

Policy

Europe: COM (2013) 659 final EU Forest Strategy, RDPs (Pillar I and II); CAP; Reg. 1698/05 1974/06 (rural development)

Italy: Legislative Decree 3/04/18 n. 34, Testo Unico in materia di Foreste e Filiere forestali (Tuff), Legislative Decree on Orientation and Modernization of the Forestry Sector, Agricultural policy instruments; Regional RDP; dlgs. 18/05/01 n.227

First draft

Machine Learning Forest Simulator (MLFS)

Territorial Scale: National

WHY

The “Machine Learning Forest Simulator” is a decision-making tool, available as R package, designed to understand the dynamics of forest development at various scales based on forest inventory data. As such, it can be used to understand the effect of harvesting on key forest processes, such as growth, carbon accumulation and mortality. It is also climate-sensitive and therefore simulates the effect of increasing temperatures on the development of forest. An important advantage of MLFS is its data-driven principle, which removes the need for model parameterization. Finally, the MLFS supports a wide range of plot-designs and data types, and can be applied to various forest types, from monocultures to forests with rich species compositions.

FOR WHOM

The MLFS end-users are diverse, starting with national administrative authorities in charge for carbon accounting and accepting national harvesting strategies; then it can be used by scientists interested in long-term effects of environmental factors and climate on forest development; and finally, MLFS can be applied by forest practitioners and engineers, as a decision-making tool in the process of forest planning.

HOW – if you want to select your Region Of Interest (ROI)ⁱ

The tool works over the Italian and Slovenian territory and allows the selection of any freely drawn region of interest (ROI), administrative unit (e.g. Municipality) by following this simple procedure:

Operational procedure for ROI (draw, save, plot)

- By clicking on the "Draw (Polygon)" button on the top bar, drawing the desired area (ROI) and assign it a nameⁱⁱ;
- Using the "Save" button, the ROI is stored in the system memory and can be retrieved whenever necessary.

Operational procedure for Administrative Unite (select, plot)

- By clicking on the "Select Administrative Unit" button on the top bar is possible to select the AU of interest (e.g. municipality).
- Using the "Run" button, the AU is clipped within the database and results are shown (see Results section).

HOW – if you need “Machine Learning Forest Simulator (MLFS)”**Operational procedure**

The tool “Machine Learning Forest Simulator (MLFS)” can be selected in the toolbox on the right of the Graphic User Interface at national scale in Italy or Slovenia; then by clicking > CAP Agriculture and Forestry > h.Supporting sustainable forestry > Forest Simulator (MLFS) the model requester will appear.

User must fill all following fields:

- Region Of Interest, freely drawn or from Administrative Limits (NUTS4 or NUTS3)
- Year (past and future)
- Yield harvesting
- SSP scenarios for Italy and RCP scenarios for Slovenia
- Mortality
- Thinning

Then by clicking the Evaluation button the system automatically switches in the result section. After the selection of the last elaboration two tables will appear in the Elaboration results section.

The first table, called Matrix 1, for each point inside the ROI reports three parameters: growing stock (m^3/ha), basal area (m^2/ha) and harvested volume ($m^3/ha /year$).

The second table produces the major statistics related to the points into the ROI: count, mean, standard deviation, minimum, maximum, 25th percentile, 50th percentile, 75th percentile.

What for

The information obtained provides support for sustainable planning and management of forests through scenario analysis aimed at understanding the dynamics of the forest development over time.

LIMITATIONS

The user of the MLFS should be aware of the following limitations:

- to run MLFS, the input data should be from at least two inventory periods, which enable the algorithms to learn about the spacetime forest processes,
- the data should be prepared in strict formats,
- the number of plots should be reasonably high, depending on forest complexity and structure.

FUTURE DEVELOPMENTS

The MLFS tool is continued of being developed with the aim for the improvement of its general use. In the future, we also plan to introduce the possibility of changing forest area and simulating the establishment of new plots. Sub models, which currently showed lower prediction capacity, will be further developed. One of the possible improvements include the growth information of dead trees, which was shown to be a very effective variable for explaining for mortality, but this information is not available in NFI data used in the scope of the Landsupport project. The MLFS model will be evaluated using national forest inventory data or long-term experiment plots from different countries, with different plot designs and species compositions, which will probably highlight further development needs of the model. Based on the interaction with potential users, model will be upgraded to meet users' expectations.

REFERENCES

To get further information on the MLFS tool, you can watch the round table presentation from October 2021, available at: <https://www.youtube.com/watch?v=oomC05Snto>.

The scientific publication about the model is currently in preparation (Jernej JEVŠENAK, Domen ARNIČ, Luka KRAJNC, Mitja SKUDNIK, 2022. New forest modelling tool: Machine Learning Forest Simulator (MLFS) available for studying future forest based on national forest inventory data).

ⁱ Special care is required when user draws/select the Region of Interest. In fact, LANDSUPPORT is a multi-scale decision support system. Each of the 15 available tools is designed for a specific application and for a specific scale. Furthermore, the databases using specific standards required for that specific scale. The users of LANDSUPPORT web platform must therefore be well aware of the limitation embedded in the different maps that they require for their specific application. The users must be expert on their specific problem and must understand if the input data offered by the platform are suitable for their problem. In light of the above, the system provides very reliable results only if used appropriately.

ⁱⁱ It is also possible to draw a ROI with numerous polygons. In this case, it is possible to assign different values (eg numbers) to each of the drawn polygons.