

Climate Change and Forest Carbon Dynamics 101

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Oct 9, 2008

Outline

- Climate change (the scientific basis)
- Impacts on forests
- Mitigation opportunities for the forest sector
- The role of forest carbon



Consider the trees. They have no legs to run with.

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Global Change

- Changes of importance for the forest sector:
 - Atmospheric concentration of CO₂
 - Atmospheric N deposition
 - Atmospheric pollutants (e.g. O₃)
 - Climate change
- Will affect:
 - Water availability and water use efficiency
 - Nutrient availability
 - Species interactions (competition, pest dynamics, etc.)
 - Wildfire
 - Extreme weather (drought, wind, etc.)

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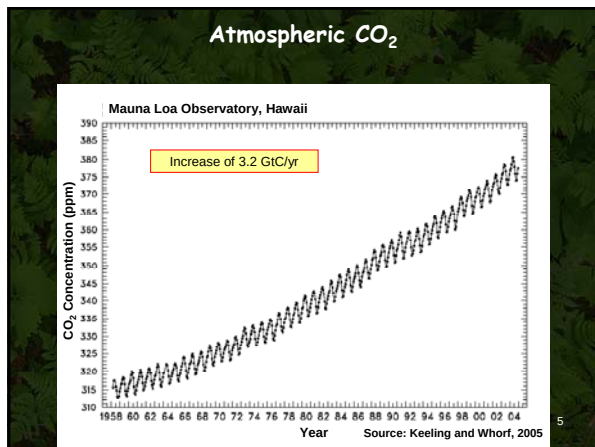
Atmospheric CO₂

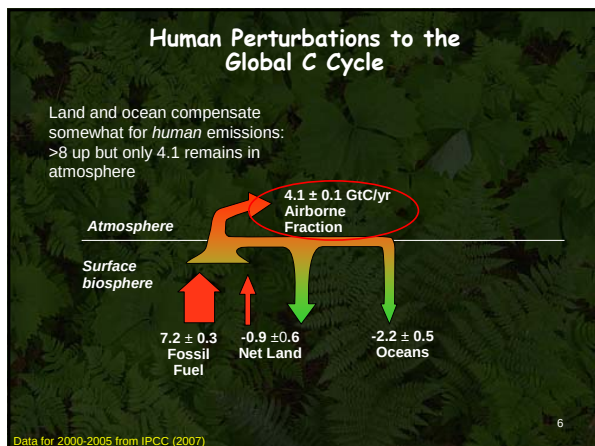
"On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground"

- Increased CO₂ in the air will increase ground temperatures.
- Stronger influence near the poles than near the equator.
- Stronger impact in the northern hemisphere.
- Diminished difference in temperature between day and night.

Svante Arrhenius (1859-1927), Stockholm University
Philosophical Magazine 41, 237 (1896)

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Atmospheric CO₂ Growth Rate Higher than Expected

Four main factors:

1. High economic growth rates
2. Increased energy intensity (energy used per GDP)
3. Reduced uptake by oceans
4. Reduced uptake by terrestrial sink

Source: Canadell et al. 2007, PNAS

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2007 Lowest Recorded Level of Arctic Sea Ice

Positive Feedback:
Less sunlight reflected
Greater warming of
surface water

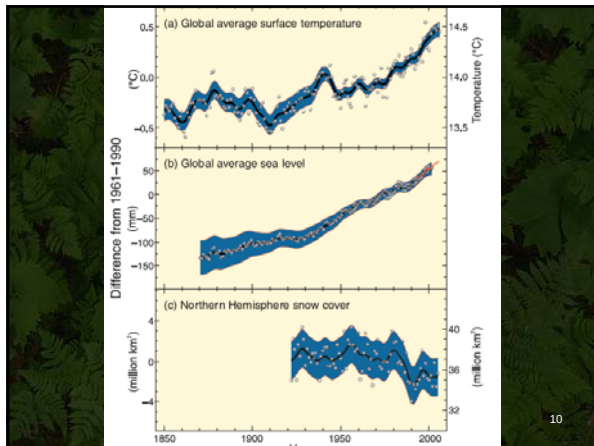


Source: NASA 2007

IPCC Fourth Assessment Report 2007

- The understanding of anthropogenic warming and cooling influences on climate leads to *very high confidence* that the net effect of human activities since 1750 has been one of warming.
- Eleven of the last twelve years (1995 - 2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850).
- Human influences will continue to change atmospheric composition throughout the 21st century.

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Bottom Line

- Balance of evidence points to a need to consider the forecasts seriously
 - Mitigation + adaptation
- Society's views of the situation are changing
 - Increased willingness to change behaviour
 - Changing social license for the forestry sector
 - New policies and new economics

Examples:

- 1) BC's involvement in the Western Climate Initiative
- 2) Recently announced Federal GHG Regulatory Framework
- 3) Future Forest Ecosystem Initiative

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Climate Change Impacts on Forest Carbon

Source: <http://ksjtracker.mit.edu/>

Impacts on Forests

Global Change will have multiple interacting impacts:

- Changes in productivity
 - CO₂ fertilization
 - Higher temperature
 - N mineralization
 - Longer growing seasons
 - Changes in water balance
- Changes in decomposition
- Regeneration and succession
- Migration of plant species (north and up)
- Changed species ensembles
- Increased area burned by forest fires
- Changes in insect dynamics



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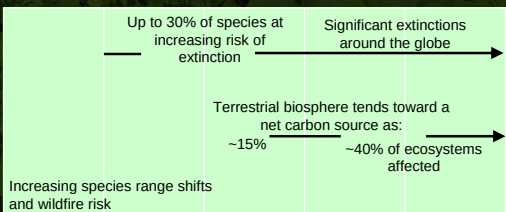
Climate Impacts on Forest Carbon

Change	Carbon stored
↑ Growth?	↑
↑ Decay?	↓
↑ Fires?	↓
↓ Regeneration?	↓ ↑
↓ Insect and disease?	↑
↑ Drought?	↓ ↑

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IPCC Future Impacts

Global mean annual temperature change relative to 1980-1999 (°C)



From Figure SPM.2. Working Group II IPCC AR4

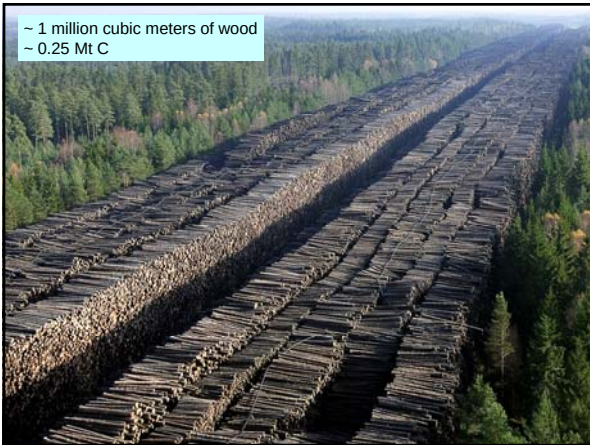
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Mitigation...



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~ 1 million cubic meters of wood
~ 0.25 Mt C



Global Fossil Carbon Emissions

- Global Fossil Carbon Emissions ~ 7 Gt C / yr
- about the biomass C in all of BC's forest

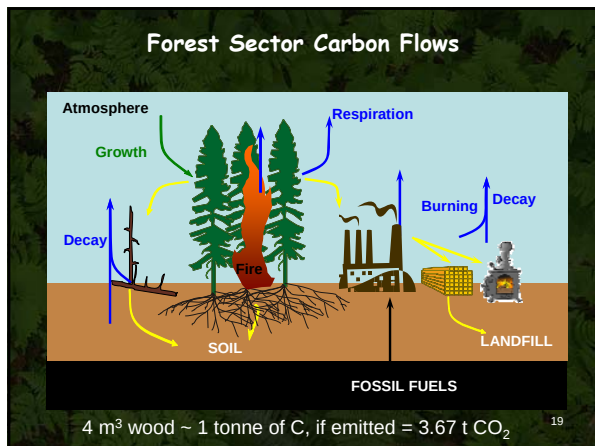


X 28,000

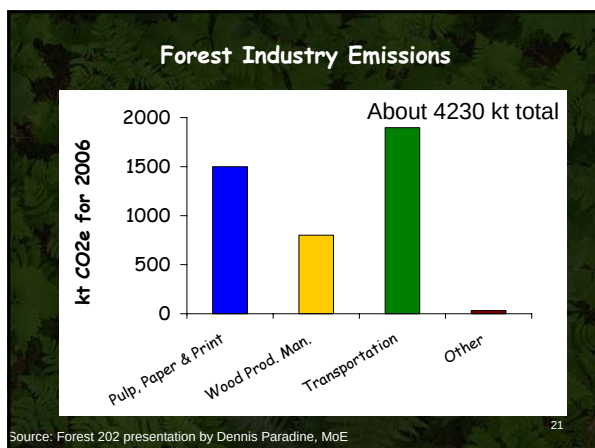
- Enough wood to produce a 2 x 4 that wraps around the earth at equator ...

.... over 200,000 times.

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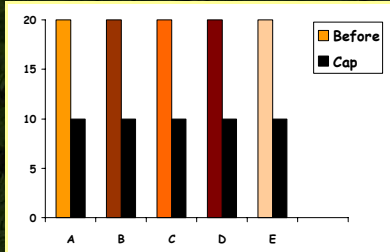


- ### Forest Sector Mitigation Opportunities
1. Reduce fossil emissions
 - More efficient operations
 - Bioenergy use of waste wood and,
 - Product substitution
 2. Increase (or maintain) forest area
 3. Increase stand-level carbon density
 4. Increase landscape-level carbon density
 5. Increase C stored in wood products.
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Cap and Trade

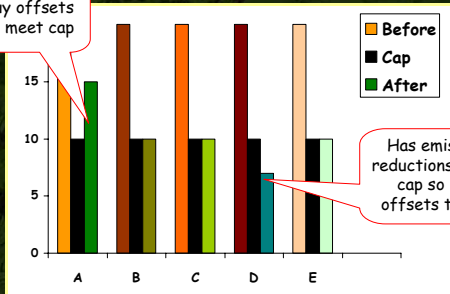
- An offset is a greenhouse gas emissions reduction or increase in carbon-storage
- Helps you meet your target for mitigating climate change.
- It's supposed to be a last-hope mechanism.



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Offset Trading

Needs to buy offsets to meet cap



Has emission reductions below cap so has offsets to sell

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Key Criterion

- The greenhouse gas reduction would not have happened anyway i.e. is "additional" or "incremental" to business-as-usual activity.

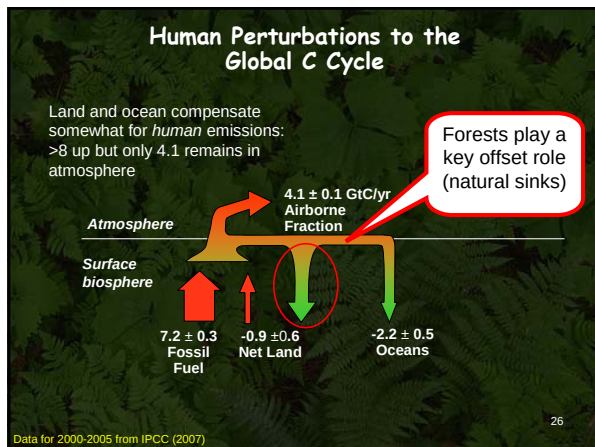


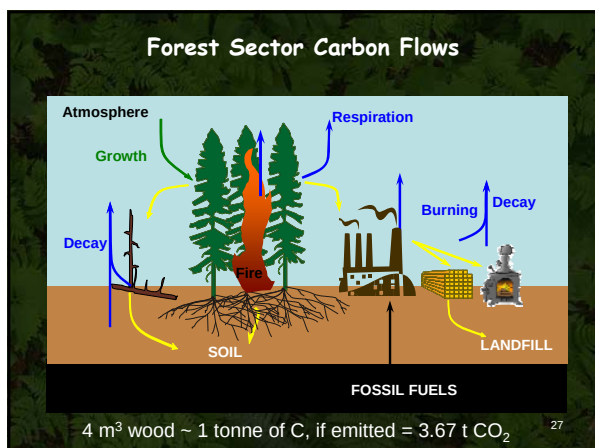
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Forest Sector Mitigation Opportunities

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Forests can act as sinks or sources

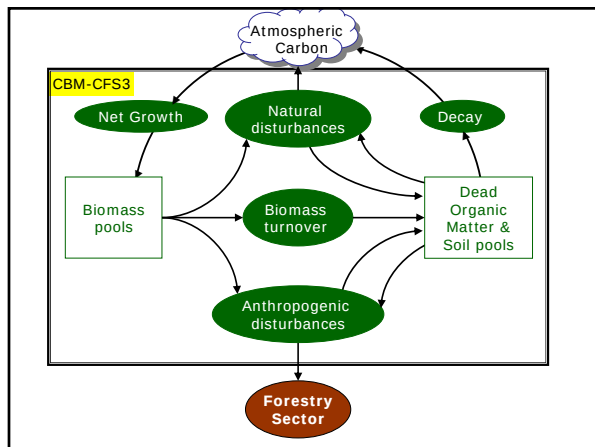
- When times are good...

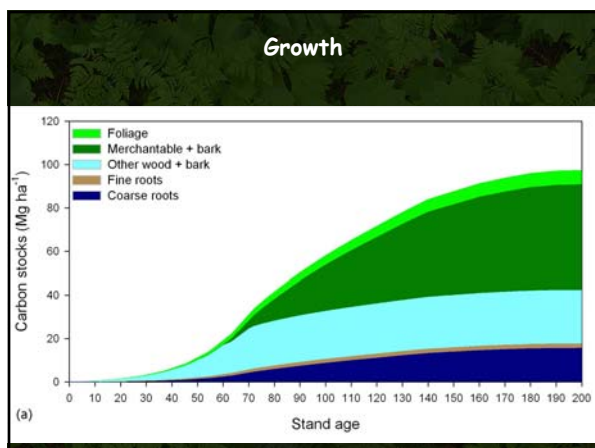


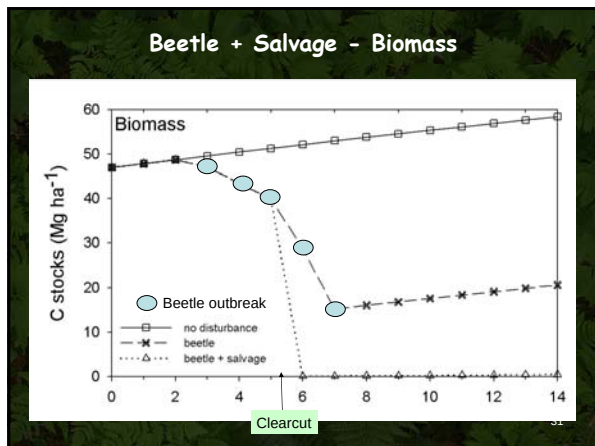
- When times are not so good...

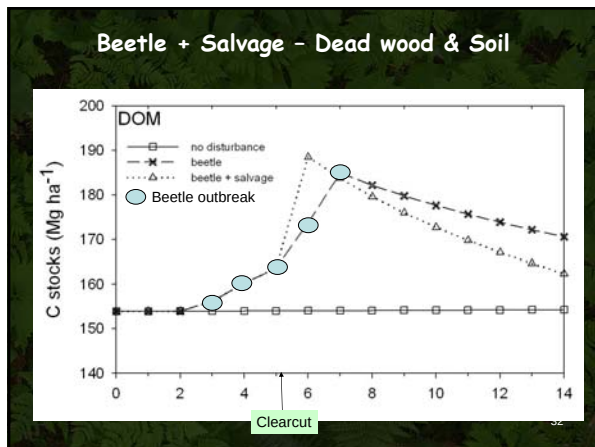


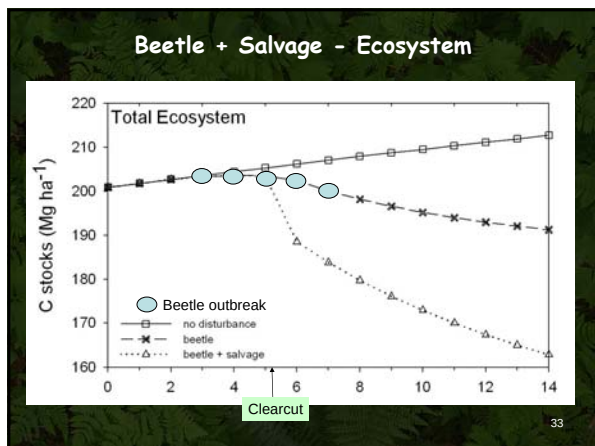

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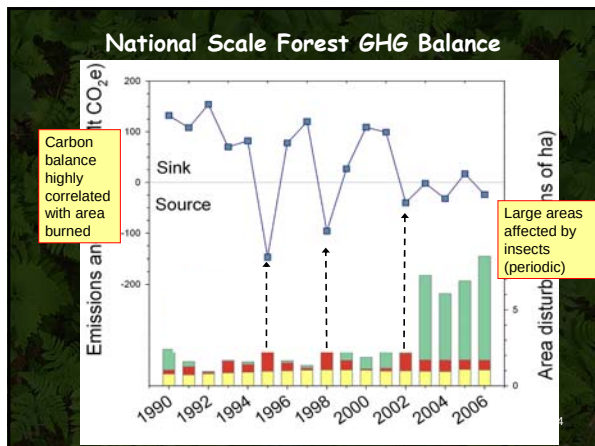










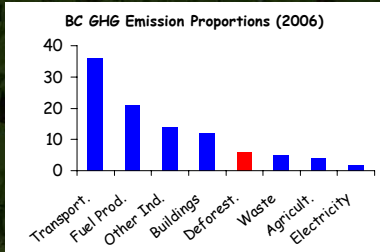


- ### Contribution of BC's forests
- Non-THLB is generally a carbon sink
 - Suppression of natural disturbances, but no harvesting
 - Coastal BC forests have generally been carbon sources
 - Conversion of old, high carbon forests to younger forests managed on shorter rotations
 - Conversion to condos and farms
 - Interior BC forests have generally been a carbon sink, but...
 - Bad fire years in 2003 and 2004
 - Mountain pine beetle

- ### Potential Changes to Forest Management...
- Longer rotation age
 - More intensive silviculture to increase carbon uptake and storage
 - Shifting harvest methods and target stands
 - Mixed species plantings
- ### and Forest Products...
- Longer-lived forest products
 - Substitution of wood products for C-intensive products
 - e.g. concrete

Reducing Emissions from Deforestation

- Global emissions from deforestation are larger than global emissions from the transportation sector (Stern Review, 2006).
- 10 to 30% of human emissions globally
- About 6% of BC's emissions



Source: BC Climate Action Plan

More Information

sharepoint.forests.gov.bc.ca/Climate_Change
www.IPCC.ch
Carbon.cfs.nrcan.gc.ca

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