Human Choice and Climate Change

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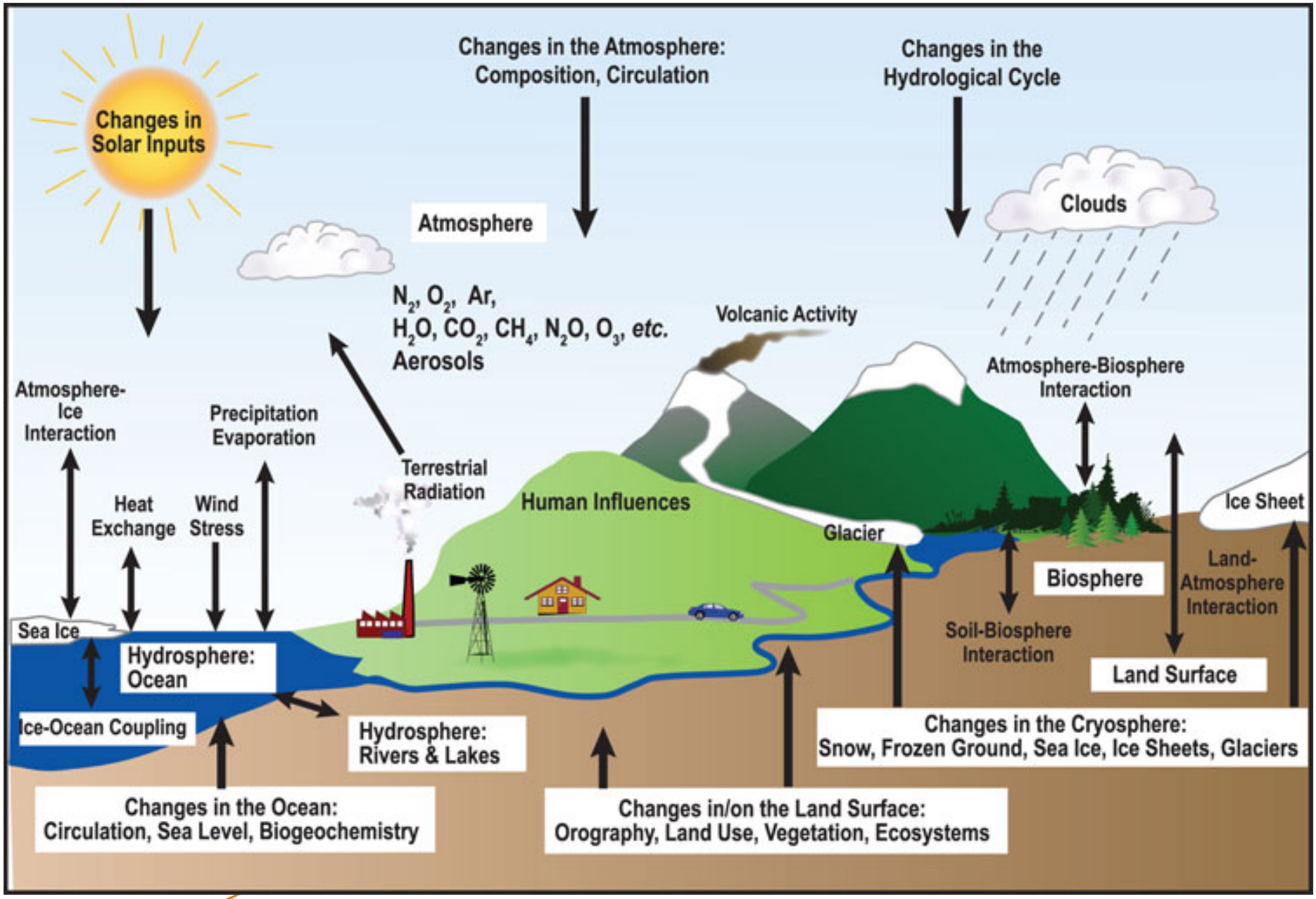
Overview

- Overview of human dimensions of climate change
- Driving forces, including scenario-based analysis
- Socioeconomic vulnerability
- Reflections on responses, risk, and the role of science



Source: Southwest Climate Network

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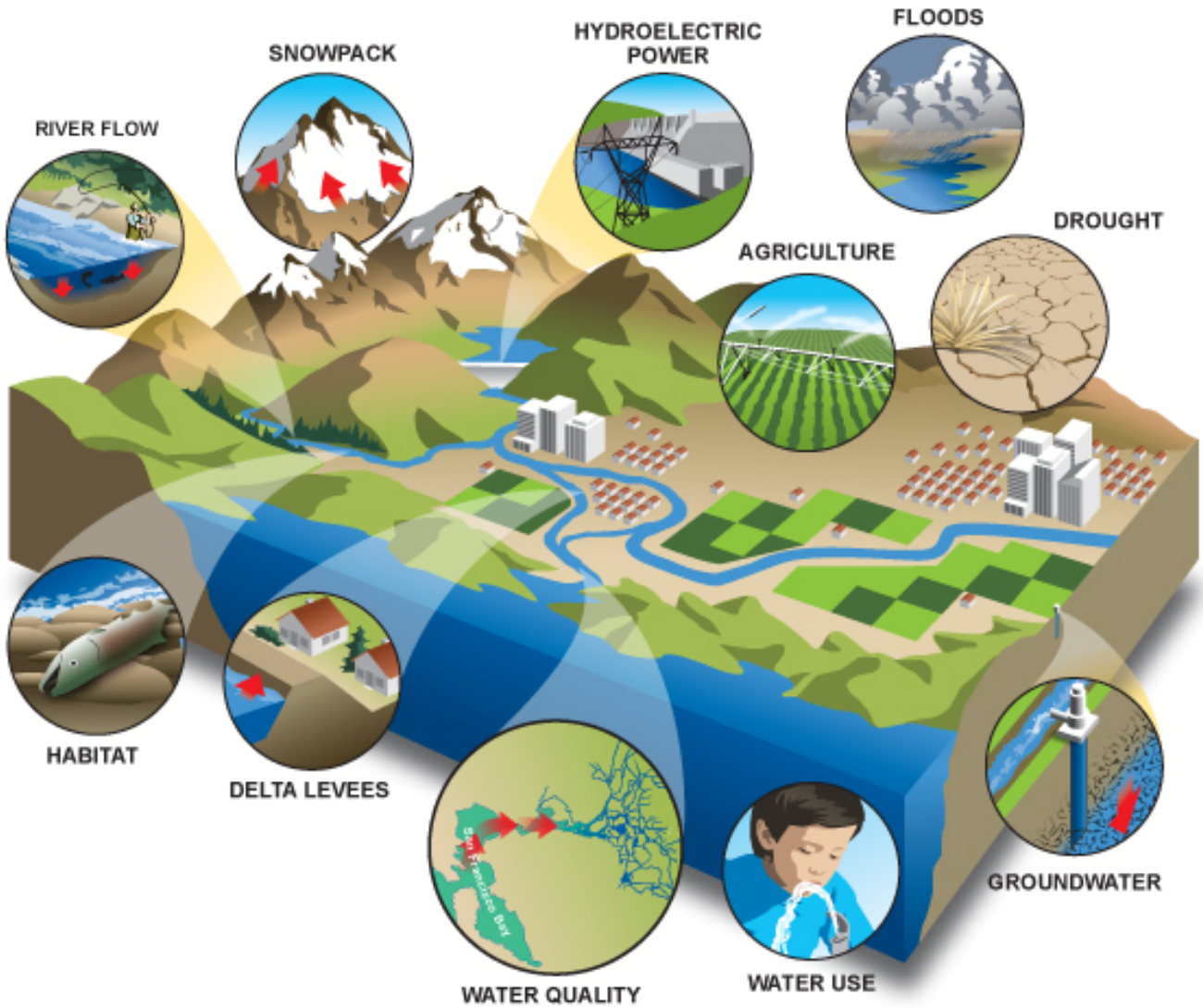

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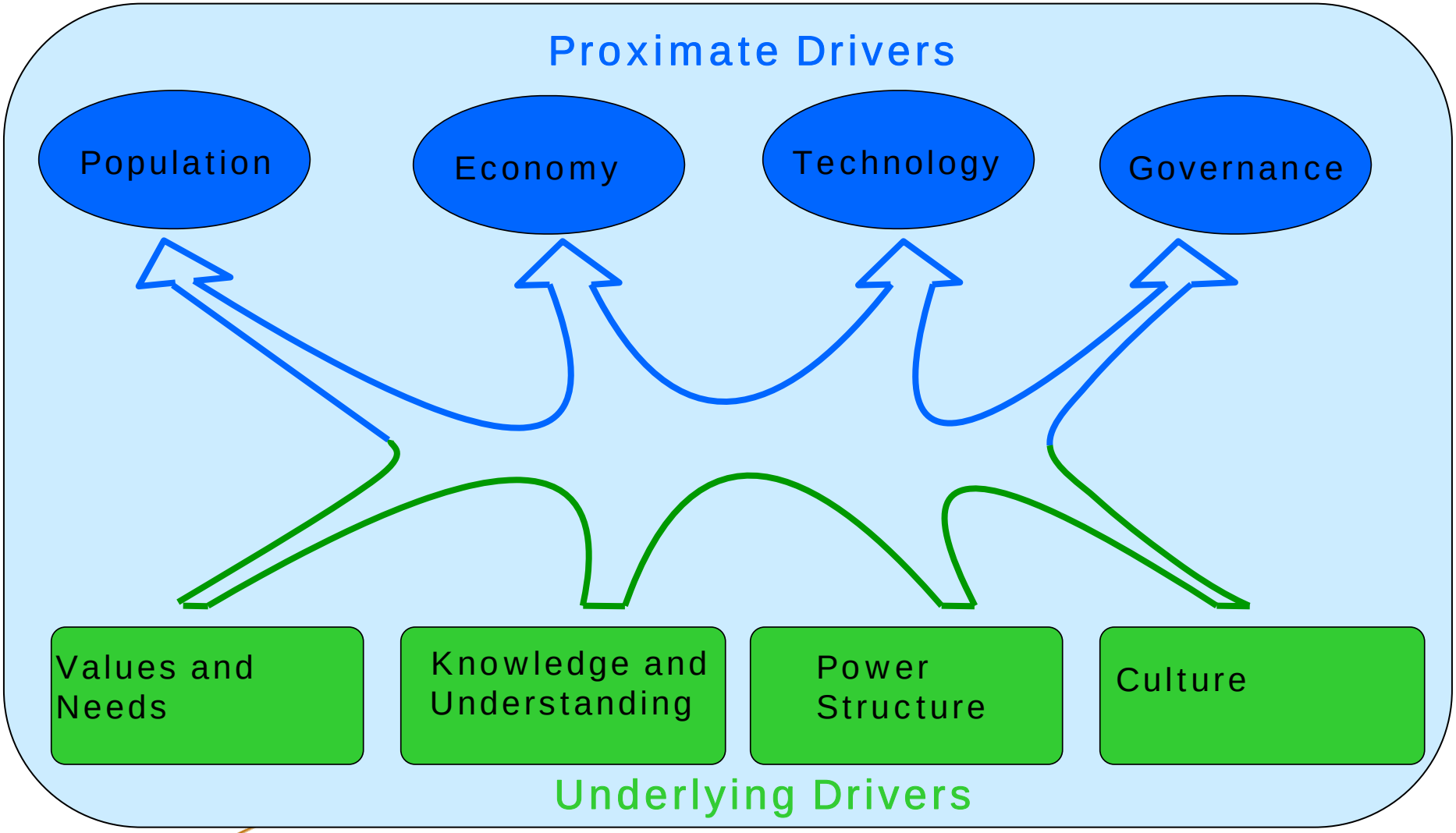
“Human Dimensions”

- Study of human traits and their implications for environmental management
  1. Drivers (needs/wants and behaviors);
  2. Vulnerabilities (interrelated natural and socioeconomic); and
  3. Responses
- Human Dimensions ➔ Human Choices

Example Topics

- Policy design (e.g., carbon tax vs. cap and trade)
- Demographics
- Economics (valuation, development, trade, commodities)
- International relations and agreements
- Socioeconomic scenarios
- Industrial ecology
- Urbanization
- Risk assessment and management
- Integrated Assessment Modeling
- Vulnerability and resilience
- Community resource management
- Livelihoods
- Cultural practices
- Attitudes and public acceptance
- Design of decision support tools
- Stakeholder engagement
- …

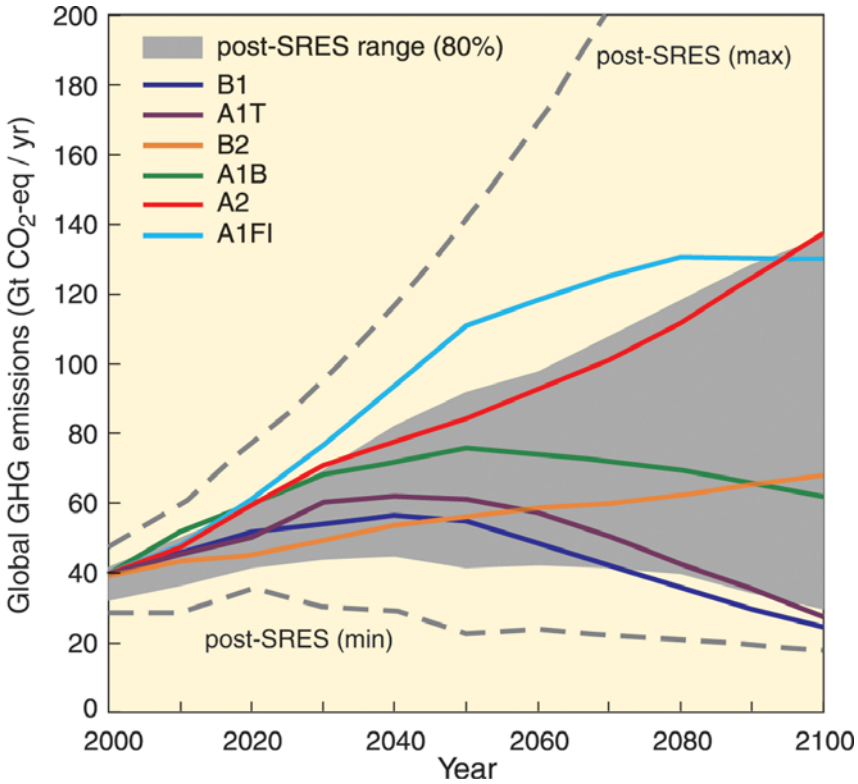
Driving Forces



Source: Paul Raskin, 2002; Nebojsa Nakicenovic, 2009

Scenarios

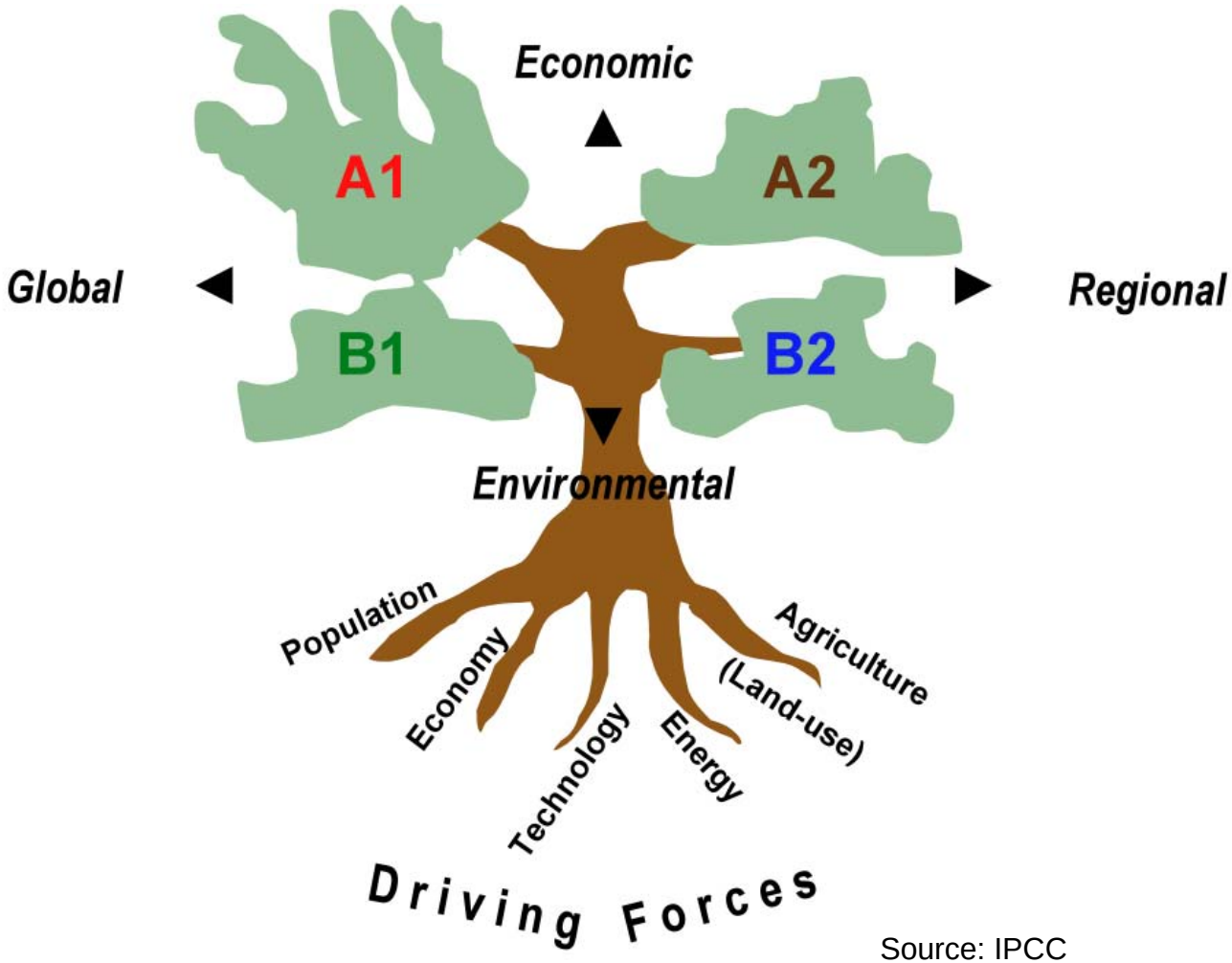
- Plausible descriptions of how aspects of the future might unfold
- Types in climate research:
  - Socio-economic
  - Emissions
  - Climate
  - Environmental
  - Vulnerability



Source: IPCC AR4

- Purpose: analyze uncertainties & strategies robust to range of futures. NOT prediction.

Schematic Illustration of Scenario Formulations



Source: IPCC

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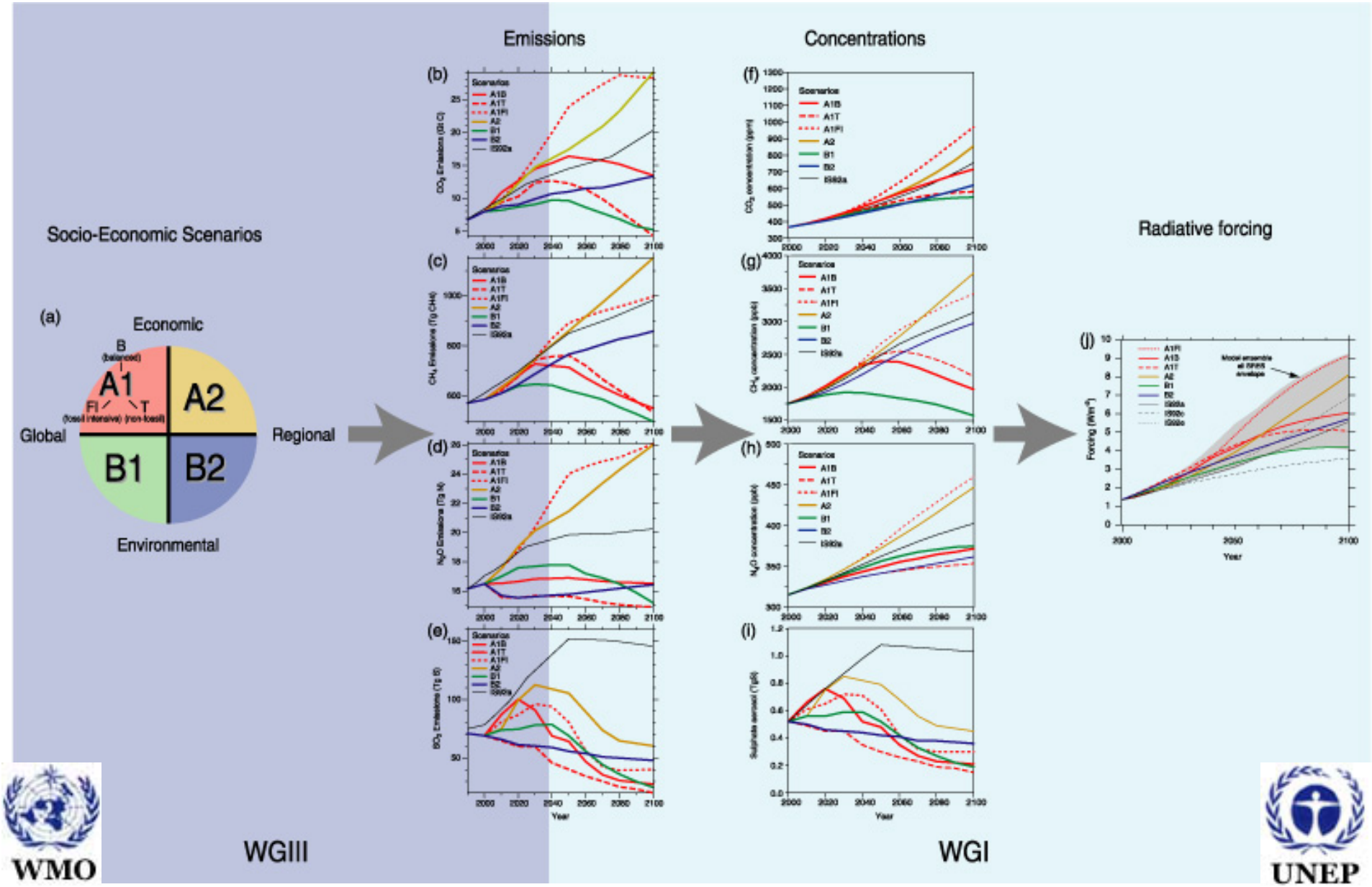

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

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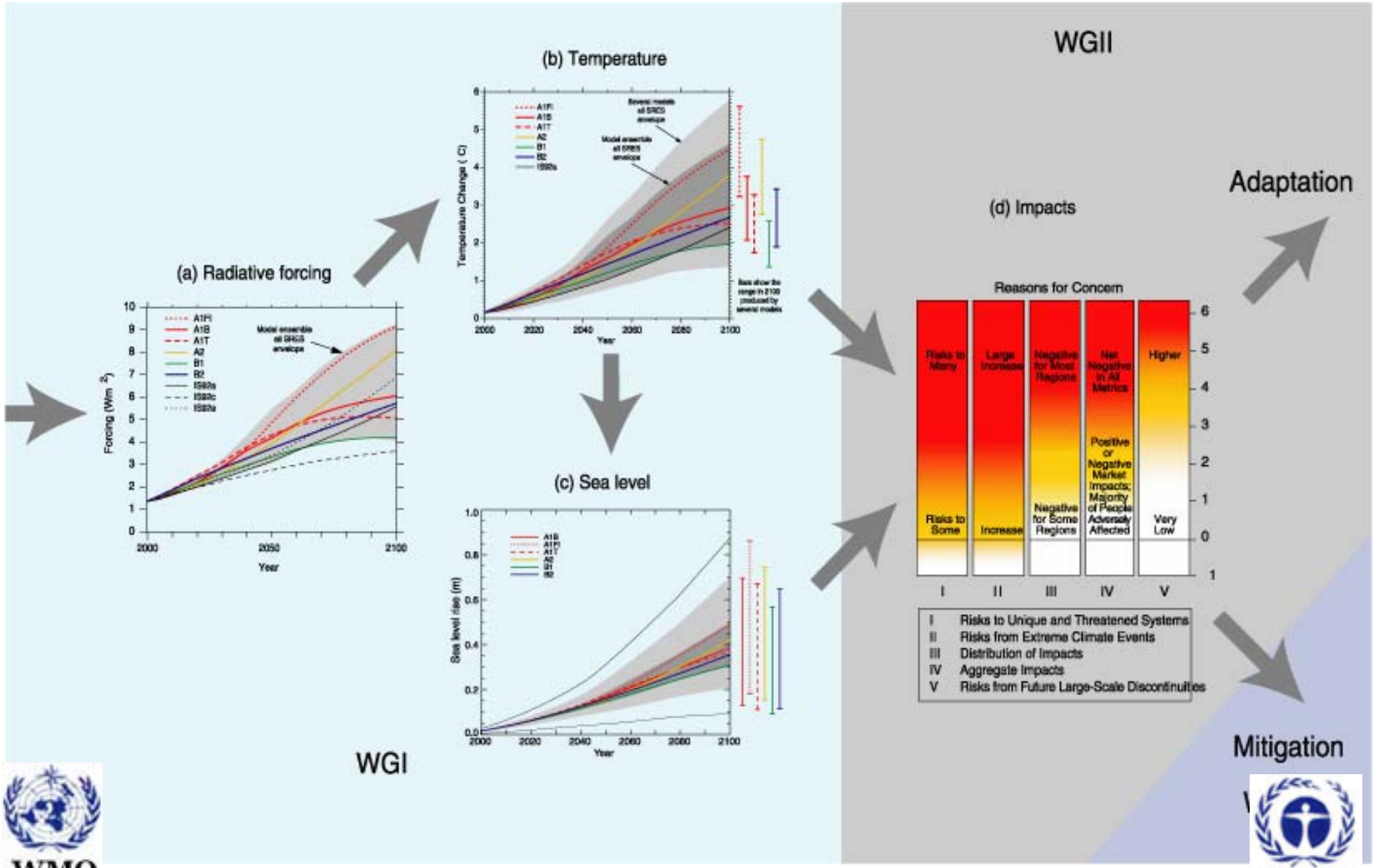

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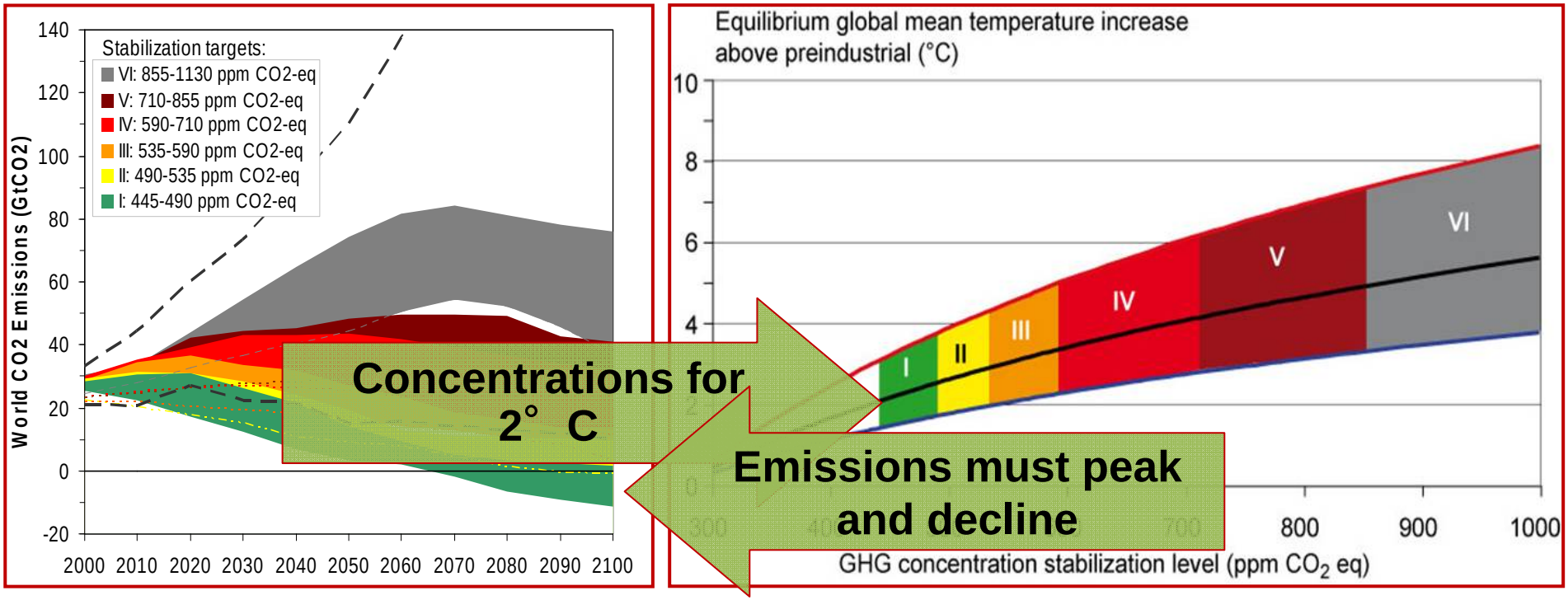
“Stabilization” Requires Unprecedented Emissions Reductions

There is little room for emissions growth if we are to stay below 2ºC



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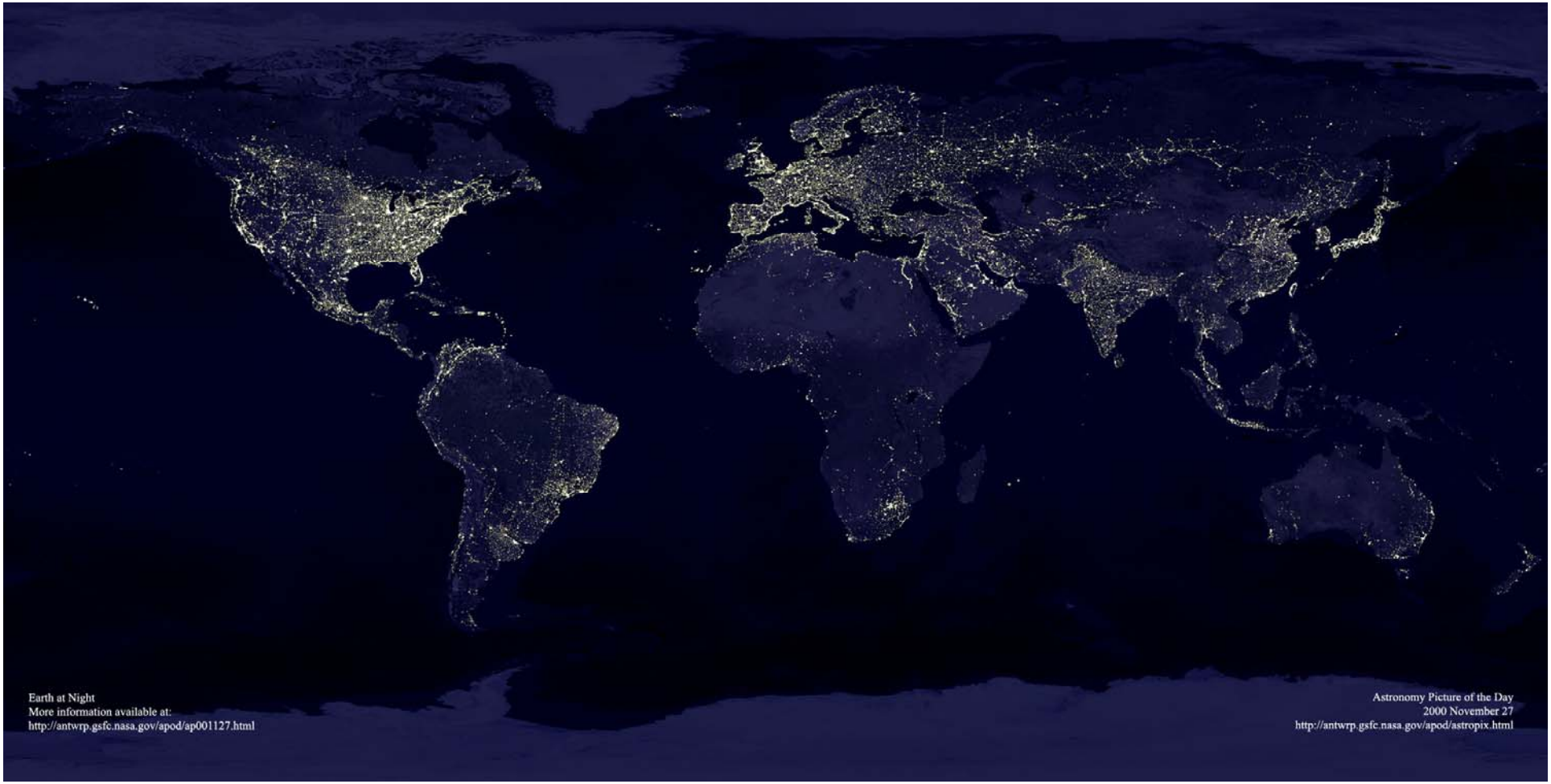
EARTH SYSTEM – HUMAN INTERACTIONS

Energy Use as Seen from Space at Night



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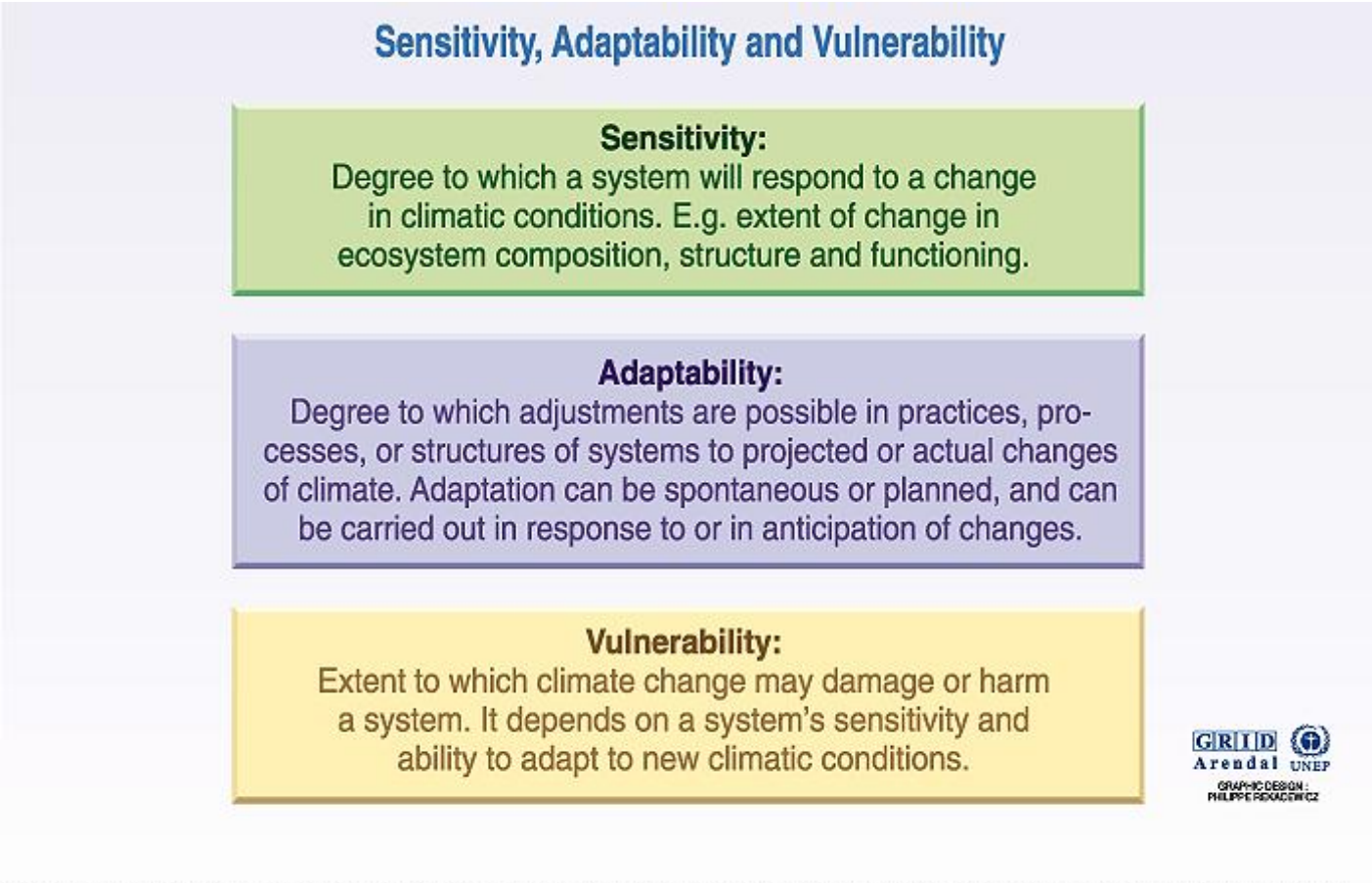
Vulnerability of Natural Resources and Human Systems



Source: Climate change 1995, Impacts, adaptations and mitigation of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

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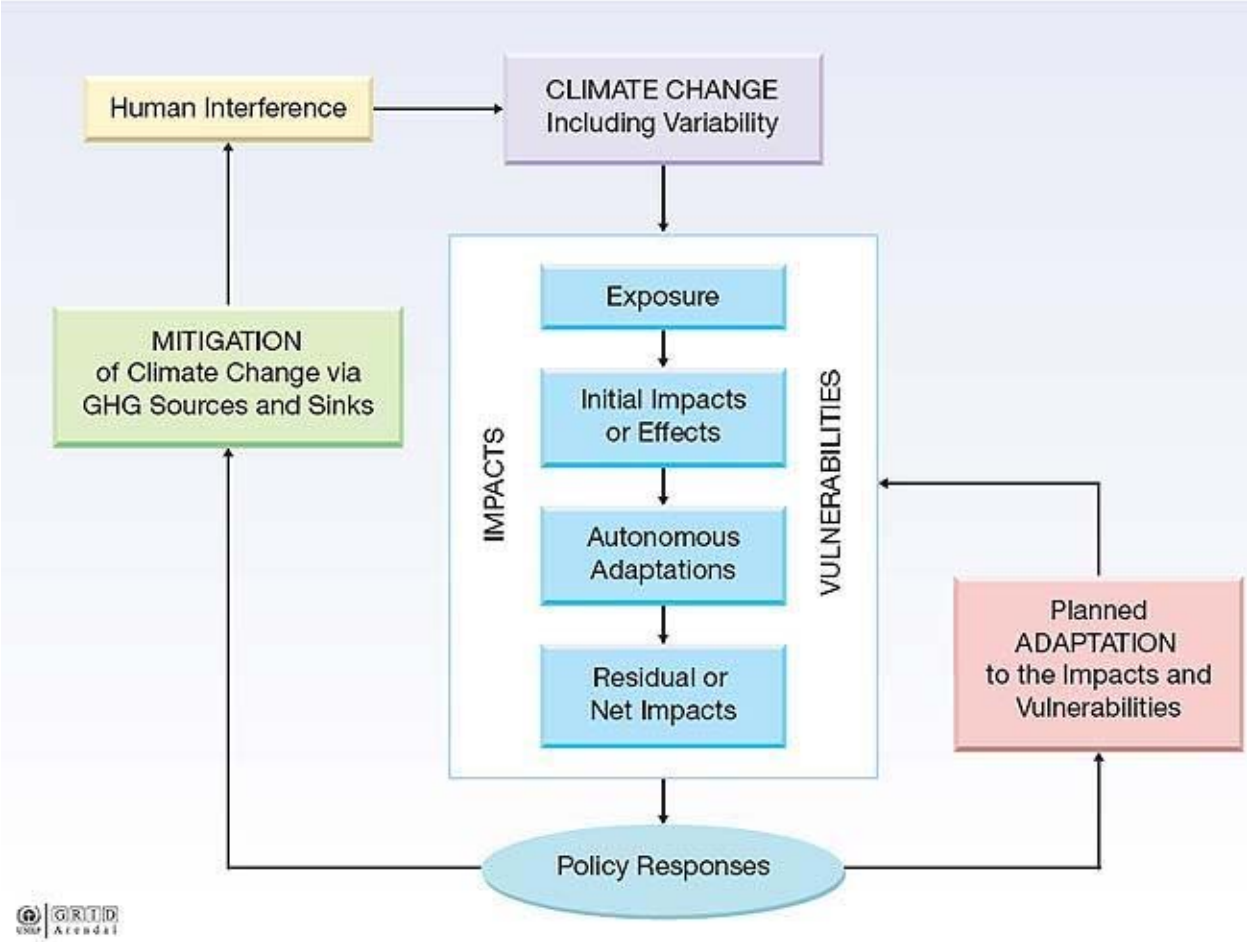
Vulnerability: Causal Influences



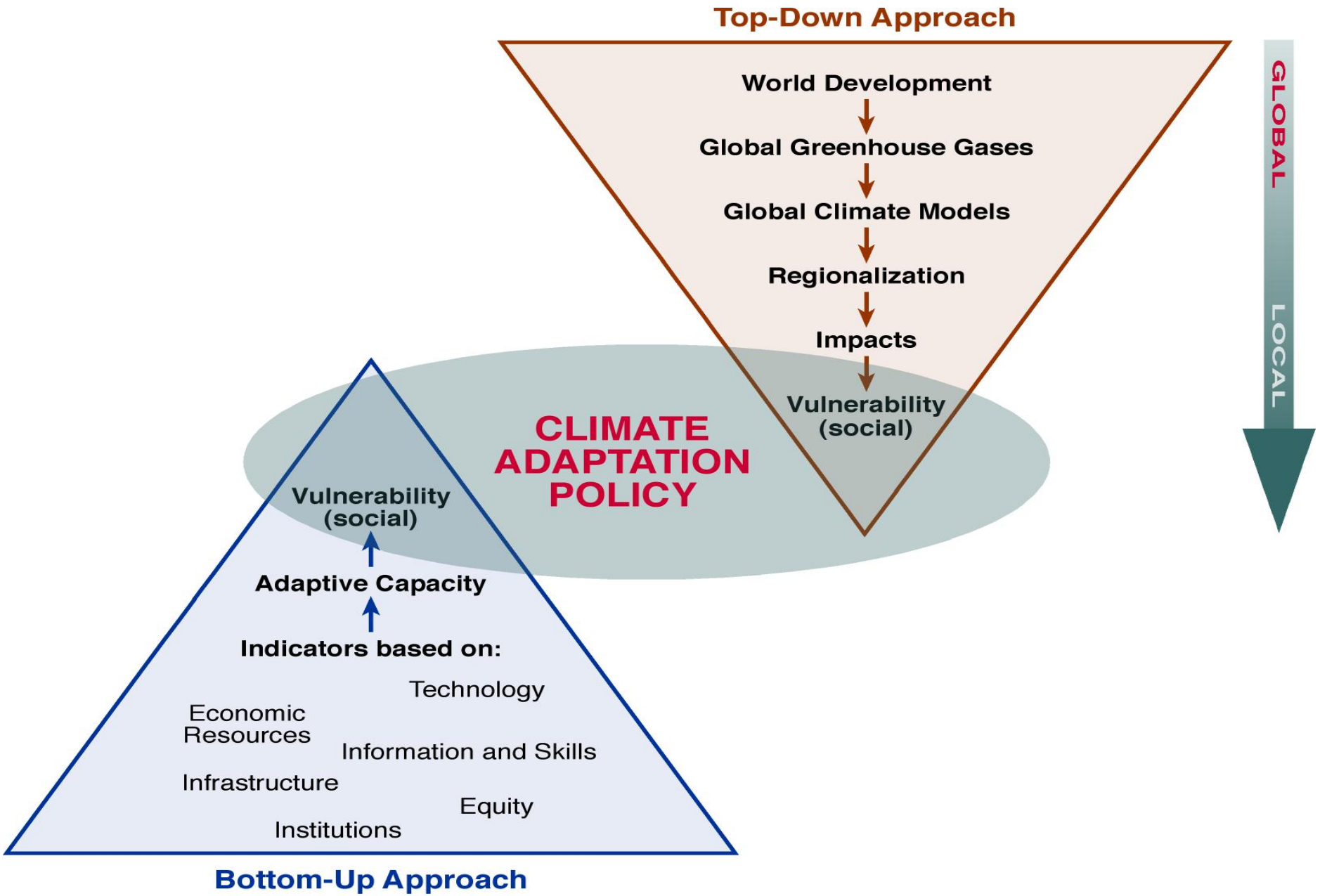
CLIMATE CHANGE

Sensitivity, Adaptability, and Vulnerability

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Climate-related stimuli encompass all the elements of climate change, including mean climate characteristics, climate variability, and the frequency and magnitude of extremes. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

Adaptive capacity is the ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.



Source: Dessai and Hulme (2003)

“Landscapes” Involve People

- People are already (mal)adapting
- Give people a stake in benefitting from adaptation
- Payment for ecosystem services
- Biodigesters for local energy to reduce deforestation

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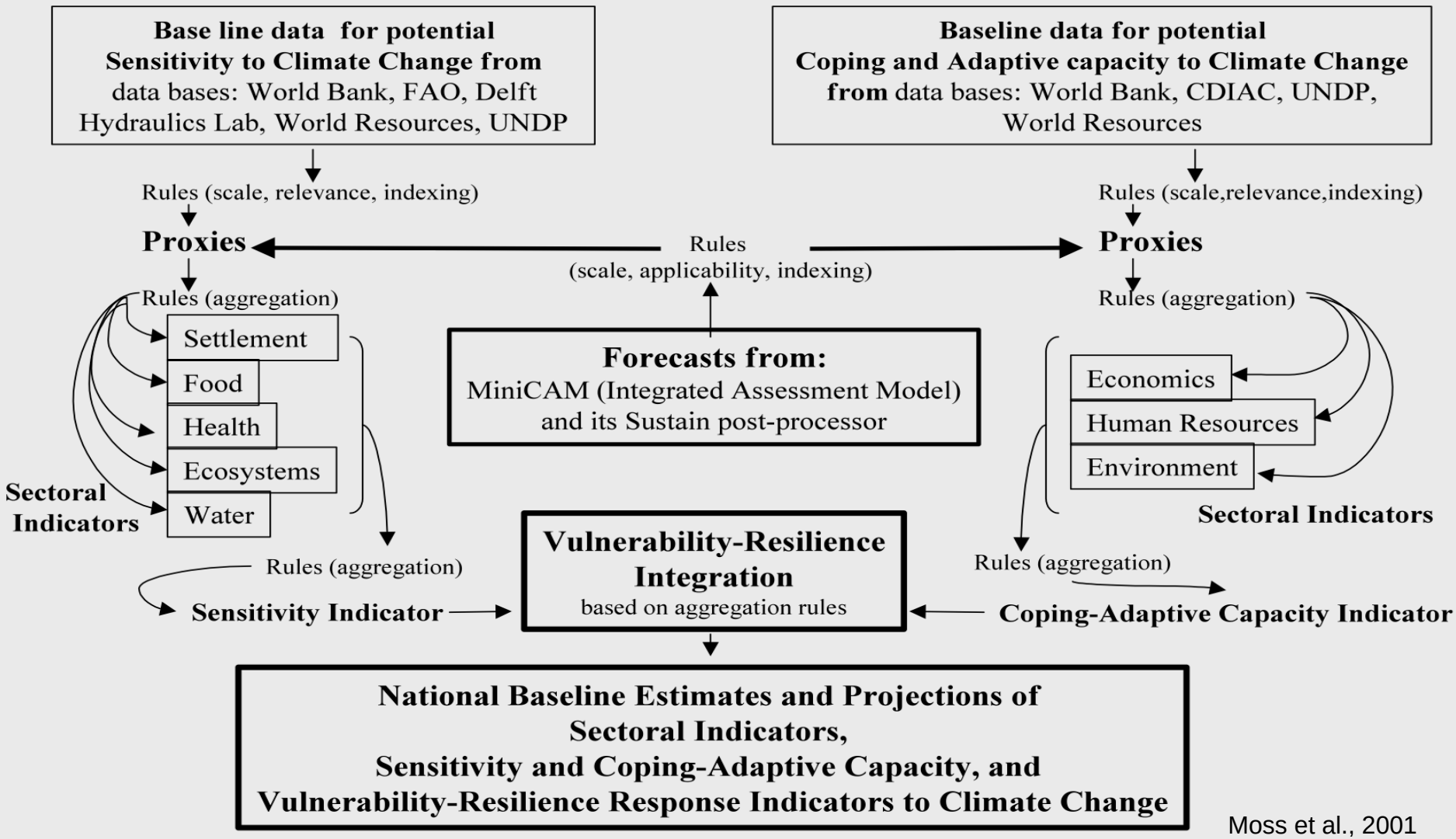
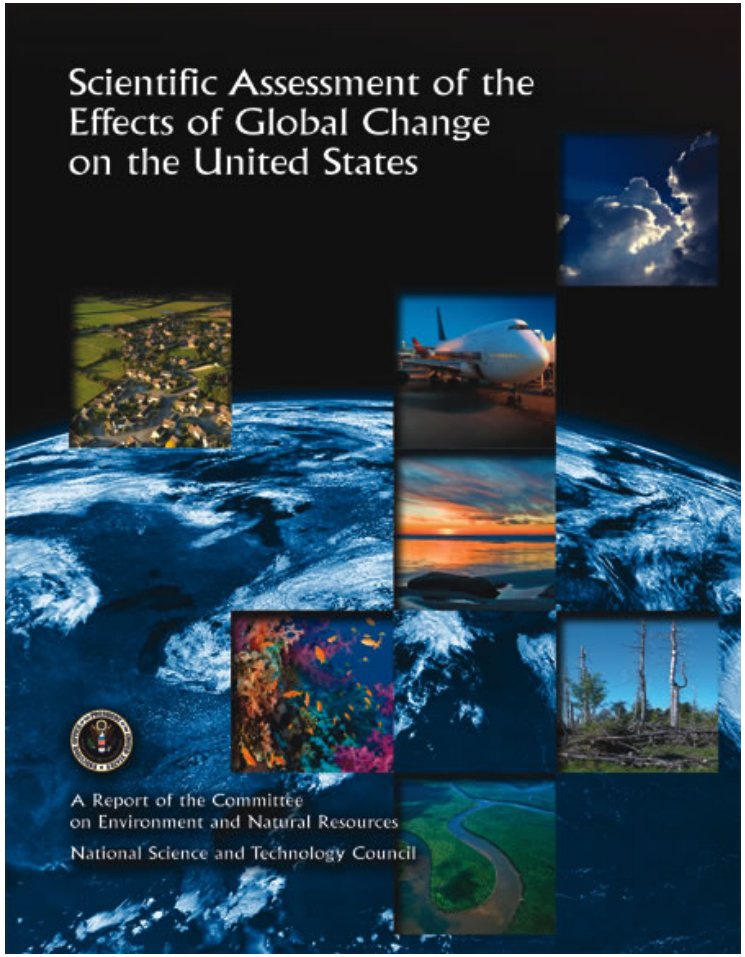
Quantifying Vulnerability and Resilience to Climate Change



Moss et al., 2001

Global Climate Change Impacts in the United States



- Produced by USGCRP
- Integrates SAP findings
- Key Findings:
  - Climate change is unequivocal and primarily human induced
  - Climate change is already having visible impacts
  - Risks depend on choices

Key Finding: **Widespread climate-related impacts are occurring now and are expected to increase**

Sea Ice and Permafrost

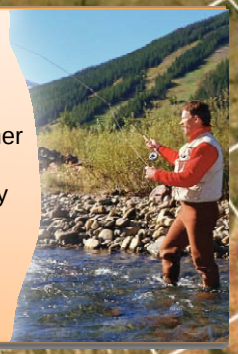
Risks and costs in Alaska increase as thawing of permafrost damages roads, buildings, and forests, and declining sea ice increases coastal erosion and threatens the existence of some communities.

Forests

Forest growth is generally projected to increase in much of the East, but decrease in much of the West as water becomes even scarcer. Major shifts in species are expected, such as maple-beech-birch forests being replaced by oak-hickory in the Northeast. Insect infestations and wildfires are projected to increase as warming progresses.

Coldwater Fish

Salmon, trout, and other coldwater fish will face additional stresses as water temperatures rise and summer streamflows decline. Ecosystems and the tourism and recreation they support will be adversely affected.



Interacting Stresses

Population shifts and development choices are making more Americans vulnerable to climate change impacts. An aging populace, and continued population shifts to the Southeast, Southwest, and coastal cities amplify risks associated with extreme heat, sea-level rise, storm surge, and increasing water scarcity in some regions.

Coral Reefs

Rising water temperatures and ocean acidification threaten coral reefs and the rich ecosystems they support. These and other climate-related impacts on coastal and marine ecosystems will have major implications for tourism and fisheries.

Key Finding: **Widespread climate-related impacts are occurring now and are expected to increase**

Heavy Downpours

More rain is already coming in very heavy events, and this trend is projected to increase across the nation. Such events are harmful to transportation infrastructure, agriculture, water quality, and human health.

Heat Waves

Heat waves will become more frequent and intense, increasing threats to human health and quality of life, especially in cities.

Agriculture

Increasing heat, pests, floods, weeds, and water stress will present increasing challenges f crop and livestock production. ecosystems will be lost.

Coastal Communities

Sea-level rise and storm surge will increase threats to homes and infrastructure including water, sewer, transportation, and communication systems. Many barrier islands and coastal marshes that protect the coastline and support healthy ecosystems will be lost.

Water and Energy

As warming increases competition for water, the energy sector will be strongly affected as power plants require large amounts of water for cooling.

Energy Supply

Warming will decrease demand for heating energy in winter and increase demand for cooling energy in summer. The latter will result in significant increases in electricity use and peak demand in most regions.

Water Supply

Reduced summer runoff, increased winter runoff, and increasing demands will compoun current stresses on water supplies and flood management, especially in the West.

Equity

It's not my Problem!

Source: P. Schultz

Damages will be greatest farthest from the problem's source (the poorest—global equity)

Damages will affect the next and future generations more than today's (intergenerational equity)

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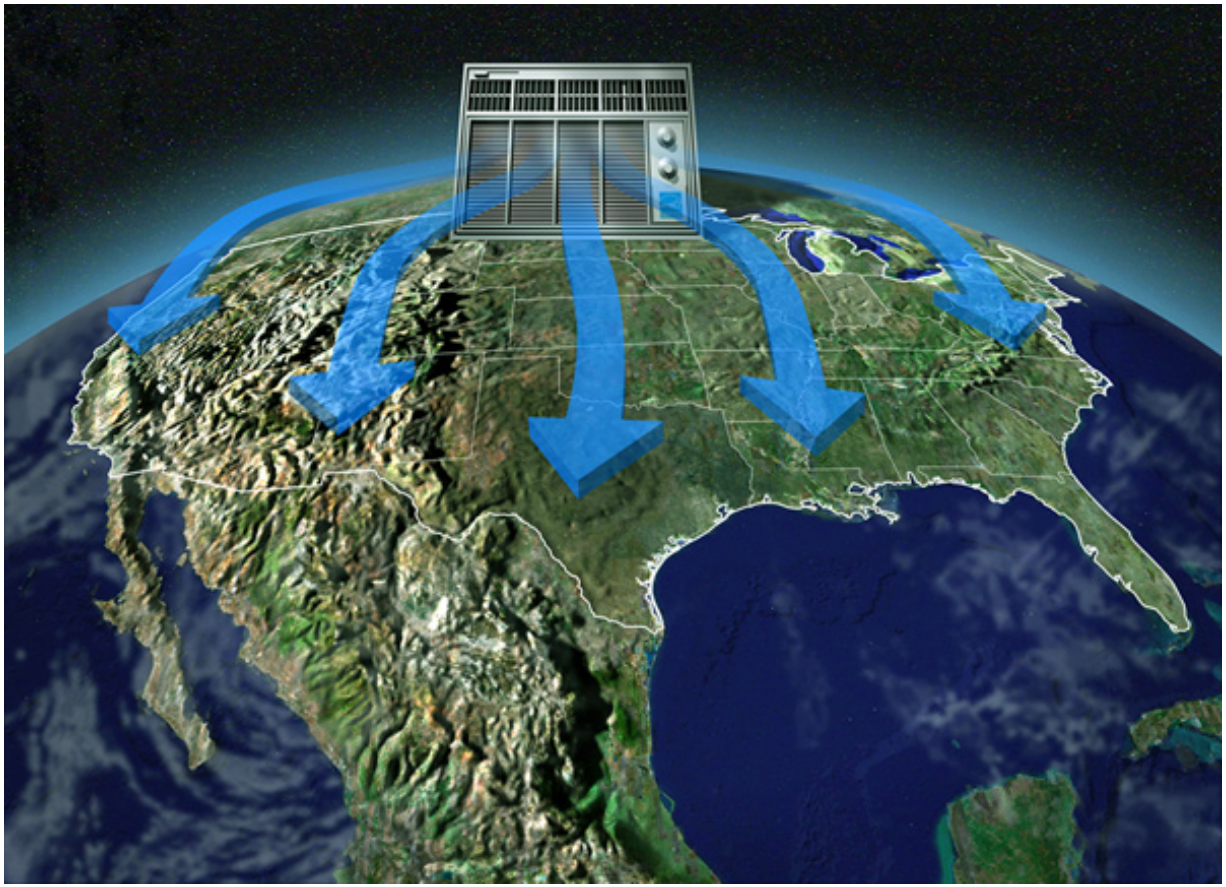
Reflections on Responses, Risk, and the Role of Science



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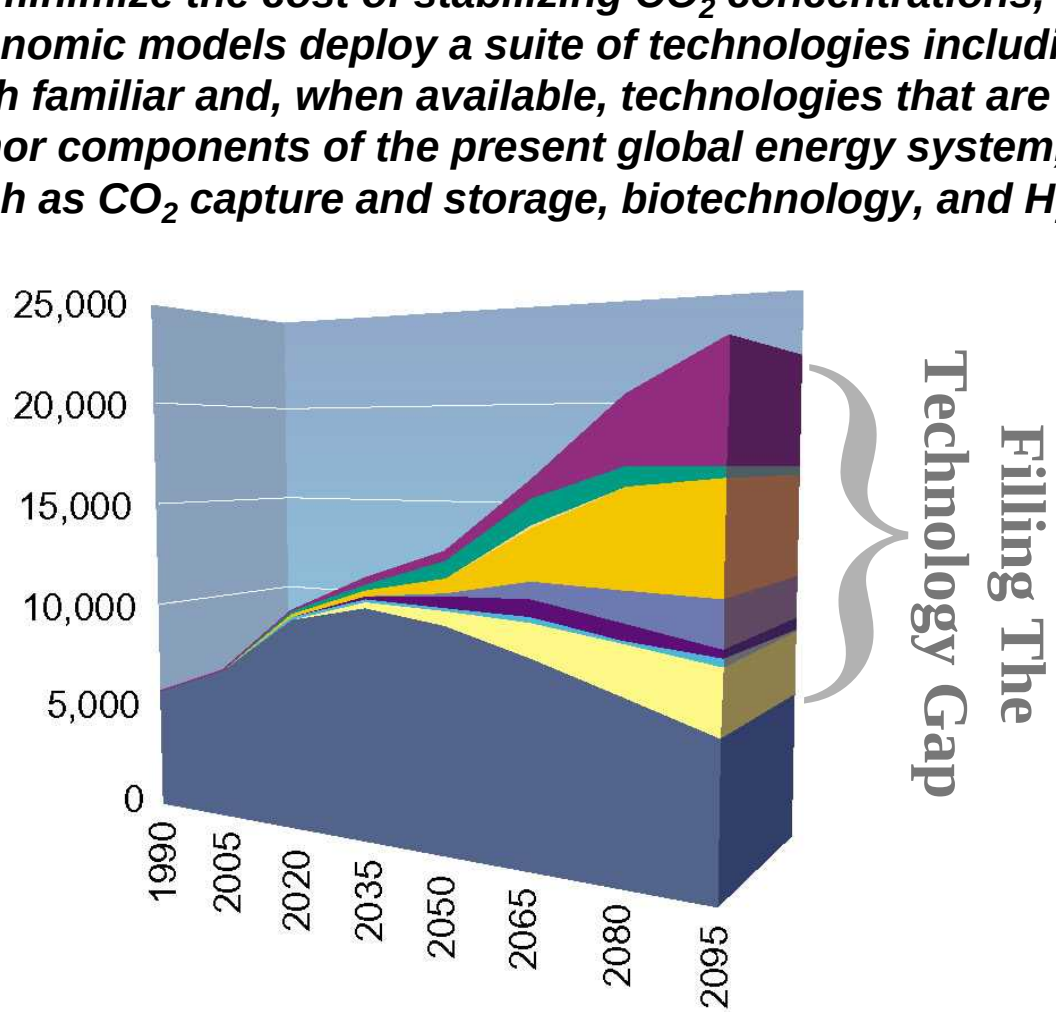
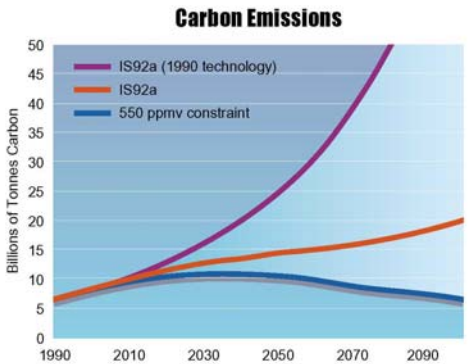
http://www.theonion.com/content/news/addressing_climate_crisis_bush

- A “Modest Proposal” – Development of a National Air Conditioner
- Concept art shows how an 800-mile-wide device would function on a "high cool" setting

Technology and Cost of Stabilization

To minimize the cost of stabilizing CO_2 concentrations, economic models deploy a suite of technologies including both familiar and, when available, technologies that are minor components of the present global energy system, such as CO_2 capture and storage, biotechnology, and H_2.





- Conservation
- Soil Carbon Sequestration
- Synfuel-Carbon Capture and Sequestration
- Carbon Capture and Sequestration from Hydrogen Production
- Central Power-Carbon Capture and Sequestration
- Solar and Hydro
- Nuclear
- Biomass
- 550 ppmv Emissions

Source: Edmonds, et al.

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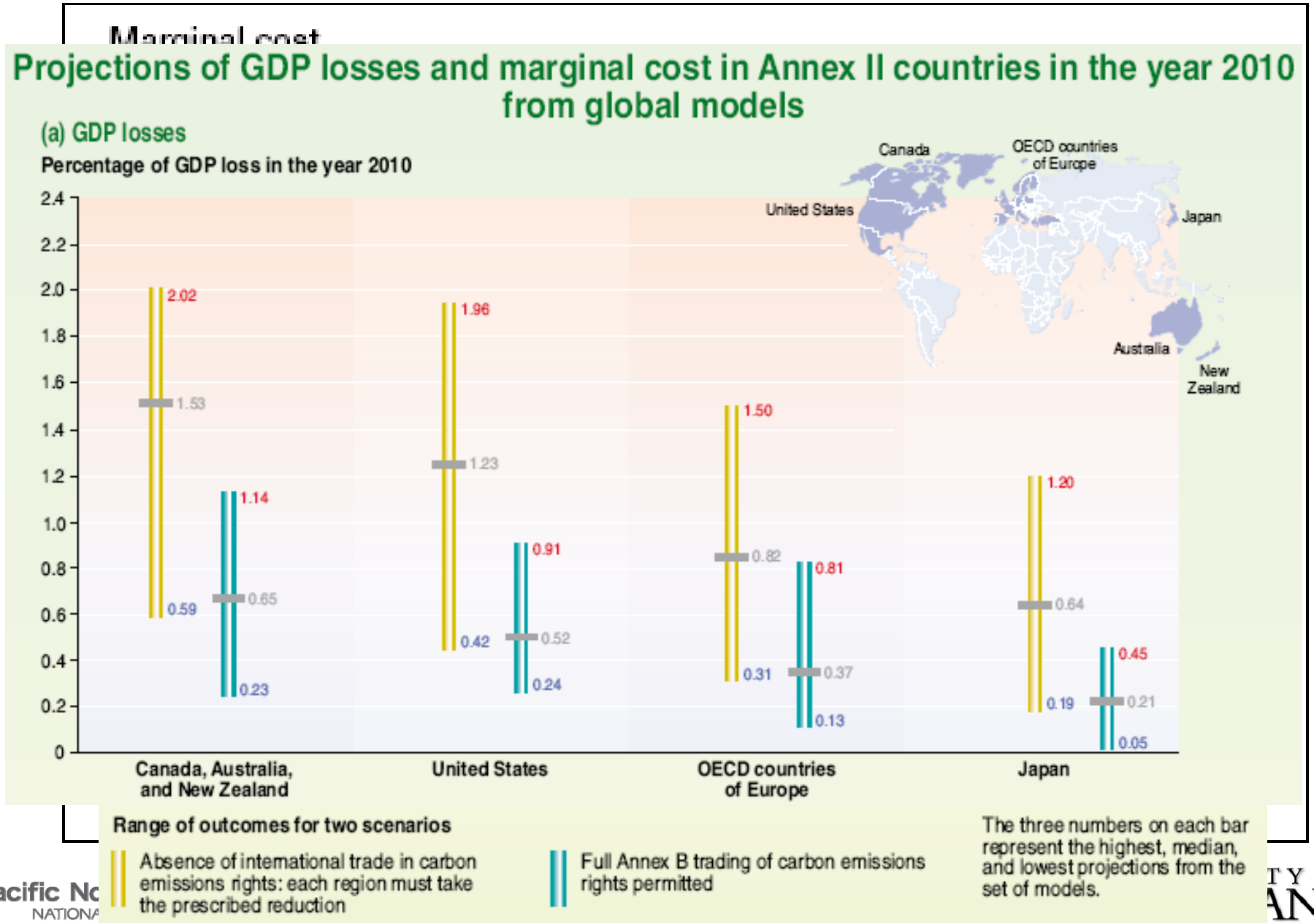
Studies Vary Widely in their



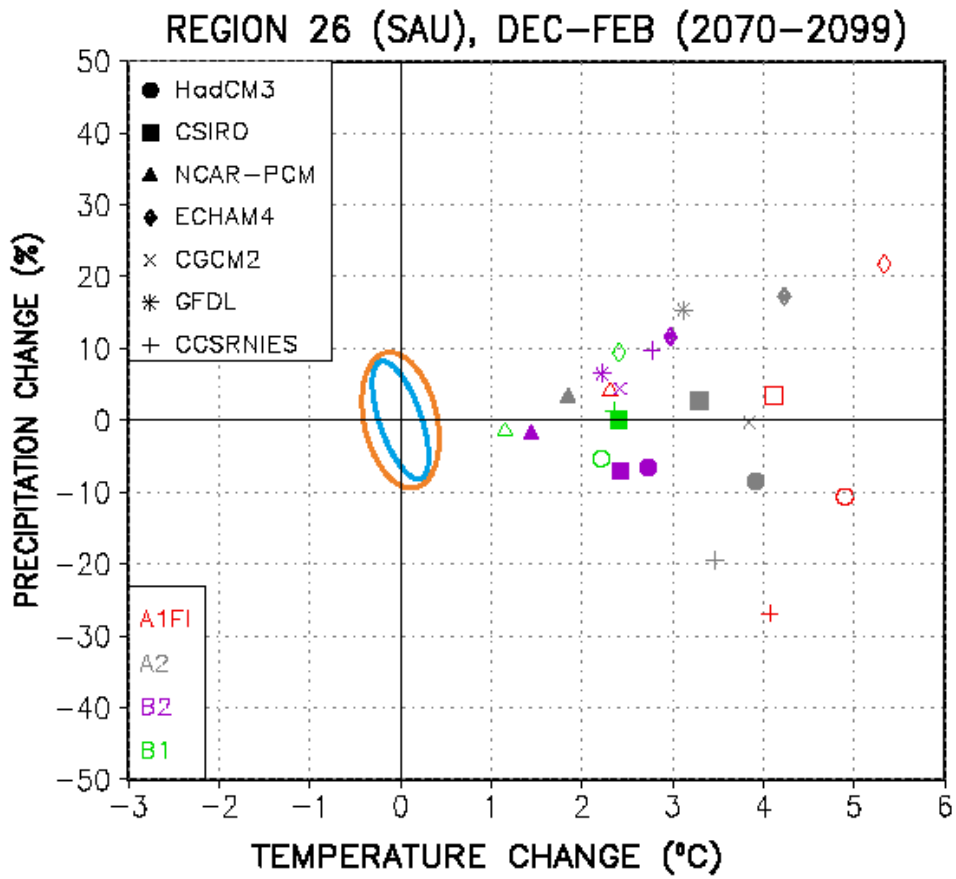
Adaptation Options for Ecosystems are Limited

- Design reserve systems for shifts in distributions and disturbance
- Maintain connected and genetically diverse populations
- Reduce habitat fragmentation, pollution, resource over-exploitation, etc.
- Setback coastal development
- Manage areas adjacent to protected areas
- Reduce fire risks (e.g., controlled burning)
- Assist species migration (e.g., manual seed dispersal)
- Reintroduce and translocate species
- Restore existing and engineer new habitats

Source: IPCC WG II, Chapter 4,

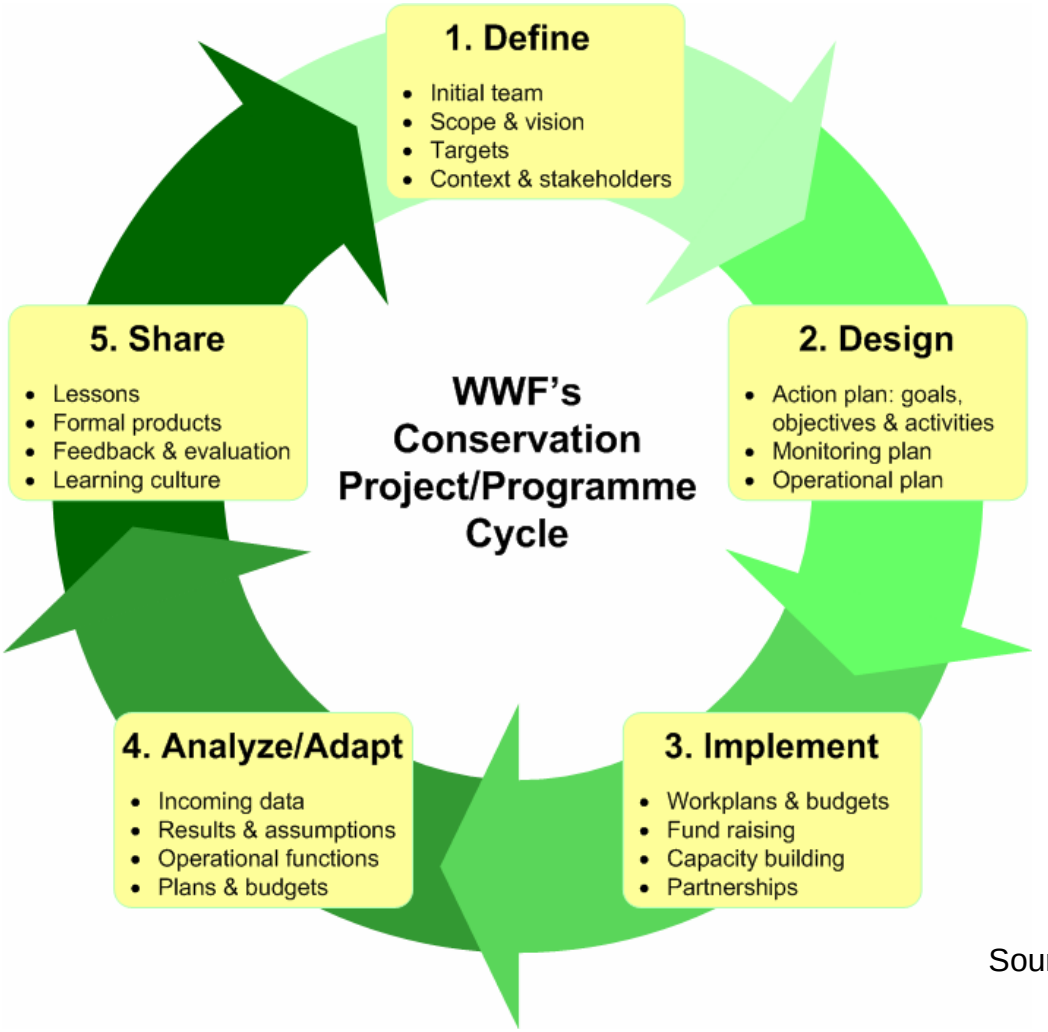
Climate Variability Can Be a Guide for Near-Term Adaptation

- Scatterplots: Climate change compared with variability
- "Buying time"



Source: Ruosteenoja *et al*. (2003) - *http://ipcc-ddc.cru.uea.ac.uk/asres/scatter_plots/scatterplots_home.html*

Include Stakeholders in Adaptation Planning and Implementation



•Build adaptation to climate change into ongoing planning processes

Source: Moser, 2010

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Share and Synthesize Knowledge

Link to Policy and Investments

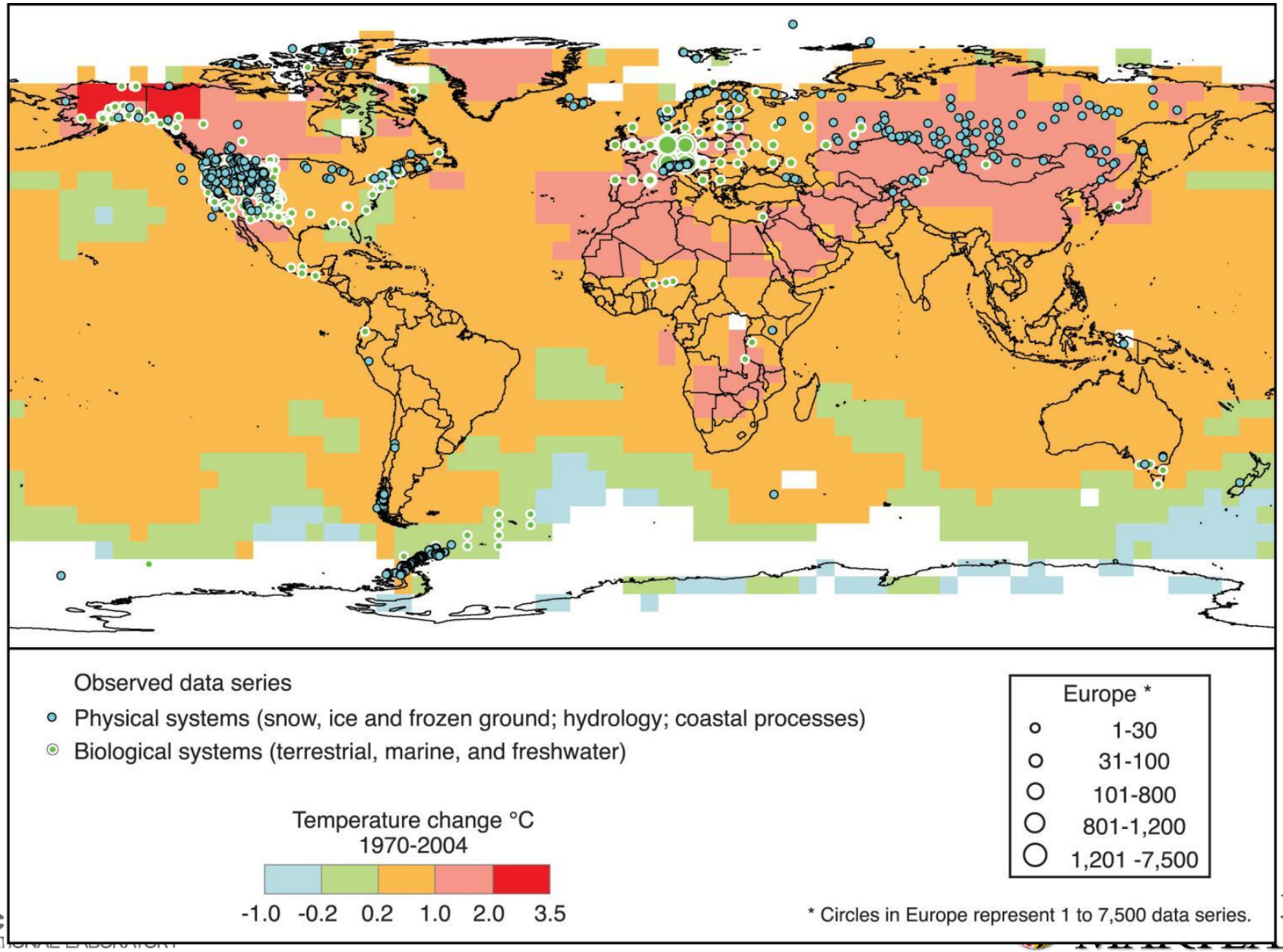
Scalable Options

Syntheses by Ecosystem Type/ Conservation planning input

Place-based Vulnerability/Adaptation Assessments/Reports/interventions

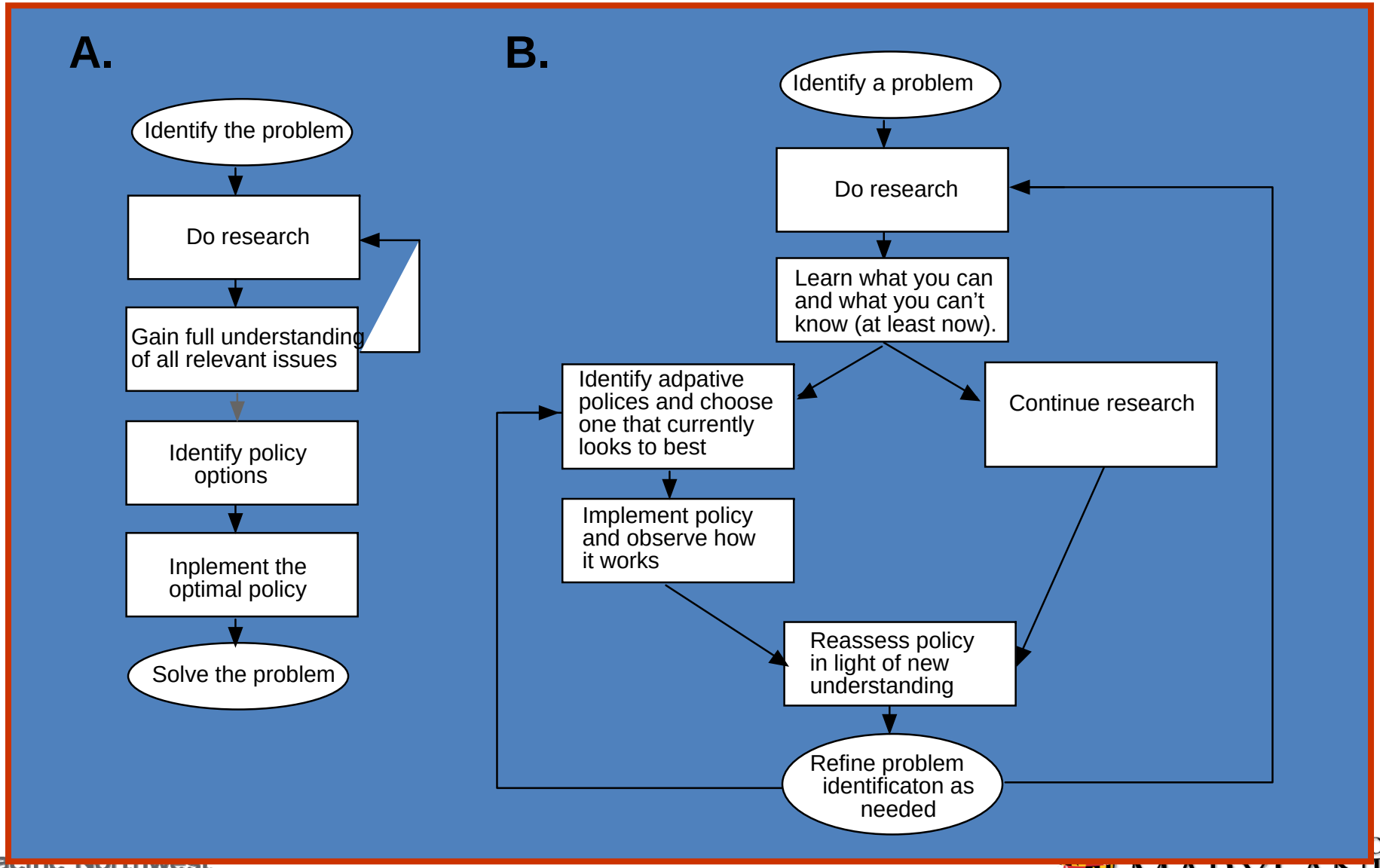
Research and Development

Collect Data on Observed Impacts

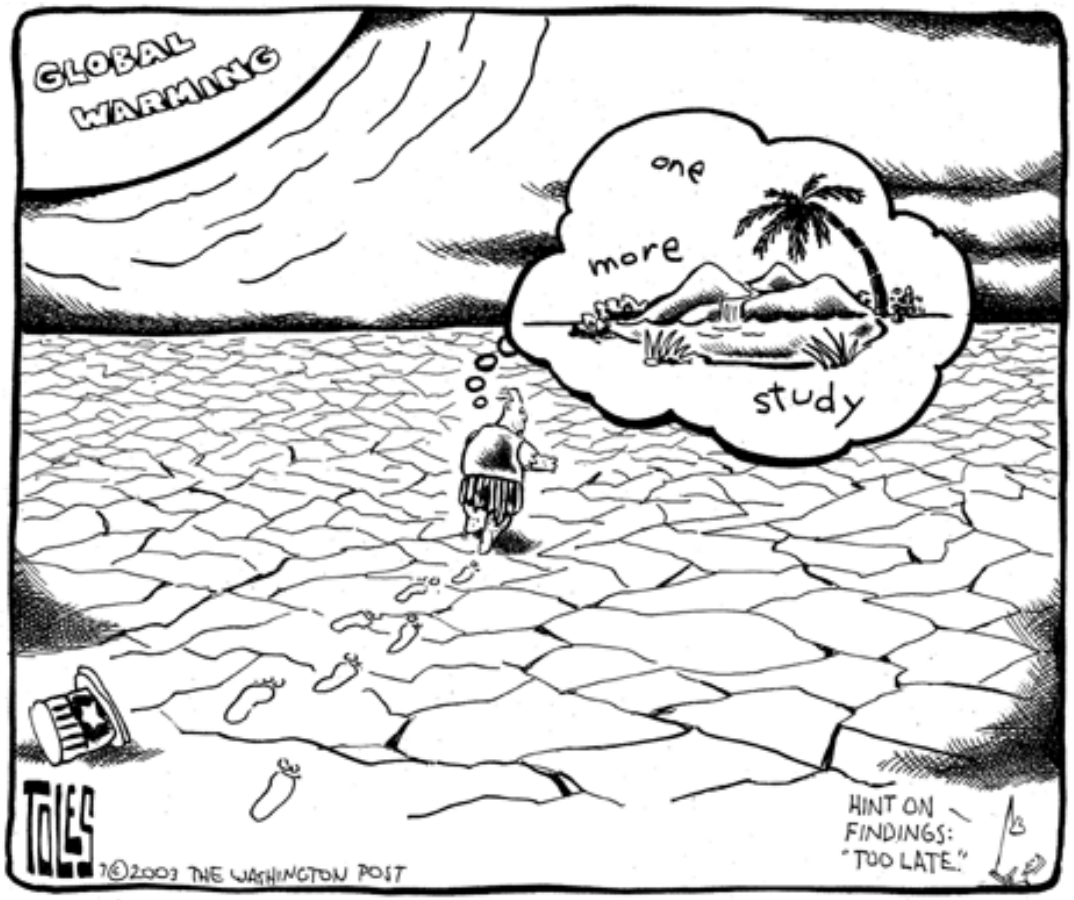


Source: IPCC AR4. WG II

Implications for Risk Management



Can Science Tell Us We Know Enough to Act?



- There will always be scientific uncertainty
- Deciding when we know "enough" is a value judgment, not a scientific issue
- Science can't answer the basic question: how much risk do we want to take?

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Managing Climate Risk is About Making Human Choices

International, National, and Local Commitment

Reducing emissions in the US and globally

Manage for Variability, Plan for Change

Enhancing adaptive capacity and resilience

Integrated Natural and Social Science Research

Incentivizing carbon storage

Partner with Stakeholders

Transforming markets and business practice to be climate friendly

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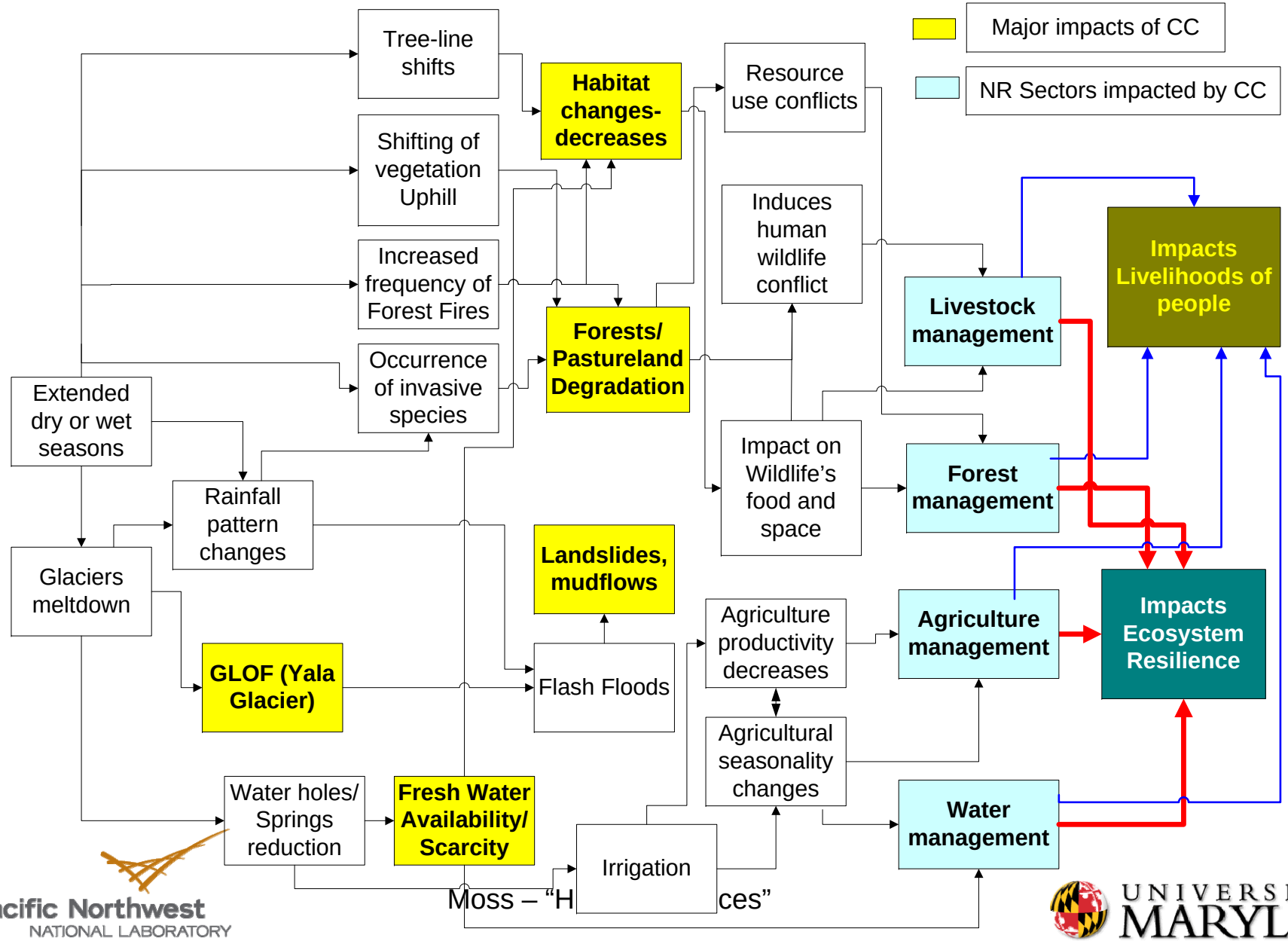
THANKS!

Back up

Example: Climate-Driven Changes in Langtang Region



Source: Anderson, 2008

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