The Basic Science of Climate Change

UNESCO-Course:
Climate Change Inside and Outside the Classroom

United Nations
Educational, Scientific and
Cultural Organization

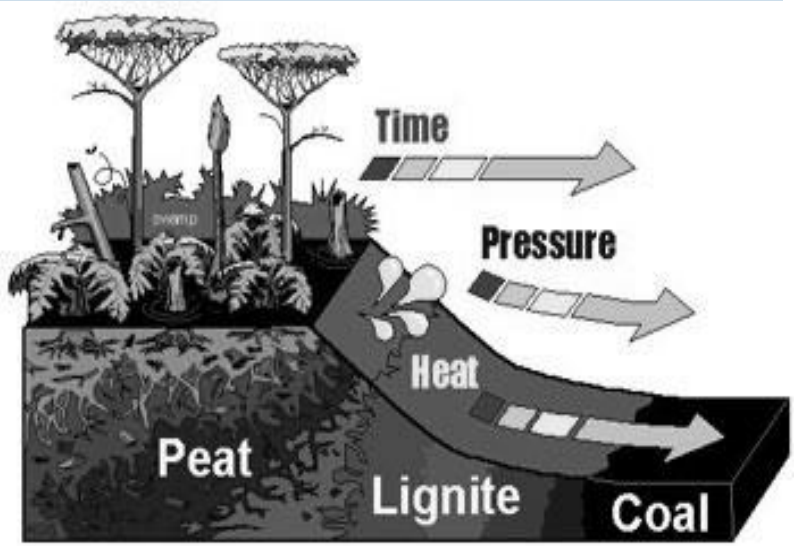
UN DECADE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT
DÉCENNIE DES N.U. POUR L'ÉDUCATION EN VUE DU DÉVELOPPEMENT DURABLE
2005-2014

sandwatch Foundation

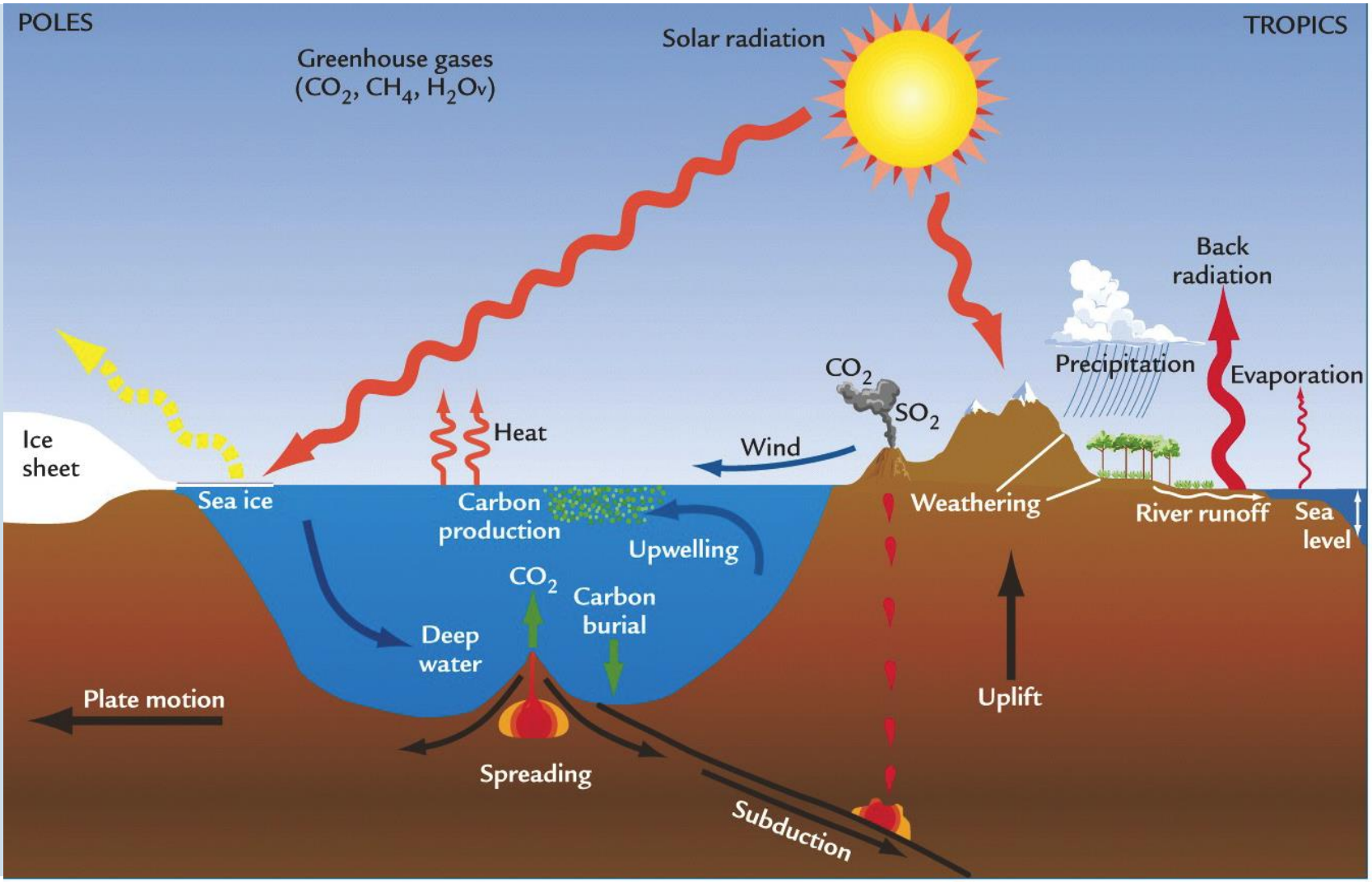
Module 1

What Are Carbon-based Fossil Fuels?

- Carbon-based molecules are the basic building blocks of all life forms (animals, plants)
- Fossil fuels were formed millions of years ago when prehistoric plants and animals died and sank to the bottom of the vast oceans and swamps.
- Under the intense pressure buried deep inside the earth, the rotting organic matter formed what is today mined as fossil fuels (coal, oil and natural gas).

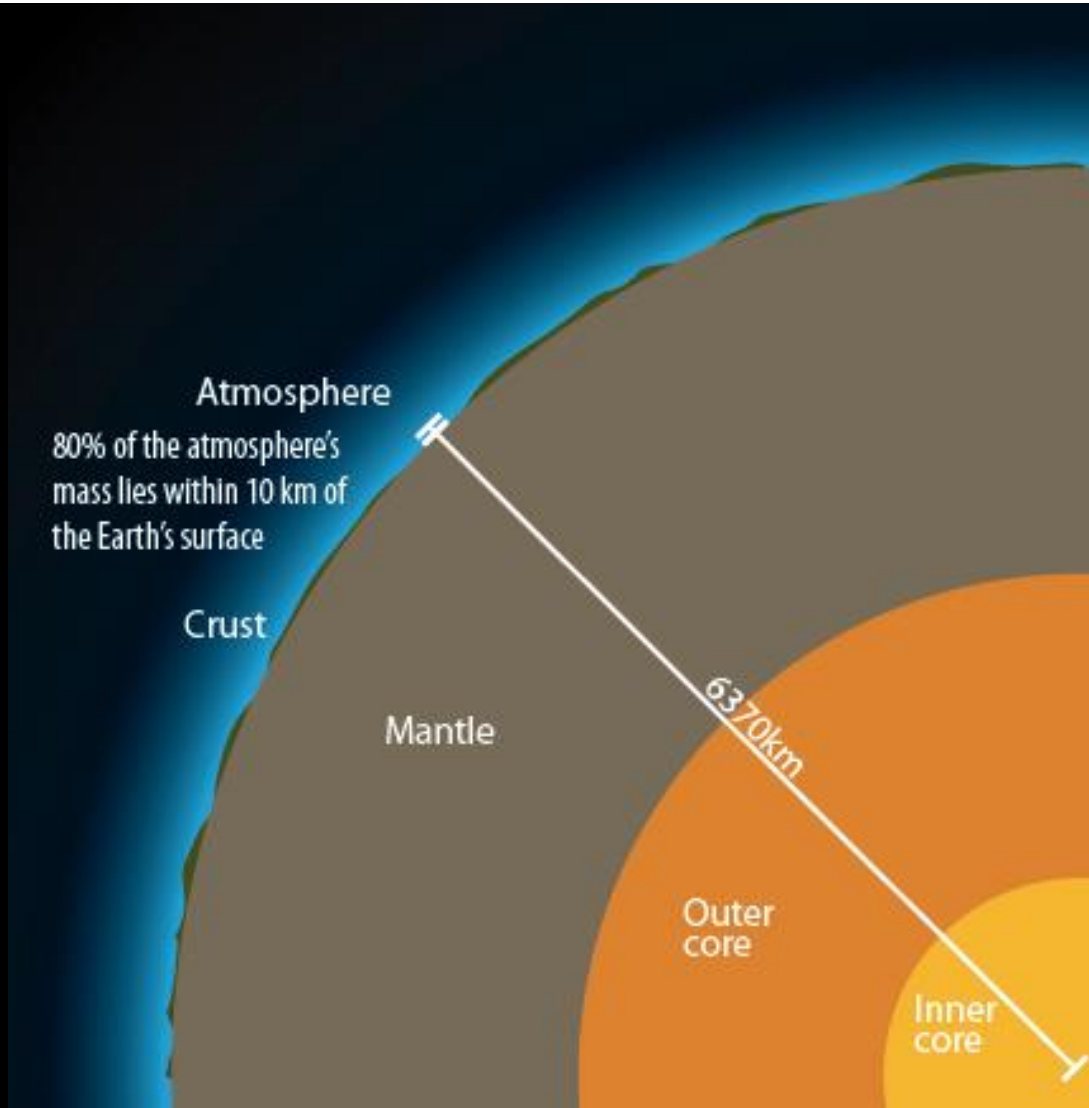


Components of Earth's Atmosphere



Composition of the Atmosphere

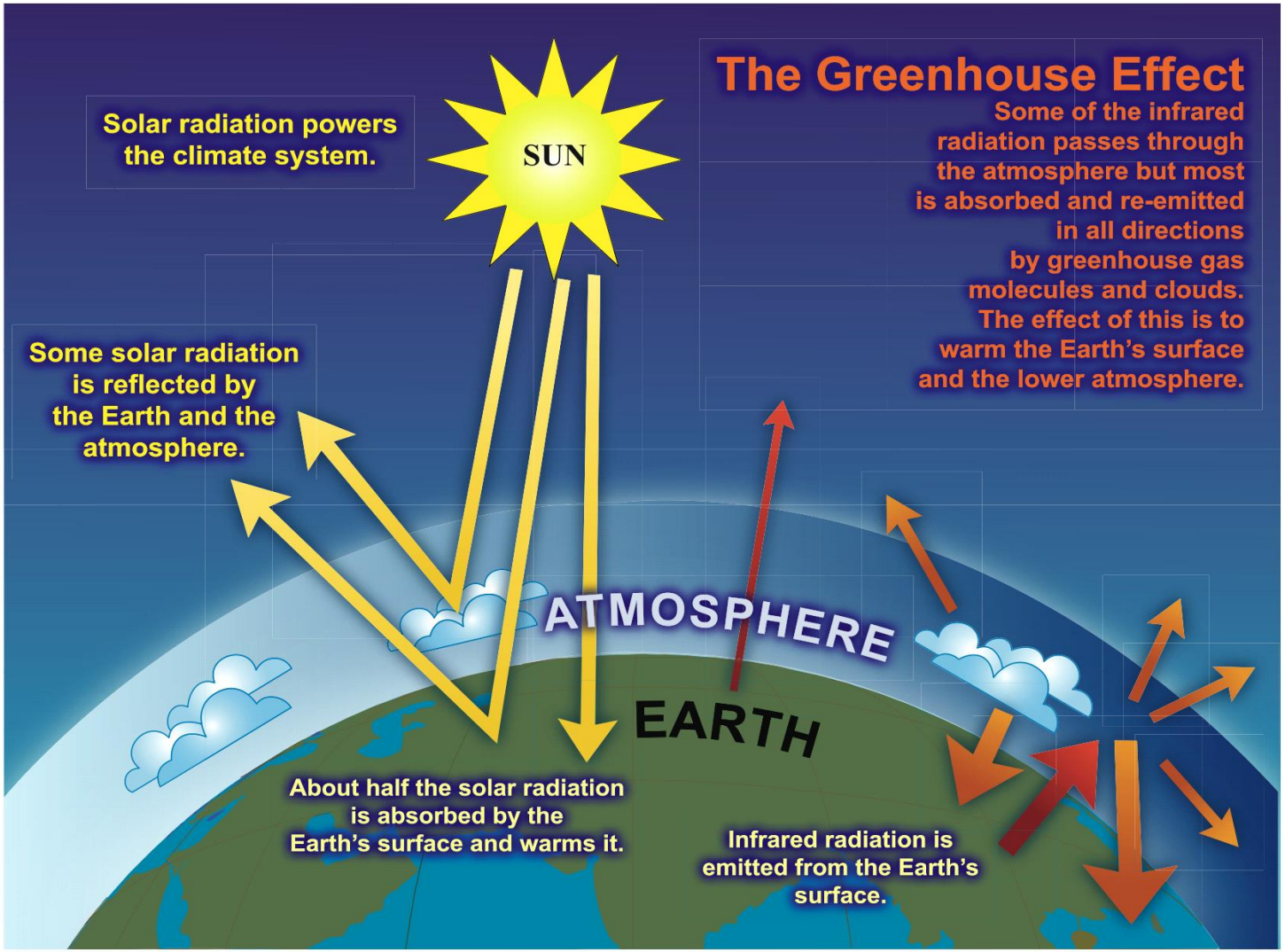
- Thin layer of gases; 80% of the mass is contained below 10km of altitude
- Predominantly made up of nitrogen (78%) and oxygen (21%)
- Remaining 1% is made up of water vapour, carbon monoxide, carbon dioxide, neon, methane, krypton and ozone, some of which are so-called greenhouse gases



The Greenhouse Effect

- Weather is the temperature, precipitation and wind as they change hour by hour and day by day
- Climate is the average weather and the nature of its rhythmical variations that we experience over time
- The greenhouse effect is the natural process of the atmosphere letting in some of the energy we receive from the Sun and trapping it. For several thousands of years the atmosphere has been delicately balanced
- Human activities have led to an increase in greenhouse gases in the atmosphere causing an increased greenhouse effect and extra warming
- The main greenhouse gas responsible for recent climate change is carbon dioxide (CO_2). Others greenhouse gases produced from human activities include methane (CH_4) and nitrous oxide (N_2O).

The Greenhouse Effect Illustrated

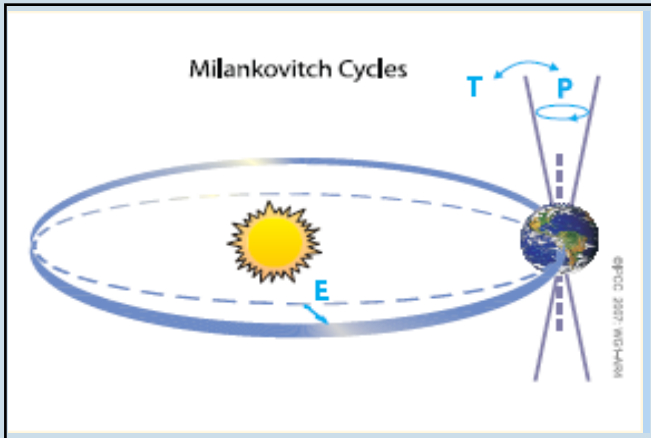


Weather and Climate

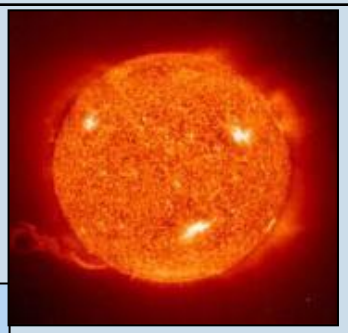
‘Weather’ describes current atmospheric conditions e.g. rainfall, temperature, wind speed, at a particular place and time

‘Climate’ is the average pattern of weather for a particular place over a long period of time – several decades

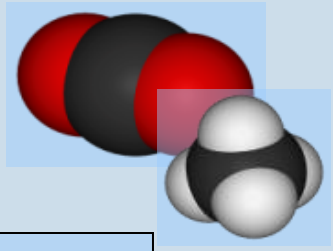
Factors Causing Changes In Climate



Changes in Earth's orbit



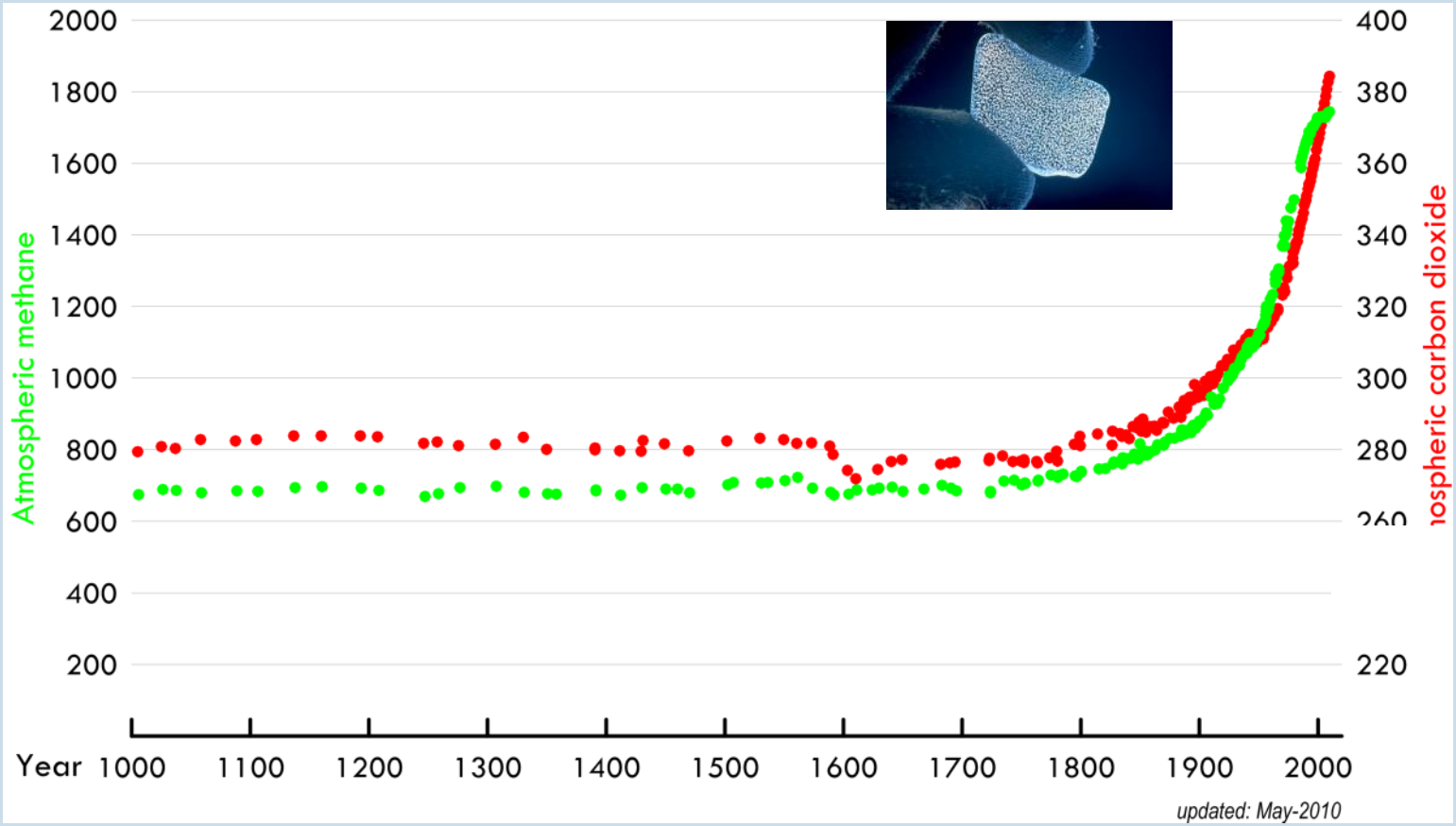
Solar changes



Changes in atmospheric chemistry

Volcanic eruptions

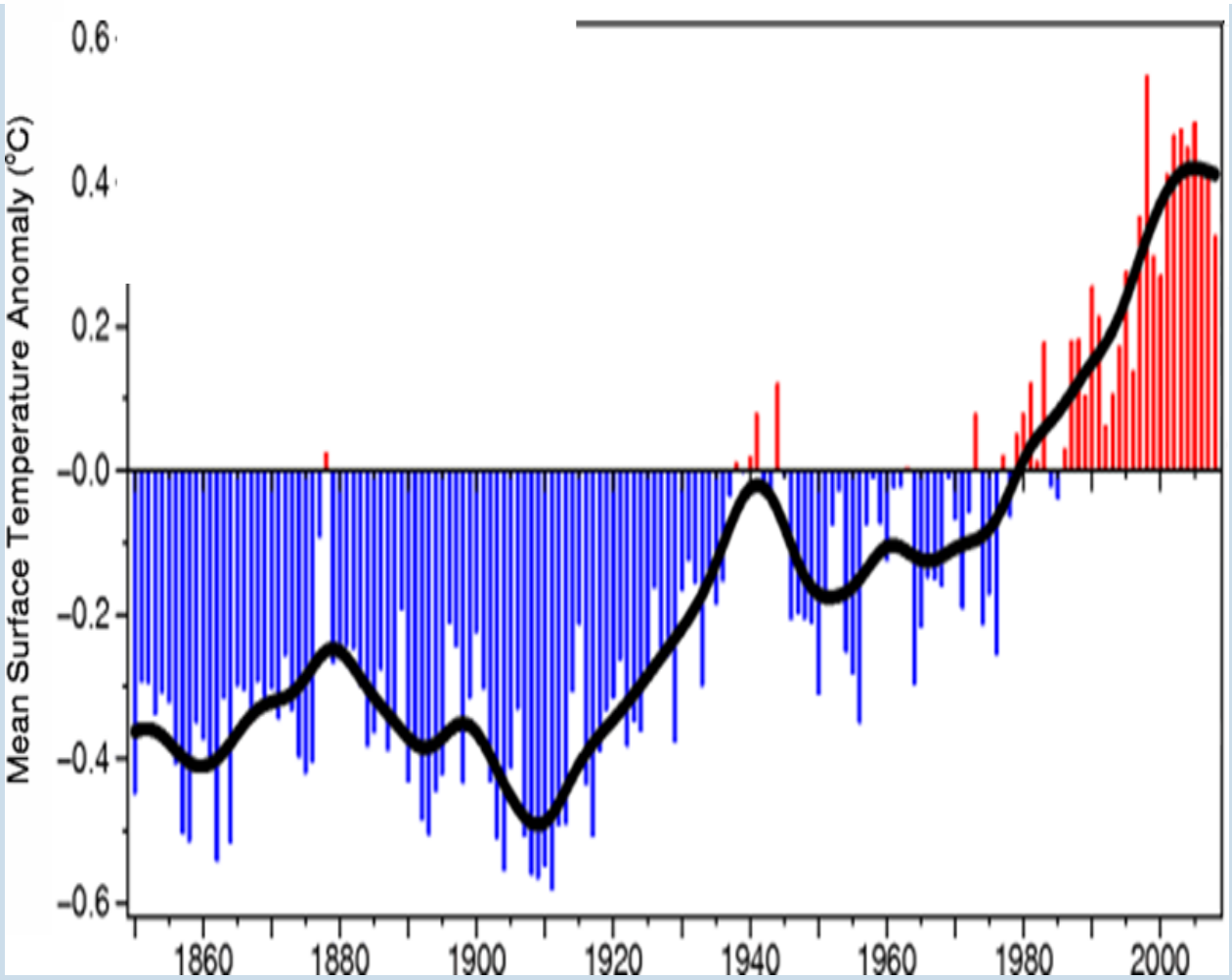
Changes in Atmospheric Carbon Dioxide and Methane Concentrations



Carbon dioxide concentrations are now greater than at any time during the past 650,000 years. The rate is accelerating.

Source: CSIRO

Global Temperature Change



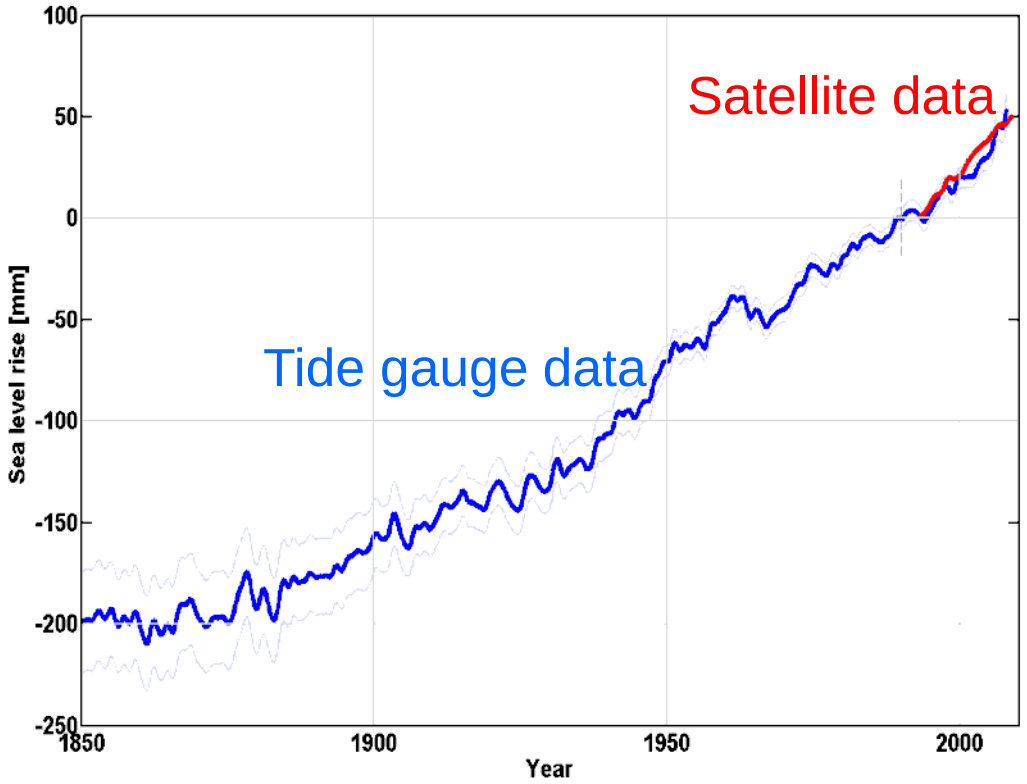
Source: Climatic Research Unit, UEA

13 of the past 14 years are the warmest ever recorded

Source: Climatic Research Unit, UEA

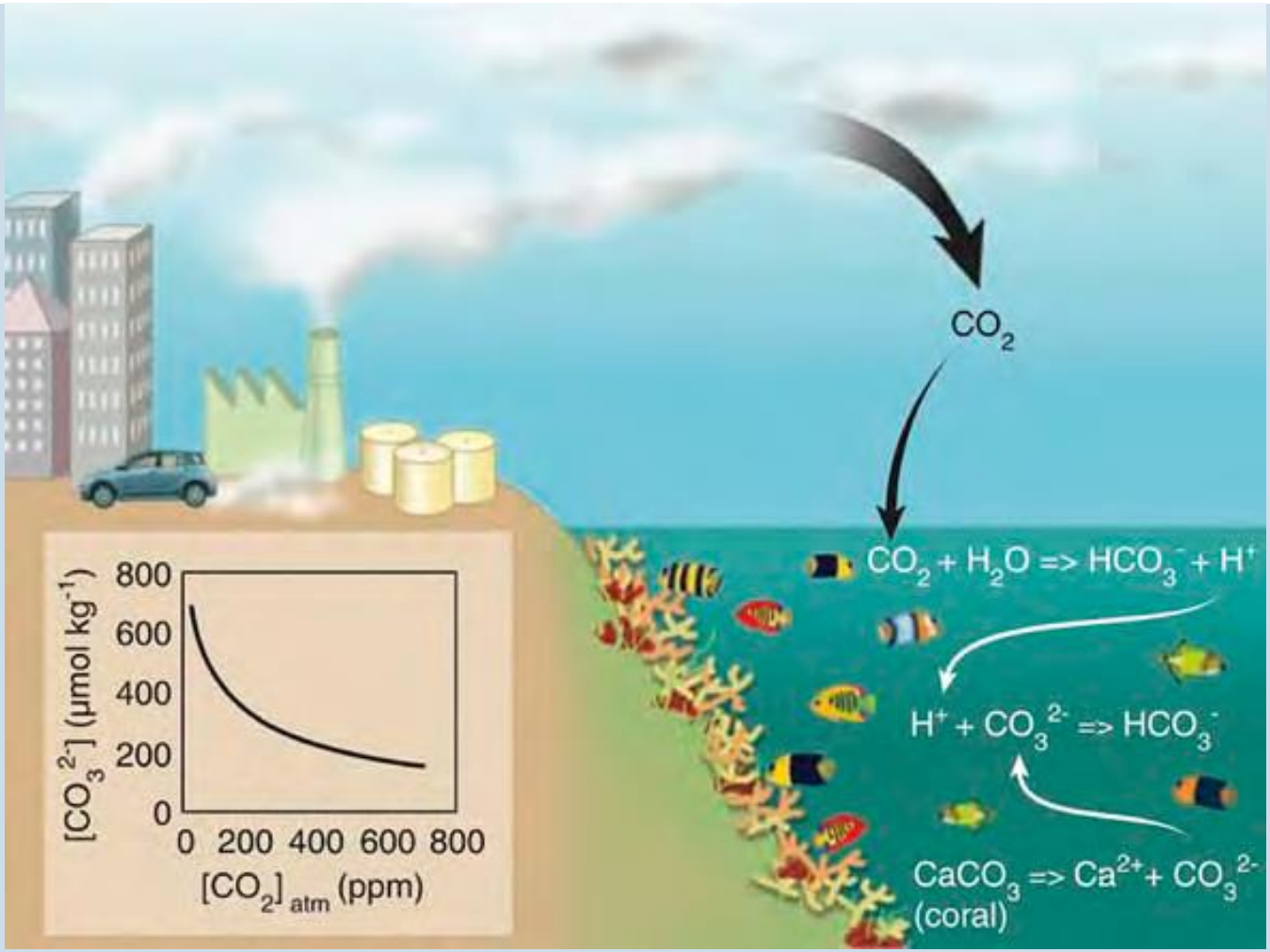
Sea Level Rise

- As water warms, it expands
- As ice-sheets and glaciers melt, they add to the ocean volume
- Both lead to sea-level rise (about 20 cm over last 100 years)



Updated from Church and White 2004

Ocean Acidification



Source: Hoegh- Guldberg et al. 2007

Much of the CO2 gets absorbed by the ocean – GOOD for slowing global warming – BAD for ocean acidification.