WMO

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Climate change
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Implications for India

R.K. Pachauri
Chairman, IPCC
Director-General, TERI

New Delhi
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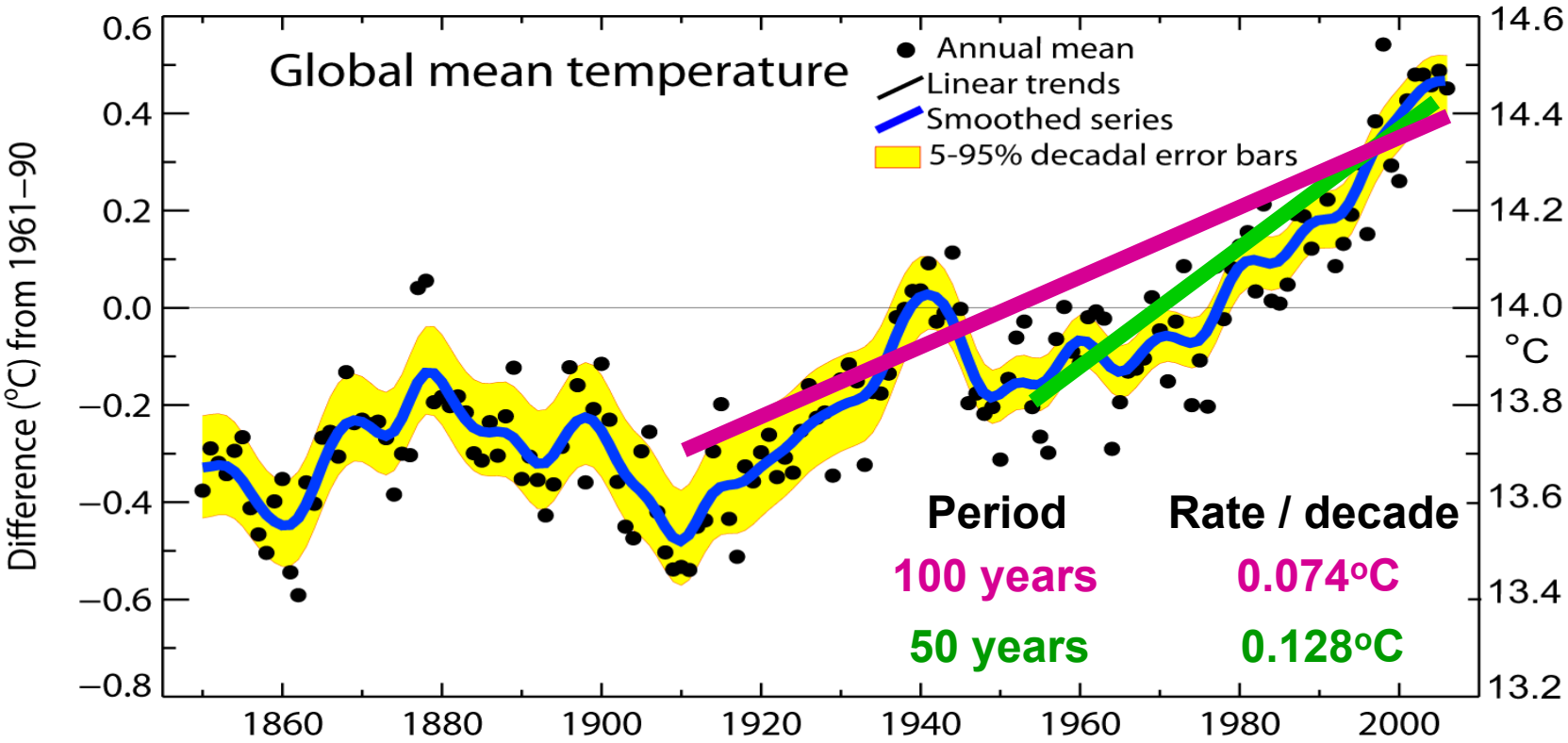
IPCC

Climate change is unequivocal

Changes in global average surface temperature



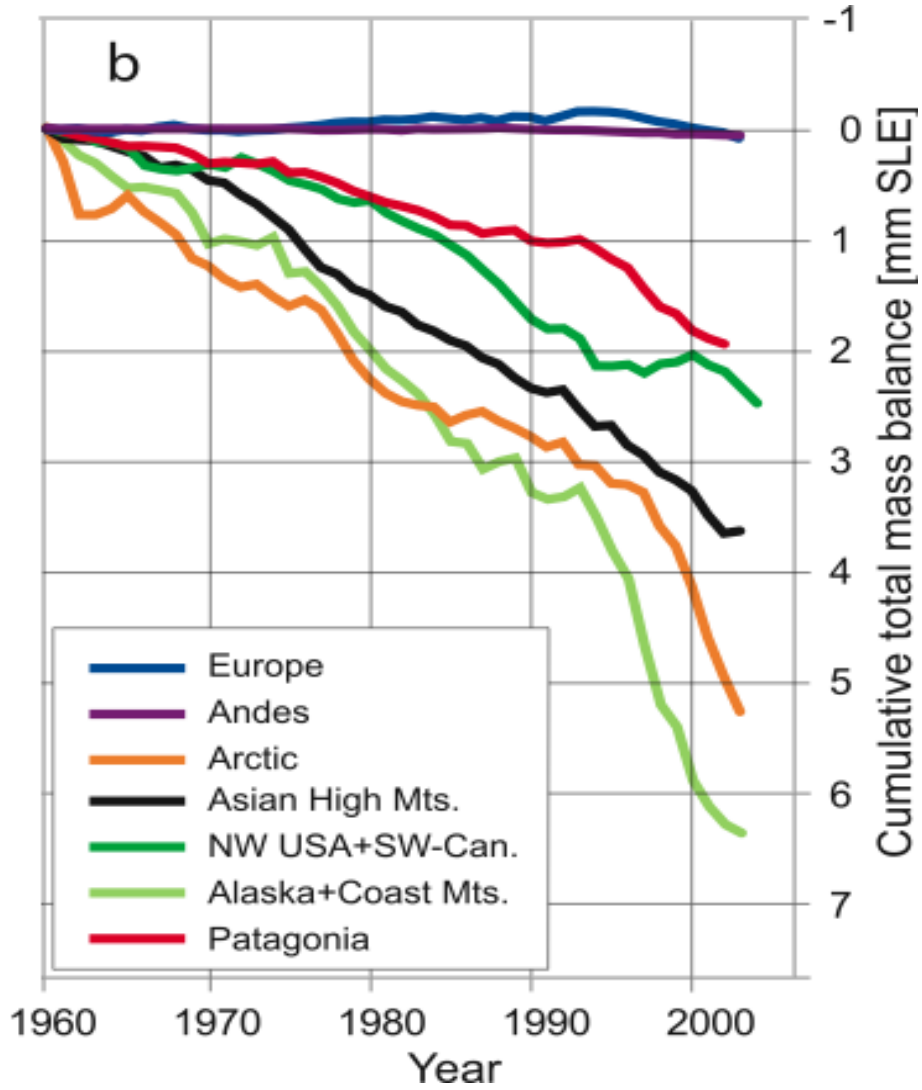
Eleven of the last twelve years rank among the twelve warmest years in the instrumental record of global surface temperature

Cumulative balance of glacier mass

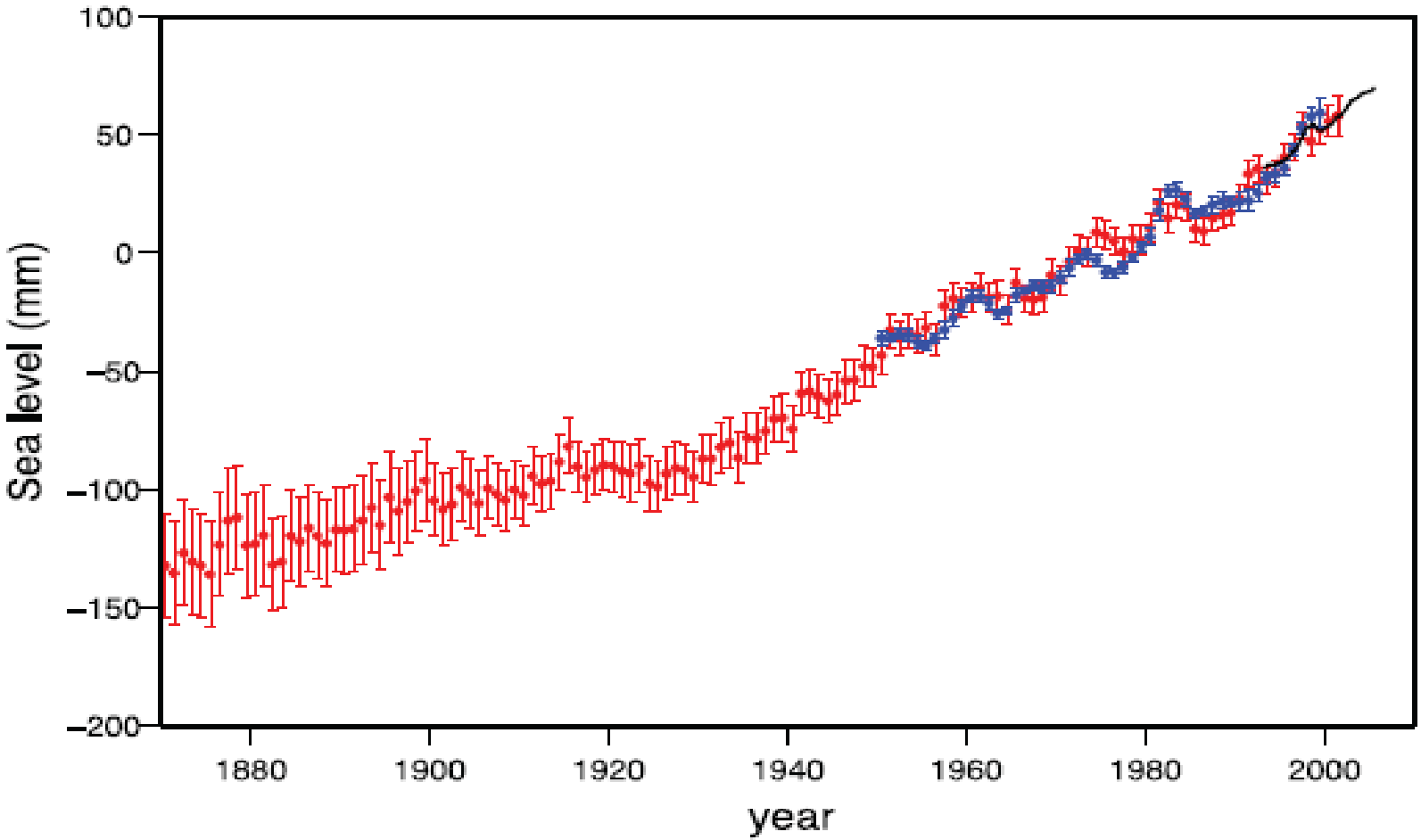
Decreases in glaciers have contributed about 28% of sea level rise since 1993

(thermal expansion oceans: 57%; losses from polar ice sheets: 15%)

Water supplies stored in glaciers are projected to decline in the course of the century



Changes in global average sea level

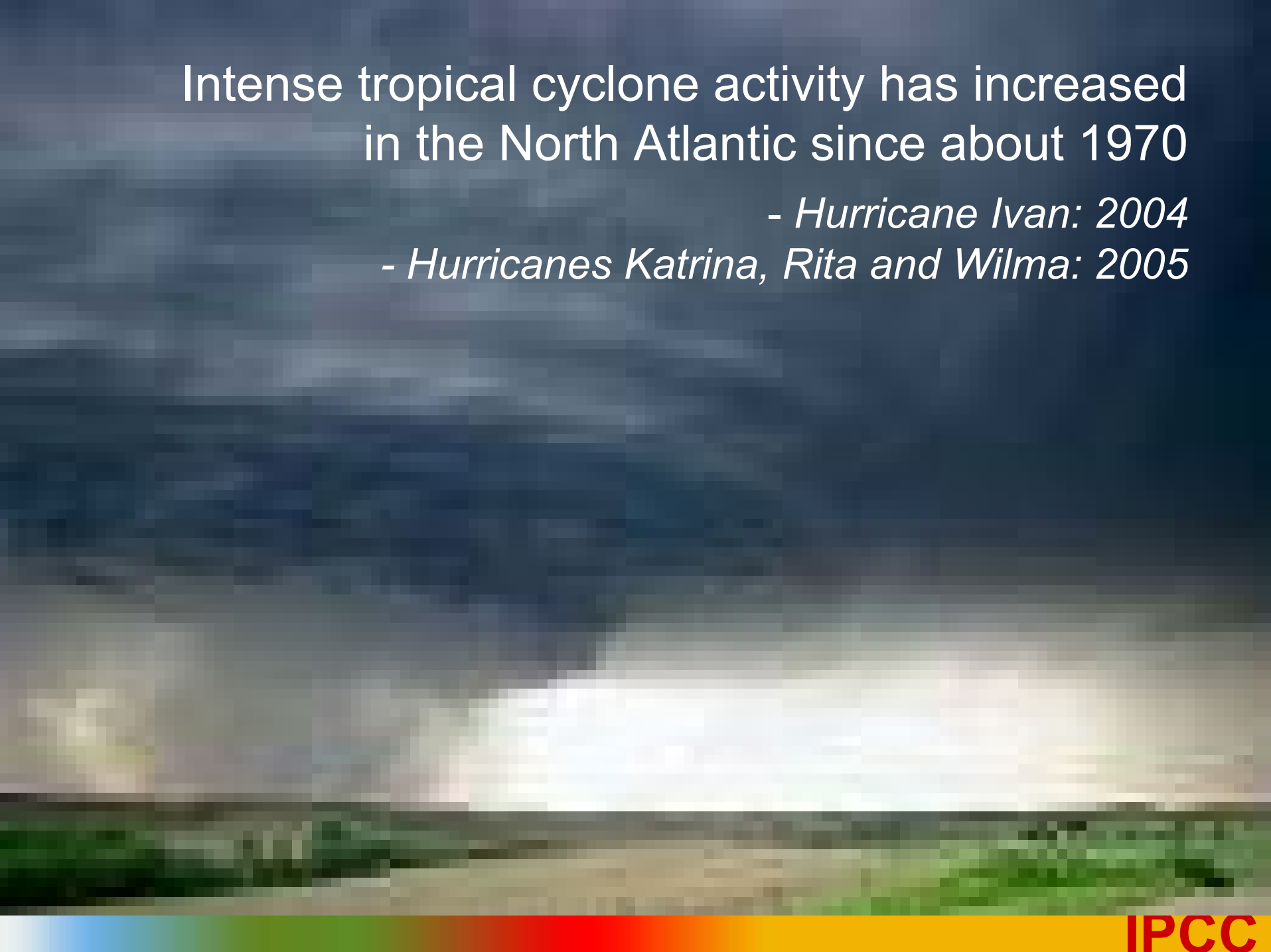


Global average sea level has risen since 1961 at an average rate of 1.8mm/yr and since 1993 at 3.1mm/yr

Average arctic temperatures increased at almost twice the global average rate in the past 100 years

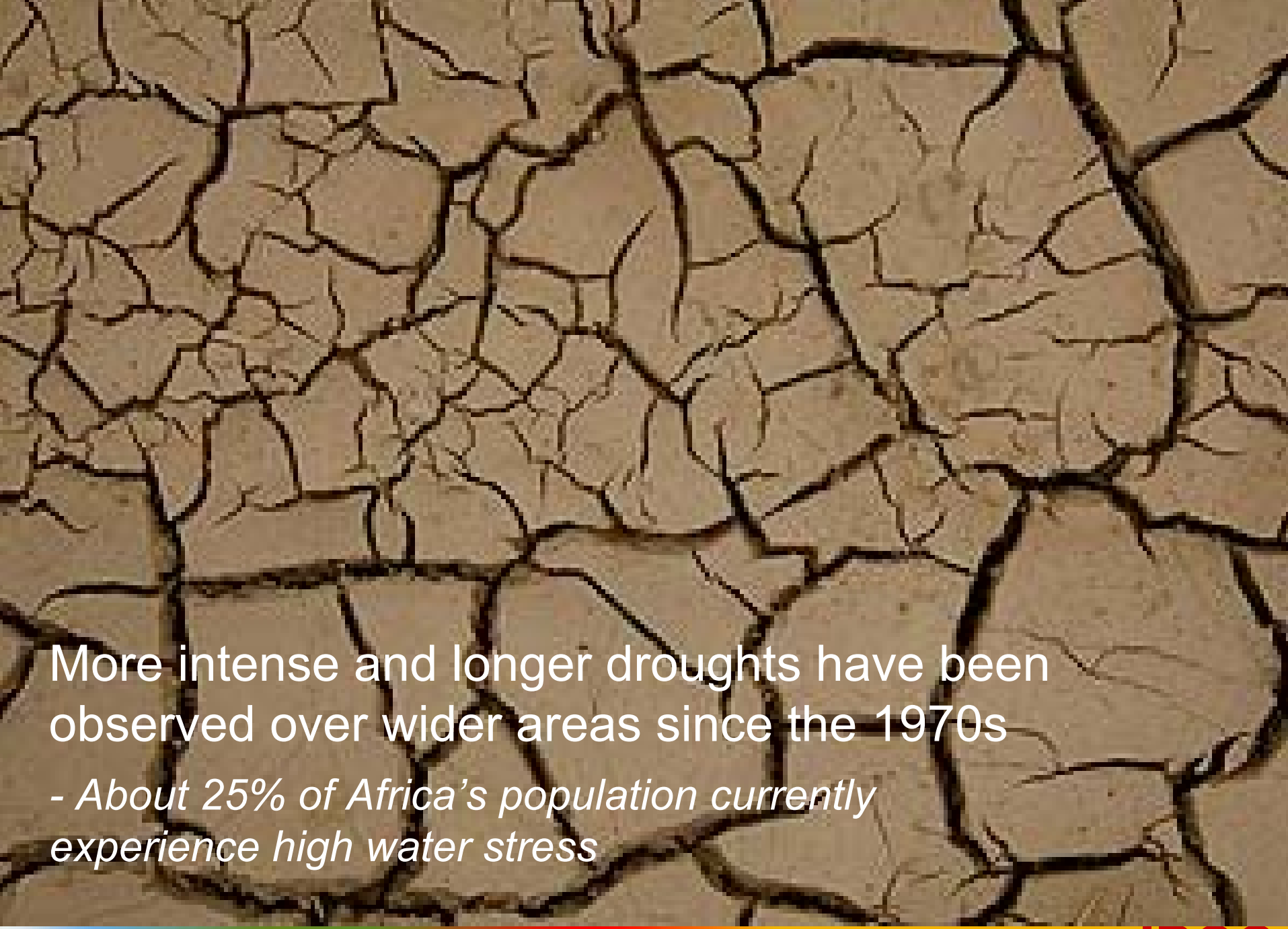
- Annual average arctic sea ice extent has shrunk by 2.7% per decade


Heat waves have become more frequent
over most land areas
- Heat wave in Europe, 2003: 35 000 deaths
IPCC


Intense tropical cyclone activity has increased in the North Atlantic since about 1970
- Hurricane Ivan: 2004
- Hurricanes Katrina, Rita and Wilma: 2005
IPCC

The frequency of heavy precipitation events has increased over most land areas

- Rainfall in Mumbai (India), 2005: 1 million people lost their homes



More intense and longer droughts have been observed over wider areas since the 1970s

- About 25% of Africa's population currently experience high water stress

Observed changes and impacts in India

Increase in frequency of **heat waves**

- 18 heat waves reported between 1980 and 1998
- More than 3000 deaths caused by heat waves in 2003 in Andhra Pradesh

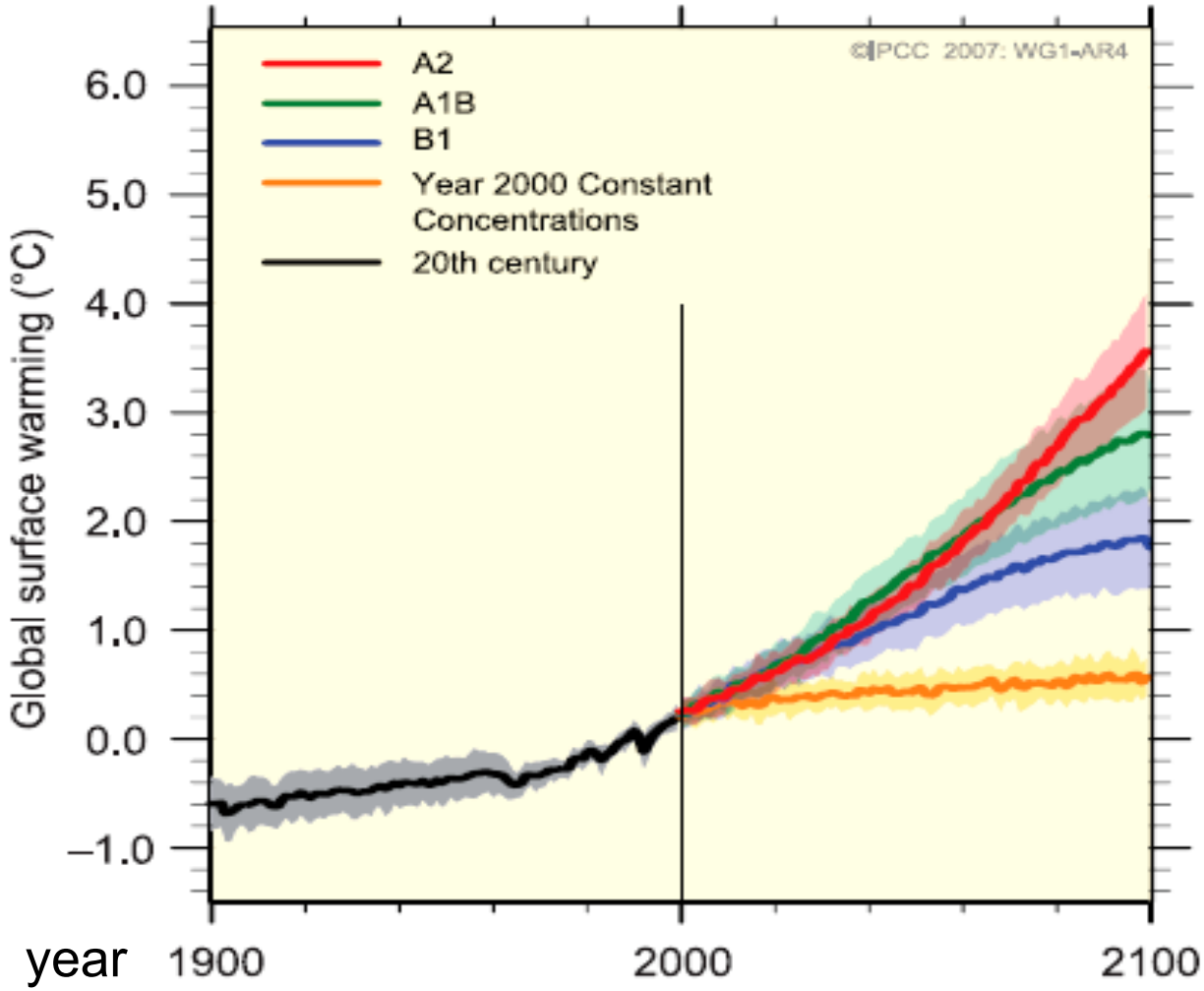
Lower number of rainy days along east coast and **droughts** in delta regions

- Exacerbation of existing water stress
- Severe degradation of ecosystems

Increase in **extreme rains** in north during monsoon

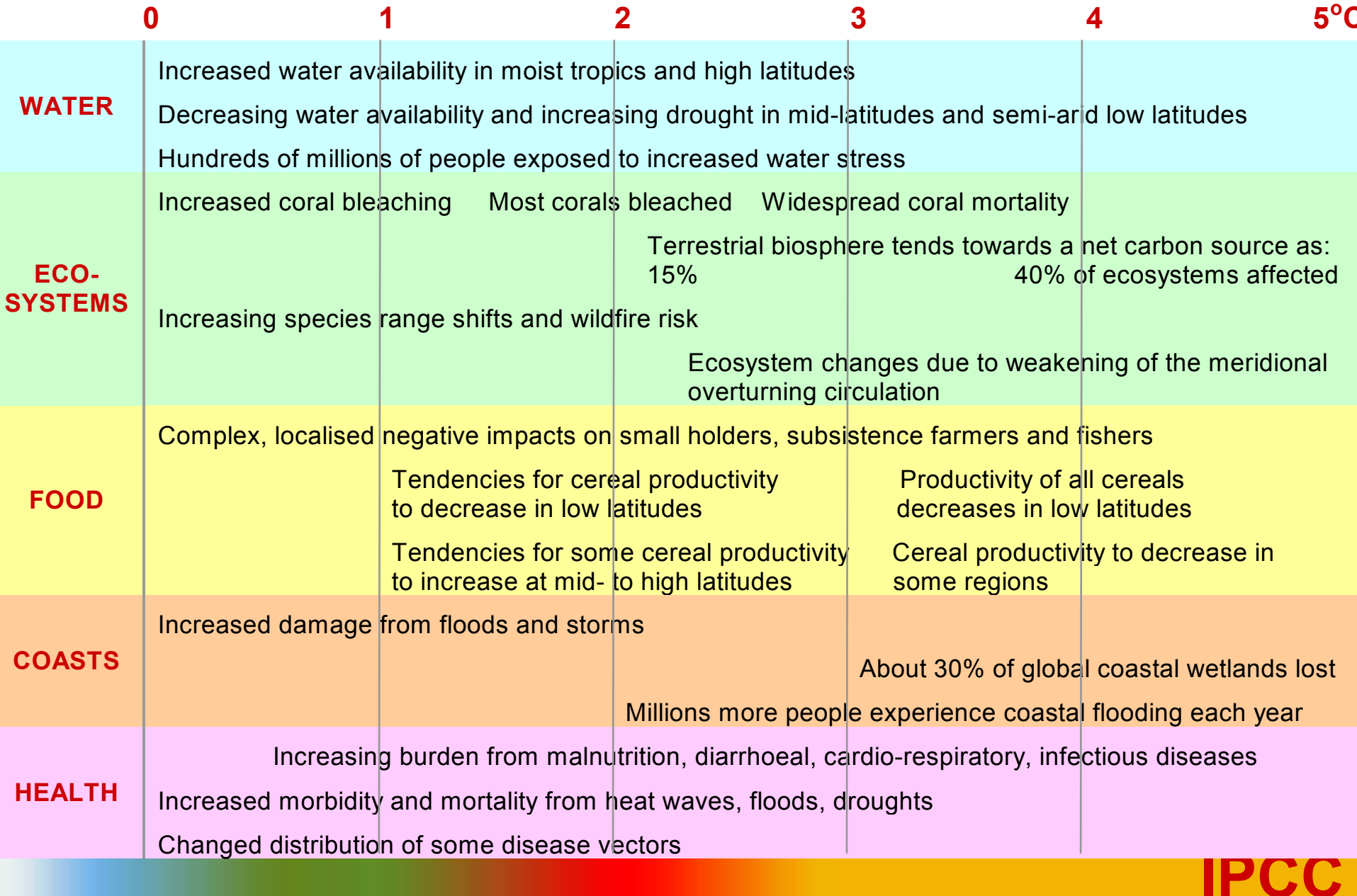
- Serious and recurrent floods in north-east states

Ranges for predicted surface warming



Continued emissions would lead to further warming of 1.8ºC to 4ºC over the 21st century

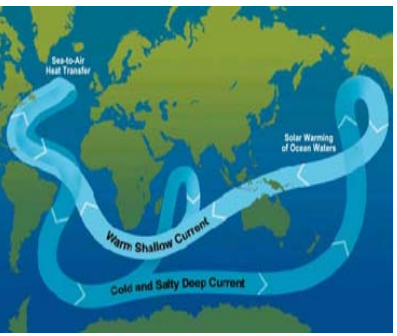
Examples of impacts associated with warming



Climate change could lead to some abrupt or irreversible impacts

Partial loss of ice sheets on polar land could imply metres of **sea level rise**, major changes in coastlines and inundation of low-lying areas

20-30% of **species** are likely to be at risk of extinction if increases in warming exceed 1.5-2.5°C



Large scale and persistent changes in **Meridional Overturning Circulation** would have impacts on marine ecosystem productivity, fisheries, ocean CO_2 uptake and terrestrial vegetation

Expected impacts of climate change in India

Impacts on human health

Endemic morbidity and mortality due to **diarrhoeal disease** primarily associated with floods and droughts

Exacerbation of the abundance and toxicity of **cholera** due to increase in coastal water temperature

Increased **deaths, disease and injury** due to heat waves, floods, storms, fires and droughts

Impacts on food production

Crop yields could increase up to 20% in East and Southeast Asia while they could decrease up to 30% in Central and South Asia by 2050

In India, wheat yields could decrease by **5-10%** per one-degree rise in temperature

Impacts on water resources

Glacier melt projected to increase flooding, rock avalanches and to affect water resources within the next two to three decades

Salinity of groundwater especially along the coast, due to increases in sea level and over-exploitation

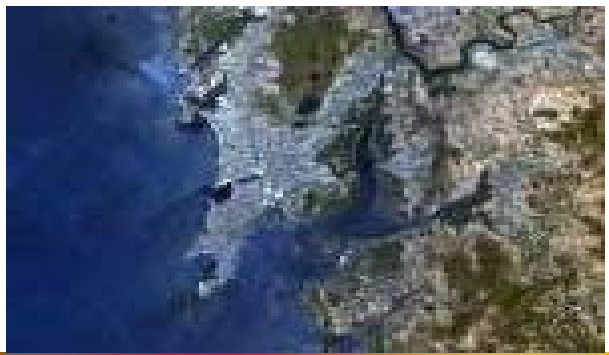
In India, gross per capita water availability will decline from 1820 m^3/yr in 2001 to **1140 m^3/yr** in 2050

Impacts on coastal areas

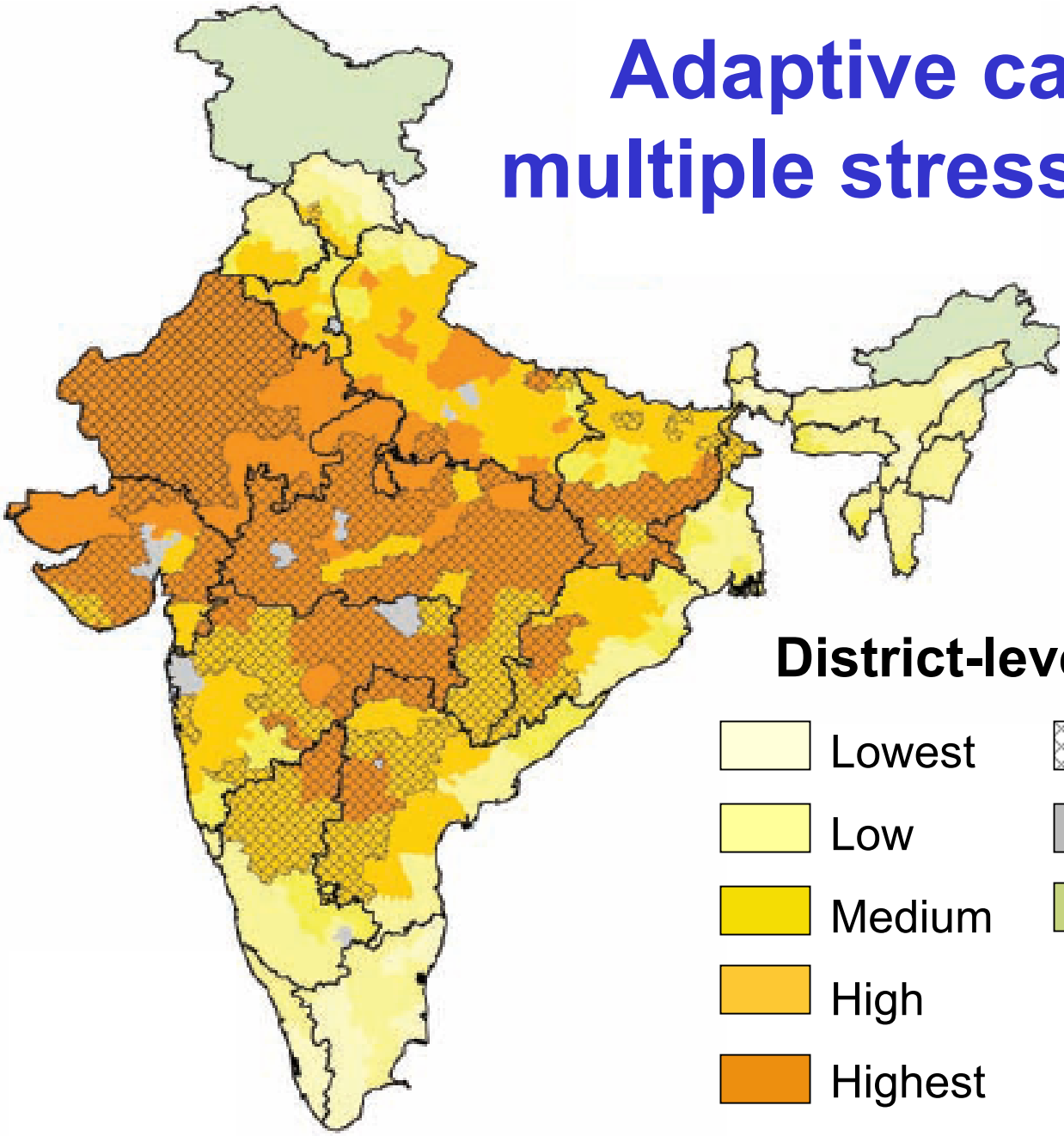
Coastal erosion and inundation of coastal lowland as sea level continues to rise, flooding the homes of millions of people living in low lying areas

In India, potential impacts of 1 m sea-level rise include inundation of **5,763 km^2**

Significant losses of coastal ecosystems, affecting the aquaculture industry, particularly in heavily-populated mega-deltas



Adaptive capacity to multiple stressors in India



District-level vulnerability

- Lowest
- Low
- Medium
- High
- Highest
- Double exposed
- Urban districts
- Missing data

The need for mitigation and sustainable development

History of climate change negotiations

1898: Swedish scientist Svante Ahrrenius warns carbon dioxide from coal and oil burning could warm the planet

1988: NASA scientist James Hansen tells U.S. Congress global warming "is already happening now"

IPCC is created

1992: **UNFCCC** aims at stabilising atmospheric concentrations of GHG

1997: UNFCCC parties approve **Kyoto Protocol** mandating emission cuts by industrial nations

2005: Kyoto Protocol takes effect

2007: IPCC and Al Gore are awarded the Peace Nobel Prize

Bali Roadmap sets stage for an agreement beyond the Kyoto Protocol and for commitments by developing countries to measurable and verifiable national mitigation actions

Mitigation targets

Under most equity interpretations and for low to medium stabilization targets (450-550ppm CO_2-eq), **developed countries** need to significantly reduce their emissions below 1990 levels:

- 10-40% by 2020
- 40-95% by 2050

Developing country emissions need to deviate below their projected baseline within the next few decades

- This requires urgent action in order to avoid lock-in of carbon-intensive technologies and patterns

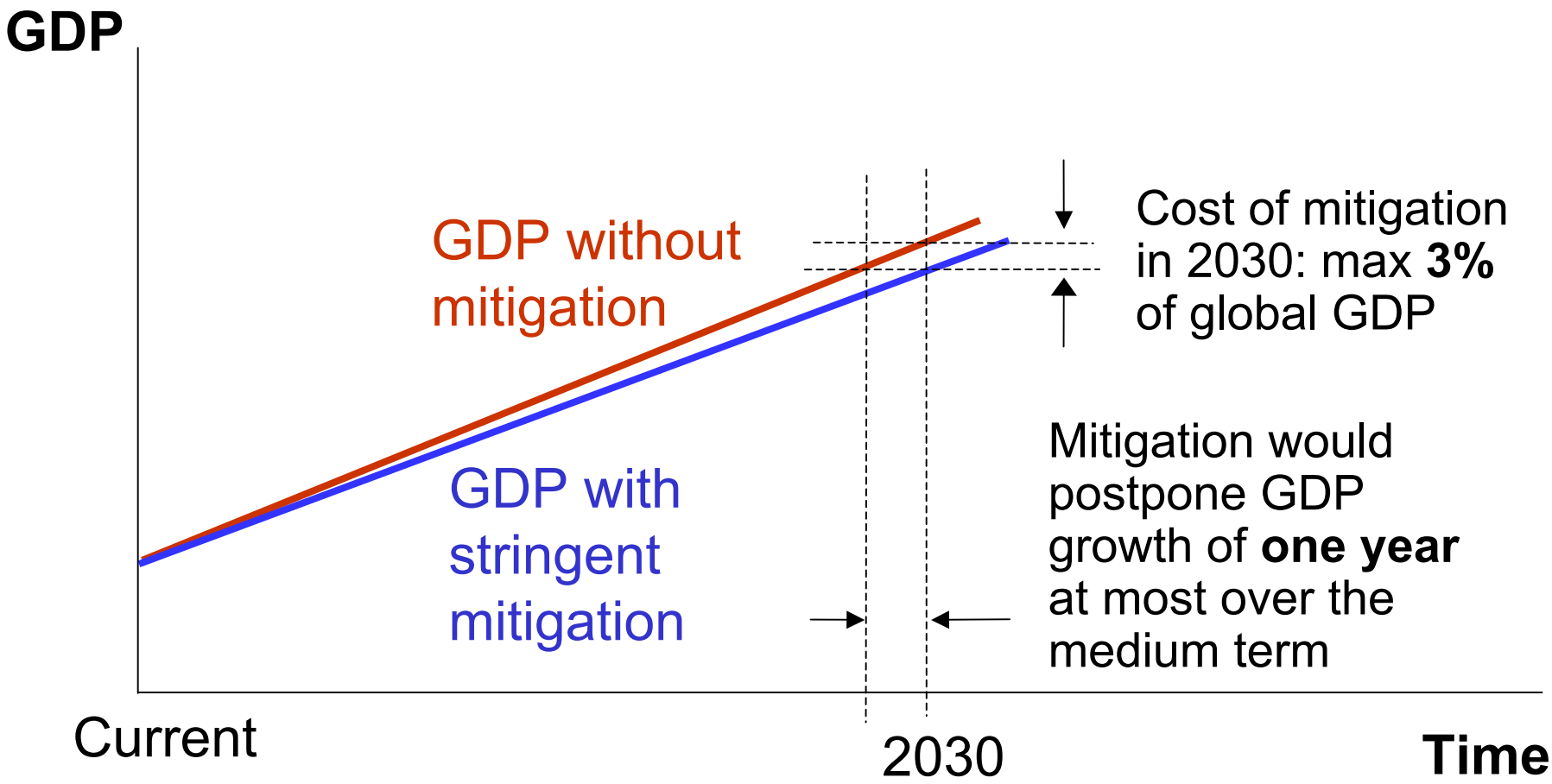
Stabilisation scenarios

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

Costs of mitigation in 2030

Stabilisation levels (ppm CO2-eq)	Range of GDP reduction (%)	Reduction of average annual GDP growth rates (percentage pts)
590 - 710	-0.6 – 1.2	< 0.06
535 - 590	0.2 – 2.5	< 0.1
445 - 535	< 3	< 0.12

Impacts of mitigation on GDP growth



Schematic graph

Co-benefits of mitigation

Common drivers lie behind mitigation policies and policies addressing economic development, poverty, health, employment, energy security, and local environmental protection

Linking policies provide the opportunity for no-regrets policies reducing greenhouse gases mitigation costs

- CO_2 mitigation potential for 2010 without net cost in India: between 13 and 23% of business as usual scenario

Energy status & prospects in India

Heavy reliance on coal, which accounts for **40%** of primary energy demand and **70%** of electricity output

70% of crude-oil requirements imported

3.6% of expected average annual increase in energy demand in 2005-2030

$1.7 trillion worth expected investment needs in energy infrastructure in 2006-2030

- **Future energy infrastructure investment decisions will have long-term impacts on GHG emissions**

Source: IEA, World Energy Outlook 2007

Towards a new development path

The **dominant path to industrialisation** has been characterised by high concurrent GHG emissions

Committing to alternative development paths requires **major changes** in a wide range of areas:

- Economic structure
- Urban design
- Transport infrastructure
- Consumption patterns
- Demography

Lighting a Billion Lives Campaign

1.6 billion people lack access to electricity
33% live in India

We commit to enable a billion lives to access light from solar technologies

Gobindarampur:
a village benefiting from the campaign

Bani and her friends run and maintain the charging station

Solar lanterns have helped families in their daily activities

Solar lanterns are used in livelihood activities such as betel leaf cultivation, coaching centres, and shops

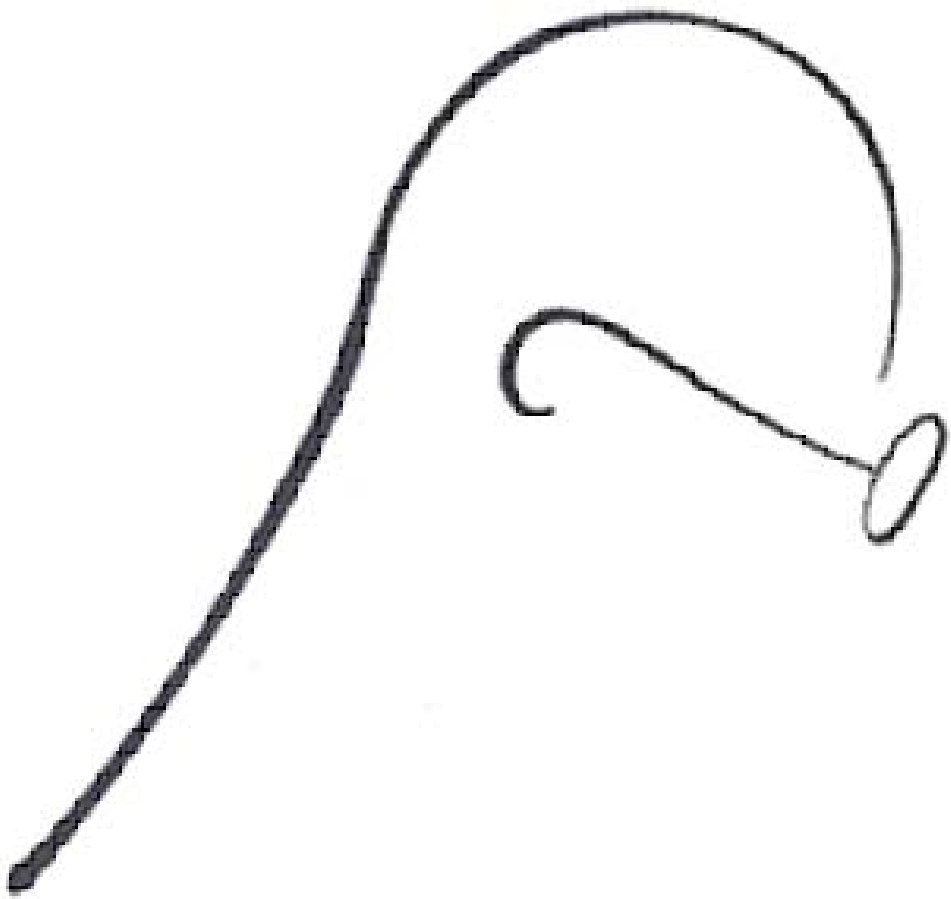
Solar lantern

Each solar lantern:

- Saves about 40-60 litres of kerosene per year
- Mitigates 145 kg CO_2 emissions per year

Alternately:

- Saves about 182.5 kWhr of electricity per year
- Mitigates 157 kg CO2 emissions per year



Gandhi was once asked if he expected India to attain the same standard of living as Britain. He replied:

It took Britain half the resources of the planet to achieve this prosperity. How many planets will a country like India require!