



Climate Change Mitigation, Adaptation and Migration

UNSW • SOCW7881 • 5 June 2013

Guest Lecture

Photo: Ermin Gutenberger / iStockphoto

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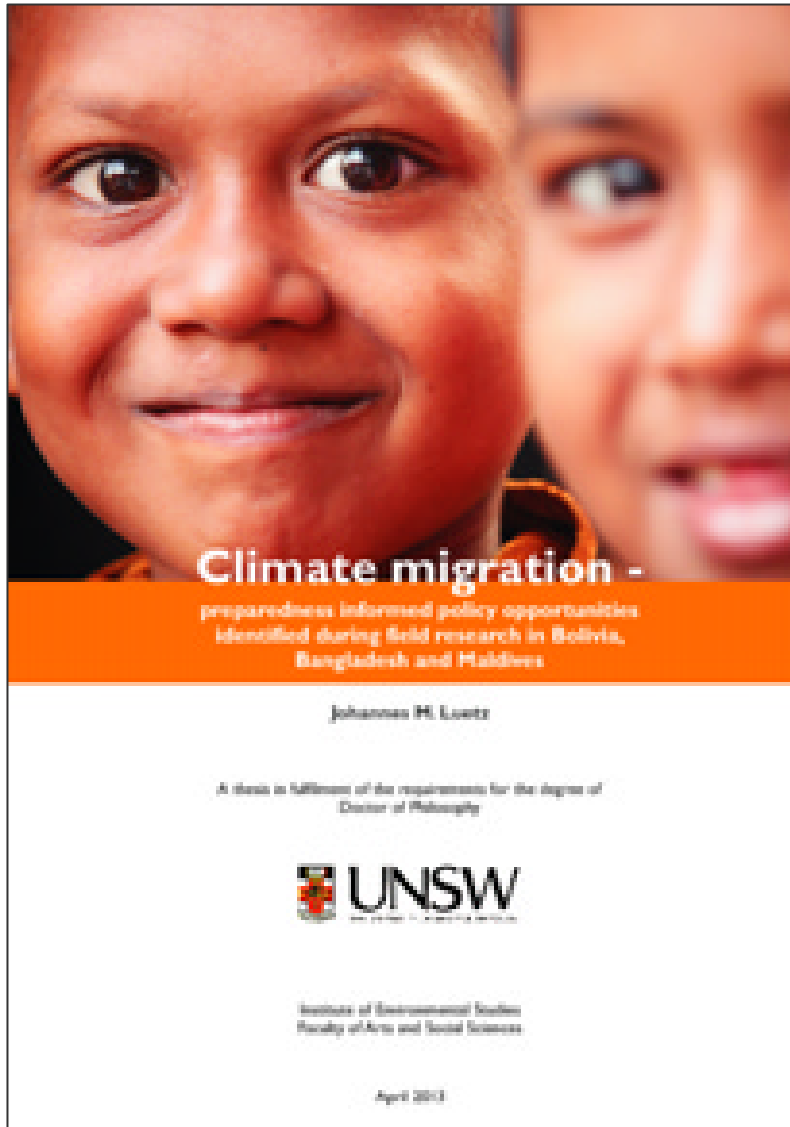
Climate Migration

This lecture has two parts:

Part 1: Climate Change (6-7pm)

Part 2: Climate Migration (7-8pm)

(Although we may not take time to discuss all details,
I've embedded links and resources in these slides that
you may want to follow up on in your own time.)



I can promise you:

I have more materials than what we will have time for tonight. So please feel free to interrupt, ask questions, engage.

Climate Change:

“

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. See also Climate variability; Detection and Attribution.

”

—Intergovernmental Panel on Climate Change, 2007:
Fourth Assessment Report; Synthesis Report, p. 78.

What to do about climate change?

I. What is climate change **mitigation**? (Discuss)

“ **Mitigation:**

Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to **Climate Change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks.** ”

—Intergovernmental Panel on Climate Change, 2007:
Fourth Assessment Report; Synthesis Report, p. 84.

I. What is climate change adaptation? (Discuss)

“ **Adaptation:**

Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc. ”

—Intergovernmental Panel on Climate Change, 2007:
Fourth Assessment Report; Synthesis Report, p. 76.

Which is more important for tackling climate change: mitigation or adaptation?

(Discuss)

These concepts are inseparably intertwined (examples?). Eg, “better insulation” can be concurrently “mitigation” (saving energy) and “adaptation” (stable indoor temperatures).

Imagine mitigation and adaptation as two sides of the same (climate) “coin”.

Plus: implementing them costs (and saves) money.

“ The only near certain conclusion we can draw from the changing climate and people’s response to it is that there is little time left in which to act. Therefore my plea is that **adaptation** is made at least equal in importance to policy-driven attempts to **reduce emissions**. ”

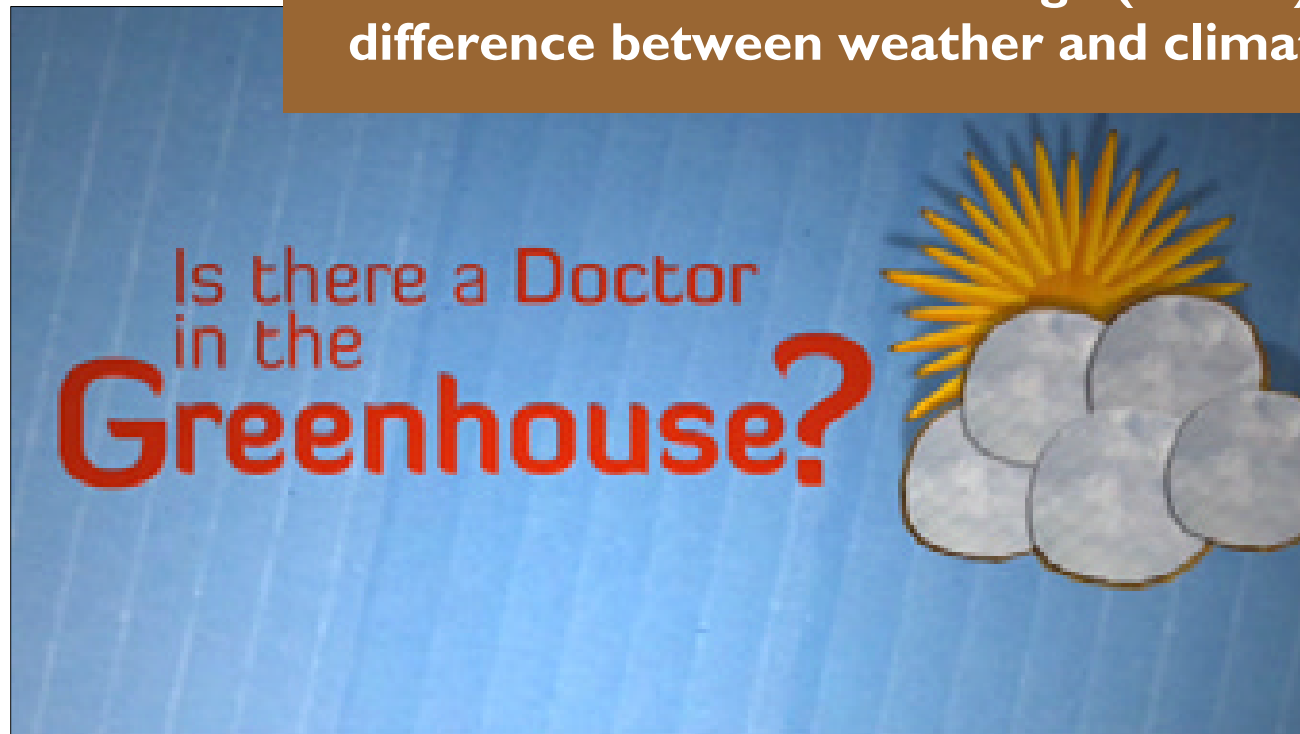
—James Lovelock, 2009; p. 75:
The Vanishing Face of Gaia

Why should this generation be serious about climate change mitigation and adaptation?



(Source: ppt
Stephen H. Schneider)

UNSW-produced video scripted for Leadership Networks for Climate Change (LNCC) to highlight difference between weather and climate



<http://tv.unsw.edu.au/04E68CE0-08D5-11E1-832C0050568336DC>

I HAVE A NEW
EXPERT WITNESS
TO DISPROVE ALL THE
CLIMATE CHANGE SCIENCE!



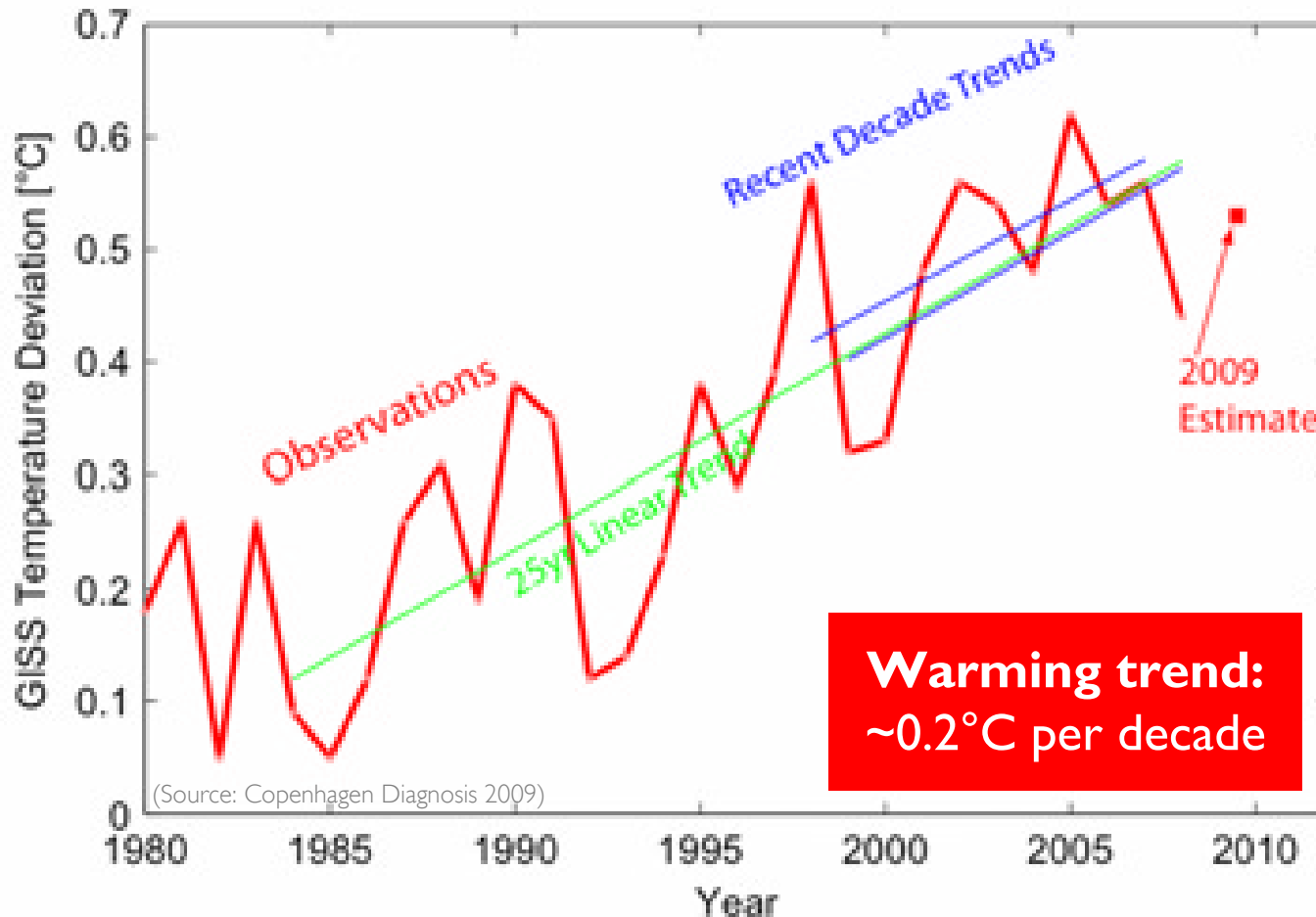
(Source: ppt Stephen H. Schneider)

“Hundreds Gather to Protest Global Warming”



(Source: ppt Stephen H. Schneider)

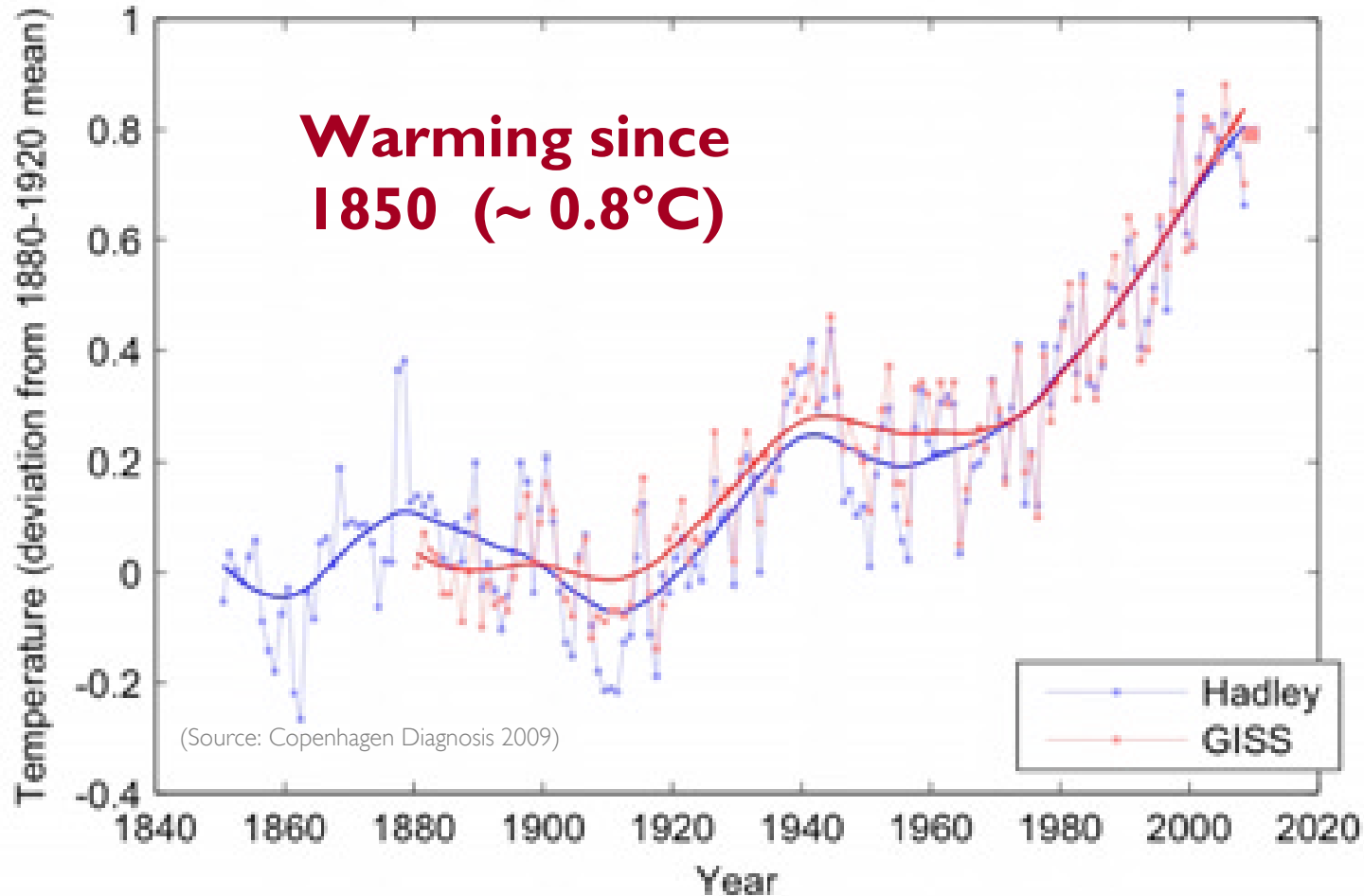
Global temperature change 1980-2009



(Source: Copenhagen Diagnosis 2009)

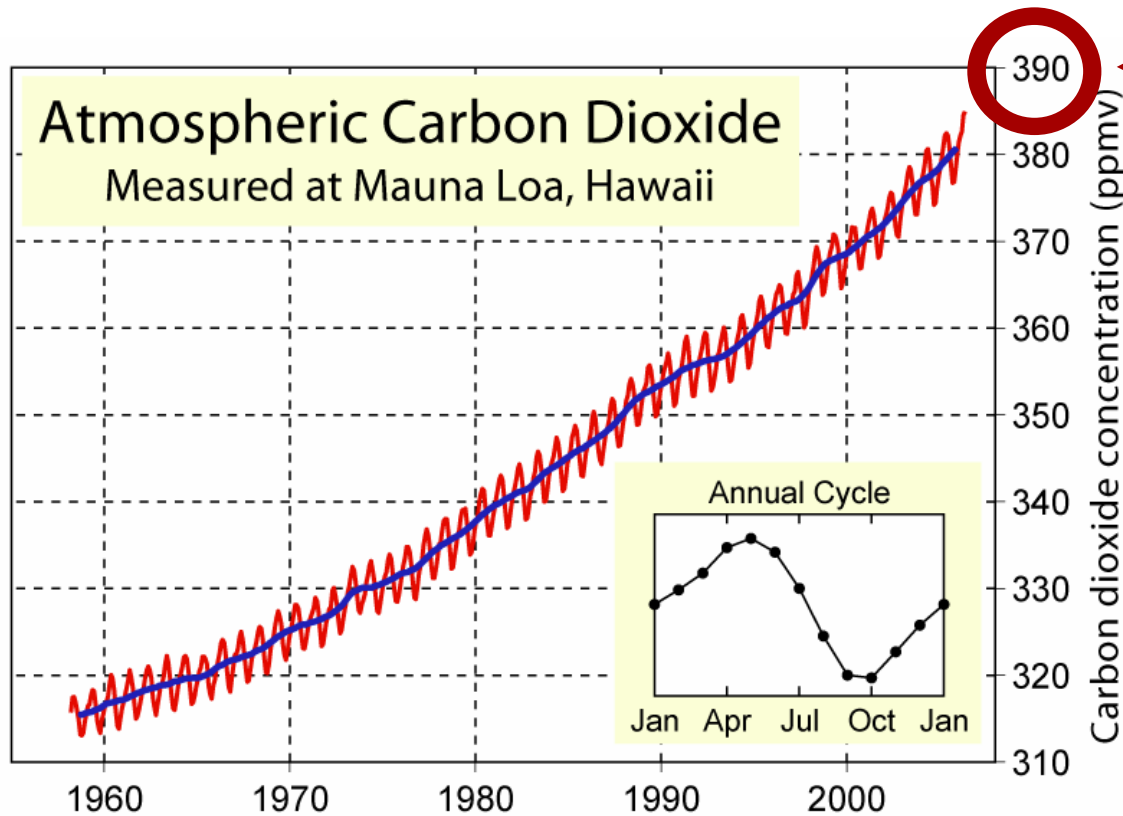
(Source: NASA GISS data, In: Copenhagen Diagnosis 2009)

Global average temperature 1850-2009



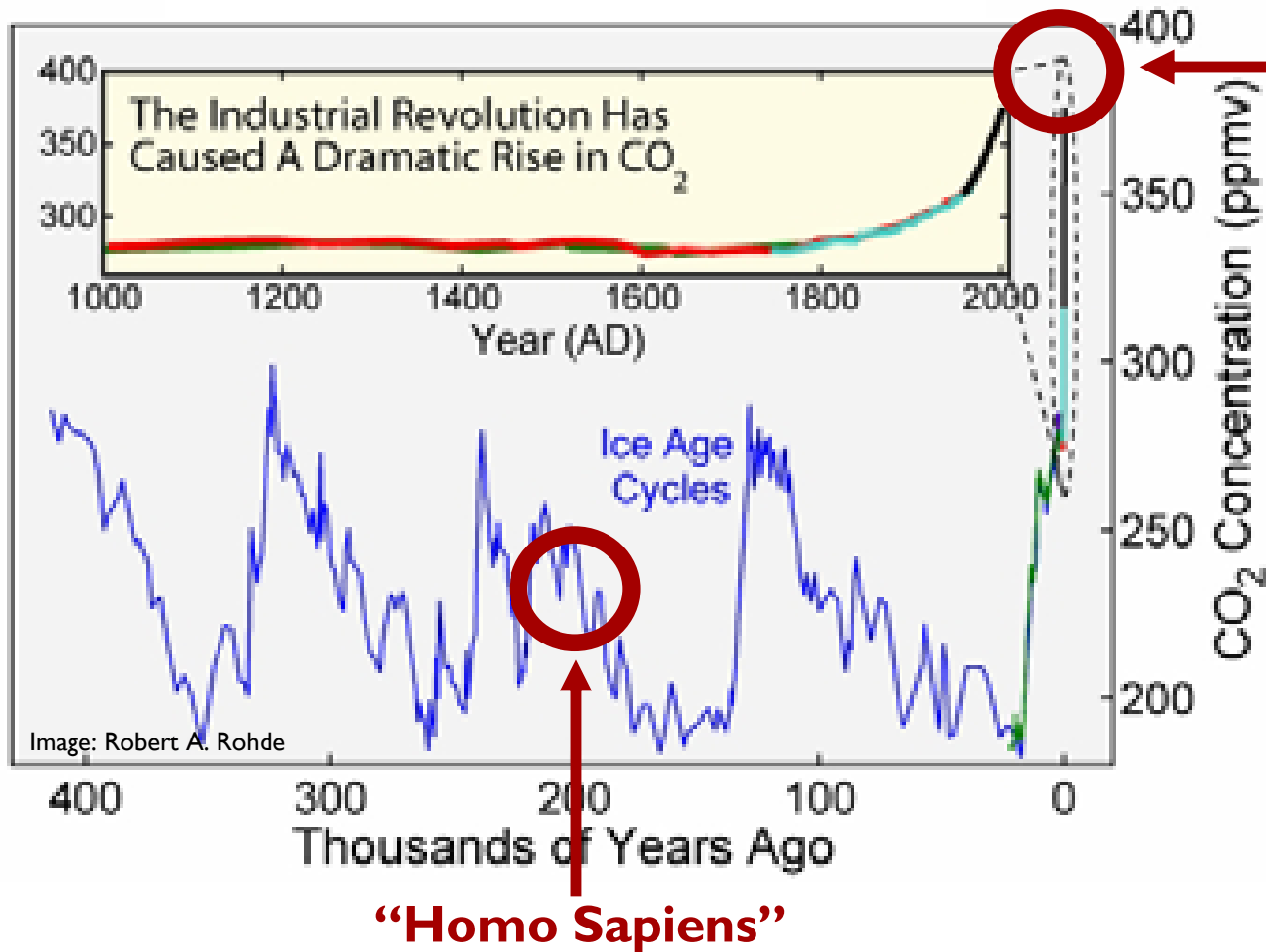
Global warming cannot be reversed due to the long life-time of CO_2 in the atmosphere. This is because CO_2 cannot be extracted from the atmosphere in massive amounts.

**CO₂ level in March
2010: 390 ppm**



The Keeling curve is an essential piece of evidence of anthropogenic greenhouse gas increases. The longest such record exists at Mauna Loa, Hawaii.

(Source: National Oceanic and Atmospheric Administration -- ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt).



CO₂ level in March 2010: 390 ppm

Today's CO₂ levels are unprecedented in the last 800,000 years; potentially the last 3-20 million years.

(Sources: 1. (blue) Vostok ice core. 2. (green) EPICA ice core. 3. (red) Law Dome ice core. 4. (cyan) Siple Dome ice core. 5. (black) Mauna Loa)

UNSW-produced video scripted for Leadership Networks for Climate Change (LNCC) to explain that climate change cannot be stopped overnight; early action is therefore urgent.

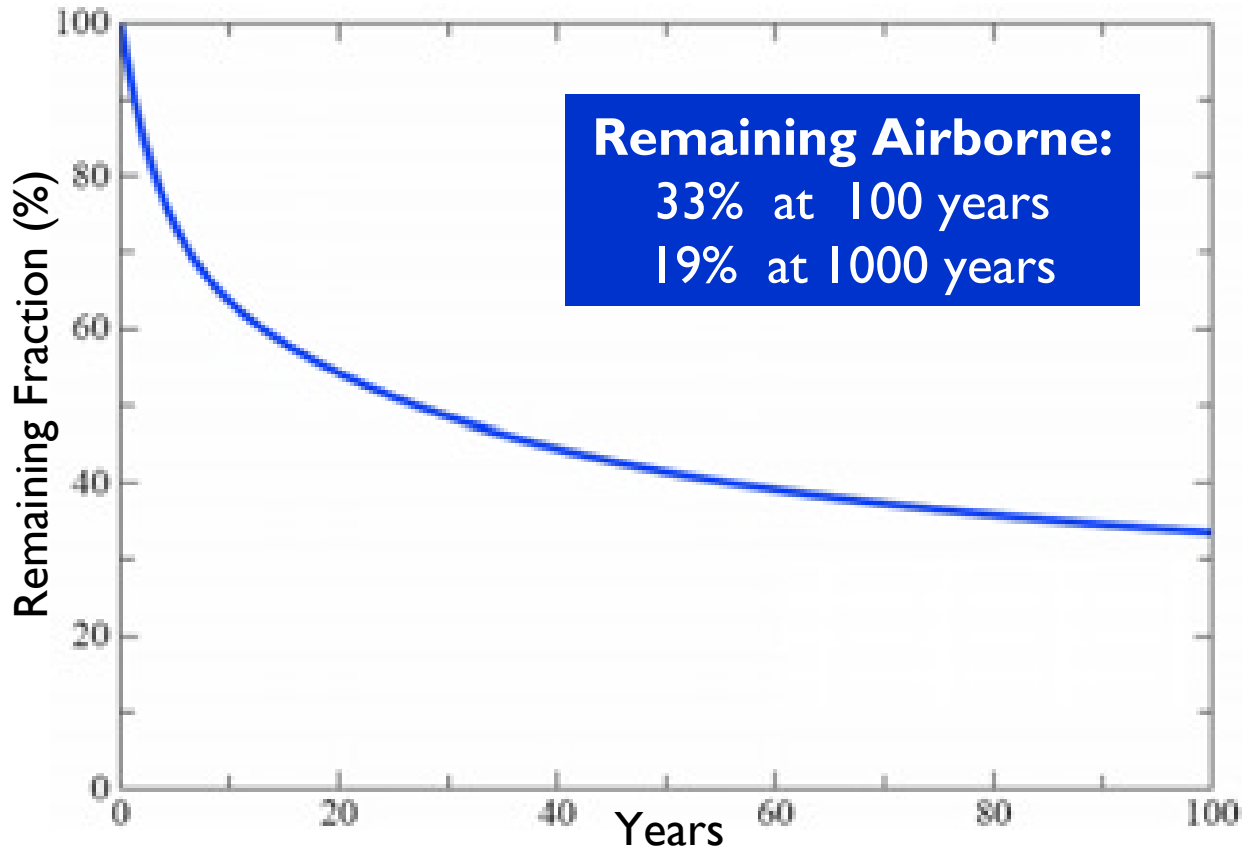


<http://tv.unsw.edu.au/video/hit-the-brakes>

“ There is a window of opportunity for avoiding the most damaging climate change impacts, but that window is closing: the world has **less than a decade** to change course. Actions taken – or not taken – ...will have a profound bearing on the future. ”

2007/2008 UN Human Development Report

Slow decay of fossil fuel CO₂ emissions



The fraction of CO₂ remaining in the air, after emission by fossil fuel burning, declines rapidly at first, but 1/3 remains in the air after a century and 1/5 after a millennium.

(Hansen, J, 2007, *Atmos. Chem. Phys.* **7**, 2287-2312).

Boeing 767-300



**1t Jet Fuel Burned
= 3.157t CO₂ Emissions**

(Photo: Adrian Pingstone)

Top of Atmosphere as seen from space at 335km altitude
(Photo: NASA Earth Observatory)

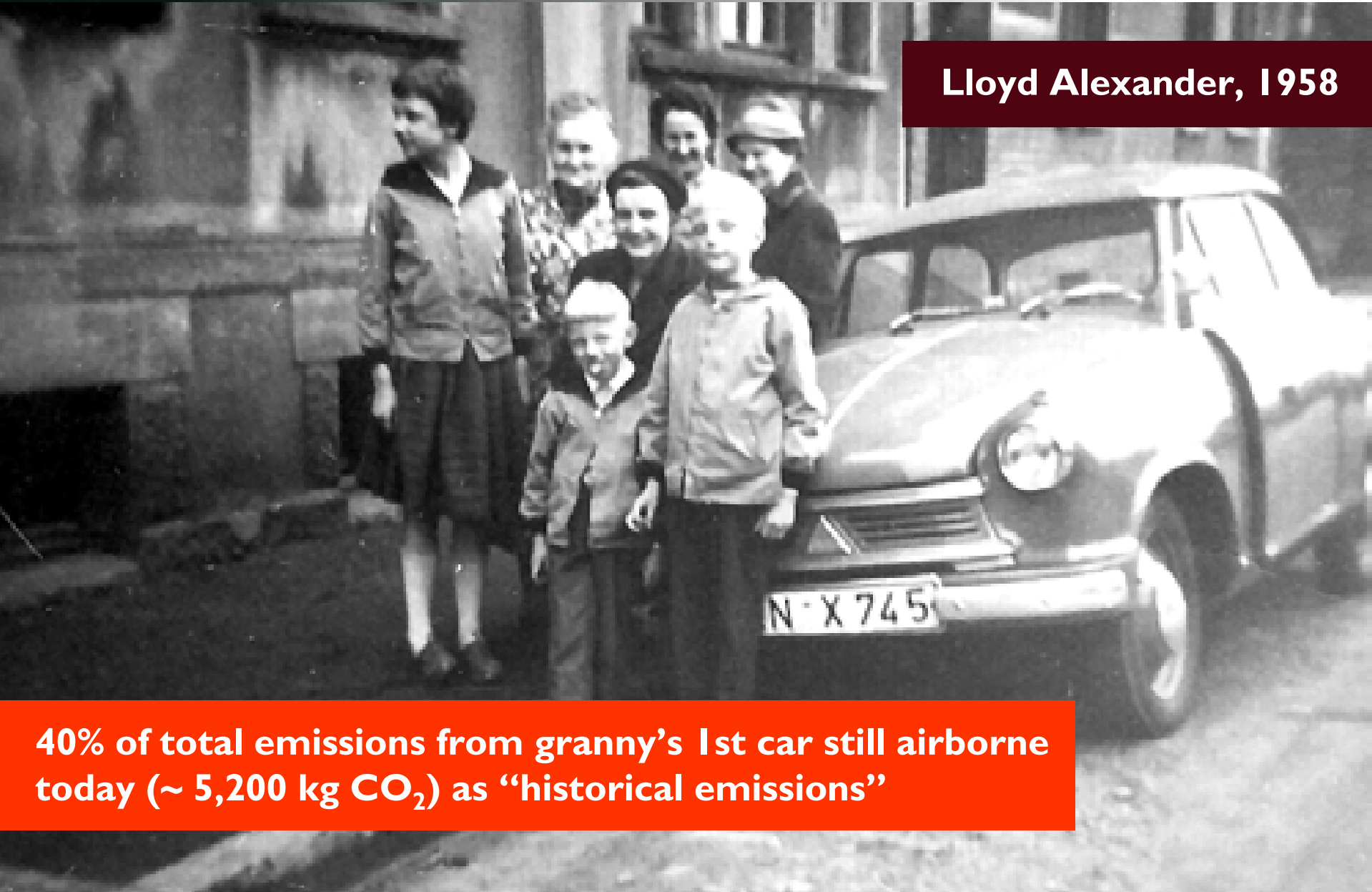
Per-capita emissions for
Canada trip in 2010: 1.4t CO₂
(2110: 460kg, 3010: 260kg)

* 2.7 (Radiative Forcing
Index, RFI) = ~ 3.8t CO₂



“Granny Maria” – 1958

Lloyd Alexander, 1958



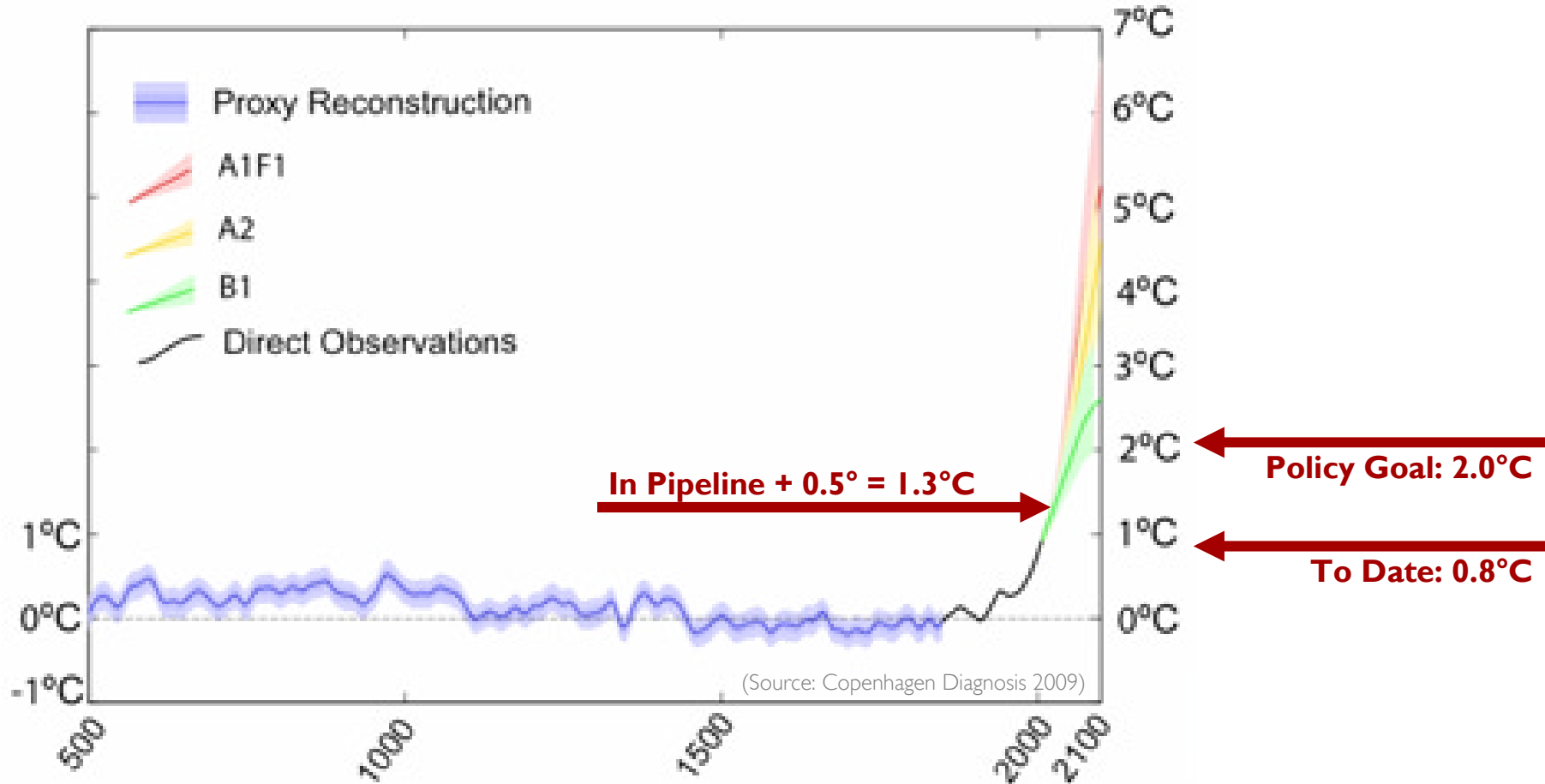
40% of total emissions from granny's 1st car still airborne today (~ 5,200 kg CO₂) as "historical emissions"

Cumulative CO₂ Emissions 1850-2006

Rank	Country	Mt CO ₂ e	% of World Total
1	United States of America	333,747.8	29.00%
2	European Union (27)	305,750.1	26.57%
3	China	99,204.2	8.62%
4	Russian Federation	93,081.6	8.09%
5	Germany	[80,377.0]	[6.99%]
6	United Kingdom	[68,235.8]	[5.93%]
7	Japan	44,535.2	3.87%
8	France	[32,278.6]	[2.81%]
9	India	27,433.6	2.38%
10	Canada	25,133.1	2.18%
Top 10	Cumulative Total	928,886	80.71%

CAIT, World Resources Institute
 CAIT GHG data are derived from CDIAC, EDGAR, EIA, EPA, Houghton, IEA, and WB.

Reconstructed, observed and future warming projections





Available resources:

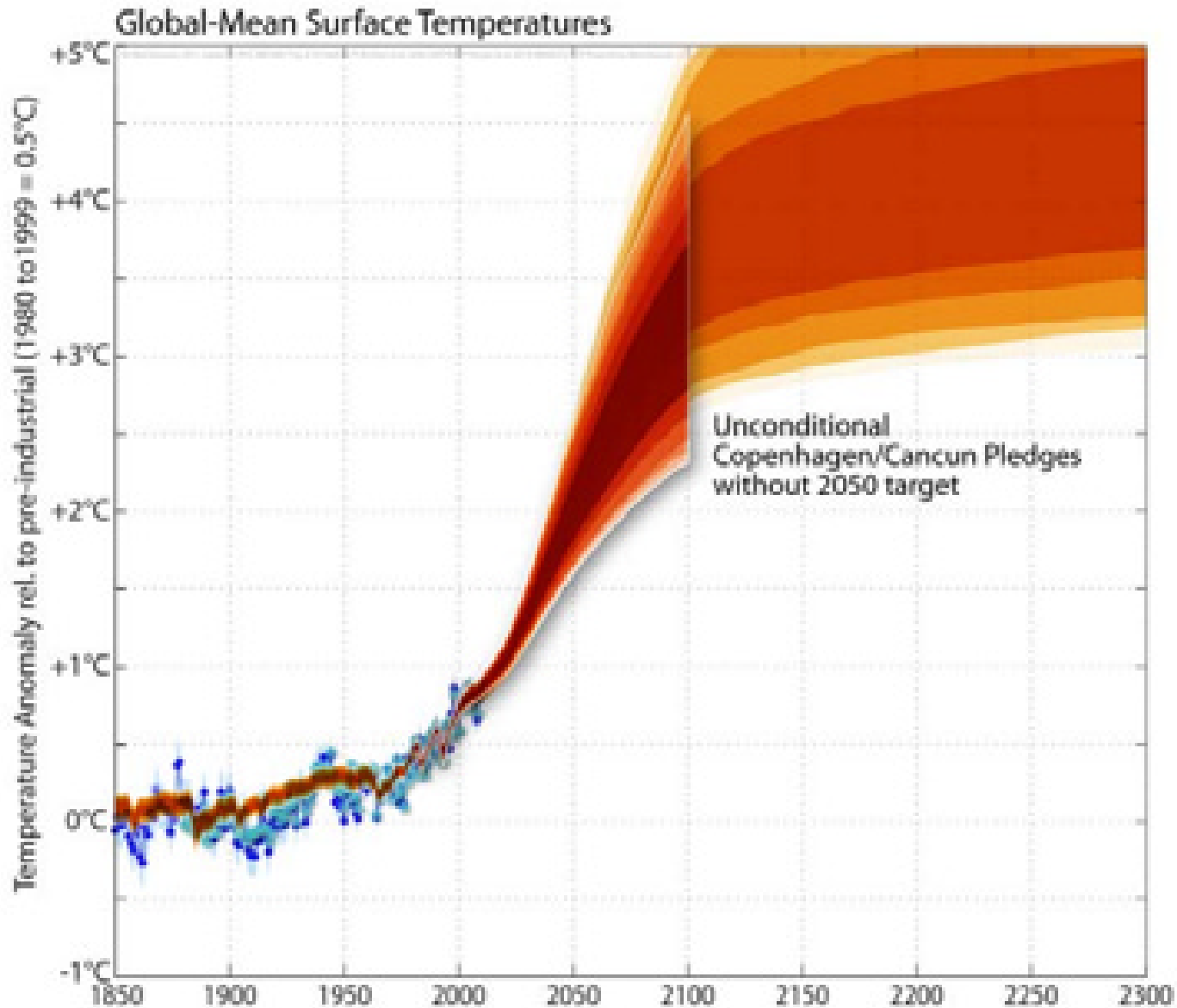
- Audio files
- Presentation files

Conference

12-14 July 2011, Melbourne

FOUR DEGREES OR MORE? AUSTRALIA IN A HOT WORLD

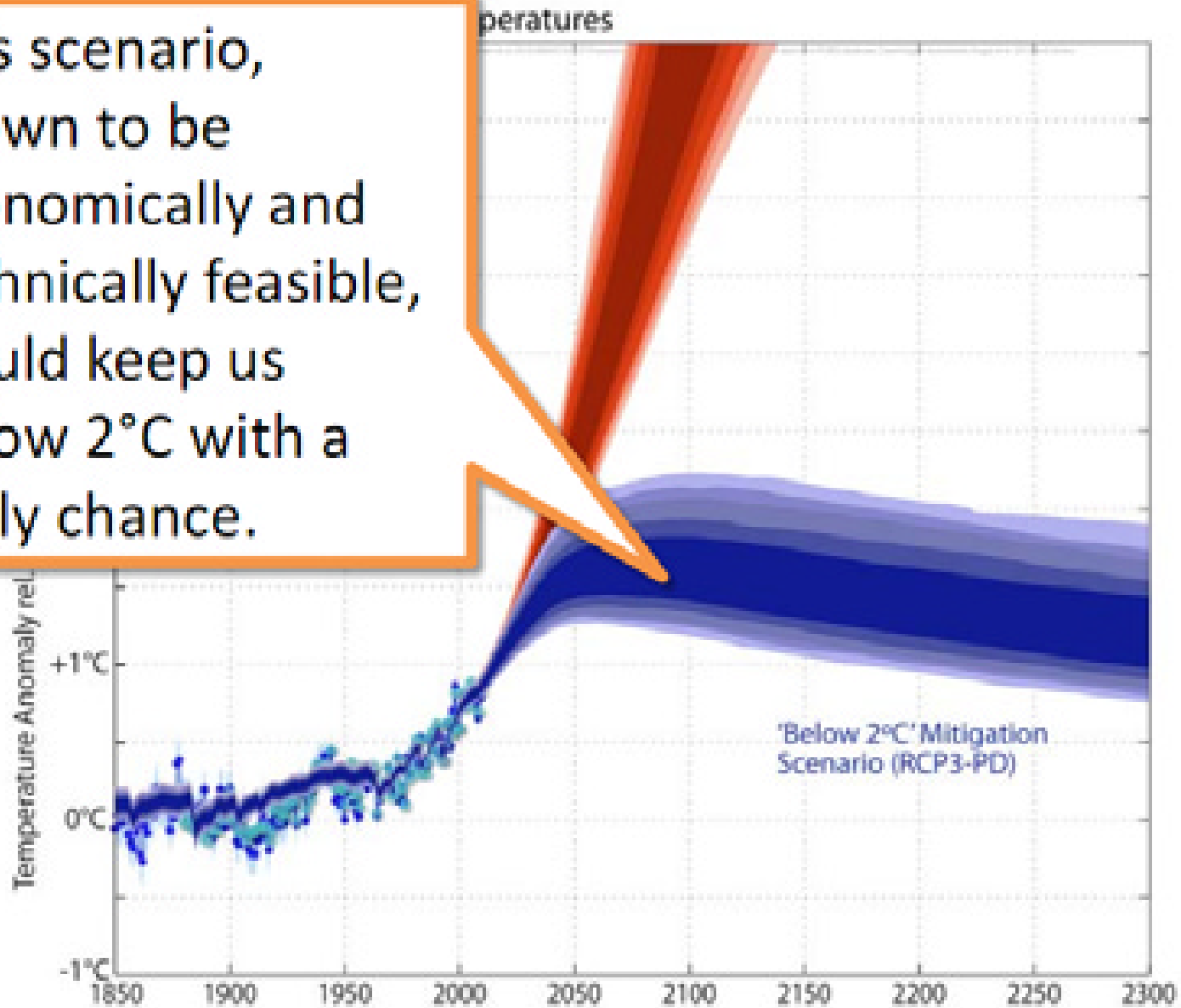
www.fourdegrees2011.com.au



Based on: Rogelj et al., Nature, 2010

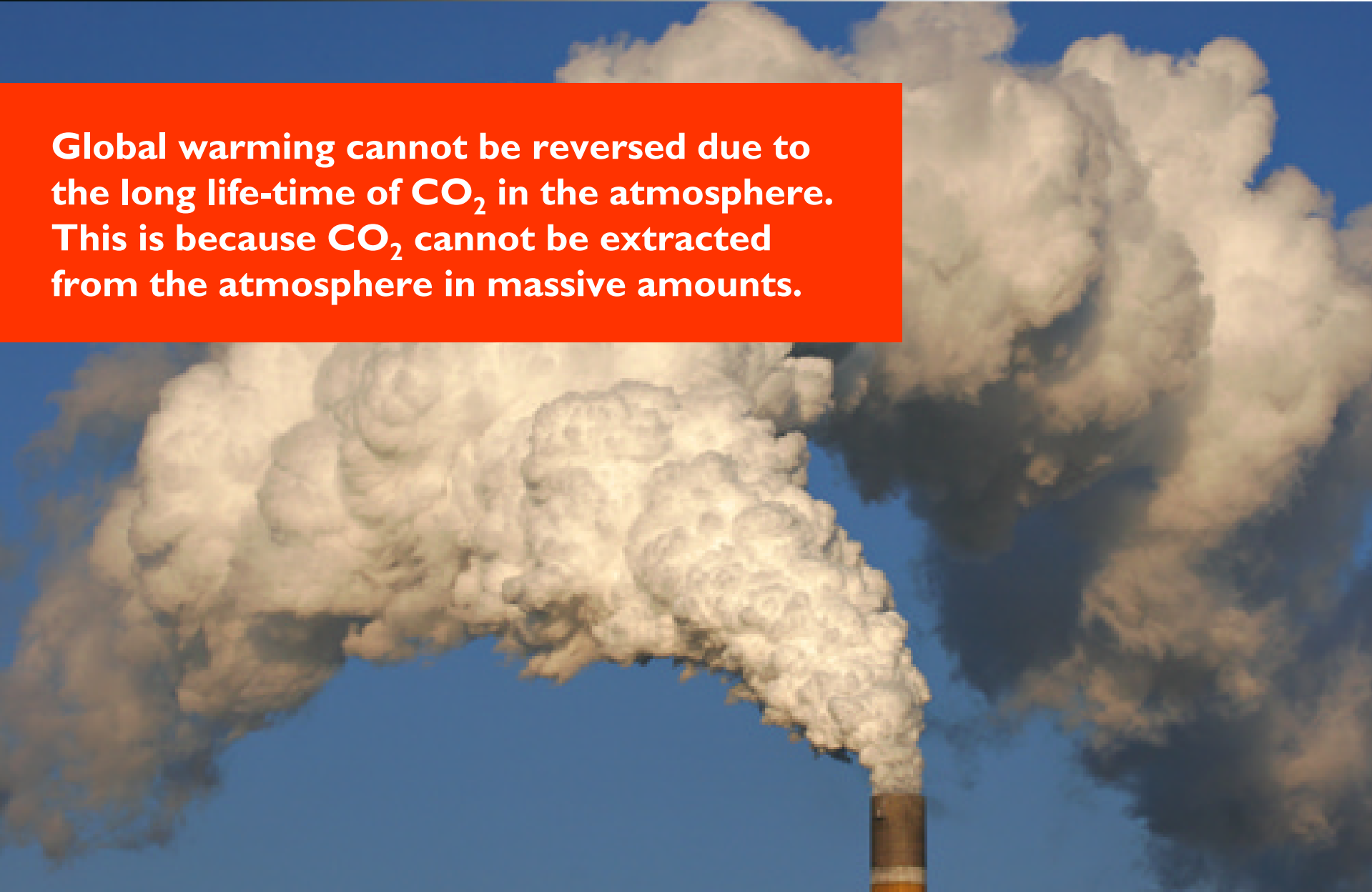
Source: Meinshausen 2011, presentation available:
<http://www.fourdegrees2011.com.au/presentations/>

This scenario, shown to be economically and technically feasible, would keep us below 2°C with a likely chance.



Source: Meinshausen 2011, presentation available: <http://www.fourdegrees2011.com.au/presentations/>
File based on data from the IPCC Working Group III contribution to the Fourth Assessment Report (AR4) Working Group III contribution to the Fourth Assessment Report (AR4) Working Group III contribution to the Fourth Assessment Report (AR4)

Global warming cannot be reversed due to the long life-time of CO_2 in the atmosphere. This is because CO_2 cannot be extracted from the atmosphere in massive amounts.





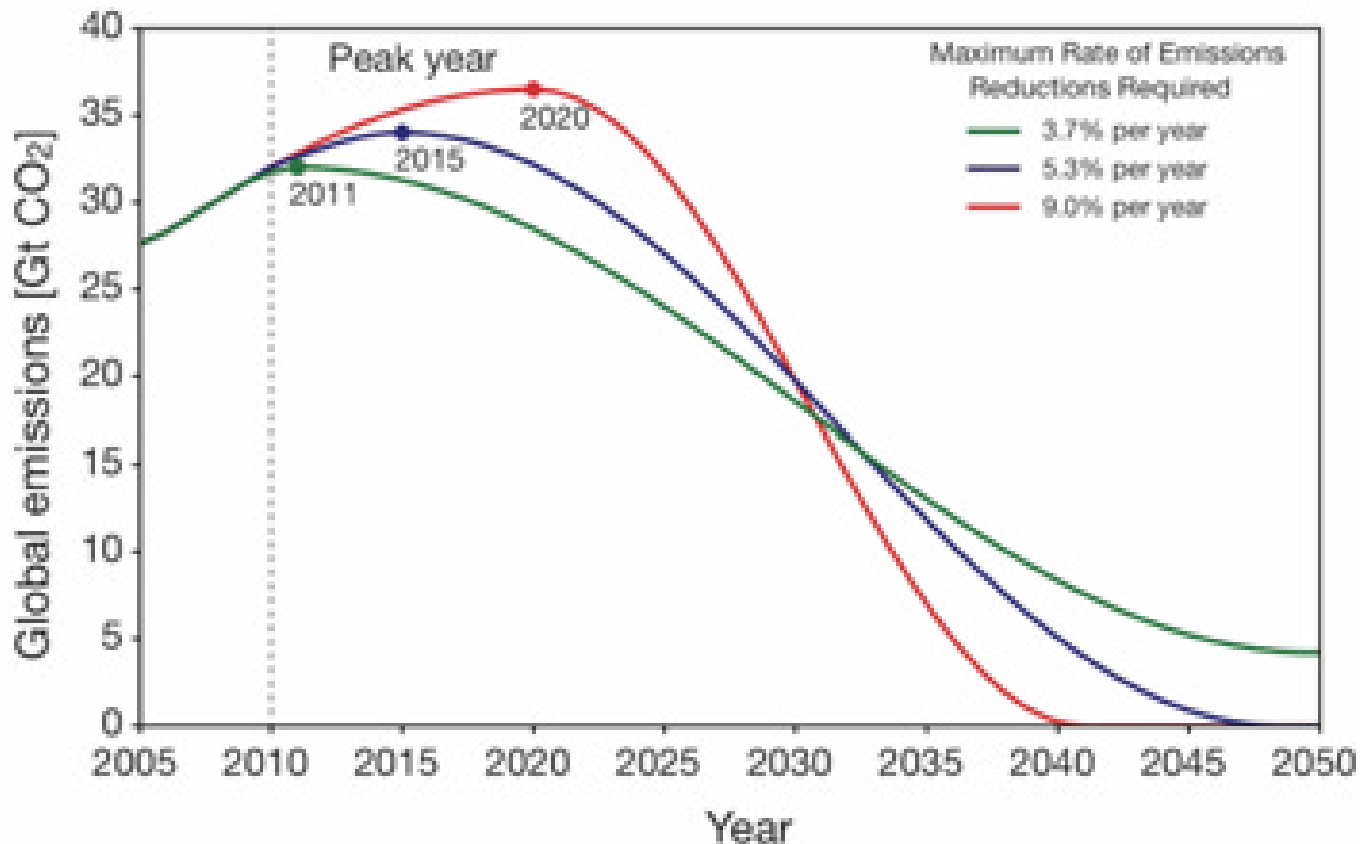
Global warming can be completely stopped. The temperature at which global warming will finally stop depends mainly on the total amount of CO₂ released into the atmosphere since industrialisation.

**The sooner
emissions stop,
the lower the
final warming
will be.**

**Zero Emissions?
Zero Regrets!**



Exemplary emissions pathways which remain within 750Gt and leave a 67% chance of limiting global warming to 2°C



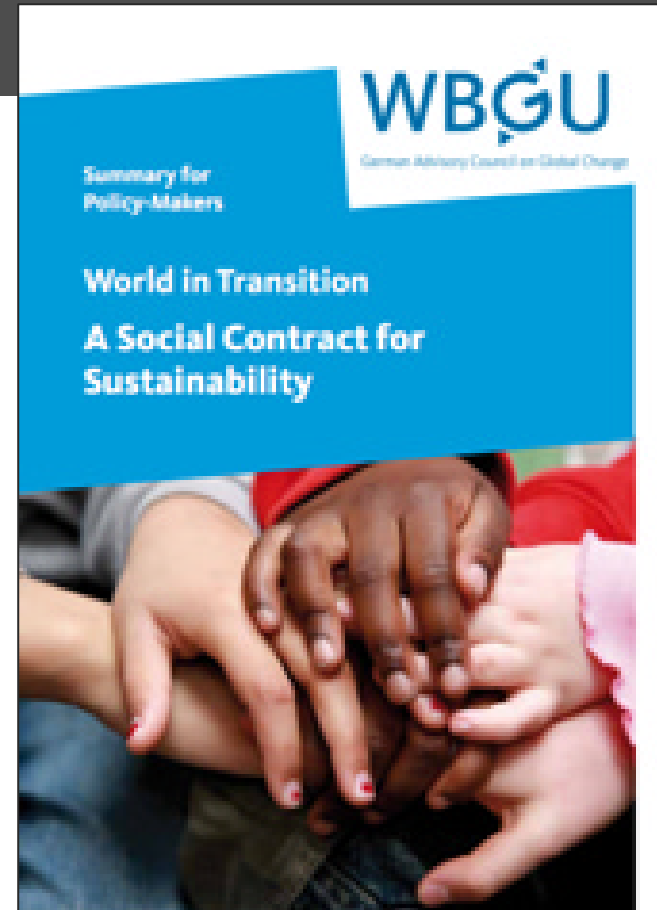
Solving the climate dilemma: The budget approach; WBGU Special Report 2009

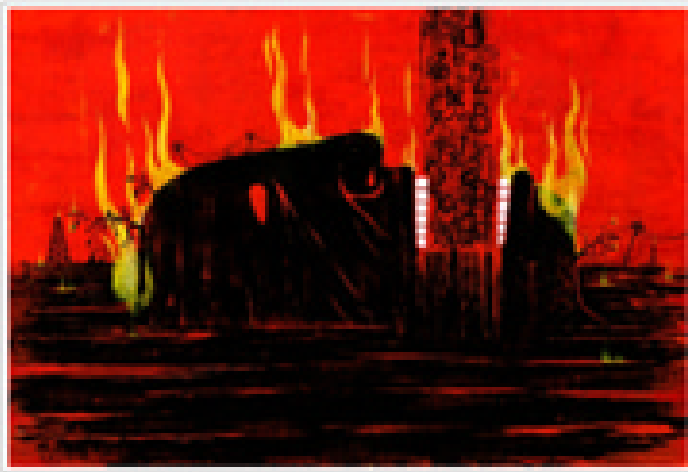
Mitigation

World in Transition: Social Contract for Sustainability

Flagship Report 2011

<http://www.wbgu.de/en/home>





<http://350.org>

Global Warming's Terrifying New Math:

Three simple numbers that add up to global catastrophe –
and that make clear who the real enemy is

The First Number: 2° Celsius → (threshold considered “dangerous” climate change)

The Second Number: 565 Gigatons → (fossil fuels remaining in 2°C cumulative budget)

The Third Number: 2,795 Gigatons → (remaining in the ground, ready for exploitation)

<http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719>

“ The climate change that the world is already locked into has the potential to result in large-scale development setbacks, first slowing, then stalling and reversing progress in poverty reduction, nutrition, health, education and other areas ... ”

—2007/2008 UN Human Development Report:
Fighting climate change : Human solidarity in a divided world.

“ The climate change that the world is already locked into has the potential to result in large-scale development setbacks, first slowing, then stalling and reversing progress in poverty reduction, nutrition, health, education and other areas ...

Hoping – and working – for the best while preparing for the worst, serves as a useful first principle for adaptation planning. ”

—2007/2008 UN Human Development Report:
Fighting climate change : Human solidarity in a divided world.



Climate Adaptation Masterclass

Friday 20 May 2011, Queensland Museum, Brisbane

The workshop
The event aims to build Australian understanding and capacity by providing researchers and decision-makers with the latest international thinking on climate change adaptation. The workshop will feature some of the world's leading climate change adaptation thinkers and practitioners.

Who should attend
Researchers, policy and decision makers, especially those in their early and mid careers.

Sessions and speakers

Defining and assessing complexity	Mats Wilander, Swedish Environment Institute, Sweden (FINO)
The process of scientific learning and scientific assessment in high problems of global change	Ulrich Schneider, Heidelberg University, Germany
Urban adaptation: Introduction	Jon Barnett, University of Melbourne, Australia
Risk and Risk Management	Maarten van Aalst, PBL Dutch Research Centre for Climate Change, Netherlands
Using Social Science and Local Knowledge	Thomas Hilborn, Oak Ridge National University, USA
Bridging the science-policy interface	Barbara Haver, Barbra Haver Research & Consulting, USA
Health responses: including risk or uncertainty?	Uwe Schaefer, Swedish Environment Institute, Sweden
Gender and climate change	Maureen Fryden, Northumbria University, UK
Preparing adaptation and implementation	Michael Hilborn, James Cook University, Australia
Adaptive management of water resources	Yngve Arne, University of Reading, UK (FINO)

Register now!
Places in the masterclass are strictly limited and available on a first-come, first-served basis. A registration fee of \$50 is payable at the time of booking. Reserve your place in the masterclass at <http://register.unsw.edu.au/nccarf>



Available resources:

- Audio files
- Presentation files

Masterclass

20 May 2011, Brisbane

FROM THEORY TO IMPLEMENTATION

<http://www.nccarf.edu.au/content/masterclass-climate-adaptation-theory-implementation>

“ *sustainable:*
able to be maintained
at a certain rate or level.
Ecology: conserving an
ecological balance by
avoiding depletion of
natural resources... ”

—Oxford Dictionary, Second Edition, 2005, p. 1703

Our Common Future: Brundtland Report 1987, pp 24-25

27. Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs...

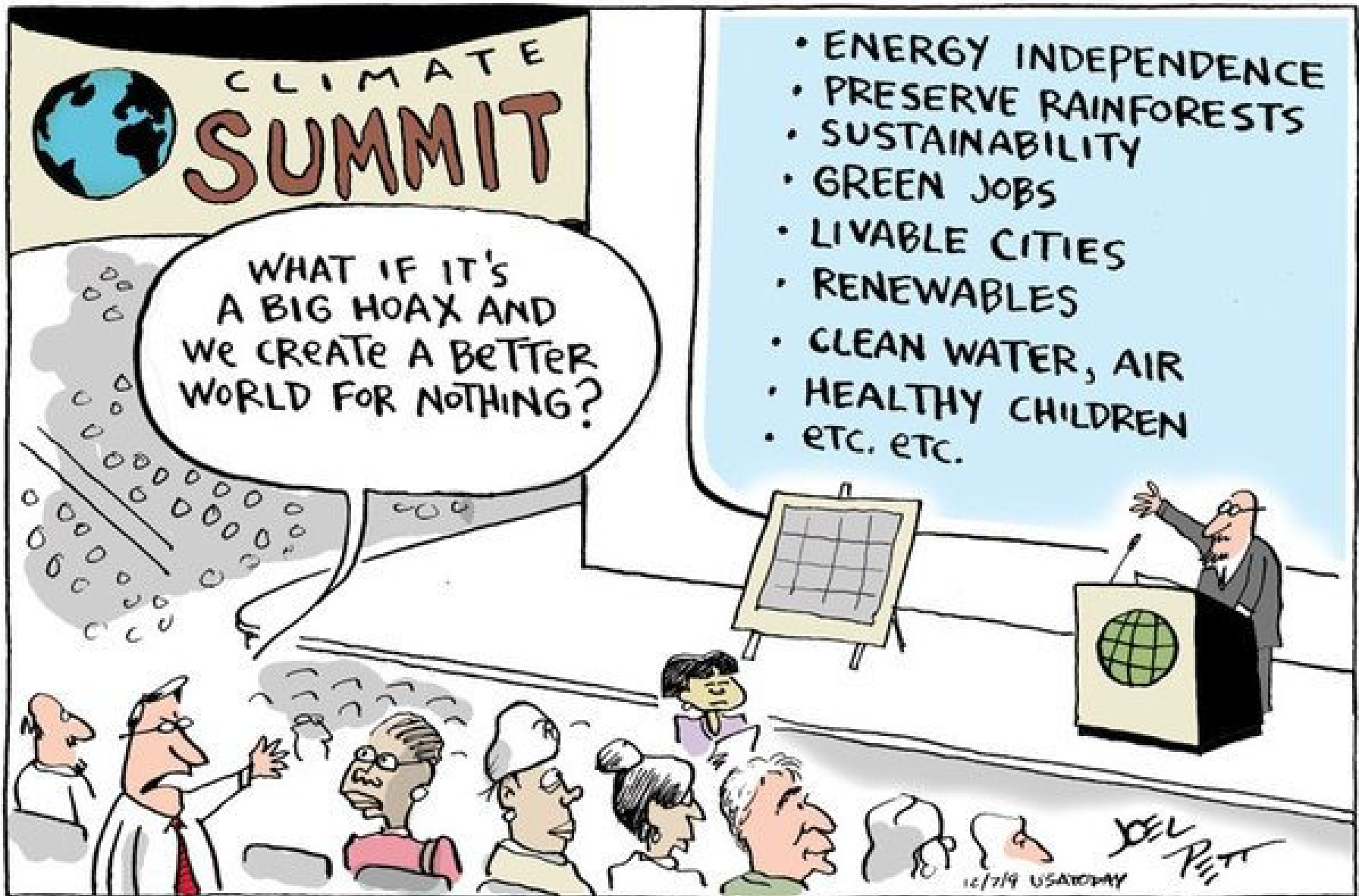
28. Meeting essential needs requires not only a new era of economic growth for nations in which the majority are poor, but an assurance that those poor get their fair share of the resources required to sustain that growth...

29. Sustainable global development requires that those who are more affluent adopt life-styles within the planet's ecological means – in their use of energy, for example. Further, rapidly growing populations can increase the pressure on resources and slow any rise in living standards...

30. Yet in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. We do not pretend that the process is easy or straightforward. Painful choices have to be made. Thus, in the final analysis, sustainable development must rest on political will.

Which are some climate change mitigation and adaptation opportunities?

(Discuss)



Borrowing/leasing tools versus owning stuff
(eg, car sharing: goget cars in my neighbourhood)

<http://youtu.be/EXZtzsR3OBk>



Carbon Tax (CT): <http://youtu.be/kY-ZnpWbJdw>
Emissions Trading Scheme (ETS)

What is the difference between CT and ETS?



Insulation:

Thermal imaging reveals where heat energy leaks



“Roofs and window frames are often the most wasteful areas.” (Picture quoted from Gore 2009, p. 263)

1. Multicausality issues impossible to untangle
2. Different values, priorities, capabilities, awareness
3. Risk aversion – risk accommodation?
4. Uneven distribution of impacts
5. Failure of markets to reflect “costs” (\neq “price”) (need to “internalise externalities”)
6. Formidable opposition by “contrarians” / “denialists” / “rejectionists” / special interest groups
7. Misinformation, exaggerations, distortions, “Doubt”

The need to give economic value to Ecosystem or Biosystem services

“... important environmental assets tend not to be priced in a market like other assets. These assets are common property – they belong to everybody, and to nobody. Without ownership rights there is not the incentive for any person or group to look after them properly... if the environment has a zero price to users it will eventually be used up.”

(Business Council of Australia, Achieving Sustainable Development: A Practical Framework, BCA, 1991, p. 9. Cited in: Sharon Beder, The Hidden Messages Within Sustainable Development, Social Alternatives, vol.13, no. 2, July 1994, pp. 8-12.)

How to internalise these costs into the economic or the market system

“Economic growth can be made compatible with environmental enhancement only if the emission of pollution is less than that which can be assimilated and transformed by the natural environment.”

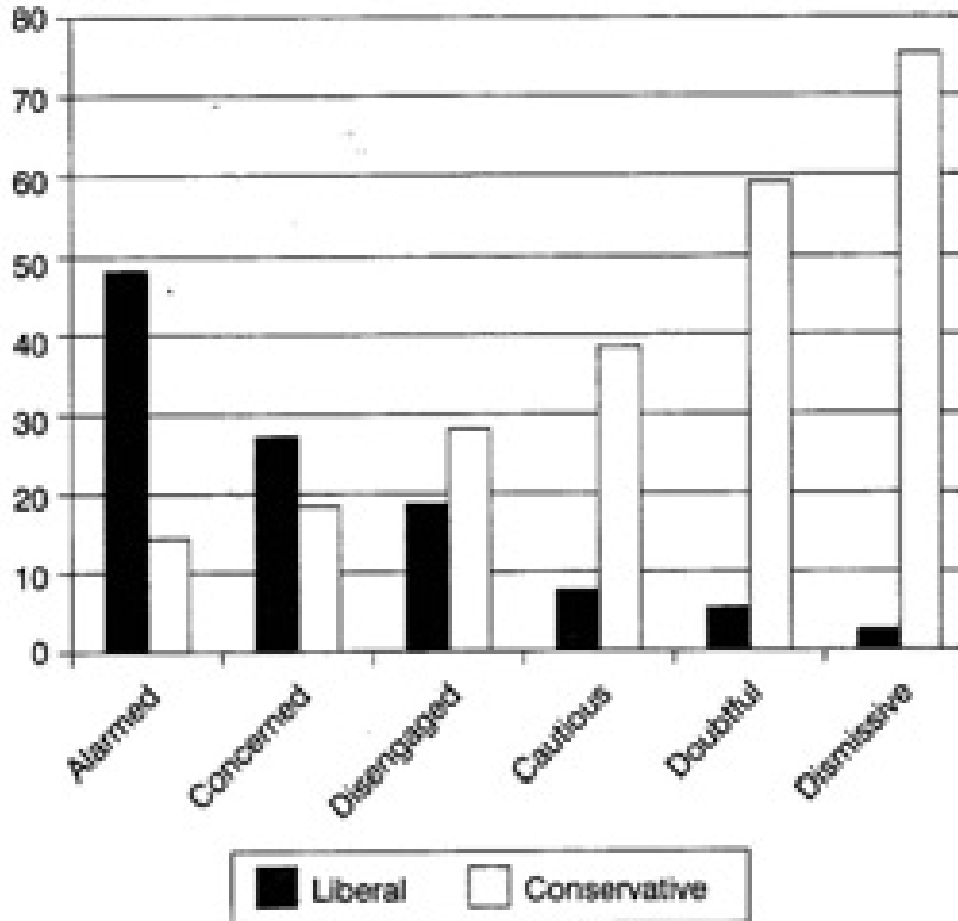
Pereira, W & Seabrook, J. 1989, Red Ink in the Blueprint for a Green Economy, Anusandhan, December, p.2. Cited in: Sharon Beder, ‘Economy and environment: competitors or partners?’, Pacific Ecologist 3, Spring 2002, pp. 50-56.

Example of externalised costs (from 8:00-10:00 min):

<http://youtu.be/gLBE5QAYXp8>

Battle of Ideologies

Shares of liberals and conservatives in each global warming group (%)



Source

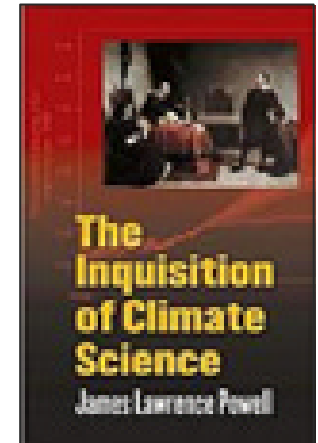
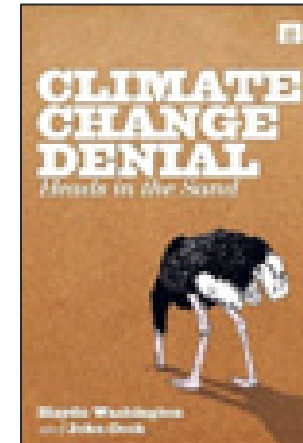
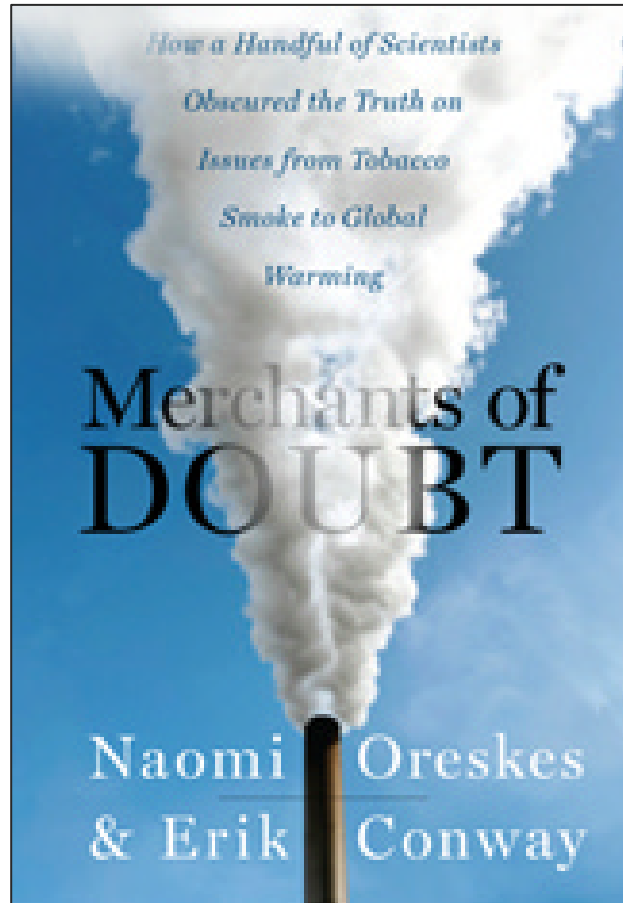
Clive Hamilton (2010):
Requiem for a species:
Why we resist the truth
about climate change
p110

Source: Based on Table 20 in Edward Malbach, Connie Rosen-Renouf and Anthony Leiserowitz, *Global Warming: Six Americas* 2009

Note: 'Moderates' are not shown

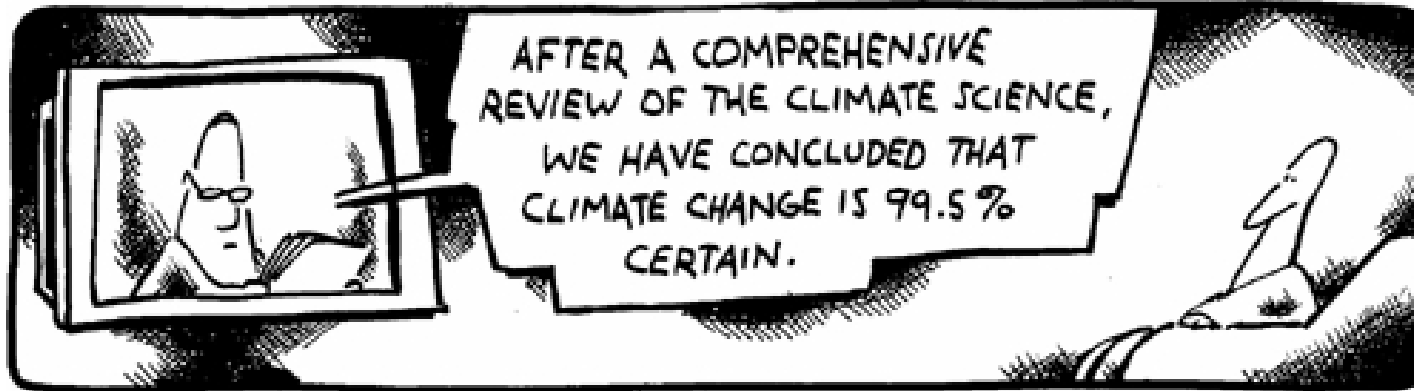


<http://climateralityproject.org/video/doubters/>
<http://youtu.be/YhDacrI1aSA>

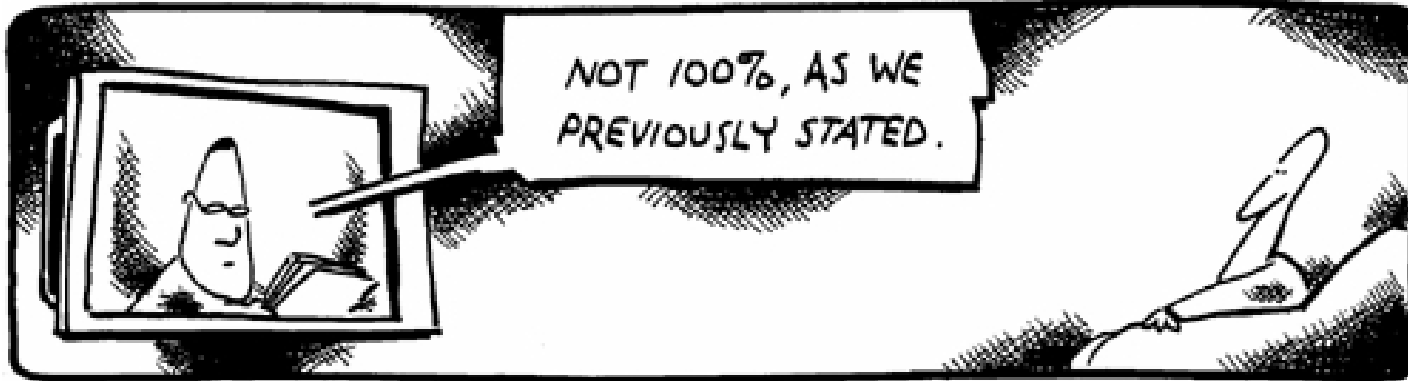
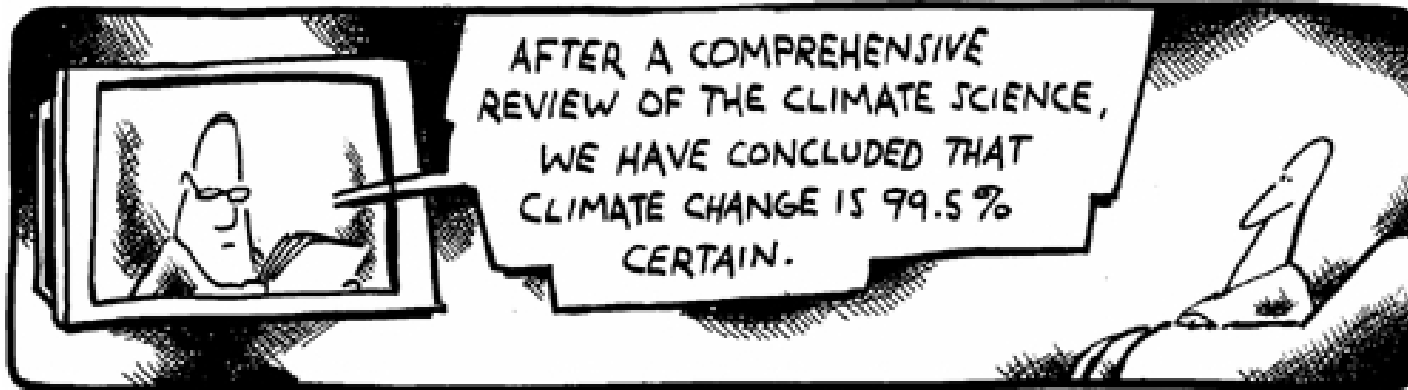


<http://www.merchantsofdoubt.org/>

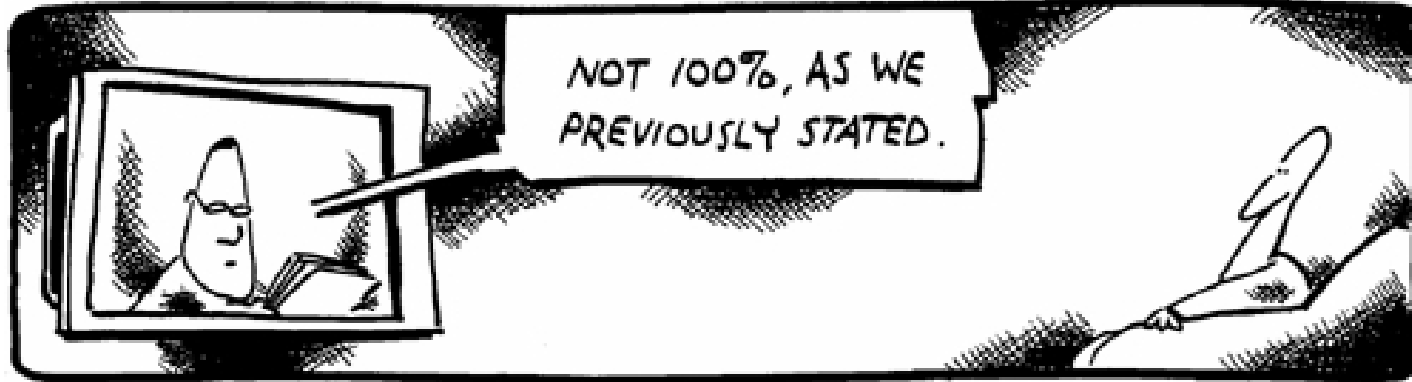
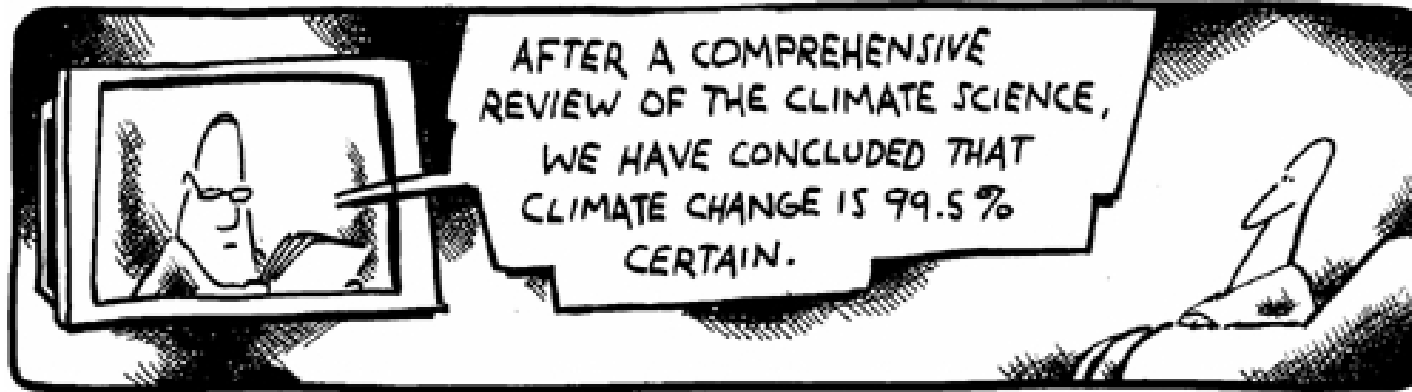
<http://www.arts.unsw.edu.au/news-and-events/public-lecture-with-naomi-oreskes-645.html>



(Source: ppt
Stephen H. Schneider)



(Source: ppt
Stephen H. Schneider)



(Source: ppt
Stephen H. Schneider)

Intergenerational equity

“Those of us alive today are the first generation to know that we live in the Age of Global Warming. We may also be the last generation to have any chance of doing something about it. Our forebears had the excuse of ignorance. Our descendants will have the excuse of helplessness. We have no excuse.”

(William Antholis and Strobe Talbott (2010) Fast Forward: Ethics and Politics in the Age of Global Warming”, The Brookings Institution)

Insight, hindsight, foresight

“A favourite concept of mine is the 200-year present, a way of thinking about change. The 200-year present began 100 years ago with the year of birth of the people who have reached their hundredth birthday today. The other boundary of the 200-year present, 100 years from now, is the hundredth birthday of the babies born today. If you take that span, you and I will have had contact with a lot of people from different parts of that span. So think in terms of events over that span and realise how long change takes.”

(Elise Boulding, Professor Emeritus of Sociology at Dartmouth College and Former Secretary General of the International Peace Research Association, interviewed by Julian Portilla in 2003)

Longevity of CO₂

Environmental Degradation

Accelerating CO₂ Emissions

Declining CO₂ Removal

Escalating Temperatures

Rogue Weather

Sea Level Rise

Historical Emissions

Inertia of the Climate System

Population Pressures

Longevity of CO₂
Environmental Degradation
Accelerating CO₂ Emissions
Declining CO₂ Removal
Escalating Temperatures
Rogue Weather
Sea Level Rise
Historical Emissions
Inertia of the Climate System
Population Pressures

**Will there be
leadership to meet
the challenge...?**

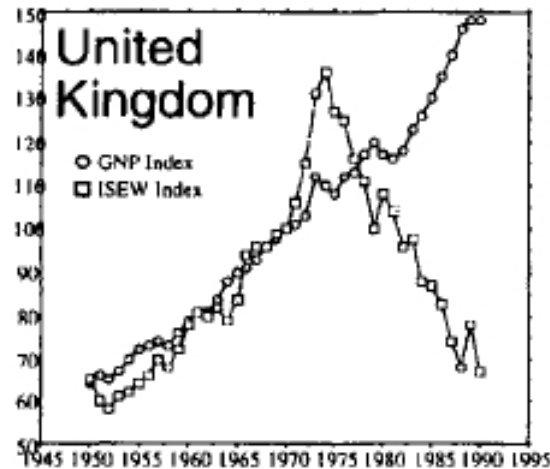
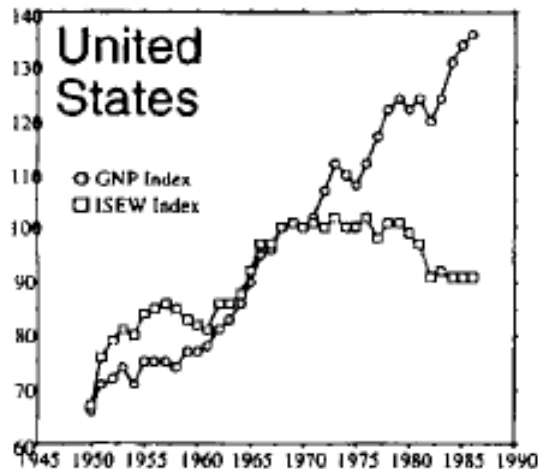
Canada presentation available at:
http://luetz.com/docs/leadership-wanted_slides.pdf

Sustainability – time, space, species

- inter-generation
- inter-geography
- inter-species

Economic growth and quality of life: A threshold hypothesis

“... for every society there seems to be a period in which economic growth (as conventionally measured) brings about an improvement in the quality of life, but only up to a point – the threshold point – beyond which, if there is more economic growth, quality of life may begin to deteriorate.” (Max-Neef 1995; Genuine Progress Indicators GPI; Index of Sustainable Economic Welfare ISEW; Environment and Sustainable Development Indicators ESDI)



***“When it comes to the future,
there are three kinds of people:
those who let it happen, those who
make it happen, and those who
wonder what happened.”***

(John M. Richardson, Jr., American Academic, born 1938)

END PART ONE

PART TWO



Photo: Pip Starr

PLANET **PREPARE**

2008 World Vision
Preparedness Study

Protect Development
Research Priorities
Empower Communities
Partner And Network
Advocate Justice And Change
Reinforce Disaster Defences
Educate Children



http://wvasiapacific.org/downloads/publications/PlanetPrepare_LowRes.pdf

Island of Matsungan, Papua New Guinea

Chief Kela: “What will
the future hold for our
children and
grandchildren?”

Matsungan, Papua New Guinea: Island Chief John Kela (right) standing on what he says was formerly dry ground.

Photo: Johannes Luetz



**Island of Torotsian,
Papua New Guinea**

Photo: Johannes Luetz



**Island of Torotsian,
Papua New Guinea**

Labutali, Papua New Guinea



Photo: Johannes Luetz

Group of environmental or climate change related forced migrants who abandoned their coastal village “because of rising sea levels.”

Photo: Johannes Luetz



**Puwamo, Papua
New Guinea**

Albert Nai: “The bush is better than the beach!”
(At his new home with two of his grandchildren)

Mohammad Shamsuddoha:
“Bhola – Bangladesh’s biggest island – is eroding. From a size of 6,400km² in the 1960s, Bhola is now only half its original size.”

*(General Secretary
Equity & Justice
Working Group)*



**Bhola Island,
Bangladesh**

Tajumuddin, Bhola, Bangladesh: (Photo: Johannes Luetz)



Present: 100,000 displaced p.a.

SLR 1m: 65 million?

SLR 3m: 92 million?

SLR 5m: 128 million?

(Rajan, 2008)

Bhola Island, Bangladesh

Tajumuddin, Bhola, Bangladesh: (Photo: Johannes Luetz)

Abdul Mannan: “The place where I was born lies 5 kilometres out in the sea. I’ve already moved my home and family four times.” Community elder Abdul Mannan (centre) points out signs of erosion.



Abdul Mannan:

“People are constantly moving back. This family left last week. Only the toilet pit is left.”

**Bhola Island,
Bangladesh**

Tajumuddin, Bhola, Bangladesh: (Photo: Johannes Luetz)

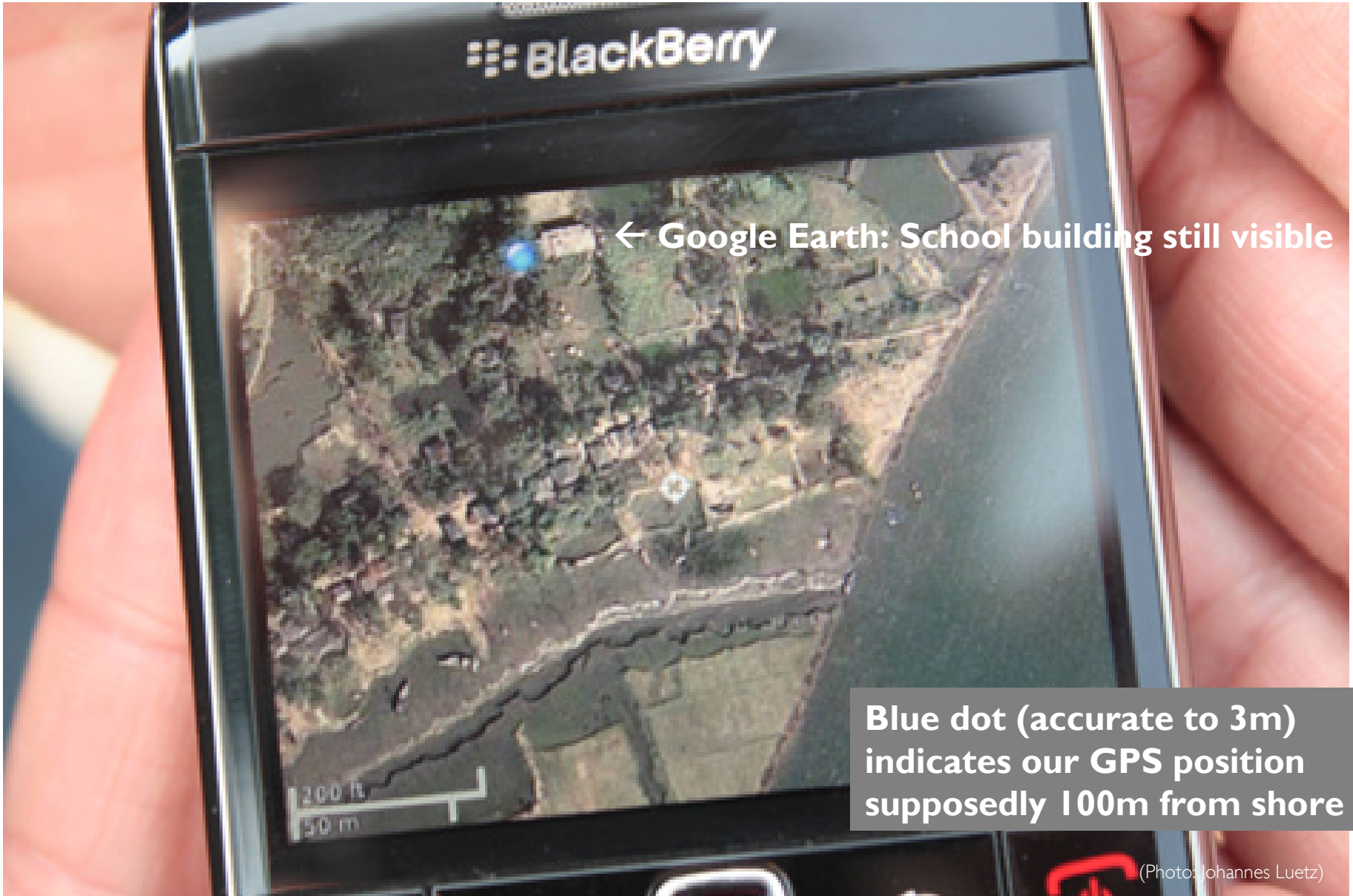
Bridge to “nowhere” (2011)



Show field research video footage:

File name “Bangladesh I”:
55:00 (1min) – Bridge to “nowhere”


(Photo: Johannes Luetz)



← Google Earth: School building still visible

Blue dot (accurate to 3m) indicates our GPS position supposedly 100m from shore

(Photo: Johannes Luetz)



**Student from that very same school
pointing to where class rooms used
to be 6 months ago**

Show field research video footage:

File name “Bangladesh 2”:

31:20 (seconds) – Google maps!

34:00 (3min) – student

**This is the same location at
the GPS derived Google Earth
“blue dot” (accurate to 3m)**

(Photo: Johannes Luetz)



Show field research video footage:

File name “Bangladesh 5”:

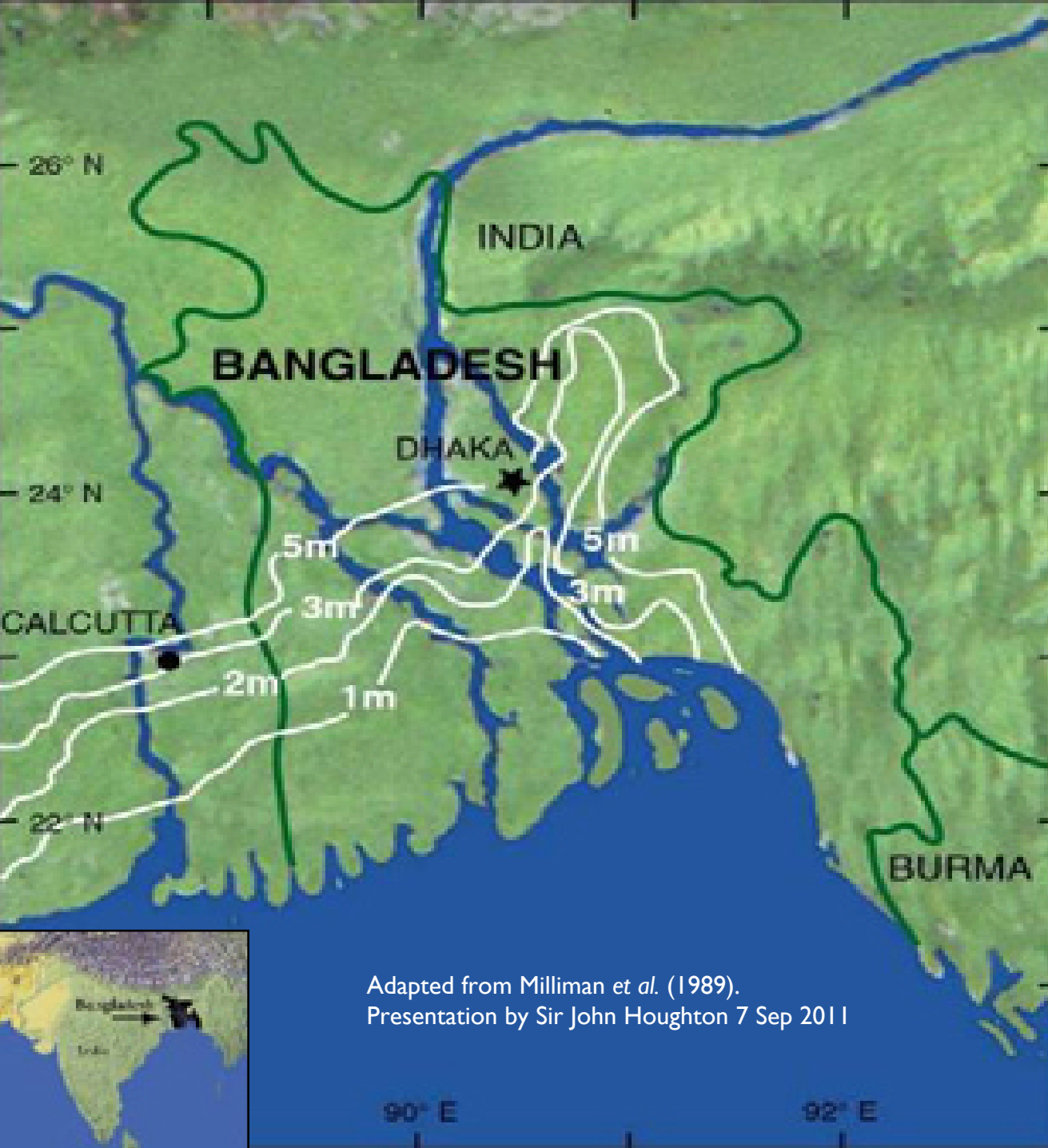
46:00 (1min) – Dhaka tenants, settlements

59:00 (30sec) – Bhola-CEGIS (6km@61min)

00:00 (3min) – INDIA I: erosion/ accretion

**Md. Faruk, migrant from
Bhola Island interviewed at
Dhaka slum**

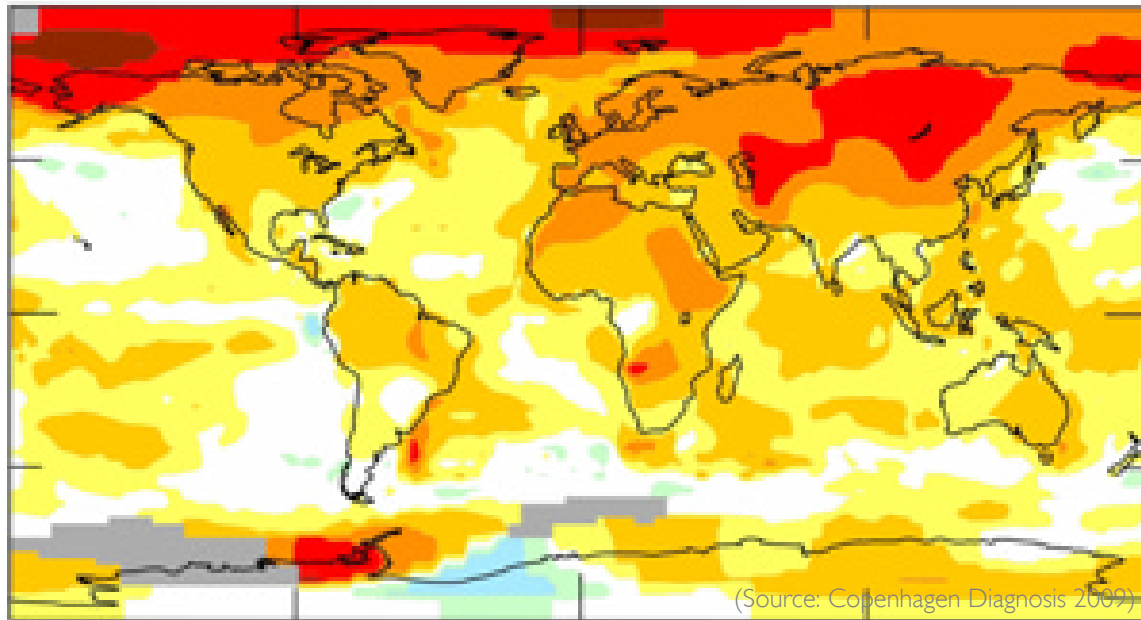
(Photo: Johannes Luetz)



Adapted from Milliman *et al.* (1989).
Presentation by Sir John Houghton 7 Sep 2011



Mean temperature change between 1950's and 2000's



Among top 10 warmest years
2001
2002
2003
2004
2005
2006
2007
2008
2009

“Climate change will make it harder to manage the world’s water. People will feel many of the effects of climate change through water. The entire water cycle will be affected. While the world as a whole will get wetter as warming speeds up the hydrological cycle, increased evaporation will make drought conditions more prevalent. Most places will experience more intense and variable precipitation, often with longer dry periods in between. The effects on human activity and natural systems will be widespread.”

—*World Bank, World Development Report 2010*



South Africa
Western Cape
21 July 2002

Photo: NASA



South Africa
Western Cape
21 July 2003

Photo: NASA



Sinazongwe, Zambia

What looks like a desert or seashore is a field where crops were planted last season. Floods washed away both crops and soil, leaving only sand and a bleaker outlook on the future.



Photo: Jon Warren / World Vision.

DRIEDUP

Kerkorisogal, Kenya: Children learn English under a tree, taught by teacher James Nakure Etot (36). Kerkorisogal is named for the river that runs through it. But the river hasn't flowed in a year and a half. Ekurichanait Naborkut (34), head teacher at Kerkorisogol School, says hunger often hits his classroom hard: "When there is no food, the children become sleepy and are absent."



Photo: World Vision Philippines

Cainta / Pasig, Philippines: Two days after Typhoon Ketsana/Onday's landfall, World Vision Philippines, with the help of a Coast Guard helicopter, drops 75 relief packs. Flood waters remain high, trapping thousands of people. (September 2009)

WATERED **DOWN**

**Precipitation rate
increase by 5-10%
per °C warming**

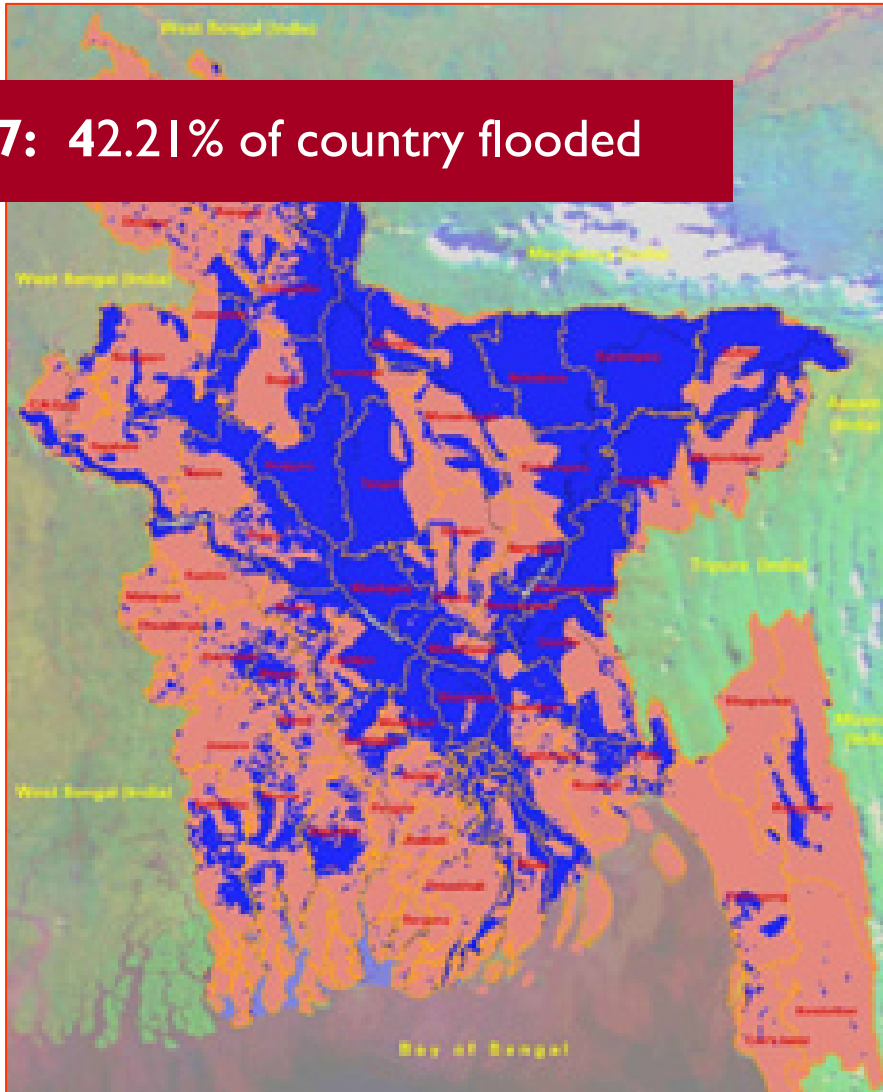
“
When it
rains, it
pours ”



Khailshabunia (Bangladesh) under water

Photo: Amio Ascension / World Vision

2007: 42.21% of country flooded



**Bangladesh,
world's largest
river delta:**
One-third floods
annually during
the monsoon.
Extreme floods
cover up to two-
thirds of the
country.

Bangladesh Space Research and Remote Sensing Organization (SPARRSO). Satellite image: August 2,3,4,5,7 & 8, 2007

Tropical Storm Ketsana over the Philippines, 26 September 2009

Study: 1°C global warming = 30% increase in tropical cyclones?

Photo: National Oceanic and Atmospheric Administration (NOAA)

<http://www.chrispforr.net/phils/survivors/survivors.htm>



Show field research video footage:

File name “Philippines 5”:

20:30 (1min) – Typhoon belt shifted south

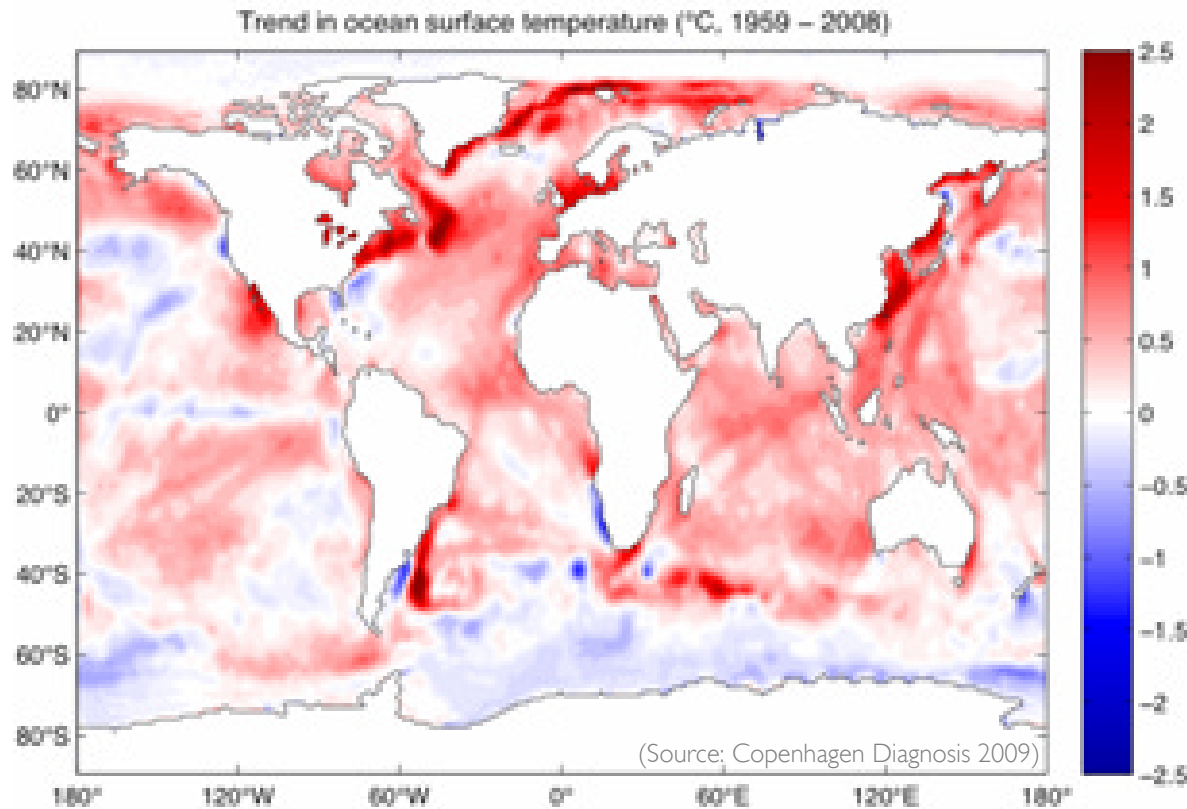
31:00 (1min) – Wealth accounting

File name “Philippines 8”:

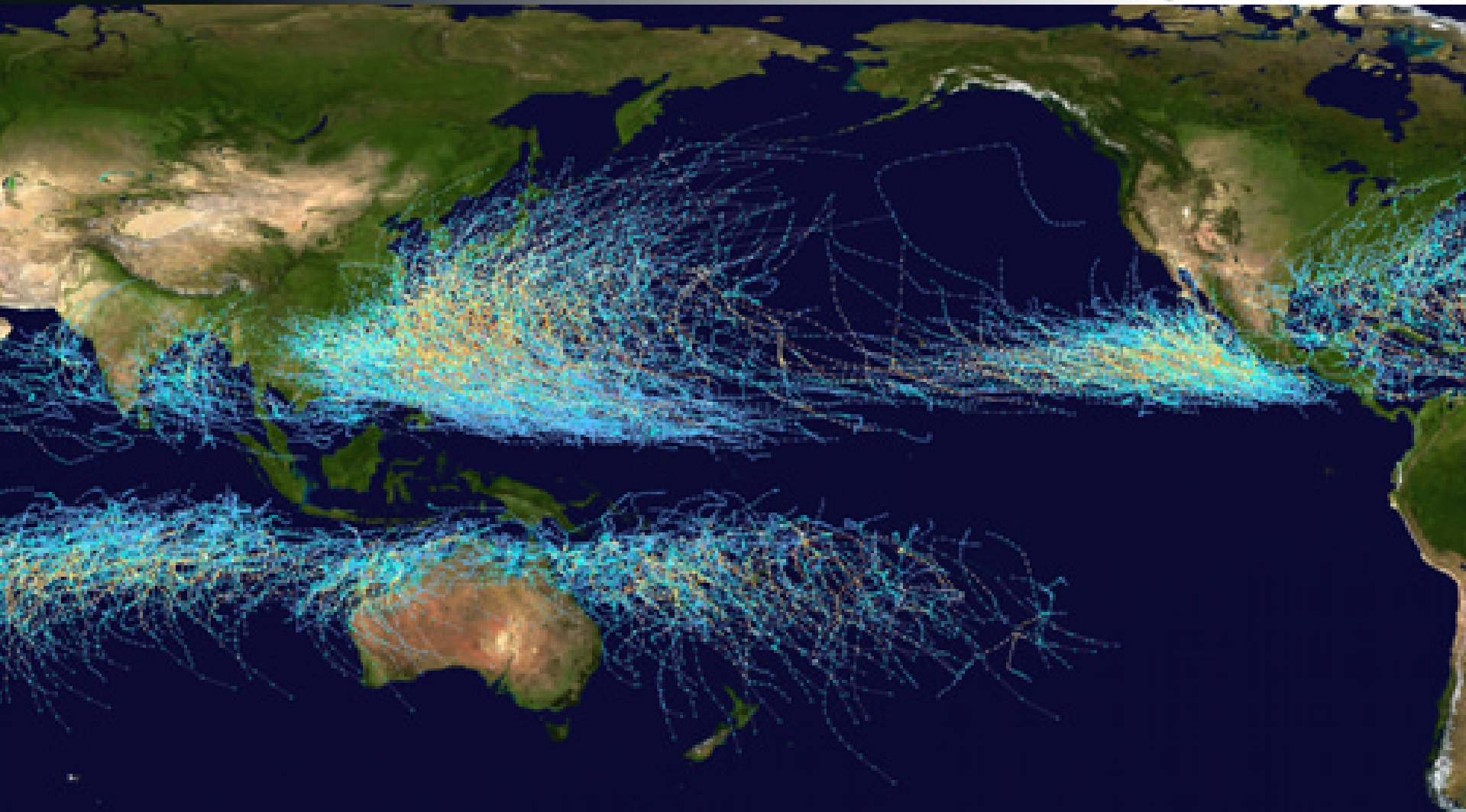
05:00 (1min) – Severe Tropical Storm Washi

(Photo: Chris Pforr)

Ocean heat uptake 50% higher than previous calculations



2007:
warmest year
ever
recorded



Hurricane Tracks 1985-2005

Photo: NASA / Nilfanion

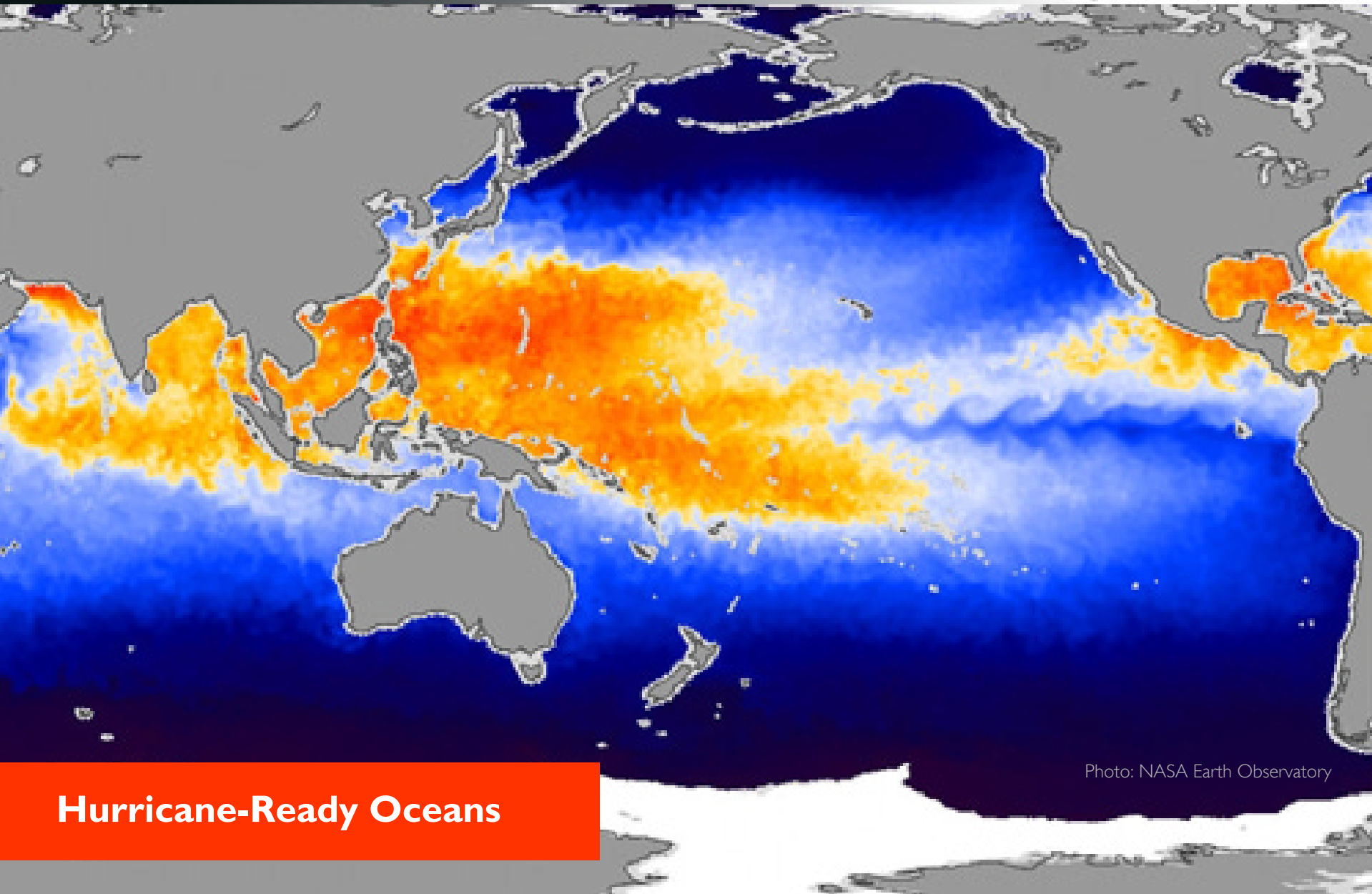


Photo: NASA Earth Observatory

Hurricane-Ready Oceans

Storm Surges

Before Cyclone Nargis

Photo: NASA/MODIS Rapid Response Team

15 April 2008

Storm Surges: Most lethal aspect of wind storms. Hydrological conditions can lift sea level by multiple metres and drive a massive flood of sea water many kilometres inland.

Storm Surges

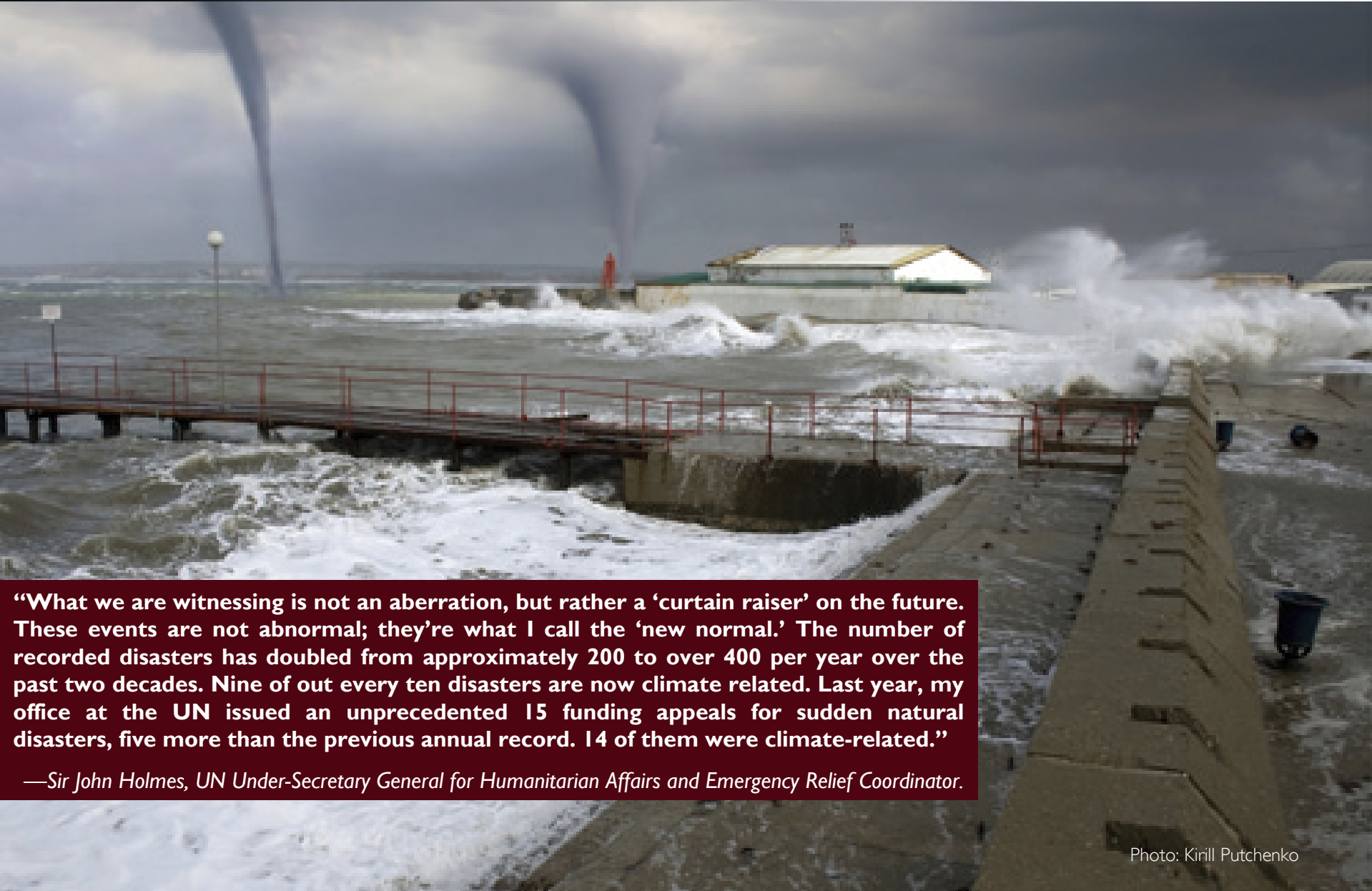
After Cyclone Nargis

Photo: NASA/MODIS Rapid Response Team

5 May 2008

World Bank Natural Disaster Hotspots Report:
“By far the most certain aspect of climate change that will influence surge characteristics is global-mean-sea-level-rise ... The overall conclusion is that the surge hazard will evolve significantly during the 21 century.”

Stronger Storms?



“What we are witnessing is not an aberration, but rather a ‘curtain raiser’ on the future. These events are not abnormal; they’re what I call the ‘new normal.’ The number of recorded disasters has doubled from approximately 200 to over 400 per year over the past two decades. Nine of out every ten disasters are now climate related. Last year, my office at the UN issued an unprecedented 15 funding appeals for sudden natural disasters, five more than the previous annual record. 14 of them were climate-related.”

—Sir John Holmes, UN Under-Secretary General for Humanitarian Affairs and Emergency Relief Coordinator.

Photo: Kirill Putchenko




Jakarta: One of many cities that needs to prepare for sea level rise. With 40% of the city below sea level, there have already been calls to relocate the Indonesian capital to Bandung, 180km away.



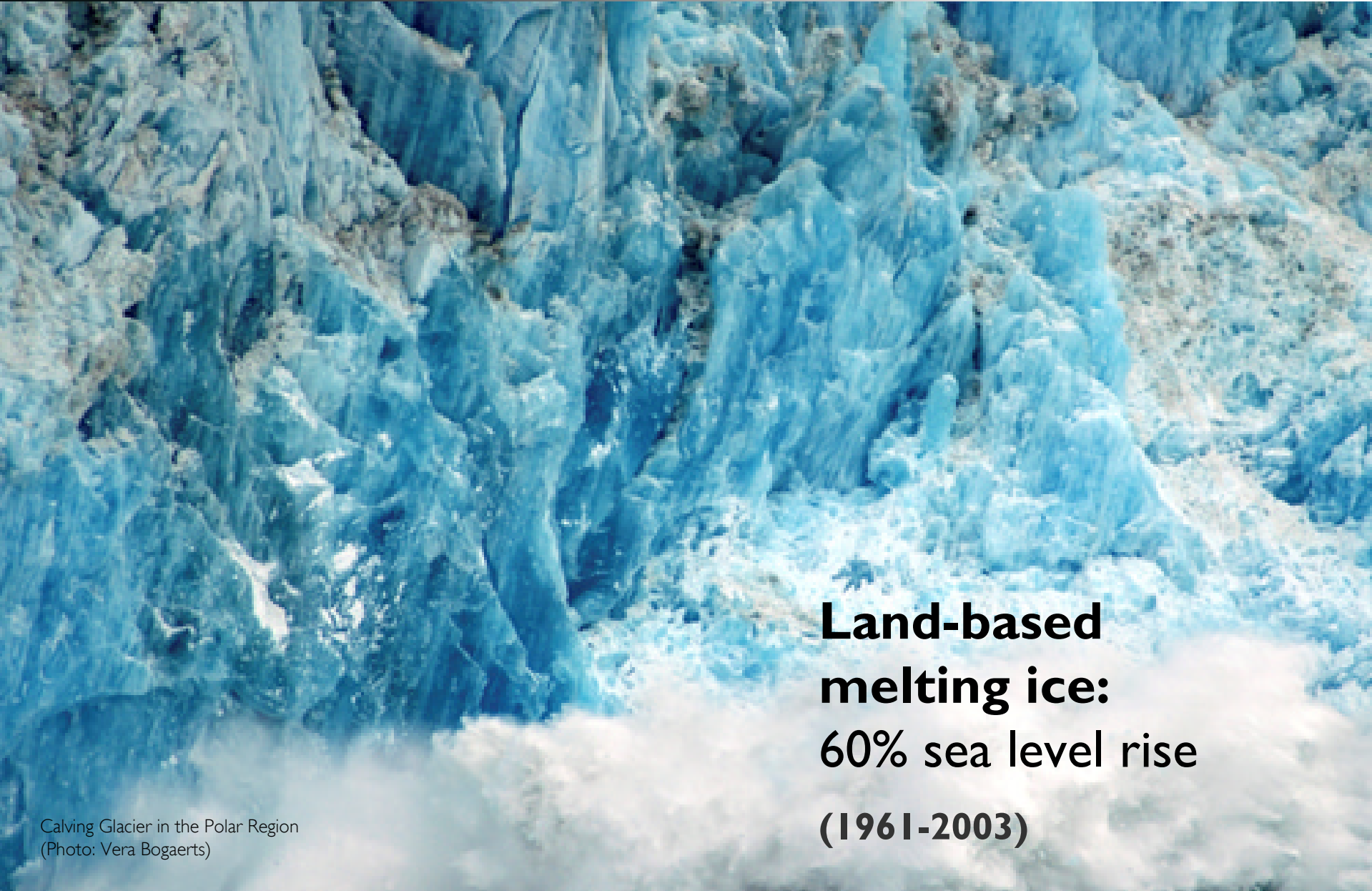
Photo: Abi Hardjatmo

Jakarta: With its 13 rivers floods in Jakarta can be devastating. The February 2007 flood displaced 450,000 people. More than 70% of the city was inundated.



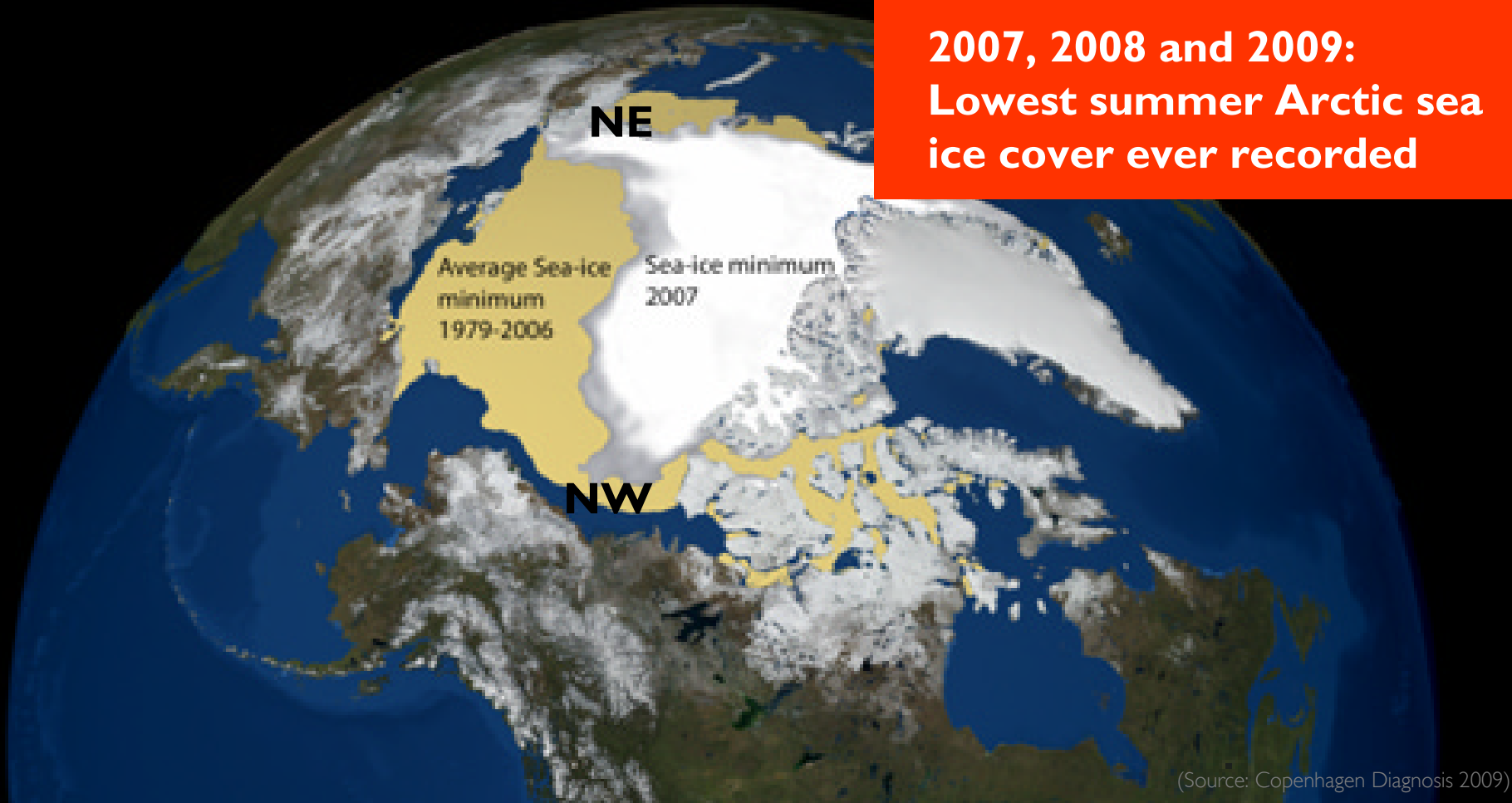
**Thermal
expansion:
40% sea level rise
(1961-2003)**

Photo: Tammy Peluso

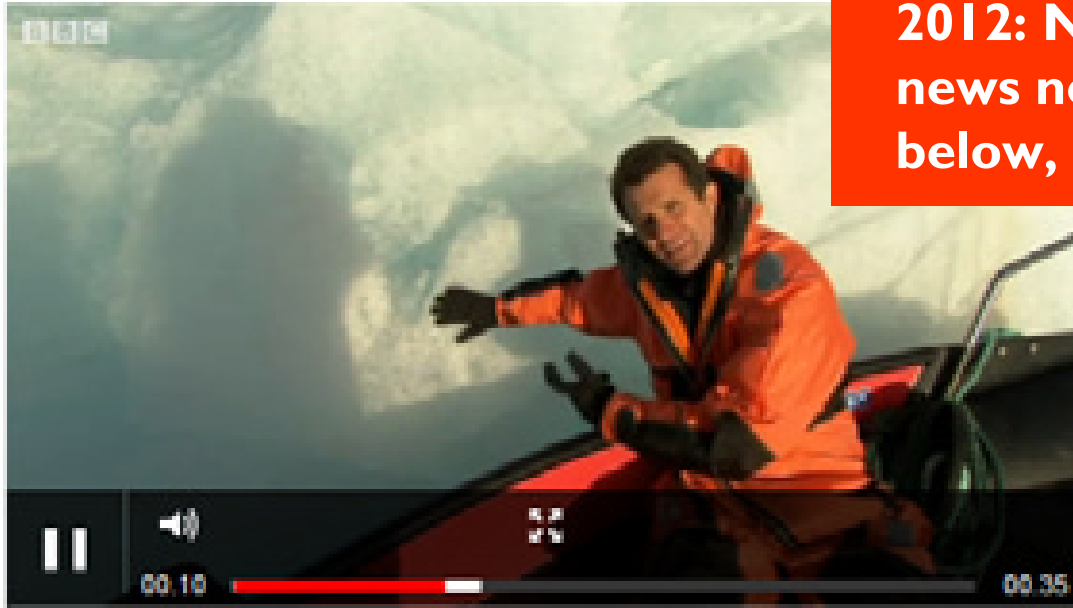


**Land-based
melting ice:
60% sea level rise
(1961-2003)**

Calving Glacier in the Polar Region
(Photo: Vera Bogaerts)



Minimum arctic sea-ice decline from 1979 to 2007



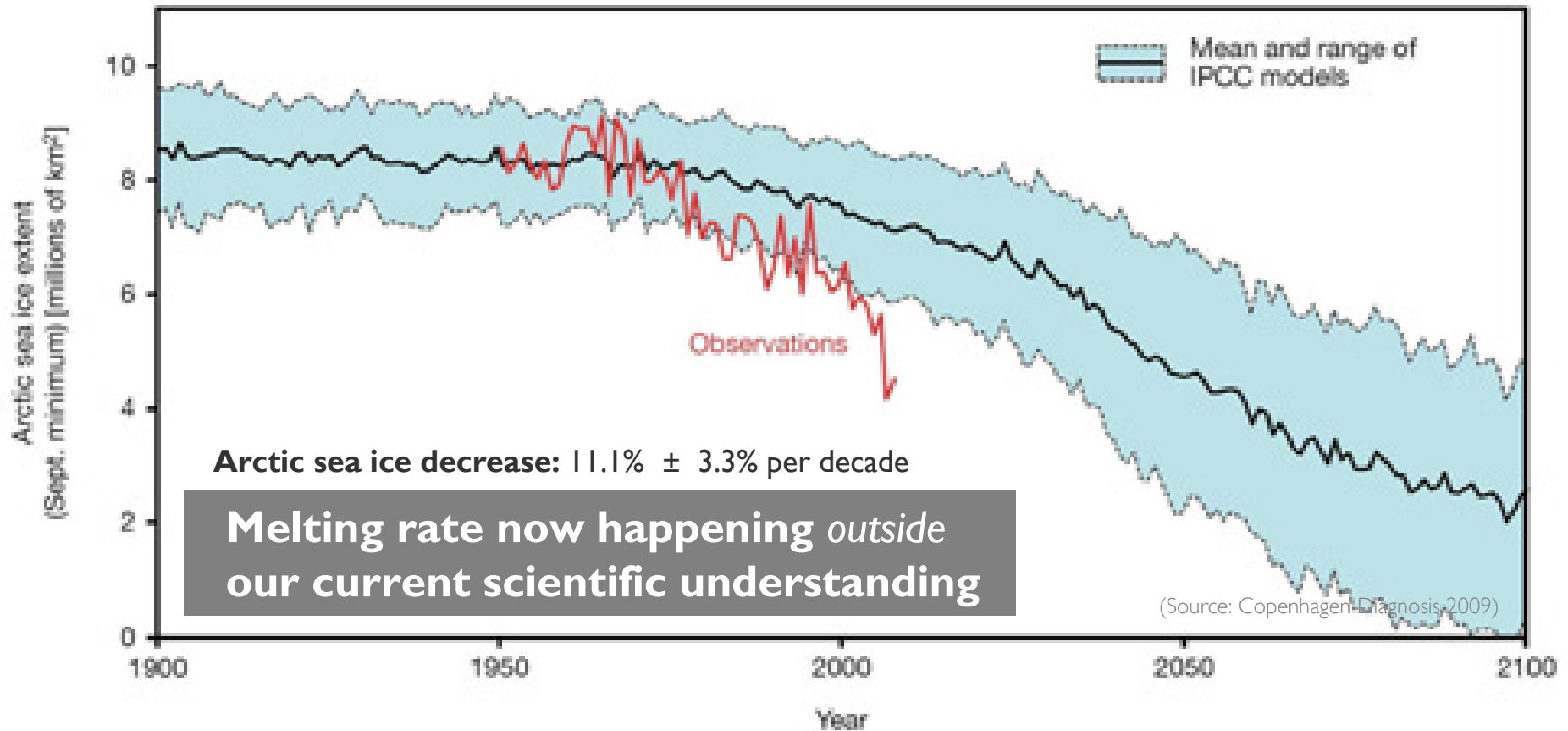
2012: New record, in the news now... (see video links below, only a few days old)

<http://www.bbc.co.uk/news/uk-19498018>

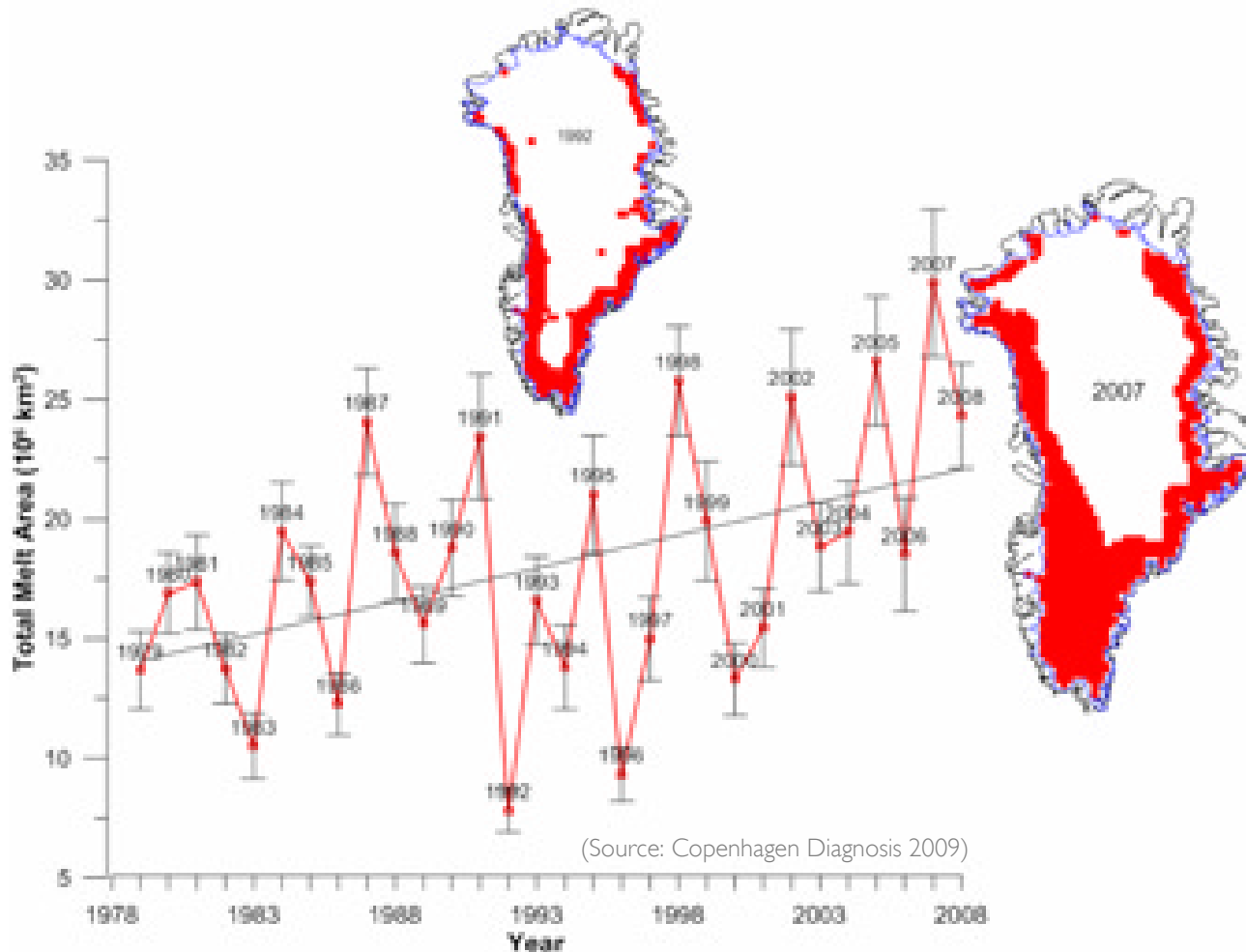
→ <http://www.bbc.co.uk/weather/features/19417327>

→ <http://www.bbc.co.uk/news/world-europe-19508906>

Observed and modeled Arctic sea-ice decline



Greenland ice-melt since 1979



2002-2009:
Greenland ice mass loss doubled

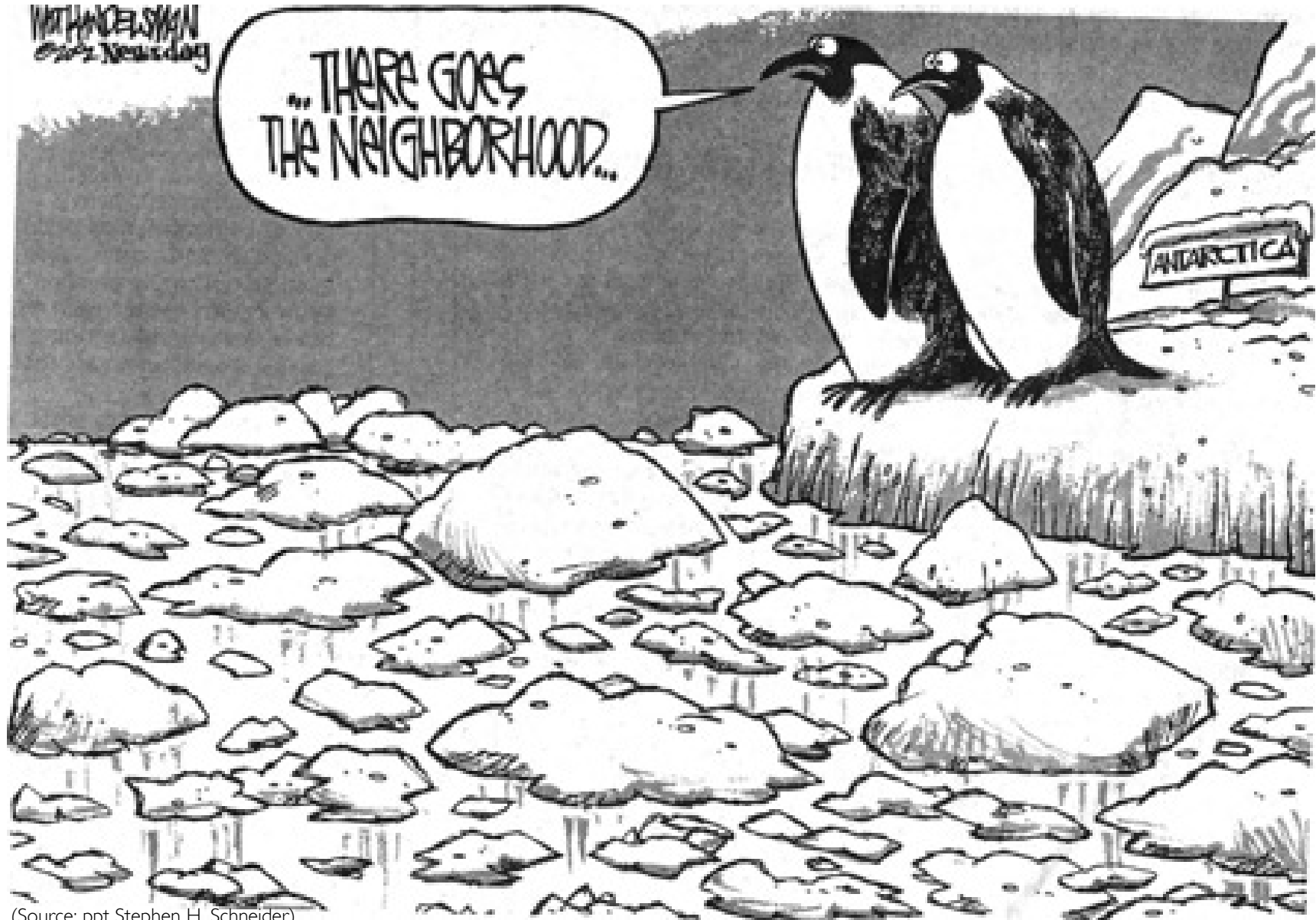
2007:
melting area 50% of total ice sheet

6.6 metres:
Greenland's total SLR potential

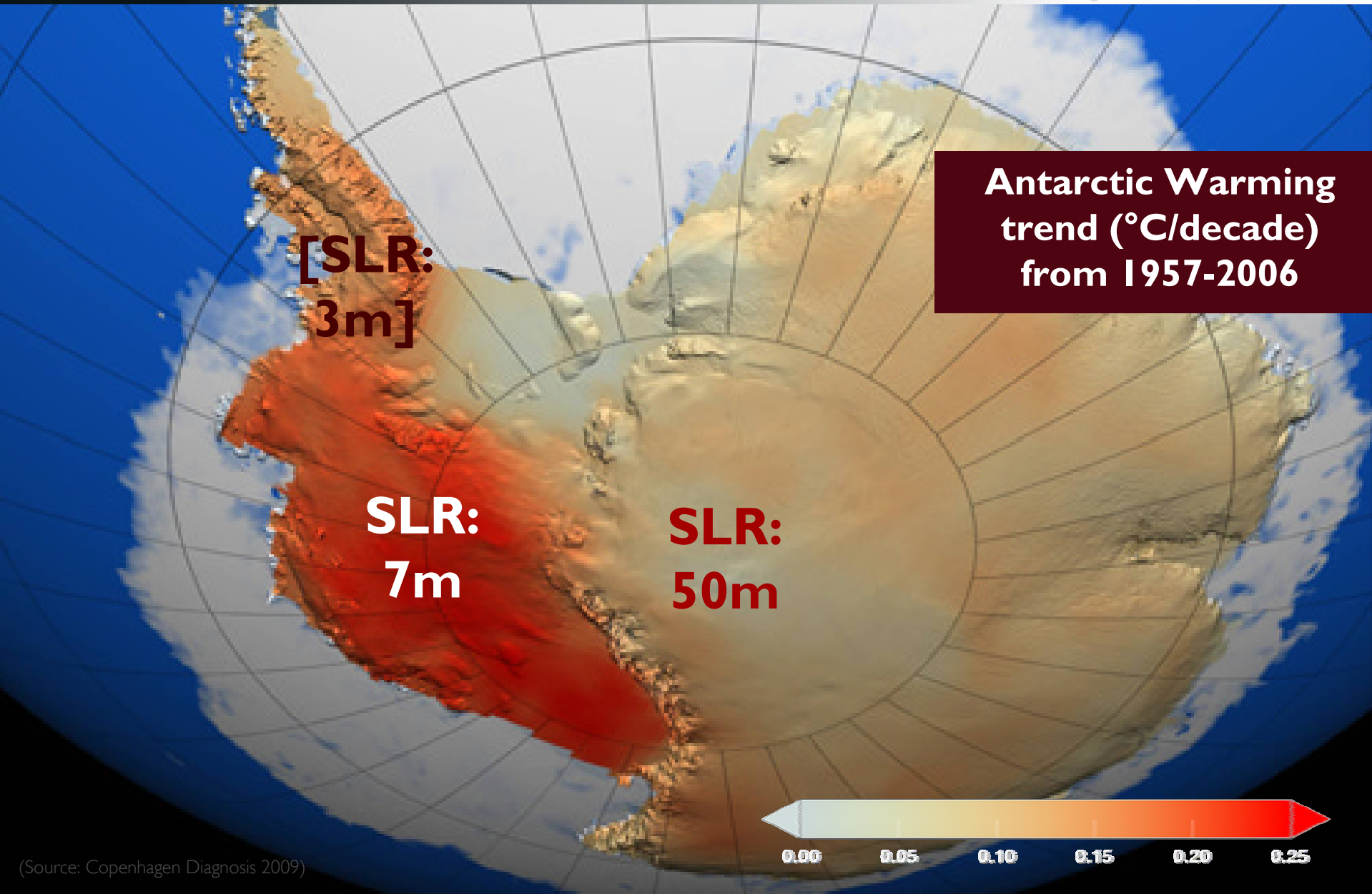
While Arctic sea-ice decline is sea level neutral, proximity to Greenland is a cause for concern

Ice-Free Arctic Summers?



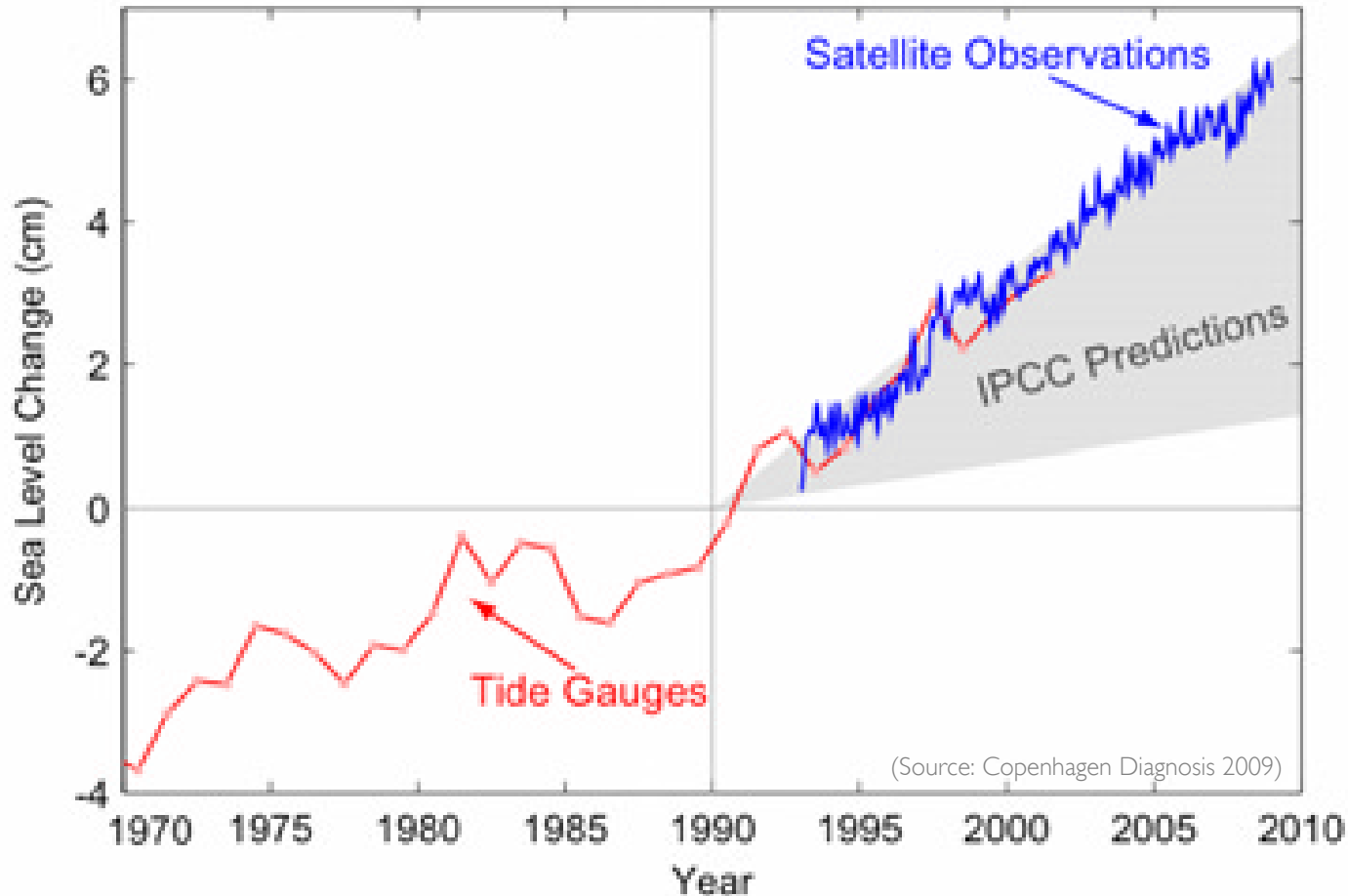


(Source: ppt Stephen H. Schneider)



(Source: Copenhagen Diagnosis 2009)

Global sea level change 1970-2010

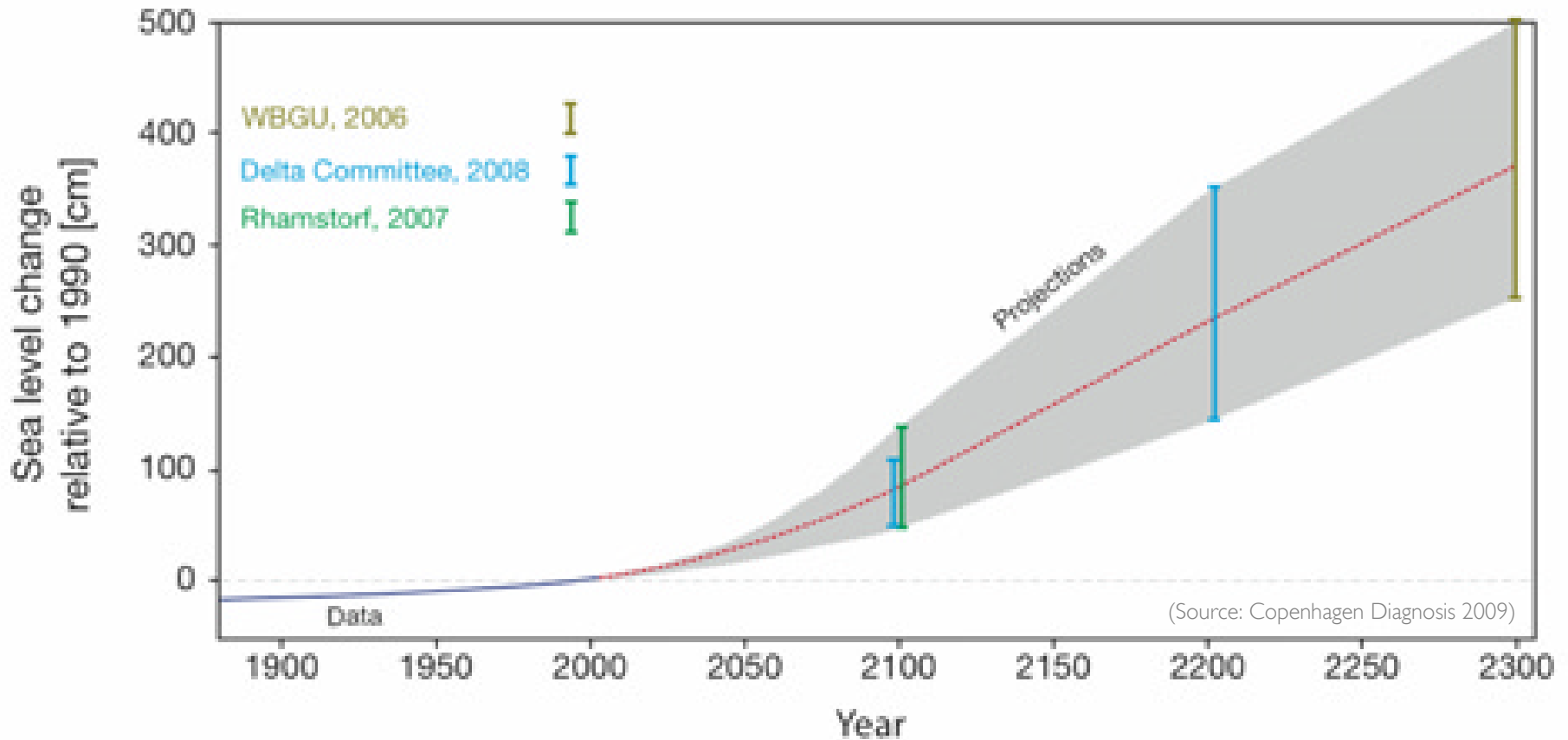


**SLR by
2100:
1-2m**

**Last 15
years:
5cm SLR ~
80% faster
than IPCC**

**SLR by
2300:
up to 5m**

Future sea-level projections





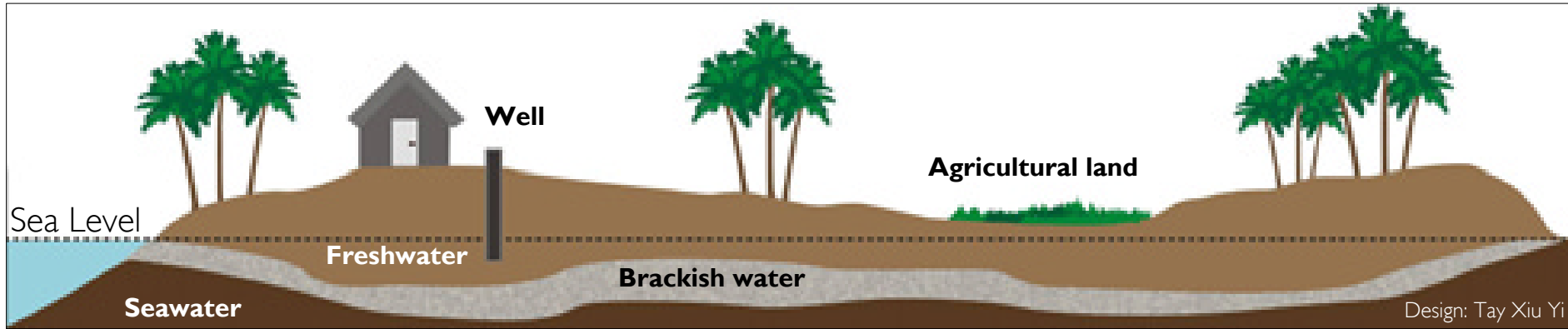
WATER
IS LIFE

Intergovernmental Panel on Climate Change (IPCC)

Island near Fiji (Photo: Wikipedia)

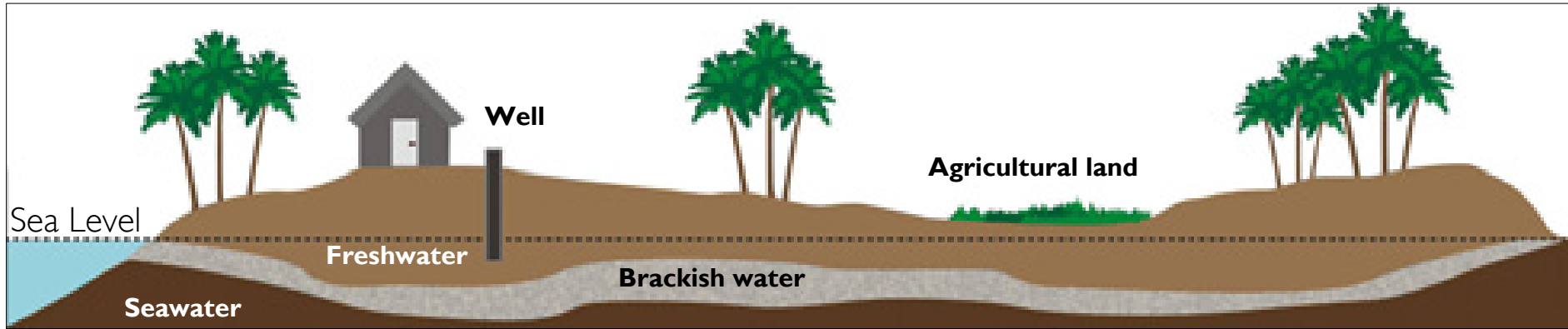
Fourth Assessment Report, 2007: “By mid-century, climate change is expected to reduce water resources in many small islands ... to the point where they become insufficient to meet demand during low-rainfall periods.”

Figure 1: Initial sea level



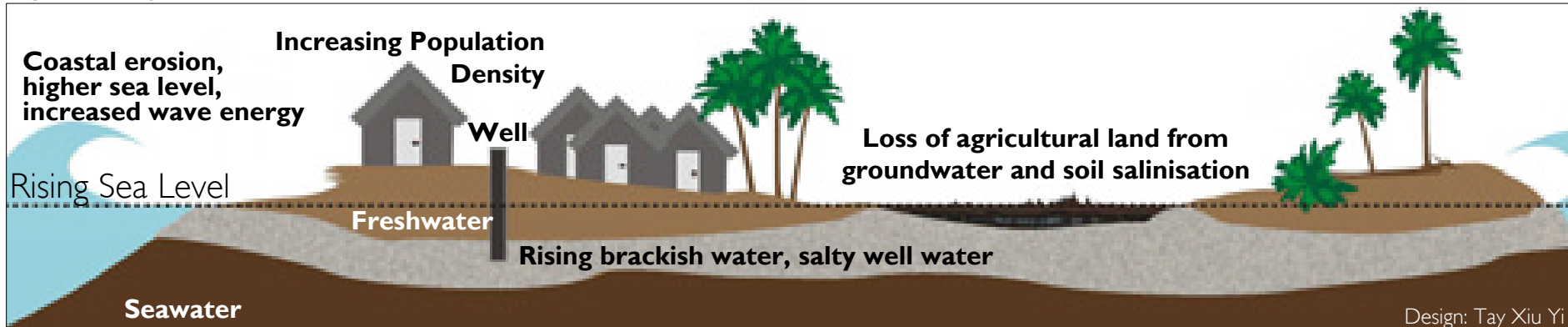
Island Submergence

Figure 1: Initial sea level



Island Submergence

Figure 2: Rising sea level



Design: Tay Xiu Yi

“Overtopping”



CARTERET ATOLL

Photos: Tulele Peisa, Courtesy Pip Starr and Ursula Rakova

Photo: Johannes Luetz



**Island of Petats:
Contaminated
Open Well**

Papua New Guinea: Island of Petats, contaminated open well

Luke Rutsie (36), Petats: “The well water tastes very salty – islanders now use it only for cooking and bathing.”

Island of Pororan: Contaminated Closed Well



Photo: Johannes Luetz

Papua New Guinea, island of Pororan,
contaminated closed well

Francis Giran (59), Pororan: “The well water has become salty and unfit for consumption. This World Vision-built pump is brown with rust.”



<http://youtu.be/KBq2jNrD-yg> OR

<http://tv.unsw.edu.au/video/bolivia-leaving-the-land>



Any other suggestions?

“climate refugees”,
“environmental refugees”,
“climate migrants”, “climate
exiles”, “climate evacuees”,
“climate displacees/
dislocatees”, “forced
migrants”, “climigrants” ...

Definitional difficulties

The list of suggestions is long and growing, and examples listed here are incomplete: “climate refugees” (eg, Biermann and Boas 2010; FOE 2007, Walker 2009, EJF 2012), “climate change refugees” (eg, Docherty and Giannini 2009, p. 361; Bob Brown 2008, Sachs 2007), “refugees” (Hansen 2008, p. 2), “environmental refugees” (eg, Ehrlich and Ehrlich 2013, p. 4; Brown 2011, pp. 72-83; Kent and Myers 1995, Bell 2004, Tickell 1989), “eco-refugees” (Cournil 2011, p. 359), “environmental and climate change refugees” (Dupont and Pearman 2006, p. 55), “sea-level refugees” (WBGU 2006, p. 61), “rising-sea refugees” (Brown 2011, pp. 73, 193), “desert refugees” (Brown 2011, p. 77), “water refugees” (Brown 2011, p. 79), “climate refugees” (eg, McAdam 2012, Bettini 2012, Hartmann 2010), “displaced persons (refugees)” (Westing 1992), “environmentally-displaced persons” (Lopez 2007), “climate migrants” (eg, Gibb and Ford 2012, Leal-Arcas 2012, Rajan 2008), “climate change migrants” (Shamsuddoha and Chowdhury 2010, pp. 3-7), “climate exiles” (eg, Wei 2011), “climate change exiles” (Byravan and Rajan 2006), “environmentally-induced [displaced] populations” (UNHCR 1996), “environmental migrants” (eg, IOM 2007, p. 1 paragr. 6; IOM 2008, p. 399; also CEEMA 2010, p. 5), “climate evacuees” (Cournil 2011, p. 359), “environmental migrants/refugees” (Renaud et al 2007, pp. 14-17), “climate-change victims” (Popovski and Mundy 2012; UNU 2011), “ecomigrants” (Wood 2001, pp. 43f), “ecological migrants” (ADB 2012, p. 9), “environmentally displaced persons [or people]” (eg, Cournil 2011, p. 359; UNHCR 1996, p. 9; UNFCCC 2007, ADB 2012, p. 9), “[climate] displaced people” (eg, NRC 2009), “climate change-induced displaced people” (McAdam 2011, p. 18), “forced migrants” (Brown 2007, p. 8), “climate change forced migra[nts]” (Brown 2008, p. 31), “climate-induced displace[d people]” (Castles 2010), “persons displaced by climate change” (Kälin 2010, p. 97), “[people] forced to leave their homes due to sudden-onset climate-related natural disasters” (UN-OCHA 2009, p. 15); “survival migrants” (Betts 2010), “climigrants” (Bronen 2008b, p. 31; Bronen 2010, p. 89).

(Literature Review, Luetz 2013, pp. 29-30)

Associations: Labels and societal perceptions

“Refugee”

- “Refugee” good semantic fit: people “seek refuge; run *from*”
- No choice
- Last resort
- Reactive
- Public empathy?
- Perceived as “helpless”?
- **“Victimisation”?**

“Migrant”

- “Migrant” more legally precise: “people run *to*”
- Free will
- Form of Adaptation
- Proactive
- Public mistrust?
- Perceived “freeloaders”?
- **“Opportunism”?**

CLIMATE CHANGE REFUGEE: “... *an individual who is forced to flee his or her home and to relocate temporarily or permanently across a national boundary as the result of sudden or gradual environmental disruption that is consistent with climate change and to which humans more likely than not contributed.*” (Docherty and Giannini, 2009)

CLIMATE REFUGEE: “... *people who have to leave their habitats, immediately or in the near future, because of sudden or gradual alterations in their natural environment related to at least one of three impacts of climate change: sea-level rise, extreme weather events, and drought and water scarcity.*” (Biermann and Boas 2007, 2008)

ENVIRONMENTAL REFUGEES: *“... persons who can no longer gain a secure livelihood in their traditional homelands because of environmental factors of unusual scope, notably drought, desertification, deforestation, soil erosion, water shortages and climate change, also natural disasters such as cyclones, storm surges and floods. In face of these environmental threats, people feel they have no alternative but to seek sustenance elsewhere, whether within their own countries or beyond and whether on a semi-permanent or permanent basis.” (Myers and Kent 1995, pp 18-19)*

ENVIRONMENTAL MIGRANTS: *“Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad” (International Organization for Migration IOM, 2007).*



“ there could be perhaps as many typologies as there are papers on the subject. ”
(Richard Black, 2001)

Disaggregational difficulties:

1. No direct “causal link” of linear nature between environmental degradation and population displacement
2. Cannot uncouple “contributing causes”
3. Factors interrelated: environmental degradation triggers migration – migration causes environmental degradation
4. Future fallout depends on actions taken today

Bottom Line: relative causal attribution is very difficult to establish



“ When global warming takes hold, there could be as many as 200 million people overtaken by disruptions of monsoon systems and other rainfall regimes, by droughts of unprecedented severity and duration, and by sea-level rise and coastal flooding. ”

(Norman Myers, 2005)

3. Predictive problems

Country or Region as analysed by Myers and Kent	Projected number of “environmental refugees”
Bangladesh	13 million
Egypt	16 million
China	73 million
India	20 million
Island States	1 million
“Agriculturally Dislocated”	50 million
Total	173 million

(Myers and Kent, 1995)

3. Predictive problems

Displacement – selected sources, projections, timeframes

Source	Projection	Timeframe
IPCC (2001)	150 million	2050
Myers (1995 and 2005)	200 million	2050
Myers (2006)	250 million	2050
Nicholls (2004)	50-200 million	2080
IOM (2009)	200 million	2050
Stern Review (2006)	150-200 million	2050
Christian Aid (2007)	1 billion	2050

21st century trend...?

Under international law, a “refugee” is a person who...

“ ... owing to well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinions, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country, or who, not having a nationality and being outside of the country of his former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it. ”

—1951 Convention relating to the Status of Refugees,
Art. 1A(2), 1951, as modified by the 1967 Protocol).

Currently accepted definition of “IDPs”

“ ... persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized State border. ”

—*Guiding Principles on Internal Displacement*,
E/CN.4/1998/53/Add.2.)

Problem components

1. Definitional difficulties
2. Disaggregational difficulties
3. Predictive problems
4. Legal limbo

= Knowledge gaps

Problem implications

1. NO agreed definition
2. NO agreed attribution
3. NO agreed forecasts
4. NO agreed framework

= Little or no input from primary stakeholders (ie, climate migrants)

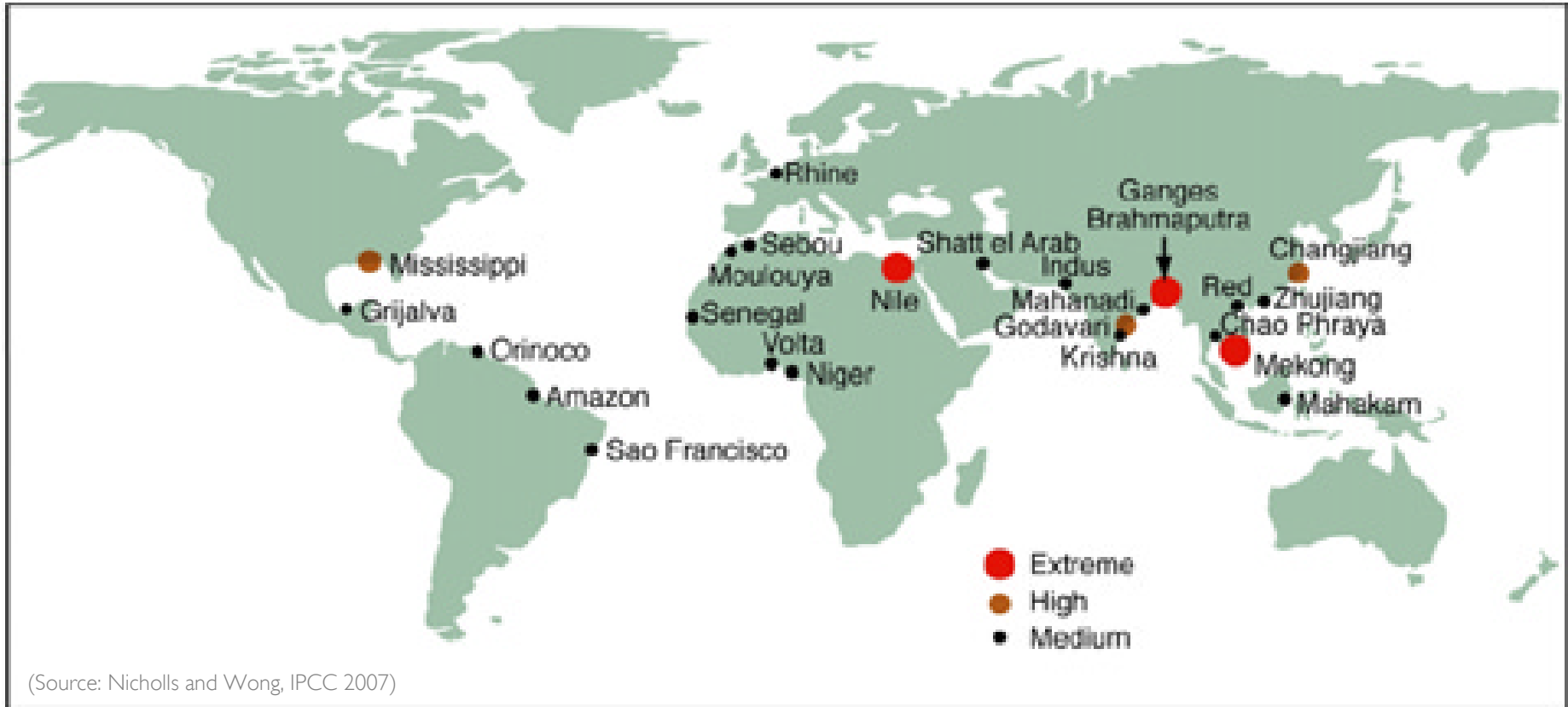
“ The objective of public policy should not be to prevent migration, but rather to ensure that it can take place in appropriate ways and under conditions of safety, security and legality ... [which] makes it all the more urgent to carry out **in-depth micro-level empirical research** to understand the changes that are taking places, how they affect various groups, and what response strategies their groups adopt.

”

—S. Castles, *In: Afterword: What Now? Climate-induced Displacement after Copenhagen*, [Ed.] Jane McAdam, 2010

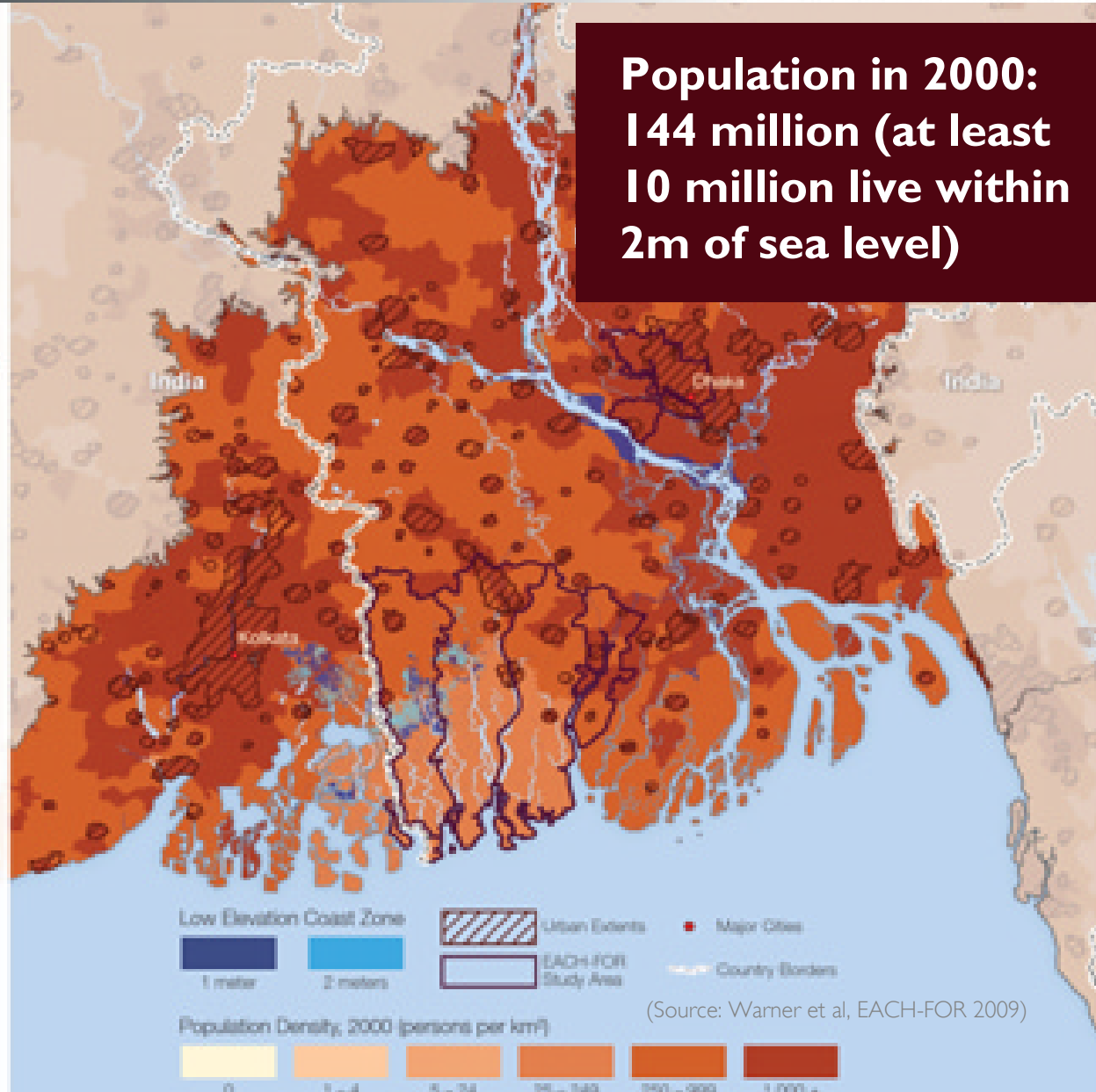
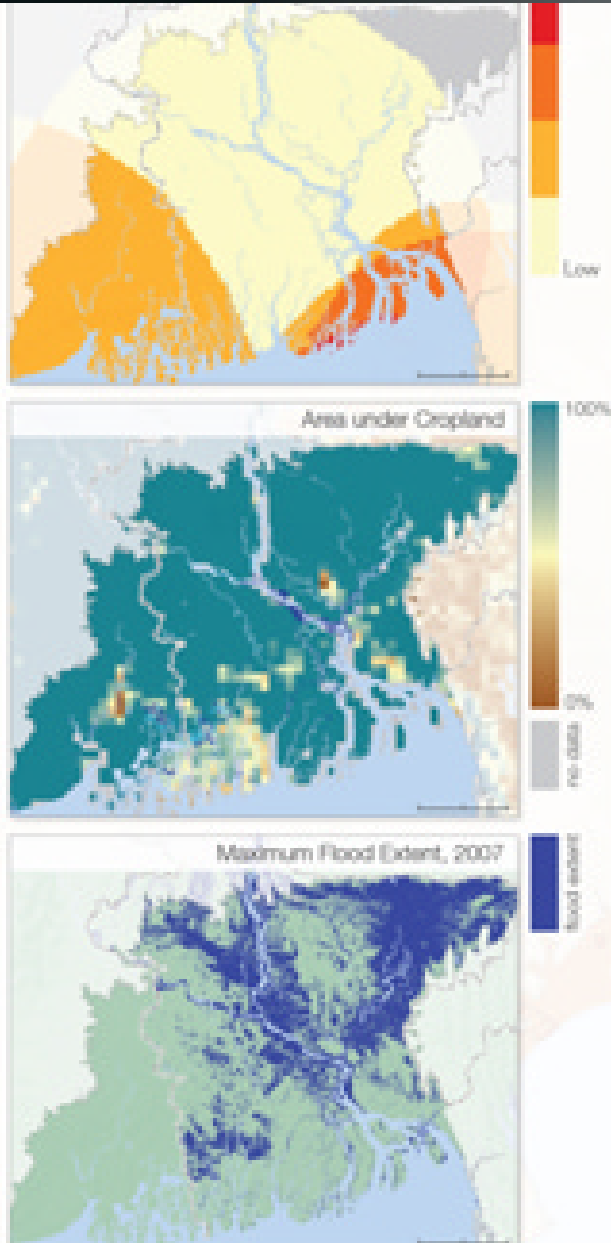
Four “Hot Spot” Categories:

1. Densely settled deltaic regions
2. Low-lying small island developing states (SIDS)
3. Coastal megacities
4. Glacier-fed / water-stressed inland regions



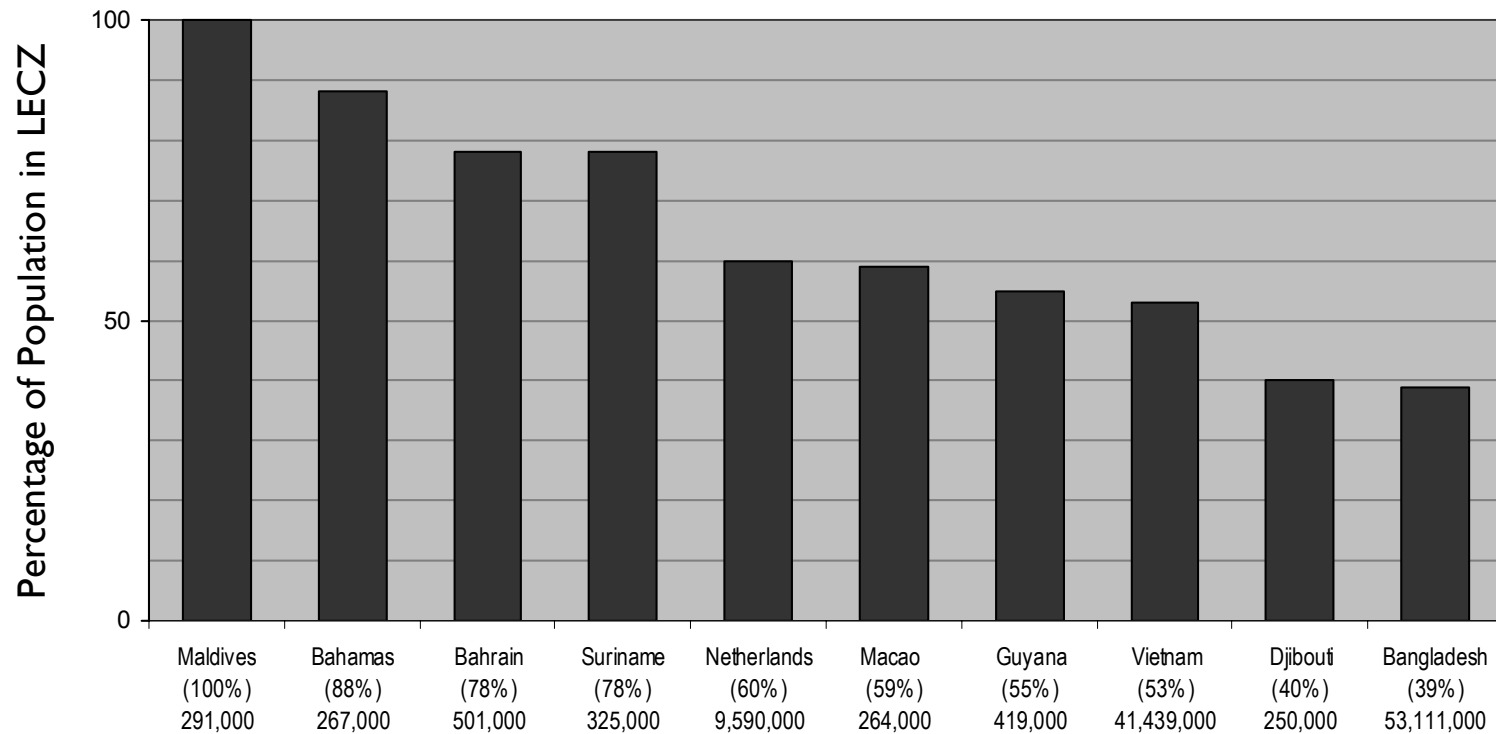
Relative vulnerability of coastal deltas: population potentially displaced by current sea-level trends to 2050 (Extreme > 1 million; high 1 million to 50,000; medium 50,000 to 5,000)

The Ganges Delta



**Population in 2000:
144 million (at least
10 million live within
2m of sea level)**

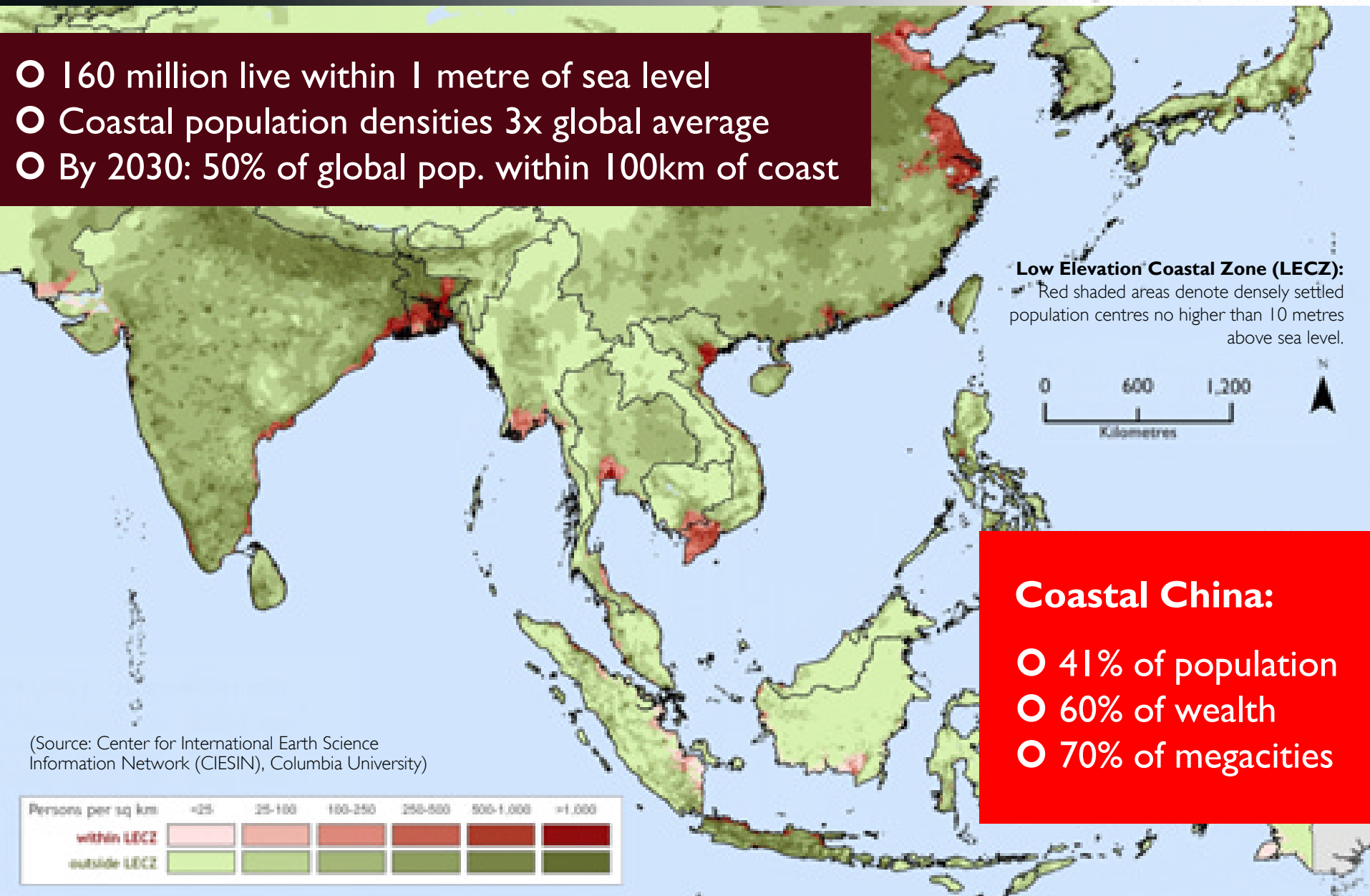
Top ten countries ranked by share of population (%) in the Low Elevation Coastal Zone (LECZ)



Note: According to the methodology of the study, countries with fewer than 100,000 people living in the LECZ (ie, below 10m above sea level) are excluded. This includes 15 small island states with population shares exceeding 39%. (McGranahan et al, 2006)

Coastal Development

- 160 million live within 1 metre of sea level
- Coastal population densities 3x global average
- By 2030: 50% of global pop. within 100km of coast

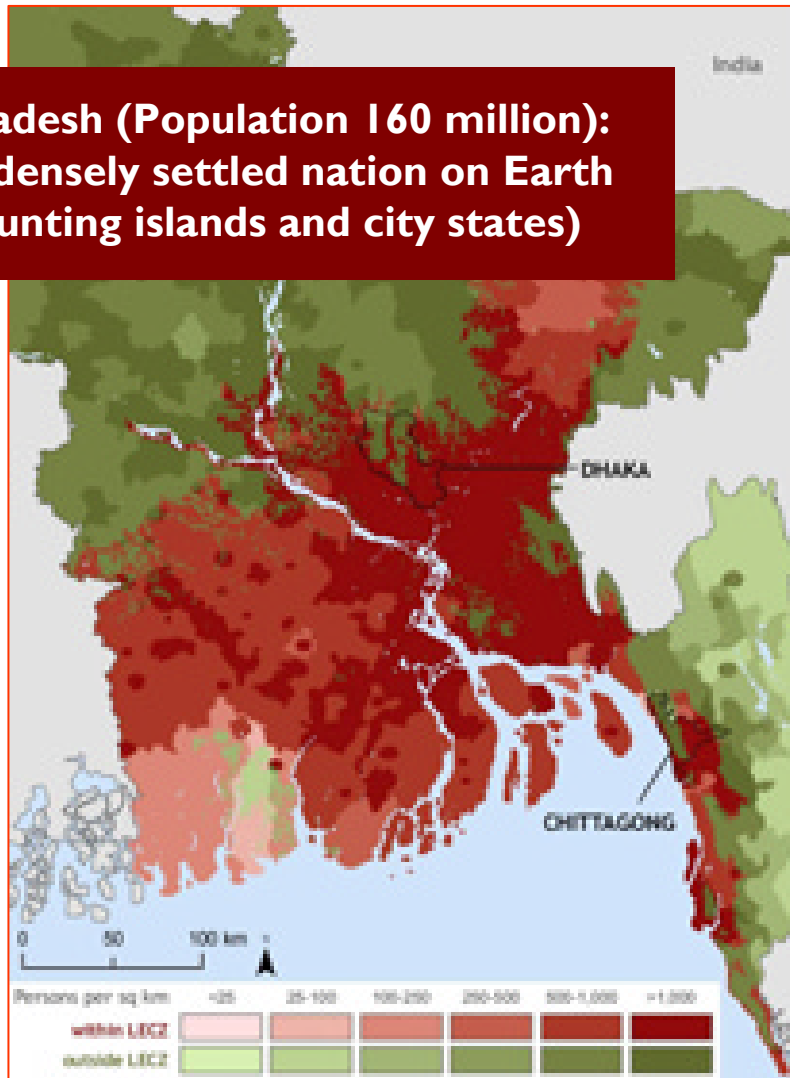


(Source: Center for International Earth Science Information Network (CIESIN), Columbia University)

Coastal China:

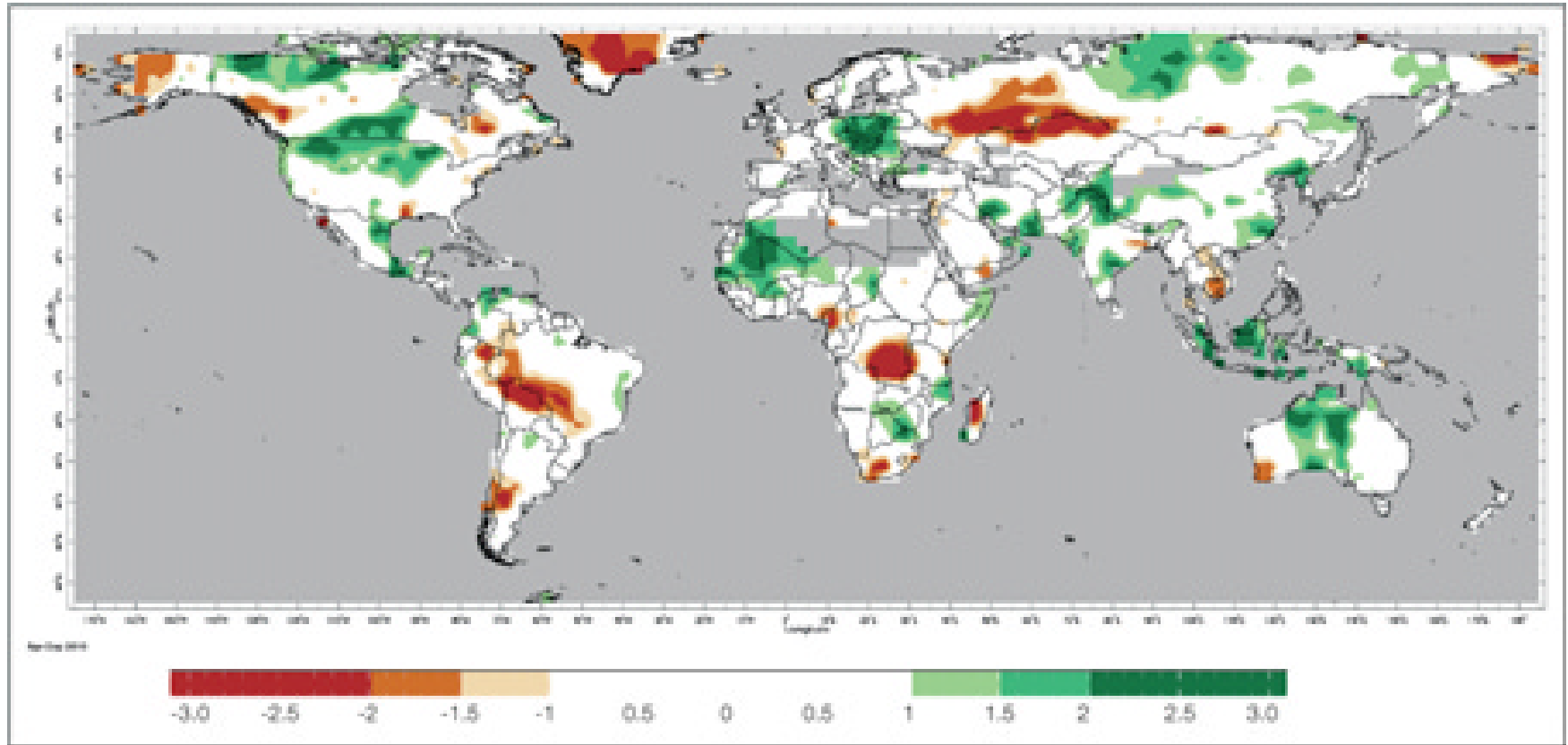
- 41% of population
- 60% of wealth
- 70% of megacities

**Bangladesh (Population 160 million):
most densely settled nation on Earth
(discounting islands and city states)**



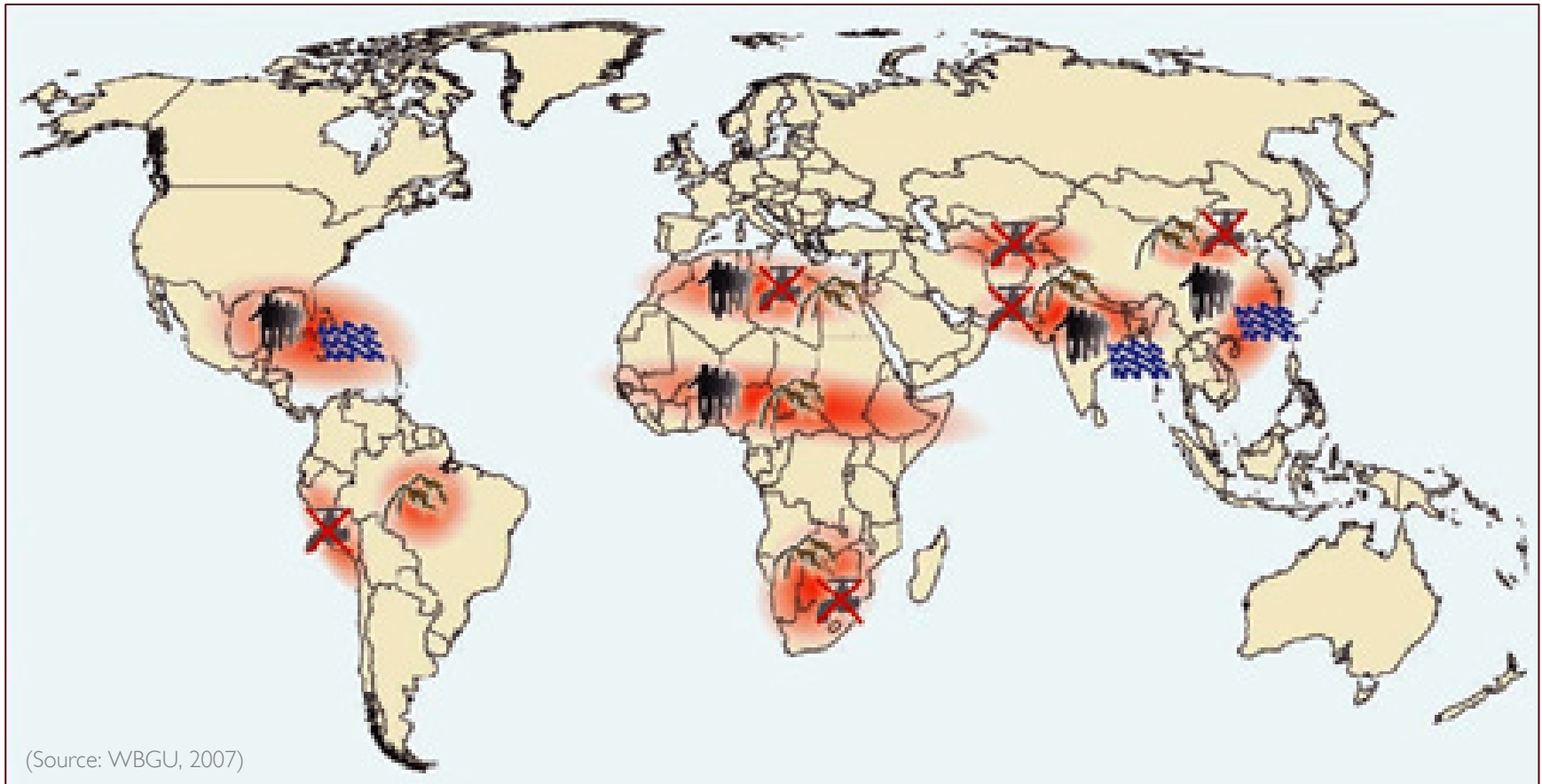
Low Elevation Coastal Zone (LECZ): Dark red shaded areas denote densely settled population centres no higher than 10 metres above sea level.

Graphic: Centre for International Earth Science Information Network (CIESIN), Columbia University



Source: UNISDR (2011, p. 58)

Video stream: <http://news.bbc.co.uk/2/hi/science/nature/8394324.stm>



Conflict constellations in selected hotspots

- | | | | | | |
|---|---|---|--|---|---------|
|  | Climate-induced degradation of freshwater resources |  | Climate-induced decline in food production |  | Hotspot |
|  | Climate-induced increase in storm and flood disasters |  | Environmentally-induced migration | | |

Declining Water Supply?

La Paz, Bolivia

Photo: Johannes M Luetz



Abandoned houses



(Photos: Johannes Luetz)



(Photo: Johannes Luetz)

“Our results reveal that hundreds of millions of people in the developing world are likely to be displaced by Sea Level Rise within this century.”

(World Bank Policy Research, 2007)



“
When we talk about a one metre rise in global sea level we are also talking about 500 million people who are going to have to look for new homes. So far we don't have any instruments to manage this.”

(Professor Hans Joachim Schellnhuber CBE, Director Potsdam Institute for Climate Impact Research, Chairman German Advisory Council on Global Change WBGU, Senior Advisor to the German Government, 2008)



Photo: Pamela Sitko

“If emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees.”

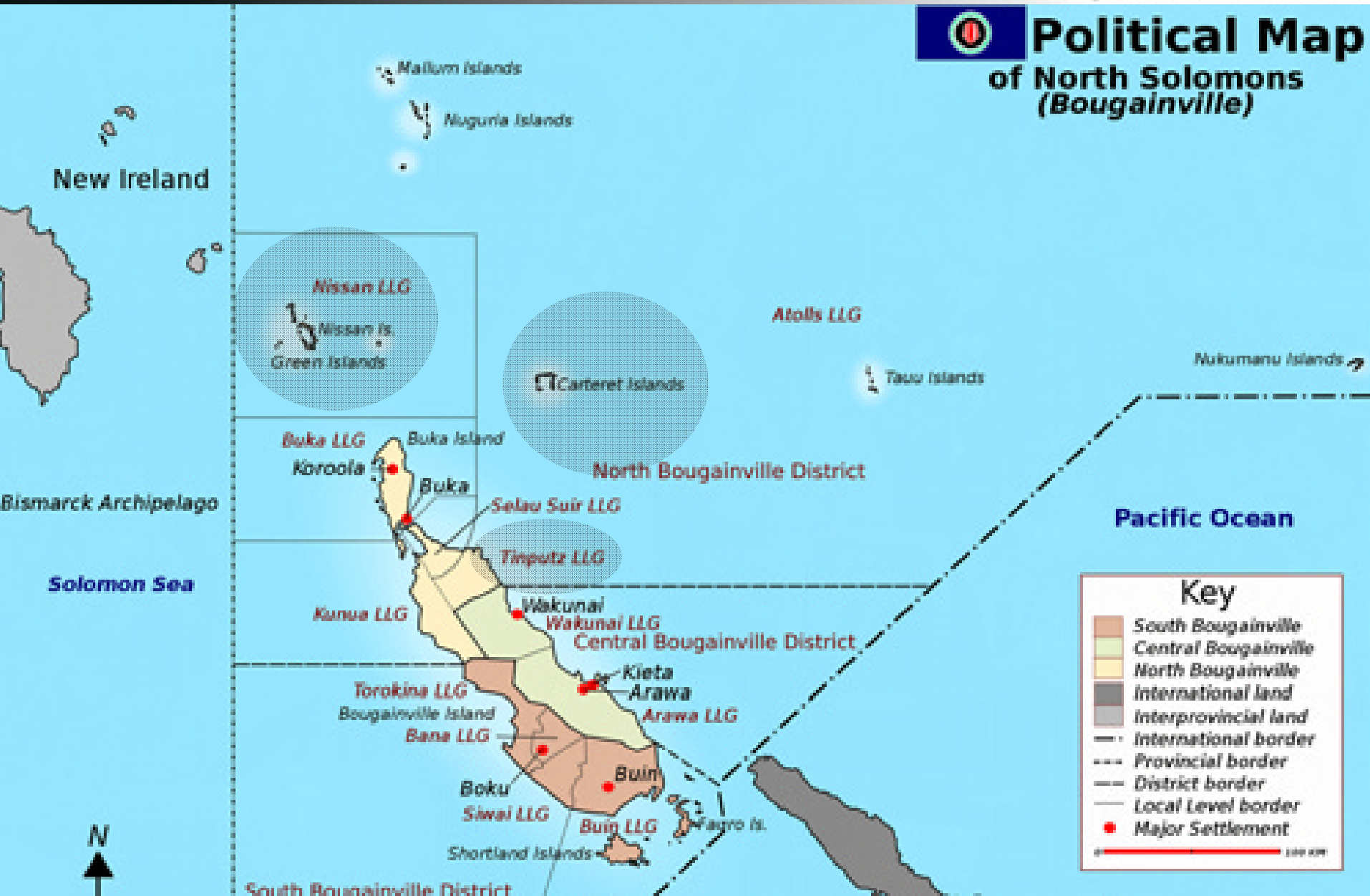
(Dr. James Hansen, Director NASA Goddard Institute, Adjunct Professor Columbia University)

How should such forced migration be managed ?



(Photo: Johannes Luetz)

Political Map of North Solomons (Bougainville)





There once was an island (trailer feature documentary)

<http://youtu.be/M7akwGUtGDw>

- Semi-structured interviews
- Trial data generation
- Observe issues raised
- Focus questionnaire





Ursula Rakova, Carteret Islander and Director of Tulele Peisa NGO, Papua New Guinea

Huene, Tulun Atoll

Photo: Pip Starr

Ursula Rakova: “After Huene was sliced in two, my family settled on Huene One (right). There are three houses there. On Huene Two (left) there are only gardens. The channel keeps widening.”

Carteret Atoll, Papua New Guinea



Carteret Islander and Director of Tulele Peisa NGO, Papua New Guinea

Photo: Pip Starr

Ursula Rakova: “Storm surges regularly overtop our islands – then the sea and low-lying land become ‘level.’ Resettlement is underway. It is so sad to leave.”

Huene Island, Tulun Atoll



(Photo: Johannes Luetz)







Island of Buka

Photo: Johannes Luetz

ISLAND ADAPTATION THROUGH SEA WALLS?



Photo: Pip Starr

Show field research video footage:

File PNG I:

- 18:00 (1min) – Han Island
- 19:20 (15sec) – drowning trees
- 22:45 (45sec) – coconut, land lost
- 26:00 (30sec) – flooded sea walls

ISLAND ADAPTATION THROUGH SEA WALLS?



<http://www.vimeo.com/4177527>



The President's Dilemma

<http://youtu.be/nZLWqa5irog>

Circling Han Island in “banana boat” – coconut tree stump, evidence of sea level rise and diminishing island size ...



“

This [is] about the injustice of sea level rise ... on average you have about a metre of sea level rise by 2100, ... all over the globe. But the ... very vicious thing is, that this sea level rise will be distributed in a highly inhomogeneous way across the planet. [...] Elementary physics – if Greenland is losing mass, that means its gravitational pull for seawater will be diminished – that means, around Greenland, sea level may even drop, in particular for the north-eastern part of the American continent, while ... the Pacific Islands ... that haven't done anything to contribute to global warming, will again get the brunt of it, will get all the water which is released from Greenland. [...] And those who are most responsible for that, northern Europe, northern America, will be spared sea level rise, at least for a while. So you see nature can be extremely unfair, if humanity is sort of provoking that injustice.

”

Professor John Schellnhuber CBE, Director Potsdam Institute for Climate Impact Research, Chairman German Advisory Council on Global Change WBGU, Senior Advisor to the German Government, Session 1 at ~ 51:00
@ <http://www.fourdegrees2011.com.au>



**Environment and non-environment
related drivers reinforce each other**




Malé, Maldives

Malé, Maldives: As the country with the lowest "highest point" on Earth the Maldives is extremely vulnerable to rising sea levels, 80% of land area is less than 1 metre above sea level. (Photo: Shahee Ilyas)

Mohamed Nasheed, President Maldives, 2009:

“We do not want to leave the Maldives, but we also do not want to be climate change refugees living in tents for decades.”

Dhuvafaaru, Maldives



Island of Dhuvafaaru, Maldives
(Photo: Johannes Luetz)



Dhuvafaaru, Maldives

Island of Dhuvafaaru, Maldives
(Photo: Johannes Luetz)



Dhuvaafaru, Maldives

Island of Dhuvaafaru, Maldives
(Photo: Johannes Luetz)



Show field research video footage:

File name “Maldives 4”:

04:00 (1 min) – Abandoned Hathifushi Island

23:00 (1 min) – Skipper, stuff, storm surge

48:00 (1 min) – Faridhoo: highest point on M.

Island of Hathifushi, Maldives
(Photo: Johannes M Luetz)



Show field research video footage:

File name “Maldives 5”:

40:00 (7min) – Minister Aslan Interview

File name “Maldives 6”:

18:30 (45sec) – Hulhumalé from the air

(Photo: Wendy Barrón Pinto)

Thank You!

PhD Sponsors:



PhD Supervisors:

A/ Prof John Merson,
Director Blue Mountains World Heritage Institute

A/Prof Eileen Pittaway,
Director Centre for Refugee Research