Uncertainties in the estimates of carbon in harvested wood products for Portugal

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Introduction

- Harvested wood products (HWP) in use accumulate carbon for periods varying from a few days to several decades. Discarded HWP can be deposited in landfills where they may persist for long periods of time

- IPCC GPG LULUCF provides methods for C estimation in HWP:
  - Tier 1 method: ignores C accumulation in HWP
  - Tier 2 method: simplified method relying on default input data
  - Tier 3 methods: methods requiring country-specific data

- Uncertainty level in the tier 2 method is expected to be higher than ±50%. Tier 3 methods are expected to decrease the uncertainty level

Objectives

- To compare the uncertainty levels in the estimates of C accumulation in HWP for Portugal using two different methods:
  - GPG tier 2 method
  - method consistent with GPG tier 3 method B
- To identify the input parameters that contribute more to the uncertainty in the estimates

Methodology

- Difference between approach and method:

APPROACH (conceptual framework) refers to the allocation of the change in carbon stocks (or emissions) between consuming and producing countries of HWP

METHOD (calculation framework) refers to the measurement and estimation of change in carbon stocks (or emissions) associated with HWP

Methodology

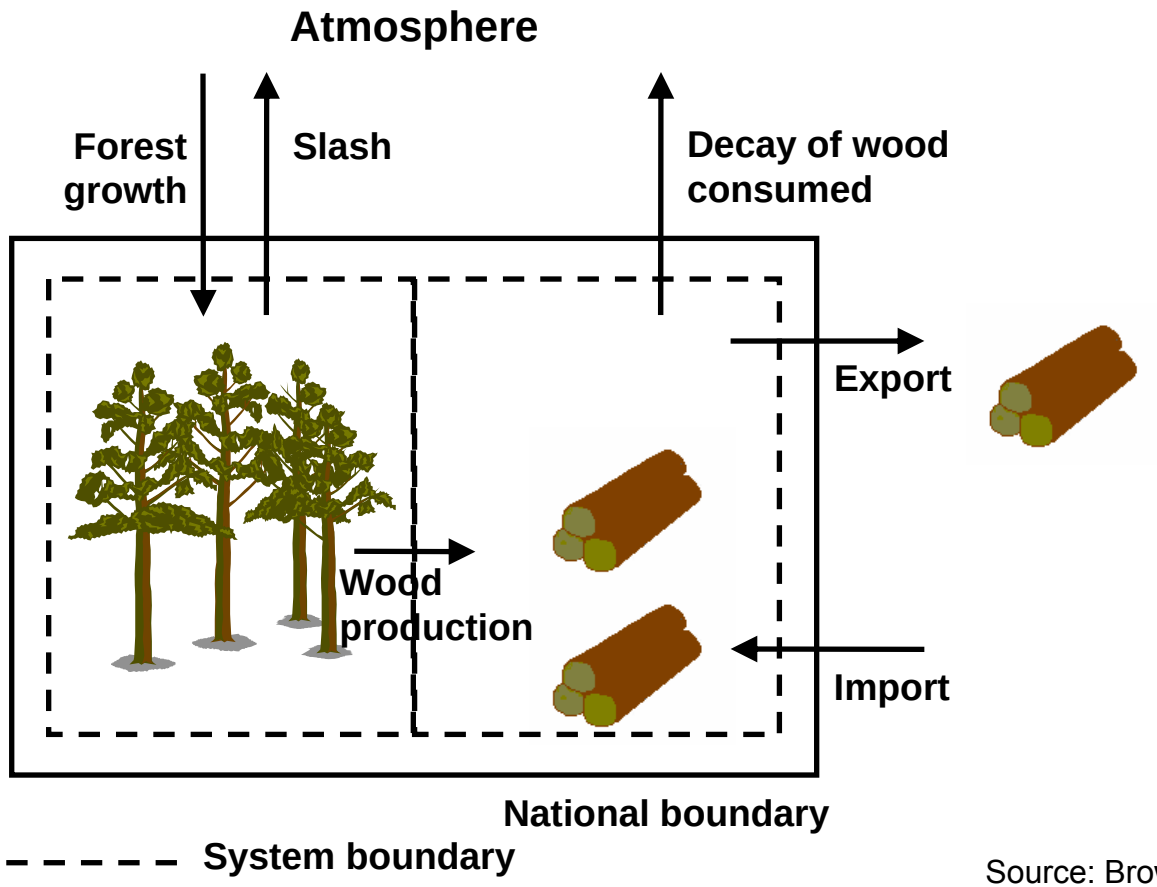
- 3 alternative approaches were applied:
  - Stock-change approach
  - Production approach
  - Atmospheric-flow approach

Differ in the way the changes in carbon stocks (or emissions) from traded HWP are allocated to consuming and producing countries

Methodology

- Stock-change approach

C accumulation = stock change in forest + stock change in consumed HWP

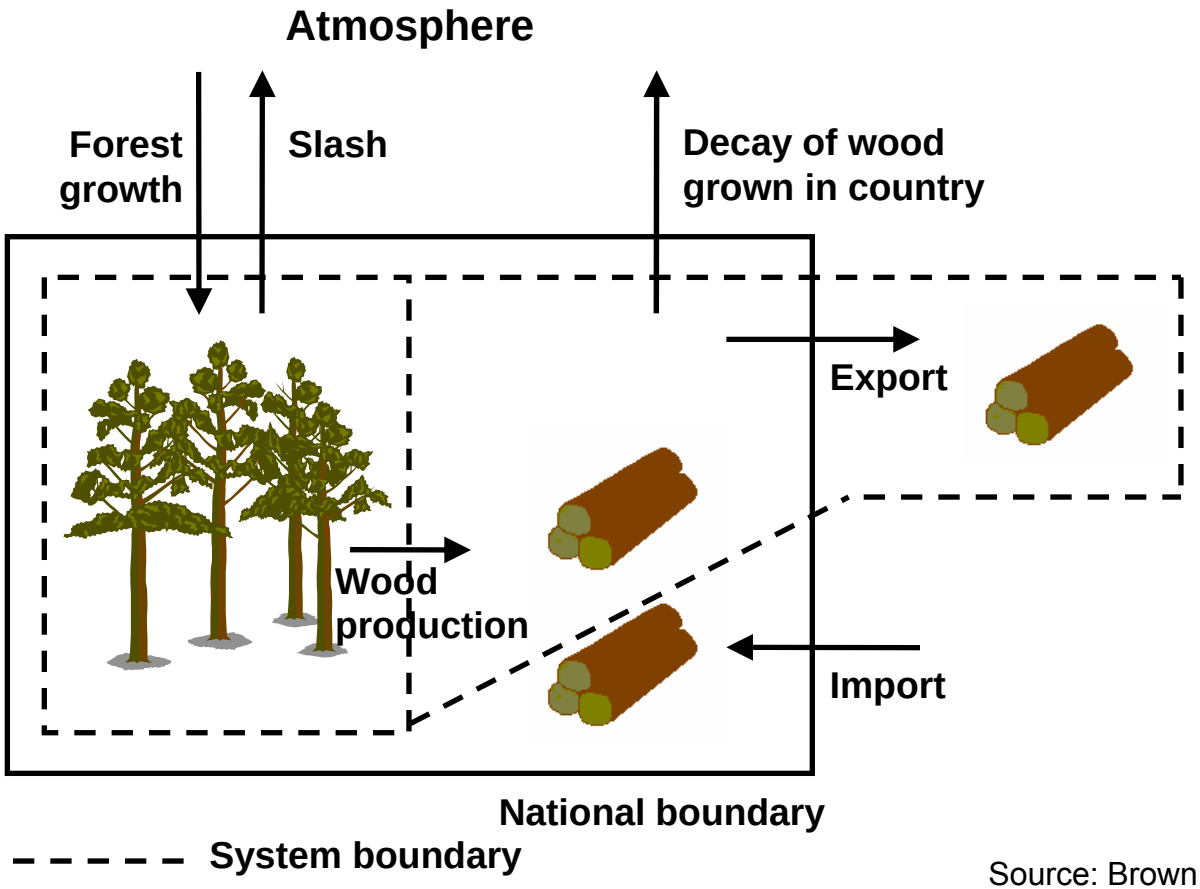


Source: Brown et al. (1999)

Methodology

- Production approach

C accumulation = stock change in forest + stock change in HWP produced from domestically-grown wood



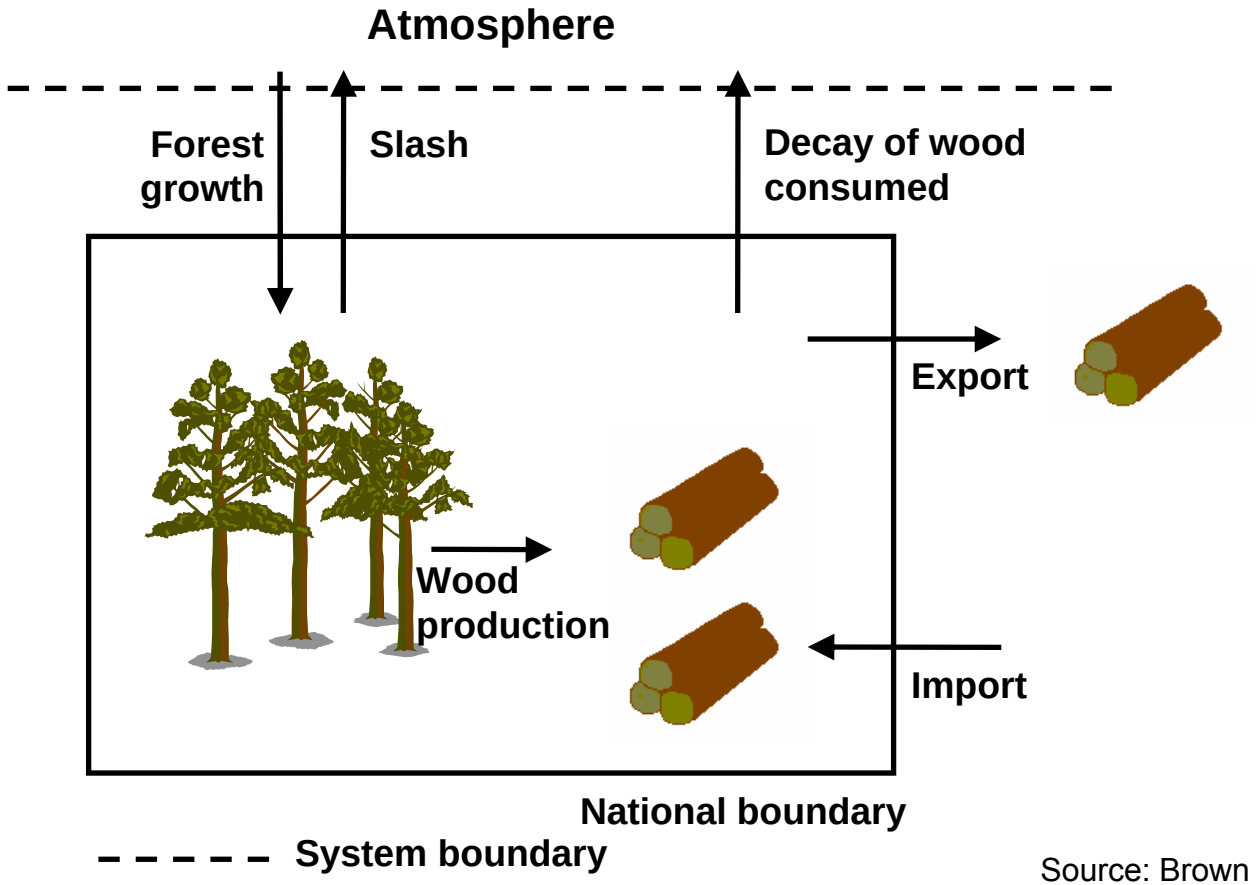
Source: Brown et al. (1999)

Methodology

- Atmospheric-flow approach

C accumulation = forest growth – slash – decay of wood consumed

C accumulation in HWP = C accumulation in the SCA + net export of C in HWP



Source: Brown et al. (1999)

Methodology

- GPG tier 2 and tier 3 methods are inflow-outflow methods based on a lifetime analysis

Change in C stocks = C input – C output

- C input: statistical data on production and trade of HWP
- C output: based on the lifetimes of HWP

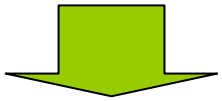
exponential decay rates

Methodology

	GPG tier 2 method	GPG tier 3 method
Semi-finished HWP categories	• sawnwood • panels • paper	• sawnwood • panels • paper • other industrial wood
Longevity categories for HWP in use	• solidwood products • paper products	• solidwood products for packaging • solidwood products for construction • solidwood products for furniture • solidwood products for other uses • printing and writing paper • other paper
Statistical data of HWP	FAO data	“best” data available
Decay rates of HWP	default data	based on a literature review
Conversion factors to C dry weight	default data	country-specific data

Methodology

- Monte Carlo method (@Risk software):
  - Definition of probability density functions (PDFs) for each input parameter
  - Specification of the simulation settings (5000 iterations, sampling method: latin hypercube)
  - Run the software (selects random values of the input data from within their individual PDFs and calculates the corresponding results; this procedure is repeated several times)

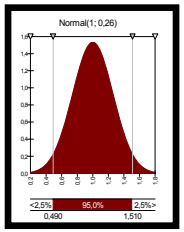


Uncertainty in the estimate given as a PDF

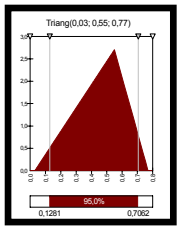
(95% confidence interval)

Methodology

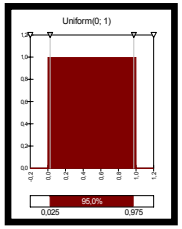
- Probability density functions:



normal distributions - applied when the uncertainty around the mean value was symmetrical



triangular distributions - applied when the uncertainty around the most likely value was not symmetrical



uniform distributions - applied when all values in a given range had equal probability

Based on measured data, literature data and expert judgement

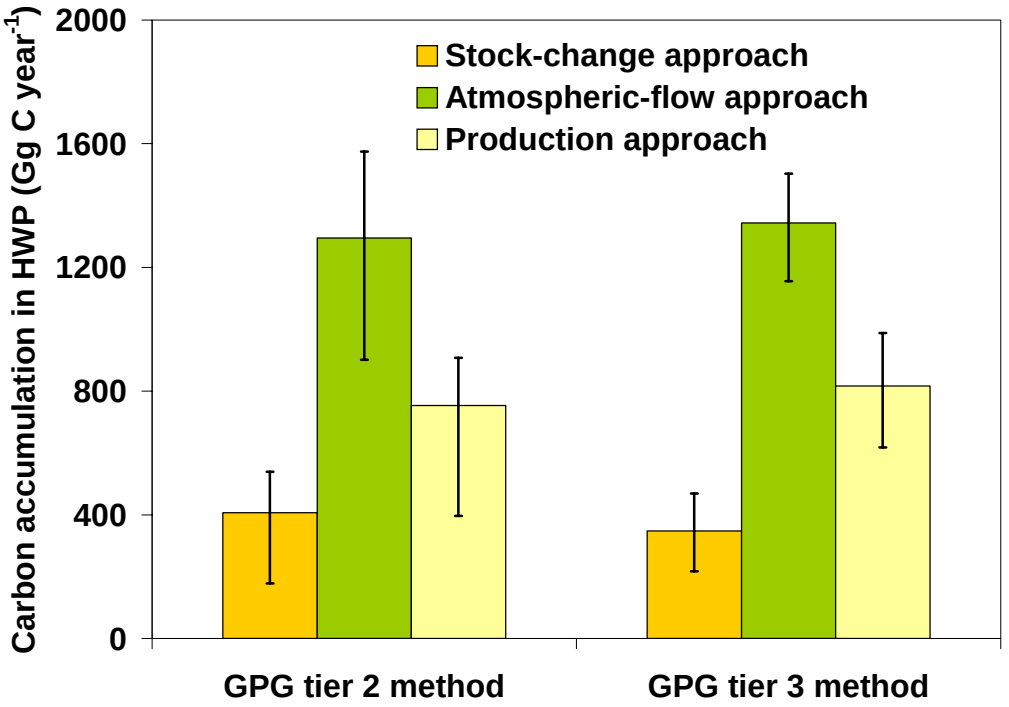
Methodology

- Relative contribution of each input parameter to the total uncertainty (RC_i, %):

$$RC_i = 100\ CI_i / \sum CI_i$$

CI_i = relative amplitude of the 95% confidence interval obtained for carbon accumulation (difference between the 2.5th and 97.5th percentiles in relation to the result obtained for carbon accumulation) when only the input parameter *i* is affected by uncertainty

Results



Reference year: 2004

- Uncertainty level (relative amplitude of the 95% confidence interval):
  - GPG tier 2: 52 - 89%
  - GPG tier 3: 26 - 72%

Results

Input parameter	Contribution to uncertainty (%)					
	GPG tier 3 method			GPG tier 2 method		
	SCA	PA	AFA	SCA	PA	AFA
Statistical data on production and trade of HWP	31	23	24	30	19	18
Growth rate of the input to the pool of HWP in use	3	2	2	3	2	2
Bark related parameters	-	-	7	-	-	-
Conversion factor to dry weight for solidwood	7	7	16	13	14	31
Conversion factor to dry weight for pulp and paper	2	2	2	1	2	2
Carbon fraction in solidwood	4	5	9	3	3	7
Carbon fraction in pulp and paper	9	10	10	11	13	18
Allocation of solidwood products to final application	1	1	1	-	-	-
Decay rate of HWP in use	18	18	12	11	11	6
Decay rate of HWP in SWDS	4	5	3	5	6	3
Fraction of HWP going to SWDS	15	19	10	16	20	9
% of anaerobic decay in SWDS	3	4	2	4	4	2
Fraction of carbon in HWP decaying under anaerobic conditions in SWDS	3	4	2	3	6	2

Conclusions

- The GPG tier 3 method originated more accurate results of C accumulation in HWP, leading to a reduction up to 50% in the uncertainty when compared to the GPG tier 2 method

- Parameters contributing more to the uncertainty:
  - Statistical data on production and trade of HWP
  - Fraction of HWP going to SWDS
  - Conversion factor of solidwood volume to dry weight
  - The decay rate of HWP in use (only in GPG tier 3)
  - Fraction of carbon in pulp and paper (only in GPG tier 2)

↳ Efforts should be made to reduce the uncertainty in these parameters, in order to decrease the global uncertainty