

# Reporting mortality losses and deadwood pools in forests



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# Outline

Reporting of biomass

How to consider mortality

Definition of net and gross increment

Conservation of mass balance

Approaches for deadwood estimations



# Introduction

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Focus on forest land

During the EU LULUCF review 2025 some raised issues were related to the treatment of mortality in biomass flux calculations and estimation of deadwood pool CSC or fluxes

Biomass and deadwood biomass pools require tier 2 approaches for reporting under the EU LULUCF regulation

The IPCC guidelines do not explicitly include mortality in biomass pools

Tier 1 assumption for deadwood is not suitable as level of harvest or disturbance losses vary over time



For all/ most MS forest biomass is key category

Use tier 2 or 3 (EU LULUCF reg requirement) based on either stock change or gains loss approach

- Stock change in living biomass
  - IPCC guidelines does not explicitly consider mortality (intrinsically included)
    - E.g. based on NFI living biomass stocks at time  $x$  and  $x+1$
    - This includes harvest, mortality and disturbance losses
  - Must apply stock change for all other pools (see mass balance later)
- Gain/loss- requires the use of net increment (NAI) not gross increment (GAI, see Ch 2 IPCC GPG AFOLU 2006)
  - NAI excludes mortality losses
  - If GAI is included in biomass gains then mortality losses must be included as biomass losses ( $\Delta C_L$ ), with harvest, disturbance and firewood losses

Biomass- Stock change or gains and losses (fluxes)

The gross annual (merchantable) volume increment ( $GAI$ ) at the time step  $t$  is defined as:

$$GAI_t = NAI_t + ANL_t \quad \text{Eq. (1)}$$

Where,  $NAI$  is the net annual (merchantable) volume increment at time step  $t$  and  $ANL$  includes annual natural losses from the (merchantable) living biomass stock due to natural turnover rate, excluding exceptional natural disturbance events (e.g., wildfires, windstorms, drought, bark beetle outbreaks).

$NAI$  includes the following items:

$$NAI_t = (St_t - St_{t-1}) + Rem_t + Res_t + Em_t \quad \text{Eq. (2)}$$

Where,

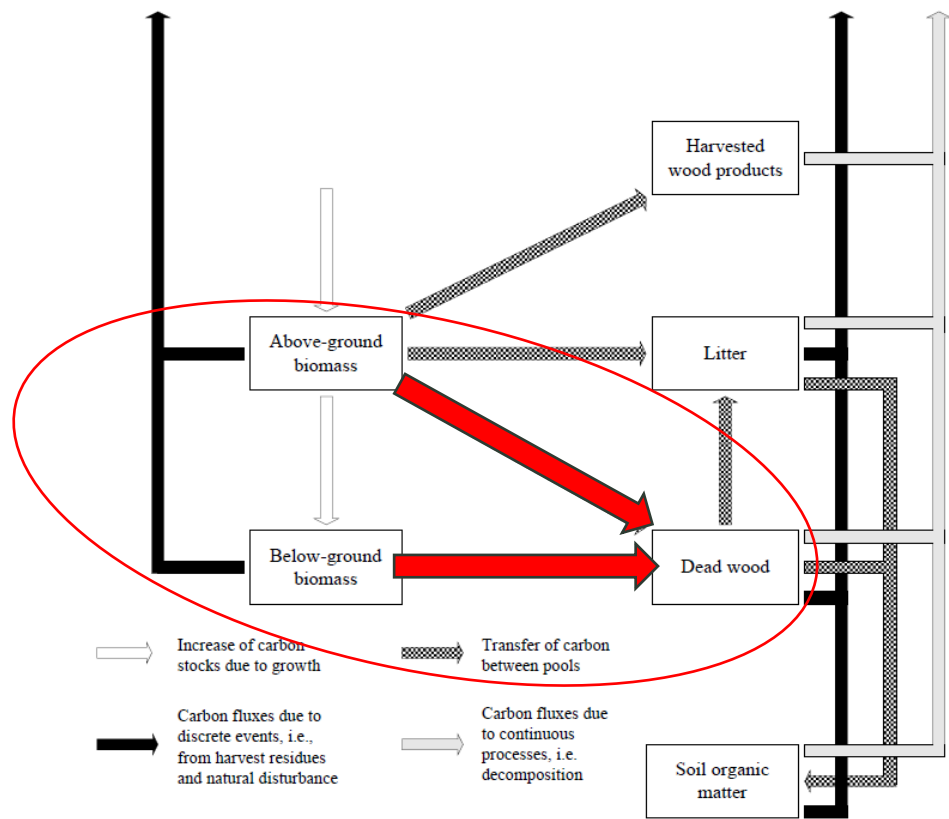
$St$  is the (merchantable) volume stock at time step  $t$  and  $t-1$  (*net of losses*)

$Rem$  includes (merchantable) volume removals occurred at time step  $t$

$Res$  includes (merchantable) residues moved from living biomass to DOM pool due to harvest or other natural disturbances occurred on time step  $t$

$Em$  includes (merchantable) direct emissions occurred on time step  $t$  due to fire events (if relevant).

## Gross and net annual increment definitions



**TABLE 2.1**  
**EXAMPLE OF A SIMPLE MATRIX (TIER 2) FOR THE IMPACTS OF DISTURBANCES ON CARBON POOLS**

From:\nTo:	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Soil organic matter	Harvested wood products	Atmosphere	Sum of row (must equal 1)
Above-ground biomass	A		B	C	D	E	F	1
Below-ground biomass								1
Dead wood								1
Litter			B					1
Soil organic matter								1

Enter the proportion of each pool on the left side of the matrix that is transferred to the pool at the top of each column. All of the pools on the left side of the matrix must be fully populated and the values in each row must sum to 1. Impossible transitions are blacked out.

Note: Letters A to F are cell labels that are referenced in the text.

# Conservation of mass balance

- Easily done using NFI data
  - $\Delta C_{DW} = \frac{C_2 - C_1}{t_2 - t_1}$
  - Annualization?
- Deadwood includes harvest residues, dead trees standing and fallen logs, branches, dead stumps and roots
  - Some NFIs do not measure stumps and roots
- Tier 1 assumption is only valid if harvest and natural disturbances do not fluctuate
  - Otherwise the deadwood pool will increase or decrease
  - Provide evidence that deadwood is net zero
- Not good practice to combine gains loss approach for biomass and stock change for deadwood (Mass balance?)
  - Does not reflect annual fluctuations biomass harvest, mortality losses and in deadwood inflows

## Deadwood stock change

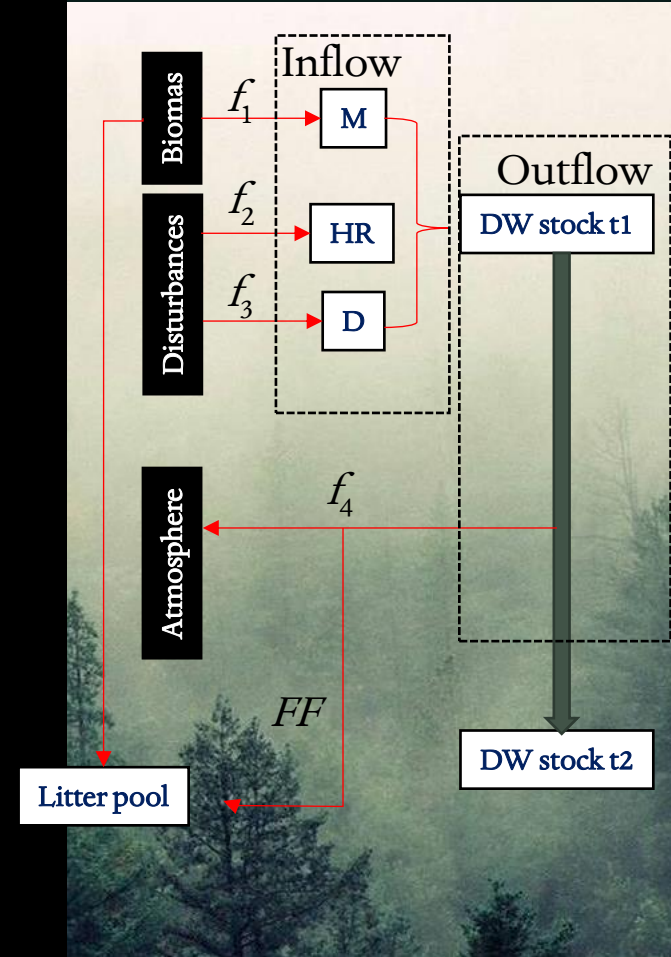
- Model as an inflow outflow (decay) model (similar to IPCC first order decay HWP model)
- Data: Harvest residue (HR), mortality (M), fire and windthrow inputs (D), Starting DW stock from NFI
- Verification of model outputs over GHGI timeseries

- Inflow

- $f_1$  = Biomass turnover (mortality rate)
- $f_2$  = Harvest residue as a function of harvest (stem, branch, stump, roots)
- $f_3$  = Fire, windthrow etc. inflow
- Parametrize using literature or by calibration using NFIs

- Outflow ( $f_4$ )

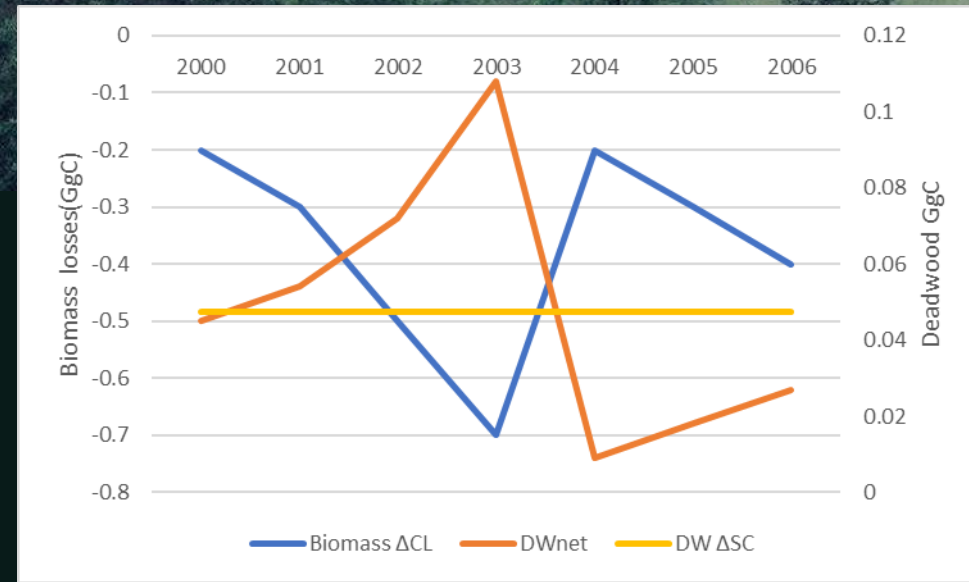
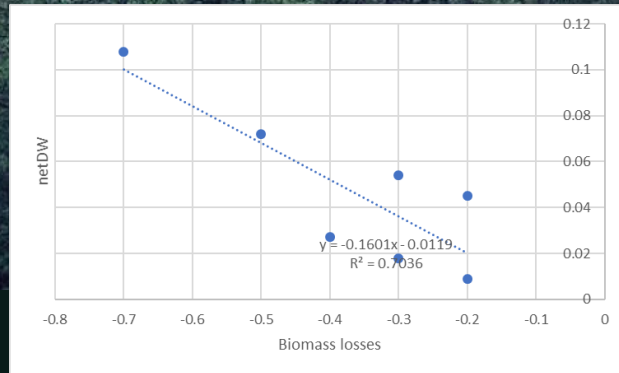
- $DW_{t1+1} = e^{-k} \times [DW_{t1} \times FF] + \left[ \frac{(1-e^{-k})}{k} \right] \times [Inflow_{ij}]$
- k= decay constant
- FF= fragmentation (goes to litter pool optional)
- Parametrize using literature or by calibration with NFI using stocks t1 and t2



# Deadwood simple inflow out flow model

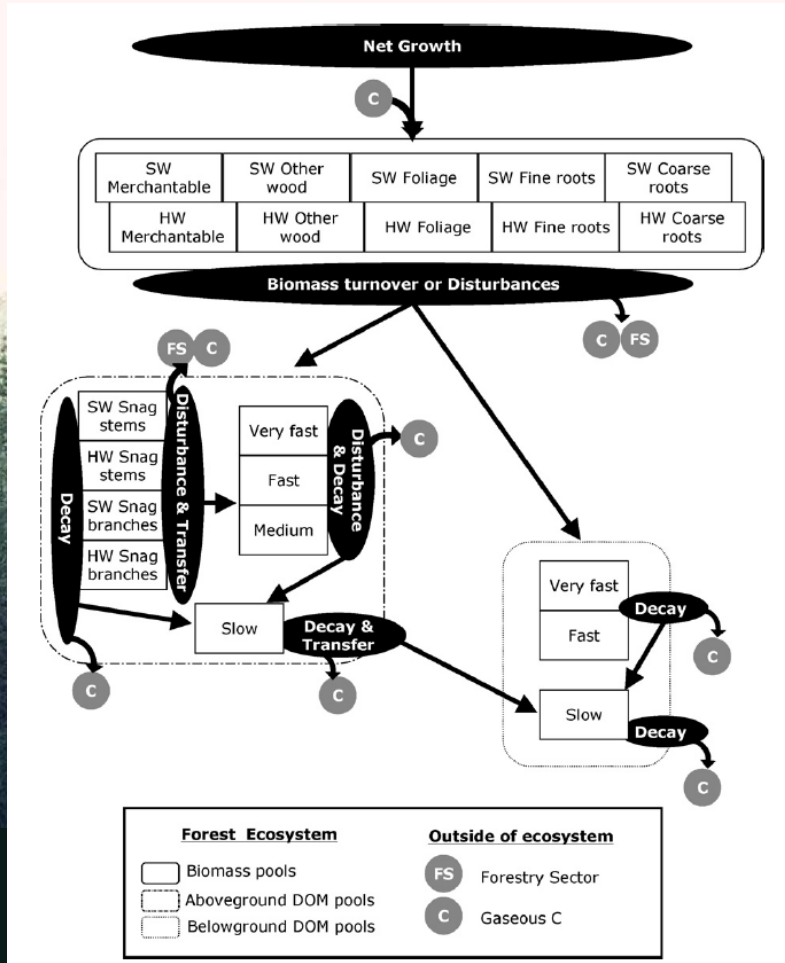
- Inflow outflow vs stock change

	Biomass $\Delta C_G$	Biomass $\Delta C_L$	Biomass net	DW $\Delta C_G$	DW $\Delta C_L$	DWnet	DW Stock	DW $\Delta SC$	Diff
2000	1	-0.2	0.8	0.05	-0.005	0.045	17.2	0.0476	-0.0026
2001	1.5	-0.3	1.2	0.06	-0.006	0.054		0.0476	0.0064
2002	2	-0.5	1.5	0.08	-0.008	0.072		0.0476	0.0244
2003	2.1	-0.7	1.4	0.12	-0.012	0.108		0.0476	0.0604
2004	2.2	-0.2	2	0.01	-0.001	0.009		0.0476	-0.0386
2005	2.6	-0.3	2.3	0.02	-0.002	0.018		0.0476	-0.0296
2006	1.9	-0.4	1.5	0.03	-0.003	0.027	17.2	0.0476	-0.0206
	13.3	-2.6	10.7	0.37	-0.037	0.333		0.333	0

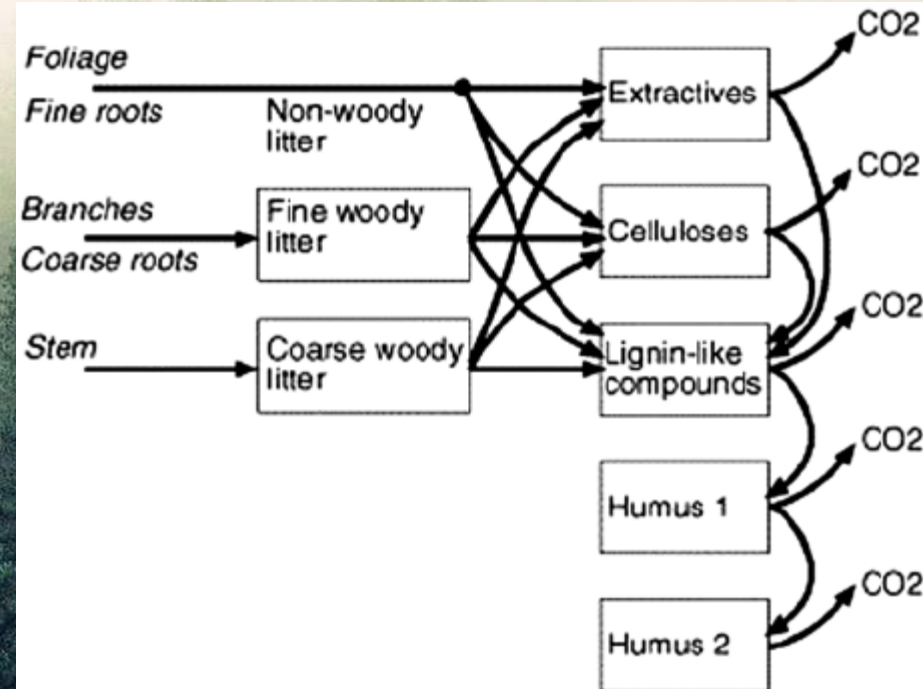


# Deadwood example

CBM-CFS3 (Kurz et al., 2009)



YASSO (Liski et al., 2005)



Full C accounting (excl. organic soils and HWP)  
 Full conservation of mass balance  
 CA, CZ, IE, JRC  
 Free to use and training provided by CFS

Model DOM only must be incorporated with NFI data or other models  
 DE, NL (with EFISCEN), FI, others

# Tier 3 models



# Questions?

