

Ecosystems, Nutrient Cycles, Soil

- Ecosystem: all the biotic and abiotic components, and their interrelations, that occupy a given area
- They can be nested
- Few are completely closed
- Most are connected to adjacent ecosystems

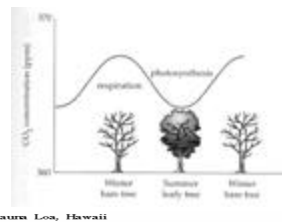


Carbon Cycle

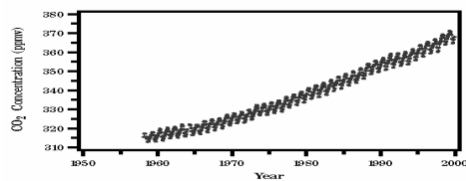
- Review
- Photosynthesis and respiration are main components
- Methane (CH_4) and calcium carbonate [$\text{Ca}(\text{CO}_3)_2$] are also important
- Closely tied with energy paths through ecosystems
- Energy isn't cycled, but carbon is

Variation in Carbon Cycle

Seasonal



Decades



Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)

Nitrogen Cycle

- Nitrogen fixation: Conversion of N_2 to NH_4^+ by nitrogen-fixing bacteria, Haber-Bosch method, lightning, internal combustion engines
- Assimilation: Conversion of NH_4^+ or NO_3^- to organic nitrogen by plants and bacteria
- Ammonification: conversion of organic nitrogen to NH_4^+
- Nitrification: Conversion of NH_4^+ to NO_3^- by nitrifying bacteria
- Denitrification: Conversion of NO_3^- to N_2 by denitrifying bacteria

Nitrogen Cycle

- Natural inputs
 - Terrestrial 100 Tg/yr
 - Marine - 5-20 Tg/yr
 - Lightning - 10 Tg/yr
- Human inputs -
 - Fertilizer - > 80Tg/yr
 - Internal combustion engine - 25Tg
 - Legume crops - 30 Tg/yr
 - Half of all N fertilizer used throughout human history through 1992 has been applied since 1982
- Humans produce more nitrogen than all of nature

Decomposition

(rotting)

- Bacteria and fungi are most important decomposers
- We would be miles deep in dead bodies if not for these creatures
- Rates are dependent on temperature, moisture, oxygen, and material being decomposed

Soil

- Much more than “dirt”
- Soil: a dynamic system involving 3 components: mineral particles, detritus, and soil organisms
- A product of parent material, time, climate, biotic processes, and topography

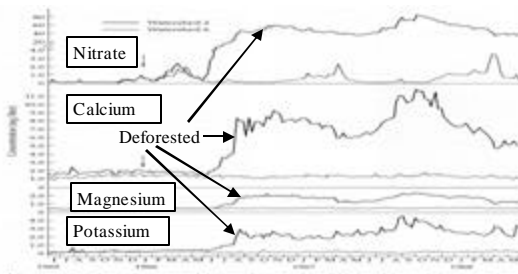


Soil Horizons

- Organic horizon
- A horizon: upper mineral horizon with high amounts of humic materials
- Eluviation (leaching) horizon
- B horizon: illuviation (accumulation) of minerals leached from the E horizon
- C horizon: weathered material (often parent) that is little affected by soil formation process
- Bedrock (parent material)

Loss of Nutrients After Deforestation

- Ecosystems fairly good at recycling, materials are lost very slowly (millions of years)
- But eventually, soil are leached of their nutrients (SE USA vs. Midwest USA)



Soil in Danger

- Agriculture
 - increased erosion (wind and water)
 - salination
 - destroys natural nutrient cycles
- Deforestation
 - increases surface runoff
 - increases erosion
 - removes organic inputs
 - trees = nutrients in tropics
- Pollution
- Forest Fire
 - removes vegetation
 - kills soil organisms

