

GLOBAL CLIMATE CHANGE

Climate change is a natural process and has been occurring for billions of years

Human activities are affecting the rate of climate change and may be changing its direction

Need to understand processes that transfer energy and material between reservoirs in order to understand global climate and human effects

Cycles

Material is transferred between reservoirs as part of a cycle

If the processes that control the cycles is understood it can be used to predict future behaviour

Time-scales of cycles vary from less than a day to more than a million years

Cycles connect with each other and have unexpected consequences

Need to know how cycles connect, then we can model and predict future changes very difficult at the moment

Greenhouse gases

Greenhouse gases trap long wave radiation leaving the Earth and alter the planetary heat budget

Carbon dioxide and methane are greenhouse gases, there are others

Sulphate reduces planetary warming by promoting cloud formation

Human activities are having major affects on some chemical cycles on the planet particularly CO₂

Recent atmospheric carbon dioxide levels

Air bubbles trapped in ice indicate pre-industrial CO₂ levels

Atmospheric CO₂ levels have risen from 280 ppmv to 360 ppmv (~29%) in the last 240 yrs

Projections imply doubling of pre-industrial atmospheric CO₂ level to 560 ppmv by year 2100

Carbon reservoirs

Largest reservoirs are carbonate sediments and organic carbon in soils

Are not believed to have changed significantly over last 240 years

Oceans have 70 times as much CO₂ in them as atmosphere

Fossil fuels and sedimentary organic carbon contain 13 times as much CO₂ as current atmosphere

Planetary biomass constant over last 200 - 300 years?

Annual cycle of plant growth and death moves CO₂ between atmosphere and biosphere and back again

Burning of fossil fuels is responsible for increasing atmospheric CO₂ levels

Observed atmospheric CO₂ increases smaller than expected

Need to know where anthropogenic CO₂ is going and how fast

Need to know relationship between atmospheric CO₂ concentration and planetary temperature

Antarctic ice core record of atmospheric CO₂

Antarctic ice core record shows current CO₂ levels higher than in last 160,000 years

Changes in average planetary temperature over last 160,000 years match atmospheric CO₂ levels

Sea level variations

During ice ages sea level goes down, water stored on continents as ice
During warm periods sea level rises as ice melts and ocean water expands
Sea level change over short periods is small and difficult to measure accurately

Current rate: 18 cm/100 yr (7 inches)

Predictions for next 100 years 18-60 cm (7-23 inches)

Predictions vary as do not fully understand all relationships

Rate of CO₂ build up in atmosphere

Amount temperature changes with atmospheric CO₂ level

How Antarctic ice caps and glaciers will behave

Groups with financial interests in fossil fuel use deny connections reminiscent of tobacco company tactics

Geologic record of atmospheric CO₂ and sea level

50-100 million years ago atmospheric CO₂ higher than today

Sea level very high at the same time, most of North America covered by inland sea

Much less habitable land

Rate of climate change and cultural development

Sediment records show abrupt changes in climate

11,000 years ago almost entered another ice age

Rise of Sumerian culture corresponds to Holocene temperature maximum

Collapse of Maya culture corresponds to change in climate between 800 and 1000 AD

Medieval warm period helped Vikings, little ice-age between ~1350 and 1850 ended colonies in Greenland

New evidence from ice cores suggest climate may change dramatically in less than 10 yrs

Anthropogenic activities are changing global chemical cycles, we need to be very careful that we do not accidentally precipitate irreversible climate change