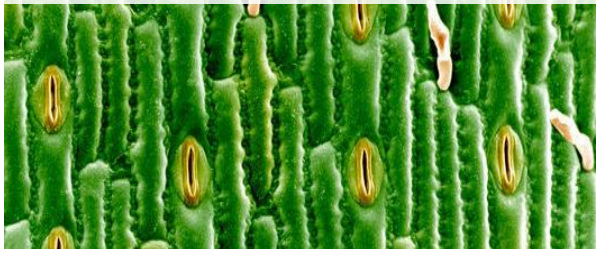
Geog 1000 - Lecture 24

Ecosystem Dynamics

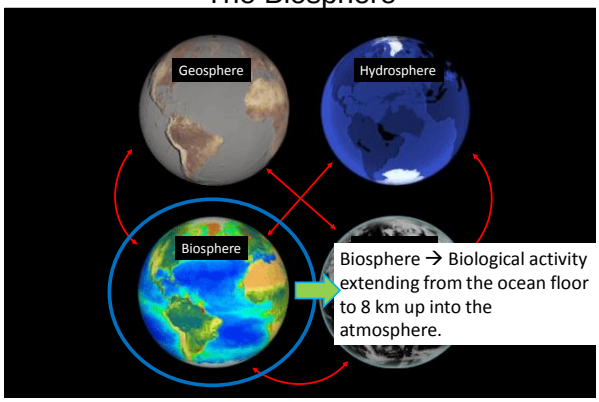
http://scholar.ulethbridge.ca/chasmer/classes/

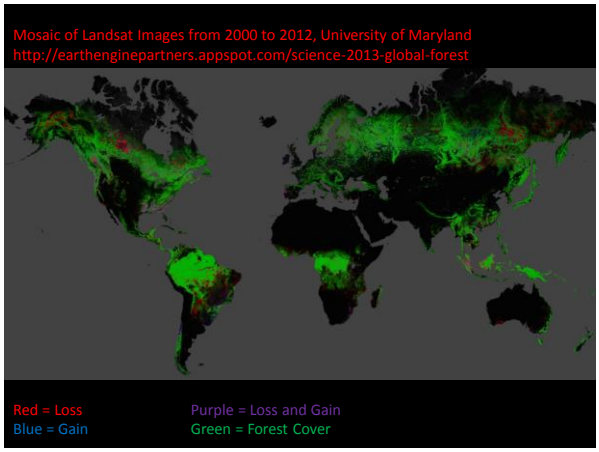


Today's Lecture (Pgs 474 – 489)

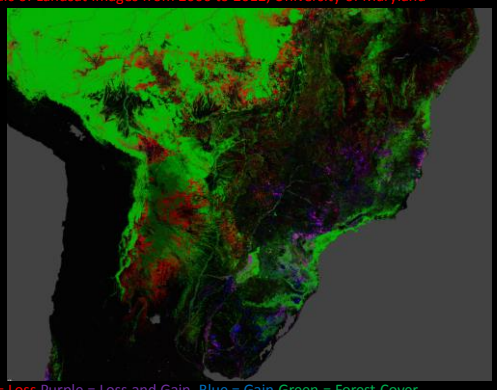
1. The study of Ecosystems, Ecology and Biogeography- why they are important
2. Communities, habitats, and niches
3. Abiotic and biotic parts of the ecosystem
4. Plant photosynthesis and respiration → Biotic environment
5. Abiotic components → light, temperature and water
6. Biogeochemical cycles: oxygen, carbon, and nitrogen
7. Energy pathways: Trophic relationships and food webs → **Friday**
8. Limits to development: species distribution and population → **Friday**

The Biosphere



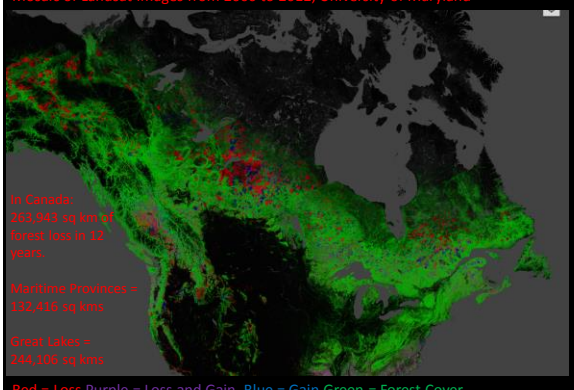


Mosaic of Landsat Images from 2000 to 2012, University of Maryland



Red = Loss Purple = Loss and Gain Blue = Gain Green = Forest Cover

Mosaic of Landsat Images from 2000 to 2012, University of Maryland



In Canada:
263,943 sq km of forest loss in 12 years.

Maritime Provinces = 132,416 sq kms

Great Lakes = 244,106 sq kms

Red = Loss Purple = Loss and Gain Blue = Gain Green = Forest Cover

Canada ranks worst in developed world on climate policy: European report

The Canadian Press
Published Monday, November 18, 2013 11:27AM EST
Last Updated Monday, November 18, 2013 9:29PM EST

OTTAWA – Environment Minister Leona Aglukkaq arrives at a climate change conference in Warsaw today amid exceedingly low expectations.

A European report released to coincide with the United Nations conference ranks Canada 55th of 58 countries in terms of tackling greenhouse gas emissions, ahead of only Iran, Kazakhstan and Saudi Arabia.

And a new national Environics telephone poll commissioned by the David Suzuki Foundation suggests public confidence in government as the lead actor in

http://www.ctvnews.ca/canada/canada-ranks-worst-in-developed-world-on-climate-policy-european-report-1.1548262

We are better than Iran, Kazakhstan, and Saudi Arabia, and WORSE than China

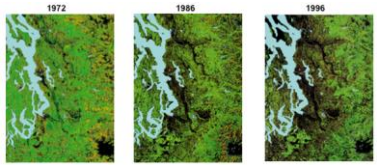
"As in the previous year, Canada still shows no intention of moving forward with climate policy and therefore remains the worst performer of all industrialized countries"

The Study of Ecosystems, Ecology and Biogeography

Ecosystems → Plants and animals living in their non-living environment.
→ Often constrained to an certain area

Ecology → Relationships between an organism and the environment.

Biogeography → Distribution of plants and animals and their past/present spatial patterns



Measuring Ecosystems: Scales and Impacts

Scales range from: Individuals → Ecosystems → Biospheres
Ease of measurement: Easy → Moderate → Difficult

Ecological/ Spatial Scale	Ecosystem Service Examples	Ease of Measurement	Accrual of Benefits	Probable Importance	Perception of Value of Benefits
Population/ Individual Wetland	•Species habitat •Food & fiber harvesting	Easy	Land owner/ Local economy	Local economies	Good
Ecosystem/ Landscape	•Flood mitigation •Aquifer recharge •Aesthetics				
Biosphere/ Global	Nitrogen, sulfur, carbon cycling	Difficult	The world	Life-sustaining	Poor

Importance: Locally important to globally important, however, perceived benefits as we 'scale out' to the globe are not realised.

Biotic vs. Abiotic

All ecosystems contain biotic and abiotic subsystems:

Biotic
→ *Producers (plants)*

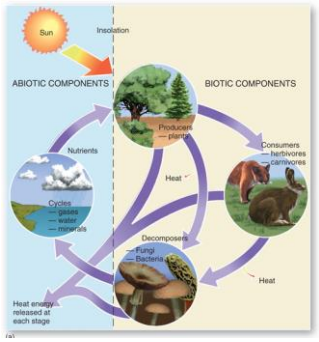
→ *Consumers (animals)*

→ *Decomposers (worms, mites, bacteria, fungi)*

Abiotic
→ *Gas (CO_2, H_2O, N cycles, etc.)*

→ *Water cycles*

→ *Mineral cycles*



Solar energy → dominant driver of biotic and abiotic systems

Spatial Scales of Interest

Decreasing size

Biome
→ Geographic area may span Earth
→ Similar climate, plants, animals

Ecosystem
→ All living organisms in non-living environment
→ Biomes = many ecosystems
→ Vary in size

Community
→ Interactions between living organisms in a community

Habitat
→ Where an organism lives

Communities, Habitats and Niches

Biotic Communities
All living organisms within an ecosystem

→ Interactions among animal and plant populations

→ Identified by: species abundance, feeding structure, interdependence

→ Can vary in size.

Habitats
→ Where the organism lives
Can you think of some habitats?

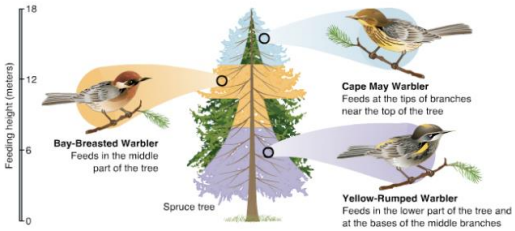
Community + Habitat = Ecosystem

Communities, Habitats and Niches

Niche

→ Organism function, including its job in a habitat, food web, and reproductive cycle.

→ No two species occupy the same niche (*competitive exclusion principal)*



Breathing Biosphere

Plant Function in the Environment

Plants link the biosphere to Solar Energy and the Atmosphere

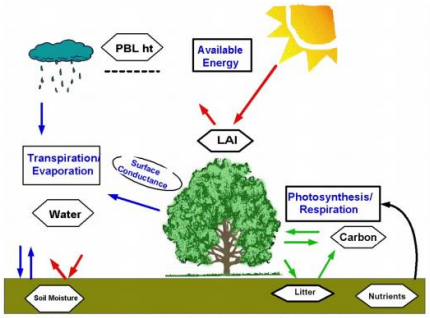
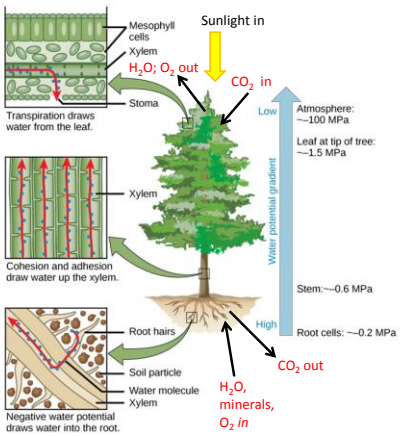


Figure 1 Links between plants and the flow of heat, water, CO2 and sunlight.

D. Baldocchi, Biometeorology



Leaf Function: Stomata

Stomata → Small pores mostly found on underside of leaf surface.

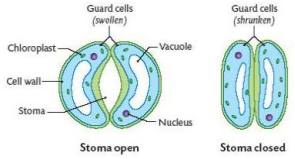
→ Water and oxygen leave through stomata = transpiration

→ Pressure is created, pulls water up through plant

→ Regulates temperature

→ Carbon dioxide enters through stomata for photosynthesis

Fine balance between water loss and CO2 uptake…

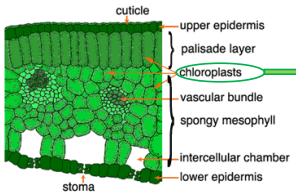


Photosynthesis

Photosynthesis → Plants convert light from sun + Carbon dioxide + water into starches and sugar = plant food

$$6CO_2 + 6H_2O + \text{Light} \rightarrow C_6H_{12}O_6 + 6O_2$$

6 molecules of carbon dioxide | 6 molecules of Water | Solar energy (red and blue) | 1 molecule of glucose (plant biomass) | 6 molecules of oxygen



Red and blue wavelengths used for photosynthesis, green, NIR reflected

Leaf cover, inclination is important for competition

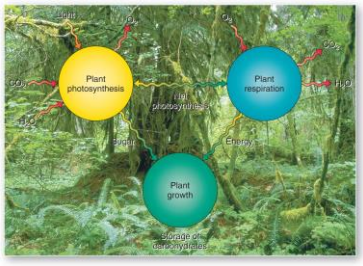
Respiration

Respiration → Consumption of stored organic material
→ Stored carbohydrates oxidized;
→ CO_2, water, energy released

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{heat energy}$$

Compensation point → Rate of production = Rate of consumption

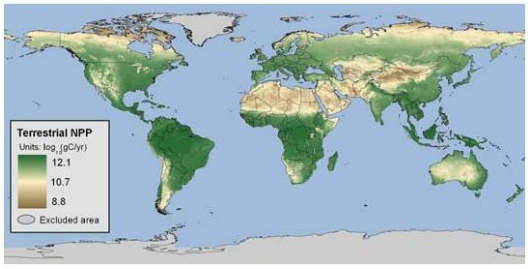
Growth = building up and storage of carbohydrates beyond respiration



Net Primary Productivity

Net primary productivity → The amount of *chemical* energy stored in a community or ecosystem. The amount of C 'fixed' per year.

Biomass → Dry weight of organic material

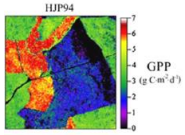


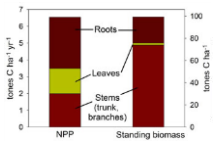
Measuring Net Primary Productivity

Field measurements – Forest mensuration

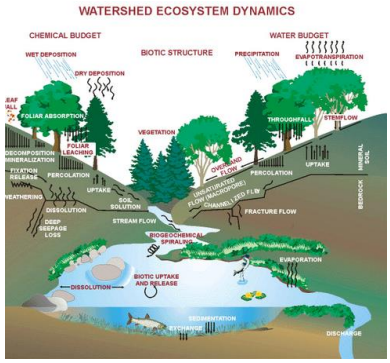
Gas exchange methods – Eddy covariance

Satellite and airborne remote sensing

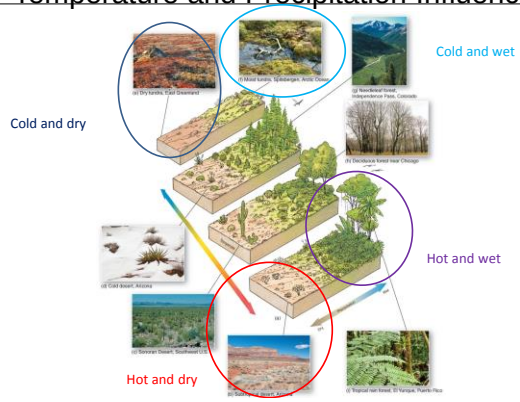




Abiotic Ecosystem Components

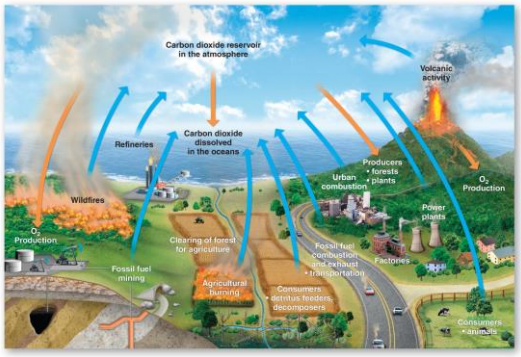


Temperature and Precipitation Influences



Biogeochemical & Nutrient Cycles

Carbon and Oxygen Cycle – inputs and outputs



Biogeochemical & Nutrient Cycles

Nitrogen Cycle

→ Atmosphere is a source of nitrogen gas; fixed by bacteria to produce ammonia

→ Lightening produces nitrates

→ Fossil fuels produce nitrogen compounds,

→ Plants use nitrogen compounds to produce biomass