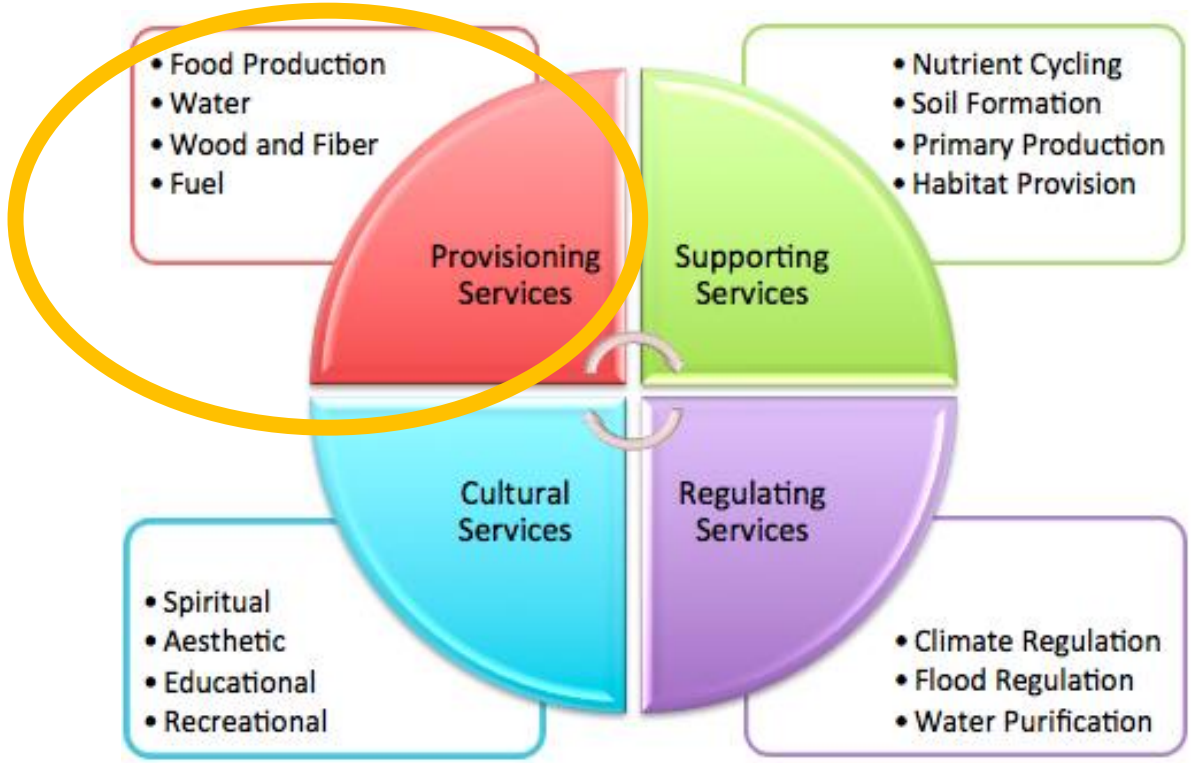
FOREST STEWARDSHIP, ECOSYSTEM SERVICES & CARBON

Ryan DeSantis

OSU EXTENSION

Overview: Ecosystem services

- **Provisioning**



Source: Millenium Ecosystem Assessment, 2005.

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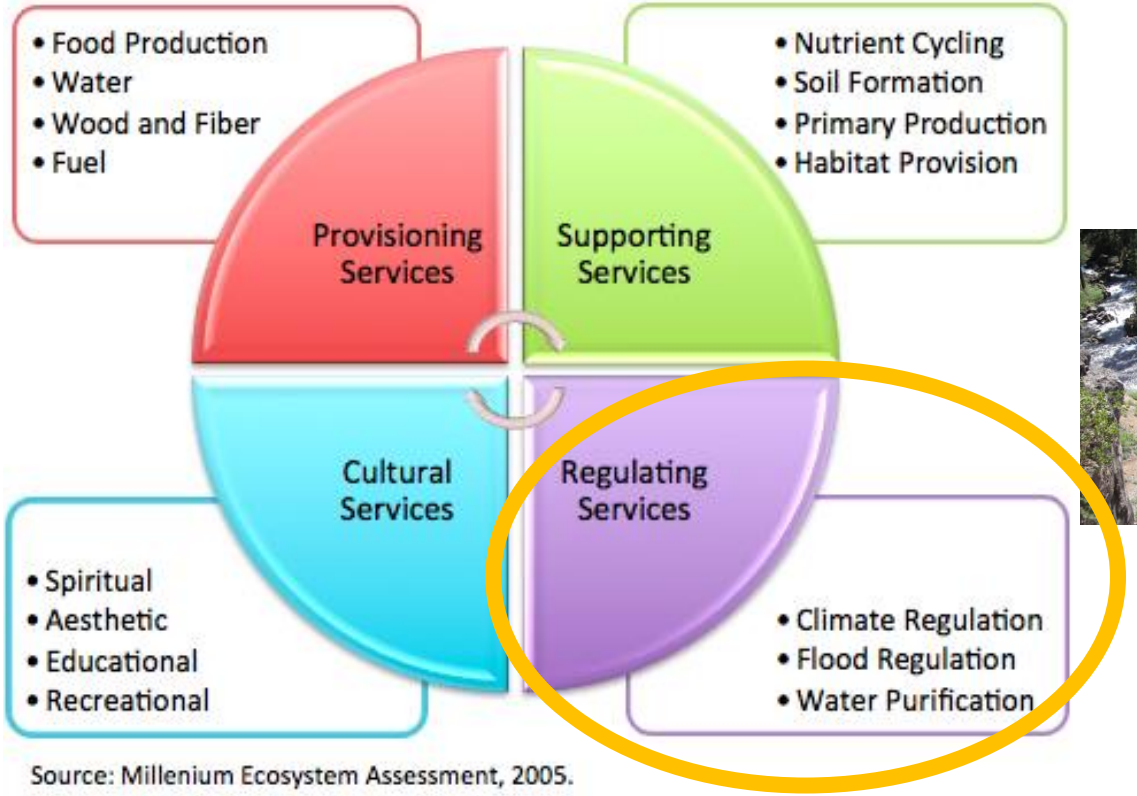
Overview: Ecosystem services

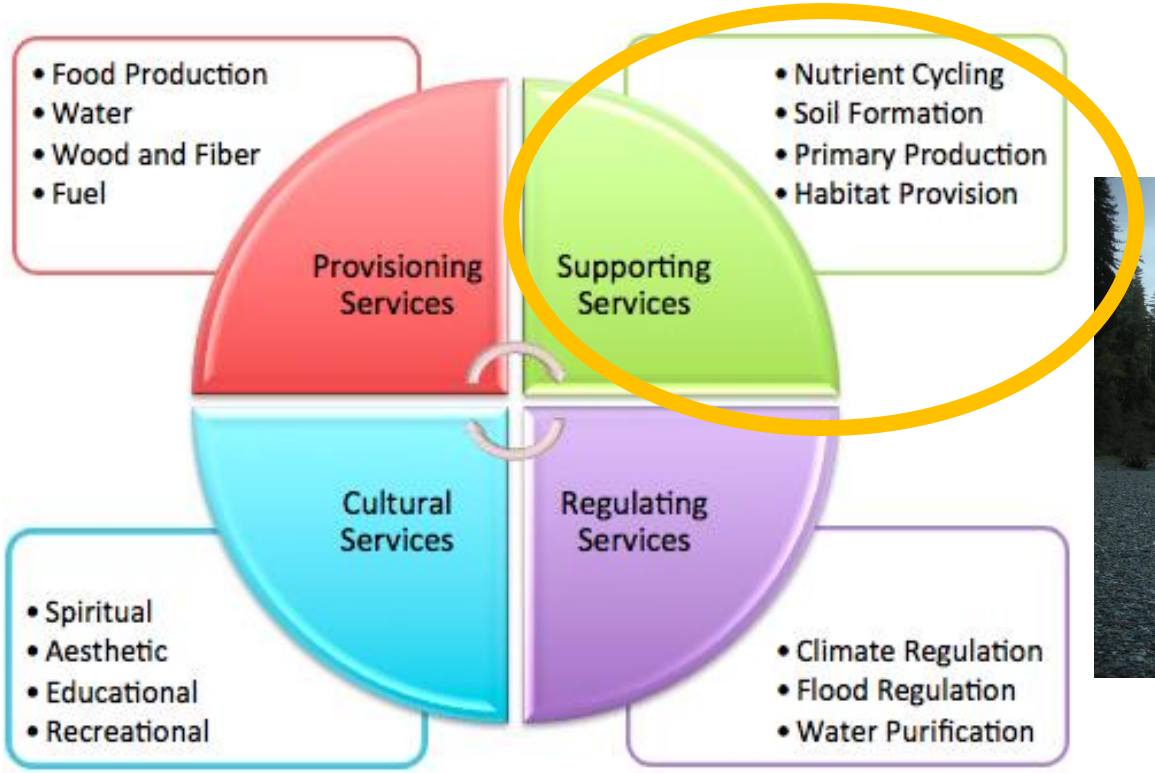
- **Regulating**



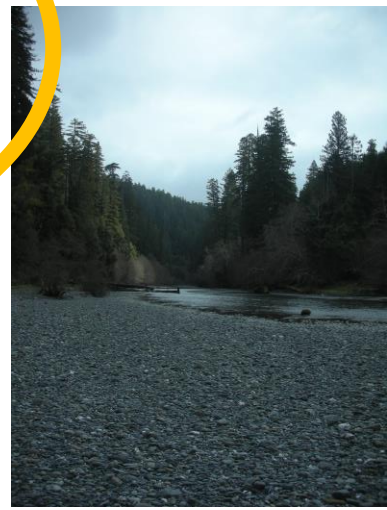
Source: Millenium Ecosystem Assessment, 2005.

Overview: Ecosystem services

- **Supporting**

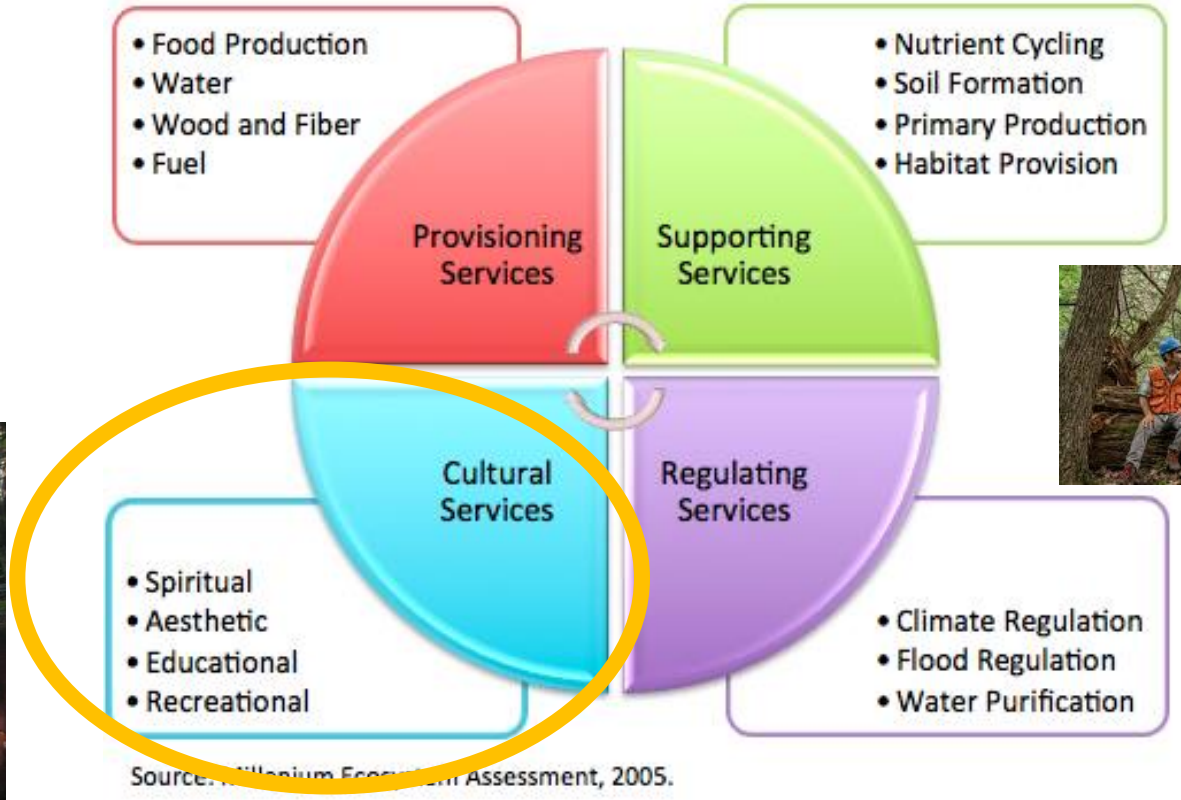


Source: Millenium Ecosystem Assessment, 2005.



Overview: Ecosystem services

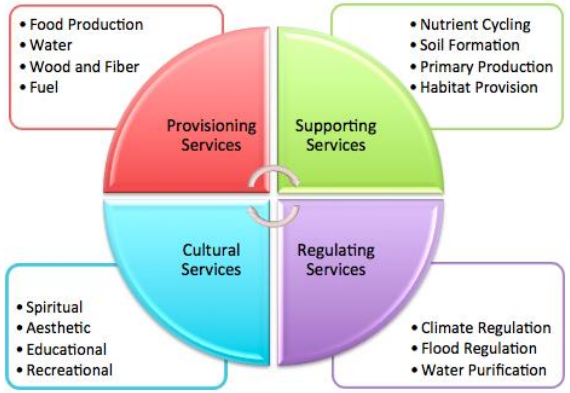
- **Cultural**



Source: Millenium Ecosystem Assessment, 2005.

Overview: Ecosystem services

- **Ecosystem service: Benefits accrued from the natural environment**
- **Important for quality of life, survival**
- **Valued and quantifiable**
  - **Forest ecosystem services valuation estimated at $4.7 trillion annually**
  - **Coastal ecosystem services valuation estimated at $12.5 trillion annually**
  - **Total ecosystem services valuation estimated at $33 trillion annually (Costanza et al. 1997 Nature)**

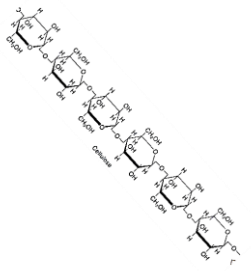


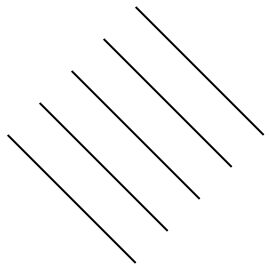
Source: Millenium Ecosystem Assessment, 2005.

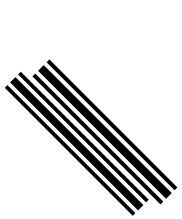
Overview: Carbon

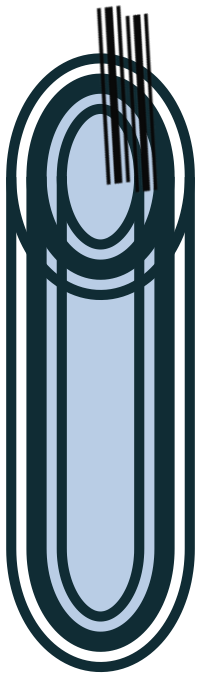
Plant growth process & accumulation of organic matter

- Carbon based products
  - Water + Carbon dioxide
  - Sugar
  - Complex molecules
  - Cells









Overview: Carbon

Three phases in growth:

1. Photosynthesis

Creation of the sugar molecules

2. Transport

Move these compounds to the sites where cell division (new cells added) occurs

3. Metabolism

Assemble into long chain molecules in cell components

The growth process first makes the raw material, transports it to the construction site, then assembles it into wood structure

Overview: Carbon

Allocation of energy (priorities) during plant growth

1. Maintain respiration (sugar + oxygen = energy for plant growth)
2. **Produce fine roots and leaves**
3. **Produce flowers and seeds**
4. **Extend branches**
5. Store energy rich chemicals
6. **Add wood to stems, roots and branches**
7. Create anti-pest chemicals for defense

Occurring at a rate determined by availability of resources

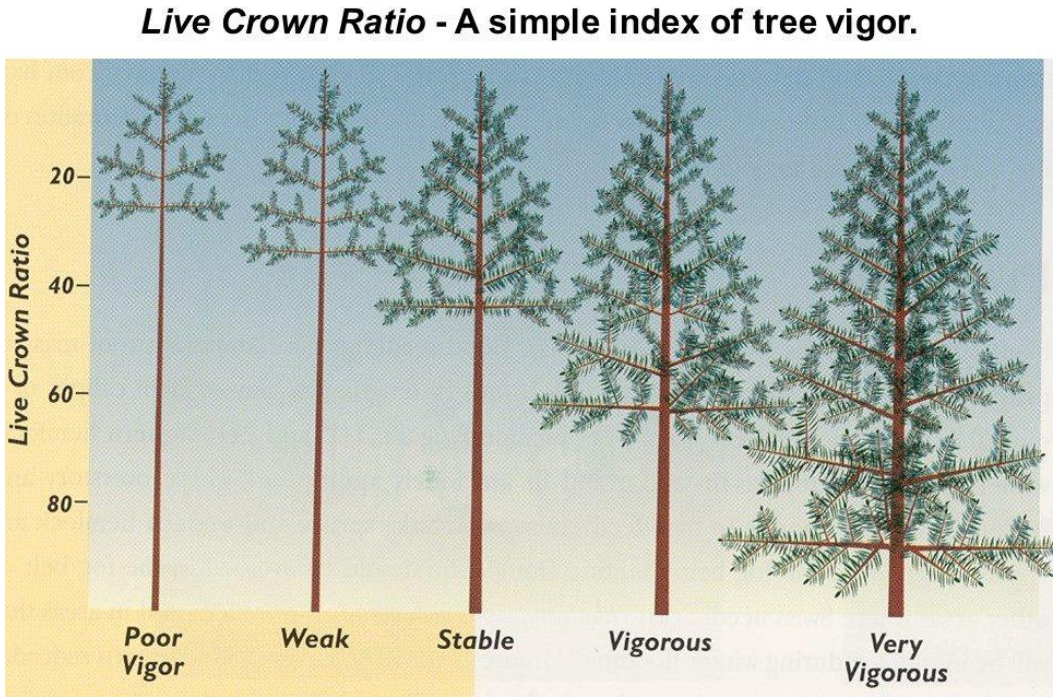
Overview: Carbon

Growth & maintenance dependent on:

- Site, growing conditions
- Plant physiology (vigor, LCR, age)

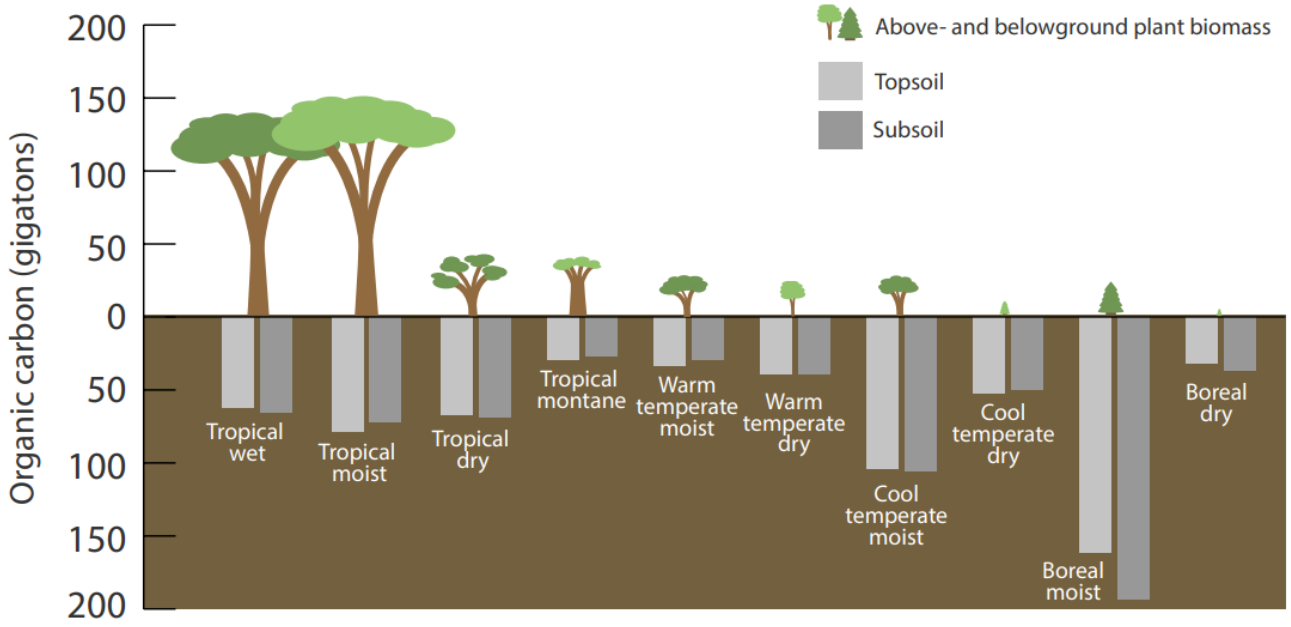
Adapted from: VanPelt & Sillett 2008

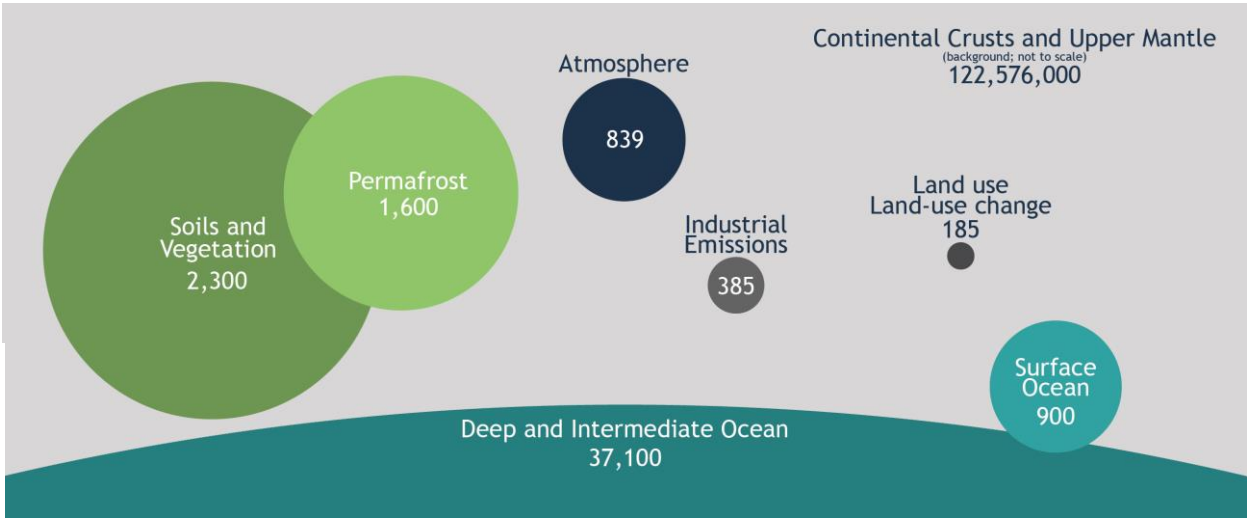
Tree Vigor



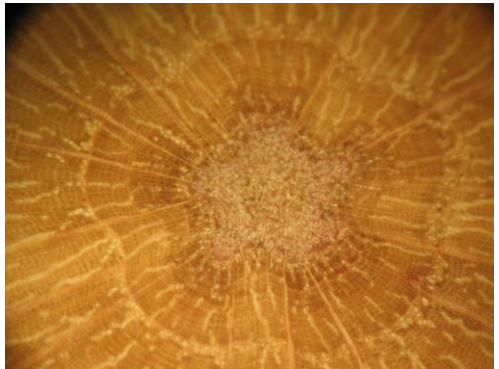
Oregon State University

Global Carbon distribution



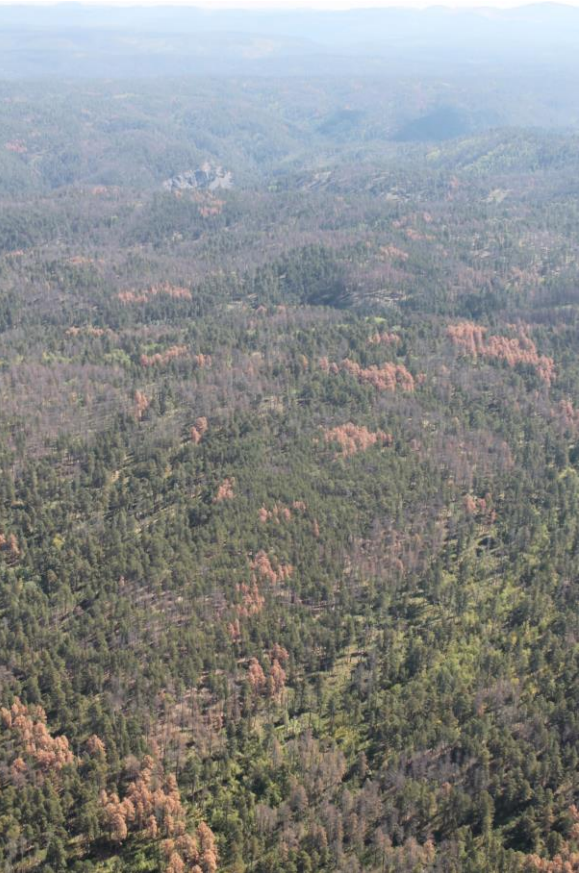


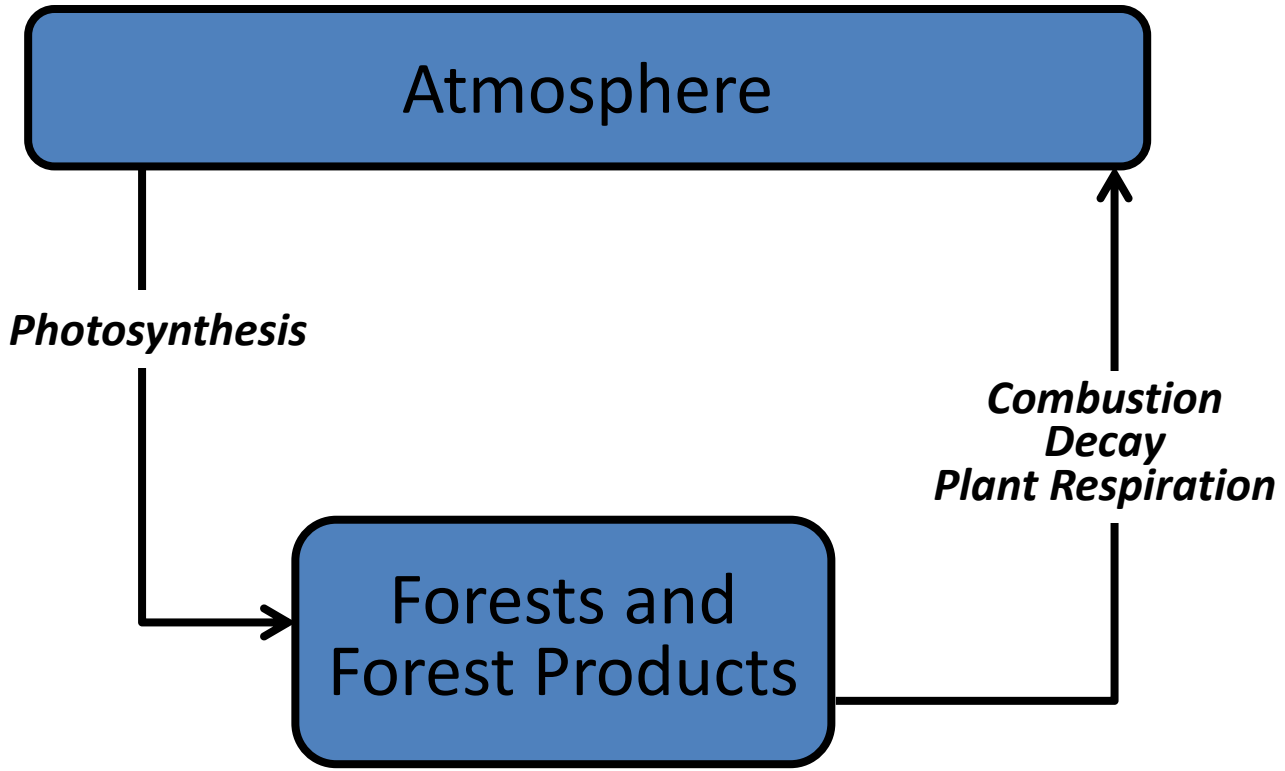
Kayler et al. 2017 (USFS)



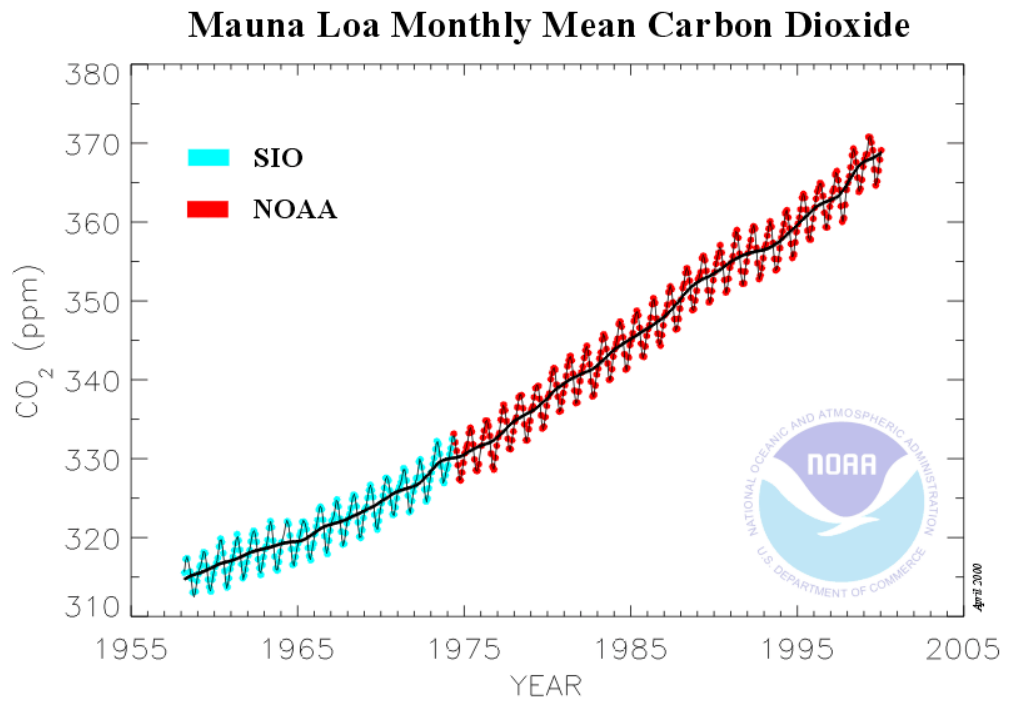
Overview: Carbon

Forest Carbon dynamics

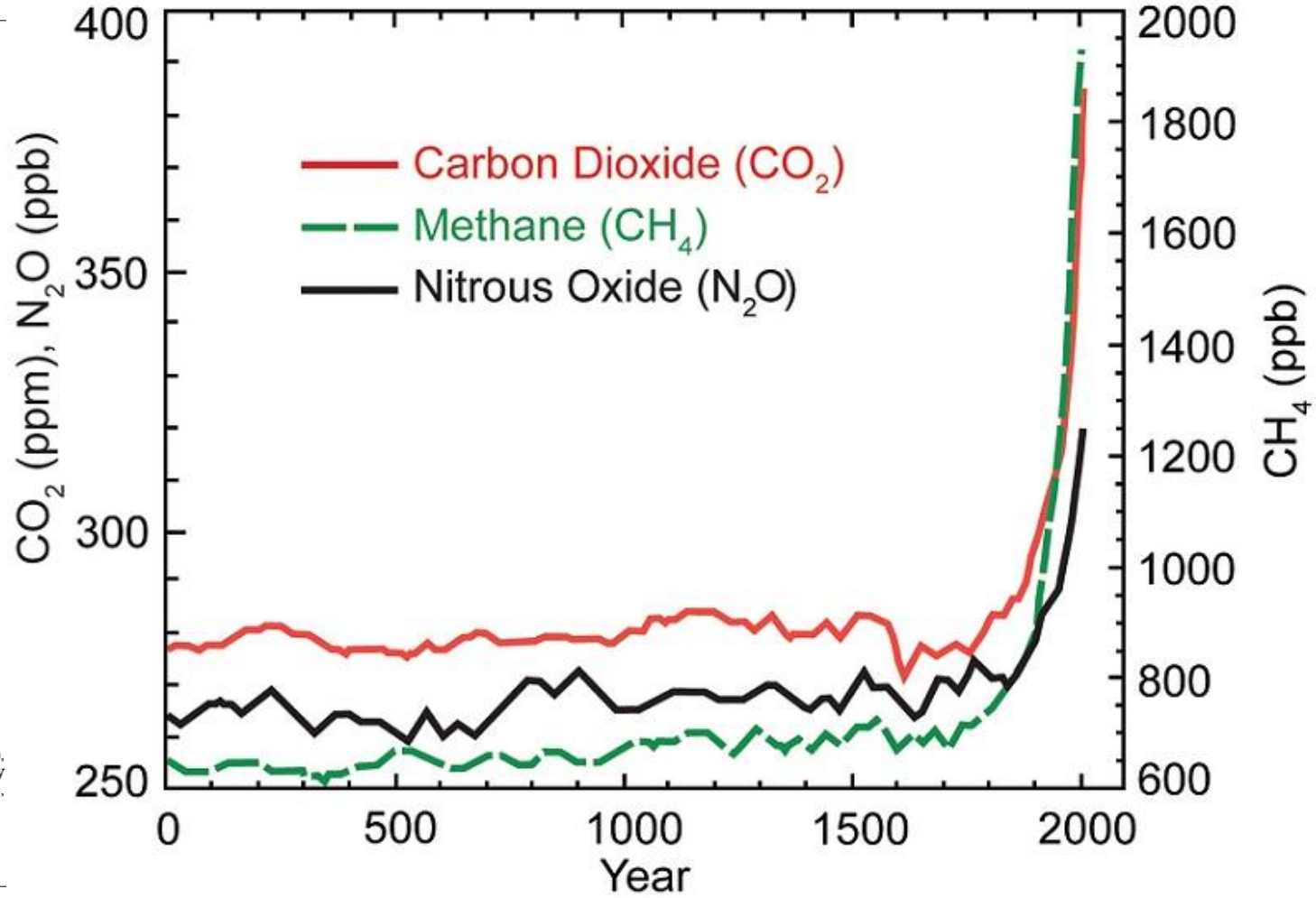




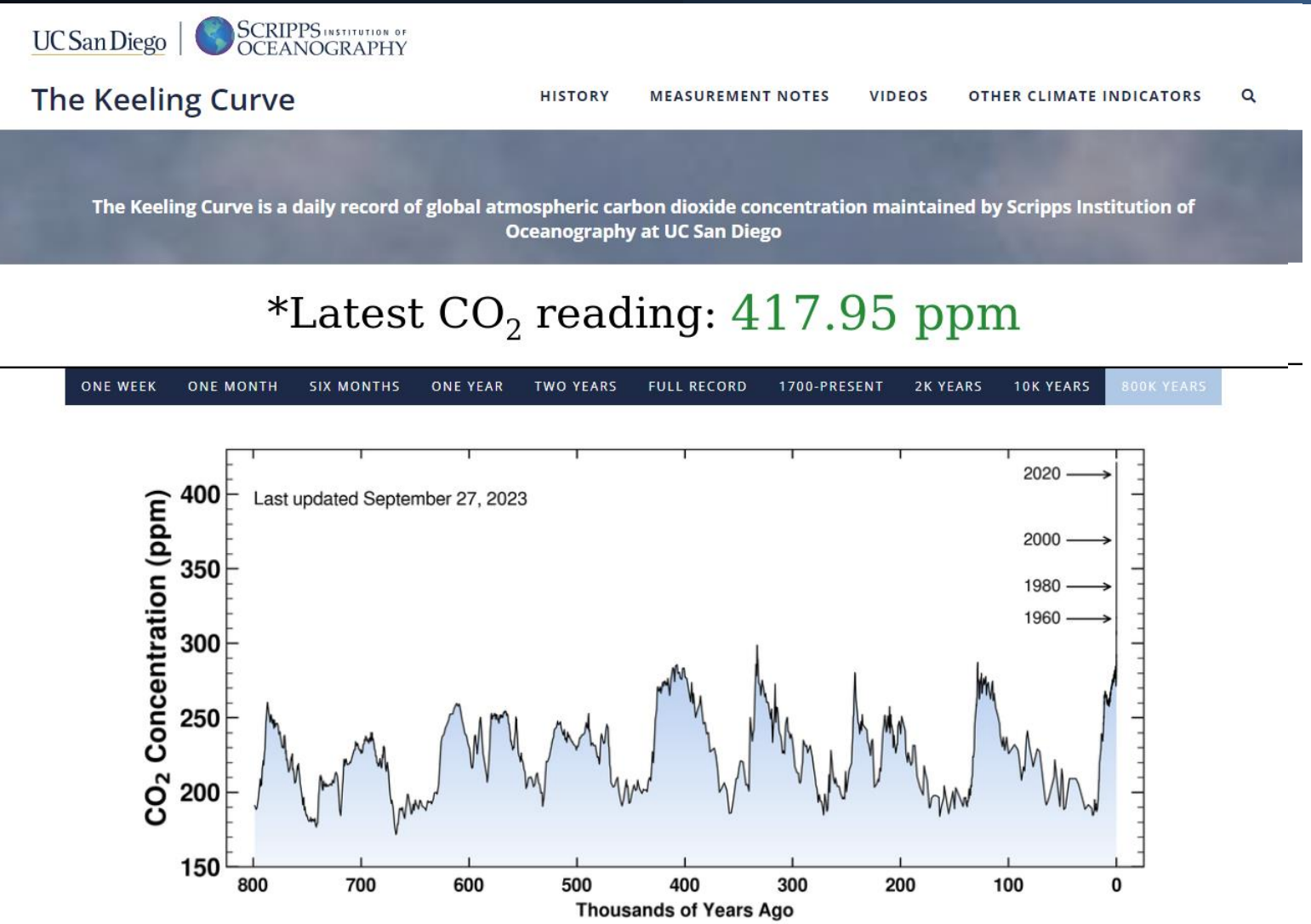
Overview: Carbon



Atmospheric carbon dioxide monthly mean mixing ratios. Data prior to May 1974 are from the Scripps Institution of Oceanography (SIO, blue), data since May 1974 are from the National Oceanic and Atmospheric Administration (NOAA, red). A long-term trend curve is fitted to the monthly mean values. Principal investigators: Dr. Pieter Tans, NOAA CMDL Carbon Cycle Greenhouse Gases, Boulder, Colorado, (303) 497-6678, ptans@cmdl.noaa.gov, and Dr. Charles D. Keeling, SIO, La Jolla, California, (616) 534-6001, cdkeeling@ucsd.edu.



Overview: Carbon



- Since 1910, Earth's atmospheric CO2 concentration (@Mauna Loa) has mostly been >300 ppm. Before 1910, when was last time Earth's atmospheric CO_2 concentration was >300 ppm?

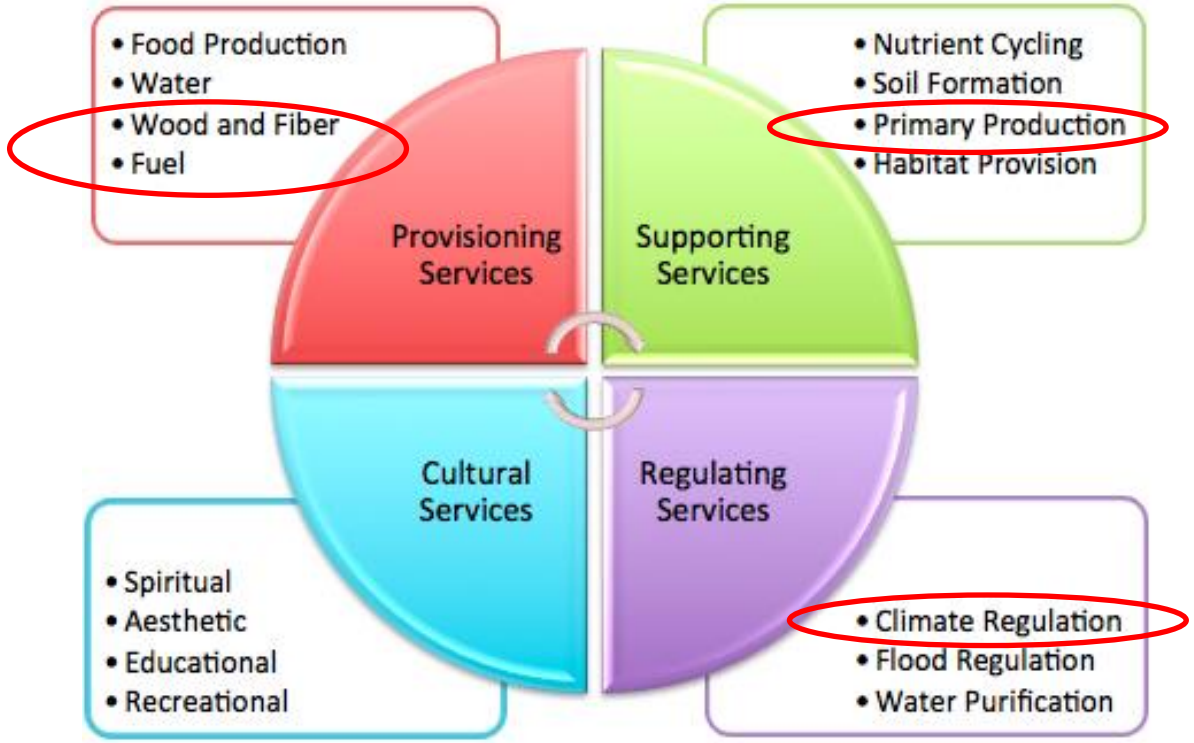
  Between 300-400 thousand years ago

- Since 2016, Earth's atmospheric CO2 concentration (@Mauna Loa) has mostly been >400 ppm. Before 2016, when was last time Earth's atmospheric CO_2 concentration was >400 ppm?

  Between 5.3-2.6 million years ago

Overview: Carbon

Carbon storage is an ecosystem service… which one?



Source: Millenium Ecosystem Assessment, 2005.

USDA U.S. FOREST SERVICE
Caring for the land and serving people
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Overview: Stewardship

- **Forest Ecology**

Overview: Stewardship

- **Forest Management**

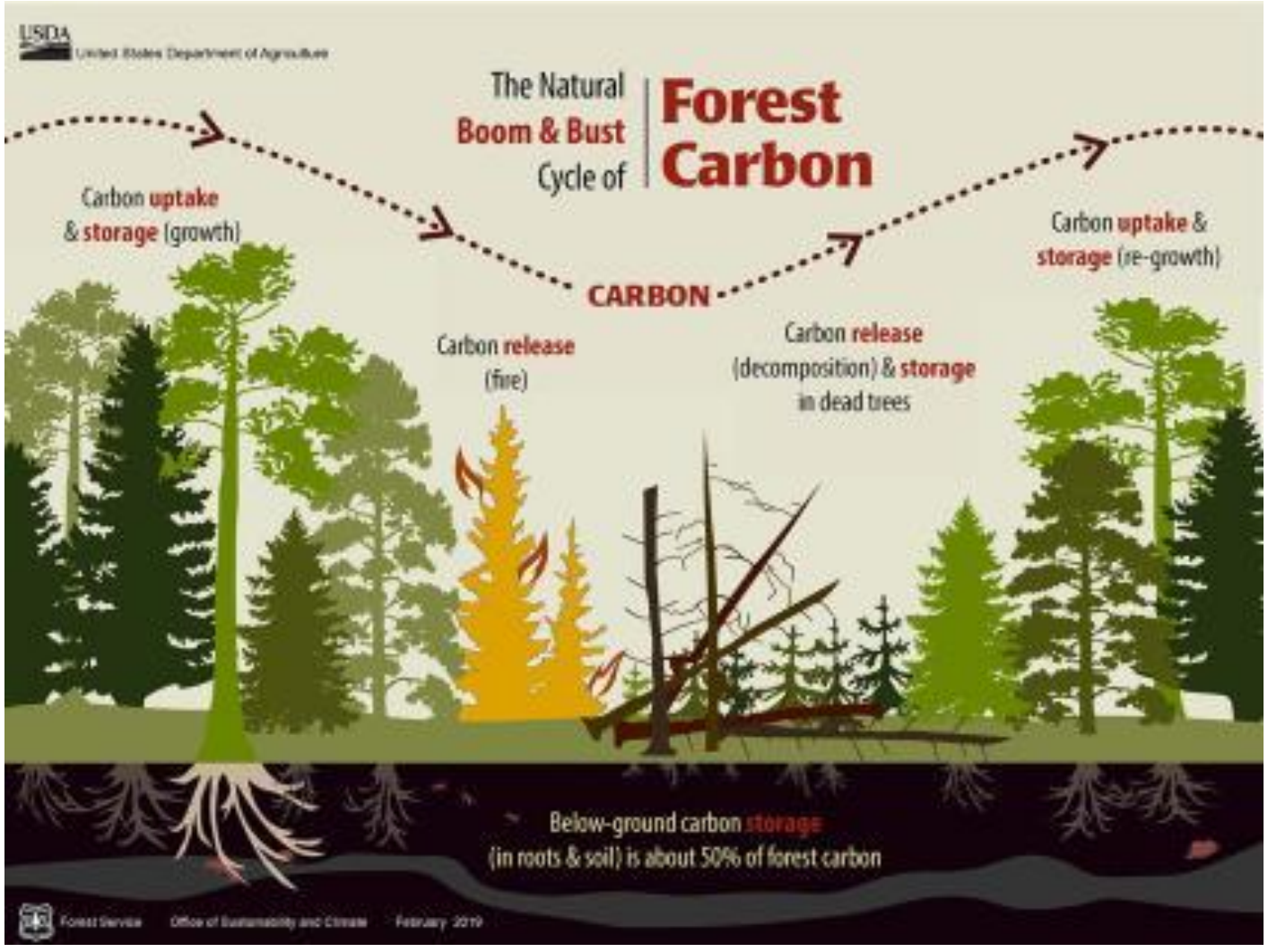
Overview: Stewardship

- **Forest Ecology & Management**

California forest: pre-wildfire thinning

Arizona forest: pre-wildfire thinning

Stewardship: Why manage land?



Stewardship: Why manage land?

<u>Converting</u> forest to other cover type is largest loss of Carbon benefit, as well as most other benefits

Possibilities:

1) **Do nothing; trees growing = Carbon storing. This may briefly maximize Carbon storage, but not sequestration rate. Will resulting forest be resilient? Probably not.**
2) **Cut trees! Following BMP guidelines may help protect soil & water. "*Doesn't bringing logs to the mill reduce Carbon storage?*" Yes- temporarily (trees = renewable resource). Replanted young forest = high <u>sequestration rate</u>.**

Stewardship: Why manage land?

CONSIDER GROWTH VERSUS REMOVAL (USFS FIA):

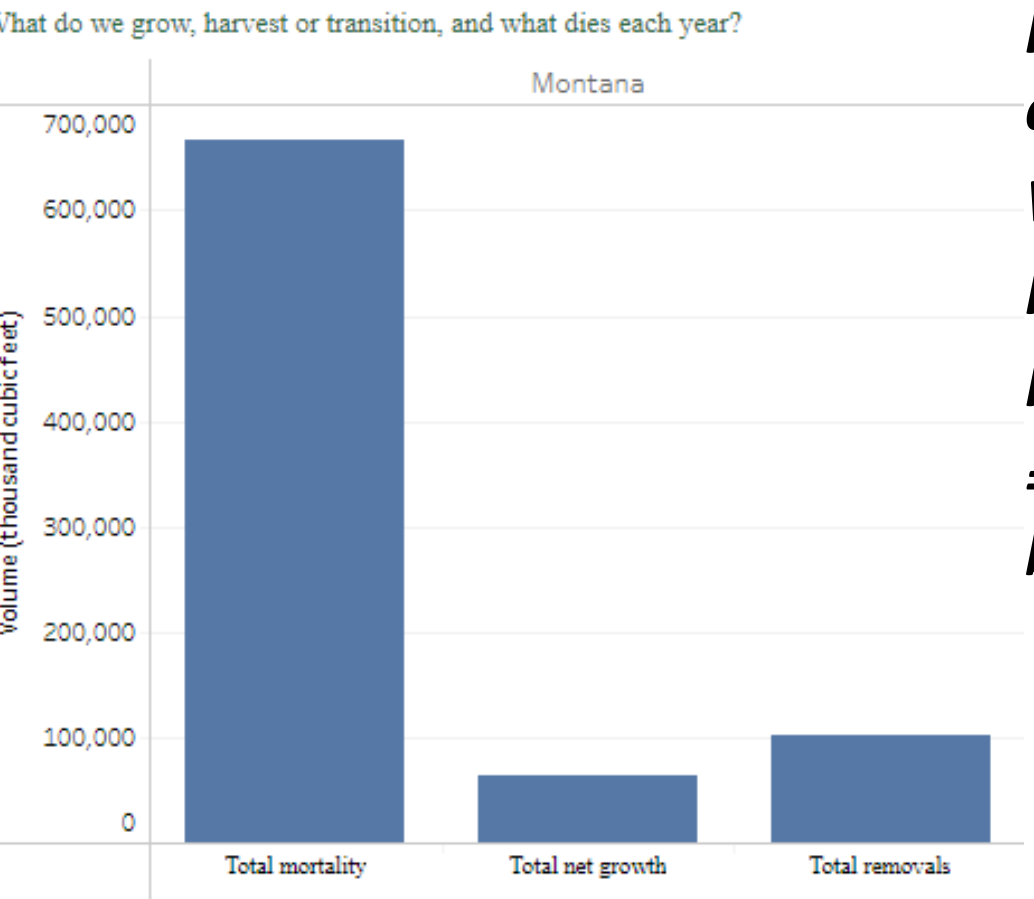
Net Growth

Harvest (Removals)

"Natural" Mortality

Consider the scenario of G:R = 1, 2, or 0.5 (Think of "banking") whereby anything >1 means we end up with more biomass than what we started with, and anything <1 means the opposite.

Stewardship: Why manage land?



GROWTH : MORTALITY & GROWTH : REMOVALS BY OWNERSHIP

In some states, natural mortality exceeds net removals and net growth

What happened in Montana?

Mortality is 9x greater than growth

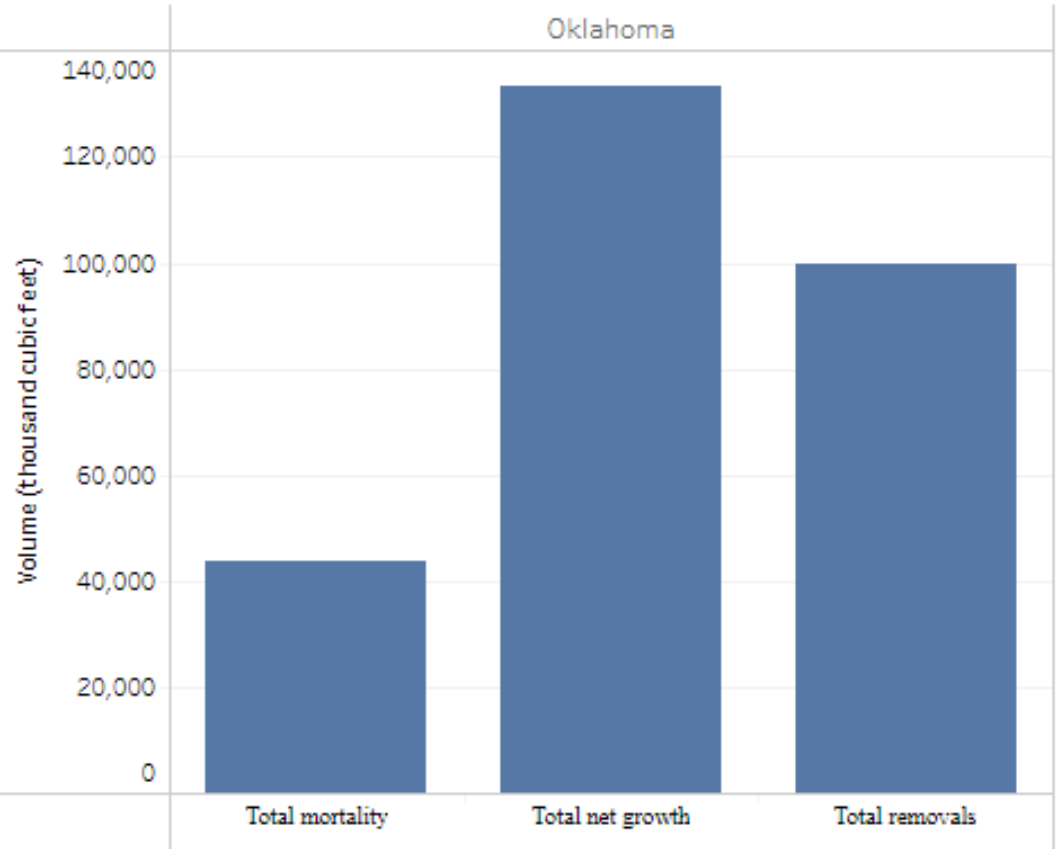
Mortality is 6x greater than removals

= more trees died than were planted or cut down. Bark beetles + fire?

Growth, removals & mortality

Stewardship: Why manage land?

What do we grow, harvest or transition, and what dies each year?



GROWTH : MORTALITY & GROWTH : REMOVALS BY OWNERSHIP

Oklahoma's total NET growth exceeds removals & mortality

Growth, removals & mortality

Stewardship: Why manage land?

GROWTH : REMOVALS by OWNERSHIP in Oklahoma

…anything >1 means there are more new trees growing than there are trees being removed

Federal……11.23

State & Local……2.94

Private Industry……1.41

Private Non-industry……..1.37

Stewardship: Why manage land?

GROWTH : REMOVALS Nationally

USA……..1.92

Stewardship: Why manage land?

Remember that REMOVALS can assume some sequestered and stored Carbon

Stewardship: Why manage land?

BOTTOM LINE: Often, no management = more Carbon loss (senescence, decomposition, fire)

- **Carbon is an Ecosystem Service which can be managed for, just like management for microclimate, water and wildlife**
- **But if forests are already storing Carbon, do we need to do any management or PROVE the management we are doing leads to increased Carbon storage/sequestration?**
- **The management we do is to OPTIMIZE Carbon storage/sequestration, and must be ADDITIONAL to what would have happened if we did nothing**

Questions?

OSU EXTENSION

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