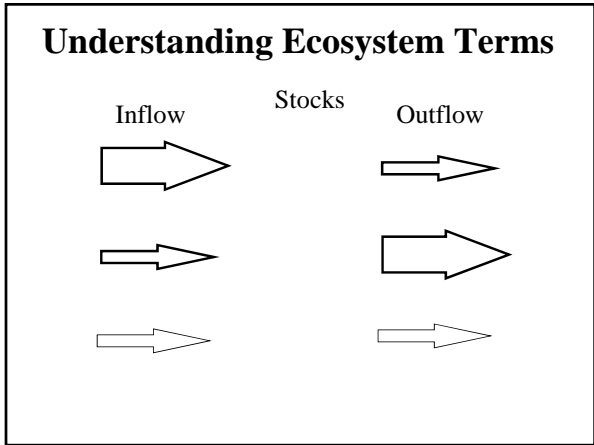


Lecture 9

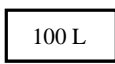


Natural Systems Recycle
Essential Nutrients



Mean Residence Time

For a system in dynamic equilibrium:

Mean Residence Time (τ) = stock / inflow or outflow

10 L/sec		10 L/sec
		

τ = Average length of time a given atom or molecule spends in the system between entering and leaving.

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Importance of Nutrient Cycles

Types of Biogeochemical Cycles

biotic/abiotic

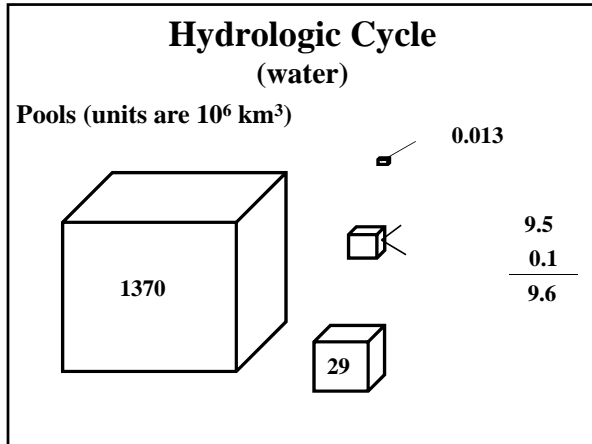
- Gaseous

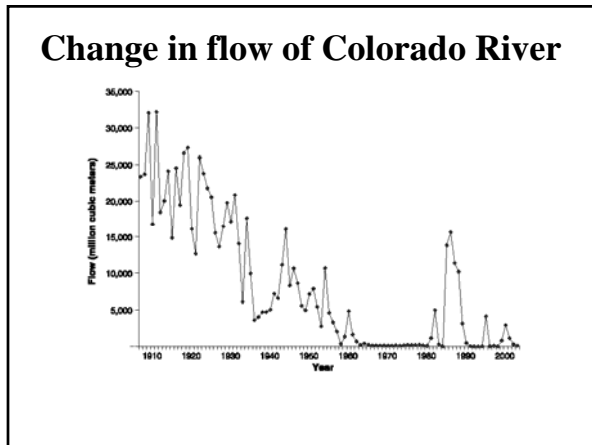
- Sedimentary

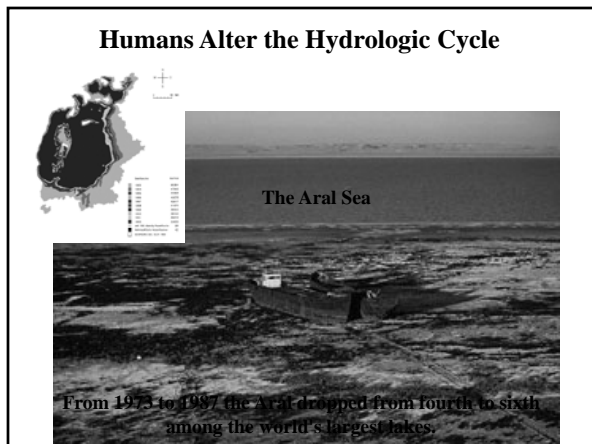
Hydrologic Cycle (water)

Read pages 38 -40 in textbook

Lecture 9







Lecture 9

Major Molecules of Life

$\begin{array}{c} \text{COOH} \\ \\ \text{NH}_2 - \text{C} - \text{H} \\ \\ \text{CH}_3 \end{array}$	Amino Acid => Protein	structure enzymes
$\begin{array}{c} \text{H} \\ \\ \text{C}=\text{O} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{HO}-\text{C}-\text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{CH}_2\text{OH} \end{array}$	Monosaccharide => Carbohydrates	structure fuel
Alanine	Glucose	<i>Note the abundance of C, H, N, & O</i>

Major Molecules of Life

$\begin{array}{c} \text{O} \\ \\ \text{C} \\ / \quad \backslash \\ \text{HN} \quad \text{CH} \\ \quad \\ \text{O}=\text{C} \quad \text{CH} \\ \backslash \quad / \\ \text{N} \\ \\ \text{H} \end{array}$	Nucleotide => DNA & RNA	genetic code
Uracil	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$	Fatty Acid => Lipids
Palmitic Acid		membranes fuel insulation
		<i>Note the abundance of C, H, N, & O</i>

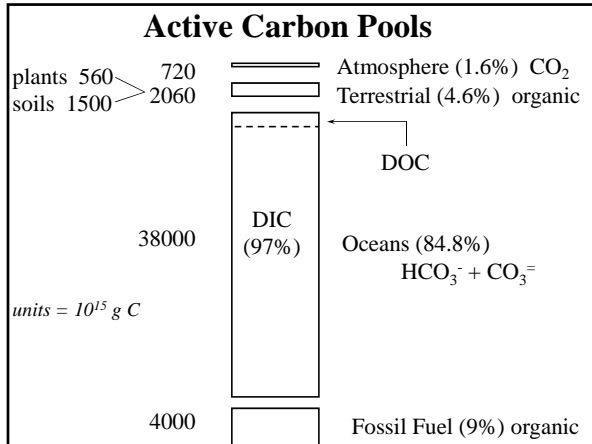
Carbon Cycle

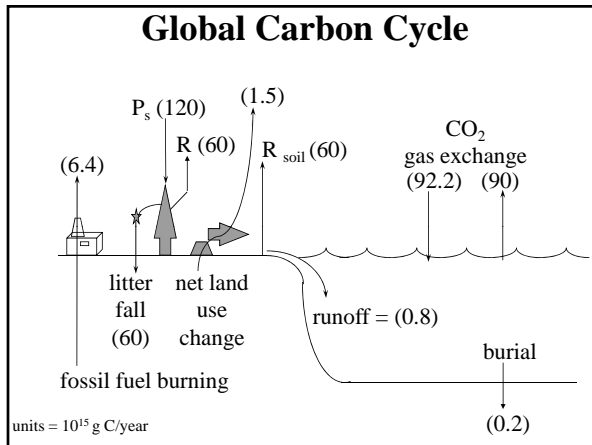
Reciprocal Processes:

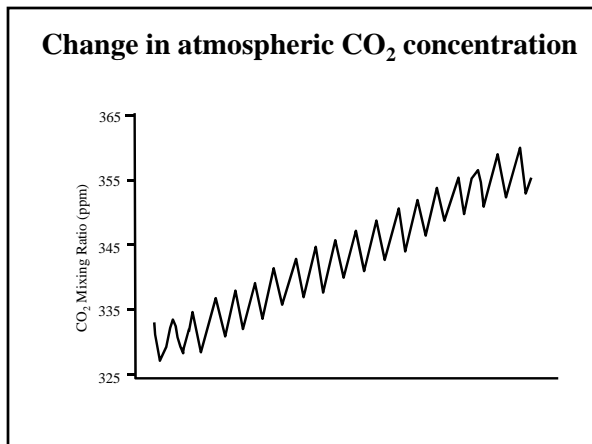
- Photosynthesis (P_s)-

- Cellular Respiration (R) -

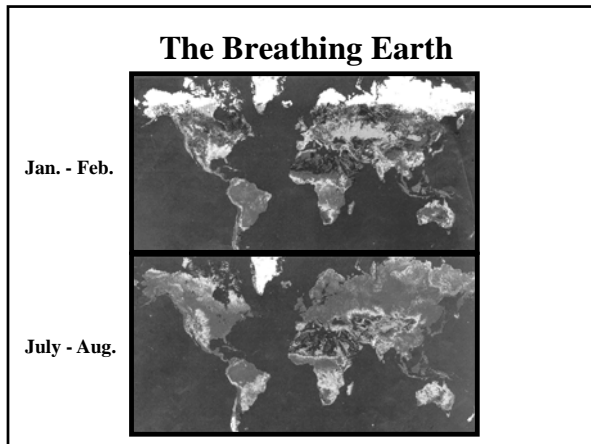
Lecture 9







Lecture 9



Carbon Cycle
Mean Residence Times

- Oceans ~ 422 years
- Atmosphere ~ 3 years
- Land Plants ~ 4.6 years
- At current rates of fossil fuel use, our recoverable supplies will last about 700 years ! (4000 Pg ÷ 6.4 Pg/yr = 625 yrs)

The Carbon Cycle is not
Always in Balance

- In the past, $P_s > R$ because ...
 - Fossil fuel deposits formed.
 - Oxygen accumulated in the atmosphere.
- In the present, inputs of $CO_2 >$ outputs to the atmosphere because ...
 - Burning of fossil fuels.
 - Net destruction of terrestrial vegetation.
- Current imbalance results in rising atmospheric CO_2 concentrations.

Lecture 9

The Missing Carbon Sink

Net CO ₂ Sources		Net CO ₂ Sinks	
Fossil Fuel Emission	6.4	Atmospheric Increase	3.2
Land Use Change	1.5	Ocean uptake	2.2
-----		-----	
Total Net Sources	7.9	Total Net Sinks	7.9

Units are Pg C/yr

The current growth rate of CO₂ in the atmosphere is unusually high:

1980's	1.58 ppm per year
1990's	1.49 ppm per year
2000-2006	1.93 ppm per year

18% of the increase may be due to reduced carbon sinks

Canadell et al. 2007

- ### Summary of Carbon Cycle
- Largest active pool is the ocean.
 - Pool on land (plant + soil) \cong 3x amount in atmosphere
 - $P_s \cong R_{total}$
 - Soil respiration \cong 10x fossil fuel emissions
 - P_s removes 1/6 of the atmospheric pool of CO₂ each year.
 - Concentration of CO₂ in the atmosphere is \uparrow ca. 0.4% per year (ca. 3×10^{15} g C/yr)
