The Carbon Budget Model of the Canadian Forest Sector: combining inventories, remote sensing and models to estimate emissions and removals

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Expert Meeting on REDD
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A Team Effort!

CFS Carbon Accounting Team in Victoria and Edmonton in close cooperation with CFS policy community in Ottawa
For national-scale analyses input from Resource Management Agencies in all Provinces and Territories
Collaboration with scientists in CFS, universities in Canada and abroad, IPCC colleagues, and many others …
Outline

• Overview of CBM-CFS3
• International Applications
• Conclusions
Approaches to Developing Forest Carbon Budgets

• Choice of methods depends on national circumstances and intended use of the system
  – Difference between two inventories (e.g. USA)
  – One inventory plus change information (e.g. Canada)
  – No Inventory – process modelling (e.g. Australia)
  – Mixed approaches (?)

• Convergence of methods can be expected
Key Elements of Canadian Approach

- Science-based conceptual framework is the foundation for the design, and for data synthesis and integration
- Build on forest management knowledge – data driven!
- Initially, combine one inventory with change information.
- Develop models, databases and infrastructure for monitoring and projections using best-available data
- Conduct scenario and sensitivity analyses
- Improve available data for use in monitoring and reporting
- System evolves with better data and new science
- IPCC Tier 3 approach
Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)

- An operational-scale model of stand and landscape-level forest C dynamics.
- Allows forest managers to assess carbon implications of forest management: increase sinks, reduce sources
- Builds on 20 years of CFS Science
- Freely available at: carbon.cfs.nrcan.gc.ca

Several publications on model structure, sensitivity analyses and applications

CBM-CFS3: A model of carbon-dynamics in forestry and land-use change implementing IPCC standards

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Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)

- CBM-CFS3 Toolbox includes
  - Software and databases
  - User’s Guide and Tutorials
- Over 600 downloads / 42 countries
- 11 Training Workshops
  - 250+ Trainees
  - from 28 countries

- Liaison Officer for support: Stephen.Kull@nrcan.gc.ca
Canada’s National Forest Carbon Monitoring, Accounting and Reporting System (NFCMARS)

Reporting of GHG balance to EC for National GHG Inventory Reporting.
Analyses in support of policy development and negotiations.
CBM-CFS3 General Approach

Stratification of forest into classes
- Species, site productivity, management type and other criteria used to divide forest estate into strata

Relies heavily on existing forest inventory information
- Input data from forest inventories (or remote sensing)
- Empirical representation of growth dynamics at the stand level.

Dead Organic Matter (DOM) Dynamics linked to Biomass
- Process modelling of litterfall, mortality, disturbance impacts and decomposition to estimate DOM pools

Simulates natural disturbances, forest management and land-use change
- Input data from forest monitoring including remote sensing
CBM-CFS3 Input Data Requirements

**Must Have**
- Forest inventory – area by growth type and age
- Volume over age curves for all growth types
- Transition rules for growth curves

**Optional Input or User-specified Assumptions**
- Schedule of harvests and other management activities
- Natural disturbance data (type, area, year)
- Land-use change (Afforestation, Deforestation)

**Provided with CBM-CFS3** *(can be changed by user)*
- Volume to biomass conversion equations
- Ecological parameters
CBM-CFS3

- Compliant with IPCC 2003 GPG and 2006 Guidelines

Good Practice Guidance for Land use, Land-use Change and Forestry
Outline

• Overview of CBM-CFS3
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• Conclusions
CBM-CFS3 International Applications: Russia

- Collaboration with Russian Federal Forest Agency and Russian Academy of Sciences through bilateral agreement between Canada and Russia.
- Application of model to three regional case studies and at national scale.
- Russian language interface in preparation
- Training workshop planned for fall 2010.

ОЦЕНКА И ПРОГНОЗ УГЛЕРОДНОГО БЮДЖЕТА ЛЕСОВ ВОЛОГОДСКОЙ ОБЛАСТИ ПО КАНАДСКОЙ МОДЕЛИ CBM-CFS*

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Assessment and Projection of Carbon Budget in Forests of Vologda Region Using the Canadian Model CBM-CFS

D. G. Zamолодчиков, V. I. Grabovsky, G. N. Korovin, W. A. Kurz
CBM-CFS3 International Applications: Mexico

- Testing of model in several pilot regions to determine potential suitability of model for UNFCCC reporting and REDD strategy development at national scale.

- 2 workshops and one training session completed in Mexico.

- 94 Spatial Units
- Forest stands > 60,000
- 7 Ecoregions & 32 States
- + Classifiers
Examples of CBM-CFS3 International Applications

• Russia
• Mexico
• Spain (Castilla y Leon Region)
• Italy (Joint Research Centre of EU)
• China (M.Sc. Student)
• US – Alaska (Ph.D. Student)
• Tasmania (Australia – Forestry Tasmania)
• Korea (two pilot areas for testing)
Opportunities for International Applications of Model

- CBM-CFS3 provides framework for integration of available data.
- Scientific focus can be on data compilation and analysis rather than development of GHG accounting framework.
- Sensitivity analyses to help prioritise data needs.
- IPCC compliant approach.
- Ongoing scientific development and improvements.
Challenges for International Applications of Model

- Long history of land use and land-use change complicates initialization of dead organic matter pools.
- Volume to biomass conversion parameters required.
- Recommend testing in pilot applications and review of results prior to large-scale application.
- Need for ground-plot data with complete carbon estimates for testing and parameter development.
Conclusions

• CBM-CFS3 is an operational-scale model for use from stand level to national scale.

• Core model of Canada’s National Forest Carbon Monitoring Accounting and Reporting System (NFCMARS)

• Used for international reporting to UNFCCC and others

• Used nationally and internationally

• Growing number of scientific publications

• Ongoing scientific and technical improvements

• Can be applied to project-level C accounting

• Assessment of forest sector mitigation options in progress.
Thank you very much!

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Model Support: stephen.kull@nrcan.gc.ca
References

• Model Description

• Uncertainty Assessment

• Example Applications:
Kurz et al., 2008, Nature, 452: 987-990,

Publications available at
http://bookstore.cfs.nrcan.gc.ca