Designing Pathways toward Climate Neutrality

Results of the project LIFE ClimatePath2050 and perspectives for modelling forest carbon sinks in Slovenia

Boštjan Mali, PhD, Jernej Jevšenak, PhD

8 October 2021

Projekt LIFE ClimatePath2050 (LIFE16 GIC/SI/000043) je financiran iz finančnega mehanizma LIFE, ki ga upravlja Evropska komisija, in iz Sklada za podnebne spremembe Ministrstva za okolje in prostor RS.

Introduction

- LULUCF
- Carbon pools
- Emissions and removals
- Complexity
- Uncertainty (natural effects)

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Modeling of forest growth in Slovenia

- Data mining approach: Modelling forest growing stock from inventory data (Debeljak et al., 2014)
- ForClim: Accurate modeling of harvesting is key for projecting future forest dynamics: a case study in the Slovenian mountains (Mina et al., 2015)
- EFDM: SC15 EFDM Country Report Slovenia (Skudnik & Mali, 2015)
- MOSES: Validation of the forest growth model MOSES for fir-beech forests in Slovenia (Hudernik, 2016)
- Matrix model: Can the use of continuous cover forestry alone maintain silver fir (Abies alba Mill.) in central European mountain forests? (Ficko et al., 2016)
- EFISCEN: Scenariji razvoja gozdov in gospodarjenja z gozdovi v Sloveniji (Klopčič, 2017)
- The effect of harvesting on national forest carbon sinks up to 2050 simulated by the CBM-CFS3 model: a case study from Slovenia (Jevšenak et al., 2020)
- Siwawa: The applicability of the SiWaWa stand model for simulating stand development of pure beech and spruce even-aged forest stands in Slovenia (Klopčič, 2021)
- Machine learning model: A random forest model for basal area increment predictions from national forest inventory data (Jevšenak & Skudnik, 2021)

LIFE CLIMATE PATH 2050

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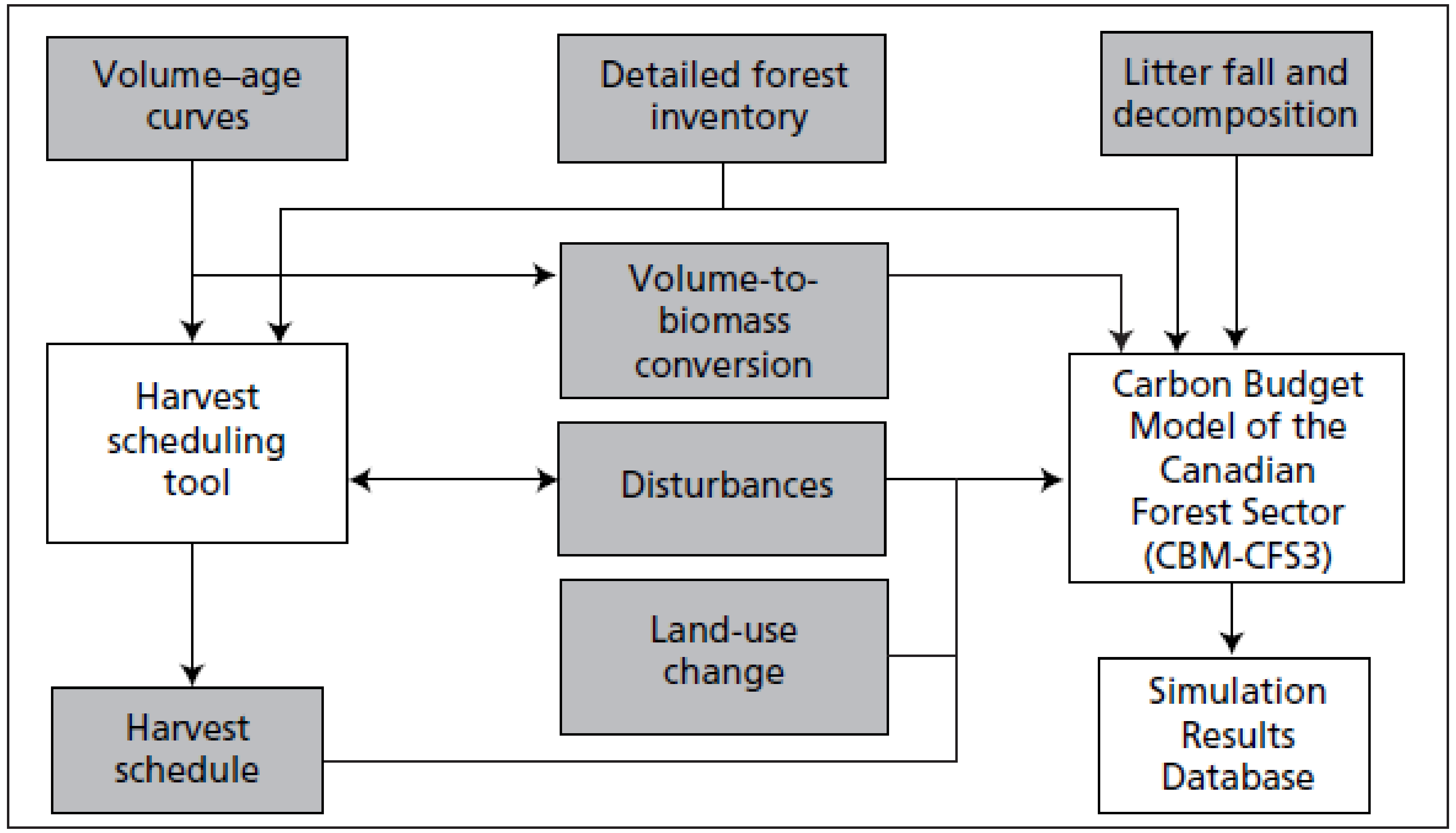
CBM model

Required data:

- Forest inventory data (stand/department/modelling categories, area, growing stock, species composition)
- Growth curves for individual forest species (or groups of species)
- Modelling categories
- Disturbances
- Transitions

1. Age Classes
2. Disturbance Types
3. Classifiers and Values
4. Inventory
5. Growth and Yields
6. Transition Rules
7. Disturbance Events



Kurz et al., 2009

Kull et al., 2019

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Modelling approach

- Division of forest departments into forest types
- Transformation of DBH data into AGE classes
- Development of growth curves
- Modification of AIDB parameters
- Preparation of input data
- Model calibration

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Short	Forest Type	Climate Unit	Total Share	BRD	CON	MIX
FT1	Forests of *Salix* spp. with *Populus* spp., forests of *Alnus glutinosa* and of *A. incana*	Slovenia CLU35	0.02	0.04	0.01	0.95
FT2	Forests of *Carpinus betulus* and of *Quercus petraea* on carbonate and mixed bedrock	Slovenia CLU45	0.07	<0.01	<0.01	0.99
FT3	Forests of *Carpinus betulus* with *Quercus petraea* on silicate bedrock	Slovenia CLU45	<0.01	<0.01	<0.01	0.99
FT4	Submontane *Fagus sylvatica* forests on carbonate and mixed bedrock	Slovenia CLU55	0.16	<0.01	<0.01	0.99
FT5	Submontane *Fagus sylvatica* forests on silicate bedrock	Slovenia CLU45	0.16	<0.01	<0.01	0.99
FT6	Montane, altimontane and subalpine *Fagus sylvatica* forests on carbonate and mixed bedrock	Slovenia CLU55	0.13	<0.01	0.01	0.99
FT7	Montane and altimontane *Fagus sylvatica* forests on silicate bedrock	Slovenia CLU54	0.08	0.01	0.02	0.97
FT8	Forests of *Fagus sylvatica* with *Abies alba*	Slovenia CLU55	0.14	0.01	0.01	0.98
FT9	Forests of *Acer* spp., of *Fraxinus excelsior* and of *Tilia* spp.	Slovenia CLU55	<0.01	0.01	0.01	0.98
FT10	Thermophilous *Fagus sylvatica* forests	Slovenia CLU55	0.06	0.01	0.01	0.98
FT11	Forests and woodlands of thermophilous broadleaves	Slovenia CLU56	0.08	<0.01	0.02	0.98
FT12	Forest of *Pinus sylvestirs* and of *Pinus nigra*	Slovenia CLU55	0.02	<0.01	0.02	0.98
FT13	Forests of *Abies alba* and of *Picea abies* on carbonate and mixed bedrock	Slovenia CLU54	0.01	<0.01	0.10	0.90
FT14	Forests of *Abies alba* and of *Picea abies* on silicate bedrock	Slovenia CLU54	0.04	<0.01	0.06	0.94
FT15	Forests of *Larix decidua* and Woodlands of *Pinus mugo*	Slovenia CLU54	0.01	0	0	1.00

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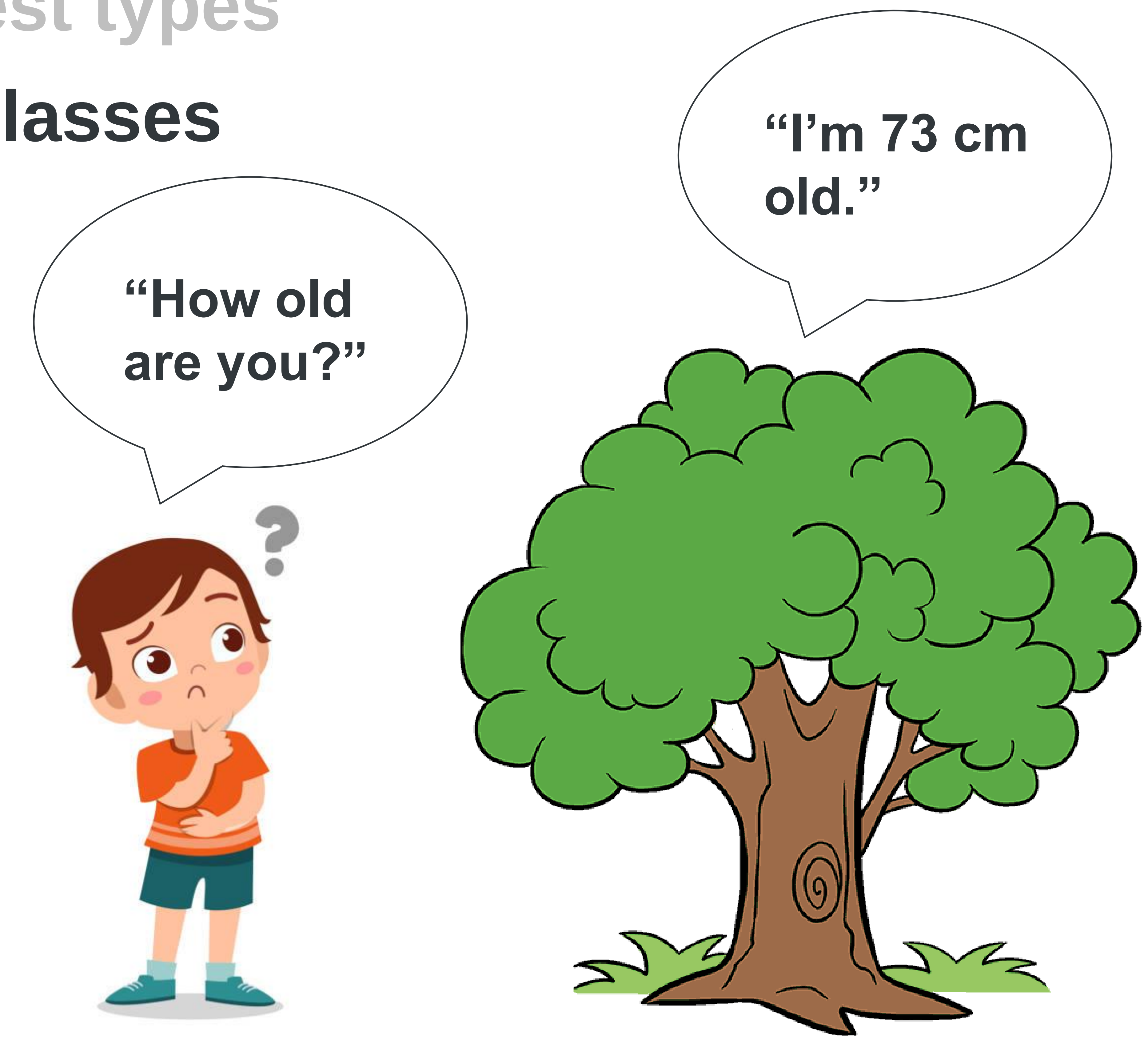

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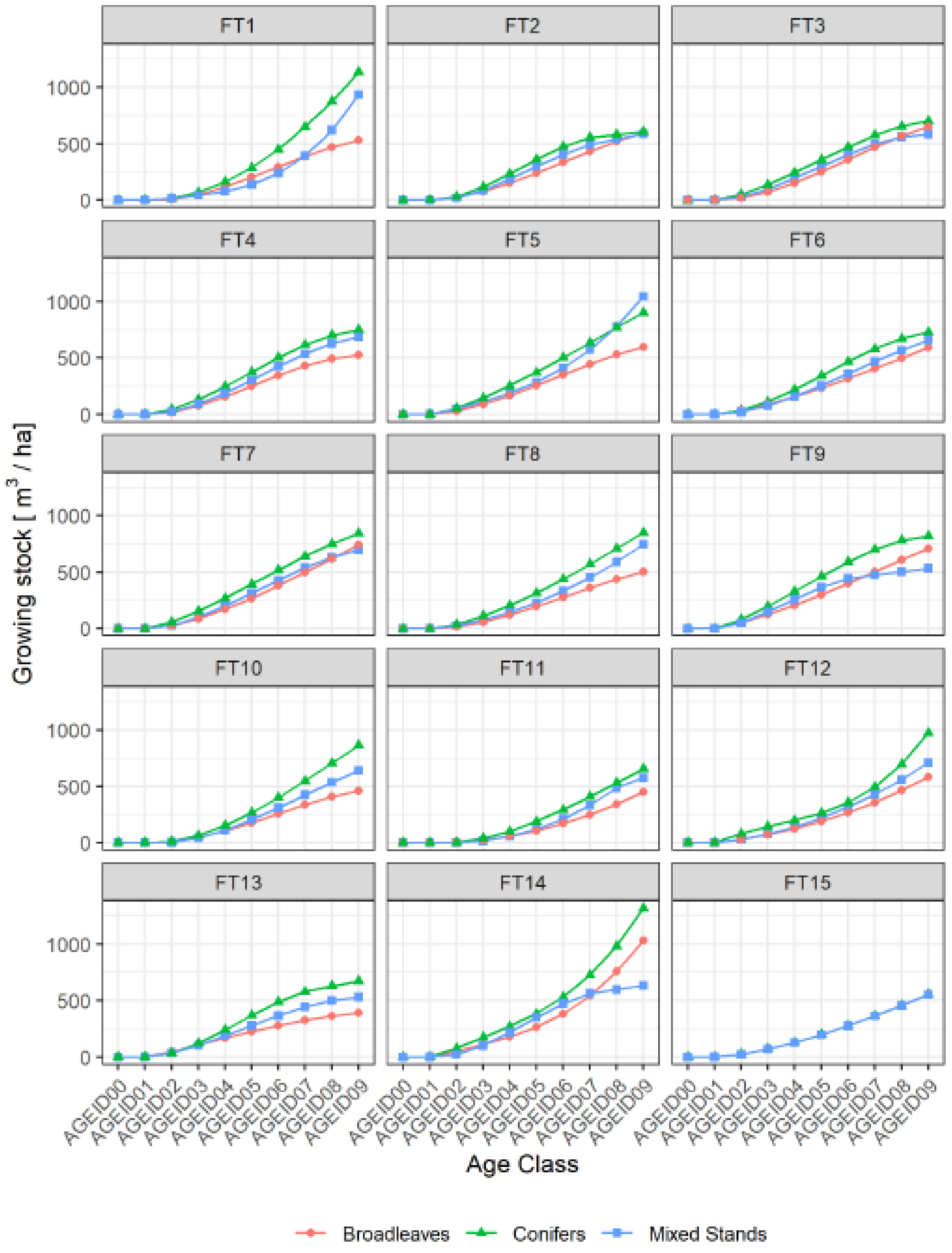
- Preparation of input data:
  - Slovenian Forest Service Inventory database 2014
  - Harvest data of Slovenian Forest Service (2005–2014)
- Model calibration:
  - Adaptation of increment/harvest ratio
  - Distribution of harvest between different forest types
  - Adjustment of thinnings and final fellings (disturbance matrix)



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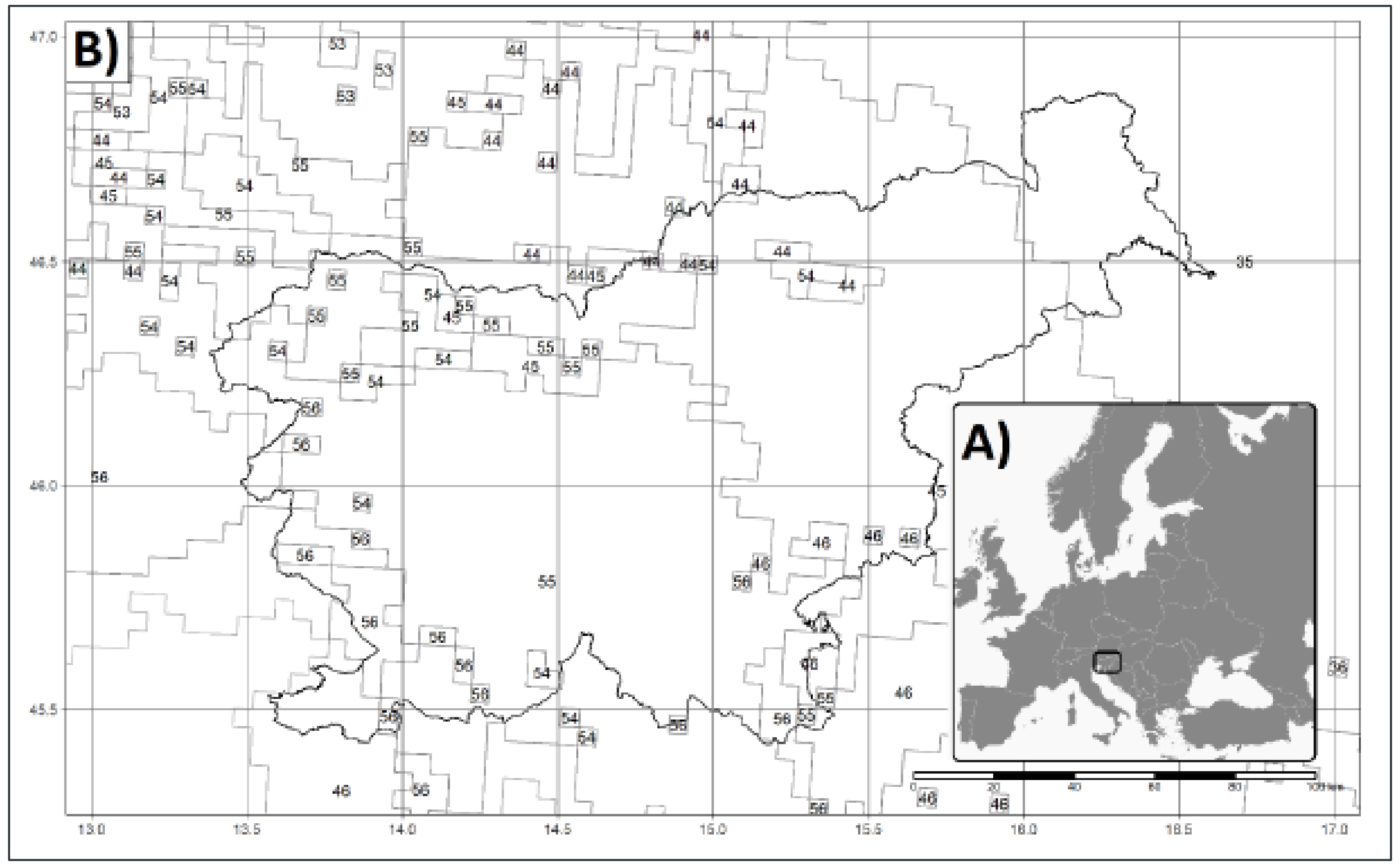
Pilli, Roberto; Kull, Stephen; Blujdea, Viorel; Grassi, Giacomo (2017): The EU Archive Index Database customised for the Carbon Budget Model (CBM-CFS3). European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/jrc-cbm-eu-aidb



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Slovenian Forest Service Inventory database 2014
Harvest data of Slovenian Forest Service (2005–2014)

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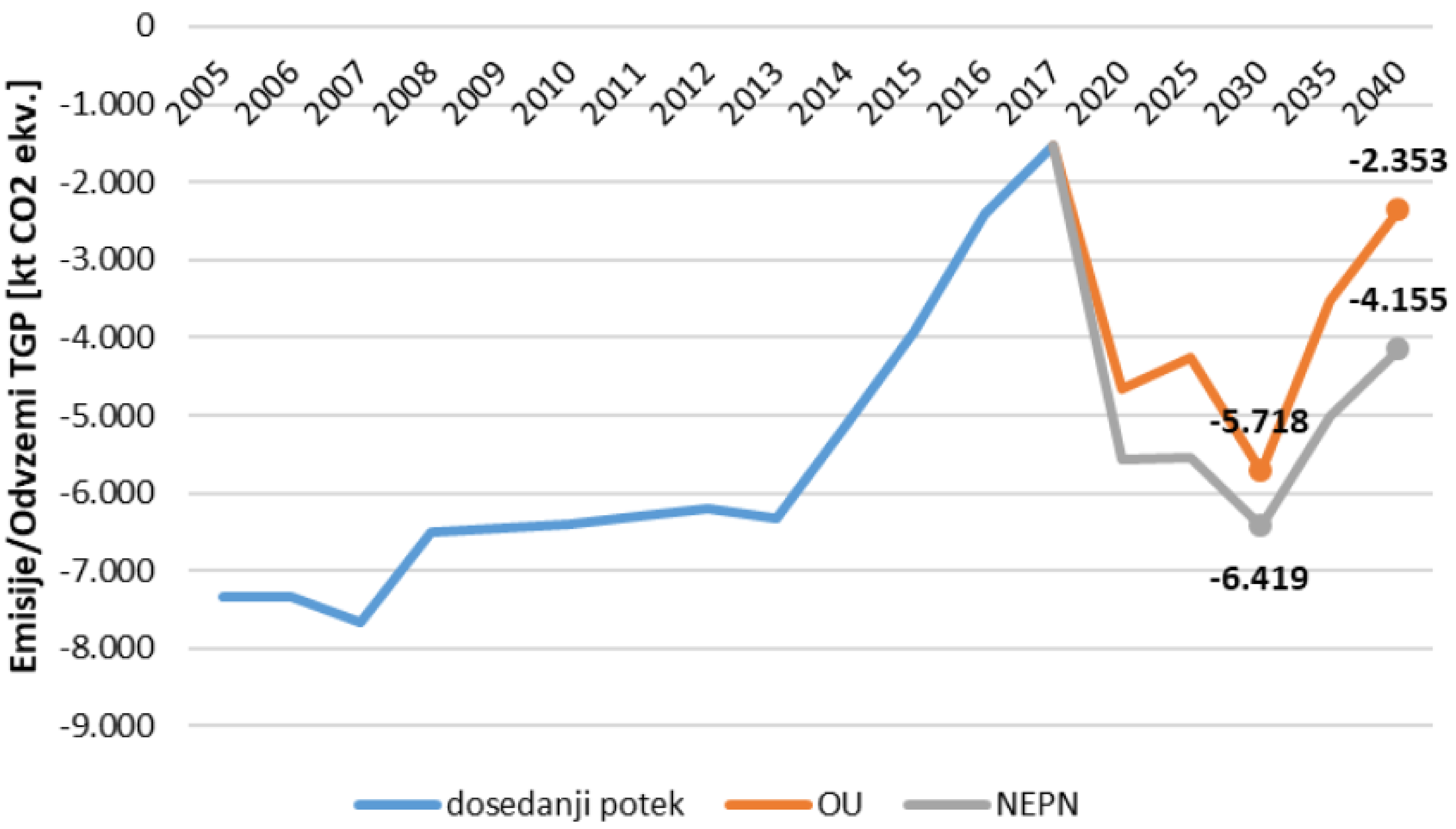
Results: projections until 2030 used in the NCEP



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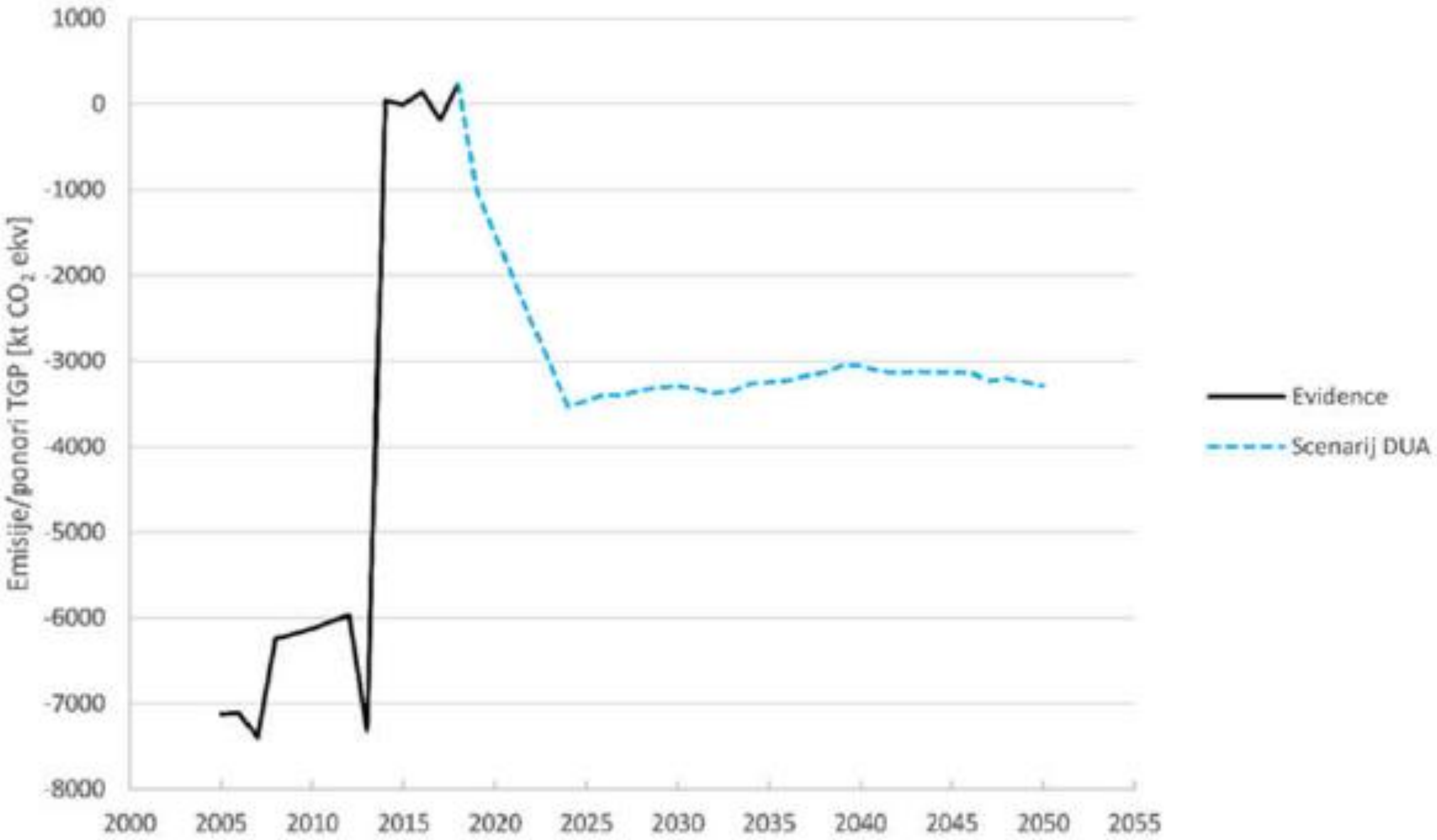
Results: projections until 2050 used in the LTS



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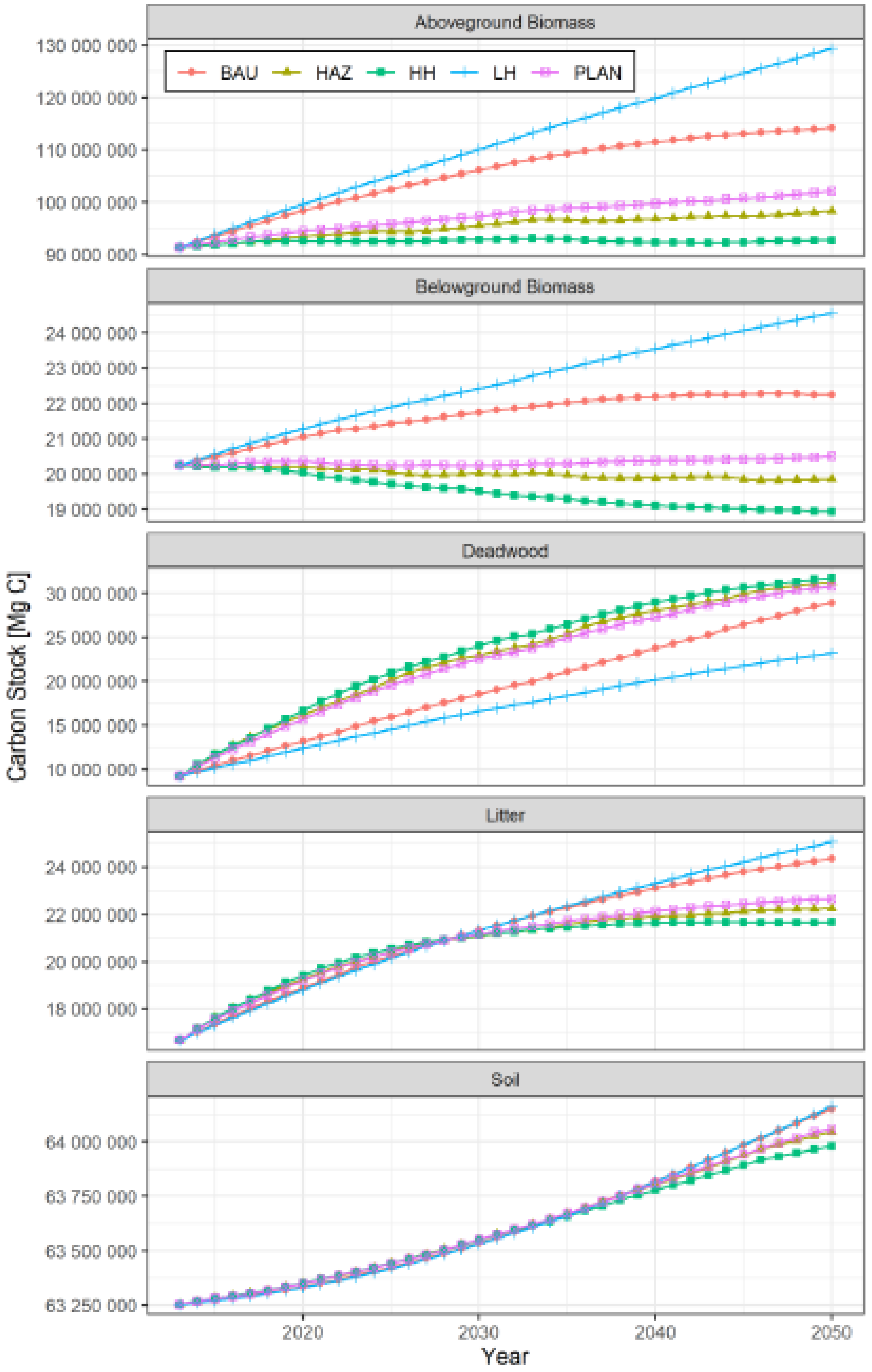
Results: projections for managed forests



BAU – business as usual
HAZ – more frequent natural hazards
HH – high harvest scenario
LH – low harvest scenario
PLAN - harvesting in line with current forest management plans

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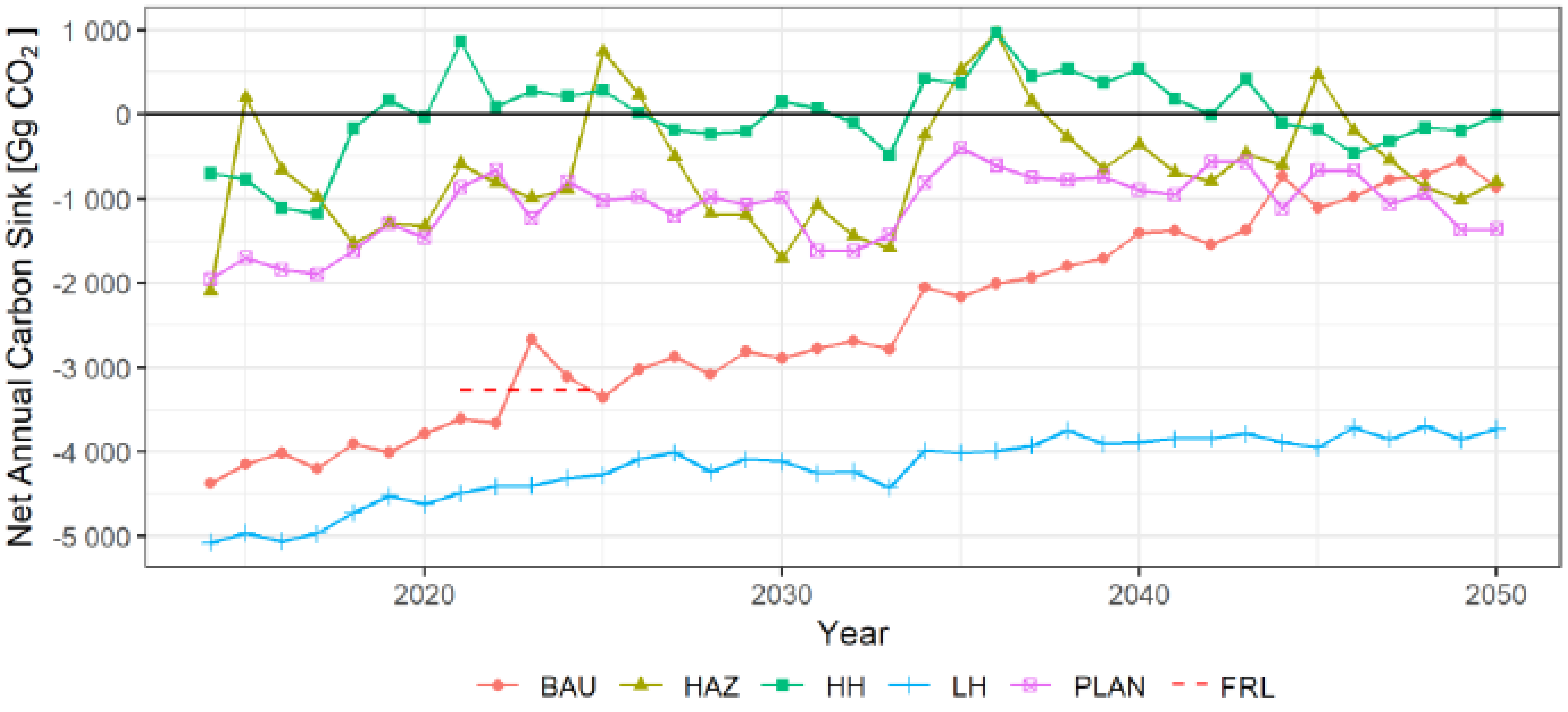
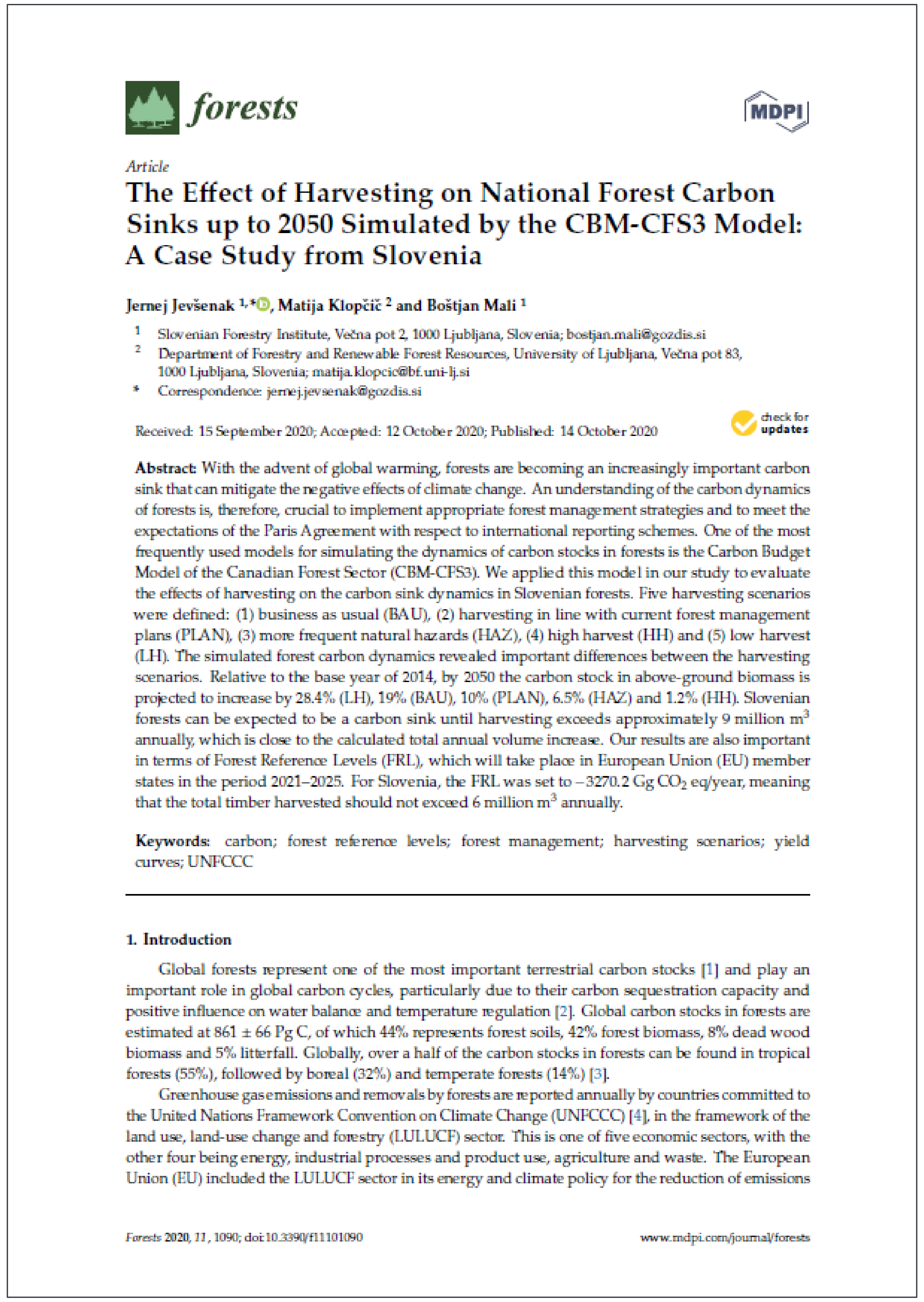
Results: projections for managed forests





forests
MDPI
Article

The Effect of Harvesting on National Forest Carbon Sinks up to 2050 Simulated by the CBM-CFS3 Model: A Case Study from Slovenia

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2 Department of Forestry and Renewable Forest Resources, University of Ljubljana, Večna pot 83, 1000 Ljubljana, Slovenia; matija.klopcic@bf.uni-lj.si
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Abstract: With the advent of global warming, forests are becoming an increasingly important carbon sink that can mitigate the negative effects of climate change. An understanding of the carbon dynamics of forests is, therefore, crucial to implement appropriate forest management strategies and to meet the expectations of the Paris Agreement with respect to international reporting schemes. One of the most frequently used models for simulating the dynamics of carbon stocks in forests is the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3). We applied this model in our study to evaluate the effects of harvesting on the carbon sink dynamics in Slovenian forests. Five harvesting scenarios were defined: (1) business as usual (BAU), (2) harvesting in line with current forest management plans (PLAN), (3) more frequent natural hazards (HAZ), (4) high harvest (HH) and (5) low harvest (LH). The simulated forest carbon dynamics revealed important differences between the harvesting scenarios. Relative to the base year of 2014, by 2050 the carbon stock in above-ground biomass is projected to increase by 28.4% (LH), 19% (BAU), 10% (PLAN), 6.5% (HAZ) and 1.2% (HH). Slovenian forests can be expected to be a carbon sink until harvesting exceeds approximately 9 million m^3 annually, which is close to the calculated total annual volume increase. Our results are also important in terms of Forest Reference Levels (FRL), which will take place in European Union (EU) member states in the period 2021–2025. For Slovenia, the FRL was set to −3270.2 Gg CO_2 eq/year, meaning that the total timber harvested should not exceed 6 million m^3 annually.

Keywords: carbon; forest reference levels; forest management; harvesting scenarios; yield curves; UNFCCC

1. Introduction

Global forests represent one of the most important terrestrial carbon stocks [1] and play an important role in global carbon cycles, particularly due to their carbon sequestration capacity and positive influence on water balance and temperature regulation [2]. Global carbon stocks in forests are estimated at 861 ± 66 Pg C, of which 44% represents forest soils, 42% forest biomass, 8% dead wood biomass and 5% litterfall. Globally, over a half of the carbon stocks in forests can be found in tropical forests (55%), followed by boreal (32%) and temperate forests (14%) [3].

Greenhouse gas emissions and removals by forests are reported annually by countries committed to the United Nations Framework Convention on Climate Change (UNFCCC) [4], in the framework of the land use, land-use change and forestry (LULUCF) sector. This is one of five economic sectors, with the other four being energy, industrial processes and product use, agriculture and waste. The European Union (EU) included the LULUCF sector in its energy and climate policy for the reduction of emissions

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Perspectives

- Data availability
- Capacity
- Faculty programs
- Models
- Forest management systems
- Time frames
- Climate change
- Decision makers

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Thank you!

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