Tools to assess the impact of proposed projects on the GHG balance of affected forest ecosystems

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Project impacts on forests

- Proposed projects could affect forest carbon in several ways

  - Land-use change

    - Deforestation = permanent forest removal and conversion to another land use

    - Afforestation = creation of new forest on land previously used for other purposes

  - Impacts on standing forests

  - Harvested wood products

- Tools exist to help assess the impact on forest carbon and GHGs

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Outline

- Background
  - Terminology, forest greenhouse gas (GHG) emissions/removals in Canada

- Tools

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Terminology

Pool = component of the climate system where a GHG is stored
  (e.g. atmosphere, land, oceans)

Source = process or activity that <u>emits</u> a GHG into the atmosphere
  Emission = release of GHGs into the atmosphere in a specified period of time

Sink = process or activity that <u>removes</u> a GHG from the atmosphere
 **Removal** = absorption of GHGs from the atmosphere in a specified period of time

Mt CO$_2$e = million tonnes carbon dioxide equivalent

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Forest carbon cycle

- Carbon is stored in various pools, temporarily or for extended periods

- Forest growth removes carbon from the atmosphere through photosynthesis (i.e., results in **removals**)

- Respiration, decomposition and fire emit CO_2 to the atmosphere (i.e., results in **emissions**)

- Harvesting transfers carbon out of the forest (i.e., for wood products or energy)
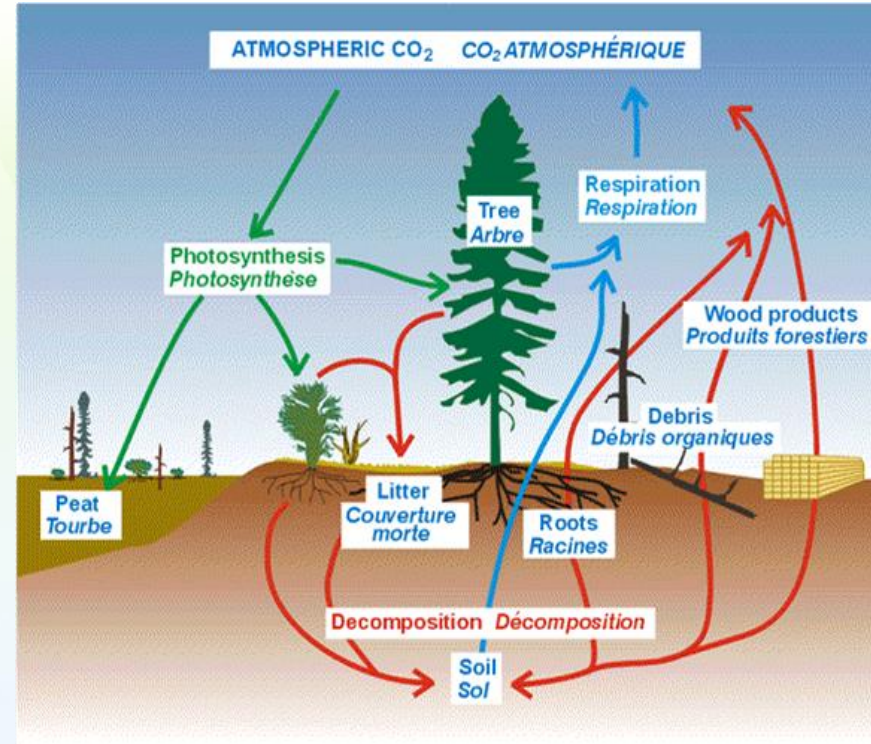
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Forest carbon 101

1 m^3 wood

~ 1 telephone pole

~ 1 tonne CO_2

~ emissions from 430 litres gasoline

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Forest emissions and removals in Canada - 2017

- NRCan-CFS prepares forest-related estimates for the annual GHG National Inventory Report published by Environment and Climate Change Canada

  - Managed forests and harvested wood = net removals of 25 Mt CO_2e *
    - Managed forests = 150 Mt removals; harvested wood products = 125 Mt emissions

  - Deforestation = emissions of 14 Mt CO_2e
    - Agriculture and oil and gas sector are the major causes; other causes include hydroelectric development, mining, transportation development industry and others.

- For comparison, total emissions not including forests and other land = 716 Mt CO_2e

* Net emissions from wildfires and significant insect infestations (50-200 Mt CO_2e per year) are not included in these estimates

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Uses of forest carbon/GHG tools

- Understand the contribution of our forests to the global carbon cycle

- Look backward - estimate historical emissions and removals (e.g., as required for Canada's GHG National Inventory Report)

- Look forward:

  - Support policy analyses (projections)

  - Assess climate change mitigation strategies (i.e., alternative strategies to increase forest carbon removals or reduce emissions)

  - Assess the potential impact of projects on forest GHGs

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NRCan tools to assess forest GHG's:
Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)

- An operational-scale model of forest carbon dynamics

- Allows users to assess how forest ecosystem carbon is affected by human activities like harvesting, tree planting or deforestation

- Builds on ~30 years of NRCan-CFS science

- Available free-of-charge at carbon.cfs.nrcan.gc.ca

- Several training workshops each year

Kurz et al. 2009, Ecological Modelling

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CBM-CFS3 is the core of Canada's NFCMARS

National
Forest
Carbon
Monitoring,
Accounting and
Reporting
System
(NFCMARS)

- NFCMARS used to estimate GHG emissions and removals from forests for reporting to Environment and Climate Change Canada for the annual GHG National Inventory Report

- The report provides details of methodologies and assumptions used

Environment and Climate Change Canada
Environnement et Changement climatique Canada

2019
NATIONAL INVENTORY REPORT 1990–2017:
GREENHOUSE GAS SOURCES AND SINKS IN CANADA
CANADA'S SUBMISSION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
PART 1

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CBM-CFS3 can operate at different scales

Can be used to model forest carbon and the impact of harvesting, deforestation or other activities at different scales

Stand-level

Operational
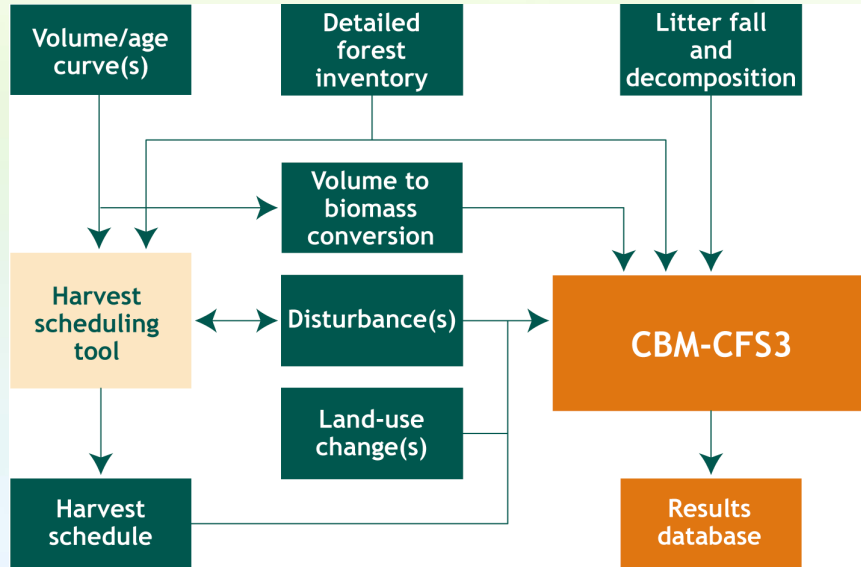
Regional or Provincial

National

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CBM-CFS3 requires information typically used in forest management planning

- Forest growth curves, detailed forest inventory, disturbance, harvesting and land-use change information must be supplied by the user

- Default data are available, for all other inputs, by province/ territory and ecozone

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NRCan tools to assess forest GHG's:
Generic Carbon Budget Model (GCBM)

- A new, spatially explicit version of the CBM-CFS3 that can employ vector or raster data

GCBM

- Permits the use of spatially explicit datasets derived from remote sensing

- Modular approach allows for easier development of new scientific modules, e.g., for mosses, peatlands, and eventually permafrost

- Not yet publically available (but can be used in research and development projects)

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NRCan tools to assess forest GHG's:
Carbon Budget Model Framework for Harvested Wood Products (CBM-FHWP)

- Models the fate of carbon in harvested wood removed from the forest for use in products and energy

- Used for GHG National Inventory Report

- Customizable, and uses default and user-defined product specific parameters (e.g., half-lives of specific harvested products in use)

- Limited availability, and training workshops not currently available
  - Planning to expand access
  - Contact NRCan-CFS about access and training

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Tools to assess forest GHG's:
Deforestation emission factors

- Emissions per hectare of deforestation depend on factors such as
    - Location, age and other characteristics of the forest
    - What is done with the biomass, e.g. left to decompose, burned, used for products

- NRCan-CFS is starting work with Environment and Climate Change Canada to produce emission factors for deforestation
    - Based on deforestation emission estimates in the GHG National Inventory Report

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For More Information

- NRCan-CFS online bookstore – for free copies of publications: https://cfs.nrcan.gc.ca/publications

- Forest carbon/GHG estimation methodologies used in Canada's GHG National Inventory Report: https://unfccc.int/documents/194925

- The CBM-CFS3, supporting software and user documentation (in English, French and Spanish) are all available free-of-charge online: https://carbon.nfis.org/cbm

- For information or to be added to a notification list for training on the CBM-CFS3, GCBM, and CBM-FHWP, contact Stephen Kull, Carbon Modelling Extension Forester: Stephen.Kull@canada.ca

- For information on deforestation emission factors, contact Mark Hafer, Physical Scientist - Carbon Accounting: Mark.Hafer@Canada.ca

- For information on deforestation area estimation see the National Deforestation Monitoring System – System description: https://cfs.nrcan.gc.ca/publications?id=36042

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