

**WANTED:**  
LEADERSHIP



PhD Candidate Johannes M. Luetz  
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# Global Relief Forum

World Vision Learning Event, Ottawa, Canada, 5-11 May 2010

(Photo: Schwartz)

**Presentation available:**

<http://luetz.com>

“ There remains a frightening lack of **LEADERSHIP** ...  
The question is not whether climate change is  
happening or not, but whether, in the face of this  
emergency, we ourselves can change fast enough. ”

—*Kofi Annan, Seventh United Nations Secretary-General*

## 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



## Island of Matsungan, Papua New Guinea



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

Photo: Johannes Luetz

**Chief Kela:** “What will the future hold for our children and grandchildren?” Island Chief John Kela (right) doesn’t understand the science of climate change. But he sees that the ocean surrounding his island is rising.

## 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.’ The time for adaptation and mitigation has run out. The time for migration and relocation has come. Resettlement is underway. It is so sad to leave.”

## Labutali, Papua New Guinea



Photo: Johannes Luetz

Group of “climate change refugees”  
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 at a phenomenal rate. From a size of 6,400km<sup>2</sup> 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

## 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. People are constantly moving back.” Community elder Abdul Mannan (centre) points out signs of extreme erosion.

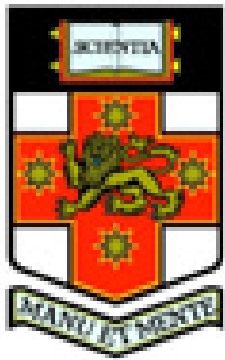


## Abdul Mannan:

“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)



**UNSW**  
THE UNIVERSITY OF NEW SOUTH WALES

**PhD Research:** Climate Change Migration

**PhD Candidate:** Johannes M Luetz

## PhD Study: Climate Migration

“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



Photo: Pip Starr

“ For tomorrow belongs to the people who **PREPARE** for it today. ”

—African Proverb

1. **Ten Pressures**
2. One Remedy
3. Global Challenge



## **The Copenhagen Diagnosis, 2009: Updating the World on the Latest Climate Science**

Ian Allison, Nathan Bindoff, Robert Bindshadler, Peter Cox, Nathalie de Noblet-Ducoudre , Matthew England, Jane Francis, Nicolas Gruber, Alan Haywood , David Karoly , Georg Kaser, Corinne Le Quéré, Tim Lenton, Michael Mann, Ben McNeil, Andy Pitman, Stefan Rahmstorf , Eric Rignot, Hans Joachim Schellnhuber, Stephen Schneider, Steven Sherwood, Richard Somerville, Konrad Steffen, Eric Steig, Martin Visbeck, Andrew Weaver.

# I. Longevity of CO<sub>2</sub>

**Boeing 767-300**



**1t Jet Fuel Burned  
= 3.157t CO<sub>2</sub> Emissions**

(Photo: Adrian Pingstone)

# I. Longevity of CO<sub>2</sub>

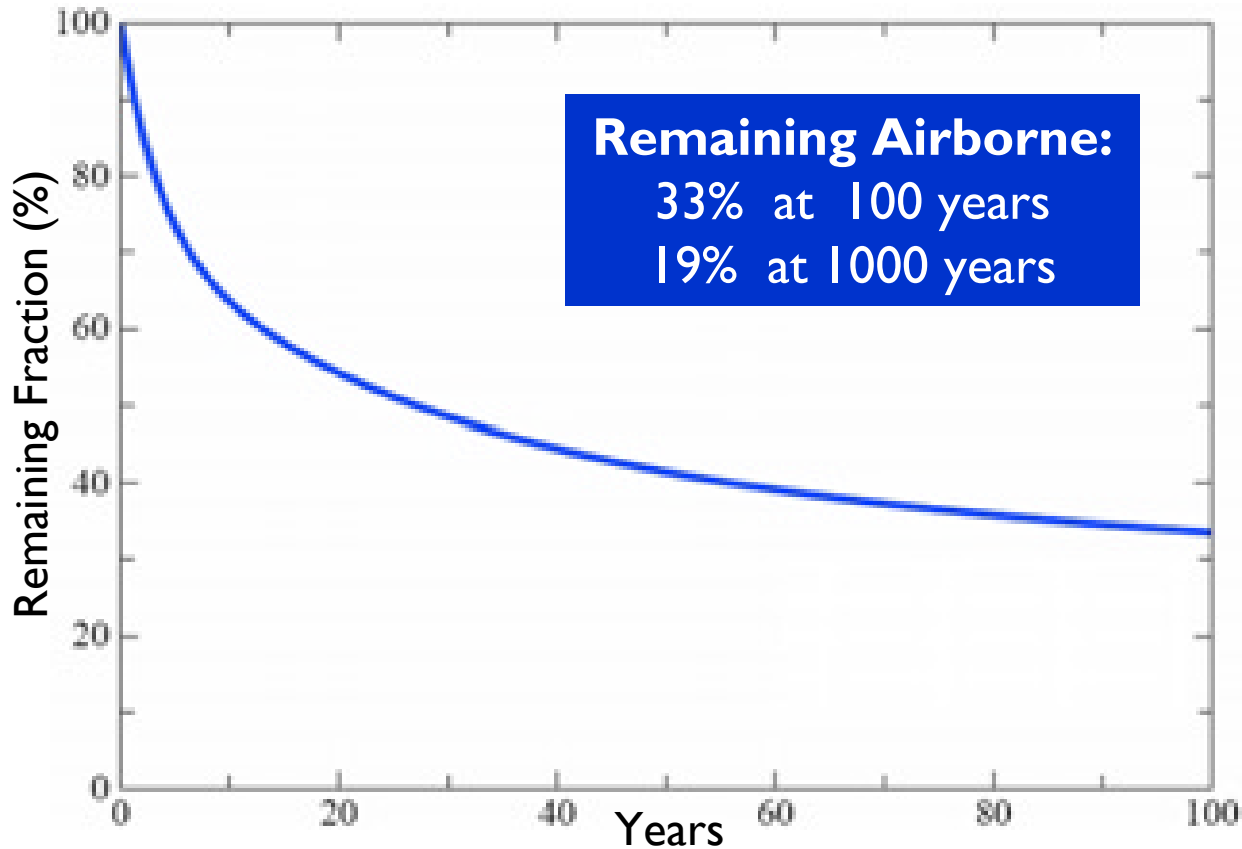
Top of Atmosphere as seen from space at 335km altitude  
(Photo: NASA Earth Observatory)

Per-capita emissions for  
Canada GRF trip: 1.4t CO<sub>2</sub>

\* 2.7 (Radiative Forcing  
Index, RFI) = ~ 3.8t CO<sub>2</sub>



## Slow decay of fossil fuel CO<sub>2</sub> emissions



**Fraction of CO<sub>2</sub> airborne after flight to Canada (per-capita basis):**

**2010: 1.4t CO<sub>2</sub>**

**2110: 460kg CO<sub>2</sub>**

**3010: 260kg CO<sub>2</sub>**

The fraction of CO<sub>2</sub> 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.

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

## 2. Environmental Degradation



**Annual Deforestation: 73,000km<sup>2</sup>  
(Area = nearly 2x Switzerland)**

**Amazon**

# 2. Environmental Degradation

**Amazon**

**Deforestation: 20% of  
Global CO<sub>2</sub> Emissions**



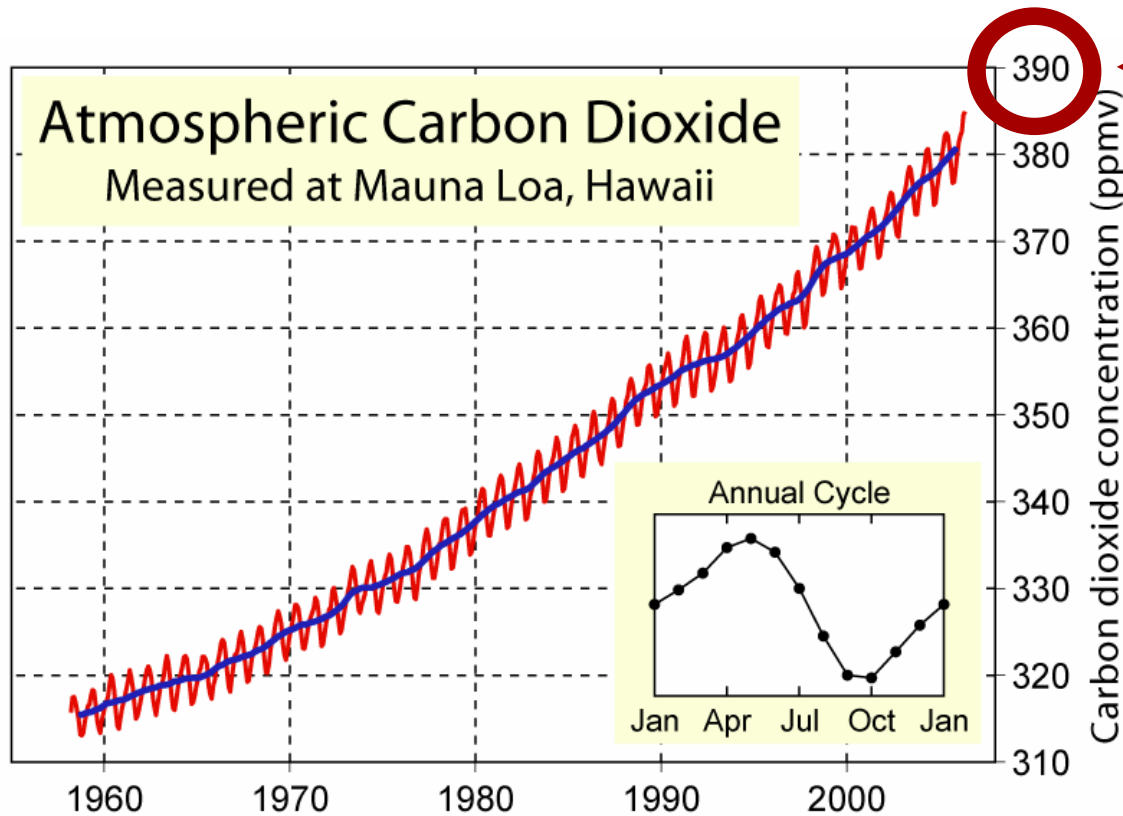


**Sinazongwe, Zambia**

**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.**

# 3. Accelerating CO<sub>2</sub> Emissions

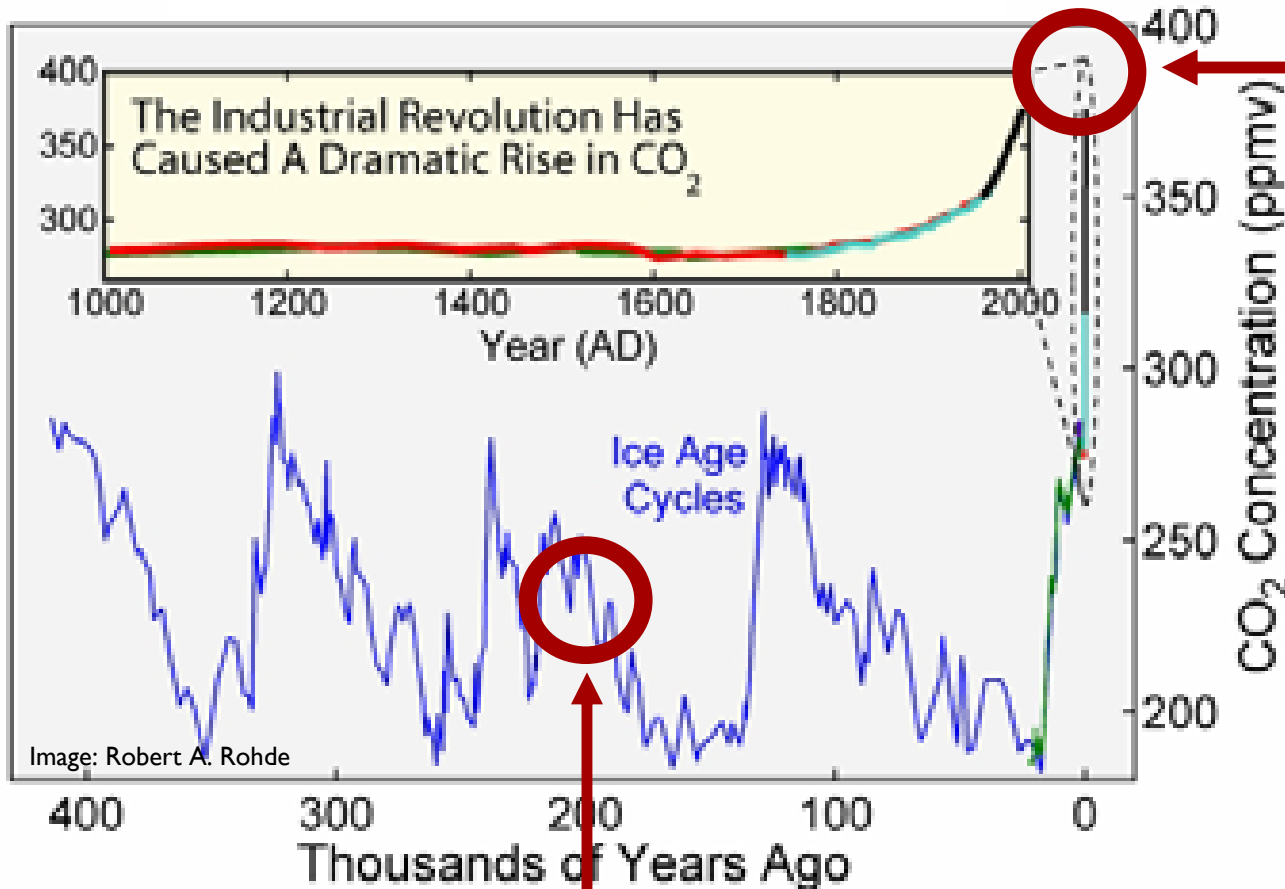
**CO<sub>2</sub> level in March  
2010: 390 ppm**



**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](ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt)).

# 3. Accelerating CO<sub>2</sub> Emissions



**CO<sub>2</sub> level in March 2010: 390 ppm**

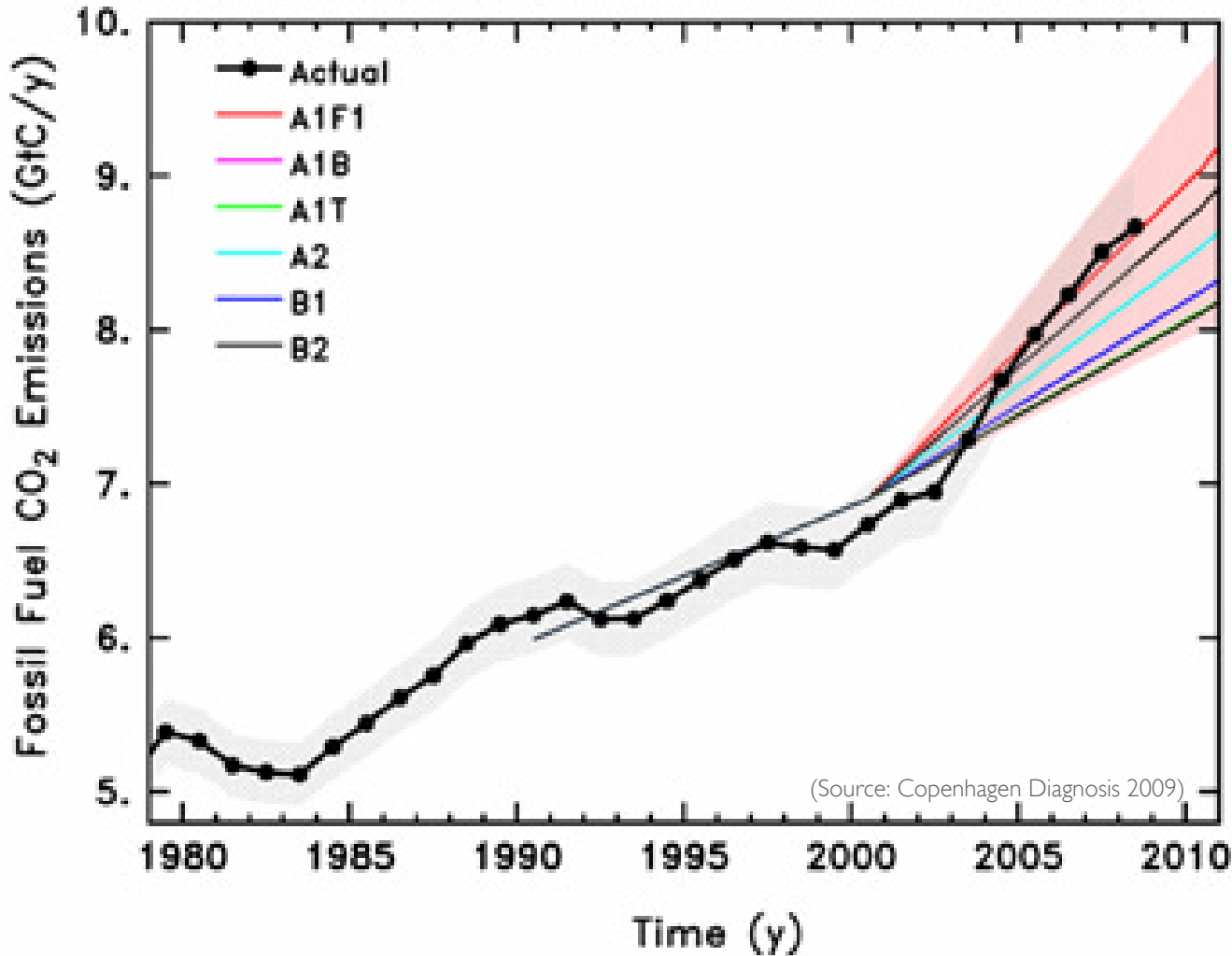
**Today's CO<sub>2</sub> levels are unprecedented in the last 800,000 years; potentially the last 3-20 million years.**

(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”**

# 3. Accelerating CO<sub>2</sub> Emissions

## Global CO<sub>2</sub> emissions from fossil fuels



**Annual CO<sub>2</sub>  
Increases:**

**1990s: 1.5 ppm CO<sub>2</sub>  
Now: 1.9 ppm CO<sub>2</sub>**

**Emissions  
in 2008:  
40% higher  
than in  
1990**

# 4. Declining CO<sub>2</sub> Removal

Forest canopy on Barro Colorado Island, Panama  
(Photo: Christian Ziegler)

**Emissions absorbed  
by “CO<sub>2</sub> sink”  
reservoirs have likely  
decreased by 5% in  
the past 50 years**



# 4. Declining CO<sub>2</sub> Removal

**North Atlantic**  
CO<sub>2</sub> sink decrease ~50% since 1990

**Southern Ocean**  
No CO<sub>2</sub> sink increase since 1981

Photo: Tammy Peluso

Deforestation in the Amazon  
(Photo: Luoman)

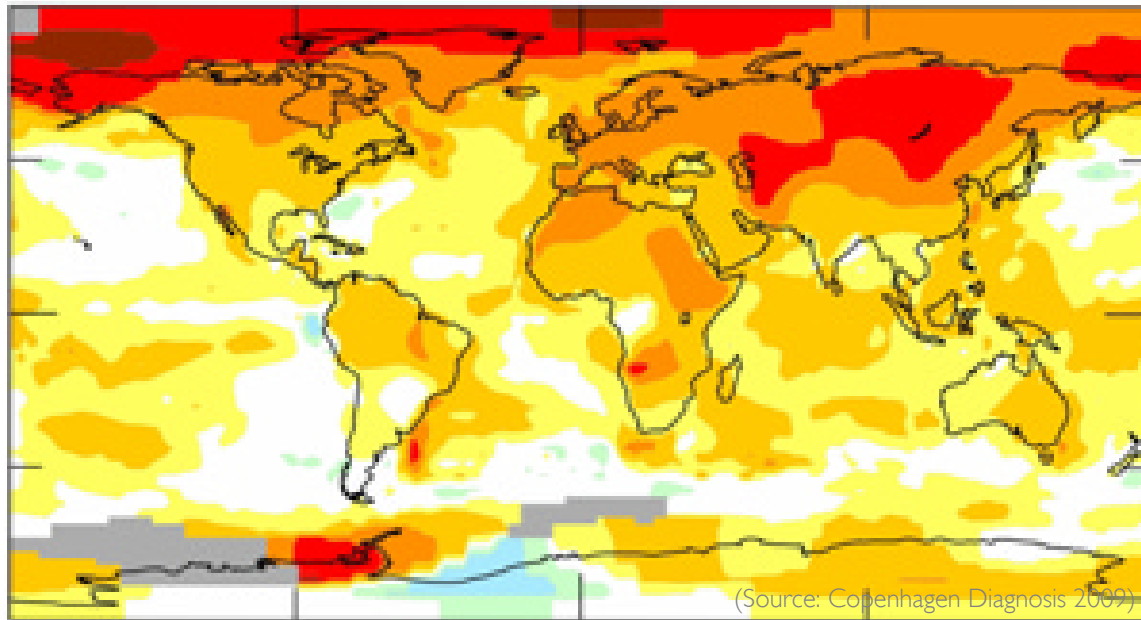
## Synthesis:

- CO<sub>2</sub> emissions increasing
- CO<sub>2</sub> removal decreasing

**Result:**  
Amplified global  
warming ~5-30%

# 5. Escalating Temperatures

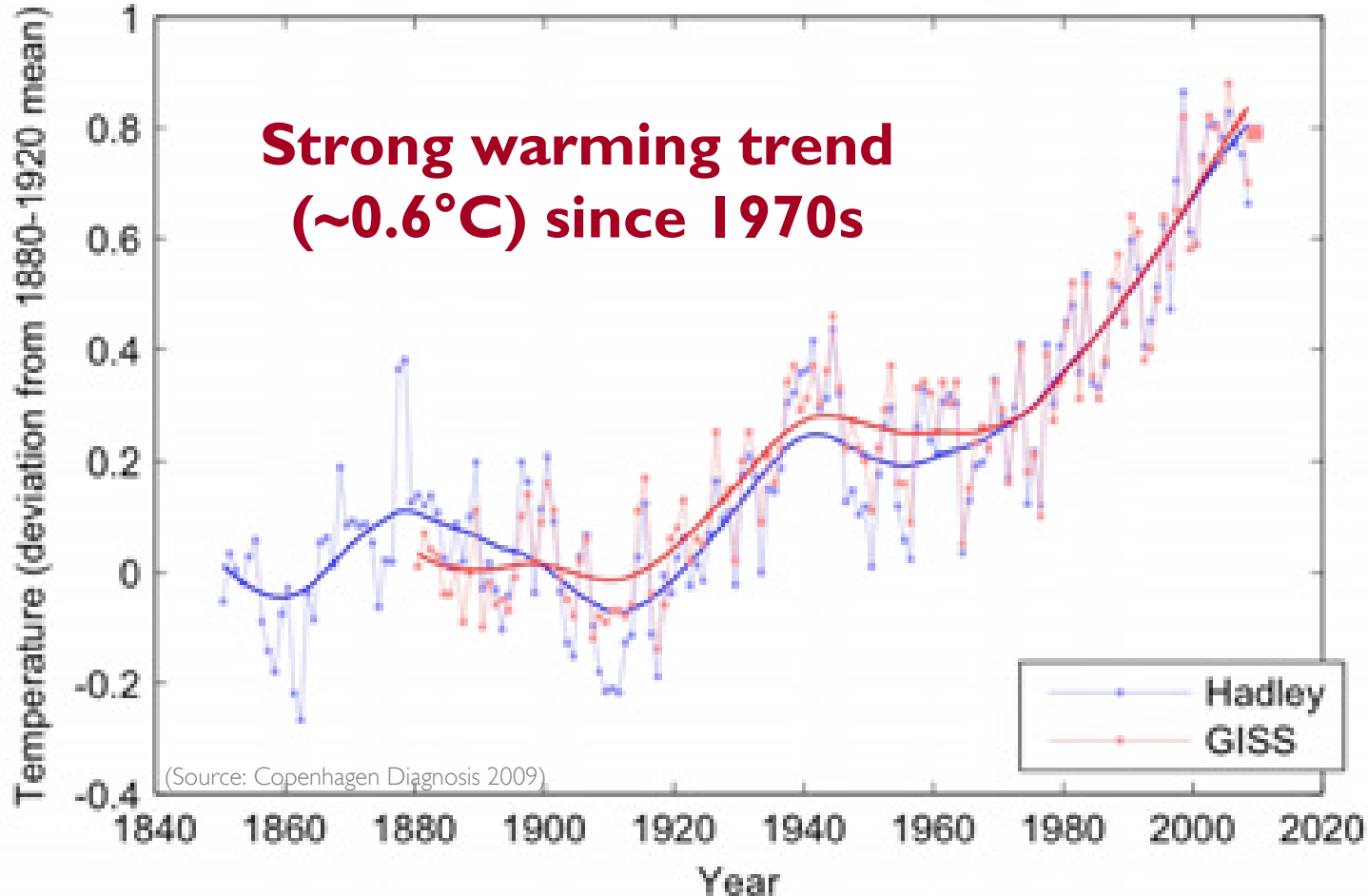
## Mean temperature change between 1950's and 2000's



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

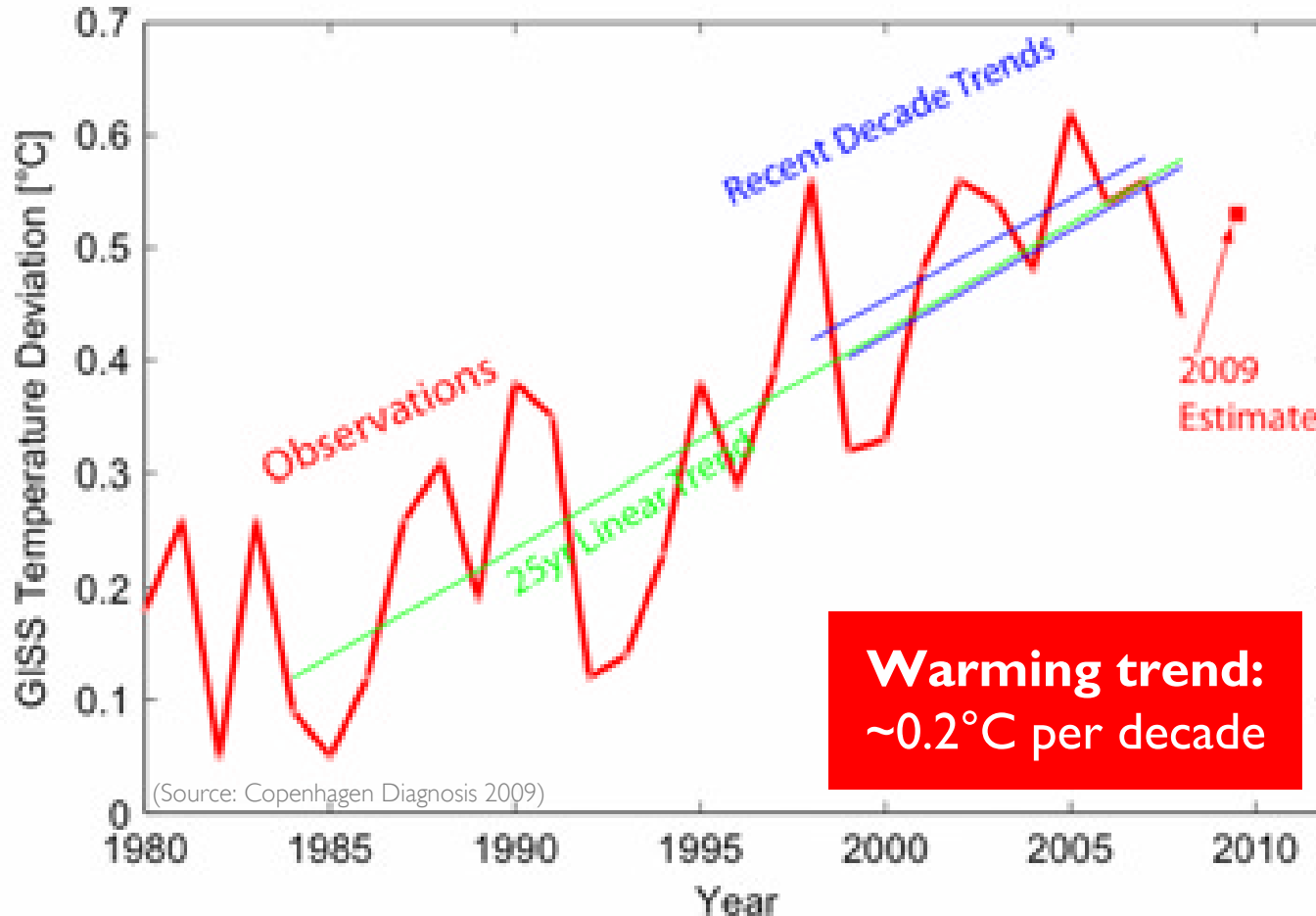
# 5. Escalating Temperatures

## Global average temperature 1850-2009



**Century-  
Scale  
Warming**

## Global temperature change 1980-2009



Decadal-  
Scale  
Warming

Warming trend:  
~0.2°C per decade

(Source: Copenhagen Diagnosis 2009)

(Source: NASA GISS data)



South Africa  
Western Cape  
21 July 2002

Photo: NASA

## Intergovernmental Panel on Climate Change (IPCC):

1. More heat waves over wider areas (**droughts**)
2. More frequent heavy precipitation events (**floods**)
3. More intense tropical cyclone activity (**storms**)

## I. Droughts

South Africa  
Western Cape  
21 July 2003

Photo: NASA

**“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*

# 6. Rogue Weather

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

2. Floods

“  
When it rains, it pours  
”

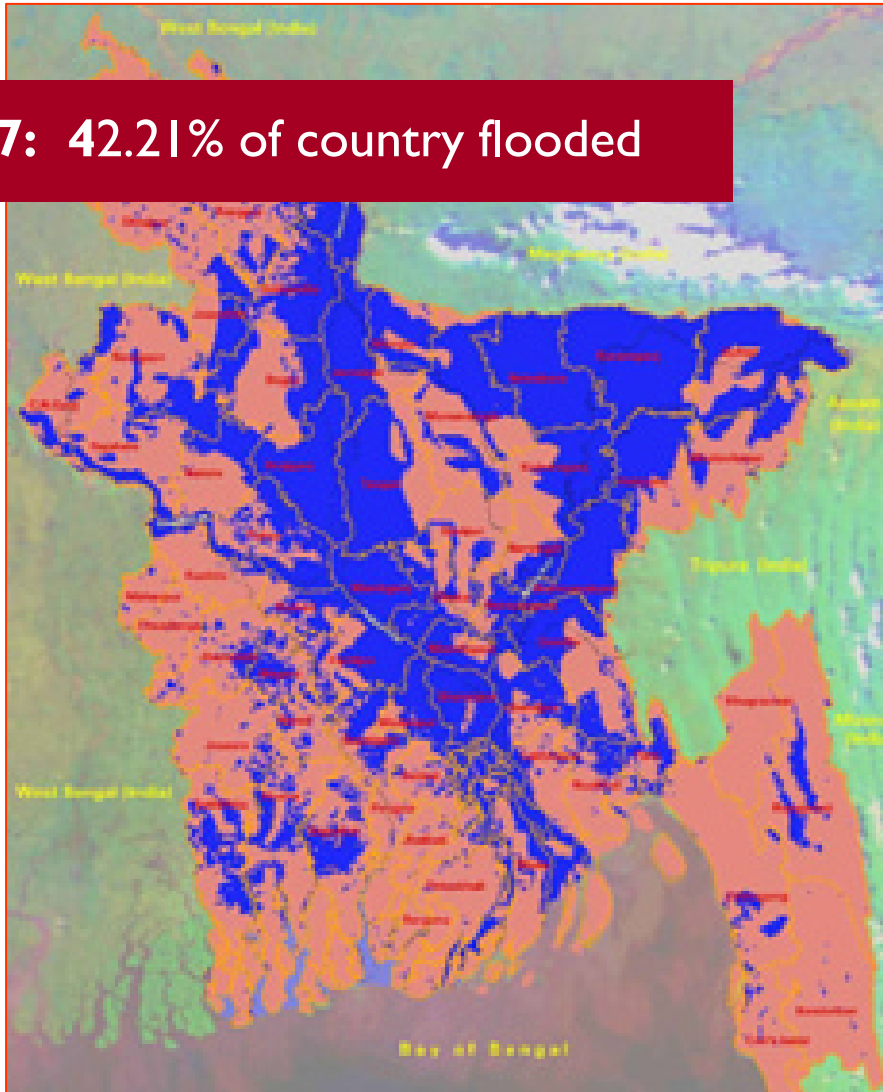


Khailshabunia (Bangladesh) under water

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



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."

# 6. Rogue Weather




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**

## 3. 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

# 6. Rogue Weather

**Tropical Storm Ketsana over the Philippines, 26. September 2009**

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

Photo: National Oceanic and Atmospheric Administration (NOAA)

# 6. Rogue Weather

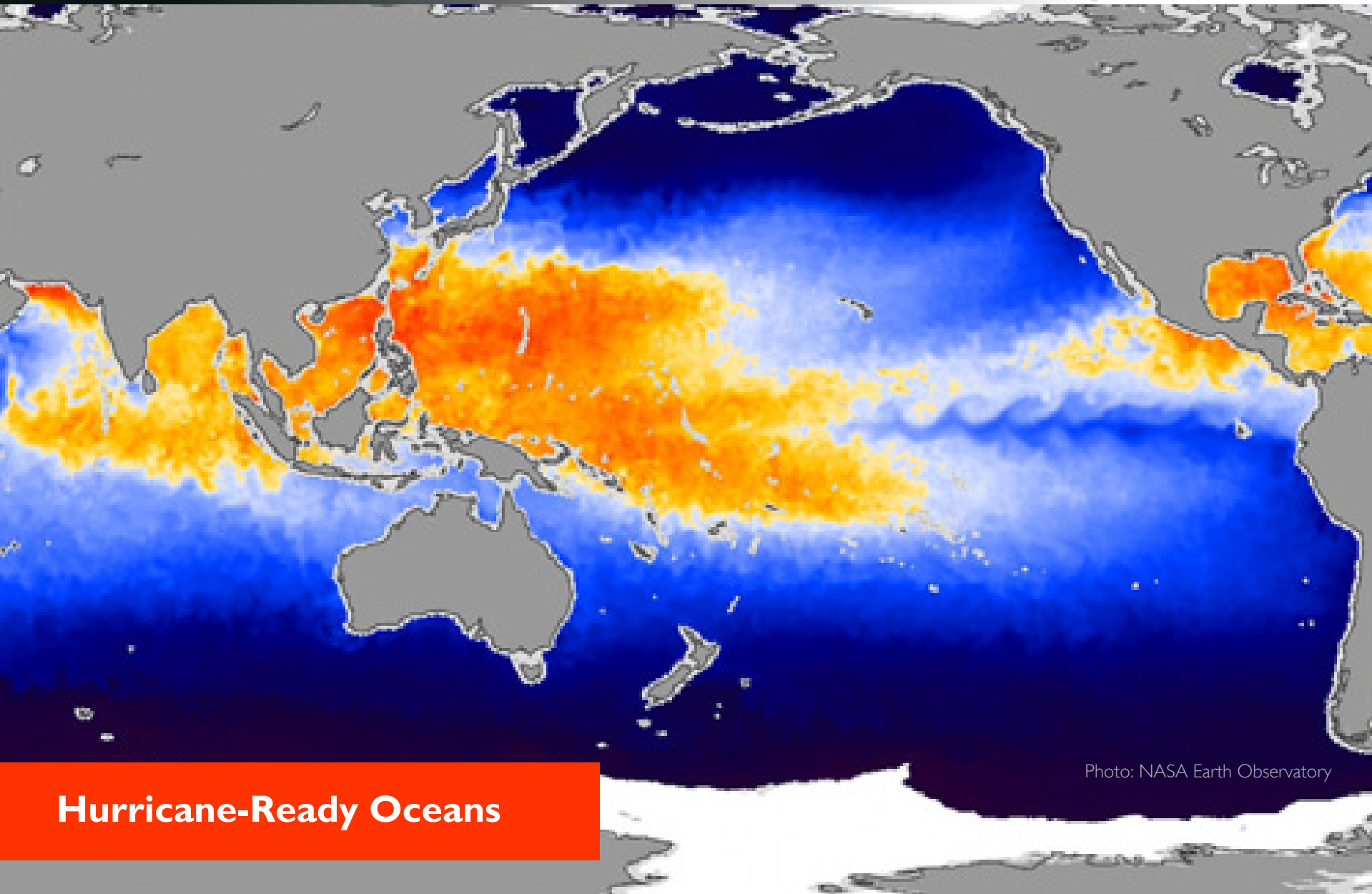
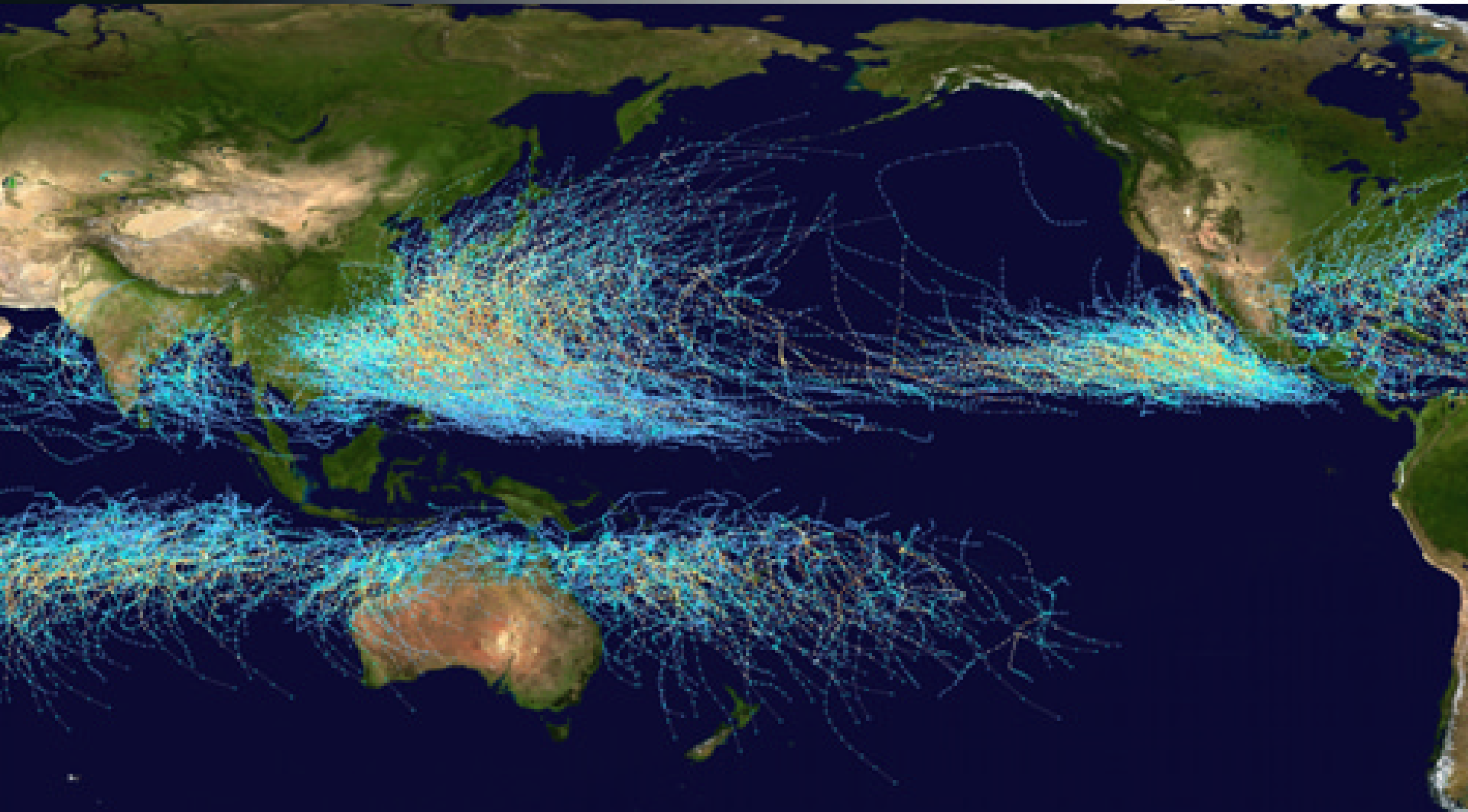


Photo: NASA Earth Observatory

**Hurricane-Ready Oceans**

# 6. Rogue Weather



**Hurricane Tracks 1985-2005**

Photo: NASA / Nilfanion

## 4. Storm Surges



Irrawaddy Delta  
Before Cyclone Nargis

15 April 2008

Photo: NASA/MODIS Rapid Response Team

**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.





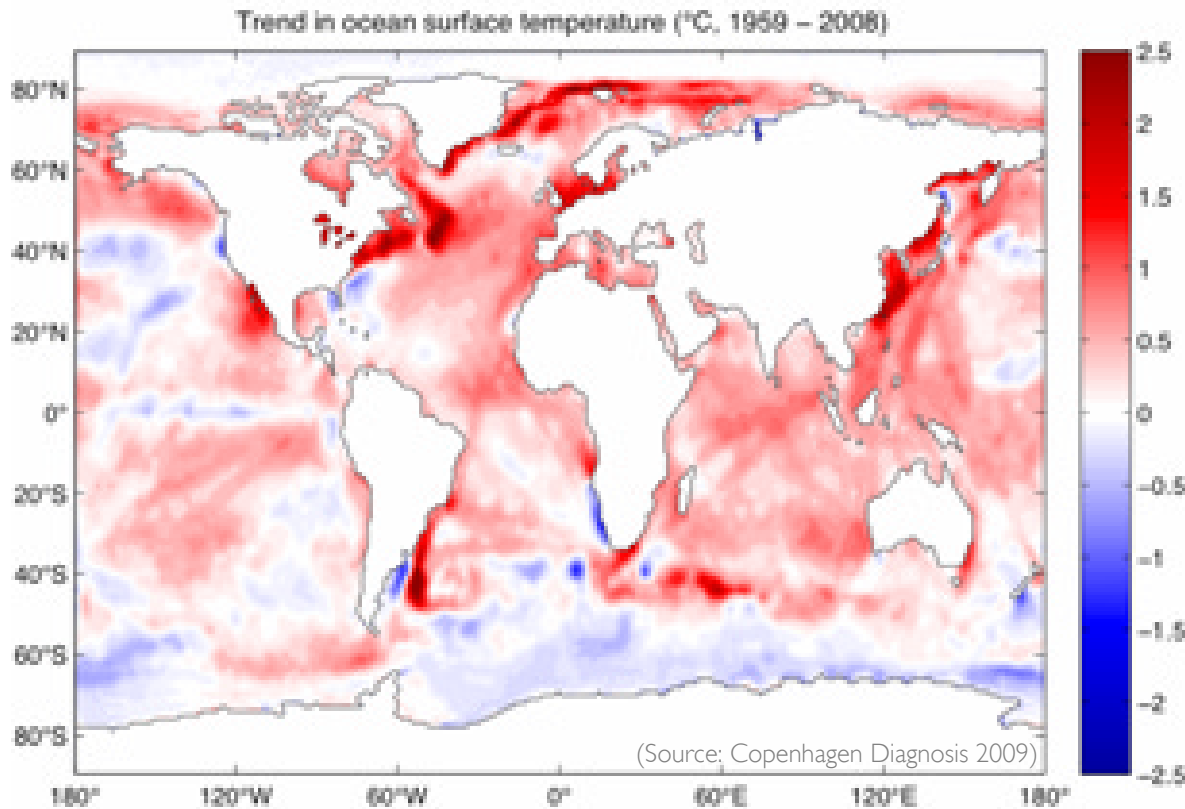
## Irrawaddy Delta After Cyclone Nargis

5 May 2008


Photo: NASA/MODIS Rapid Response Team

**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.”

## Ocean heat uptake 50% higher than previous calculations



**2007:**  
warmest year  
ever  
recorded



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

Photo: Tammy Peluso

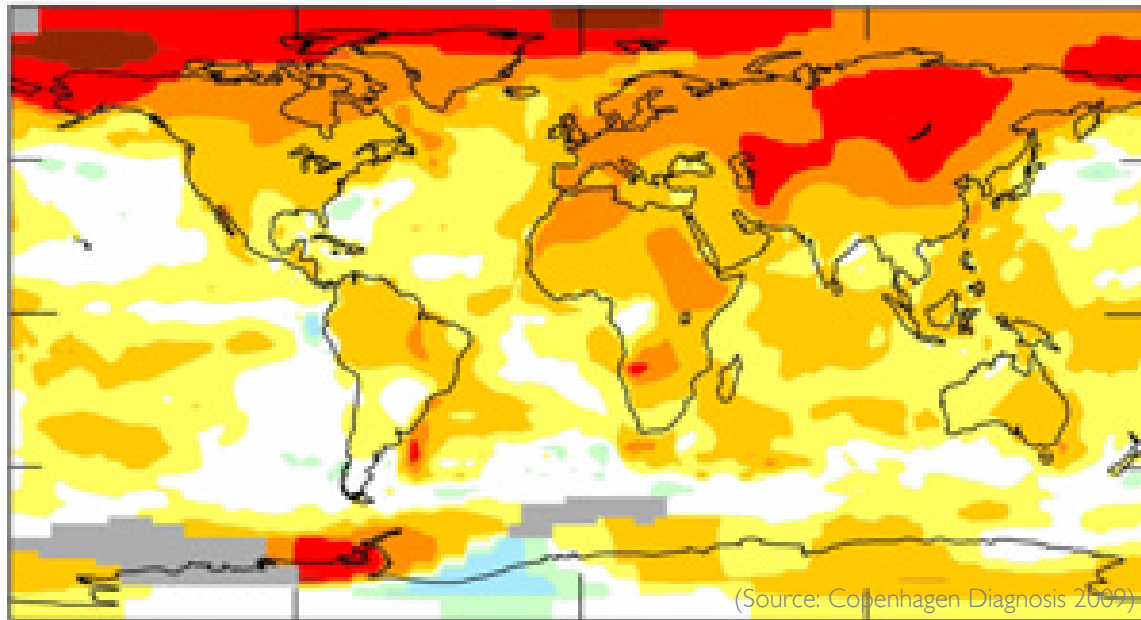


**Land-based  
melting ice:  
60% sea level rise  
(1961-2003)**

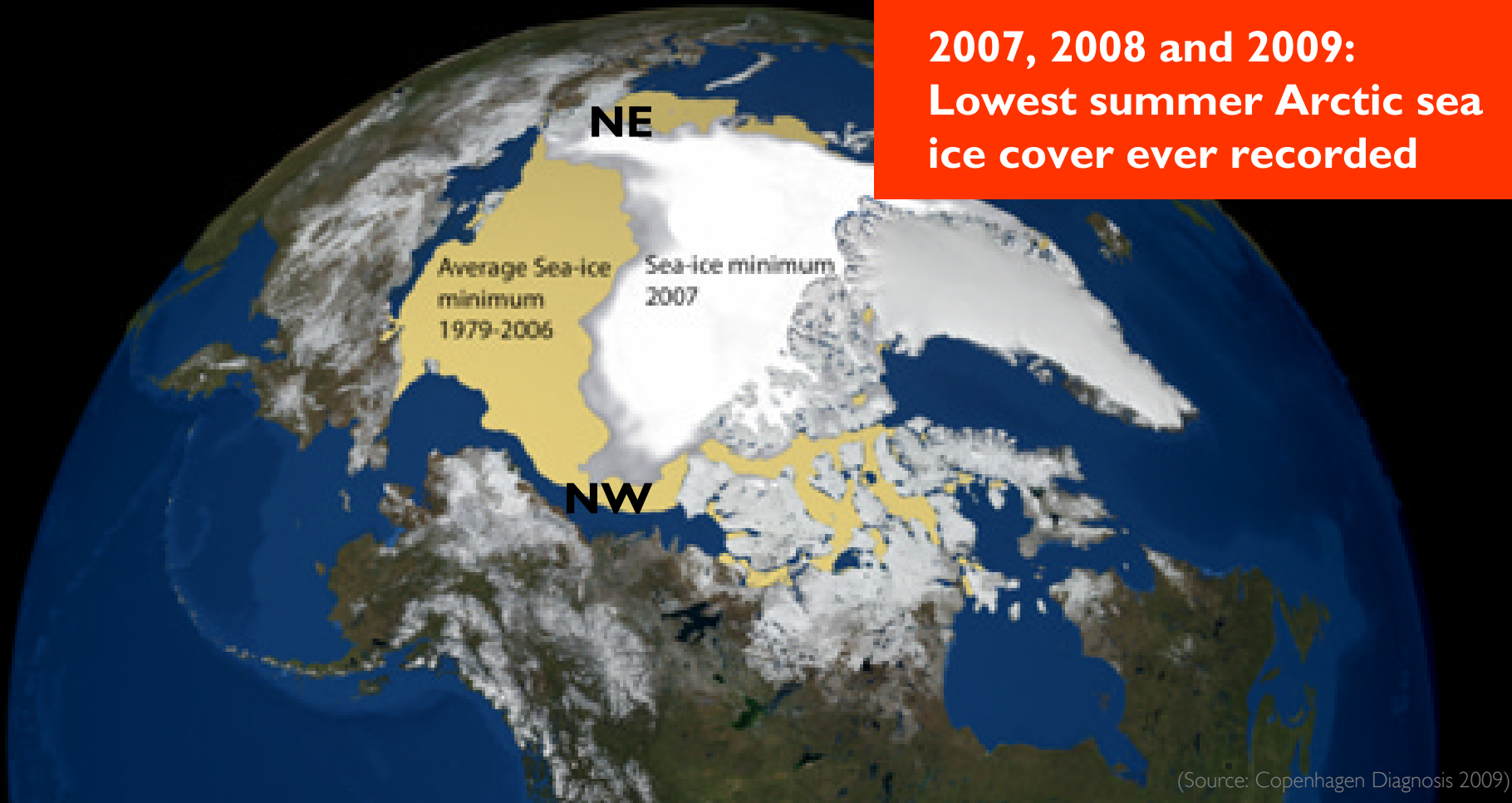
Calving Glacier in the Polar Region  
(Photo: Vera Bogaerts)

# 5. Escalating Temperatures

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

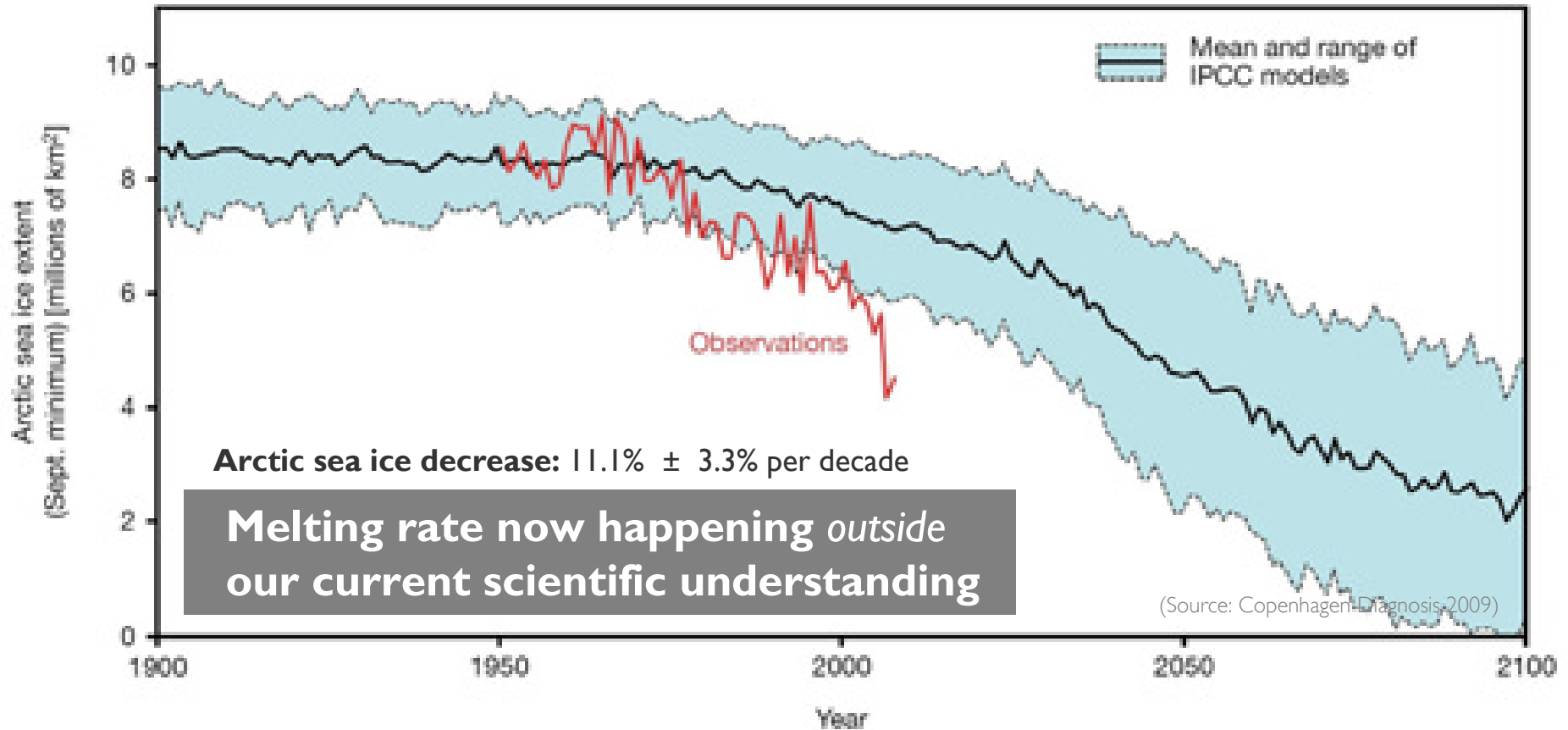


Among top 10 warmest years
2001
2002
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2006
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2008
2009



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

## Observed and modeled Arctic sea-ice decline



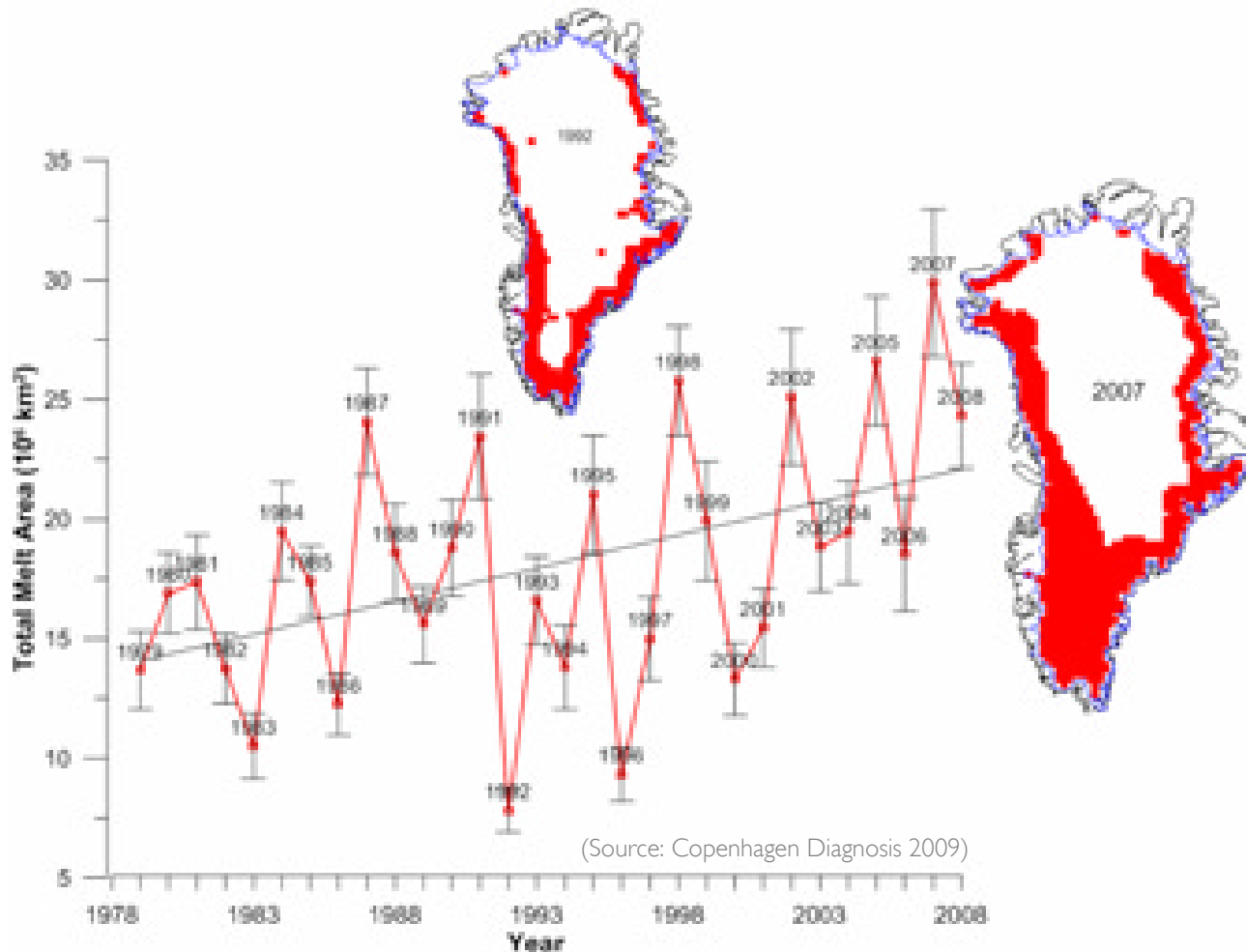
**While Arctic sea-ice decline is sea level neutral, proximity to Greenland is a cause for alarm**

**Coming Soon:**  
**Ice-Free Arctic Summers**





## 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

# 7. Sea Level Rise

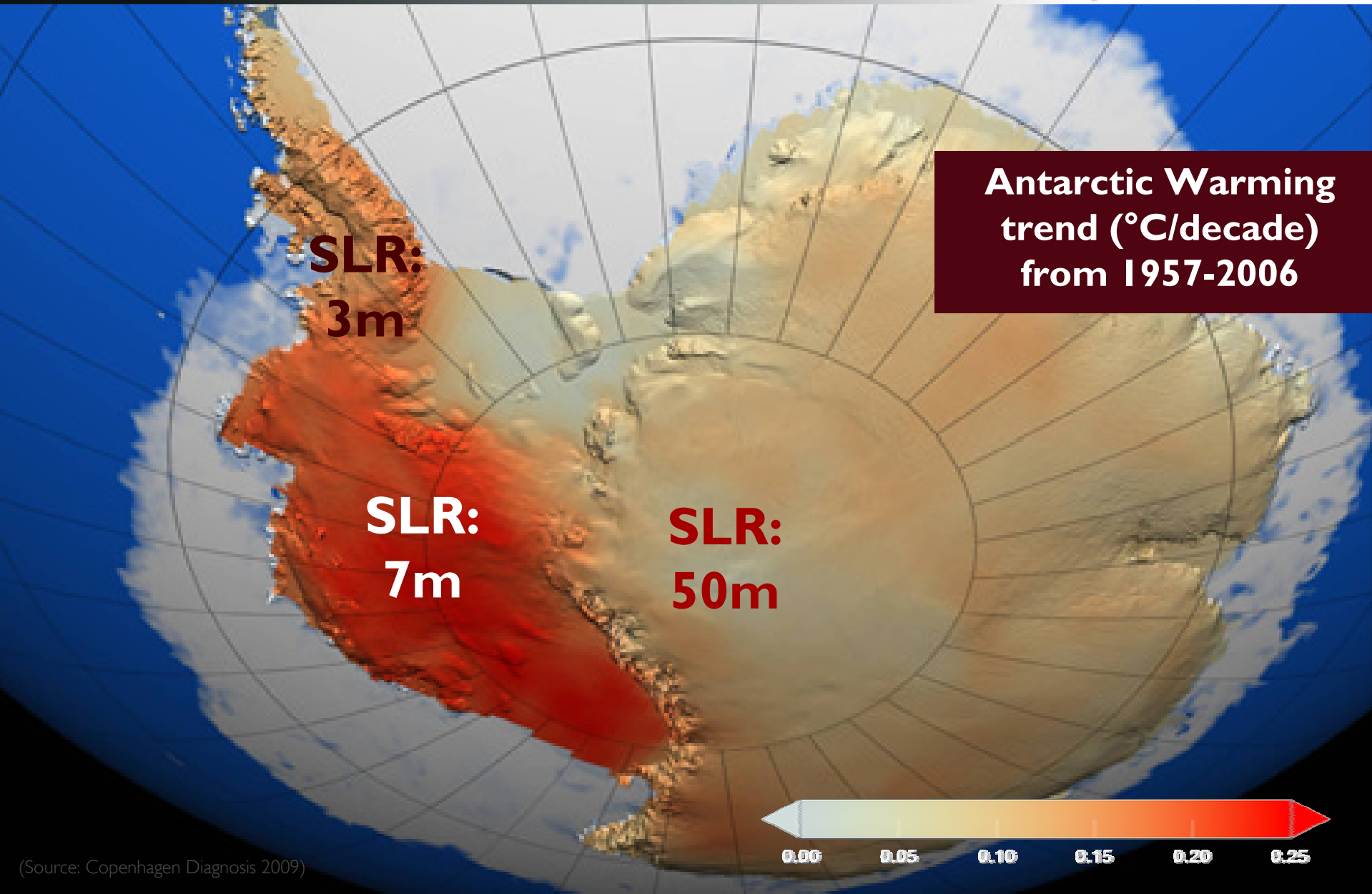


(Source: Copenhagen Diagnosis 2009)



**Greenland: Jakobshaven Isbrae  
ice shelf calving since 1851**

# 7. Sea Level Rise



(Source: Copenhagen Diagnosis 2009)

**Destabilisation of floating ice shelves is widespread along Antarctic Peninsula**

Antarctic ice shelf

(Photo: Armin Rose)

# 7. Sea Level Rise

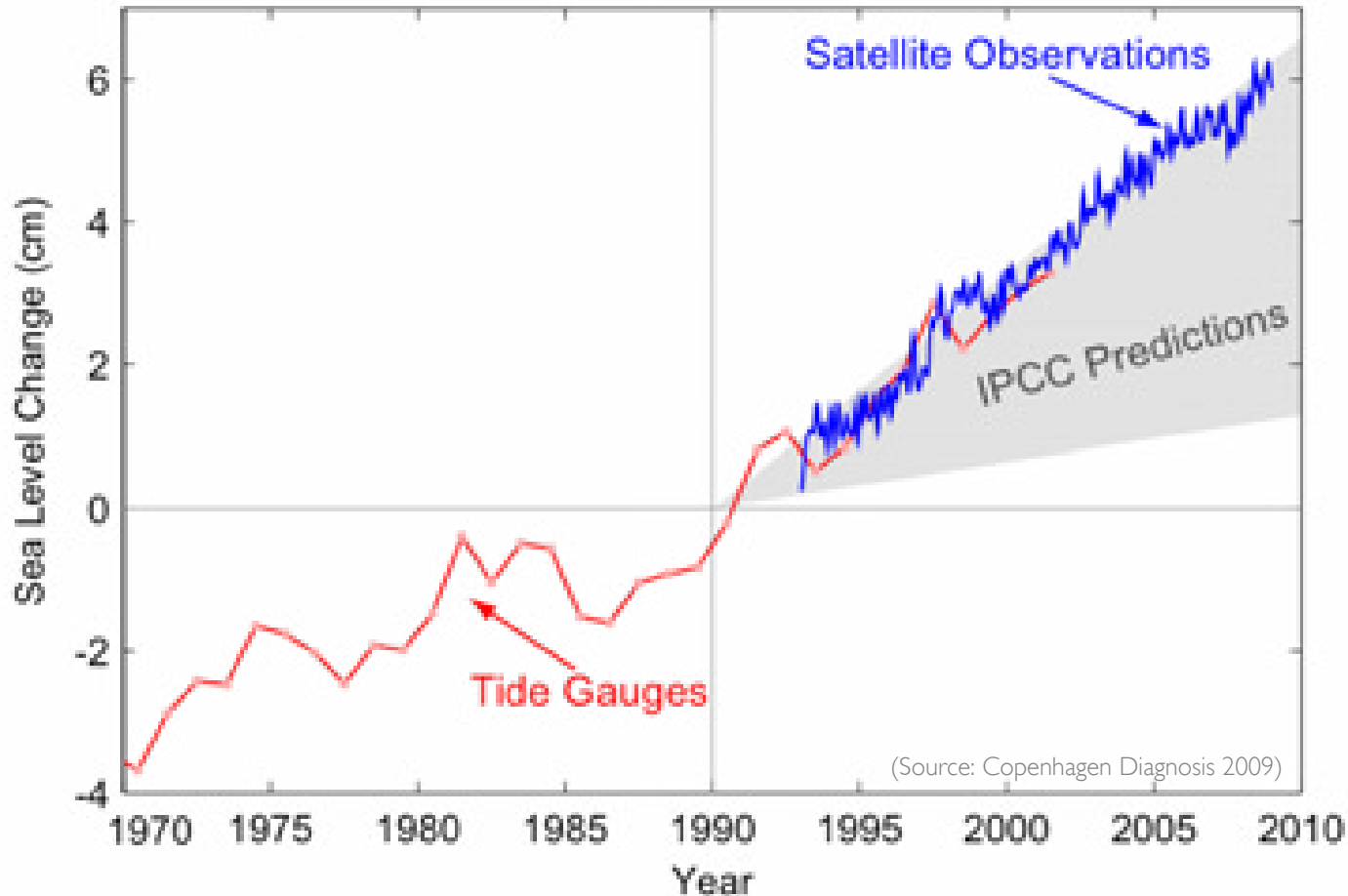


**2002: Larsen B Break-Up**

**7 Collapses in last 20 years**

(Photo: Amin Rose)

## Global sea level change 1970-2010

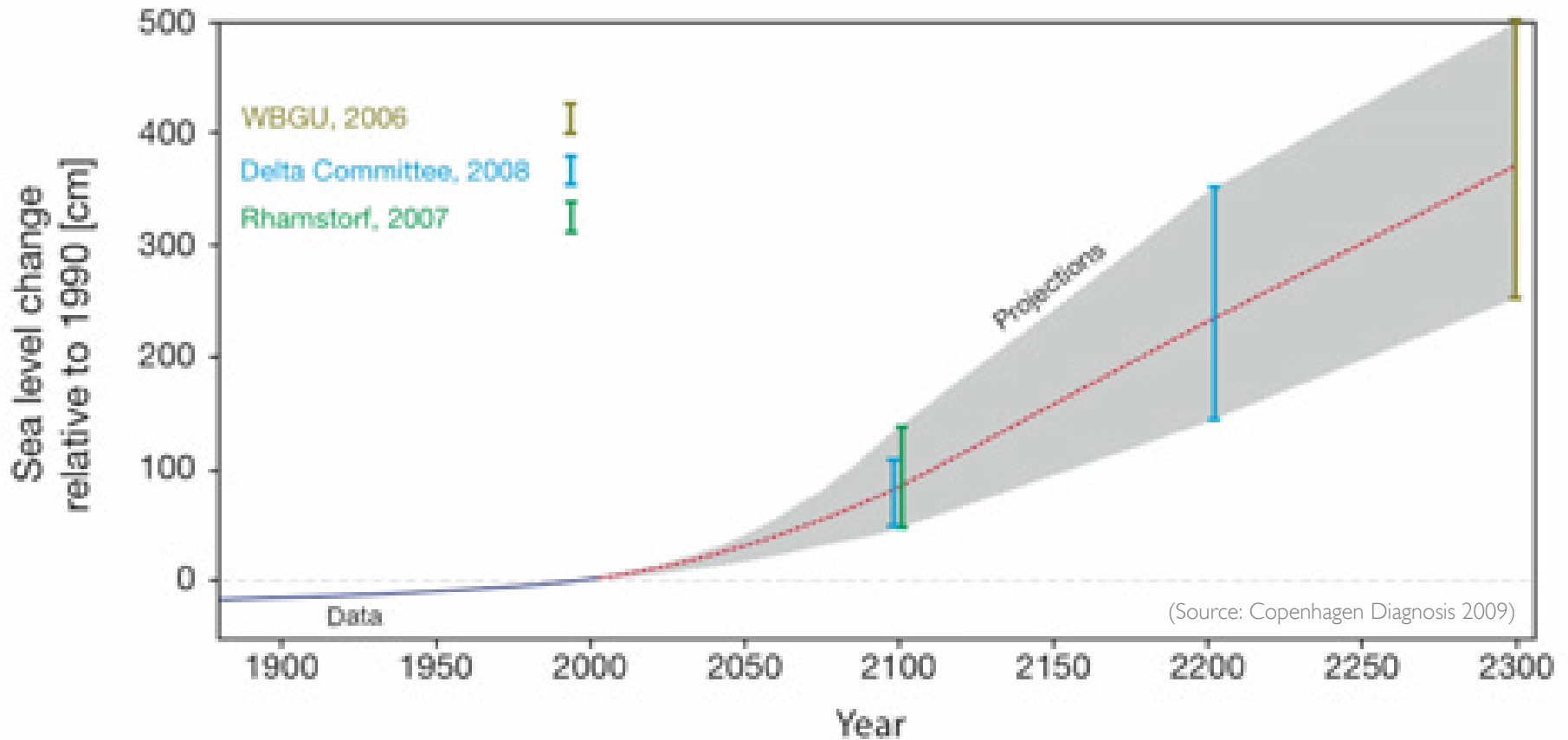


**SLR by  
2100:  
1-2m**

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

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

## Future sea-level projections



## Real Life Examples

**WATER**  
IS LIFE

Intergovernmental Panel on Climate Change (IPCC)

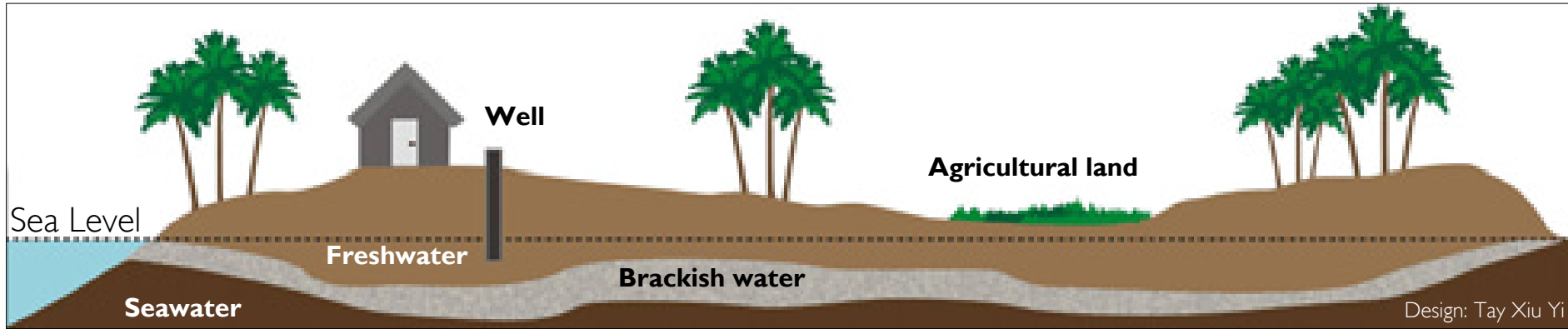
Island near Fiji (Photo: Wikipedia)

**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.”



# 7. Sea Level Rise

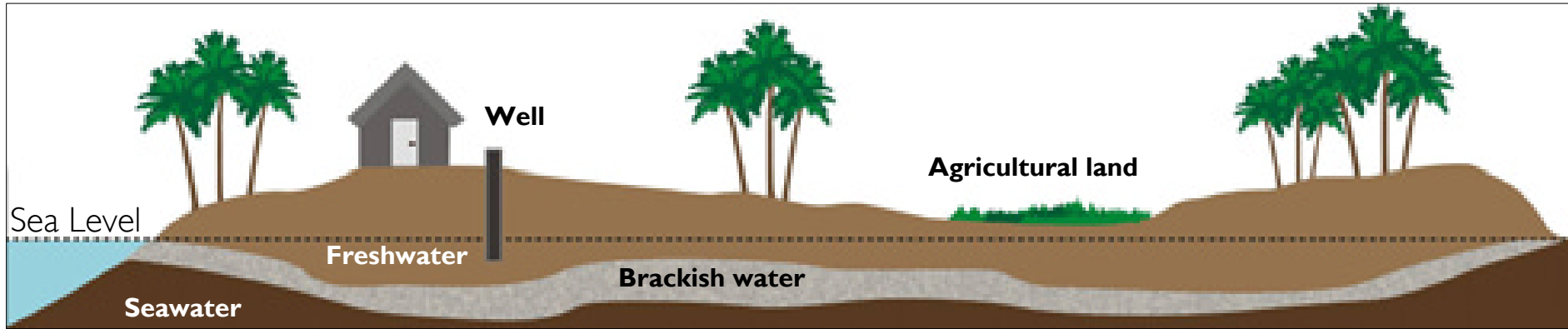
**Figure 1:** Normal sea level



**Island Submergence**

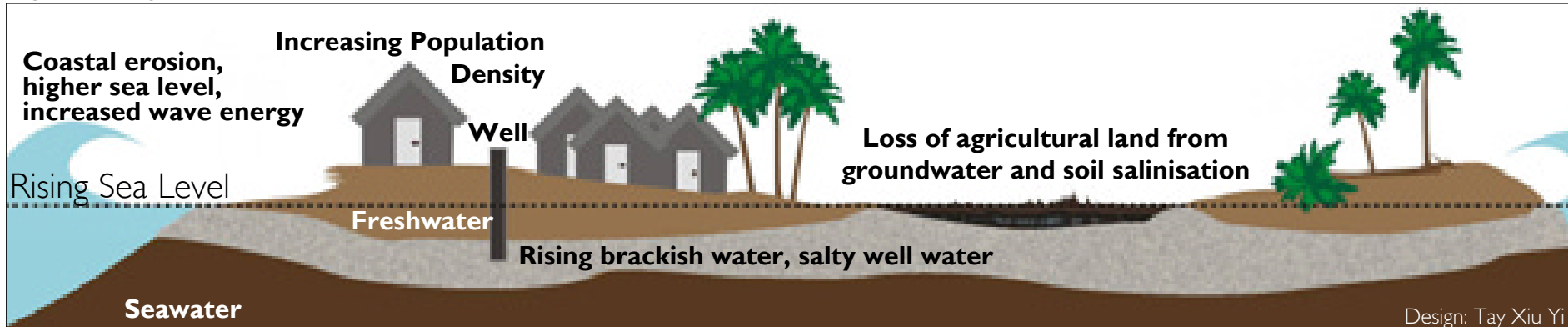
# 7. Sea Level Rise

**Figure 1:** Normal sea level



## Island Submergence

**Figure 2:** Rising sea level



Design: Tay Xiu Yi

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.”

# 7. Sea Level Rise

## 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.”



**Mosquito breeding swamps**

## **CARTERET** ATOLL

Photos: Tulele Peisa, Courtesy Pip Starr and Ursula Rakova

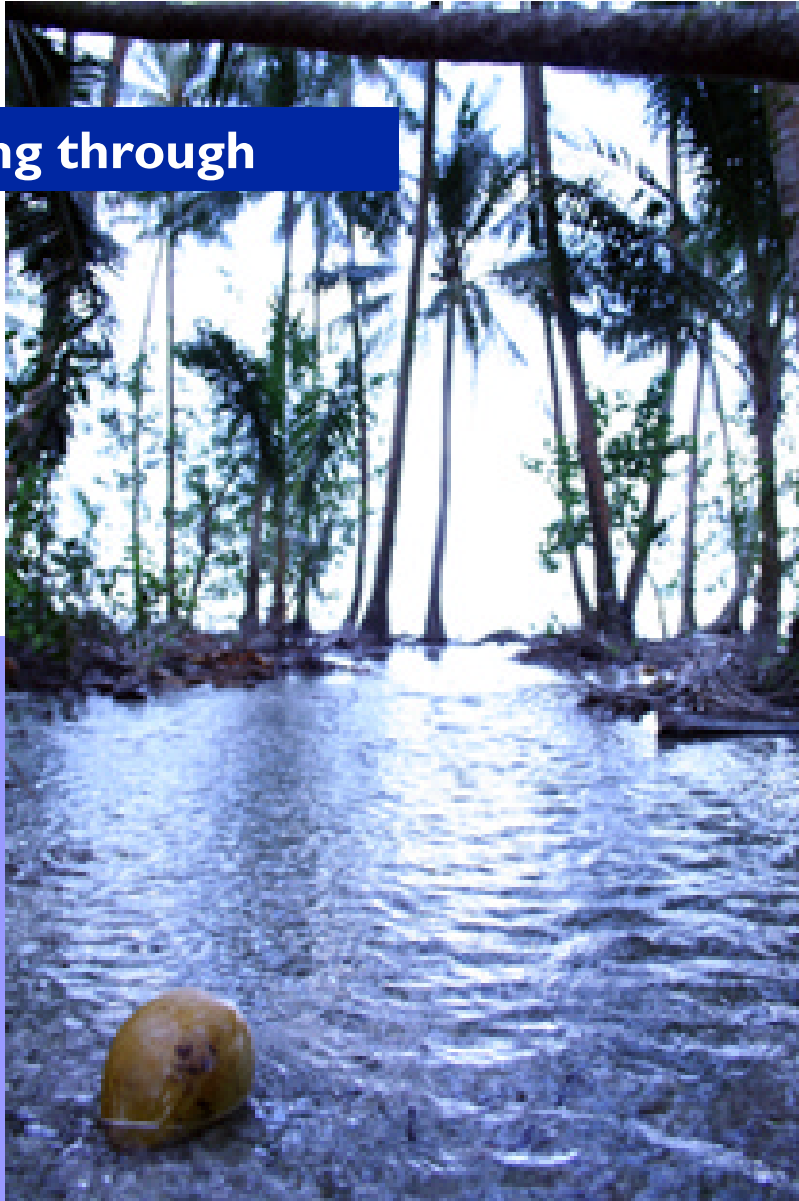


**Slicing through**

# CARTERET ATOLL

Photos: Tulele Peisa, Courtesy Pip Starr and Ursula Rakova

Slicing through



# CARTERET ATOLL

Photos: Tulele Peisa, Courtesy Pip Starr and Ursula Rakova



## Huene, Carteret Atoll

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

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.”





**Island of Buka**

Photo: Johannes Luetz

## **ISLAND ADAPTATION THROUGH SEA WALLS?**



- Island Fact 1:** uninhabitable long before submergence
- Island Fact 2:** difficult to “adapt/protect” long-term
- Island Fact 3:** eventually evacuation only escape route
- Island Fact 4:** 10 million islanders affected in Asia Pacific



**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 of Maldives:**

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

# 7. Sea Level Rise

## Dhuvafaaru, Maldives



Island of Dhuvafaaru, Maldives  
(Photo: Johannes Luetz)

# 7. Sea Level Rise



**Dhuvaafaru, Maldives**

Island of Dhuvaafaru, Maldives  
(Photo: Johannes Luetz)

# 7. Sea Level Rise



**Dhuvaafaru, Maldives**

Island of Dhuvaafaru, Maldives  
(Photo: Johannes Luetz)

# 8. Historical Emissions



**“Granny Maria” – 1958**

# 8. Historical Emissions



**Lloyd Alexander, 1958**



# 8. Historical Emissions

**40% of total emissions still airborne today  
(~ 5,200 kg CO<sub>2</sub>) as “historical emissions”**



# 8. Historical Emissions

## Cumulative CO<sub>2</sub> Emissions 1850-2006

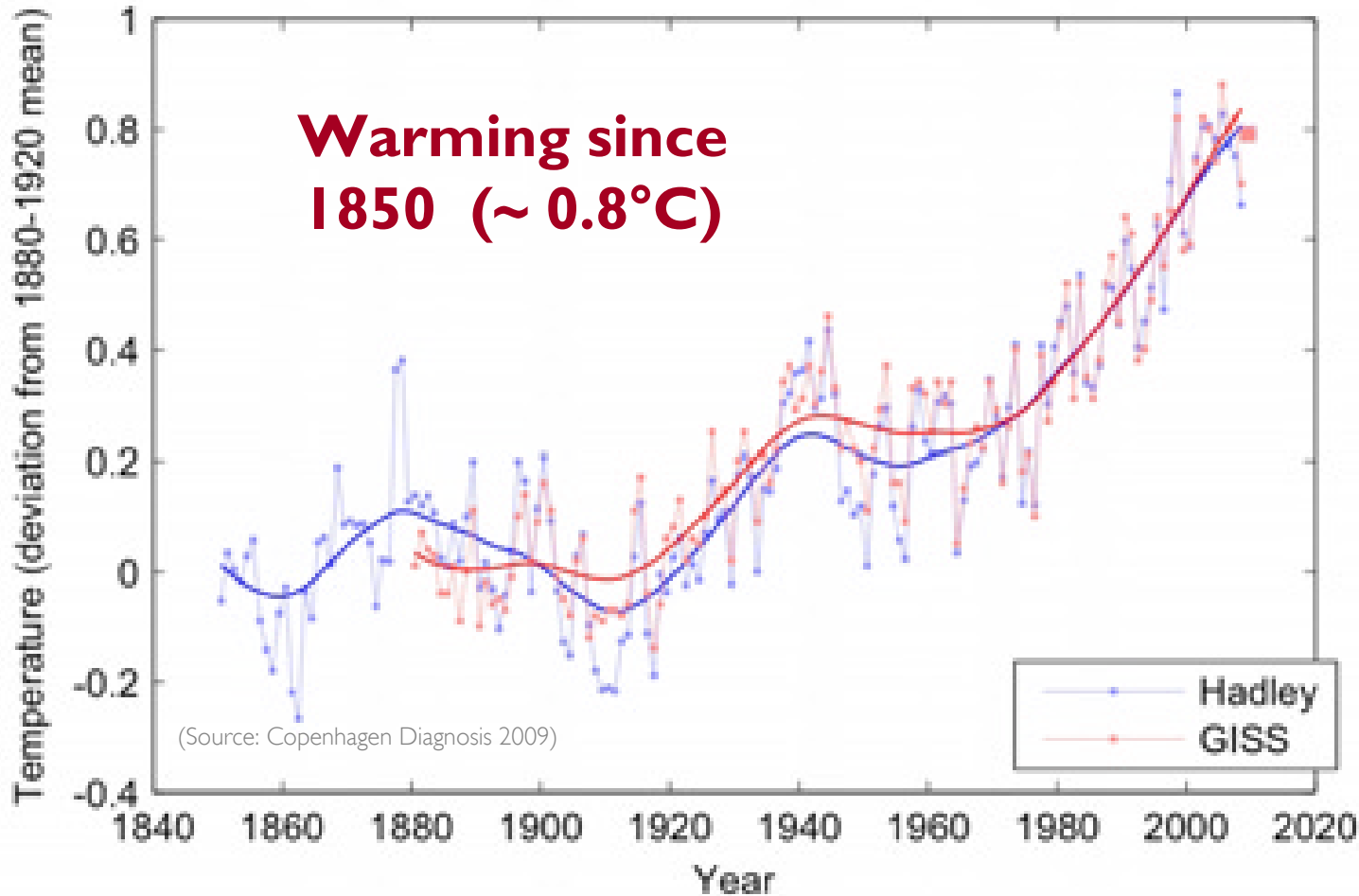
Rank	Country	Mt CO <sub>2</sub> e	% of World Total
1	United States of America	333,747.8	29.00%
2	European Union (27)	305,750.1	26.57%
3	China	99,204.2	8.62%
4	Russian Federation	93,081.6	8.09%
5	Germany	[80,377.0]	[6.99%]
6	United Kingdom	[68,235.8]	[5.93%]
7	Japan	44,535.2	3.87%
8	France	[32,278.6]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

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

# 9. Inertia of Climate System

1.3°Celsius

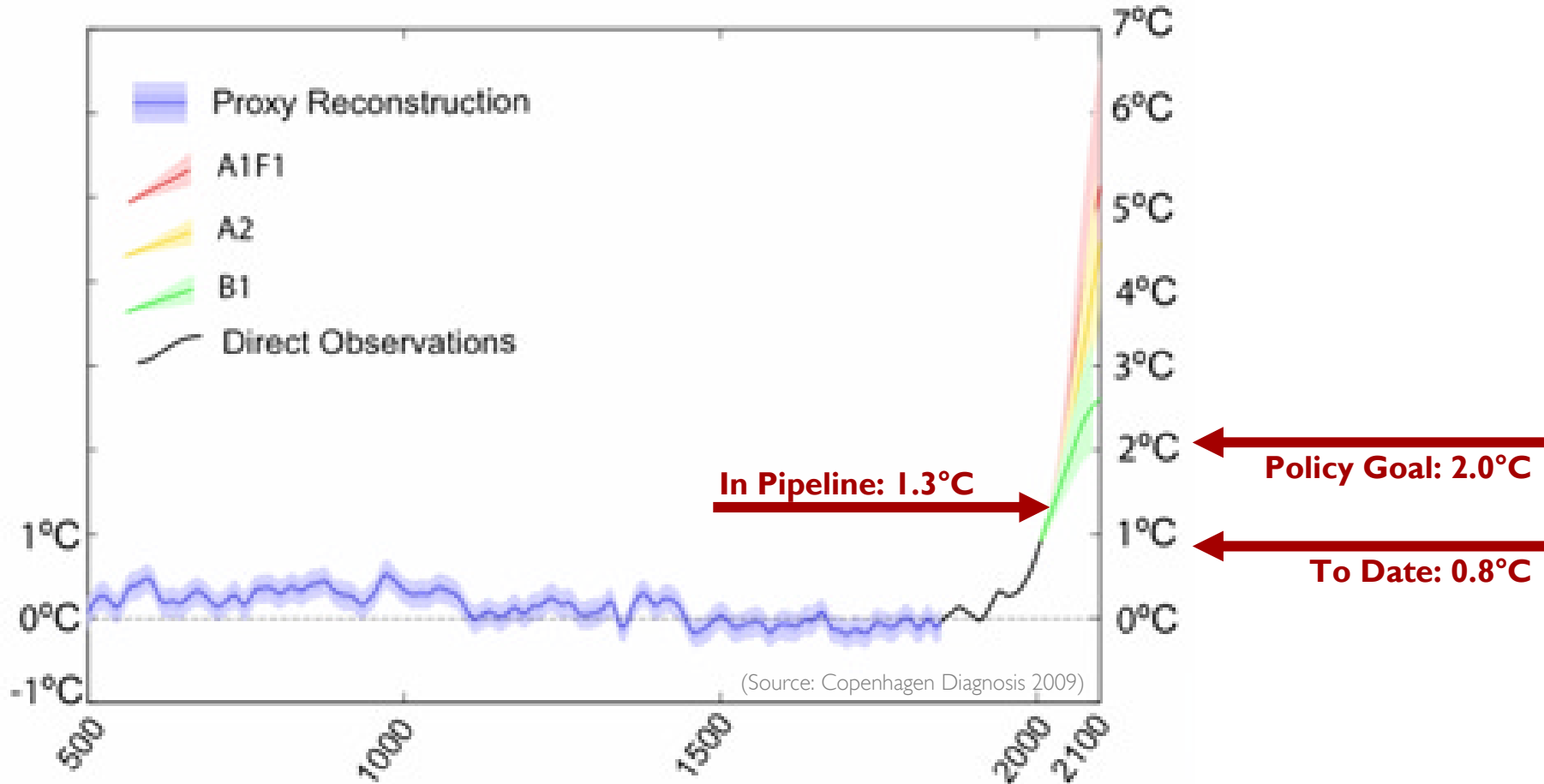
## Global average temperature 1850-2009



**“ Unchecked climate change outside the **2°Celsius** guard rail entails great risk. The negative consequences would pose unprecedented challenges for humankind. ”**

*German Advisory Council on Global Change (WBGU)*

## Reconstructed, observed and future warming projections



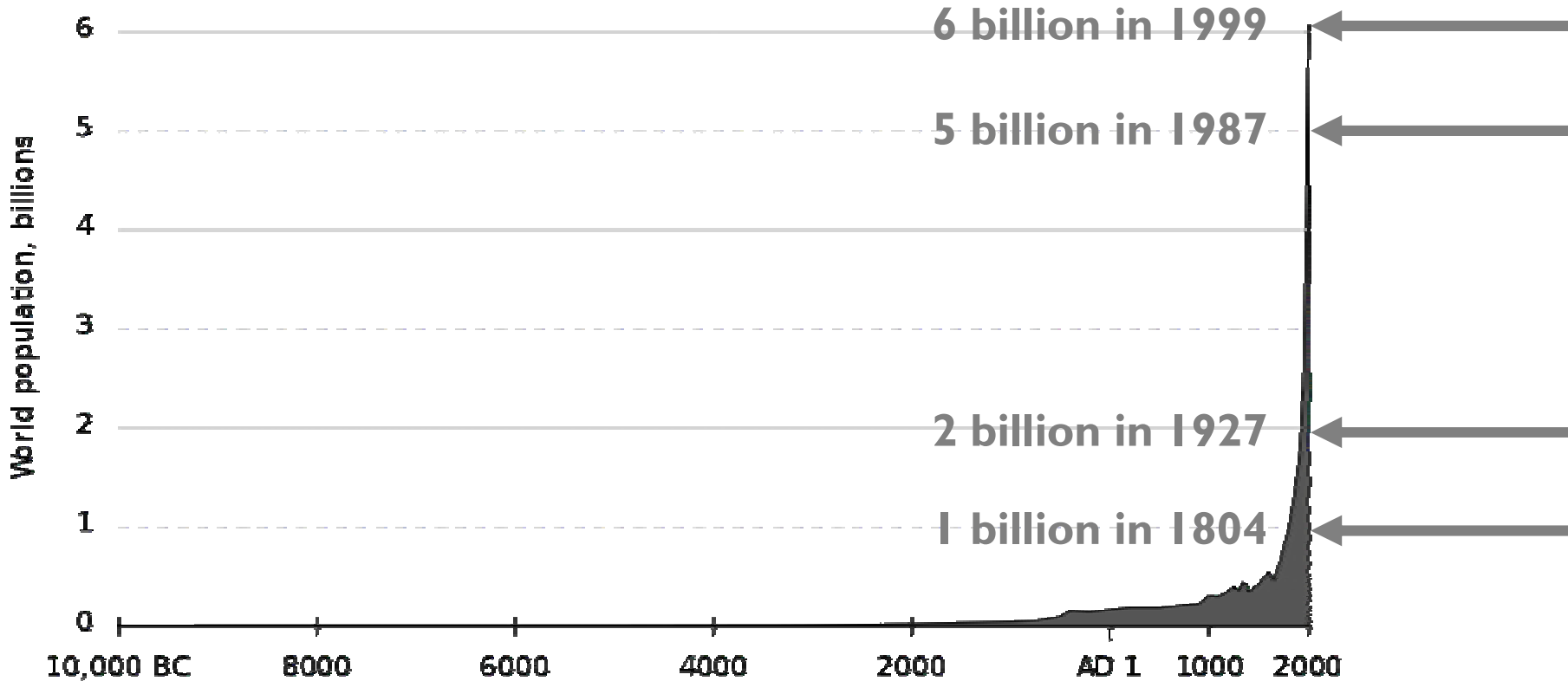
“ There is a window of opportunity for avoiding the most damaging climate change impacts, but that window is closing: the world has **less than a decade** to change course. Actions taken – or not taken – ...will have a profound bearing on the future. ”

*2007/2008 UN Human Development Report*

# 10. Population Pressures

**9.2 billion in 2050** ←

**Global Population in 2010 is 6.8 billion** →



# 10. Population Pressures

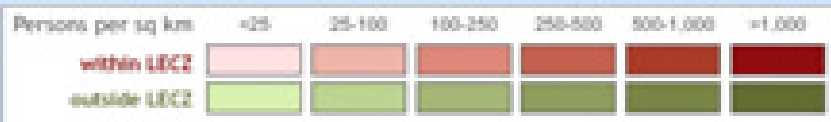
- 160 million live within 1 metre of sea level
- Coastal population densities: 3x higher than global average

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



**Coastal Hazards**

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





# 10. Population Pressures



Photo: Abi Hardjatmo

**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.

# 10. Population Pressures

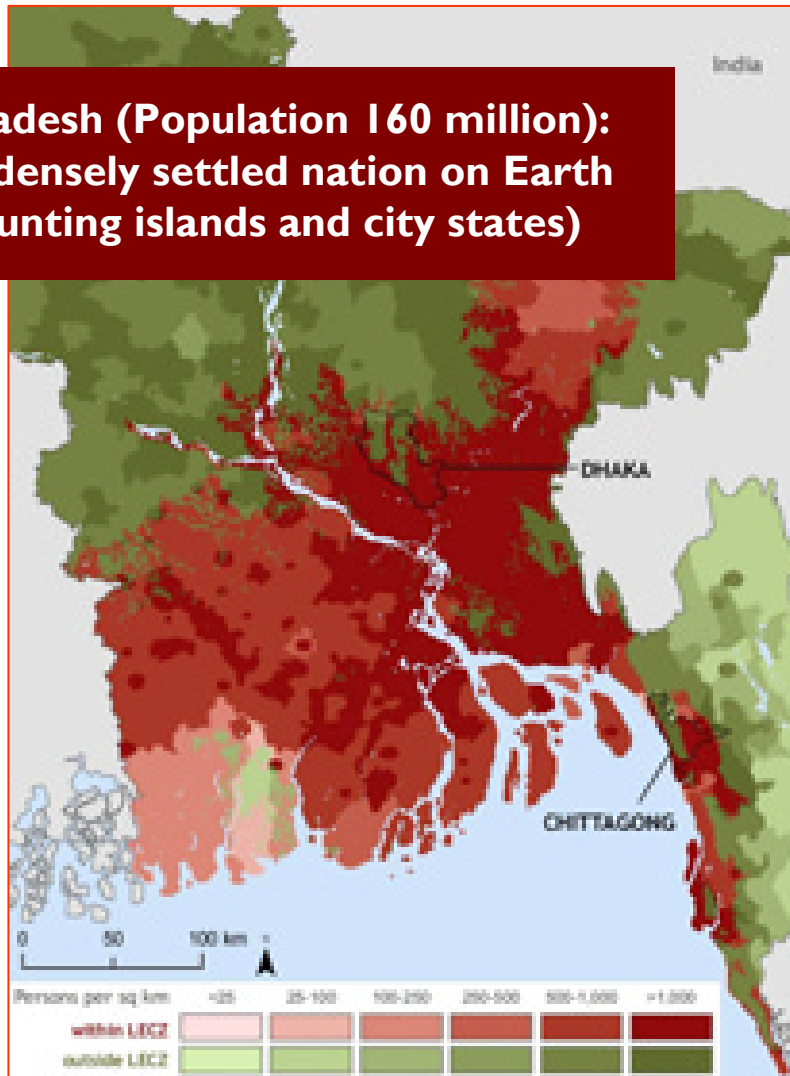


Photo: Abi Hardjatmo

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

# 10. Population Pressures

**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

**200 million climate  
exiles by 2050**

*(Norman Myers)*

**“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 Study)*

Darfur Blanket Feeding  
(Photo: World Vision)

“ For tomorrow belongs to the people who **PREPARE** for it today. ”

—African Proverb

1. Ten Pressures
2. **One Remedy**
3. Global Challenge

Longevity of CO<sub>2</sub>

Environmental Degradation

Accelerating CO<sub>2</sub> Emissions

Declining CO<sub>2</sub> Removal

Escalating Temperatures

Rogue Weather

Sea Level Rise

Historical Emissions

Inertia of the Climate System

Population Pressures

**L**ongevity of CO<sub>2</sub>  
**E**nvironmental Degradation  
**A**ccelerating CO<sub>2</sub> Emissions  
**D**eclining CO<sub>2</sub> Removal  
**E**scalating Temperatures  
**R**ogue Weather  
**S**ea Level Rise  
**H**istorical Emissions  
**I**nertia of the Climate System  
**P**opulation Pressures

**L**ongevity of CO<sub>2</sub>  
**E**nvironmental Degradation  
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**E**scalating Temperatures  
**R**ogue Weather  
**S**ea Level Rise  
**H**istorical Emissions  
**I**nertia of the Climate System  
**P**opulation Pressures

“  
**Courage is  
not the  
absence of  
fear – it is  
inspiring  
others to  
move  
beyond it.**”

—Nelson Mandela,  
*Lessons of Leadership*

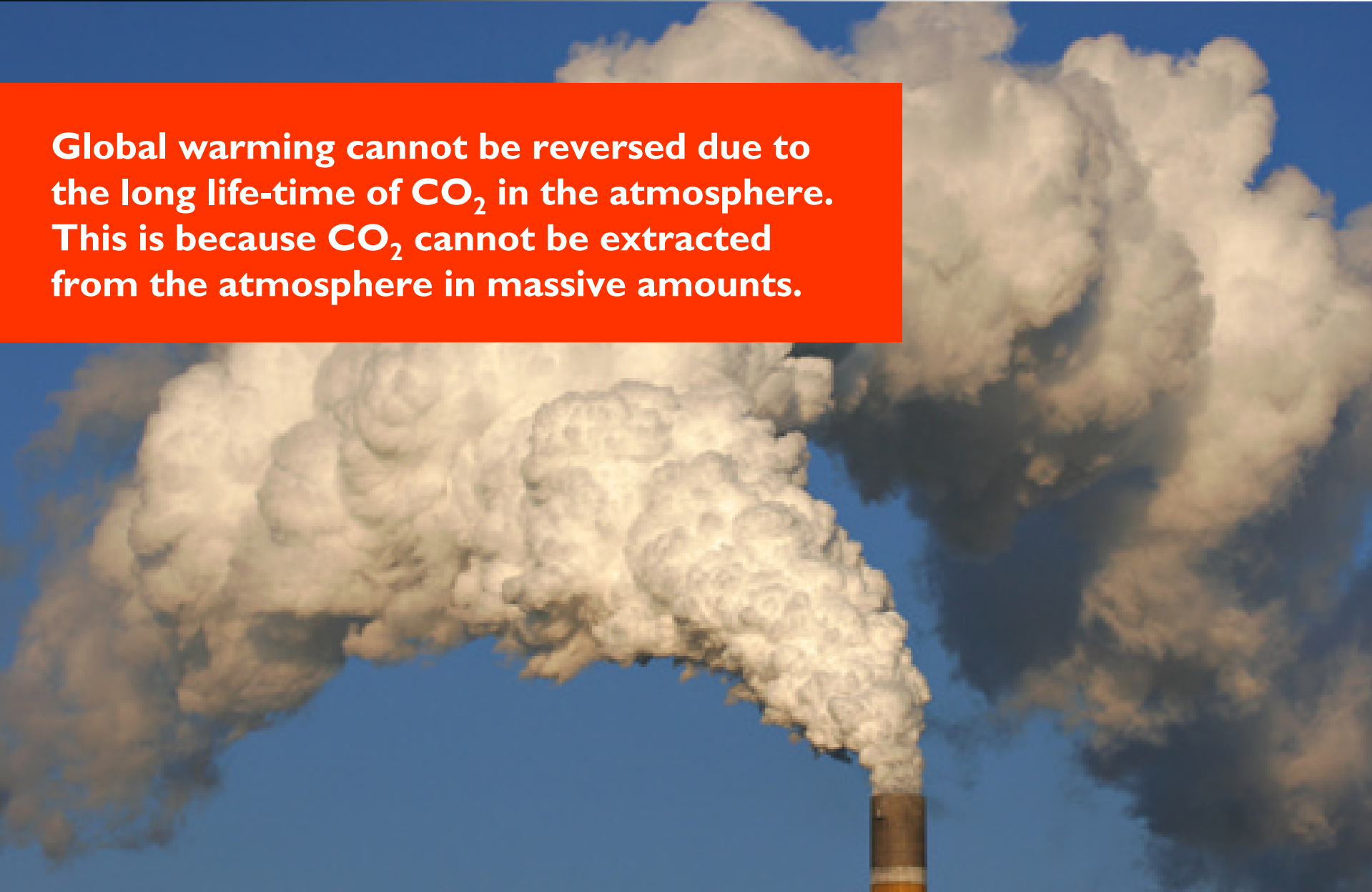


“ *For tomorrow belongs to the people who **PREPARE** for it today.* ”

—*African Proverb*

1. Ten Pressures
2. One Remedy
3. **Global Challenge**

**Global warming cannot be reversed due to the long life-time of  $\text{CO}_2$  in the atmosphere. This is because  $\text{CO}_2$  cannot be extracted from the atmosphere in massive amounts.**





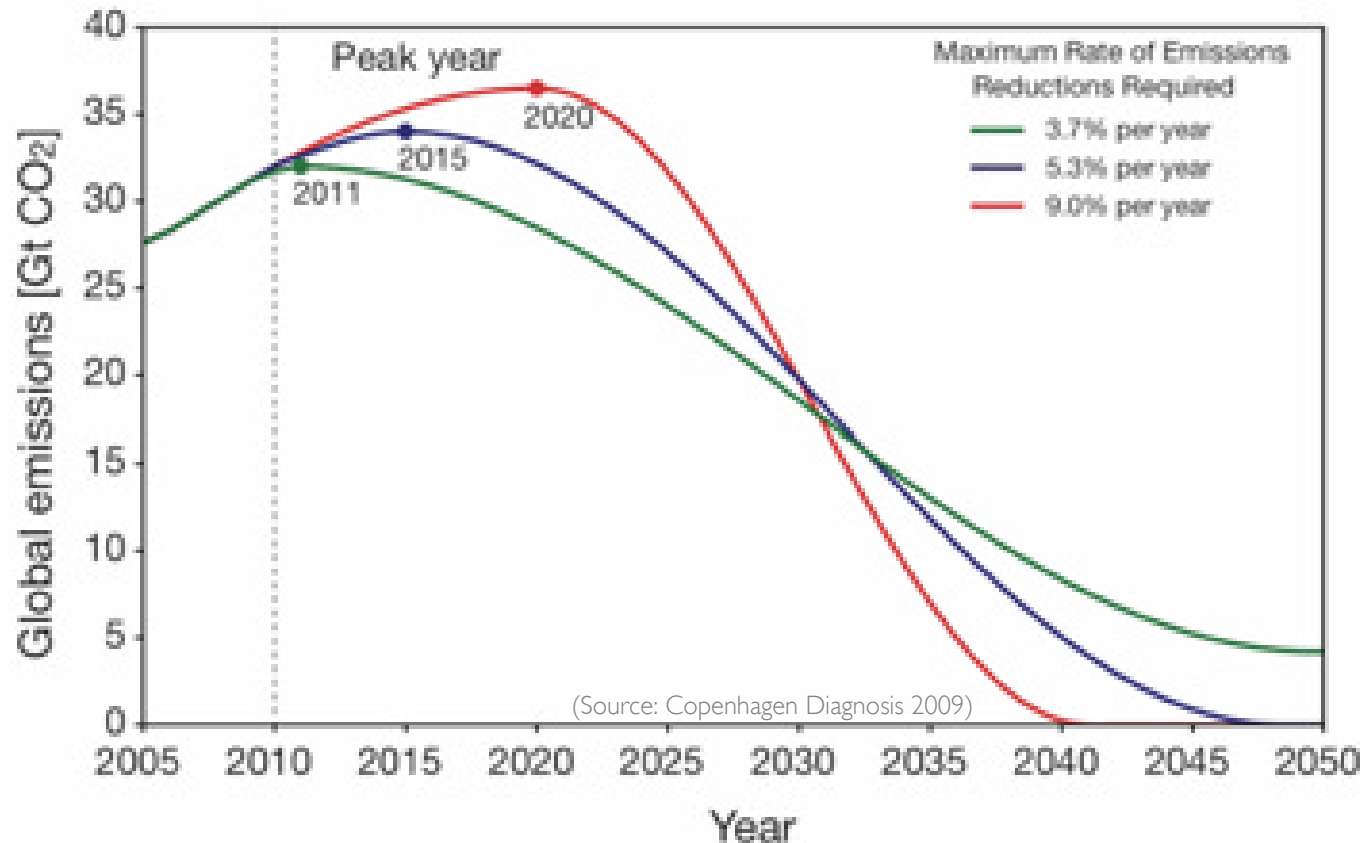
**Global warming can be completely stopped. The temperature at which global warming will finally stop depends mainly on the total amount of CO<sub>2</sub> released into the atmosphere since industrialisation.**

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

**Zero Emissions?  
Zero Regrets!**



## Emissions pathways leaving 67% chance of limiting global warming to 2°C



**750Gt – 2050**

**By 2050,  
annual per  
capita  
emissions  
very likely will  
need to be  
below 1 ton.**

**Annual per-capita CO<sub>2</sub>  
emissions below 1 ton**

**A decarbonised  
global society with  
near-zero emissions  
of CO<sub>2</sub> needs to be  
reached by 2050  
(1 Person = 1t CO<sub>2</sub>)**



**2010 → Per-capita CO<sub>2</sub> emissions from Canada trip:  
well over 1 ton**

**2050 → Total annual per-capita CO<sub>2</sub> emissions:  
well under 1 ton**

# Wanted: Leadership!



(Photo: Schwartz)



# Wanted: Leadership!



**“We need to be the change  
we wish to see in the world.”**

*—Gandhi*

(Photo: Jean Schweitzer)

“

*... indecision brings its own delays,  
And days are lost lamenting o'er lost days.  
Are you in earnest? Seize this very minute —  
What you can do, or dream you can, begin it,  
Boldness has genius, power, and magic in it.  
Only engage, and then the mind grows heated —  
Begin it, and the work will be completed!*

”

—Johann Wolfgang von Goethe,  
German Playwright, Poet, Novelist and Dramatist (1749-1832)

# Thank You!

## **World Vision Global Relief Forum:**

Planet Prepare – Next Steps

Ottawa, Canada, 5-11 May 2010

**Report and background material:**

<http://www.copenhagendiagnosis.org>

<http://www.wbgu.de>

<http://www.ipcc.ch>

**Presentation available for  
World Vision internal use:**

<http://luetz.com>



**LUETZ**

Promoting poverty reduction, climate justice and organisational learning

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