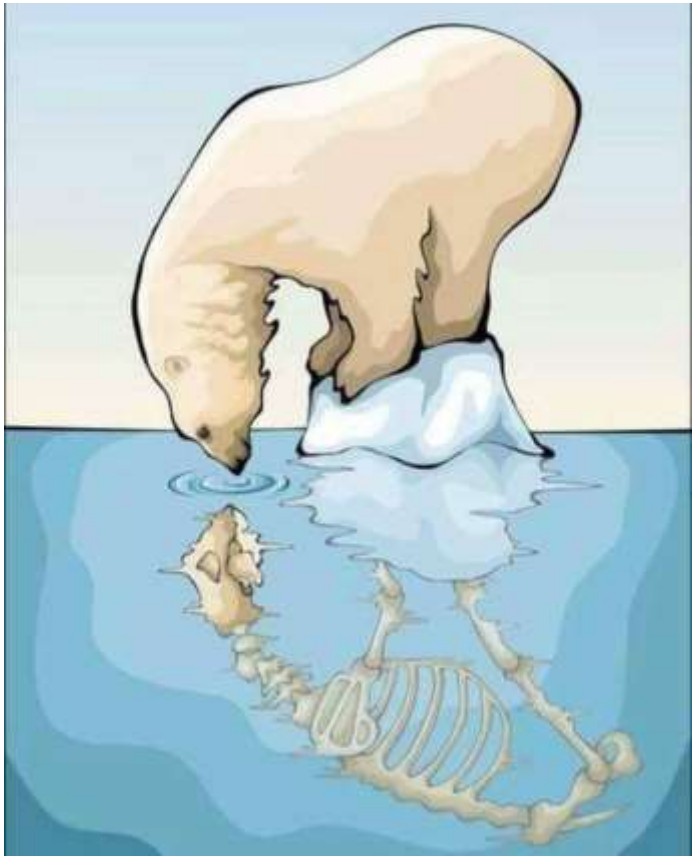
Climate Change, Sources and Impacts



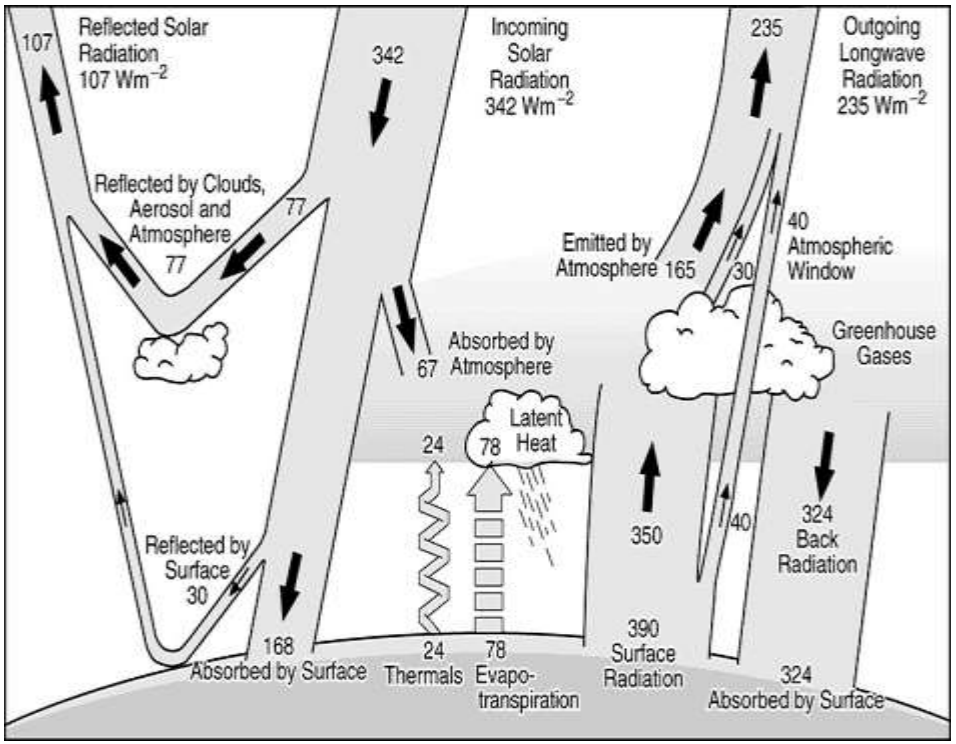
Climate Change Cell
Dept. of Environment Govt. of Delhi

- ✓ What is Climate Change ? Science
- ✓ Causes of Climate Change ?
- ✓ Climate Impacts ?
- ✓ Global Goals of Climate Change ?
- ✓ How to address Climate Change ? Mitigation + Adaptation

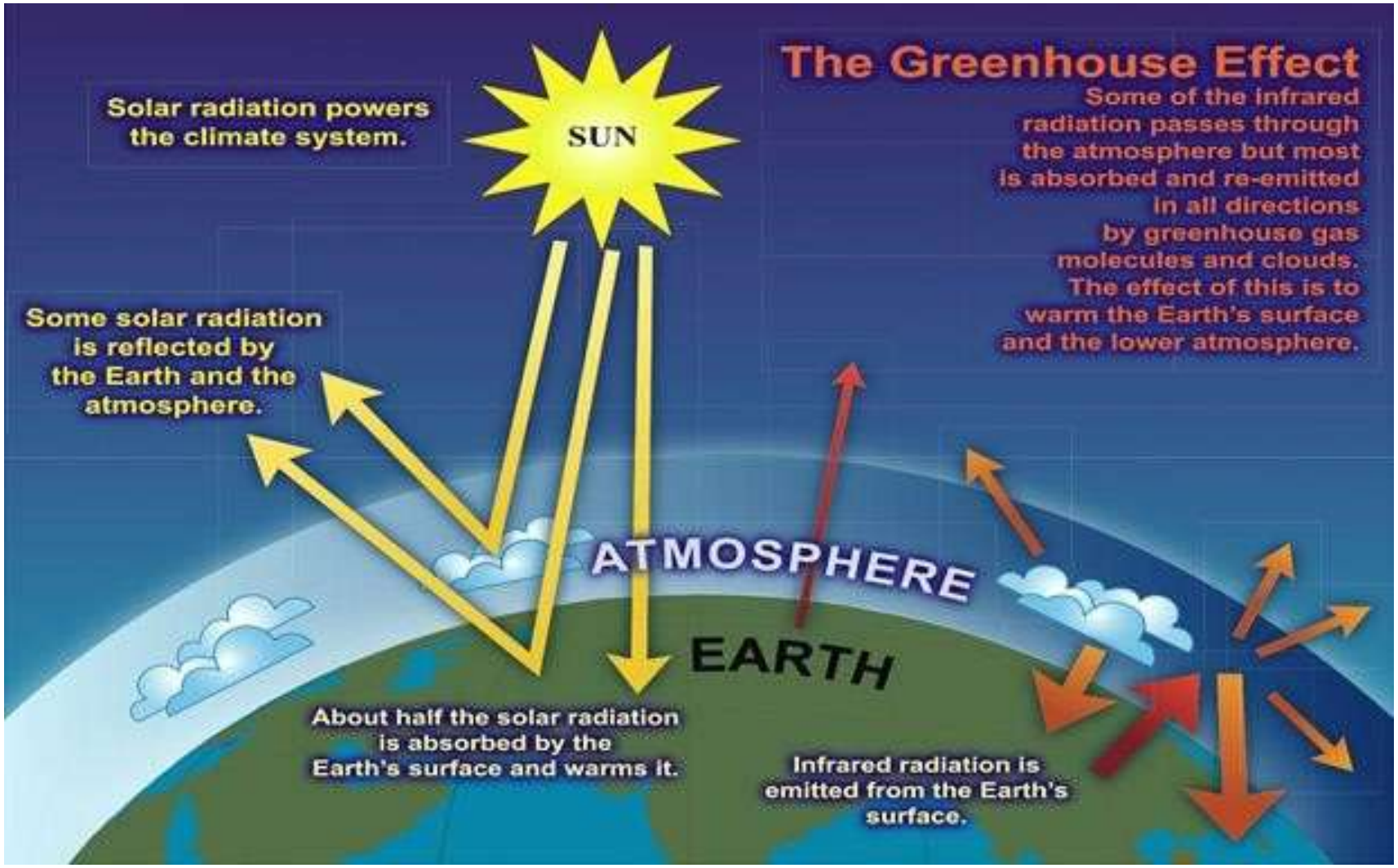

1971
Conference of leading scientists reports a danger of rapid and serious global climate change caused by humans, calls for an organized research effort.
NOW
Scientists are more certain than ever that the warming since 1950 has been primarily caused by humans.
1982
Strong global warming since mid-1970s is reported, with 1981 the warmest year on record.
NOW
The period 2001–2010 was the hottest decade on record.
Scientists have known for decades. They've warned us. And changes are well underway.
CLIMATE CHANGE IS HAPPENING NOW
1965
Leading scientists point out the chaotic nature of the climate system and the possibility of sudden shifts.
NOW
A warming climate is increasing the frequency and severity of many extreme weather events.
1990
IPCC First Assessment Report finds global warming is likely to increase heatwaves in summer.
NOW
Many regions including Australia have experienced longer and more intense heatwaves.

Energy budget and greenhouse effect

The delicate balance between the incoming short wave (ultra violet) radiation and the outgoing long wave (infra red) radiation maintains earth's surface temperature at a level sufficient to support life on the planet



Some gases (called *greenhouse gases*) present in the earth's atmosphere (in trace amounts) trap the outgoing radiation, raising the temperature of the earth's surface the phenomenon is commonly known as the greenhouse effect


The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation powers the climate system.
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
ATMOSPHERE
EARTH
About half the solar radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

Causes of Climate Change…

GHG emissions from

- Industrialization
- Urbanization
- Deforestation
- Land use changes

The targets cover emissions of the six main greenhouse gases:

- Carbon dioxide (CO2);
- Methane (CH4);
- Nitrous oxide (N2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF6)

Montreal Protocol

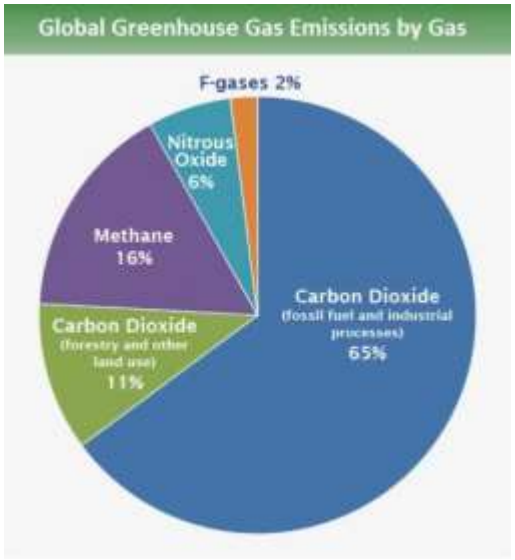
GHGs affected by human activities …

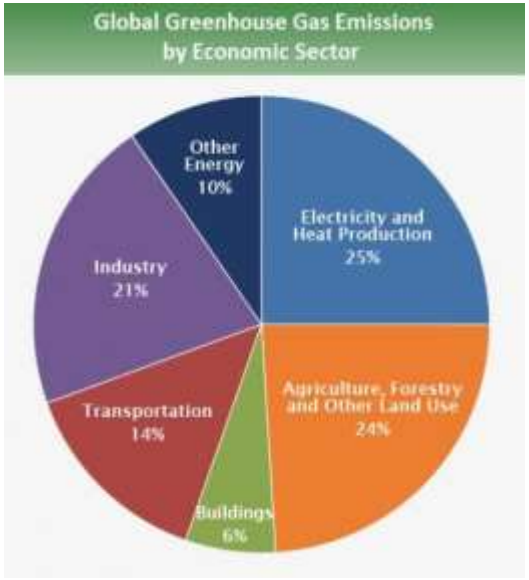
	CO_2	CH_4	N_2O	HFC-23
Pre-industrial concentration	About 290 ppm	About 700 ppb	About 270 ppb	Zero
Concentration in 1998	365 ppm	1745 ppb	314 ppb	14 ppt
Rate of concentration change	1.5 ppm/yr	7.0 ppb/yra	0.8 ppb/yr	0.55 ppt/yr
Atmospheric lifetime	5 to 200 yr	12 yr	114 yr	260 yr

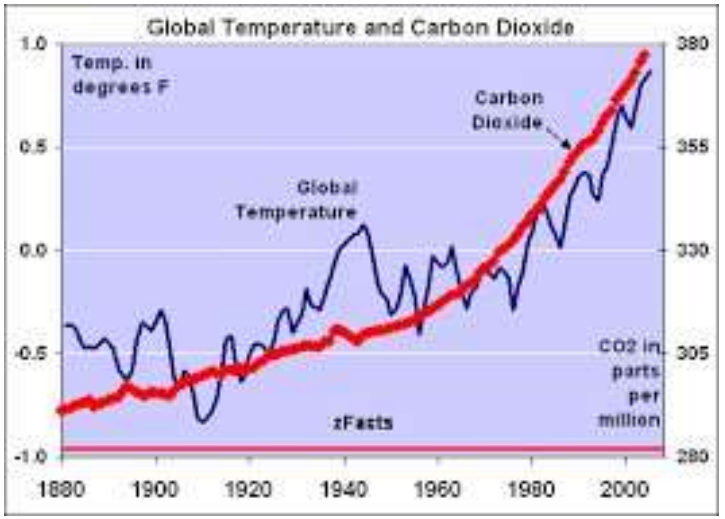
Source: climate change 2001, The Scientific Basis, Technical Summary of the Working Group/Report

Carbon Accumulated in Atmosphere…

- 421 ppm already accumulated as of 2017



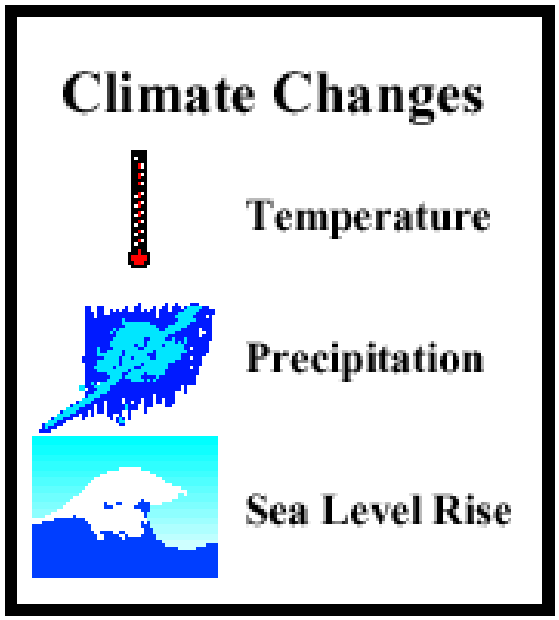




- last 130 years, the world has warmed by approximately 0.85oC. Each of the last 3 decades has been successively warmer than any preceding decade since 1850

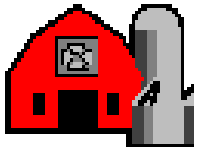
Climate Change Imapcts

Potential Climate Change Impacts



Health Impacts

Weather-related Mortality
Infectious Diseases
Air Quality-Respiratory Illnesses



Agriculture Impacts

Crop yields
Irrigation demands

Forest Impacts

Change in forest composition
Shift geographic range of forests
Forest Health and Productivity

Water Resource Impacts

Changes in water supply
Water quality
Increased Competition for water

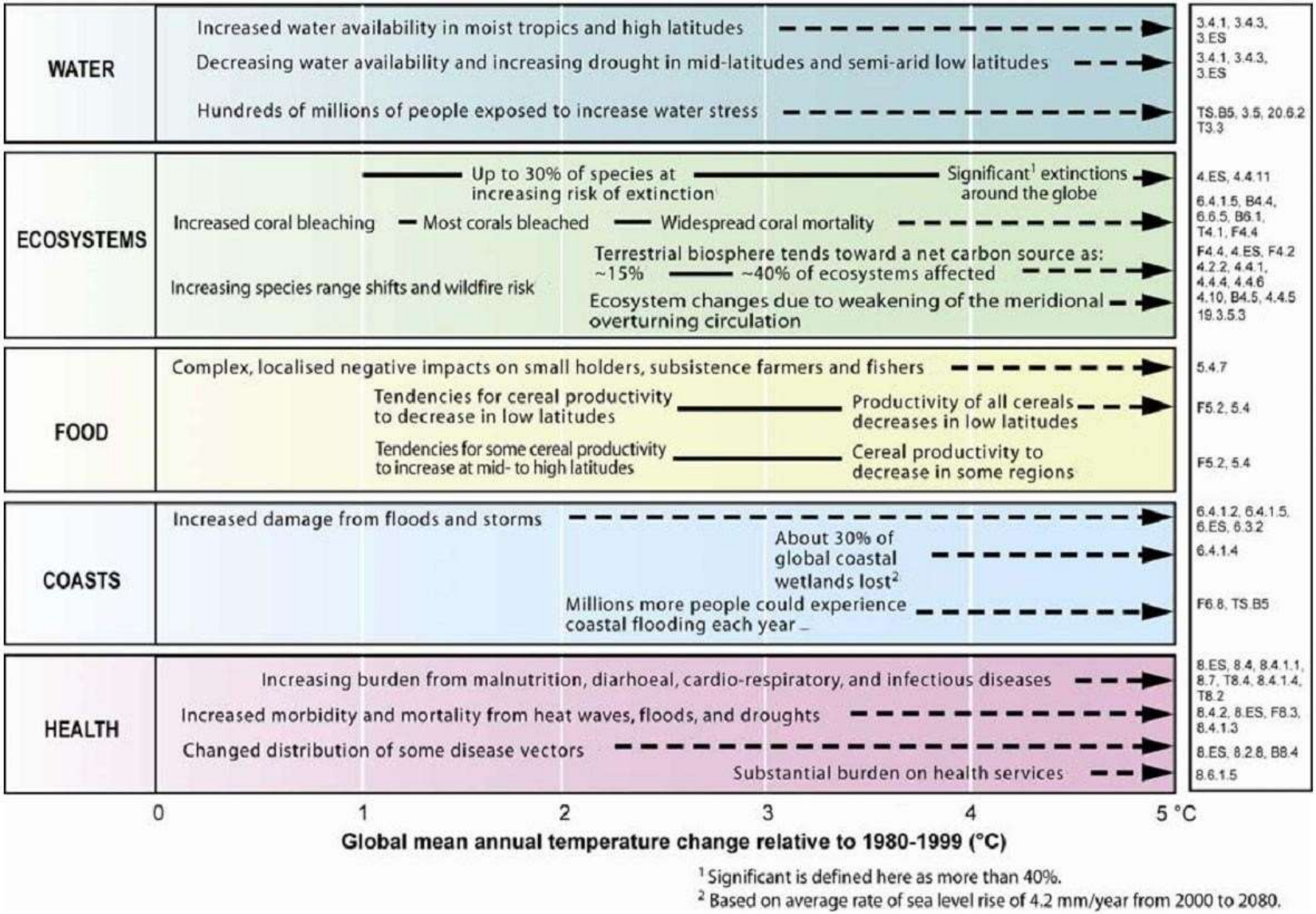
Impacts on Coastal Areas

Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities

Species and Natural Areas

Shift in ecological zones
Loss of habitat and species

Key impacts as a function of increasing global average temperature change…



[1] Significant is defined here as more than 40%.

[2] Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

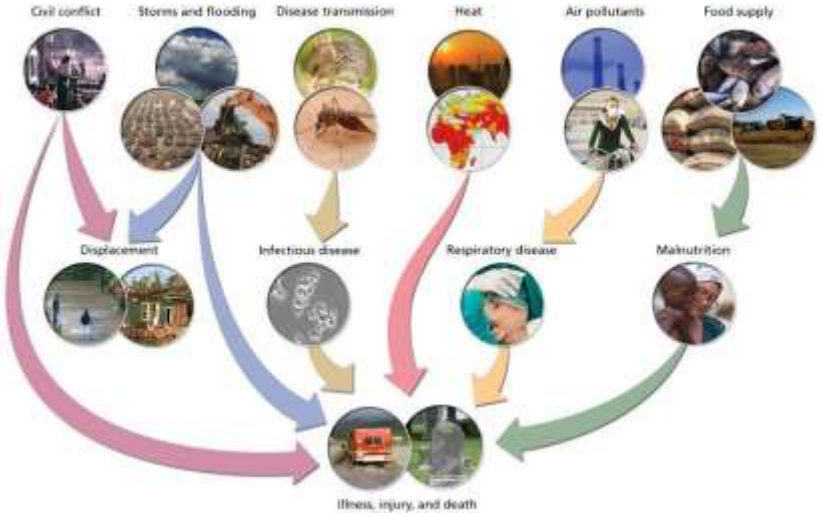
Impacts Reported…

- Snow Melting = Sea level rise
- Loss of biodiversity = Growth of deserts / desertification
- Droughts = loss of livelihoods / food / nutrition
- Reduction in crop yields = Displacement / Migration
- Floods = Loss of human lives / damage to infrastructure

'Between 1994 and 2013, EM-DAT recorded 6,873 natural disasters worldwide, which claimed 1.35 million lives or almost 68,000 lives on average each year. In addition, 218 million people were affected by natural disasters on average per annum during this 20-year period.' …UN office on DRR

Health Impacts forecasted …

- Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from malnutrition, malaria, diarrhoea and heat stress
- The direct damage costs to health (i.e. excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between US$ 2-4 billion/year by 2030.



Highlights of AR 5 (Science)…

- Global changes- estimated warming of 0.85 degrees Celsius since 1880, with the fastest rate of warming in the Arctic.
- Sea- level rise- Greater that 66% chance that the Arctic Ocean will be ice free during a greater part of the summer before 2050 under a high emission scenario.
- Land based food systems- climate change to affect food security in areas where most of the world's food production occurs.
- Temperature rise- average annual temperatures could rise by more than 2°C over land in most of South Asia by the mid-21st century and exceed 3°C under a high emissions scenario.

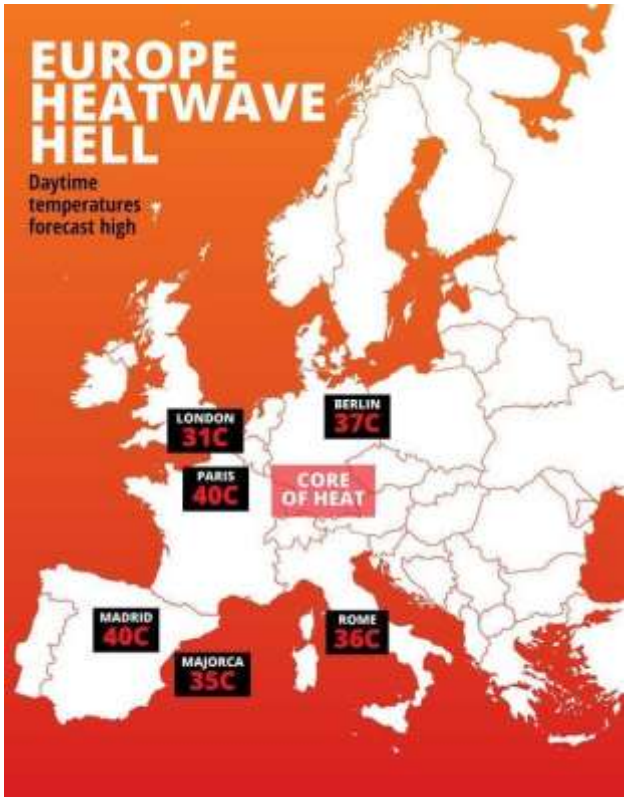
Highlights of AR 5 (Science)…

- Rainfall trends- by mid-21st century southern areas of Asia will experience more rainfall. Rainfall will be more extreme near the centres of tropical cyclones making landfall in South Asia.
- Sea level rise- magnitude of sea level rise by the century's end implies increased risks for South Asia's coastal settl combined with changes in intensity.

Vicious Cycle…

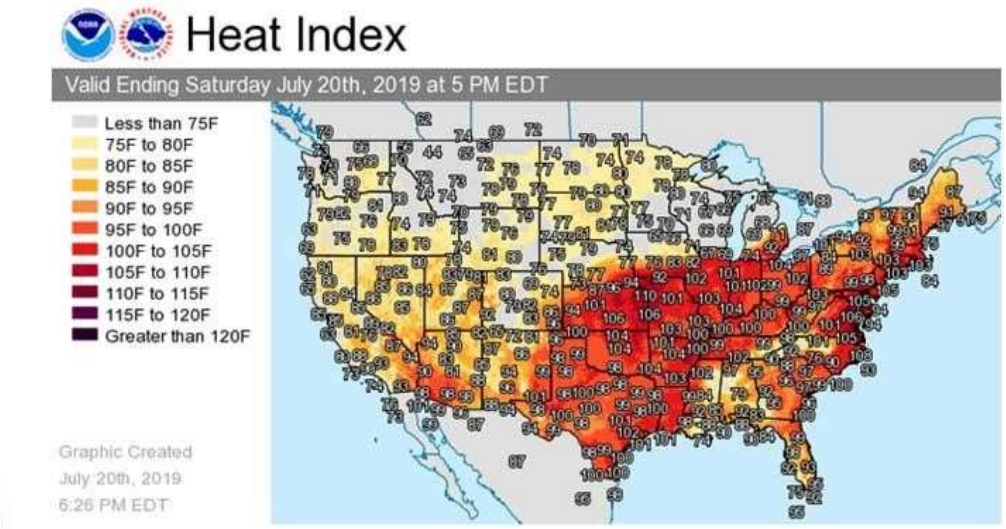
Polluters are also impacted !

Heat Wave in Europe 2019…



2016 Mathew Cyclone in America…

2019 Heat Waves in USA…



2016 Cyclone in Japan…

Three Cyclones at once !

2016 Cyclone in Australia…

Australia's Bureau of Meteorology recorded temperatures over 40C on Friday. The high for Sydney's Observatory Hill – the official temperature for the city – was 40.9C, meaning the 41.8C November record set in 1982 remains intact.

Above, swimmers wade into the sea as others seek relief from the heat by swimming in the saltwater pool at Bondi Icebergs Swimming Club in Sydney.

2016 Snow Blizzard in China…

HUNCHUN, Jan. 19, 2016 (Xinhua) -- A woman waits for taxi in snow on a road in Hunchun, northeast China's Jilin Province, Jan. 19, 2016. Most parts of China will experience a rapid drop in temperatures along with snow and rain in the coming days as a strong cold front is on the way, and will disrupt travel for the upcoming Spring Festival, which falls on Feb. 8 this year. The National Meteorological Center said temperatures will drop sharply in northwestern, northern and northeastern China, with temperatures in some areas down by up to 14 degrees Celsius. (Xinhua/Wu Zhanlong)

2019 Floods in Mumbai

Cities Flooded

- Mumbai
- Ahmedabad
- Chennai
- Assam

Drought in India…

- 20 % Water left in Country's Water reservoirs

Water Trains to Drought impacted regions in India

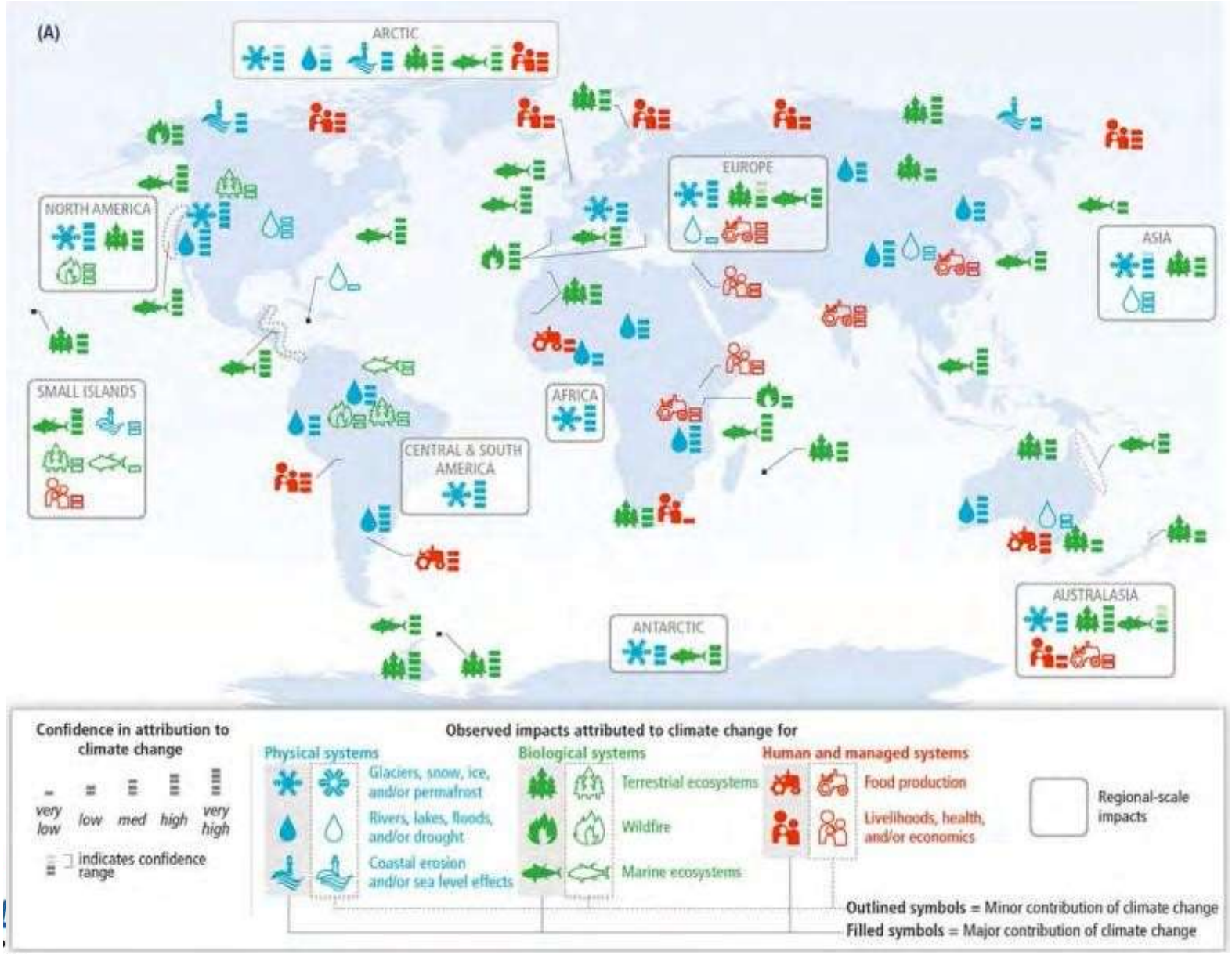
- **In 2016**
- **In 2018**
- **In 2019**

Gangotri Glacier Receding…


April
2008
Imja Glacial lake


Imja Glacial lake

Observed Impacts…



Climate change and women

Climate change disproportionately increases women's time burdens.

- After a flooding event, women have to spend additional time collecting water, cleaning their home, and ensuring family well-being.
- Coastal flooding may lead to increased salinization of household and business water sources, which is a particular problem in coastal areas. As a result, water security and conflict will become bigger issues and multiple agencies will become involved.
- With droughts, women need to spend more time and calories on water collection and suffer physical strains from heavy loads.
- As water-borne or sanitation-related illnesses increase, so do demands for women's time for family care-giving.

Impacts of Climate Change on Food and Nutrition

FOOD SECURITY DIMENSION	CONSEQUENCES OF CLIMATE CHANGE
AVAILABILITY (sufficient quantity of food for consumption)	• Reduced agricultural production in some areas locally (especially at tropical latitudes) could affect dietary diversity • Changes in the suitability of land for crop production • Changes in precipitation patterns could affect the sustainability of rain-fed agriculture in some areas • Increases in temperature could lead to longer growing seasons in temperate regions and reduced frost damage
ACCESS (ability to obtain food regularly through own production or purchase)	• Lower yields in some areas could result in higher food prices • Loss of income due to the potential increase in damage to agricultural production
STABILITY (risk of losing access to resources required to consume food)	• Instability of food supplies due to an increase in extreme events • Instability of incomes from agriculture
UTILISATION (quality and safety of food, including nutrition aspects)	• Food security and health impacts include increased malnutrition • Ability to utilise food might decrease where changes in climate increase disease • Impact on food safety due to changes in pests and water pollution

Climate change challenges and its impact on health and nutrition

Climate change Challenges	Impact on health and nutrition
Change in rainfall pattern	Crop damage and reduce agriculture production, Decreases the grain quality Increases food insecurity at household level.
Change in temperature	Hotter temperature and recurring droughts, Exposure to heat and increased work load on women in agriculture production and fetching drinking water Poor nutritional status of mothers
Increase in extreme weather events like floods and droughts	Food insecurity, Increase in the incidences of pre-mature births Prevalence of stunting, wasting and under-nutrition increases Drought has been found associated with stunting
Spread of diseases	Vector-borne diseases are on a significant increase owing to changes in temperature, rainfall, humidity and water logging and affecting children are Malaria, Dengue, Kala Azar and Japanese Encephalitis
Drinking water and sanitation	Hand pumps during the flood, get drowned, silted up which ultimately affects the accessibility of safe drinking water during the stress period. Depletion of ground water and water table during summer
Water logging and water quality	The problem of water logging after the flood or extreme rainfall creates stagnant pools which are used by local people for drinking, washing and defecating as there are no alternate options.

India: climate change impact on Education…

•School absenteeism and drop-out are higher in flood-prone areas; inhibits completion of school programs; closure of at least one-and-a-half months due to flooding.

•Climate related disasters such as floods, landslides, have destroyed school infrastructures. Reconstruction and refurbishment incur huge costs at the expense of continuity of education.

• Migration due to loss of livelihood in climate-change-affected areas takes children away from schools.

•Interrupted and/or impeded access to education has a detrimental impact on learning outcomes, reducing the likelihood that children and young people – especially girls – will be able to break the cycle of poverty.

India: climate change impact on Education as perceived

•Impacts in the direct effects on educational provision (schooling and regular nutrition through mid day meal) due to increasing incidence of severe weather events (drought, flooding, cyclones, heat waves).

•Over the longer term, incremental environmental changes (e.g. sea level change, salination, changes in season patterns, desertification, soil erosion, species loss, etc.) are likely to result in deteriorating livelihoods, which impact upon both household expenditure on schooling and the nutritional status of children.

•Emergency responses to extreme weather events and their aftermath thus have the potential to undermine investment in improving the quality of education.

Impact on WASH sector

Climate effect	Hazard	Impact on WASH sector
Decrease in precipitation	Drought	Reduction in raw water supplies, reduced flow in rivers, less dilution/increased concentration of pollutants in water, challenge to hygiene practices.
Increase in precipitation and severe weather	Flooding	Pollution of wells, inundation of wells, inaccessibility of water sources, flooding of latrines, damage to infrastructure, landslides around water sources, sedimentation and turbidity, challenges to sustainability of sanitation and hygiene behaviours, and waterborne diseases.
Increase in temperatures	Heatwaves	Damage to infrastructure, increase in pathogens in water leading to increased risk of disease.
	Melting and thawing of glaciers, snow, sea ice and frozen ground	Seasonality of river flows affected leading to a reduction in water availability in summer.
Sea-level rise	Flooding and saline intrusion into freshwater aquifers	Reduction in availability of drinking water, with high impacts on quality.

Slow Onset Impacts …

- Glacial melt with increased threat of GLOF
- Agriculture productivity diminishing
- Ocean acidification
- Increased desertification reducing areas under cultivation

Migration

Income/Economy

Livelihoods

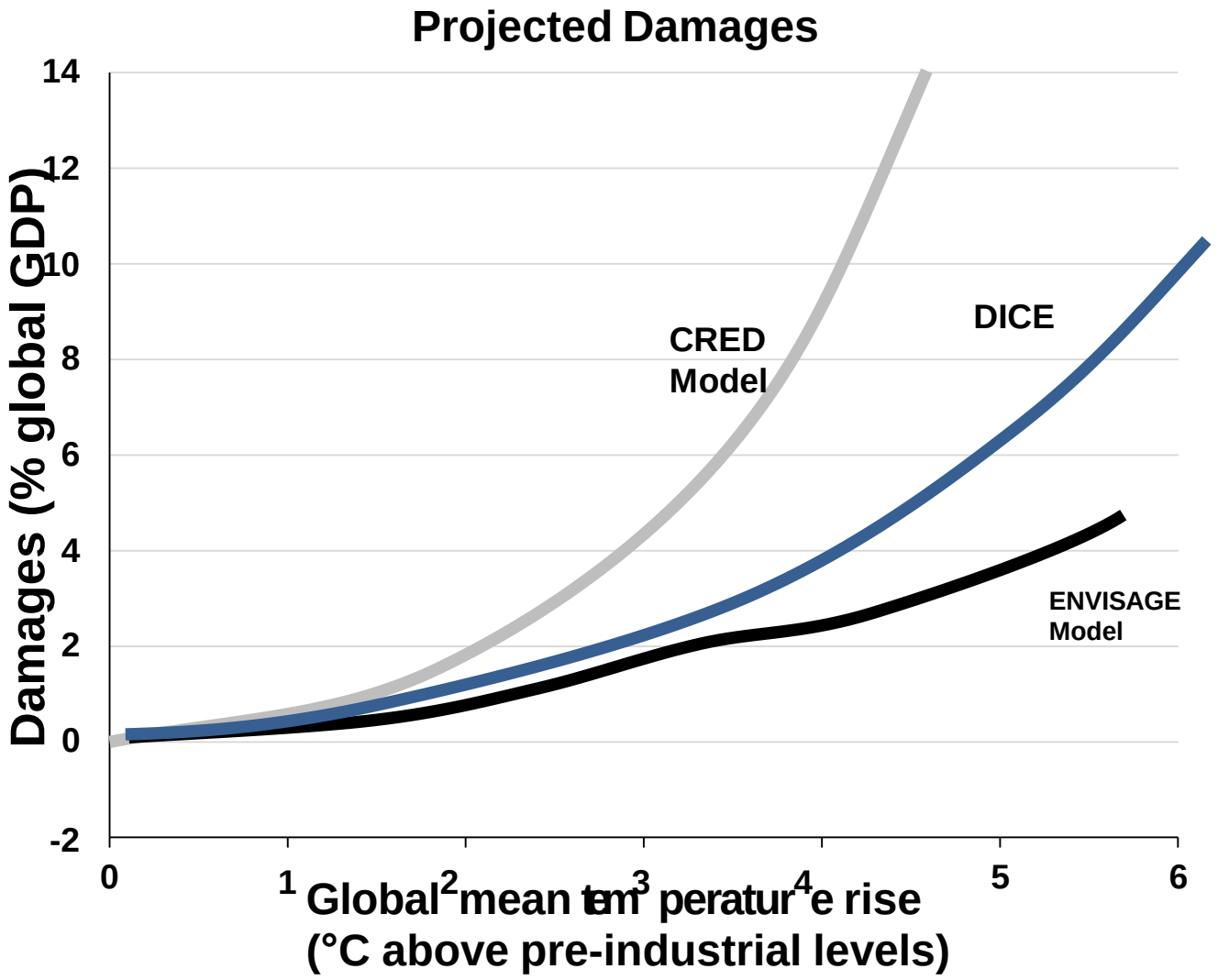
Possible Effects of Climate Change as Temp Rises

Eventual Temperature Rise Relative to Pre-Industrial Temperatures

Type of Impact	1°C	2°C	3°C	4°C	5°C
Freshwater Supplies	Small glaciers in the Andes disappear, threatening water supplies for 50 million people	Potential water supply decrease of 20–30% in some regions (Southern Africa and Mediterranean)	Serious droughts in southern Europe every 10 years 1–4 billion more people suffer water shortages	Potential water supply decrease of 30–50% in southern Africa and Mediterranean	Large glaciers in Himalayas possibly disappear, affecting ¼ of China's population
Food and Agriculture	Modest increase in yields in temperature regions	Declines in crop yields in tropical regions (5–10% in Africa)	150–550 million more people at risk of hunger Yields likely to peak at higher latitudes	Yields decline by 15–35% in Africa Some entire regions out of agricultural production	Increase in ocean acidity possibly reduces fish stocks
Human Health	At least 300,000 die each year from climate–related diseases Reduction in winter mortality in high latitudes	40–60 million more exposed to malaria in Africa	1–3 million more potentially people die annually from malnutrition	Up to 80 million more people exposed to malaria in Africa	Further disease increase and substantial burdens on health care services
Coastal Areas	Increased damage from coastal flooding	Up to 10 million more people exposed to coastal flooding	Up to 170 million more people exposed to coastal flooding	Up to 300 million more people exposed to coastal flooding	Sea-level rise threatens major cities such as New York, Tokyo, and London
Ecosystems	At least 10% of land species facing extinction Increased wildfire risk	15–40% of species potentially face extinction	20–50% of species potentially face extinction Possible onset of collapse of Amazon forest	Loss of half of Arctic tundra Widespread loss of coral reefs	Significant extinctions across the globe

Sources: IPCC, 2007b; Stern, 2007.

Increasing Damages from Rising Global Temperatures



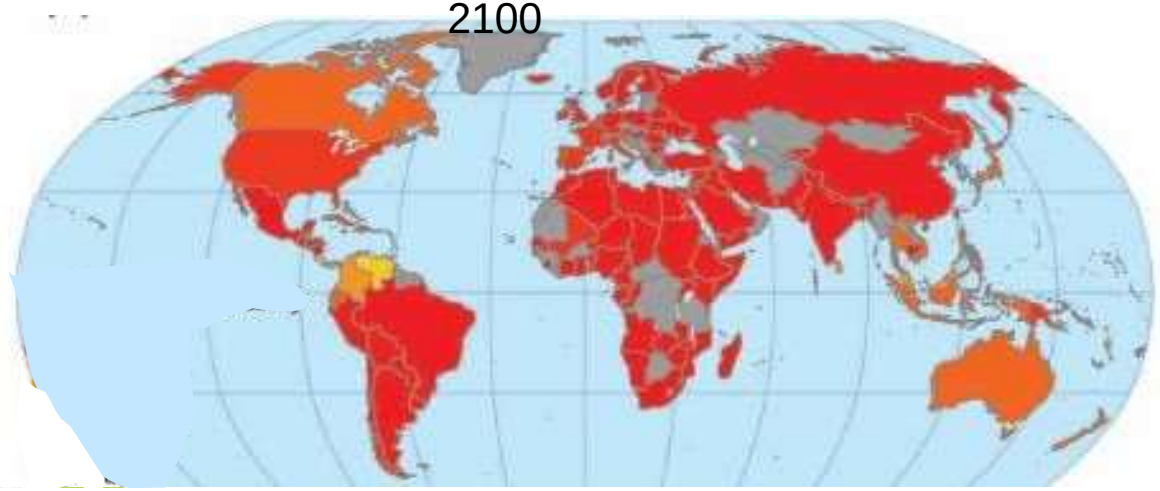
Source: R. Revesz, K. Arrow et al., 2014.
http://www.nature.com/news/global-warming-improve-economic-models-of-climate-change-1.14991
Note: The three different models (ENVISAGE, DICE, and CRED) shown in this figure give damage estimates that are similar at low to moderate levels of temperature change, but diverge at higher levels, reflecting different assumptions used in modeling.

Distribution of vulnerability

Year 2050

- 9 Severe vulnerability
- 7 Moderate
- 6 Moderate
- 5 Modest
- 4 Modest
- 3 Little
- 2 Little
- No data

Year 2100



- 10 Extreme
- 9 Severe
- 8 Serious
- 7 Moderate
- 6 Moderate
- 5 Modest
- No data

Thank you !

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