



Analysing Climate Vulnerability: Using Climate Models & Scenarios

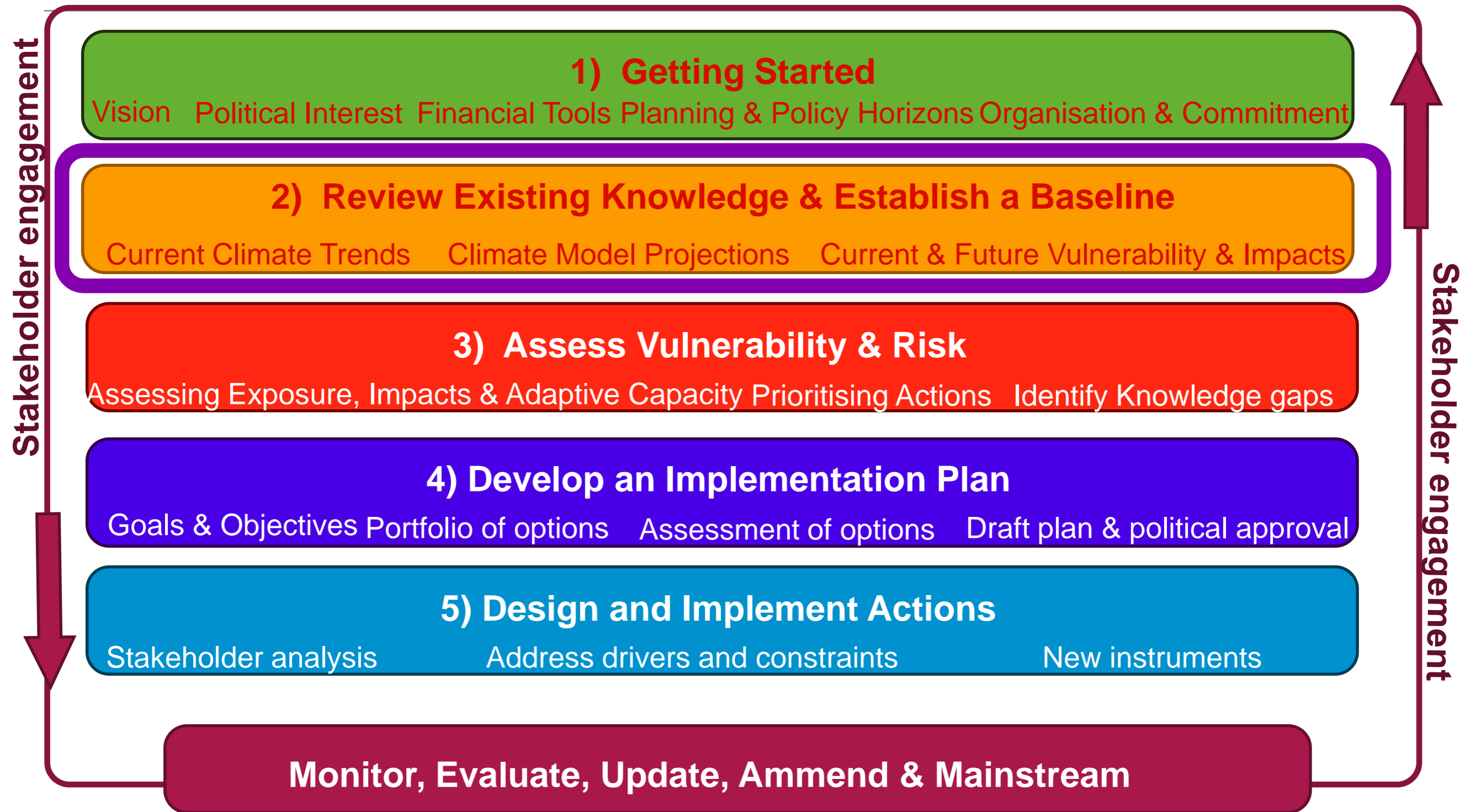
Training for Adaptation 
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Contents

- Process stages - doing adaptation
Re-cap
- Review existing knowledge & establish a baseline - climate trends, models and projections
- Developing and applying scenarios for adaptation - combining approaches



Process Stages: Doing Adaptation



Process Stages: Doing Adaptation

2) Review Existing Knowledge & Establish a Baseline

Current Climate Trends Climate Model Projections Current & Future Vulnerability & Impacts

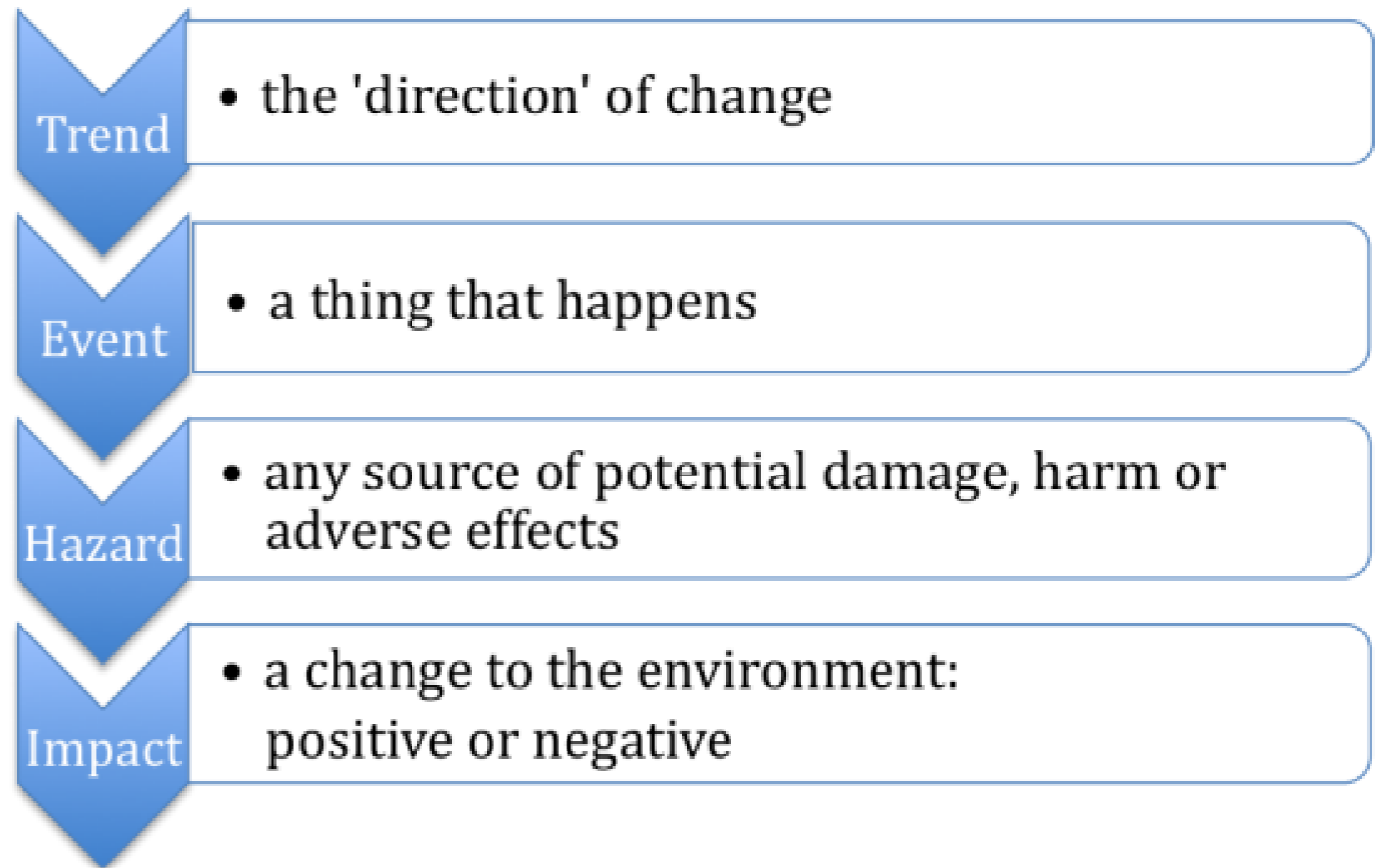
**Current Baseline For
Adaptation**

**Develop Scenarios
For Adaptation**



Review the Available Information & Establish a Baseline

- **Current Baseline For Adaptation**



- **Current Climate Trends**

In most regions, changes in extremes are occurring more rapidly than changes in long-term, average patterns; i.e., trends.

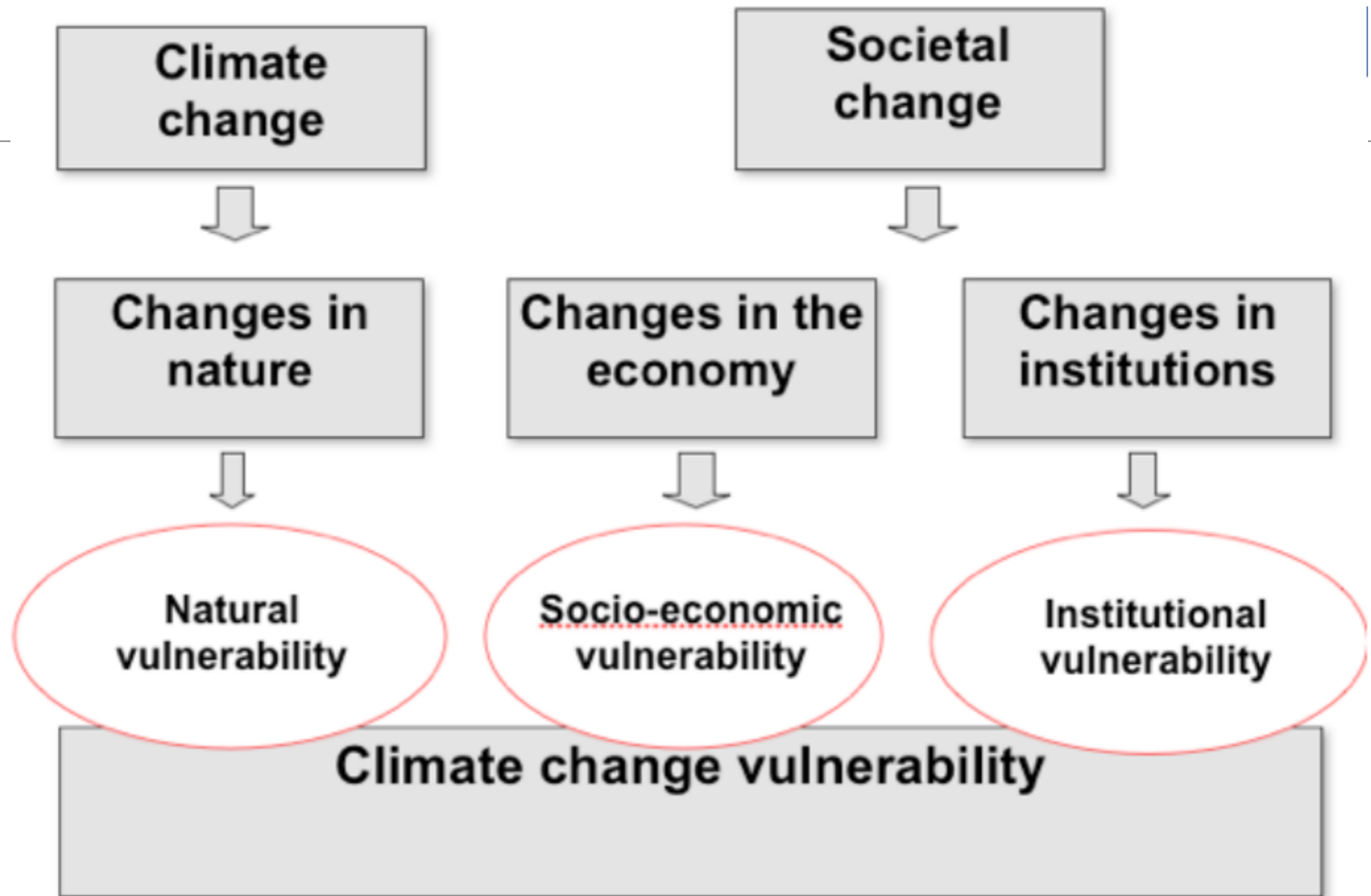


Review the Available Information & Establish a Baseline

Current Baseline For Adaptation

- Current Climate Trends



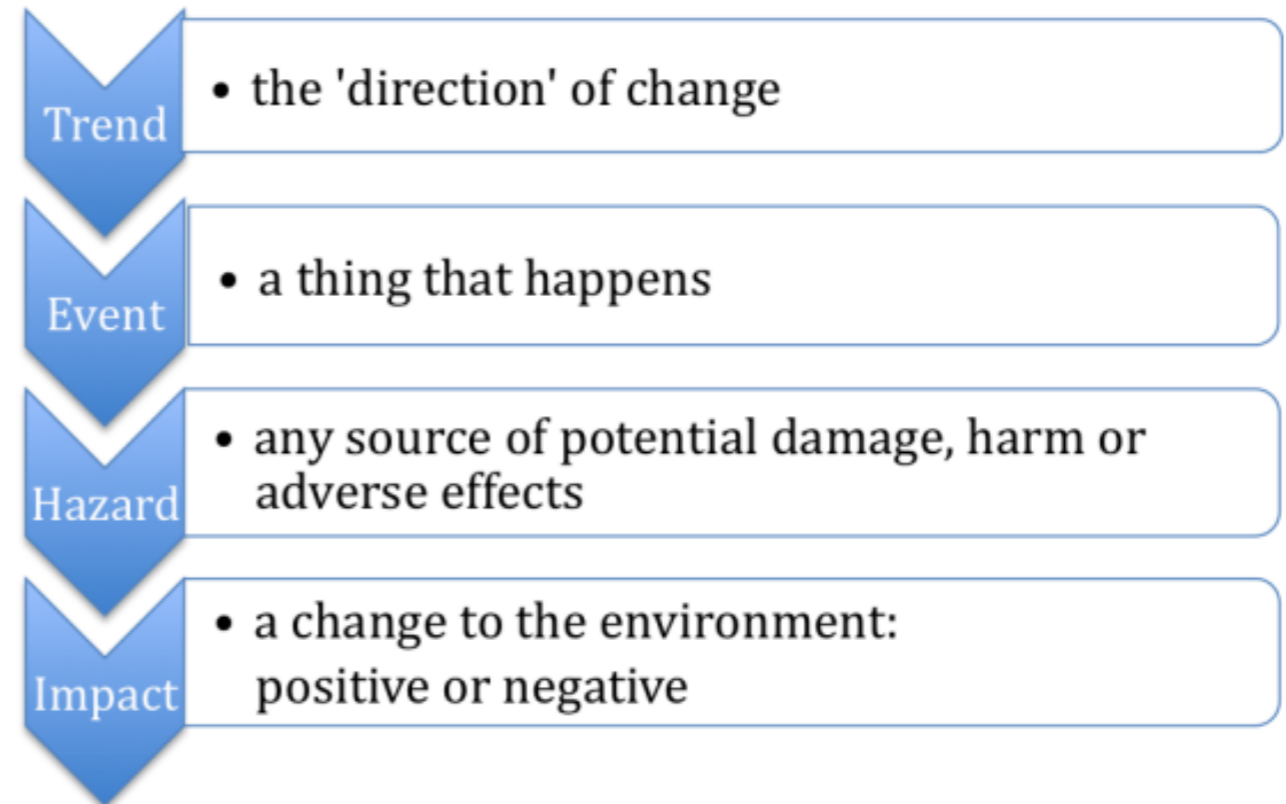


Review the Available Information & Establish a Baseline

- **Current Baseline For Adaptation**

- **Current Climate Trends**

- **Current Climate Change Impacts &**



What is driving your adaptation programme - *current vulnerability* or *future climate change* or both?

Process Stages: Doing Adaptation

2) Review Existing Knowledge & Establish a Baseline

Current Climate Trends Climate Model Projections Current & Future Vulnerability & Impacts

**Current Baseline For
Adaptation**

**Develop Scenarios
For Adaptation**



Review the Available Information & Establish a Baseline

- **Develop Scenarios For Adaptation**
- **Future Climate Change Impacts & Vulnerabilities**





Modell	Utarbeidet av	Oppløsning
HadRM3H	The Met Office Hadley Centre, Storbritannia	50 km
HIRHAM, DMI 50km	Danske Meteorologiske Institut (DMI), Danmark	50 km
HIRHAM, DMI 25km	Danske Meteorologiske Institut (DMI), Danmark	25 km
RCAO, SMHI	Sveriges Meteorologiska och Hydrologiska Insitututs (SMHI) Rossby Centre, Sverige	50 km
CHRM, ETH	Eidgenossische Technische Hochschule (ETH), Sveits	55 km
REMO, MPI	Max-Planck-Institut für Meteorologie (MPI-M), Tyskland	55 km
CLM, GKSS	Deutscher Wetterdienst (DWD) / GKSS Forschungszentrum, Tyskland	55 km
RACMO, KNMI	The European Centre for Medium Range Weather Forecast (ECMWF) / Het Koninklijk Nederlands Meteorologisch Instituut (KNMI), Nederland	50 km
HIRHAM, METNO	Meteorologisk institutt, Norge	55 km

The Bjerknes Centre is a collaboration on climate research, between the University of Bergen, Uni Research, the Institute of Marine Research, Nansen Environmental and Remote Sensing Centre.



What makes a climate model projection?

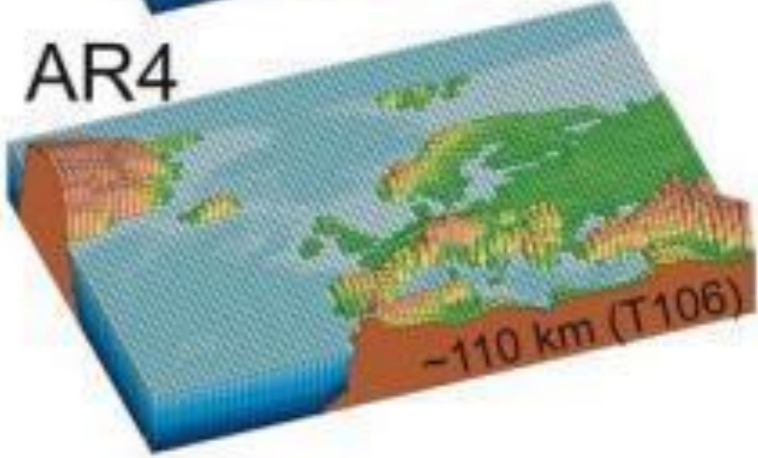
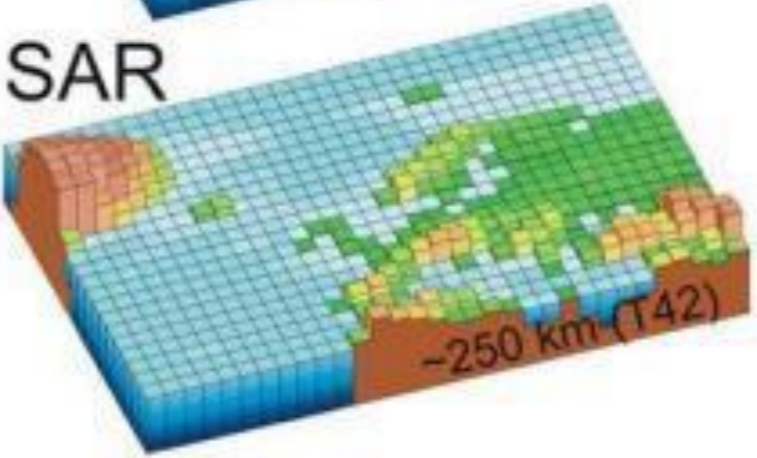
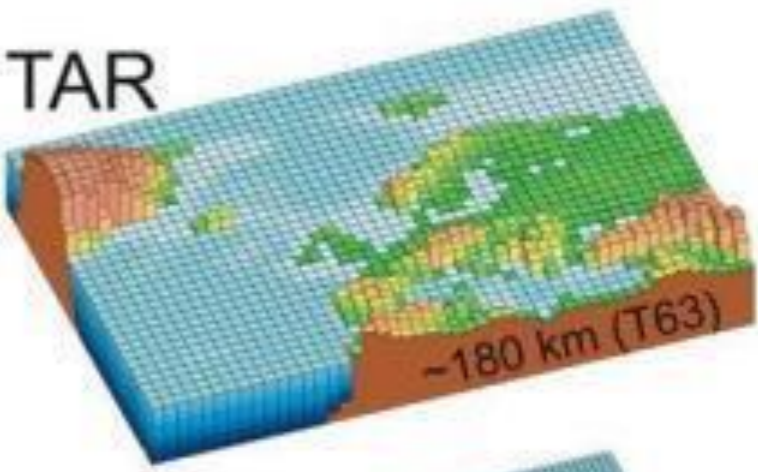
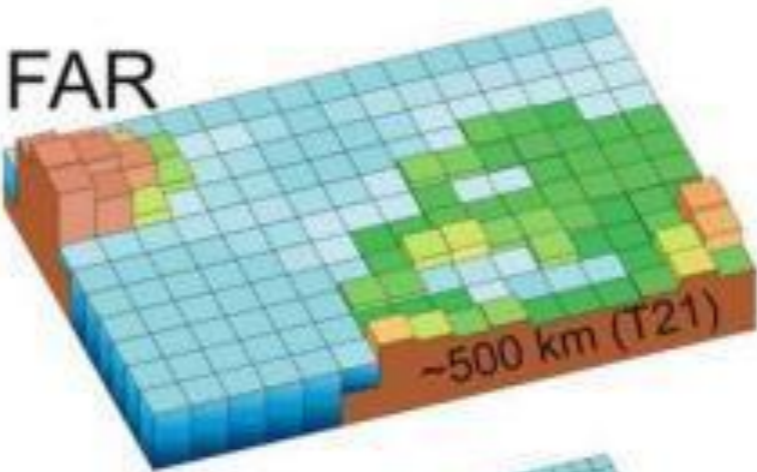
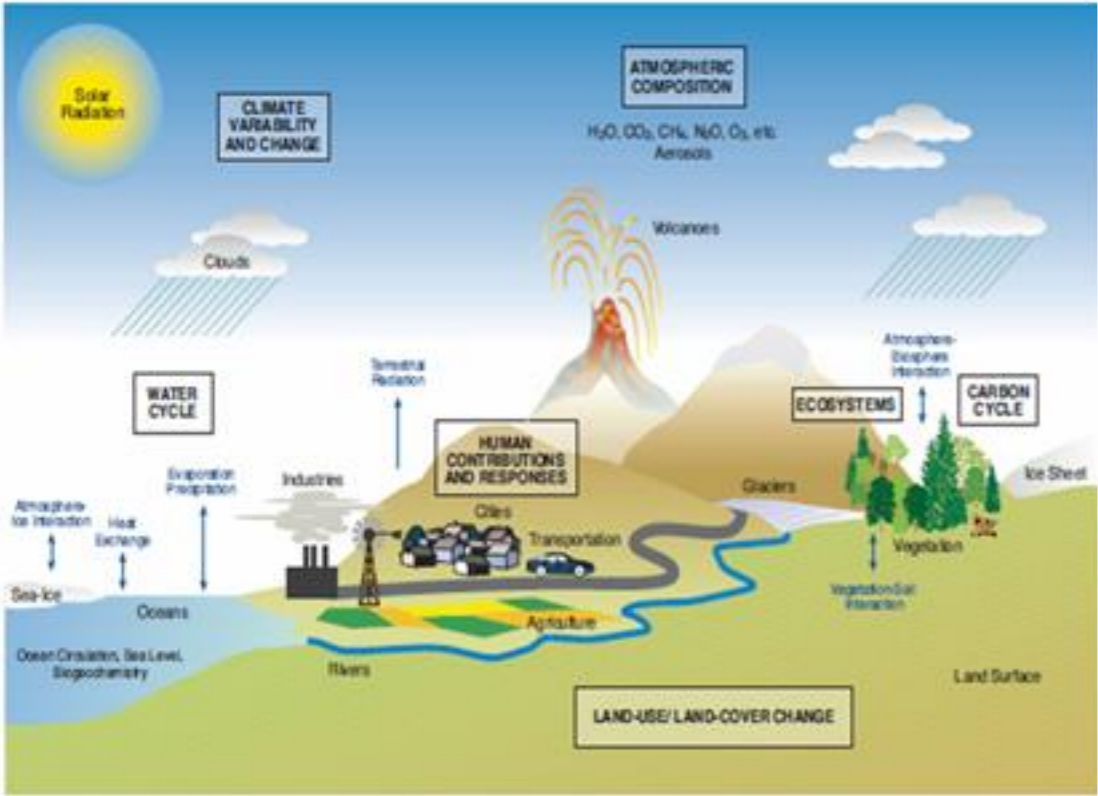
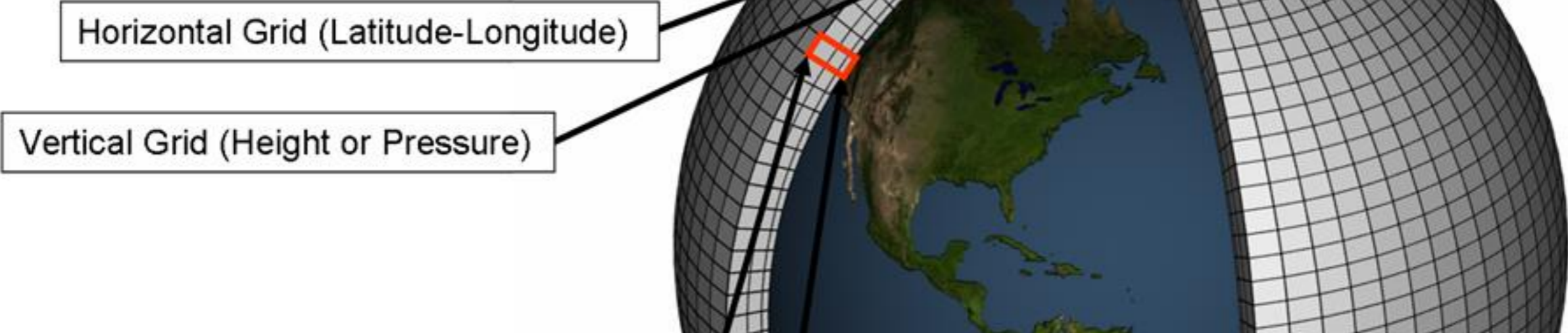
$$T = [(1-\alpha)S/(4\varepsilon\sigma)]^{1/4}$$

- (*T is temperature, α is the albedo, S is the incoming solar radiation, ε is the emissivity, and σ is the Stefan-Boltzmann constant*)

Zero-dimensional - treating the Earth as a point mass at a fixed time.

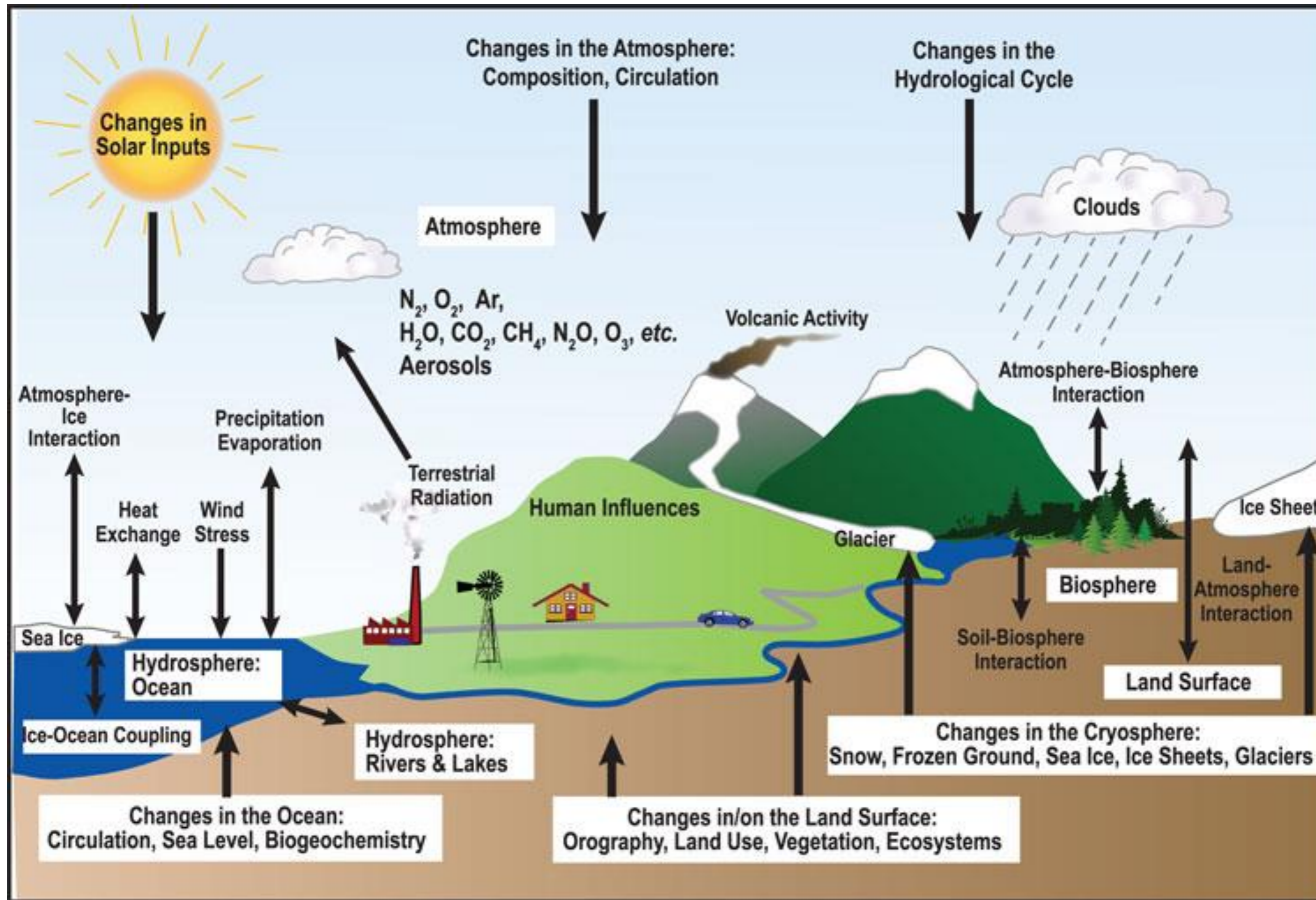
It doesn't consider the greenhouse effect, ocean currents, nutrient cycles, volcanoes, or pollution.

Schematic for Global Atmospheric Model



QuickTime™ and a
decompressor
are needed to see this picture.





(Image: Maslin and Austin, Nature, 2012, 486, 183)

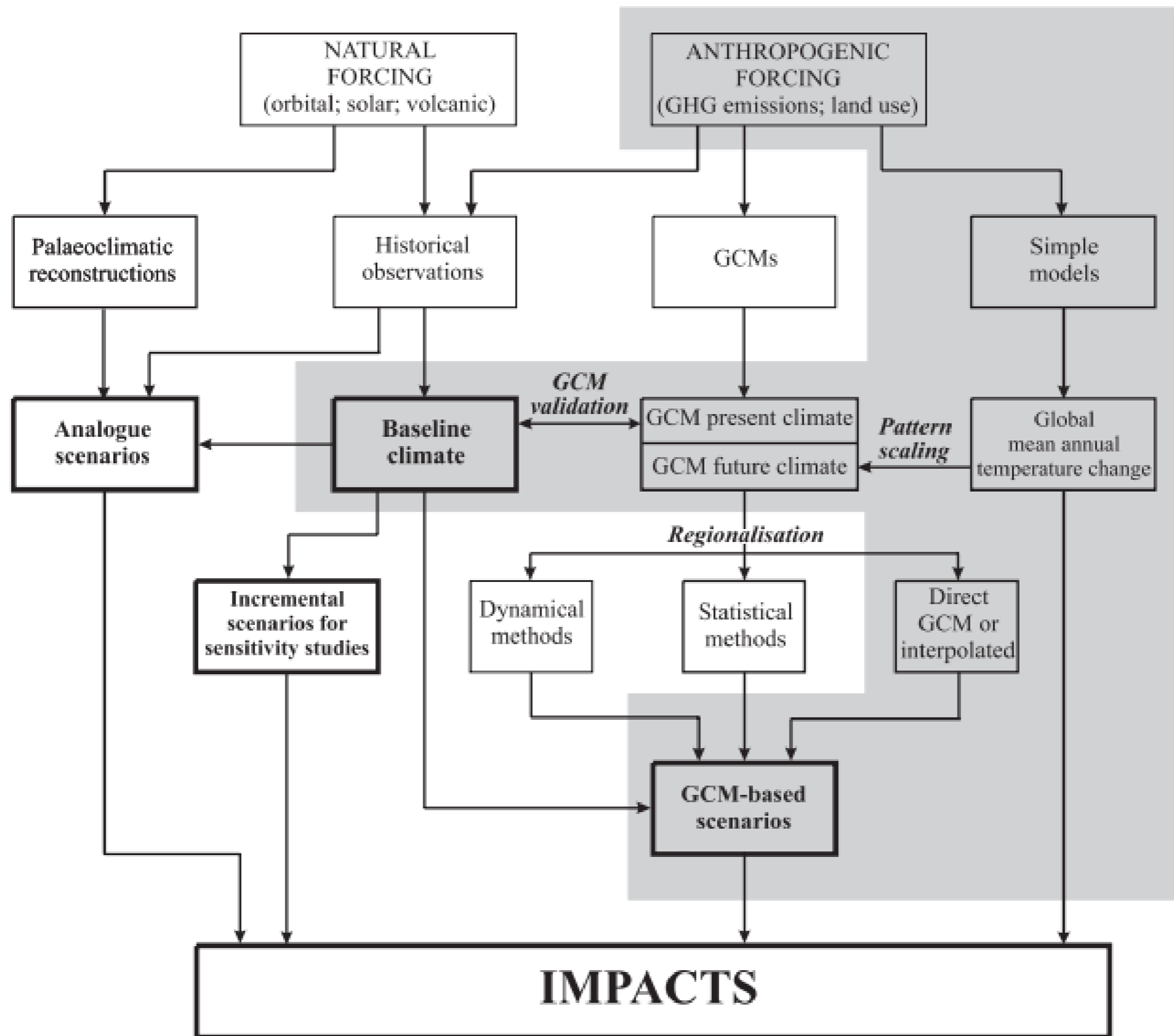


Figure 13.3: Some alternative data sources and procedures for constructing climate scenarios for use in impact assessment. Highlighted boxes indicate the baseline climate and common types of scenario (see text for details). Grey shading encloses the typical components of climate scenario generators.

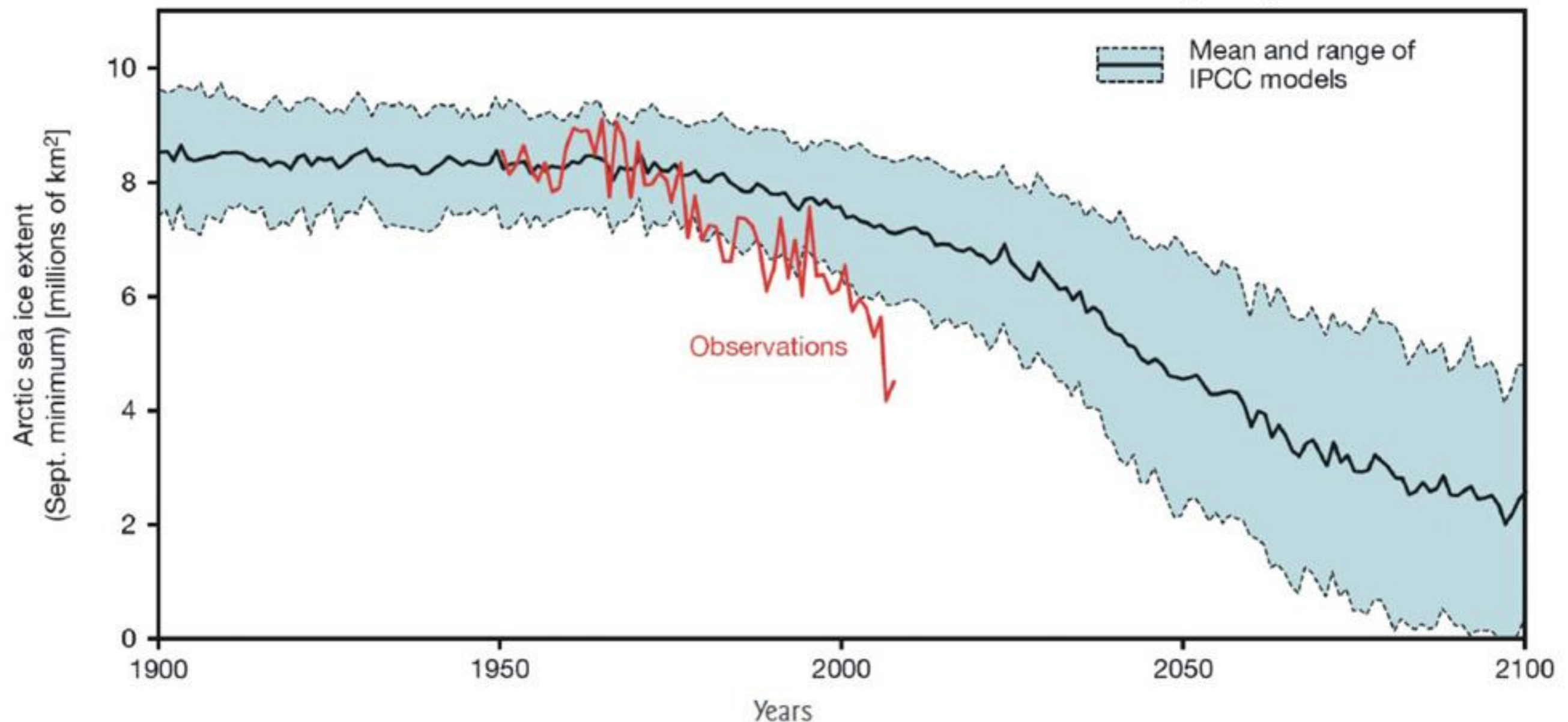
What makes a climate model projection?

- Earlier models were crude and did not account for many fine-grained factors that are now being included (such as the rate at which ice falls through clouds

- ✓ Now that more real world factors are being included, the uncertainties endemic in these factors reveal themselves and get tacked on to the models.



Observed Arctic sea ice extent vs IPCC projections

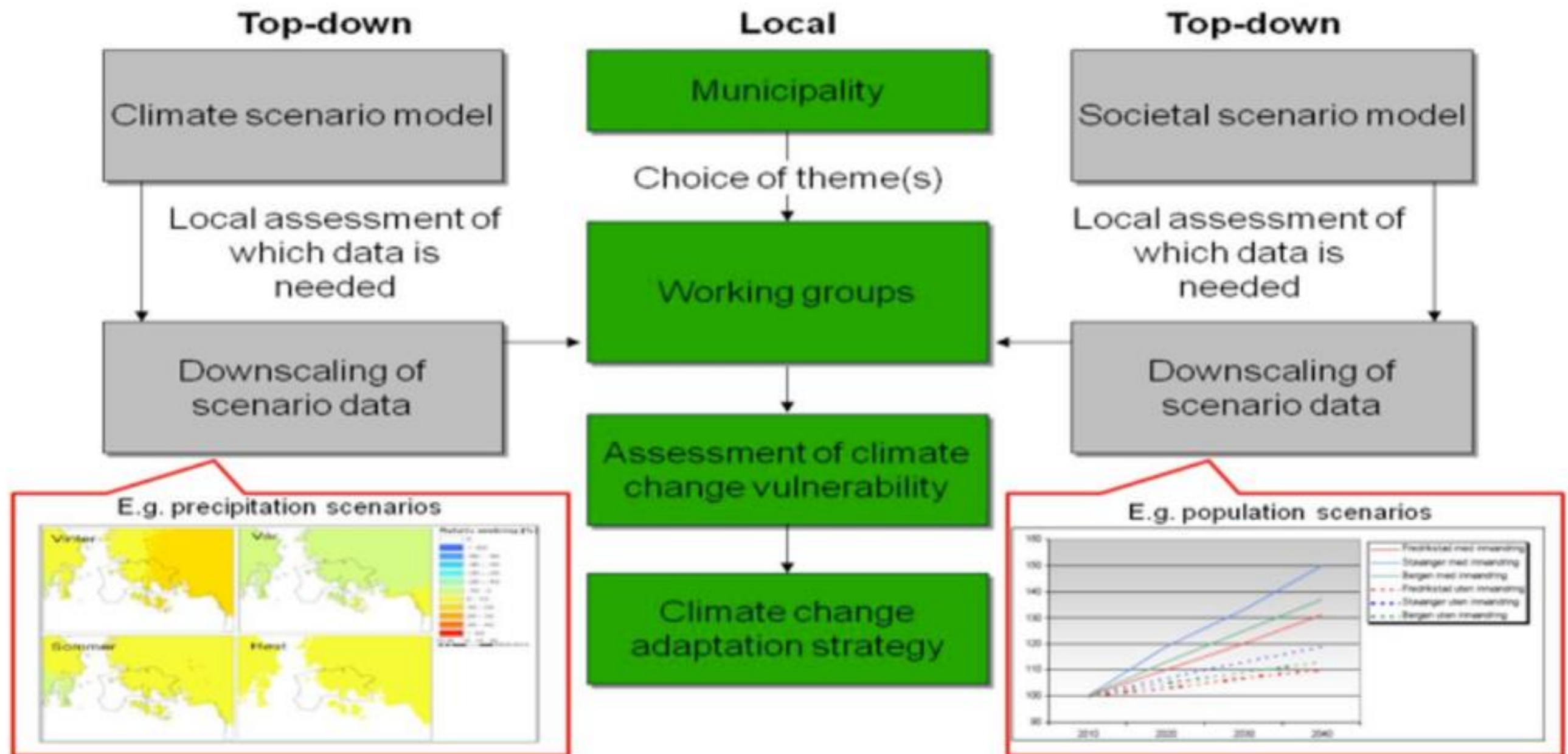


History has shown us that when climate models make mistakes, they tend to be too stable, and *underestimate* the potential for abrupt changes

Copenhagen Diagnosis

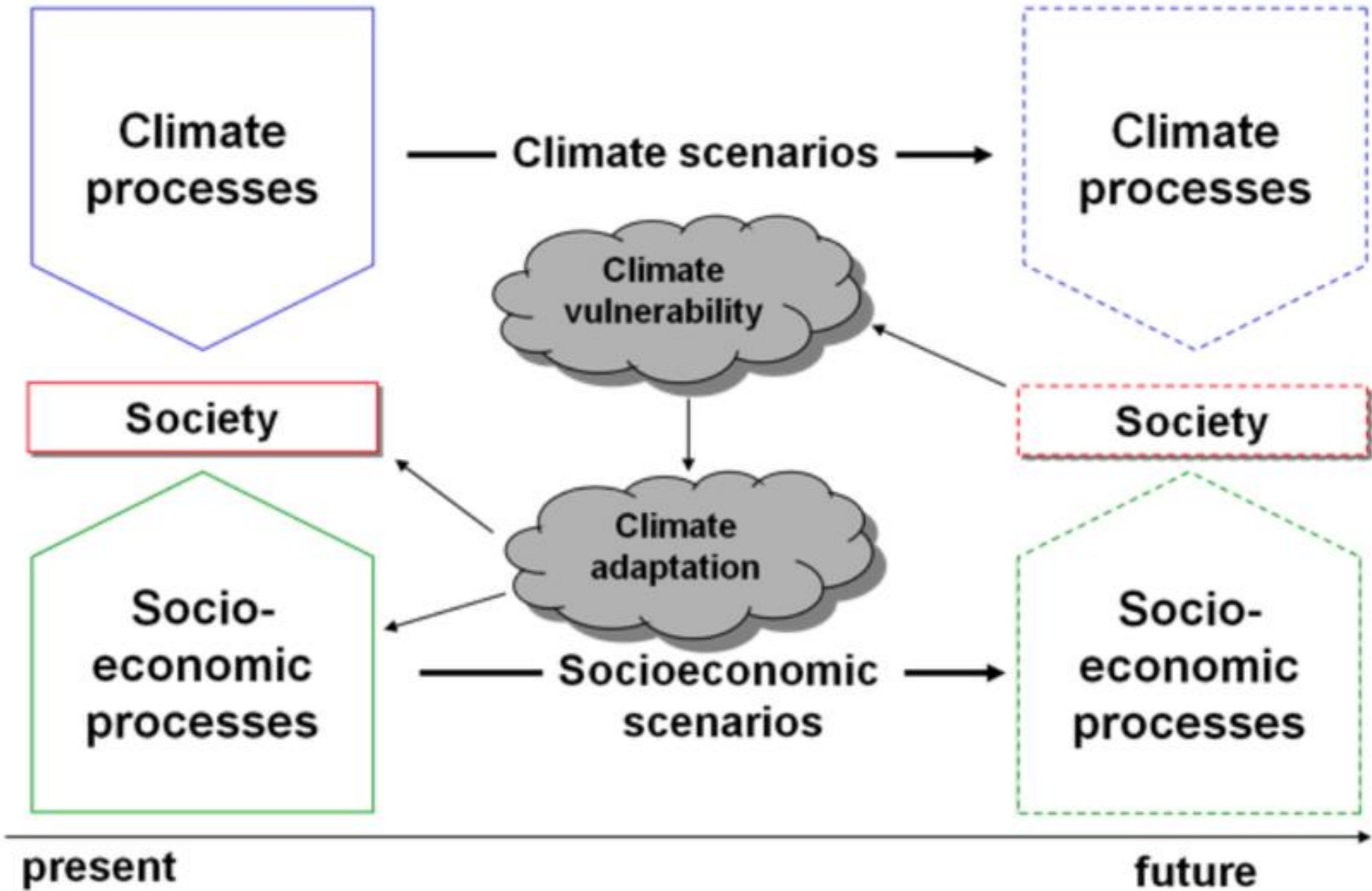
/sks.to/model

Combining the Two Approaches



Sources: Sælensminde and Aall 2010, Selstad 2010

The 'two-dimensional' Approach



Developing Scenarios to Guide Adaptation



Vestlandsforskning-rapport nr. 4/2008

Naturskade i kommunene

Sluttrapport fra prosjekt for KS

Kyrre Groven, Hege Høyer Leivestad og Carlo Aall, Vestlandsforskning
Tor Selstad, Østlandsforskning
Øyvind Armand Høydal, Norges Geotekniske Institutt
Aud Solveig Nilsen og Synnøve Serigstad, Universitetet i Stavanger



First of it's kind in Norway.

Developed scenarios for both climate and society at the local (municipality) level and systematically tried to connect themes of these scenarios to achieve better insight into future climate vulnerability.

Community scenarios built around a simple model

- (1) population,*
- (2) employment and business,*
- (3) community and built structures a*
- (4) attitudes*

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A2 storyline & family of scenarios



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	A1b	A1f	A1t	A2	B1	B2
Population growth	low	low	low	high	low	medium
Economic growth	very high	very high	very high	medium	high	medium
Energy use	very high	very high	high	high	high	medium
Pace of changes in technology	rapid	rapid	rapid	slow	medium	medium
Technological changes favoring	balance of energy options	coal, oil, & gas	non-fossil fuels	varied by region	clean & resource efficient	varied by region
Environmental awareness	low	low	low	varied by region	high	high
Focus on social equality	low	low	low	varied by region	high	high
Scale	global	global	global	local/ regional	global	local/ regional



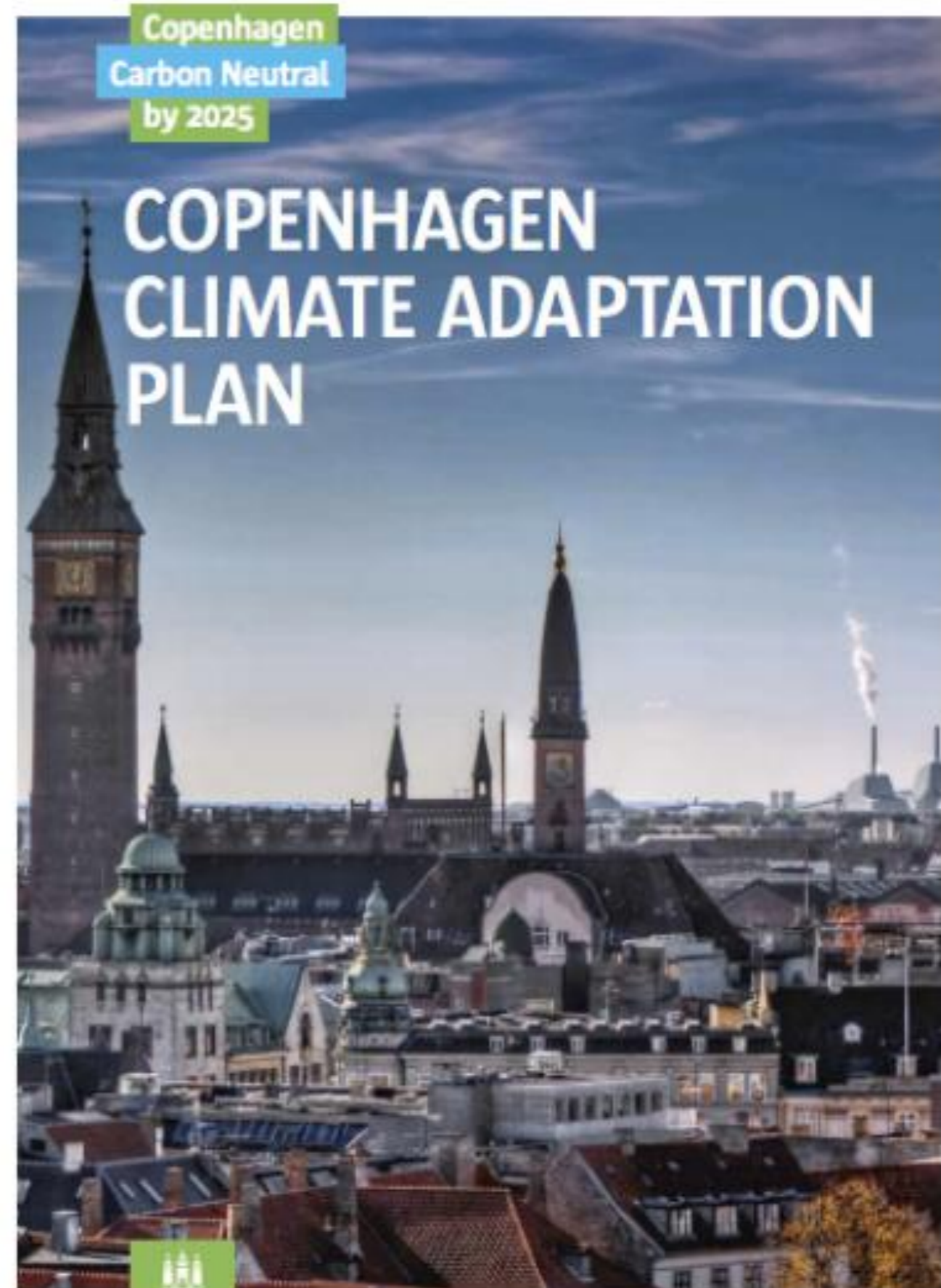
Using IPCC Scenarios

The climate adaptation plan adopts a development scenario in line with the **SRES A2** scenario as presented by the UN's Intergovernmental Panel on Climate Change (**IPCC**).

The Ministry of Climate and Energy in Denmark recommended that municipalities apply the **IPCC's A1B** scenario for planning in relation to climate change over the next 50 years.

This recommendation came after work on the Copenhagen plan had been carried out

What are these different scenarios?



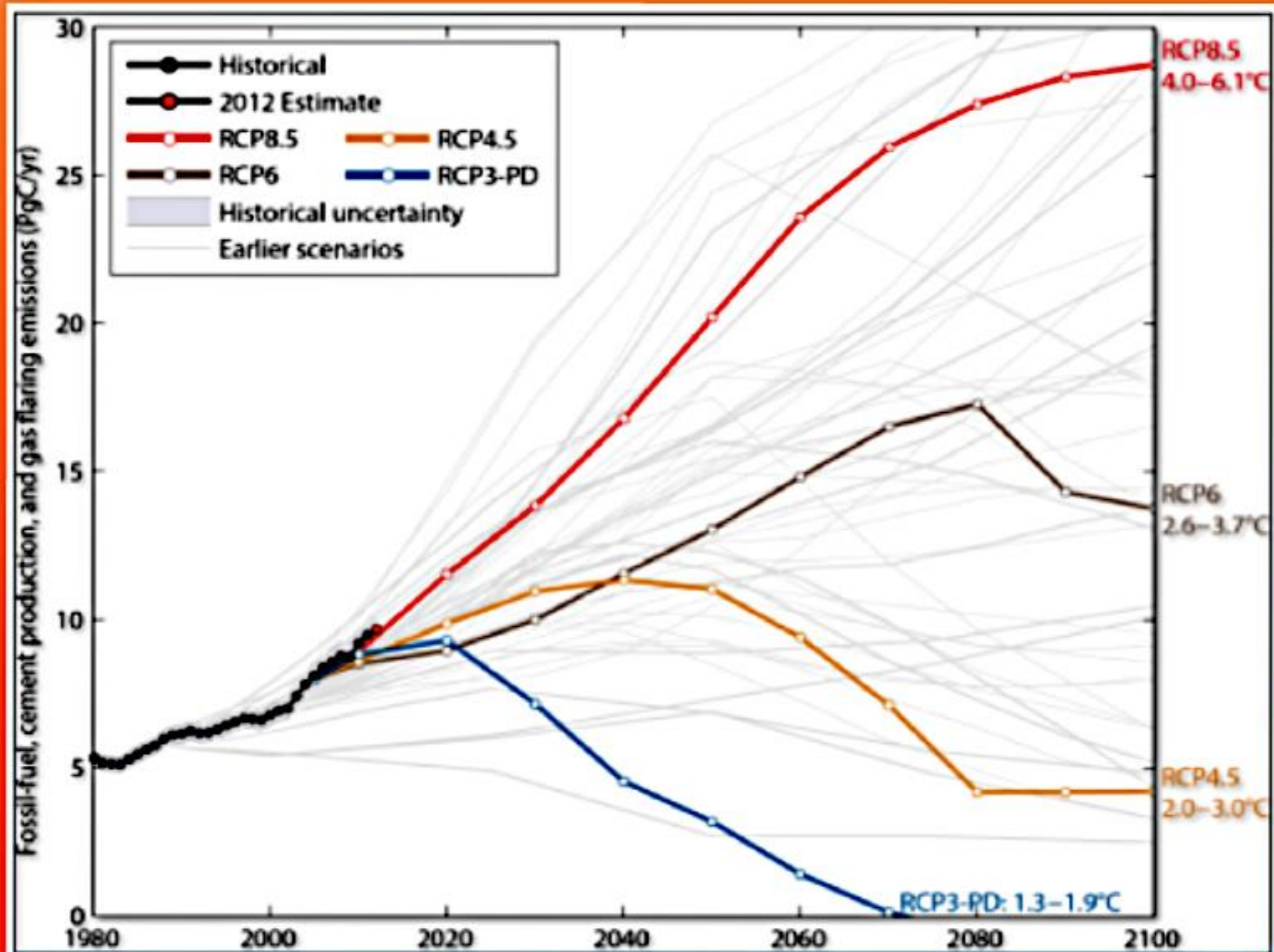
IPCC Scenarios

- **The A1 storyline** and scenario family describes a future world of very rapid economic growth, global population that peaks in the mid-century and declines thereafter and the rapid introduction of new and more efficient technologies.

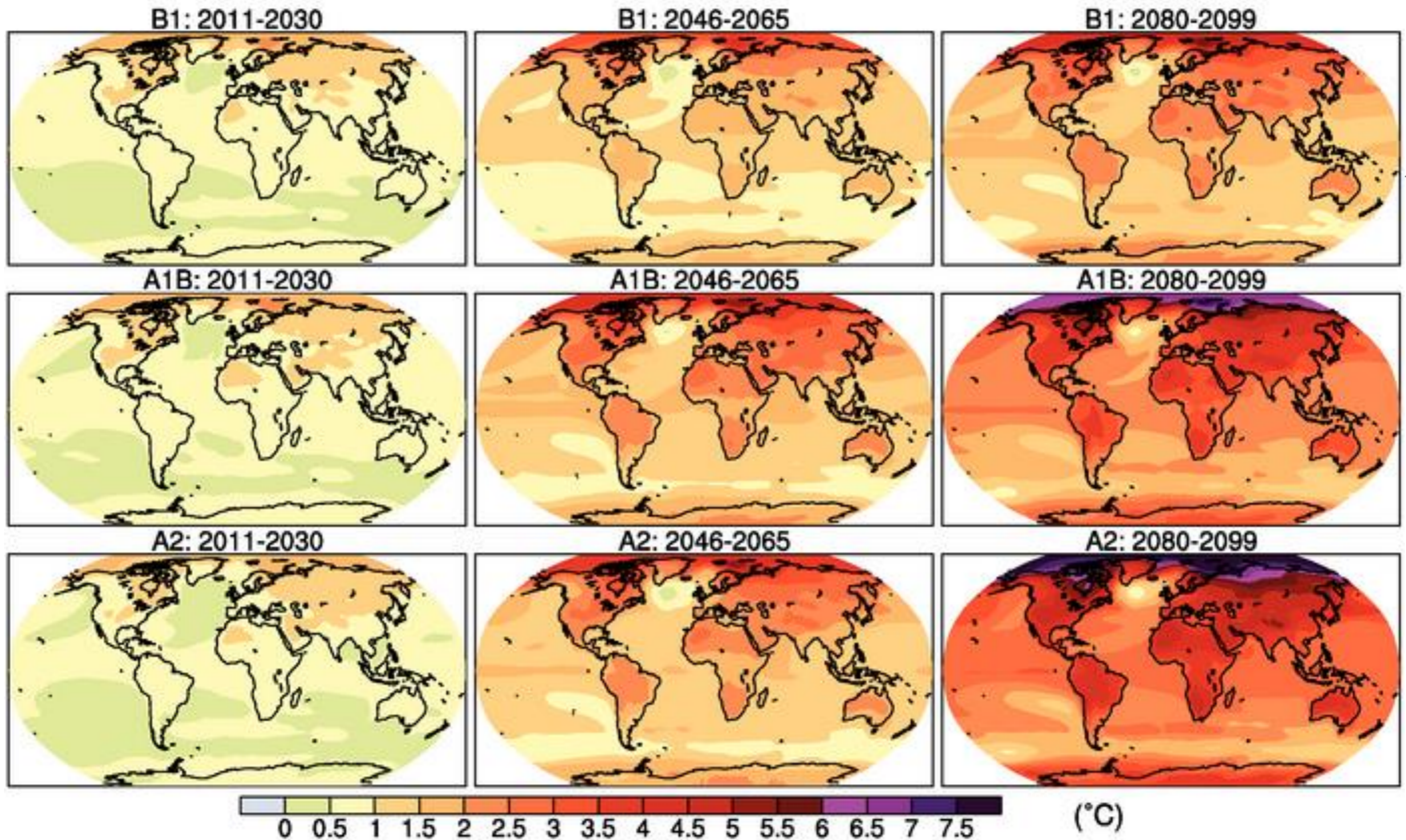
balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end-use technologies.



REPRESENTATIVE CONCENTRATION PATHWAYS (RCPs)



Four RCPs were selected and defined by their total radiative forcing (cumulative measure of human emissions of GHGs from all sources expressed in Watts per square meter) pathway and level by 2100. The RCPs were chosen



This model output shows temperature change over the next century, depending on how many greenhouse gases we emit:

Sample Vulnerability Assessment

Planning Area	Current and Expected Stresses	Projected Climate Change Impacts	Vulnerability Assessment		
			Sensitivity	Adaptive Capacity	Vulnerability
Water supply	Summer drought	Increases in summer droughts due to warmer, drier summers	High - water supply is very sensitive to changes in snowpack	Low - numerous regulatory constraints on reallocating water, options for expanding supply limited, summer demand already greater than supply	High
Stormwater management	Combined sewer overflows (CSOs) during heavy rainstorms	More localized flooding, water quality problems possible if precipitation becomes more intense and/or frequent	High - CSO events are sensitive to changes in the intensity and frequency of rain events	Medium - can upgrade the system but costly; some upgrades already underway	Medium

UKCIP 'Adaptation Wizard' (2010)

Table 2.1

How have previous weather events affected your municipality/ organisation?

Describe past weather events that have affected your organisation, giving specific details of each particular weather event where possible.
Identify the consequences of those weather events for your organisation and quantifying these as far as possible.
From those consequences, identify any critical thresholds that were exceeded. For example, a windspeed above which operations have to stop for health and safety reasons; a temperature threshold above which staff performance or customer complaints increase significantly; a point at which quality of service fines maybe imposed.
Make a note of your information sources, and how confident you are in that information. For example, if you draw on news sources and your organisation's own records, you may have more confidence in one source of information than the other.
Reanalyse the records you think could increase your organisation's understanding of the impacts of particular past weather events.
Identify which records could be monitored in an on-going basis.

<p>Completed by:</p> <p>Date:</p>							
a	b	c	d	e	f	g	h
Type of weather event (a)	Specific event (b)	Identify any critical thresholds (the point at which sudden or rapid change occurs) (c)	Impact(s) (d)	Consequence(s) (e)	Actions taken to address impact (f)	Effectiveness of those actions (g)	Source & credibility of information (h)
<p>For example:</p>							
High summer temperatures	Very hot summer in 2012 with temperatures often in excess of 30°C	Internal office temperatures exceed 28°C	Offices overheated	Staff uncomfortable	Relax dress code; flexible working hours; use fans; supply staff with cold drinking water	highly effective though needed initial high spend to buy fans and water	Past experience. Reliable
Other examples could include: Mild winter temperatures, dry summer, wet winter, rising sea level							

Blending Natural & Socio-Economic Vulnerability

How to Assess the Total Climate Change Vulnerability

		Natural vulnerability		
		Effect N1 (e.g. increased risk of avalanches)	Effect N2 (e.g. increase in growth season)	Effect N3 (e.g. sea-level rise)
Socio-economic and institutional vulnerability	Effect S1 (e.g. centralisation)	Does S1 lead to changes in conclusions regarding N1?	etc	
	Effect S2 (e.g. more buildings close to the sea)			
	Effect S2 (e.g. poorer maintenance of public buildings)			

Grading potential impacts

Likelihood	Consequence				
	1.Catastrophic	2.Major	3.Moderate	4.Minor	5.Insignificant
A. Very likely	1A	2A	3A	4A	5A
B. Likely	1B	2B	3B	4B	5B
C. Medium	1C	2C	3C	4C	5C
D. Unlikely	1D	2D	3D	4D	5D
E. Very unlikely	1E	2E	3E	4E	5E

Source: Adapted from NZCCO 2004; CSIRO et al., 2007; IPCC, 2007



- **HORDAKLIM** - Climate Service for Hordaland, scale down climate models and to tailor climate data for Hordaland's municipalities - Erik Kolstad Uni Research Climate

- Current climate models of poor resolution irrelevant for Hordaland. A lack of knowledge about how the climate will develop could result in considerable economic

m

- *Bergen needs more definite data about the intensity of daily rainfall over the forthcoming years. When the city council has to make decisions about whether to trade their pine systems, they have often*



“In grappling with long-term climate change, it is natural to turn to climate modeling for guidance ...

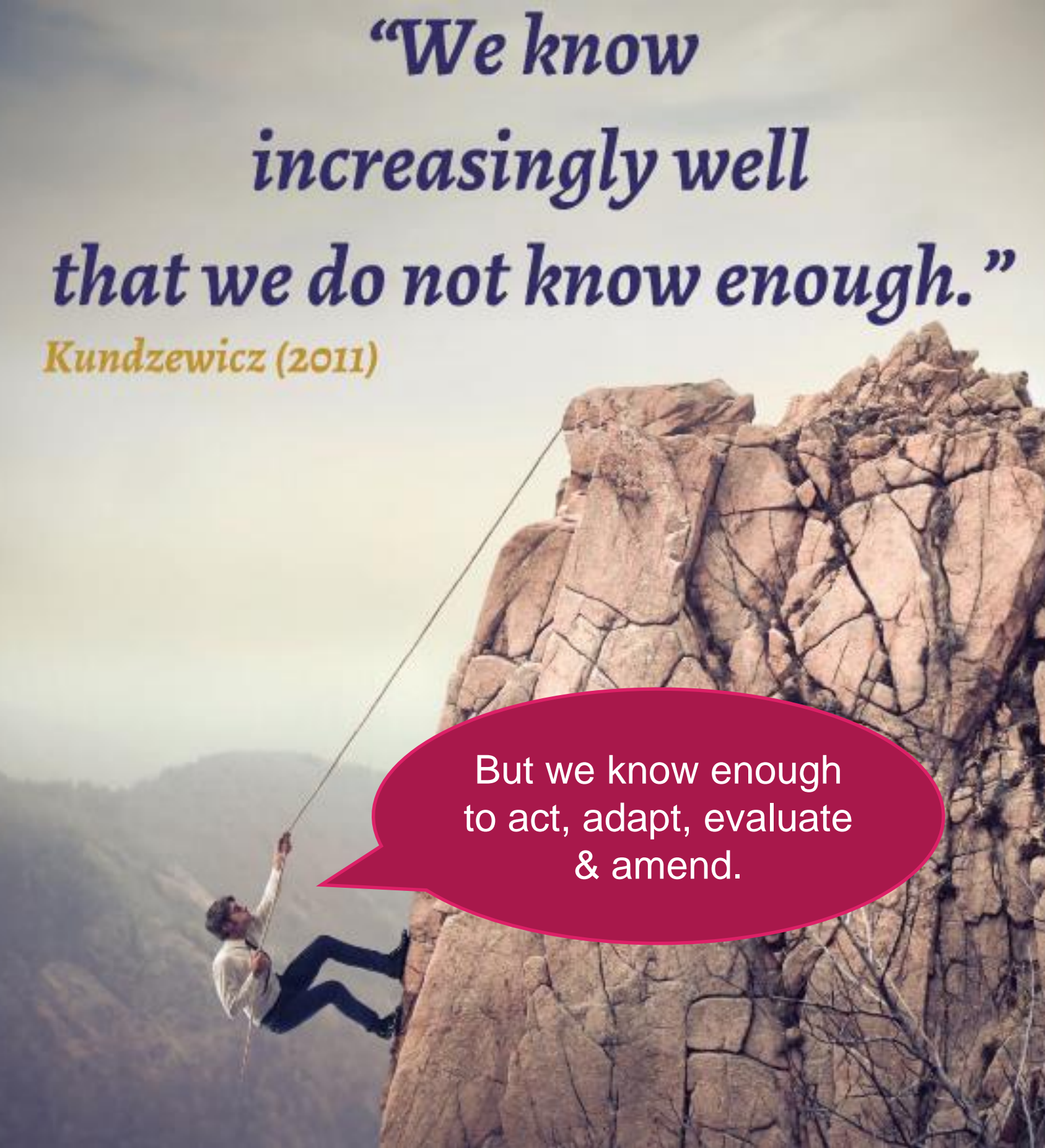
The models, which are essential for elucidating the global climate system, have been informative in some applications related to agriculture or water development over large regions.

But for many planning and design applications, especially when applied to smaller areas, to precipitation, and to extreme events, **models often give too wide a dispersion of readings to provide useful guidance.** A review of the application of these models...found that they are often used as a backdrop for urging the adoption of ‘no-regret’ actions, and rarely for quantitative decision-making on options.”

Adapting to Climate Change: Assessing the World Bank Group Experience.
Independent Evaluation Group (IEG)- World Bank/IFC/MIGA. Washington, DC,
2012. Overview, pp xxii-xxiii

***“We know
increasingly well
that we do not know enough.”***

Kundzewicz (2011)

A person is rappelling down a steep, rocky cliff face. The person is wearing a light-colored shirt and dark pants, and is holding onto a rope that extends from the top of the cliff. The cliff face is composed of large, reddish-brown rock blocks. In the background, there are more cliffs and a valley.

But we know enough
to act, adapt, evaluate
& amend.

**Thank you
Sibiu**