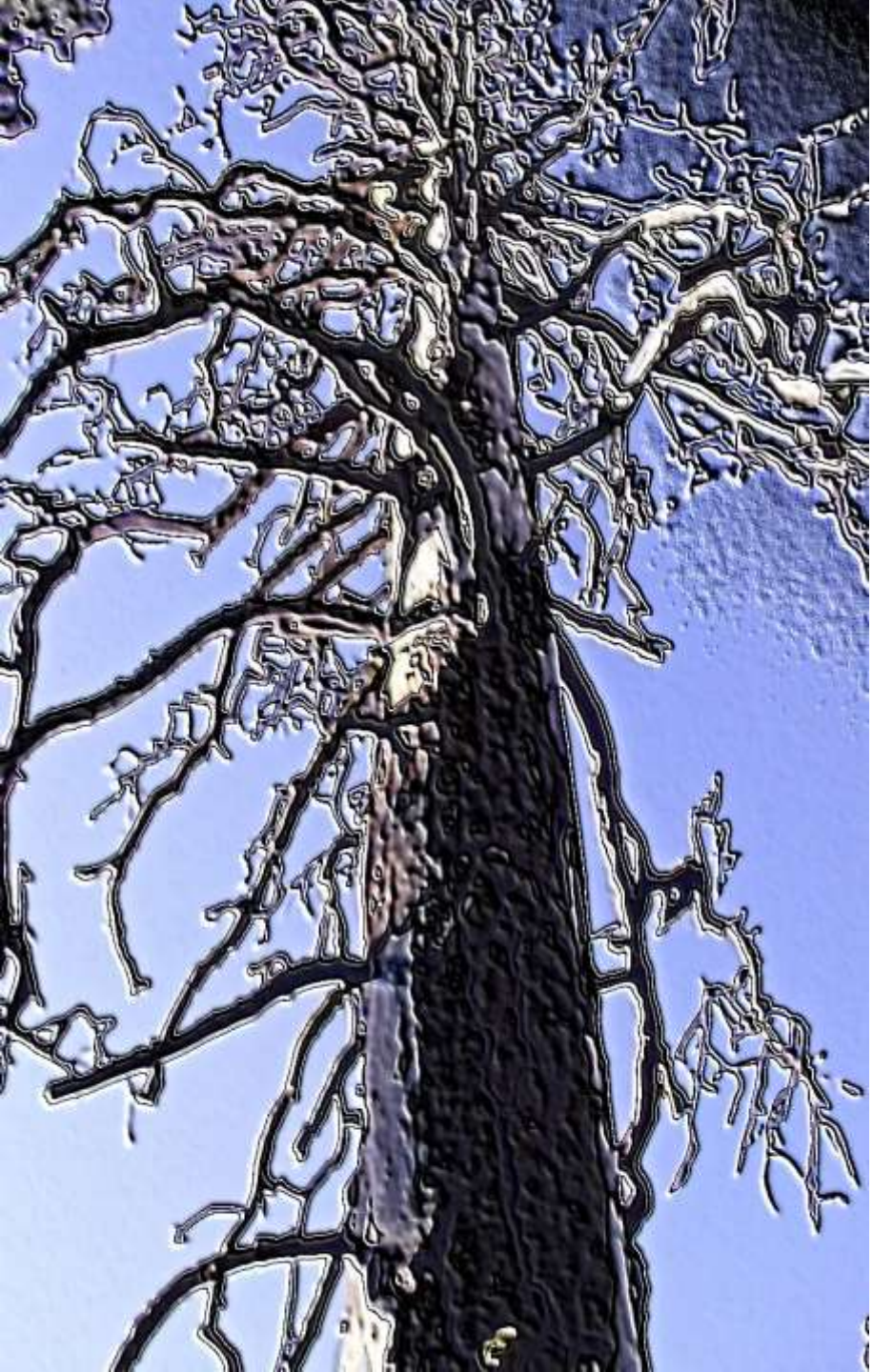


Myths & Facts…

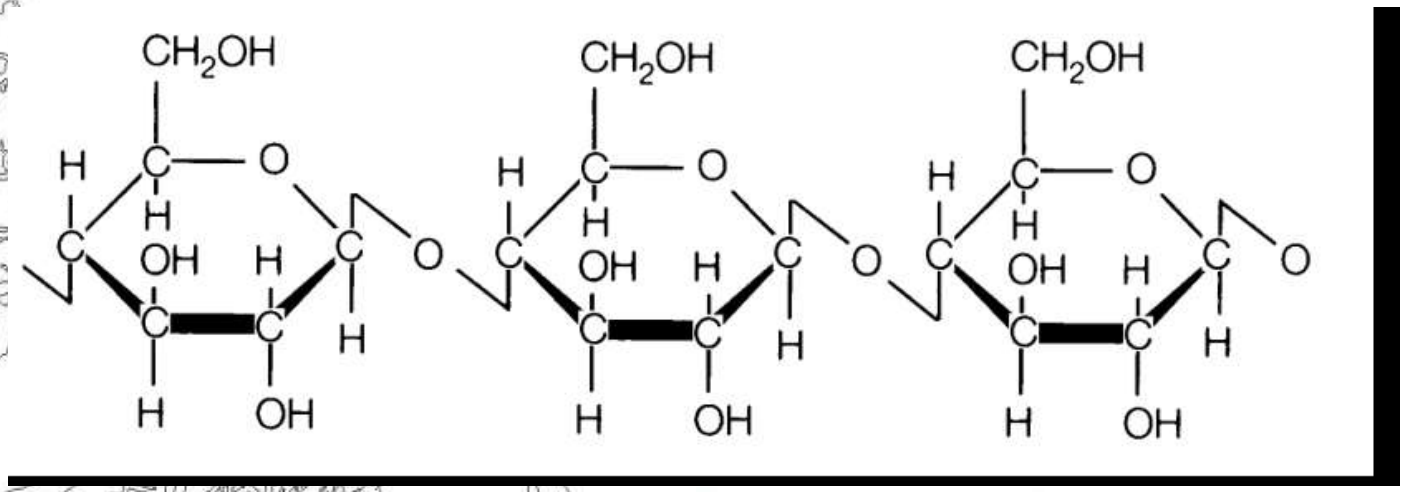
Forests, Carbon, and Global Warming

Doug Heiken

OREGON WILD

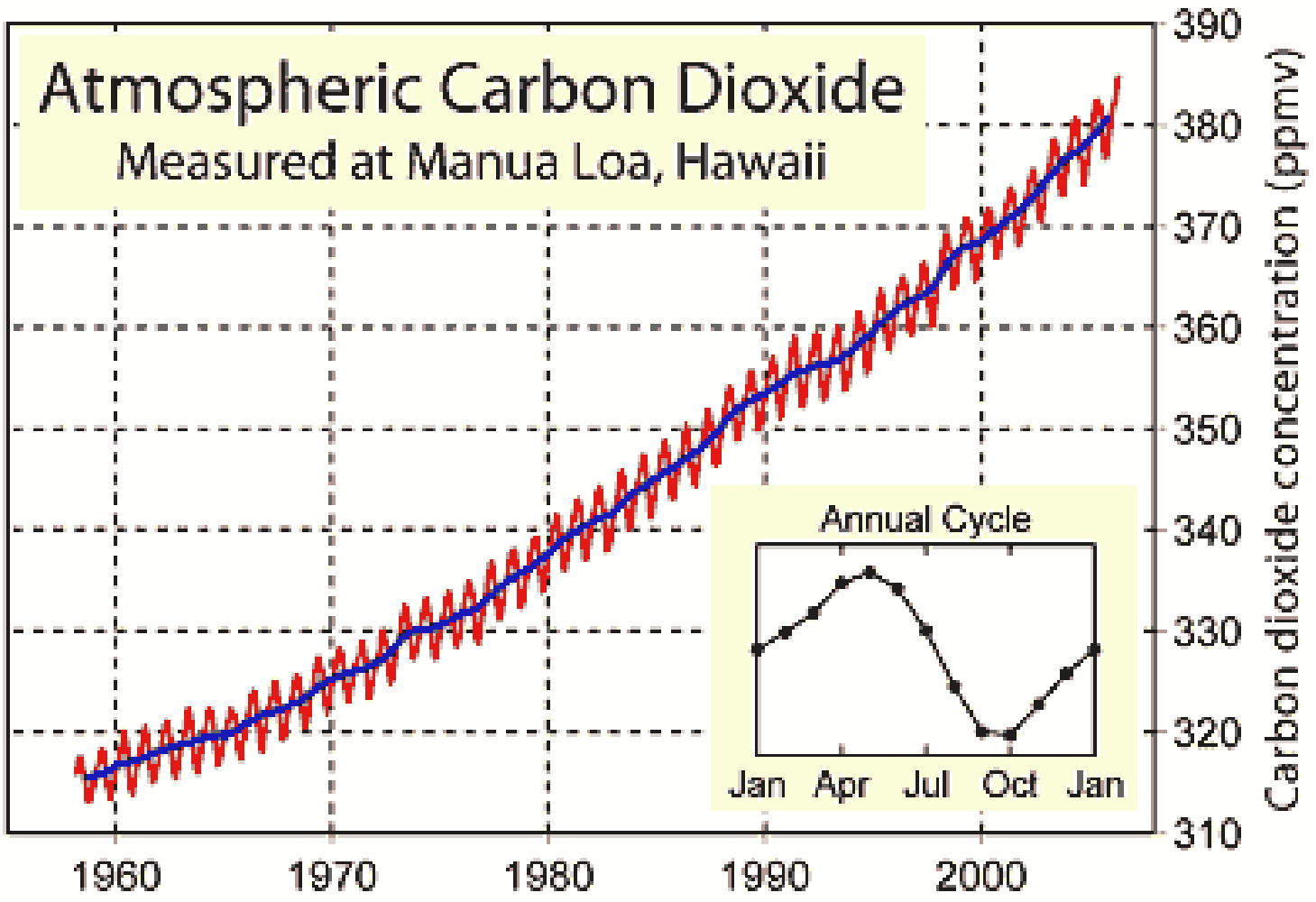
Formerly Oregon Natural Resources Council (ONRC)

The Essence of Life:
Constructing and Deconstructing Carbon Chains



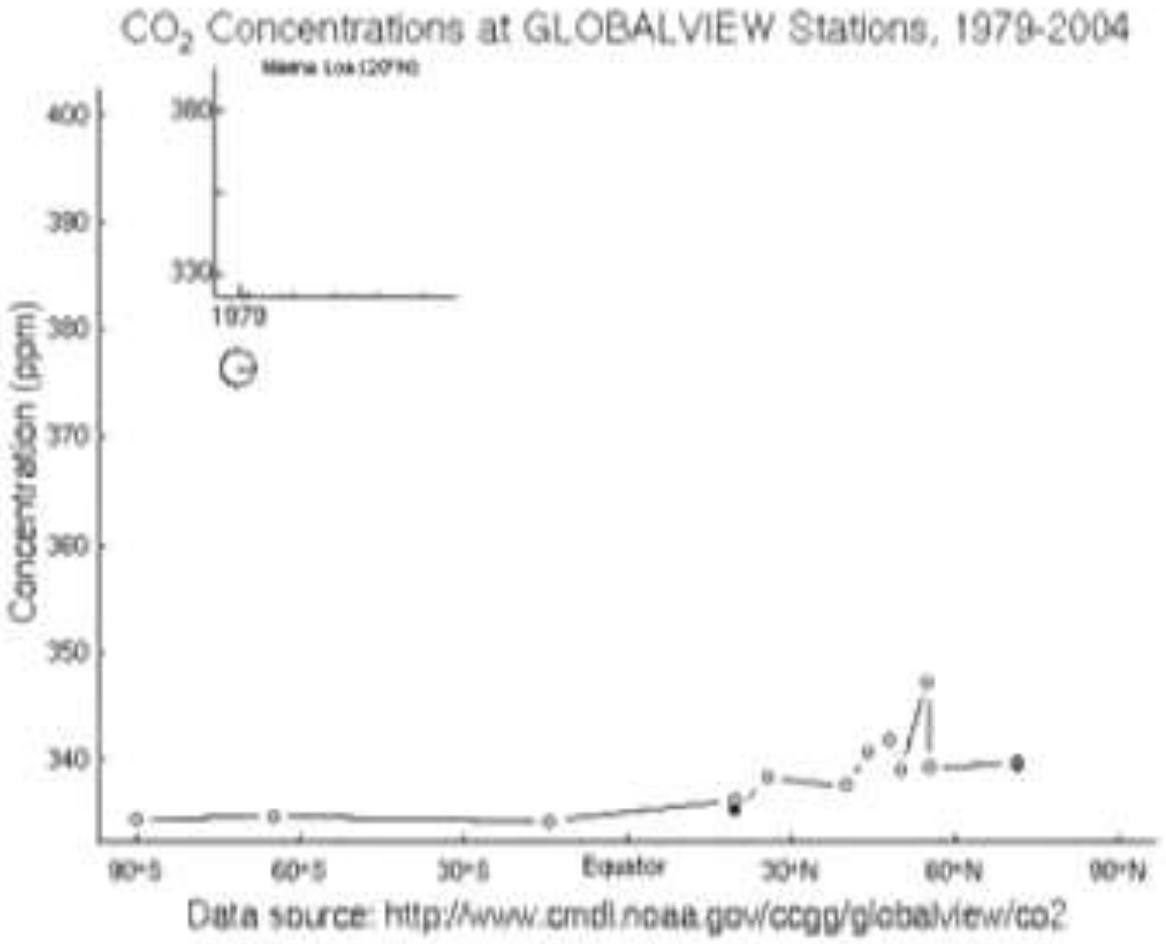
Glucose and cellulose are *built up* through photosynthesis and *broken down* to CO_2 by respiration and combustion.

Forests Really Are the Lungs of the Planet



Keeling Curve, http://heartspring.net/images/atmospheric_carbon_dioxide.gif

Watch the Planetary Biosphere Breathe!



http://www.youtube.com/watch?v=HKq-0Kfu3KE

Understanding forest carbon flows

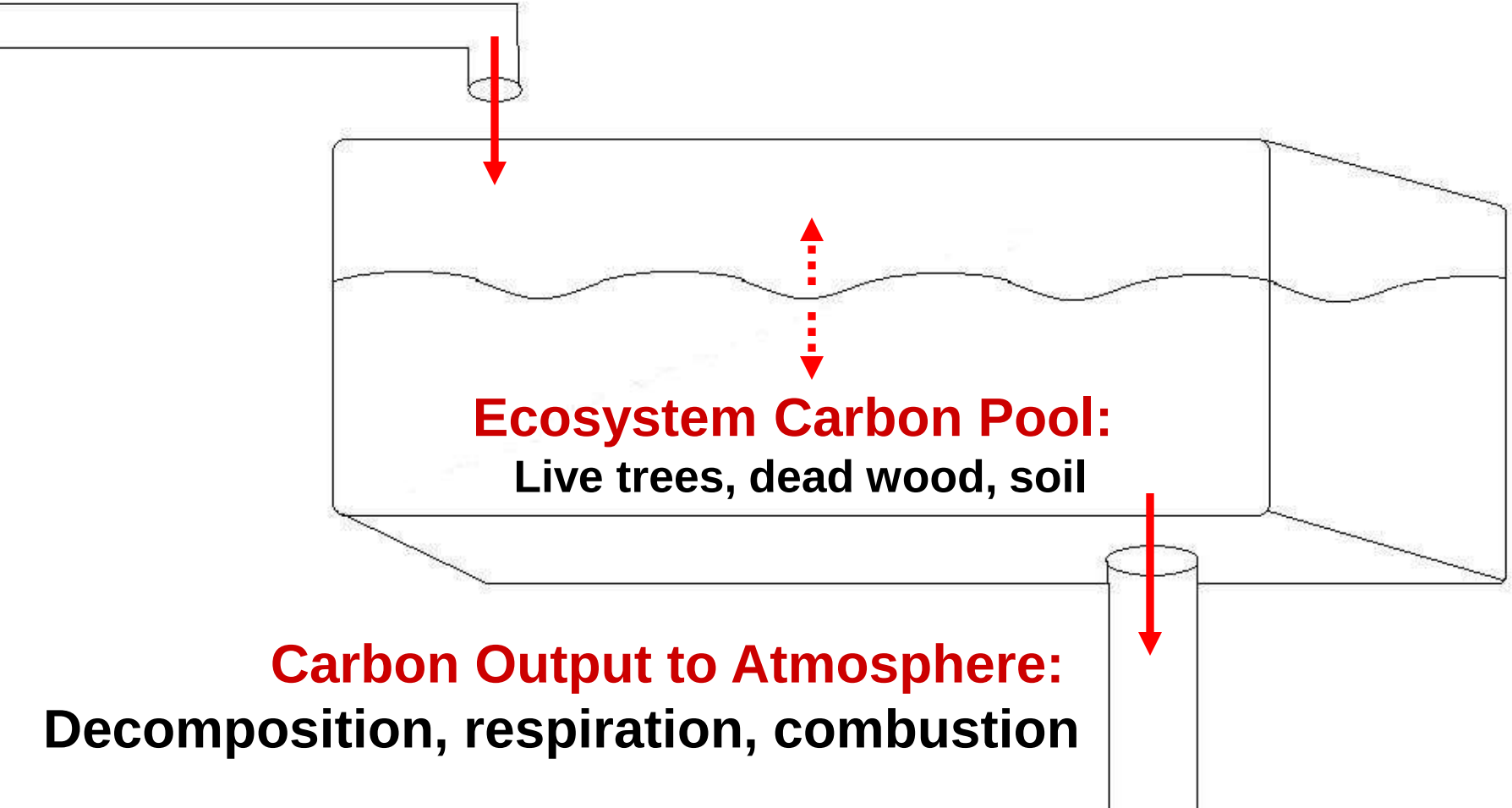
- Forests capture, store, and release carbon. Decisions whether to log or conserve forests affect all three.
- Relevant carbon pools include not just live trees, but dead wood, other plants, roots, litter, and soil.
- Method to debunk myths:
  - Find the grain of truth.
  - Follow the flow of carbon from the forest and atmosphere.
  - Consider the longevity of carbon in each pool.

Systems View: Input-Output Model

The size of the forest carbon pool is determined by the rate of carbon input relative to output over time

Carbon Input to Forest:

photosynthesis, length of growing season



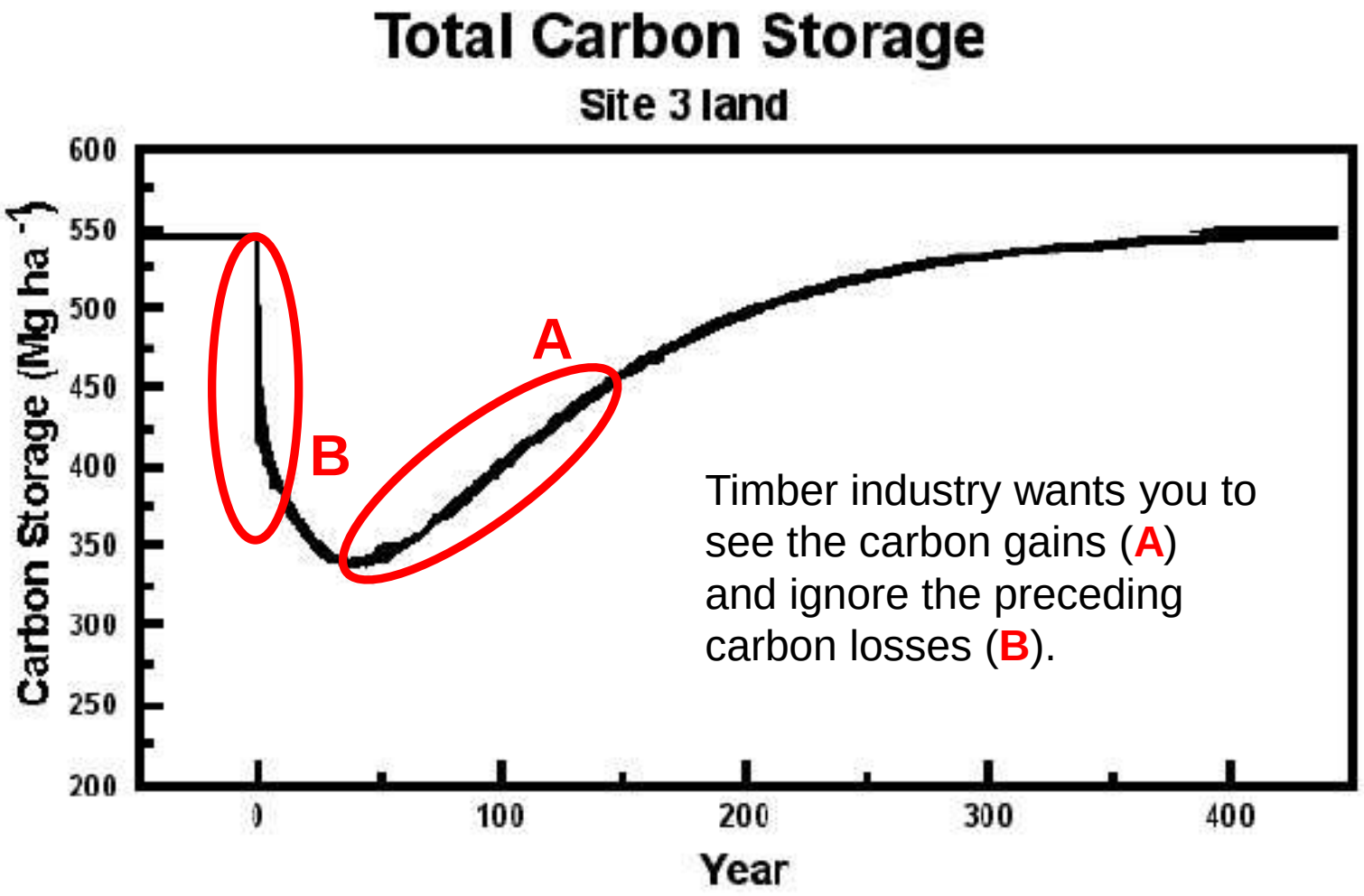
Ecosystem Carbon Pool:

Live trees, dead wood, soil

Carbon Output to Atmosphere:

Decomposition, respiration, combustion

Forest Carbon Storage Following Disturbance



OVERVIEW

- Young Forest Myth
- Wood Products Myth
- Harvest Myth
- Fire Myth
- Tropical Forest Myth
- Albedo Myth
- “Doomsday” Myth
- Substitution Myth
- Methane Myth
- “No Surprises” Myth
- Solutions

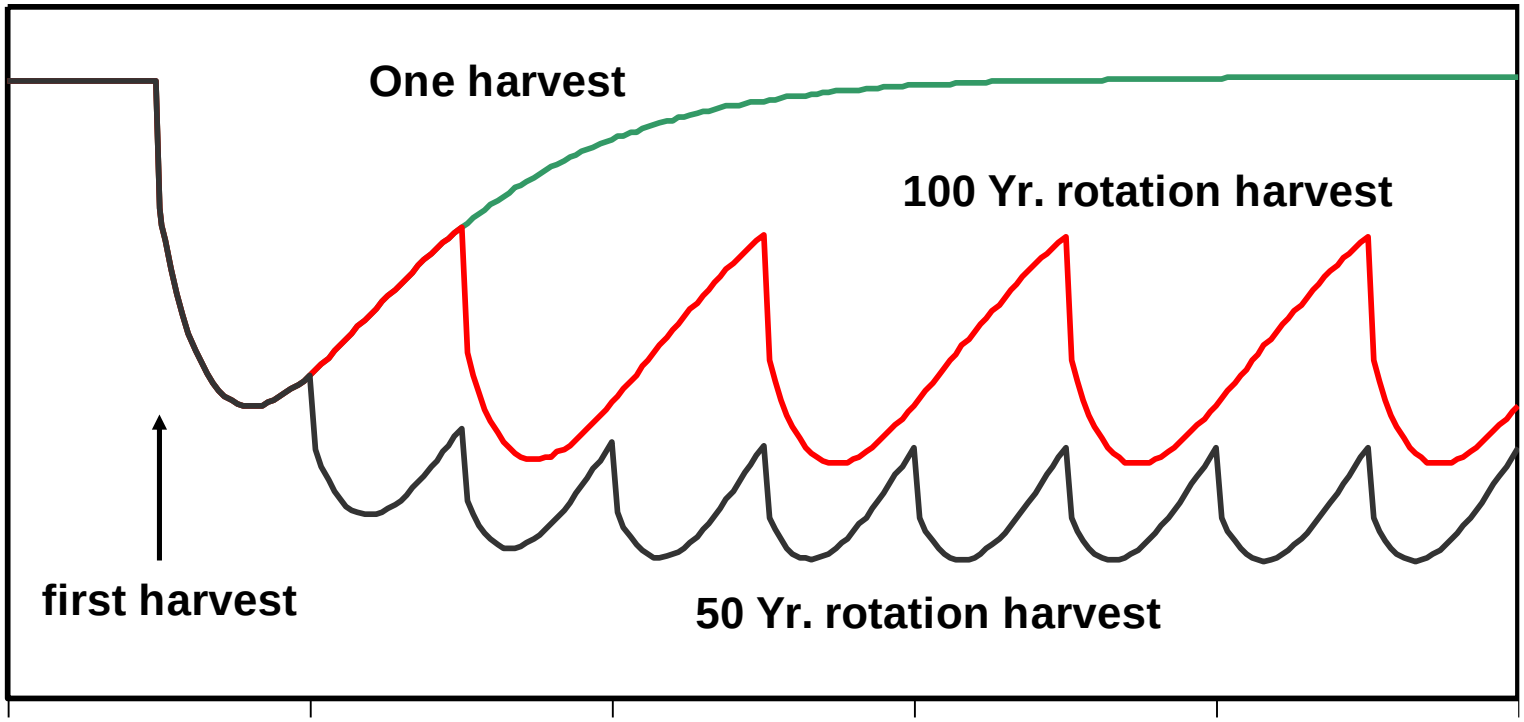
YOUNG FOREST MYTH:

Fast-growing young forests absorb more carbon and are better for the climate than slow-growing old forests.

Reality:

- Old forests *store* far more carbon than young forests.
- Old forests are still growing and absorbing carbon.
- KEY: Old forests cannot be converted into young forests without losing most of the carbon to the atmosphere.

Disturbance Frequency Affects Carbon Storage



EXPERTS AGREE

"In contrast to the sink management proposed in the Kyoto protocol, which favors young forest stands, **we argue that preservation of natural old-growth forests may have a larger effect on the carbon cycle than promotion of regrowth**. ... [I]ncreasing life-span of the stand, proportionally more carbon can be transferred into a permanent pool of soil carbon ... **replacing unmanaged old-growth forest by young Kyoto stands ... will lead to massive carbon losses to the atmosphere mainly by replacing a large pool with a minute pool of regrowth** and by reducing the flux into a permanent pool of soil organic matter."

Ernst-Detlef Schulze, Christian Wirth, Martin Heimann. CLIMATE CHANGE: Managing Forests After Kyoto. Science 22 September 2000: Vol. 289. no. 5487, pp. 2058 - 2059.


Photosynthesis still happens in old forests.


Wind River Canopy Crane


Old forests store lots of carbon.


“Dead trees don’t go to heaven.” Olga Krankina

Where did the carbon go?

WOOD PRODUCTS MYTH:

It's better to store carbon in wood products, rather than in forests.

Examples:

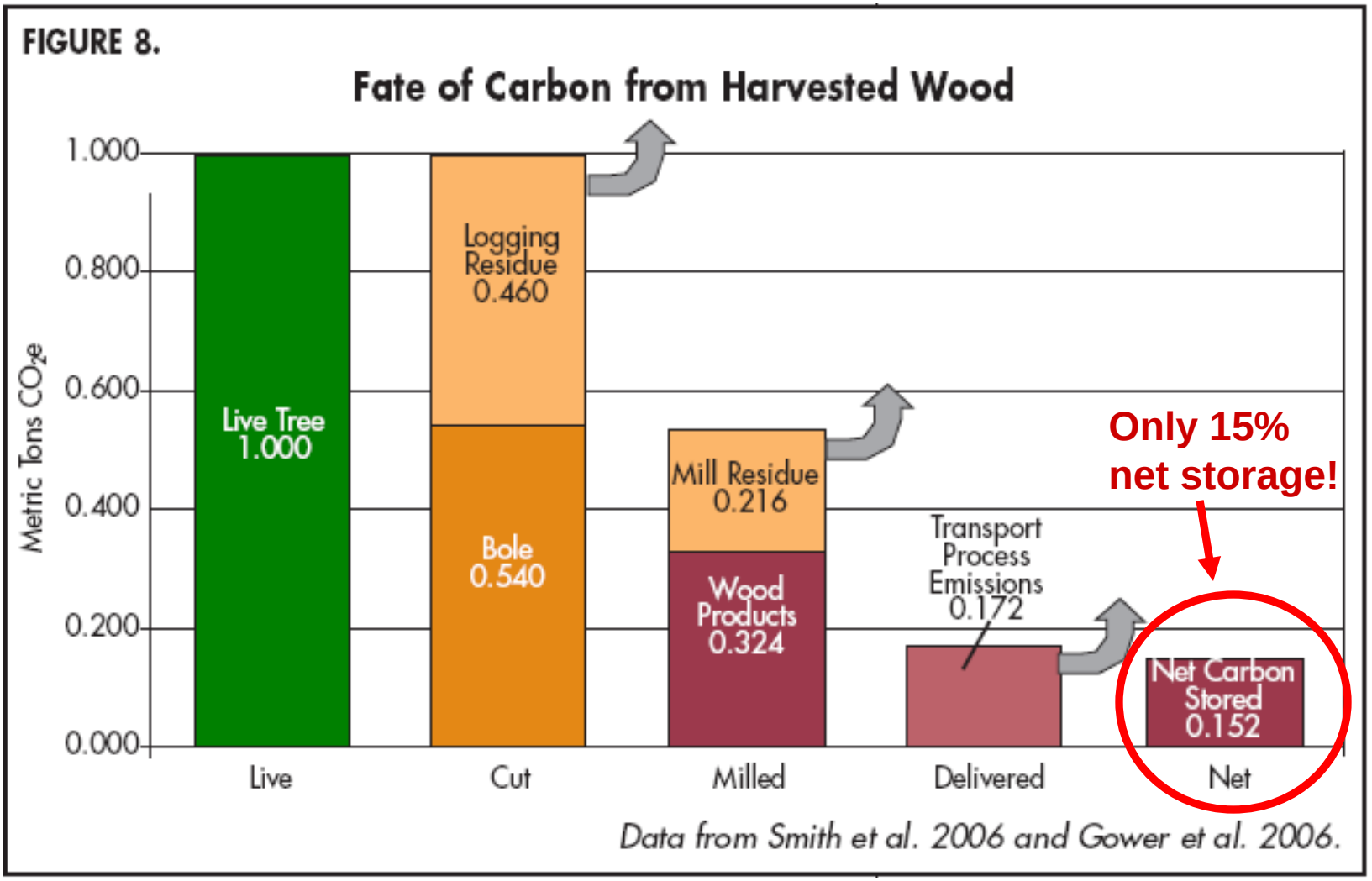
"The key to sequestering carbon will be to move harvested biomass into solid wood products …" [a]

"Carbon stays trapped in the wood, locked in the lumber …." [b]

Reality: Carbon is stored more securely in long-lived forests than in short-lived wood products.

a Forest Service Strategic Framework For Responding to Climate Change, V 1.0
b California Forests Magazine, Winter 2006, http://calforests.org/media/enhanced/Winter06-CalForest-FINAL.pdf

Only a small fraction of forest carbon is stored in wood products.



Logging transfers most of the carbon in the forest to the atmosphere as logging slash, mill waste, and processing emissions.

Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. Washington, D.C.: The Wilderness Society.
http://www.uvm.edu/rsenr/greenforestry/LIBRARYFILES/ForestCarbonReport.pdf


Carbon is stored for hundreds of years here.

Carbon may be stored for a few years here.

or stored for some months here…

How much carbon remains in wood products after 100 years?

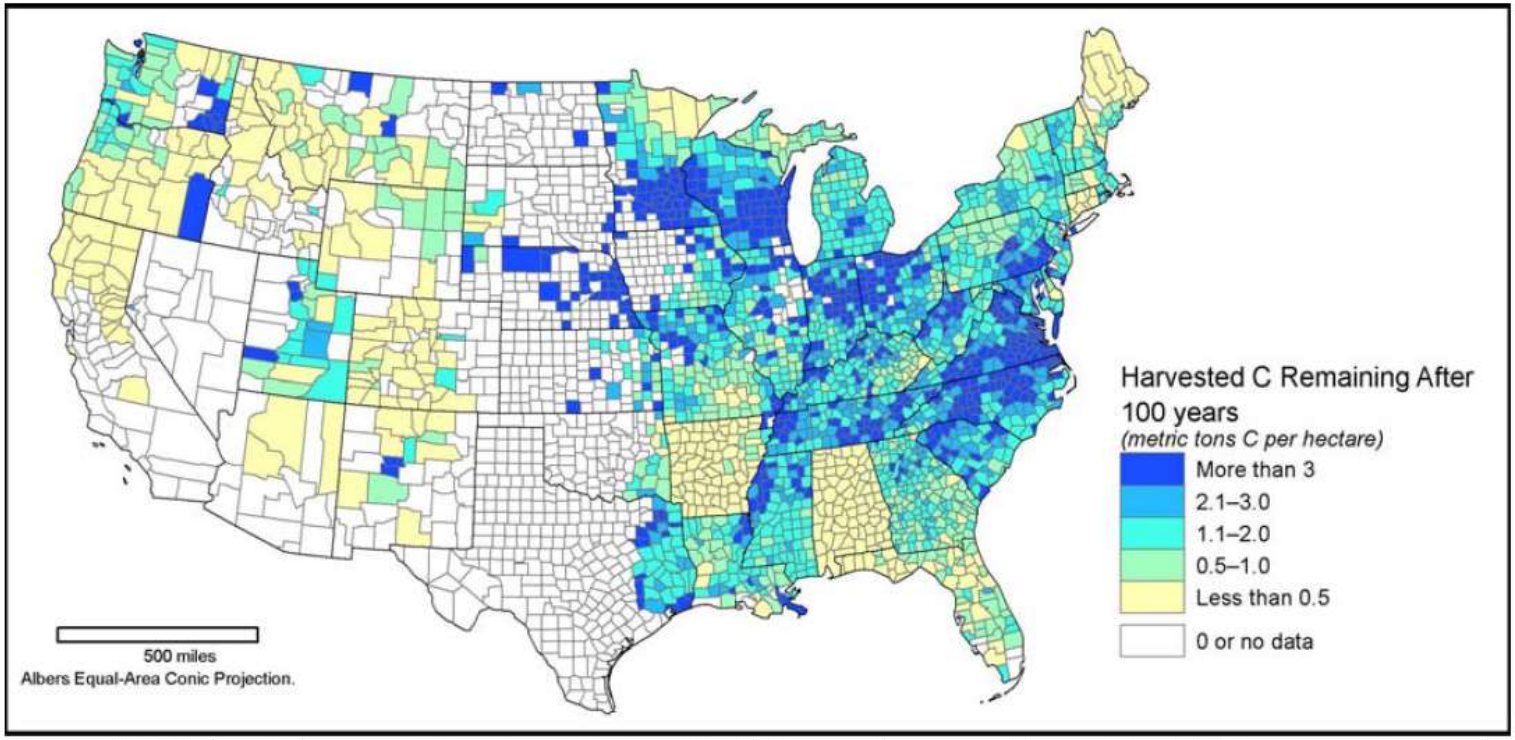


Figure 23-4 Estimated amount of carbon still stored in 100 years from wood harvest in 2006 by county (tons carbon per hectare of timberland). http://www.fs.fed.us/research/sustain/2010SustainabilityReport/documents/draft2010sustainabilityreport.pdf

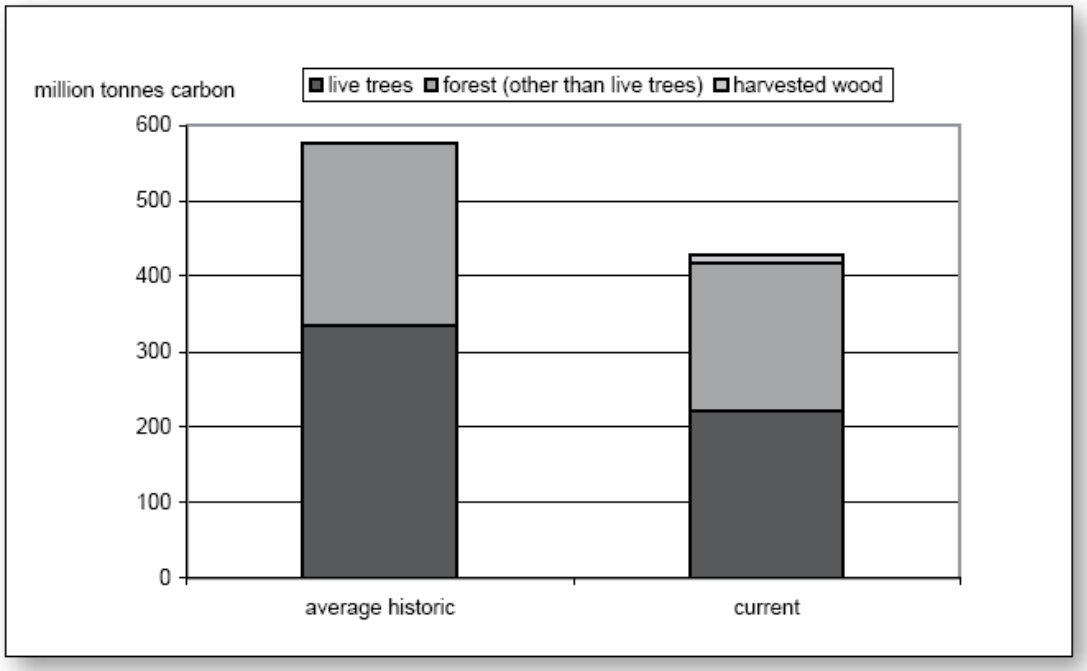
Timber harvest in the NW typically disturbs 150-300 tons of carbon per hectare but less than one percent of that carbon may go into long-term storage. Most of the carbon from logged forests gets emitted to the atmosphere.

BLM forests in western Oregon

Across 2.5 million acres of forest …

- 149 million tons are missing from the forest due to logging.
- 11 million tons are stored in wood products.
- Therefore, 13x more carbon is emitted than stored.

FIGURE 3-18. HISTORICAL AND CURRENT CARBON STORAGE



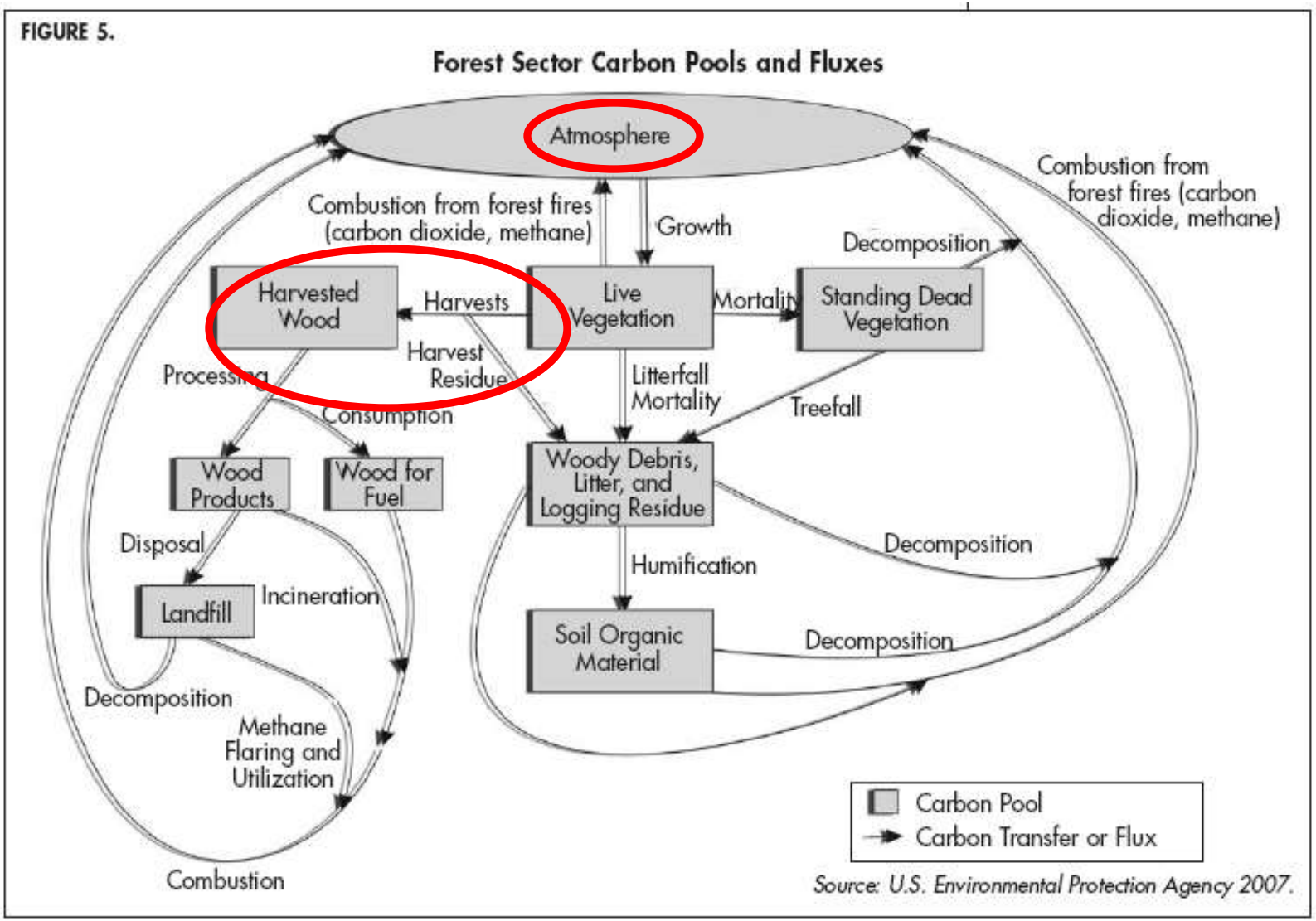
HARVEST MYTH:

Timber harvest “absorbs” carbon.

Source: California Forest Products Commission. Modern Forestry & Climate Change.

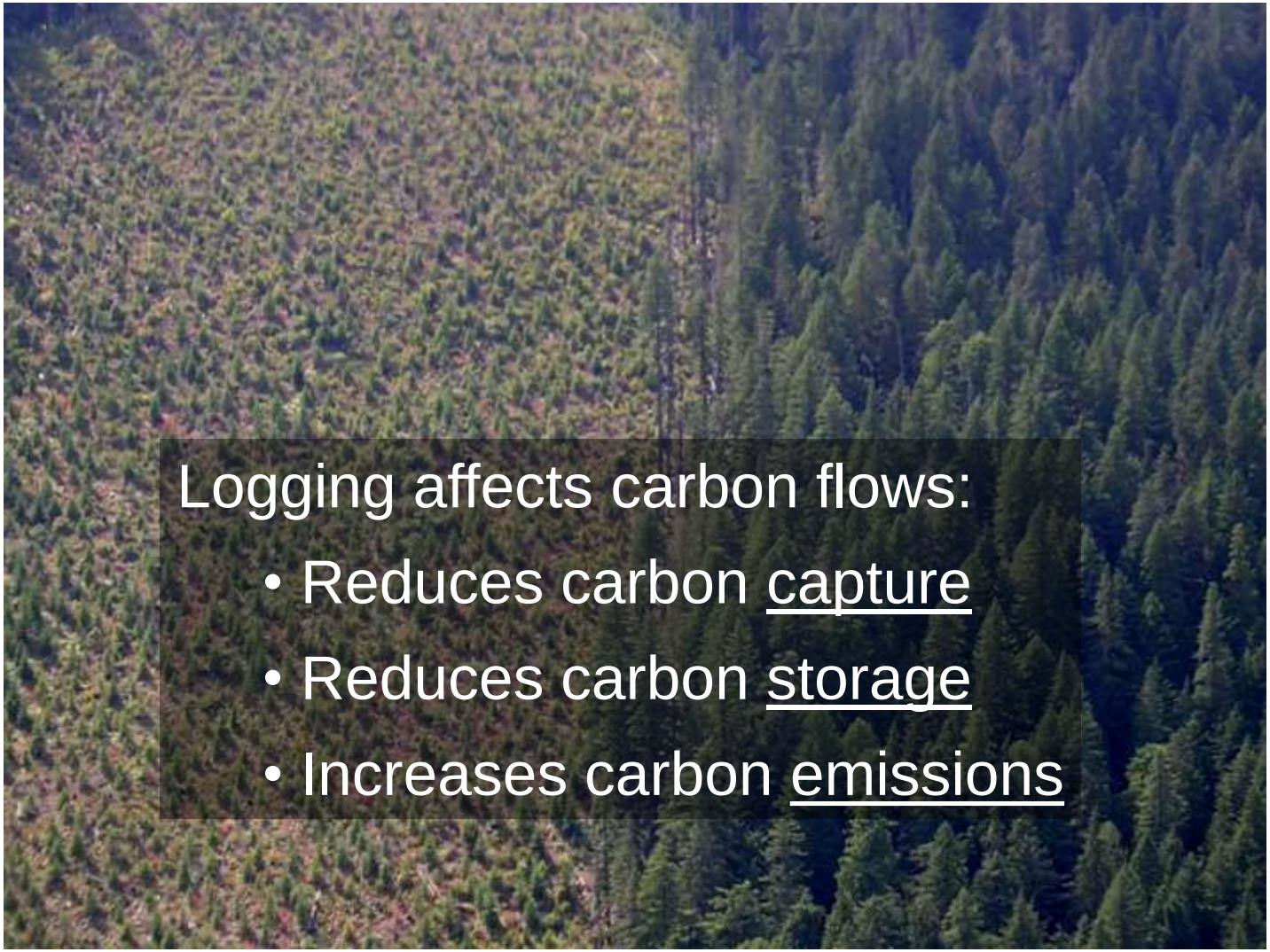
Reality: logging emits carbon.

Just follow the arrows from harvest back to the atmosphere.



Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. Washington, D.C.: The Wilderness Society.

Logging Creates C arbon Contrast.



Reality: Carbon is more secure in live trees . . . rather than dead trees.

Logging kills trees, stops photosynthesis, initiates decay, and starves the soil foodweb.

Reality: Carbon is safer when protected by tree bark …

rather than paint.

Living trees have an arsenal of defenses that help keep carbon safe from decay, insects, and fire.

Reality: Carbon is safer in big pieces of wood

. . . rather than small.

Logging fragments large wood and increases surface area exposed to microbial decomposition.

Reality: Carbon is more secure in a cool forest . . . rather than a warm forest.

Reducing canopy cover warms the soil surface and increases the rate of decomposition.

Reality: Logging debris is burned, emitting carbon.

Summary: Long-lived forests store carbon better …

. . . than short-lived wood products.

FIRE MYTH:

Forests are not good places to store carbon because forest fires release stored carbon through combustion.

Example: “When a tree burns it releases *all* the carbon it previously stored.”*

* California Forest Products Commission. Modern Forestry & Climate Change.

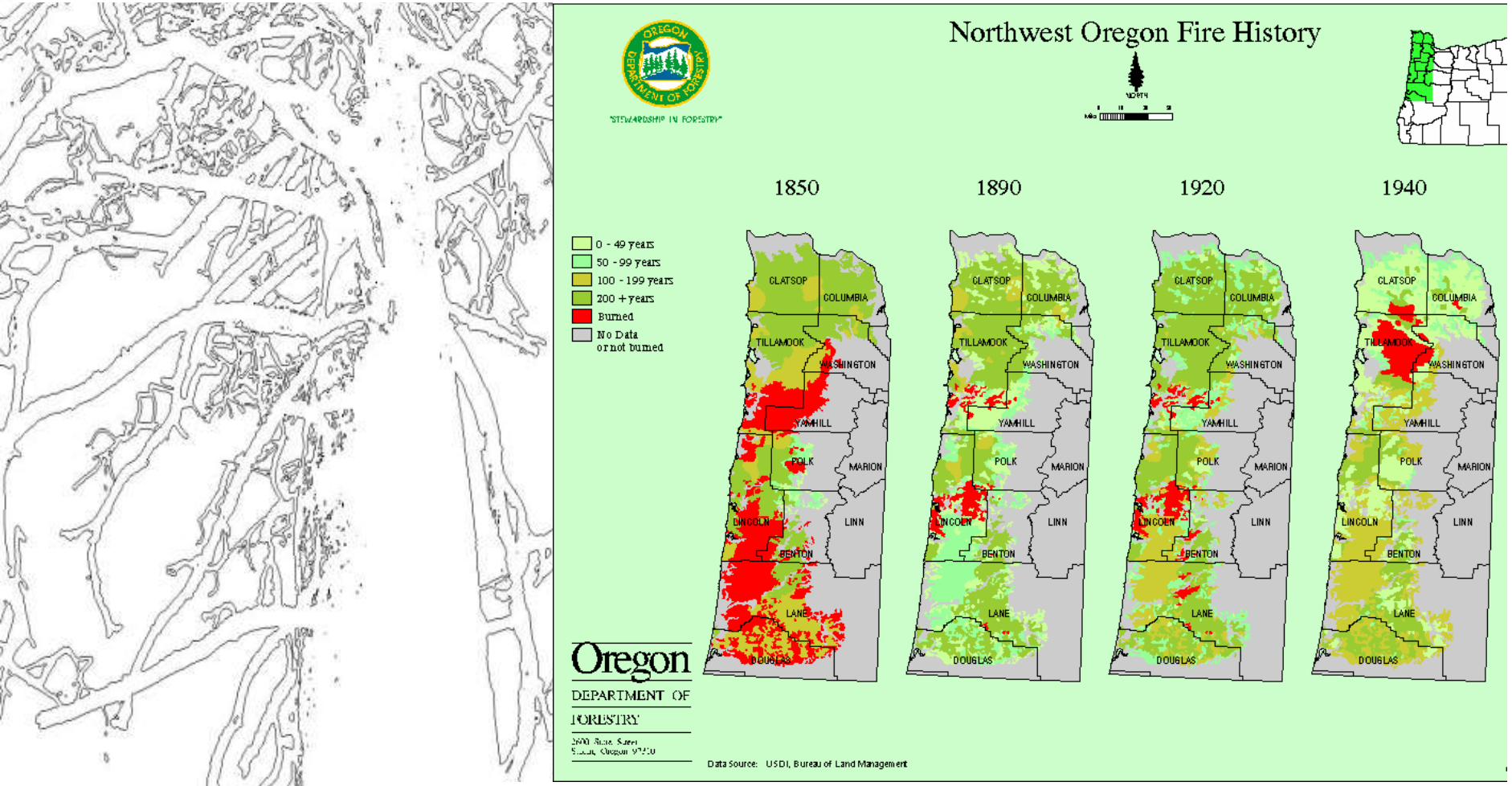
Reality: Many forests are maintained by fire.

Some trees die …

… so that others may live long and grow large.

Fire is an essential ecological process that helps forests stay healthy.

Reality: Fires occur in limited areas for a limited time, while photosynthesis dominates everywhere else.



Places that don't burn absorb more carbon than is released by the places that do burn.

“Carbon emissions due to fire are surprisingly low”

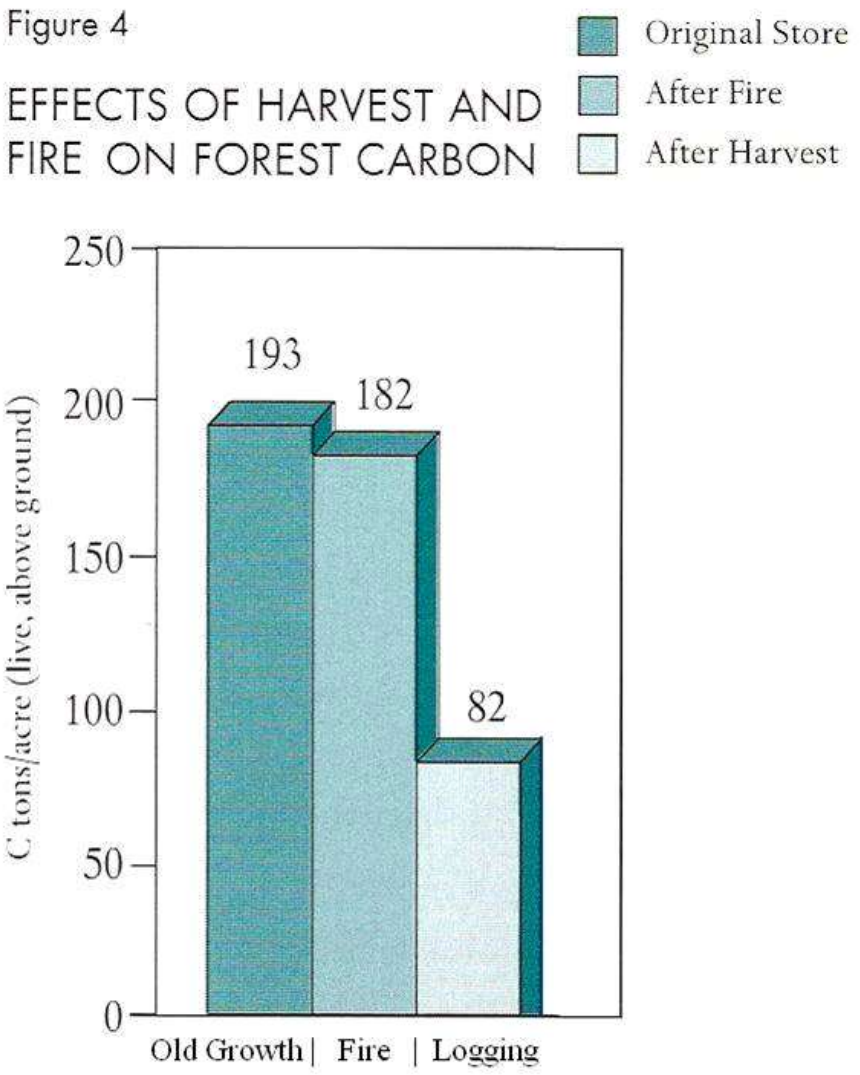
Carbon emissions from forest fires in Oregon are dwarfed by both carbon gains from forest growth AND also dwarfed by carbon losses from logging.

FIRE IS NOT THE PROBLEM. IT’S LOGGING!

Reality: Fires emit far less carbon than logging.

Figure 4

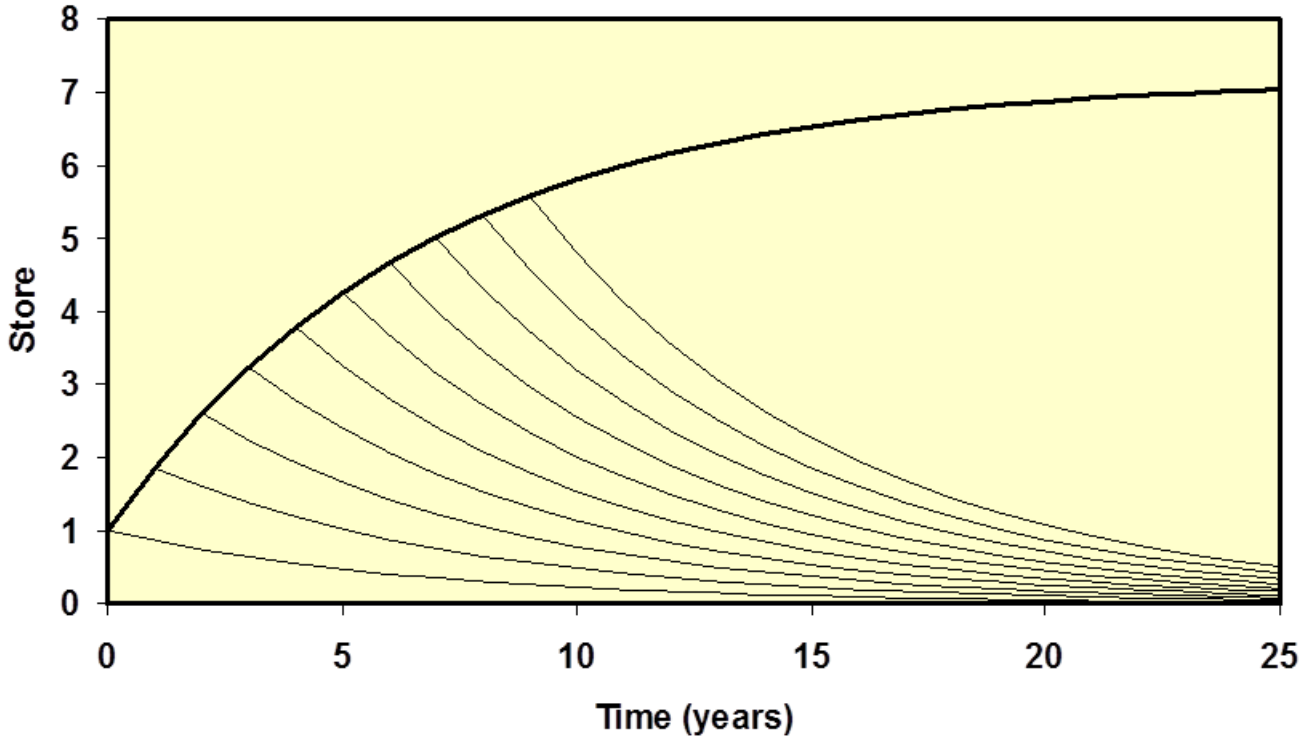
EFFECTS OF HARVEST AND FIRE ON FOREST CARBON



Wayburn, Laurie A., et al. 2000. Forest Carbon in the United States: Opportunities & Options for Private Lands. San Francisco: Pacific Forest Trust.

Reality: Most carbon remains on site after fire. Large dead trees can last for many decades.

DEAD WOOD STORES CARBON



Even though dead wood decays over time, continuous input of dead wood leads to increasing carbon storage.

Reality: Fire creates charcoal, a stable form of carbon often incorporated into the soil.

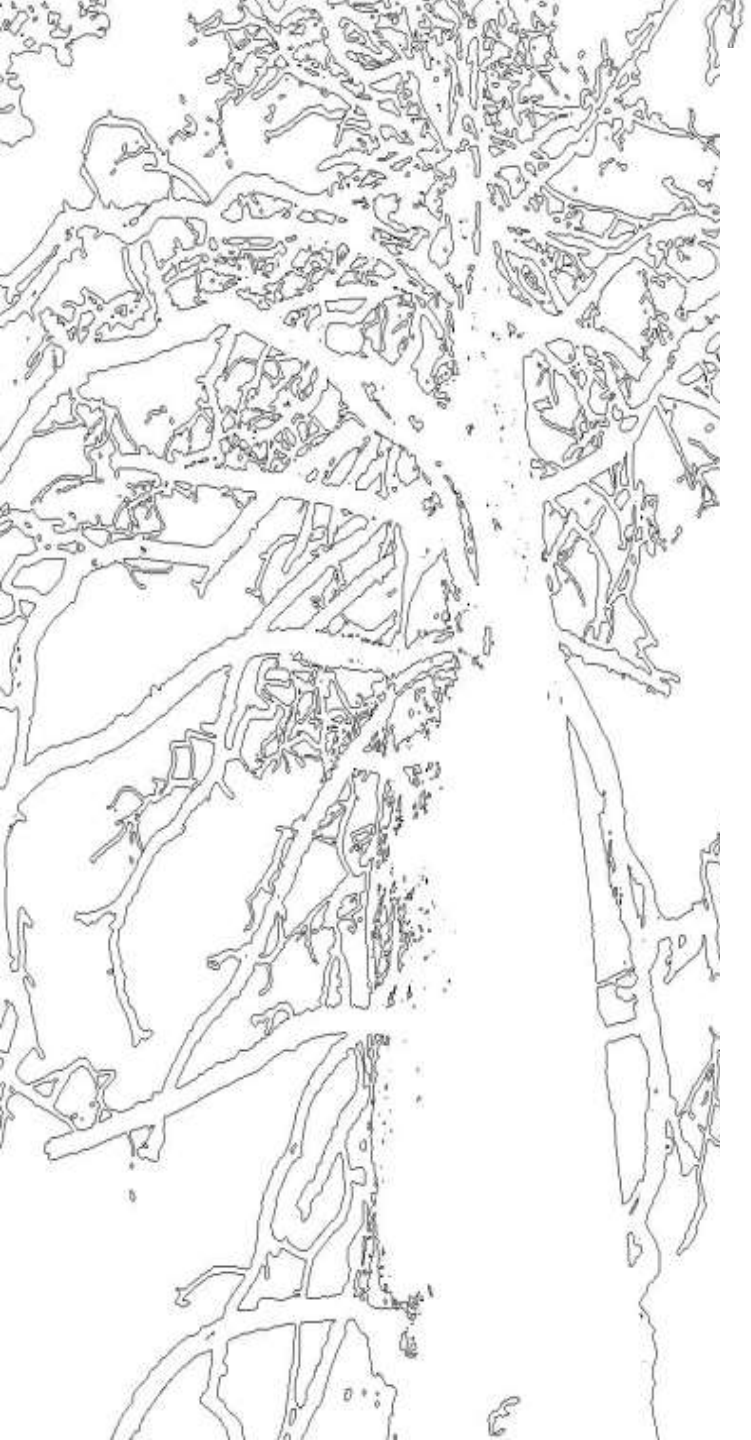
Worst case:
Fire + logging = carbon desert

FUEL REDUCTION MYTH

Logging removes fuel, reduces fire hazard, and therefore reduces carbon emissions.

Reality: One cannot predict where or when fire will occur, so in order to limit fire behavior logging has to be very extensive and treat many acres that will not burn. It turns out that the total carbon removed by logging is greater than the total carbon removed by fire. Also, fire tends to remove small wood (less carbon), while logging tends to remove large wood (more carbon).

Mitchell, Harmon, O'Connell. 2009. Forest fuel reduction alters fire severity and long-term carbon storage in three Pacific Northwest ecosystems. Ecological Applications. 19(3), 2009, pp. 643–655
http://ecoinformatics.oregonstate.edu/new/FuelRedux_FS_CStorage_Revision2.pdf

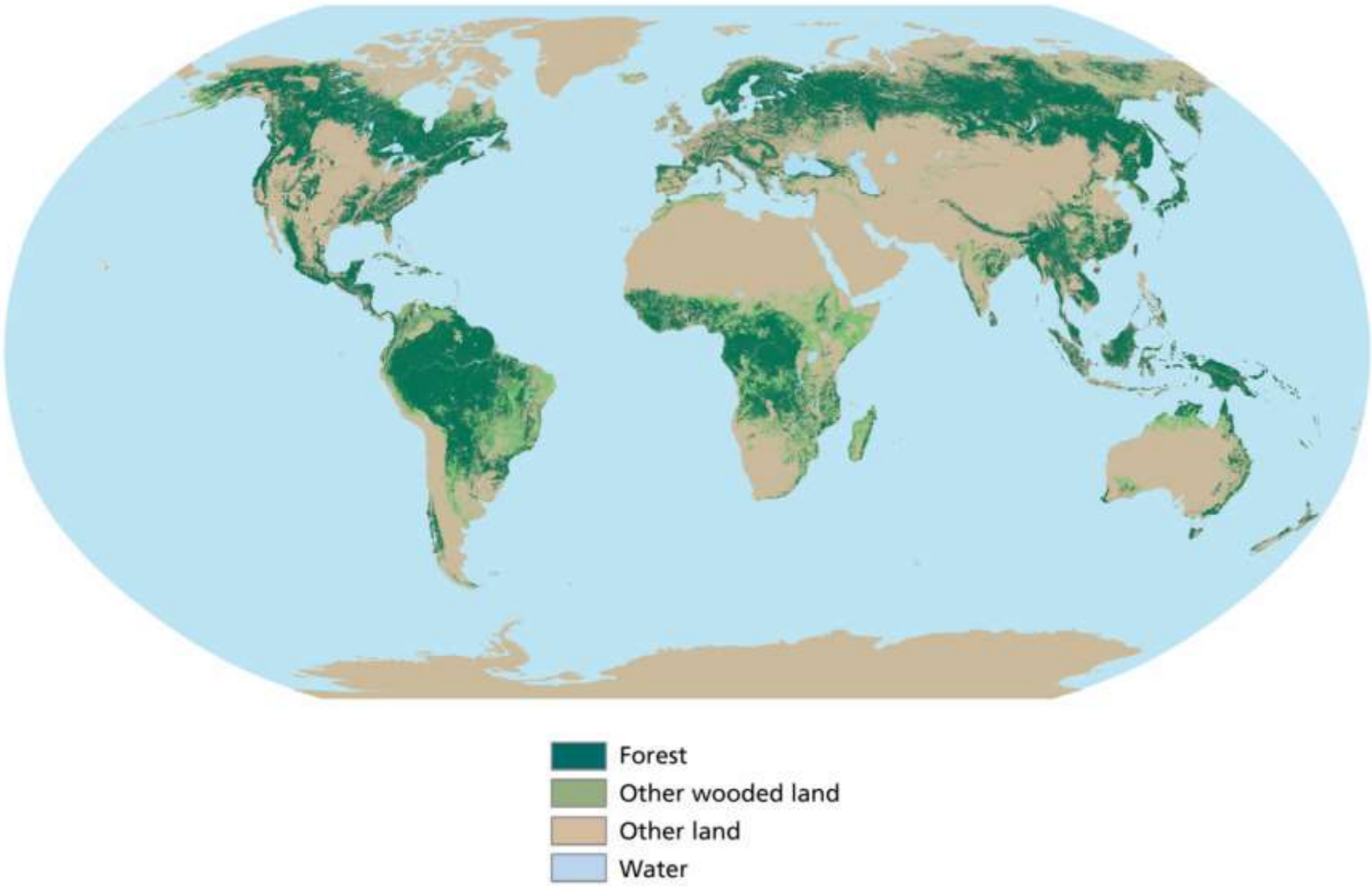


TROPICAL FOREST MYTH:

Forests outside the tropics are unimportant, because they do not contribute significantly to global carbon storage.

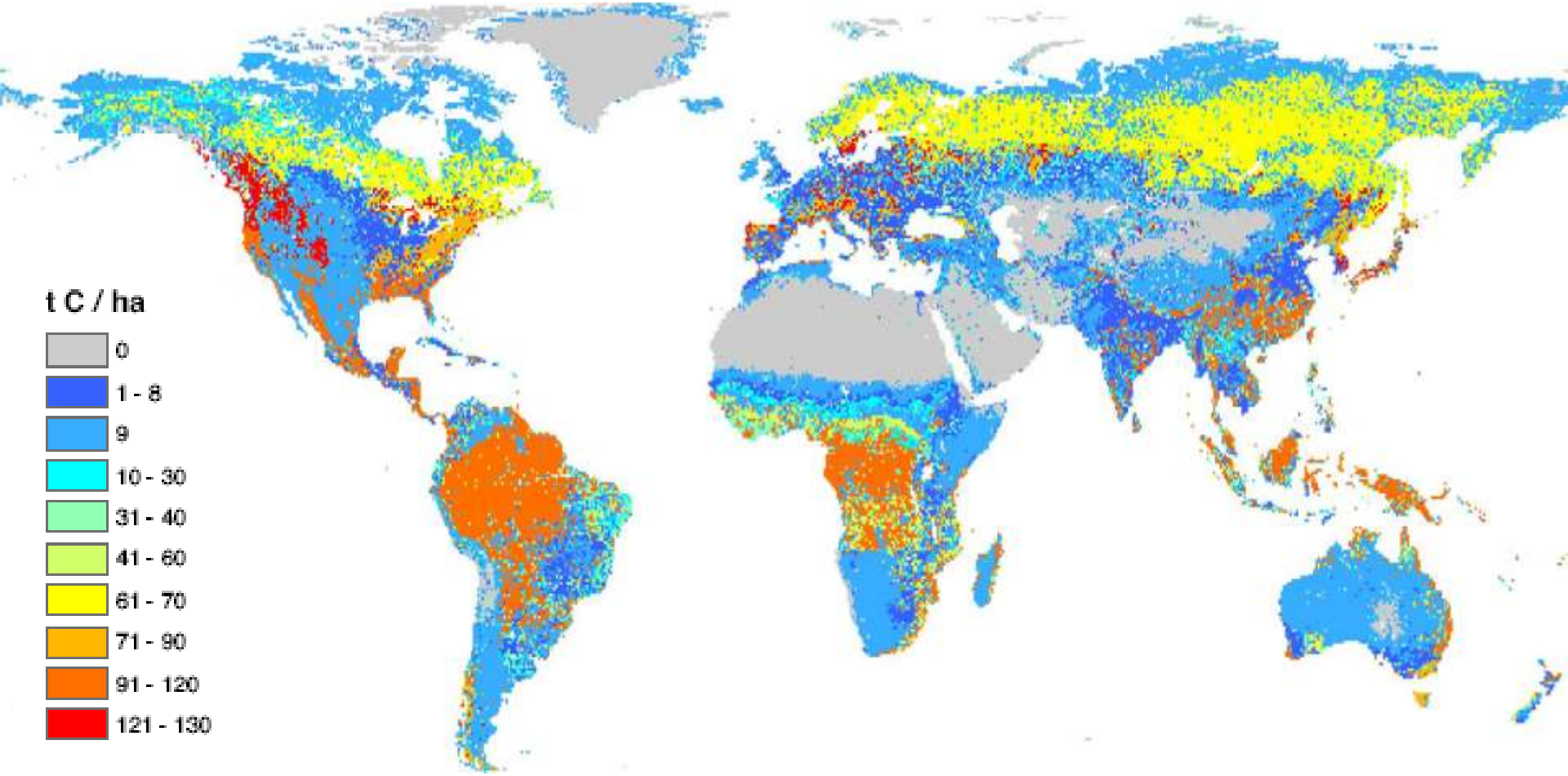
Reality: Pacific NW temperate rainforests may attain the greatest biomass per acre of any ecosystem on earth. Forests outside the tropics are very extensive. Cooler temperatures inhibit decay and allow carbon accumulation.

The world's forests



http://www.fao.org/forestry/static/data/fra2005/maps/2.2.jpg

Global Forest Carbon Density



R. Naidoo, A. Balmford, R. Costanza, B. Fisher, R. E. Green, B. Lehner, T. R. Malcolm, and T. H. Ricketts. Global mapping of ecosystem services and conservation priorities. *PNAS July 15, 2008 vol. 105 no. 28 9495-9500.*
http://www.pnas.org/content/suppl/2008/07/07/0707823105.DCSupplemental/0707823105SI.pdf

Live Tree Carbon Density in the U.S.

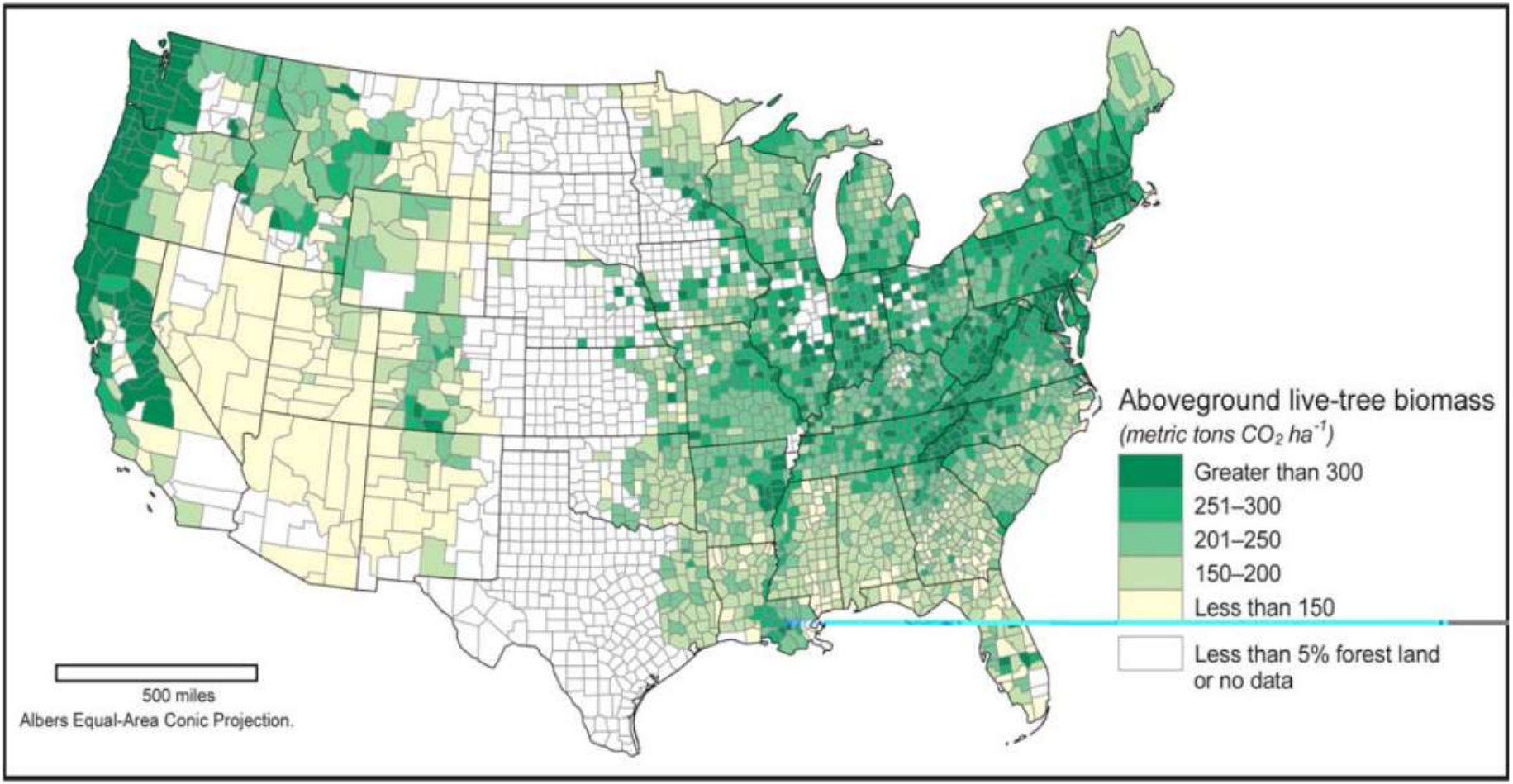


Figure. 22-2. Forest aboveground live biomass carbon stocks by county for United States, 2006.

http://www.fs.fed.us/research/sustain/2010SustainabilityReport/documents/draft2010sustainabilityreport.pdf

A Closer Look at Oregon

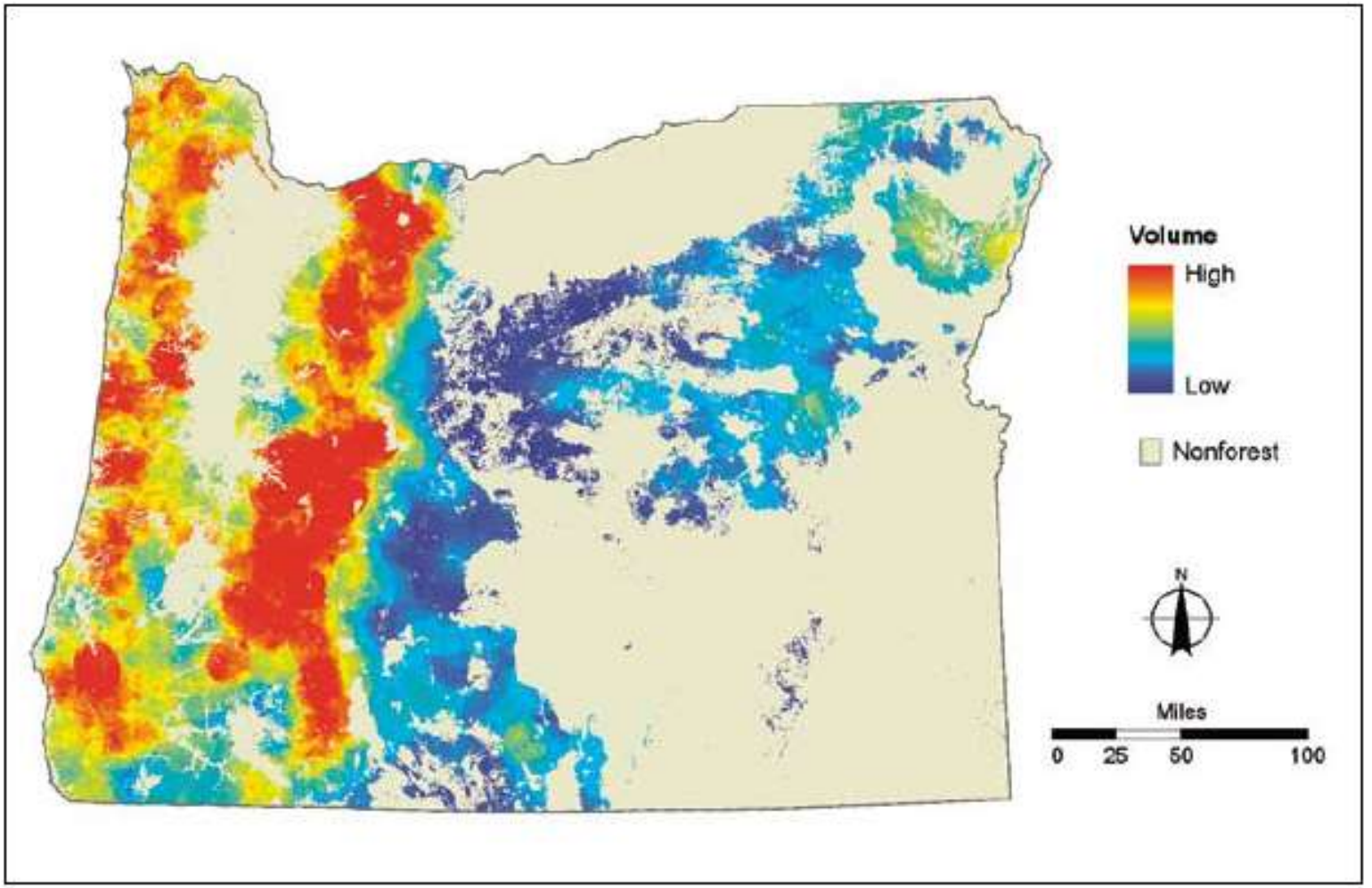
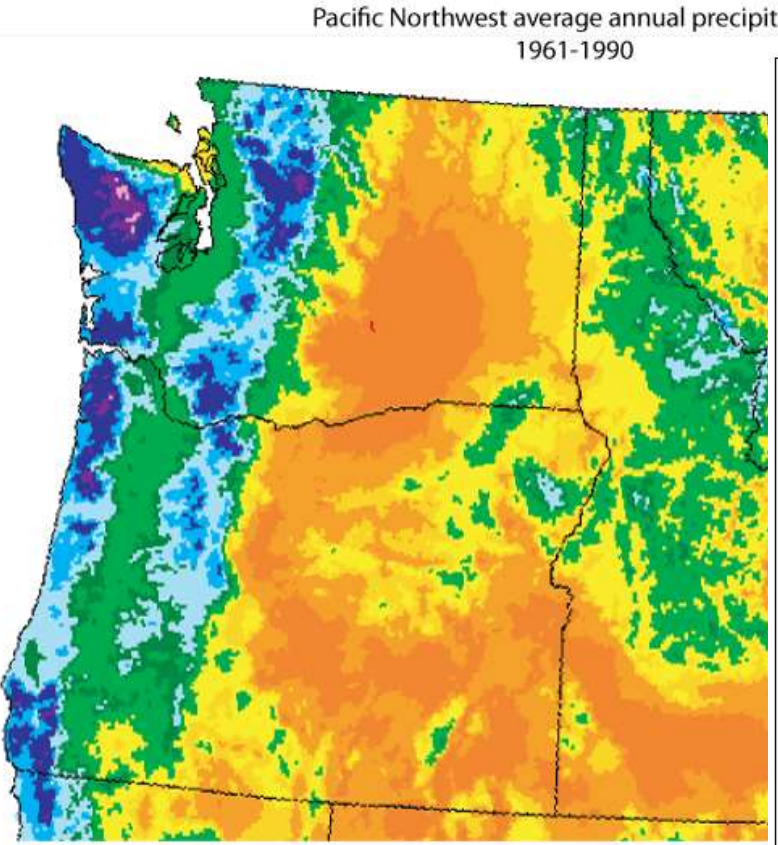


Figure 27—Estimated live-tree volume (net cubic feet per acre), Oregon, 2001–2005. Red color indicates higher predicted per-acre volumes. Estimates are kriged predictions of likely volume per acre on forest land, based on mean net cubic foot volume per plot (forest/nonforest geographic information system layer: Blackard et al. 2008). Source: PNW-GTR-765a.

Note: This shows wood volume in live trees, not total carbon stores in soil, dead wood, and other vegetation, so it's only a rough indicator of relative carbon density.

Carbon Density Controlled by Climate and Fire



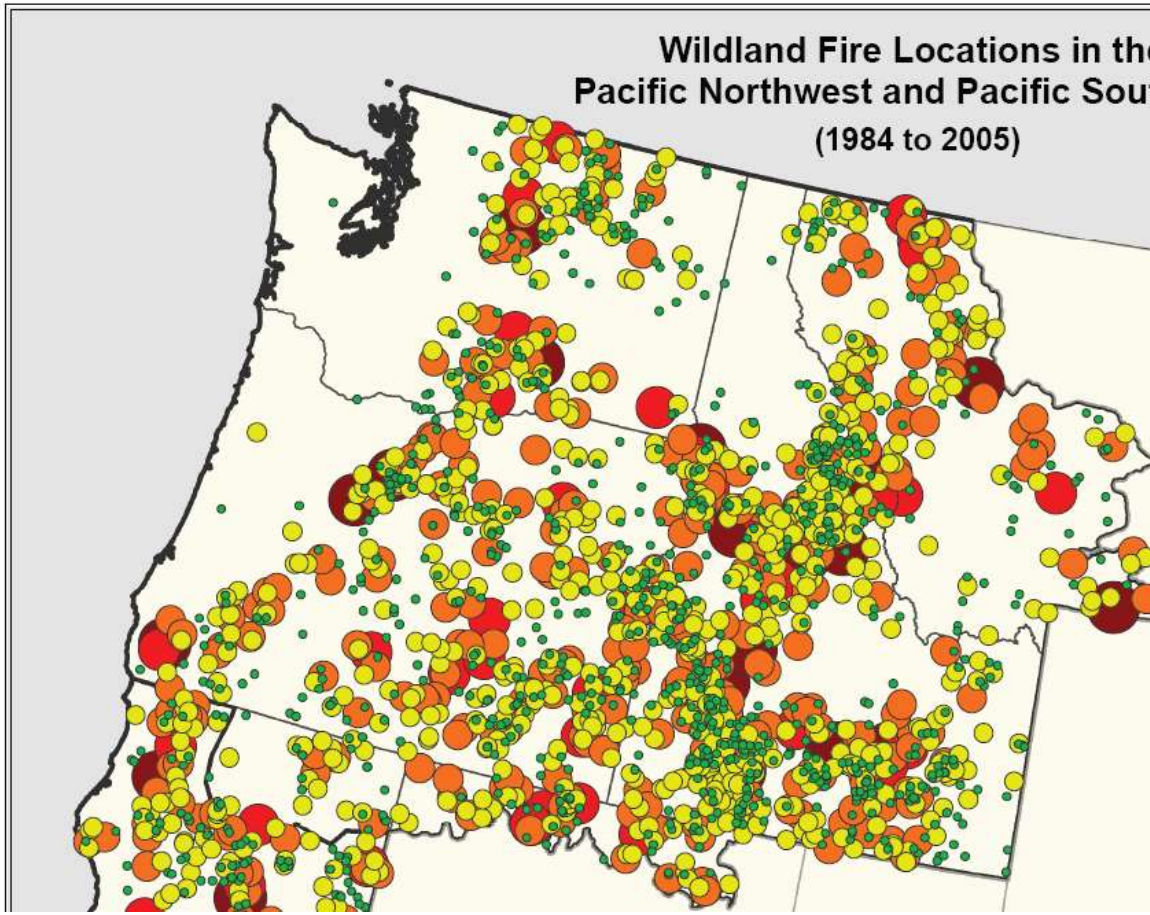
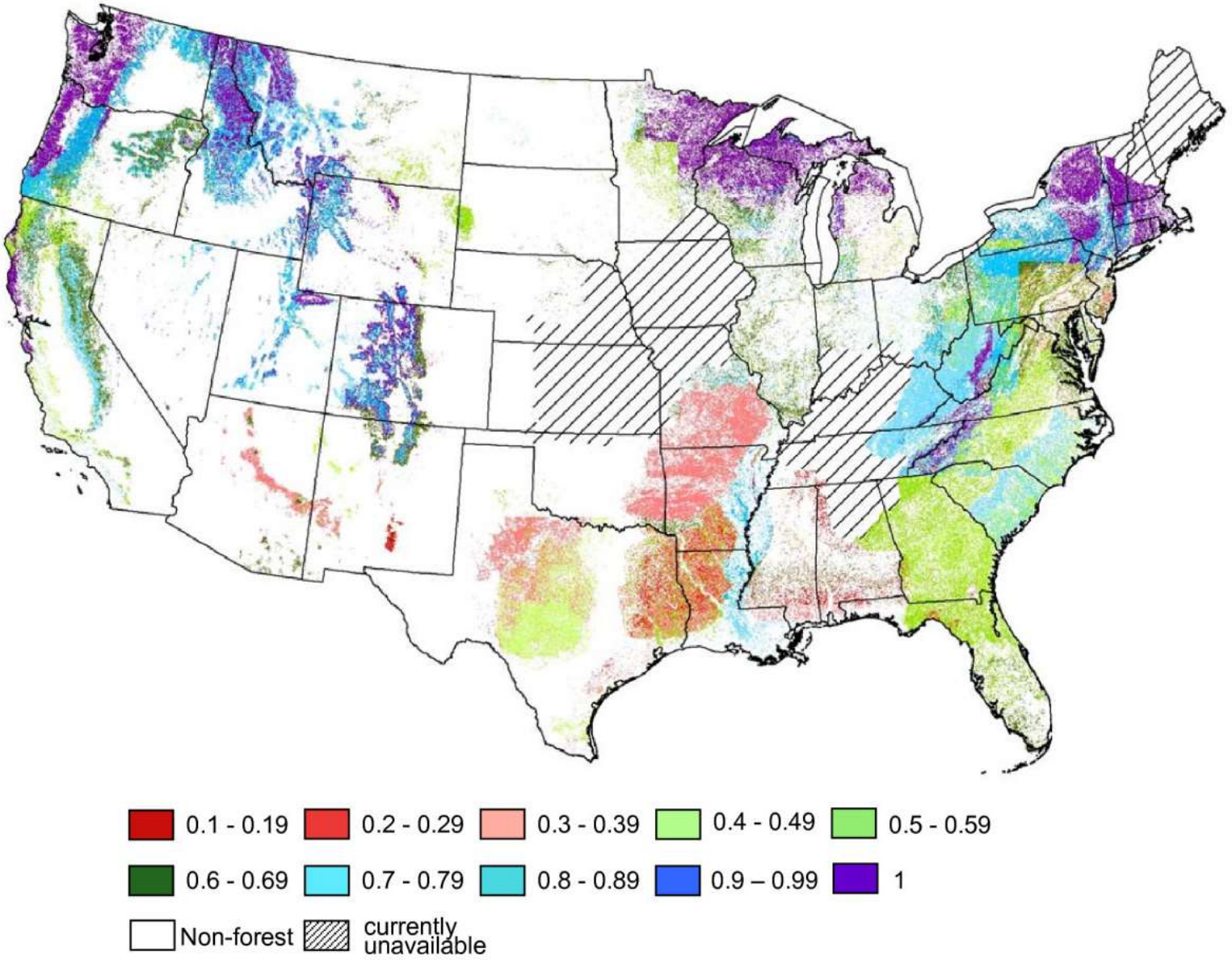


Figure courtesy of Oregon Climate Service (Oregon State University)

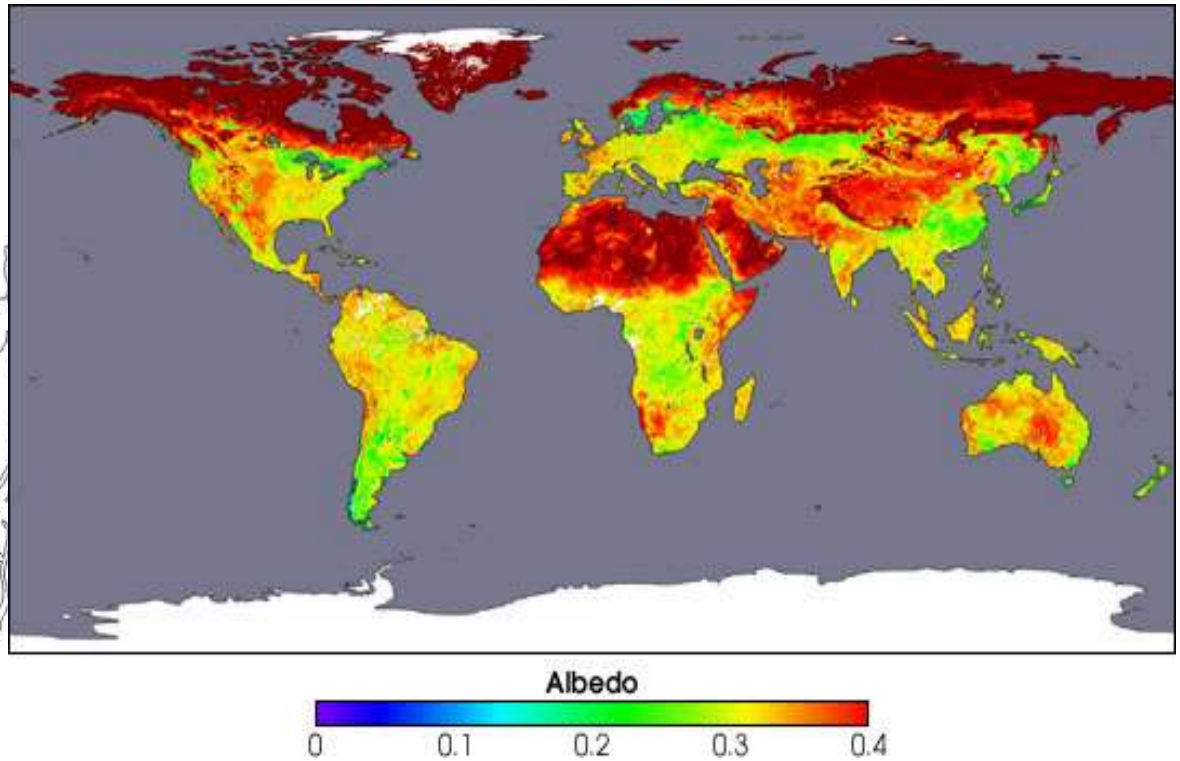
Forest Carbon Risk/Permanence Index



Hurteau et al. 2009. Accounting for risk in valuing forest carbon offsets. Carbon Balance and Management 2009, 4:1. http://www.cbmjournal.com/content/4/1/1

ALBEDO MYTH:

Forests are dark green, so they exacerbate global warming by absorbing rather than reflecting the sun's energy.



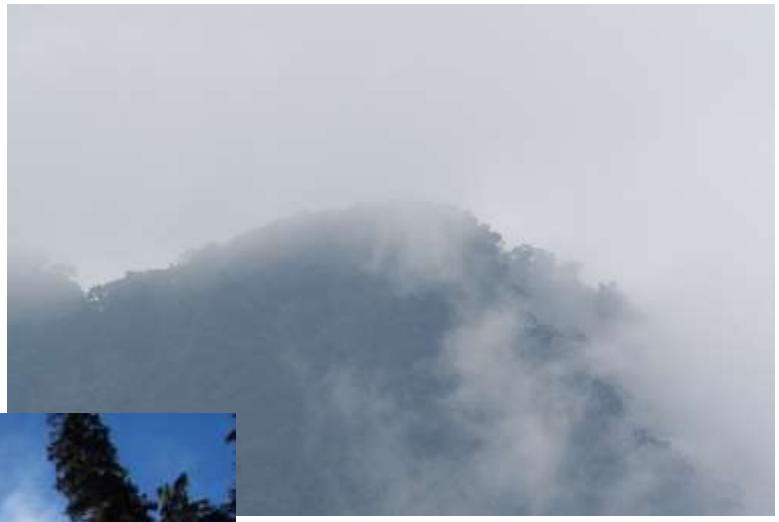
Forests influence climate in 3 ways:

- **Albedo –**
  warming influence
- **Carbon storage –**
  cooling influence
- **Evapotranspiration –**
  cooling influence

Reality: Albedo may offset carbon storage in boreal areas where forests are replaced by snow for long periods, not so in less snowy areas.

Albedo is not a big issue in the low elevation temperate forests of the Pacific Northwest that are green virtually all the time.

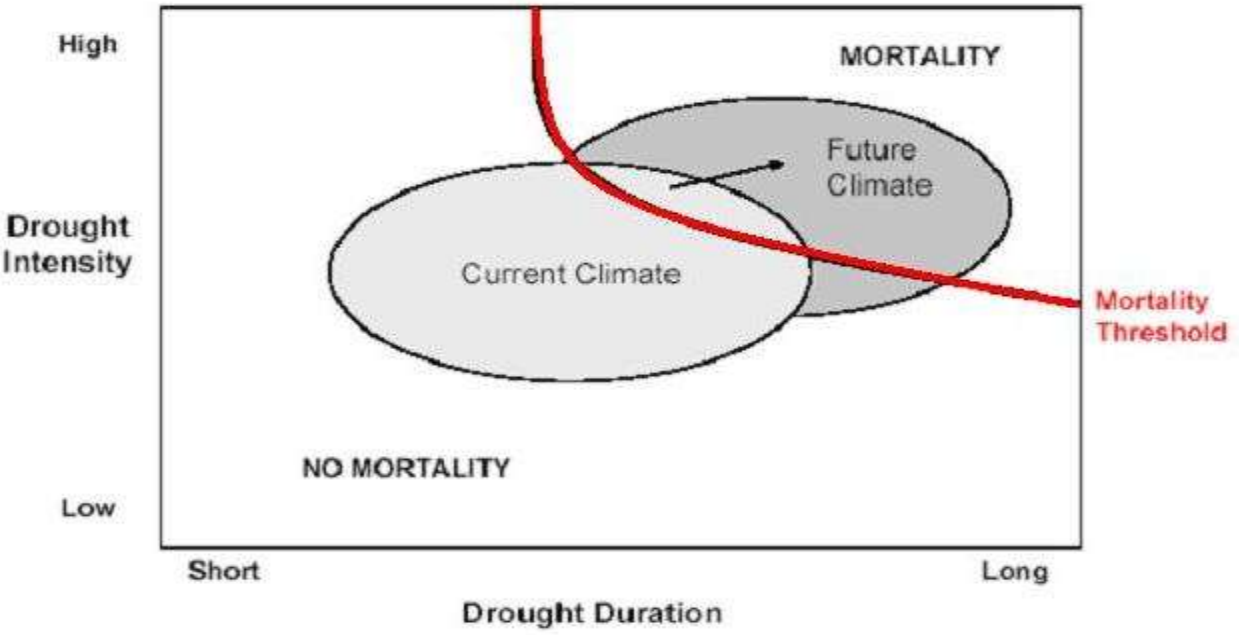
Reality: Forests also have a cooling effect through cloud formation.



Forests transpire a lot of water and emit “cloud condensation nuclei” which helps create reflective clouds that increase albedo.

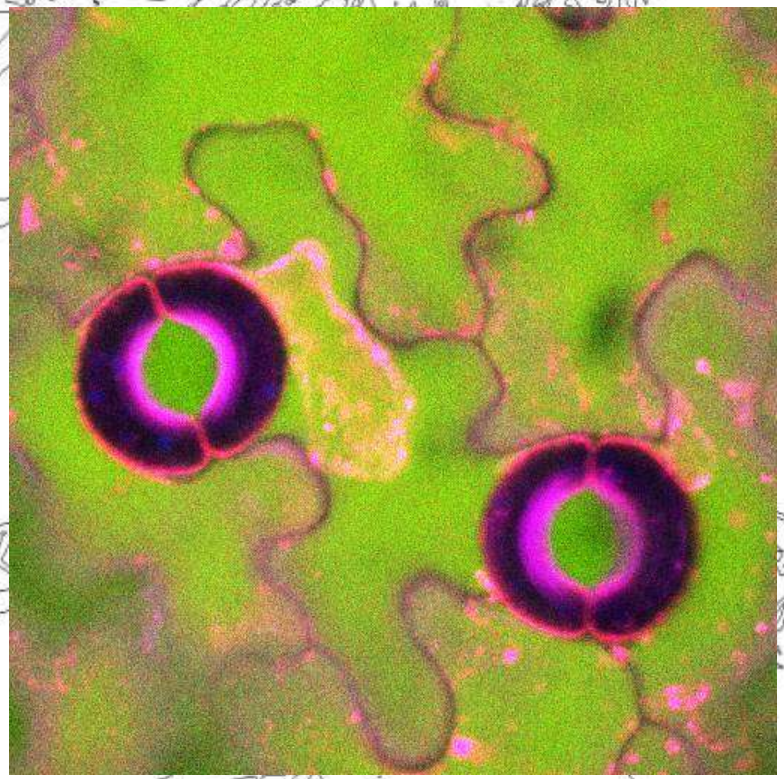
THE "DOOMSDAY" MYTH:

Protecting forests won't do any good because climate change will be so extreme, causing forests to release large amounts of carbon due to stress and disturbance.

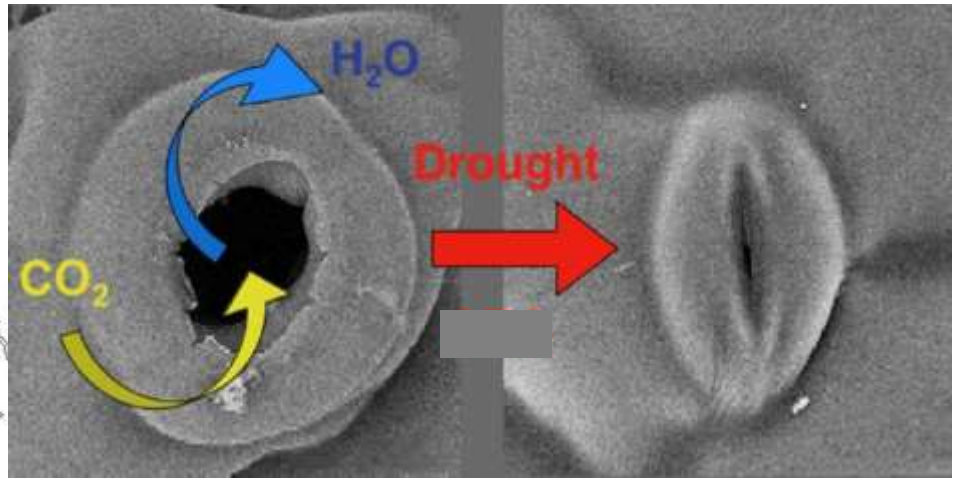


http://www.x-cd.com/mcss04/S01a.pdf

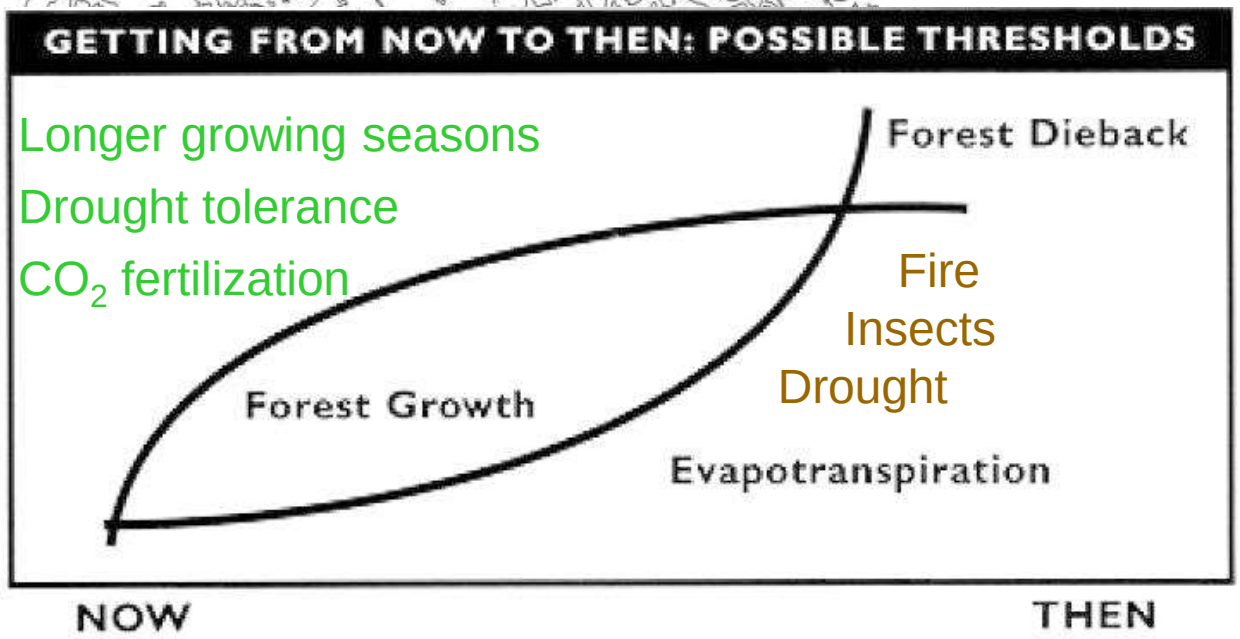
The CO_2 enriched atmosphere makes some trees more drought tolerant.



With more CO_2 in the air, plants quickly get their fill of carbon, then actively close their stomata which limits water loss.



Reality: Many forests may thrive before they decline.



A *Early global warming may increase productivity and density of vegetation in certain areas, but at the point where vegetation outstrips its own water needs, drought-induced dieback could begin and eventually reach large proportions.*

Forests will first …

"Green Up"

Then …

"Brown Down"

Reality: Even under extreme climate scenarios, forest conservation still helps the climate.

- If forests do switch from being carbon “sinks” to carbon “sources,” we will only exacerbate emissions through misguided logging.
- If the carbon emissions from logging forests are added to anticipated emissions from climate-stressed forests, total carbon emissions will increase.

METHANE MYTH:

Allowing wood to rot in the forest releases methane (CH_4) with a warming potential 23 times greater than CO_2.

Reality: Methane emissions are more likely when wood ends up in oxygen-starved land-fills than in oxygen-rich forests.

Land-filling forests is unwise.

Wood that decays in the forest produces less GHG than wood that decays in landfills. Even if land-fill methane is captured and flared, wood in land-fills still produce about twice as much GHG as dead wood in the forest.

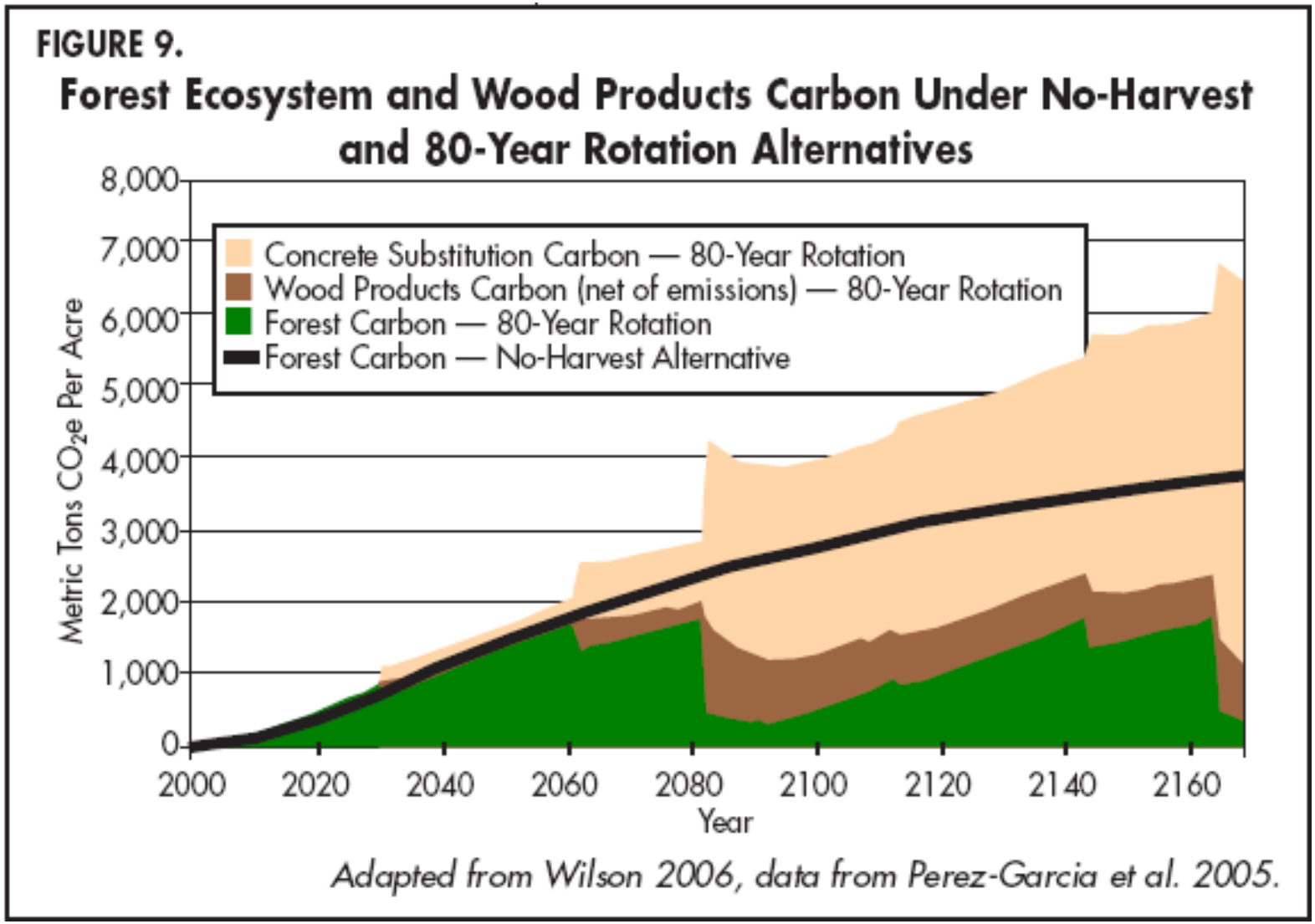
Lineback et al.: Combustion of biomass residue for energy Vol. 13: 221–229, 1999
http://www.int-res.com/articles/cr/13/c013p221.pdf

SUBSTITUTION MYTH:

Using more wood products reduces carbon emissions because wood replaces carbon-intensive building materials such as steel and cement.

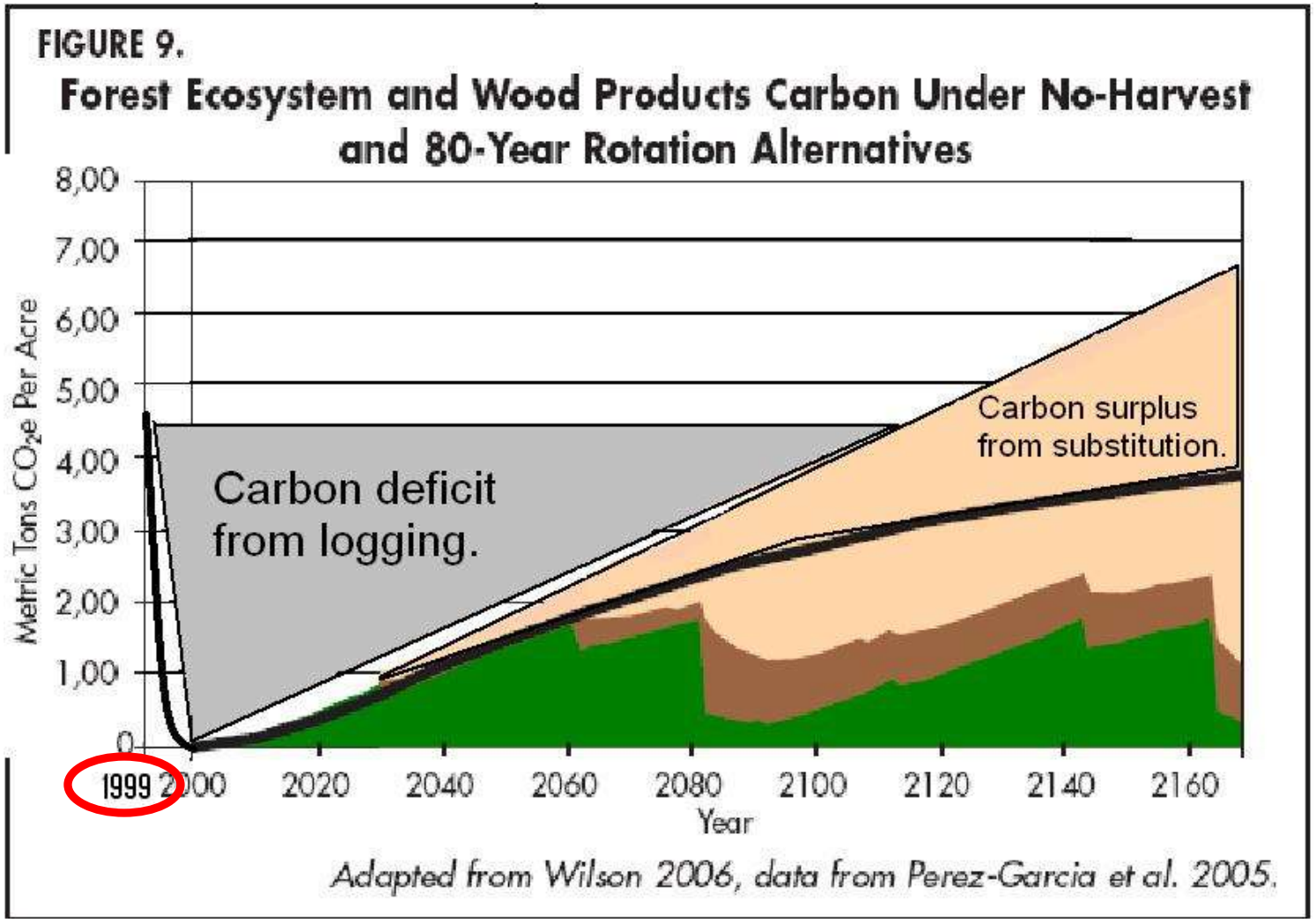
Reality: Substitution is speculative because it takes more than a century to off-set the carbon emissions caused by logging mature forests. Future benefits must be discounted.

The alleged value of substituting wood products for steel and concrete.



Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. Washington, D.C.: The Wilderness Society.

But if we start from a native forest instead of a clearcut…



It takes a very long time for substitution to off-set the carbon deficit caused by logging native forests. What discount rate do we apply?

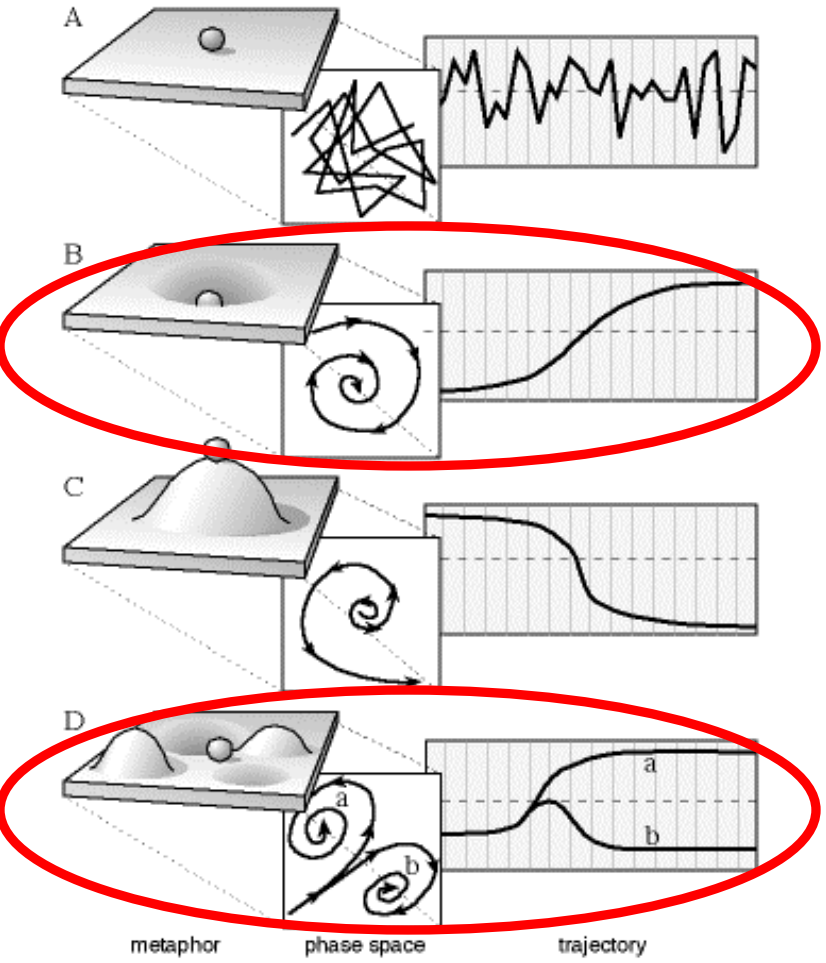
More Facts About Substitution

- Using wood may delay, but does not prevent, fossil fuel use.
- It's virtually impossible to verify that a given wood product from a given harvest activity actually being used to substitute for steel and concrete.
- People have a strong preference for wood houses, so less logging does not necessarily translate into more steel and cement houses.
- Carbon credits require "additionality." Credit can only be given if the market share of wood increases relative to steel and concrete. This is unlikely.

SOLUTIONS:

- Expect surprises
- Correct the market
- Conserve forests:
  - Prepare / Adapt
  - Mitigate

“NO SURPRISES” MYTH:



Climate change will be slow. Forests will make a smooth transition to a new equilibrium.

Reality: Accelerating climate change will increase disequilibrium between the climate and biosphere. Reorganization of ecosystems will sometimes be rapid and chaotic. Ecosystems will disassemble and reassemble in novel ways.

Holling et al. In Search of a Theory of Adaptive Change

Solution: Prepare Forests for Climate Change

- Resilience - Manage ecosystems to be resistant and resilient to change.
- Diversity - Maintain the “library of possibilities” by managing for bio-diversity in all its dimensions.
- Spread Risk - Maintain functional redundancy.
- Porous landscapes - Facilitate migration of species. Provide protected areas along climatic gradients.
- Self-organization - Where possible, rely on self-organized ecosystem processes, rather than human intervention.

SOLUTION: MARKET CORRECTIONS

Ensure that carbon consequences are reflected in the *price* of wood and other products. This will help:

- **Level the playing field** between wood and alternative materials.
- **Reduce demand** – e.g., reverse the trend toward larger houses, “supersized” stuff, and excessive packaging.
- **Reuse/Recycle** – e.g., “salvage” wood from old buildings, not forests.
- **Increase longevity** of products – Build to last. Delay replacement.
- **Reward forest owners for conservation.**

CLIMATE MITIGATION RECOMMENDATIONS

HELP FORESTS "RETAIN" AND "REBUILD" CARBON STORES.

- Conserve existing large stores of carbon such as old-growth forests and roadless areas.
- Let young forests grow longer. Extend harvest rotations.
- During harvest, retain more trees, both live and dead.
- Avoid uncharacteristic fire. This might involve removing some small trees in fire-adapted forests.
- Protect large trees and soil both before, during, and after fire.

Current policy is going in the wrong direction.

- About 1 million acres of mature and old-growth forests remain unprotected on public lands in the northwest.
- Spotted owl habitat is a great carbon reservoir but owl habitat remains threatened.
- BLM tried to adopt a huge increase in old-growth clearcutting in Western Oregon.
- Forest Service and BLM have eliminated protections for biodiversity.

Don’t forget all the other reasons to protect forests.

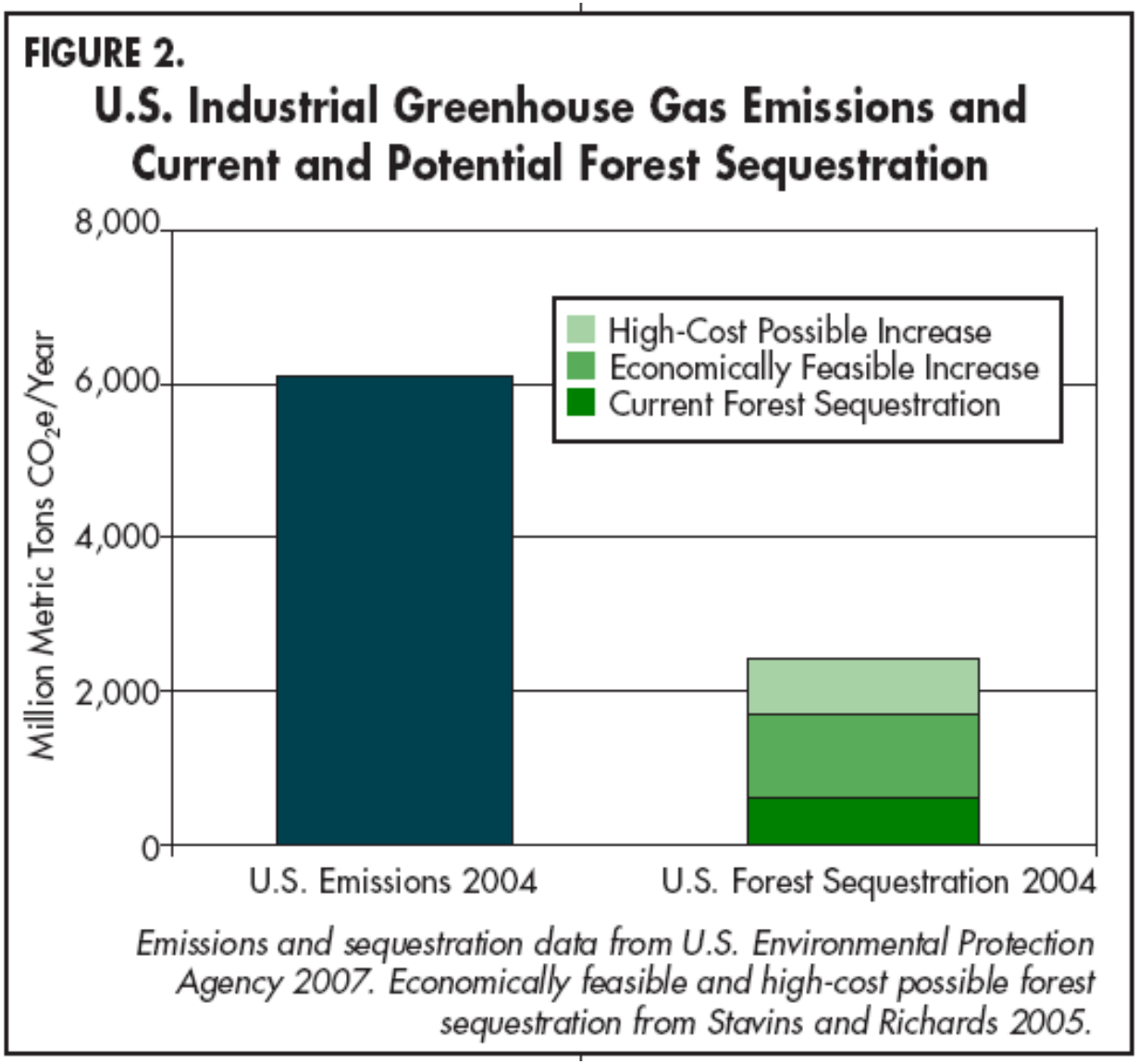
Forest carbon storage is *complementary* with other important “ecosystem services” that we obtain from forests:

- Clean Water
- Fish & Wildlife Habitat
- Soil Conservation
- Quality of Life
- Economic Diversification
- Capture, Storage & Release of Water, Nutrients & Sediment.

Water

Wildlife

The climate won't be saved by simply saving forests … while continuing to rely on fossil fuels.



Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. Washington, D.C.: The Wilderness Society.

It’s not just about forests …

Oceans, prairies, rivers are all at risk,

and can play a role in mitigating climate change.

Thanks for listening!

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Detailed report on forests-carbon-climate available:
http://tinyurl.com/2n96m5