BI 416/516 Midterm #1 study guide

Be ready to relate the main concepts from lectures and the textbook (well, maybe not that), with our readings from the literature.

Chapter 1 - Introduction

What are the five state factors? What are the 4-5 interactive controls? How do state factors differ from interactive controls? What are negative and positive feedbacks? What are producers, consumers, autotrophs, heterotrophs, decomposers, detritivores, and what roles do they play in ecosystems? What are 5 major global changes currently happening on Earth? Which ones are being driven by the others?

Chapter 2 - Climate

What factors determine how much energy is absorbed by Earth's surface? By the atmosphere? What are the roles of clouds and radiatively active gases in determining the relative importance of these pathways? What is the difference between latent and sensible heat?

Differentiate between the greenhouse effect and the enhanced greenhouse effect. How do these depend on atmospheric composition?

How does unequal heating of Earth by the sun and the resulting atmospheric circulation produce the major latitudinal climate zones, such as those characterized by tropical forests, subtropical deserts, temperate forests, arctic tundra, and polar deserts? How are these related to major wind patterns? How are both winds and latitudinal climate zones related to Hadley cells, Ferrell cells, Polar cells, and the Intertropical Convergence Zone?

How does the rotation of Earth (and the resulting Coriolis forces) and the separation of Earth's surface into oceans and continents influence the circulation patterns in the oceans and atmosphere? By what mechanisms do oceans influence terrestrial climate? What causes regions of oceanic upwelling? Why is England so balmy (at least for its latitude)? How does heat move from tropical to polar latitudes?

How does topography affect climate at continental and local scales? We know that climate affects vegetation. Can vegetation affect climate? If so, by what mechanisms?

What are some major causes of temporal variation in climate at seasonal scales? Interannual scales? Multimillenial scales? How do El Niño/La Niña cycles relate to these patterns? What mechanisms cause the ENSO? How do the orbital parameters of the Earth influence the seasons? How do they influence long-term (20,000 - 100,000 year) changes in climate? What are Milankovitch cycles and how do they relate to glacial/interglacial cycles in the long-term climate record? Are differences in solar forcing alone sufficient to cause observed changes in CO_2 and temperature levels? Are temperature differences primarily driven by CO_2 differences or vice versa?

How are humans affecting climate? What evidence do we have that climate is changing? Where is that change most dramatic?

Chapters 5, 6 & 15 - Production processes, changes to the global C cycle

<u>Chap. 15</u>

How do current changes in atmospheric CO_2 relate to changes in the past 1000 years? 400,000 years? 650,000 years? What factors are responsible for some of the major fluctuations in climate over the past 650,000 years?

What are the 4 main pools of carbon globally? How do these differ in size and turnover rate? What mechanisms are responsible for fluxes among these different pools?

What two sources of evidence clearly link fossil fuel burning and land-use change to elevated atmospheric CO_2? What circumstantial evidence also supports this link? What are the primary fates of anthropogenic CO_2? Which sinks are the largest? Which are the most well-known?

What are the anticipated direct and indirect effects of elevated CO_2 on ecosystems? How does elevated CO_2 differ from human effects on the stratospheric ozone layer? (in reading)

Chap 6.

What is the difference between biomass and productivity? What are GPP, NPP, NEP, NEE, NECB, NBP, Plant respiration and heterotrophic respiration? How are all these related to one another? What is the difference between change in plant biomass and NPP? What are the major ecosystem carbon pools? What are the major fluxes between those pools? What are some examples of feedbacks that operate between those pools and fluxes?

Chap. 5.

What are the main controls on GPP at the leaf, plant, and ecosystem levels? Do they differ? Do the main controls differ when comparing across ecosystems (spatially) vs. within ecosystems (temporally)? How so? How does understanding the basic reactions of photosynthesis help us understand the basic principle of environmental control by which plants regulate their photosynthetic rates and growth? What enzymes are particularly important for understanding the biochemical and ecological differences between C3, C4, and CAM photosynthesis? Why? How do C4 and CAM photosynthesis increase water use efficiency of photosynthesis? What inherent tradeoffs are involved?

What are the main isotopes of carbon? Which are stable and which are radioactive? What are δ values and how do they differ for ^{13}C between C3 and C4 plants? Why do they differ between C3 and C4 plants?

What are the main components of a light response curve of photosynthesis? How does acclimation/adaptation to different light regimes change those different parameters? How can we understand those adaptations in the context of the basic principle of environmental control? How do these adaptations/acclimations influence canopy-level photosynthetic LUE?

How do down-regulation, indirect effects (e.g., on water availability) and photosynthetic pathway (C3 vs. C4) influence GPP response to elevated CO_2?

How do soil resources, particularly nitrogen, influence GPP at the leaf, whole plant, and community scales? How do they influence the most important proximal controls on GPP when comparing across ecosystems? What is SLA and how does it relate to leaf longevity and photosynthetic capacity of leaves?

What is transpiration and why is it a "necessary evil" for plants? How do plants deal with water stress on short, medium and long (evolutionary) time-scales? How does growing season length, as controlled by both temperature and water, influence GPP? Why are temperature differences not major drivers of GPP when comparing across ecosystems and how does this relate to patterns of plant adaptation and acclimation?

Chap. 6. again

Why is NPP so hard to measure accurately? What are the main components of plant respiration and how do they vary with environmental conditions (especially temperature), plant species, and tissue type? How does plant respiration vary temporally and across biomes?

What are the basic principles of plant allocation to alleviate resource limitation?

What component(s) of climate explain much of the variation across ecosystems in NPP? Is this similar to or different from controls on GPP? In addition to direct effects on plant growth and respiration, what indirect mechanisms are important for climate control of NPP?

What do we mean by a limiting resource? What soil resources primarily limit production in different ecosystem types? How do soil resources (both water and nutrients) interact with organisms to influence NPP?

How do rates of GPP, NPP and NEP change through successional time?

What is NEP and how can it be measured? How does NEP differ from NEE and NECB? What causes variation in NEP across ecosystems? Within ecosystems (across time)? How well characterized are differences among ecosystems in NEP and/or NEE?