
Climate Change

General Overview

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What is Climate Change?

- Climate change is the change in the magnitude of a single climate parameter such as temperature
- This change leads to **shifts** in weather patterns which might result in a shift to colder, wetter, cloudier, and windier conditions



What is Climate Variability?

Climate **variability** is the **fluctuation** about the mean for a specific parameter



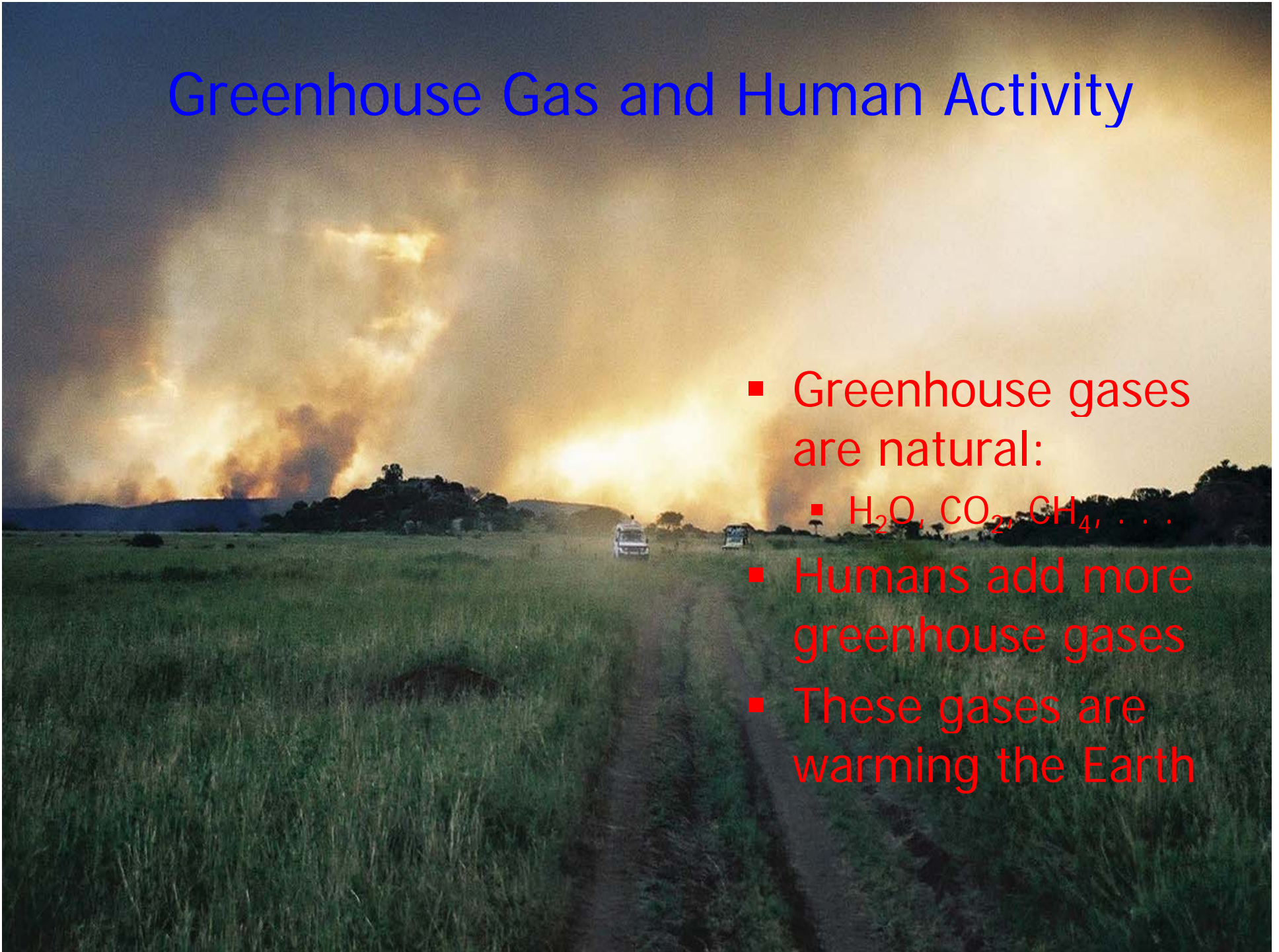
What is Global Warming?

- The term **global warming** is often taken to refer to **global increases in temperature** accompanying the increases in greenhouse gases in the atmosphere
- Increases in **greenhouse gases** in the atmosphere produce global warming through an increase in downward infrared radiation
- This increase in surface heating can indeed increase surface temperatures but it also increases evaporation

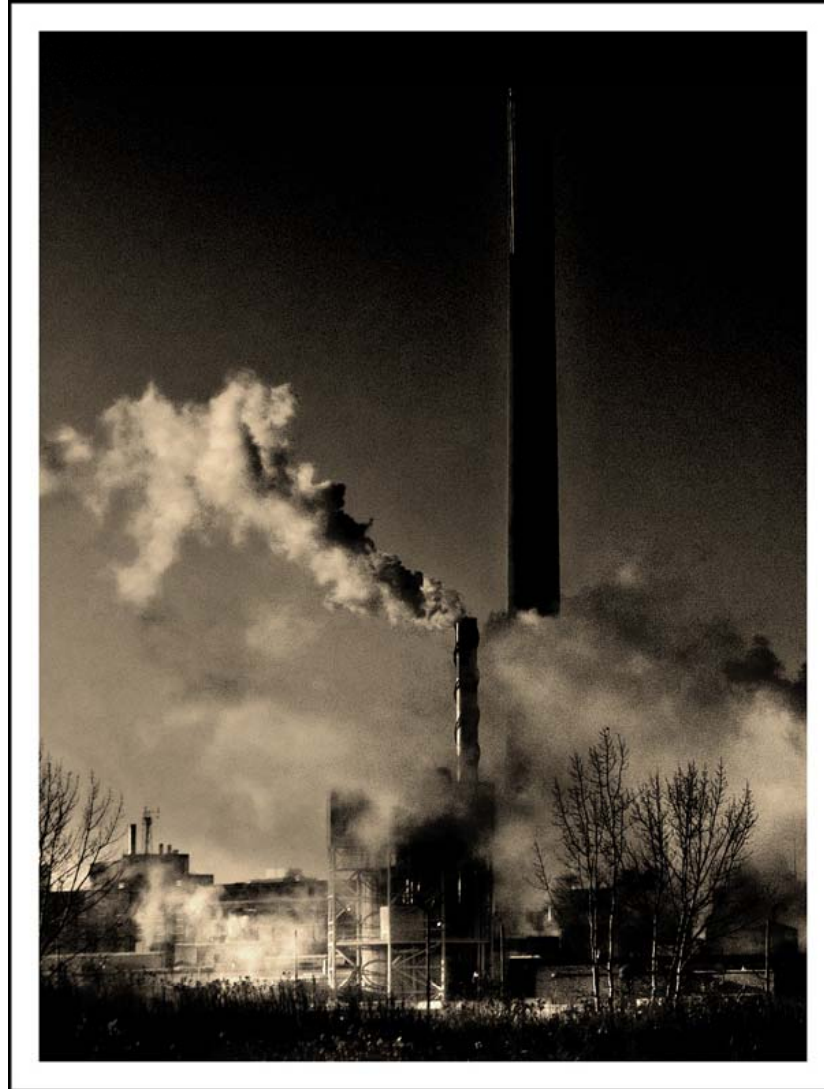


Greenhouse Gas and Human Activity

- Greenhouse gases are natural:
 - H_2O , CO_2 , CH_4 , . . .
- Humans add more greenhouse gases
- These gases are warming the Earth



Greenhouse Gas and Human Activity



Greenhouse Effect

- The **greenhouse effect** is responsible for the Earth's warm
- Gases like **methane** and **carbon dioxide** trap heat near the surface thus keeping the Earth **warmer** than it would be
- The **greenhouse effect** is a natural phenomenon. However, human activities can enhance its effect and destabilize the climate



Greenhouse Effect

- The sun sends **energy** toward Earth (light and radiation)
- When sun's rays strike the atmosphere, some of the radiation is immediately **reflected** into space
- The radiation that **gets through** the atmosphere heads toward the Earth's surface



Greenhouse Effect

- Solar radiation that passes through the Earth's clear atmosphere is **absorbed** by the ground, water, plants,.....
- They emit **infrared radiation** as **heat**
- A portion of the solar radiation bounces back into space where the heat energy **dissipates**



Greenhouse Effect

- Molecules of **greenhouse gases** in the atmosphere **absorb** infrared radiation and energy and **release** heat
- This **raises the temperature** of the **ground** and **air** and warms the Earth's surface



Parameters of Climate Change

Climate Changes



Temperature



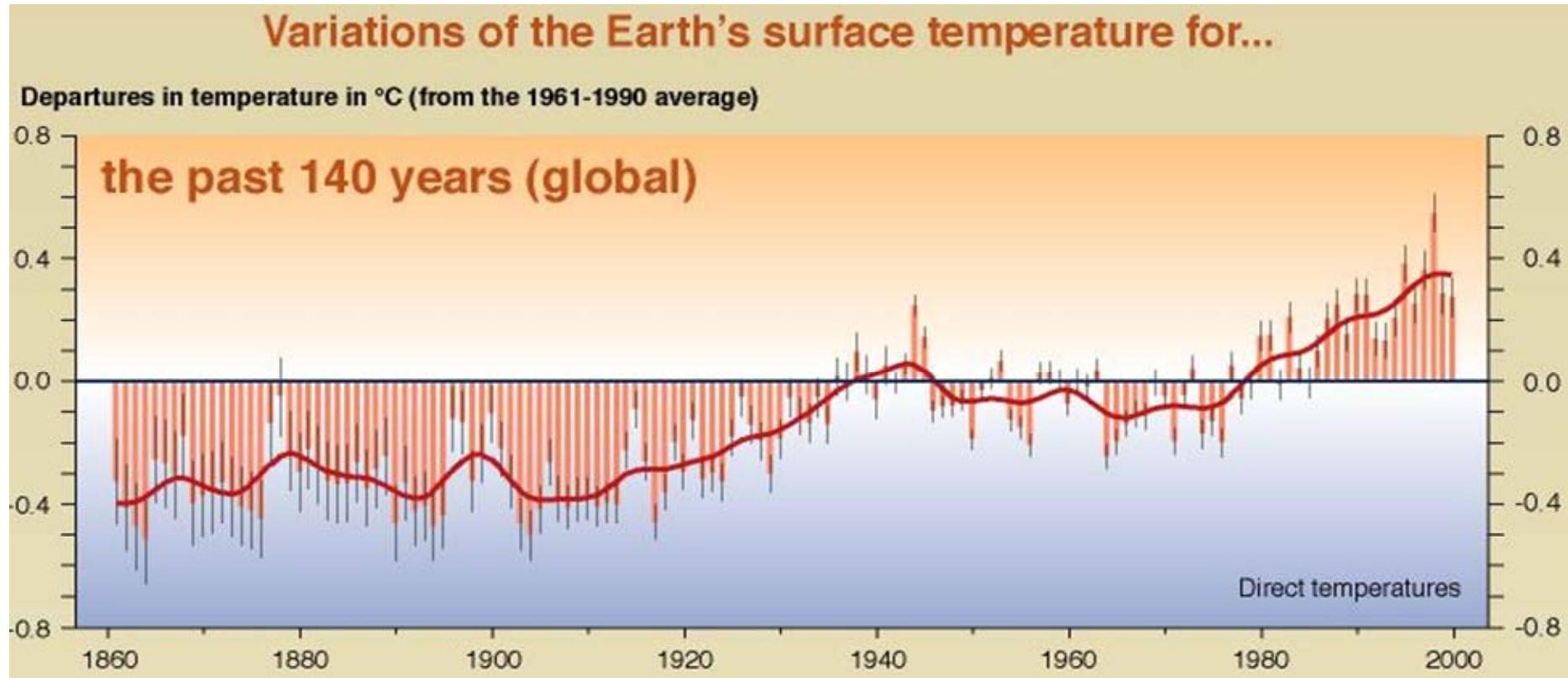
Precipitation



Sea Level Rise



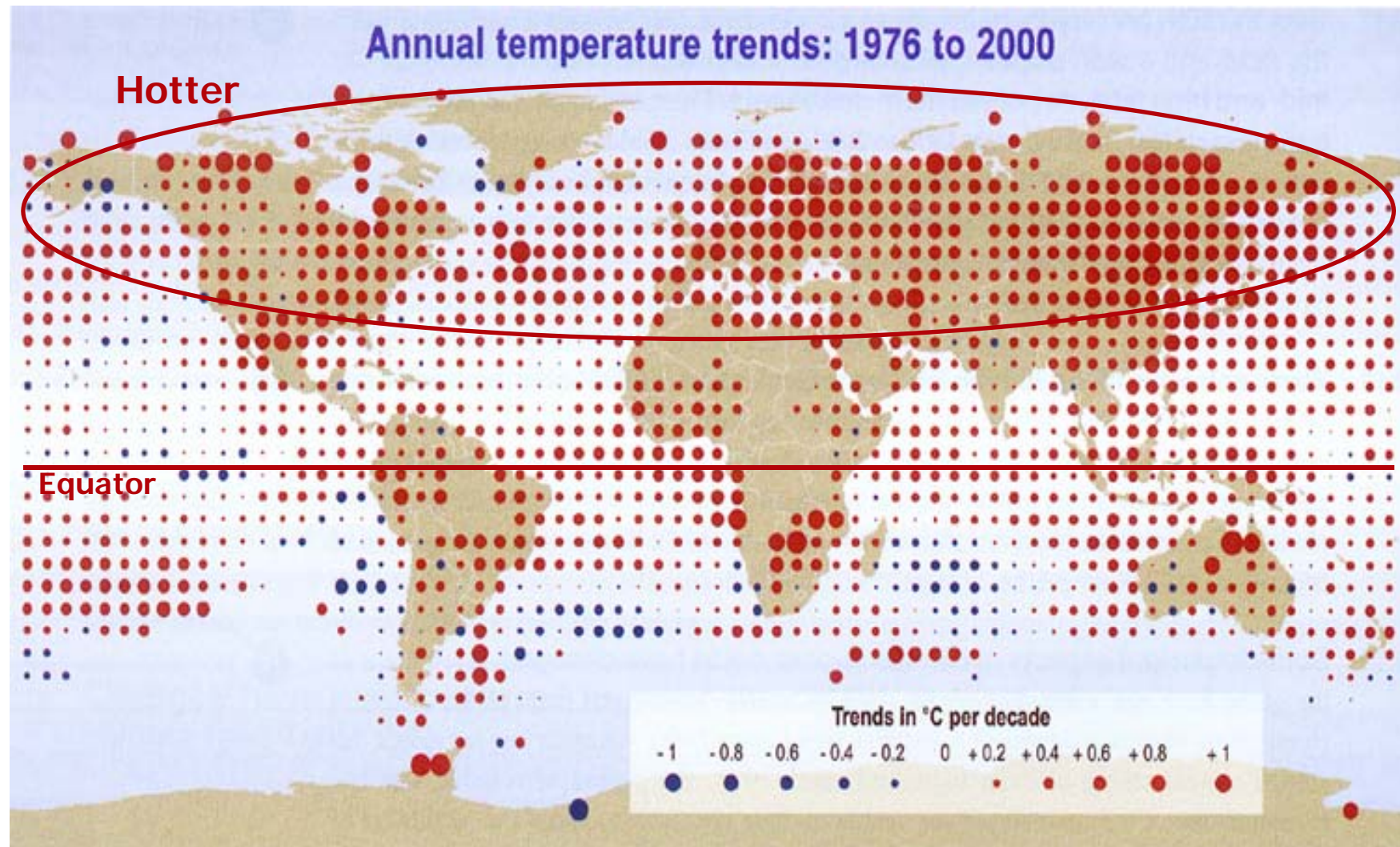
Variation of the Earth's Surface Temperature for the Past 140 years



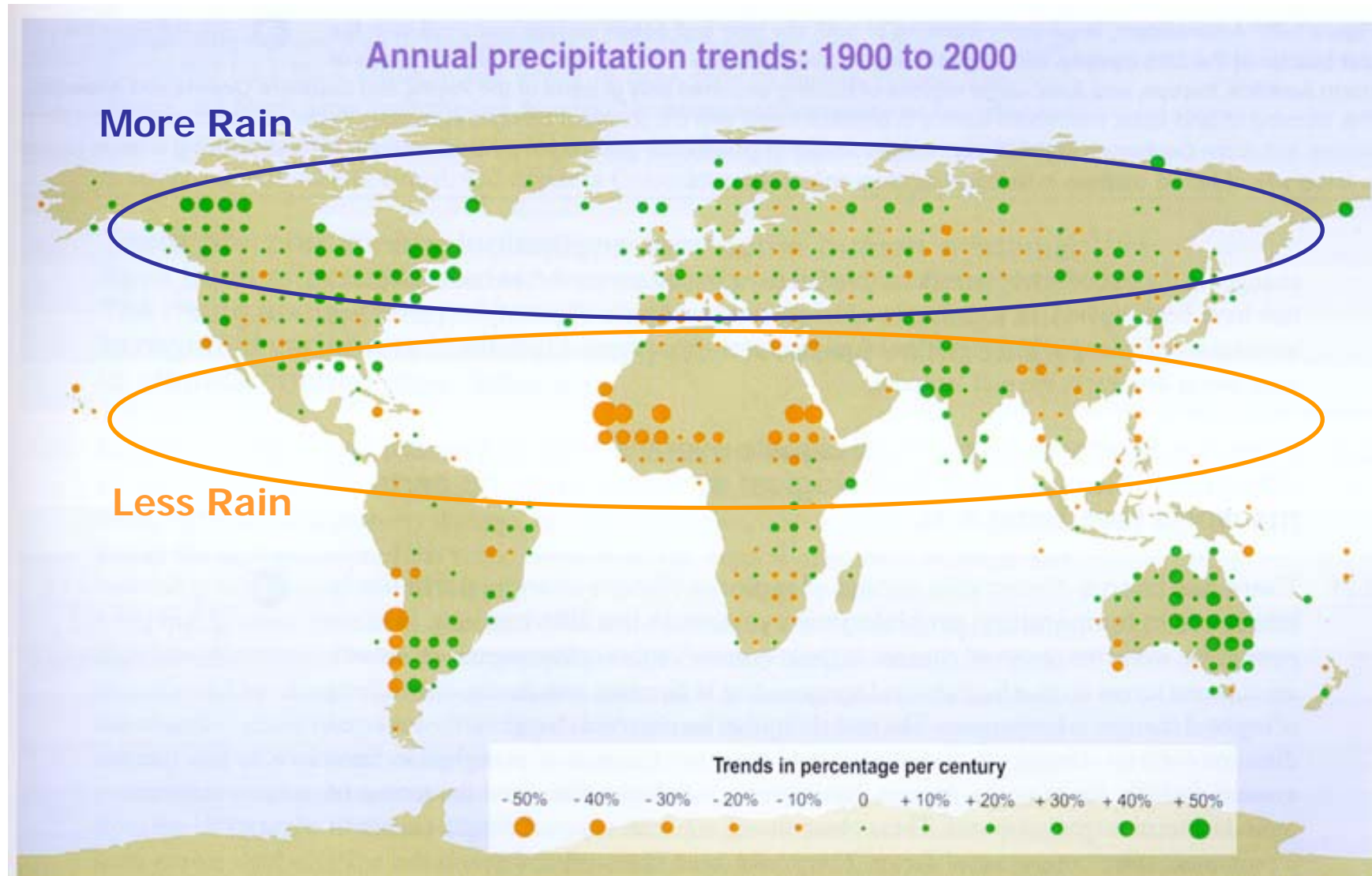
Global mean surface temperatures have increased



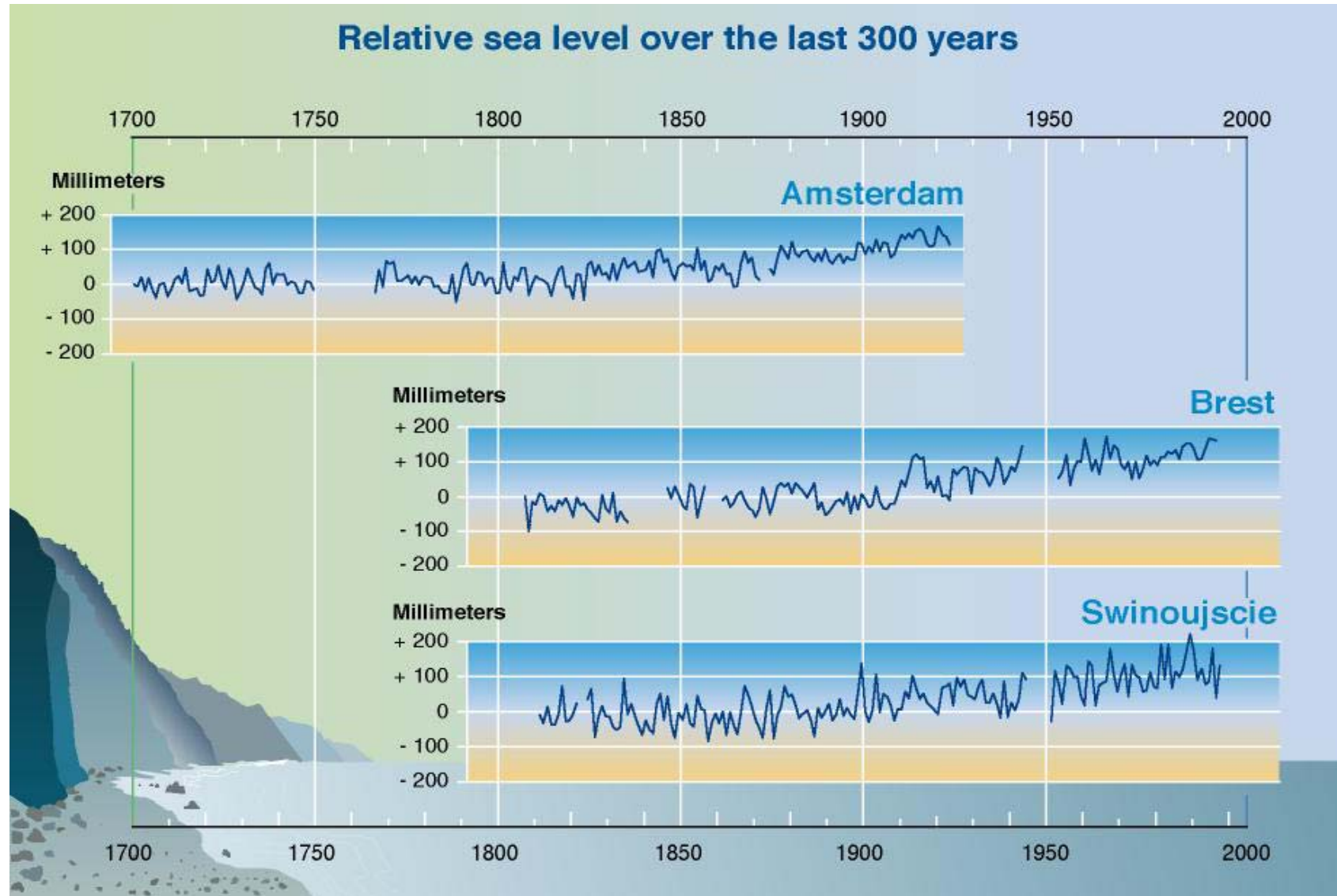
Where has the Earth warmed?



Changes in Precipitation



Sea Levels have Risen

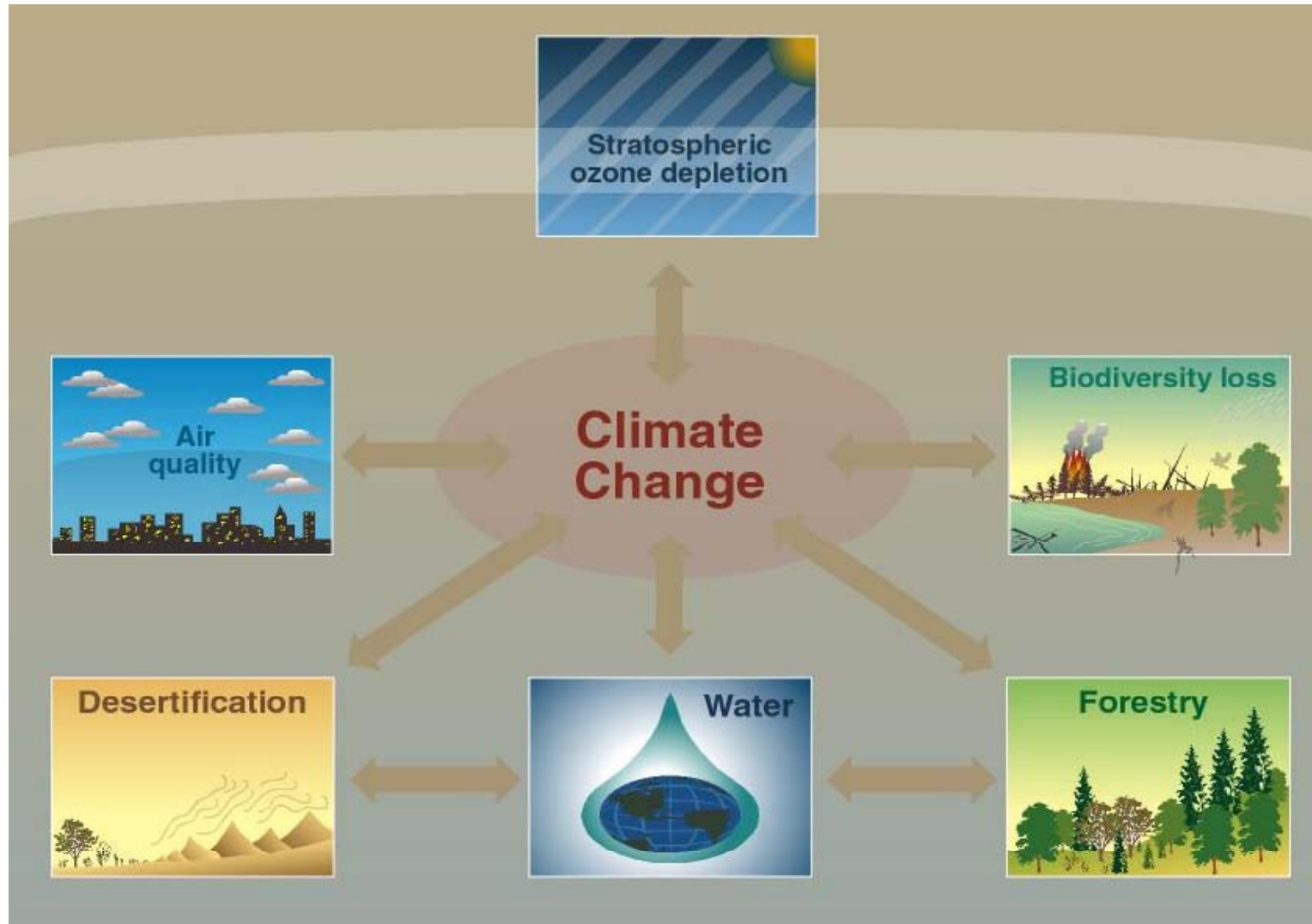


Projected global-average temperature and sea level

- Global-average surface temperature projected to increase by 1.4 °C to 5.8 °C by **2100**
- Global average precipitation will increase over 21st century
- Very likely to be more intense precipitation events
- Snow cover and sea-ice extent projected to decrease further
- Global mean sea-level projected to increase by 9 cm to 88 cm by **2100**



Pathways of Climate Change Impacts



Potential Climate Change Impacts on Water

Hydrologic (Water) Cycle

- Change in average precipitation
- Change in the character of precipitation (more heavy downpours)
- Changes in amount, timing and distribution of floods and droughts
- With a warmer land and atmosphere:
 - Runoff changes:
 - More precipitation falls as rain
 - Winter runoff is increased
 - Winter starts later and ends earlier
 - Spring runoff pulse is earlier
 - Summer runoff is decreased



Potential Climate Change Impacts on Water

Water Quantity and Quality

- Surface water
- Groundwater
- Competition for water supplies



Potential Climate Change Impacts on Water

Sea Level Rise

- Drinking water
- Coastal property and infrastructure
- Economic activity

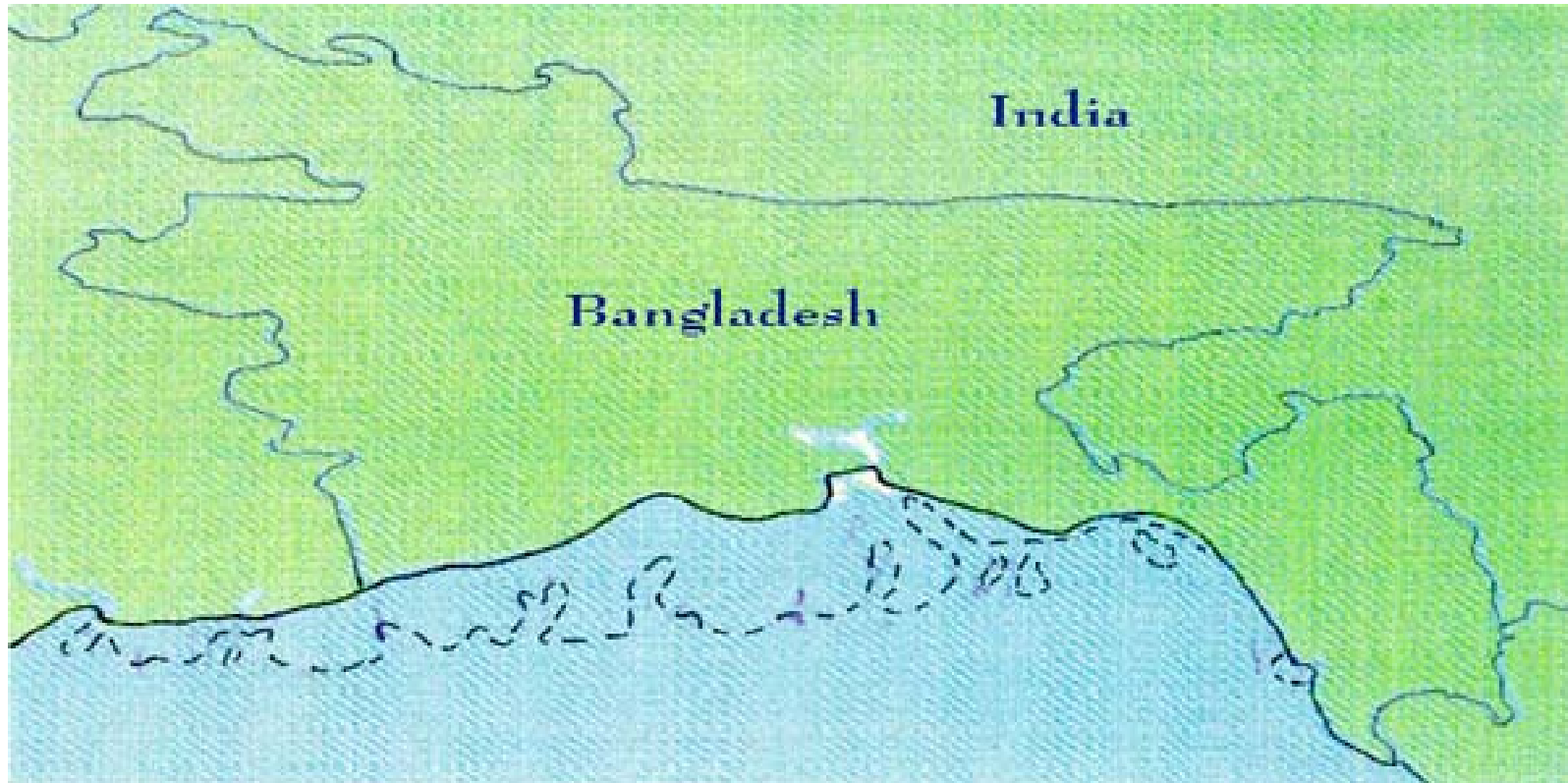


Precipitation Intensity Increases

- More intense precipitation
- Precipitation increases are due to the strong events



Flood Risk



Increased risk of floods due to **sea level rise** and **heavy rainfall events**

Bangladesh is projected to lose about **17%** of its land area with a sea level rise of one meter



Impact of Climate Change on Agriculture

- Food production needs to double to meet the needs of an additional 3 billion people in the next 30 years
- Areas that experience reduced rainfall and increased temperature as a result of CO₂-induced climate change also could experience declines in agricultural yields, livestock yields, and tree cover, placing local people at risk of **famine**
- Climate change is projected to decrease agricultural productivity in the tropics and sub-tropics for almost any amount of warming



Impact of Climate Change on Desertification

- Drylands cover around one third of the world's land surface and are inhabited by more than one sixth of its population
- Lower soil moisture and sparser vegetative cover also would leave soil more susceptible to wind erosion
- Reduction of organic matter of soil could reduce the long-term water-retention capacity of soil which leads to exacerbating **desertification**
- Moreover, increased wind erosion increases wind-blown mineral dust, which may increase absorption of radiation in the atmosphere



Impact of Climate Change on Forests



- Wood fuel is the only source of fuel for one third of the world's population
- Wood demand will double in the next 50 years
- Forest management will become more difficult due to an increase in pests and fires



Impact of Climate Change on Water Availability



- One third of the world's population is now subject to water scarcity
- Climate change is projected to decrease water availability in many arid- and semi-arid regions



Developing countries are the most vulnerable to climate change

- **Impacts are worse** - already more flood and drought prone and a large share of the economy is in climate sensitive sectors
- **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge
- Net market sector effects are expected to be negative in most developing countries



Polar Ice



Melting and Thickening

