The Potential Role of Forests in Aiding Global Attempts to Reduce Atmospheric CO_2 Concentrations

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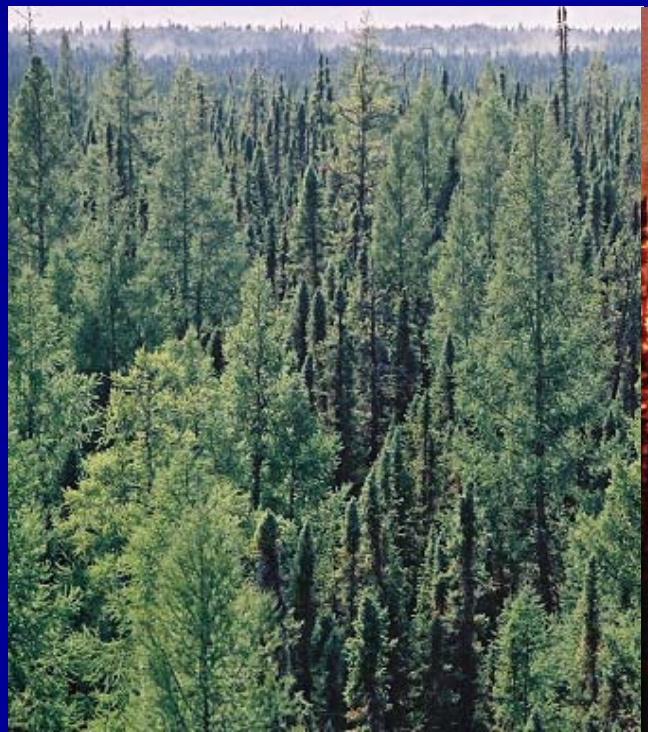
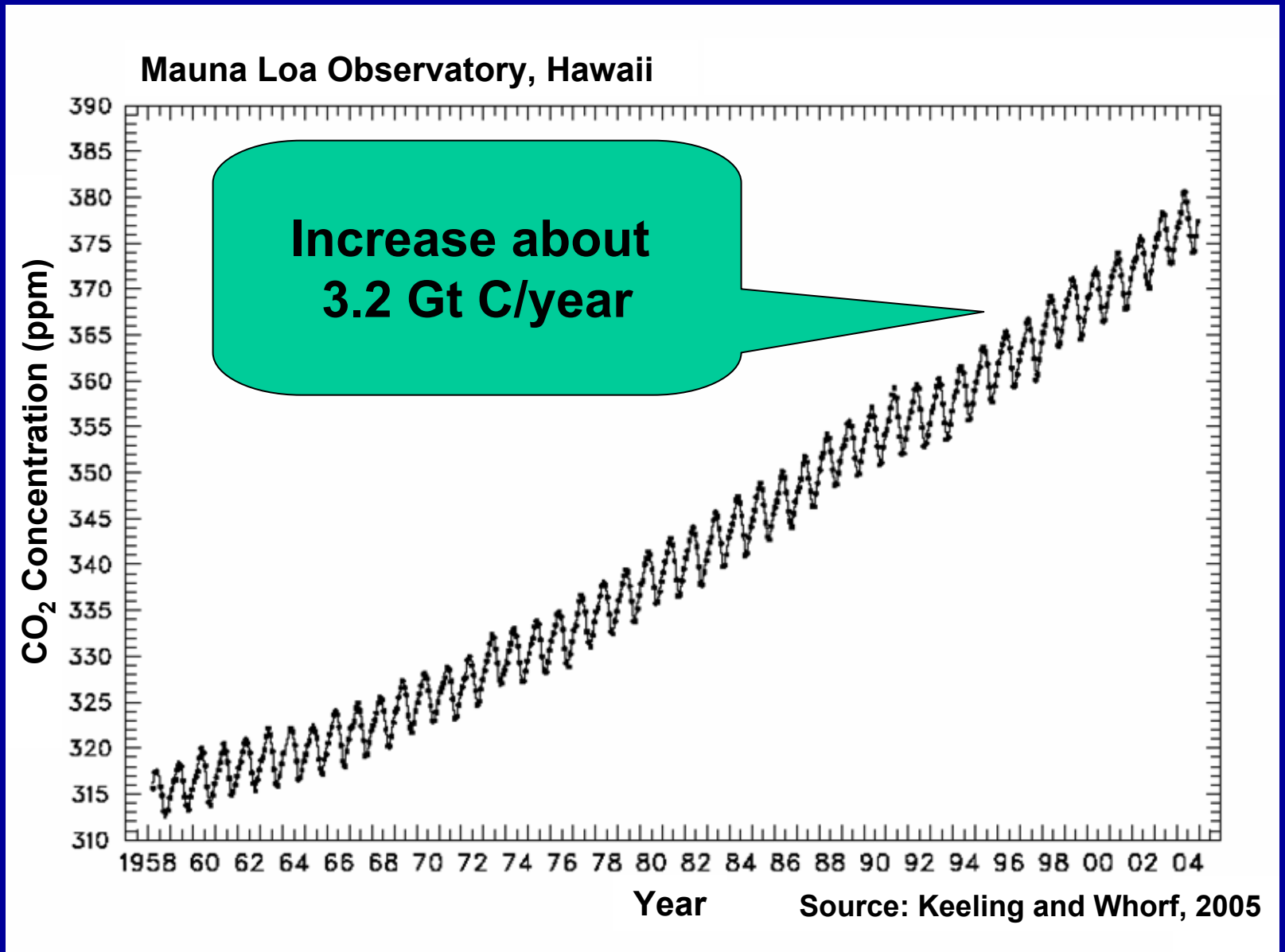
Outline

- Background: Atmospheric CO_2 concentration and forests
- Forest sector contribution to a climate mitigation portfolio
- Conclusions

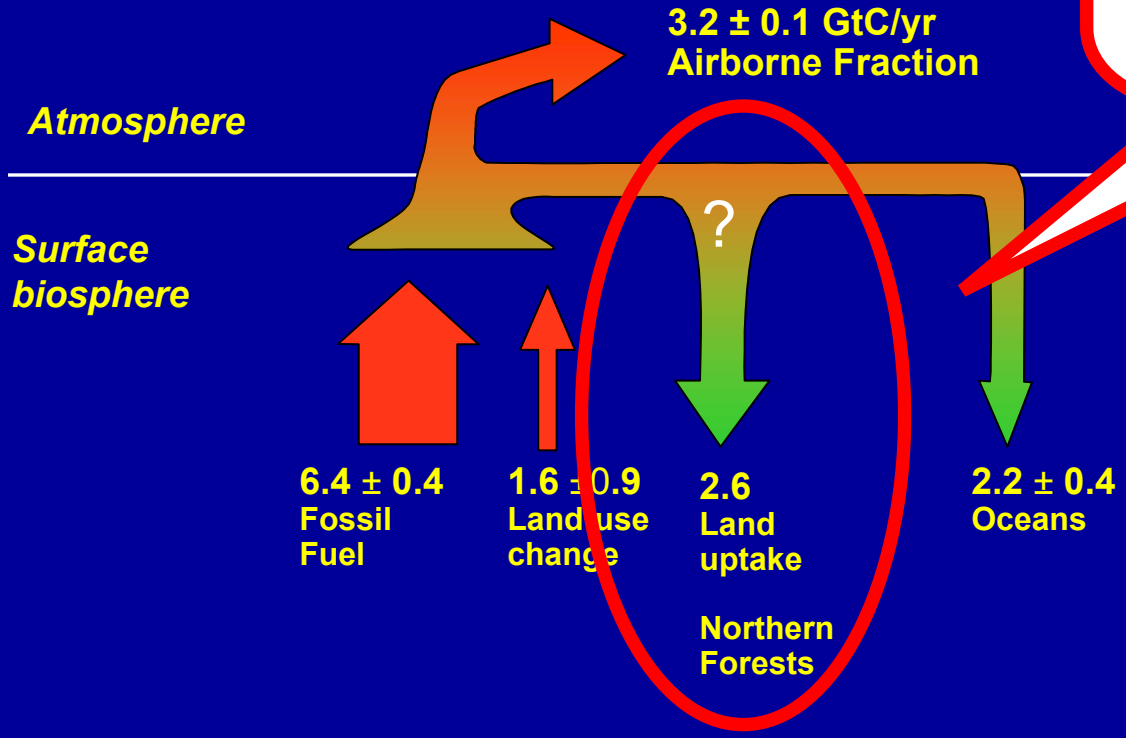


Increase in Atmospheric CO_2 Concentration



Human Perturbations to the Global C Cycle

Less than half of *human* emissions stay in the atmosphere:
8.0 Gt C up, only 3.2 remain



The role of northern forests will affect the future CO_2 concentration.

Data for 1990s from IPCC 2007

50% of the weight of wood is carbon

1 ton of carbon

~ 4 m^3 of wood

if burned releases

~ 3.7 tons of CO_2


~ 1 million cubic meters of wood
~ 0.25 Mt C

Global Fossil Carbon Emissions

- Global Fossil Carbon Emissions ~ 7 Gt C / yr
- About half of the biomass C in Canada's forests
- Solid wood cube of 28 billion m^3 or 28 km^3

X 28,000

- Enough wood to produce a 2 x 4 that wraps around the earth at equator …

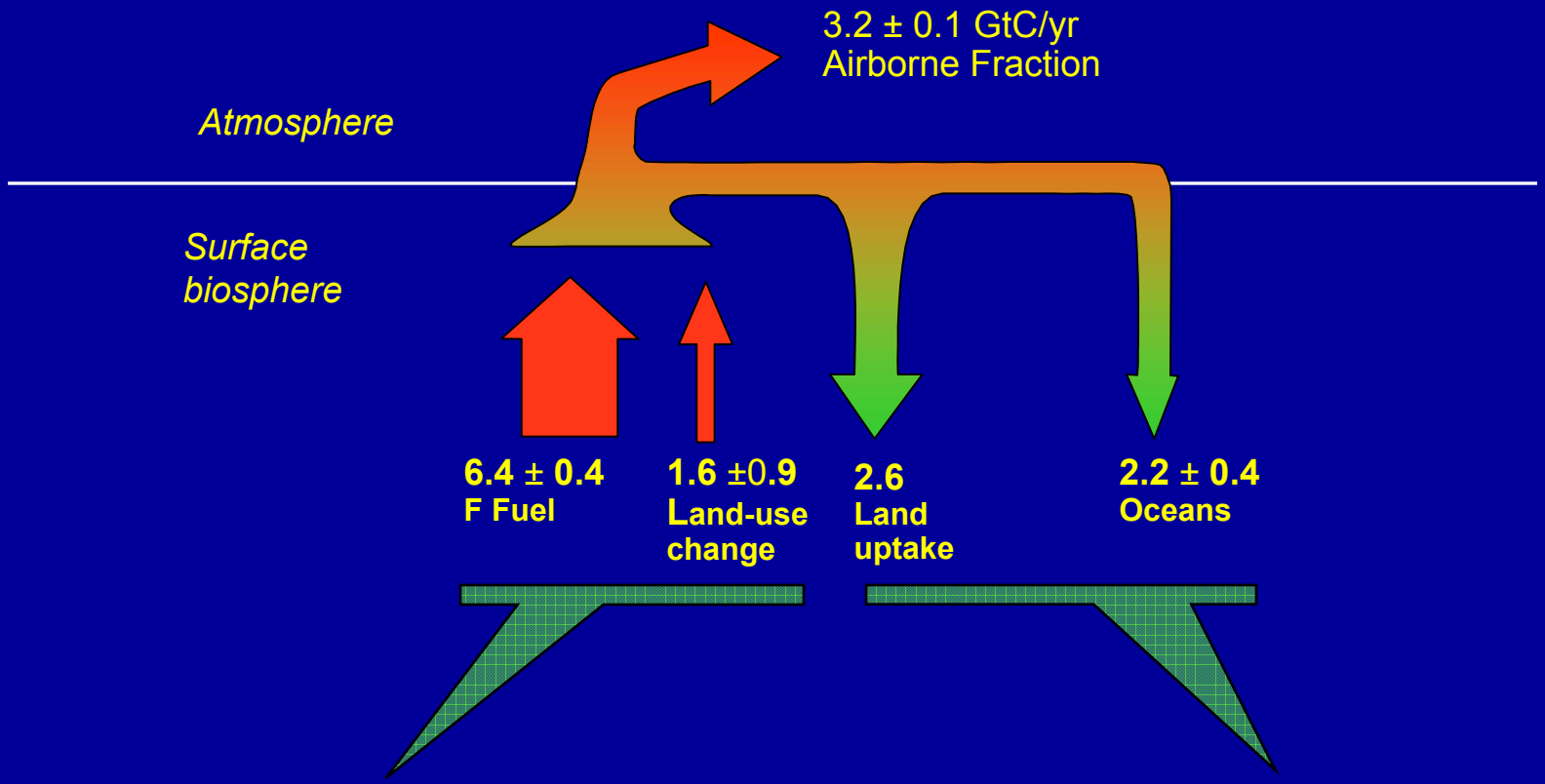
…. over 200,000 times.

Forest Mitigation Options

- Forests and forestry cannot solve the problem of fossil C emissions, but they can contribute to the solution.

Mitigation Options:
How can forestry influence the atmospheric GHG balance?

Mitigation Opportunities:
Can forest management reduce sources and increase sinks?



Mitigation Potential

- The economic potential is 1.3 - 4.2 Gt CO_2 eq/yr by 2030 (at carbon prices < 100 US$/tCO2-eq).
- About 65% of the total mitigation potential is located in the tropics and about 50% of the total could be achieved by reducing emissions from deforestation.

Source: Nabuurs et al. 2007, IPCC AR4

Mitigation Options in the Forest Sector

- What are possible elements of a forest sector mitigation portfolio?

Mitigation Options in the Forest Sector

1. Increase (or maintain) forest area
2. Increase stand-level carbon density
3. Increase landscape-level carbon density
4. Increase C stored in products, reduce fossil emissions through product substitution and through bioenergy use

Reducing Emissions from Deforestation

- Global emissions from deforestation (i.e. land-use change) are larger than global emissions from the transportation sector (Stern Review, 2006).

Reducing Deforestation

- Global (gross) deforestation rates are 12.9 Mha/yr
- Emissions from deforestation ~1.6 Gt C /yr
- Net deforestation rates are 7.3 Mha/yr but the carbon storage per ha in afforested stands is initially much lower than per ha losses from D.
- Reducing deforestation rates by 50% by 2050 and maintaining them at this level to 2100 would avoid direct release of 50 Gt C this century.

Sources: FAO 2006, Nabuurs et al. 2007, IPCC AR4, Gullison et al. 2007 Science

Increasing Afforestation

- Afforestation increases forest area, carbon stocks in biomass, litter and soils, and the potential for future harvest.
- While several million hectares of land are potentially available for afforestation, costs and competition with agricultural land use contribute to regional constraints to afforestation.

Forest Management Activities

- Stand and landscape-level forest management activities can reduce emissions and increase carbon storage in biomass, litter and soils.
- Increase stand-level carbon density
  - Silviculture, harvest systems with partial cover, avoid slashburning, reduced regeneration delays, species selection
- Increase landscape-level carbon density
  - Longer rotations, conservation areas, protection against fire and insects
- Forest management technologies for mitigation portfolios exist and are implemented operationally.

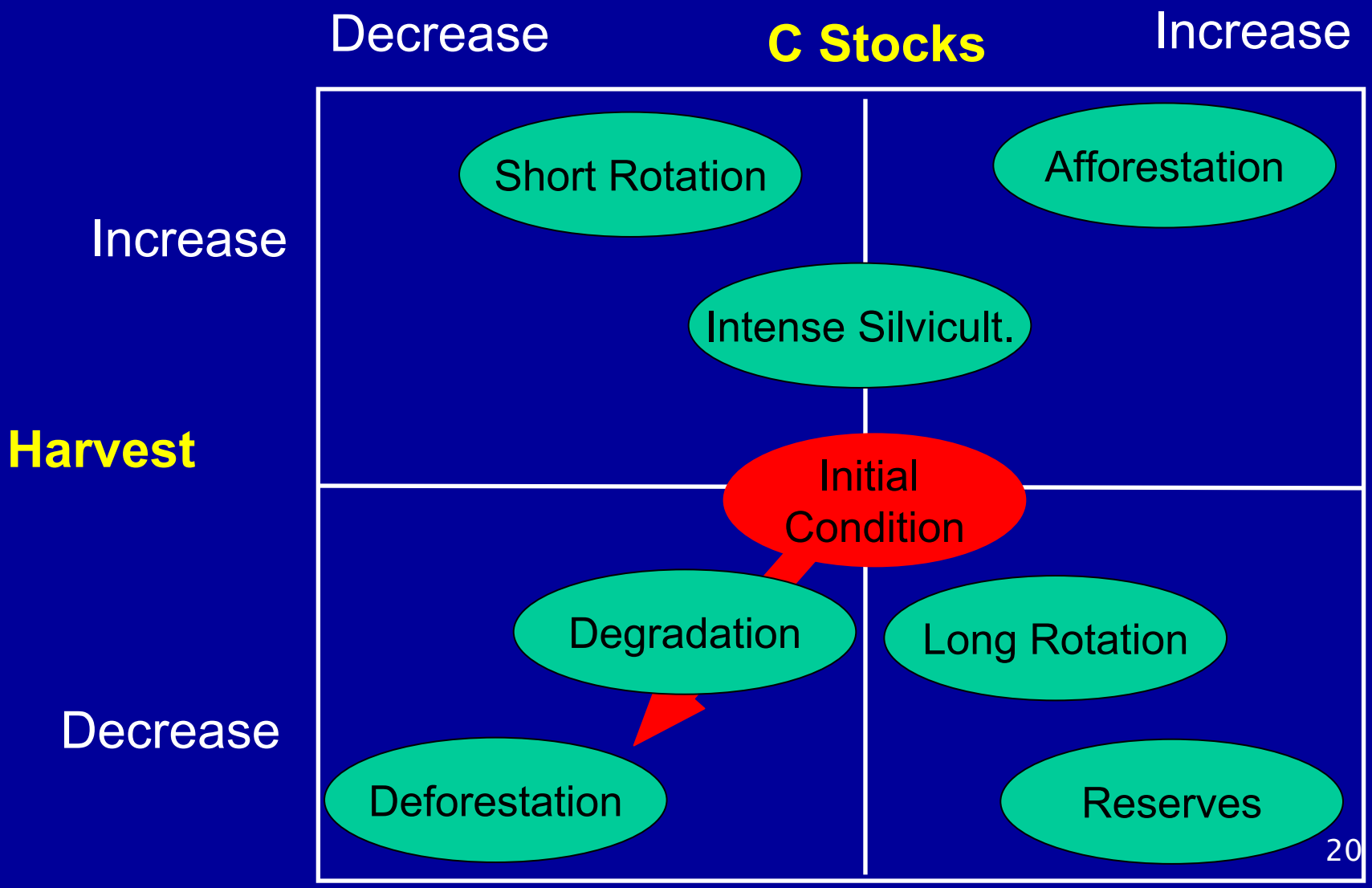
Mitigation Options in the Forest Sector

- Global wood harvest transfers ~750 Mt C/yr to meet society's needs.
- Canada's wood harvest was 46 Mt C/yr (average 2000 – 2005)
- Mitigation options include
  - longer retention of C in harvested wood products,
  - increased use of wood products instead of more fossil-energy intensive materials
  - reduce wood disposal in landfills (reduce CH_4 emissions)
  - increased use of woody biofuels to substitute fossil fuels

Managing Forest Carbon Stocks

- Increase C stored in forest
- Manage C harvest to meet society's needs

Managing Forest Carbon Stocks

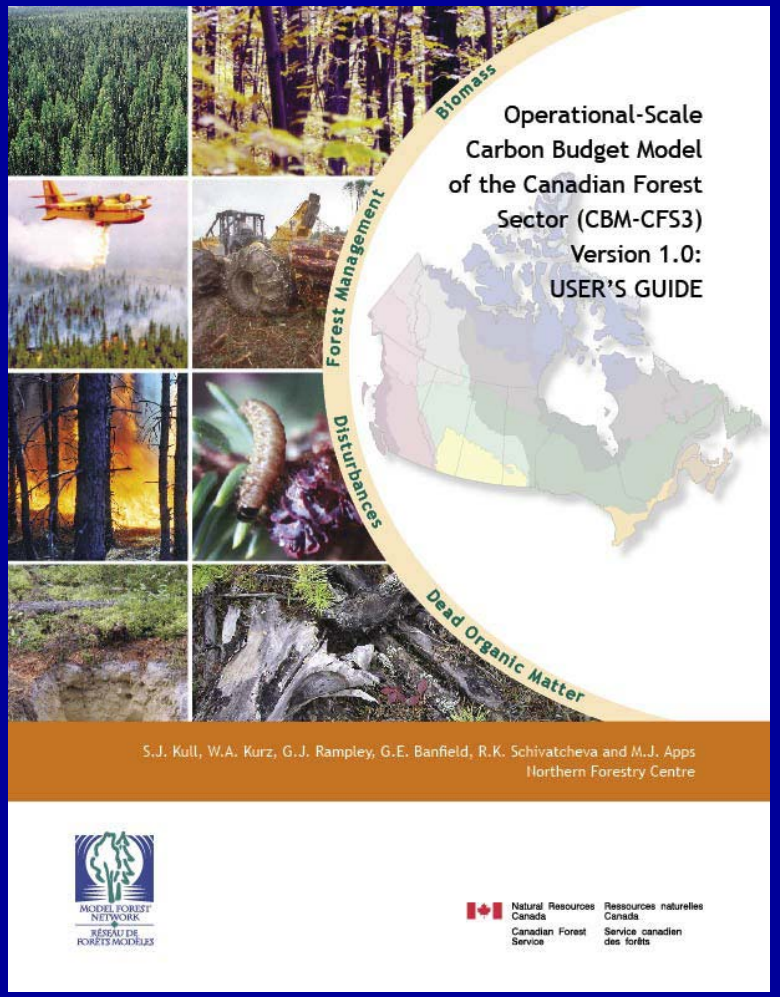


Mitigation Strategies in the Forest Sector

- The mitigation strategy needs to seek the balance between C storage in the forest and providing wood-based products.
- The design of a mitigation portfolio requires an understanding of the time dynamics of carbon benefits resulting from mitigation activities:
  - Reduced Emissions from Deforestation – immediate large gain relative to baseline
  - Reduced regeneration delay – initial benefit, decreasing over time
  - Increased sink from Afforestation – low initial benefits but increasing sink over time

Analyzing C Benefits of Mitigation Activities

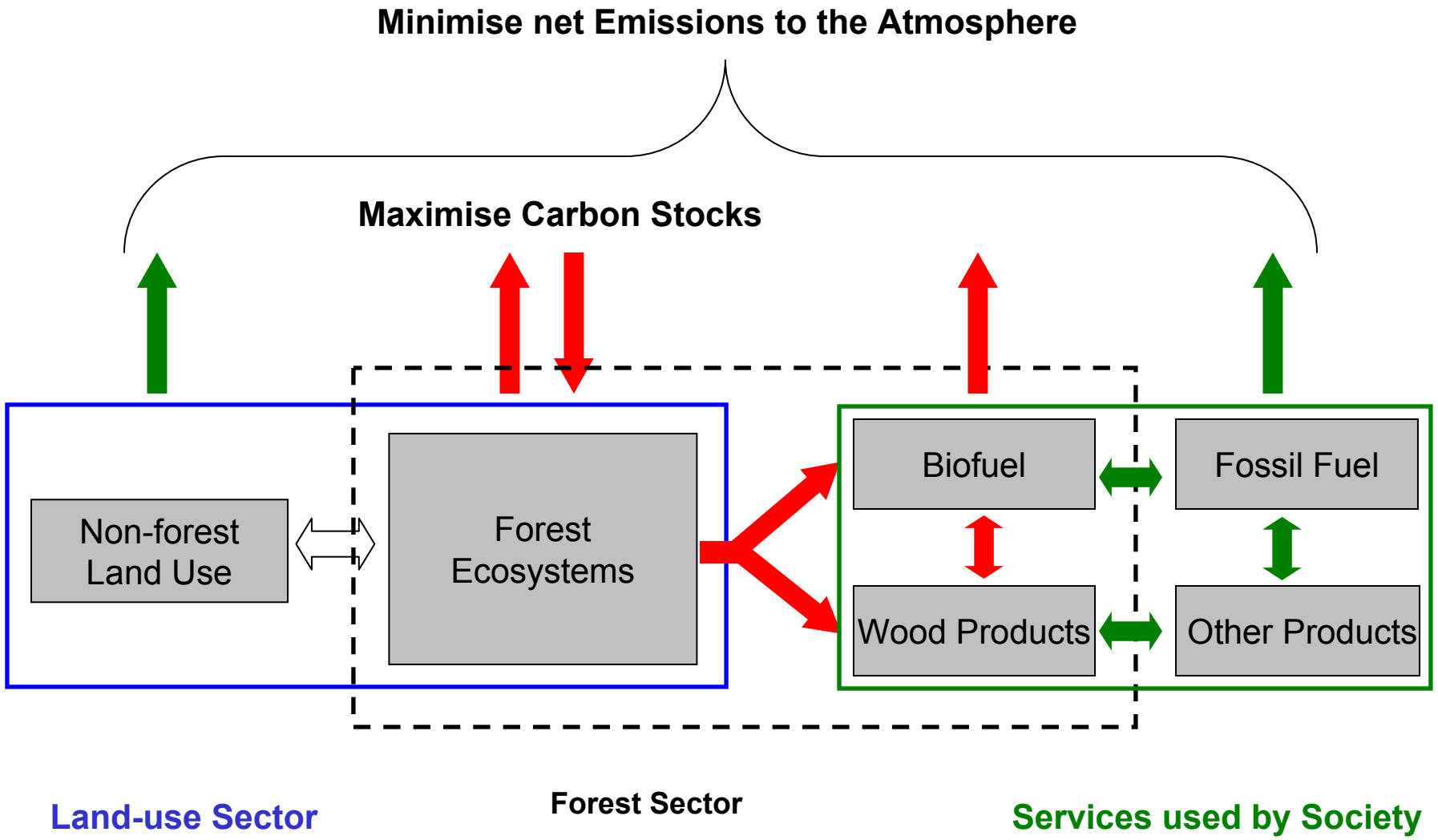
- Models such as the CBM-CFS3 can be used to simulate the ecosystem-level C stock changes without (baseline) and with the proposed project. The difference represents the estimate of project-level C benefits.
- Issues such as “leakage” and additionality have to be addressed external to the model.



Designing a Forest Sector Mitigation Portfolio

- Assess the regional / national opportunities for mitigation.
- Quantify magnitude and time dynamics of carbon benefits for each mitigation option in the portfolio.
- Predict forest ecosystems response to management actions for different regions and species.
- Quantify risk of natural disturbances and ability to reduce risk through management actions.
- Assess trade-offs between storing C in forest ecosystems and using wood biomass to meet society's needs (avoided emissions through product and fossil fuel substitution).
- Take global system's perspective for portfolio design.

Forest Mitigation Strategies: What to Optimise?



Source: Nabuurs et al. 2007, IPCC AR4

Cobenefits

- Forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial cobenefits in terms of:
  - employment,
  - income generation,
  - biodiversity and watershed conservation,
  - renewable energy supply, and
  - poverty alleviation.

Source: Nabuurs et al. 2007, IPCC AR4

Forest Mitigation Strategies: Climate Change Impacts?

- Climate change is likely to negatively affect the forest sector's mitigation potential
  - Changes in forest growth rates
  - Increased natural disturbances
  - Species maladapted to shifting climate zones
  - Changes in ecological processes (drought, decomposition, permafrost melting)
  - May create opportunities in some regions

Conclusions

- Forests can remove CO_2 from the atmosphere (sinks), are significant stores of C, and provide an annual supply of C to meet society's demand for timber, fiber and energy.

- Forest-related mitigation activities can considerably reduce emissions from sources and increase CO_2 removals by sinks at low costs, and can be designed to create synergies with adaptation and sustainable development (IPCC AR4).

- The development of mitigation and adaptation strategies involving forests must be based on the scientific understanding of forest responses to management actions.

Conclusions

- Monitoring, improved understanding and models of forest carbon dynamics are essential building blocks for the development of mitigation (and adaptation) strategies.

- Climate change will negatively affect the forest mitigation potential.

- A sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit (Nabuurs et al. 2007, IPCC AR4).

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Forest Carbon Accounting
Comptabilisation du Carbone Forestier

Canadian Forest Service
Service canadien des forêts

http://carbon.cfs.nrcan.gc.ca

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