Projects for sale

1) (already sold) Map out stability curve of global mean temperature and sea ice extent versus solar constant in "som planet"

2) Moving mountains – or flattening them anyway in a run with observed SST prescribed and otherwise real topography (I provide the "control")

3) Adding land to the tidally locked (synchronous orbit) earth that we ran as a som planet before

4) Reverse the rotation rate of the Earth with observed SST prescribed and real topography (I provide the control)

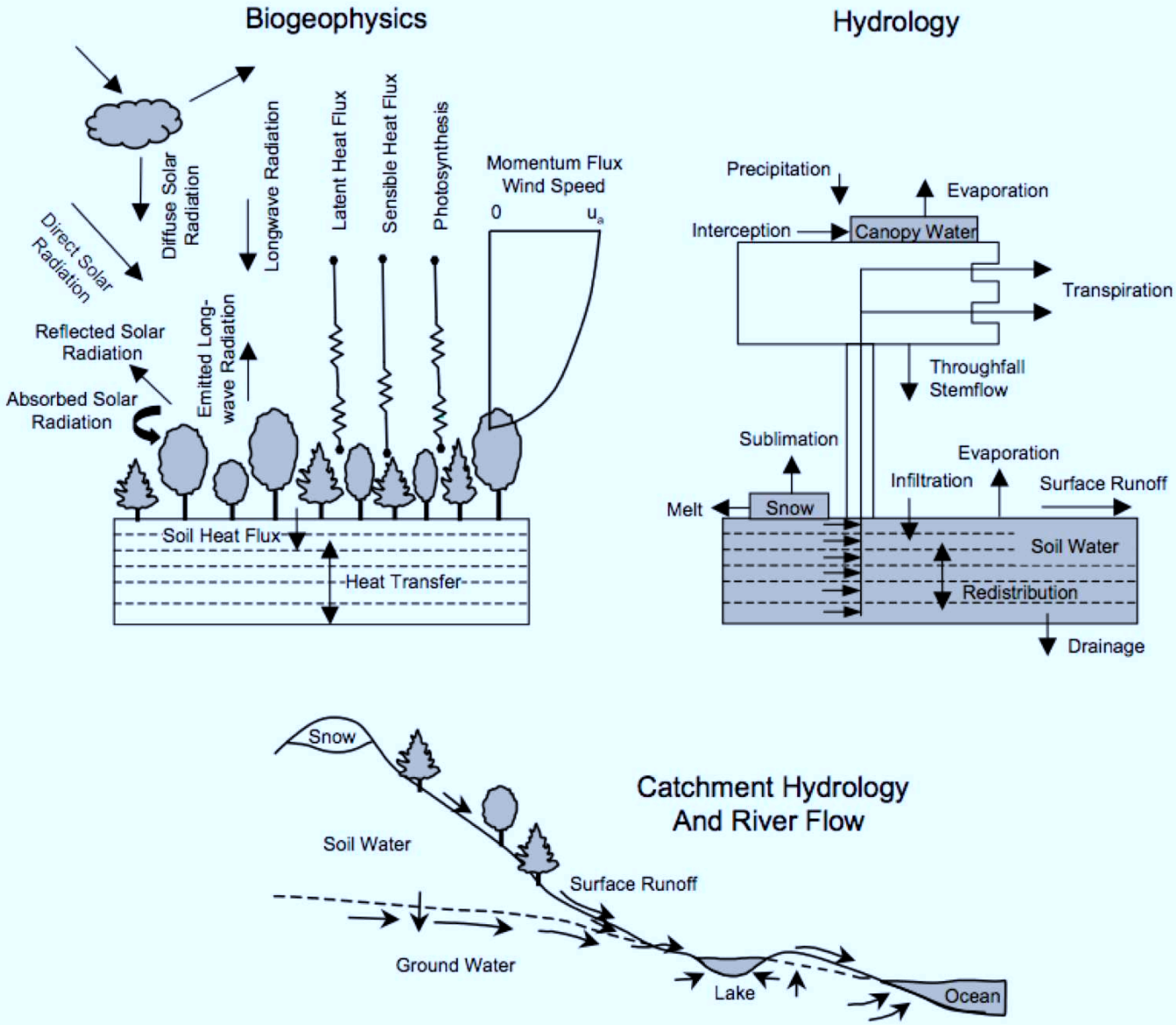
5) Vary location of the initial perturbation in the dry, adiabatic, baroclinic wave experiments

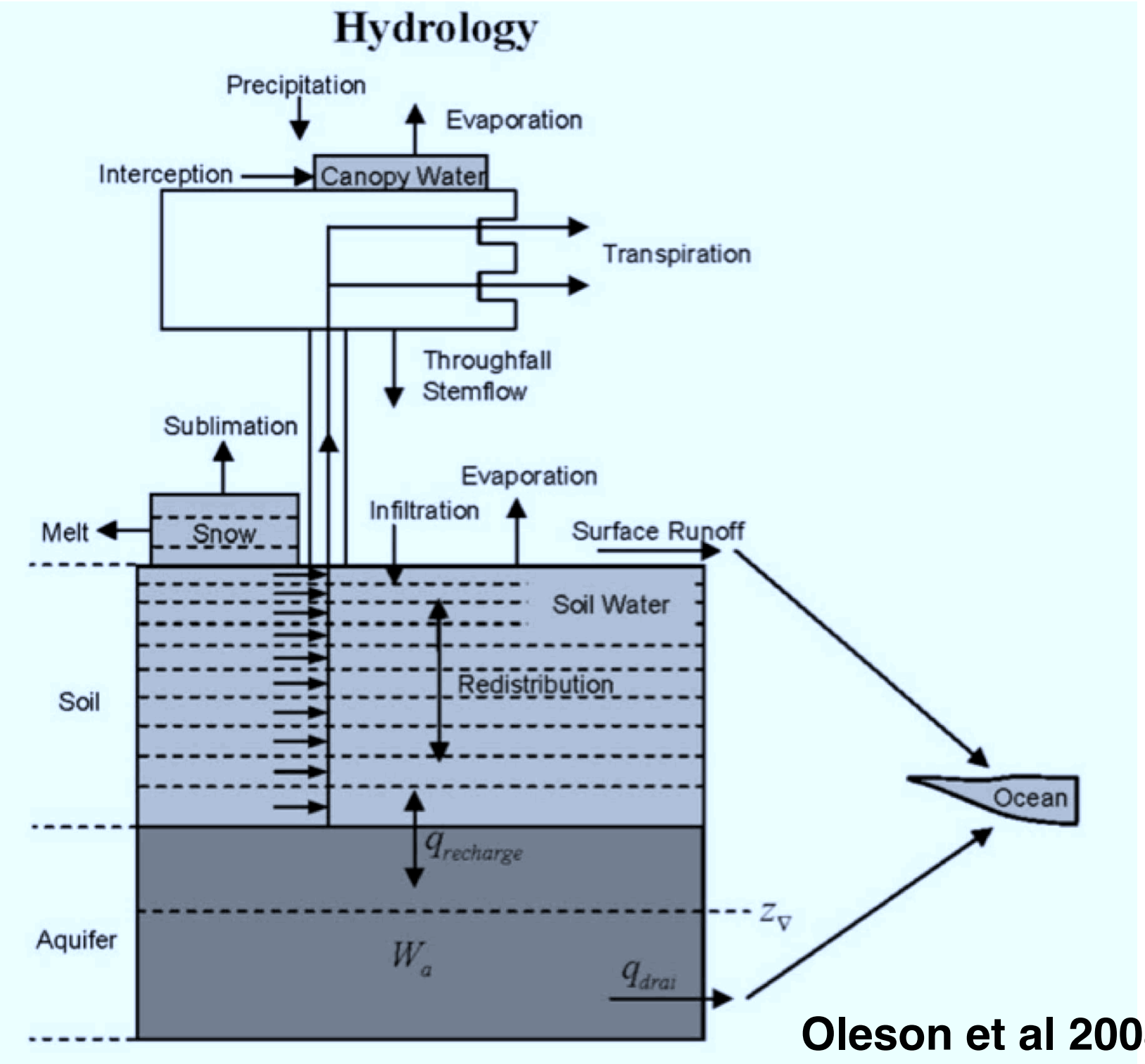
6) Vary parameters in CAM/CLM with observed SST prescribed and real topography (I provide the control)

A state-of-the-art vegetation model, with C-N cycling and dynamic veg options

mostly from CCSM's land model, called CLM

Community Land Model





Oleson et al 2008

Each grid cell may have any combinations of these surface types:

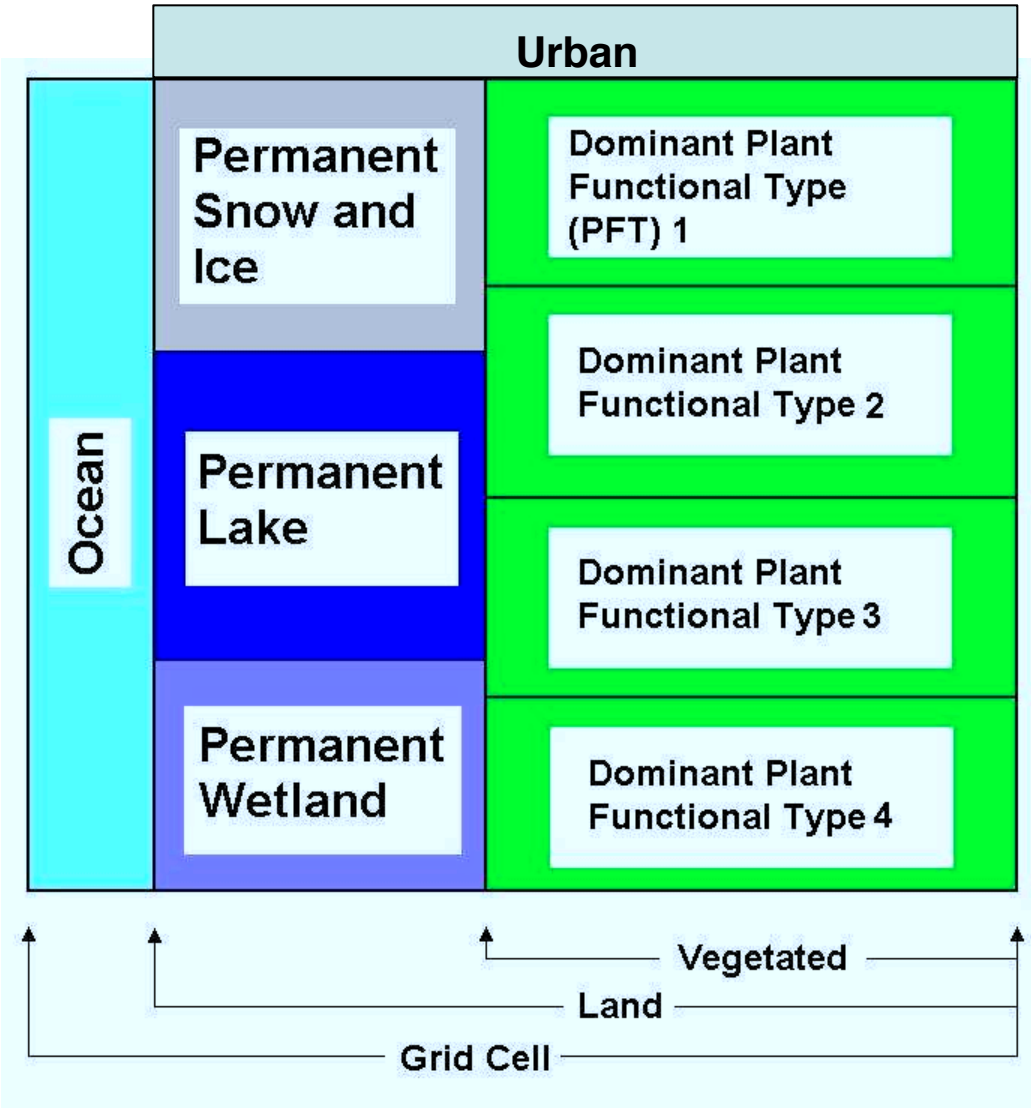


fig adapted from D. Lawrence

Fully prognostic for

1) water and energy in the vegetation-snow-soil system

and

2) option for carbon and nitrogen cycling in the vegetation, litter, and soil organic matter

For (2), new vegetation growth and litterfall must also be prognostic, responding to soil and air temperature, soil water availability, and daylength.

and

(3) option for dynamic vegetation, where one plant type can die and another can begin to grow

Plant Functional Types PFTs

Tree:

- Needleleaf Evergreen Temperate
- Needleleaf Evergreen Boreal
- Needleleaf Deciduous Boreal
- Broadleaf Evergreen Tropical
- Broadleaf Evergreen Temperate
- Broadleaf Deciduous Tropical
- Broadleaf Deciduous Temperate
- Broadleaf Deciduous Boreal

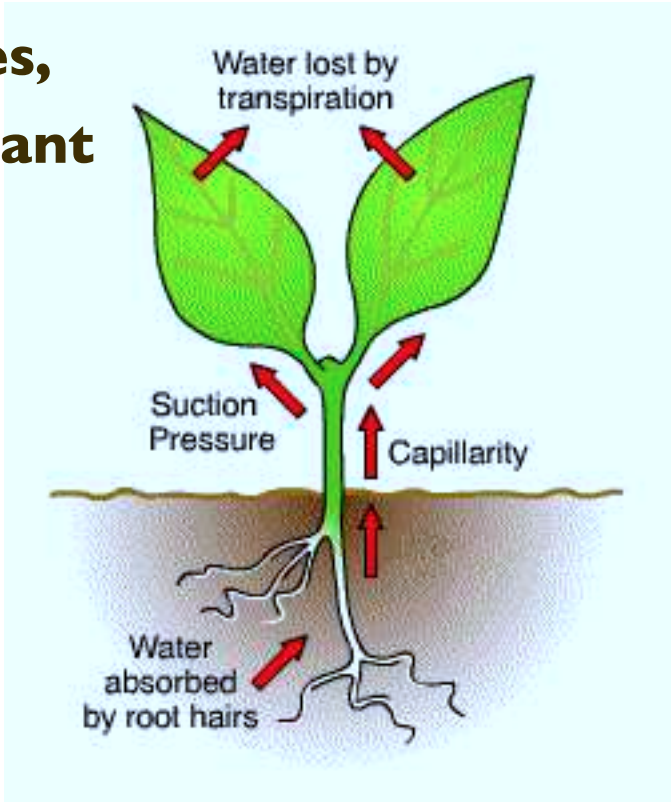
Herbaceous / Understorey:

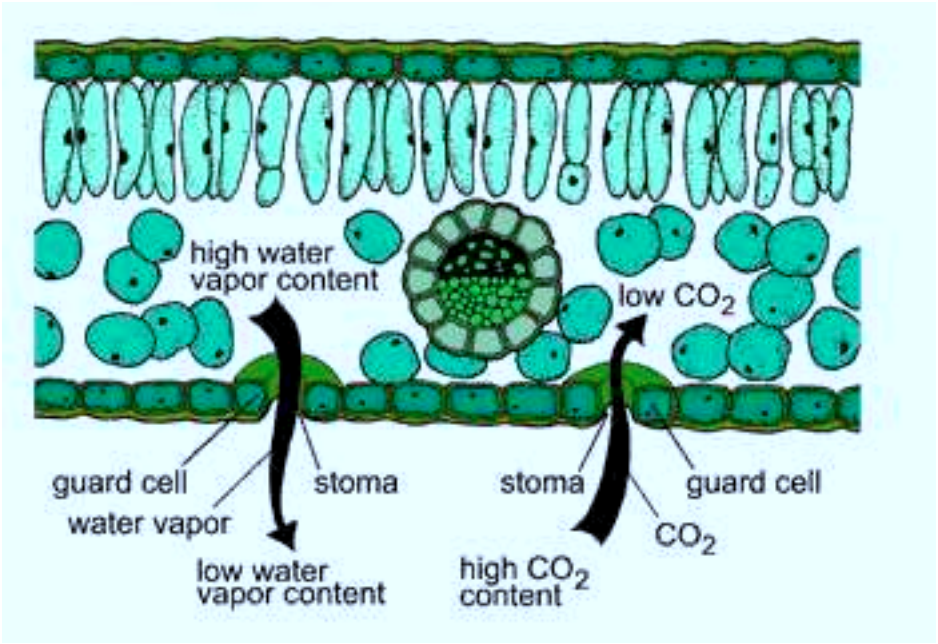
- Evergreen Shrub
- Deciduous Temperate Shrub
- Deciduous Boreal Shrub
- C3 Arctic Grass
- C3 non-Arctic Grass
- C4 Grass
- Crop

Bare ground

Each has a leaf and stem area, plus canopy top and bottom heights

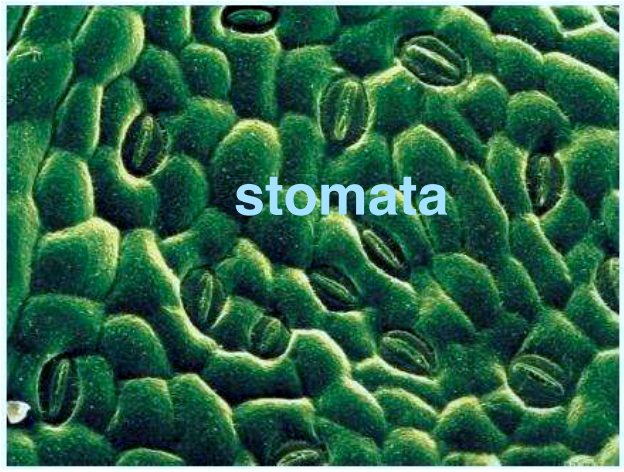
Plants transpire less water vapor as CO2 rises, but population changes may be more important

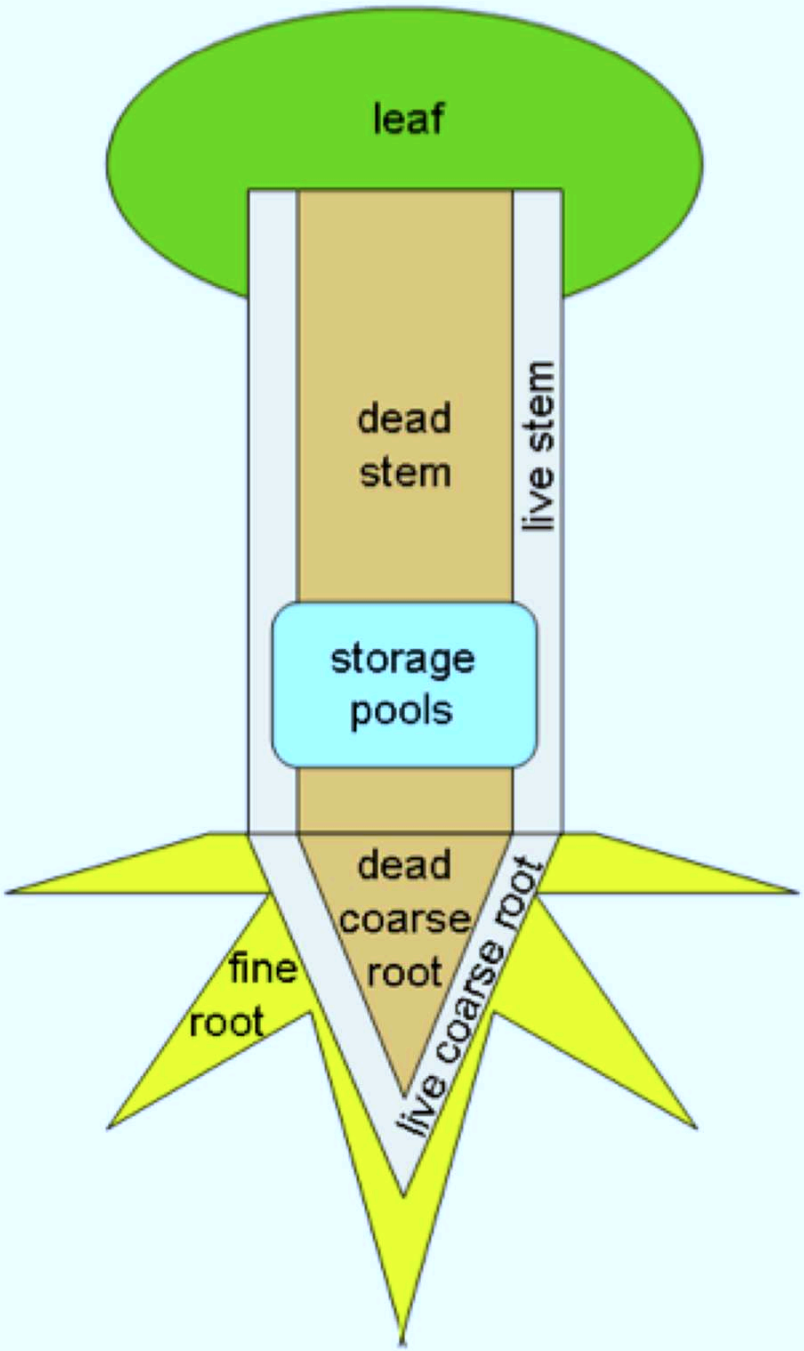




CO2 enters pores (or stomata) for photosynthesis. Opening raises water vapor canopy drawing water from leaf/stem/soil, known as “conductance”. Conductance depends on

- photosynthesis
- CO2 and water vapor at leaf surface





CLM vegetation state variables (pools):

C and N pools for each tissue (structural pools):

- Leaf
- Stem (live and dead)
- Coarse root (live and dead)
- Fine root

Each structural pool has two corresponding storage pools:

- Long-term storage (> 1 yr)
- Short-term storage (< 1 yr)

Additional pools:

- Growth respiration storage (C)
- Maintenance respiration reserve (C)
- Retranslocated nitrogen

Total number of pools…

Carbon: 6 + 12 + 2 = 20

Nitrogen: 6 + 12 + 1 = 19

When PFTs are prescribed, not dynamic

Must specify

- **Each PFT fractional coverage**
- **Monthly canopy height**

Predict leaf and stem area, hydrology, C and N pools.

C uptake need not be coupled to atmosphere

(this is how you are running ccsm4)

Plant functional types (PFTs) are modeled

As an individual plant with average physical properties for its type also "new growth" of each PFT.

Each grid cell dynamic model has prognostic

- **Number of individual plants**
- **Fractional coverage**
- **Leaf area**
- **Carbon and nitrogen "pools" in foliage, wood, & roots**

These quantities in turn depend on

- **Physical needs (eg precip., sunlight, temperature, pCO2)**
- **H2O conductance, photosynthesis, respiration, etc**

All of which must be parameterized somehow

Photosynthesis

Depends on internal leaf pCO_2, temperature,& soil moisture

Also foliage nitrogen concentration and leaf area which varies among PFTs

About dirt

Prescribe soil texture (sand, clay, rock) and color

Model temperature, liquid and ice water in 15 vertical levels

Model snow accumulation and ablation in 4 vertical levels

Model litterpools of carbon