Climate Change: Challenge and Opportunities for International Shipping

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Advisor for the COP 23 Fiji Presidency,

Former IPCC Vice-Chair (2008 – 2015)

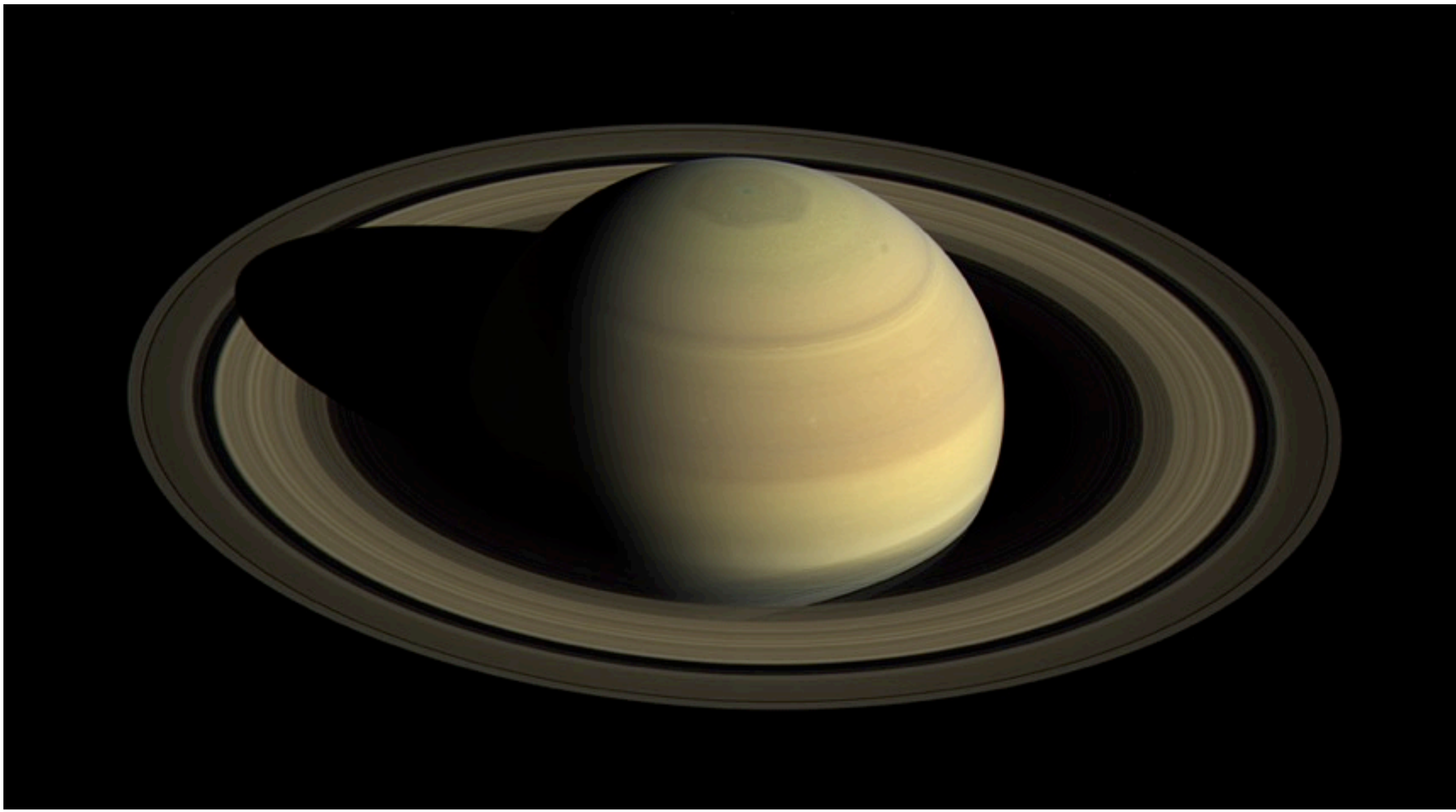
Twitter: @JPvanYpersele

International Maritime Organization,

London, 24 October 2017

Thanks to the Walloon Government (funding the Walloon Platform for IPCC) and to my team at the Université catholique de Louvain for their support

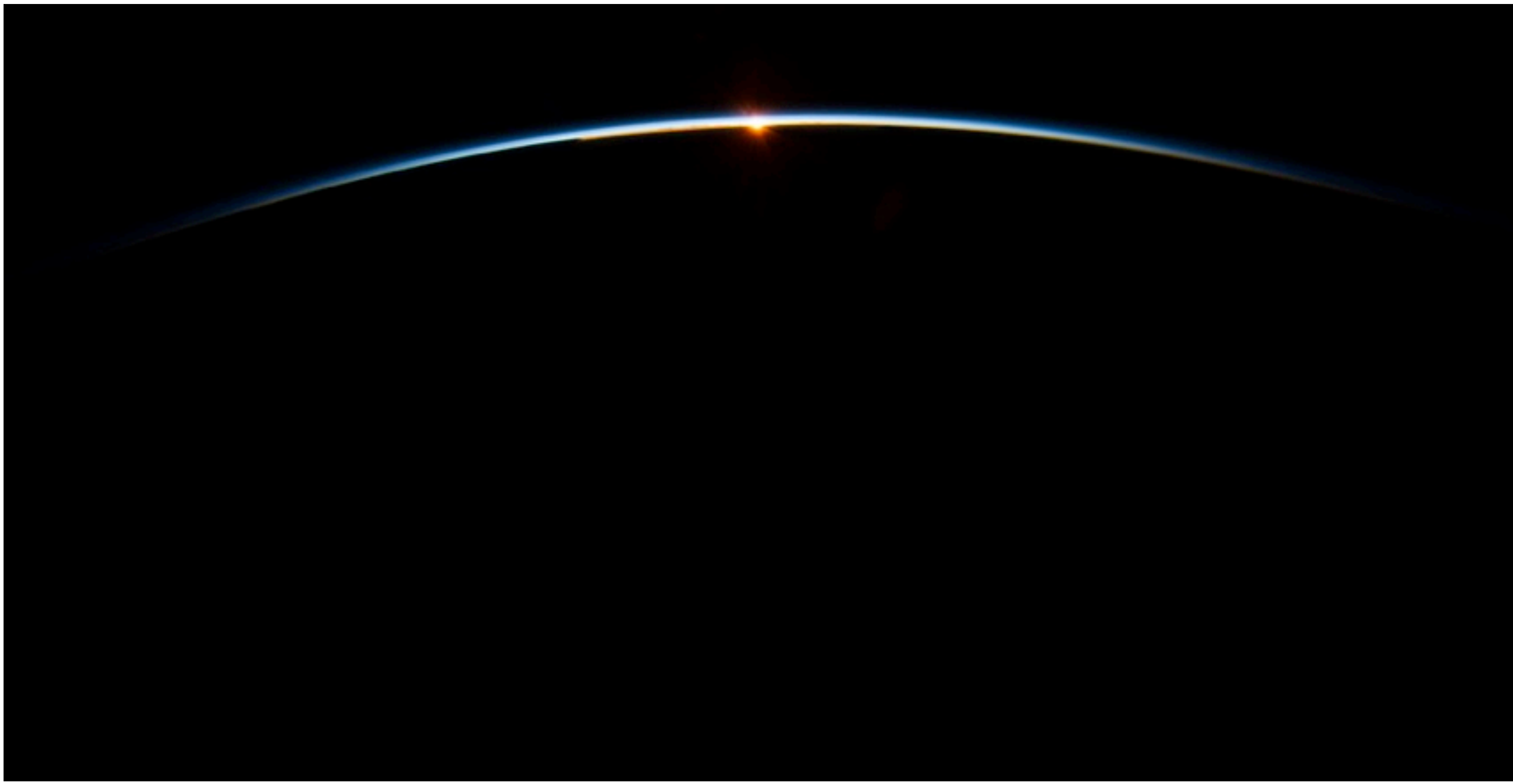
Saturn, as seen on 25-4-2016 from a 3 million km distance by the Cassini satellite launched in October 1997, 40 years after Sputnik



That small blue dot is the Earth, a seen from Cassini, orbiting Saturn, 1.44 billion km from us, on 19-7-2013

Apollo 17,
7 Dec. 1972

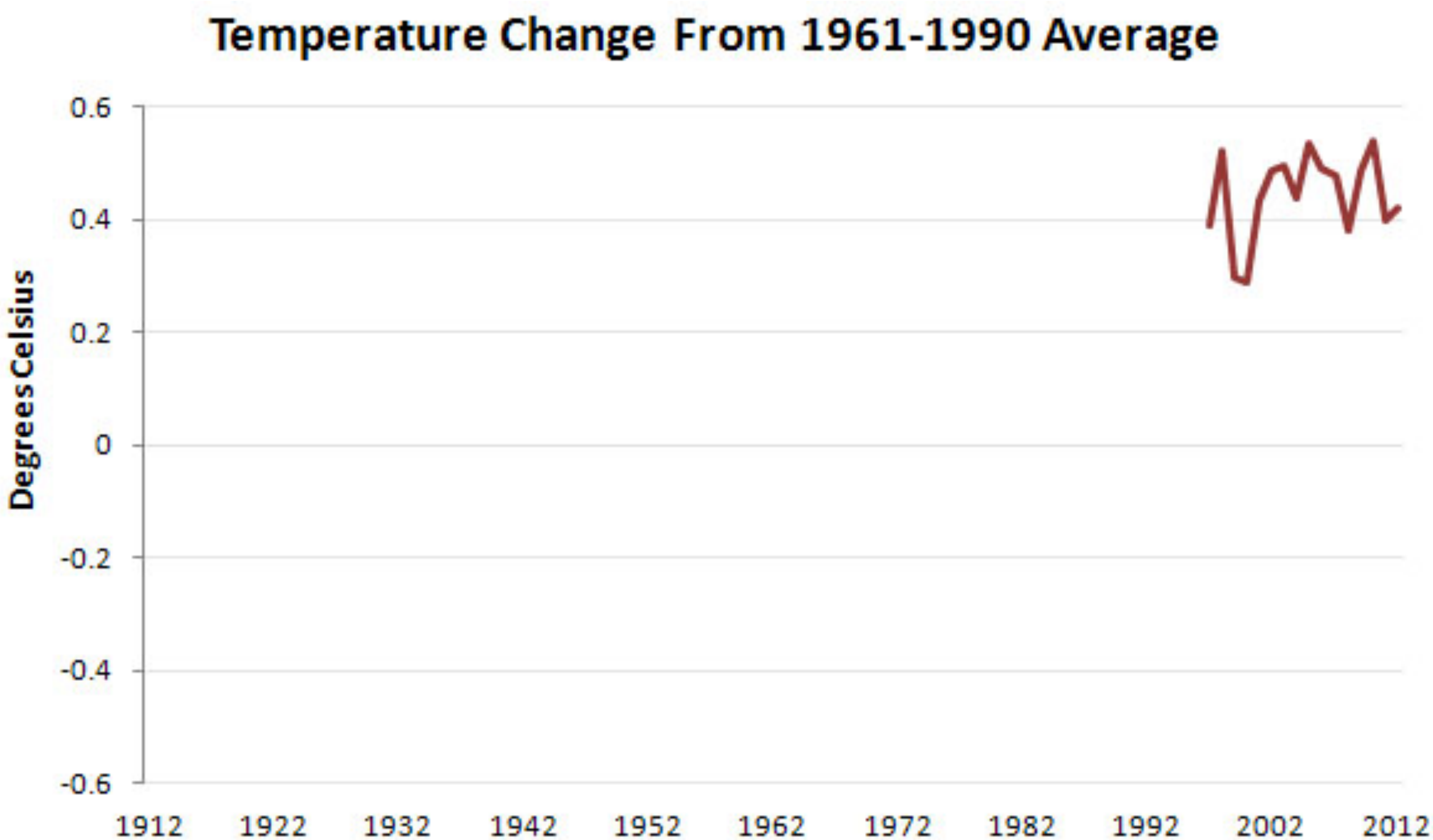
Our atmosphere is thin and fragile (as seen by ISS crew on 31 July 2013)



Jean-Pascal van Ypersele
(vanyp@climate.be)

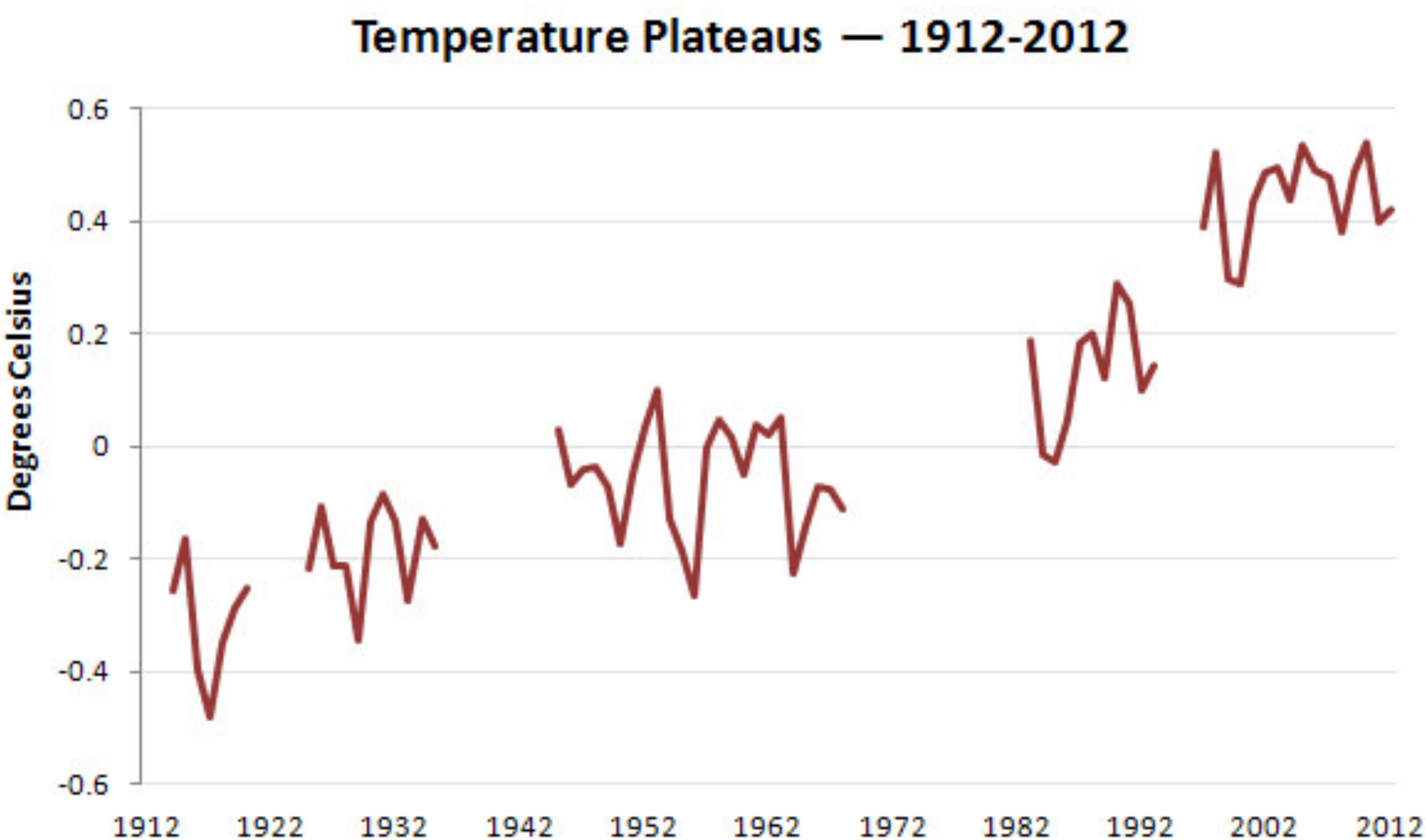
In Puerto Rico, Hurricane Maria created the worst humanitarian crisis in the US for decades

Source: FEMA, 24-9-2017



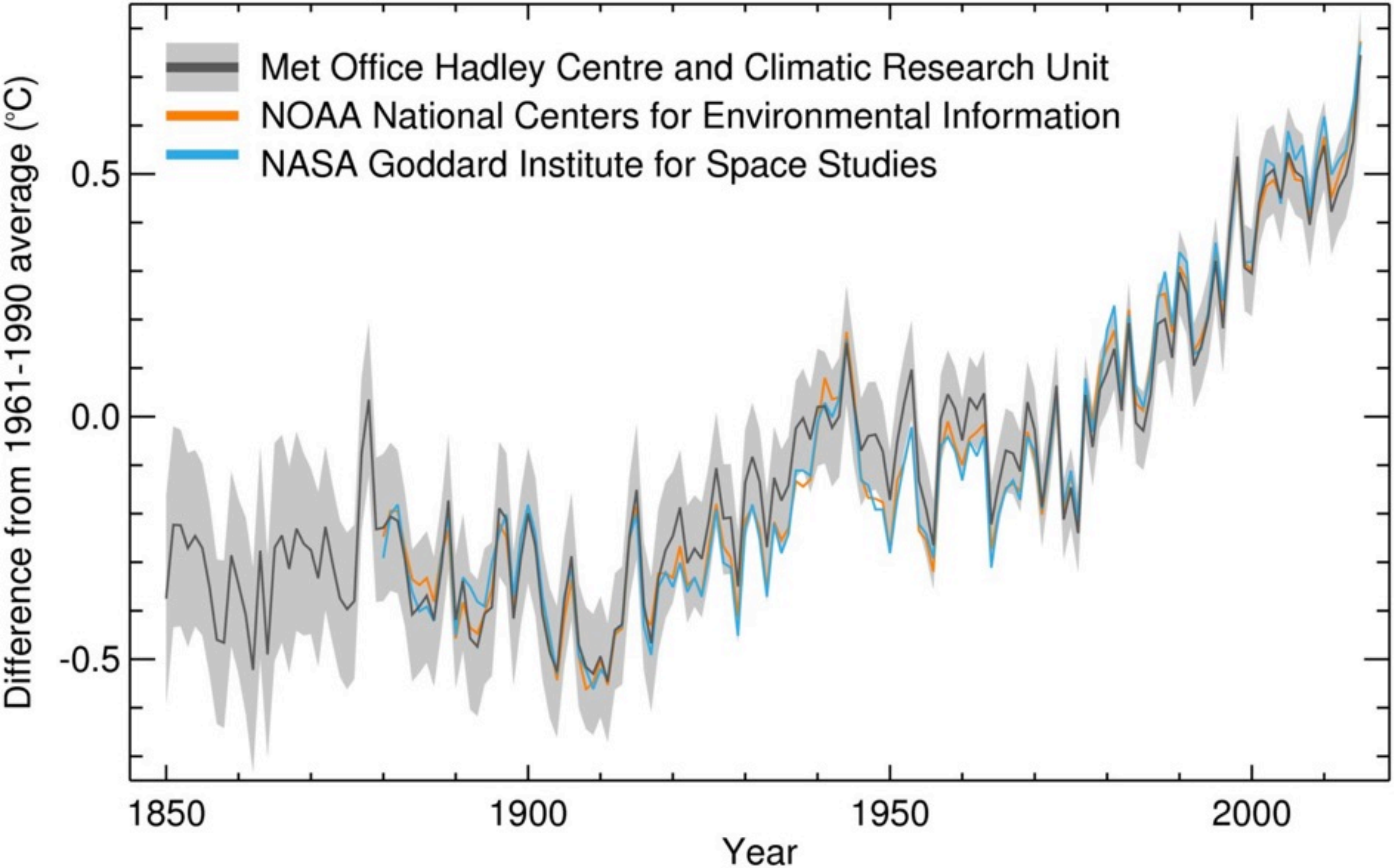
http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

Lying With Statistics, Global Warming Edition



http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

Global average temperature anomaly (1850-2015)



Source: NASA GISS

Why the IPCC ?

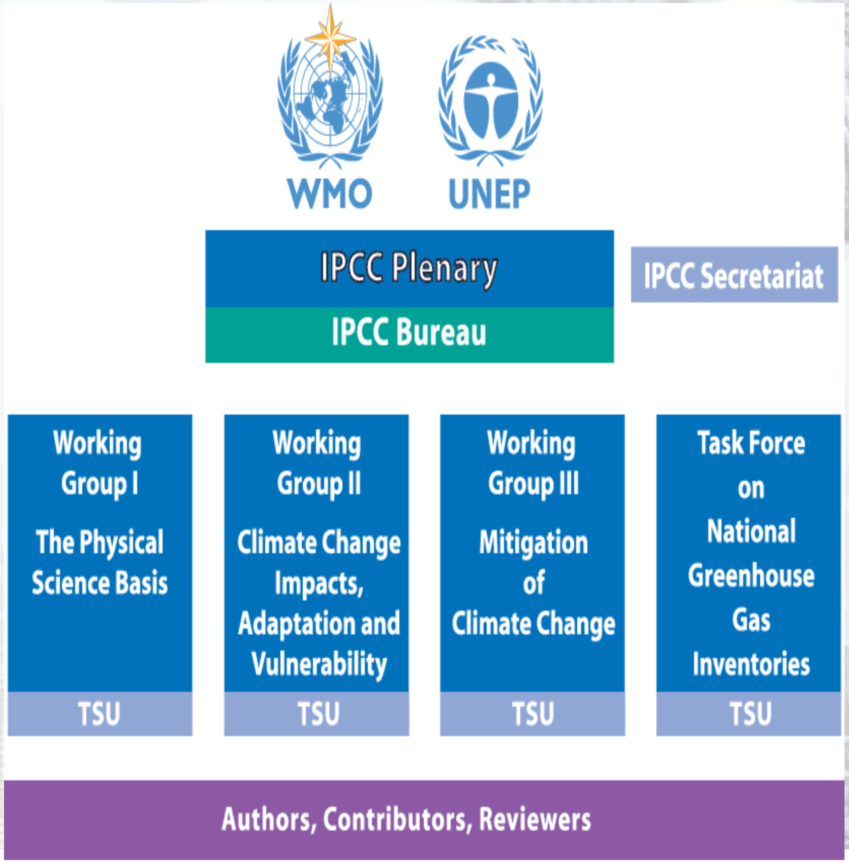
Established by WMO and UNEP in 1988

to provide policy-makers with an objective source of information about

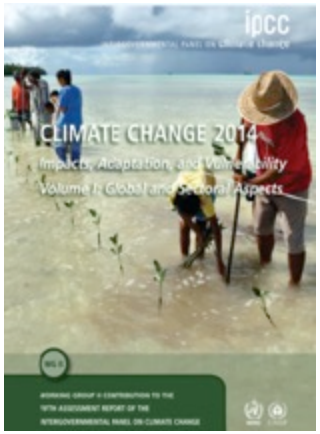
- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

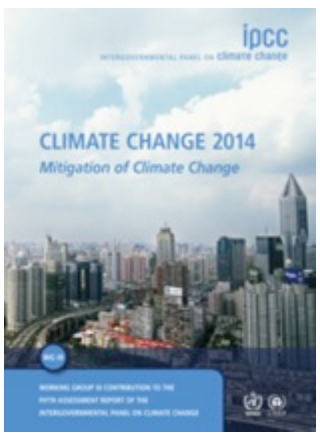
WMO=World Meteorological Organization
UNEP= United Nations Environment Programme

Inter-governmental Panel on Climate Change (IPCC): Organization Structure



- IPCC plenary comprises of all countries in the world
- IPCC Bureau comprises of 34 elected members; IPCC elects its Bureau every 6-7 years
- 3 Working Groups & a Task Force on National Greenhouse Gas Inventories
- Authors, Contributors, Reviewers, Review Editors





What is happening in the climate system?

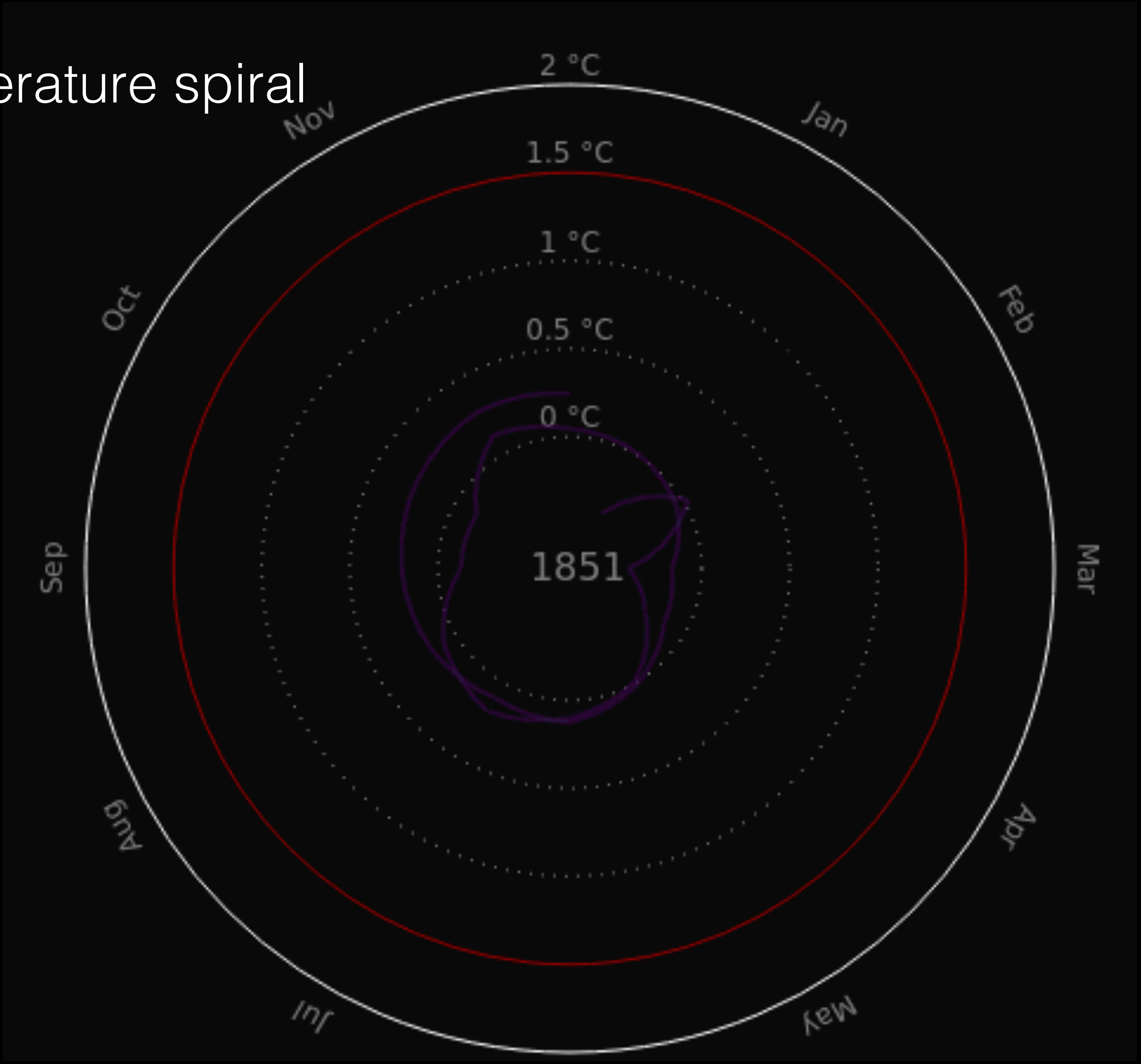
What are the risks?

What can be done?

ipcc
INTERGOVERNMENTAL PANEL ON climate change

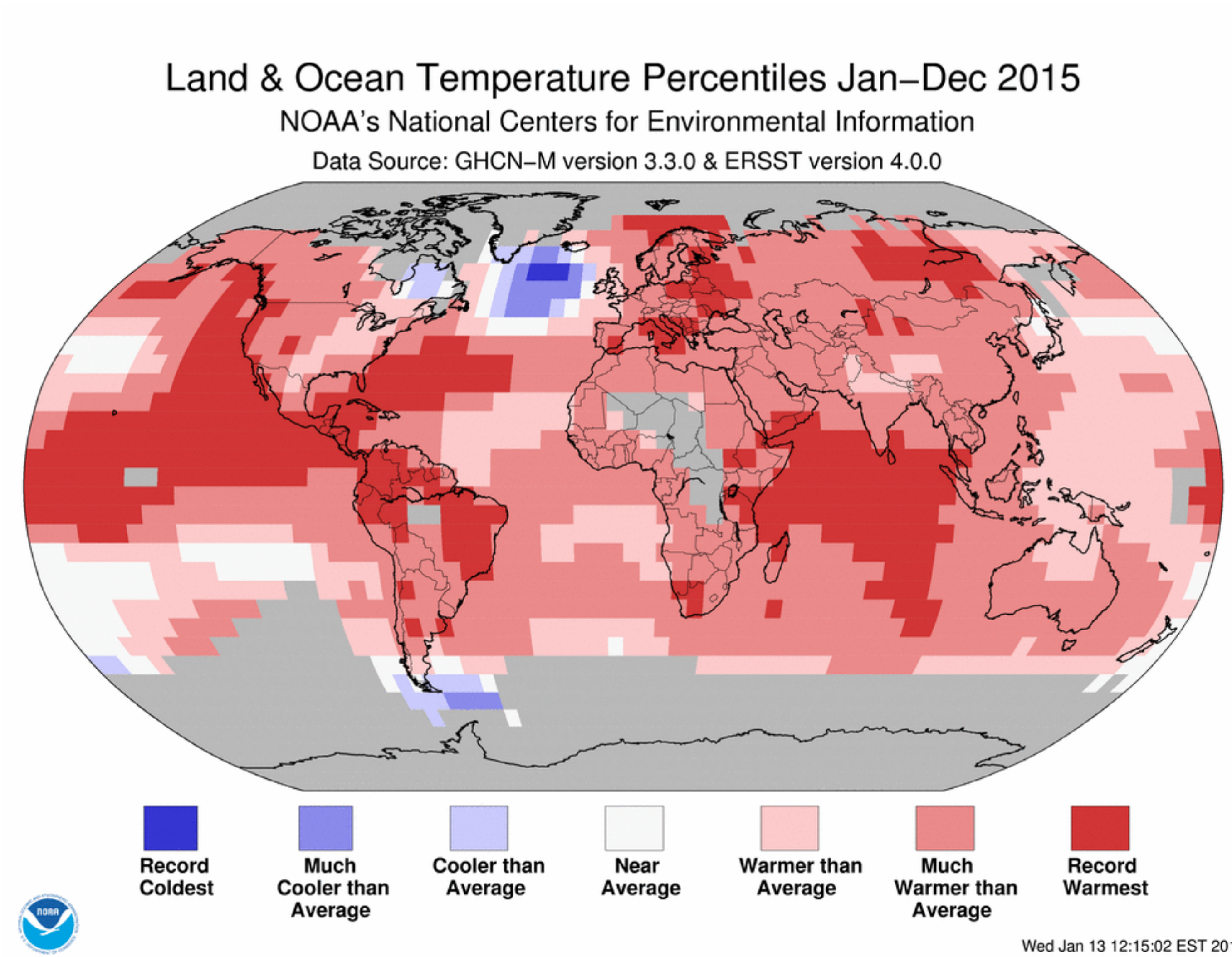
WMO UNEP

Temperature spiral

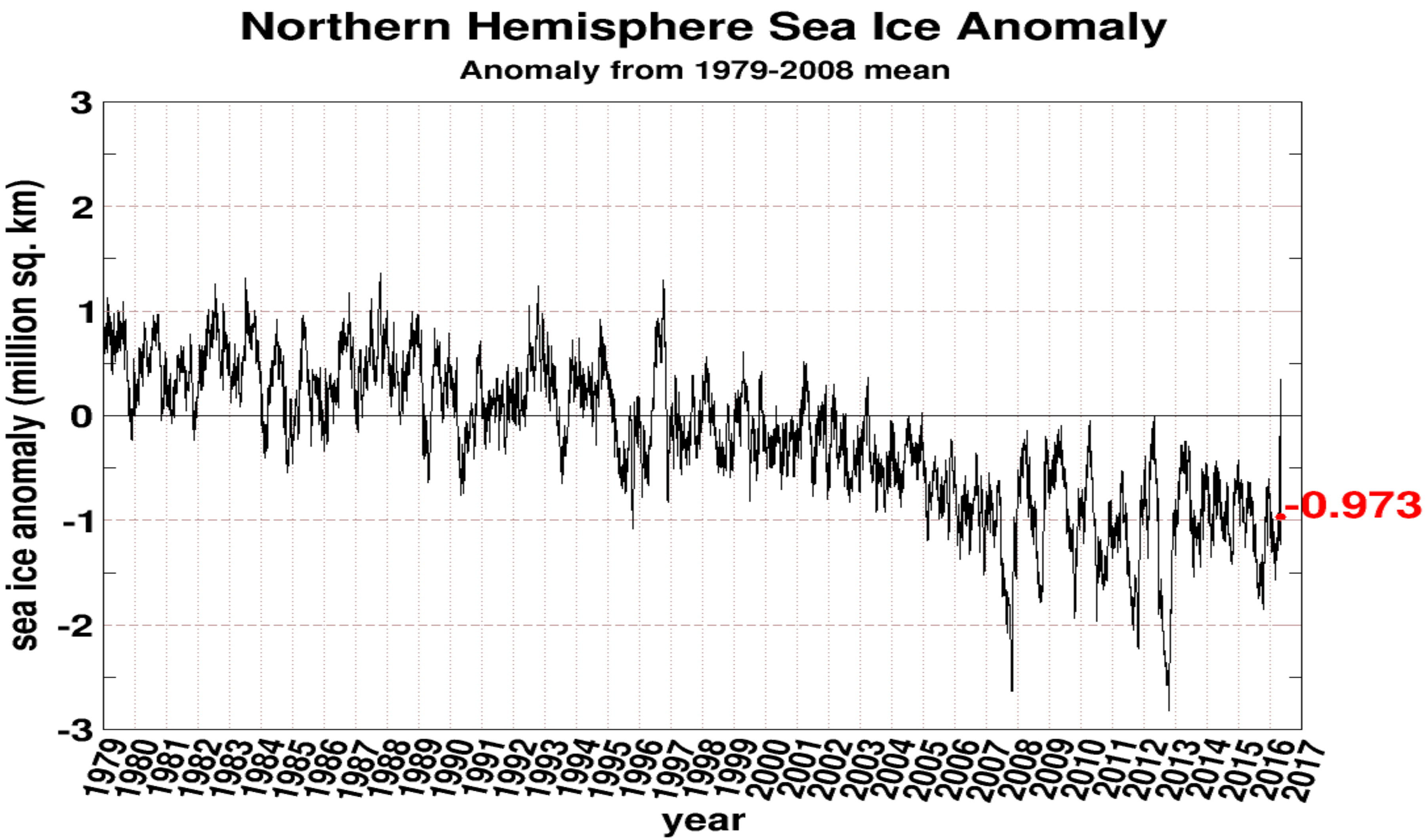


Global Mean Temperature in °C relative to 1850 – 1900
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset
Available on http://openclimatedata.net/climate-spirals/temperature

2014, 2015, 2016= warmest years since 1880

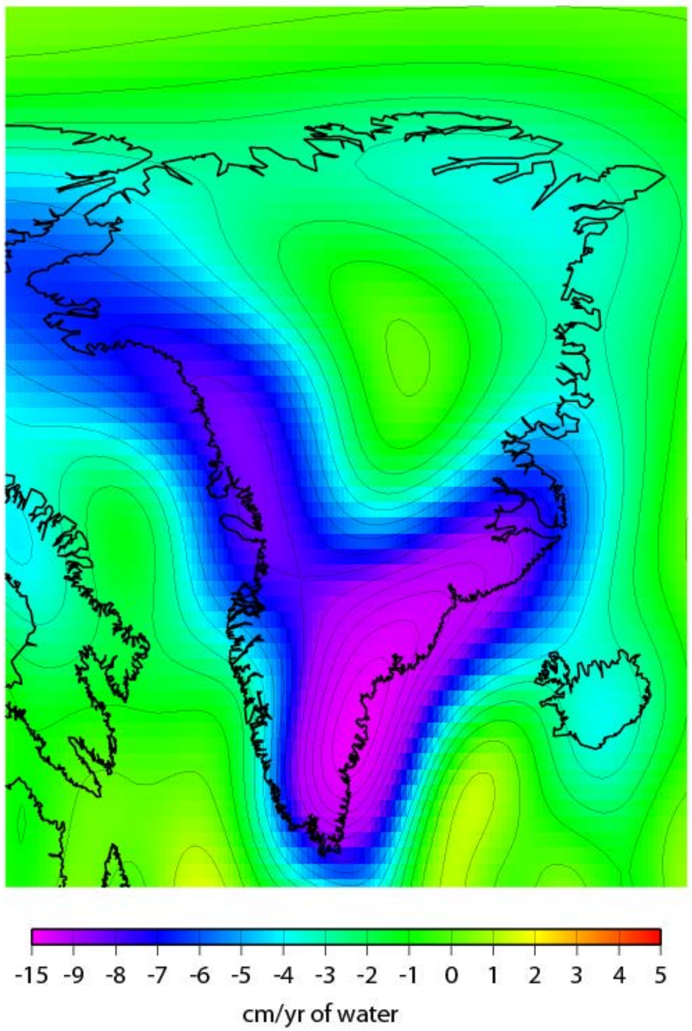


Arctic Sea Ice Cover (1979-2016)

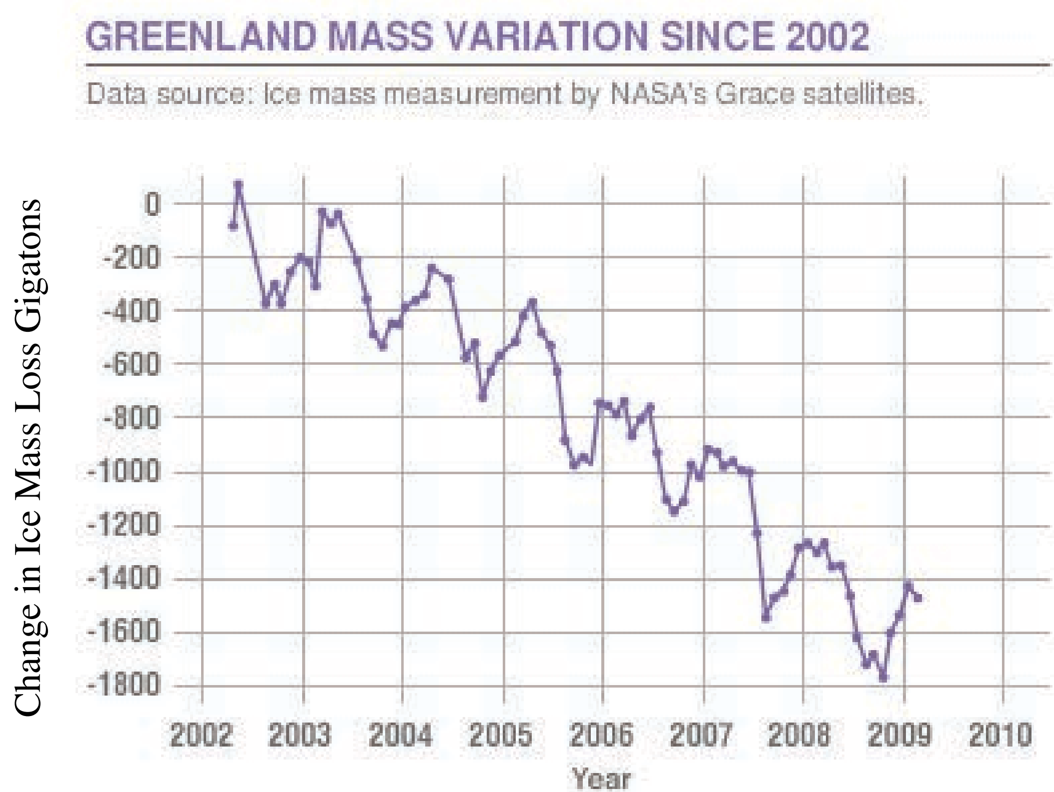


Greenland Ice Mass Loss 2002-2009
Derived From NASA GRACE Gravity Mission

Greenland



J. Wahr, U. Colorado

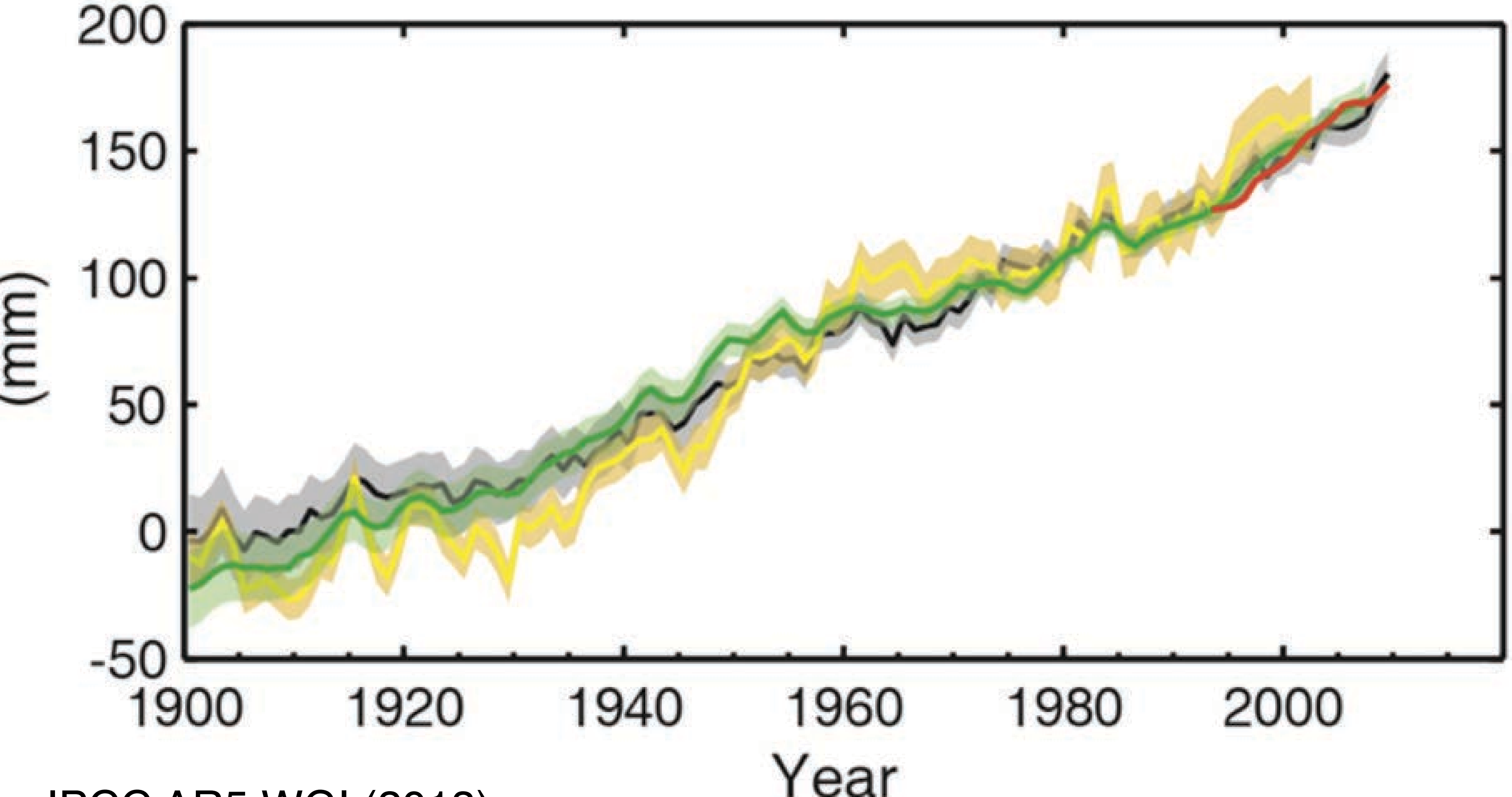


Velicogna, Geophysical Research Letters, 2009

•Contributes to sea level rise

B. Holt - JPL

Change in average sea-level change

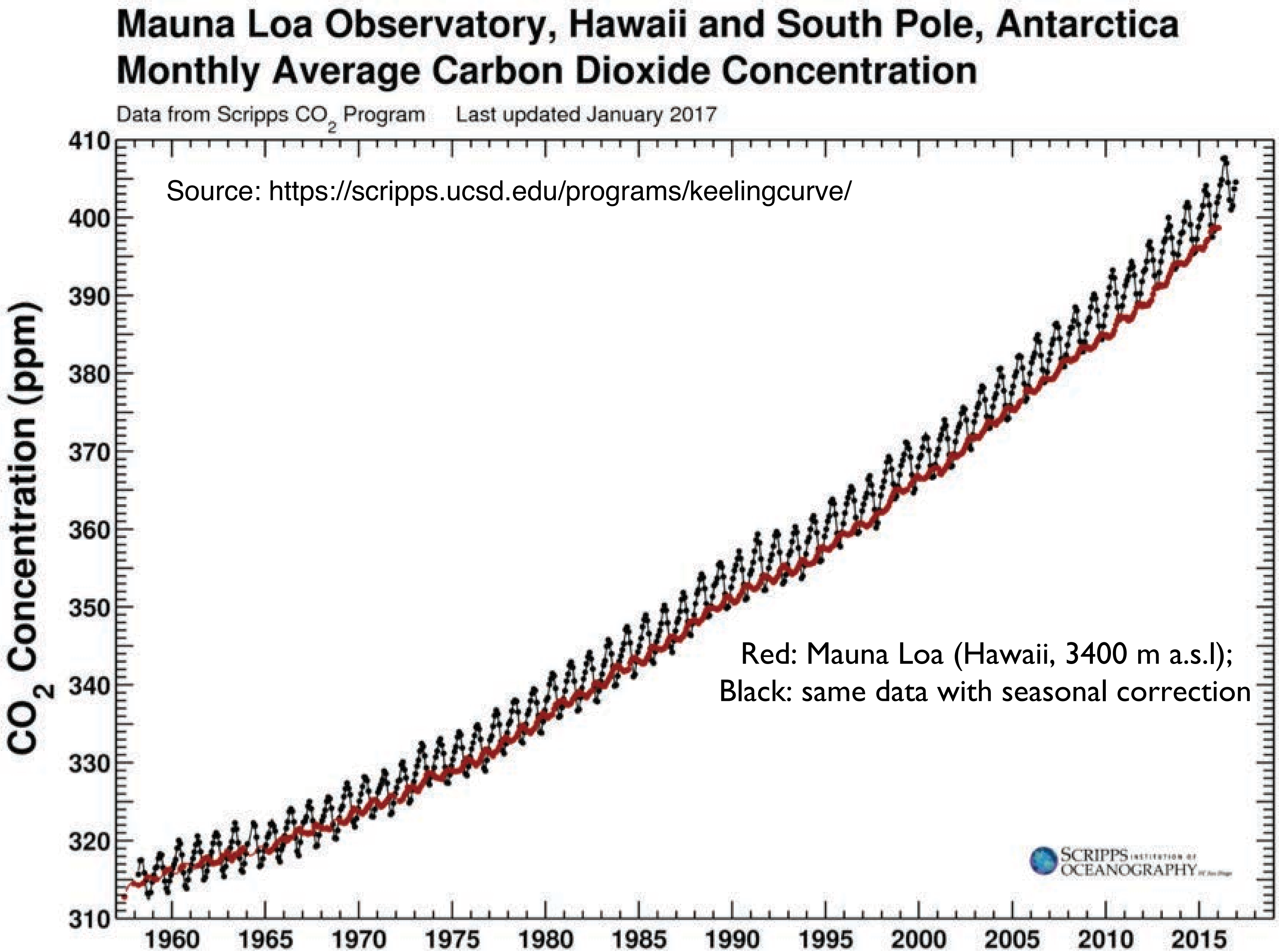


IPCC AR5 WGI (2013)

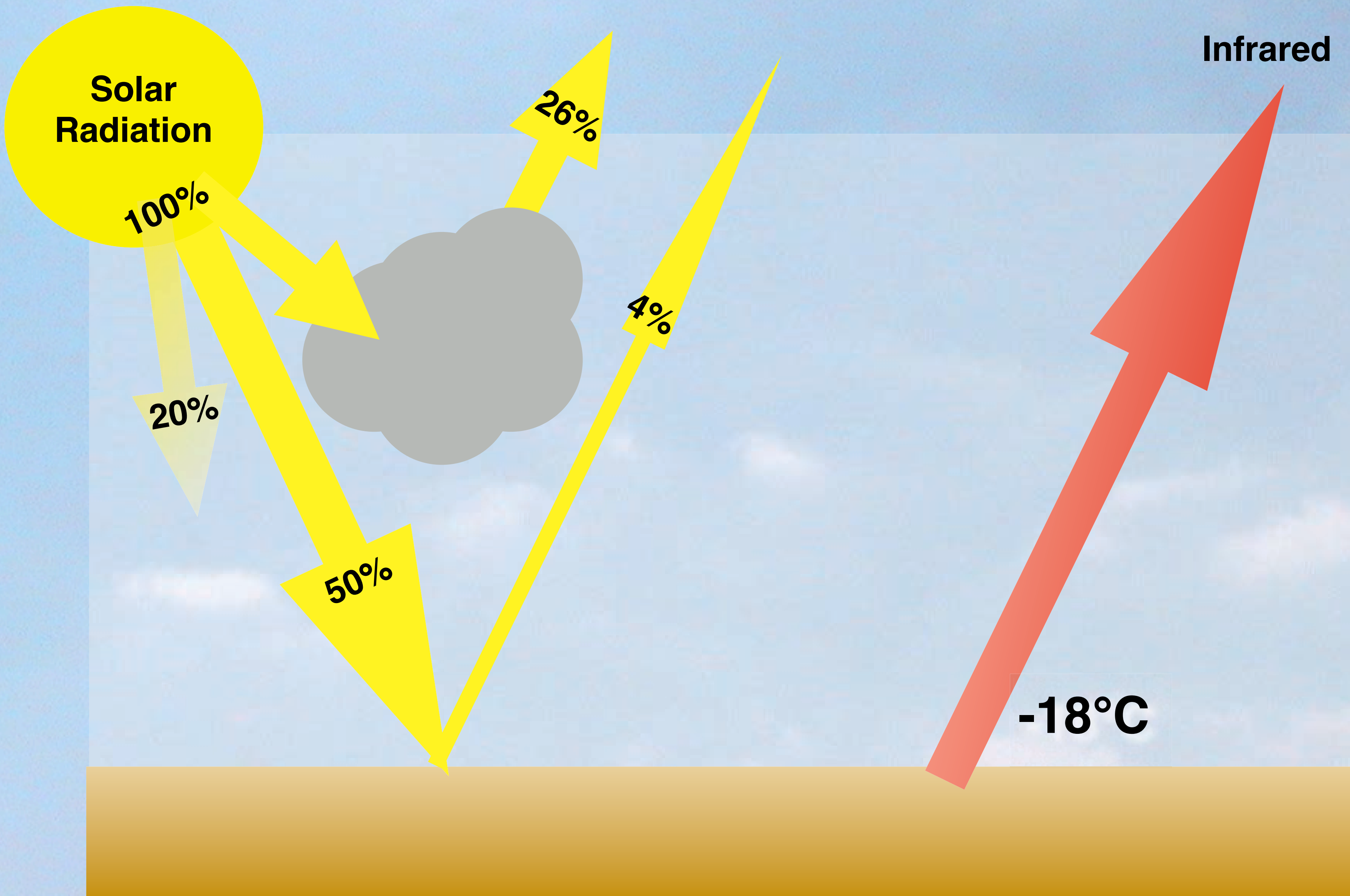
Coral reefs are dying

American Samoa (from www.globalcoralbleaching.org)

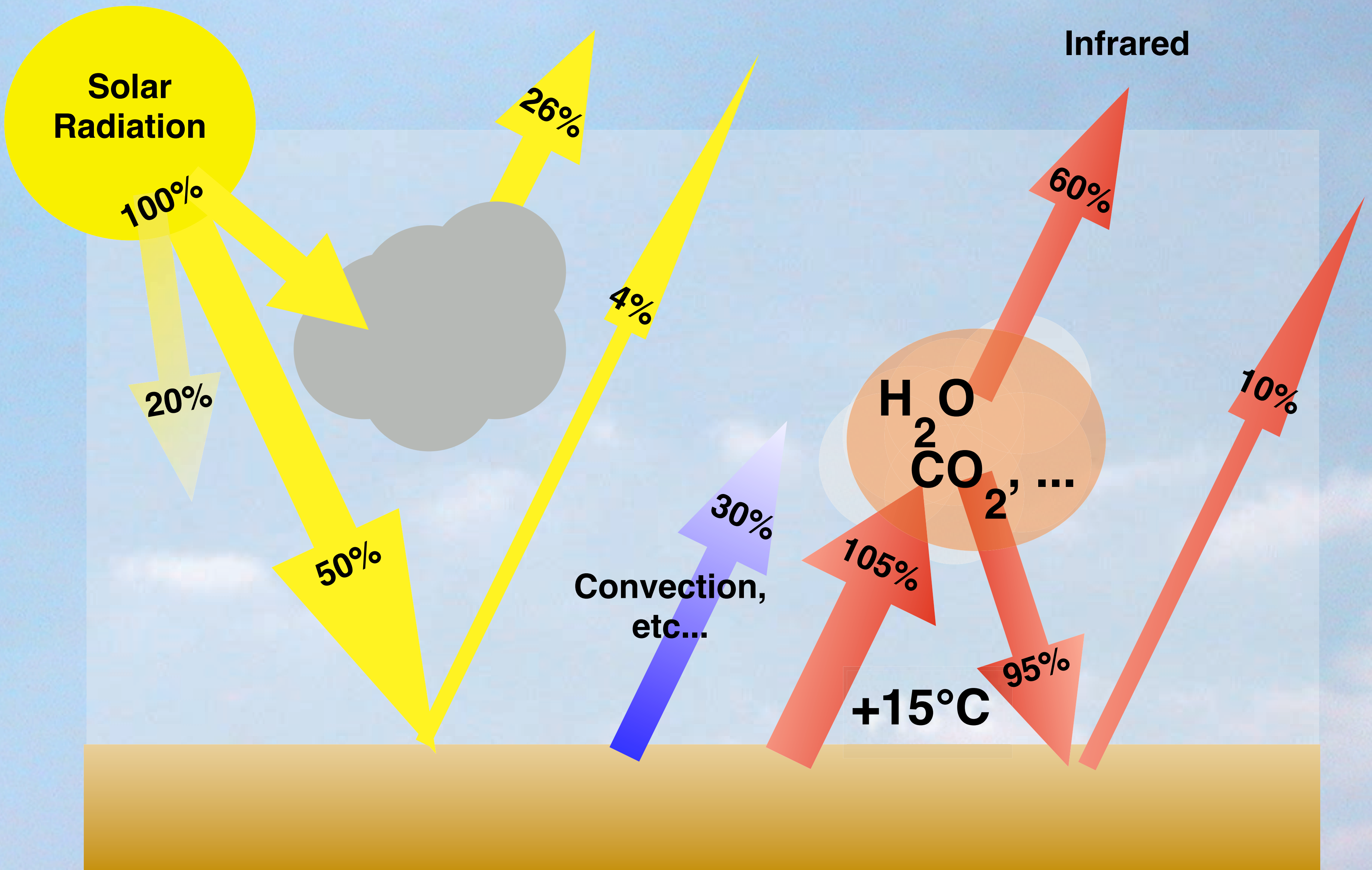
Atmospheric CO_2 concentration: the Keeling curve



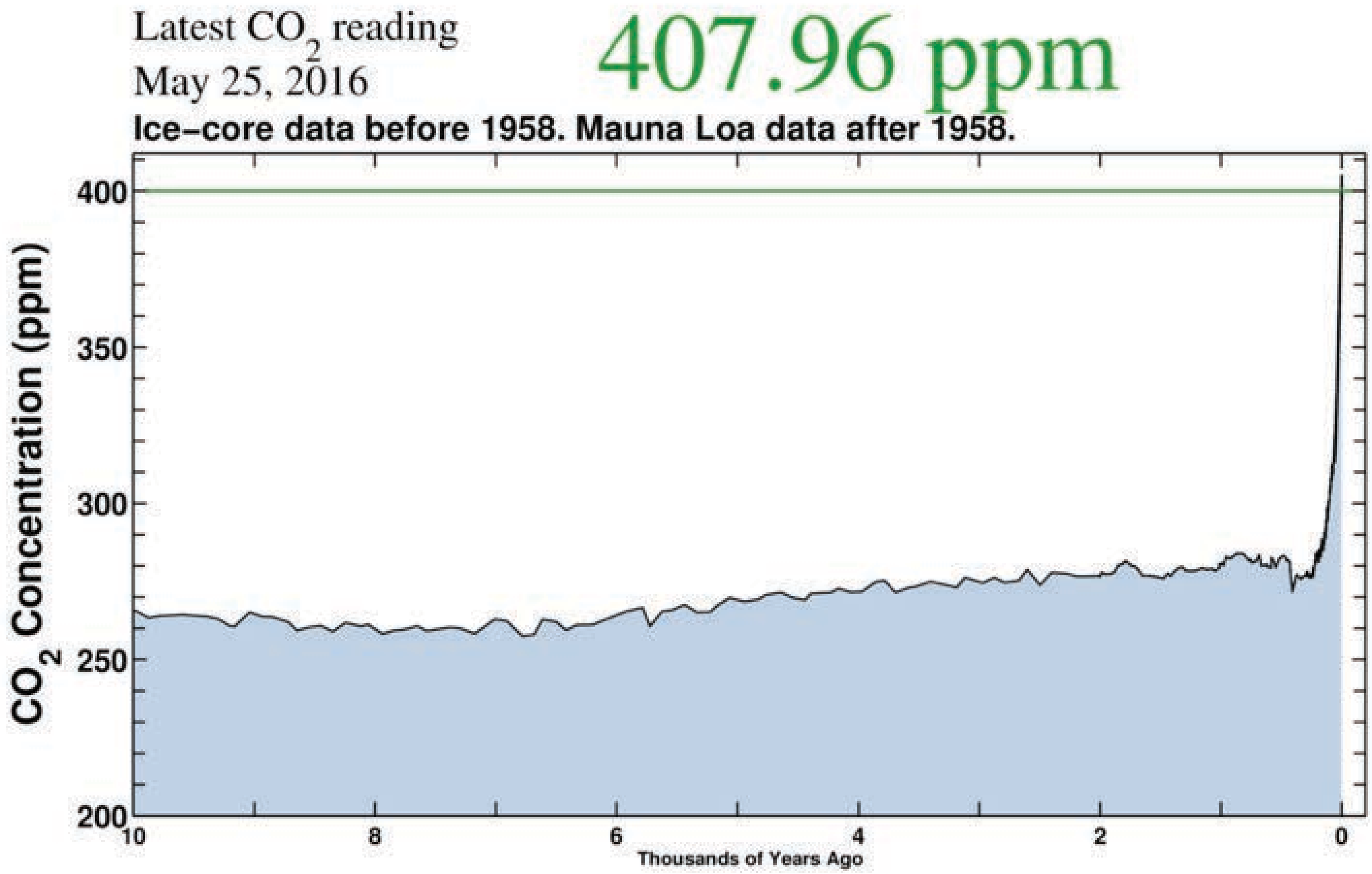
Energy Cycle Without Greenhouse Gases



Energy Cycle with Greenhouse Gases

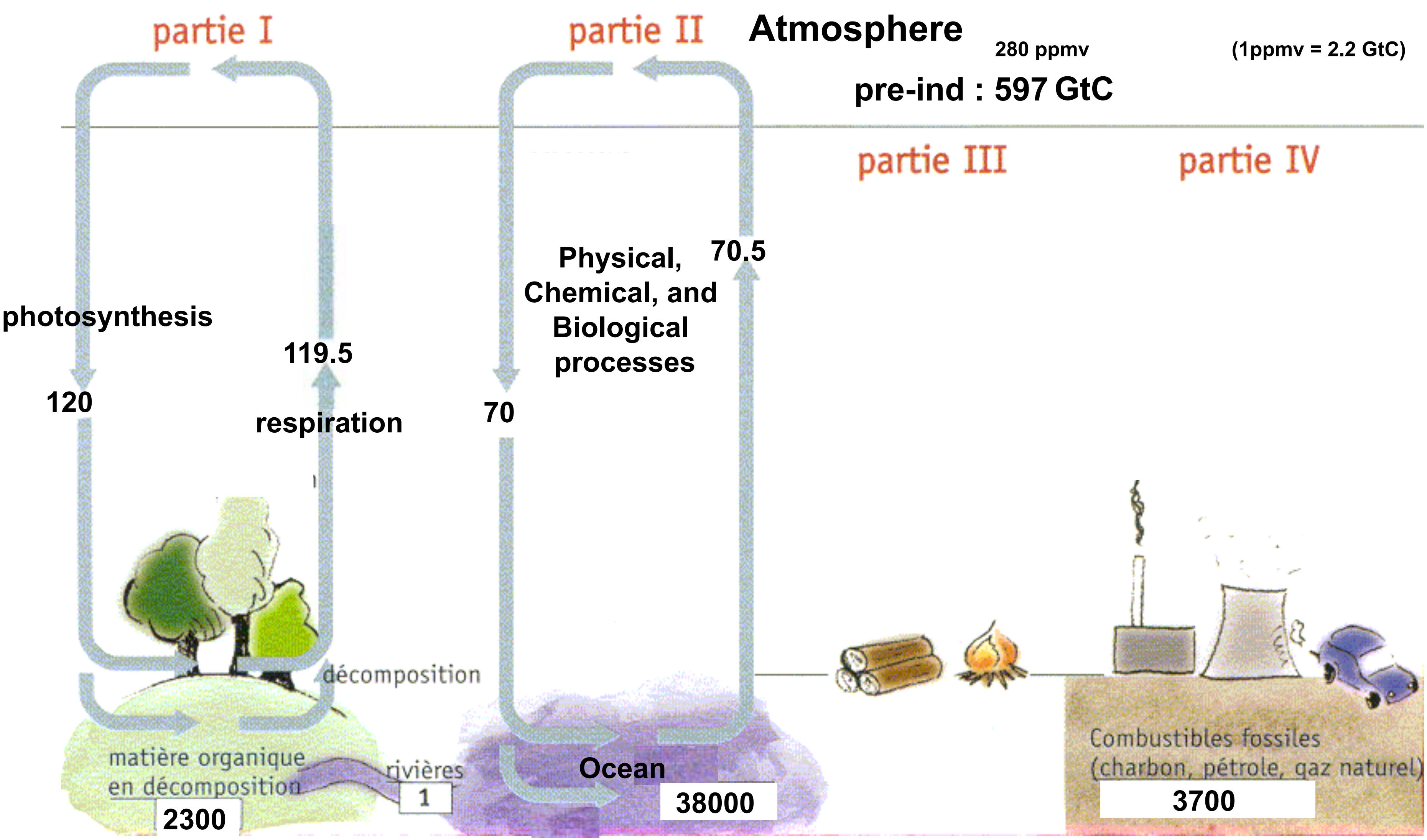


CO_2 Concentration, 25 May 2016 (Keeling curve)



Source: scripps.ucsd.edu/programs/keelingcurve/

Carbon cycle: unperturbed fluxes

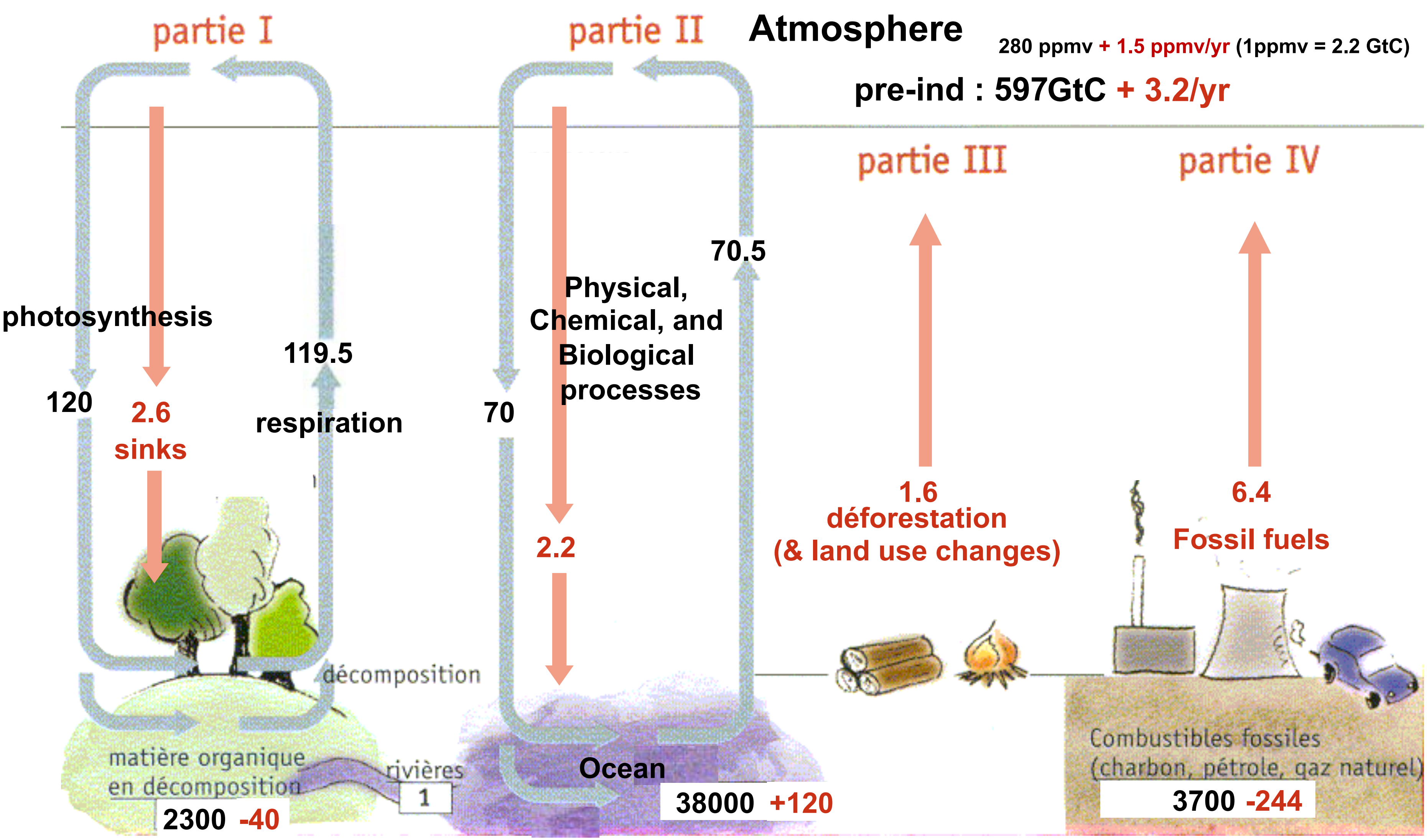


Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get $GtCO_2$)

vanyp@climate.be

Carbon cycle: perturbed by human activities

(numbers for the decade 1990-1999s, based on IPCC AR4)



Units: GtC (billions tons of carbon) or GtC/year

Stocks!

vanyp@climate.be

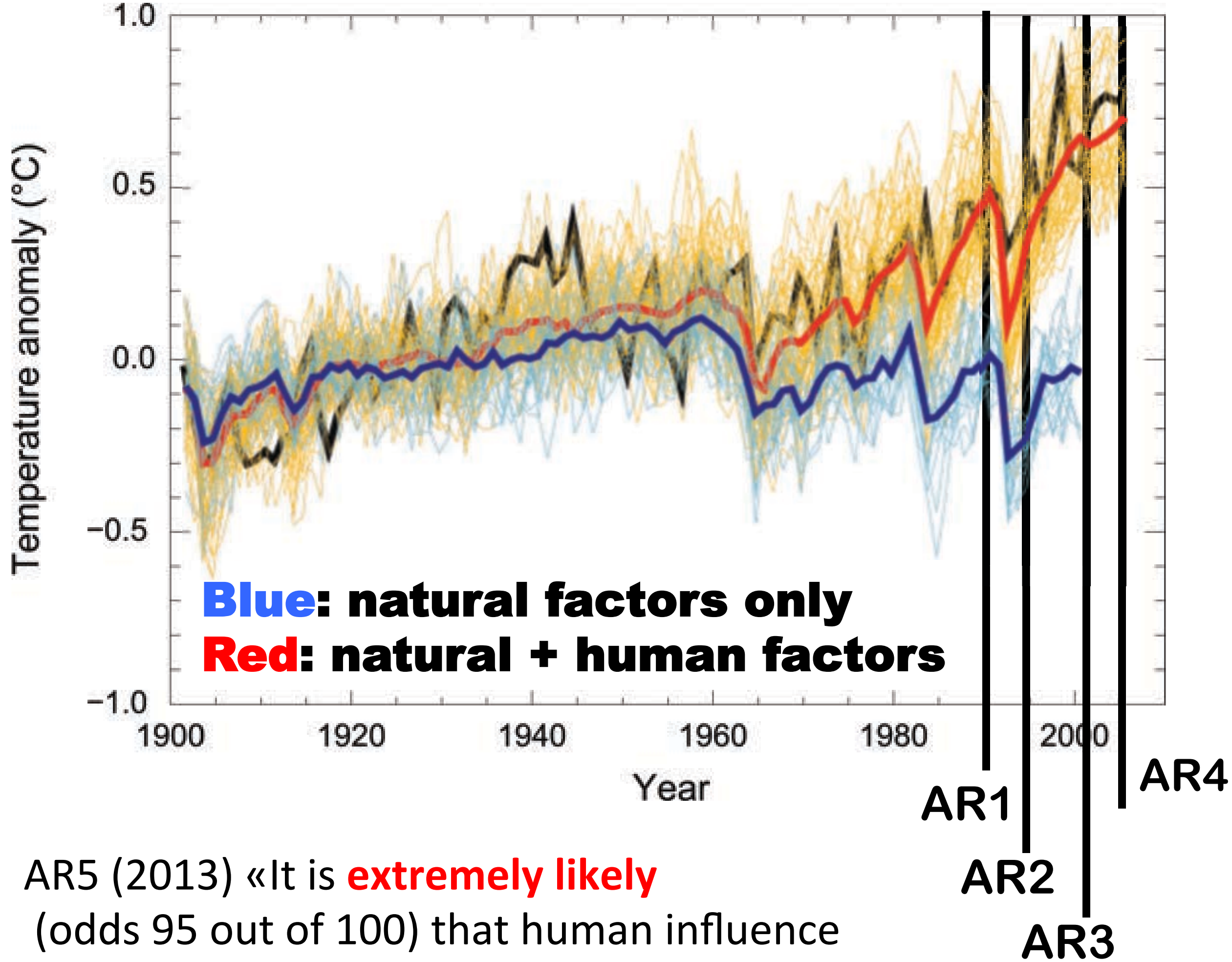
A Progression of Understanding: Greater and Greater Certainty in Attribution

AR1 (1990): “unequivocal detection not likely for a decade”

AR2 (1995): “balance of evidence suggests **discernible** human influence”

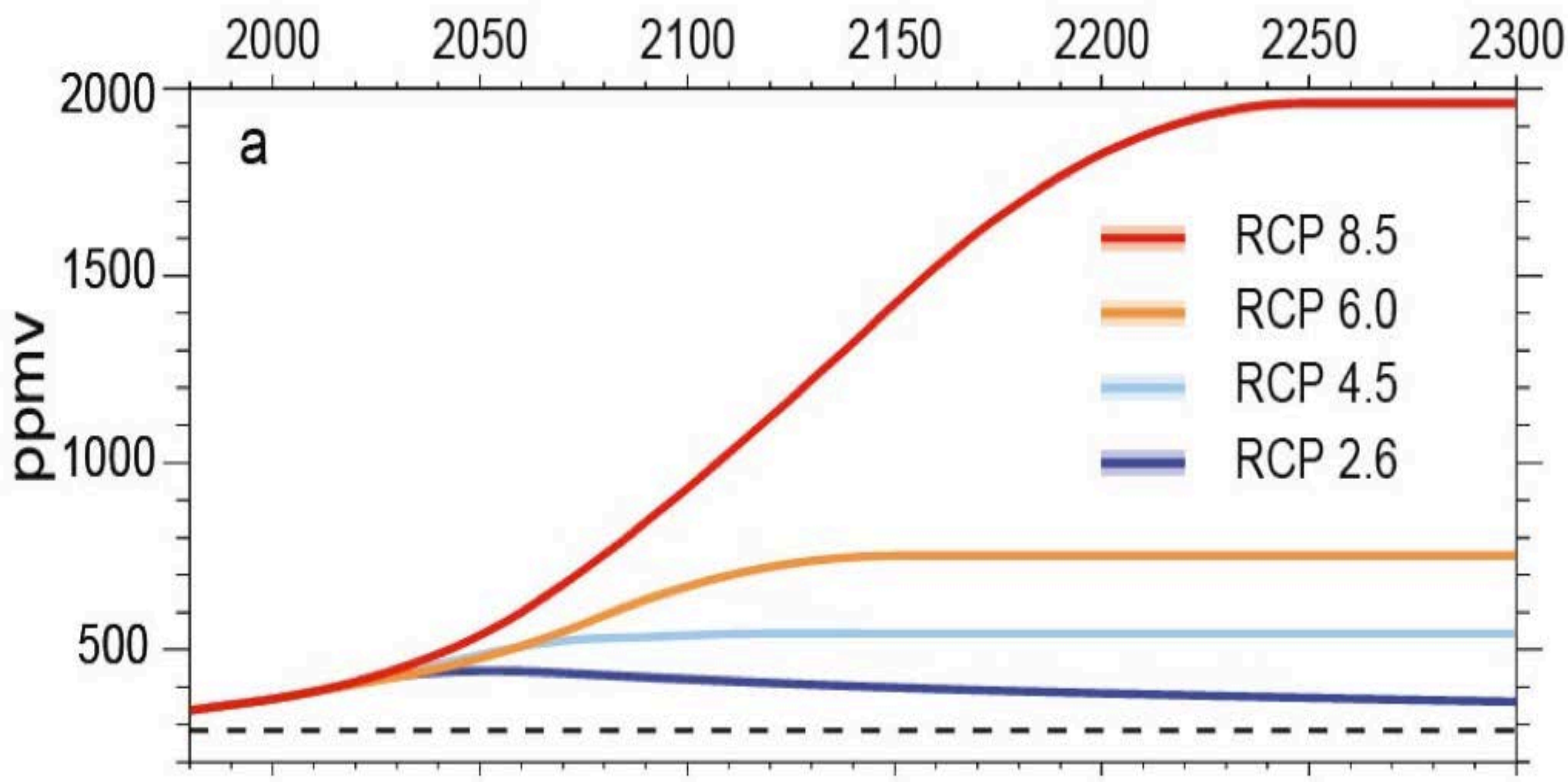
AR3 (2001): “most of the warming of the past 50 years is **likely** (odds 2 out of 3) due to human activities”

AR4 (2007): “most of the warming is **very likely** (odds 9 out of 10) due to greenhouse gases”



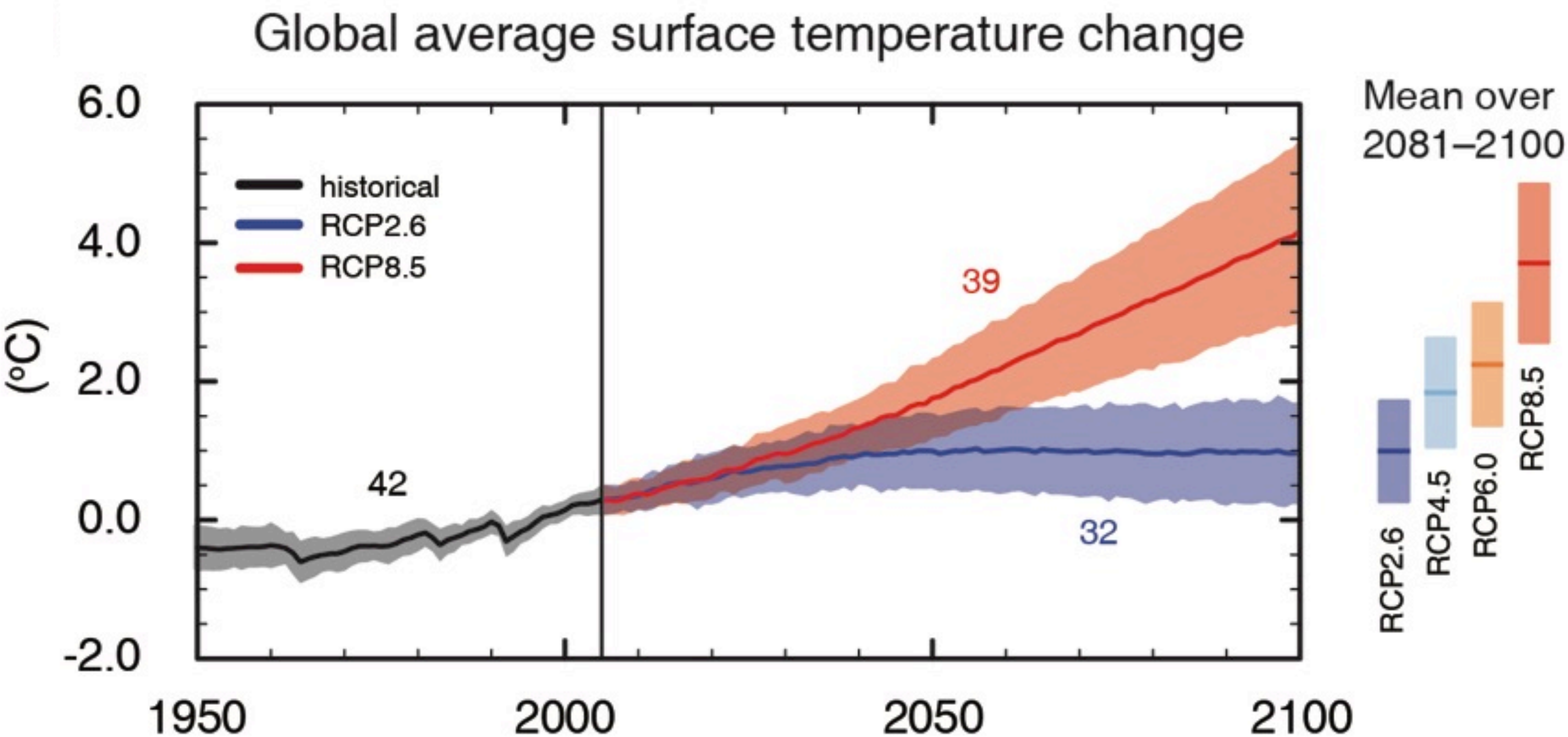
AR5 (2013) «It is **extremely likely** (odds 95 out of 100) that human influence has been the dominant cause... »

RCP Scenarios: Atmospheric CO_2 concentration



Three stabilisation scenarios: RCP 2.6 to 6
One Business-as-usual scenario: RCP 8.5

AR5, chapter 12. WGI- Adopted version / subject to final copyedit



(IPCC 2013, Fig. SPM.7a)

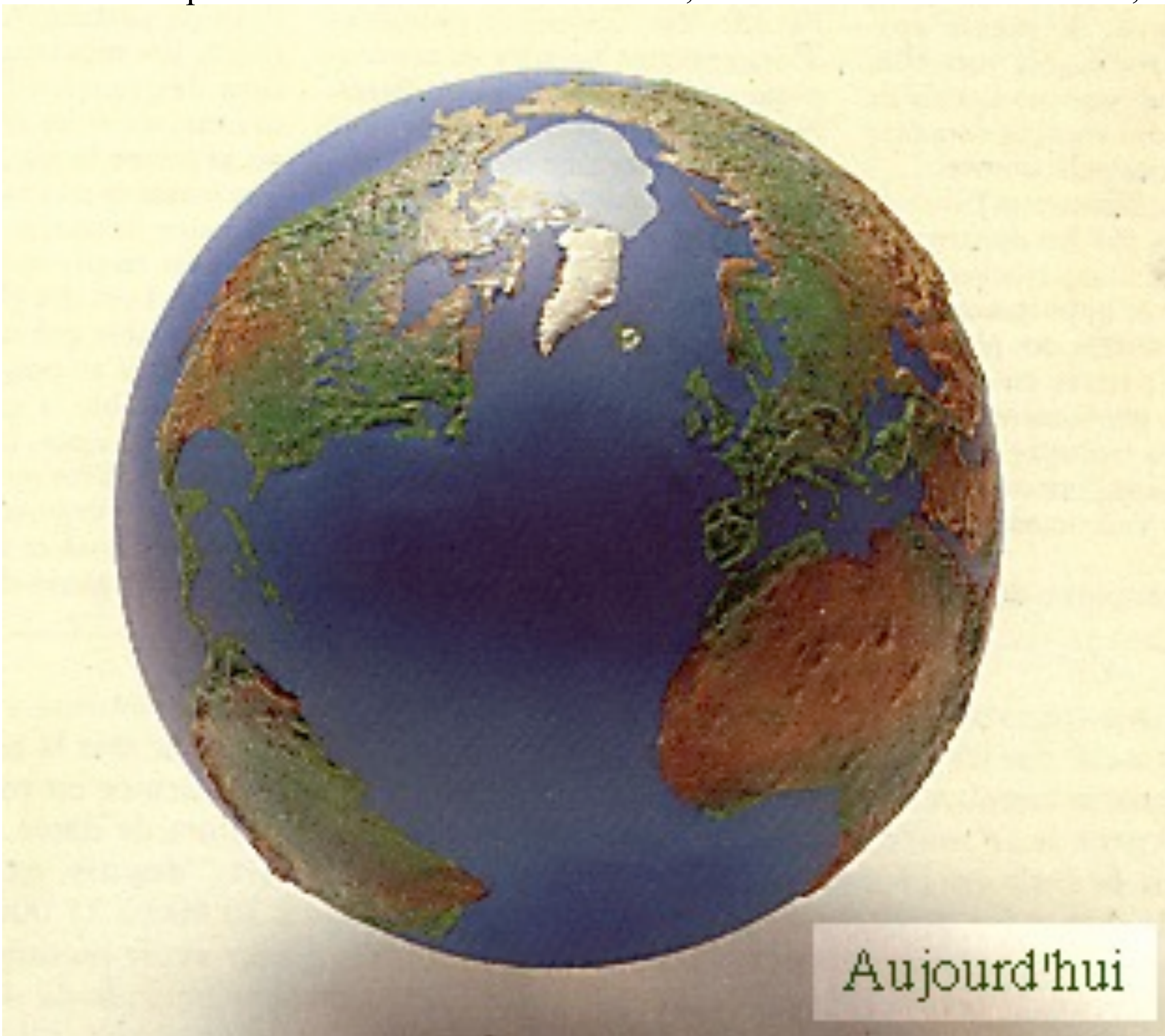
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2°C with at least 66% probability

18-20000 years ago (Last Glacial Maximum)

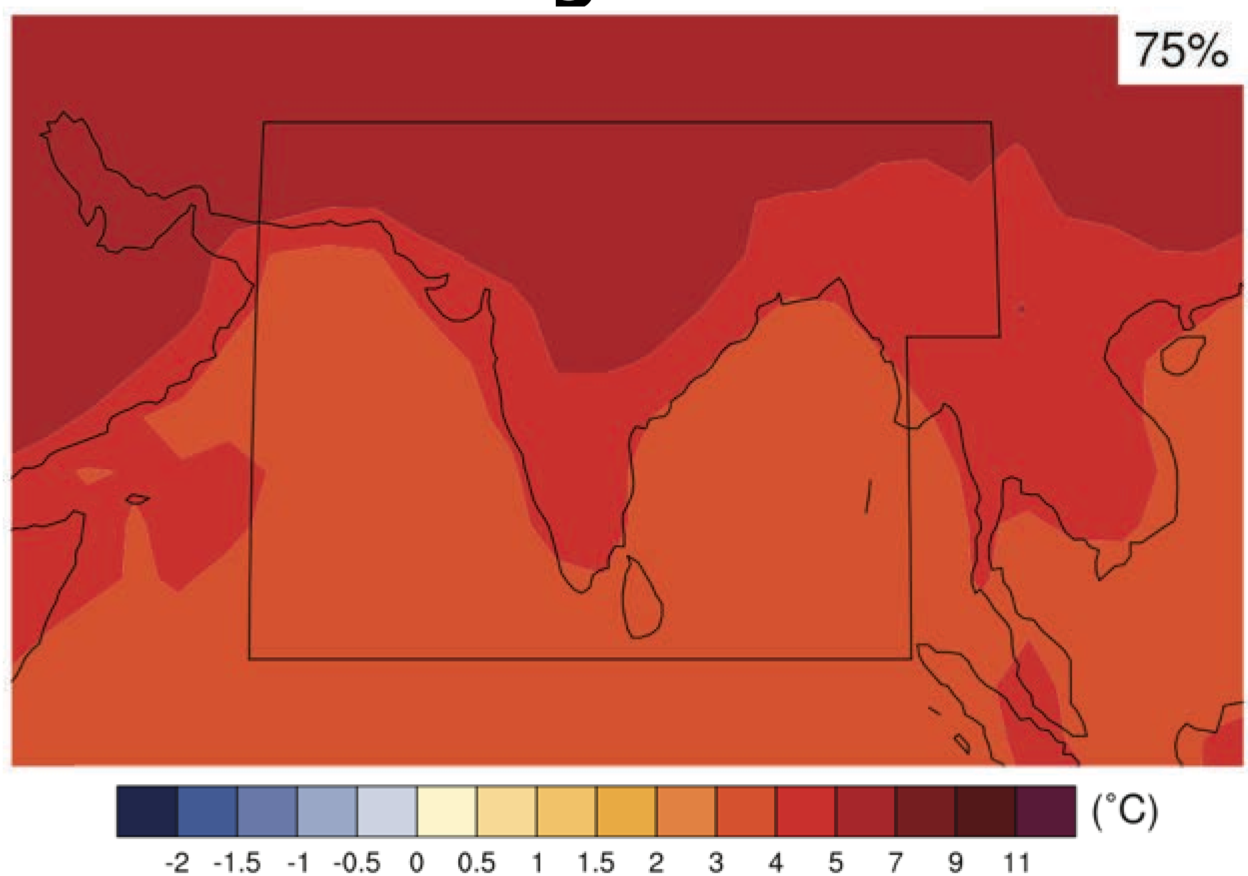
With permission from Dr. S. Joussaume, in « Climat d’hier à demain », CNRS éditions.

Today, with +4-5°C globally

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.

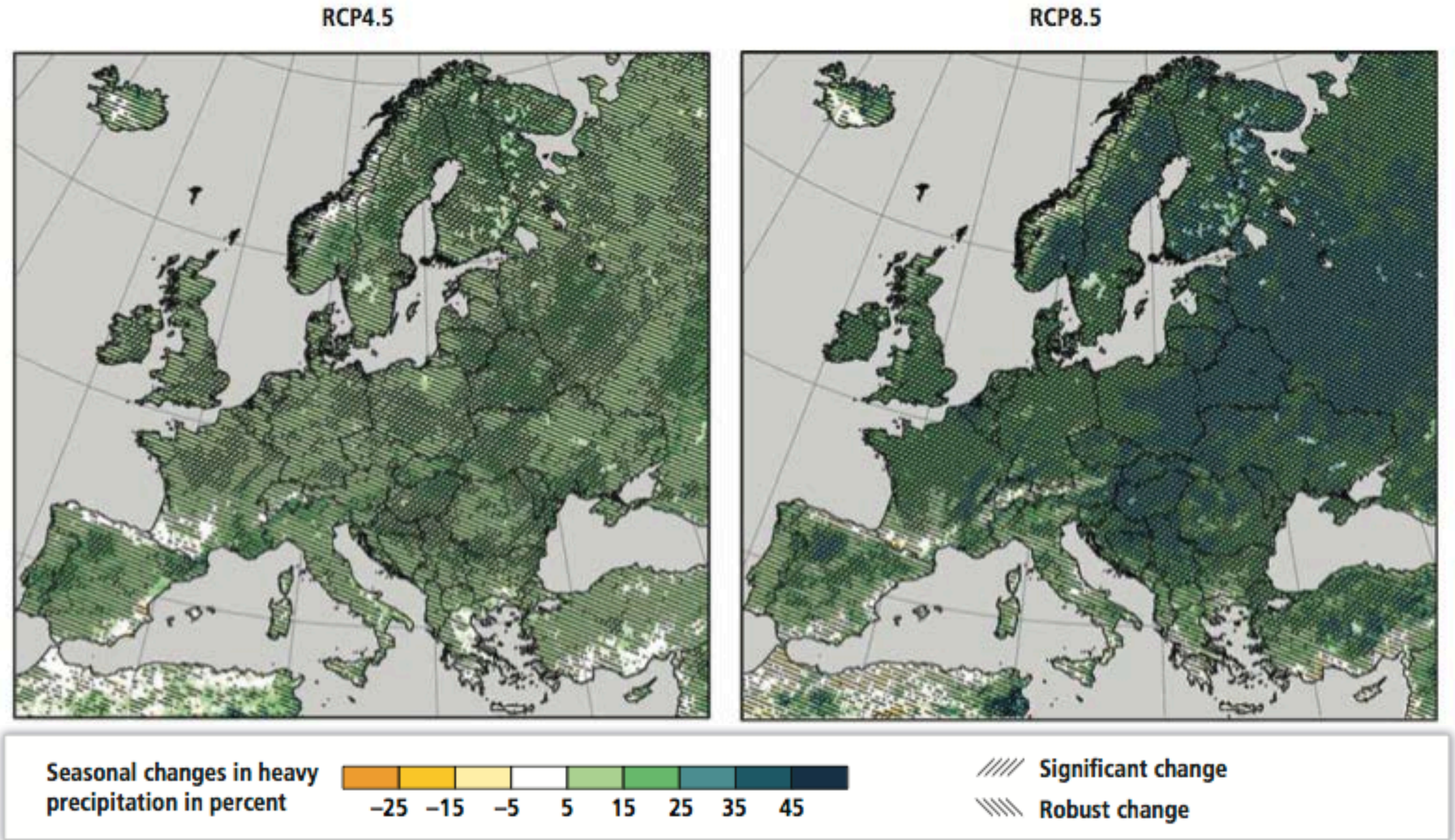


Maps of temperature changes in 2081–2100 with respect to 1986–2005 in the RCP8.5 scenario



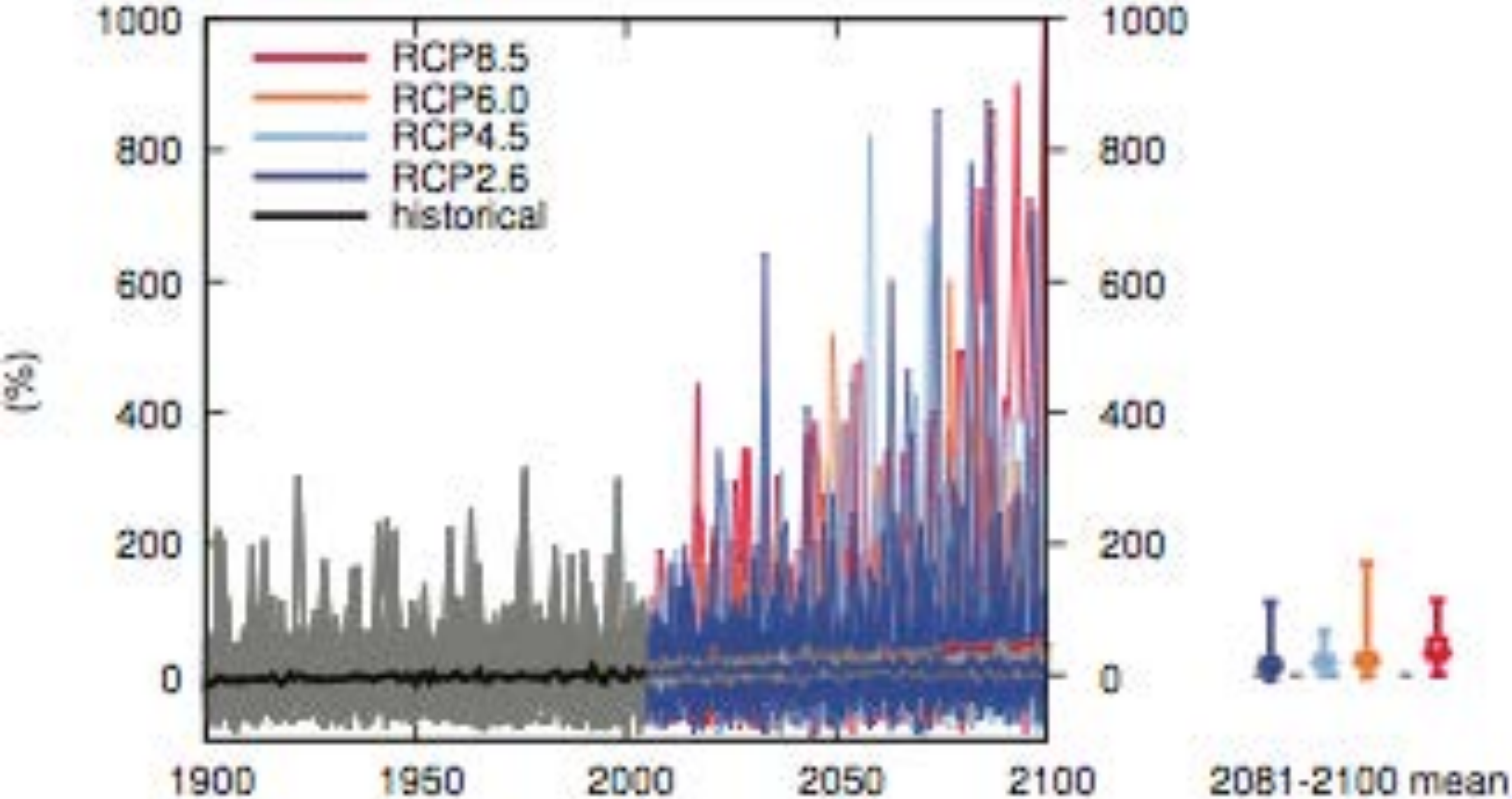
IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

Winter (DJF) seasonal changes in heavy precipitation (%), 2071-2100 compared to 1971-2000

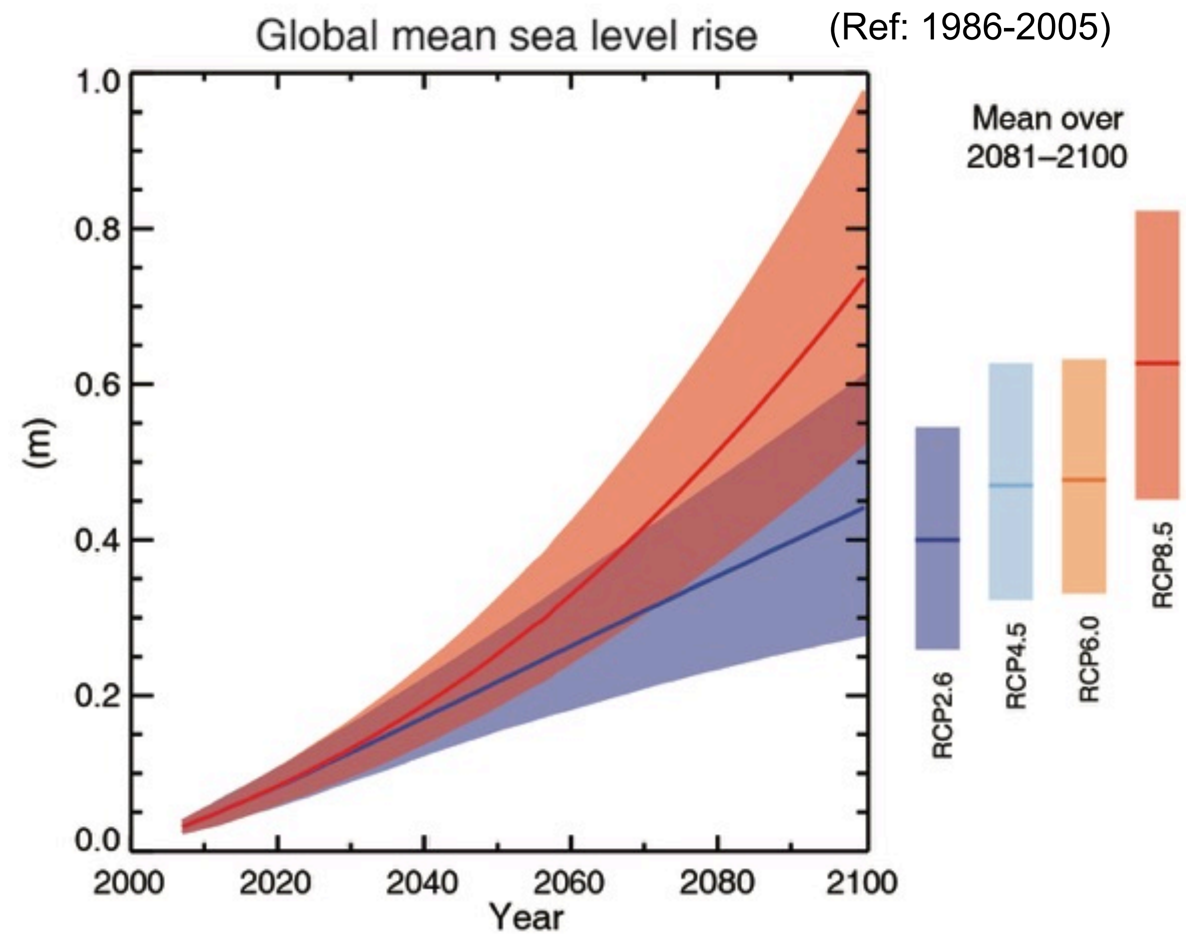


IPCC, AR5, WG II, Chap. 23, p. 1277

Precipitation change Equatorial Pacific (annual)



IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5



(IPCC 2013, Fig. SPM.9)

Sea level due to continue to increase

Effects on the Nile Delta, where more than 10 million people live less than 1 m above sea level

(Time 2001)

With 8 metre sea-level rise: 3700 km² below sea-level in Belgium (very possible in year 3000) (NB: flooded area depends on protection)

Source: J.P. van Ypersele et P. Marbaix (2004) See www.climate.be/impacts

On the frontline: The Maldives

(here with the IPCC Focal Point)

In front of Environment Ministry, Maldives, Aug. 2015

In front of Ministry of Foreign Affairs, Maldives, Aug. 2015


MINISTRY OF FOREIGN AFFAIRS

Disproportionate storm impact (1998-2009) on Asia-Pacific SIDS population & GDP

Table 29-5 | Top ten countries in the Asia–Pacific region based on absolute and relative physical exposure to storms and impact on GDP (between 1998 and 2009; after Tables 1.10 and 1.11 of ESCAP and UNISDR, 2010).

Rank	Absolute exposure (millions affected)	Relative exposure (% of population affected)	Absolute GDP loss (US$ billions)	Loss (% of GDP)
1	Japan (30.9)	Northern Mariana Islands (58.2)	Japan (1,226.7)	Northern Mariana Islands (59.4)
2	Philippines (12.1)	Niue (25.4)	Republic of Korea (35.6)	Vanuatu (27.1)
3	China (11.1)	Japan (24.2)	China (28.5)	Niue (24.9)
4	India (10.7)	Philippines (23.6)	Philippines (24.3)	Fiji (24.1)
5	Bangladesh (7.5)	Fiji (23.1)	Hong Kong (13.3)	Japan (23.9)
6	Republic of Korea (2.4)	Samoa (21.4)	India (8.0)	Philippines (23.9)
7	Myanmar (1.2)	New Caledonia (20.7)	Bangladesh (3.9)	New Caledonia (22.4)
8	Vietnam (0.8)	Vanuatu (18.3)	Northern Mariana Islands (1.5)	Samoa (19.2)
9	Hong Kong (0.4)	Tonga (18.1)	Australia (0.8)	Tonga (17.4)
10	Pakistan (0.3)	Cook Islands (10.5)	New Caledonia (0.7)	Bangladesh (5.9)

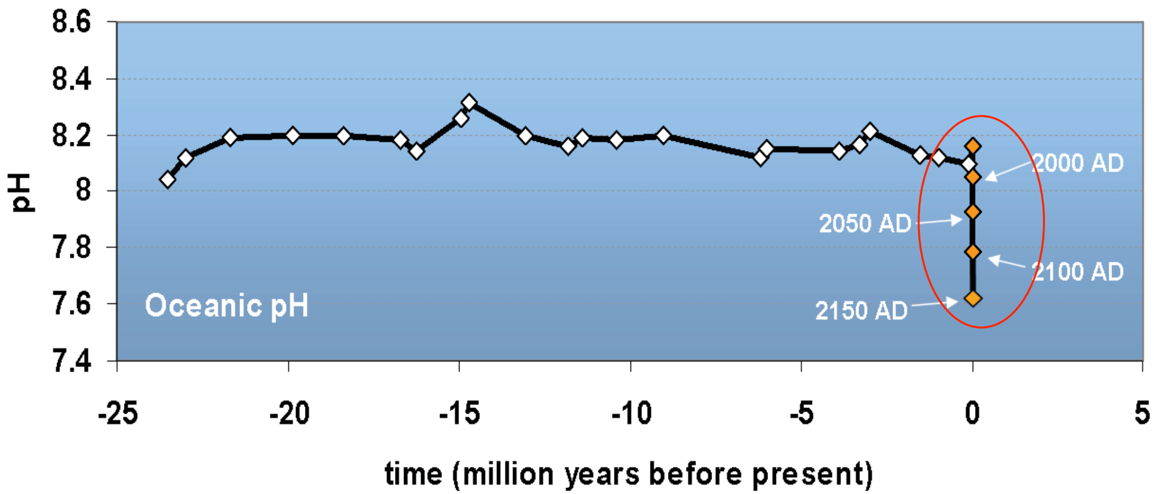
Note: Small islands are highlighted in yellow.

(Yellow= Small Islands)

IPCC AR5 WGII Chapter 29

Oceans are Acidifying Fast …

Changes in pH over the last 25 million years



"Today is a rare event in the history of the World"

- **It is happening now, at a speed and to a level not experienced by marine organisms for about 60 million years**

- **Mass extinctions linked to previous ocean acidification events**

- **Takes 10,000's of years to recover**

Turley et al. 2006

Slide courtesy of Carol Turley, PML

Climate-related drivers of risk for small islands include:

- Sea level rise (SLR),
- Tropical and extratropical cyclones,
- Increasing air and sea surface temperatures, and changing rainfall patterns

•(+ Acidification)

IPCC AR5 WGUU Chapter 29, P1616

Climate change impacts are already underway

- Tropics to the poles
- On all continents and in the ocean
- Affecting rich and poor countries (but the poor are more vulnerable everywhere)



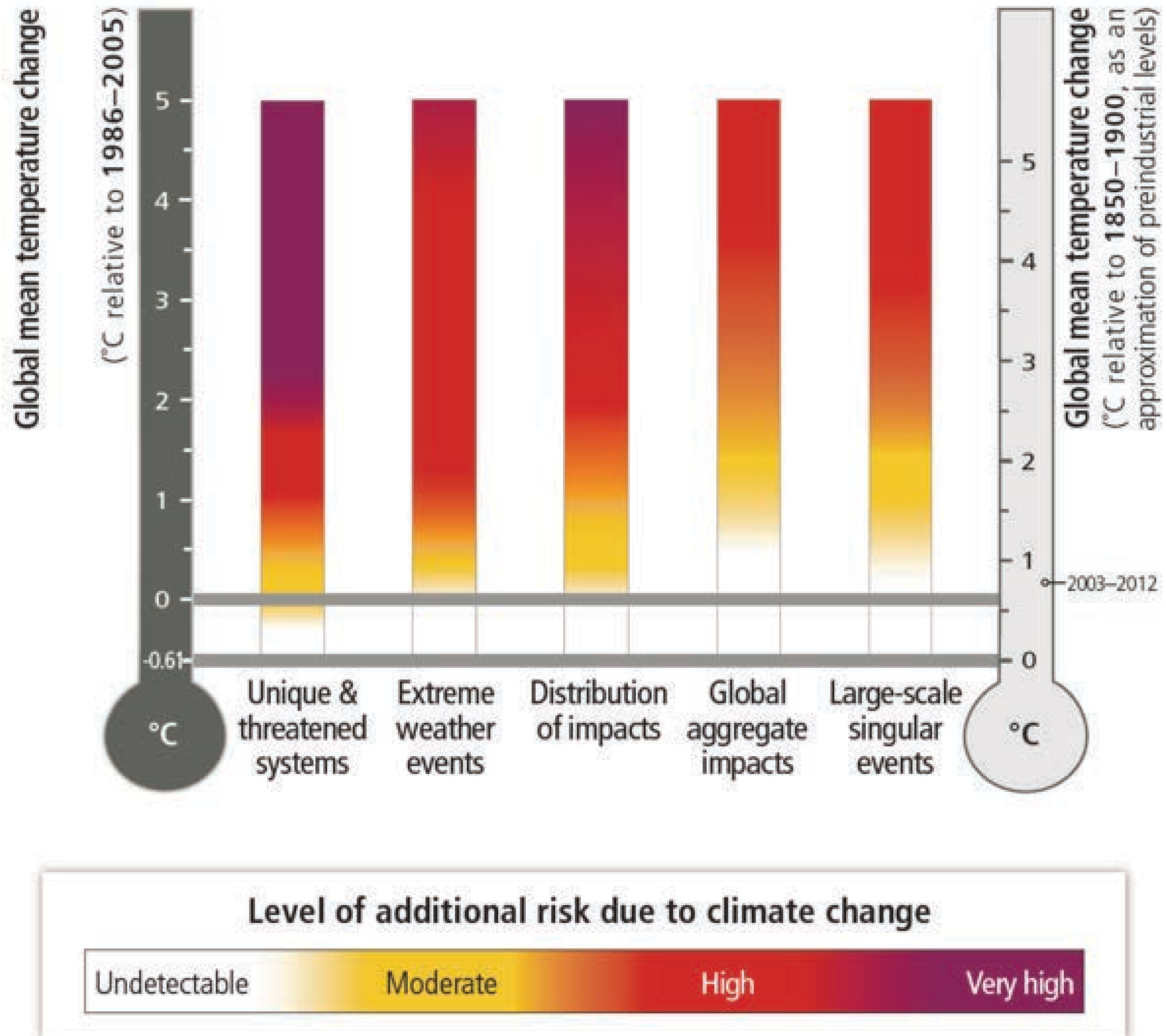

AR5 WGII SPM

INTERGOVERNMENTAL PANEL ON climate change

Risk = Hazard x Vulnerability x Exposure (Katrina flood victim, New Orleans, 2005)

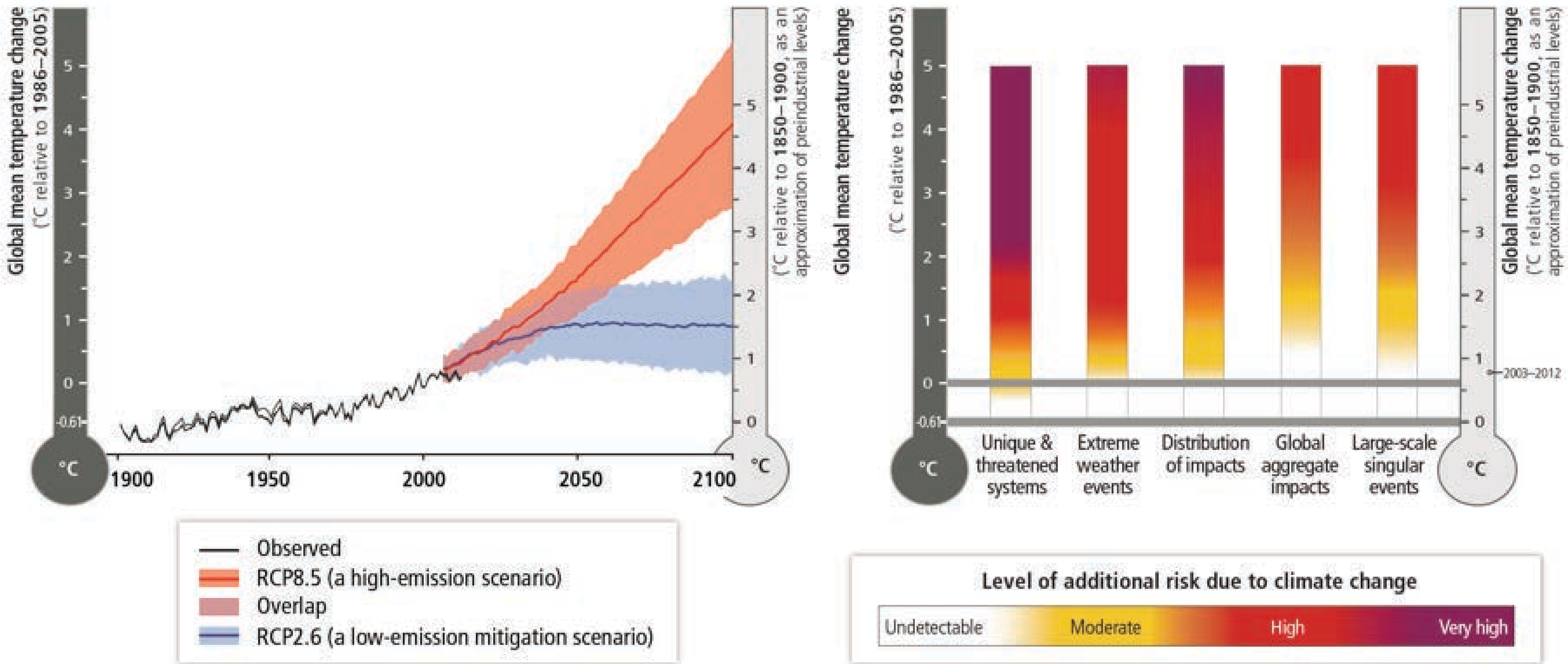
AP Photo - Lisa Krantz (http://lisakrantz.com/hurricane-katrina/zspbn1k4cn17phidupe4f9x5t1mzdr)

Synthesis: 5 key Reasons For Concern



AR5, WGII, Box SPM.1 Figure 1

Only scenario RCP2.6 allows avoidance of the red (high additional) risk zone



IPCC AR5

ipcc INTERGOVERNMENTAL PANEL ON climate change

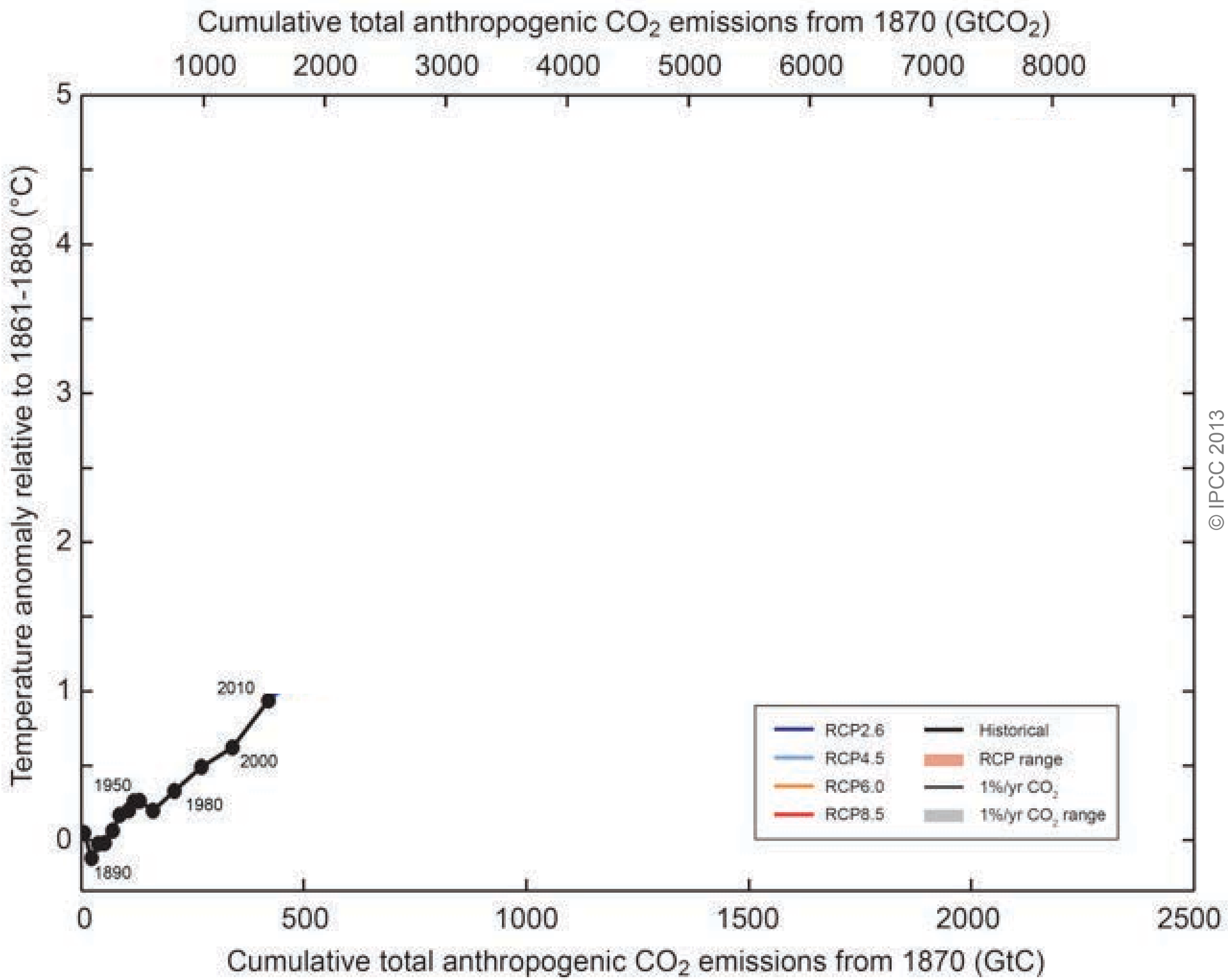


Fig. SPM.10

Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond.

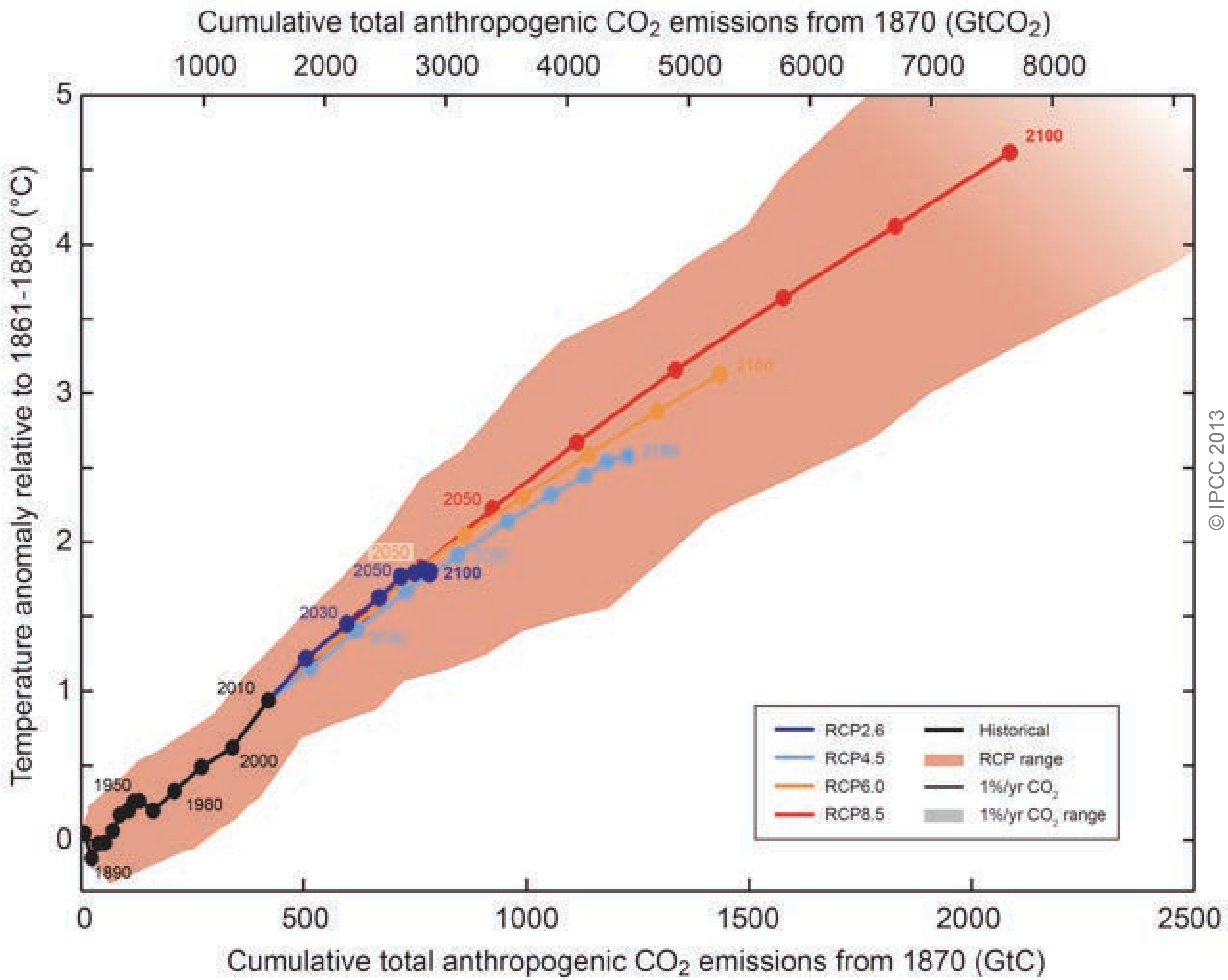
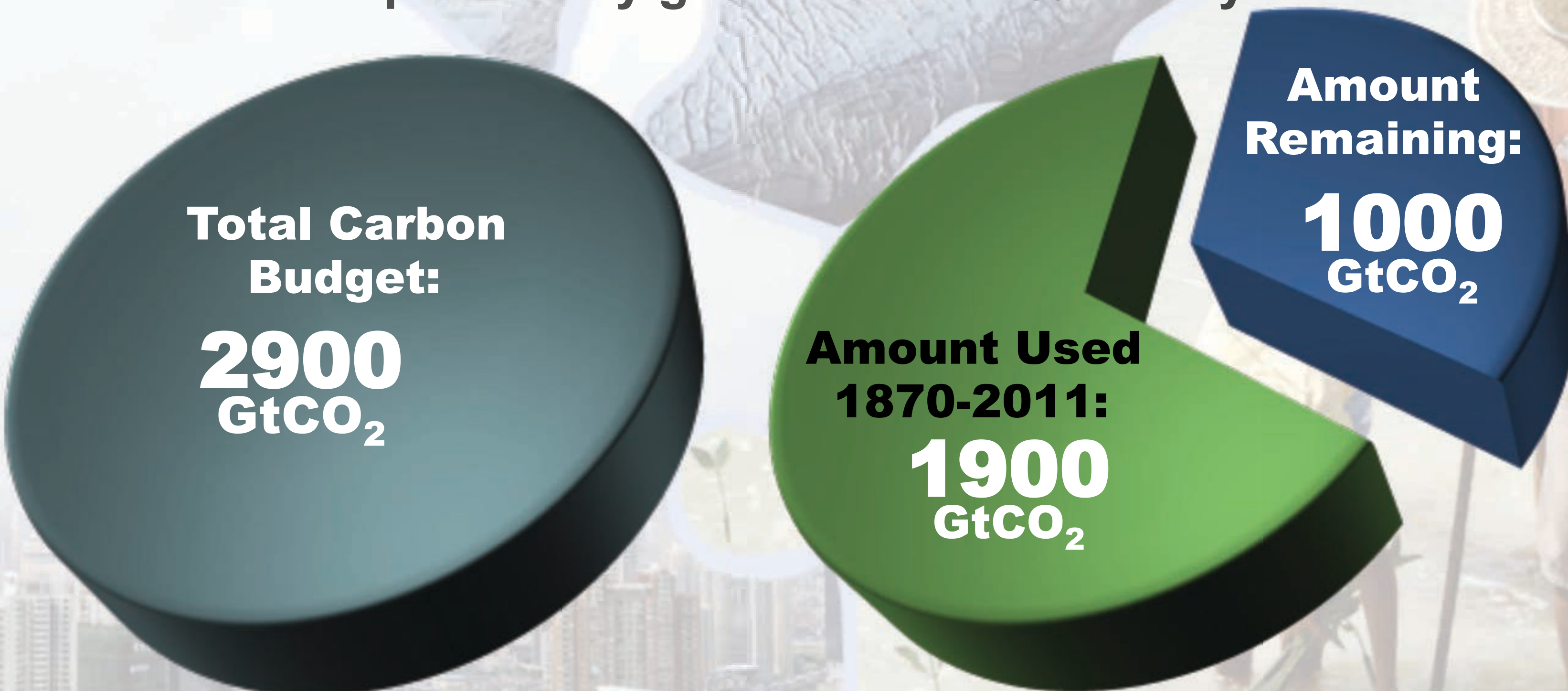


Fig. SPM.10

Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

The window for action is rapidly closing

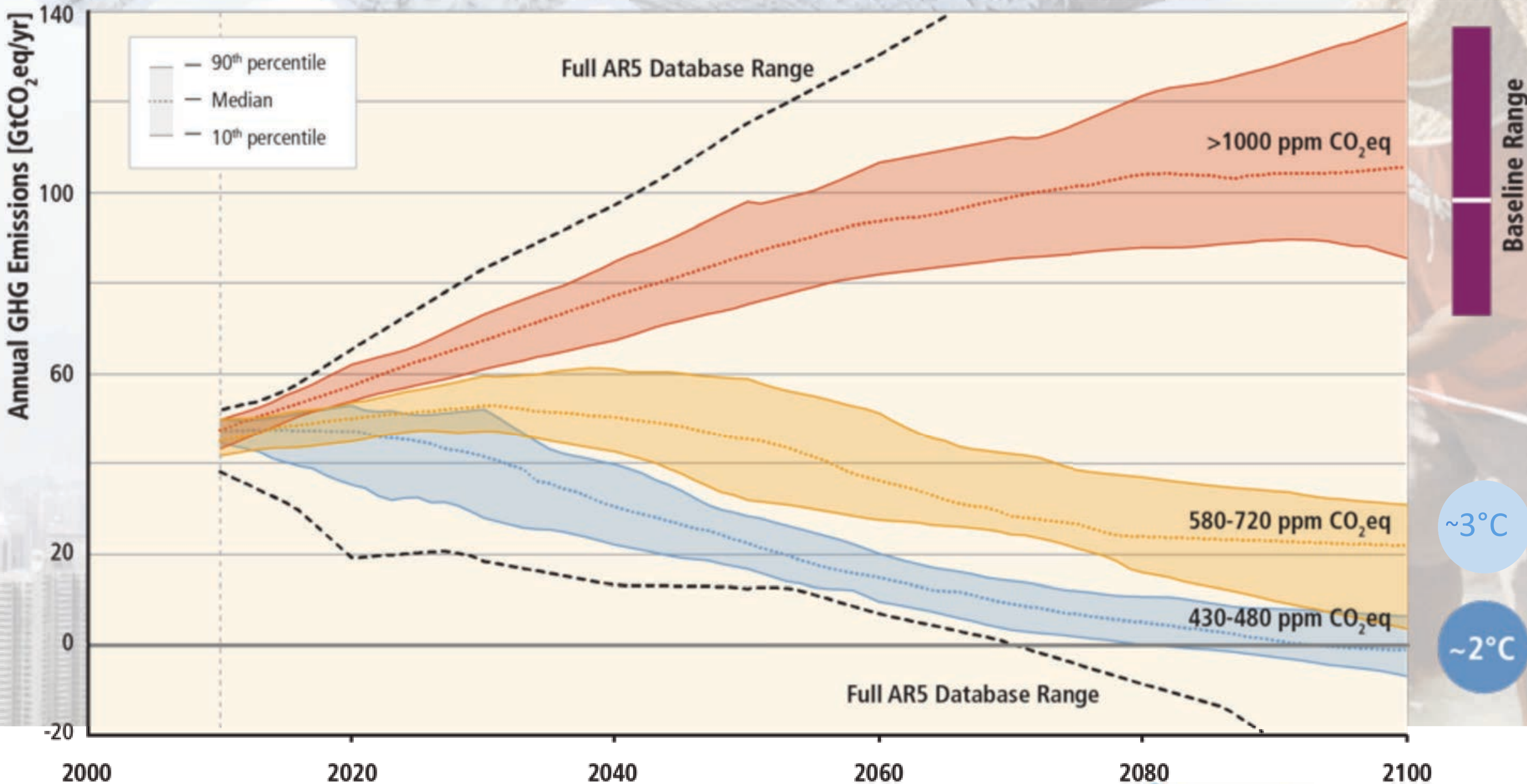
65% of the carbon budget compatible with a 2°C goal is already used
NB: this is with a probability greater than 66% to stay below 2°C



NB: Emissions in 2011: 38 GtCO2/yr

AR5 WGI SPM

Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.



Based on Figure 6.7

AR5 WGIII SPM

IPCC AR5 Synthesis Report

INTERGOVERNMENTAL PANEL ON climate change

Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **Many scenario studies confirm that it is technically and economically feasible to keep the warming below 2°C, with more than 66% probability ("likely chance").** This would imply limiting atmospheric concentrations to 450 ppm CO_2-eq by 2100.
- **Such scenarios** for an above 66% chance of staying below 2°C **imply reducing by 40 to 70% global GHG emissions compared to 2010 by mid-century, and reach *zero* or negative emissions by 2100.**

Mitigation Measures

More efficient use of energy

Greater use of low-carbon and no-carbon energy

- Many of these technologies exist today
- But worldwide investment in **research** in support of GHG mitigation is small…

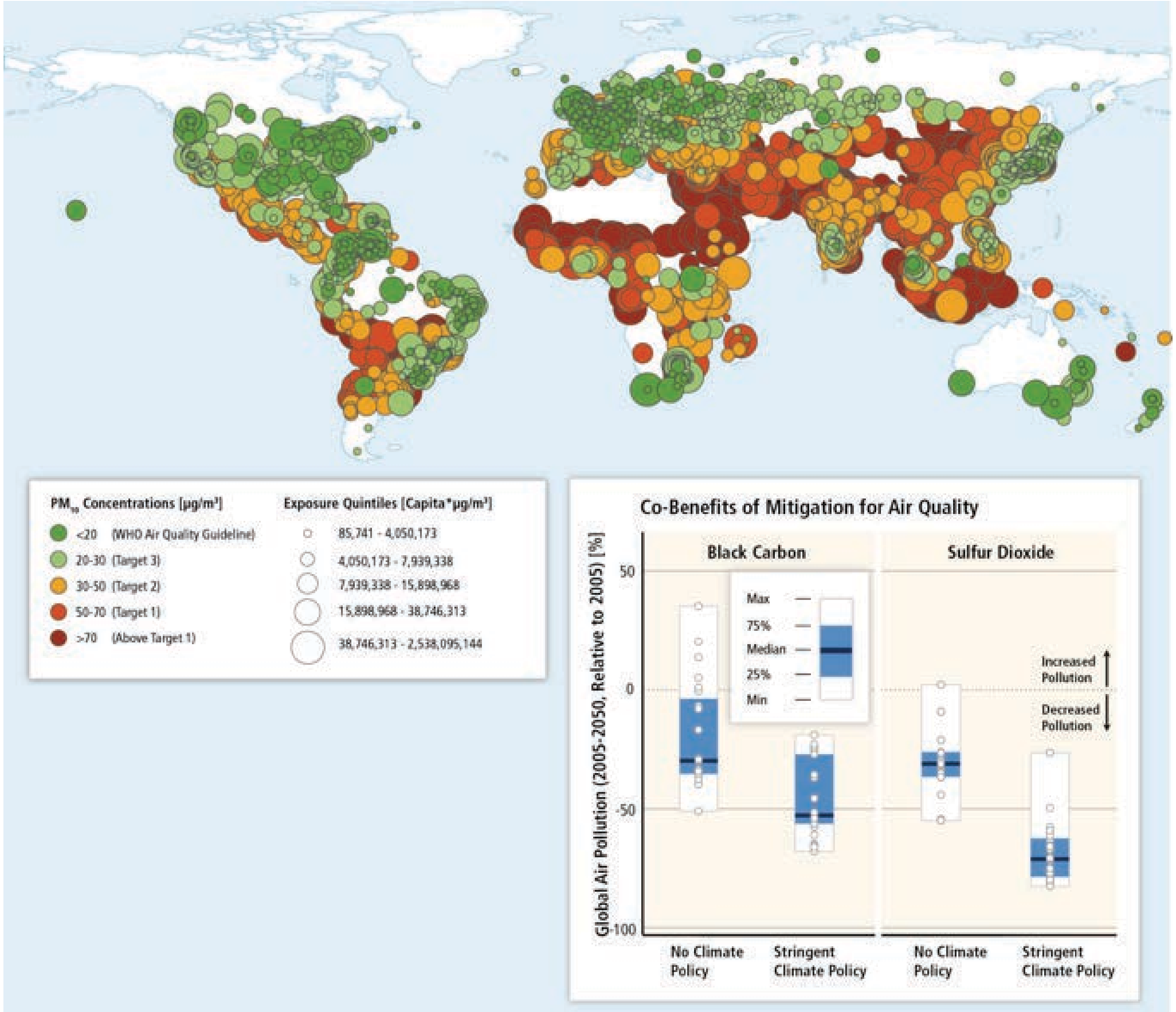
Improved carbon sinks

- **Reduced deforestation** and improved forest management and planting of new forests
- **Bio-energy with carbon capture and storage**

Lifestyle and behavioural changes

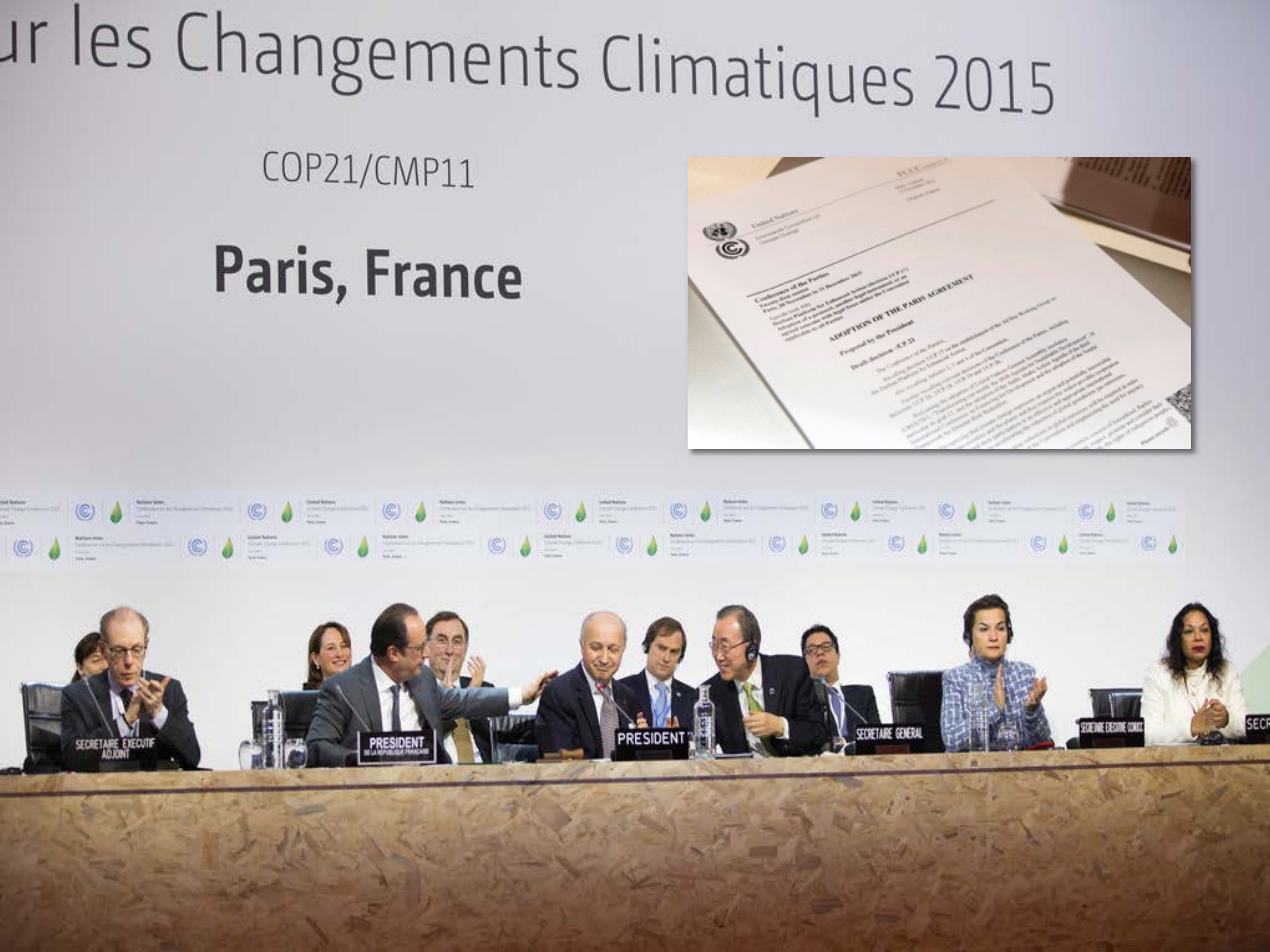
AR5 WGIII SPM

- **Substantial reductions in emissions would require large changes in investment patterns e.g., from 2010 to 2029, in billions US dollars/year:**
  (mean numbers rounded, IPCC AR5 WGIII Fig SPM 9)
- **energy efficiency: +330**
- **renewables: + 90**
- **power plants w/ CCS: + 40**
- **nuclear: + 40**
- **power plants w/o CCS: - 60**
- **fossil fuel extraction: - 120**



Mitigation can result in large co-benefits for human health and other societal goals.

IPCC AR5


ur les Changements Climatiques 2015
COP21/CMP11
Paris, France
United Nations
ADOPTION OF THE PARIS AGREEMENT
Proposal by the President
SECRETAIRE EXECUTIF ADJOINT
PRESIDENT
PRESIDENT
SECRETAIRE GENERAL

Paris Agreement

- Article 2:
  - (...) to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
    - Holding the increase in the global average temperature to **well below 2 °C** above pre-industrial levels and to **pursue efforts** to limit the temperature increase to **1.5 °C** above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
    - **Increasing the ability to adapt** (...) and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
    - Making **finance flows consistent** with a pathway towards low greenhouse gas emissions and climate-resilient development

Paris Agreement

- Article 4:
  - 1. (…) Parties aim to reach **global peaking** of greenhouse gas emissions **as soon as possible**, recognizing that **peaking will take longer for developing country Parties**,
  - and to undertake **rapid reductions thereafter in accordance with best available science**,
  - so as to achieve a **balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century**, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty
  - 3. **Each Party's successive nationally determined contribution will represent a progression**(…)

The Economist

Fire and fury over North Korea

The Fed's runners and riders

Was Google right to sack him?

Competitive punning: game of groans

AUGUST 12TH–18TH 2017

Roadkill

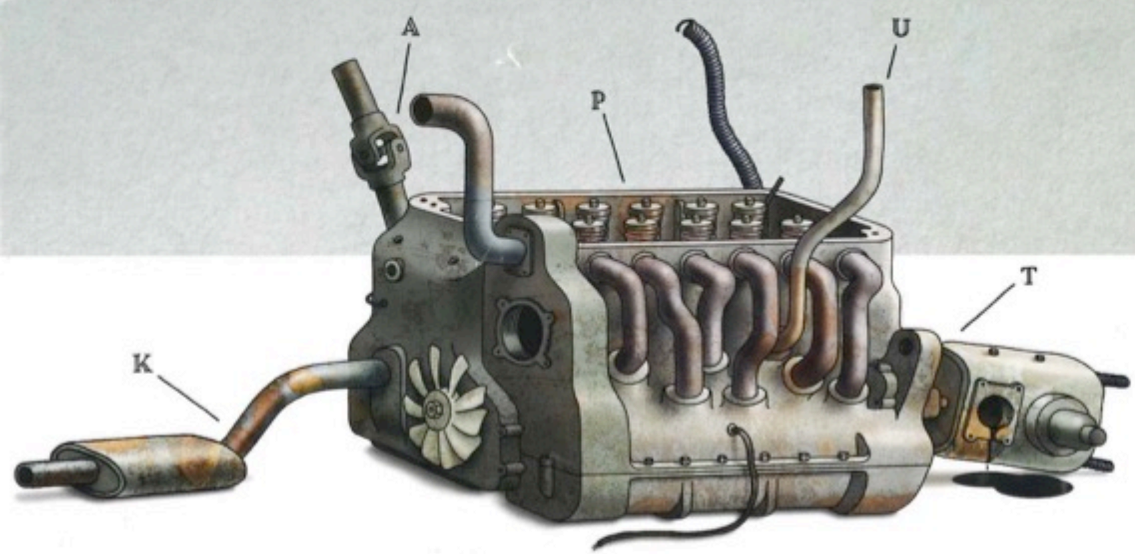
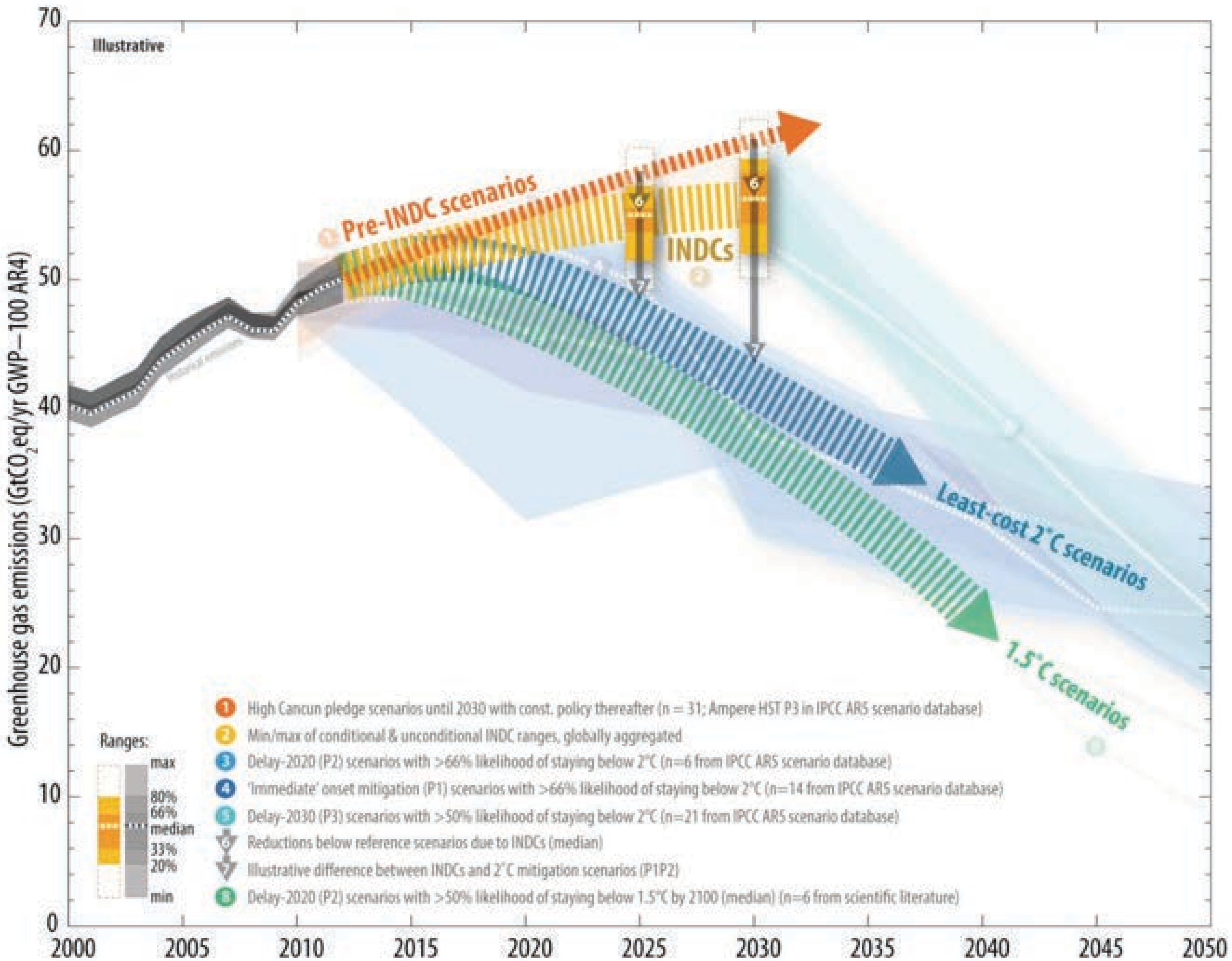


Fig.1 The Internal Combustion Engine

Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update
http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

Delaying additional mitigation to 2030 will substantially increase the challenges associated with limiting warming over the 21st century to below 2°C relative to pre-industrial levels.

Integration of efforts can be constructive

SUSTAINABLE DEVELOPMENT GOALS

Conclusions

The challenge is huge: transform the world in a few decades so that the whole world activities are decarbonized, while poverty and hunger are eliminated;

Addressing it opens so many opportunities, as Humanity is forced to challenge past practices, innovate, and integrate research results in meaningful actions by all: governments, businesses, NGOs, and citizens;

It opens also economic opportunities, and opportunities to address in a synergistic manner other societal goals, such as the 17 Sustainable Development Goals adopted by the UN in 2015

Only together…

Source: UNICEF

Useful links:

- www.ipcc.ch : IPCC (reports and videos)
- www.climate.be/vanyp : my slides and other documents
- www.skepticalscience.com: excellent responses to contrarians arguments
- **On Twitter: @JPvanYpersele**

  and @IPCC_CH

Jean-Pascal van Ypersele
(vanyp@climate.be)