Managing Forests for Carbon Storage

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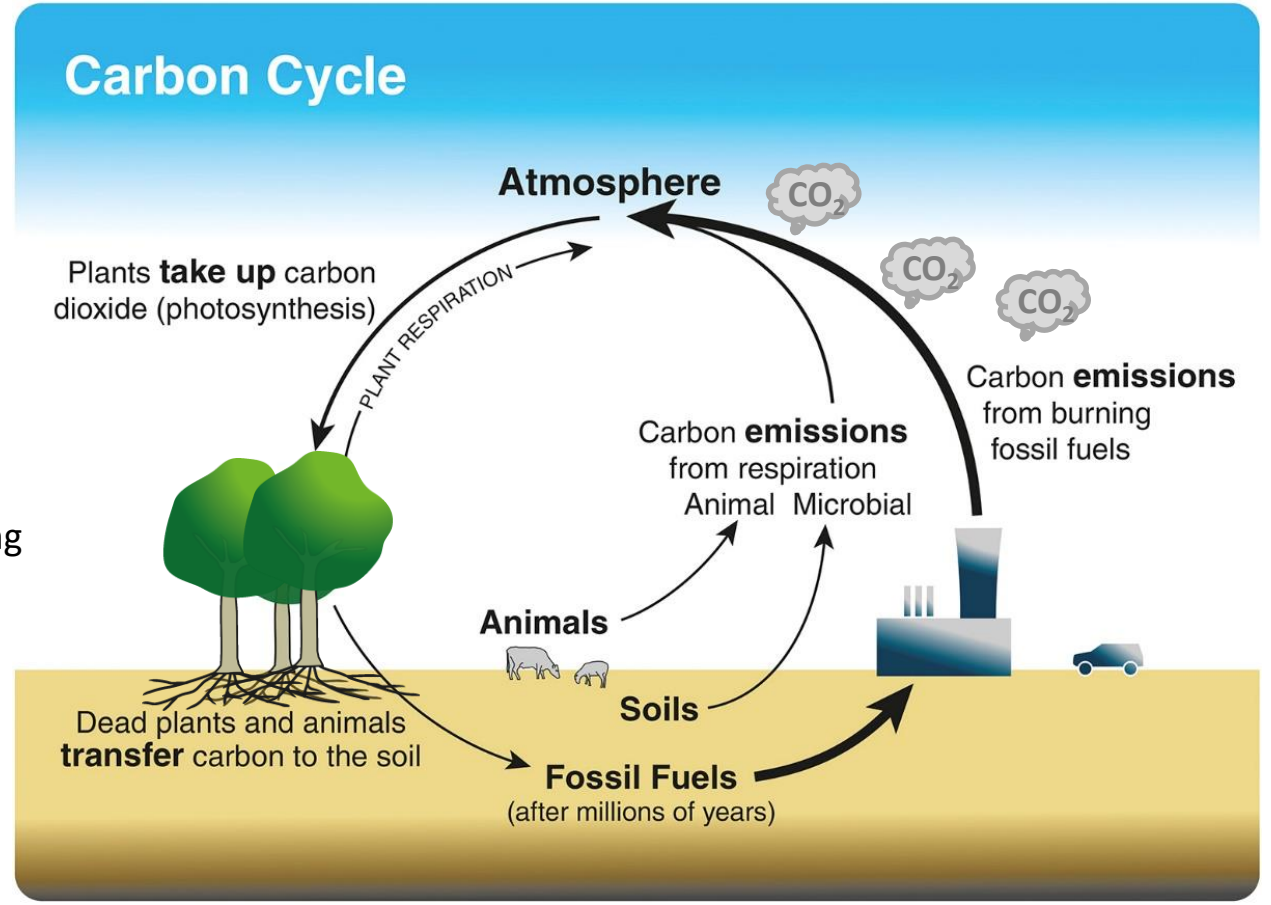
Mitigation benefits from forests

Forests contribute to mitigating the problems of climate change by taking up carbon from the atmosphere and storing it on the land.

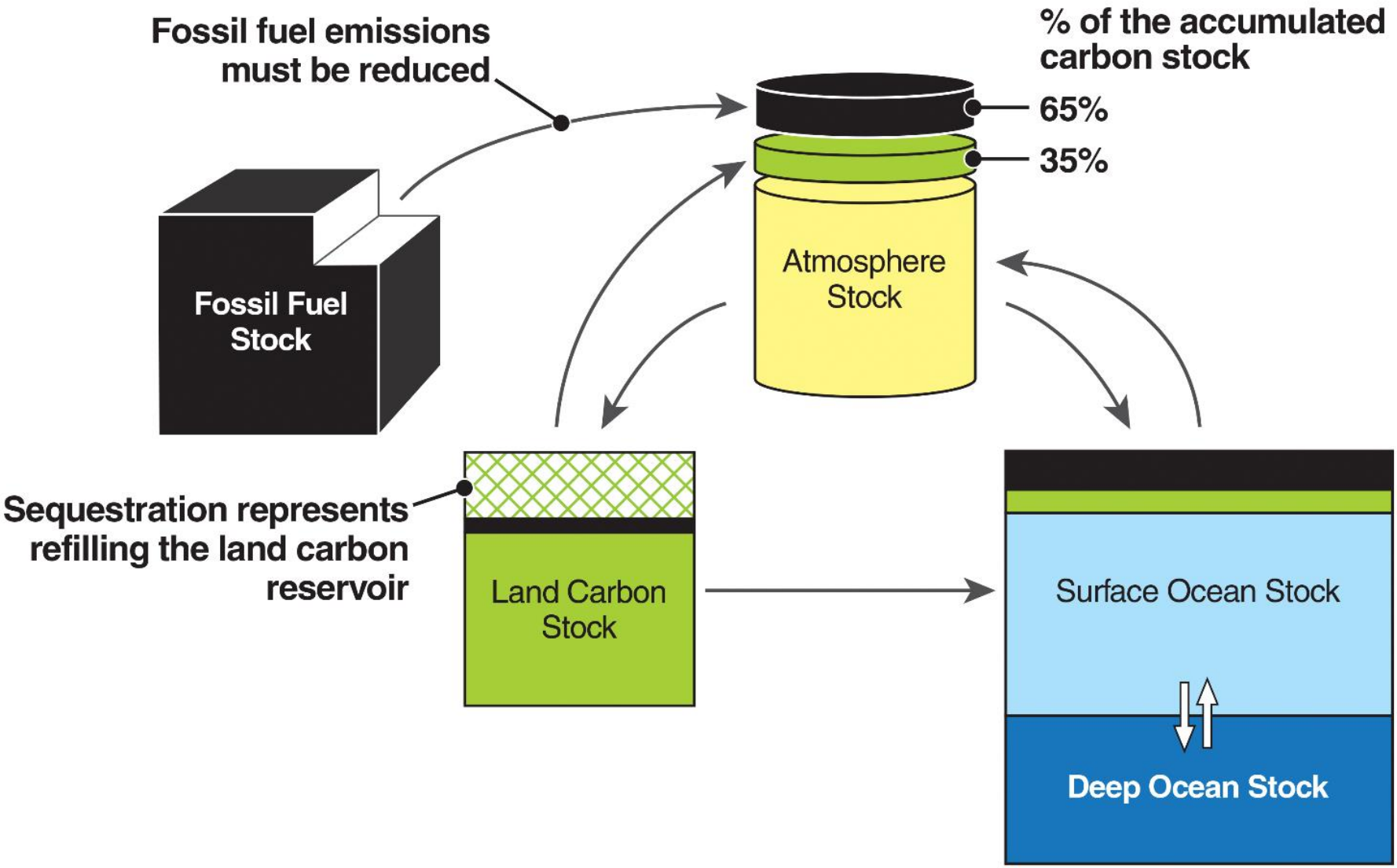
Priority mitigation activities in the land sector:

1. Avoiding emissions from degradation of natural ecosystems

2. Sequestering carbon in regrowing native forests



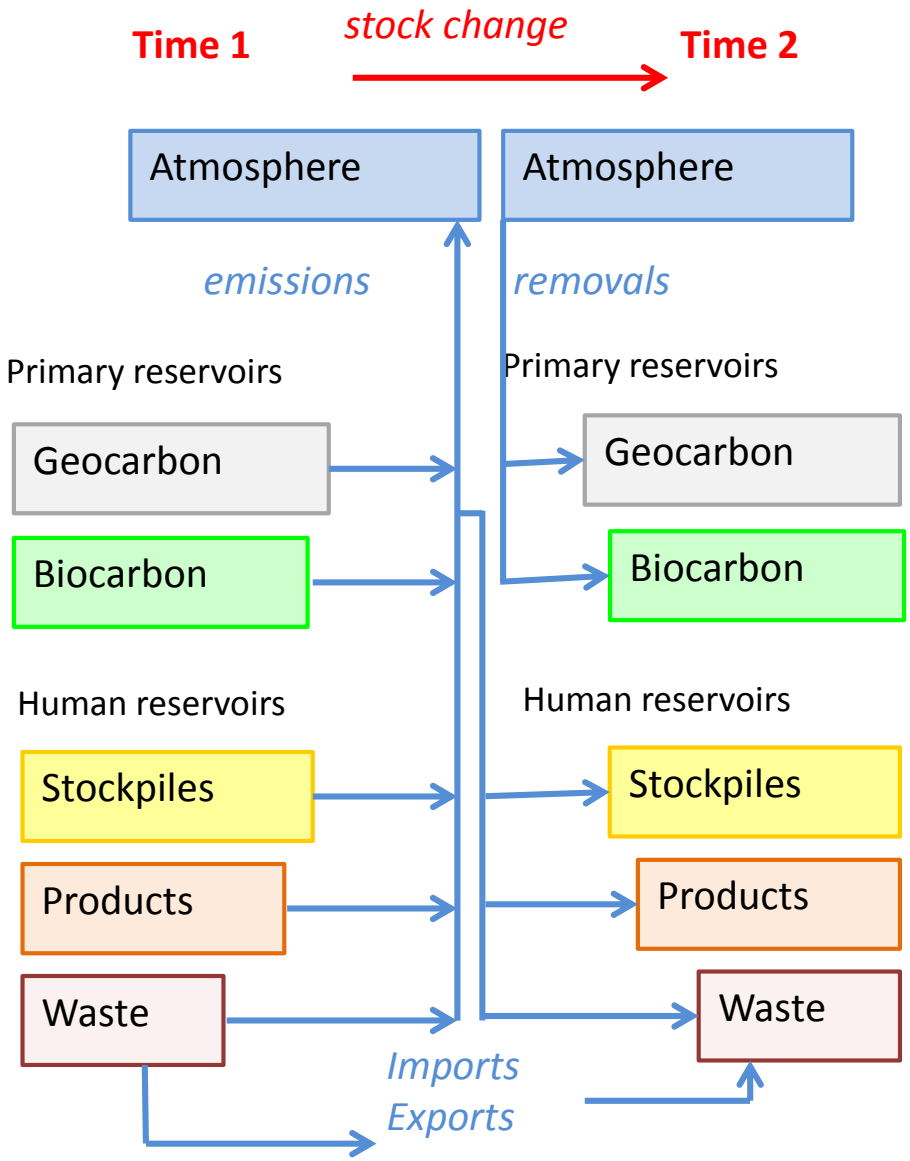
Global carbon cycle



Comprehensive carbon stock accounting system

Characteristics:

- Reservoirs of carbon disaggregated: geocarbon, biocarbon, human
- All stocks and stock changes accounted
- All lands and activities accounted.
- Ranking of reservoirs by their quality: stability, longevity, resilience, density



Criteria for ranking primary carbon reservoirs for protection

Carbon reservoir	Stability	Restoration time	Carbon density	Rank
Geocarbon	High	Geological	High	A. High
Biocarbon Natural ecosystems	High-moderate	Decades to millennia	High	A. High
Semi-natural ecoystems	Moderate	Years to centuries	Potentially high	B. Moderate
Agricultural systems	Low	Annual to decades	Low - moderate	C. Low

Accounting for quality of carbon stocks:
Plantations are not equivalent to natural forests

- longevity and stability of carbon stocks in the native forest should taken into account
- capacity of native forests to adapt to change and regenerate following disturbance
- resilience to human pressures

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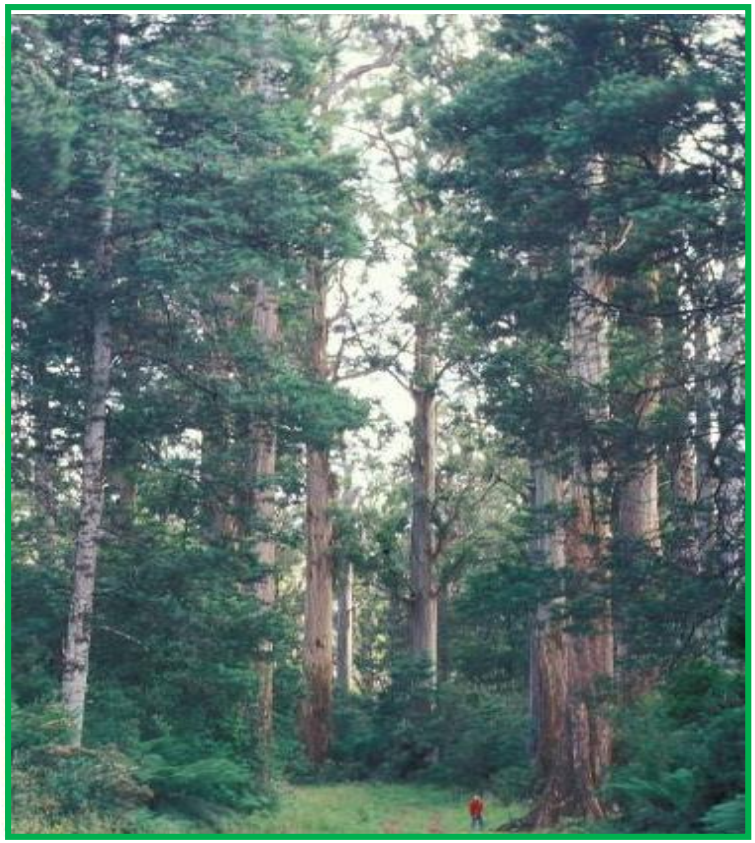
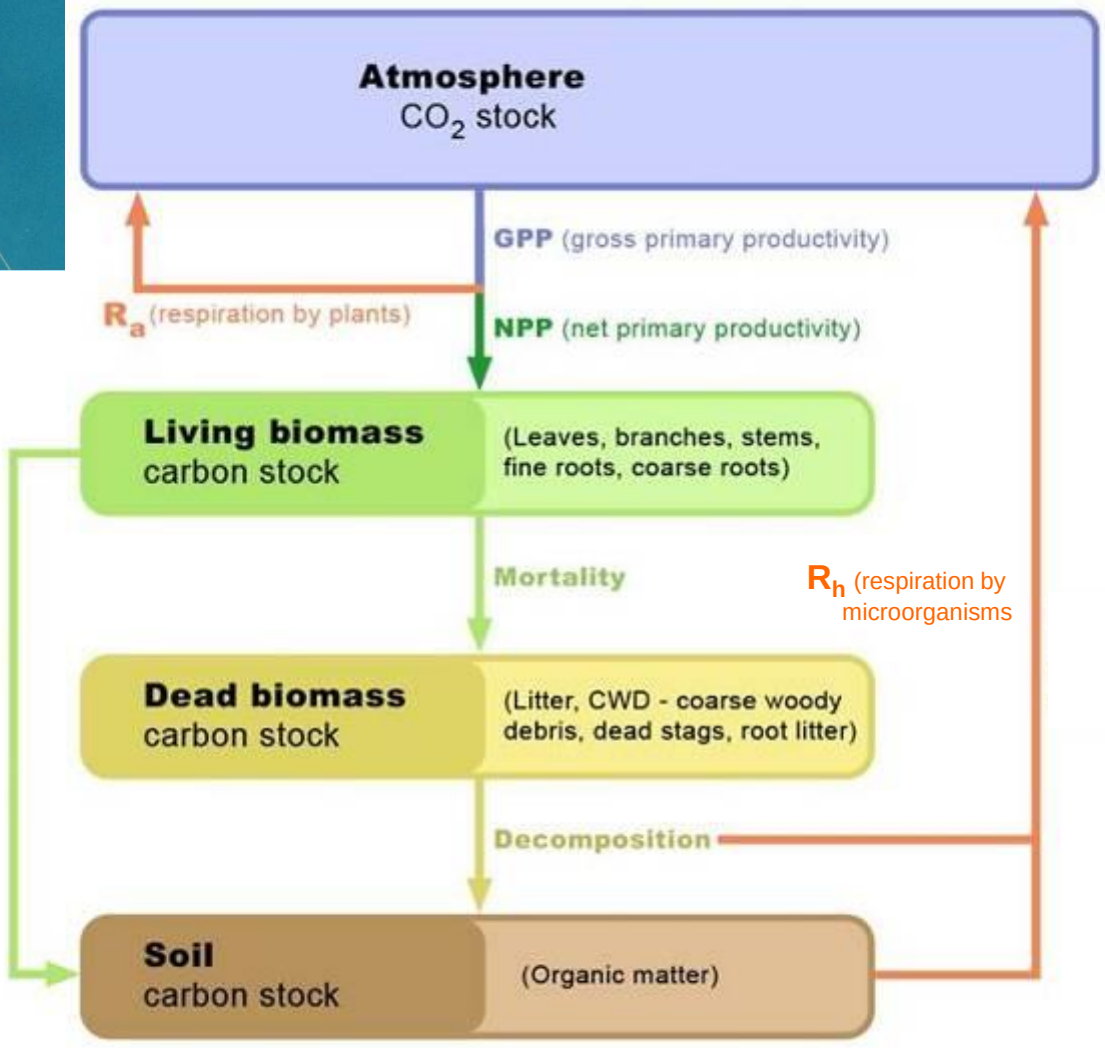
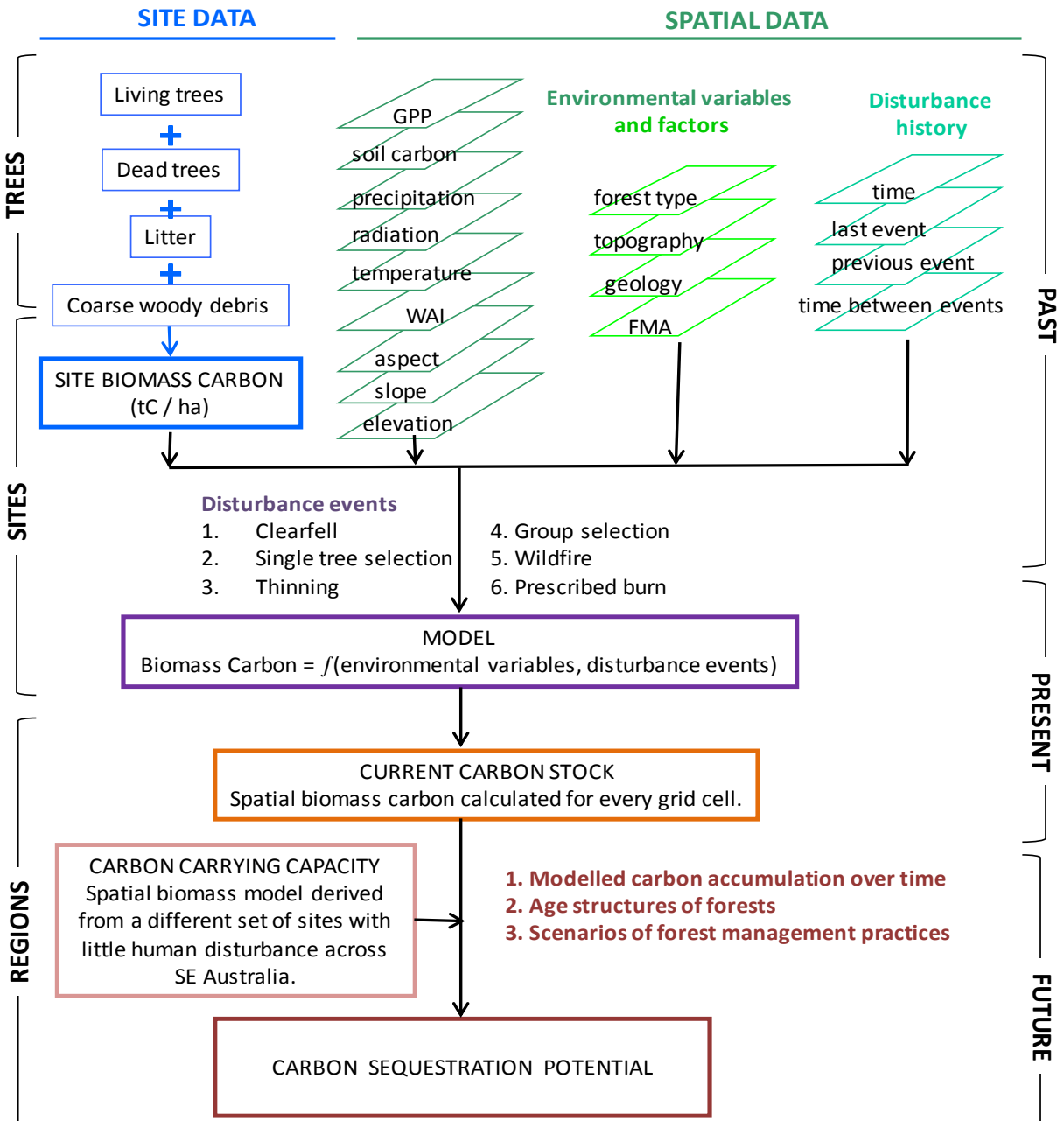


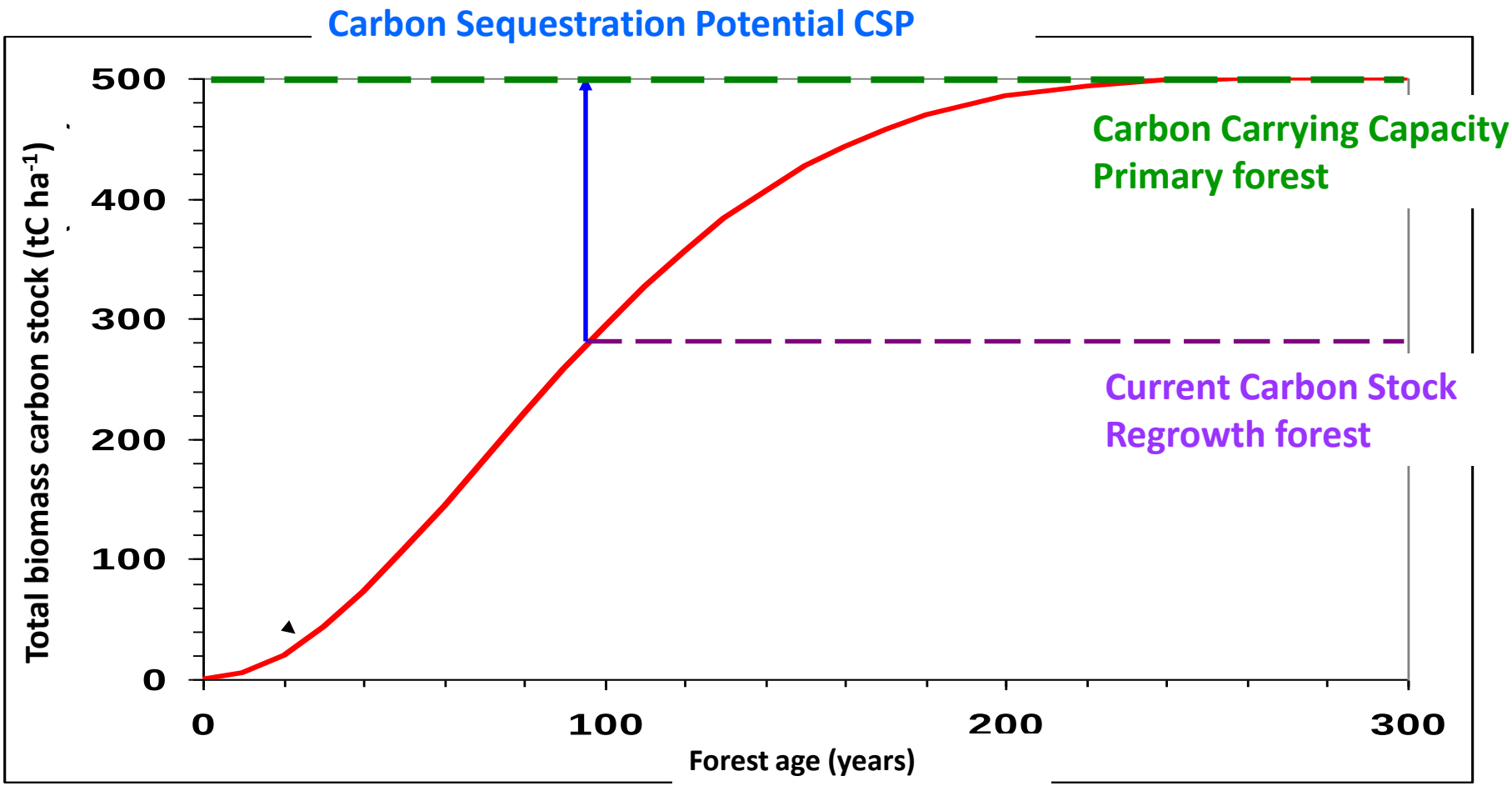
Components of the forest carbon cycle



Framework for scaling measurements to models



Change in carbon stock with forest age



Stand age structure determines carbon stock

Size distribution of Eucalypt forest in SE Australia

Large, old trees

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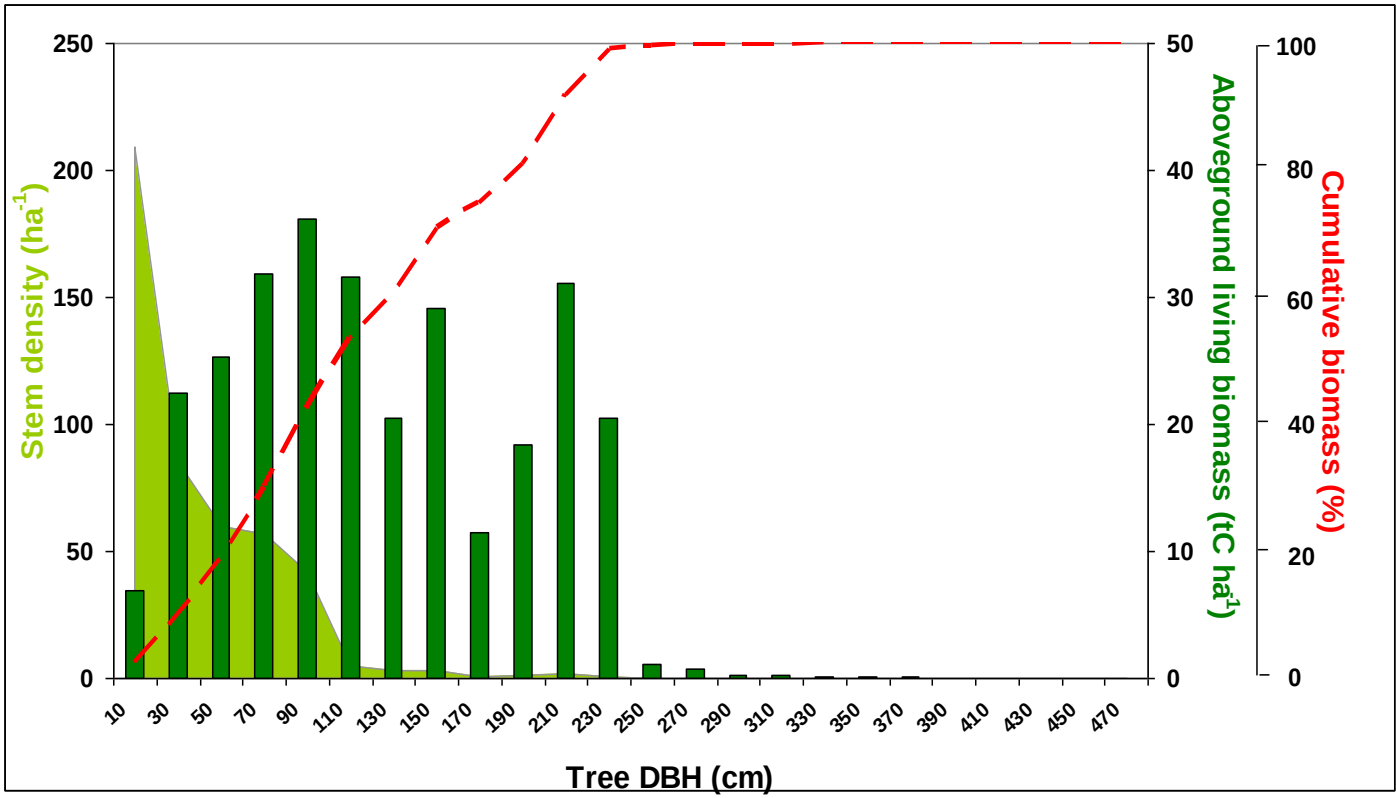
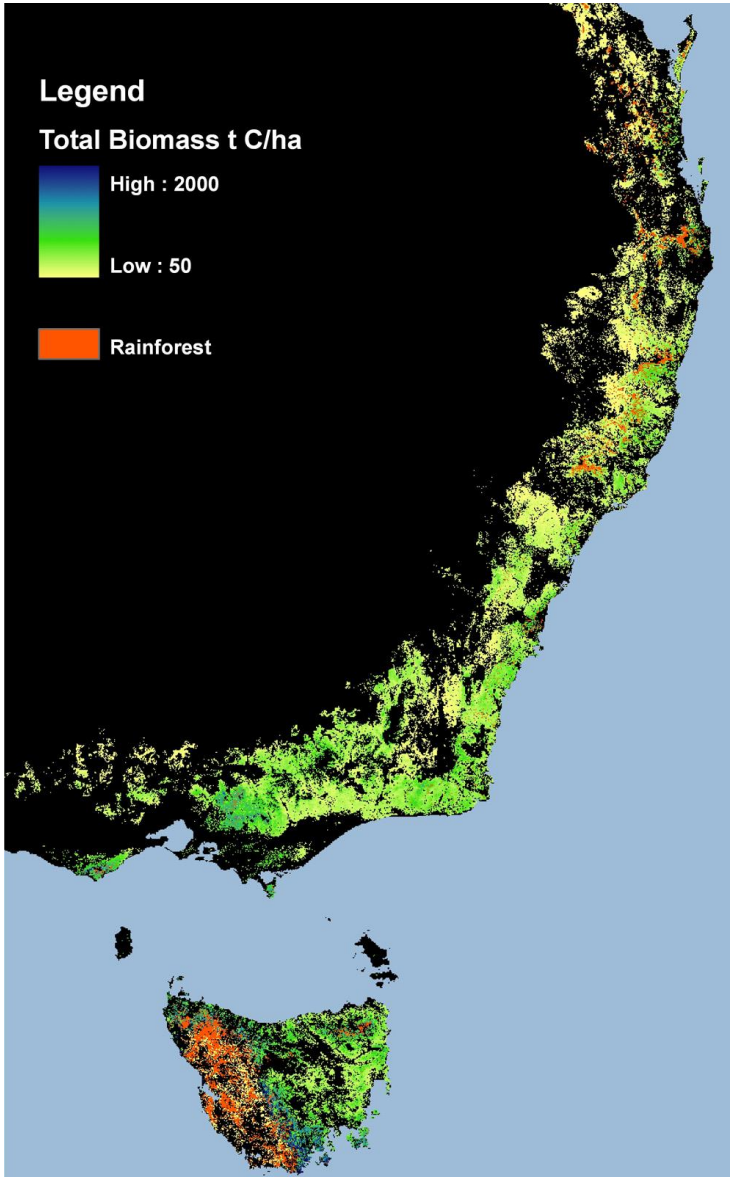
high carbon stock

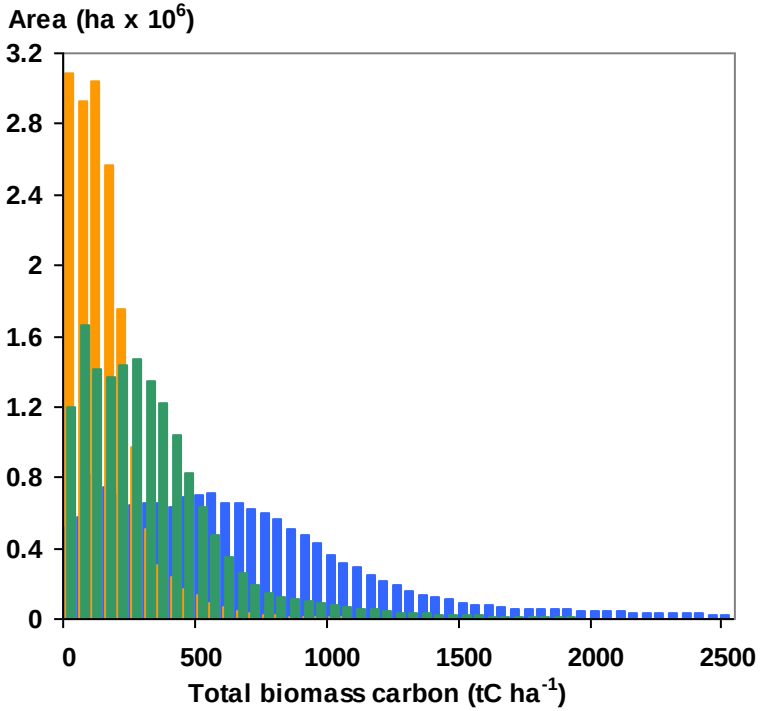


Carbon carrying capacity in native eucalypt forests

Distribution of biomass carbon density in eucalypt forests of SE Australia



Estimation of uncertainty of the predicted biomass



Mean

Lower 95% confidence interval

Upper 95% confidence interval

Causes of change in carbon stocks

1. Natural disturbances eg wildfires

- Large emissions measured in the atmosphere due to large areas burnt (1 million ha in Victoria 2009).
- Carbon stock loss of 3.9 TgC from montane ash forest ≈ 27% of Australian annual emissions reduction target.
- Important to measure emissions from combustion for comprehensive carbon accounting.

2. Human activities eg logging

Change in carbon stock depends on:

- silvicultural system
- rotation length
- proportion of slash and products
- slash management
- waste during processing
- storage in products

Proportion of ecosystem carbon stock combusted in wildfire is small

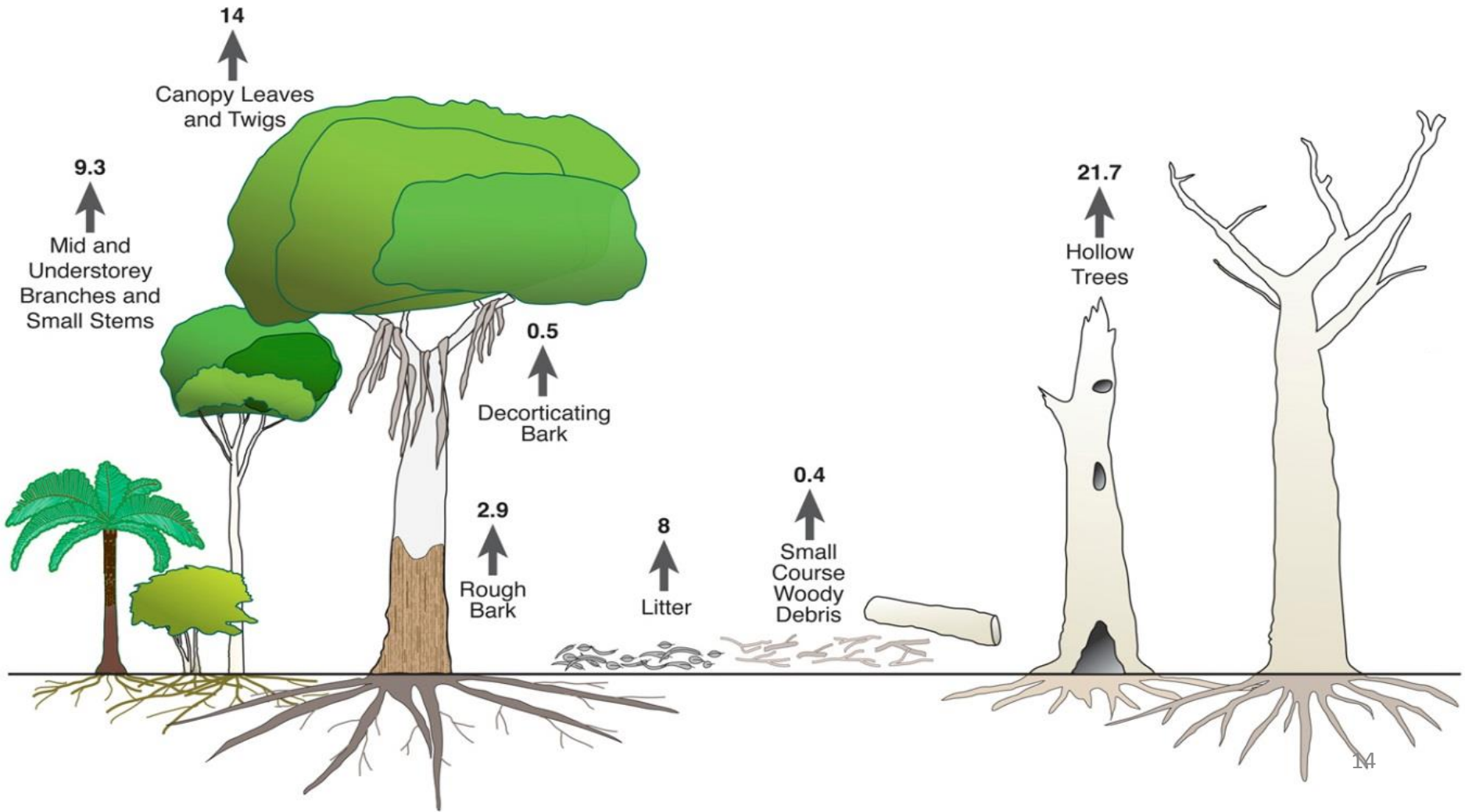
Most of the biomass remains in the forest after fire.

The same forest at Site 470 Victorian Central Highlands following high severity fire

Biomass components combusted in wildfire

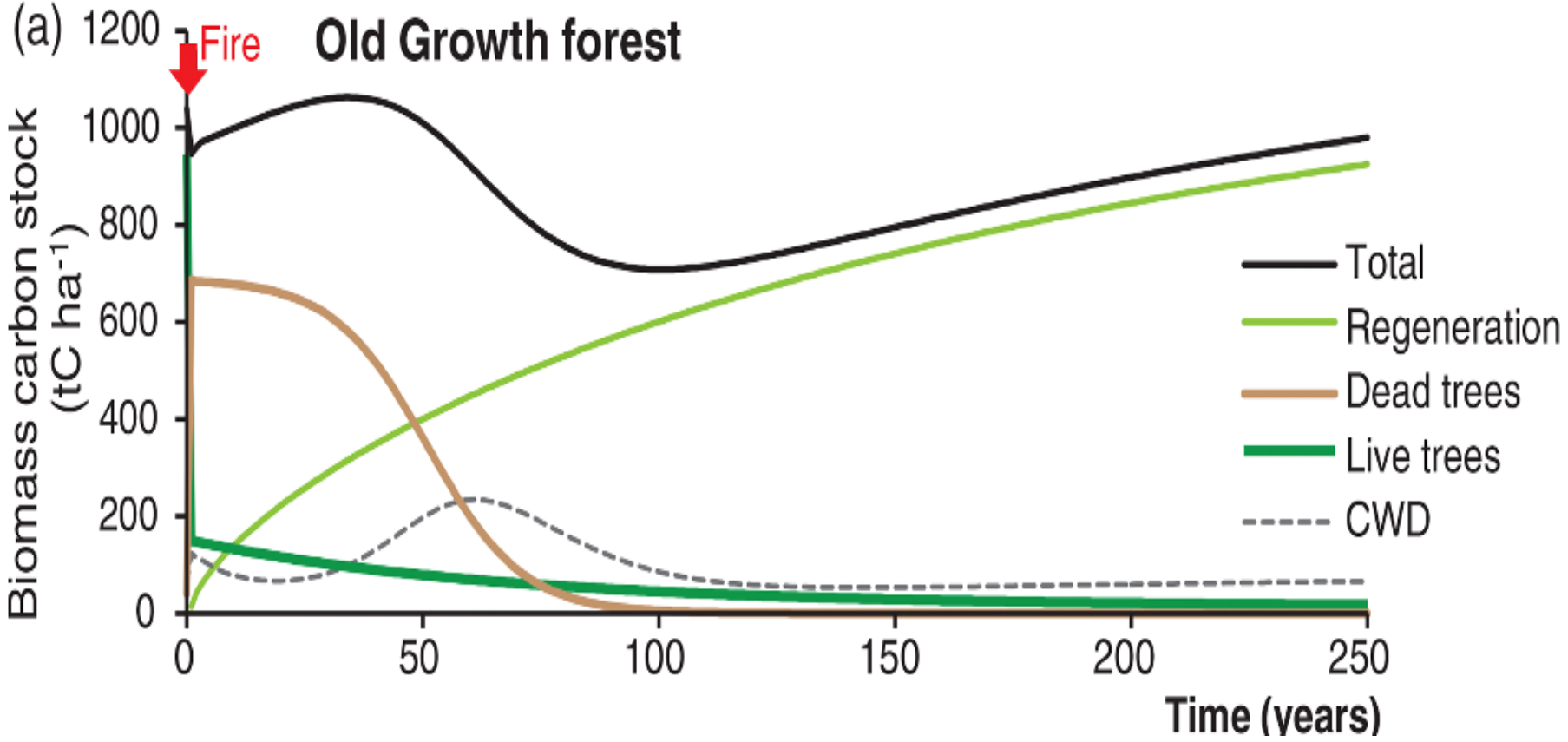
Total Carbon Stocks (tC ha^{-1})

	Living Biomass	Litter	Course Woody Debris	Dead Standing Trees
Pre-fire	822	8	51	41
Post-fire	795.3	0	50.6	19.3

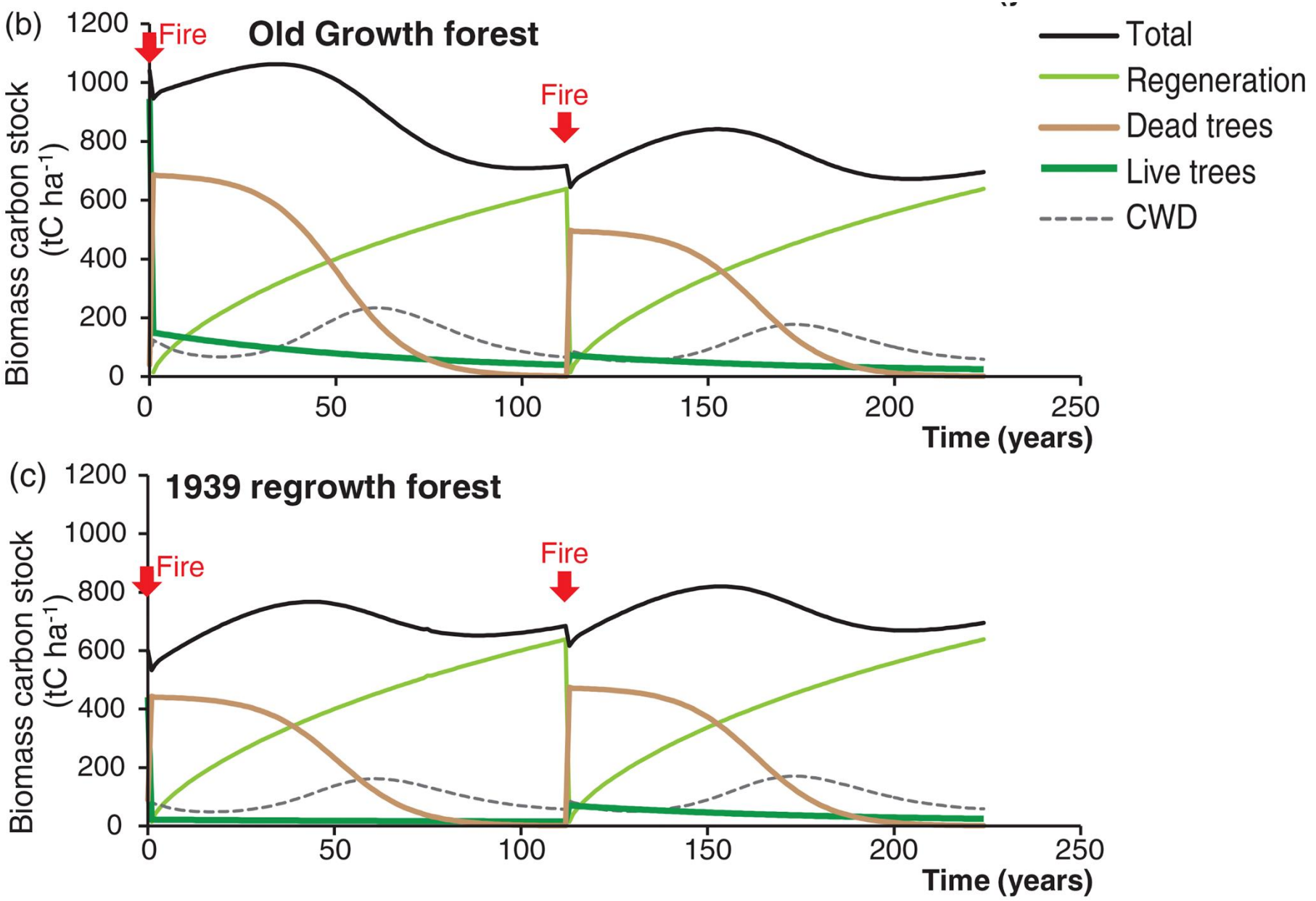


Long-term carbon dynamics after wildfire

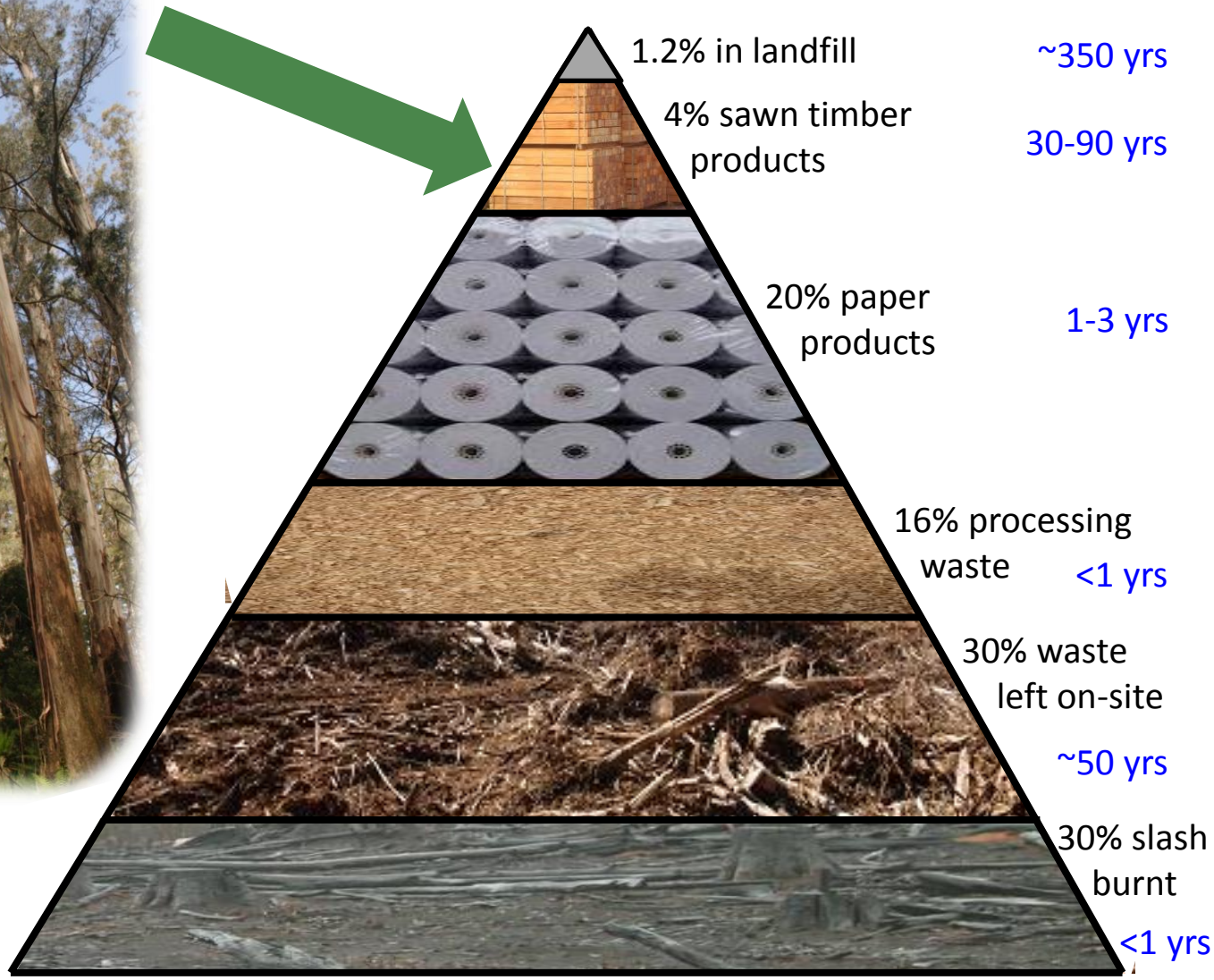
Total carbon stock changes over time due to rates of mortality, decomposition and regeneration.



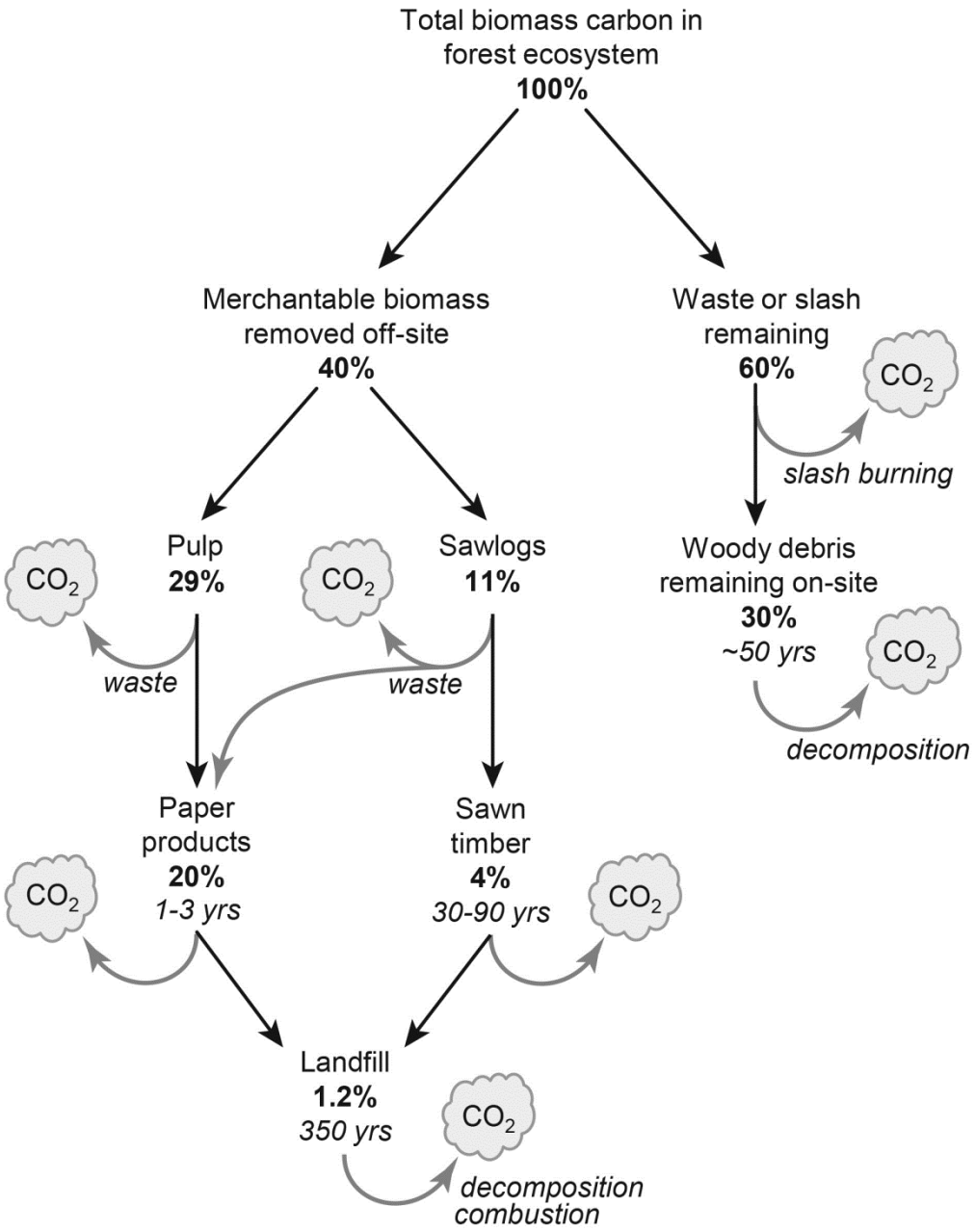
Long-term carbon dynamics under a fire regime



Transfer of carbon stocks in harvested Mountain Ash forest



Processes of carbon transfer in harvested Mountain Ash forest



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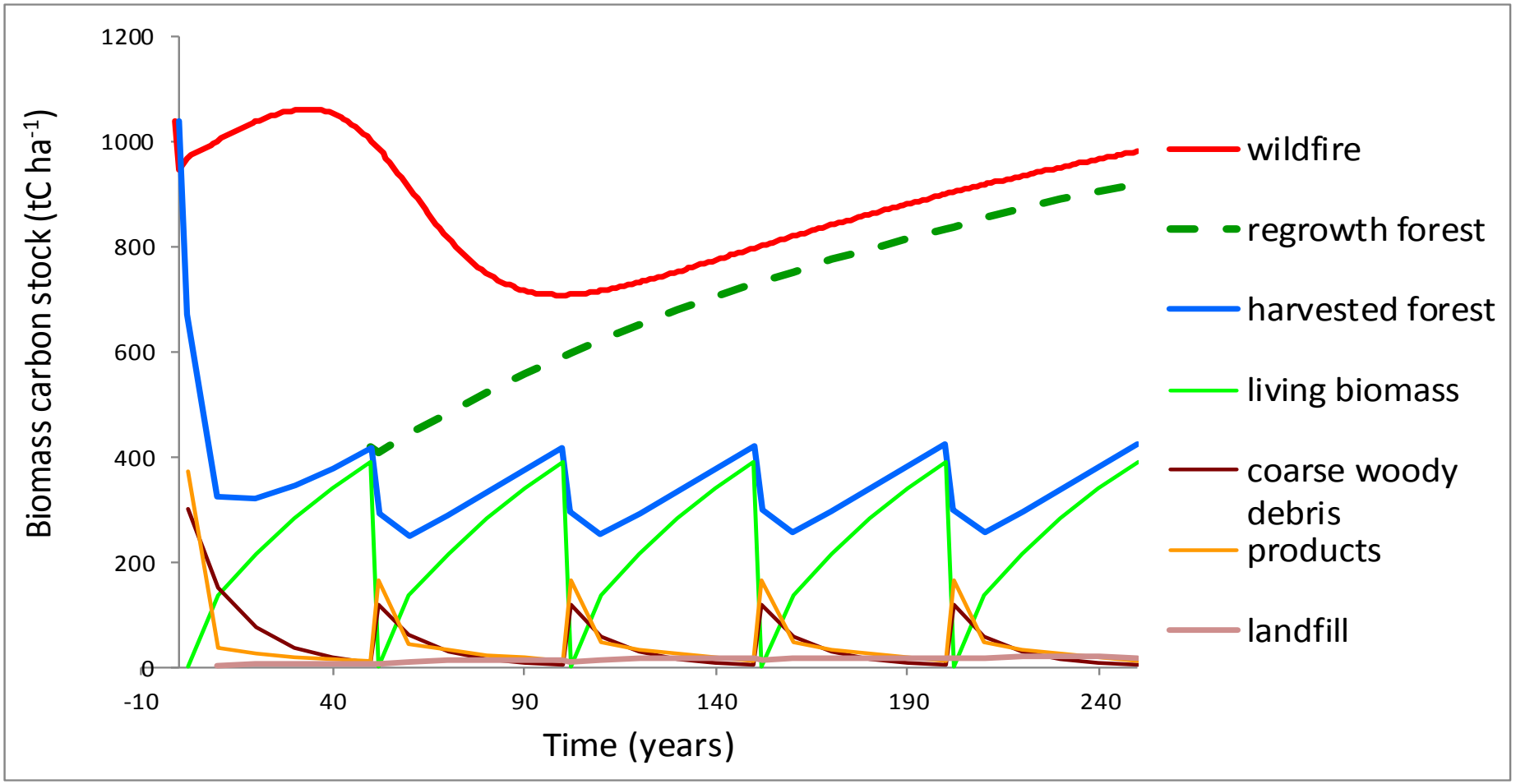
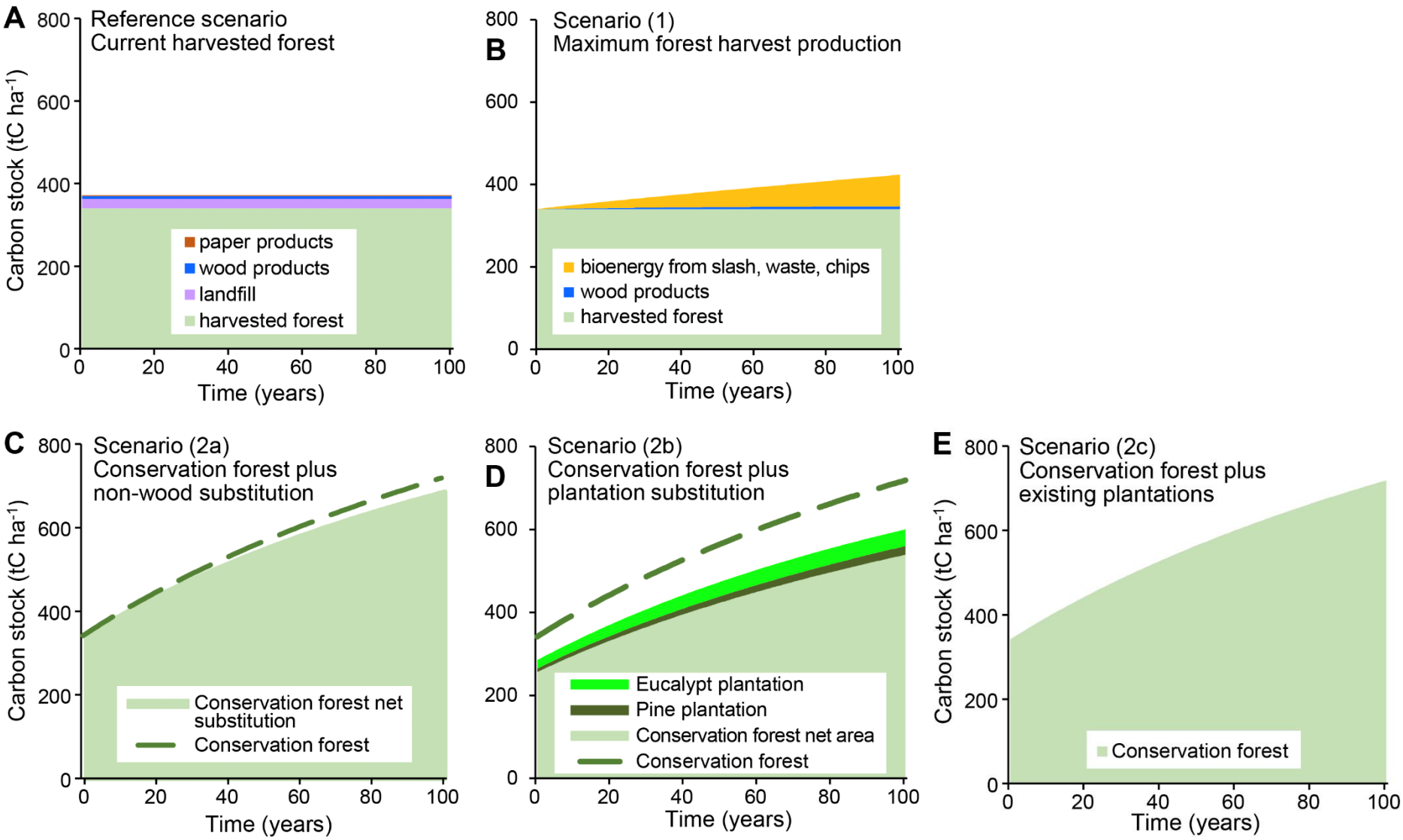


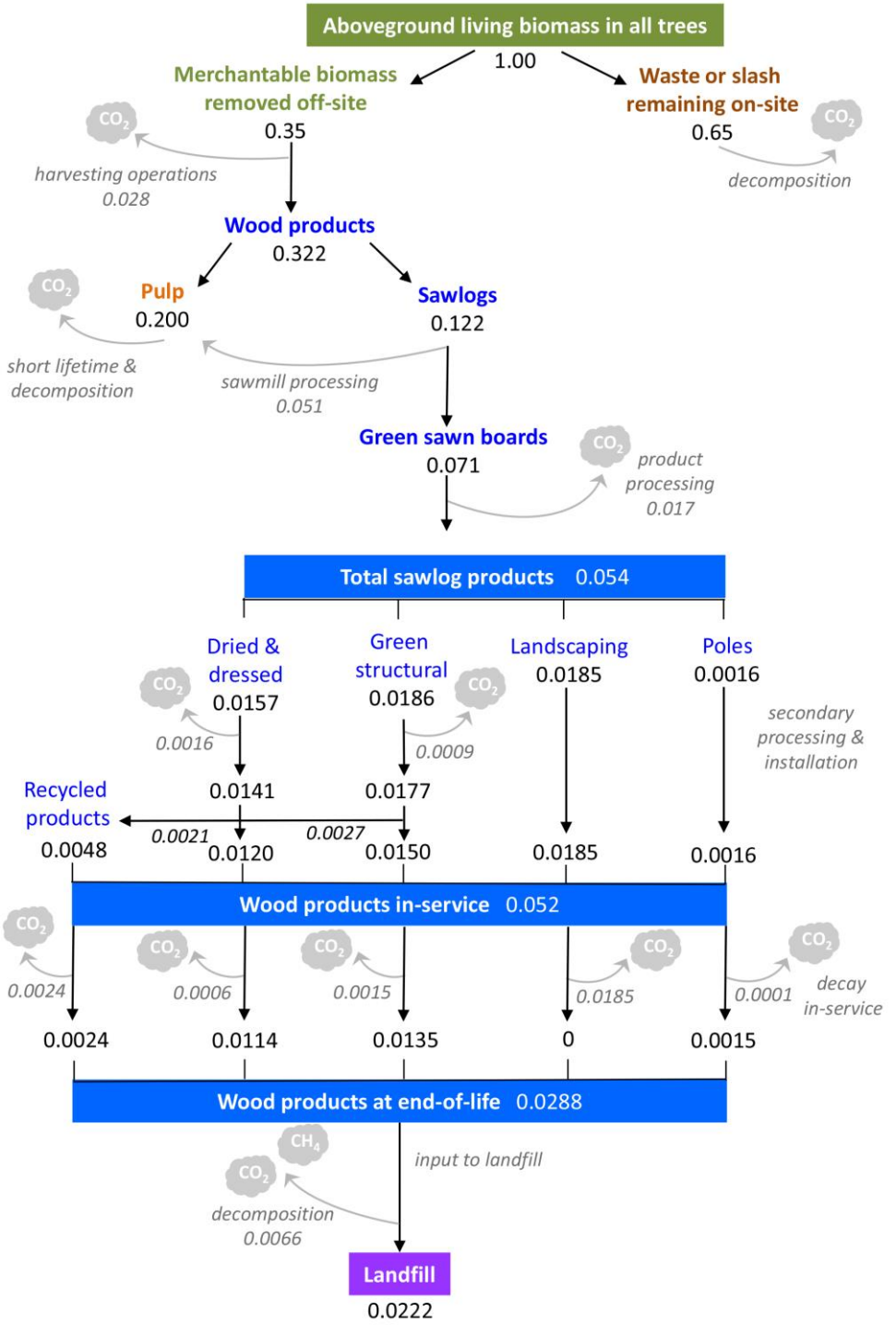
Changes in carbon stocks post-fire are not as great as that in harvested forest.

Regional average carbon stocks in scenarios of harvested forest systems

Victorian Central Highlands Mountain Ash forest

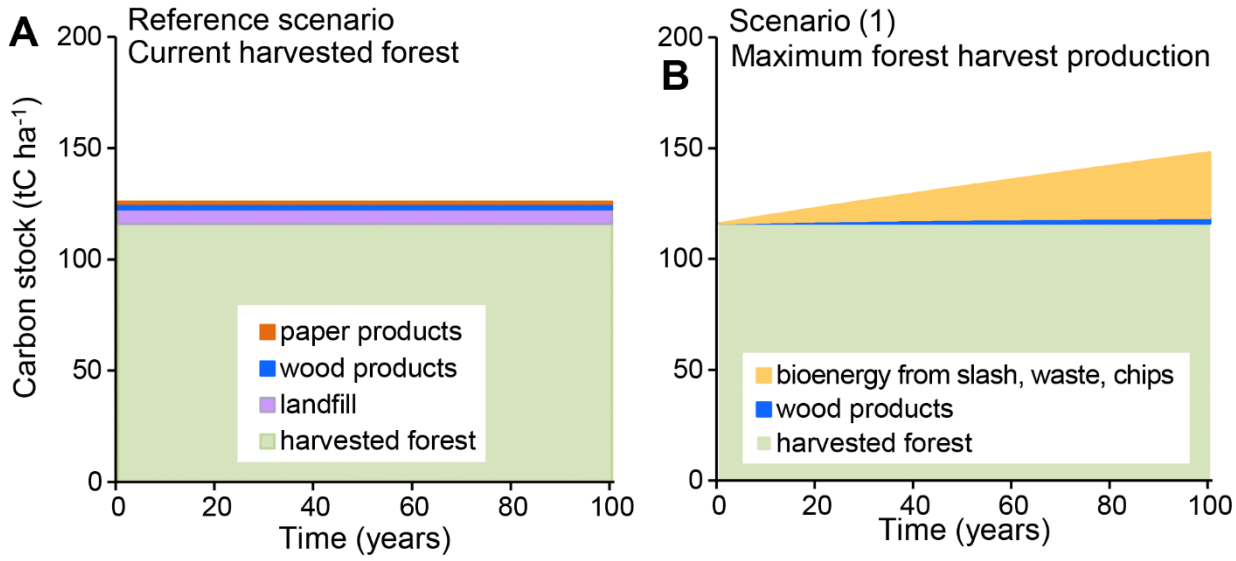


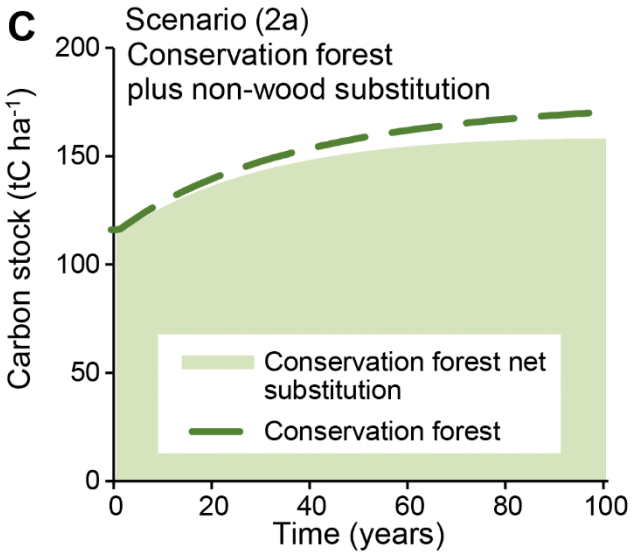
Transfer of carbon stocks in harvested mixed eucalypt forest, NSW South Coast

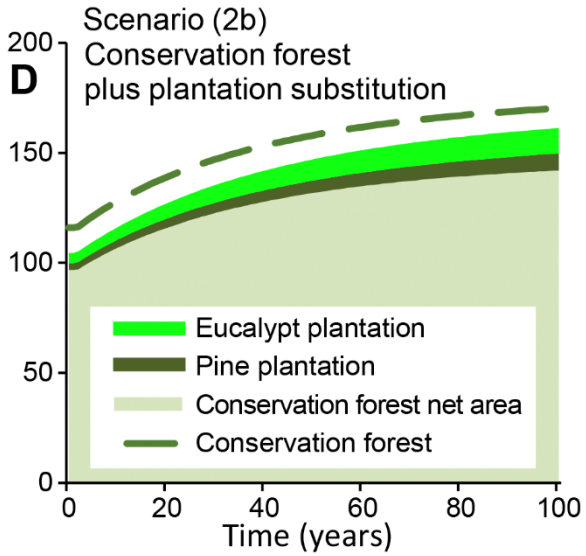


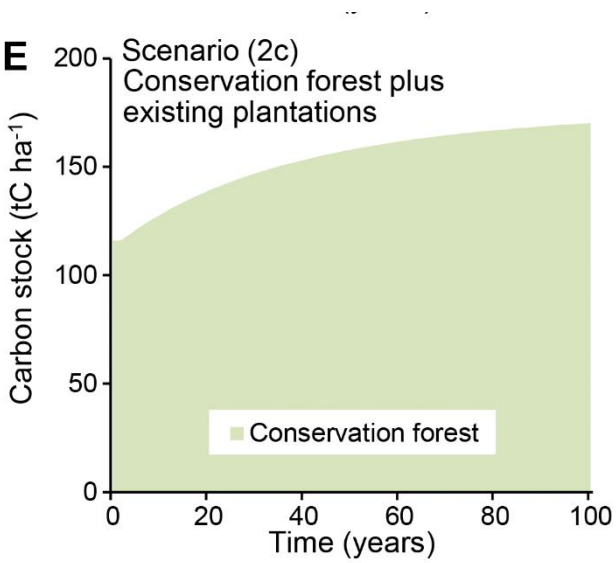
Regional average carbon stocks in a logged forest system

NSW South Coast mixed native eucalypt forest

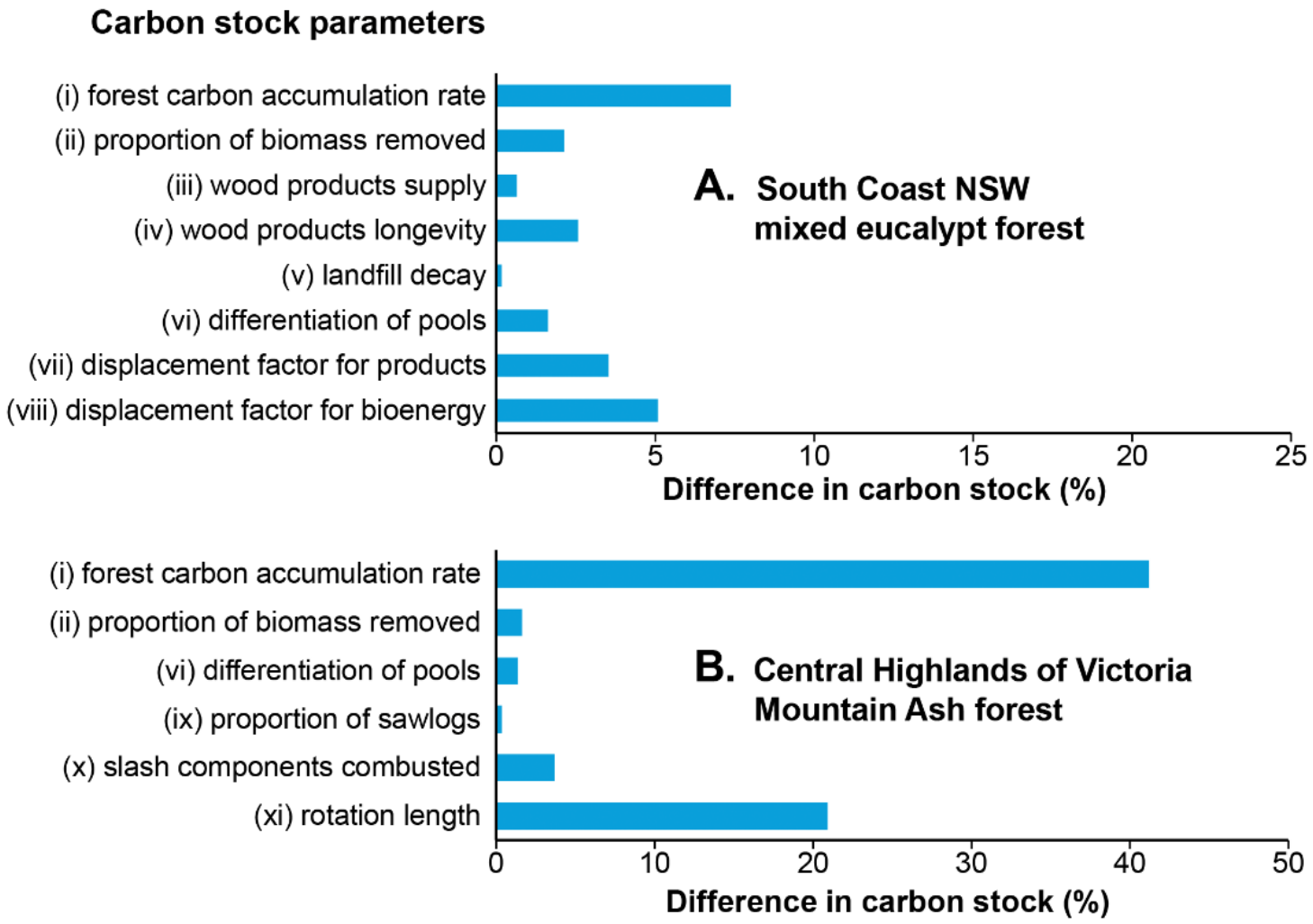








Sensitivity of parameters in the harvested forest system

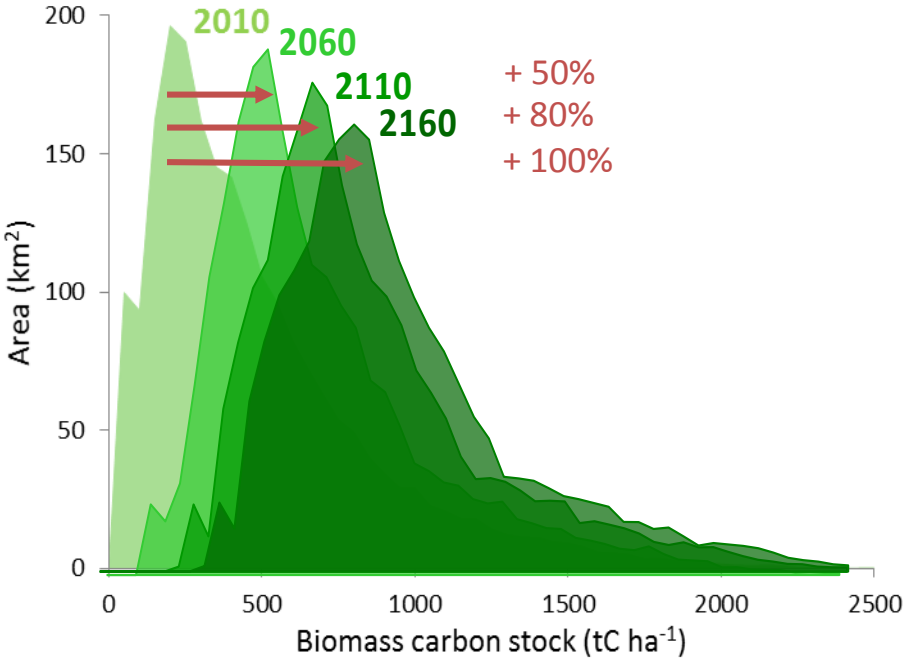


Difference in carbon stock is a percent of the total system carbon stock, calculated from using the minimum and maximum values for the parameter reported in the literature.

Predicting carbon sequestration across the landscape

- Harvesting creates a mosaic of forest ages at the landscape scale.
- Protection allows native forests to regrow.

Projected increase in total landscape carbon stock over 50, 100 and 150 years in regrowing forest.



- Avoided emissions from ceasing logging Mountain Ash forests in Victoria is equivalent to about one-third the annual emissions from the Yallourn Power Station (generating 22% of Victoria's electricity from brown coal).
- Protection of Mountain Ash forests would about double the carbon storage and contribute about 8% of Australia's total emissions abatement task for 2014-2020.

Managing forests for carbon storage

1. Avoiding emissions by protecting natural ecosystems and stopping deforestation and degradation

2. Increasing sequestration by afforestation with biodiverse long-lived plantings and restoration

Benefits: cost-effective, rapid implementation, co-benefits

Restrictions: limited area of land available, biophysical limits on carbon sequestration

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