Projection of the future EU forest carbon sink as affected by recent bioenergy policies using two forest management models

Böttcher H.[1*], Verkerk J. P.[2], Gusti M.[1], Havlik P.[1], Grassi G.[3]

[1]International Institute for Applied Systems Analysis. Schlossplatz 1, A-2361 Laxenburg, Austria
[2]European Forest Institute, Sustainability and Climate Change Unit, Torikatu 34, 80100 Joensuu, Finland
[3]European Commission - Joint Research Centre, Institute for Environment and Sustainability Climate Change and Air Quality Unit - TP 290 - Via Fermi, 21027 Ispra (VA), Italy

www.iiasa.ac.at/Research/FOR/LULUCF.html

Abstract

A relevant question for climate policy is: based on the expected evolution of harvest rates, how long the current sink of EU forests will be maintained in the near future? In this article we describe results of the comparison of two advanced forest management models that are used to project CO_2 emissions and removals from EU forests until 2030. EFISCEN, a detailed statistical matrix model and G4M, a geographically explicit economic forestry model, use scenarios of future harvest rates and forest growth information to estimate the future carbon balance of forest biomass. Two scenarios were assessed: the EU baseline scenario and the EU reference scenario (including additional bioenergy and climate policies).

EU member states report removals from forest management of around 400 Mt CO_2 in 2000 and approximately stable levels in the period 2000-2008. Our projections suggest a significant decline of the sink until 2030 in the baseline scenario of about 25-40% compared to 2010. Including additional bioenergy targets of EU Member States has an effect on the development of this sink. A sensitivity analysis was performed on the role of future wood demand and proved the importance of this driver for the future sink development. This is one on the few studies so far that assesses more comprehensively the tradeoffs of bioenergy use and carbon sequestration at large scale.

Tab. 1: Differences between baseline and reference scenario (reference value/baseline value) for prescribed harvest and forest management carbon sink.

	2010	2015	2020	2025	2030
Total wood production GLOBIOM	1%	2%	3%	1%	-1%
Sink G4M	0%	-1%	-4%	-1%	8%
Sink EFISCEN	-4%	-8%	-11%	5%	18%

Background and Methodology

Background and approach

Forests of the European Union (EU) have been intensively managed for decades, and they have formed a significant sink for carbon dioxide (CO_2) from the atmosphere over the past 50 years. The reasons for this behavior are multiple, among them are: forest ageing, area expansion, increasing plant productivity due to environmental changes of many kinds, and, most importantly, the growth rates of European forest having been higher than harvest rates.

To produce projections for forest emissions and removals until 2030 a number of different models were applied in this study. The economic land use model GLOBIOM was applied to estimate future wood production and this information was used by two forest management models – EFISCEN and G4M – to assess impacts on emission or removals of CO_2 by forests in the EU member states. To ensure consistency, the data used by different models was harmonized to the extent possible. Finally, the models were applied for two bio-energy scenarios, as well as in a sensitivity analysis.

Scenario development

GLOBIOM is a global static partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to give policy advice on global issues concerning land use competition between the major land-based production sectors. Two scenarios of wood demand were developed using GLOBIOM by combining two bioenergy scenarios retrieved from the PRIMES energy model and developed by Capros et al. (2010) with projections of the future demand of wood for material use for EU regions

The baseline scenario, describes the development of the EU energy demand under current trends and policies.

The reference scenario is based on the same macroeconomic, price, technology and policy assumptions as the baseline. In addition to the measures reflected in the baseline, it includes policies adopted between April and December 2009 and assumes that national targets under the Renewables Directive 2009/28/EC and the GHG Effort Sharing Decision 2009/406/EC are achieved in 2020.

G4M Model

The Global Forest Model (G4M, Gusti 2010; Gusti and Kindermann 2011; Kindermann et al. 2008) is a geographically explicit model that simulates decisions made by virtual land owners on deforestation, afforestation taking into account profitability of forestry and agriculture, and forest management aimed at satisfying domestic wood demand. G4M used a forest biomass map to initialize growing stock, forest growth is determined by a potential NPP map.

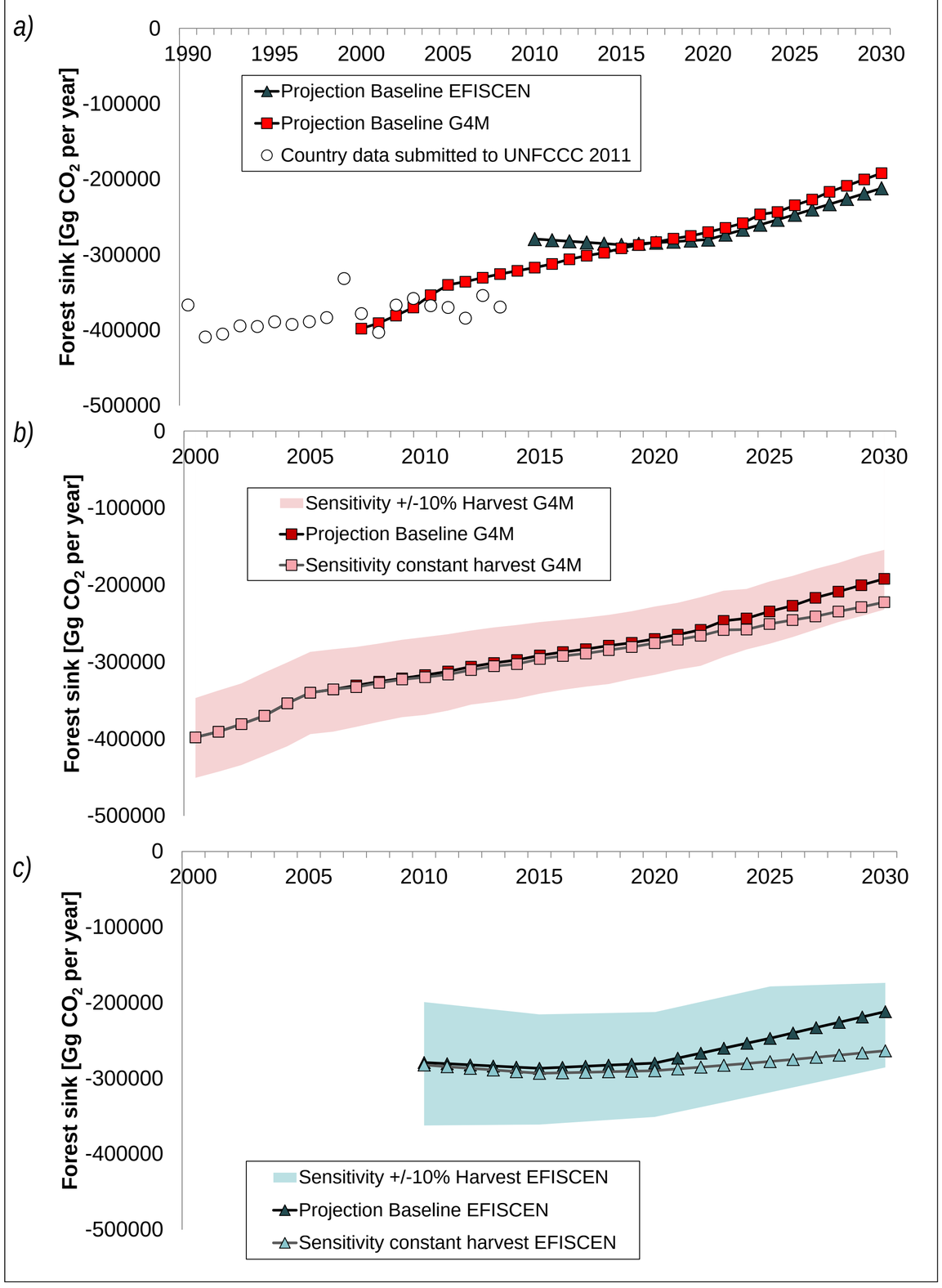
EFISCEN Model

The European Forest Information SCENario model (EFISCEN; Sallnäs 1990; Schelhaas et al. 2007) is is a large-scale forest scenario model that projects forest resource development on regional to European scale. A detailed model description is given by Schelhaas et al. (2007). In EFISCEN, the state of the forest is described as an area distribution over age- and volume-classes in matrices, based on national forest inventory data.

Results

- The projected net forest CO_2 sink for the EU is expected to decline under the baseline scenario. It is reduced on average by up to 15% in 2020 and 25-40% in 2030 compared to 2010 (Fig. 1).
- The drivers explaining the forest management sink decline are increased demand for wood for energy and material use and shifts in the forest structure towards an older forests that lower the strength of forest carbon accumulation.
- The reference scenario that was applied includes the national renewable targets of EU Member States for 2020 to meet the EU target of a share of 20% renewable energy sources in energy consumption in 2020 as well as the 20% reduction in GHG emissions compared to 1990.
- The effect of this is a further decrease in the FM sink compared to the baseline in the medium run (Tab. 1).

Fig. 1: Comparison of the forest management biomass sink from the model baselines and data submitted by countries to UNFCCC in May 2011 (a) and sensitivity runs for G4M (b) and EFISCEN (c) for EU member states (excl. Cyprus, Malta and Greece).



References

Capros, P., L. Mantzos, N. Tasios, A. De Vita and N. Kouvaritakis, 2010. EU energy trends to 2030 — UPDATE 2009. EUROPEAN COMMISSION Directorate-General for Energy in collaboration with Climate Action DG and Mobility and Transport DG, Brussels.

Gusti, M., 2010 An algorithm for simulation of forest management decisions in the global forest model. Artificial Intelligence. N4: 45-49.

Gusti, M. and G. Kindermann, 2011. An approach to modeling landuse change and forest management on a global scale. SIMULTECH-2011. Proceedings of 1st International Conference on Simulation and Modeling Methodologies, Technologies and Applications, Noordwijkerhout, The Netherlands July 29 - 31 2011, SciTePress - Science and Technology Publications, Portugal.

Kindermann, G., M. Obersteiner, B. Sohngen, J. Sathaye, K. Andrasko, E. Rametsteiner, B. Schlamadinger, S. Wunder and R. Beach, 2008. Global cost estimates of reducing carbon emissions through avoided deforestation. Proceedings of the National Academy of Sciences of the United States of America. 105: 10302-10307.

Sallnäs, O., 1990 A matrix model of the Swedish forest. Studia Forestalia Suecica. 183.

Schelhaas, M. J., J. Eggers, M. Lindner, et al., 2007. Model documentation for the European Forest Information Scenario model (EFISCEN 3.1.3). Alterra and European Forest Institute, Wageningen and Joensuu.

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Funding:

Science for Global Insight
IIASA www.iiasa.ac.at

The study was financially supported by the European Commission - DG Climate Action through the tender contract "Analysis of potential and costs of LULUCF use by EU Member States", contract ref no. 07.0307/2009/541003/SER/C5

GHG Europe
www.ghg-europe.eu/

CCT-TAME
www.cctame.eu

Contact:

* Corresponding author:
Hannes Böttcher
ESM IIASA
Schlossplatz 1, A-2361 Laxenburg, Austria
Phone : +43 2236 807-538
E-Mail: bottcher@iiasa.ac.at