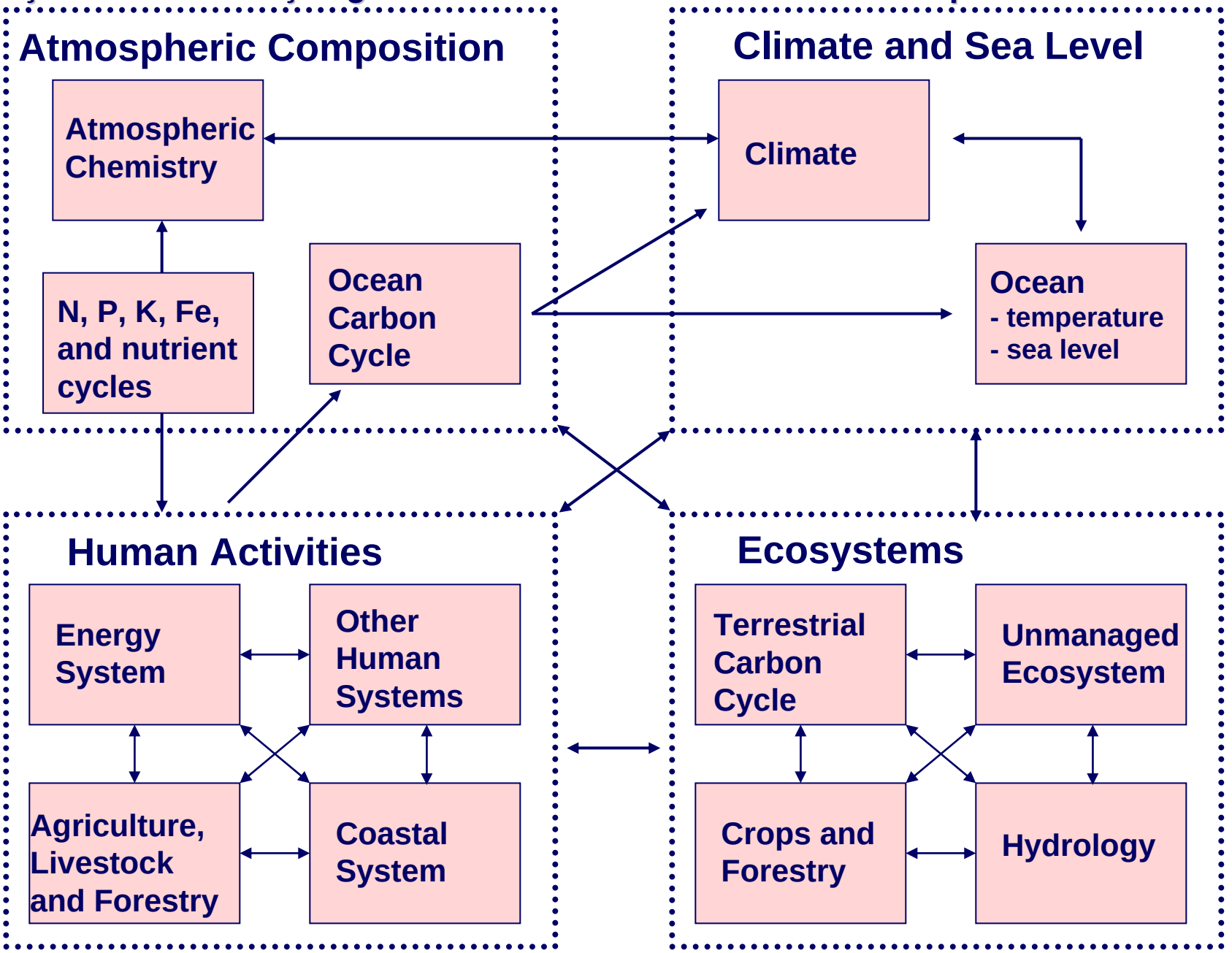
Updates da Climate Change Congress: Global Risks, Challenges & Decisions Copenhagen, Denmark, Março 2009

Interações das mudanças globais com as atividades humanas e processos naturais



Mitigation + Adaptation + Development

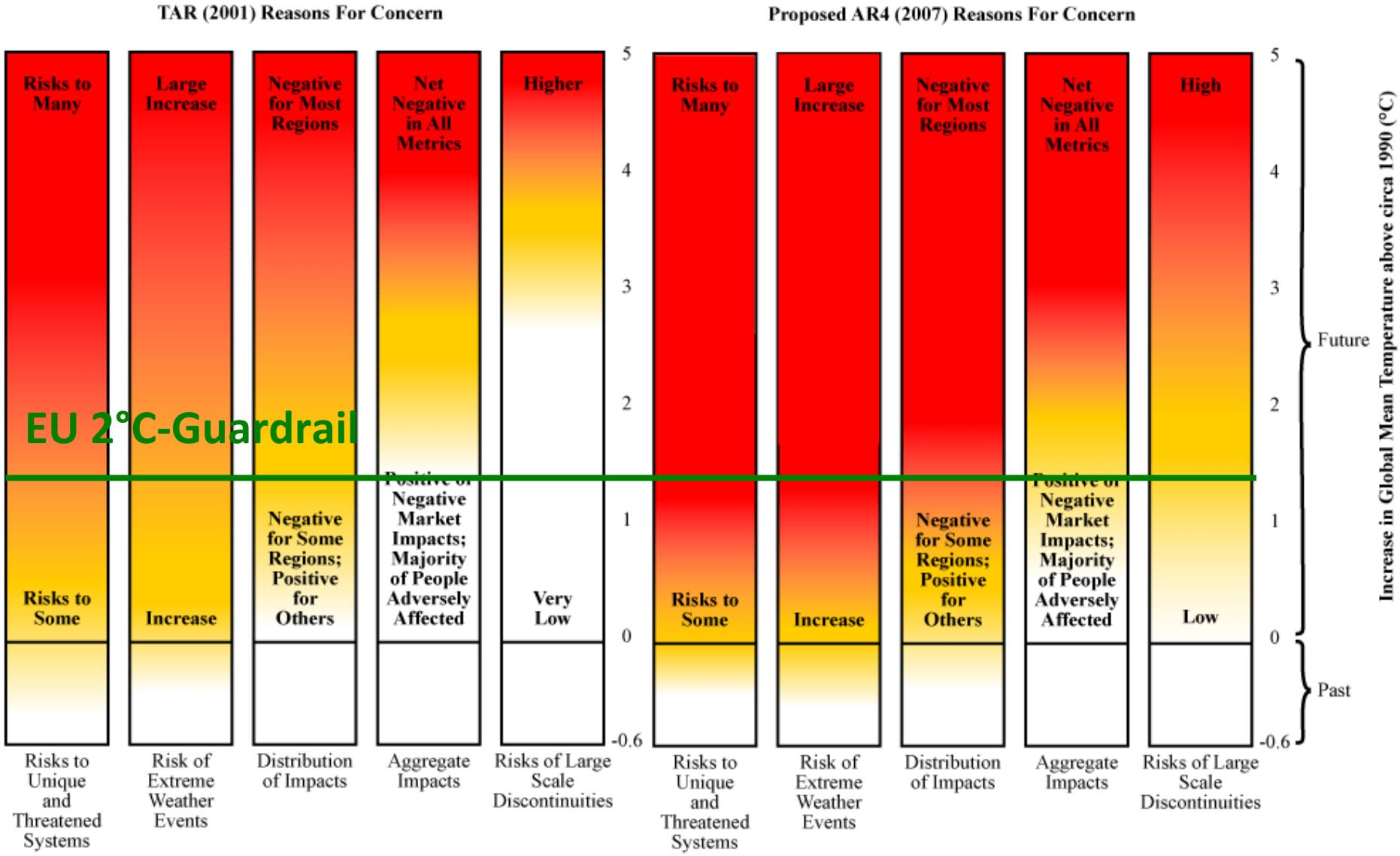
=

The MAD Challenge

➔ **Novel Global Division of Land (+ Water) Use? +CO2 emissions?**

Professor H. J. Schellnhuber CBE, Potsdam Institute, Oxford University

Updated Reasons for Concern



(Smith et al. 2009 PNAS)

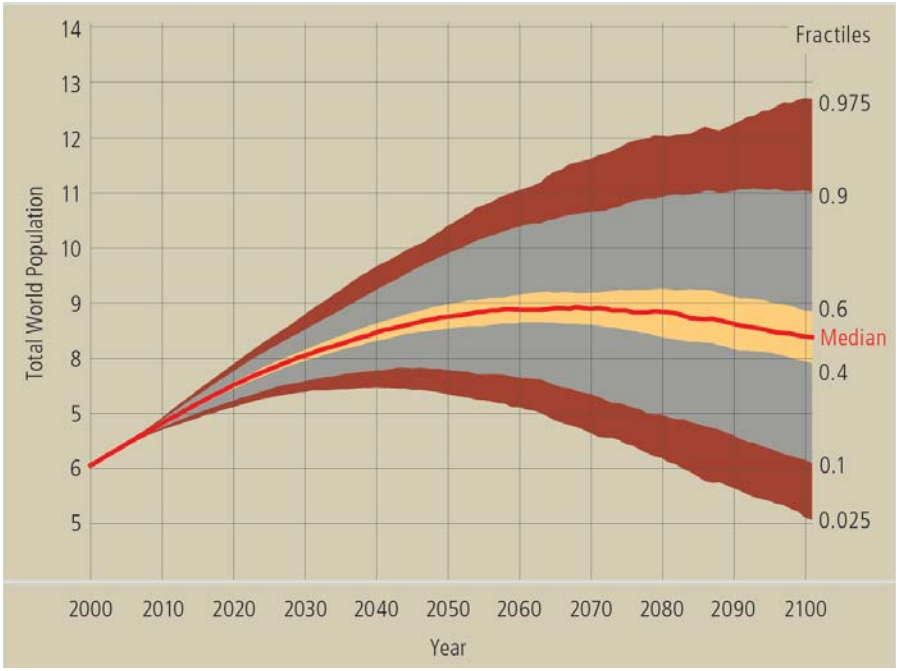
Russian-Roulette Chance (p = 5/6) of Holding 2°C-Line:

80% Reduction of Global GHG Emissions by 2050, Relative to 1990 Levels

(According to GCM-Ensembles Calculations)

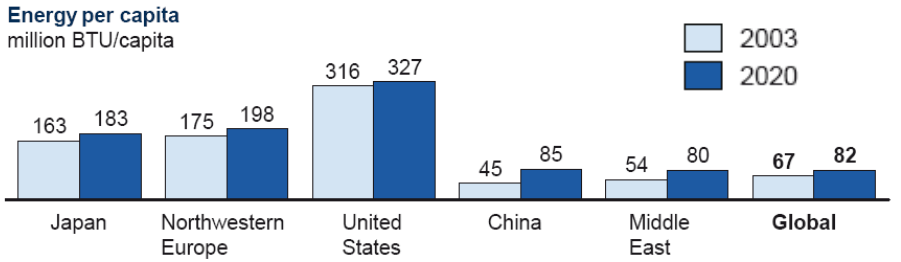
Negative Emissions after 2070 !

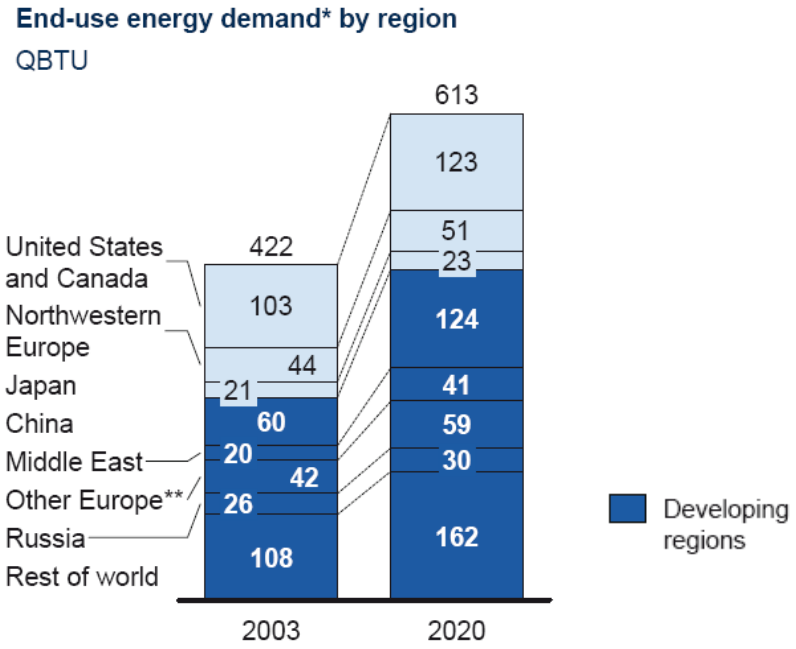
Population Growth / Energy Demand Projections



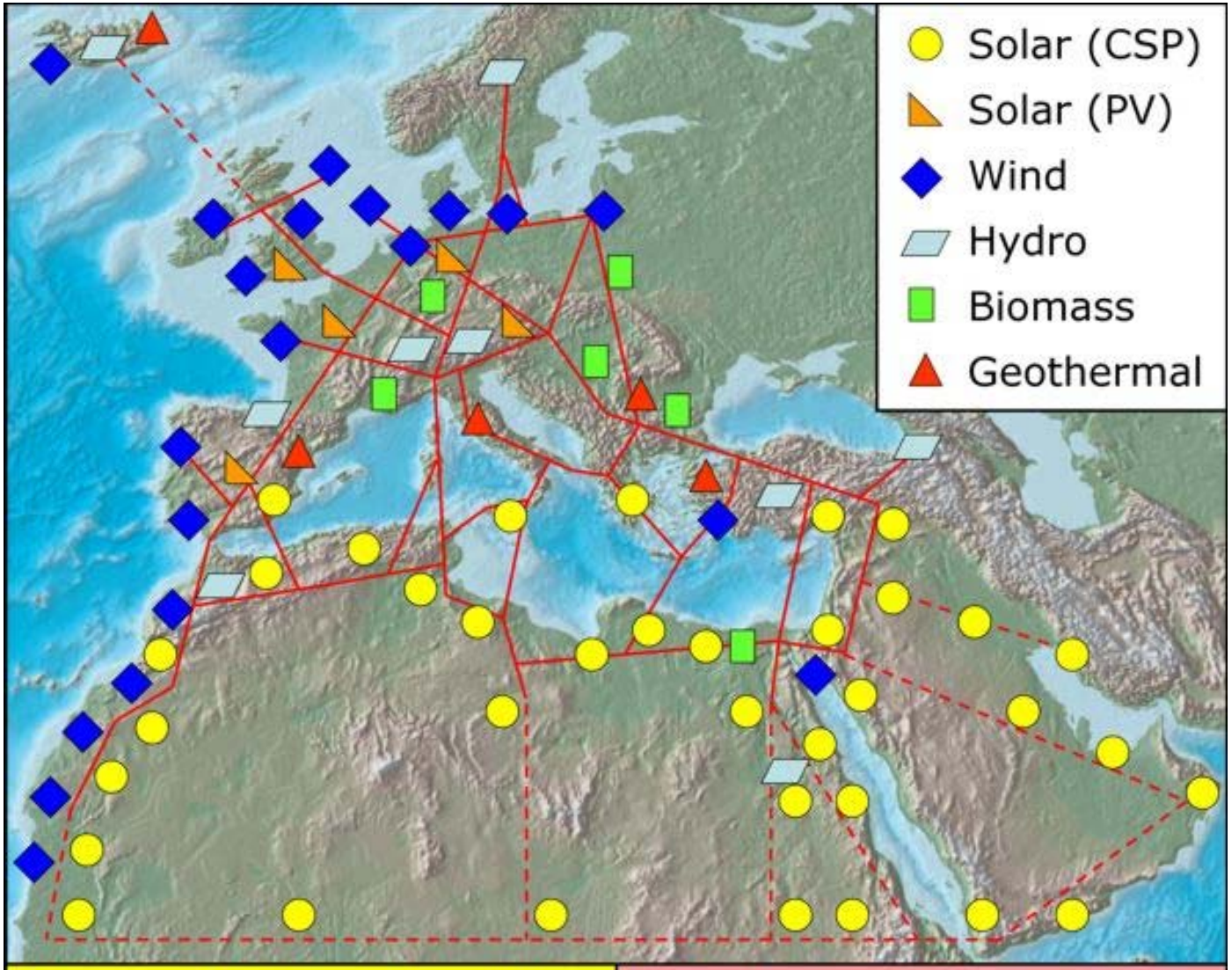
Uncertainty distribution of total world population in 2100, in billions

(Lutz et al. IIASA 2007)





(MGI Global Energy Demand Model 2007)



Concentrating **S**olar Thermal **P**ower (**CSP**):
- Solar heat storage for day/night operation
- Hybrid operation for secured power
- Power & desalination in cogeneration

Sketch of **H**igh-**V**oltage **D**irect **C**urrent (**HVDC**) grid: Power transmission losses from the **M**iddle **E**ast and **N**orth **A**frica (**MENA**) to Europe less than 15%.

Power generation with CSP and transmission via future **EU-MENA** grid: 5 - 7 EuroCent/kWh
Various studies and further information at **www.DESERTEC.org**

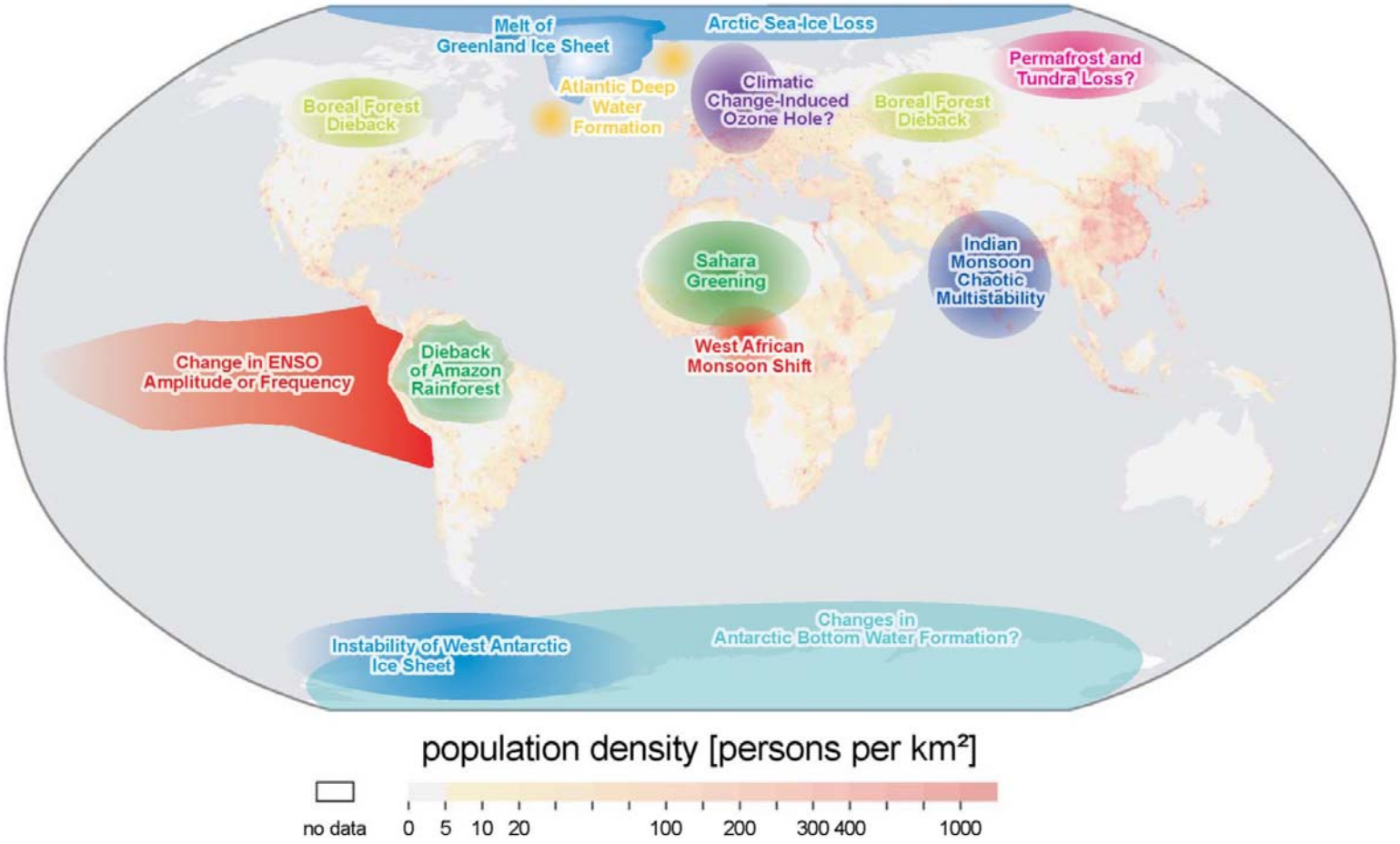
Tipping elements in the Earth's climate system

Timothy M. Lenton*†, Hermann Held‡, Elmar Kriegler‡§, Jim W. Hall¶, Wolfgang Lucht‡, Stefan Rahmstorf‡, and Hans Joachim Schellnhuber†‡‖**

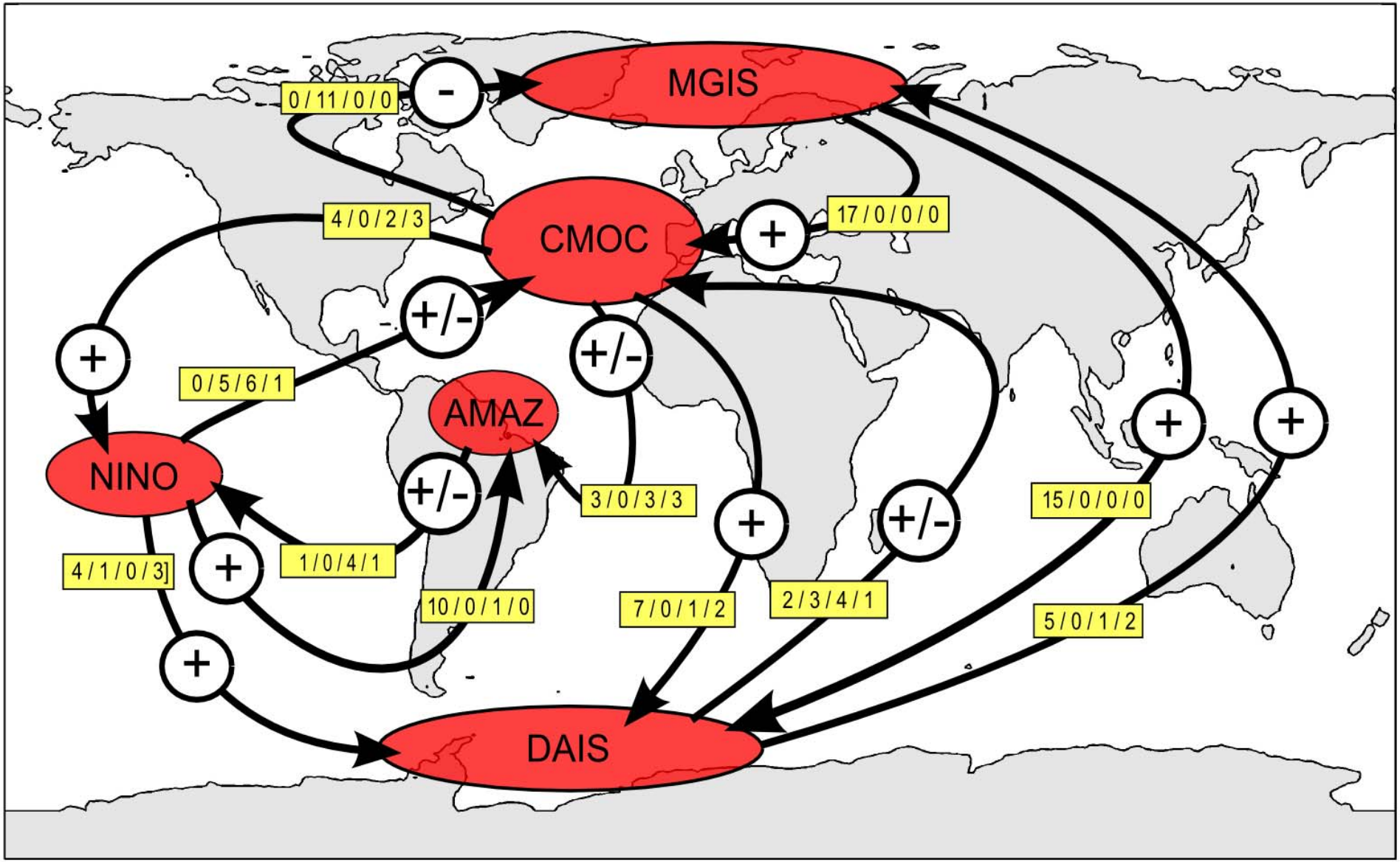
**School of Environmental Sciences, University of East Anglia, and Tyndall Centre for Climate Change Research, Norwich NR4 7TJ, United Kingdom; ‡Potsdam Institute for Climate Impact Research, P.O. Box 60 12 03, 14412 Potsdam, Germany; §Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA 15213-3890; ¶School of Civil Engineering and Geosciences, Newcastle University, and Tyndall Centre for Climate Change Research, Newcastle NE1 7RU, United Kingdom; and ‖Environmental Change Institute, Oxford University, and Tyndall Centre for Climate Change Research, Oxford OX1 3QY, United Kingdom*

**This contribution is part of the special series of Inaugural Articles by members of the National Academy of Sciences elected on May 3, 2005.

Edited by William C. Clark, Harvard University, Cambridge, MA, and approved November 21, 2007 (received for review June 8, 2007)

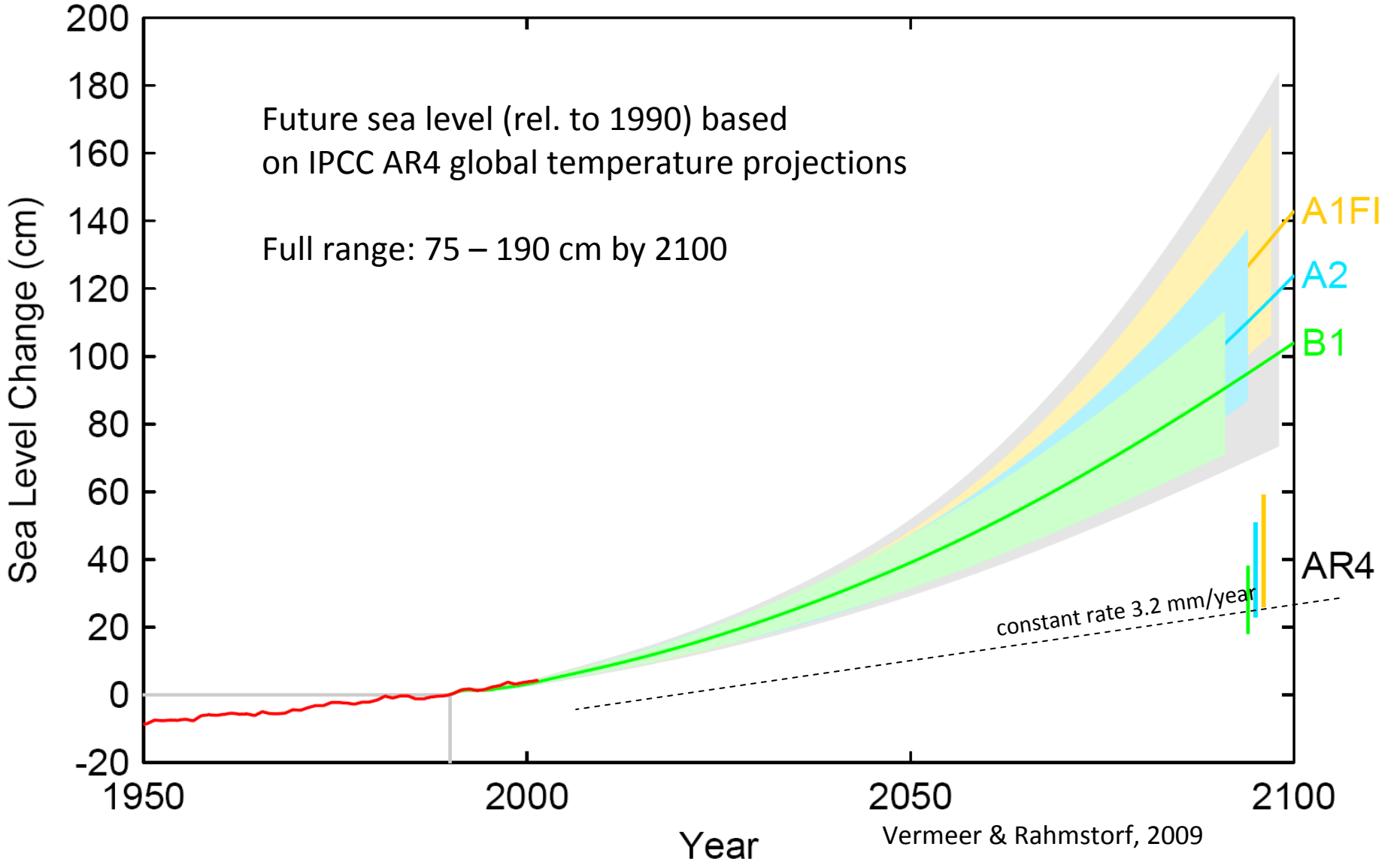


Interdependency between tipping points

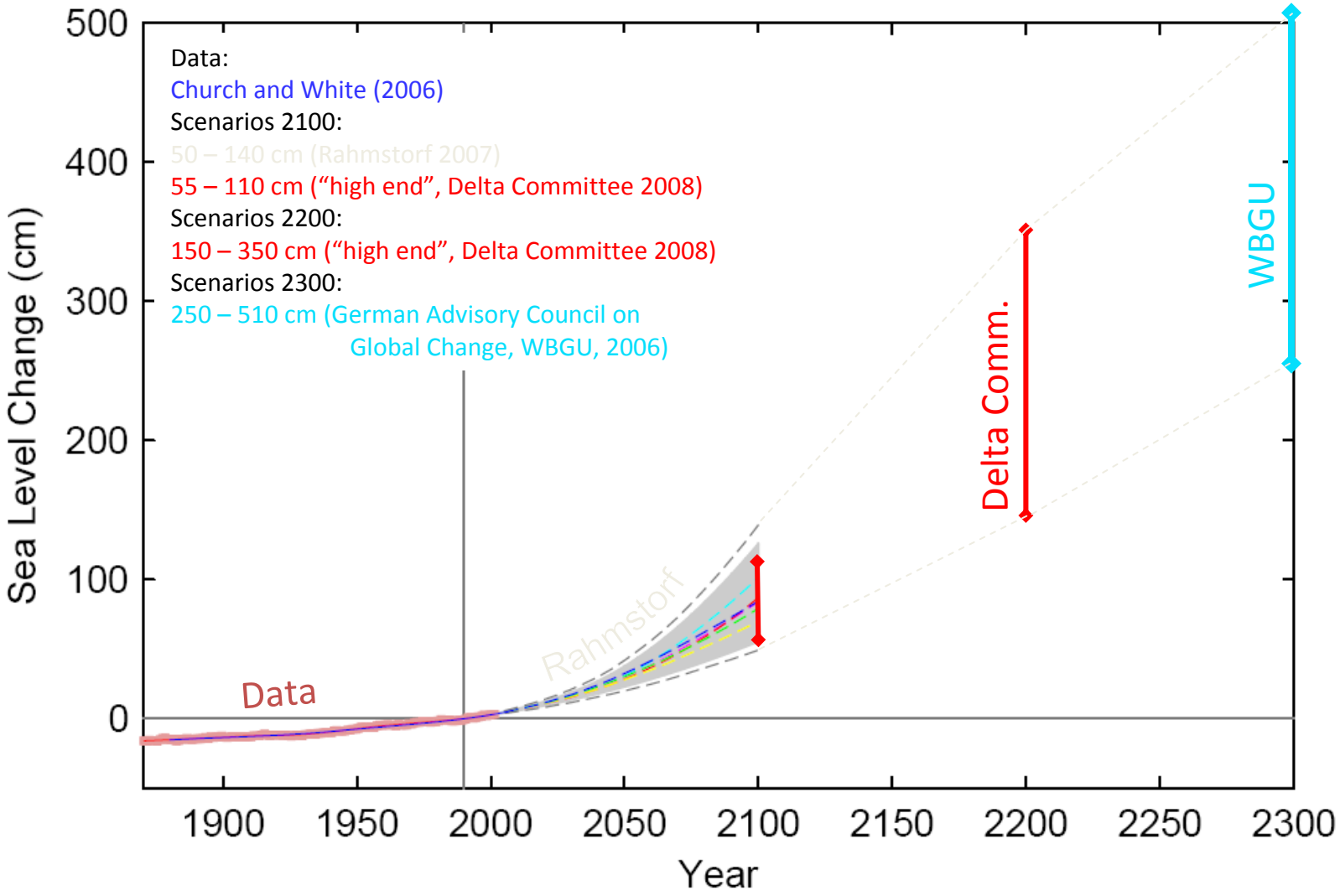


Kriegler et al., PNAS xx: x-y, 2009

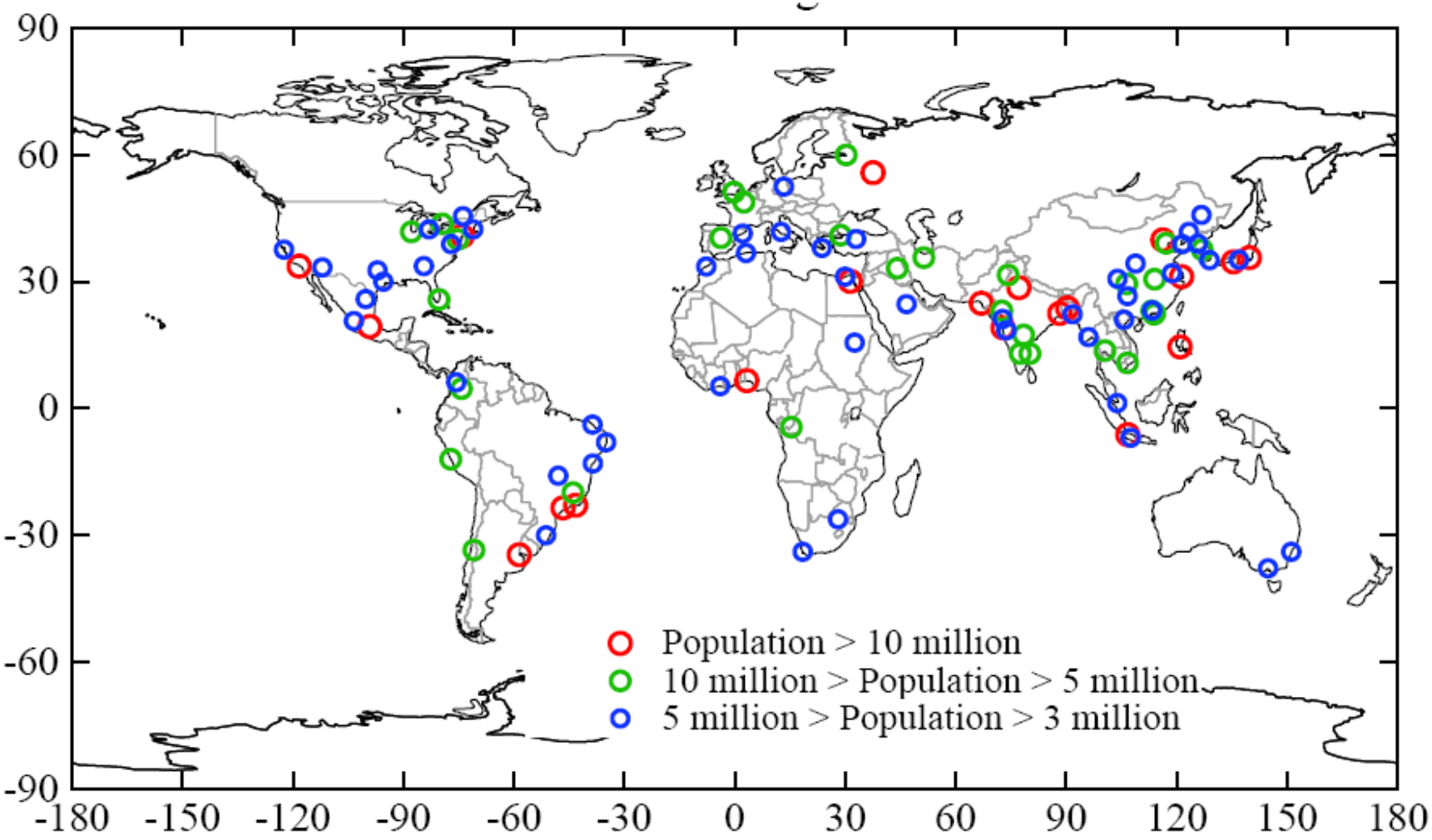
Sea Level Future Projections



Other recent sea level projections

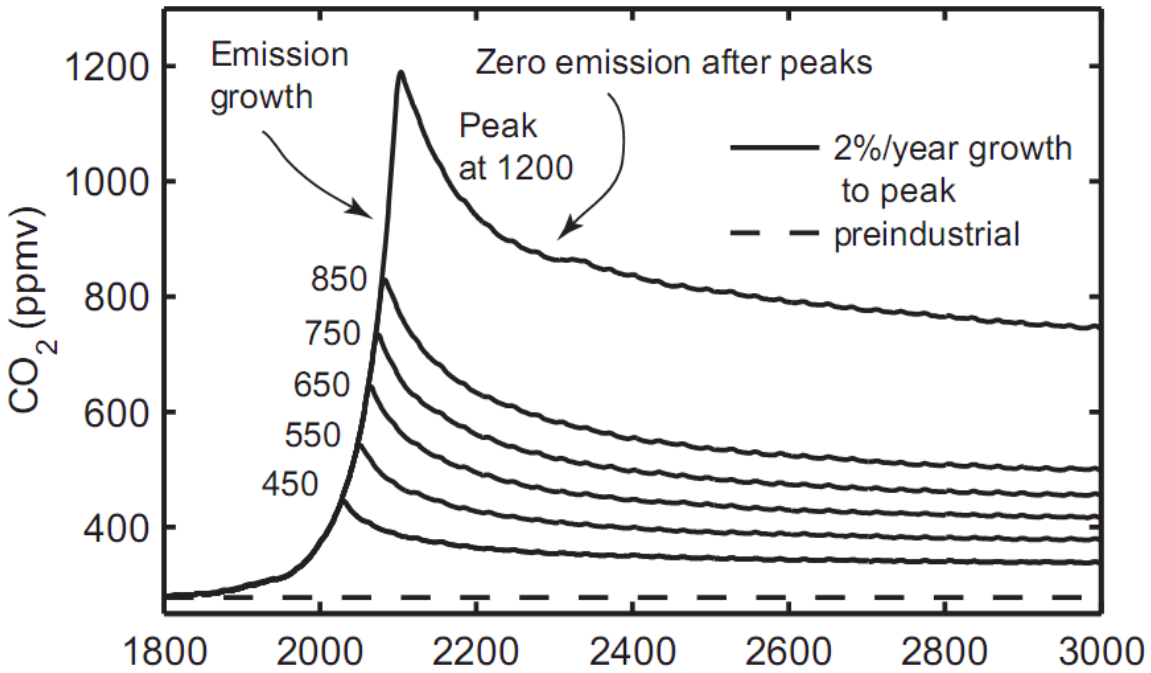


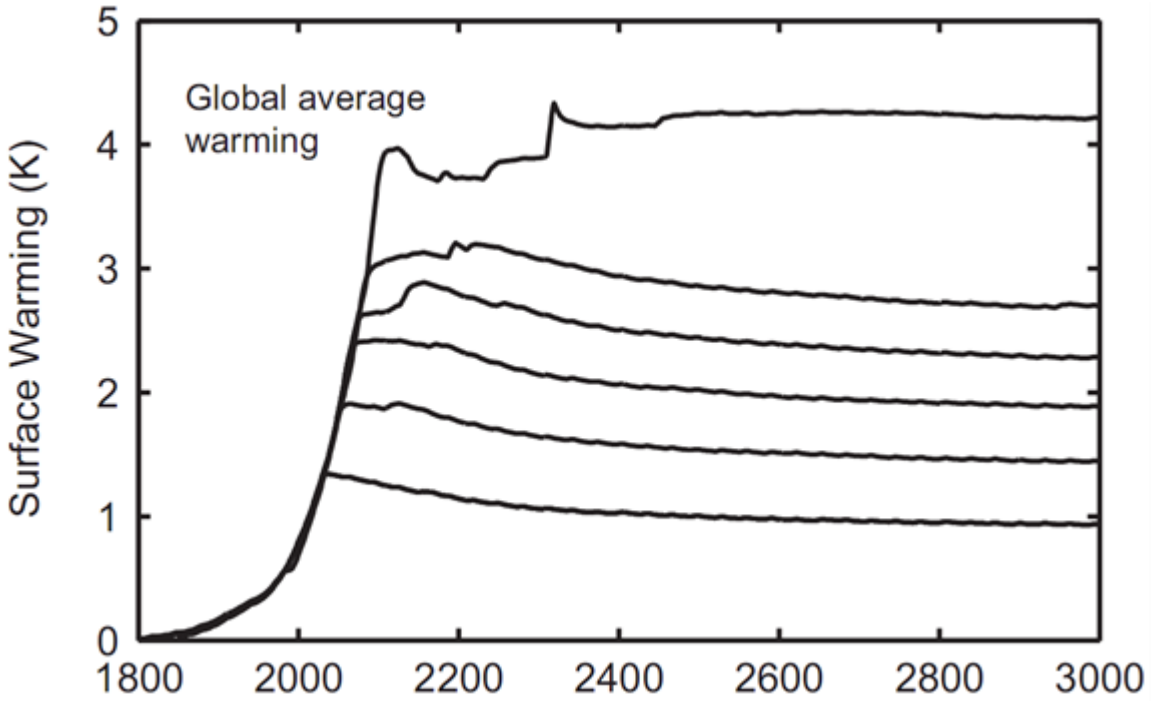
As 100 maiores cidades do nosso planeta



Quanto tempo durarão os efeitos da injeção de CO_2 na atmosfera?

Susan Salomon PNAS Fev 2009





Jim Hanssen – NASA GISS Inference

1. **Non-CO_2 Forcings Substantial**

   Comparable to CO_2 forcing <u>today</u>

2. **Strategic Mitigation Role**

   <u>If</u> coal phased out, non-CO_2 important

3. **Aerosols Complicate the Story**

   If all pollution is reduced, how much will aerosol cooling effect be altered?

Nasty Aerosol Problem

1. **Aerosol Forcing Not Measured**

   Based in good part on presumptions

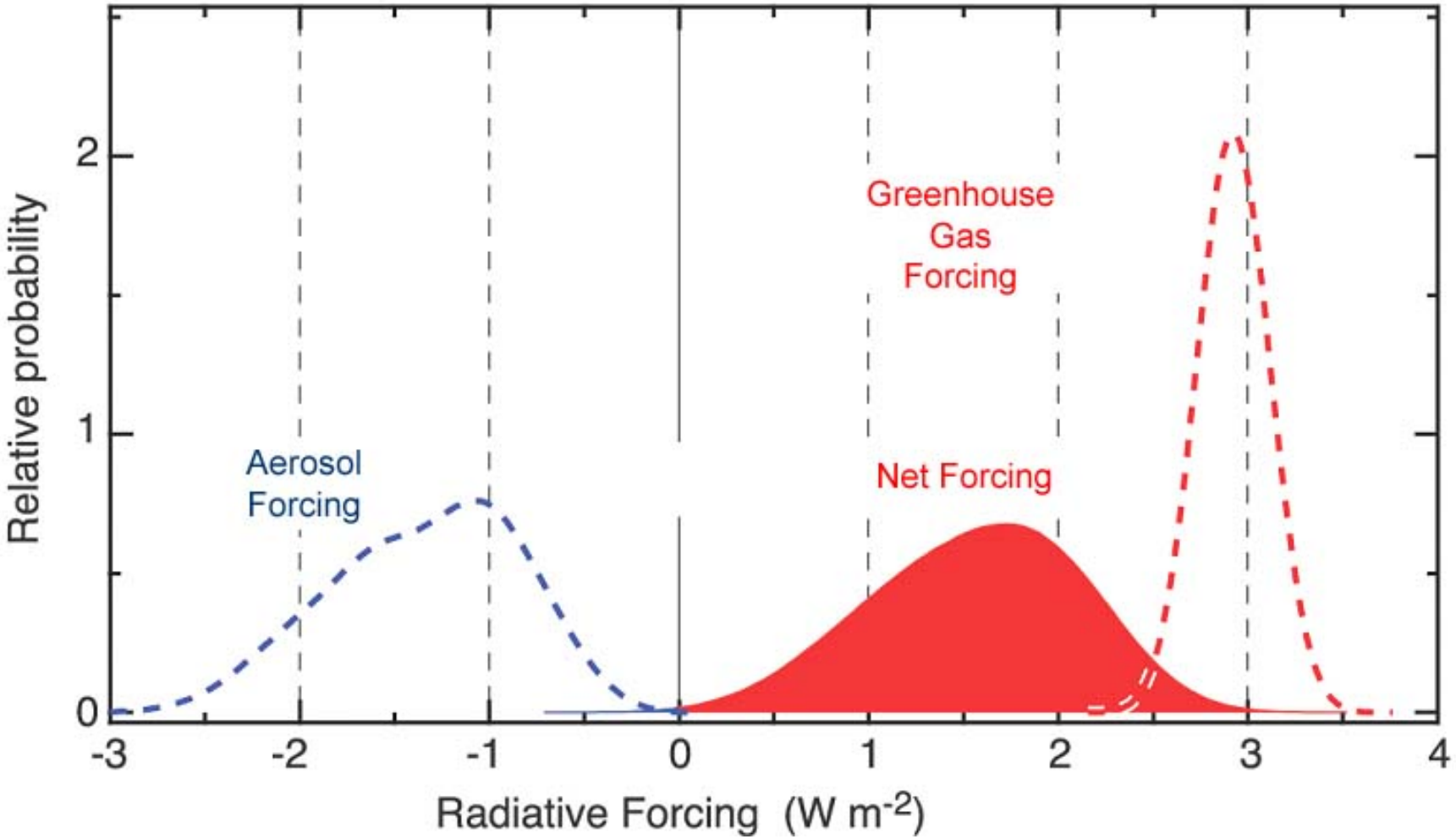
2. **Aerosol Data Include Feedbacks**

   Aerosols decrease in warming climate

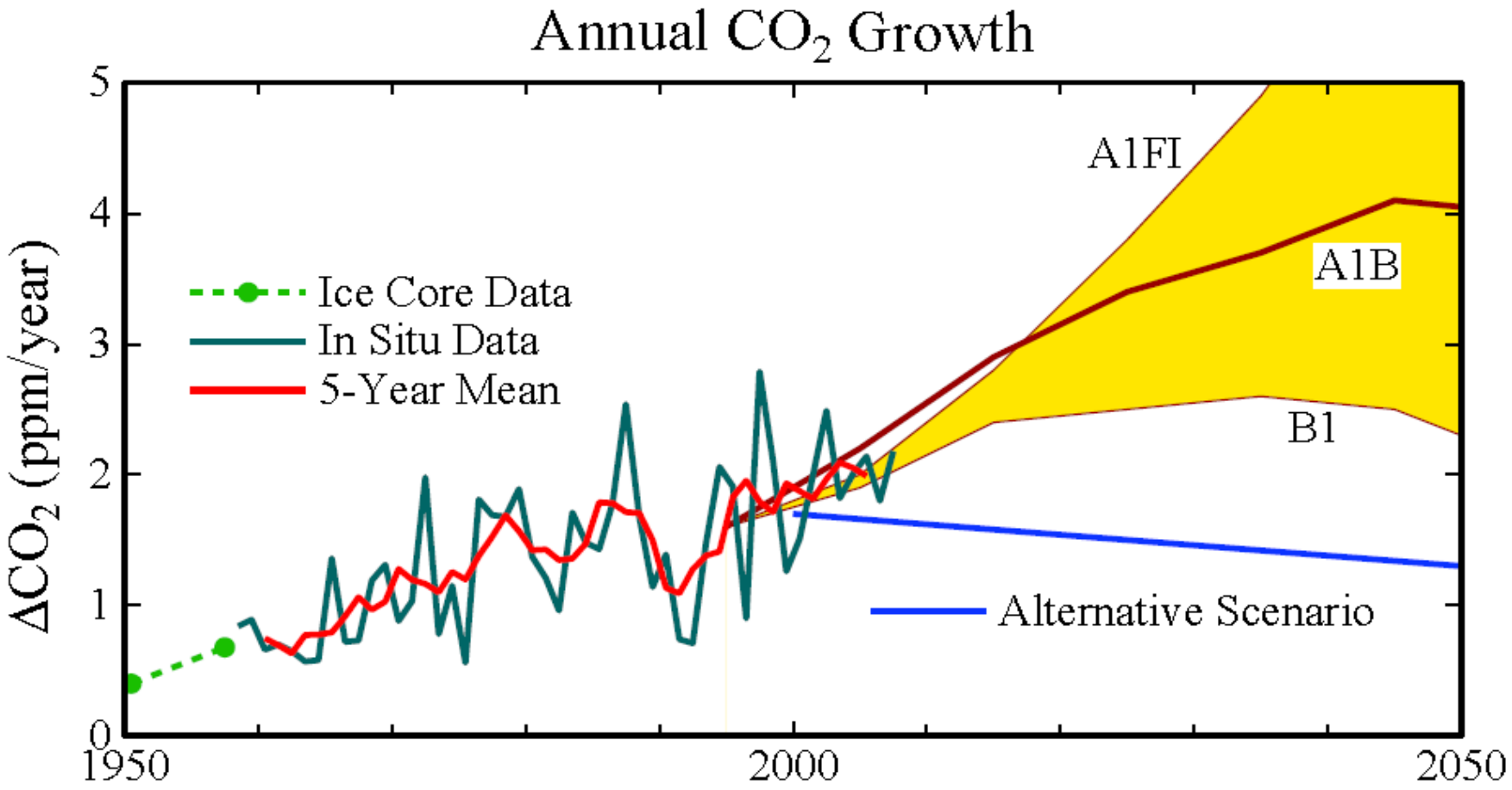
3. **Aerosol Cloud Effects Complex**

   Aerosol forcing practically unknown

Greenhouse Gas, Aerosol & Net Climate Forcing

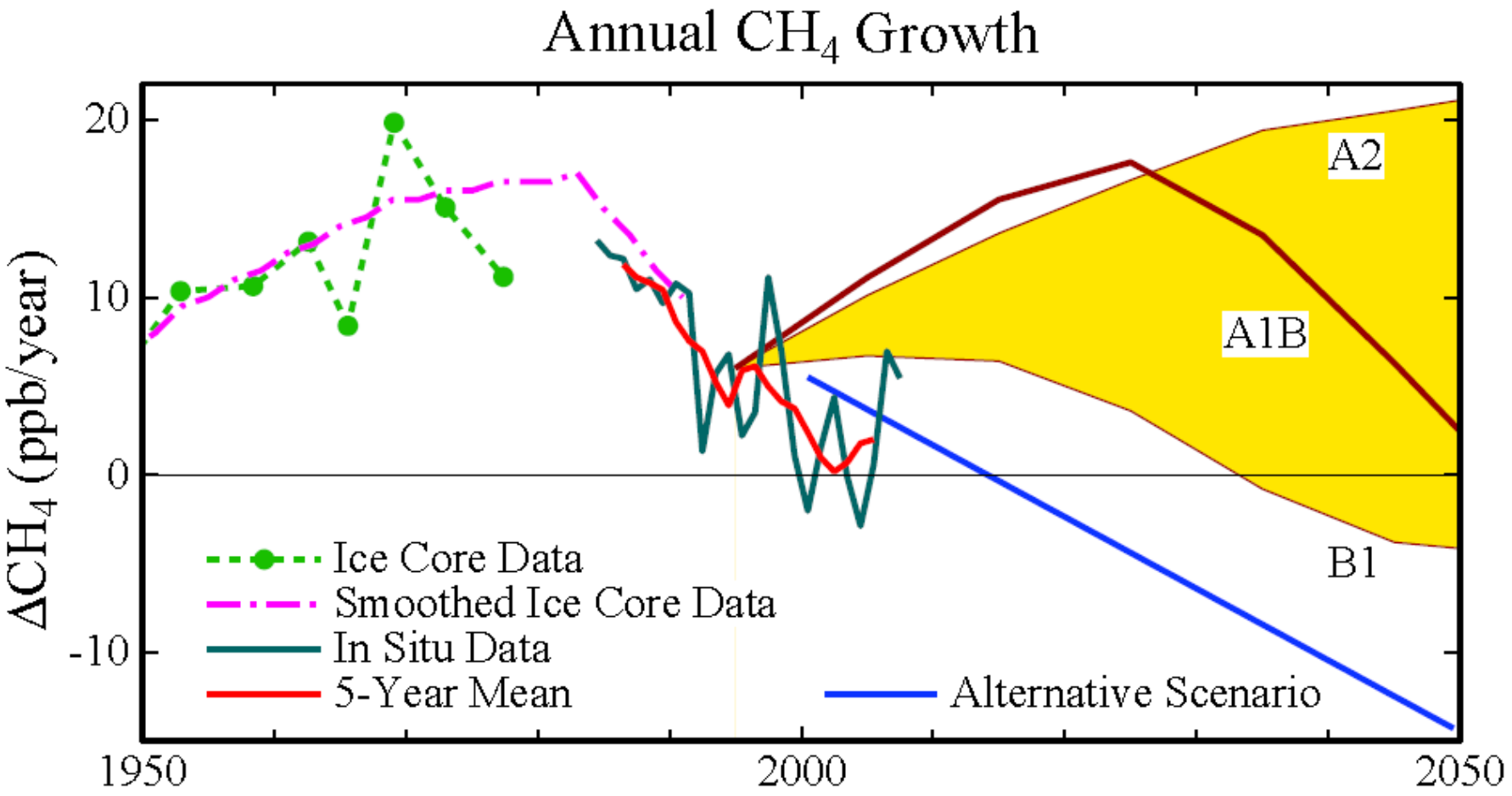


Greenhouse gas forcing is accurately known (~3 W/m^2), but aerosol forcing is very uncertain. Source: IPCC (2007)



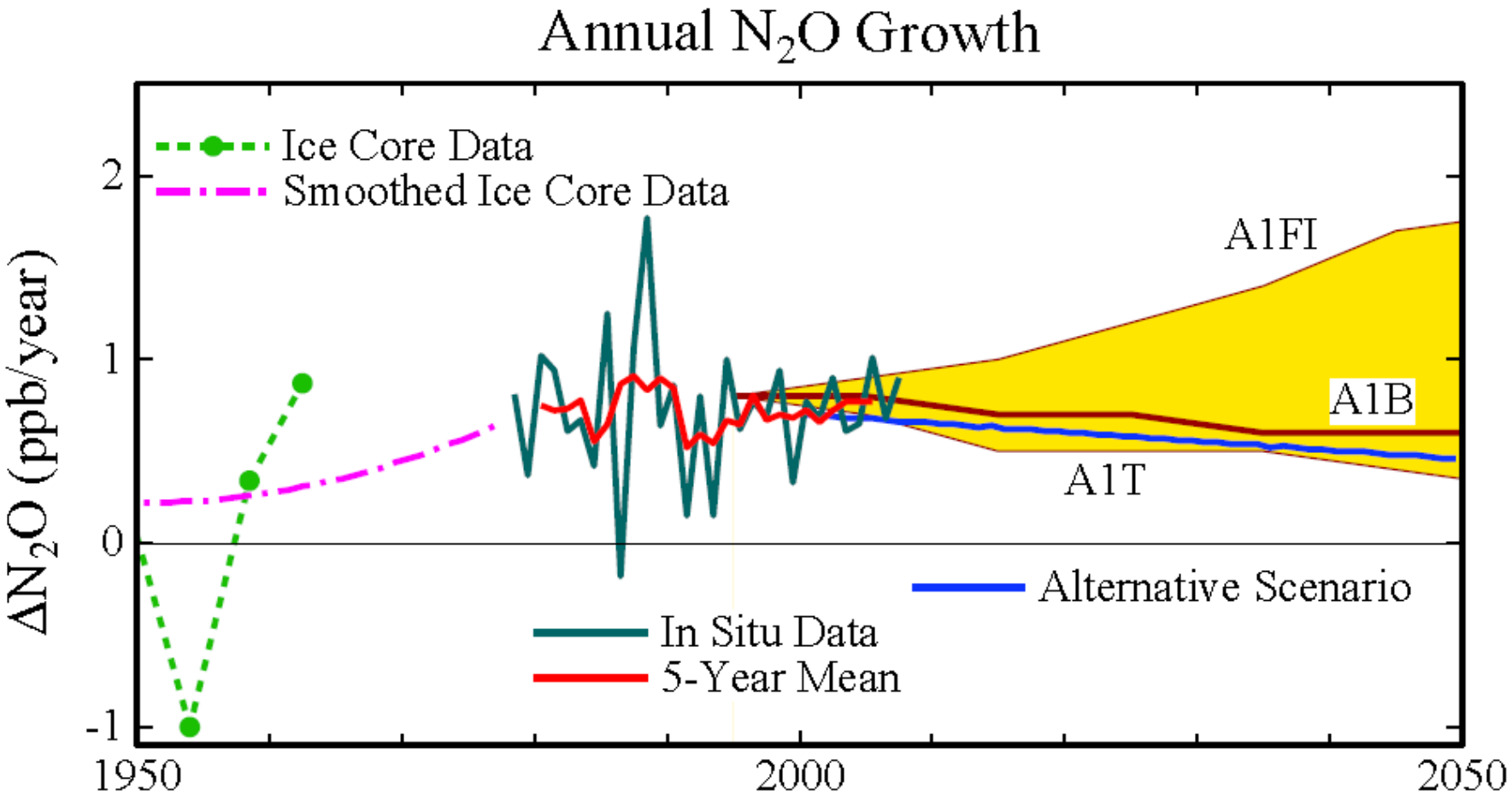
Update of Fig. 2A of Hansen and Sato (PNAS 101, 16109, 2004).

IPCC Scenarios from Houghton et al. (2001).



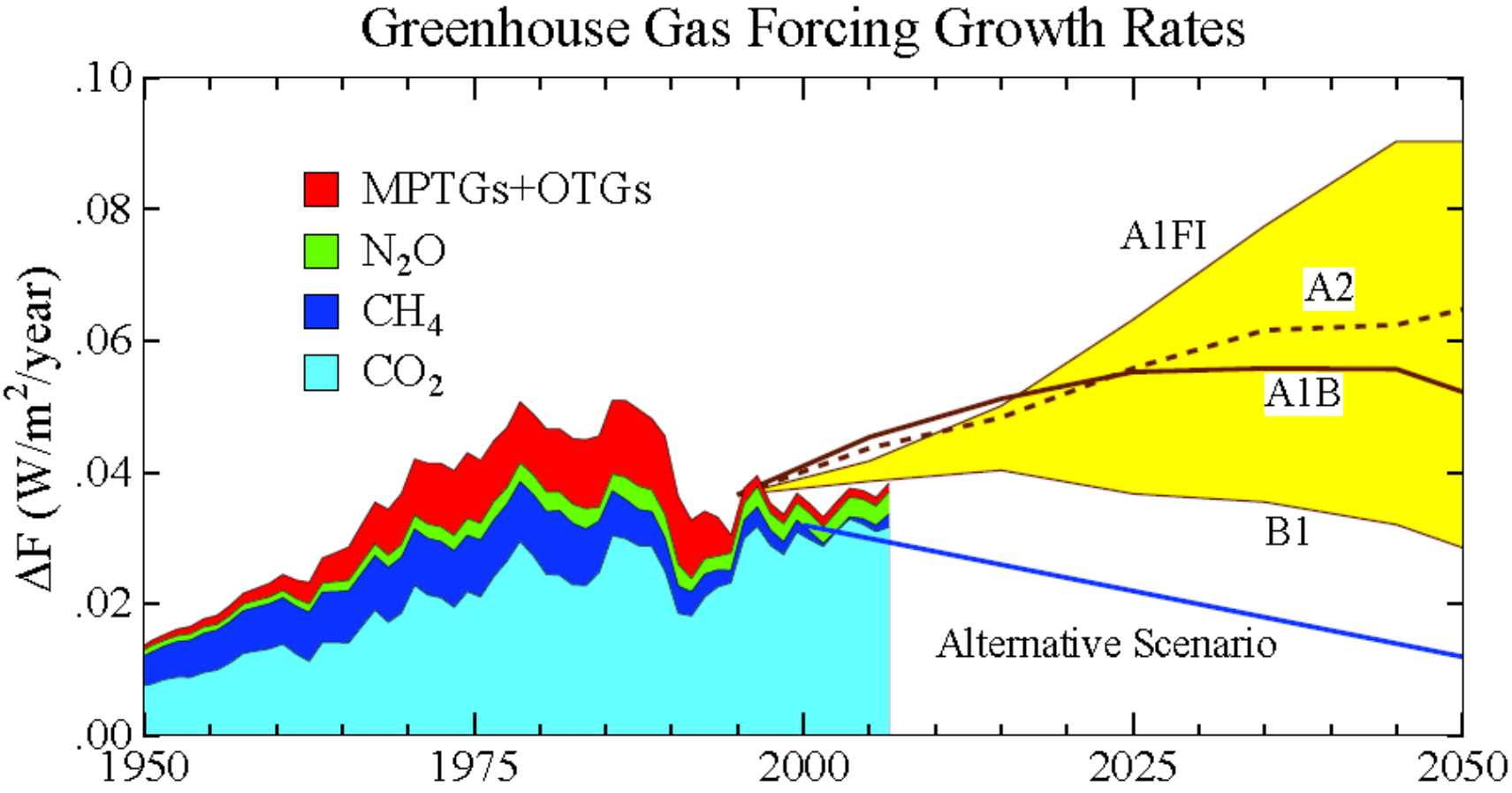
Update of Fig. 2B of Hansen and Sato (PNAS 101, 16109, 2004).

IPCC Scenarios from Houghton et al. (2001).



Update of Fig. 2C of Hansen and Sato (PNAS 101, 16109, 2004).

IPCC Scenarios from Houghton et al. (2001).



Update of Fig. 4 of Hansen and Sato (PNAS 101, 16109, 2004).

IPCC Scenarios from Houghton et al. (2001).

Assessment of Target CO_2

Phenomenon	Target CO_2 (ppm)
1. Arctic Sea Ice	300-325
2. Ice Sheets/Sea Level	300-350
3. Shifting Climatic Zones	300-350
4. Alpine Water Supplies	300-350
5. Avoid Ocean Acidification	300-350

→ Initial Target CO_2 = 350* ppm

***assumes CH_4, O_3, Black Soot decrease**

Reference: Hansen et al. Target Atmospheric CO_2, Open Atmos. Sci., 2008

How Can Climate be Stabilized?

Must Restore Planet's Energy Balance

Modeled Imbalance: $+0.75 \pm 0.25$ W/m^2

Ocean Data Suggest: $+0.5 \pm 0.25$ W/m^2

Requirement Might be Met Via:

Reducing CO_2 to 350 ppm or less

&

Reducing non-CO_2 forcing ~ 0.25 W/m^2

Are Needed Actions Feasible?*

Coal must be phased out & Unconventional Fossil Fuels avoided

- **Requires Carbon Tax & Dividend**
- **'Cap & Trade' a Proven Failure**

Do not lump non-CO_2 forcings w CO_2

- **Methane + Ozone most important (reduction feasible as fossil fuel use declines)**
- **Emphasize BC reductions among aerosols**

***My opinions**

“Free Will” Alternative

1. **Phase Out Coal CO_2 Emissions**
   - by 2025/2030 developed/developing countries
2. **Rising Carbon Price**
   - discourages unconventional fossil fuels & extraction of every last drop of oil (Arctic, etc.)
3. **Soil & Biosphere CO_2 Sequestration**
   - improved farming & forestry practices
4. **Reduce non-CO_2 Forcings**
   - reduce CH_4, O_3, trace gases, black soot

Pachauri: Stabilisation scenarios

Global mean temp. increase (ºC)	Stabilization level (ppm CO_2-eq)	Year CO_2 needs to peak
2.0 – 2.4	445 – 490	2000 – 2015
2.4 – 2.8	490 – 535	2000 – 2020
2.8 – 3.2	535 – 590	2010 – 2030
3.2 – 4.0	590 – 710	2020 – 2060

Food for a Week, Darfur Refugees, Chad

Food for a Week, Germany