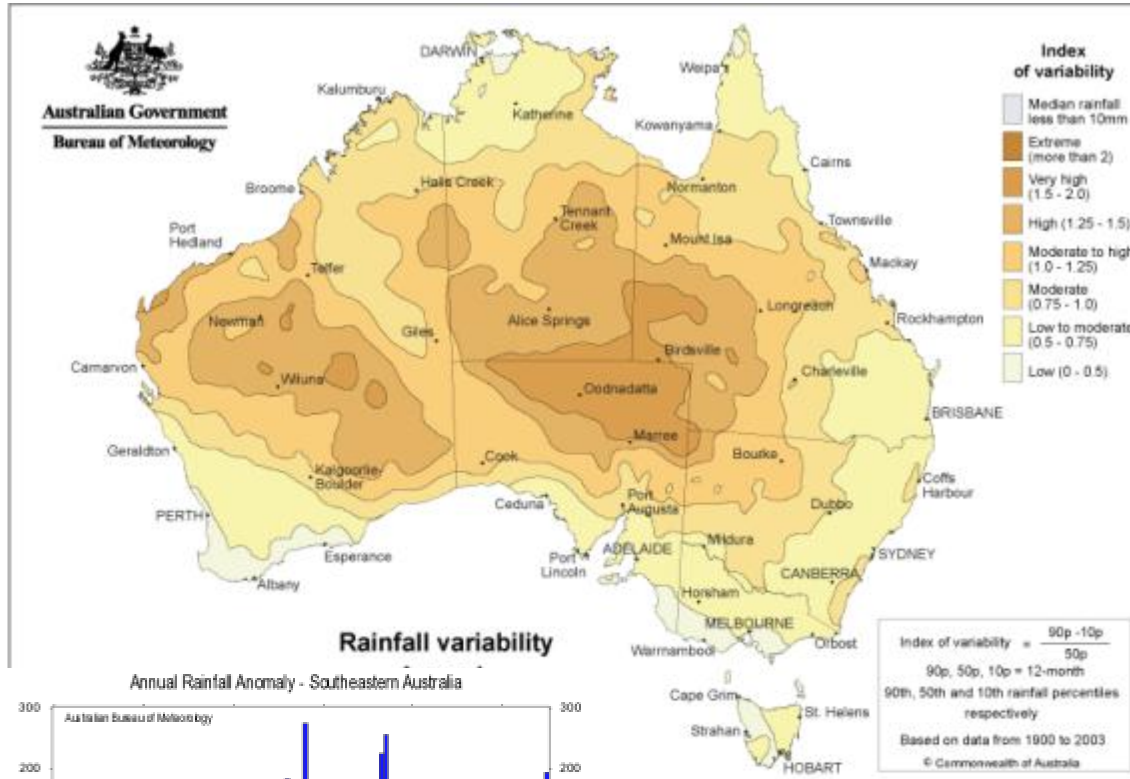
AUSTRALIAN FORESTRY STANDARD ®
AFS/01-21-06

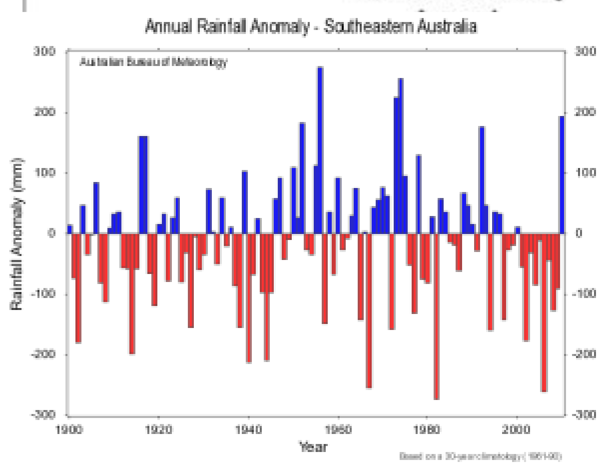
Climate literacy in forest management

The Australian Environment

I love a sunburnt country,
A land of sweeping plains,
Of ragged mountain ranges,
Of droughts and flooding
rains **Dorothea MacKellar 1904**

- ❑ **Climate hot, dry, variable**
- ❑ **Driven by ENSO, IOD, STR and SAM**
- ❑ **Production water and nutrient limited**
- ❑ **Fire a significant force**
- ❑ **Plant reproduction and growth opportunistic, disturbance adapted**





Future climate

1 projected increases in average temperatures in Australia

compared with 1990

	2030 °C	2050 °C	2070 °C
Australia	1.0	0.8 - 2.8	1.0 - 5.0
coastal	0.7 - 0.9		
inland	1.0 - 1.2		

Source: CSIRO and BoM (2007).

2 projected future changes in precipitation in Australia

compared with 1990

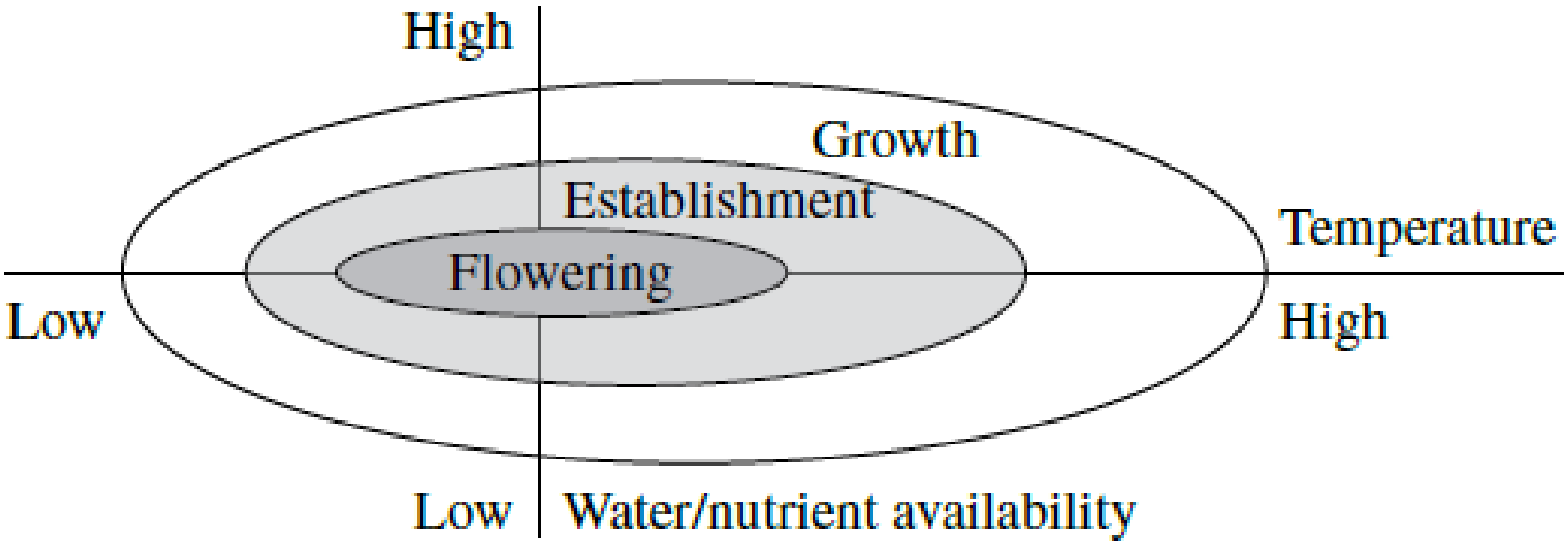
	2030 %	2050 %	2070 %
annual			
northern areas (and central and eastern for 2050 and 2070)	-10 to +5	-20 to +10	-30 to +20
southern areas	-10 to 0	-20 to 0	-30 to +5
winter and spring			
south east	-10 to 0	-20 to 0	-35 to 0
south west	-15 to 0	-30 to 0	-40 to 0
eastern areas	-15 to +5	-20 to +10	-40 to +15
summer and autumn	-15 to +10	-20 to +15	-40 to +30

Source: CSIRO and BoM (2007).

Forest states and processes responding to climate change

	FAST	SLOW	
INDIRECT	Fire frequency/intensity More disease More insect pests More invasives Water quality	Habitat composition and structure Wood supply Erosion Water yield	Ecosystem goods and services
DIRECT	Photosynthesis Water use/transp. Flowering/phenology Regeneration Wood density/quality Growth and mortality Frost/storm damage	Decomposition Tree nutrient status Genetic change Species distribution/ local extinction	

Climate change and forest processes



Doley. D. ***Australian Forestry 2010 Vol. 73 No. 2 pp. 115–125***

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Bushfire risk

- In south eastern Australia
- Frequencies of days with VH and extreme FFDI ratings likely to increase
    - 4-25 % by 2020
    - 15-70 % by 2050
- Higher fire-weather risk in spring, summer and autumn will increasingly shift periods suitable for prescribed burning toward winter

(Hennessy et al 2005)

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Decision-led adaptation

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Dealing with uncertainty

Characteristics of climate change

- Difficult to separate signal from 'noise'
- High range of future possibilities
- Worst potential impacts mostly longer term

Future climate for Melbourne in 2030 A1B scenario

	Little change (up to 0.5C warmer)	Warmer (0.5 to 1.5C warmer)	Hotter (1.5 – 3.0C warmer)	Much hotter (more than 3.0C warmer)
Much wetter (more than +15%)	*No evidence*	*No evidence*	*No evidence*	*No evidence*
Wetter (0 to 15% wetter)	*No evidence*	Possible *5 models*	*No evidence*	*No evidence*
Drier (0 to 15% drier)	Slight evidence *2 models GISS AOM, PCM*	Most Likely *16 models*	*No evidence*	*No evidence*
Much drier (More than 15% drier)	*No evidence*	*No evidence*	*No evidence*	*No evidence*

Whetton, P. CSIRO personal communication

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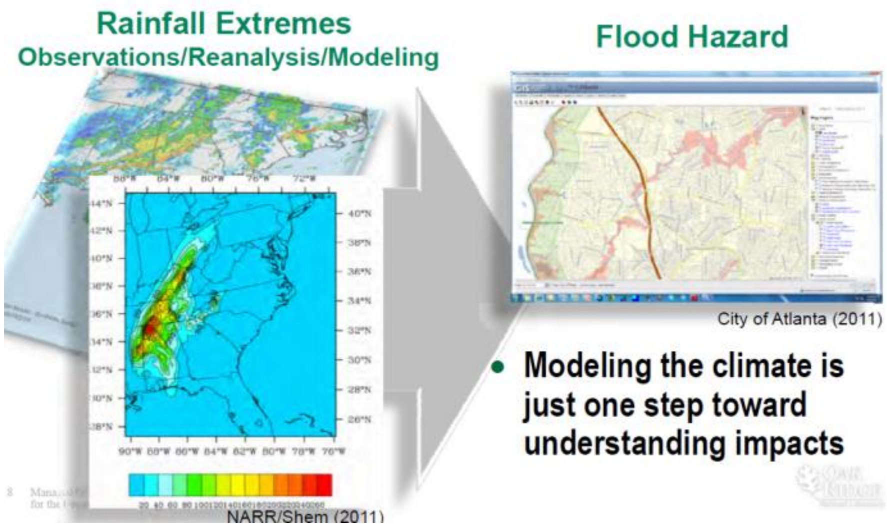
Moving from climate data to hazard assessment



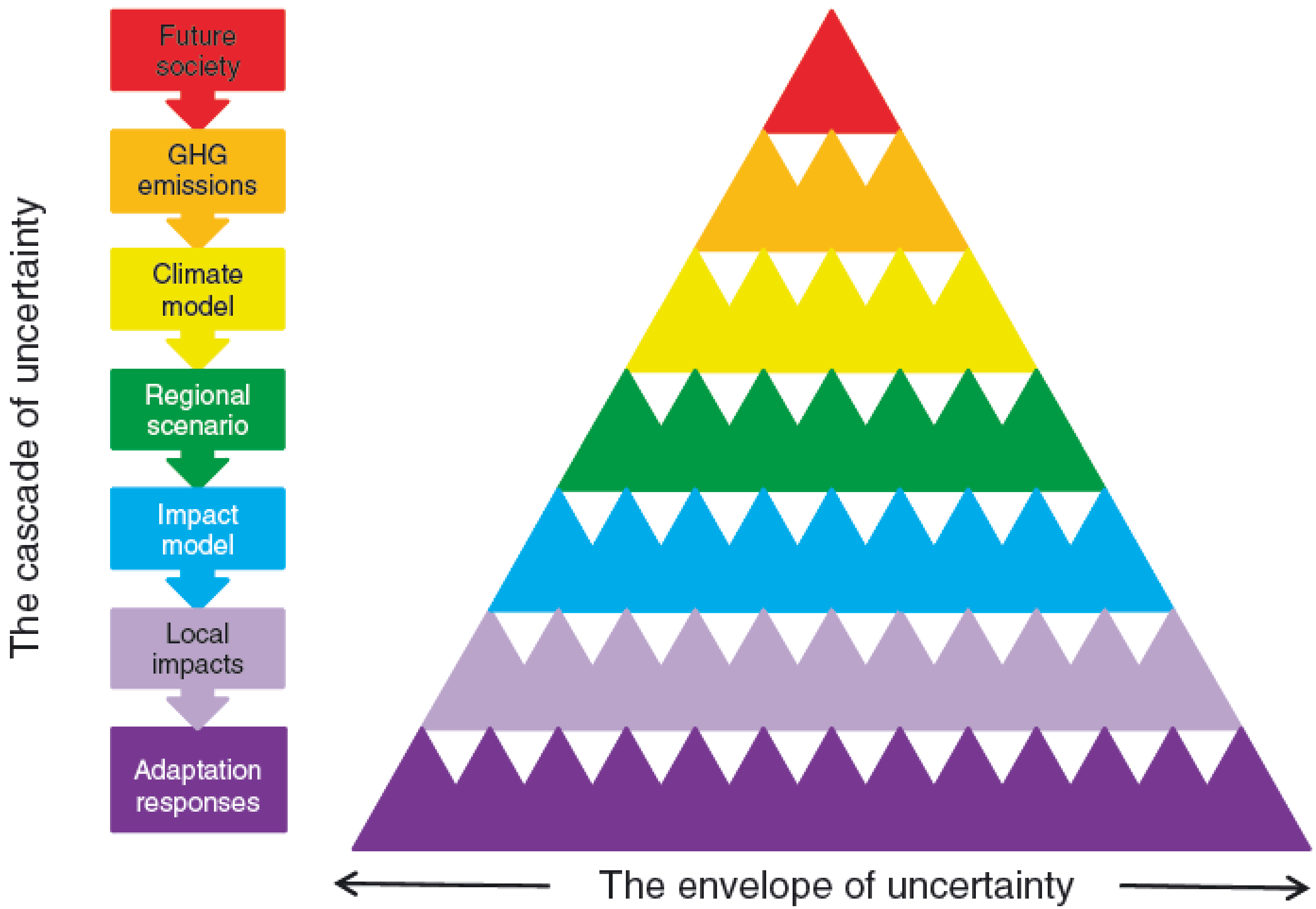
Disaster	% of Total Damages	Resolved in GCMs/RCMs?
Flooding	21%	No
Tropical cyclones	19%	Yes/No
Drought	8%	Yes
Tornado	8%	No
Winter weather	7%	Yes
Hail	5%	No
Severe Storms	5%	Yes
Wildfire	5%	No

Ben Preston keynote address Greenhouse 2011 conference, Cairns

Like looking for keys under a lamp post

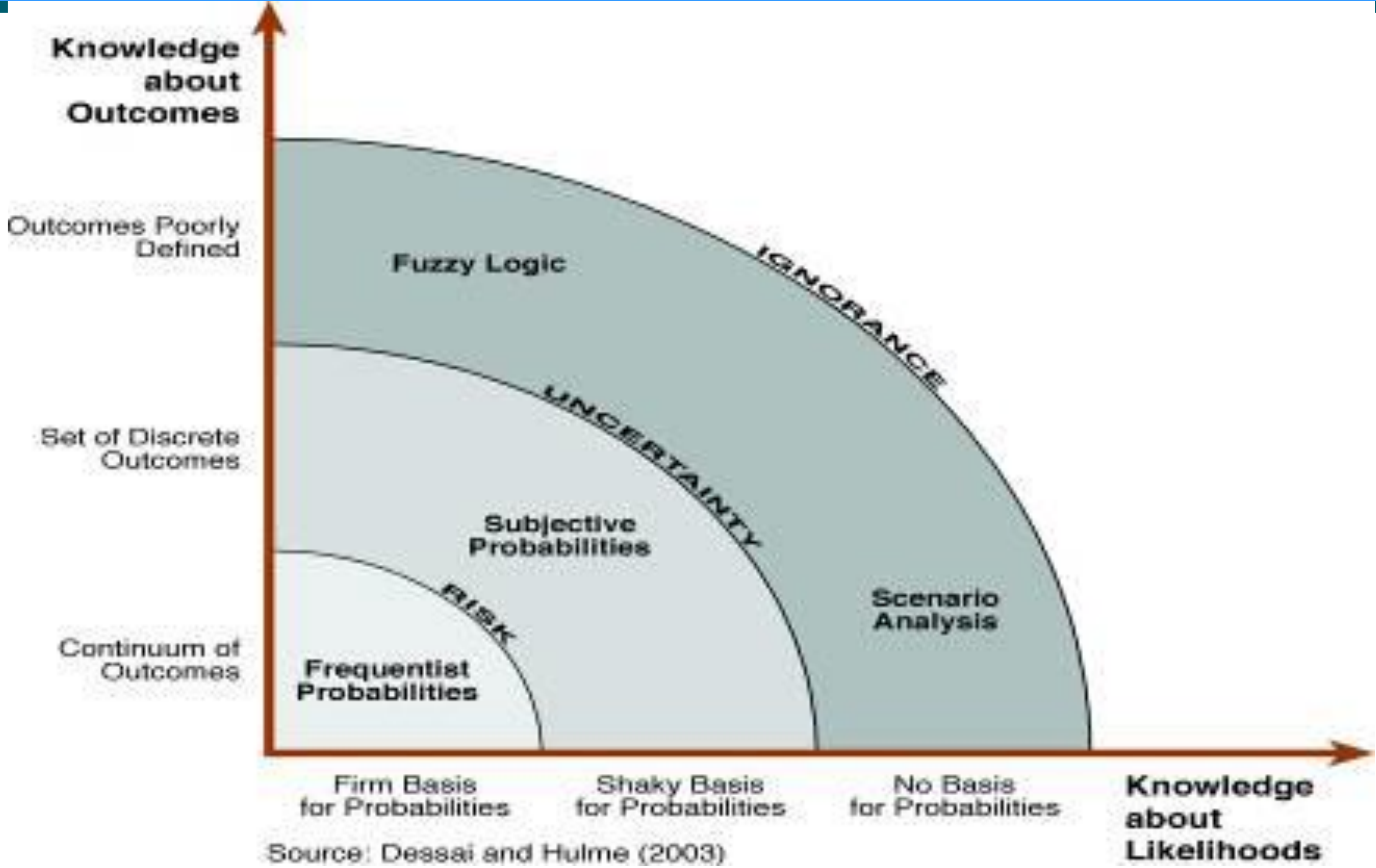
Bert Christensen's Illustrations Gallery

High uncertainty



Wilby and Dessaix 2010

Thinking the unthinkable – scenario planning



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Identifying and prioritising adaptation options

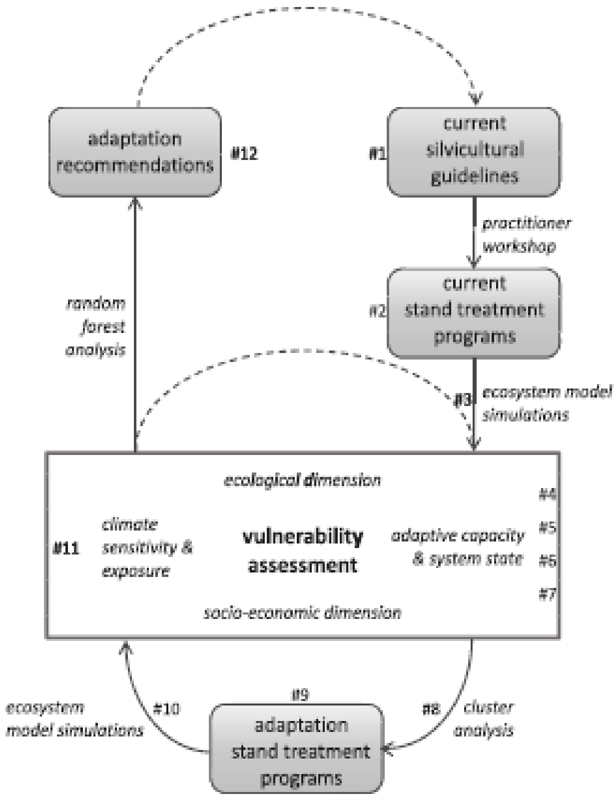
Adaptation responses

- **Do nothing**
- **Reactive or planned (proactive)**
  - **, new built environment**
- **Hard or soft**
  - **Infrastructure-based eg. flood barriers**
  - **Public and industry education**
  - **Using infrastructure differently**
  - **Accepting new conditions, living with change**
- **Incremental (short-term) or transformational (longer-term)**
- **Insufficient, misguided, unnecessary or mal-adaptive (Wood et al 2010)**

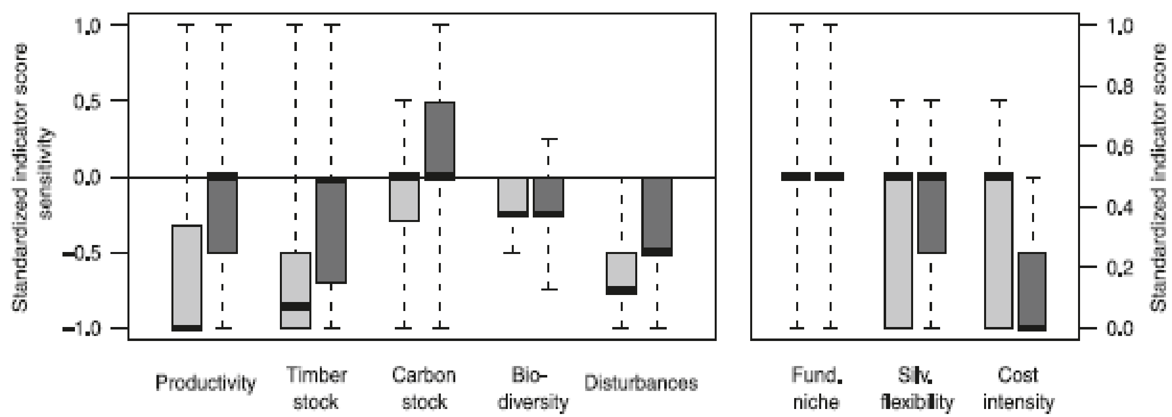
Austrian forest example

Seidl et al 2011 Can. J. For. Res. Vol. 41

Fig. 1. Overview of the approach to derive climate change adaptation recommendations for the current management guidelines of the Austrian Federal Forests (AFF). Numbers 1 to 12 indicate the analysis steps as described in Table 1.



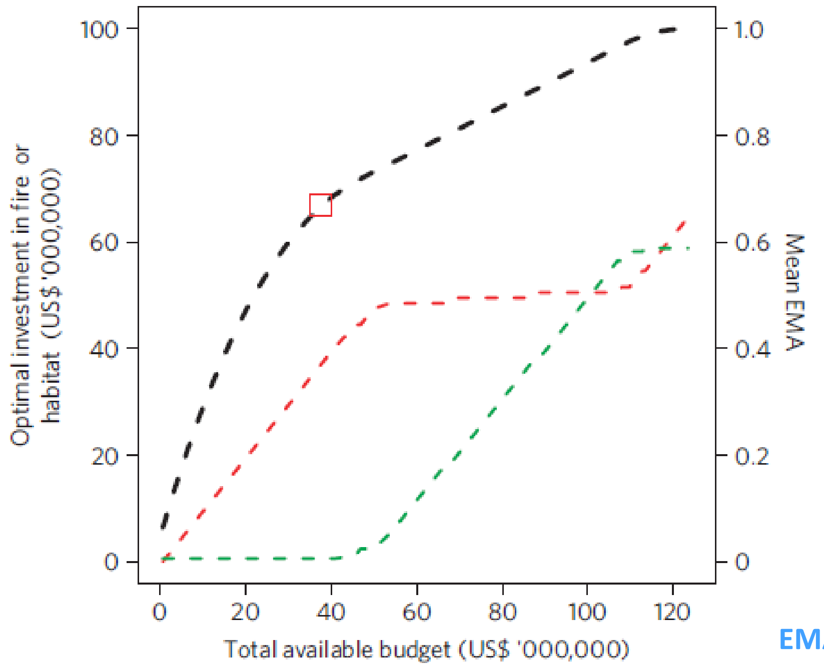
- 165,000 ha
- 52 management units with different topography, altitude and soil type
- Ecosystem modelling and MCDA
- 2 future time periods
- Strong stakeholder participation and practical options
- New guidelines for species composition, rotation length, thinning



Evaluating options
(Wintle et al 2011)

South African example

GOAL:
maximize net expected persistence of fynbos species over 50 years within economic and social constraints



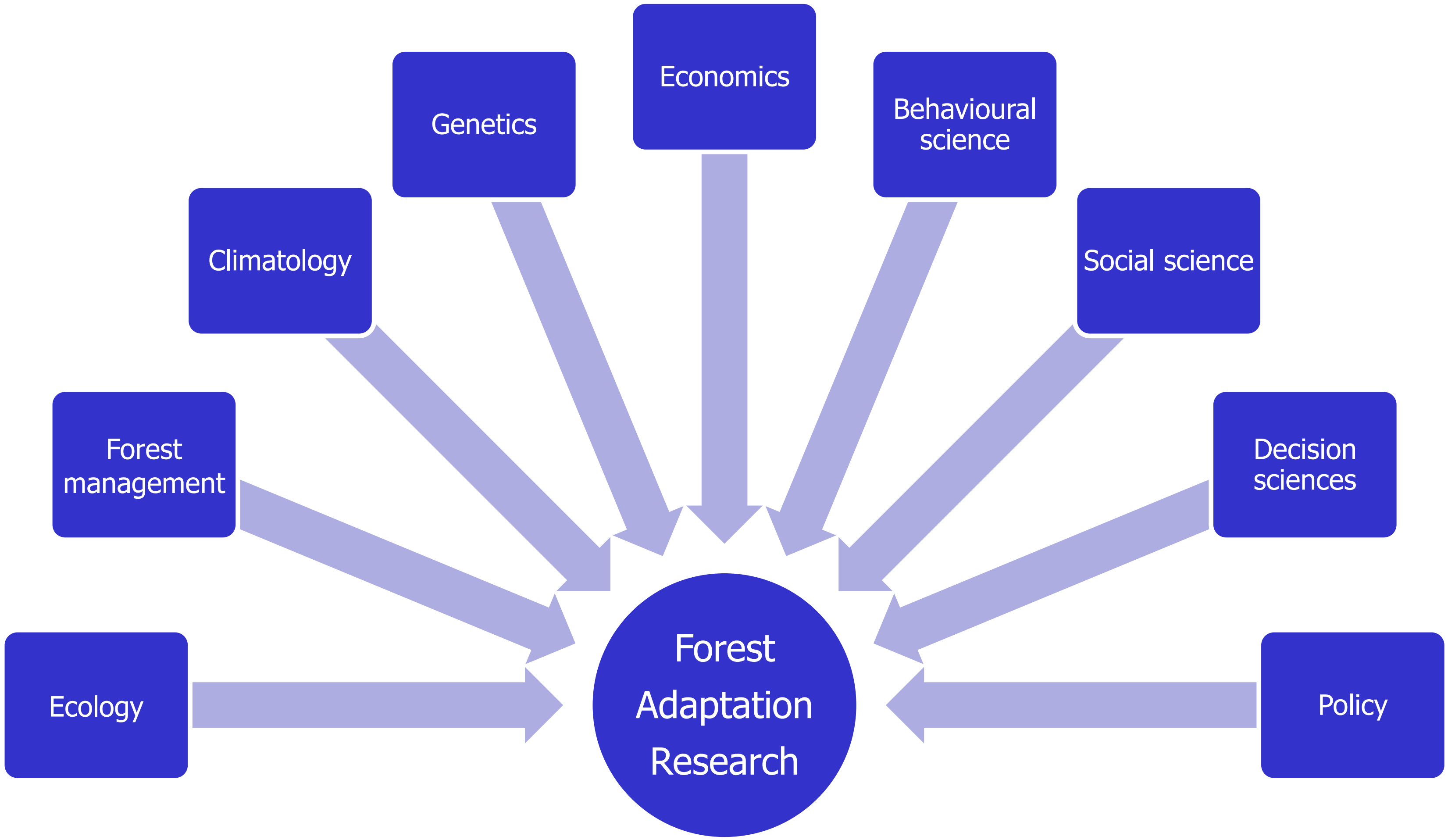
EMA = expected minimum abundance



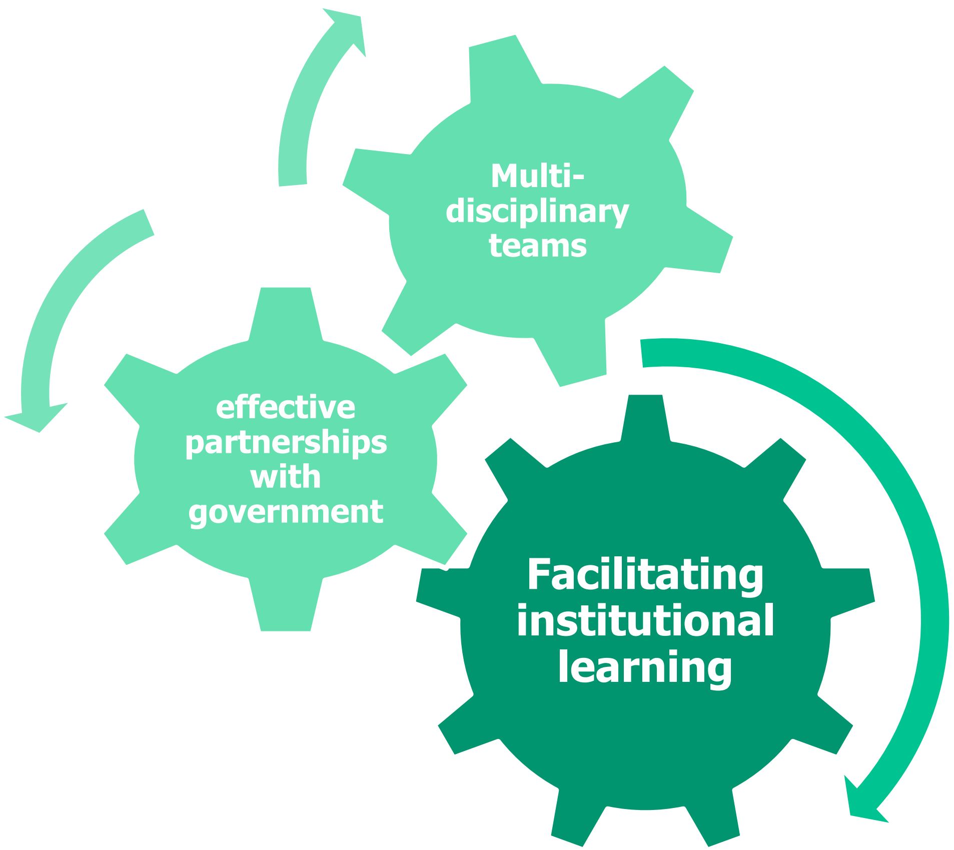


Science-policy-practice-partnerships

Multi-disciplinary teams



Research-policy partnerships



Challenges

- Presenting research outputs in a useable way
- Building an innovation culture in government
- Monitoring and reflection

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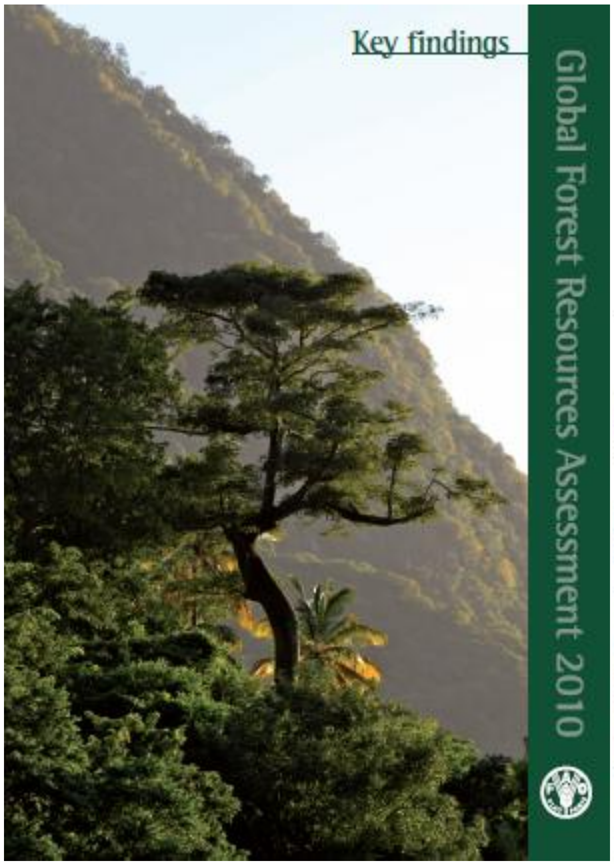
Monitoring, and data analysis and reporting

UN-REDD
PROGRAMME



Research needs

- Regional climate downscaling – debatable
- Genetic variation, genomics and physiological basis of local adaptation and analysis to underpin of translocation options
- More complex and more realistic SDMs that incorporate factors such as age to sexual maturity, fecundity, dispersal ability, and competition effects
- Understanding key climate thresholds (temperature, moisture) for ecosystem functions
- Fire regimes for changed climate, that reduce risk but also maintain biodiverse ecosystems and their functions
- Decision making tools incorporating management of climate change risks
- Social engagement processes to determine what we value and want to retain
- Understanding policy and management barriers to adaptation

Conclusions

- Improve 'climate literacy' in the forest management community
- Recognise that high uncertainties prediction of future climate and impacts are unlikely to be resolved
- Identify 'robust' responses that maintain forest functions under a range of future conditions
- Need multi-disciplinary teams
- Incorporating potential climate change in management decisions likely to make forests and people more resilient to other types of shocks