Climate Change

Physical Geography Lecture - GEOG B1

Available on: www.cherylnail.com

Carbon Concentrations

Fig. 11.2 - CO_2 concentrations for last 800,000 years *
Fig. 11.3 - Population growth after 1950 (LDCs vs. MDCs) **

CO_2 is one of the gases that enhances the natural "greenhouse effect" we have in our atmosphere

* Data collected from ice core samples and direct CO2 measurements - note the rise since the Industrial Revolution
** Since 1950, pop has increased in LDCs far more than MDCs - that trend is expected to increase to 2050

Deciphering Past Climates

Paleoclimatology - the study of past climates
Data is collected by drilling into and taking core samples from:

- Ocean-bottom sediments **Fig. 11.8**
- Thickest ice sheets **Fig. 11.9** and **11.10**
- Speleothems **Fig. 11.13** *
- Tree rings **Fig. 11.12** ** ***

Fig. 11.11 - 650,000 year record of CO_2, methane, and temperature in atmosphere from ice core samples

*up to350,000 years of data
** up to 5,000 years of data
*** samples can also be obtained from lake bed core (up to 50,000 years) and coral reel core samples (up to 20,000 years)

Natural Climate Function

Solar Variability - sunspots increase the amount of solar radiation we receive at the top of the atmosphere *

Earth's Orbital Cycles **Fig. 11.6**

>>elliptical orbit can vary in a 100,000 year cycle

>>tilt varies from 21.5° to 24.5° (41,000 year cycle)

>>"Wobble"

Continental Position & Topography **

Atmospheric Gases & Aerosols ***

* 11 year solar cycle for sunspot activity - but we are in a period of low sunspot activity, so that does not seem to contribute the temperature we are currently seeing

** Out continents and ocean basins experience movement - we'll be going over it more in chapters 12-13, the proportion of land and sea can affect surface albedo, as do the positions of the land masses to the poles, and the positions of continents affects ocean currents which are critical for redistributing heat

*** Natural outgassing through volcanoes and vents - increases water vapor, CO_2 and methane in atmospheree

Climate Feedback and the Carbon Cycle

Climate feedbacks - processes that either amplify or reduce climatic trends *
Carbon cycle - biogeochemical cycle - remains naturally balanced - process in which carbon cycles through atmospheric, oceanic, terrestrial and living systems in a series of carbon sources (releases) and carbon sinks **p. 302 - GIA 11.1**
Carbon sinks - natural areas of carbon storage

>>Ocean - CO_2 dissolves into water / photosynthesis with phytoplankton

>>Forests, soils, and rocks

>>Atmosphere

The Industrial Revolution took solid carbon from the forests, soils, and rocks and put it in the atmosphere. **

* LIttle Ice Age - example of ice-albedo feedback - volcanic eruption of Krakatau in Indonesia. Volcanic eruptions in the 13th and 15th centuries appear to have triggered the Little Ice Age, a centuries long cool spell that appears to have been caused by a series of volcanic eruptions and sustained by sea ice: eruptions increased atmospheric aerosols, cooled the temperatures, increased the amount of sea ice, which increased the surface albedo, which cooled temperatures even further. These conditions persisted until the onset of the Industrial Revolution in the 1800s

Deforestation - **p. 303 GIA 11.3 - burning forests to use the land for agriculture and clearcutting releases carbon and lowers the amount of natural carbon storage the surface has

P. 302 GIA 11.2 - Carbon emissions from fossil-fuel burning - 2 graphs

Permafrost Thaw Feedback

Carbon and methane emissions from arctic permafrost thaw **p. 303 - GIS 11.4**

- Increased temperature
- Increased melting of permafrost
- Increased release of carbon and methane
- Which increases the temperature
- When permafrost remains intact, the carbon budget remains in balance. *
- Warming temperatures cause vegetation and soils to take up more carbon, and as permafrost thaws more carbon from tundra soils is released than absorbed.

*Soil organic matter decays slowly (if at all) in cold temperatures. Arctic soils only release a small amount of carbon.

Evidence for Present Climate Change

Temperature - **Fig. 11.17** - global land-ocean temperature trends 1880-2010

Ice Melt - **Fig. 11.19**, **11.20**, **11.21**