# Climate change and small island states

UNSW • ARTS1751 • 12 September 2012

## Field research in the Pacific and Maldives

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# PLANET **PREPARE**

**2008 World Vision Preparedness Study**

**P** rotect Development
**R** esearch Priorities
**E** mpower Communities
**P** artner And Network
**A** dvocate Justice And Change
**R** einforce Disaster Defences
**E** ducate Children


Photo: Paul Willows/NASA

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

# Intro (2008)


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

# Intro (2008)

**Island of Torotsian, Papua New Guinea**

Photo: Johannes Luetz

# Intro (2010)

Island of Torotsian,
Papua New Guinea

# Intro (2008)


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

# Intro (2008)


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

# Intro (2008)

**Mohammad Shamsuddoha:**
"Bhola – Bangladesh's biggest island – is eroding. From a size of 6,400km$^2$ 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)

# Intro (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.

# Intro (2008)

**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)

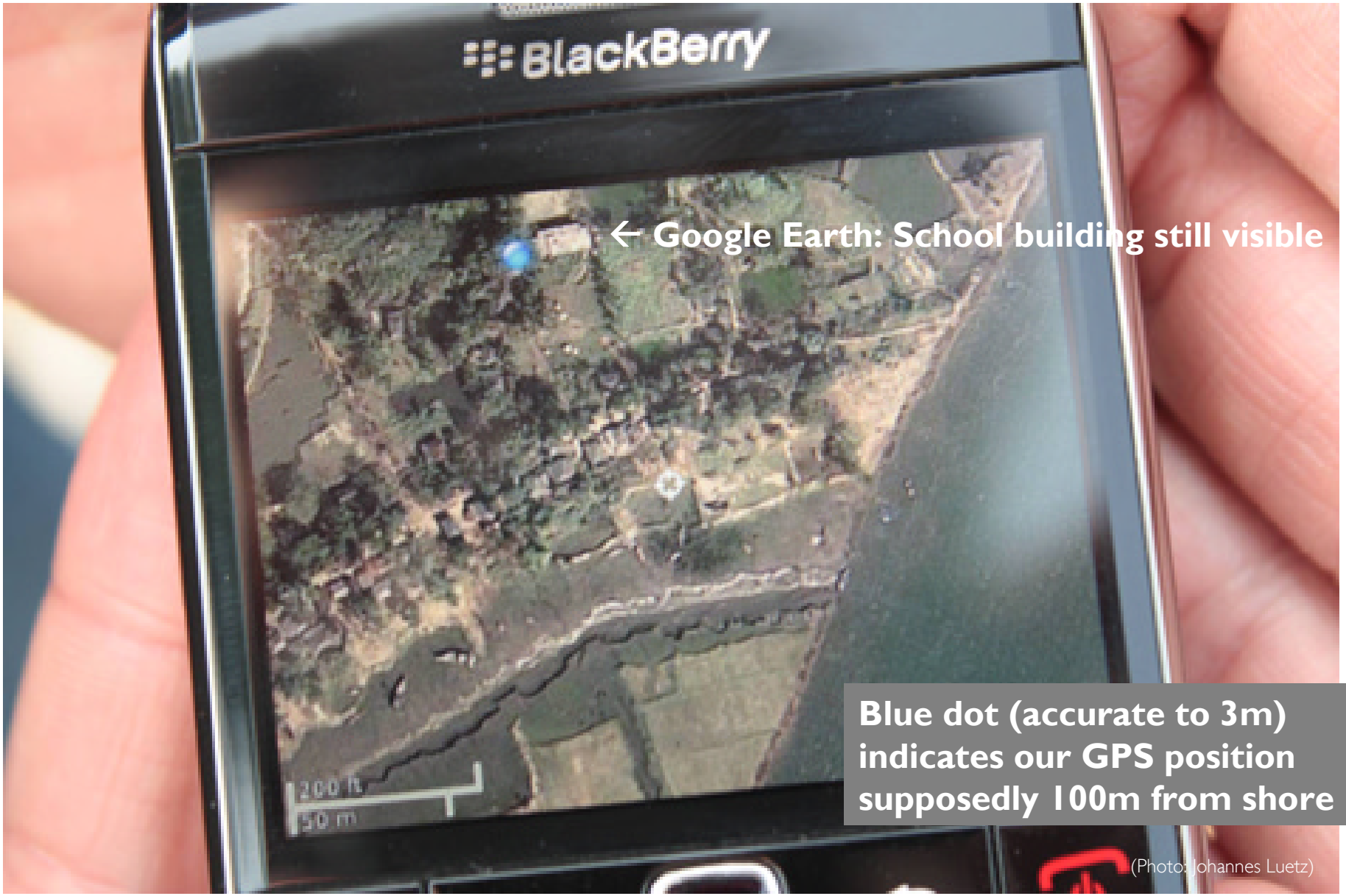
# Bridge to “nowhere” (2011)

**Show field research video footage:**

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

(Photo: Johannes Luetz)

# Google




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

(Photo: Johannes Luetz)

# Bhola (2011)


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)

# Dhaka (2011)

**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) – INDIA1: 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

# Climate change and small island states

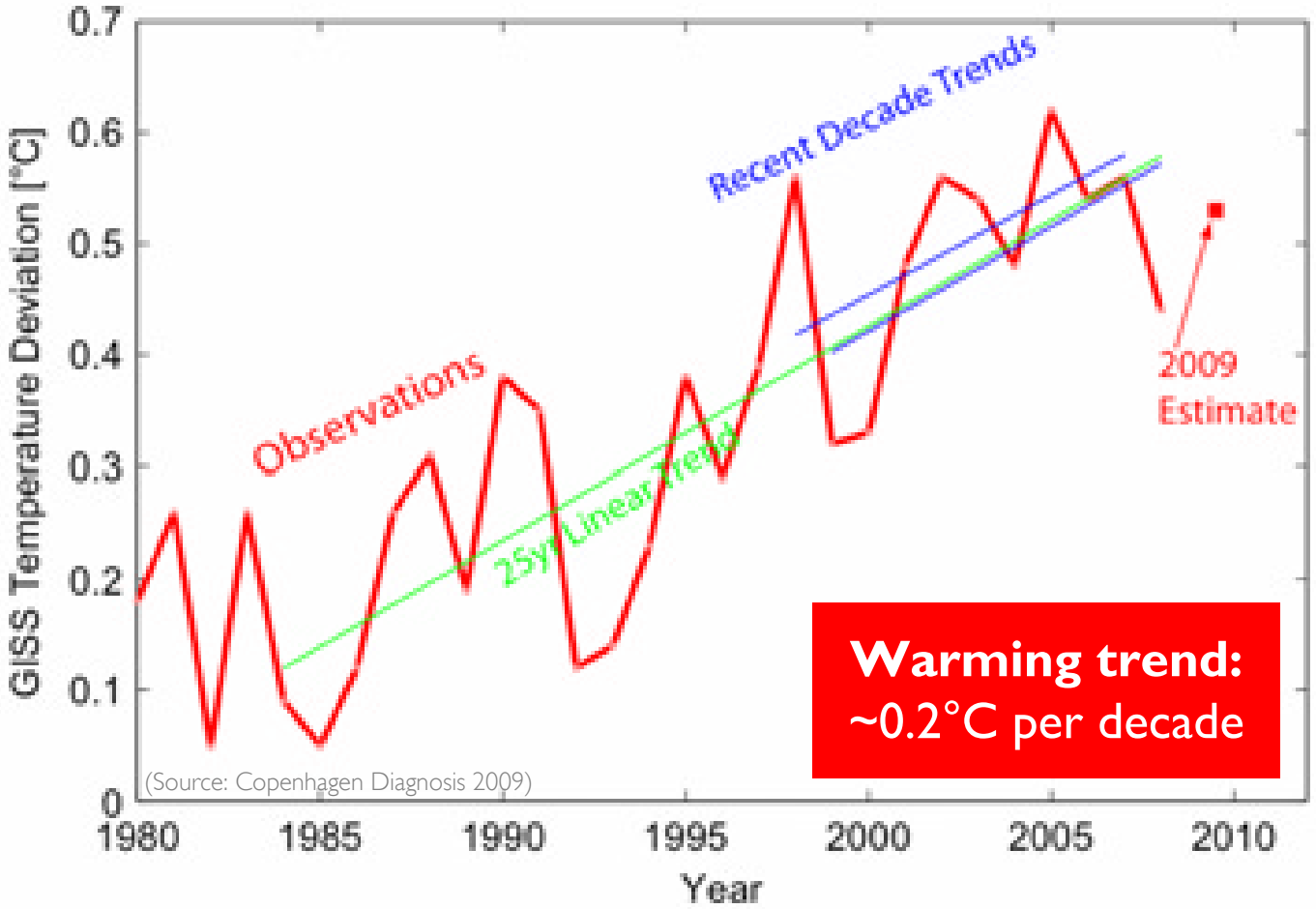
1. **Climate Change Science**
2. Impacts
3. Research Problem and Methodology
4. Discussion
5. Conclusion and Policy Recommendations

# Weather ≠ Climate

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

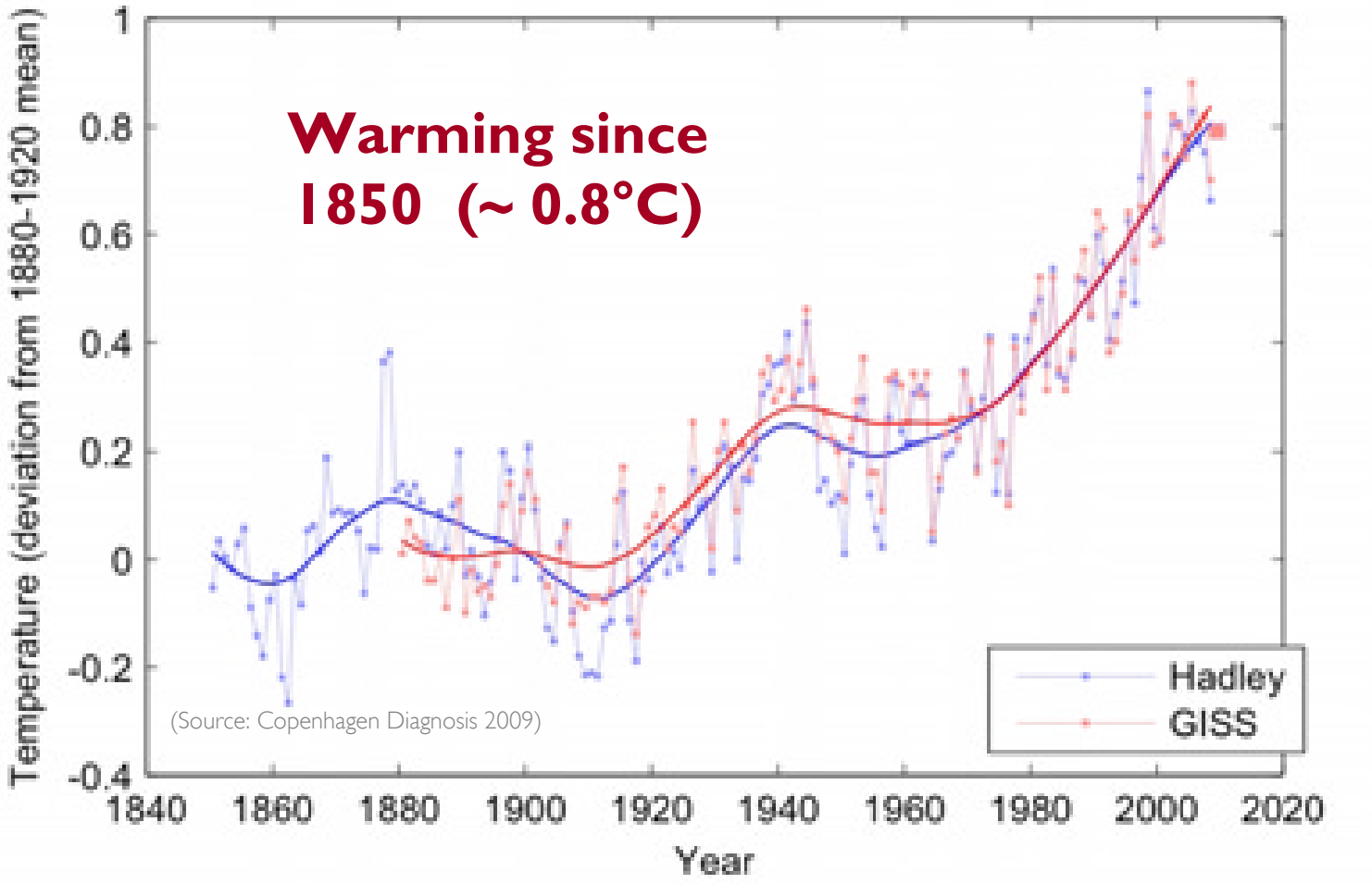

http://tv.unsw.edu.au/04E68CE0-08D5-11E1-832C0050568336DC

## Global temperature change 1980-2009

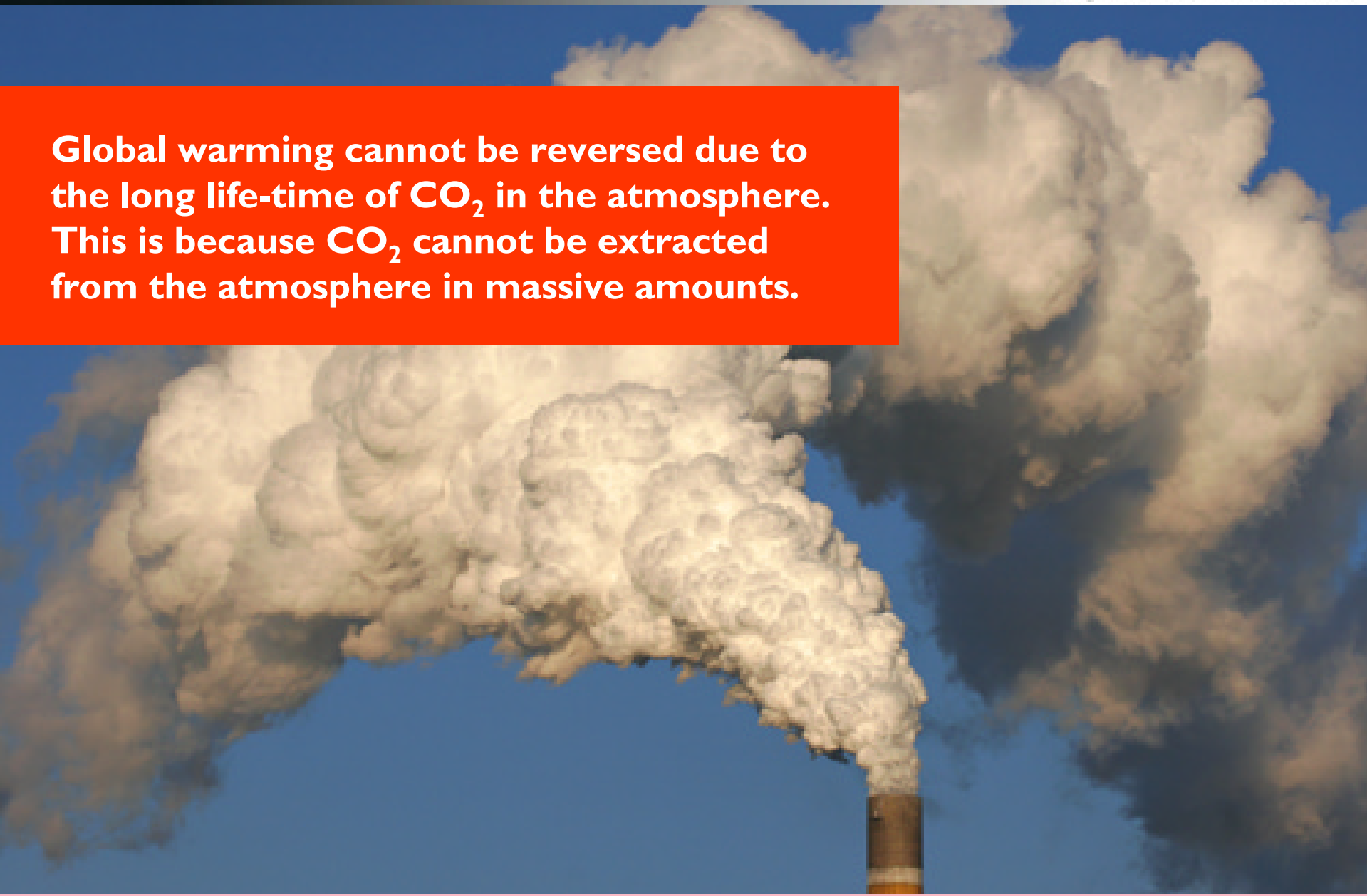



(Source: NASA GISS data, In: Copenhagen Diagnosis 2009)

## Global average temperature 1850-2009



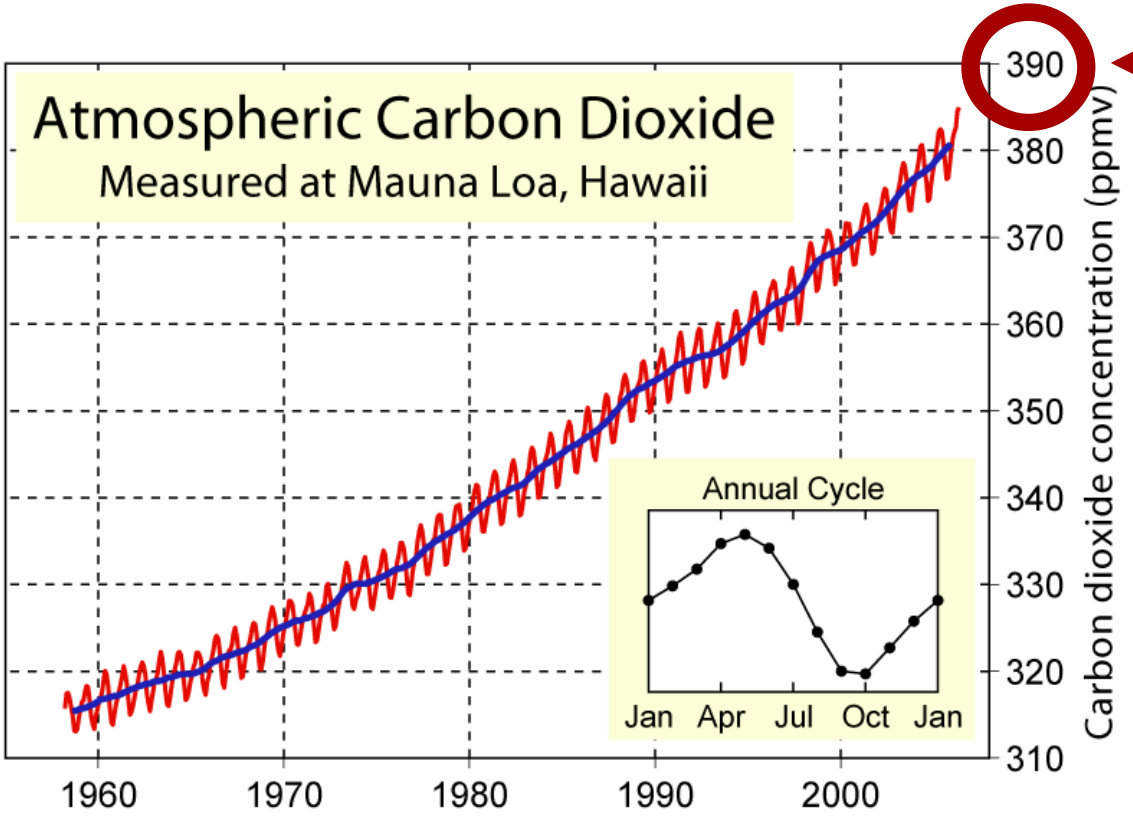
# One-Way Warming



**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.**

# $CO_2$ Concentrations

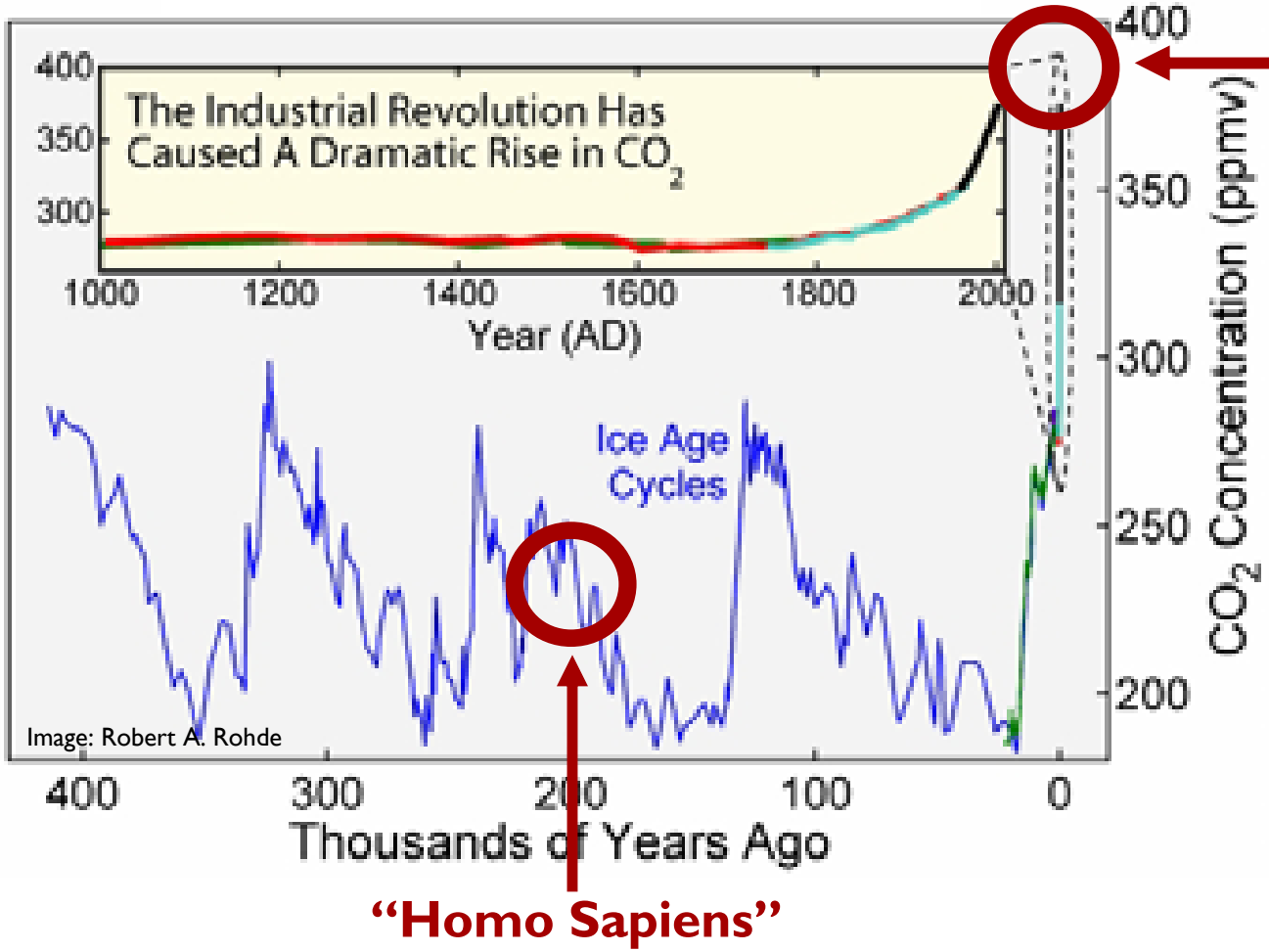
$CO_2$ level in March 2010: 390 ppm




**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).

# $CO_2$ Context




**$CO_2$ level in March 2010: 390 ppm**

**Today's $CO_2$ 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)

**"Homo Sapiens"**

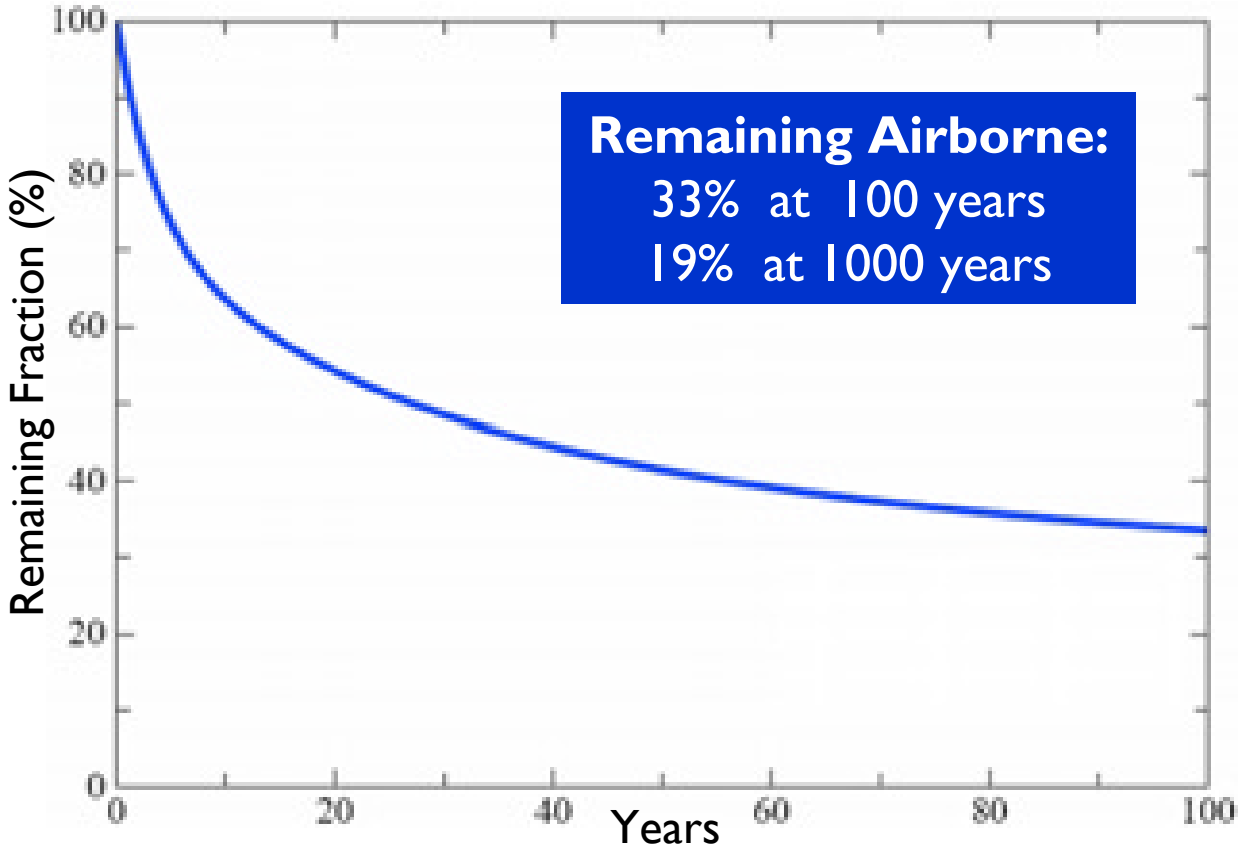
# Stopping Distance

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


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

# Longevity of $CO_2$

## Slow decay of fossil fuel $CO_2$ emissions




The fraction of $CO_2$ 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).

# Longevity of $CO_2$

**Boeing 767-300**


**1t Jet Fuel Burned**
**= 3.157t $CO_2$ Emissions**

(Photo: Adrian Pingstone)

# Longevity of $CO_2$

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

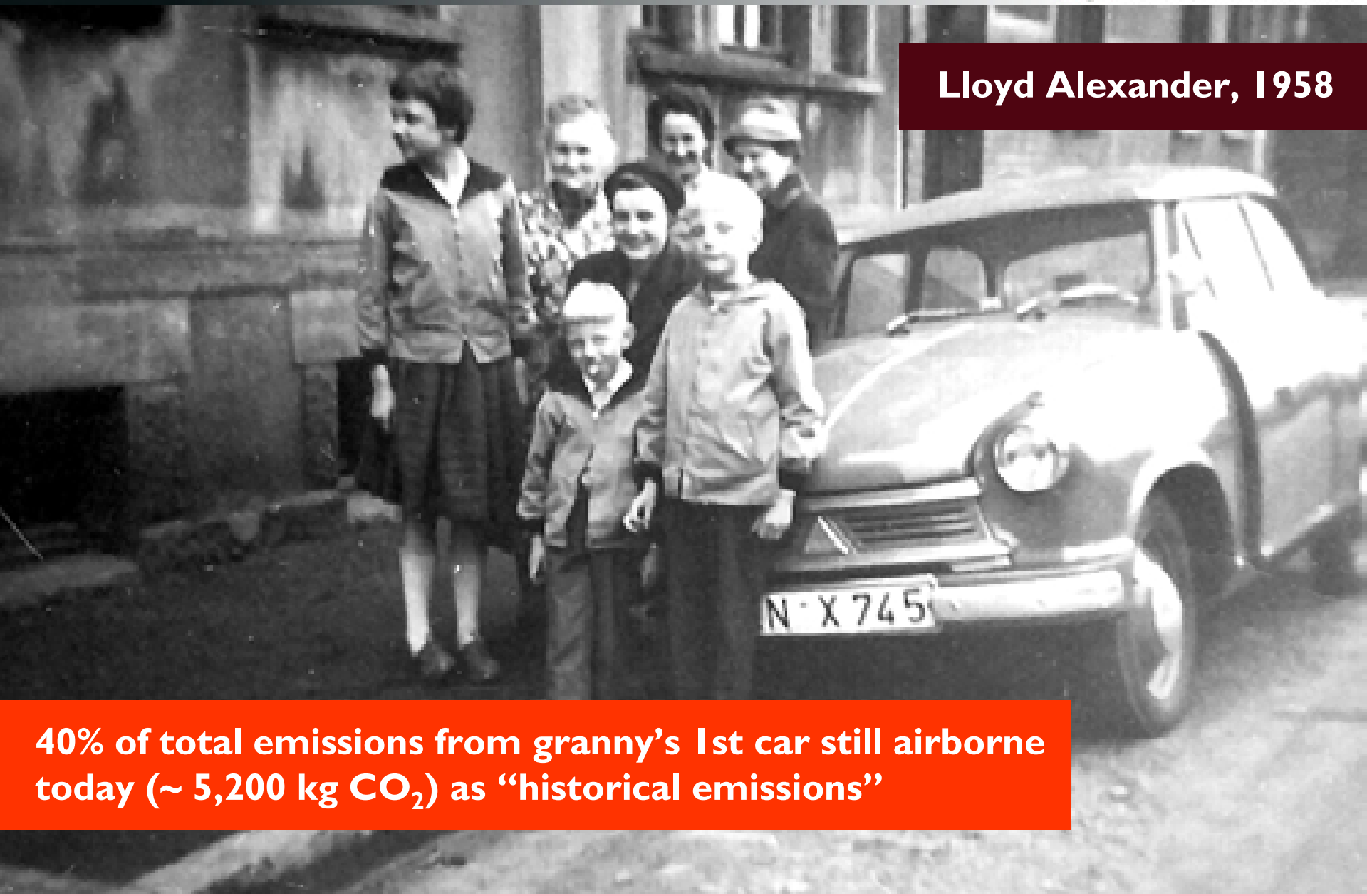
**Per-capita emissions for Canada trip in 2010: 1.4t $CO_2$ (2110: 460kg, 3010: 260kg)**

*** 2.7 (Radiative Forcing Index, RFI) = ~ 3.8t $CO_2$**

# Historical Emissions

"Granny Maria" – 1958

# Historical Emissions




**Lloyd Alexander, 1958**

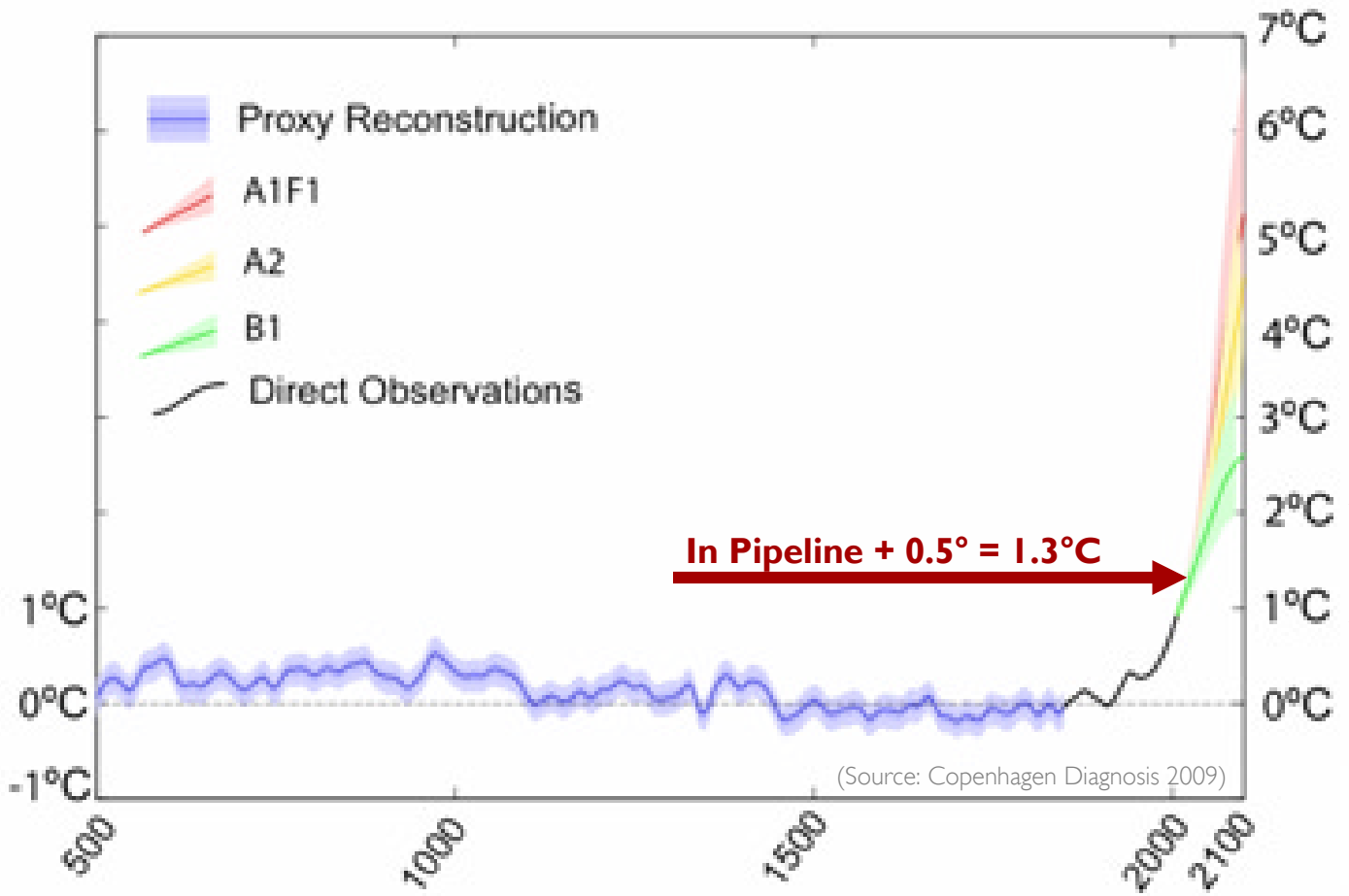
**40% of total emissions from granny's 1st car still airborne today (~ 5,200 kg $CO_2$) as "historical emissions"**

## Cumulative $CO_2$ Emissions 1850-2006

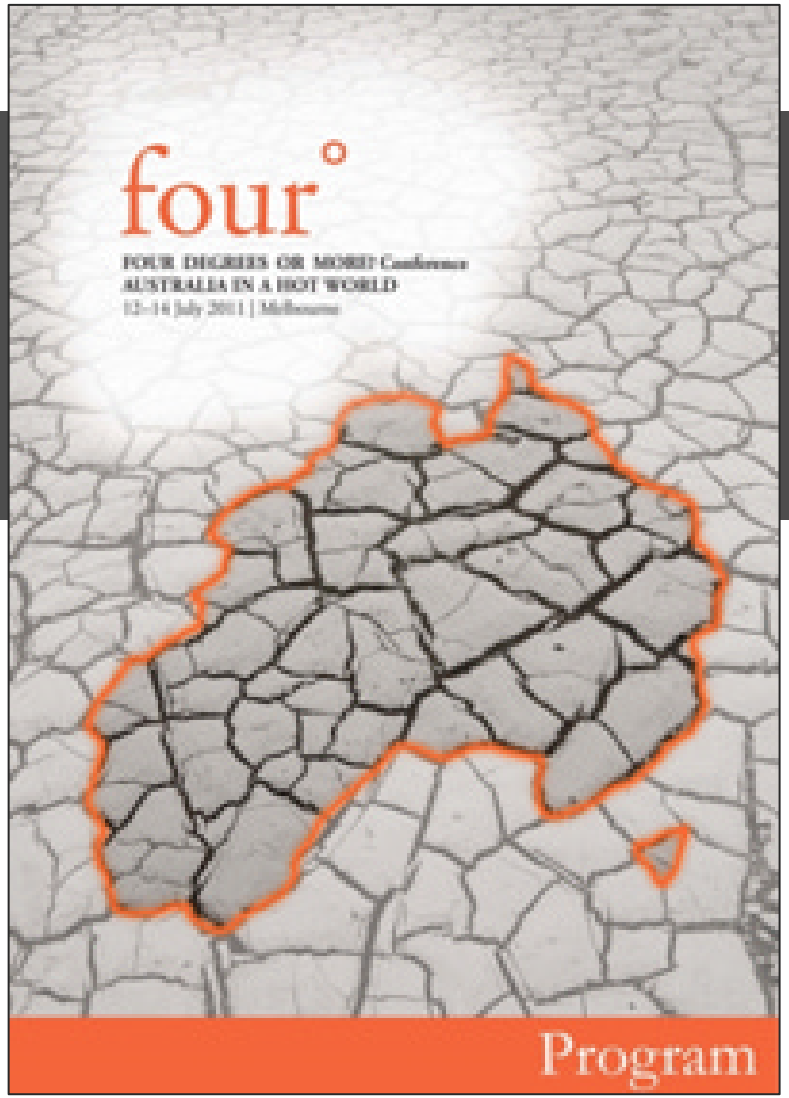
| Rank | Country | Mt $CO_2e$ | % of World Total |
|---|---|---|---|
| 1 | United States of America | 333,747.8 | 29.00% |
| 2 | European Union (27) | 305,750.1 | 26.57% |
| 3 | China | 99,204.2 | 8.62% |
| 4 | Russian Federation | 93,081.6 | 8.09% |
| 5 | Germany | [80,377.0] | [6.99%] |
| 6 | United 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



# Four degrees or more?




**Available resources:**

- Audio files
- Presentation files

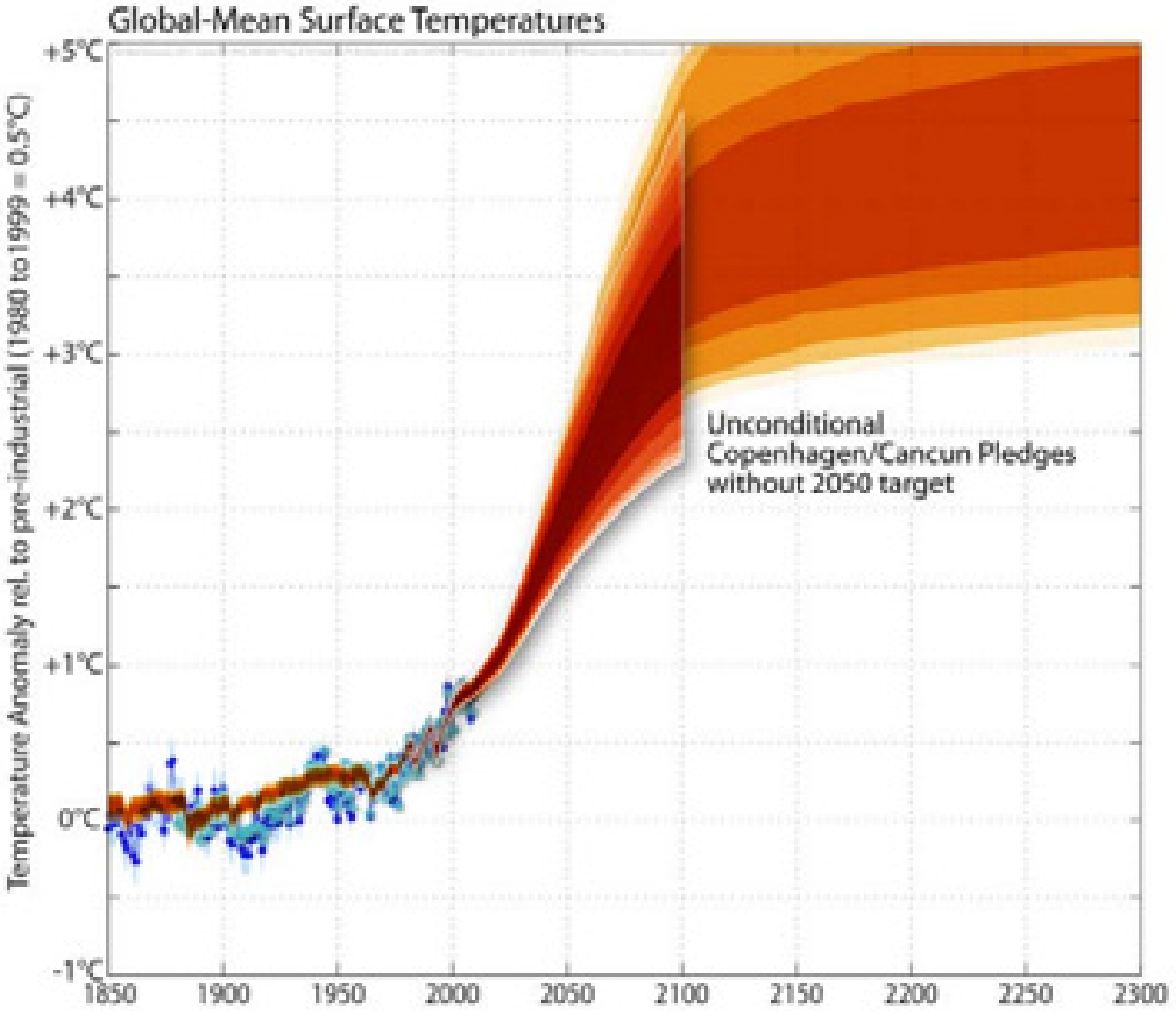
## Conference

12-14 July 2011, Melbourne

**FOUR DEGREES OR MORE?**
**AUSTRALIA IN A HOT WORLD**

www.fourdegrees2011.com.au

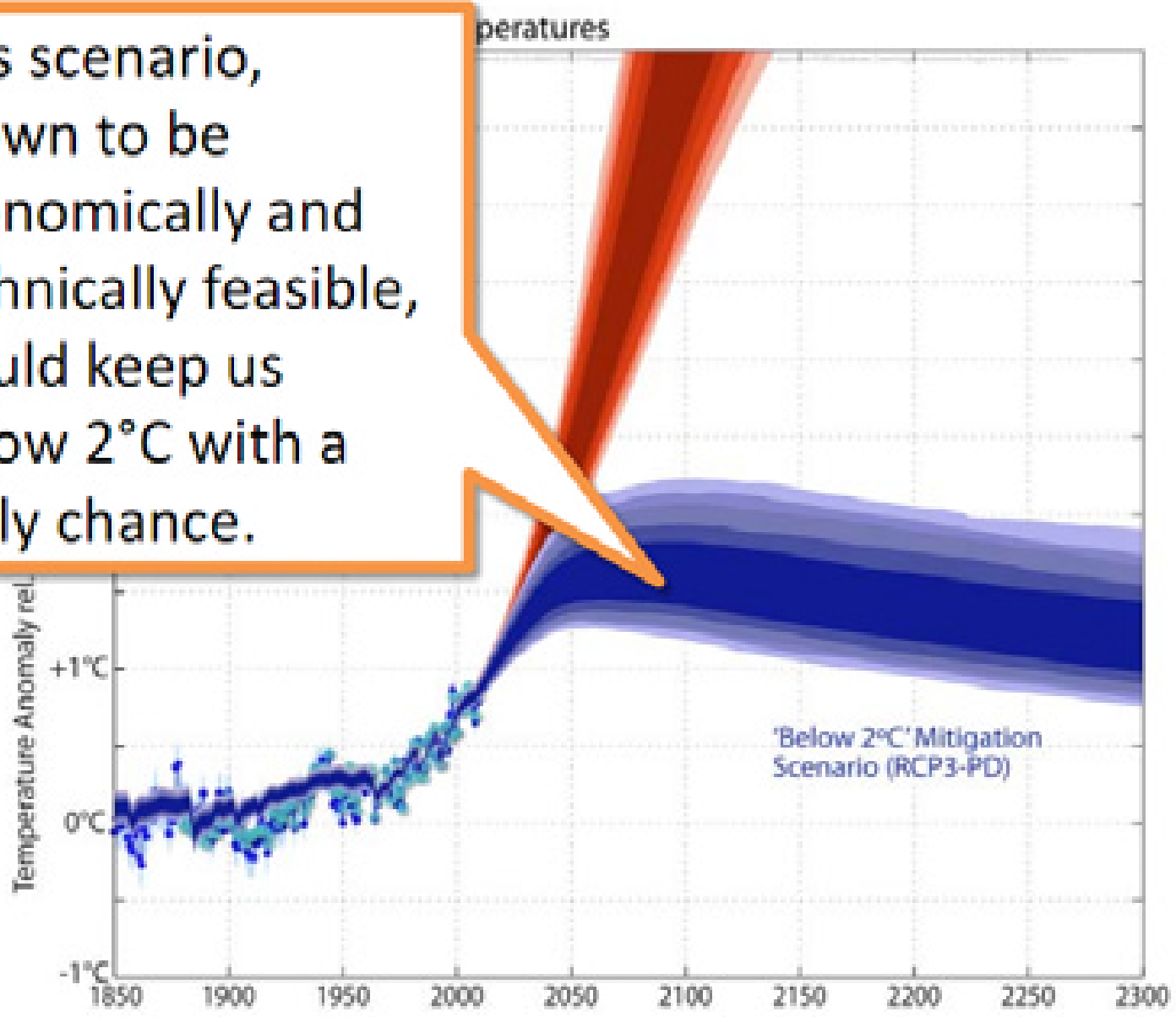
# Copenhagen implemented




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/

# Climate change and small island states

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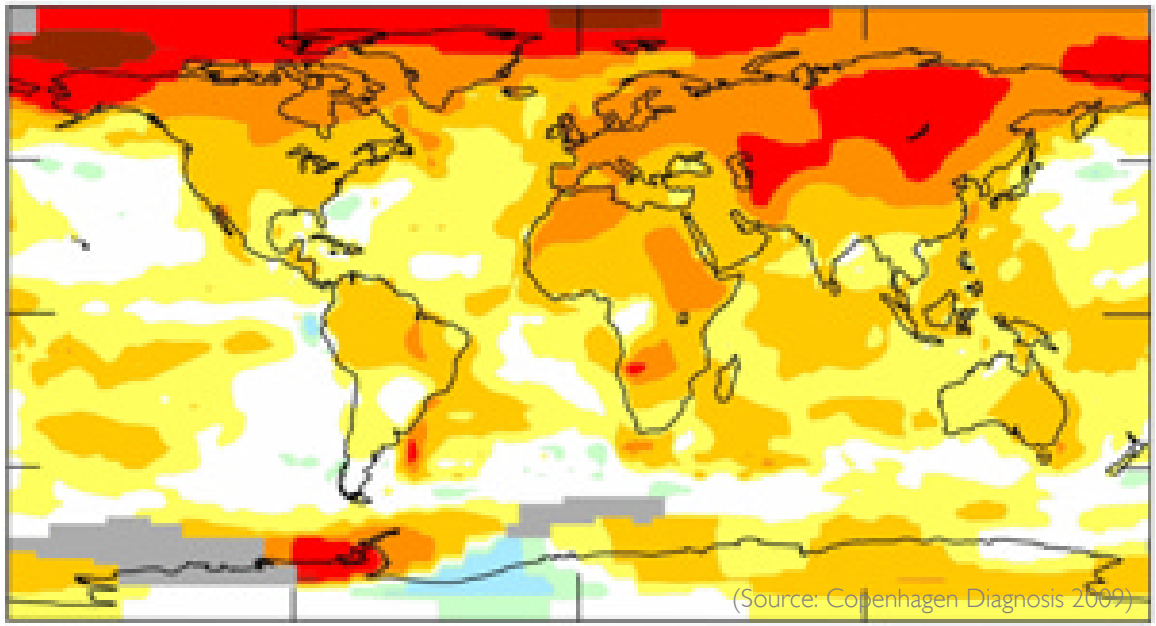
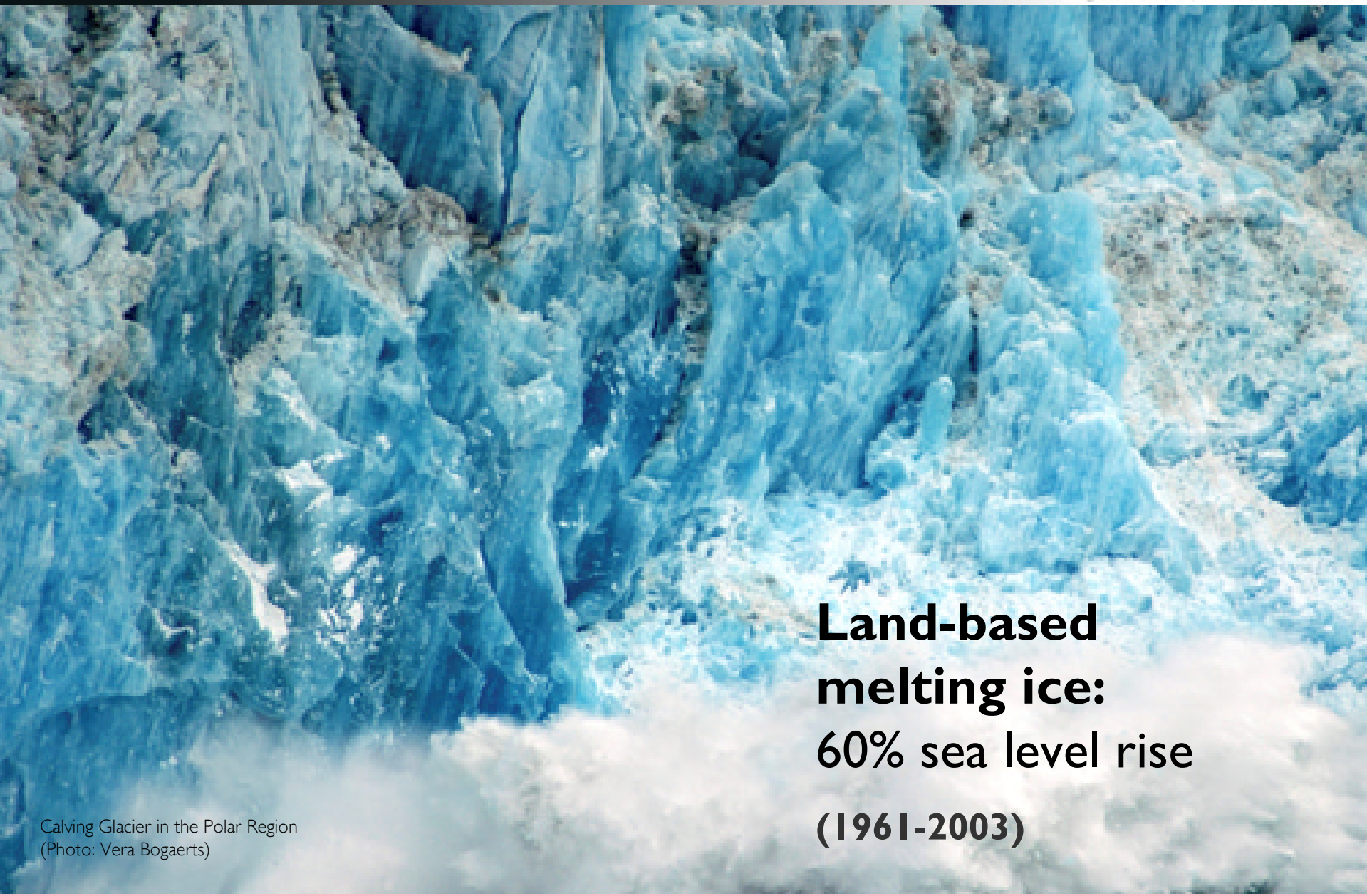
## Mean temperature change between 1950's and 2000's




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

# Sea Level Rise

# Sea Level Rise

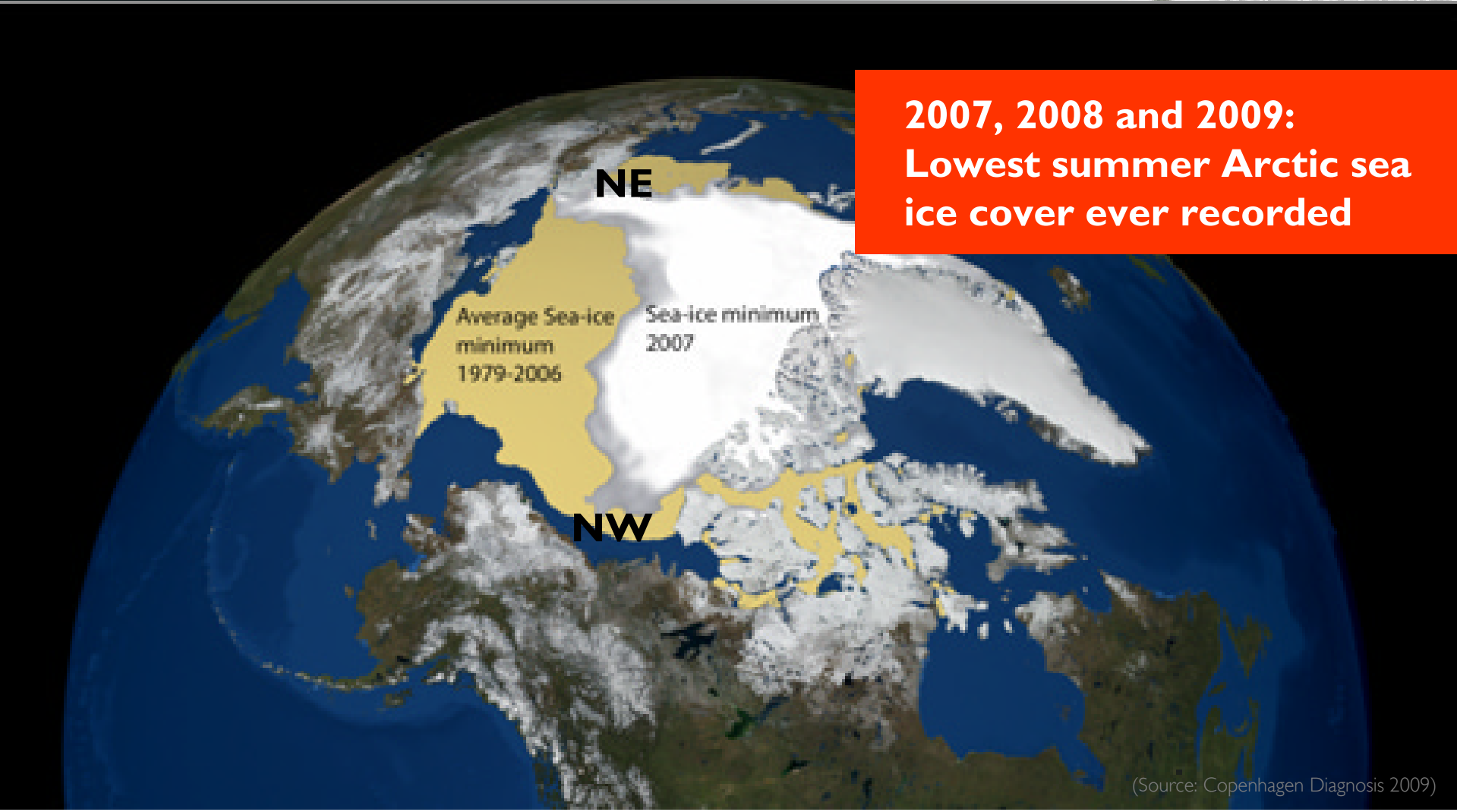


**Land-based melting ice:**
60% sea level rise

**(1961-2003)**

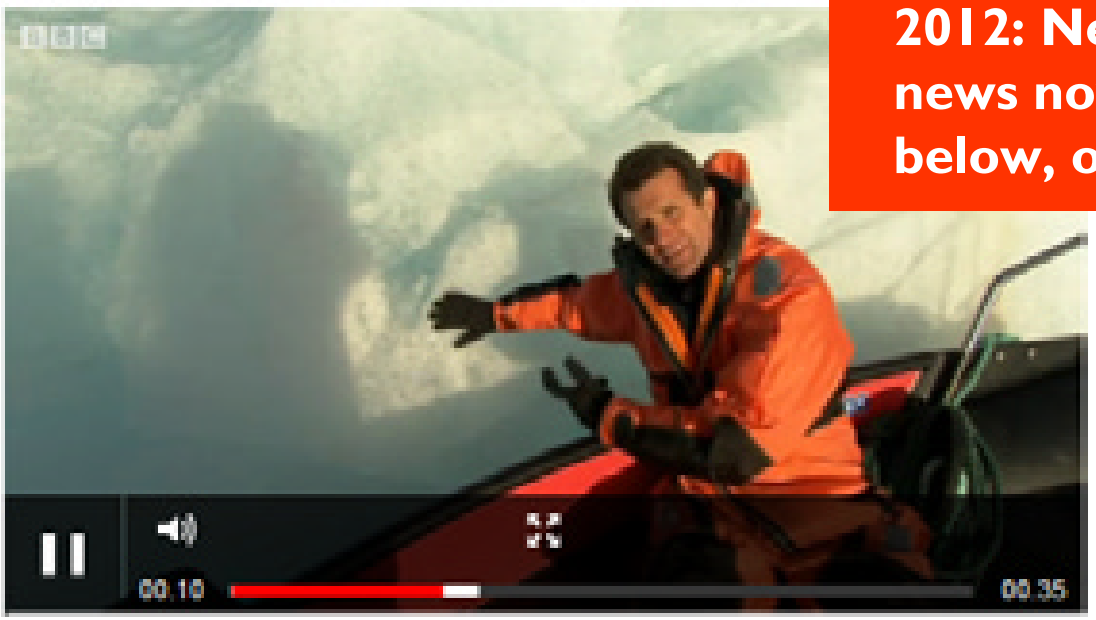
Calving Glacier in the Polar Region
(Photo: Vera Bogaerts)

# Sea Level Rise




**Minimum arctic sea-ice decline from 1979 to 2007**

# Arctic record melting 2012



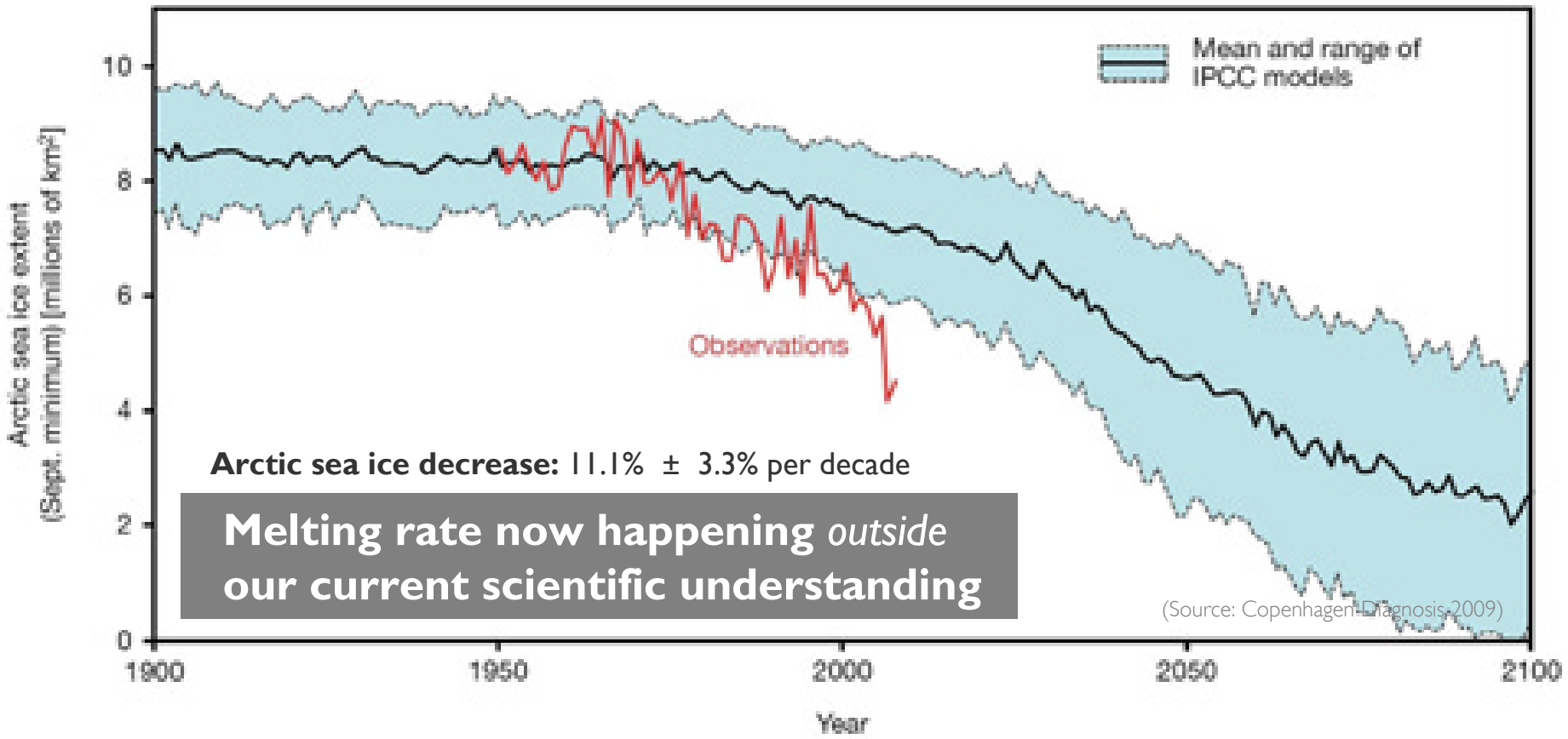

**2012: New record, in the news now... (see video links below, only a few days old)**

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

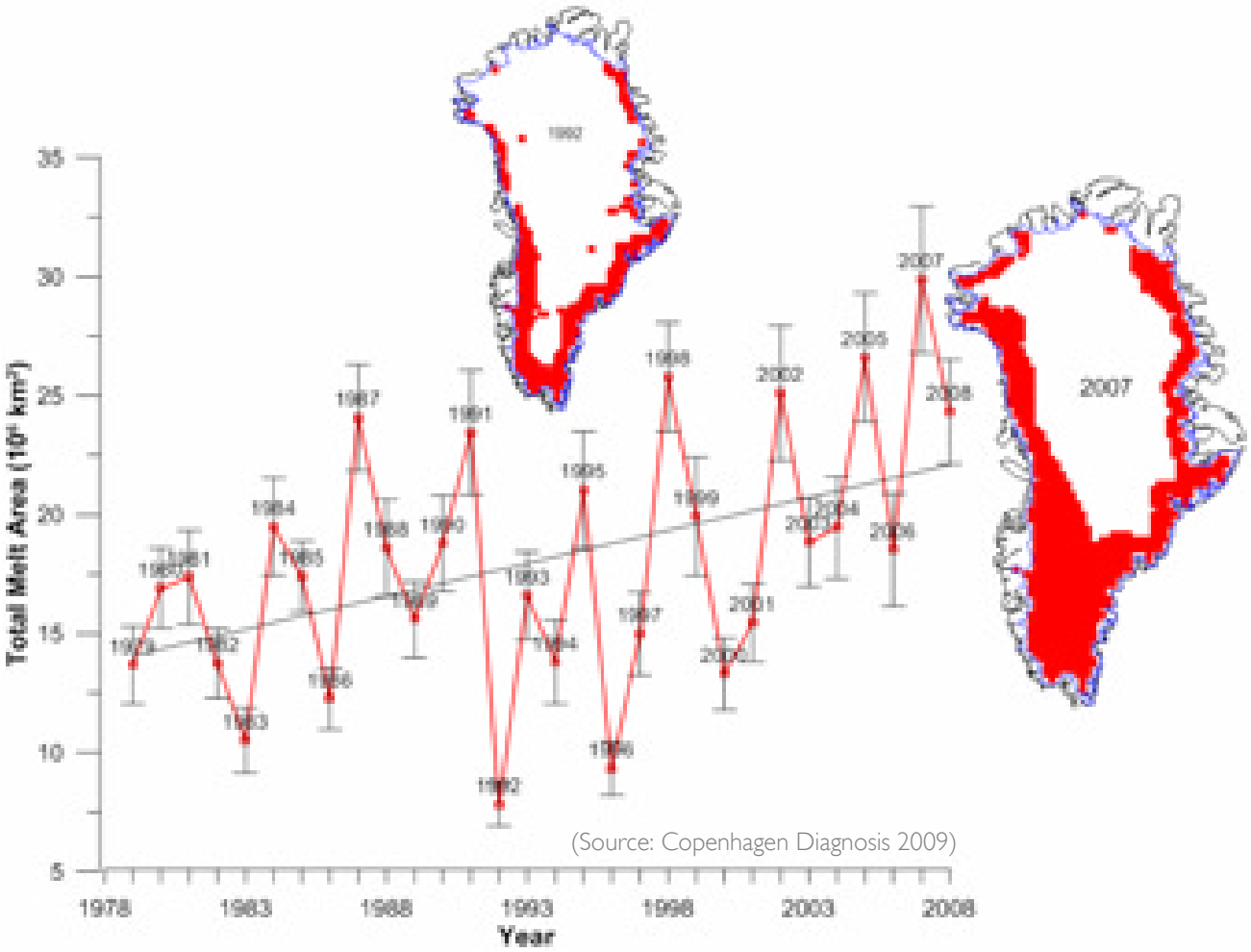



**Arctic sea ice decrease:** 11.1% ± 3.3% per decade

**Melting rate now happening *outside* our current scientific understanding**

(Source: Copenhagen Diagnosis 2009)

## Greenland ice-melt since 1979

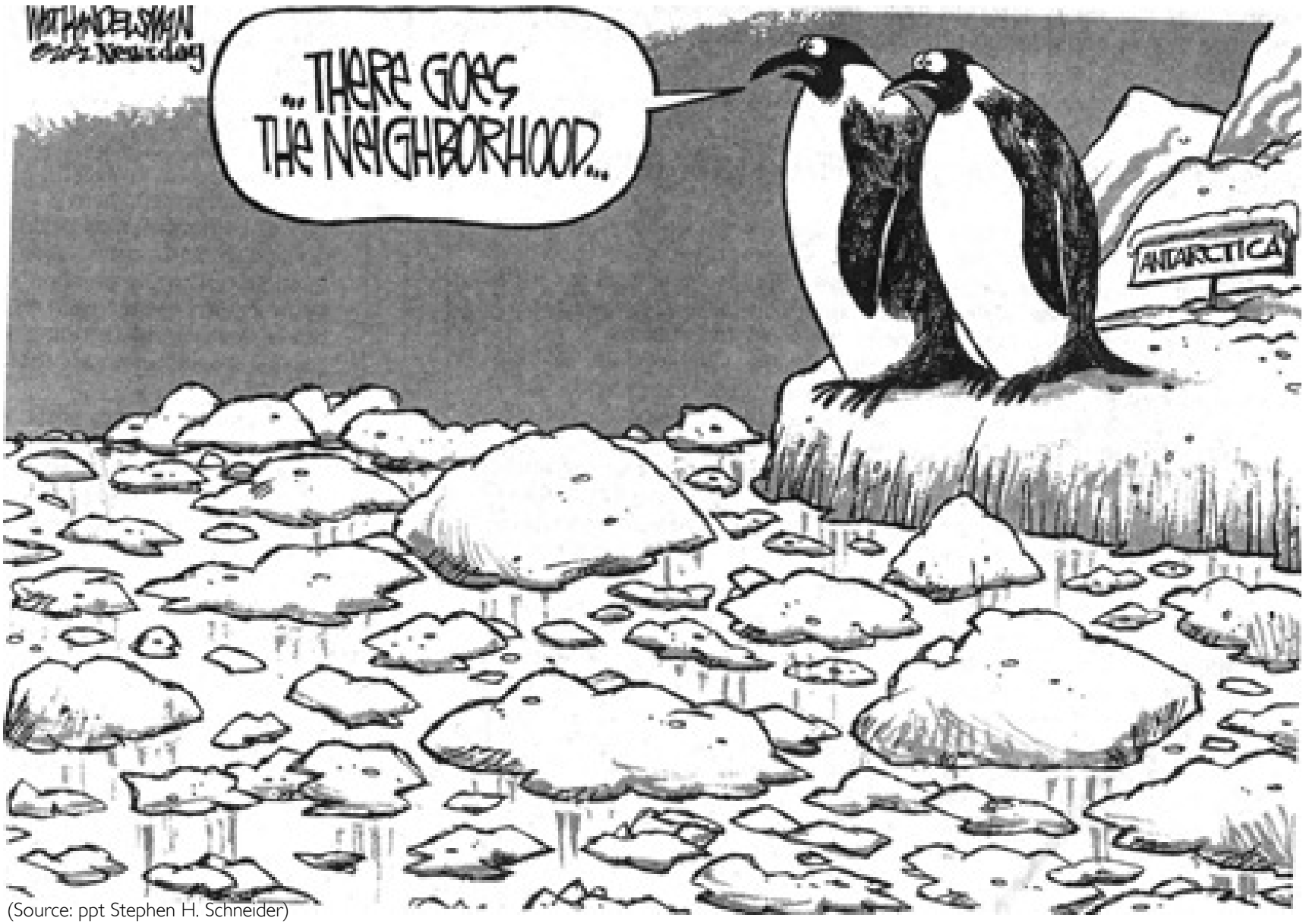



**2002-2009:**
Greenland ice mass loss doubled

**2007:**
melting area 50% of total ice sheet

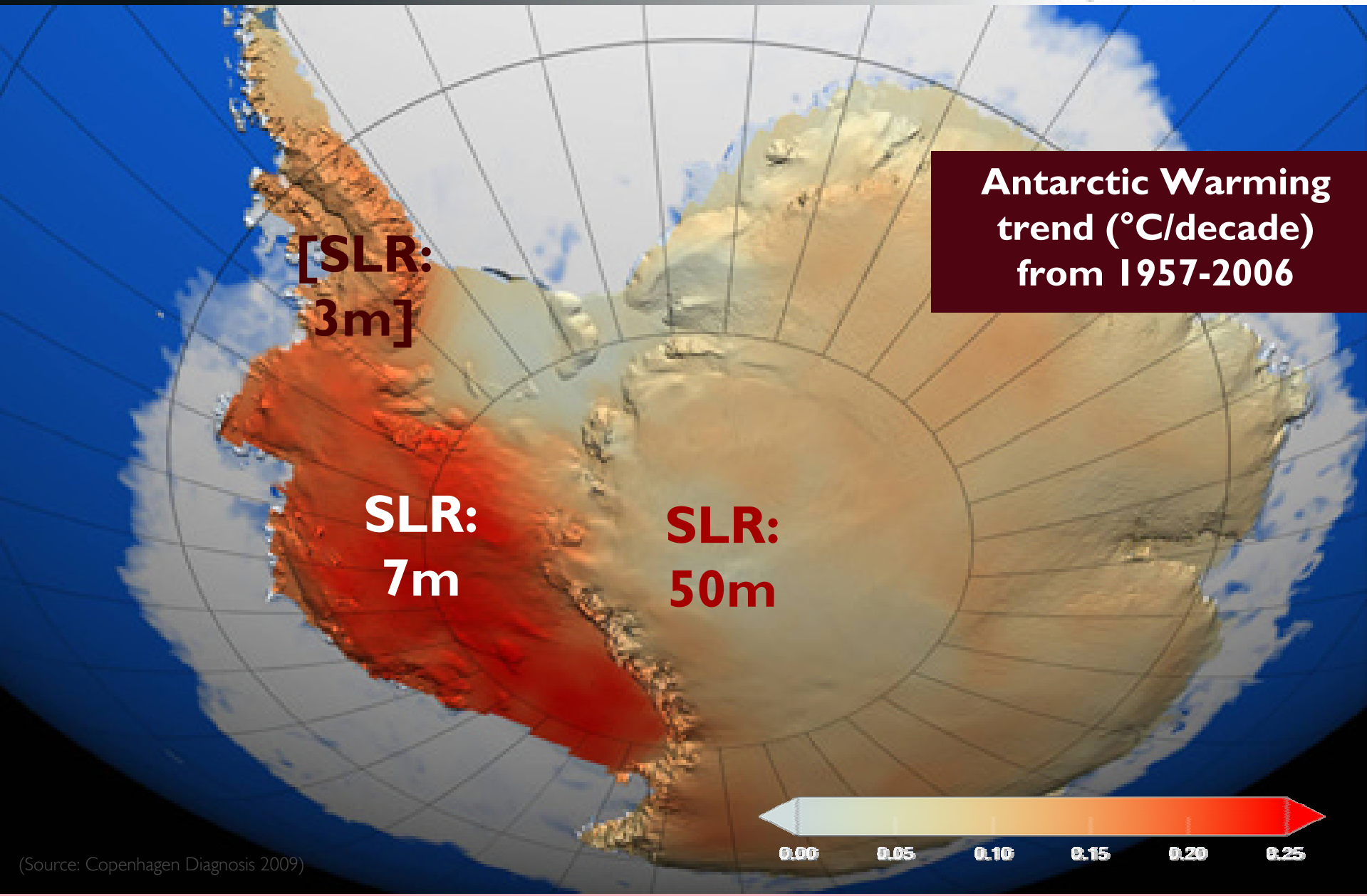
**6.6 metres:**
Greenland's total SLR potential

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



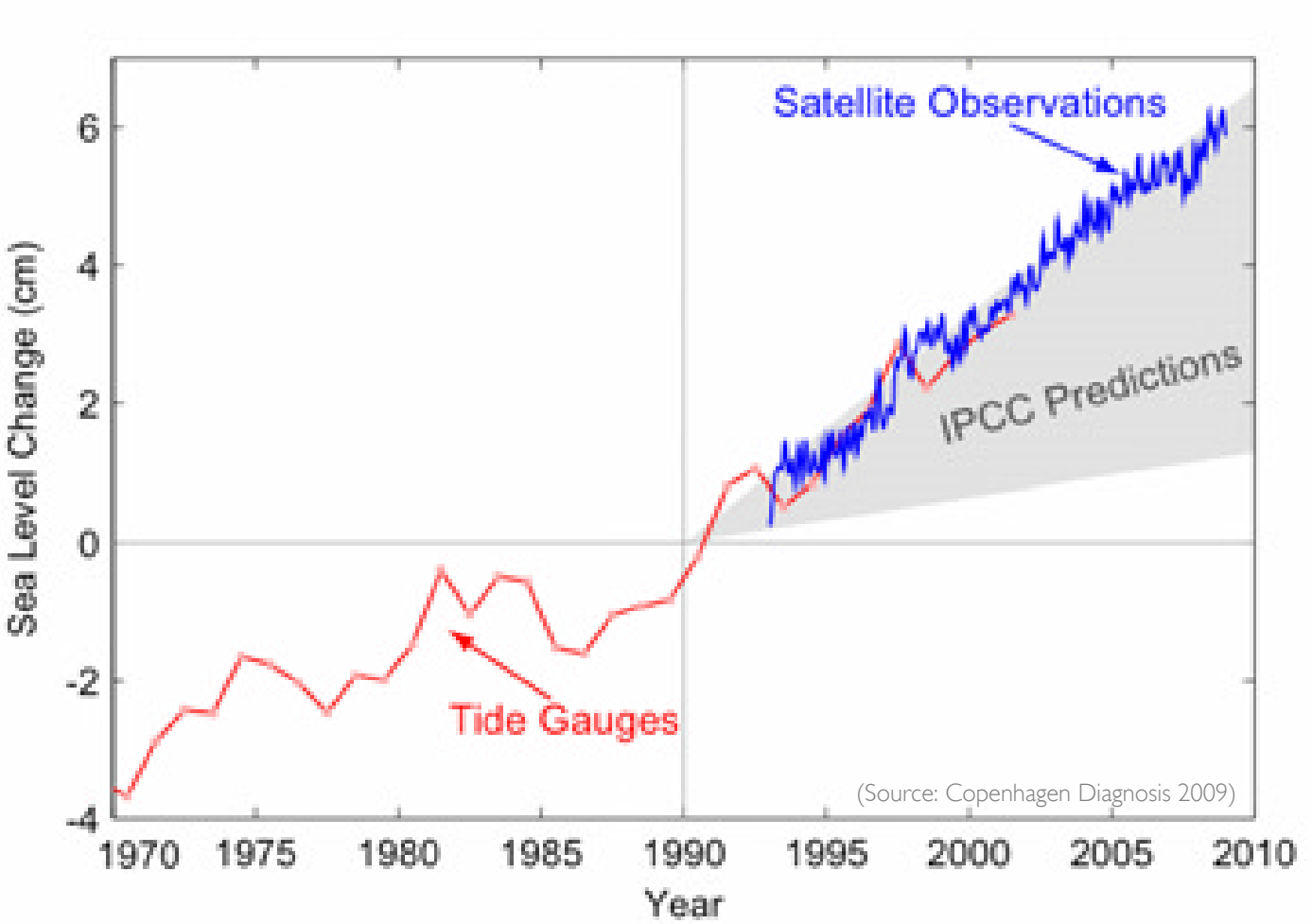

(Source: ppt Stephen H. Schneider)

# Sea Level Rise




(Source: Copenhagen Diagnosis 2009)

## Global sea level change 1970-2010




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

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

# Projected Sea Level Rise

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

## Future sea-level projections

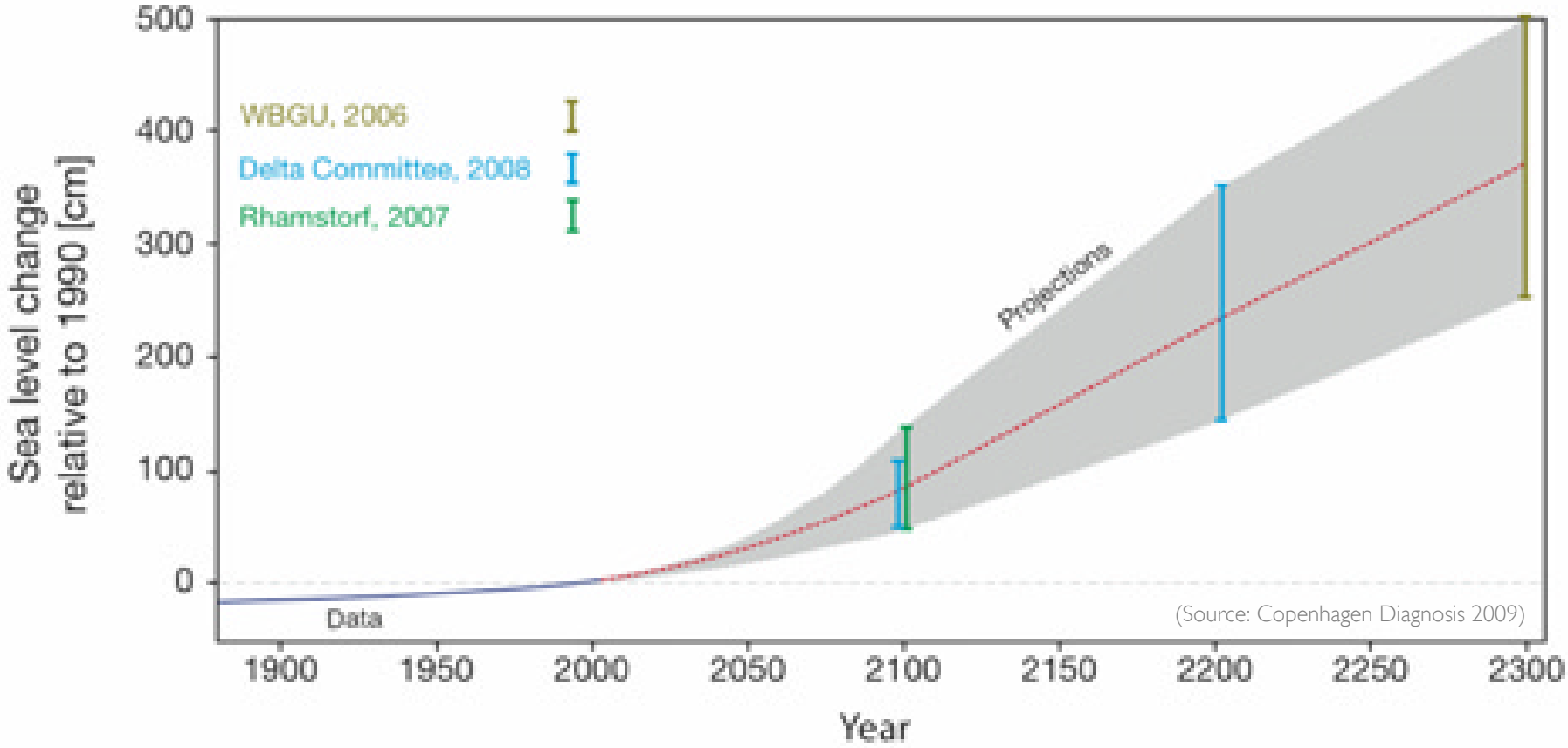
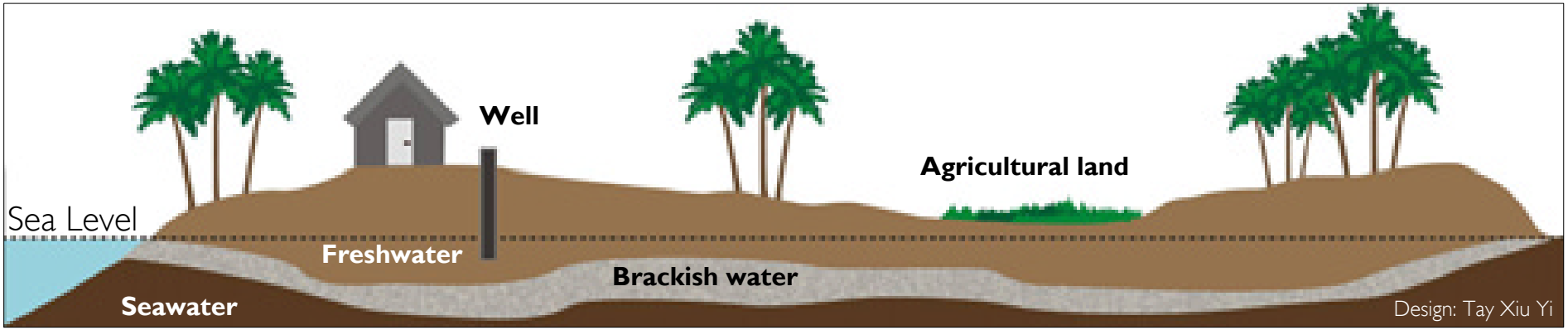


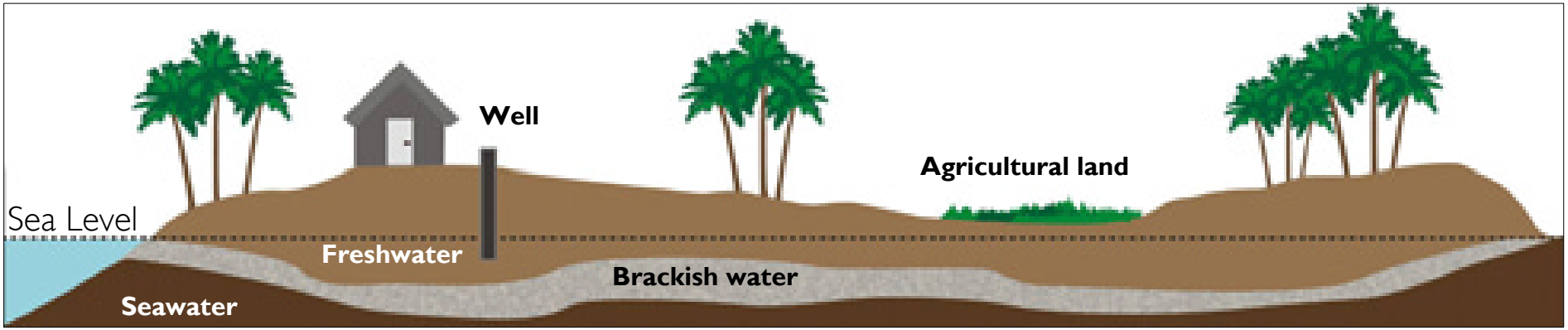
**Figure 1:** Initial sea level




## Island Submergence

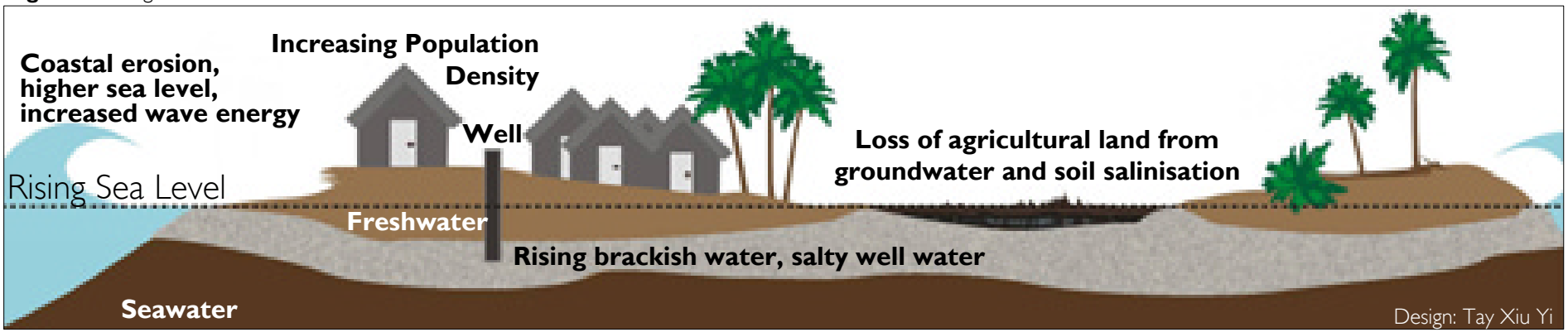
# Small Island States

**Figure 1:** Initial sea level

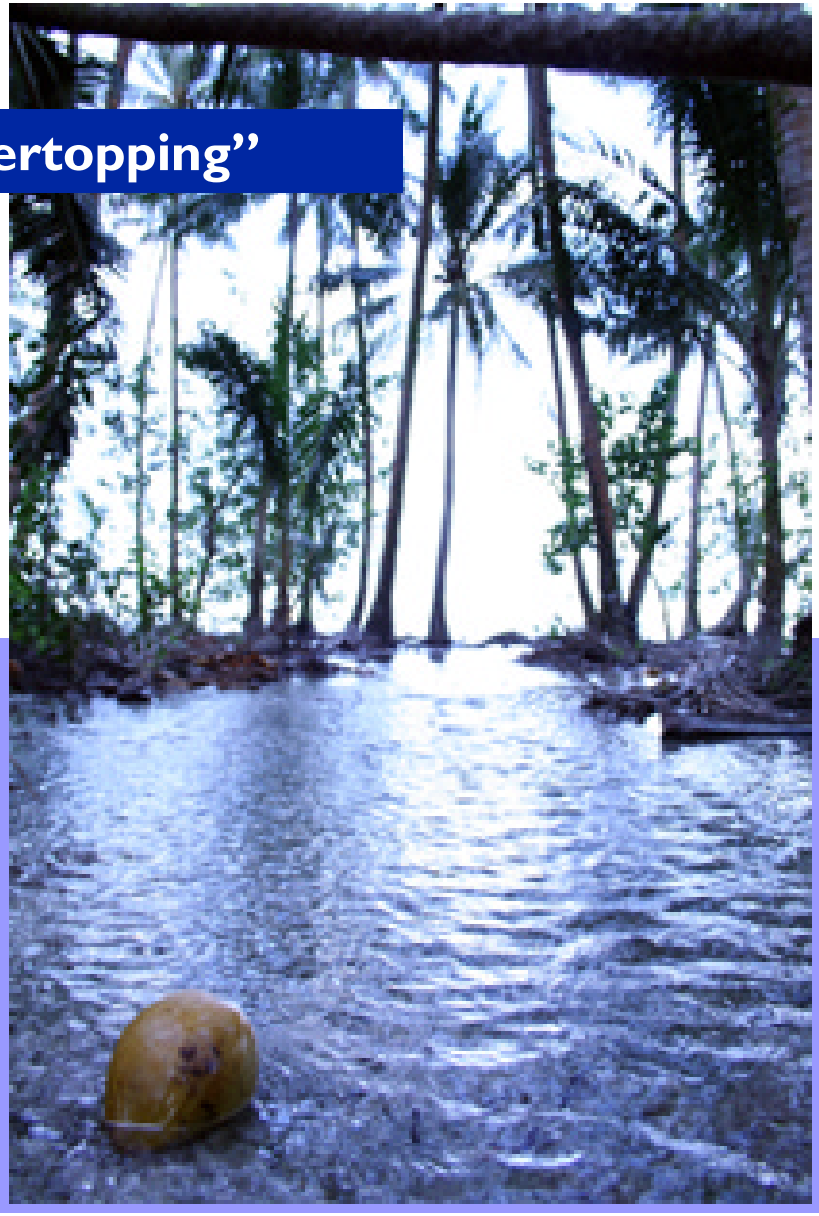



## Island Submergence

**Figure 2:** Rising sea level



# Small Island States



"Overtopping"

**CARTERET**

ATOLL

Photos: Tulele Peisa, Courtesy Pip Starr and Ursula Rakova

# Small Island States


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

# Small Island States

**Island of Pororan: Contaminated Closed Well**

Papua New Guinea, island of Pororan, contaminated closed well

Photo: Johannes Luetz

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

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# World Bank Policy Research


**"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)

# H.J. Schellnhuber CBE

"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)*

# James Hansen

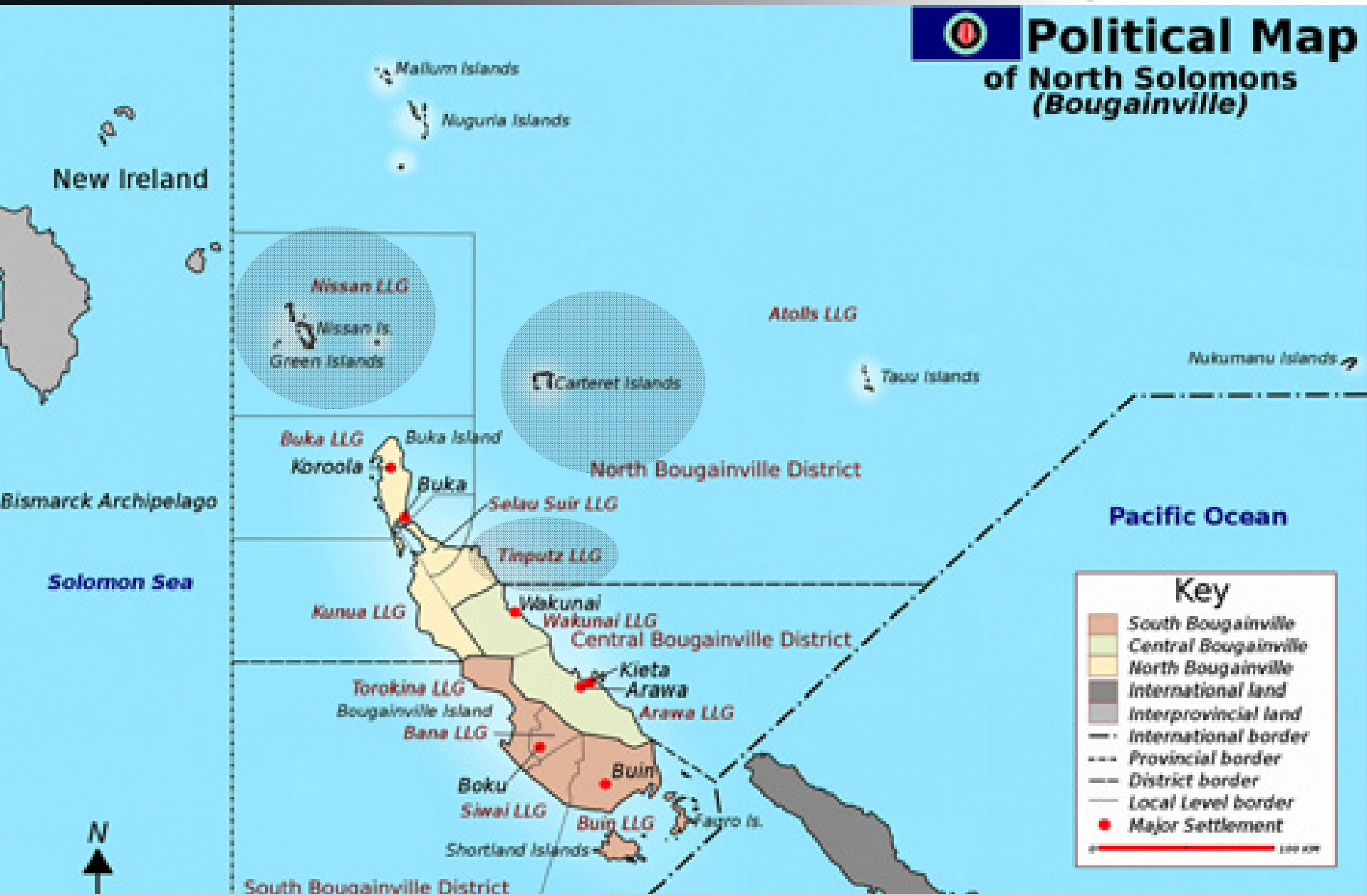

**"If emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees."**

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

# Pilot study


How should such forced migration be managed ?
(Photo: Johannes Luetz)

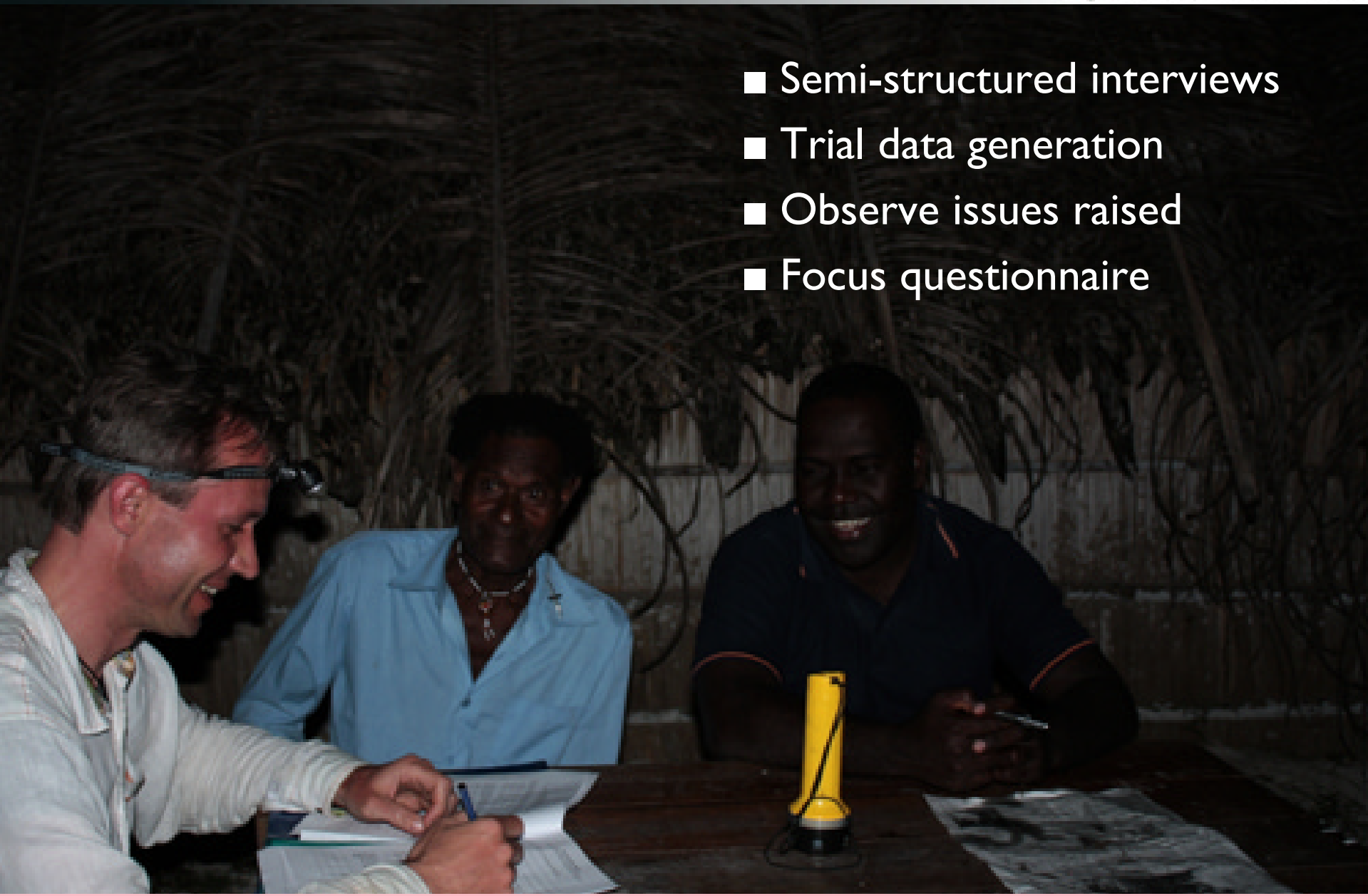
# Pilot study


Political Map
of North Solomons
(Bougainville)
Mallum Islands
Nuguria Islands
New Ireland
Nissan LLG
Nissan Is.
Green Islands
Carteret Islands
Atolls LLG
Takuu Islands
Nukumanu Islands
Buka LLG
Buka Island
Kovroola
Buka
North Bougainville District
Bismarck Archipelago
Selau Suir LLG
Pacific Ocean
Timputz LLG
Solomon Sea
Kunua LLG
Wakunai
Wakunai LLG
Central Bougainville District
Kieta
Arawa
Torokina LLG
Bougainville Island
Arawa LLG
Bana LLG
Buin
Boku
Siwai LLG
Buin LLG
Fagro Is.
Shortland Islands
South Bougainville District
N
Key
South Bougainville
Central Bougainville
North Bougainville
International land
Interprovincial land
International border
Provincial border
District border
Local Level border
Major Settlement

# Award winning documentary


There once was an island (trailer feature documentary)
http://youtu.be/M7akwGUtGDw

# PhD pilot study objective



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

# Tulun Atoll


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

# Origin Community

# Destination Community

# Climate change and small island states

1. Climate Change Science
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# ISLAND ADAPTATION
## THROUGH SEA WALLS?

# Small Island States


**Show field research video footage:**

**File PNG1:**
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?

# Tulun Atoll


http://www.vimeo.com/4177527


The President's Dilemma
http://youtu.be/nZLWqa5irog

# Tulun Atoll


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

# Injustice of sea level rise

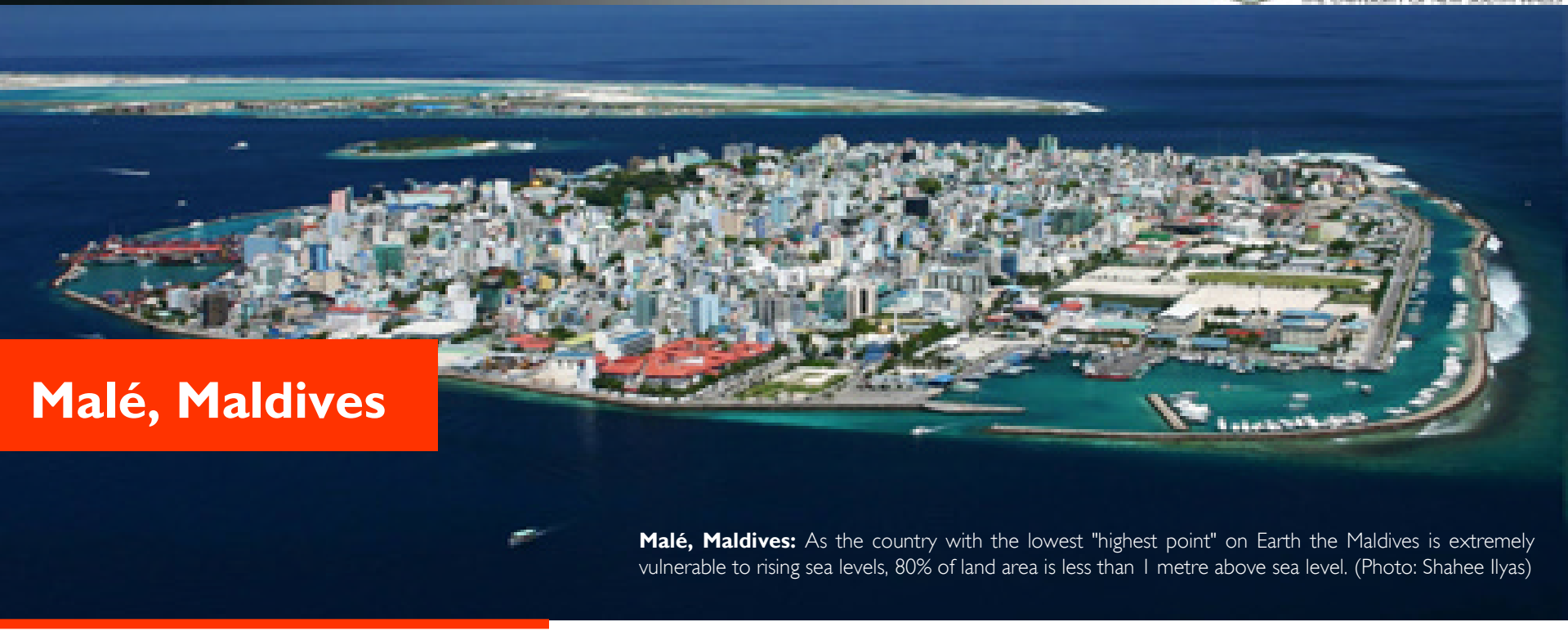
> “**This [is] about the injustice of sea level rise** ... on average you have about a metre of sea level rise by 2100, ... all over the globe. But the ... very vicious thing is, that this sea level rise will be distributed in a highly inhomogeneous way across the planet. [...] Elementary physics – if 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*

# Multiplier Effects

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

# Small Island States



## 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."

# Small Island States


Island of Dhuvafaaru, Maldives
(Photo: Johannes Luetz)

# Small Island States

## Dhuvafaaru, Maldives

Island of Dhuvafaaru, Maldives
(Photo: Johannes Luetz)

# Small Island States

**Dhuvafaaru, Maldives**

Island of Dhuvafaaru, Maldives
(Photo: Johannes Luetz)

# Abandoned Hathifushi Island

**Show field research video footage:**

**File name "Maldives 4":**
04:00 (1min) – Abandoned Hathifushi Island
23:00 (1min) – Skipper, stuff, storm surge
48:00 (1min) – Faridhoo: highest point on M.

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

# Engineering Solutions?

**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)

# Climate change and small island states

1. Climate Change Science
2. Impacts
3. Research Problem and Methodology
4. Discussion
5. **Conclusion and Policy Recommendations**

# Mitigation

> “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*

# Bad News

**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.**

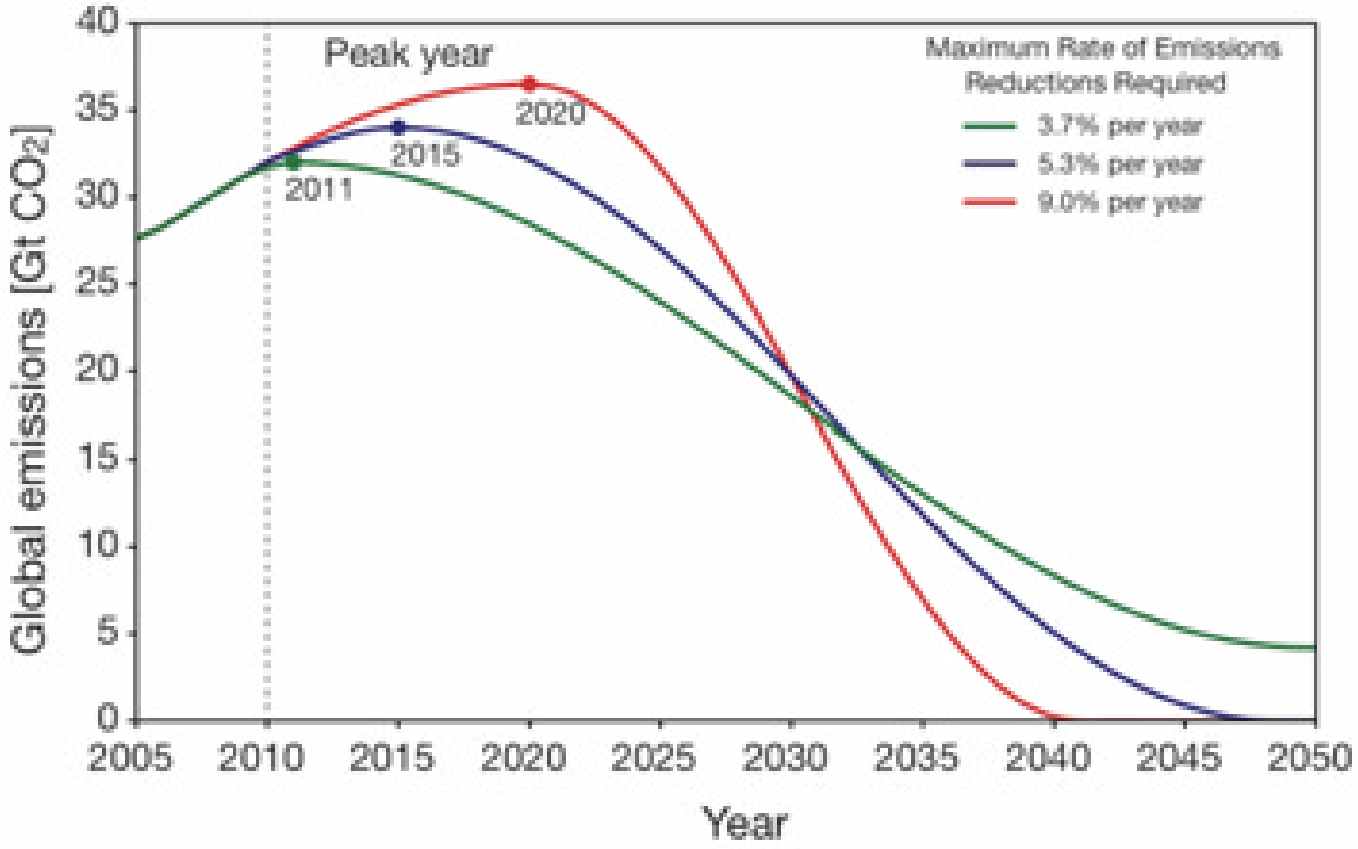
# Good News

**Global warming can be completely stopped. The temperature at which global warming will finally stop depends mainly on the total amount of $CO_2$ released into the atmosphere since industrialisation.**

# The Challenge

# Global decarbonisation

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

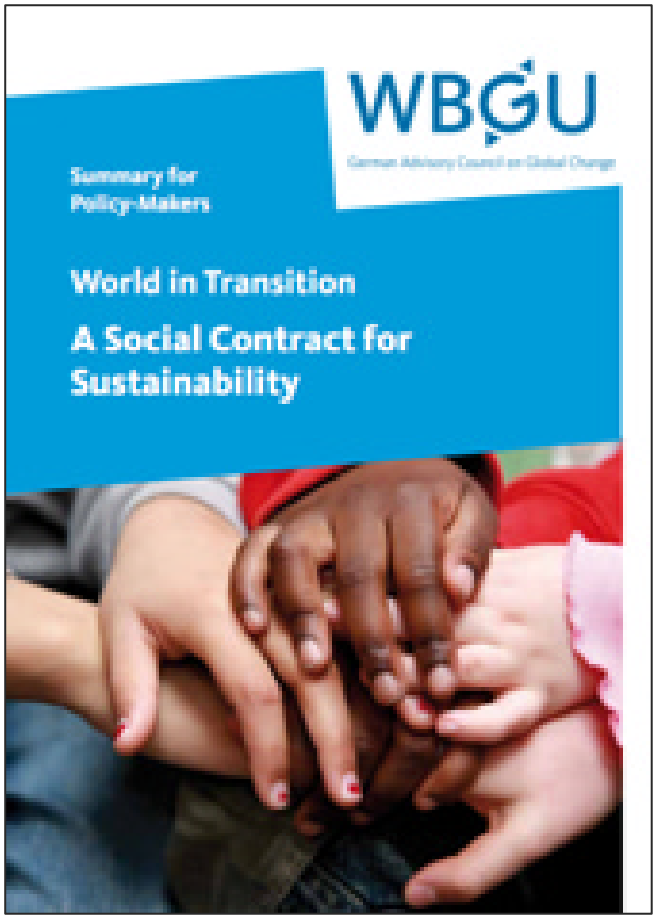



Solving the climate dilemma: The budget approach; WBGU Special Report 2009

**World in Transition: Social Contract for Sustainability**

Flagship Report 2011

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

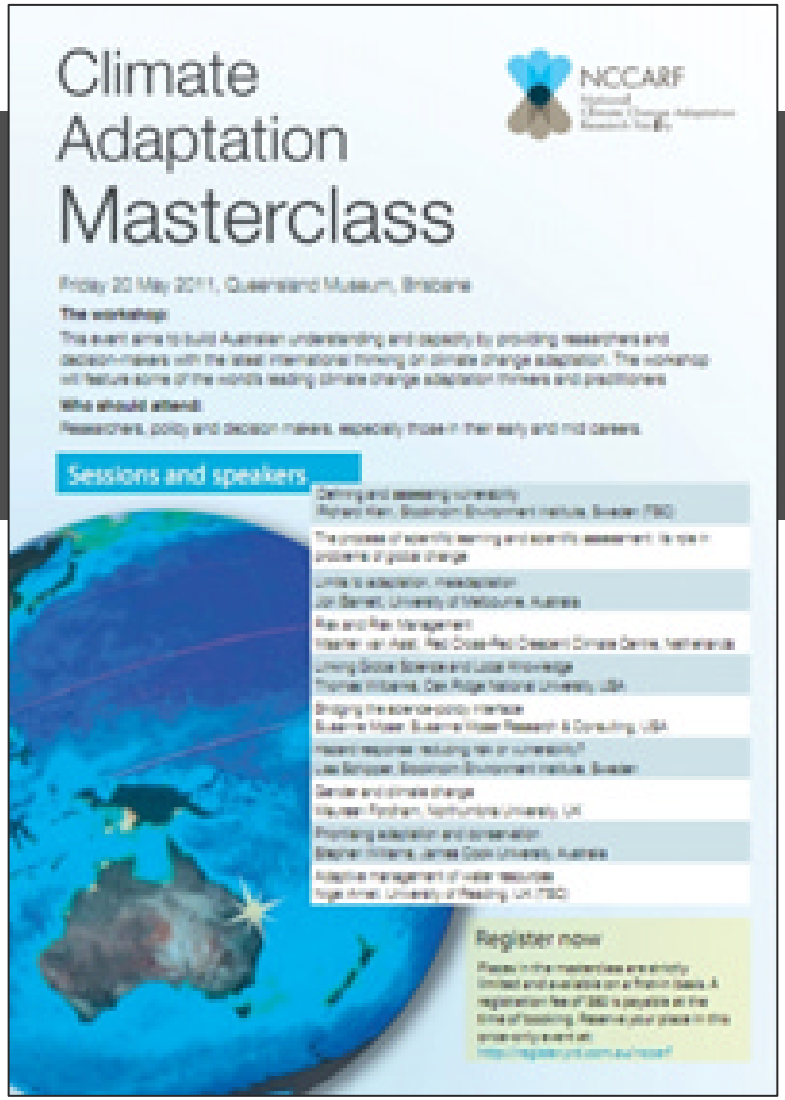


# Adaptation

> “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.

# Adaptation Critical




**Available resources:**

- Audio files
- Presentation files

## Masterclass

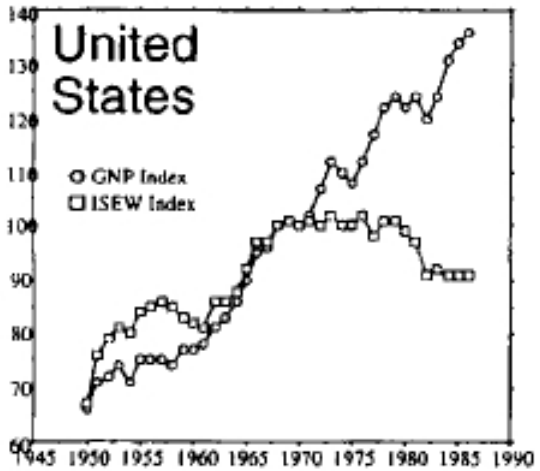
20 May 2011, Brisbane

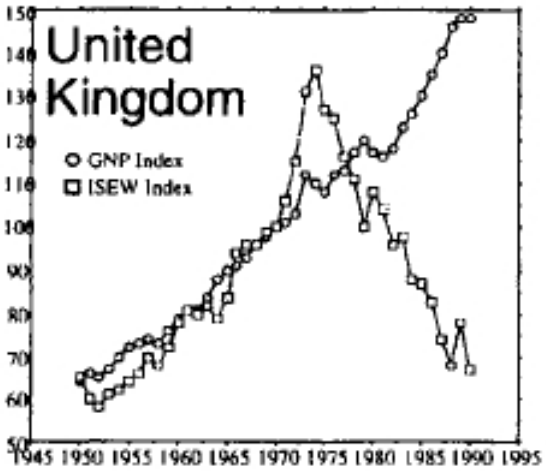
## FROM THEORY TO IMPLEMENTATION

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

## 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)*




# Sustainable Development?

## 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.*

# The Future

*"**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)*

# Thank You!

## PhD Sponsors:



# Contacts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# Backup: UNSW-TV


http://youtu.be/KBq2jNrD-yg OR
http://tv.unsw.edu.au/video/bolivia-leaving-the-land