

# **Climate and climate variability: overview and options for transformation**

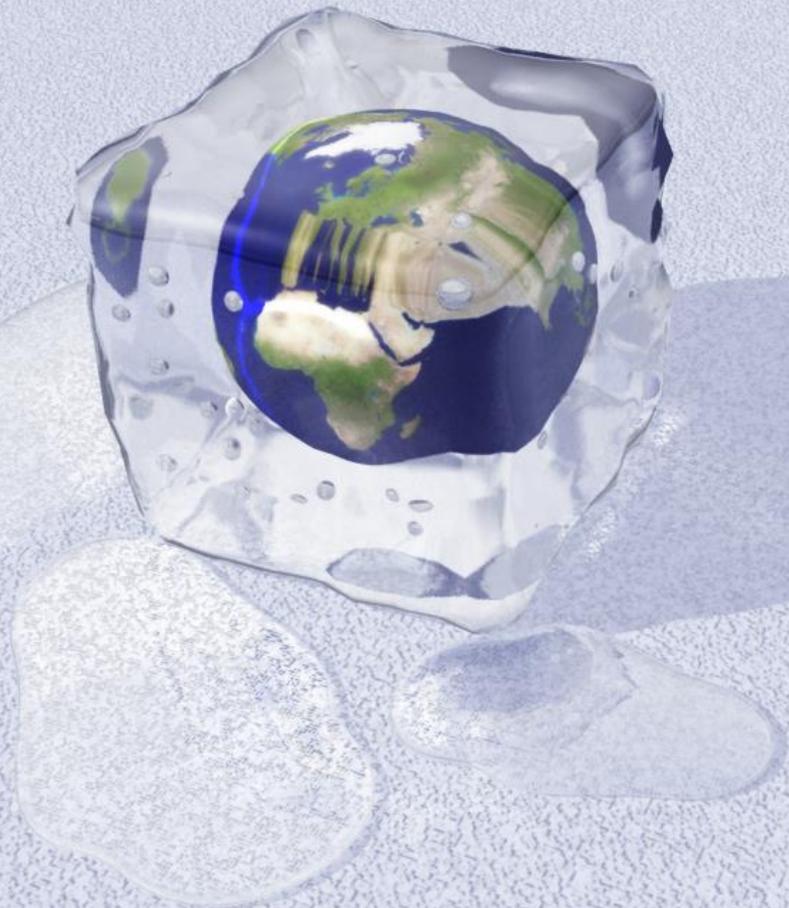
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**University of the Witwatersrand**

# Knowledge

For citizens to address the complex problems of modern society, educators must help learners to:

- develop higher level skills (e.g. 1) **meta-cognition**, or thinking about thinking);
- 2) **meta-knowledge** (knowledge about the nature and limitations about knowledge);
- 3) **meta-learning** (learning how to learn); and
- 4) **meta-dialogue** (dialog about how we engage in dialog) (Willow-Dea, 2011, 29-30 and Murray, 2008).



## The IPCC fourth Assessment Report (AR4)

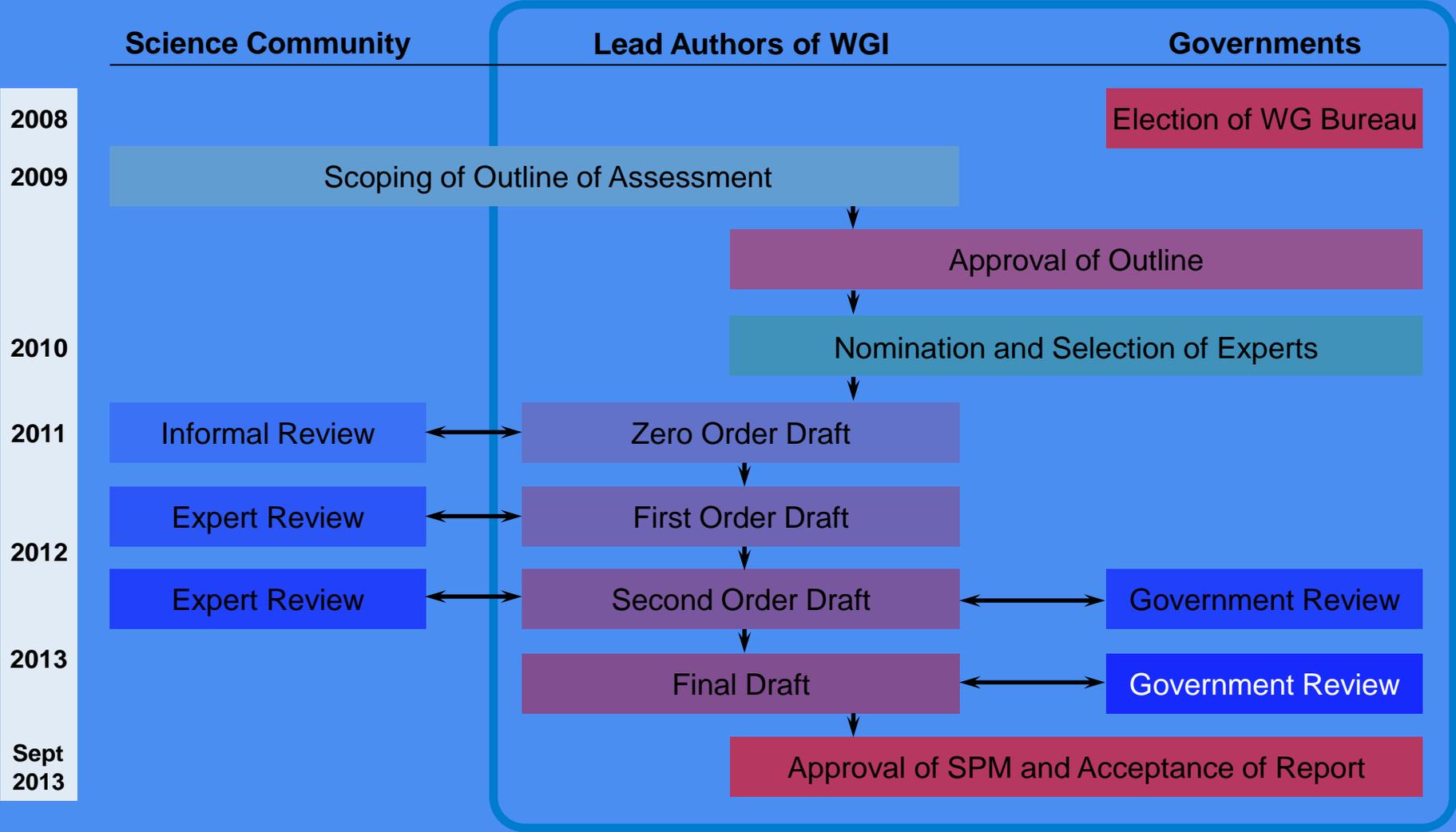
2500+ scientific expert reviewers  
600 authors from 40 countries  
More than 620 expert reviewers  
A large number of government reviewers  
Representatives from 113 governments  
6 years, 11 Chapters, TS, and SPM  
Unanimous approval at plenary in Paris, Feb 2007

### Notices:

Thursday: Evening snack  
Evening session



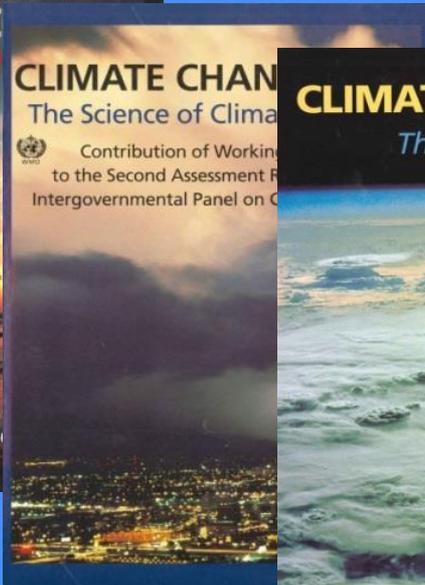
# Development Process of the WGI Contribution to the IPCC 5th Assessment Report



# IPCC Assessment Reports since 1990: WGI Contribution



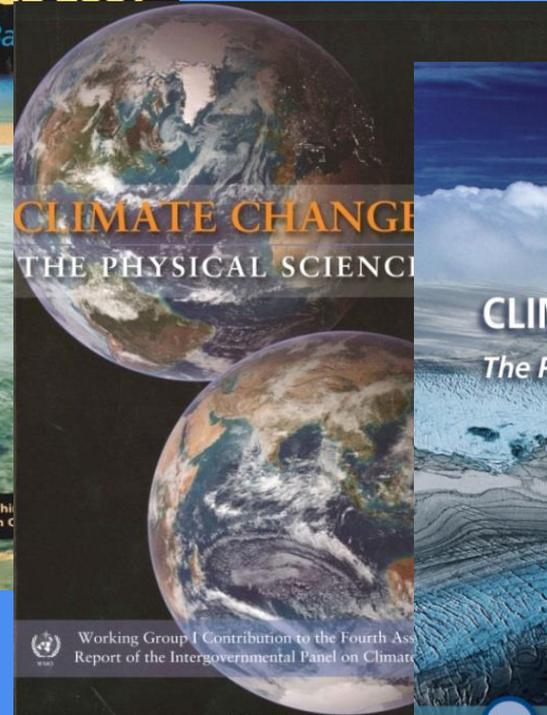
1990



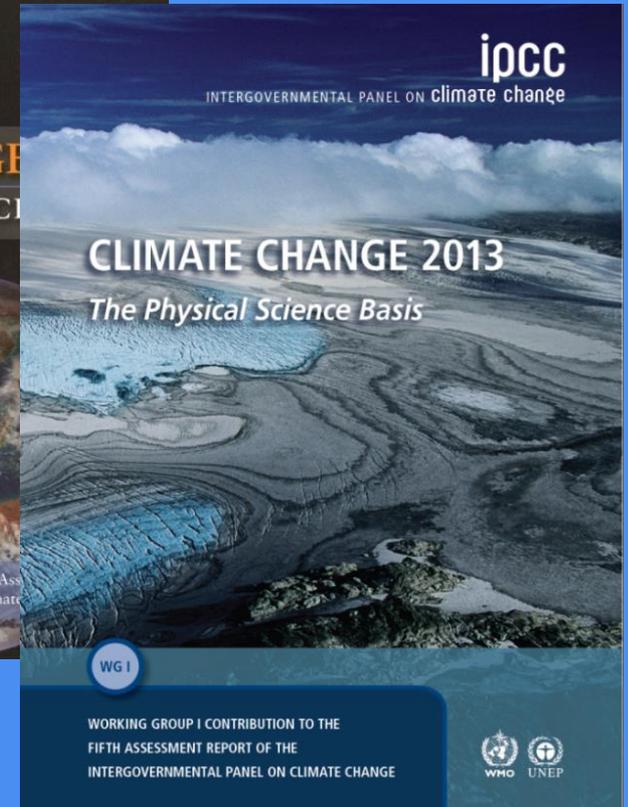
1995



2001



2007

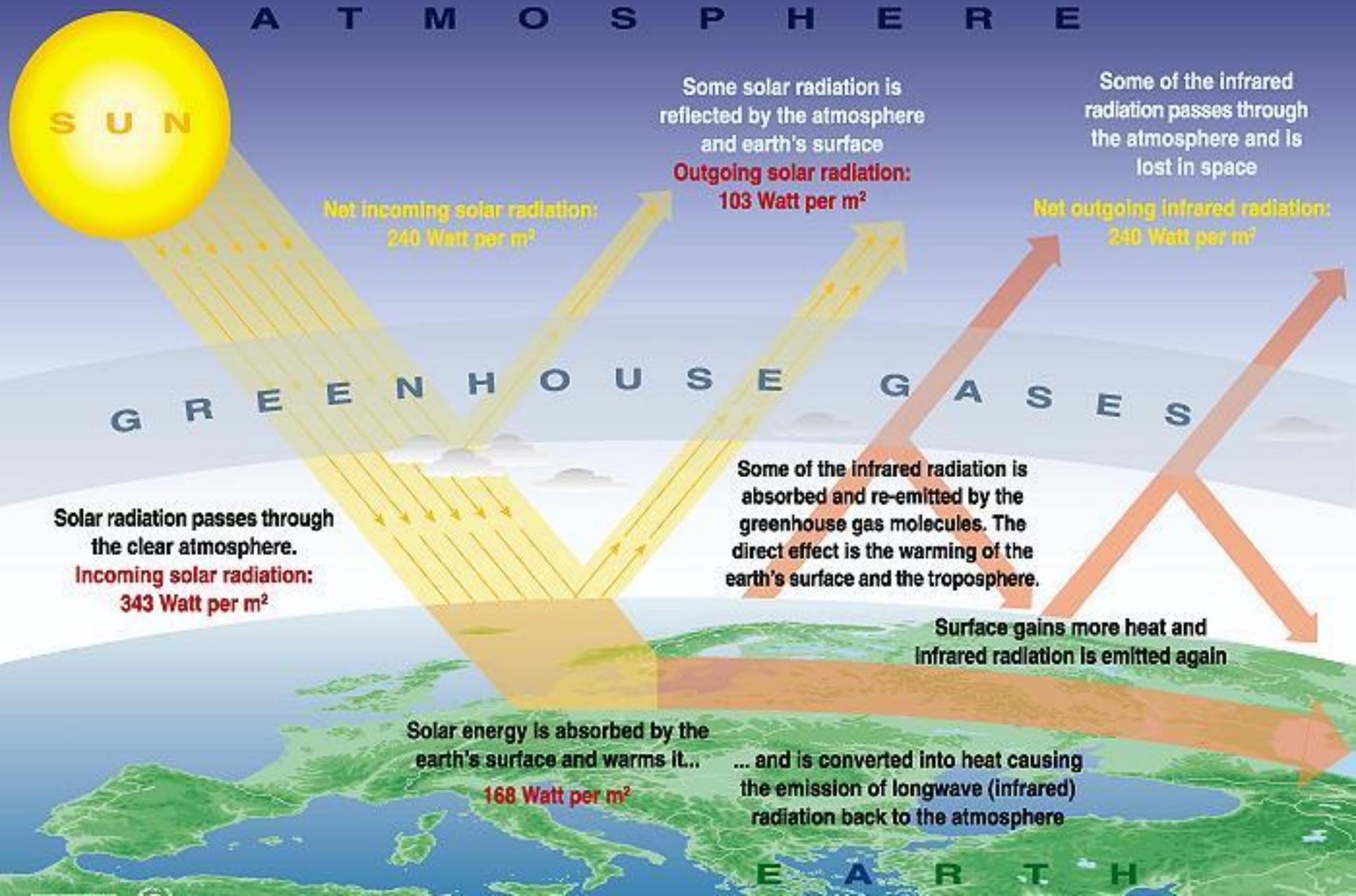


2013

# Content knowledge

- Human and natural attribution
- Responses therefore have to be cognizant of this duality:
- Two key issues:
- **Adaptation and mitigation**
- **Climate change and variability**

# The Greenhouse effect





1100  
IPCC 2000  
Scenarios  
for 2100 AD

3700

450

Today

1600

ppbv CH<sub>4</sub>

1200

800

400

Vostok Ice Core

ppmv CO<sub>2</sub>

360

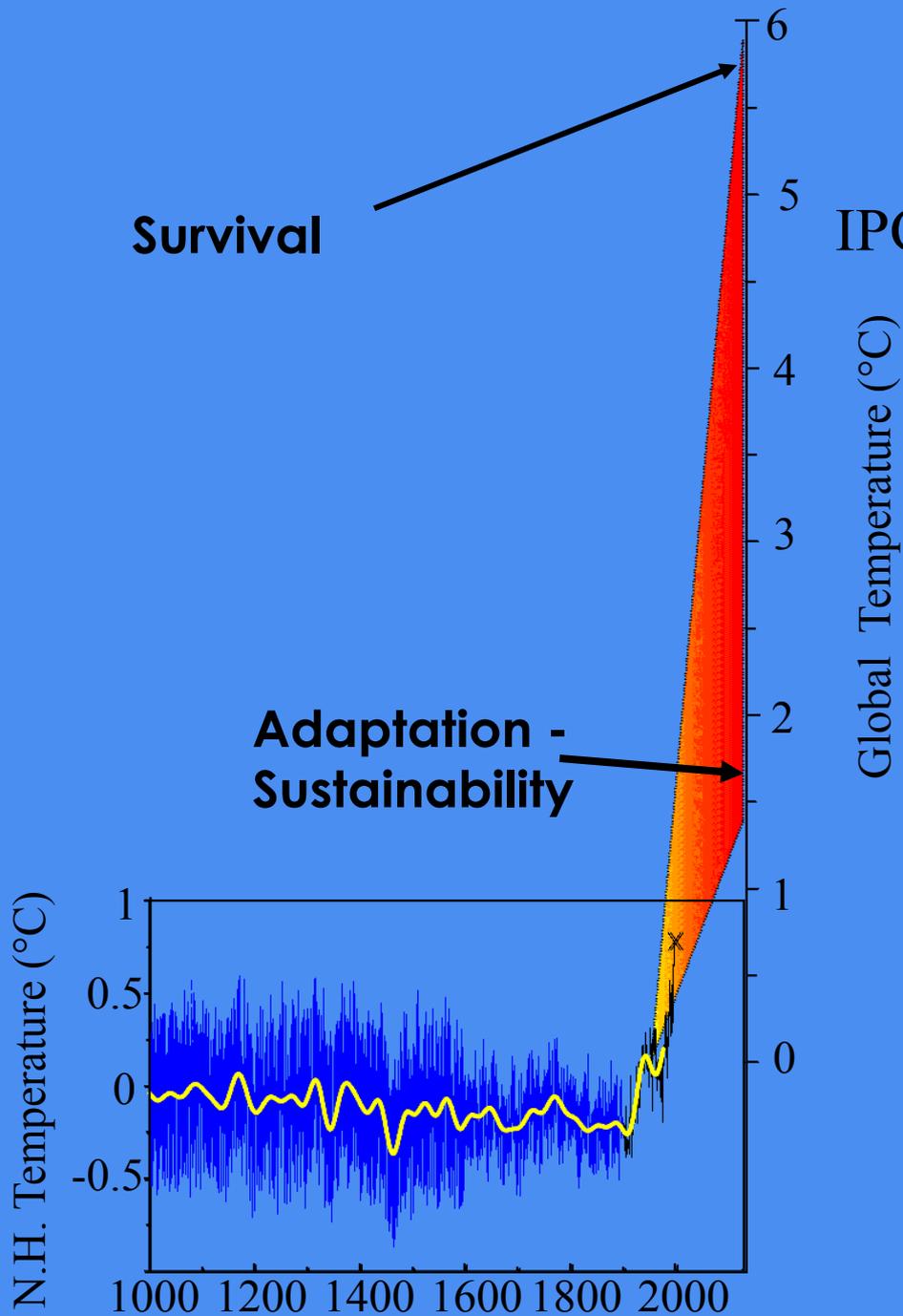
300

240

180

400 350 300 250 200 150 100 50 0

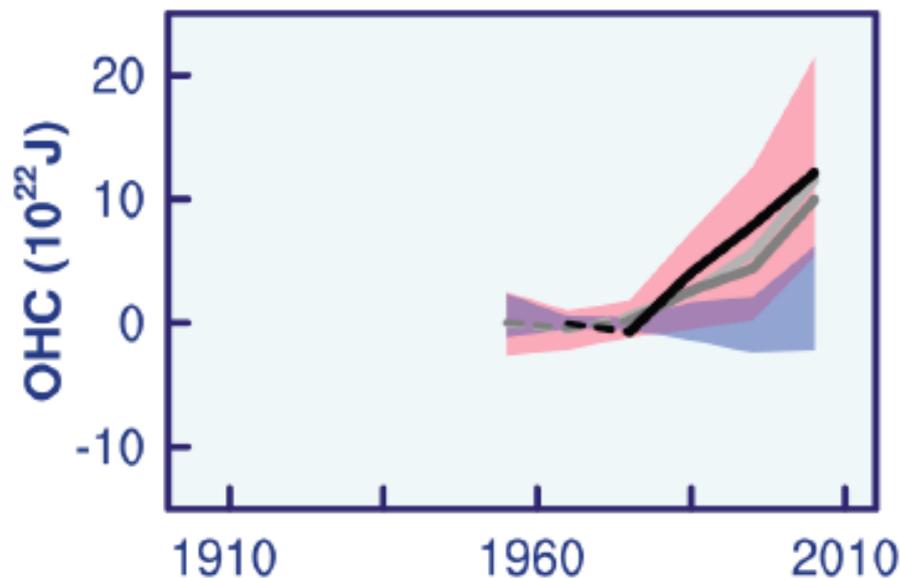
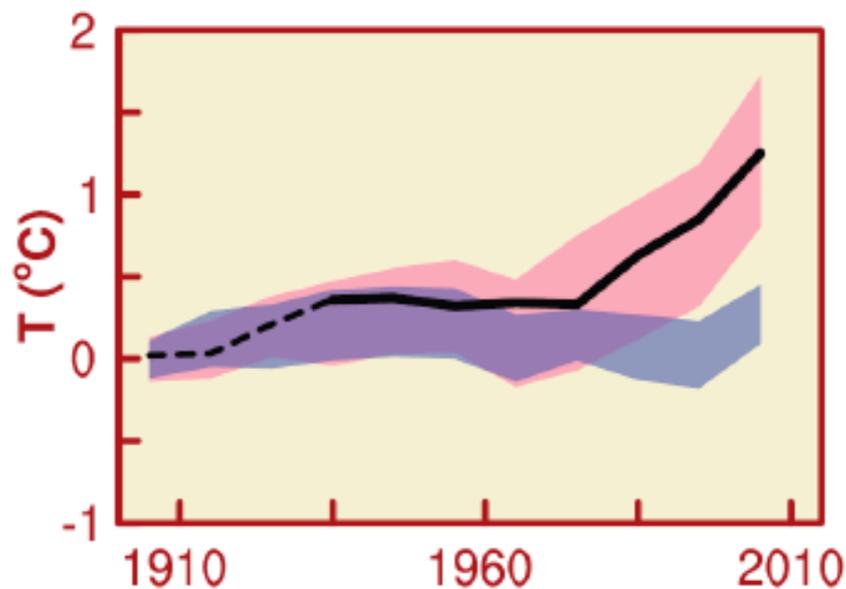
Thousands of years before present



# Human and natural environment interactions

Humans playing a role because of our actions and this is compounding natural change over time.

CLIMATE CHANGE = HUMANS + NATURAL CHANGE



(IPCC 2013, Fig. SPM.6)

— Observations

— Models using only natural forcings

— Models using both natural and anthropogenic forcings

Human influence on the climate system is clear. Observed warming consistent with simulations that include anthropogenic factors.

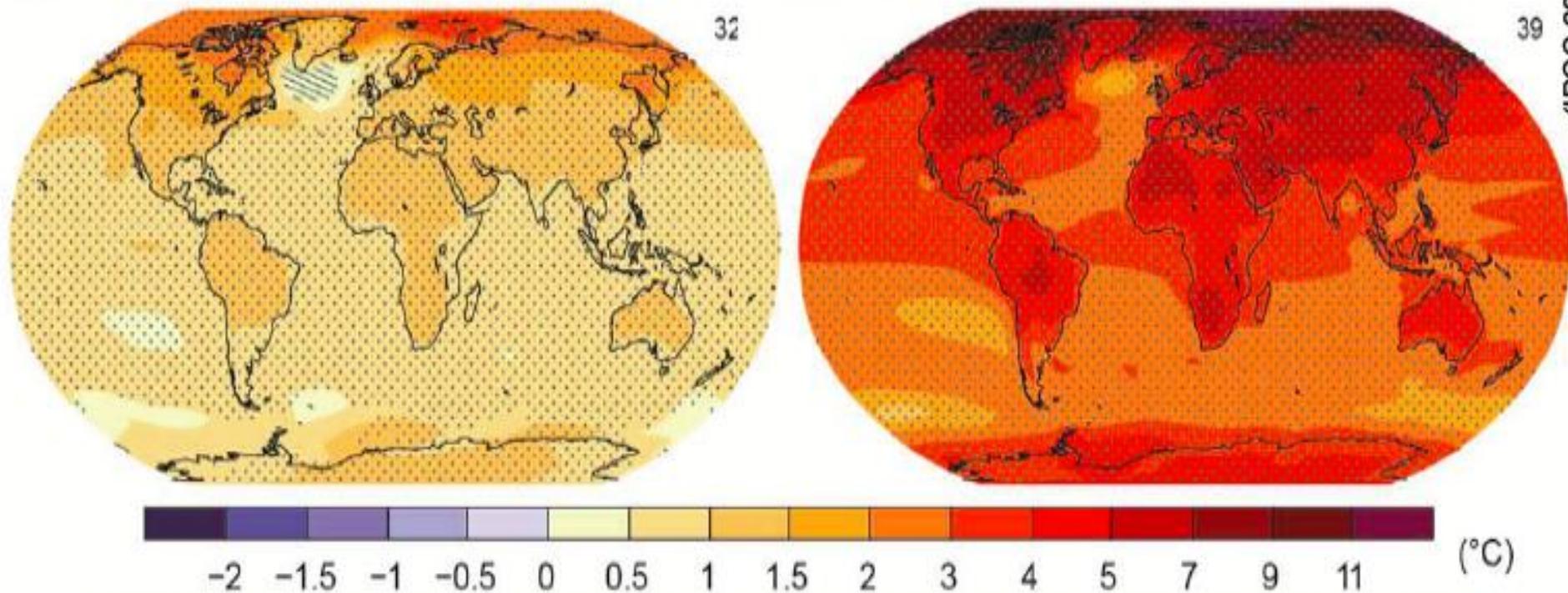
Attribution of warming to human influence in many continental regions

RCP 2.6

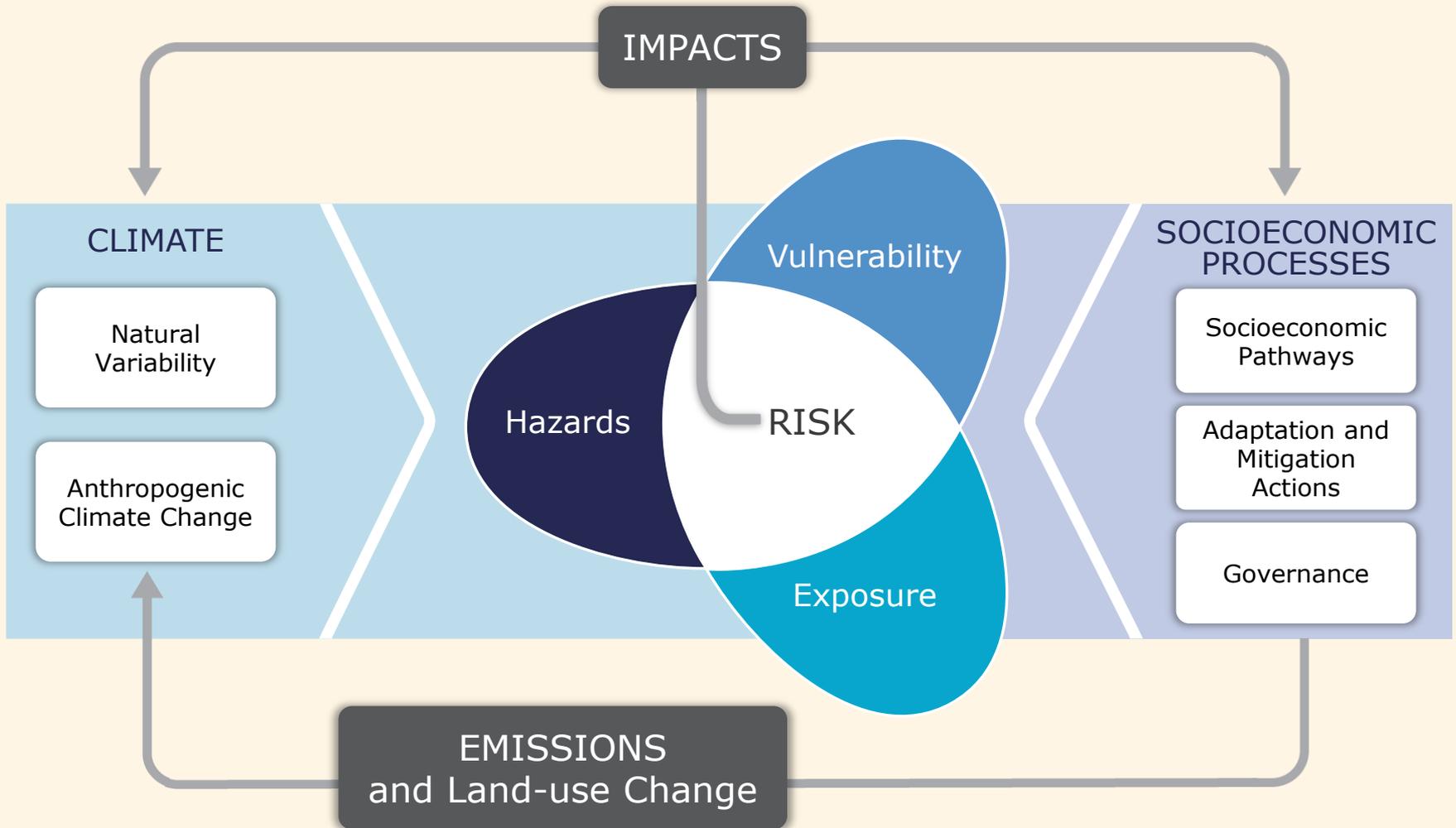
RCP 8.5

(a)

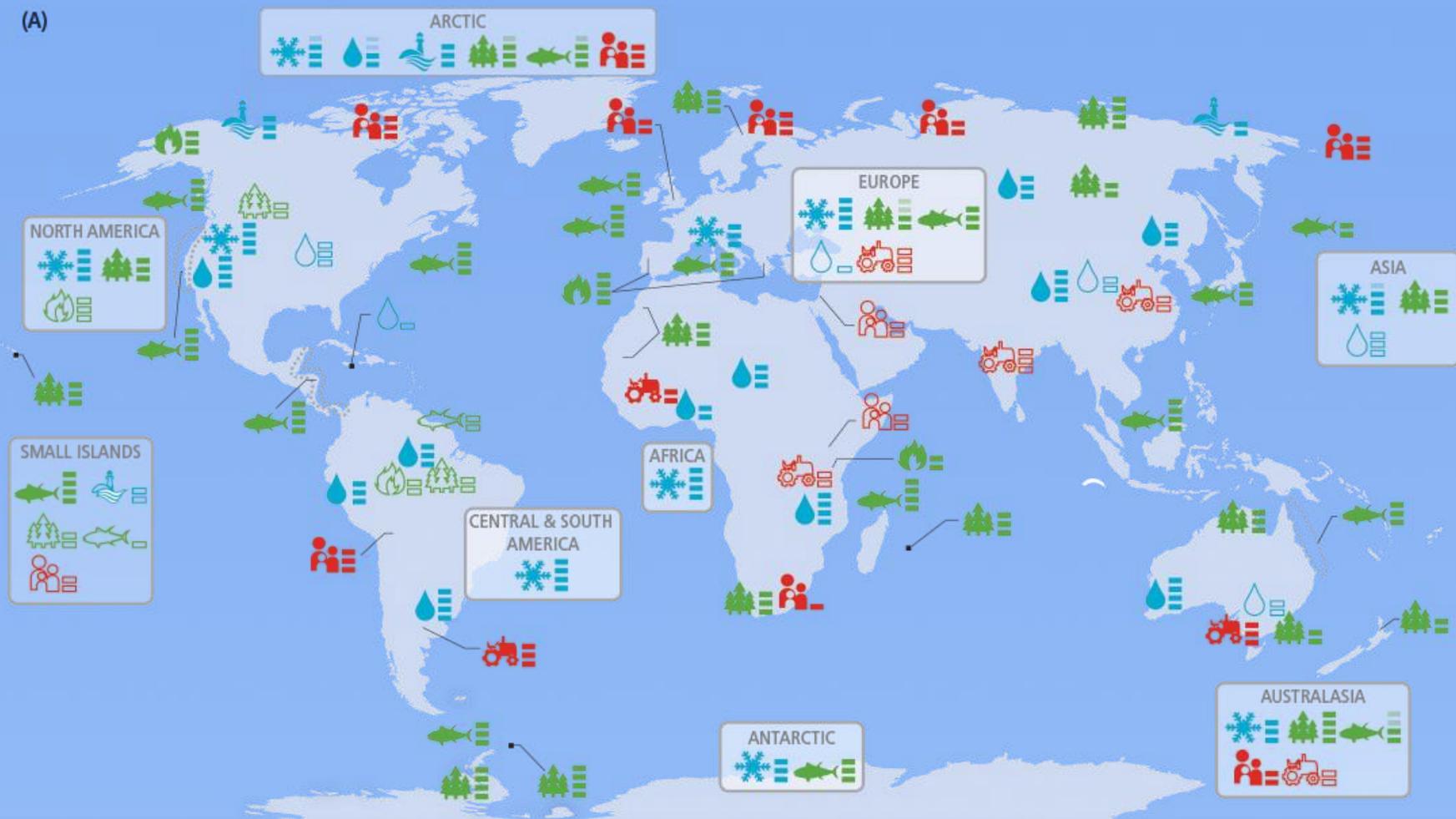
Change in average surface temperature (1986–2005 to 2081–2100)



Increase of global mean surface temperatures for 2081–2100 relative to 1986–2005 is projected to likely be in the ranges derived from the concentration driven CMIP5 model simulations, that is, 0.3°C to 1.7°C (RCP2.6), 1.1°C to 2.6°C (RCP4.5), 1.4°C to 3.1°C (RCP6.0), 2.6°C to 4.8°C (RCP8.5).



(A)



**Confidence in attribution to climate change**

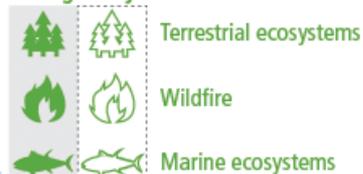


**Observed impacts attributed to climate change for**

**Physical systems**



**Biological systems**



**Human and managed systems**



□ Regional-scale impacts

**Outlined symbols = Minor contribution of climate change**  
**Filled symbols = Major contribution of climate change**

|  |  |  |                         |  |           |  |
|--|--|--|-------------------------|--|-----------|--|
| <p>Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure (<i>high confidence</i>)</p> <p>[22.3-4]</p> | <ul style="list-style-type: none"> <li>• Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems)</li> <li>• Enhancing smallholder access to credit and other critical production resources; Diversifying livelihoods</li> <li>• Strengthening institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender-oriented policy</li> <li>• Agronomic adaptation responses (e.g., agroforestry, conservation agriculture)</li> </ul> |  | Very low                | Medium                                     | Very high |  |
|  |  |  | Present                 |  |           |  |
|  |  |  | Near term (2030 – 2040) |  |           |  |
|  |  |  | Long term (2080 – 2100) | $2^{\circ}\text{C}$<br>$4^{\circ}\text{C}$ |           |  |

|   |  |  |                         |  |           |  |
|---|--|--|-------------------------|--|-----------|--|
| <p>Adverse effects on livestock linked to temperature rise and precipitation changes that lead to increased heat and water stress, and shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty (<i>medium confidence</i>)</p> <p>[22.3.4.2, 22.4.5.2, 22.4.5.6, 22.4.5.8]</p> | <p>Addressing non-climate stressors facing pastoralists, including policy and governance features that perpetuate their marginalization, is critical for reducing vulnerability. Natural resource-based strategies such as reducing drought risk to pastoral livelihoods through use of forest goods and services hold potential, provided sufficient attention is paid to forest conservation and sustainable management.</p> |  | Very low                | Medium                                     | Very high |  |
|   |  |  | Present                 |  |           |  |
|   |  |  | Near term (2030 – 2040) |  |           |  |
|   |  |  | Long term (2080 – 2100) | $2^{\circ}\text{C}$<br>$4^{\circ}\text{C}$ |           |  |

|   |   |  |                         |  |           |  |
|---|---|--|-------------------------|--|-----------|--|
| <p>Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (<i>medium confidence</i>)</p> <p>[22.3]</p> | <ul style="list-style-type: none"> <li>• Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance</li> <li>• Vulnerability mapping and early warning systems</li> <li>• Coordination across sectors</li> <li>• Sustainable urban development</li> </ul> |  | Very low                | Medium                                     | Very high |  |
|   |   |  | Present                 |  |           |  |
|   |   |  | Near term (2030 – 2040) |  |           |  |
|   |   |  | Long term (2080 – 2100) | $2^{\circ}\text{C}$<br>$4^{\circ}\text{C}$ |           |  |



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# VULNERABILITY AND EXPOSURE

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## AROUND THE WORLD



# VULNERABILITY AND EXPOSURE

## AROUND THE WORLD

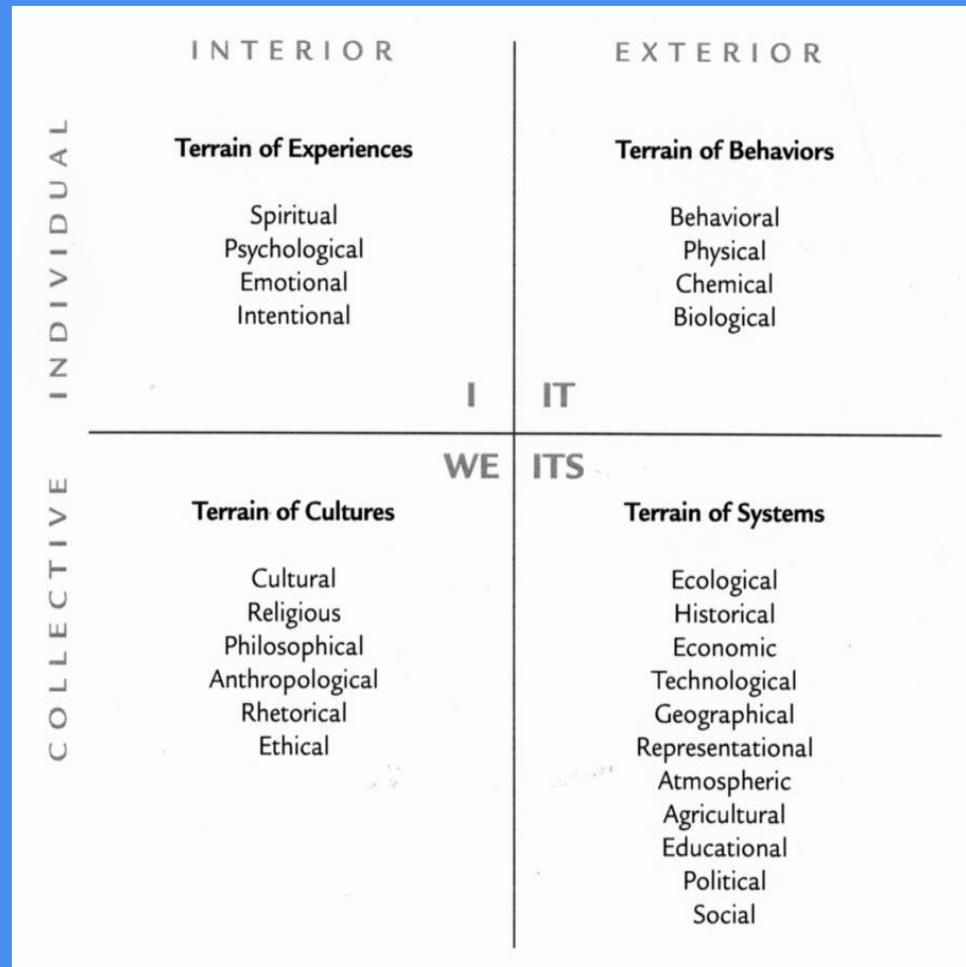
# Interventions

- 1) International – COP, Kyoto etc.
- 2) Regional and national – NAPAs etc.
- 3) Personal – lifestyles, beliefs, memes!

## What YOU do about CC also depends on your paradigm (view of change)

- **Positivism (nomothetic) vs Critical theory (interpretative, ideographic)**
- **Epistemology and how knowledge is created**
- Dualist/objective; findings true
- Transactional, subjectivist; value mediated findings.
- **Values**
- Excluded – influence denied
- Included-formative
- *Source: Guba and Lincoln, 2005.*

# Integral approaches Twenty-five major dimensions of climate change (after Esbjorn-Hargens, 2010).



## Experiential

- Values, beliefs, attitudes, mental models, frames
- Need to make climate change a tangible experience
- Need representations of climate change that engage multiple audiences
- Focus on positive messages
- Motivate using existing interior structures (translation)
- Motivate by facilitating interior development (transformation)

## Cultural

- Need validation from identity groups
- Supportive groups help individuals to initiate and maintain new behaviors (e.g. Eco Teams, Transition Towns, CRAGs)
- Social movements and activist cultures (e.g. Climate Action Groups, Climate Camps)
- Cultural change – symbols, media, discourse
- Supportive change agent cultures
- Cultural barriers – custom, myths
- Dialogue with participants

## Behavioral

- Observe current behaviors
  - Carbon footprinting
  - Direct and indirect emissions
- Identify desired (target) behaviors
  - Potential to bring about desired change
  - Feasibility
- Behavior categories (e.g. environmental activism, non-activist public sphere, private-sphere environmentalism, other – Stern, 2000)

## Systemic

- Systems help or hinder target behaviors
- Hierarchy of preferential behaviors
- Diffusion of innovations – different strategies for early adopters vs mainstream
- Feedback systems to support learning
- Persuasive technology and choice architecture
- Information is important but not sufficient
- Financial incentives and penalties
- Supportive legal, political and social context

# Transformative change

- Knowledge that is made of facts and content not enough!
- Need to explore 'interior' views and 'exterior' views in knowledge production
- Blindspots, values, how one comes to see something not just made up of 'facts'!

# It makes sense to study beliefs in the context of climate change:

- Climate change discussions often proceed from a plurality of viewpoints (different belief systems simultaneously held by different stakeholders) (O'Brien *et al*, 2010b). Belief systems therefore determine consensus/dissensus regarding our future in the changing climate.
- Belief systems influence our perception of climate change and motivates our behavior towards nature. This means that changes in belief systems can be linked to fundamental changes in the ways that we deal with climate change.

# Current research on the relationship between beliefs and climate change:

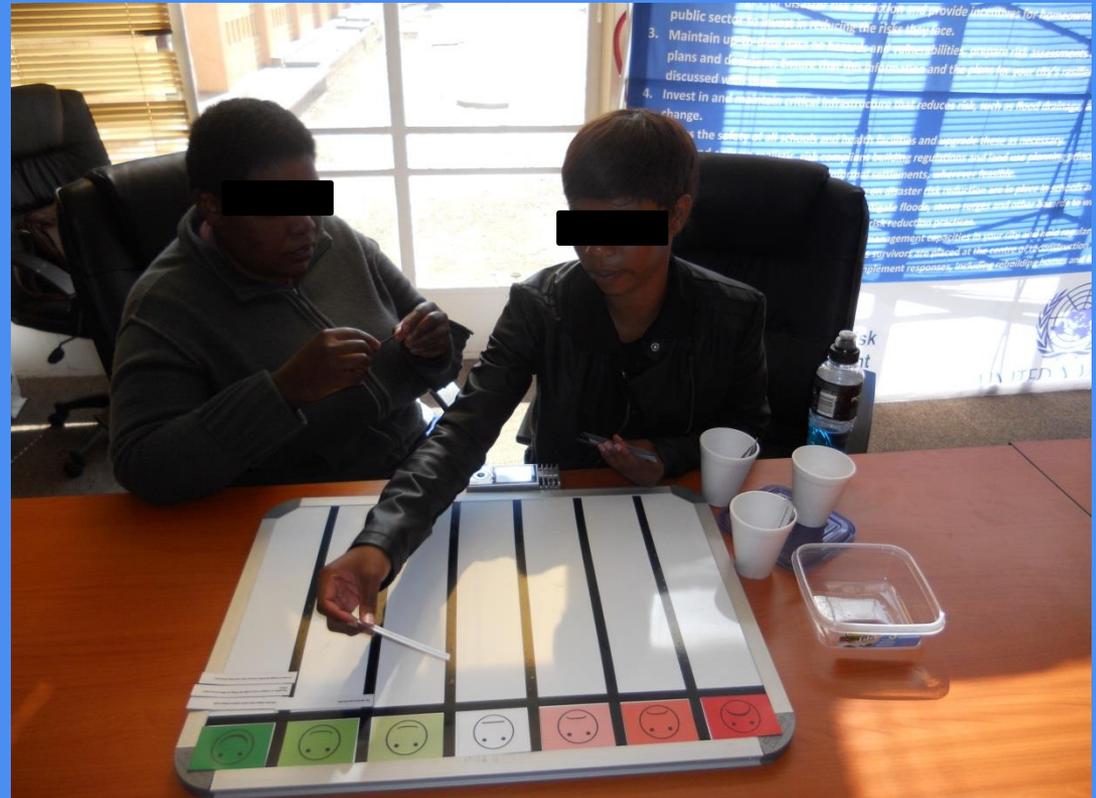
- The Climate Beliefs project is part of the SANCOOP bilateral co-operation between South Africa and Norway, funded by the NRF and RCN.
- This project aims to find out how the causality between the impacts and drivers of climate change challenge belief systems, by studying the flexibility of environmental beliefs in rural communities in North West Province, South Africa.
- Dr. Ananka Loubser (NWU) and Prof. Karen O'Brien (UiO) mapped the beliefs by using semi-structured interviews and Q methodology.
- Flexibility was tested by introducing contradictory statements offering both indigenous and scientific explanations for climate change.
- Preliminary results show belief system plasticity: belief systems provide stable points of reference to make sense of the world, but at the same time they need to adapt to changes in the external environment, so that more flexible belief systems lead to more proactive responses to climate variability and change.
- These findings may lead to a flexibility indicator with implications for climate change adaptation and disaster risk reduction.

## Field work: Climate Beliefs project: Jouberton, NW Province, SA

A participant in the study sorts community-derived belief statements in a Q sorting grid (likert scaling). The results are analyzed statistically (Q factor analysis) to determine the interrelationships between the beliefs.

### References:

- LOUBSER, A.; 2012. Changes in epistemic frameworks: random or constrained? *Koers*, 2012 77(2): Art #425.
- LOUBSER, R.A.; 2013. Tracing some consensus regarding pre-scientific frameworks in philosophy of science. *Acta Academica*, 2013 45(2): 1-26.
- O'BRIEN, K; HOCHACHKA, G; 2010a. Integral adaptation to climate change. *Journal of Integral Theory and Practice*, 5(1): 89-102.
- O'BRIEN, K; WOLF, J; 2010b. A values-based approach to vulnerability and adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*. ISSN 1757-7780. 1(2): 242-253.



# Transdisciplinarity

- Knowledge made up of scientific, social and experiential.
- When seeking a solution to a problem 'science alone may not be enough'
- Mode 1 and Mode 2 knowledge production key to distinguish.

# *Transdisciplinarity (Nicolescu, 1998 slide courtesy M. Rich-Tolsma)*

## Transdisciplinarity

**Axiom 1**  
Multiple Levels  
of Reality and  
the Hidden  
Third

**Axiom 2**  
The Logic of  
the Included  
Middle

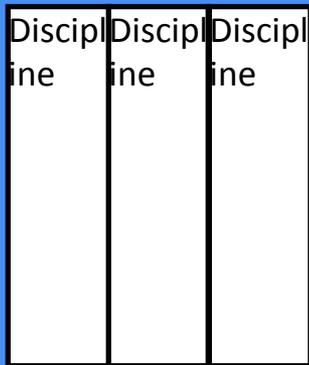
**Axiom 3**  
Knowledge:  
Complexity,  
Emergence

# Transdisciplinarity:

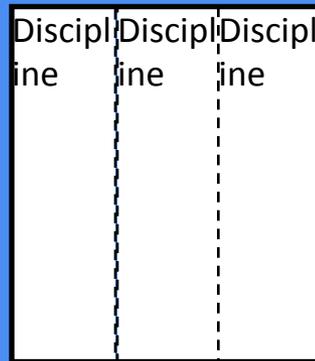
“a new form of **learning** and **problem solving** involving cooperation among **different parts of society and academia** in order to meet **complex challenges of society**” (Julie Klein et al., 2001)



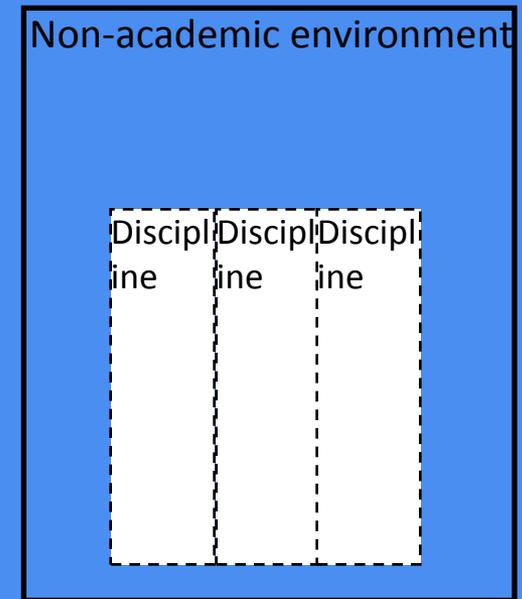
Mono-disciplinary



Multi-disciplinary



Inter-disciplinary



Trans-disciplinary

# Climate Information and Planning

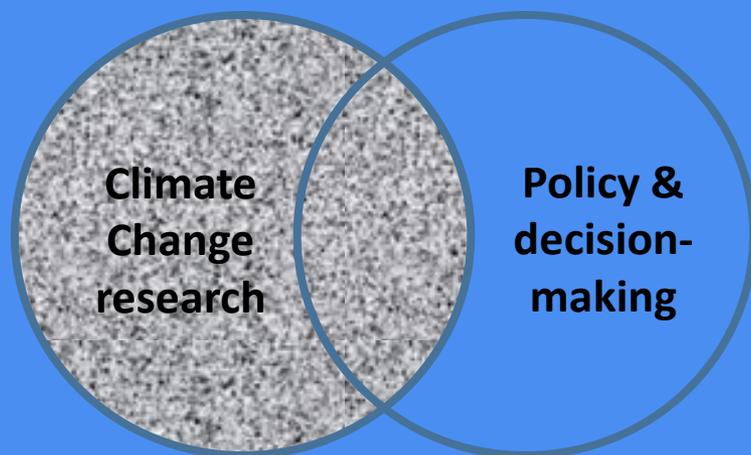


Fig 2: After Bradshaw and Borchers, 2000

1. What is our handle on climate change science and climate variability?
2. What are the roles of scientists, policy makers and 'brokers' in research, adaptation and planning?

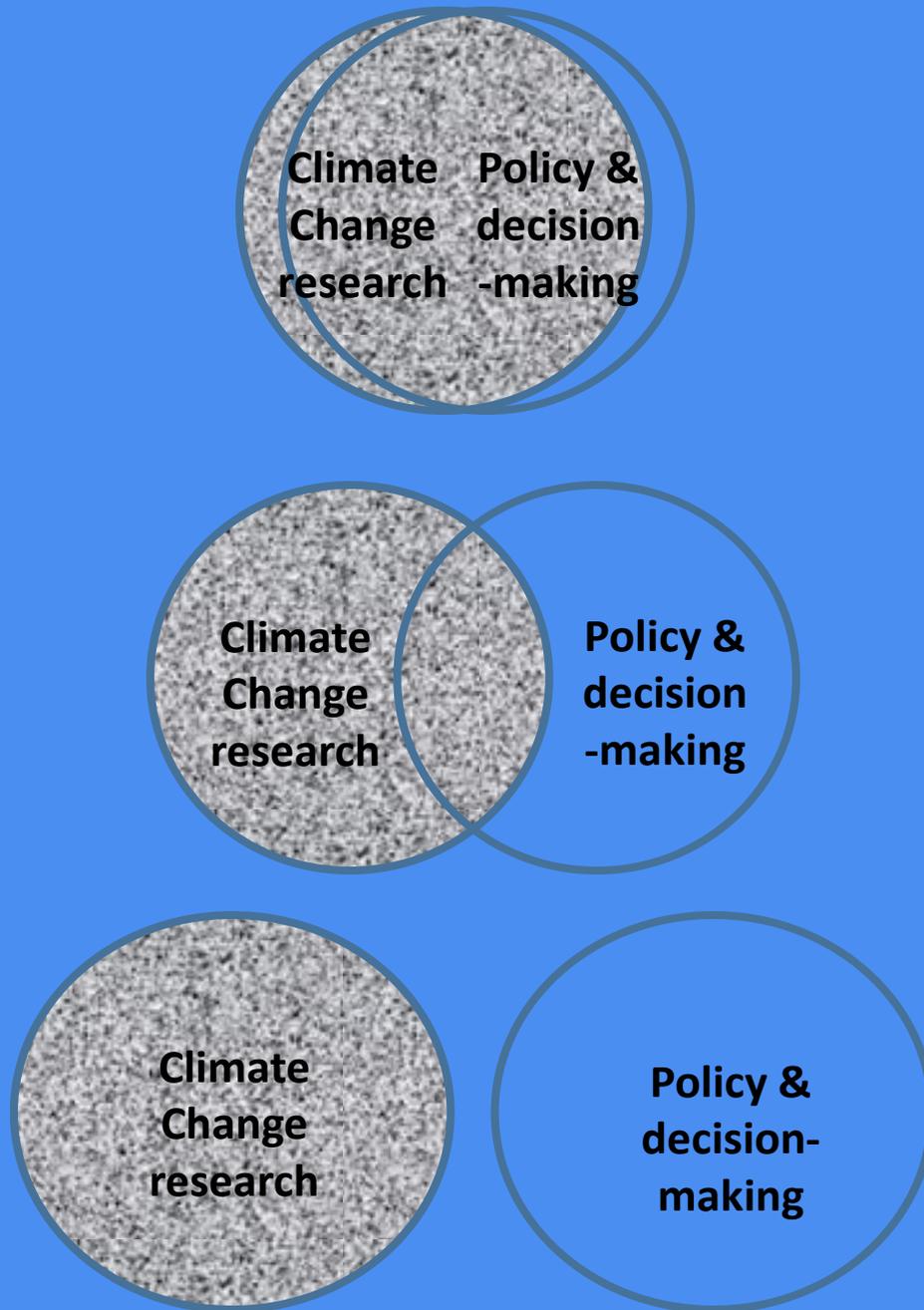


Fig 4: After Bradshaw and Borchers, 2000

# Some References and web sites

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- IPCC web site, [www.ipcc.ch](http://www.ipcc.ch)
- Various IPCC reports
- IPCC Fourth Assessment report, Working Group II
- IPCC Fifth Assessment report, Working Group II
- UNEP reports
- Riedy, C., 2005: *The eye of the storm: An integral perspective on sustainable development and CC*, Thesis PDF [uts.edu.au](http://uts.edu.au).
- Dea W., 2010: *Igniting Brilliance, Integral education for the 21<sup>st</sup> century*, Integral Publishers.
- Wilber, F., 2007: *Integral Spirituality*, Integral Books.