



Global Environmental Change and Biodiversity for Agriculture

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A photograph of a rocky coastline with turquoise water and people walking on the rocks. The rocks are light-colored and have a wavy, layered appearance. The water is a vibrant blue-green color, and there are several people walking on the rocks in the distance.

Key words:

1. Global Environmental Change

2. Natural Resources

3. Education and Research

Photo: Roger Braithwaite

History of Greenhouse Effect

1914-1938 Milutin Milanković showed by calculation that a quasi-periodic change of Earth's orbit around Sun causes the interchange of global warming and global cooling period

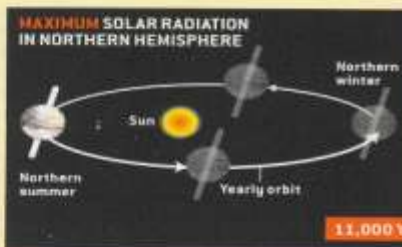
Orbital Controls over Greenhouse Gases

Natural variations in the earth's orbit, such as those related to precession (diagrams), redistribute the sunlight that reaches the globe over long timescales. For the past million years, these subtle changes have driven major dips and swells in atmospheric concentrations of methane and carbon dioxide

(graphs). Although scientists do not fully understand why, global concentrations of these greenhouse gases respond mainly to changes that occur during summer in the Northern Hemisphere, the time of year when the North Pole is pointed most directly at the sun.



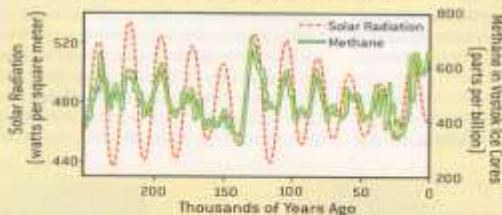
Wobble in the earth's axis of rotation, known as precession, is one of the three orbital cycles that account for sunlight variations in the Northern Hemisphere. Like a toy top about to fall, the earth's axis traces imaginary circles in space, making one revolution every 22,000 years.



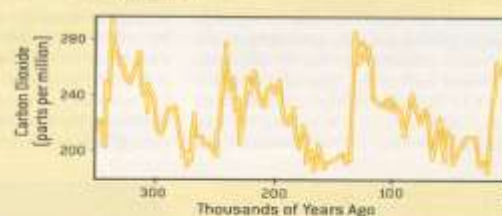
Summer warmth in the Northern Hemisphere peaks once every 22,000 years, when the yearly northern summer coincides with the earth's closest passage to the sun and the Northern Hemisphere receives the most intense sunlight.



Summer heat bottoms out 11,000 years later, after the earth's axis has shifted (precessed) to the opposite position. The Northern Hemisphere then receives the least summer sunlight, because the earth is farthest from the sun.



Methane concentrations rise and fall over the past 250,000 years in near harmony with the precession-induced ups and downs of solar radiation in the Northern Hemisphere. The highest temperatures stimulated extreme methane production in wetlands, which are the atmosphere's primary natural source of this greenhouse gas.



CO₂ concentrations, which fluctuated in cycles over the past 350,000 years, varied in response to precession as well as to shifts in the tilt of the earth's rotational axis and in the shape of its orbit. These other cycles occur every 41,000 and 100,000 years, respectively.



Main Contributing Factors to Changes of Earth's Climate

- **Change of Earth's orbit**
- **Greenhouse effect**
- **Thermal pollution**
- **Chemical pollution**
- **(De) Forestation**
- **Volcanic activities**
- **Change of Earth's magnetism**
- **Other**





What is Global Change?

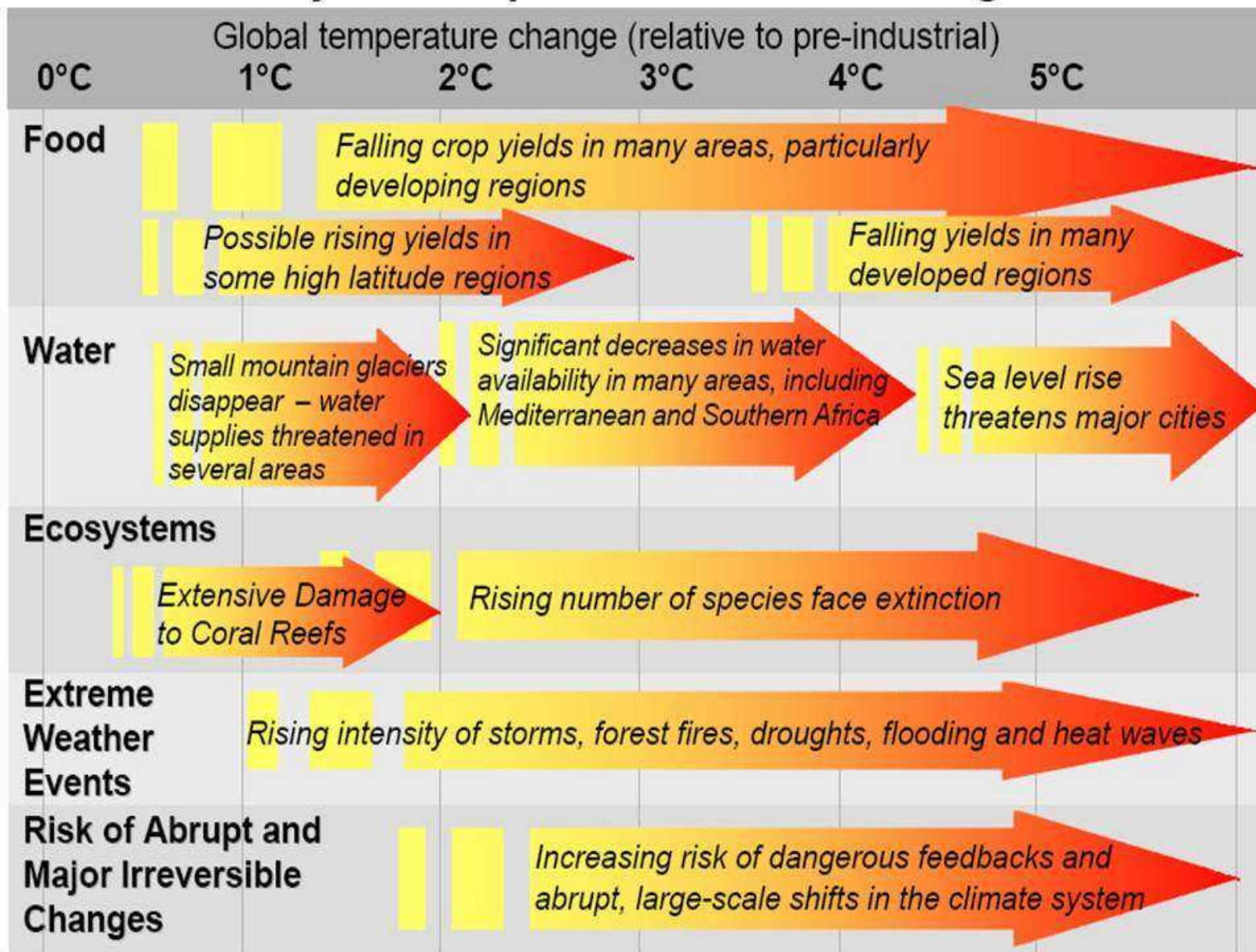
- (i) **Systemic global change**: Environmental changes which impact the functioning of a global system (e.g. effects of greenhouse gas emissions on the global climate system and of ozone-depleting substances on the stratosphere).
- (ii) **Cumulative global change**: Localized environmental changes whose cumulative impacts are widespread or which impact a significant fraction of a global resource (e.g. widespread localized problems such as land degradation, groundwater depletion and species extinction that may affect a large portion of the world's forests and soil, groundwater supply or biological diversity).



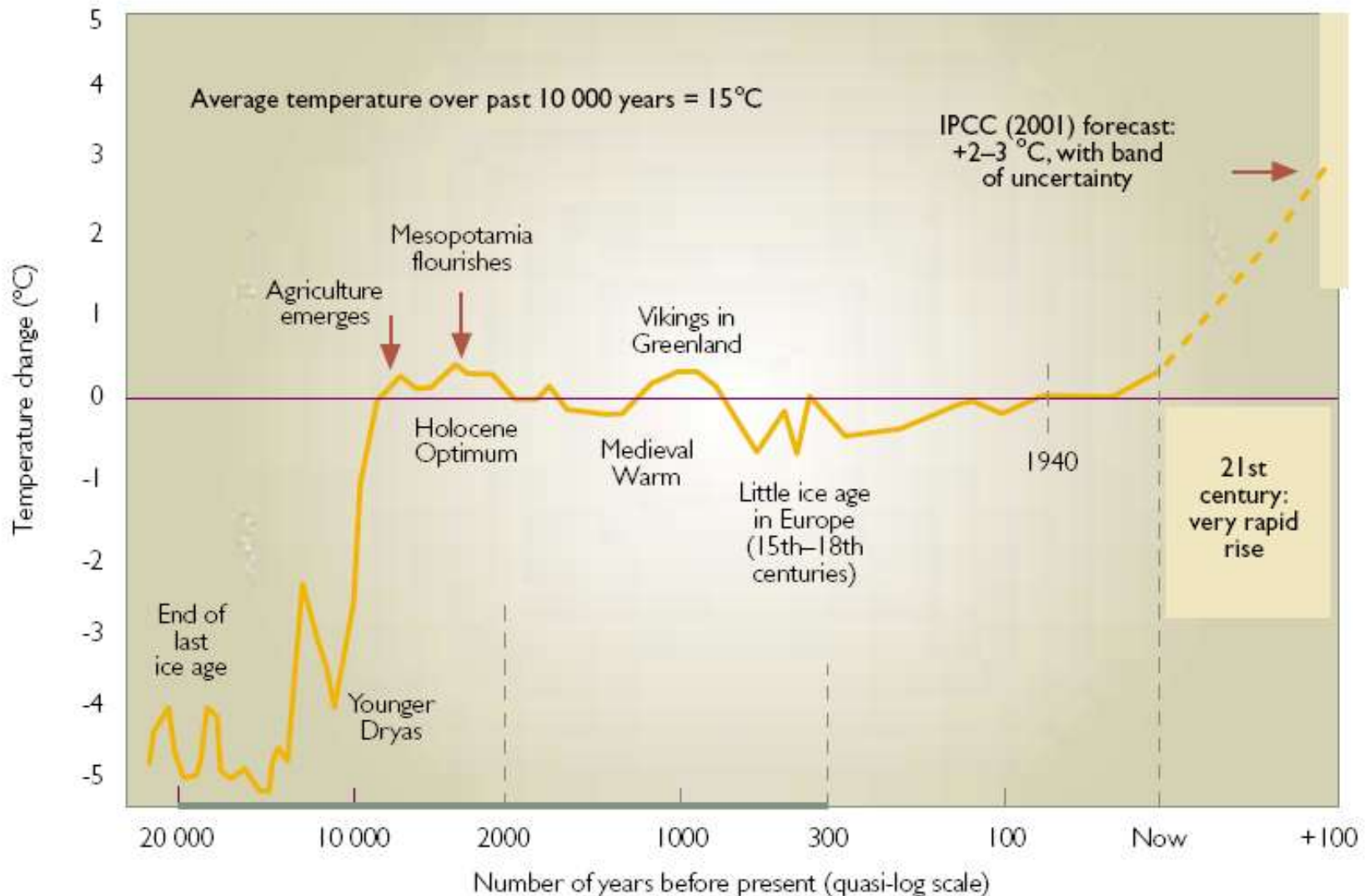
The Problem of Climate Change

- **Cause:** Anthropogenic emissions of greenhouse gases
- **Impacts:**
 - Rising temperatures (0.7° C)
 - Sea level rise
 - Frequent occurrence of droughts, floods and other extreme climatic events
 - Threats to food supply
 - Threats to fresh water supply
 - Threats to human health
- **Global response:** UNFCCC and Kyoto Protocol

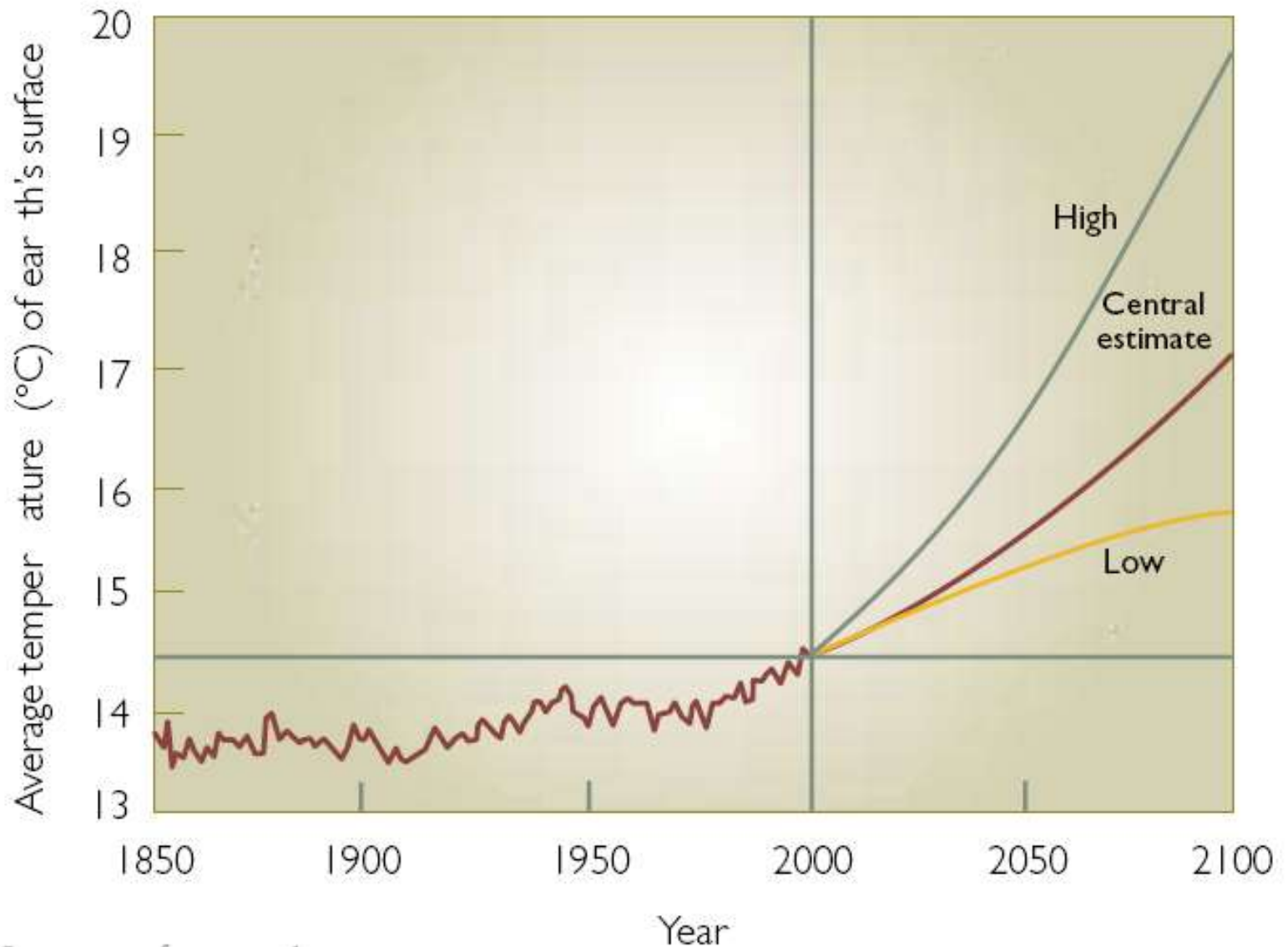
Projected Impacts of Climate Change



Variations in Earth's Temperature the Last 20000 Years

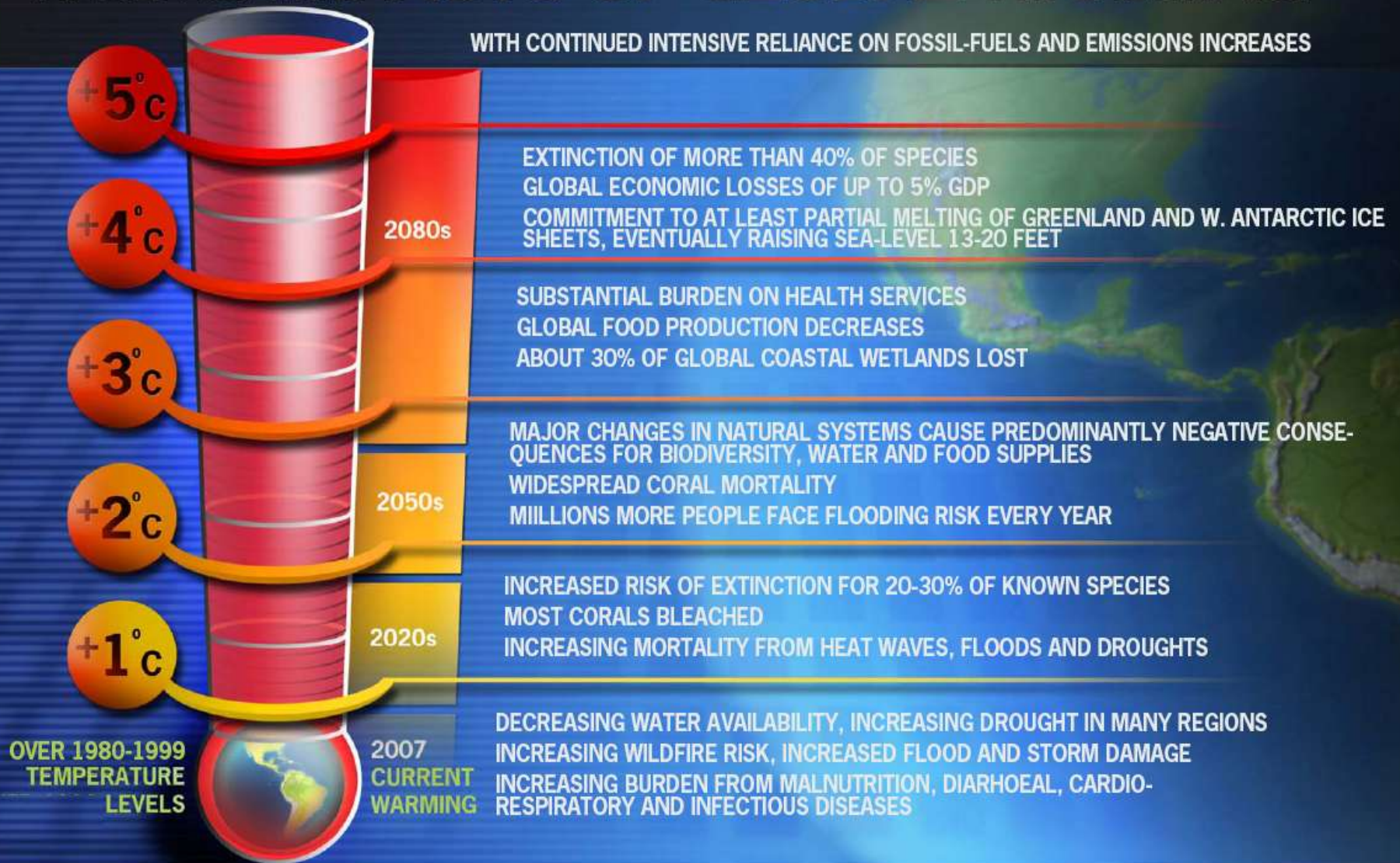


Global Temperature Record Since 1860 and Projection to 2100 year



RISING IMPACTS OF GLOBAL WARMING

WITH CONTINUED INTENSIVE RELIANCE ON FOSSIL-FUELS AND EMISSIONS INCREASES



www.net.org



CO₂ Concentration



Experts predict that by 2015, mankind will be pumping 10 billion more tons of carbon dioxide into the atmosphere each year than in 2000. According to those projections, North America and East Asia will each contribute about 24 percent of all emissions. By contrast, Africa (in two shades of green) will contribute just 4 percent.

Source: Dorling et al. Yale University, 2008



The Last 100 Years

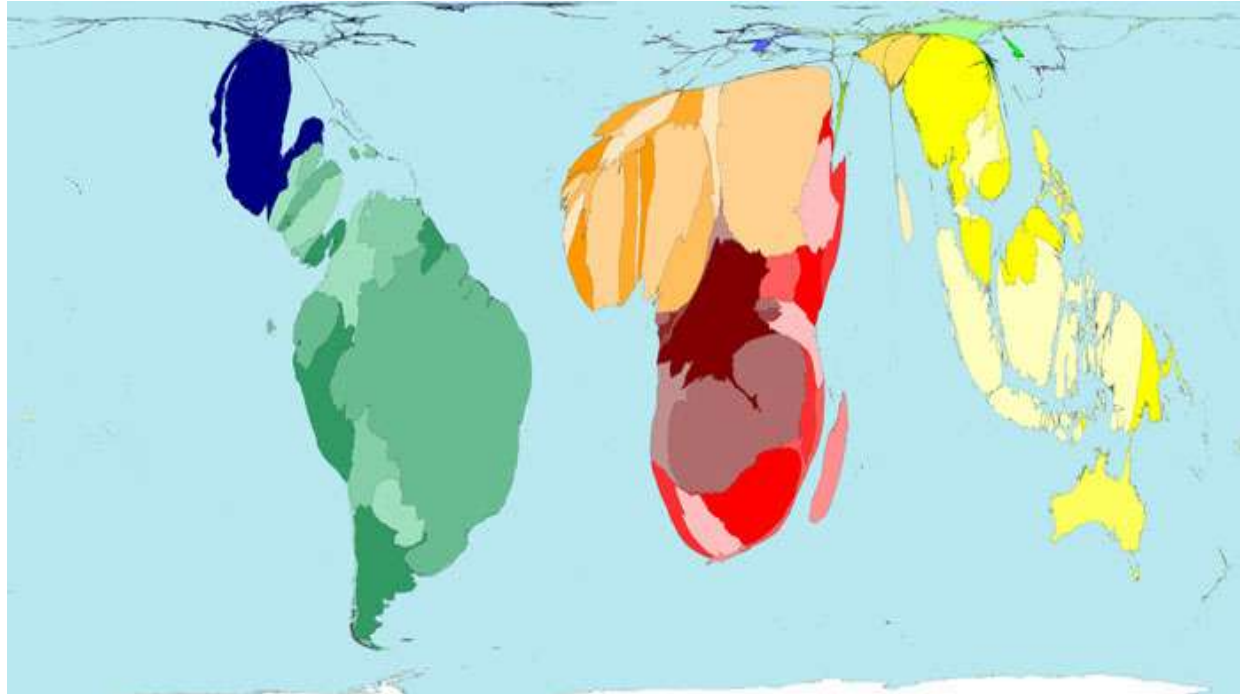
The web of life has become moth-eaten:

- **Tripling of world population**
- **World's forests reduced by half**
- **Freshwater consumption increased by 6**
- **Half of the world's wetlands gone**
- **20% of the world's freshwater fish stocks gone or threatened**
- **Climate change**
- **Biodiversity threatened**
- **Most sea fisheries threatened**
- **Freshwater crisis: 4 000 000 000 people will suffer from too little water in 2025"**

Source: "Environment Matters" 2003. World Bank



From 1990 and 2000 year of All the Forest Loss 31% in South America, and 21% in the Asia-Pacific Region



The globe's three hotspots of forest loss - the Brazilian Amazon (in mint green) Indonesia and Southeast Asia (in yellow), and the Congo basin (in maroon) — are shown in this map.

Source: Dorling et al. Yale University, 2008



The Size of Beijing in 1978 and 2000 year



Source: USGS 2001



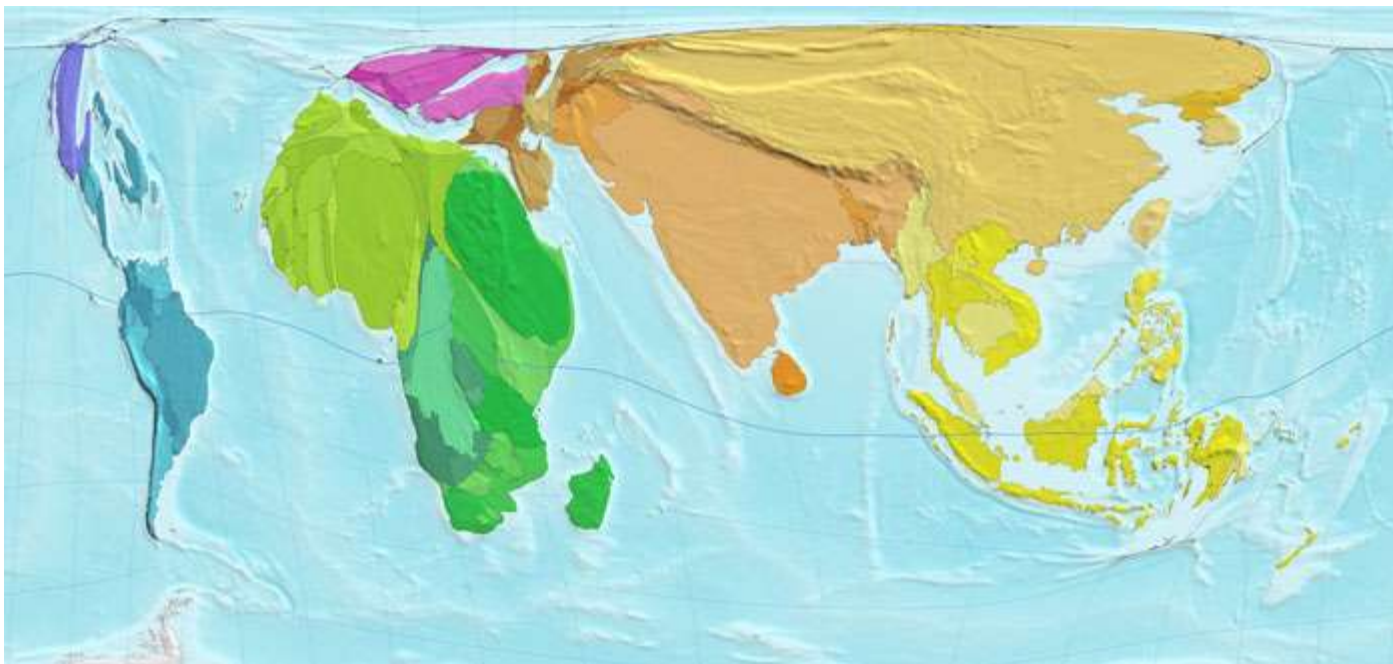


Deforestation in the Amazon 1995 – 1997 year





Without Access to Clean Drinking Water



25% of the population in China (mustard color) or 324 million people - lack clean drinking water. India (light brown) and Africa (green) also have huge populations with no access to safe drinking water.

Source: Dorling et al. Yale University, 2008

**Global
Climate
Change**

**Land
Degradation**

**Global
Water
Crises**

**Global
Reduction
of Living
Forms**

**Global food
crises**

**Agriculture and
forestry in
global climate
changes**

**Loss of
species/
genes and
food crises**

Effects of Climate Change in Europe

- **Climate change will lead to more periods of high temperature and periods of heavy rain.**
- **Unseasonable or extreme weather will have an increasing impact on crop production**
- **There are already examples of what to expect**
- **Modelling can help predict consequences and guide adaptation.**
- **Extreme weather in the Europe may not in itself make us go hungry but its impact will exacerbate other pressures on food supply**



Extreme Weather Condition in Serbia Was in 2007 year

Climate variability and extremes are already a major obstacle to development in many regions including SEE



**Exceptional drought in Serbia:
losses in agriculture
cc. 0.5bn US\$**



Climate Variability and Extremes are Already a Major Obstacle to Development in All Countries in the SEE Region

Cases and effect of floods in Serbia 2005 and 2006 year



Climate Variability and Extremes are Already a Major Obstacle to Development in All Countries in the SEE Region

Cases and effect of hail and strong wind in Serbia 2006

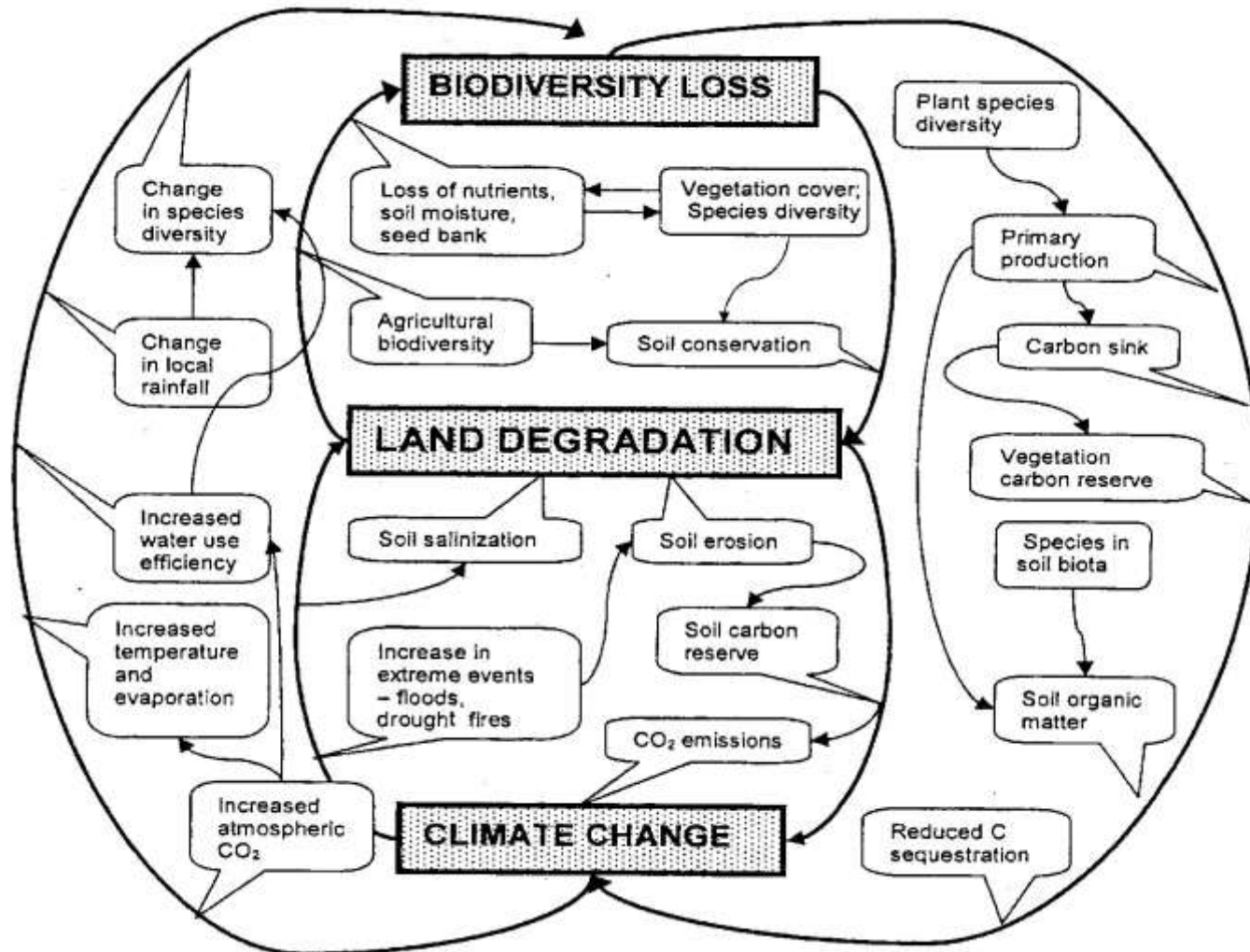


Impact of Climate Change on Food and Agriculture

- **Extreme weather: flooding, storms, drought**
 - Farming systems, crops, animals
 - Land: coastal zones disappearing
- **Livelihood vulnerability: Africa, the world's poorest region, most dependent on agriculture**



Climate Change, Land Degradation and Biodiversity Loss



Agriculture - Sustainability



Plant biodiversity - irreplaceable genetic natural capital.



Environment





Biodiversity & Plants for Food and Agriculture

- **Biodiversity**
- **Plant Genetic Resources for food and agricultur**
- **Classification of agriculture plants**
- **Exotic germplasm in agriculture**
- **Biodiversity as a source of new agriculture plants**

Sources: Prodanovic & Surlan-Momirovic: Plant Genetic Resource, 2006)



No. of plant species in Serbia vs. World

Group	Number of species			
	World	%	Serbia	%
Higher plants	350.000	100	4.300	100
Resources for food and agriculture	100.000	29%	1.500	35%
Resources for food (eatables)	40.000	11%	1.000	23%
Cultivated plants	8.000	2%	250	5%
Main crops	200	0.06%	60	1.4%
> 50% cal	15	0.004%	20	0.5%

Sources: Prodanovic & Surlan-Momirovic: Plant Genetic Resource, 2006)

Genetic resources of vegetables



Genetic resources of forage plants



Genetic resources of industrial crops



Genetic resources of tuberose plants



**Genetic resources of
aromatic, spice and
medicinal plants**

- **Genetic resources of
decorative plants**



Genetic Resources Within Species - Wheat

	No. of accessions			
Wheat	World	%	Serbia	%
No. of accessions	6.000.000	100	6.000	100
No of cultivars	6.000	0.1	40	0.67
> 50% area	500 cultivars	0.008	10	0.167



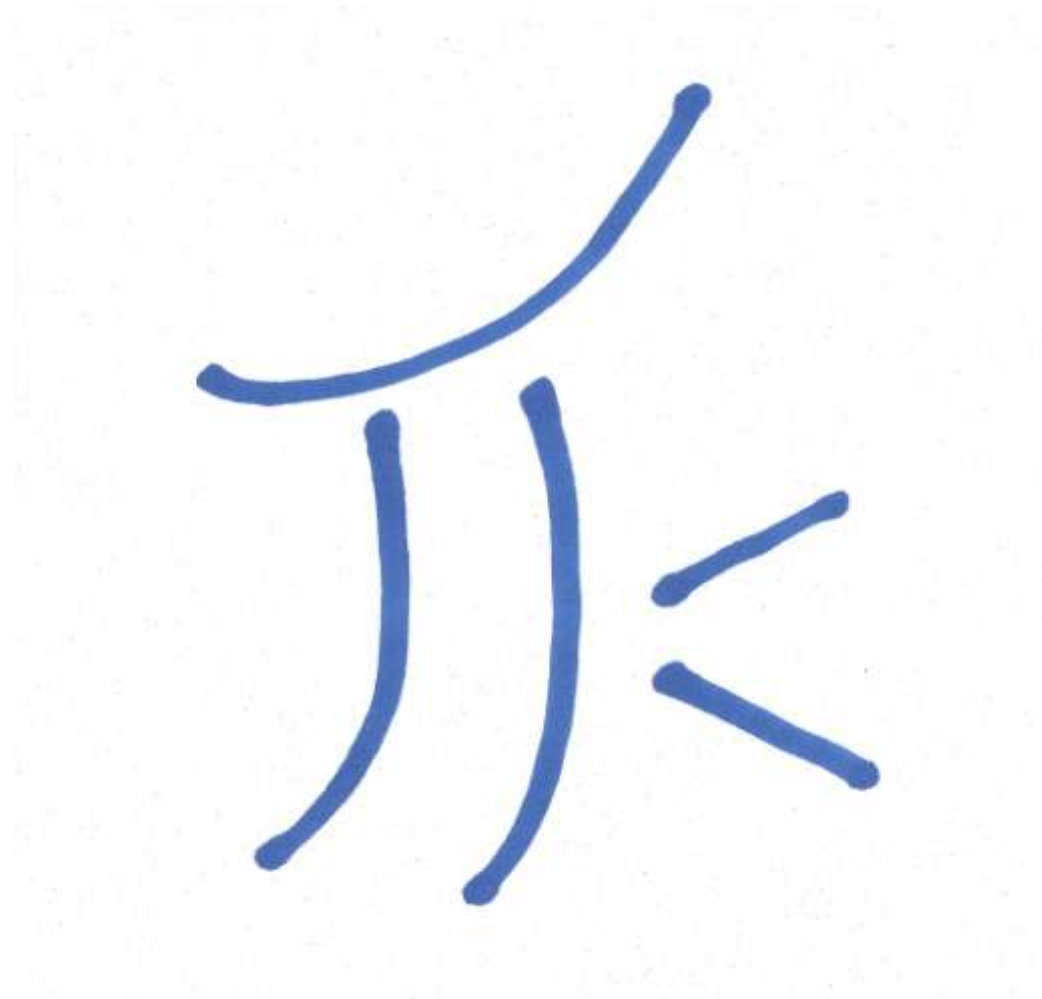


Impacts of Climate Change on Agriculture

- **Indirect impacts:**
- **Changing crop-weed competition dynamics**
- **Range changes of pests & pathogens**
 - **Expanded range predicted for many pathogens**
 - **Less-cold winters allow increase in pests**
 - **Different range changes between pests & pathogens and natural controls**
- **Decreased biodiversity in natural ecosystems**



“Environment for Europe” Ministerial Conference organized in Belgrade (October 2007 and 2008)



A global crisis needs enthusiasm, synergistic collaboration, hard work and good management



THANK YOU

