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Forest Land

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According to 2006 IPCC GL

2006 IPCC GL

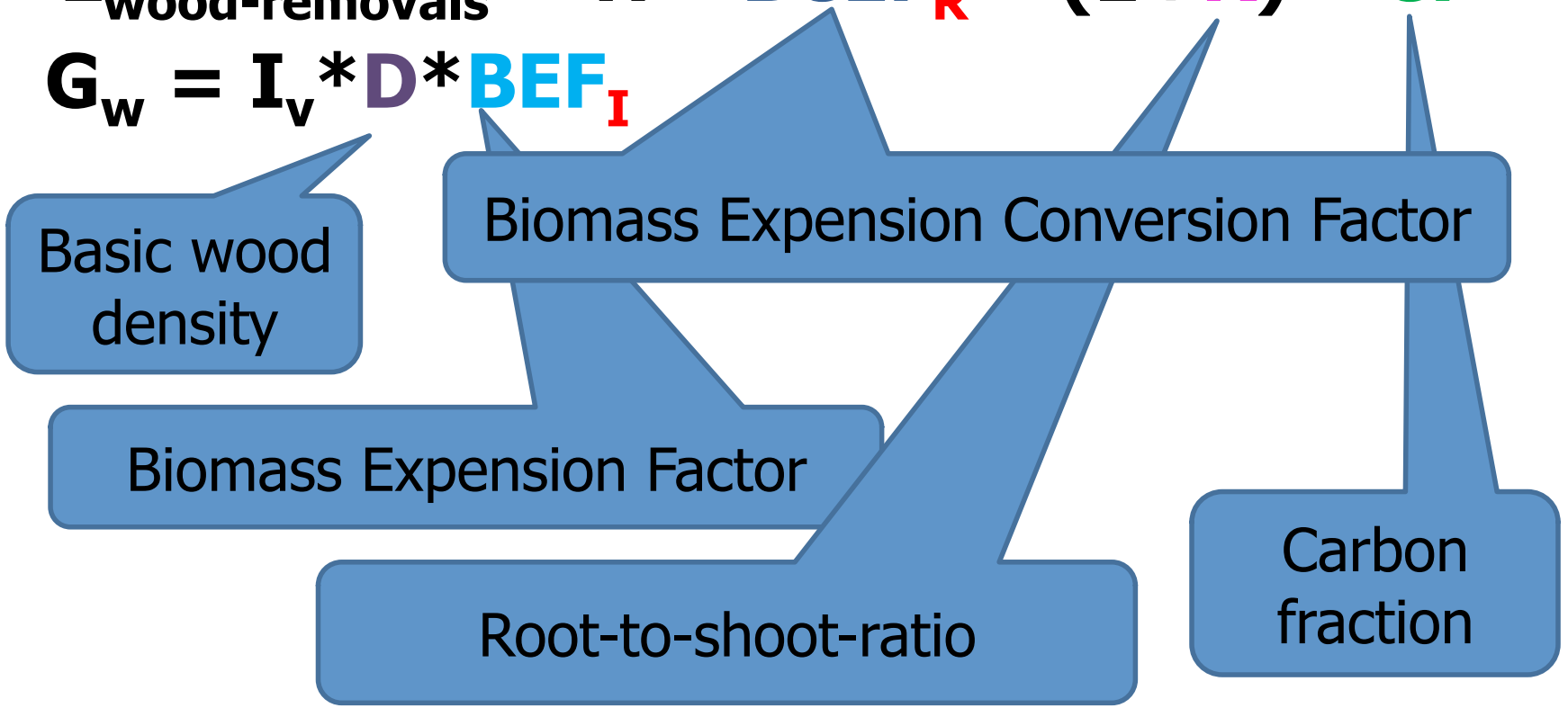
- http://www.ipcc-nggip.iges.or.jp/
- Volume 4
- Chapter 4

Let's look at some of the ingredients

$$\Delta C_G = A * I_V * BCEF_I * (1+R) * CF$$

$$L_{wood\text{-}removals} = H * BCEF_R * (1+R) * CF$$

$$G_w = I_v * D * BEF_I$$

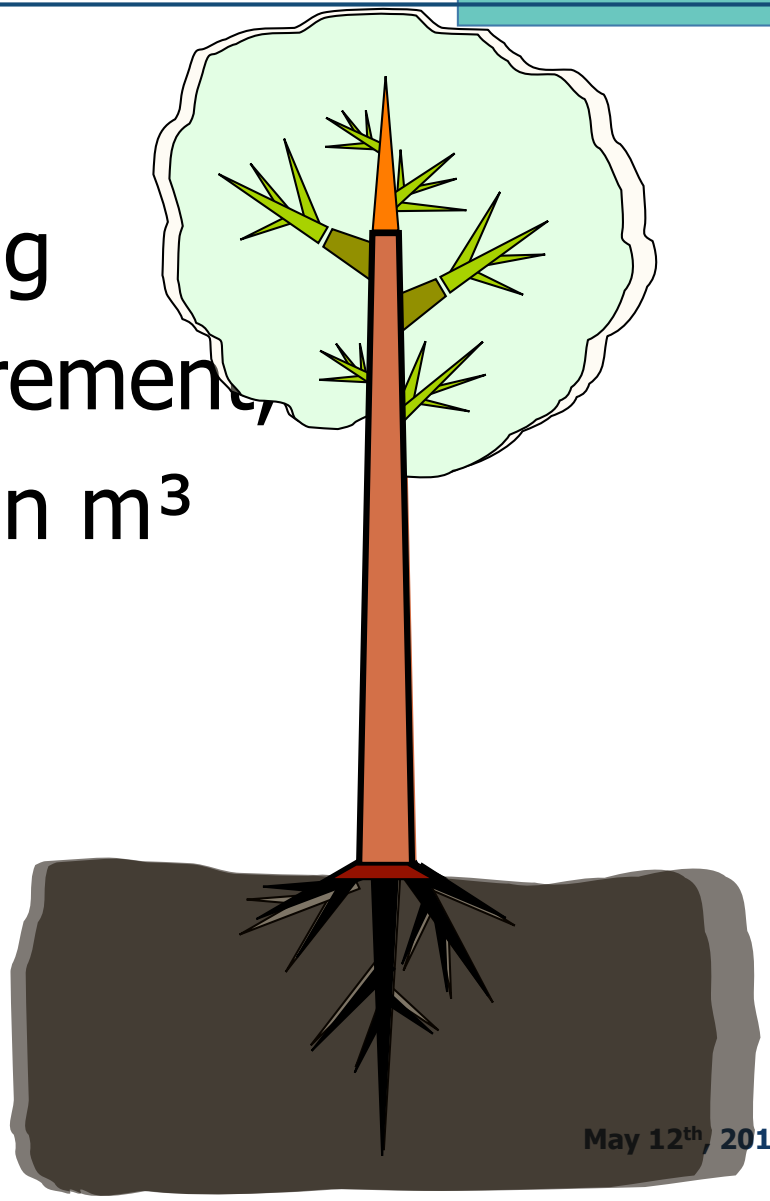


Estimating with proxies

- Expansion:
  - from merchantable to total above-ground (BEF)
  - from above-ground to total (1+R)
- Conversion:
  - From wood volume to biomass (basic density)
  - From biomass to carbon (carbon fraction)
- Combined: BCEF

Biomass Expansion Conversion Factor

- Forest inventories record usually growing stock, net annual increment, and wood removals in m^3
- What is left out?



Biomass Expansion Conversion Factor

- Assessment of biomass & C stock change is on the **total** biomass, biomass growth, biomass removals in tonnes of dry weight

How to estimate above-ground biomass and its changes?

- 2 ways possible according to 2006 IPCC GL

Biomass Expansion Conversion Factor

1. Do the measuring in the field and apply species-specific allometric equations or biomass tables on these equations
2. Transform available volume data from forest inventories*

*transformation is achieved by applying biomass regression functions, expresses biomass of species (t/ha) or ist rate of change, directly as a function of growing stock density (m^3/ha) and age, eco-regions, etc.

Biomass Expansion Conversion Factor

Discrete transformation factor:

- **BEF** expands the dry weight to account for non-mechantable components of tree, stand, and forests
- BUT before applying BEF volume (m^3) must be converted into dry-weight (tonne) → multiply with wood density (D in t/m^3)
- Good results when local D have been used

Biomass Expansion Conversion Factor

Example:

- Above-ground growing stock volume is 80 m^3/ha
- BEF = 1,3 (tropical pine species, dbh minimum of 10 cm)
- D = 0,51 t/m^3 (*Pinus caribea*)

Total above-ground biomass = 80 m^3/ha* 0,51 t/m^3*1,3 = 53, 04 t/ha

Biomass Expansion Conversion Factor

Discrete transformation factor:

- **BECF** combines conversion and expansion
- Transforms with one single multiplication directly into above-ground biomass, biomass growth, biomass removals (t)
- BECFs very convenient, applicable on volume-based forest inventories data
- Good when derived locally

Example:

- Above-ground growing stock volume is 80 m^3/ha
- BECF = 0,76 (humid tropical, growing stock volume of 80-120 m^3)

Total above-ground biomass = 80 m^3* 0,76
= 60,8 t/ha

Biomass Expansion Conversion Factor

- Relation of BCEF and BEF:

$$BCEF = BEF*D$$

- 2006 IPCC GL uses 3 BCEFs:
  - $BCEF_S$: vol. growing stock →above-ground biomass
  - $BCEF_I$: vol. net annual increment →above-ground biomass growth
  - $BCEF_R$: wood & fuelwood removal into above-ground biomass removal (including bark)

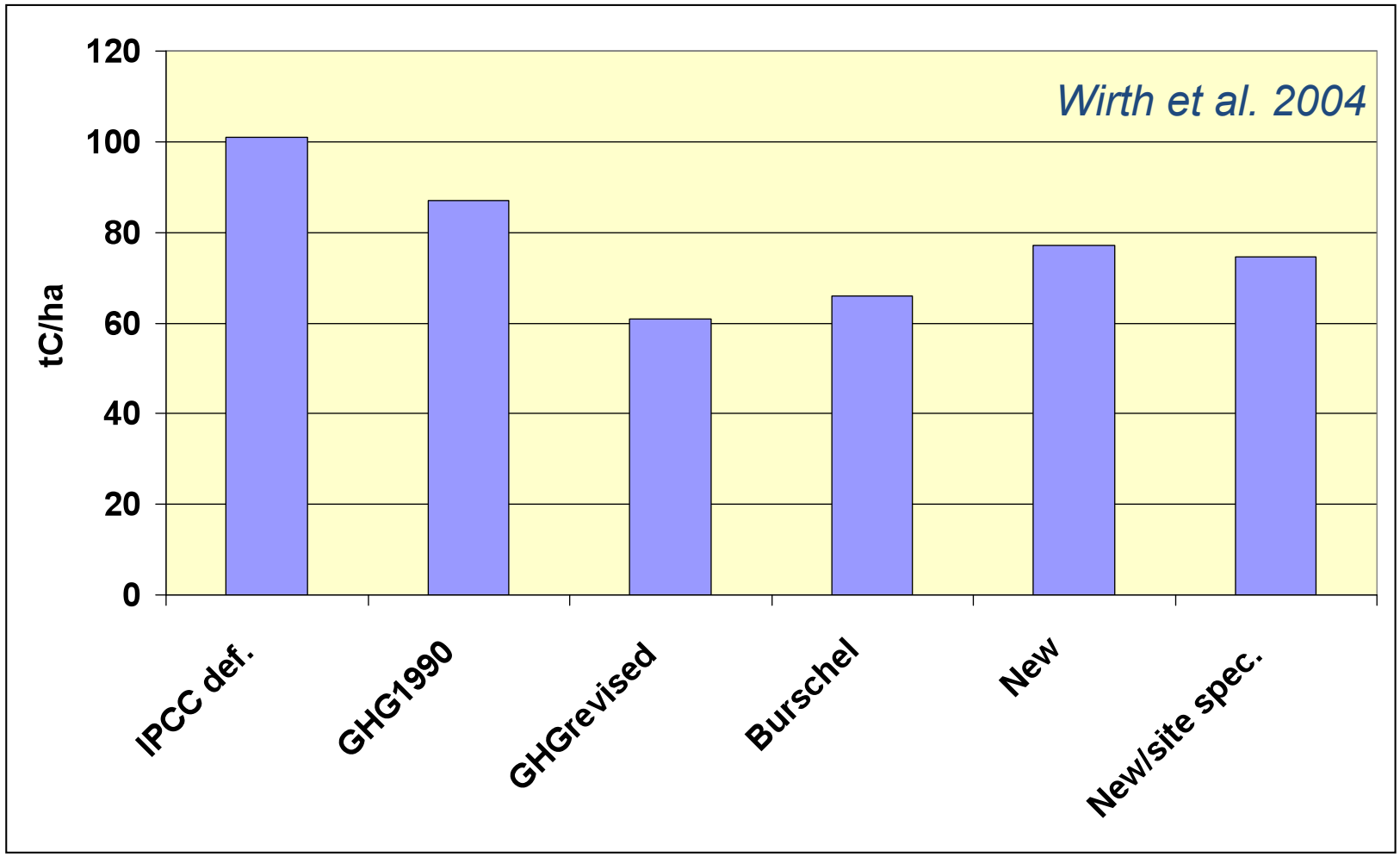
Biomass Expension Conversion Factor

TABLE 4.5 (CONTINUED)
DEFAULT BIOMASS CONVERSION AND EXPANSION FACTORS (BCEF), TONNES BIOMASS (M^3 OF WOOD VOLUME)$^{-1}$

BCEF for expansion of merchantable growing stock volume to above-ground biomass ($BCEF_S$), for conversion of net annual increment ($BCEF_I$) and for conversion of wood and fuelwood removal volume to above-ground biomass removal ($BCEF_R$)

Climatic zone	Forest type	BCEF	Growing stock level (m^3)							
			<10	11-20	21-40	41-60	61-80	80-120	120-200	>200
Humid tropical	conifers	$BCEF_S$	**4.0** (3.0-6.0)	**1.75** (1.4-2.4)	**1.25** (1.0-1.5)	**1.0** (0.8-1.2)	**0.8** (0.7-1.2)	**0.76** (0.6-1.0)	**0.7** (0.6-0.9)	**0.7** (0.6-0.9)
		$BCEF_I$	2.5	0.95	0.65	0.55	0.53	0.58	0.66	0.70
		$BCEF_R$	4.44	1.94	1.39	1.11	0.89	0.84	0.77	0.77
	natural forests	$BCEF_S$	**9.0** (4.0-12.0)	**4.0** (2.5-4.5)	**2.8** (1.4-3.4)	**2.05** (1.2-2.5)	**1.7** (1.2-2.2)	**1.5** (1.0-1.8)	**1.3**(0.9-1.6)	**0.95** (0.7-1.1)
		$BCEF_I$	4.5	1.6	1.1	0.93	0.9	0.87	0.86	0.85
		$BCEF_R$	10.0	4.44	3.11	2.28	1.89	1.67	1.44	1.05

Biomass Expansion Conversion Factor



Root-to-shoot ratio

- Ratio of below-ground biomass to above-ground biomass
- t d.m. bgb/ t d.m. abb
- Table 4.4

Root-to-shoot ratio

TABLE 4.4
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R)

Domain	Ecological zone	Above-ground biomass	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	References
Tropical	Tropical rainforest		0.37	Fittkau and Klinge, 1973
	Tropical moist deciduous forest	above-ground biomass <125 tonnes ha^{-1}	0.20 (0.09 - 0.25)	Mokany *et al.*, 2006
		above-ground biomass >125 tonnes ha^{-1}	0.24 (0.22 - 0.33)	Mokany *et al.*, 2006
	Tropical dry forest	above-ground biomass <20 tonnes ha^{-1}	0.56 (0.28 - 0.68)	Mokany *et al.*, 2006
		above-ground biomass >20 tonnes ha^{-1}	0.28 (0.27 - 0.28)	Mokany *et al.*, 2006
	Tropical shrubland		0.40	Poupon, 1980
	Tropical mountain systems		0.27 (0.27 - 0.28)	Singh *et al.*, 1994
Subtropical	Subtropical humid forest	above-ground biomass <125 tonnes ha^{-1}	0.20 (0.09 - 0.25)	Mokany *et al.*, 2006
		above-ground biomass >125 tonnes ha^{-1}	0.24 (0.22 - 0.33)	Mokany *et al.*, 2006
	Subtropical dry forest	above-ground biomass <20 tonnes ha^{-1}	0.56 (0.28 - 0.68)	Mokany *et al.*, 2006
		above-ground biomass >20 tonnes ha^{-1}	0.28 (0.27 - 0.28)	Mokany *et al.*, 2006

Wood density

- Ratio between oven dry mass & fresh stem-wood volume w/o bark
- From m^3 to t
- Table 4.13 for tropical tree species
- Table 4.14 for temperate & boreal tree taxa

Wood density

TABLE 4.13 BASIC WOOD DENSITY (D) OF TROPICAL TREE SPECIES (OVEN-DRY TONNES (MOIST M^{-3}))

1 = Baker *et al.*, 2004b; 2 = Barbosa and Fearnside, 2004; 3 = CTFT, 1989; 4 = Fearnside, 1997; 5 = Reyes *et al.*, 1992

Species	Density	Continent	Reference
Degeneria vitiensis	0.35	Asia	5
Dehaasia triandra	0.64	Asia	5
Dendropanax arboreum	0.40	Americas	4
Desbordesia pierreana	0.87	Africa	5
Detarium senegalensis	0.63	Africa	5
Dialium excelsum	0.78	Africa	5
Dialium guianense	0.88	Americas	4
Dialium sp.	0.80	Asia	5
Dialyanthera sp.	0.36-0.48	Americas	5
Diclinanona calycina	0.47	Americas	4
Dicorynia ghuianensis	0.65	Americas	4
Dicorynia paraensis	0.60	Americas	5
Didelotia africana	0.78	Africa	5
Didelotia letouzeyi	0.50	Africa	5
Didymopanax sp.	0.74	Americas	5
Dillenia sp.	0.59	Asia	5
Dimorphandra mora	0.99	Americas	5
Dinizia excelsa	0.86	Americas	4

TABLE 4.13 BASIC WOOD DENSITY (D) OF TROPICAL TREE SPECIES (OVEN-DRY TONNES (MOIST M^{-3}))

1 = Baker *et al.*, 2004b; 2 = Barbosa and Fearnside, 2004; 3 = CTFT, 1989; 4 = Fearnside, 1997; 5 = Reyes *et al.*, 1992

Species	Density	Continent	Reference
Enterolobium cyclocarpum	0.35	Asia	5
Enterolobium maximum	0.40	Americas	4
Enterolobium schomburgkii	0.78	Americas	4
Eperua falcata	0.78	Americas	4
Epicharis cumingiana	0.73	Asia	5
Eribroma oblongum	0.60	Africa	5
Eriocoelum microspermum	0.50	Africa	5
Eriotheca longipedicellata	0.45	Americas	4
Erisma uncinatum	0.47	Americas	1
Erismadelphus ensul	0.56	Africa	5
Erythrina sp.	0.23	Americas	5
Erythrina subumbrans	0.24	Asia	5
Erythrina vogelii	0.25	Africa	5

Carbon fraction

- Allows to estimate C in the biomass
- t C/t d.m.
- Table 4.3

Carbon fraction

TABLE 4.3
CARBON FRACTION OF ABOVEGROUND FOREST BIOMASS

Domain	Part of tree	Carbon fraction, (CF) [tonne C (tonne d.m.)$^{-1}$]	References
Default value	All	0.47	McGroddy *et al.*, 2004
Tropical and Subtropical	All	0.47 (0.44 - 0.49)	Andreae and Merlet, 2001; Chambers *et al.*, 2001; McGroddy *et al.*, 2004; Lasco and Pulhin, 2003
	wood	0.49	Feldpausch *et al.*, 2004
	wood, tree d < 10 cm	0.46	Hughes *et al.*, 2000
	wood, tree d ≥ 10 cm	0.49	Hughes *et al.*, 2000
	foliage	0.47	Feldpausch *et al.*, 2004
	foliage, tree d < 10 cm	0.43	Hughes *et al.*, 2000
	foliage, tree d ≥ 10 cm	0.46	Hughes *et al.*, 2000

What is needed for tier 1?

	Biomass	DOM	Soil
FL remaining FL			
Tier 1	BCEFs, R, CF = 0,47 t C/ t d.m.	0	Mineral S = 0 Organic S= A*1,36
L converted to FL			
Tier 1	BCEFs, R, CF = 0,47 t C/ t d.m.	Data on C – Stock in Litter, Table 2.2	Minerarl S: SOC Referenz C stock, table 2.3, land-use factors, mgt-factors, C input factors Organic S= A*1,36
FL converted to L			
Tier 1	BCEFs, R, CF = 0,47 t C/ t d.m., Tables 4.7 to 4.12	Data on C – Stock in Litter, Table 2.2	SOC Referenz C stock table 2.3, land-use factors, mgt-factors, C input factors Minerarl S: SOC Referenz C stock, table 2.3, land-use factors, mgt-factors, C input factors Organic S= A*1,36

Thank you!