ForestPaths
Co-designing holistic forest-based policy pathways for climate change mitigation

ForestPaths Features #2:
a series showcasing ForestPaths' insights and results.

How can models help achieve climate and biodiversity targets in the forest and forest-based sectors?

This information note describes the ForestPaths next generation assessment framework, outlining:

- key methodological features
- concepts and definitions
- variables considered
- expected simulation results

ForestPaths' integrated assessment modelling framework can:

- help to explore the implications of different forest management practices and policies on the production of wood and other ecosystem services, climate, and biodiversity.
- enable a spatio-temporal evaluation of substitution and carbon sink effects of wood-based products and energy over their life cycle.
- address the interactions between relevant land use and economic sectors.
- provide results at different scales, from sub-national to national and European scales, with linkages to global scale.

The challenge

EU's targets to significantly reduce greenhouse gas (GHG) emissions by 2030 and become climate neutral by 2050 require urgent and major reforms by all sectors. Simultaneously, the EU has committed to conserving biodiversity.

To meet this challenge, the ForestPaths project is co-designing, quantifying and evaluating holistic forest-based policy pathways to optimise the contribution of forests and the forest-based sector to climate change mitigation, while considering the need to adapt forests to climate change, conserve forest biodiversity and sustain forest ecosystem services provisioning.

Funded by the European Union

ForestPaths receives funding from the European Union's Horizon Europe Research and Innovation Programme (ID No 101056755), as well as from the United Kingdom Research and Innovation Council (UKRI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the EU nor the EC can be held responsible for them.

How modelling can help

Through modelling, we can evaluate the impacts of different scenarios on how the future may develop. The scenarios are based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, climate) and their relationships. Scenarios are neither predictions nor forecasts, but are intended to provide alternative potential future developments and actions. Modelling can then help to unveil new insights on medium- to long-term challenges characterised by uncertainty and complexity, helping to explore the implications of these alternative choices.

- Model-based scenario assessments can support policy design, guide action towards sustainability, and increase public awareness of the impacts of human behaviours on the environment.

The ForestPaths approach

ForestPaths is constructing policy narratives together with stakeholders, based on their visions on European forests, the forest-based sector, taking into account the required policies and actions needed for the transition to a climate-neutral and resilient society and economy. Policy narratives and policy targets will be turned into policy pathway scenarios. These scenarios will be modelled to provide information on the potential effectiveness of policies and possible interactions across sectors and spatial scales.

- Next generation models developed and improved in ForestPaths have the capacity to account for diverse forest management practices, climate, biodiversity, as well as forest management decision making.

ForestPaths' model evaluations

ForestPaths will integrate and synergise the strengths of various existing models, tools and methods through a next-generation integrated assessment framework that considers forest growth, climate change risks and interactions with the forest-based sector and economic system.

The multiple modelling approaches applied in ForestPaths combine and compare empirical vs. process based and agent-based vs. neo-classical economic models. Consistency between modelling activities is ensured through the combinations of models that are compatible conceptually and in terms of internal definitions.

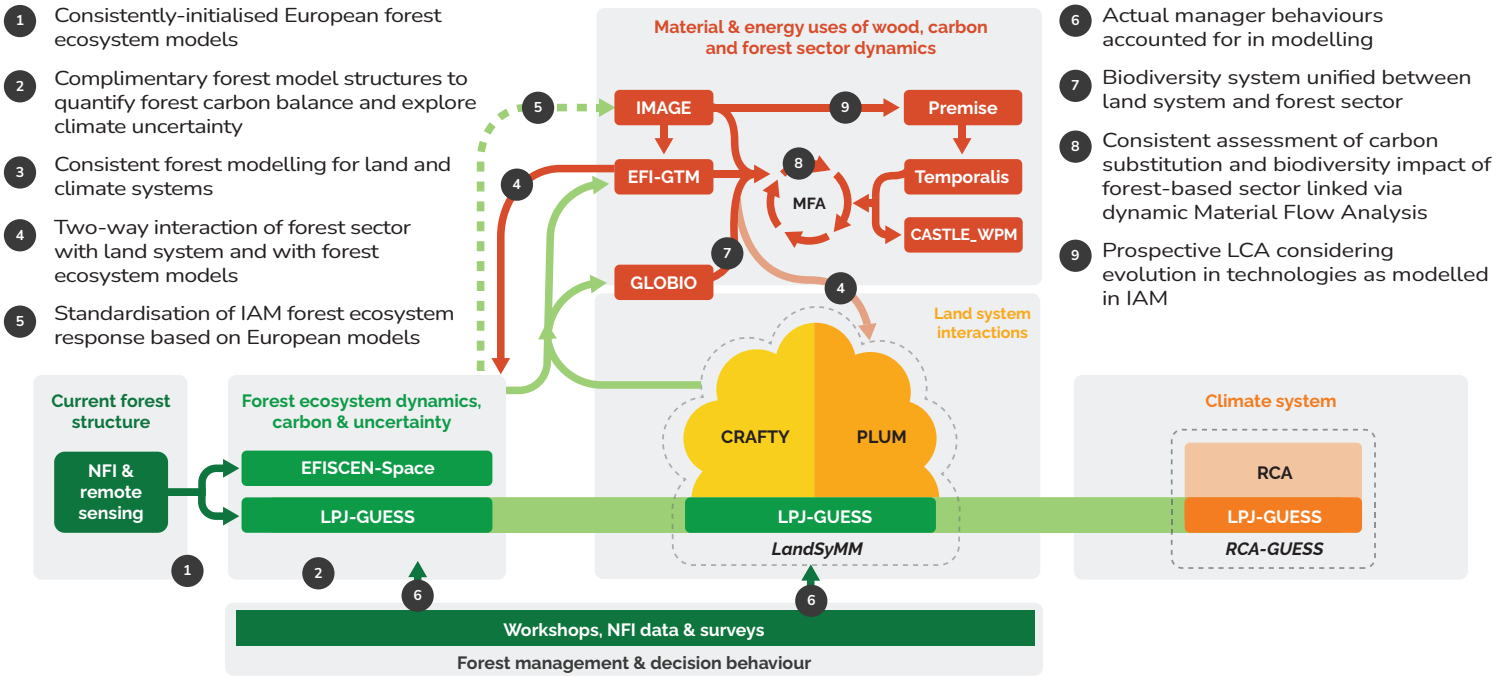

Figure 1. The ForestPaths next generation Integrated Assessment framework flows from state-of-the-art monitoring data on forests and disturbances through to a future land and climate system. ForestPaths can carry out assessments that focus on a particular aspect of the system (e.g., forest ecosystems, or forest-based sector), as well as interactions between forest ecosystems and the overall economy.

Table 1. Overview of the modelling types available to ForestPaths.

Model	Description	Use
EFISCEN-space	Empirical, spatial model designed for European forest resources based on forest inventory plot data [1].	Forest disturbances; Forest management
EFI-GTM	Partial equilibrium model for the global forest sector, covering major forest and energy products [2a, 2b].	Production, consumption & trade
CASTLE_WPM	Model to dynamically estimate carbon stock and flow in harvested wood products [3].	Wood products and wood use
LandSyMM	Modular framework to conduct Integrated Assessments; includes LPJ-GUESS, CRAFTY and PLUM, which can also act as stand-alone models [4].	Land use and ecosystem processes
LPJ-GUESS	Process-based terrestrial ecosystem model for regional or global studies with explicit representation of forest structure, European tree species, forest management actions and forest disturbances [5].	Forest disturbances; Forest management
CRAFTY	Agent-based modelling framework based on decision-making by simulated land managers who generate a variety of forest ecosystem services (FES) [6].	FES decision-making
PLUM	Economic model estimating future land use and management change, based on changing socioeconomic conditions and climate effects on agricultural yield [7].	Production, consumption & trade
GLOBIO	Global biodiversity model for quantifying human-nature interactions, impacts of land use change, climate change and other pressures on biodiversity and various ecosystem services, linked with IMAGE [8].	Forest management
IMAGE	Global model representing interactions between society, the biosphere and the climate system; assess and explore pathways addressing climate change, biodiversity (with GLOBIO) and human wellbeing [9].	Forest management; Production, consumption & trade
RCA-GUESS	Regional Earth system model (linked with LPJ-GUESS) covering the coupled dynamics of climate, vegetation, and terrestrial ecosystem biogeochemistry for regional applications [10].	Forest management

Climate and Biodiversity-Smart forest management

ForestPaths is evaluating **Climate and Biodiversity-Smart (CBS)** forest management practices for different European regions. Analyses go well beyond the earlier coarse spatial resolutions and process representation, and depict the necessary variation of forests, soils, land-use history, and albedo effect, as well as social constraints and policy considerations important for policy implementation.

Scale

High-resolution data allows for modelling forest information from stand level all the way to European level. Combining different modelling approaches, the project will provide assessments of forest carbon pools and their links with economic systems at European and global level.

Climate and Biodiversity-Smart (CBS) forest management practices aim to respond to increased climate change risks, contribute to climate change mitigation, and maintain biodiversity. CBS forest management practices will be defined, discussed, evaluated and validated throughout the project with stakeholders and forestry practitioners in field workshops. CBS management practices will be assessed for their biophysical suitability for different forest ecosystems and bioclimatic regions, considering the latest knowledge on climate change, disturbance risks and forest management influencing forest biodiversity, through modelling. ForestPaths will also assess the socio-economic suitability of CBS practices, including barriers and enablers for implementation by practitioners, and will facilitate co-design policies with policymakers and other stakeholders to support the implementation of CBS forest management practices that contribute to climate change mitigation, adaptation, and biodiversity maintenance.

Model outputs

- Consumption, production, trade and price of various forest products; harvested quantity of roundwood; amount of collected wastepaper.
- Indicators for Ecosystem Services.
- Land use types, cropland types and intensity, product demand, nutritional health, prices.
- Indicators for biodiversity (e.g., Mean Species Abundance, Species population change).
- C stock in wood products pools.
- Forest variables (e.g., number of trees per ha, volume per ha, mortality, deadwood volume, number of harvested trees, etc.).
- Land use dynamics.
- Concentration of greenhouse gases in the atmosphere and radiative forcing.
- Impacts on some biophysical variables (e.g., surface temperature, heat fluxes).
- Changes in temperature and precipitation.

References

[1] Schelhaas, M. J., Hengeveld, G., Filipek, S., König, L., Lerink, B., Staritsky, I., de Jong, A., Nabuurs, G. J. (2022). EFISCEN-Space 1.0 model documentation and manual. Wageningen Environmental Research, Report 3220. https://doi.org/10.18174/583568

[2a] EFI-GTM. Kallio, A.M.I., Moiseyev, A., Solberg, B. (2004). The global forest sector model EFI-GTM– the model structure. Technical report 15. European Forest Institute, Joensuu.

[2b] EFI-GTM. Kallio, A.M.I., Chudy, R., Solberg, B. (2018a). Prospects for producing liquid wood-based biofuels and impacts in the wood using sectors in Europe. Biomass and Bioenergy 108, 415-425.

[3] CASTLE_WPM. Brunet-Navarro, P., Jochheim, H., Muys, B. (2017). The effect of increasing lifespan and recycling rate on carbon storage in wood products from theoretical model to application for the European wood sector. Mitig. Adapt. Strategies Glob. Change 22, 1193e1205. https://doi.org/10.1016/j.jclepro.2017.09.135

[4] LandSyMM. https://landsymm.earth/

[5] LPJ-GUESS. https://web.nateko.lu.se/lpj-guess/

[6] CRAFTY. https://landchange.imk-ifu.kit.edu/CRAFTY

[7] PLUM. https://landsymm.earth/PLUM

[8] GLOBIO. https://www.globio.info/

[9] IMAGE. Stehfest, E., van Vuuren, D.P., Bouwman, L., & Kram, T. (2014). Integrated assessment of global environmental change with IMAGE 3.0: Model description and policy applications. Netherlands Environmental Assessment Agency (PBL); Van Vuuren, D.P., et al. “The 2021 SSP scenarios of the IMAGE 3.2 model.” (2021): Netherlands Environmental Assessment Agency (PBL)

[10] RCA-GUESS. Smith, B., Samuelsson, P., Wramneby, A., Rummukainen, M. (2011). A model of the coupled dynamics of climate, vegetation and terrestrial ecosystem biogeochemistry for regional applications. https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0870.2010.00477.x

Scan to access ForestPaths’ website

forestpaths.eu

forestpaths_eu

forestpaths-project