THE AUSTRALIAN NATIONAL UNIVERSITY

Building Effective Adaptation to an Uncertain Climatic Future:

Challenges to the Research Community

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Outline of Talk

1. The nature of adaptation research

2. Three climate adaptation case studies
   - Adaptation in Australian agriculture
   - Biodiversity Vulnerability Assessment
   - Vulnerability of ecosystem services in Europe

3. Lessons from the case studies

The Nature of Adaptation Research

Research to support adaptation to climate change is fundamentally different from climate impacts research. Adaptation is more closely related to research on vulnerability and resilience.

Good adaptation research is driven by the sectors or systems that need to adapt. Climate science often plays a relatively minor role.

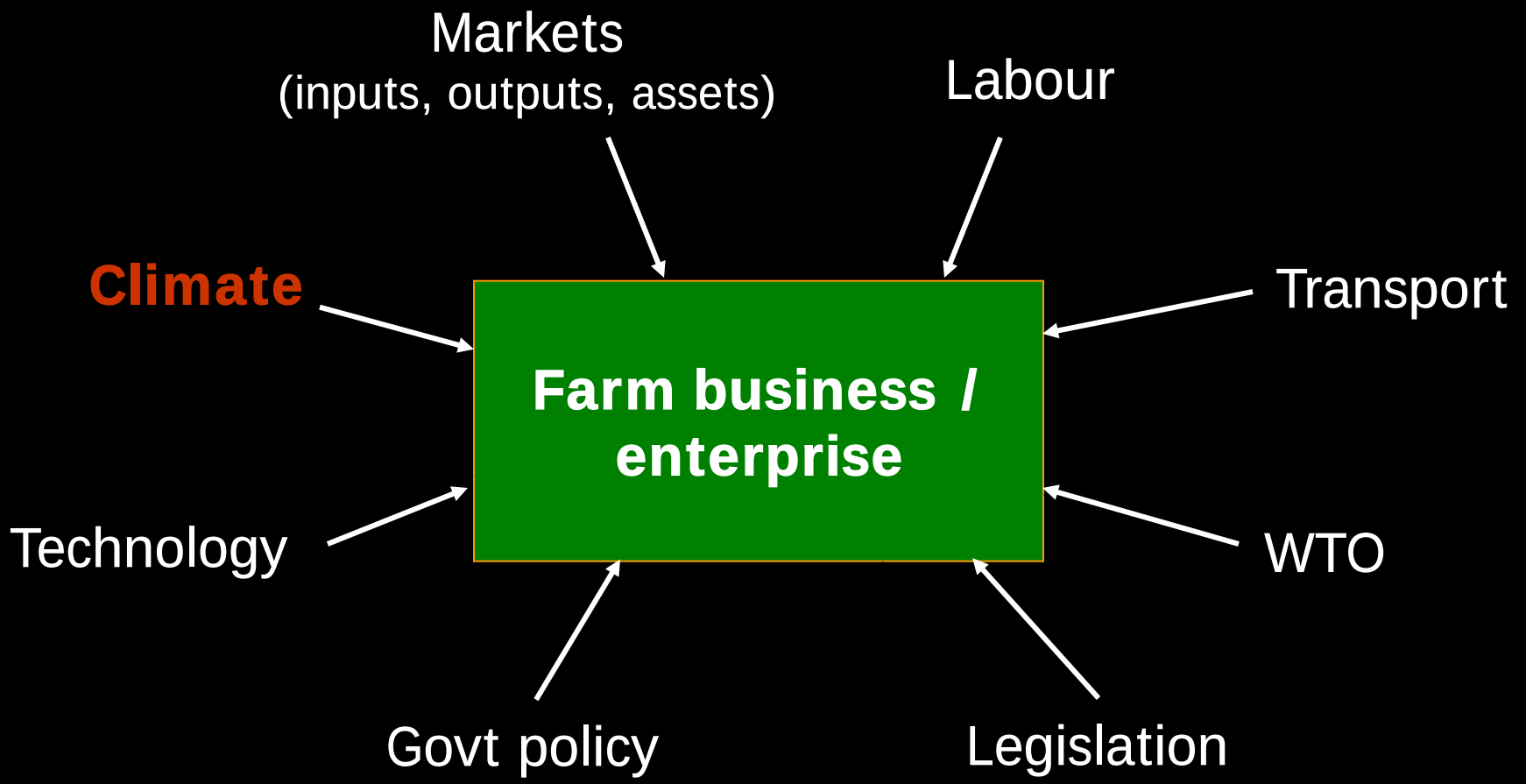
Adaptation to climate change nearly always must be integrated with other factors that affect the performance of sectors or systems.

Farming Profitably in a Changing Climate: A risk management approach

John Sims
Program Leader
Climate Impact Sciences

Traditional Approach to Climate Impact Studies

Risk management approach



Dealing with climate change: A risk management approach

1. **Establish priorities –** where do you want your business to go?
2. **Identify the risk –** what type of climate changes might hinder you getting there?
3. **Analyse the risk –** what is the likelihood of these climate changes happening?
4. **Evaluate the risk –** what can you do to mitigate the risk or exploit opportunities? What are the relative costs and benefits?
5. **Treat the risk –** implement your decision

Variability v. Reliability?

Producers are more interested in reliability than in means or in variability. But what do they mean by ”reliability”?

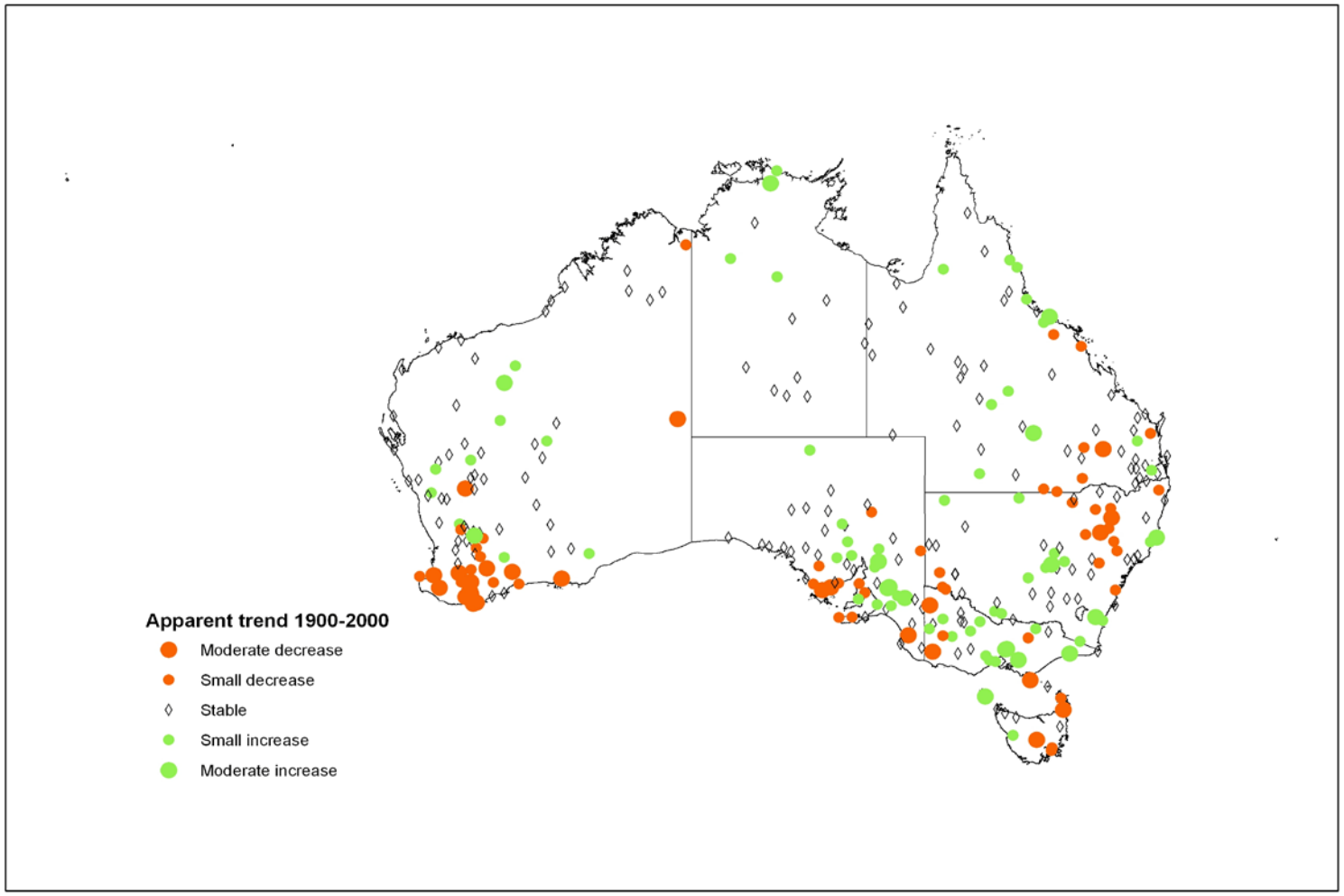
Consider a winter wheat growing season (June, July, August):

***Mean rainfall*: 125 mm for the winter months**

***Variability*: By how much does that mean vary? (e.g., 3 SDs gives range from 35 to 185 mm)**

***Reliability*: In how many years out of 10 does at least 25 mm of rainfall in <u>each</u> of June, July and August?**

Observed Changes in Rainfall Reliability



Source: G. Laughlin, BRS

From Principles to Practice:
National Approaches to Managing Biodiversity under Climate Change in Australia

Will Steffen, Andrew Burbidge, Lesley Hughes, Roger Kitching, David Lindenmayer, Warren Musgrave, Mark Stafford Smith and Patricia Werner

Photo: D. Lindenmayer

Current stressors on biodiversity

Land clearing and fragmentation, changed land uses

Introduction of new species

Altered disturbance regimes

Redistribution of water resources; changes in nutrient capital

Direct removal of species through hunting and fishing

Mineral extraction

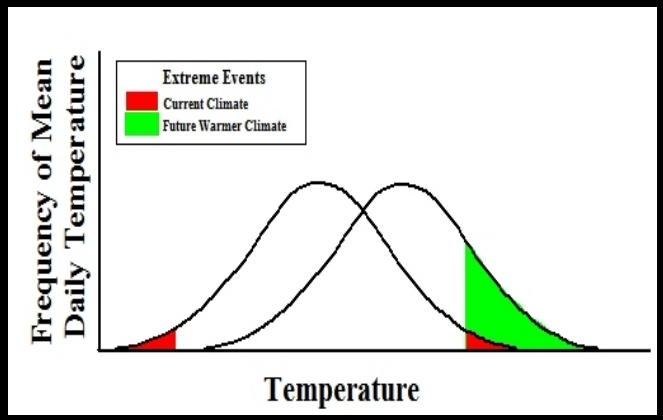
Dealing with Ecological Complexity

Indirect effects rule!!

Averages v. extremes

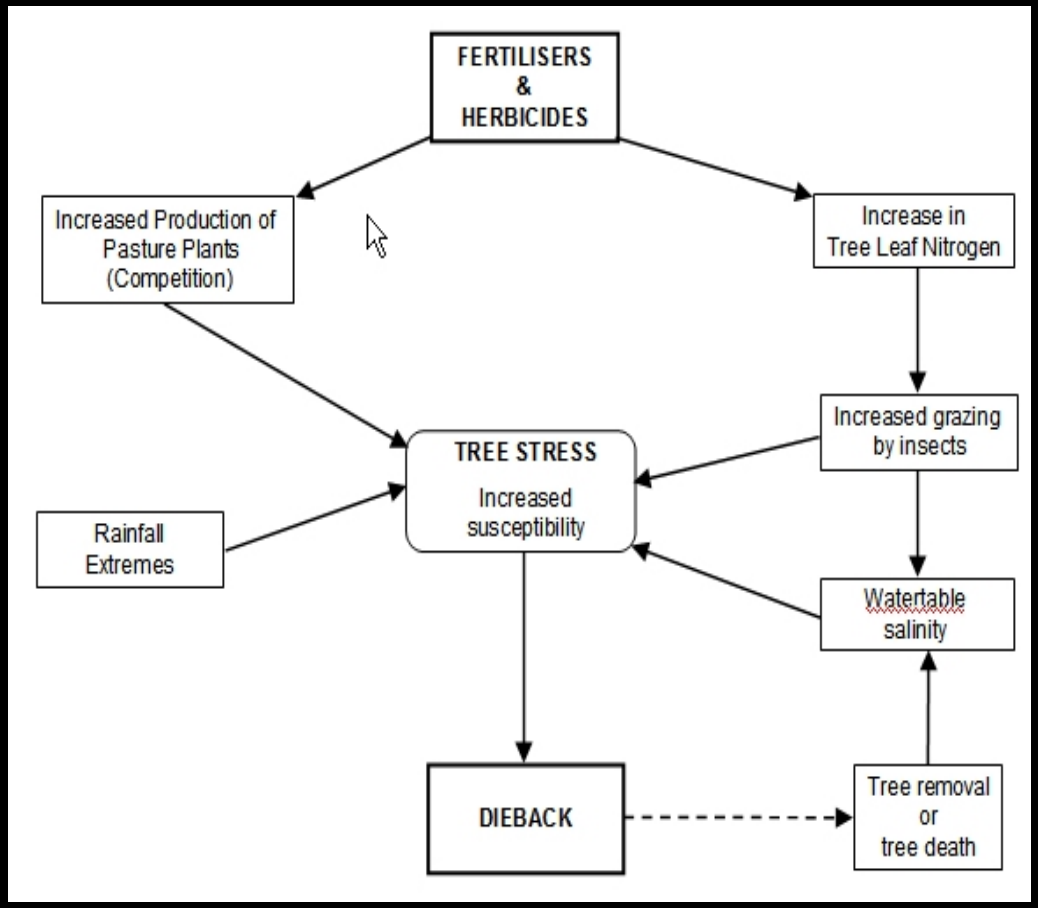
Synergistic effects & surprises

Nonlinearities, time lags, thresholds
feedbacks, rapid transformations



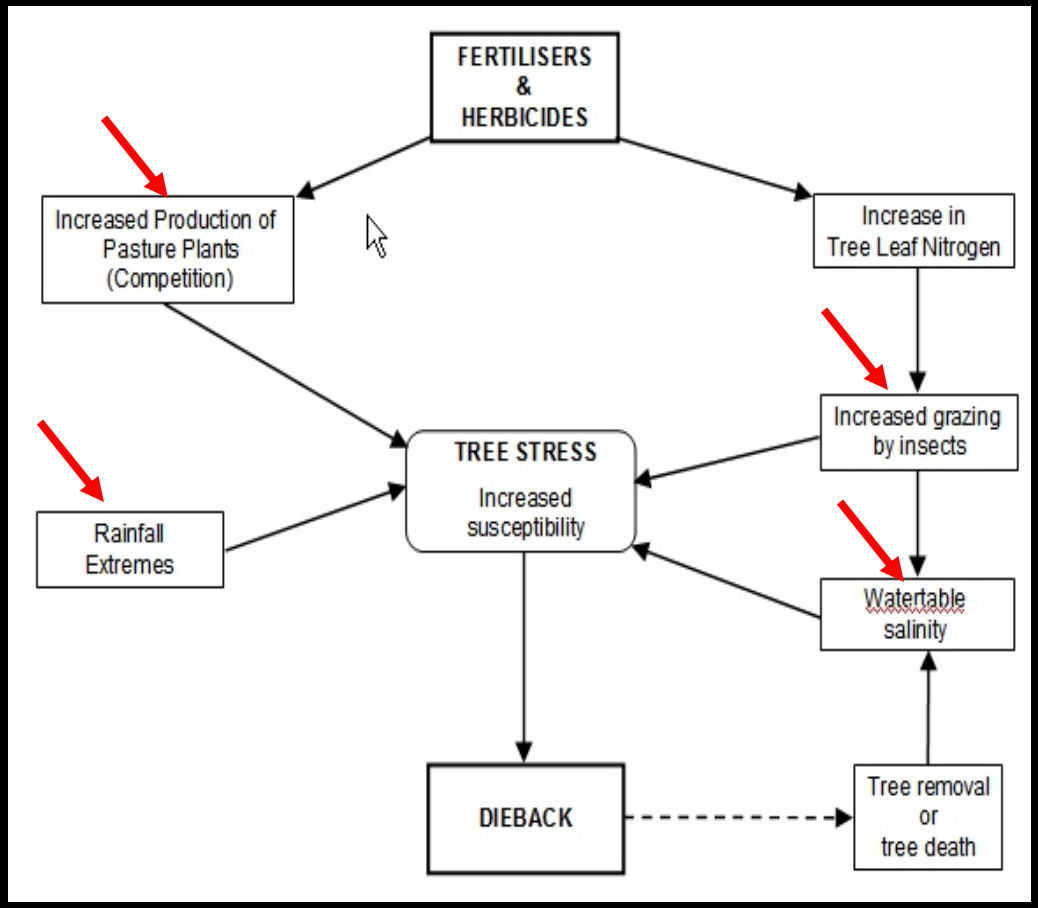
Dealing with ecological complexity implies that most (>90%) of research on “climate change and biodiversity” has little relevance for adaptation, or for policy and management in general.

An Ecological Cascade



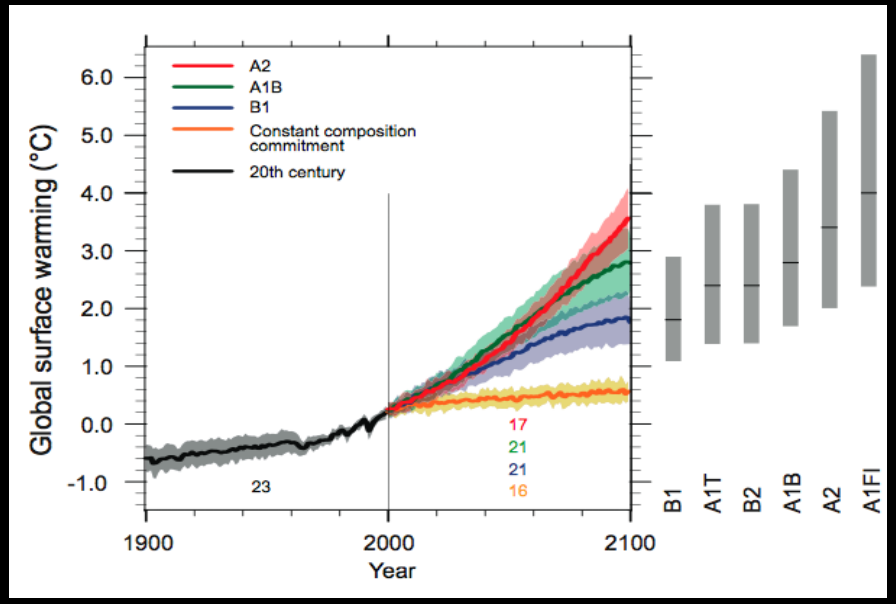
Dieback of pasture trees

An Ecological Cascade

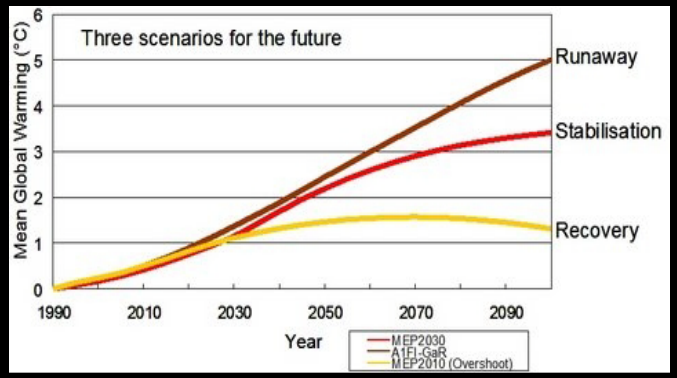


Dieback of pasture trees

Implications of accelerating climate change



IPCC projections



Stylised projections used in BVA

New perspectives and goals

Potential magnitude and rate of change is beyond anything fully modern humans or the ecosystems from which we derive essential services have experienced

In Australia, we cannot go back to a 1770 world. Expect the unexpected - novel ecosystems and species in different places.

Develop policy and management for change - build fluid landscapes and agile managers; aim to maximise diversity in a multi-scale and dynamic sense (not maintain species in existing locations). Emphasis on maintenance of well functioning ecosystems and critical ecosystem services.

Building resilience, facilitating transformation

Maintain well-functioning ecosystems

Protect a representative array of ecosystems

Remove or minimise existing stressors

Build appropriate connectivity

Identify and protect refugia

Pro-active interventions

Eco-engineering

Genetic preservation

Flexible policy and management approaches

Reconsider management objectives

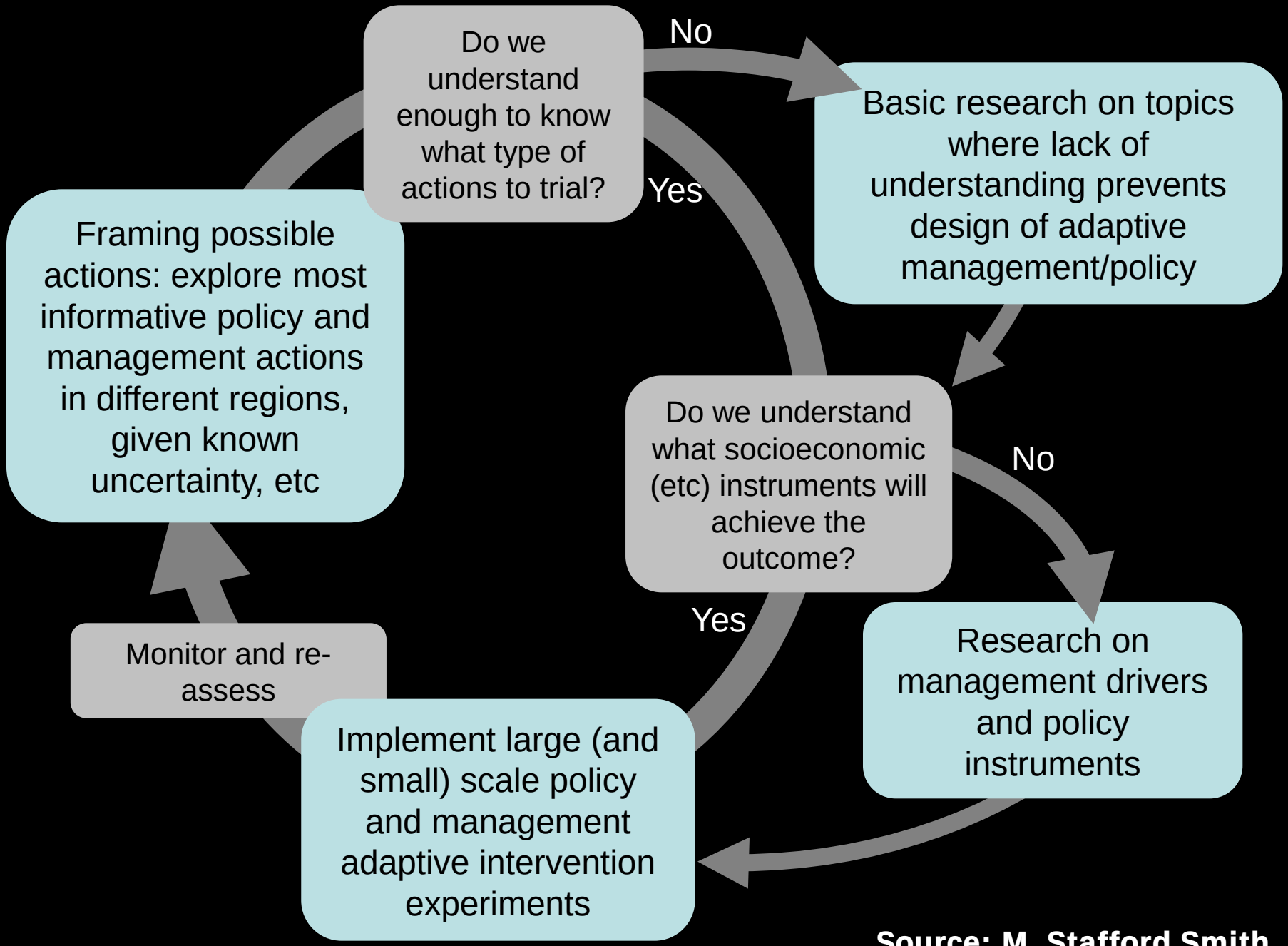
Consensus-building in society

Uncertainty about future climate projections is no excuse for delay

Greater focus on risk assessments

Active adaptive management

Opportunities from mitigation



Source: M. Stafford Smith

Key Messages

Build resilience and facilitate transformation

The most effective adaptation approach is to increase resilience of ecosystems and to "make space for species and ecosystems to self-adjust" as climate shifts. Management strategies include removing or minimising existing stressors and managing for appropriate connectivity.

Strengthen the conservation effort at all levels

Dealing with the climate change challenge effectively will require at least an order-of-magnitude increase in the conservation effort across the board - investment in natural capital; creating innovative, agile governance systems; generating widespread public support; enhancing off-reserve conservation, implementing regional integrated response strategies.

Meet the mitigation challenge

Australia's biodiversity has only so much capacity to adapt to climate change, and we are approaching that limit. Therefore, strong emissions mitigation action globally and in Australia is vital – but this must be carried out in ways that deliver both adaptation and mitigation benefits

A vulnerability approach to impacts and adaptation

Dagmar Schröter

Kennedy School of Government, Harvard University
and
Potsdam Institute for Climate Impact Research


food production


slope stability


fire prevention


water storage


fibre production


biodiversity

Ecosystem services

- Ecosystems provide **services** that sustain and fulfill human life (Daily 1997, Daily and Ellison 2002)
- Ecosystem services are **vital links** between humans and the environment (*Ecosystems and Human Well-Being*, Millennium Ecosystem Assessment 2003)
- **Potential impacts:** Global change changes ecosystem service supply.


pollination


fodder production


carbon sequestration


flood protection


tourist attraction


recreation


stabilising micro-climate

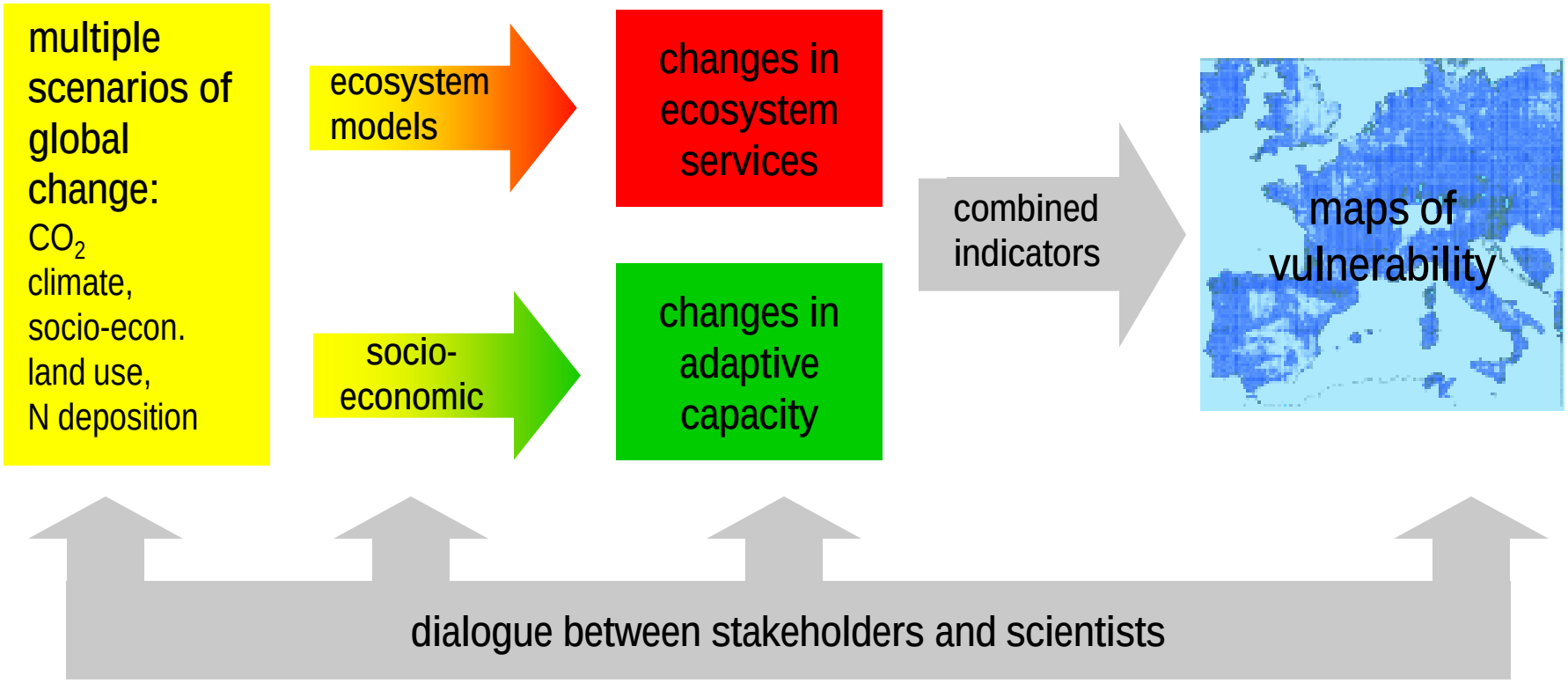

game reserve


shelter for life stock


beauty

European Vulnerability Study

Methodology



Schröter et al. 2004. www.pik-potsdam.de/ATEAM

Water

- 30-year-mean runoff is expected to decrease in Southern Europe (by up to 30%) and increases in Northern Europe (by up to 10%) by the 2030s
- Both more severe droughts and more extreme floods are expected
- With climate change 30-75 million more people will live under severely limited water resources by 2080 (I.e. less than 1700 m^3 per capita and year)
- Runoff seasonality changes in Northern and alpine catchments
  - loss of water storing snow cover
  - Monthly peak flow shifts to earlier date and decreases
  - reduction in summer runoff

Zierl et al. 2005 (in review). *Water Resources Research*.
Wilson and Arnell 2005. (in preparation)
Arnell et al. 2004ab. *Global Environmental Change.*
Schröter et al. 2005 (accepted). In: *Ecology without Frontiers.* BES.

Adaptive capacity

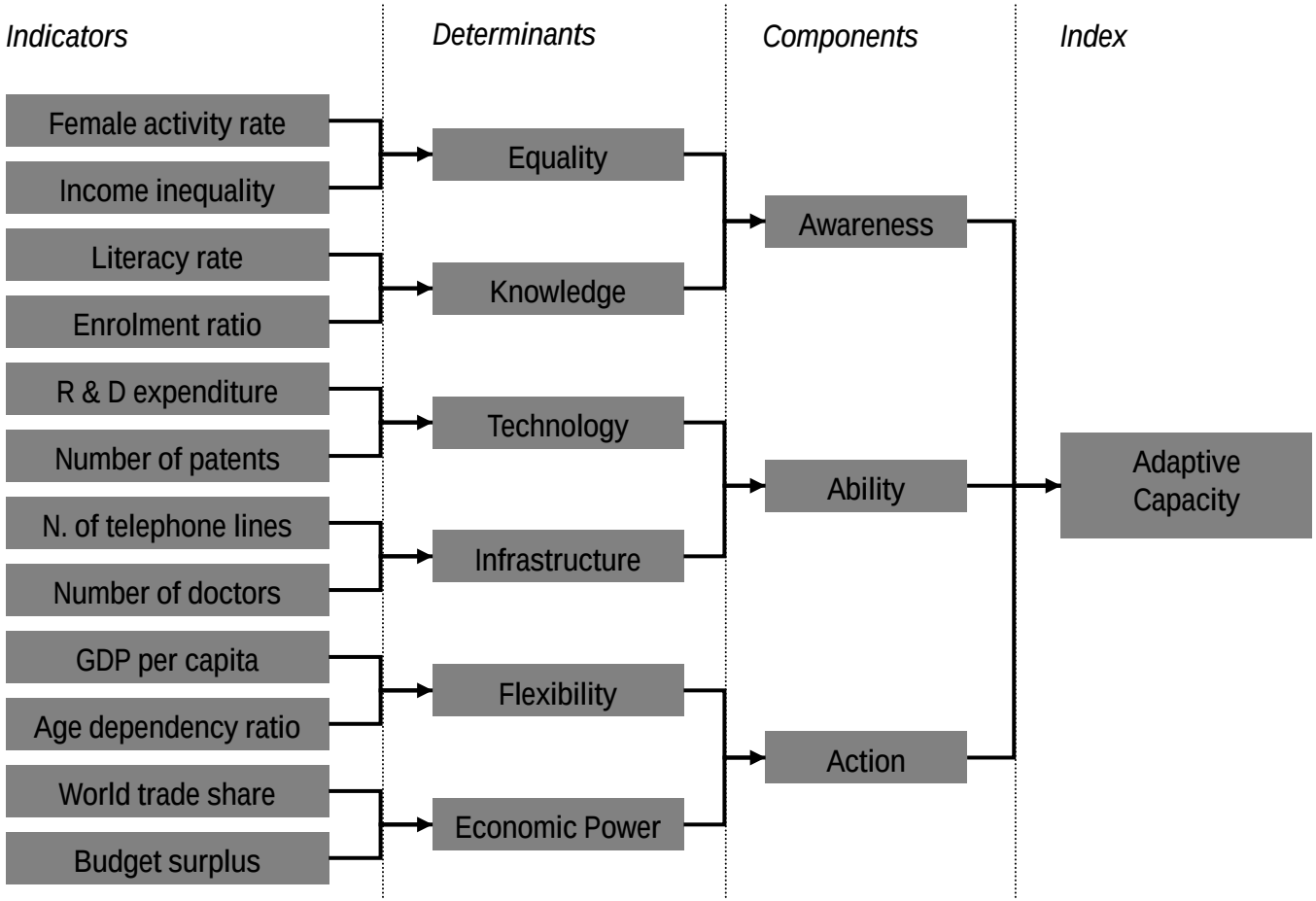
'the capacity to innovate' (Paul Raskin)

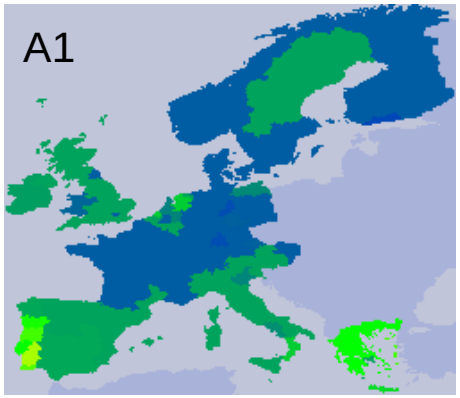
- Knowledge
  - Awareness
  - Understanding
- Will
  - Trust
  - Motivation
  - Values
  - Urgency
- Power
  - Freedom
  - Equity
  - Technology
  - Wealth

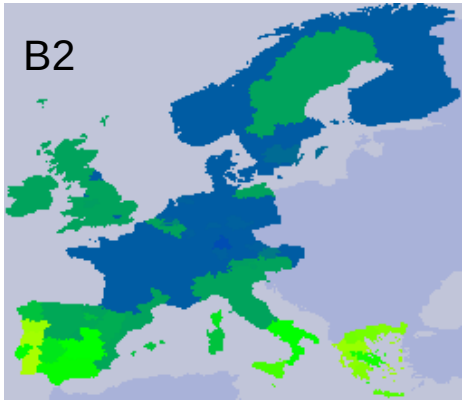
Countries
Provinces
Cities
Villages
Sectors
Groups
Individuals

Adaptive Capacity

'the ability to implement planned adaptation measures' (based on IPCC TAR)







Klein et al., in prep.
Schröter et al. 2003. http://sedac.ciesin.columbia.edu/openmtg/

Stakeholder Dialogue










Who were our stakeholders?

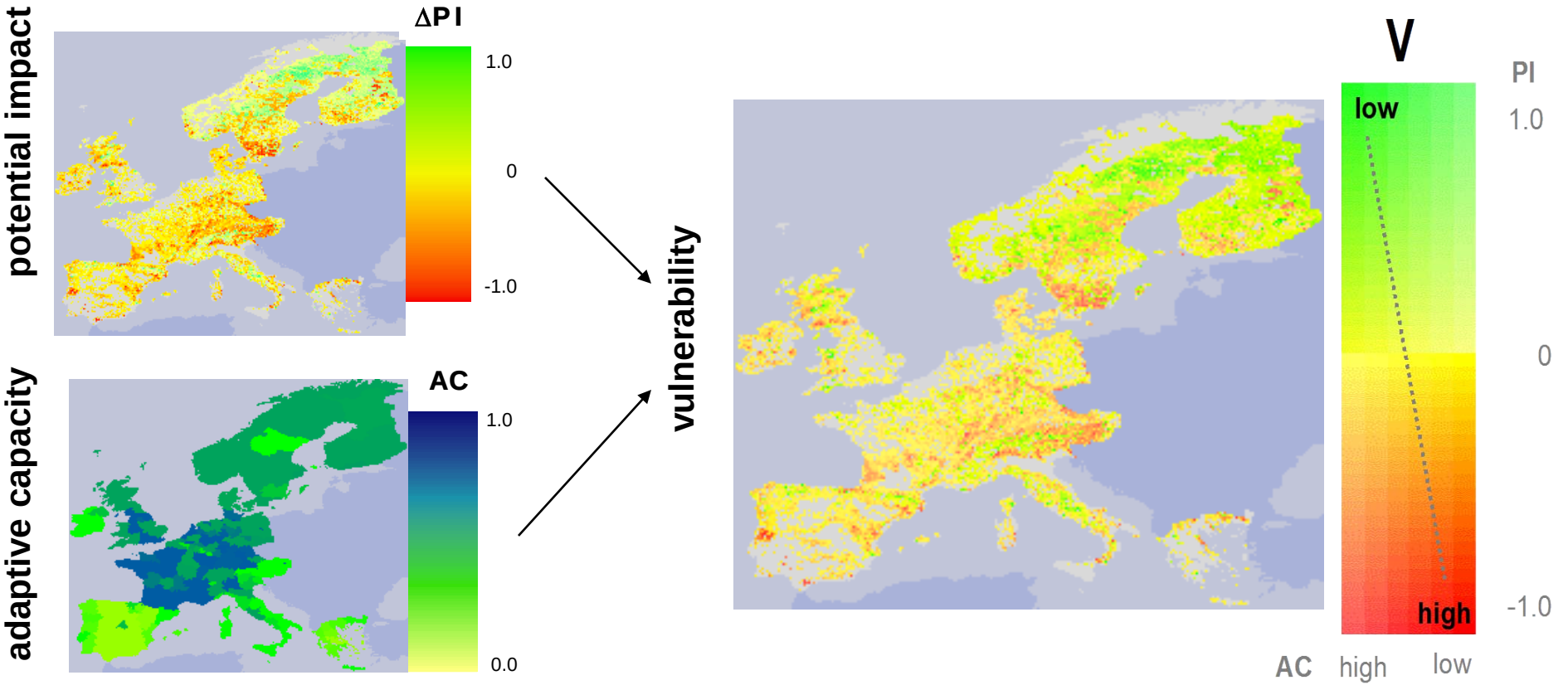
- **Private sector**: farmers, land owners, agricultural association, hydropower and bioenergy producers, foresters, paper industry, winter tourism enterprises, tourism consultants, and more
- **Non-governmental organisations**: Nature conservation (e.g. RSPB), Bioenergy promoters
- **Policy makers and governmental organisations**:
  - Federal environmental agencies
  - EU directorates
  - UNFCCC
  - European Environmental Agency
  - German Foreign Ministry

Integration: Vulnerability

2080A1

wood production

Visual overlay



V = f(PI, AC)

A relationship that is not specified beyond *high PI* and *low AC* → *high V*, etc...

Lessons from the case studies....1

Framework for research

The focus should be on the sector/system being affected by climate change, from the perspective of its performance. Climate change should be viewed as an additional, interacting stressor.

Stakeholder dialogue

Two-way interaction with stakeholders is crucial throughout the entire research process, from the formulation of questions to the application of results (and at several points in between).

Climate information

The nature and level of detail of climate information needed should arise from the stakeholder dialogue and formulation of questions. Detailed downscaling of GCM (climate model) outputs is often not very useful. GCM-based scenarios of future climate change is usually most useful to underpin sensitivity analyses, not only to estimate future impacts.

Lessons from the case studies....2

Adaptive capacity

The concept of adaptive capacity is crucial to adaptation research and its application to real-world situations. Adaptive capacity is largely determined by socio-economic and cultural factors, and thus a wide range of “non-traditional” disciplines from the social sciences, economics and humanities need to be engaged in the research.

Complexity and uncertainty

Adaptation research must embrace complexity and uncertainty as unavoidable and, indeed, integral aspects of the work. Concepts such as resilience and risk management offer robust approaches to deal with complexity and uncertainty.

Active adaptive management

Active adaptive management is a powerful approach to implement adaptation activities. It is an iterative approach built around explicit, experimentally based development of plausible management options. Such an adaptive, cyclical approach needs high quality information based on monitoring and experimentation.