Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 125 (2017) 372–378

Energy Procedia

www.elsevier.com/locate/procedia

European Geosciences Union General Assembly 2017, EGU Division Energy, Resources & Environment, ERE

Assessing the resources and mitigation potential of European forests

Hubert Hasenauer[a,*], Mathias Neumann[a], Adam Moreno[b], and Steve Running[c]

[a]*University of Natural Resources and Life Science, Institute of Silviculture, Peter-Jordan-Str. 82, 1180 Wien, Austria*
[b]*NASA Ames Research Center, Mail Stop 204-14, Moffett Field, CA 94035-0001, USA*
[c]*Numerical Terradynamic Simulation Group, College of Forestry & Conservation, The University of Montana, Missoula, MT 59812, USA*

Abstract

National and international carbon reporting systems require information on forest carbon stocks. This information can be derived from national forest inventory data and remote sensing. Here we present the conceptual challenges in assessing forest resources across Europe by combining MODIS satellite versus terrestrial driven NPP estimates calculated from 13 national forest inventory (NFI) data covering 200.000 sampling plots. The results suggest that MODIS NPP predictions using local daily climate data and addressing stand desnsity effects, provide realistic forest productivity estimates. Ignoring these effects leads to an overestimation in the estimated carbon storage of European forests derived from satellite data.

Peer-review under responsibility of the scientific committee of the European Geosciences Union (EGU) General Assembly 2017 – Division Energy, Resources and the Environment (ERE).

Keywords: carbon; forest inventory; MODIS; NPP; NFI, biomass; volume; MOD17; satellite; remote sensing; bioeconomy

1. Introduction

Today 40 % of the European land area is covered with forests managed for the provision of ecosystem services such as timber production, drinking water or welfare and nature conservation. Forests store large amounts of carbon [1, 2] and thus play a key role in the global carbon cycle including mitigating climate change effects [3]. In addition, forests are an important resource for the growing demand of a bio-based economy and they are a major source for biodiversity. Thus a consistent pan-European gridded data set on the state of forest resources is essential for

* Corresponding author. Tel.: +43 1 47654 91311
E-mail address: hubert.hasenauer@boku.ac.at

1876-6102
Peer-review under responsibility of the scientific committee of the European Geosciences Union (EGU) General Assembly 2017 – Division Energy, Resources and the Environment (ERE).
10.1016/j.egypro.2017.08.052

researchers, policy makers and conservationists to study and understand the role of European forests for the global carbon cycle independent of political boundaries.

In principle three different carbon monitoring methods are currently available: (i) forest inventory sampling based on repeated tree observations, (ii) flux tower observations recording the gas exchange between plants and atmosphere, and (iii) remote sensing information in combination with ecosystem modeling techniques providing continuous Net Primary Production estimates [4]. The purpose of this study is to use existing European data to develop a consistent pan-European data set for Net Primary Production (NPP), live tree carbon and volume per hectare, mean tree height and mean tree age by integrating remotely sensed satellite and harmonized forest inventory data from 13 different European countries.

We address the conceptual challenges in comparing "space based" Moderate Resolution Imaging Spectroradiometer (MODIS) satellite driven Net Primary Production (NPP) versus terrestrial "ground based" productivity estimates using national forest inventory (NFI) data. We apply the biomass functions of each country as they are used for the national carbon reporting to estimate ground based NPP from repeated tree observations on each NFI plot. We link the terrestrial driven information with remotely sensed data to combine the advantages of the two approaches, e.g. the continuous and consistent coverage using remote sensing information, and capturing changes in the carbon allocation pattern due to forest management effects using the terrestrial data. Fig. 1 provides the conceptual outline of our study.

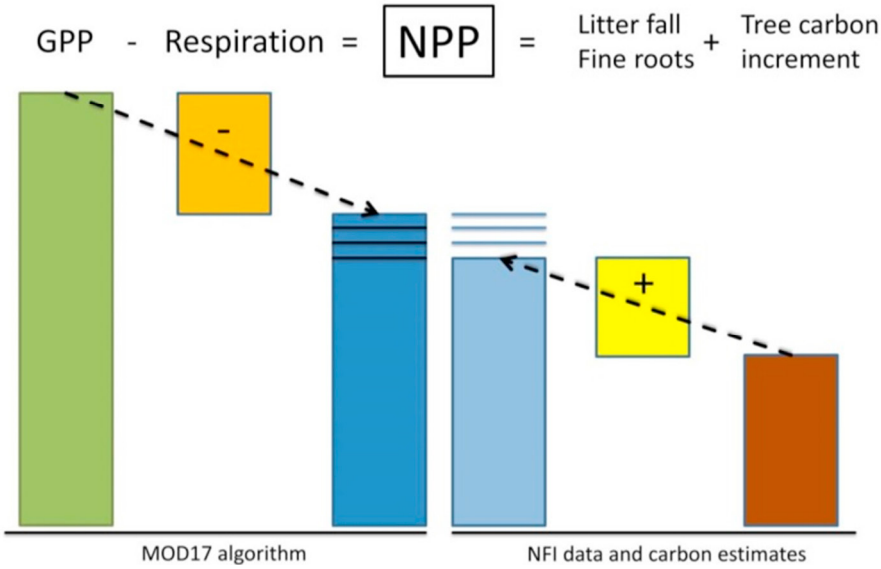

Fig. 1. Conceptual approach of the carbon estimation methods in combining top-down versus bottom-up data sources. The MOD17 algorithm provides Gross Primary Production (GPP) and Net Primary Production (NPP). Terrestrial NFI (National Forest Inventory) data provides tree carbon increment, which can be used to derive NPP by adding aboveground litter fall and belowground fine root turnover.

1.1. Consistent Net Primary productivity across Europe

Net Primary Production (NPP) is an important ecological metric for studying forest ecosystems, their carbon sequestration, the potential supply of food or timber, and for quantifying the impacts of climate change [3]. For this study we obtain the original global MOD17 NPP estimates (called MODIS GLOB), which can be downloaded from http://www.ntsg.umt.edu/project/mod17#data-product. Since previous studies have indicated that MODIS driven NPP estimates can be substantially improved, if local climate data are used [4, 5], we rerun the original MOD17 algorithm with our newly down-scaled daily climate dataset across Europe [6]. This resulted in a new NPP dataset for Europe, called MODIS EURO [7]. The gridded MODIS EURO data are presented in Fig. 2.