Representation of disturbances in the Carbon Budget Model of the Canadian Forest Sector

Werner A. Kurz

Natural Resources Canada
Canadian Forest Service
PFC, Victoria, BC

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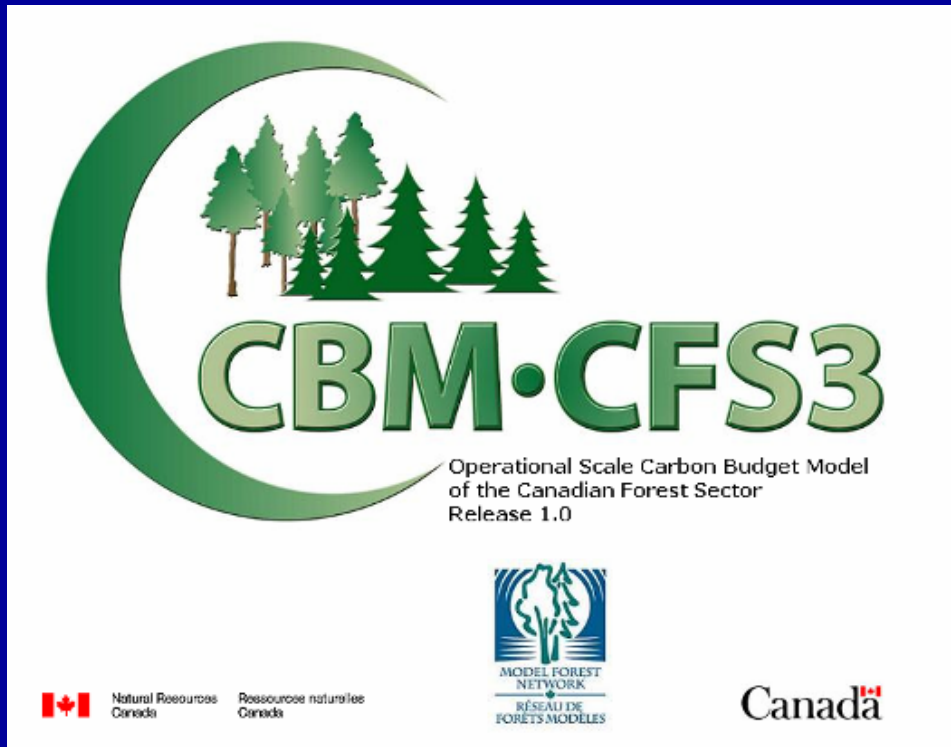
Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)

- An operational-scale model of stand and landscape-level forest C dynamics.
- Stand to national applications in Canada and internationally
- Allows forest managers to assess carbon implications of forest management: increase sinks, reduce sources

- Builds on 20 years of CFS Science

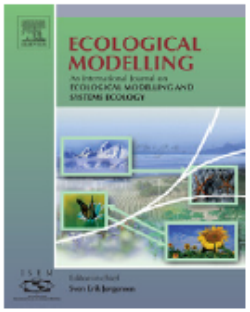
- Freely available at: carbon.cfs.nrcan.gc.ca

Kurz et al. 2009, Ecol. Modelling



Several publications on model structure, and model applications

available at www.sciencedirect.com
Ecological Modelling (2009) 220: 480-504
ScienceDirect
journal homepage: www.elsevier.com/locate/ecolmodel



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

W.A. Kurz[a,*], C.C. Dymond[a], T.M. White[a], G. Stinson[a], C.H. Shaw[b], G.J. Rampley[a], C. Smyth[a], B.N. Simpson[b], E.T. Neilson[a], J.A. Trofymow[a], J. Metsaranta[a], M.J. Apps[a]

… and many more – see last slide for partial list of references.

A General Framework to Represent Disturbance Impacts on Forest C Dynamics

- Disturbances include all events that redistribute carbon within ecosystems, reduce growth rates, or affect post-disturbance C dynamics.
- E.g. fire, insects, windthrow, forest management and land-use change
- 1 framework for all disturbance types

Disturbance Amount

- Defined by user for each disturbance type and year as
  - area,
  - harvest volume (carbon) target, or
  - proportion of eligible stands.
- Spatially explicit (i.e. each polygon) or spatially referenced (i.e. within geographic area).
- If spatially referenced then rules define which stands within area are eligible for each disturbance type.

Disturbance Matrices define impacts on C pools for each disturbance type

Pool sizes before disturbance

Pool	C (t/ha)
Biomass	20
DOM	50

X

Disturbance Matrix transfer proportions

	Bio	DOM	CO2	CO	CH4
Bio	0	.8	.18	.018	.002
DOM	0	.8	.18	.018	.002

=

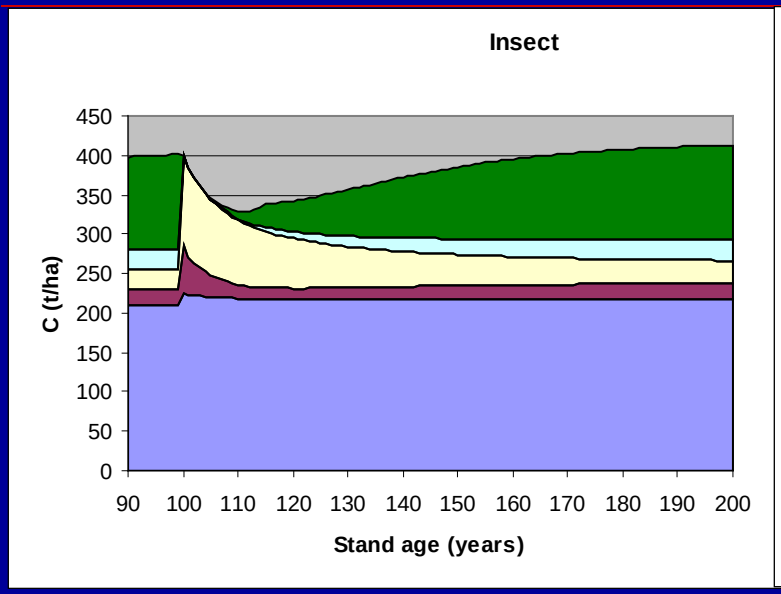
Residual after disturbance

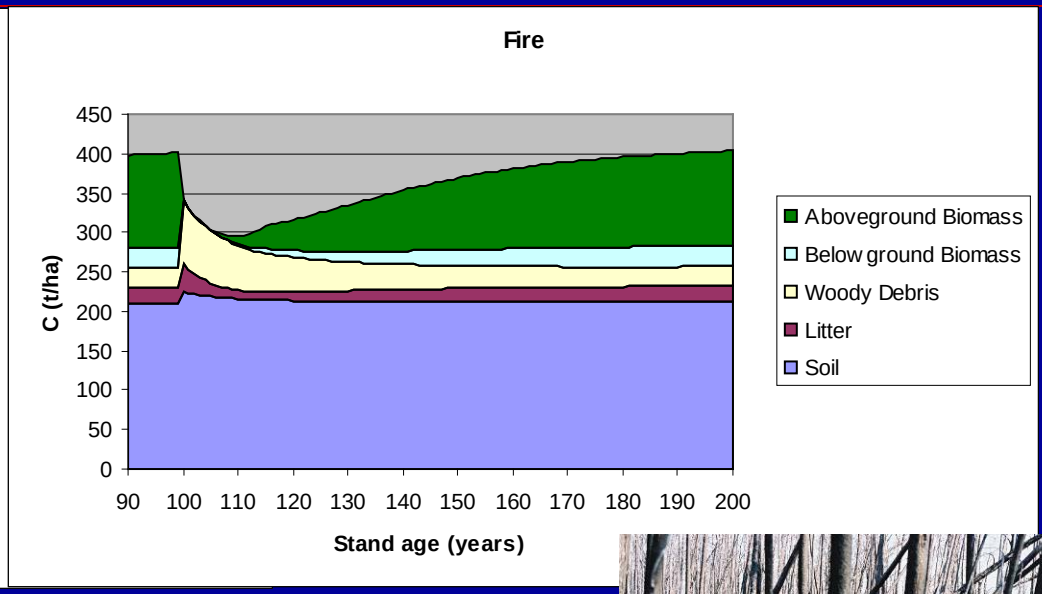
Pool	C (t/ha)
Biomass	0
DOM	56

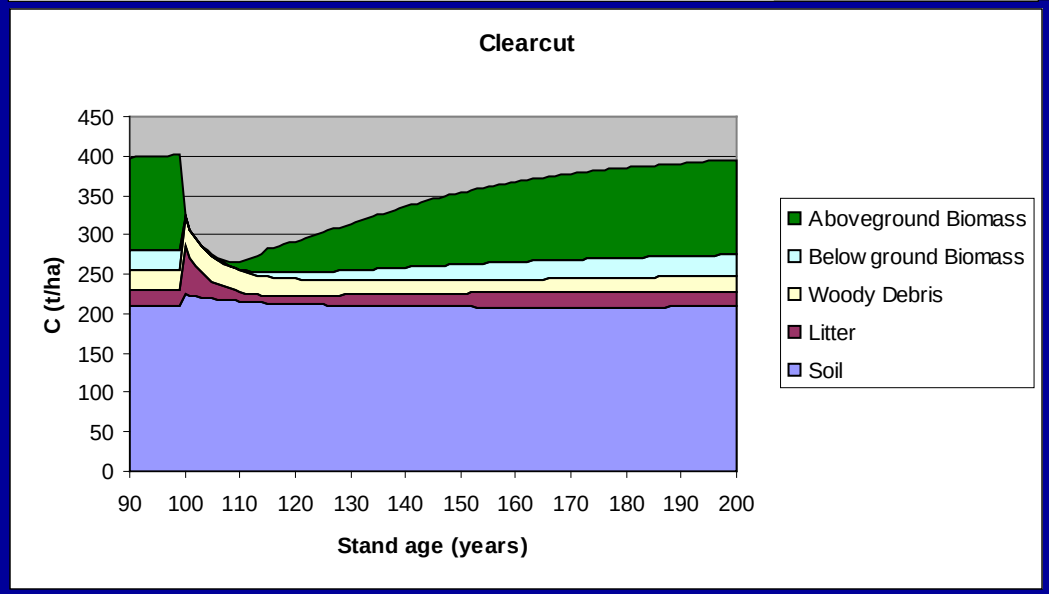
Direct emissions from each disturbance type depend on choice of DM and amount of C contained in biomass and dead organic matter pools.

Actual Disturbance Matrix is 21 x 25 but only few cells require data.

Disturbance type affects size and composition of post-disturbance forest C pools







Disturbance Impact

- Disturbances also affect age-class structure.
- Disturbances can also merely reduce growth rates e.g. light defoliation events by insects.
- Post disturbance dynamics of DOM and soil C pools represented through process simulation.
- Post disturbance growth defined through “transition rules” to same or new growth curve.
- Additional complexities such a regeneration delays can also be defined.

Conclusions

- The CBM-CFS3 includes a very general framework for representing impacts of disturbance events on forest (and C) dynamics.
- Spatially explicit or spatially-referenced
- Range of direct and post-disturbance impacts.

References

• ***Model Description***

Kurz, et al. 2009, Ecological Modelling 220: 480-504.

Kurz and Apps. 2006. Mitigation & Adapt. Strat for Global Change, 11: 33–43.

• ***Uncertainty Assessment***

White et al. 2008. Ecological Modelling 219: 373–382.

• ***Example Applications:***

Metsaranta and Kurz 2012 Ecological Modelling 224: 111– 123

Stinson et al. 2011, GCB 17: 2227–2244

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

Kurz et al., 2008, PNAS, 105(5): 1551-1555.

Kurz et al. 2007, Phil. Trans. R. Soc. B doi:10.1098/rstb.2007.2198

Trofymow et al. 2008 Forest Ecology and Management 256: 1677–1691

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

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Thank you very much!

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e-mail: werner.kurz@nrcan.gc.ca

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