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What Are “Key Vulnerabilities” and Do They Relate to, “Dangerous” Climate Change?

Yale Symposium

21 October 2005

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or climatechange.net

Key vulnerabilities are a product of the exposure of systems and populations to climate change, the sensitivity of those systems and populations to such influences, and the capacity of those systems and populations to adapt to them

Objective and subjective criteria for assessing and defining key vulnerabilities:

- Magnitude
- Timing
- Persistence and reversibility
- Likelihood and confidence
- Potential for adaptation
- Importance of the vulnerable system

General conclusions from the literature:

*Global mean temperature changes associated with different key vulnerabilities that are global in scale typically range from 1.5 to 4°C above pre-industrial temperature (corresponding to ~0.8 to 3.3ºC above current temperatures). Temperature changes associated with different key vulnerabilities that are regional or local in scale range from 0.5 to >5ºC above pre-industrial levels.

*Some impacts of climate change that are already underway have been identified in some studies as key vulnerabilities. Among these are loss of glaciers, adverse impacts on biodiversity, increases in severity of extreme events, and loss of cultural amenities.

*World regions that are already at high risk from current climate variability are more likely to be adversely affected by anthropogenic climate change in the near future.

Munich Re:
“We need to stop this dangerous experiment humankind is conducting on the Earth’s atmosphere.”

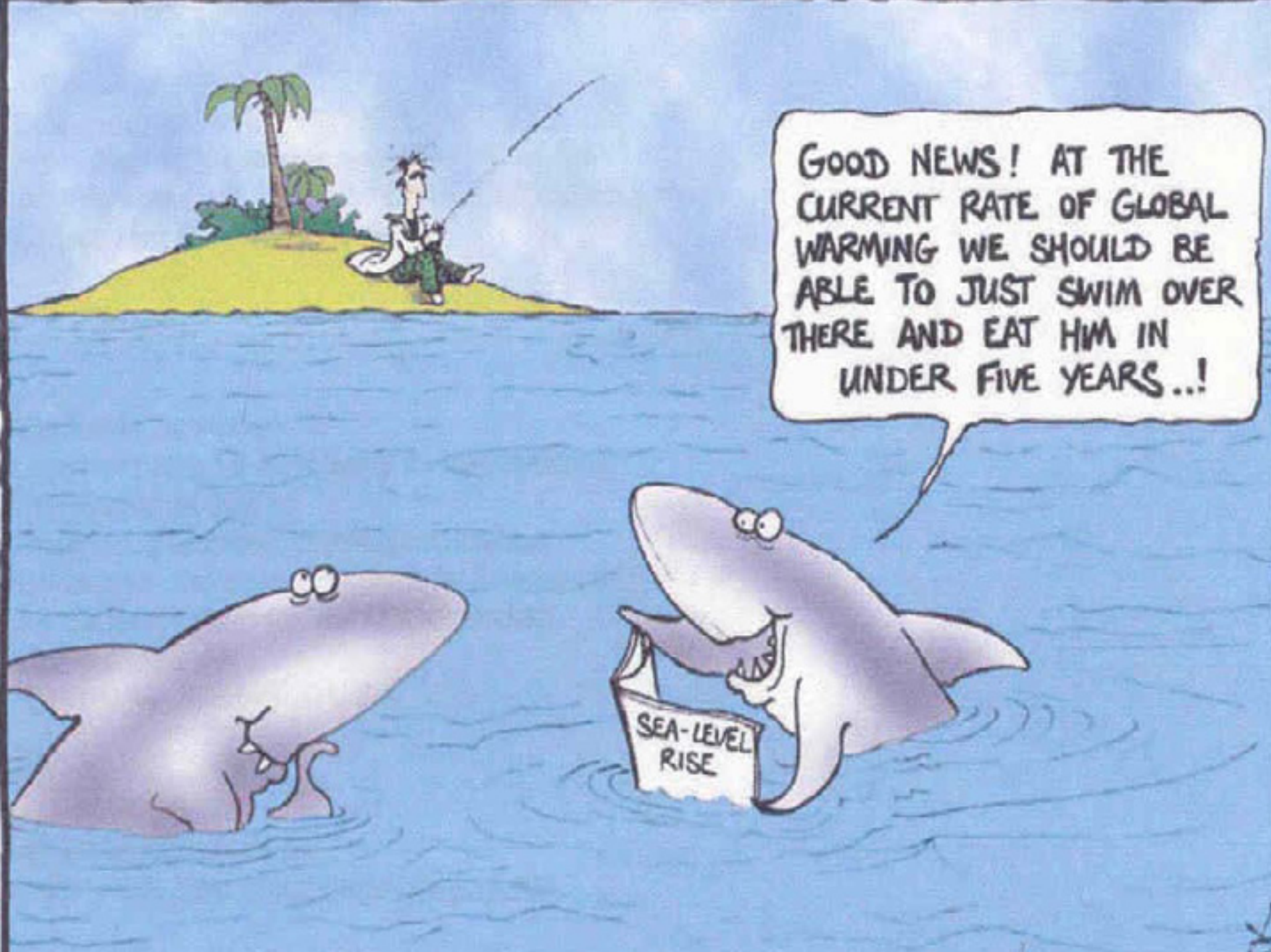
What does “dangerous” climate change really mean?

Article 2 of the UN Framework Convention on Climate Change (UNFCCC) states that: The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Framework Convention on Climate Change further suggests that "Such a level should be achieved within a time frame sufficient

- to allow ecosystems to adapt naturally to climate change,
- to ensure that food production is not threatened and
- to enable economic development to proceed in a sustainable manner."

“Dangerous” Climate Change

- Who decides what is “dangerous” in DAI?


GOOD NEWS! AT THE CURRENT RATE OF GLOBAL WARMING WE SHOULD BE ABLE TO JUST SWIM OVER THERE AND EAT HIM IN UNDER FIVE YEARS..!
SEA-LEVEL RISE

“Dangerous” Climate Change

- Who decides what is “dangerous” in DAI?
- Many ways to define DAI

“Dangerous” Climate Change

Who decides what is “dangerous” in DAI?

Many ways to define DAI

Ultimately, not a scientific choice

Climate Uncertainty

- Inherent uncertainty in projections of future climate

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- Best guess → Range → PDFs

Climate Uncertainty

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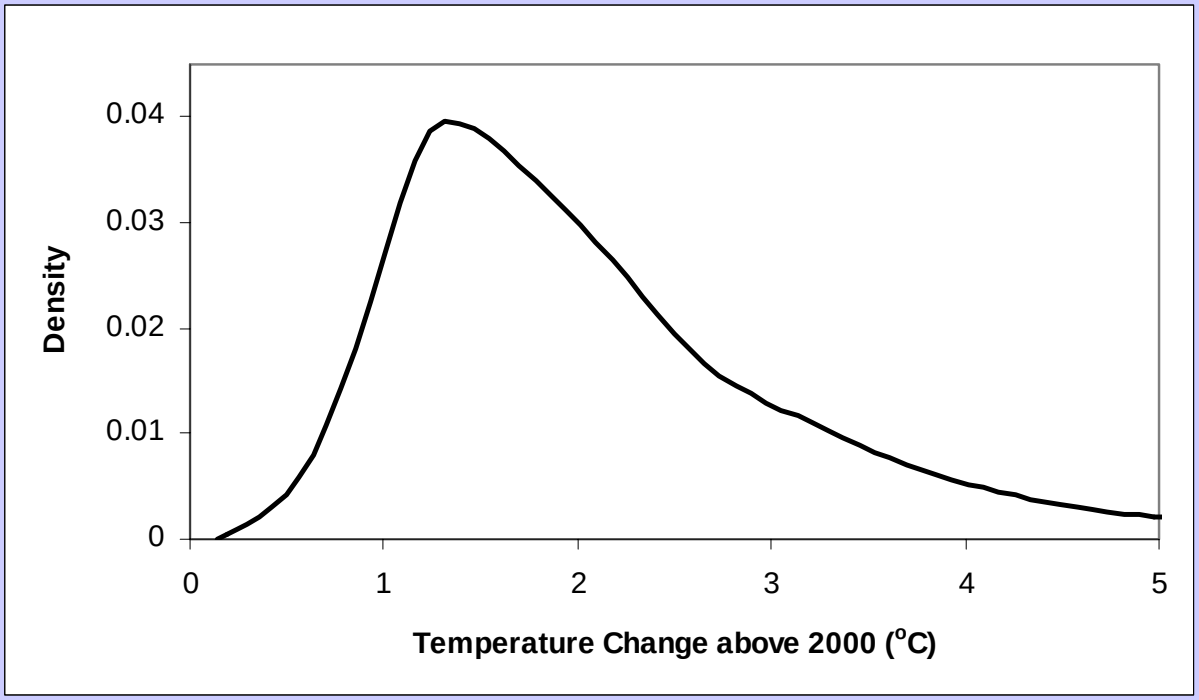


Climate Uncertainty

- Inherent uncertainty in projections of future climate

- Best guess → Range* → PDFs

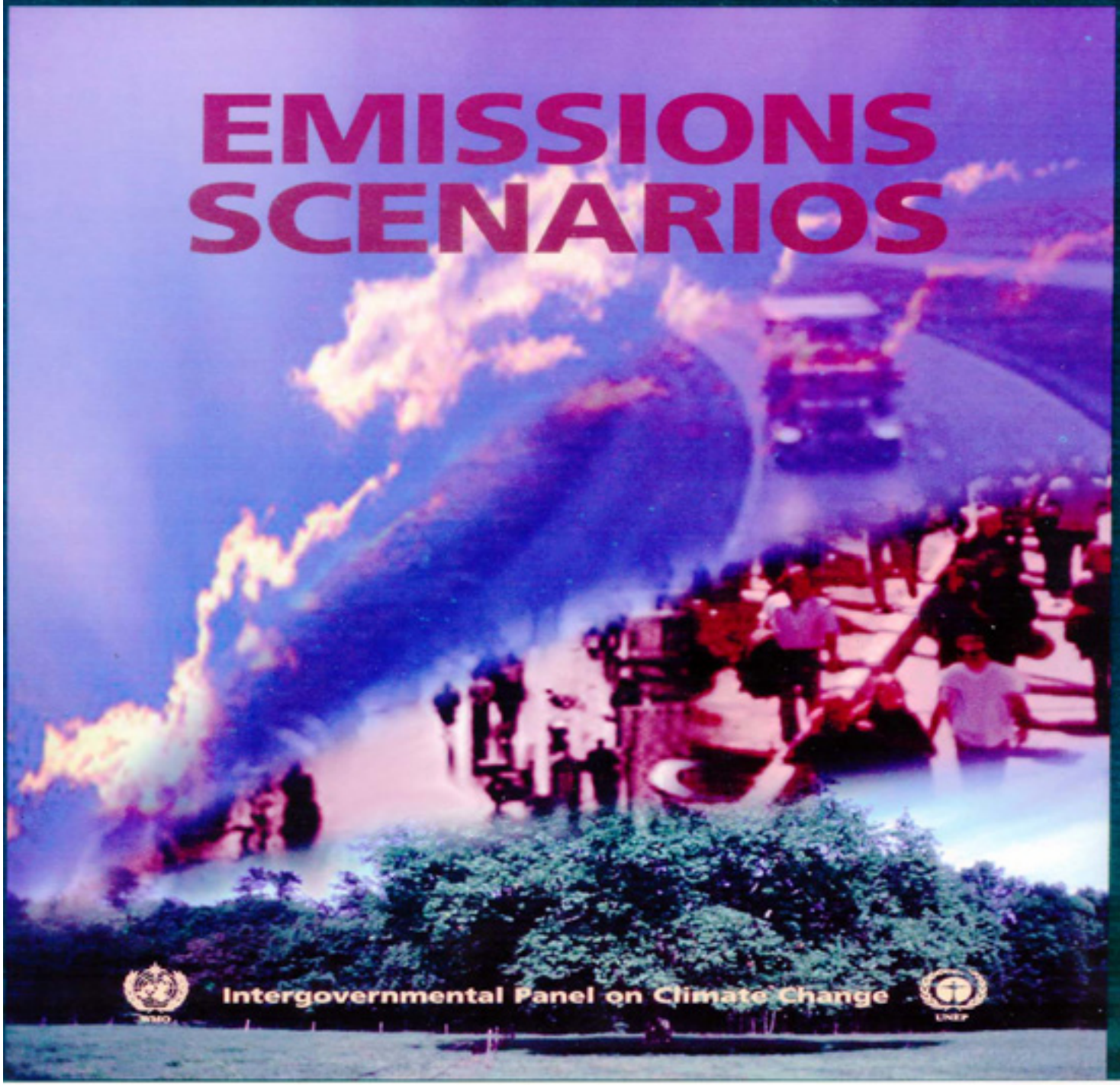
*Climate Sensitivity: 1.5→4.5 C:

Charney Report (1979?)

(with Bob Dickinson prime mover)

Probabilistic assessment??

EMISSIONS SCENARIOS



Intergovernmental Panel on Climate Change

Projected CO_2 concentrations using IPCC storylines

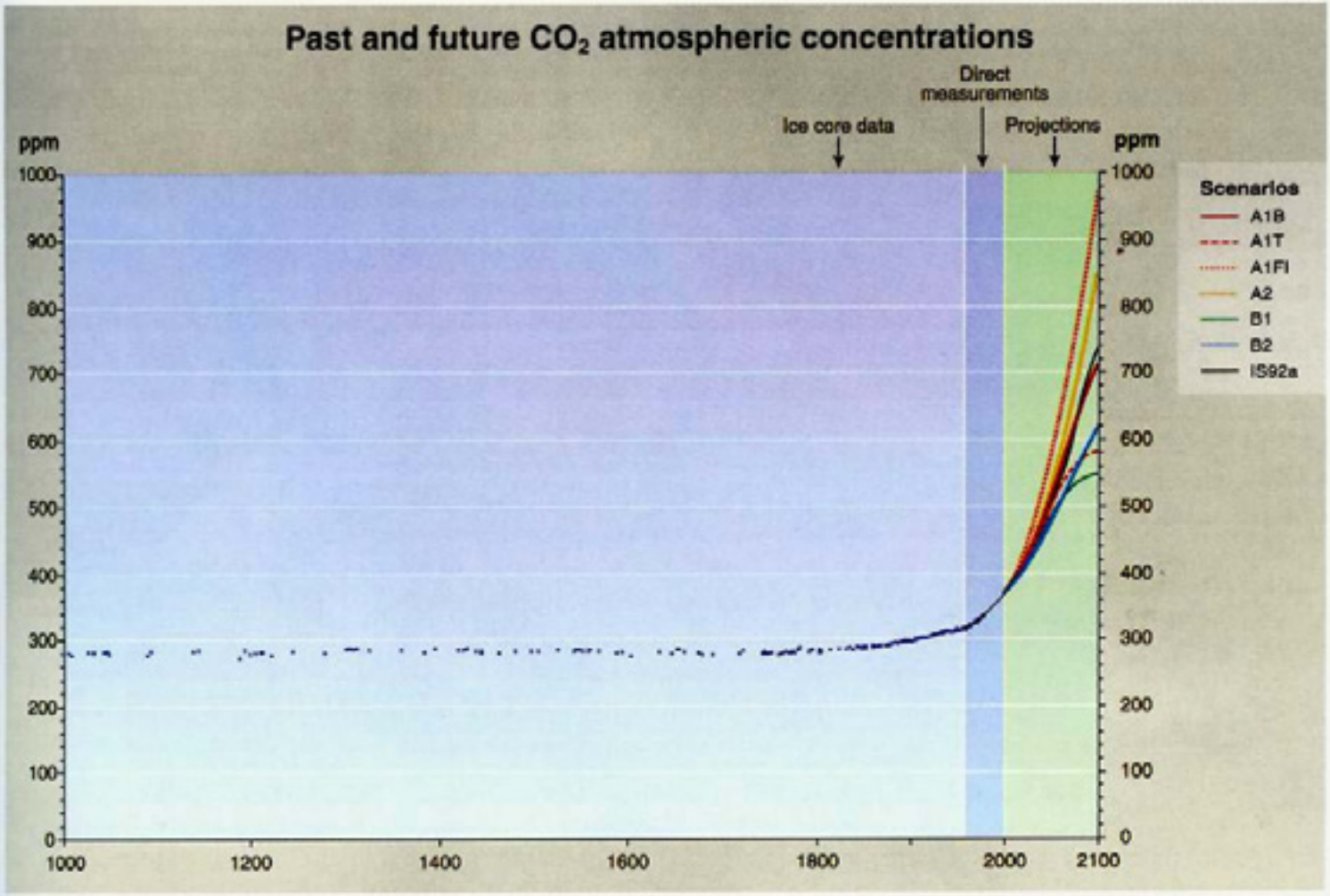


Figure SPM-10a: Atmospheric CO_2 concentration from year 1000 to year 2000 from ice core data and from direct atmospheric measurements over the past few decades. Projections of CO_2 concentrations for the period 2000 to 2100 are based on the six illustrative SRES scenarios and IS92a (for comparison with the SAR).

O9 Figure 9-1a

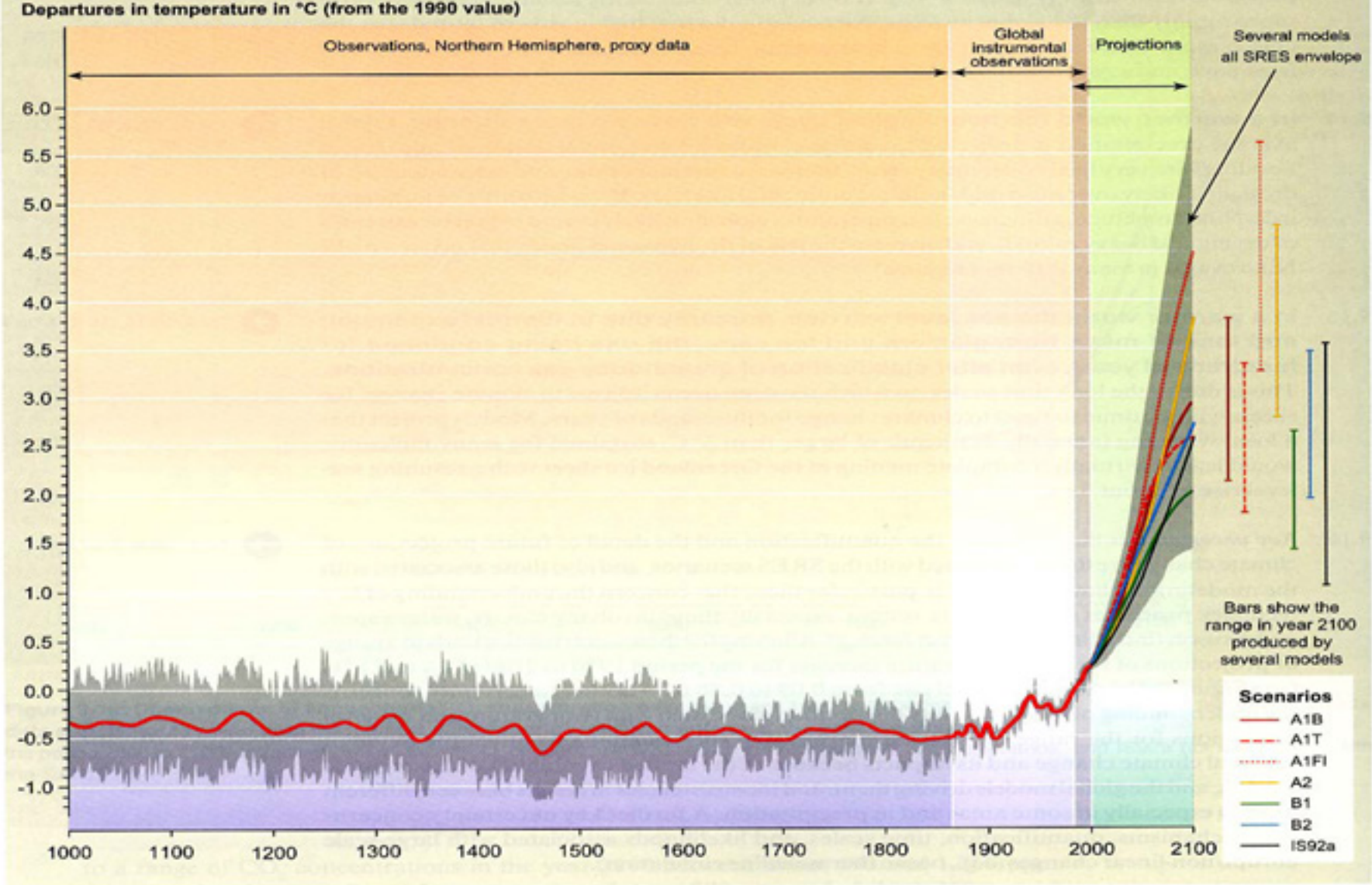


Figure 9-1b: Variations of the Earth's surface temperature: years 1000 to 2100. Over the period 1000 to 1860, observations are shown of variations in average surface temperature of the Northern Hemisphere (corresponding data from the Southern Hemisphere not available) constructed from proxy data (tree rings, corals, ice cores, and historical records). The line shows the 50-year average, and the grey region the 95% confidence limit in the annual data. From the years 1860 to 2000, observations are shown of variations of global and annual averaged surface temperature from the instrumental record. The line shows the decadal average. Over the period 2000 to 2100, projections are shown of globally averaged surface temperature for the six illustrative SRES scenarios and IS92a as estimated by a model with average climate sensitivity. The grey region "several models all SRES envelope" shows the range of results from the full range of 35 SRES scenarios in addition to those from a range of models with different climate sensitivities.

WGI TAR SPM Figures 1b & 5d

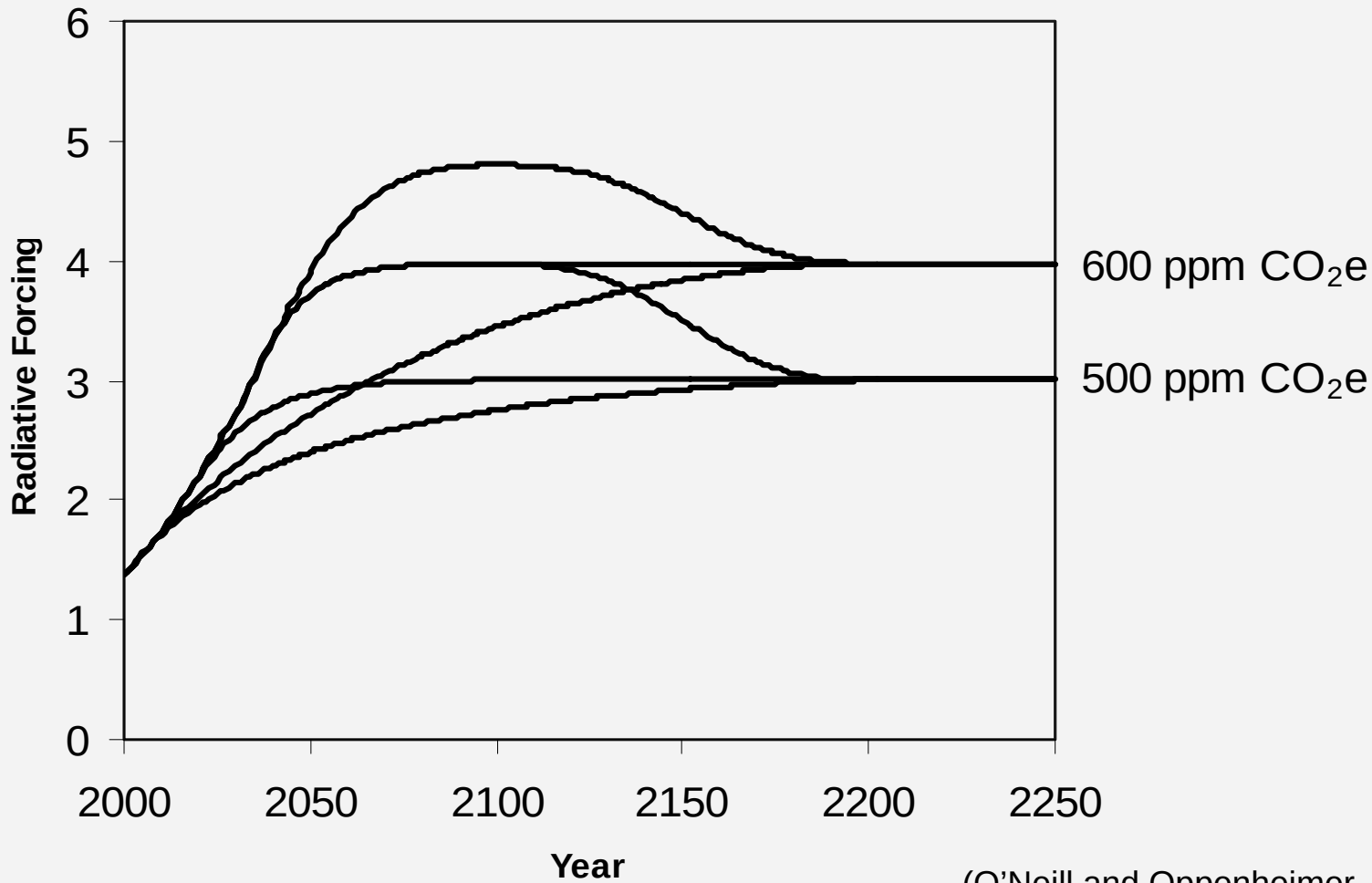
Climate Uncertainty

- Inherent uncertainty in projections of future climate
- Best guess → Range → PDFs
- Climate policy → risk management

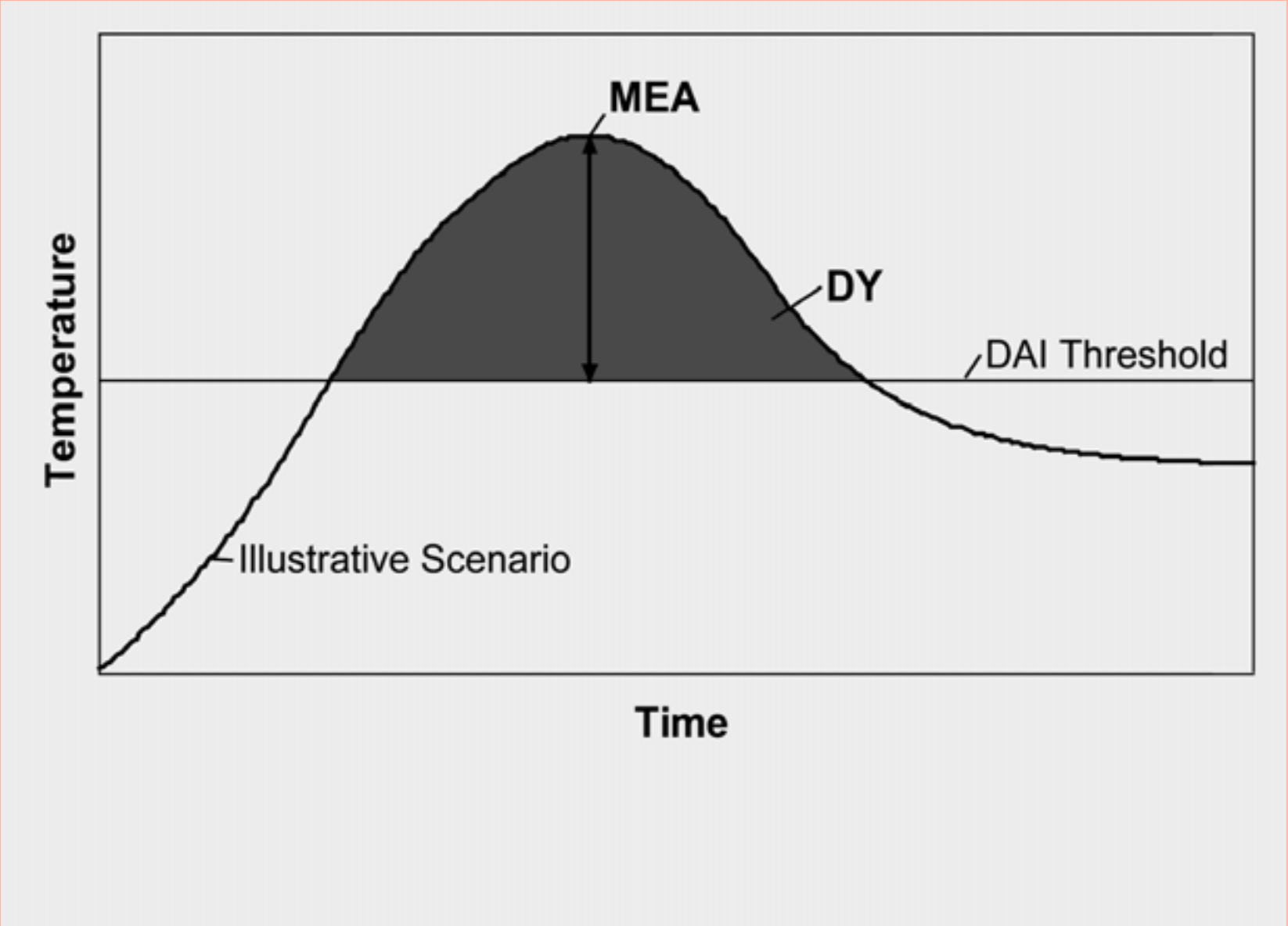
Climate Policy Analysis

- Assess risk as a function of policy choices

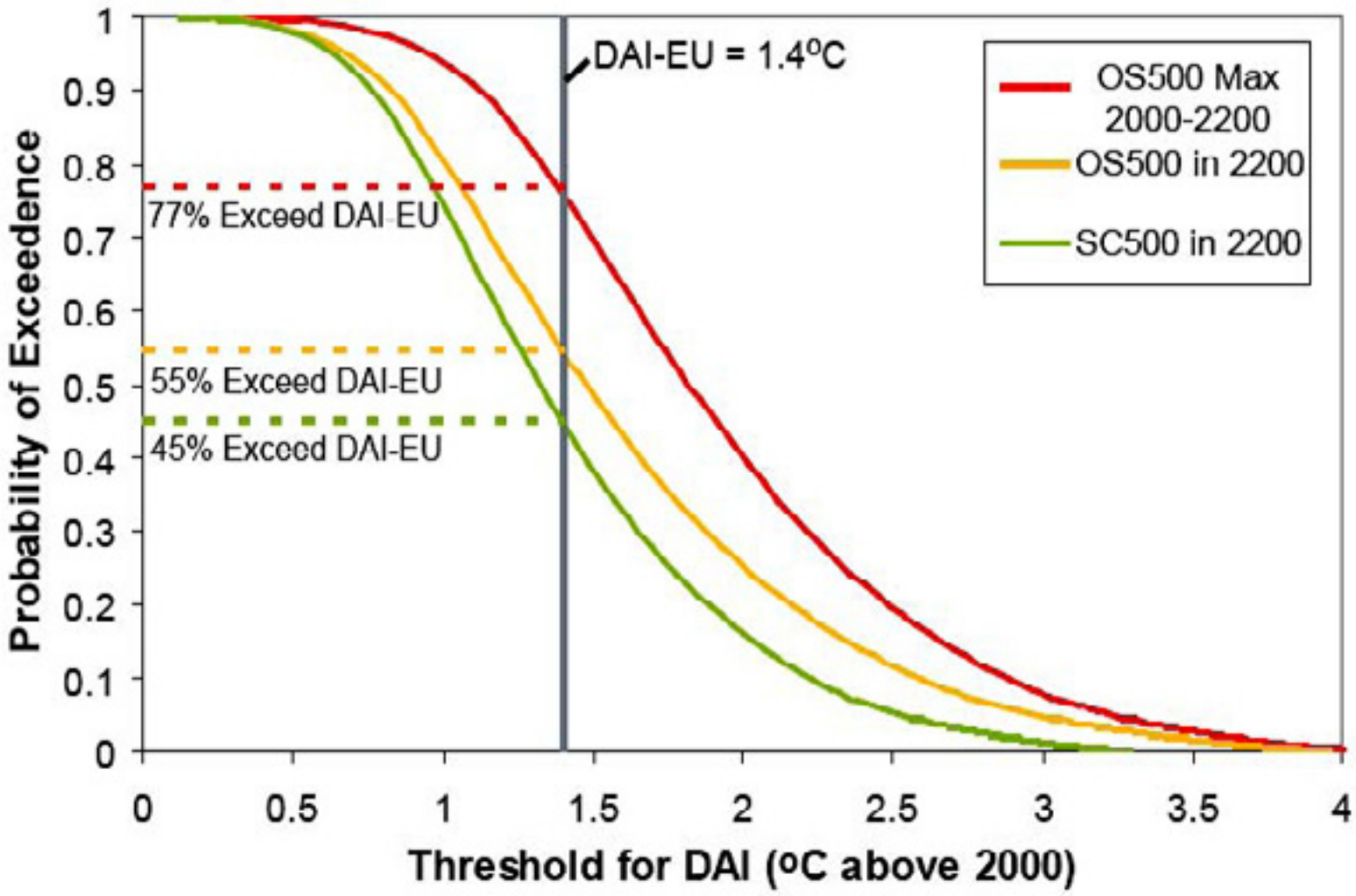
Emissions Scenarios



(O'Neill and Oppenheimer, 2004)



Source: Schneider and Mastrandrea, PNAS, Oct 2005



Source: Schneider and Mastrandrea, PNAS, Oct 2005

Risk = Probability x Consequence [What metrics of harm?]

-$/ton C avoided

-lives lost/ton C avoided

-species lost/ton C avoided

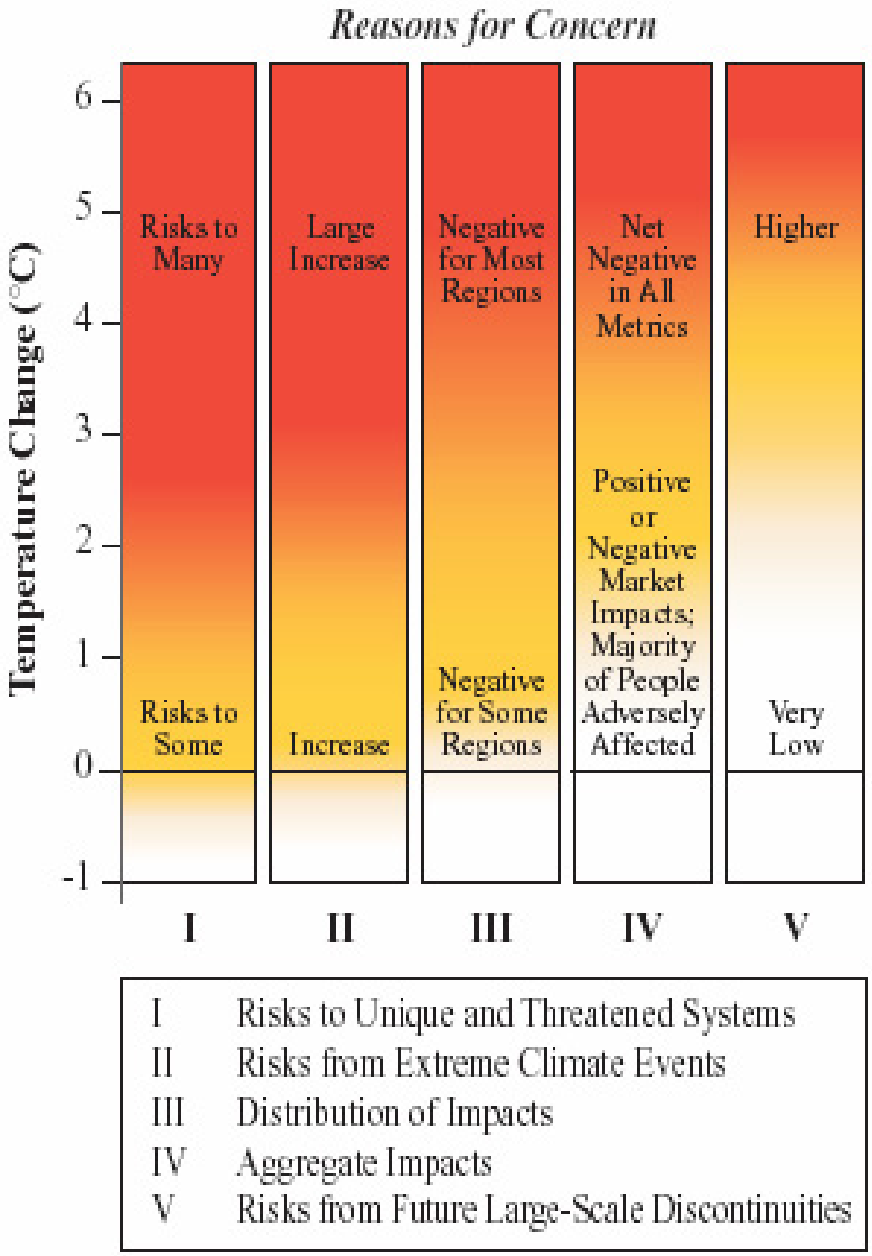
-increased inequity/ton C avoided*

-quality of life degraded/ton

*Perception that prime generators of the risks are not accepting responsibility for their emissions or helping victims to adapt (e.g., OECD countries refusing to join in Kyoto Protocol) itself creates risks.

[Source: “The Five Numeraires”, Schneider, Kuntz-Duriseti and Azar 2000]

Reasons for Concern



(IPCC TAR, 2001)

Branching coral

Brain coral

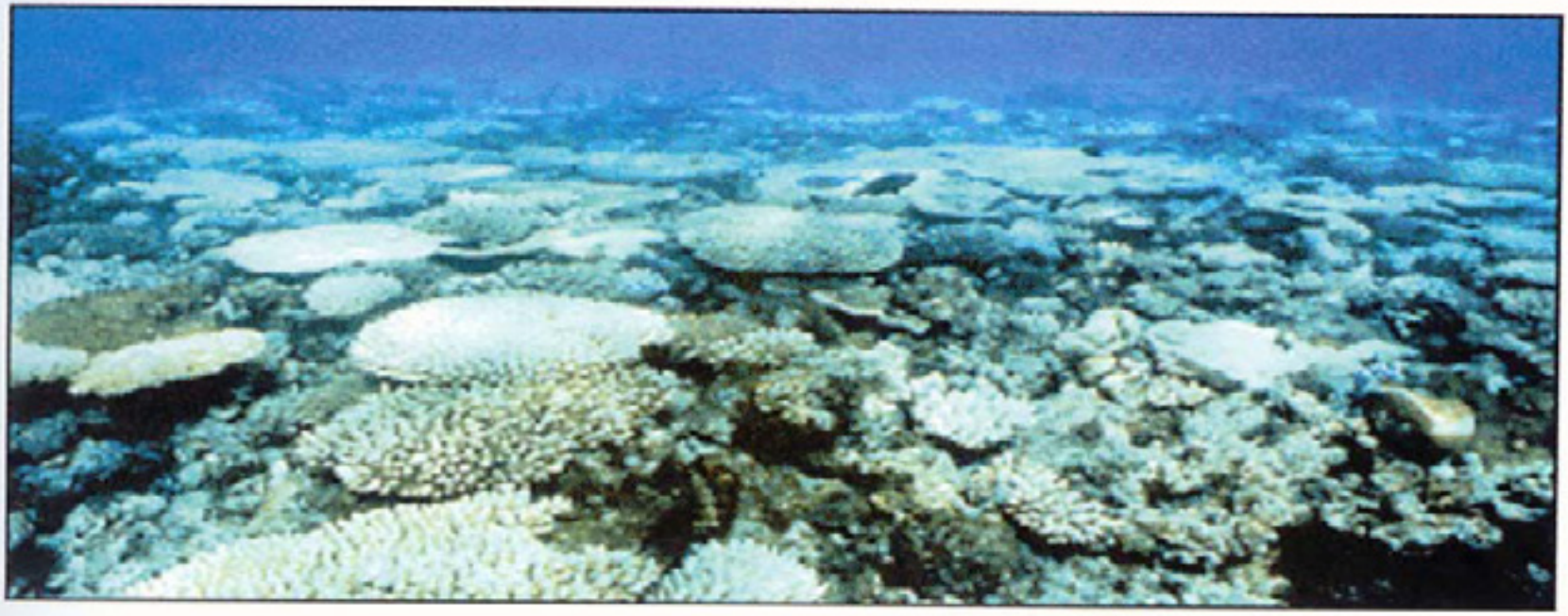


Figure 4-3: The diversity of corals could be affected with the branching corals (e.g., staghorn coral) decreasing or becoming locally extinct as they tend to be more severely affected by increases in sea surface temperatures, and the massive corals (e.g., brain corals) increasing.

PAGE ONE

The Ukukus Wonder Why a Sacred Glacier Melts in Peru's Andes

It Could Portend World's End, So Mountain Worshipers Are Stewarding the Ice

By ANTONIO REGALADO
Staff Reporter of THE WALL STREET JOURNAL
June 17, 2005; Page A1

Vicente Revilla/BMCC-CUNY

An ukuku hauls a block of mountain ice near Cuzco, Peru, in 1999. The tradition is disappearing along with Peru's glaciers.

Climate change assessments and the development of response strategies are hampered by multiple uncertainties and unknown. The most relevant sources of uncertainty in this context are:

(i) Natural randomness
(ii) Lack of scientific knowledge
(iii) Value diversity
(iv) Social choice

Some sources of uncertainty can be represented by probabilities whereas others cannot. The natural randomness in the climate system can be characterized by frequentist (or objective) probabilities, which describe the *likelihood* of a repeatable event under known circumstances. The reliability of knowledge about uncertain aspects of the world (such as the "true" value of climate sensitivity) can only be represented by Bayesian (or subjective) probabilities, which refer to the *degree of belief* in a particular statement. Bayesian probabilities may be elicited through expert surveys, constraining uncertain model parameters with observations, or a combination of these methods. Whether probabilities can be applied to describe future social choice, in particular uncertainties in future greenhouse gas emissions, has been the subject of considerable scientific debate. Value diversity (such as different attitudes towards risk or equity) cannot be meaningfully described probabilistically and is often assessed through sensitivity analysis or scenario analysis.

Questions??

Comments??

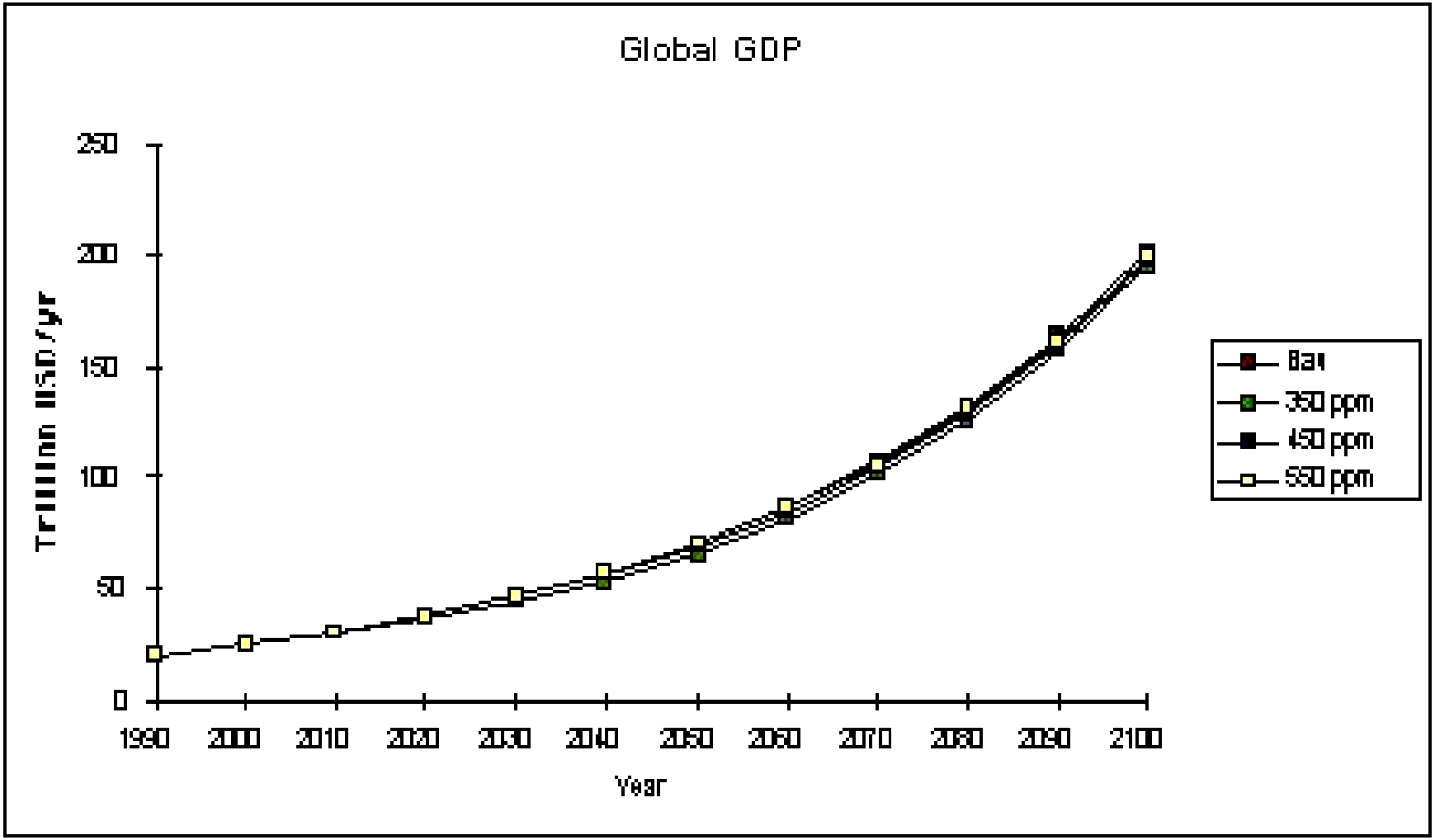


Fig. 1. Global income trajectories under Business as Usual and in the case of stabilising the atmosphere at 350 ppm, 450 and 550 ppm. Observe that we have assumed rather pessimistic estimates of the cost of atmospheric stabilisation (average costs to the economy assumed here are $200/tC for 550ppm target, $300/tC for 450ppm and $400/tC for 350ppm) and that the environmental benefits (in terms of climate change and reduction of local air pollution) of meeting various stabilisation targets have not been included.