

Modelling carbon accumulation in wood products

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Introduction

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



Objectives

- To develop a model for estimating carbon accumulation in wood products in Portugal, using country-specific data
- To estimate the associated uncertainty levels



Methodology

- Difference between method and approach:

METHOD (calculation framework)

refers to the measurement and estimation of change in carbon stocks (or emissions) associated with wood products

APPROACH (conceptual framework)

refers to the allocation of the change in carbon stocks (or emissions) between consuming and producing countries of wood products



Methodology

● 3 alternative approaches were applied:

- Stock-change approach
- Production approach
- Atmospheric-flow approach



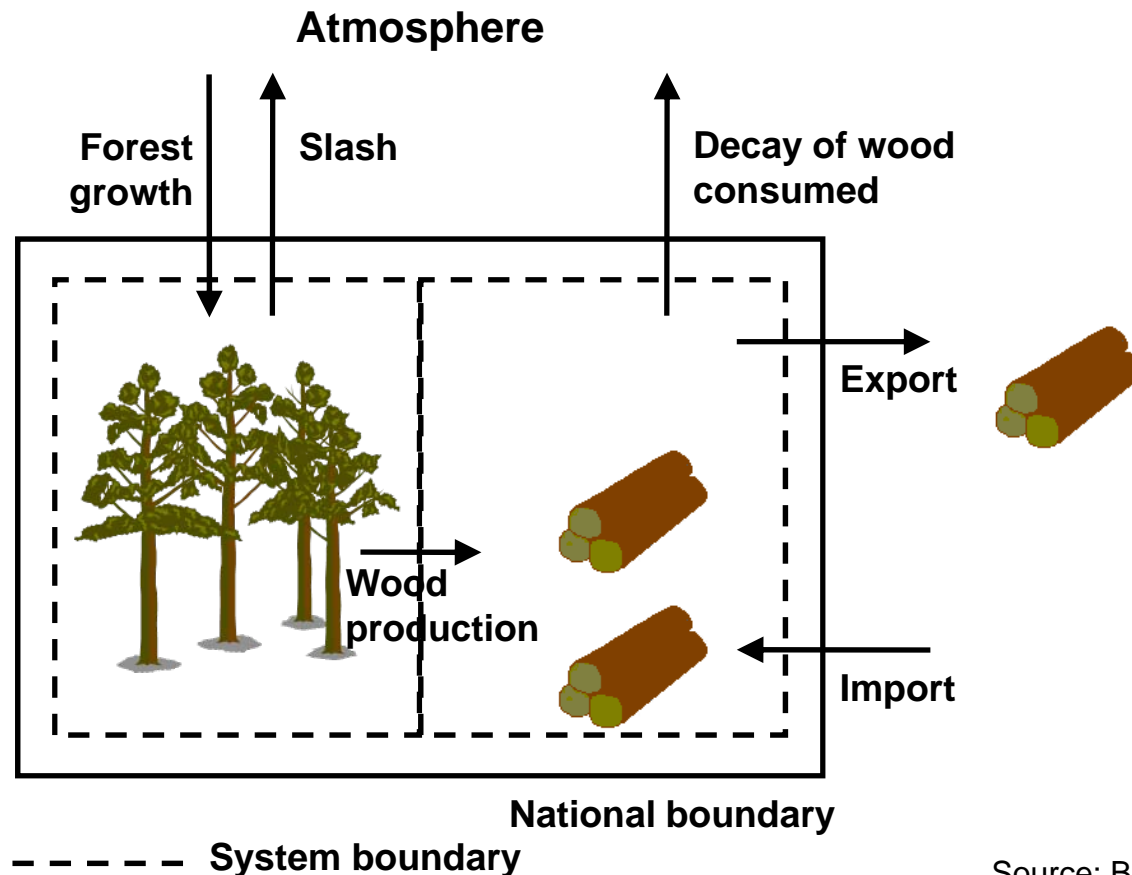
Differ in the way the changes in carbon stocks (or emissions) from traded wood products are allocated to consuming and producing countries



Methodology

● Stock-change approach

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



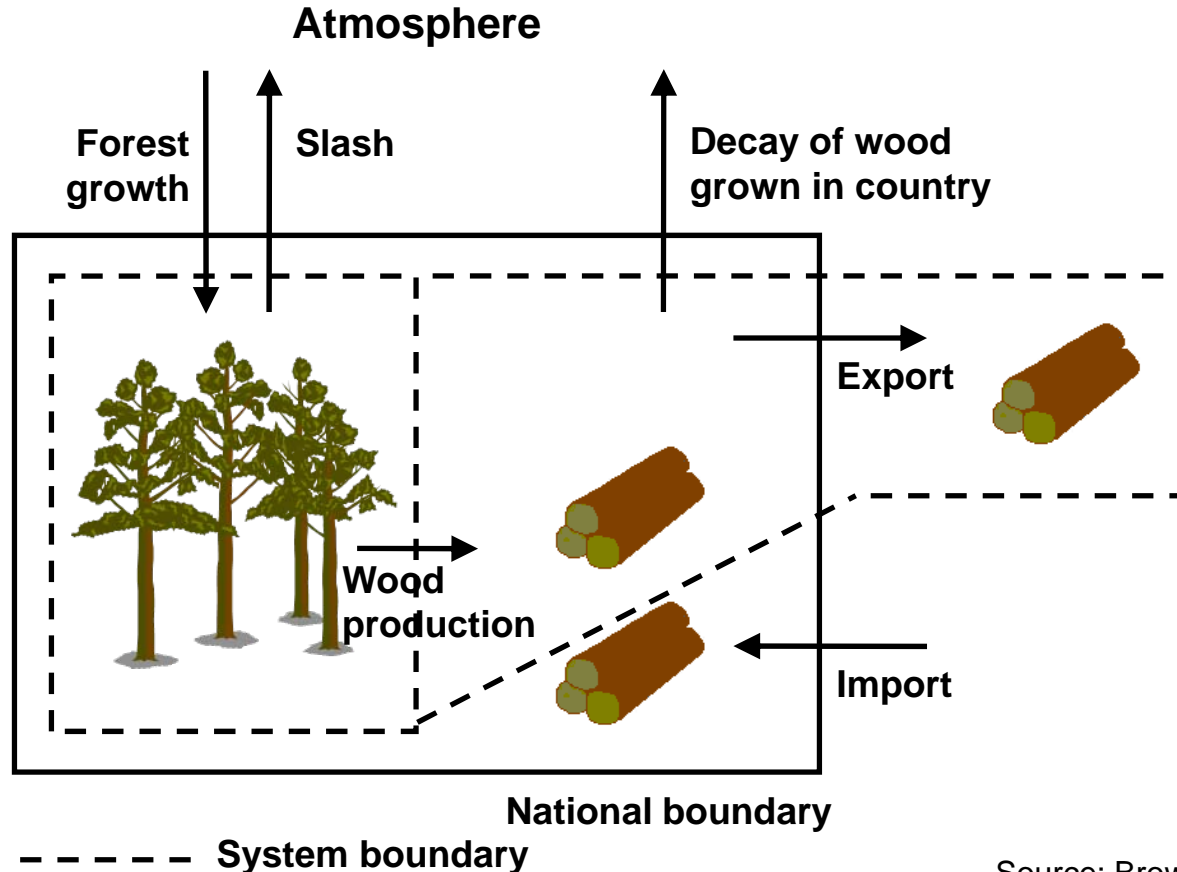
Source: Brown et al. (1999)



Methodology

● Production approach

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

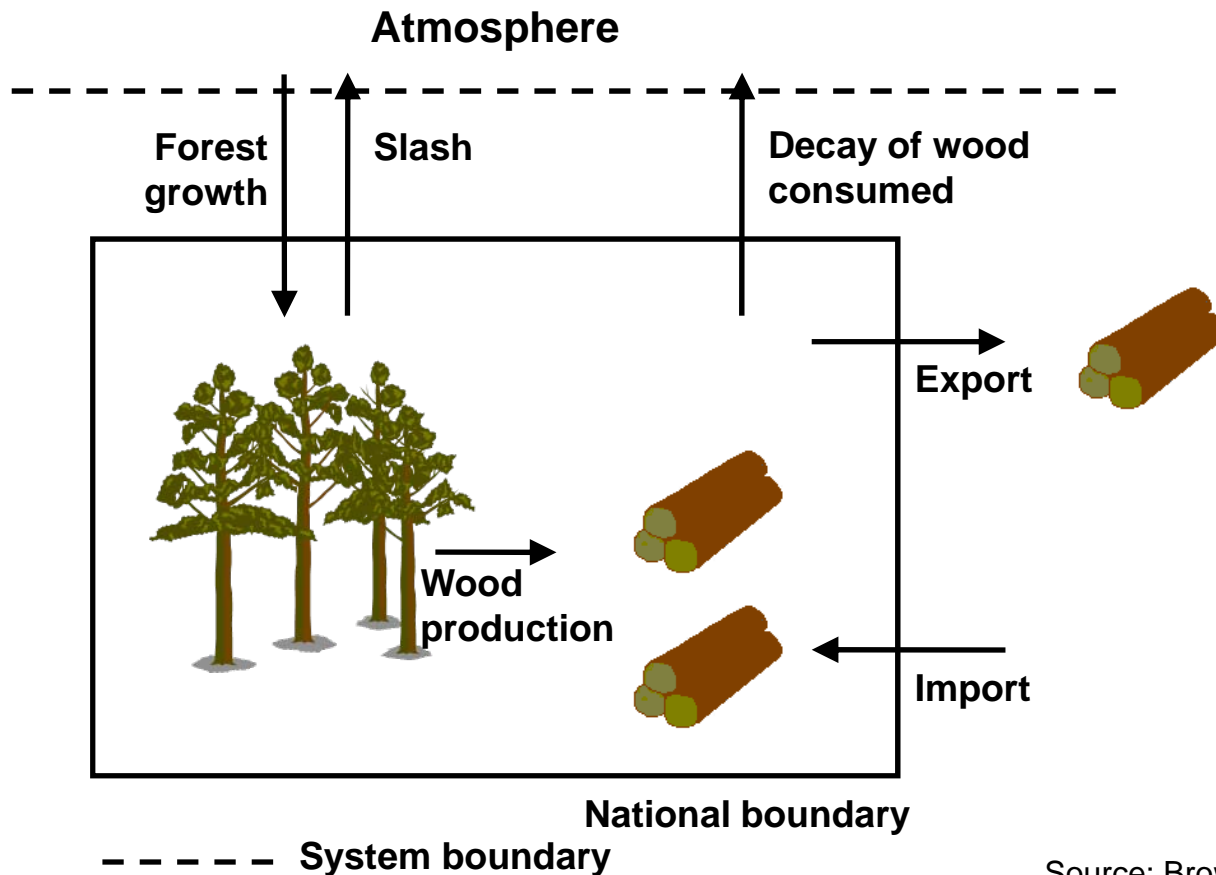


Methodology

● Atmospheric-flow approach

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

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



Methodology

● Lifetime analysis method:

- consistent with the tier 3 method proposed by the IPCC Good Practice Guidance for LULUCF



$$\text{Change in C stocks} = \text{C input} - \text{C output}$$

- C input: statistical data on production and trade of wood products

- C output: C emissions from the decay of wood products



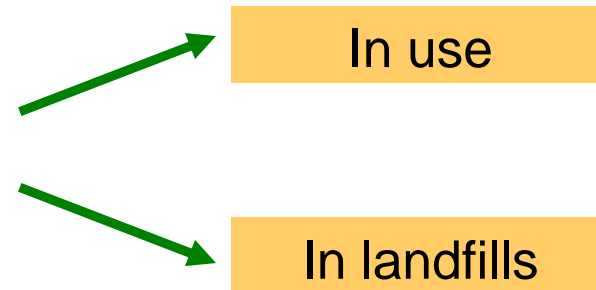
first order decay (a constant fraction of each pool decays annually)



Methodology

- Change in C stocks was estimated separately for semi-finished products:

- Sawnwood
- Wood-based panels (veneer sheets, plywood, particle board, fibre board)
- Other industrial wood (poles, posts, pitprops)
- Paper and paperboard



- Data on production of finished products are scarce



Methodology

Input parameter	Data source
Production, imports and exports	National statistics/FAO statistics (from 1943/1961)
Growth rate of consumption from 1900 to the first year covered by statistical data	Estimated
Conversion factors (to C weight)	Industry/literature
Allocation of wood products by end use	National statistics
Fraction of wood products going to landfills	National statistics
Lifetime of wood products in use and in landfills	Literature
Degradable organic carbon dissimilated in landfills	Literature



Methodology

Product	Final use	Average lifetime in use (years)	Average lifetime in landfill (years)
Solidwood products	Packaging	2	20
	Construction	30	
	Furniture	20	
	Other uses	25	
Paper products	Printing and writing	10	
	Other uses	1	



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)

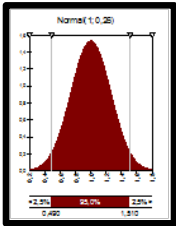


Uncertainty in the estimate given as a PDF
(95% confidence interval)

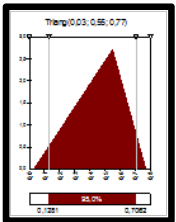


Methodology

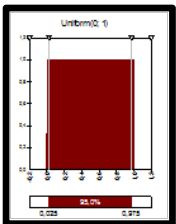
● Probability density functions:



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



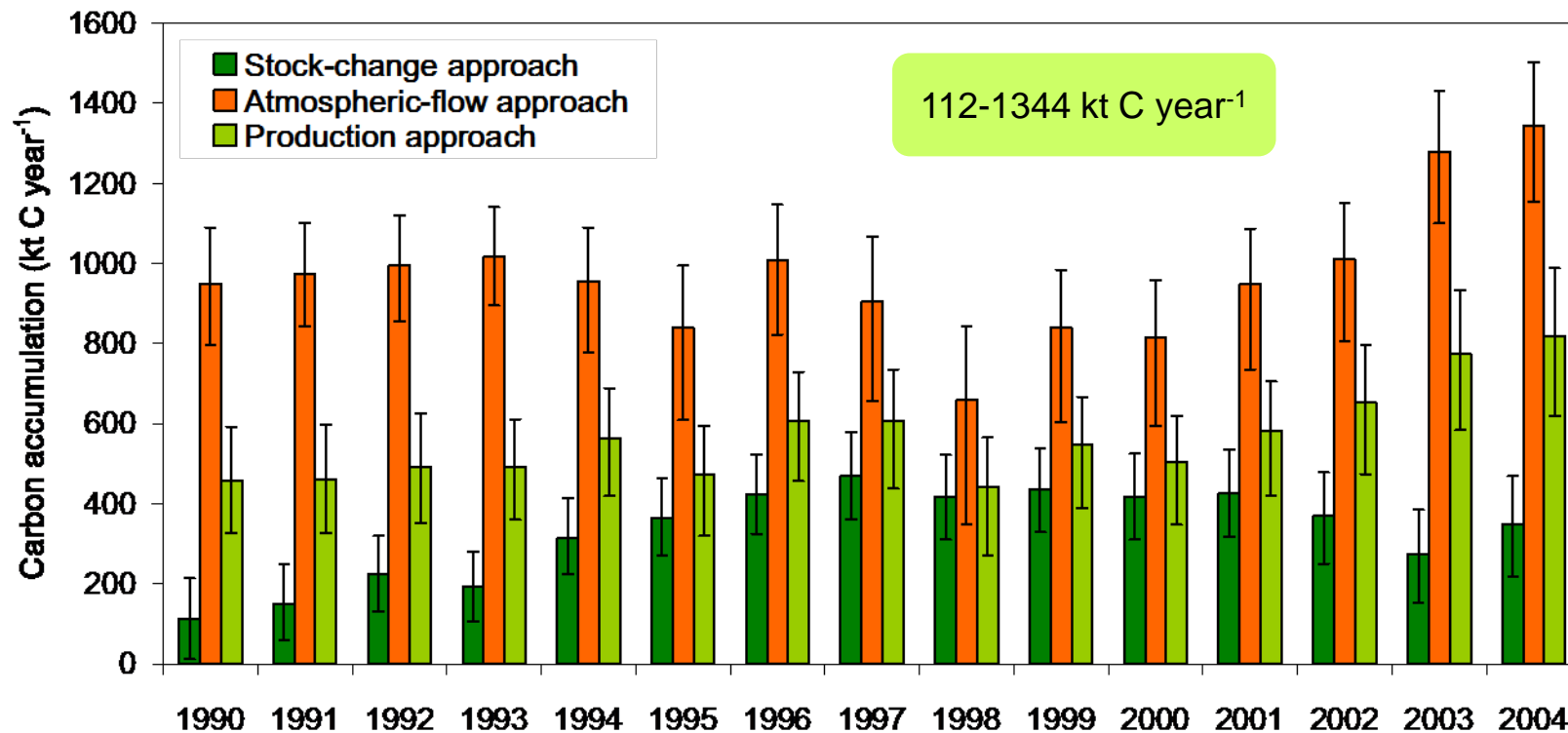
uniform distributions - applied when all values in a given range had equal probability



Based on measured data, literature data and expert judgement



Results

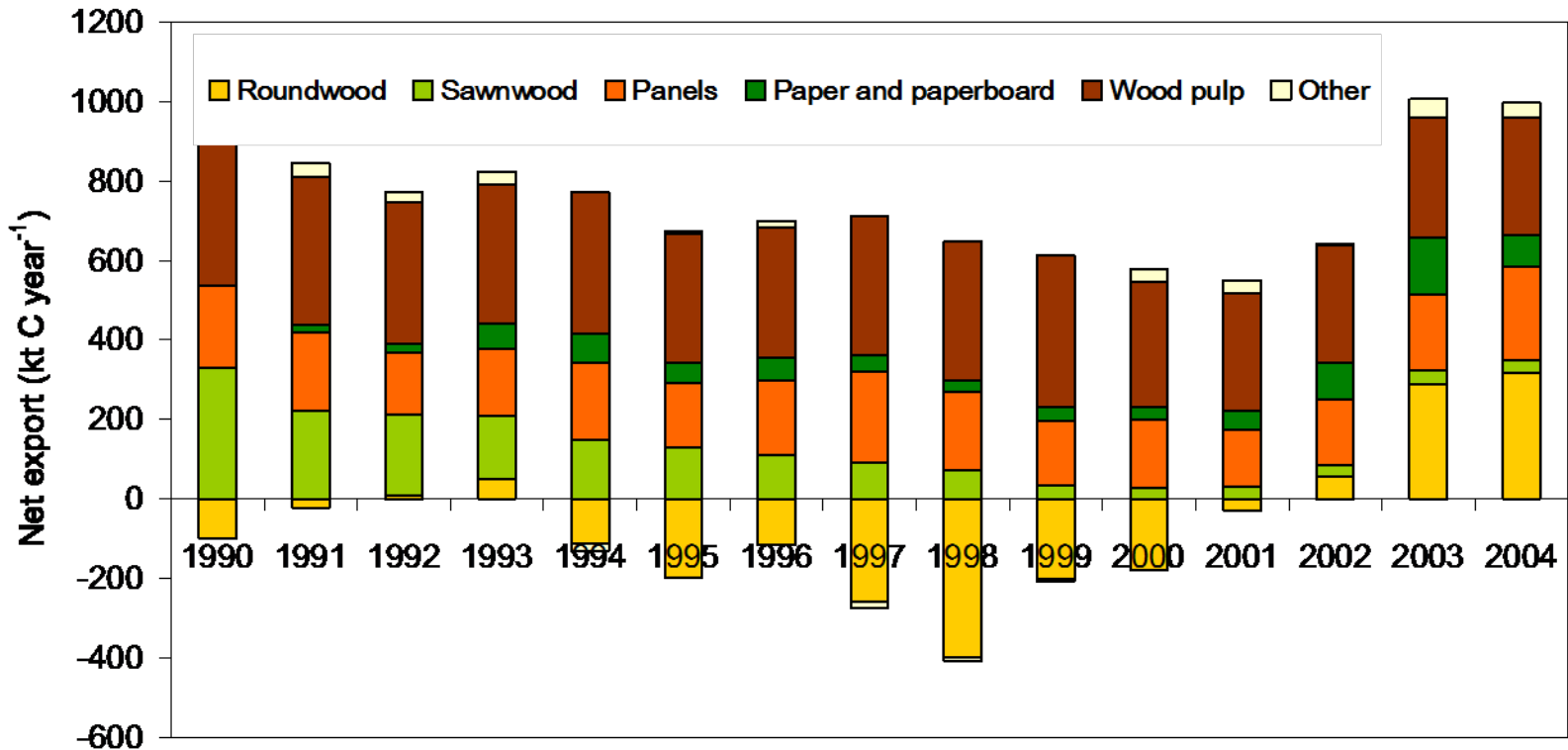


AFA > PA > SCA

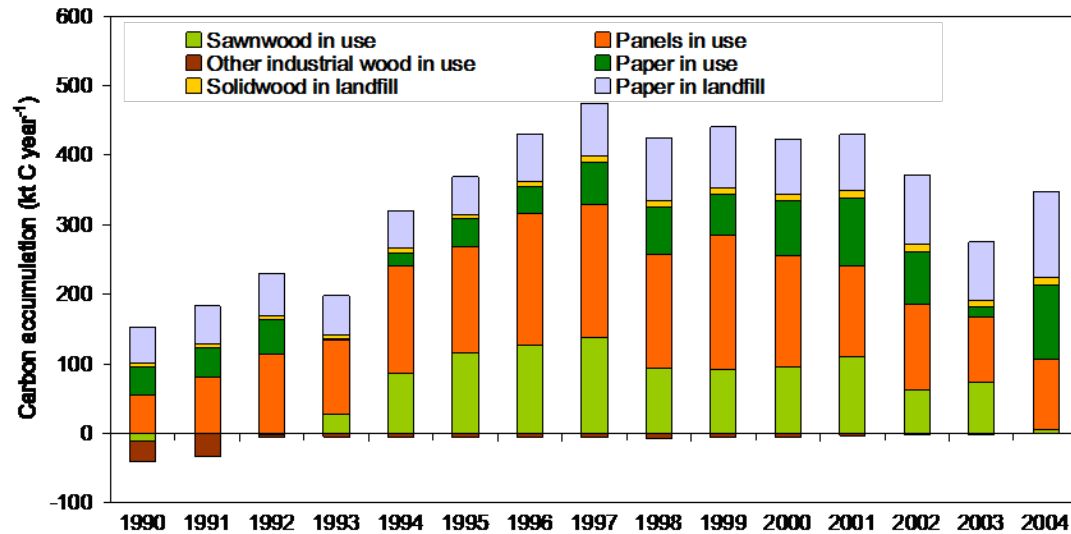
Uncertainty: $\pm 10\%$ to $\pm 90\%$



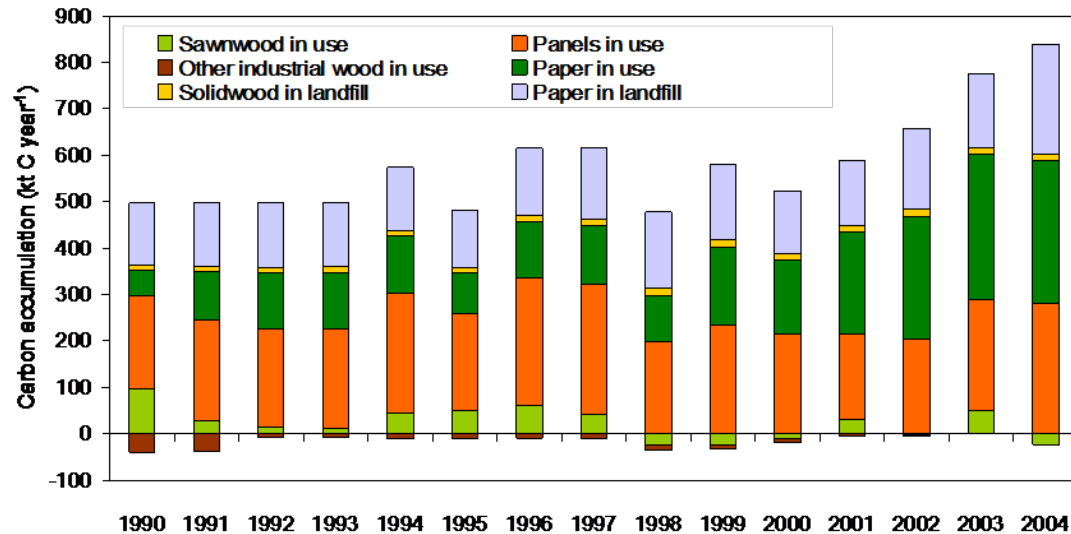
Results



Results



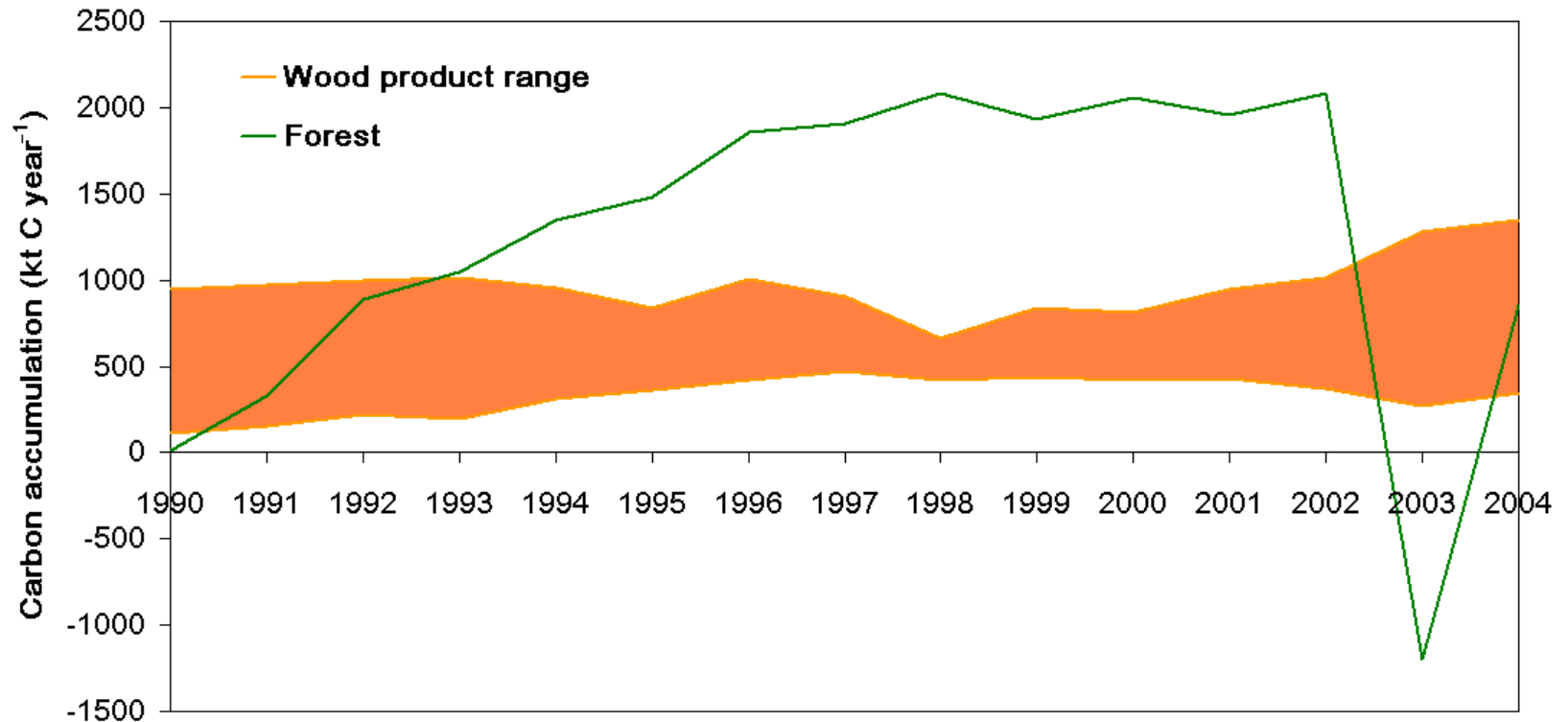
Stock-change approach



Production approach



Results



Data source for forest C accumulation:

Pereira T. C., Seabra T., Maciel H. e Torres P. (2009). Portuguese national inventory report on greenhouse gases 1990-2007 submitted under the UNFCCC and the Kyoto Protocol. Agência Portuguesa do Ambiente, Amadora



Conclusions

- Wood products play an important role in C accumulation
- The atmospheric-flow approach generates the highest C accumulation in wood products for countries like Portugal that are net exporters of wood products
- Criteria used in the evaluation of the approaches should include technical and policy aspects
- The approaches may generate different socio-economic and environmental impacts:
 - trade, consumption and production of wood products
 - use of bioenergy
 - recycling of wood products
 - employment and population dynamics
 - wood harvesting and forest management
- The uncertainty in the estimates ranged between 10% and 90%



Thank you for your attention!

