

What is plant ecophysiology?

Jan 17, 2023

Ecophysiology = Ecology +
Physiology

Ecology: definition

The study of the relationships between organisms and:

1. Each other
2. The environment

Ecology: definition

The study of the relationships between organisms and:

1. Abiotic environment

2. Biotic environment

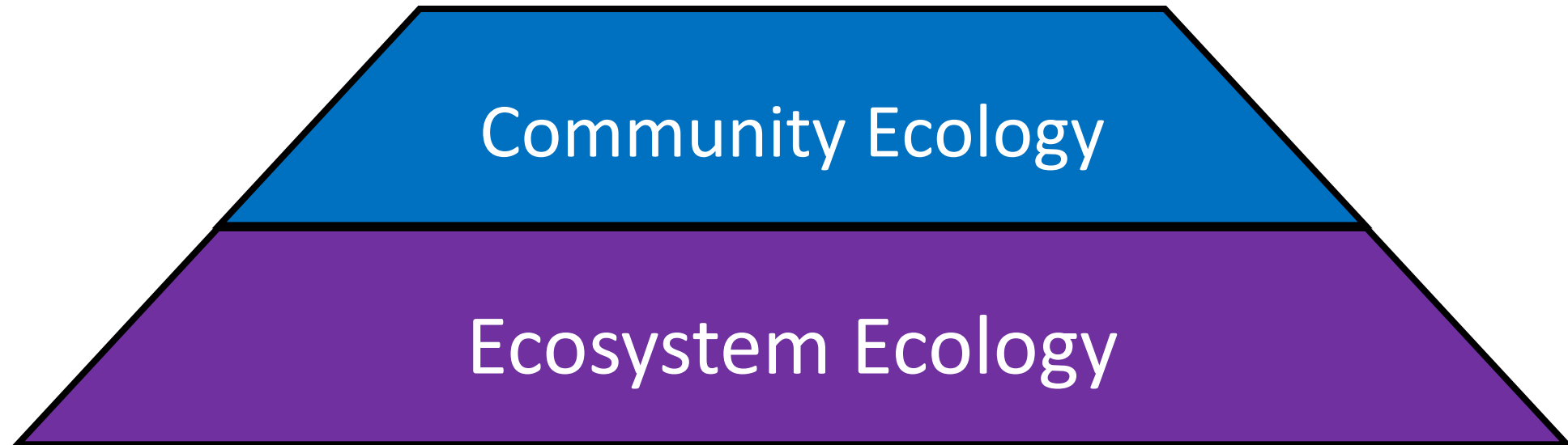
What aspects of the abiotic and biotic environment influence plant functioning?

Hierarchy of Ecology

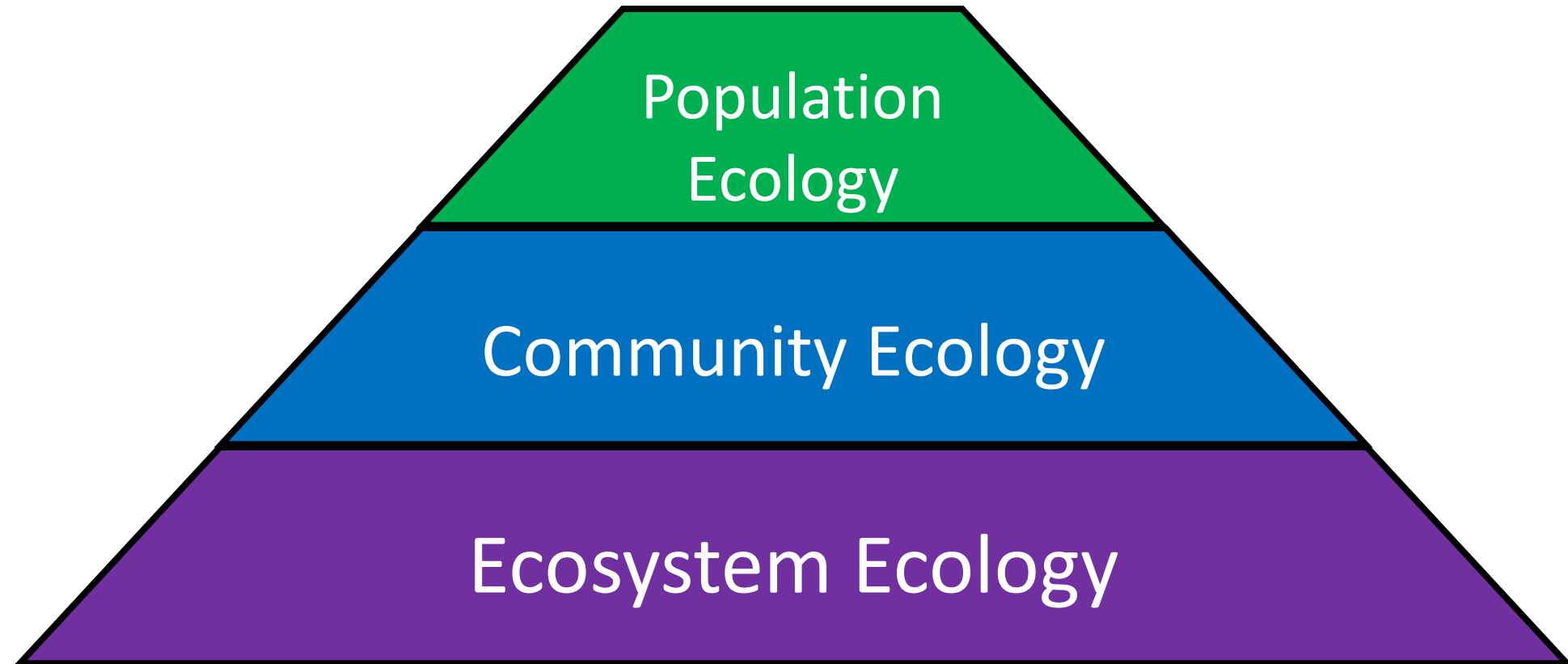


Ecosystem Ecology

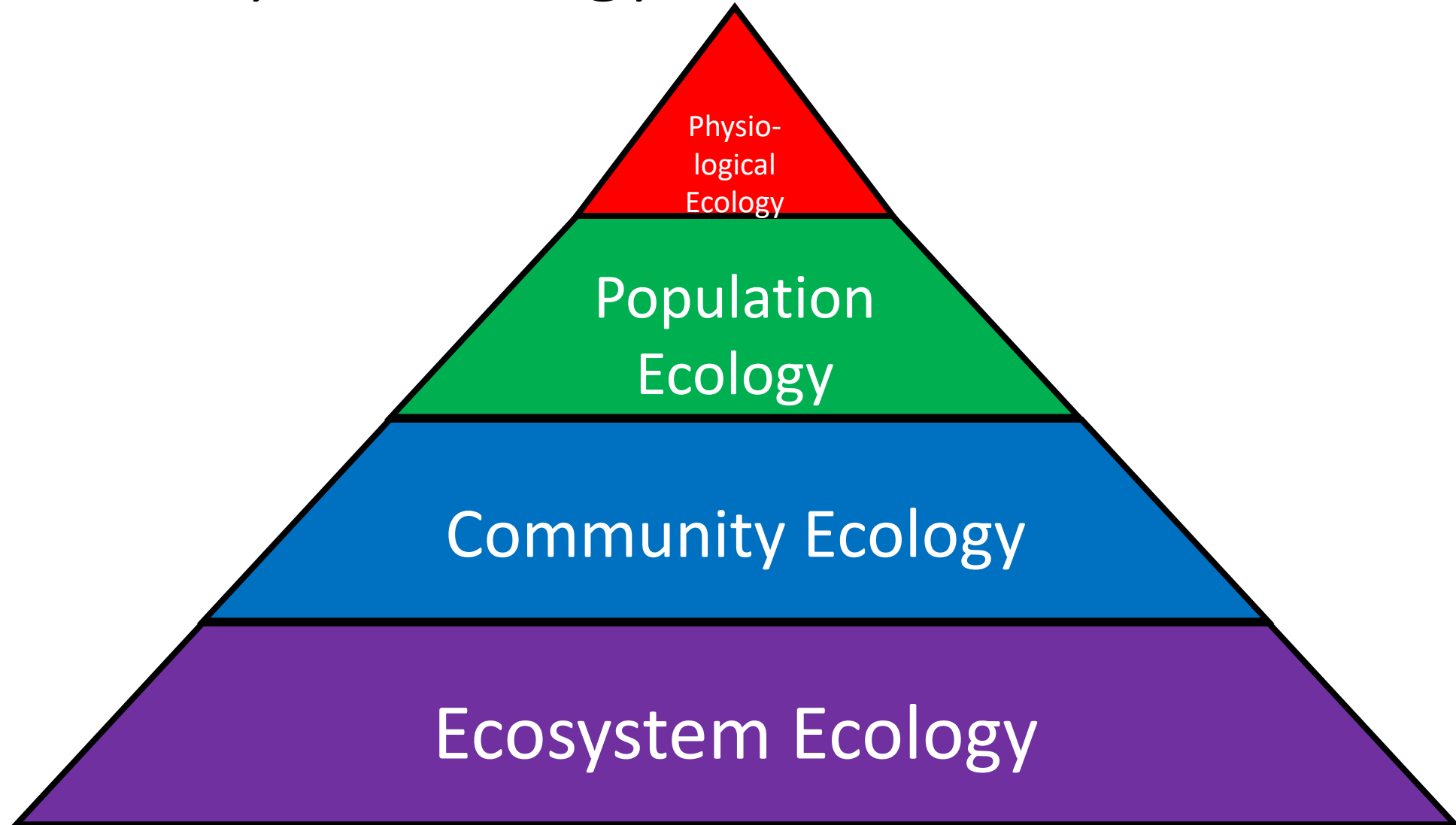
Hierarchy of Ecology



Hierarchy of Ecology



Hierarchy of Ecology



Physiology: a definition

The functioning of an organism that allows it to survive, grow, and reproduce

Ecophysiology: a definition

Responses to environmental conditions
observable at the *individual* level



Ecophys discussion: traits

Discussion

- What is a plant trait?
- How do plants get their traits?

Functional traits are “morpho-physio-phenological traits which impact fitness indirectly via their effects on growth, reproduction, and survival, the three components of individual performance.”

Let's talk about some traits...

| Organ | Abbreviation | Definition | Units |
|-------------|--|--|--|
| Leaf | SLA | Specific leaf area | $\text{m}^2 \text{g}^{-1}$ |
| | LMA | Leaf mass per area (1/SLA) | g m^{-2} |
| | A_{area} or A_{mass} | Photosynthetic rate on a mass or area basis | $\mu\text{mol m}^{-2} \text{s}^{-1}$ or $\text{nmol g}^{-1} \text{s}^{-1}$ |
| | Ψ | Leaf water potential | MPa |
| Stem | k_{stem} | Stem hydraulic conductivity | $\text{mmol m}^{-1} \text{s}^{-1} \text{MPa}^{-1}$ |
| | [no symbol] | Wood density | g m^{-3} |
| Root | SRL | Specific root length | m g^{-1} |
| All | R_{area} or R_{mass} | Respiration rate on a mass or area basis | $\mu\text{mol m}^{-2} \text{s}^{-1}$ or $\text{nmol g}^{-1} \text{s}^{-1}$ |
| Whole-plant | RGR | Relative growth rate | $\text{g g}^{-1} \text{day}^{-1}$ |

...but characteristics can also be traits

- Photosynthetic pathway (C3 or C4)
- Growth form (tree, shrub, forb, grass)
- Lifespan (annual, perennial)
- Mycorrhizal association (AM, ECM)
- Etc.

Discussion

- What is the difference between acclimation and adaptation?
- How would you know?

Why do we care about plants and their traits? Discussion of Chapin (2003)

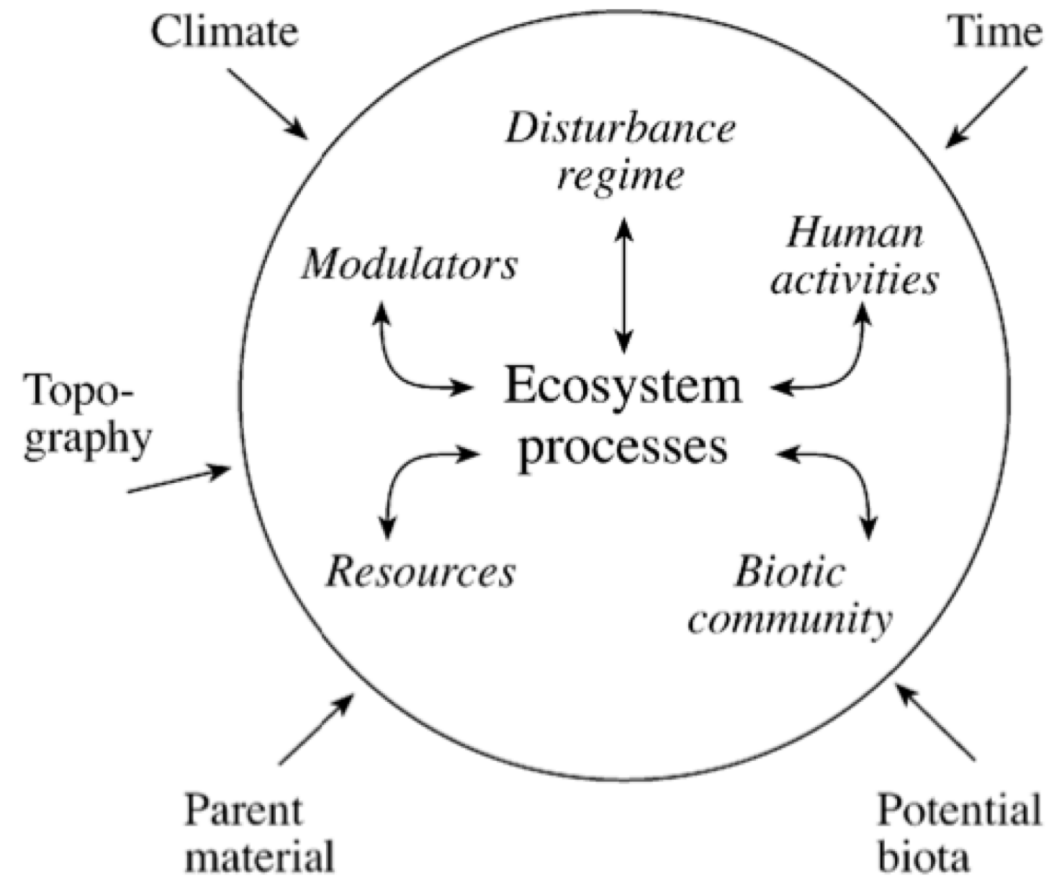


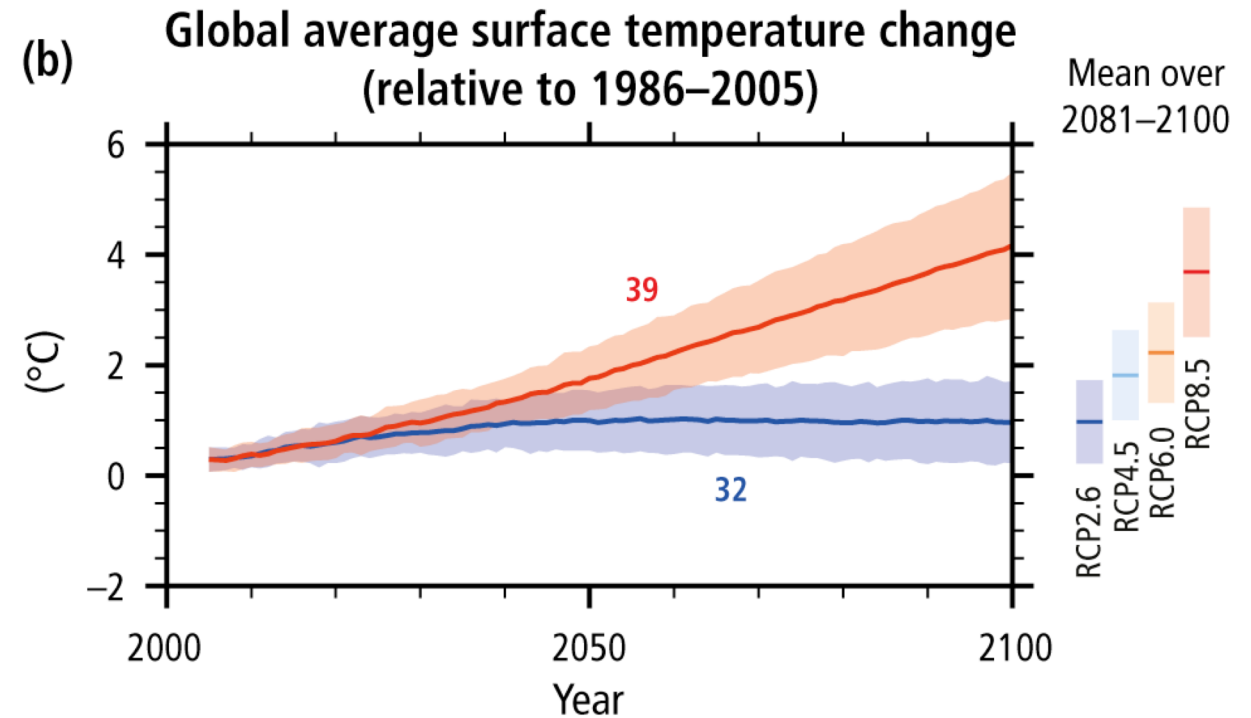
FIG. 1. The relationship between state factors (outside the circle), interactive controls (inside the circle) and ecosystem processes. The circle represents the boundary of the ecosystem. Reprinted from Chapin *et al.* (2002), with the permission of Springer-Verlag.

Ecosystem Service



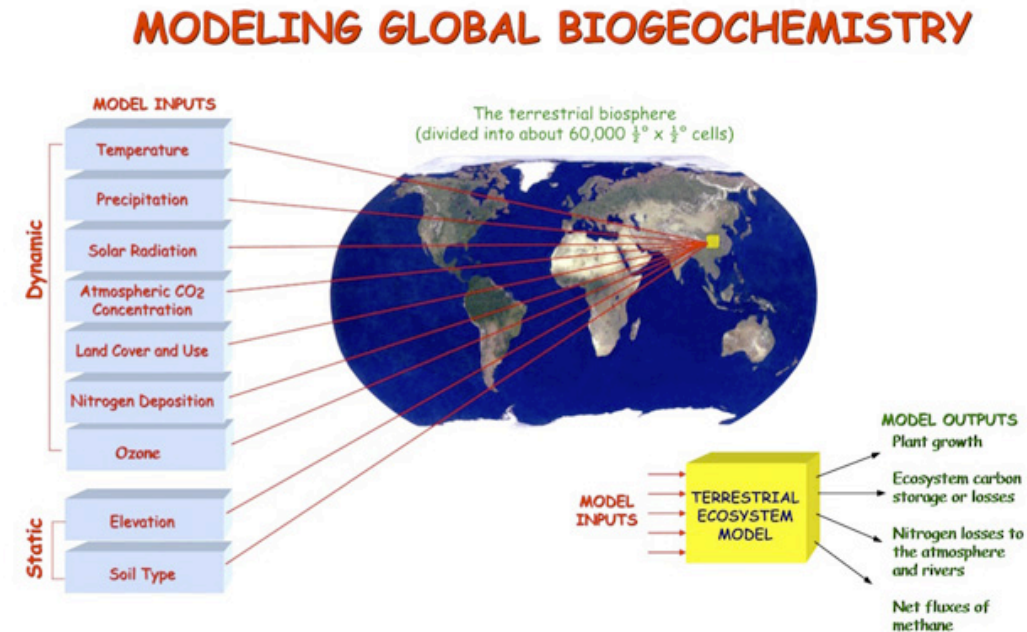
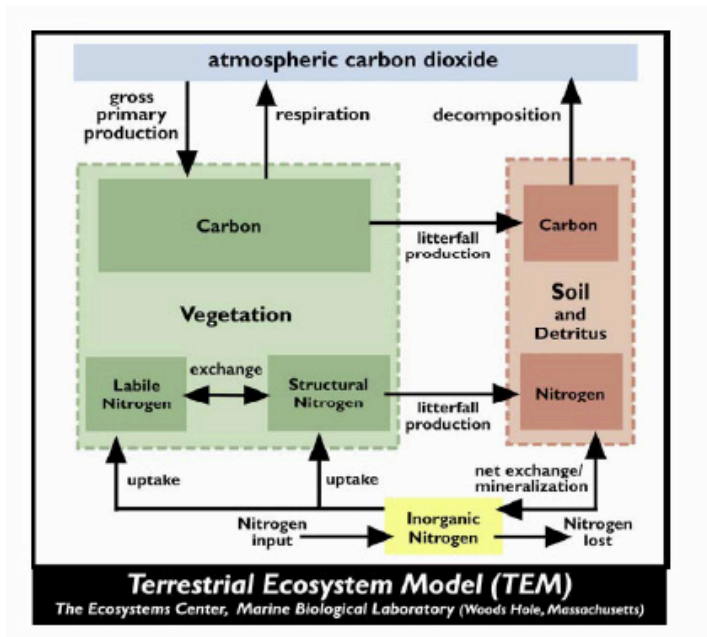
Global changes to state factors

- Changes in atmospheric gas concentration (e.g., elevated CO₂)
- Warming temperatures
- Altered precipitation patterns
- Nutrient deposition



Plants as interactive controls

- Biodiversity
- Disturbance regulators (e.g., fire)
- Movers of resources
- Modulators (e.g., albedo, microclimate)
- Interaction with humans (e.g., agriculture)



To understand how ecosystem services will change in the future, we need to understand plants

Questions/thoughts about
Chapin (2003)?