

# Forest Resource Modelling in Finland

Natural Resources Institute Finland (Luke)

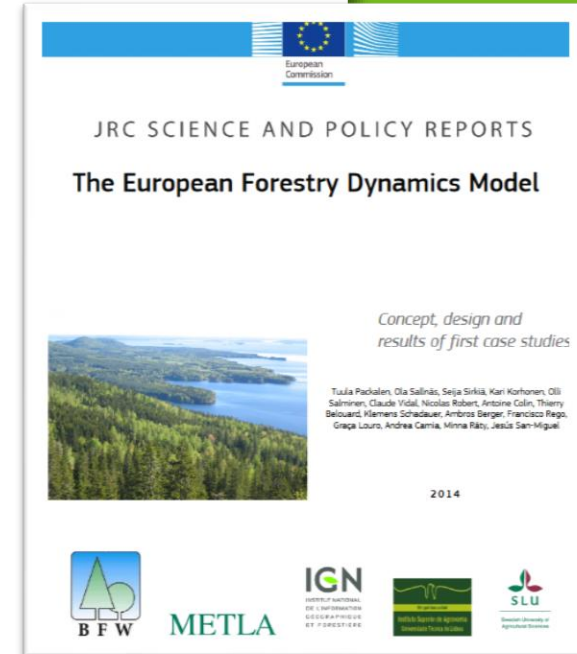
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# European Forestry Dynamics Model (EFDM)

**Model:** A Markov chain model

- Area-based matrix model
- Developed by Luke (Metla) and SLU for JRC
- Tested in several European countries
- Used, for example, in DIABOLO: <http://diabolo-project.eu/>



Packalen et al. 2014. The European Forestry Dynamics Model: Concept, Design and Results of First Case Studies; JRC Science and Policy Reports; EUR 27004;

DOI: [10.2788/153990](https://doi.org/10.2788/153990)

# Data requirements (EFDM)

- Depends on the desired level of details or data availability: from inventory sample plot data to statistics
- Including:
  - **Extent:** Forest area stratified into different forest types
  - **Structure:** Classified into *volume – age/stem count* classes
  - **Growth:** Forest development – either with paired data from two different inventories or modelled
  - **Management:** What and when activities are applied and how they affect on volume - age/stem count classes
  - **Result coefficients:** turn areas into volumes, biomasses...

# Implementation (EFDM)

**Implementation from scratch** takes from couple of weeks to some months 1-2 persons working on it

**Advantage:** once implemented fast to run

**Scenario modification time depends on the change**

- Change in output variable vs. change in forest classification
  - First is not requiring much
  - The latter: basically everything needs to be redone

# Availability (EFDm)

Desktop based, open source R functions

Original codes:

- <https://github.com/ec-jrc/efdm> (vol-age matrix)
- <https://github.com/ec-jrc/efdm-nea> (vol-stem matrix)

New development made in Finland, R package:

- <https://github.com/mikkoku/efdm>
- vol-age-stem in a same run
- Allows land-use and forest type changes
- **Support available**

# Use and Climate Change (EFDM)

Used as scenario tool for policy support:

- 1) Future forest resources, biomass and wood supply
- 2) Impacts of *alternative forest treatments* and *protection* on biodiversity and wood supply
- 3) Carbon related metrics

Climate change implementation depends on user.

Linkages to other models possible.

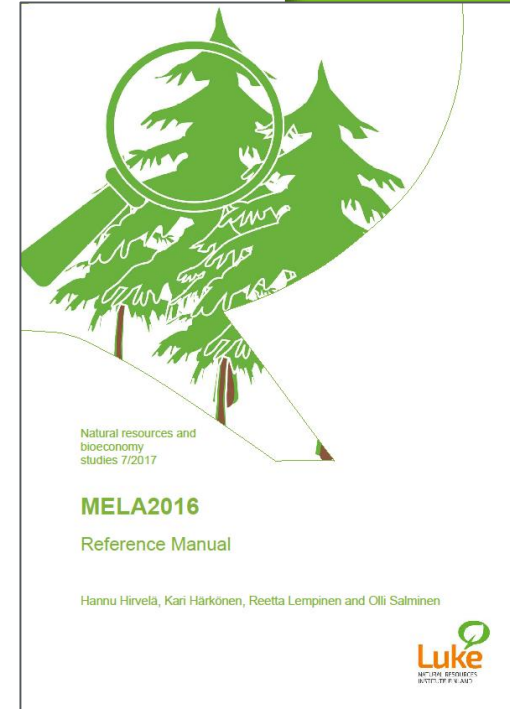
# MELA System (MELA)

**Model:** A tool for large-scale scenario analysis in Finland

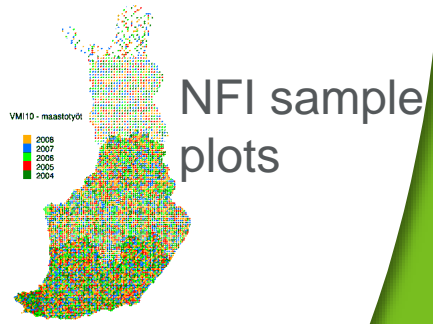
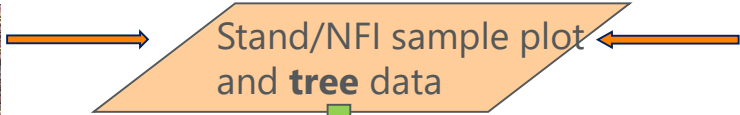
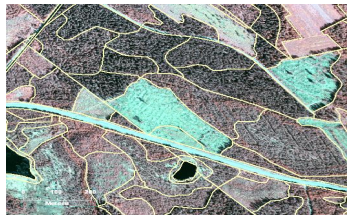
- Developed by Luke (Metla)
- First official version MELA96, current version MELA2016
- Based on simulation and optimisation, tree level models
- Used in many national and regional level analyses in Finland, for example, in National Forestry Accounting Plan for Finland (2019)

Hirvelä, H., Härkönen, K., Lempinen, R. & Salminen, O. 2017. MELA2016 Reference Manual. Natural resources and bioeconomy studies. 7/2017. 547 p. ISBN 978-952.326-1 (Online).

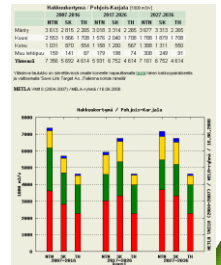
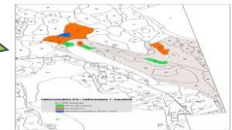
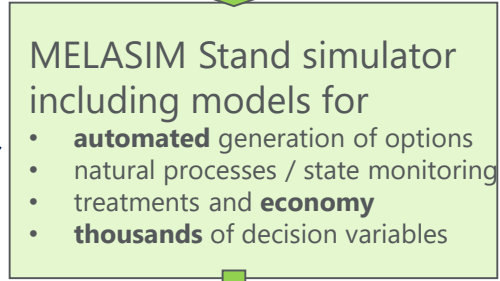
<http://urn.fi/URN:ISBN:978-952-326-358-1>



# MELA: Simulation and optimisation



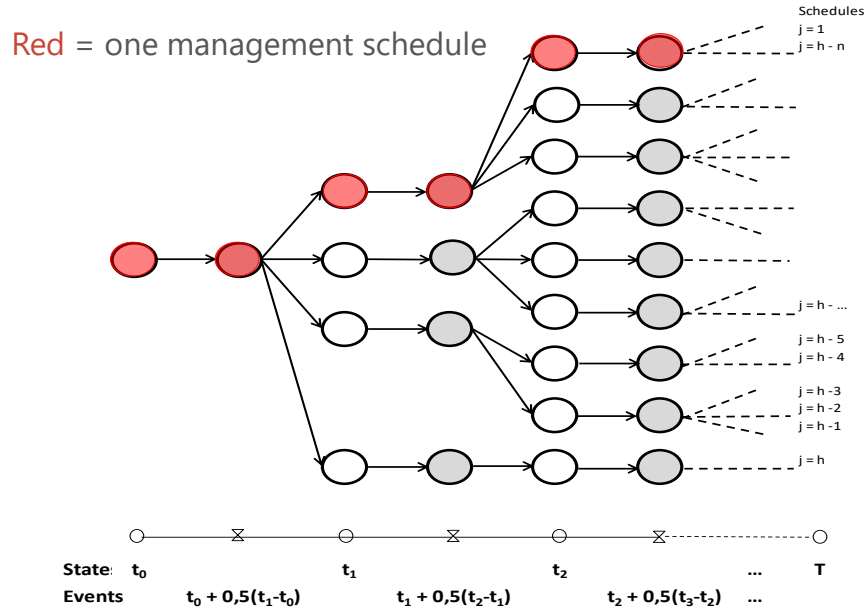
**User defines:**  
 Management activities  
 Prices, costs  
 Discount rates  
 Goals for region/enterprise  
 Etc.





# Simulation in MELA System

Large number of alternative schedules for each management unit  
(stand/sample plot etc.) – simulation tree of feasible schedules



## Events

- Tending of young stand
- Thinnings based on number of stems or basal area
  - saw logs, pulpwood and/or energy wood
- Final fellings
  - saw logs, pulpwood and/or energy wood
- Soil surface preparation
- Cleaning of regeneration area
- Regeneration for pine, spruce or birch
- Fertilization
- Drainage
- No treatment

# Data requirements (MELA)

- Forest data is described as set of management units
- Management unit
  - Forest stand, sample plot, sample plot + satellite images etc.
- Management unit includes
  - Stand level variables (area, owner, coordinates, date of inventory, land use category, forest site type, earlier treatments ...)
  - Tree stratum/tree level variables (number of stems, tree species, basal area, diameter, height, age ...)
- Three input data formats (RSD, RSU, XML)
  - RSD and RSU MELA-specific
  - XML widely used by private sector in Finland

# Implementation (MELA)

- Time of implementation from scratch depends on e.g.
  - Data conversion to MELA data format
  - Type and details of scenario analysis
  - Level of expertise of forest planning and optimisation
- No ready-to-use scenario applications
- MELA routines are controlled by parameters
  - Most have default values
  - Examples of parameter definitions (Reference Manual)
  - No graphical user interface – definitions saved to text files
- Scenario modification time depends on the change
  - Changes in simulation and/or optimisation problem

# Availability (MELA)

- Desktop application
  - Based mainly on Fortran source code
  - Windows, Linux
- Commercial application - not open source
- MELA is made for Finnish conditions only
  - Models (growth etc. natural processes, time-consumption in human made treatments ...)
- Support
  - MELA Reference Manual  
<http://urn.fi/URN:ISBN:978-952-326-358-1>
- MENU project (2019-2022)
  - Target: Next-generation open-source system

# Use and Climate Change (MELA)

- Used as scenario tool for large-scale management planning analysis, estimation of felling possibilities and policy support
  - Future forest resources, biomass and wood supply
  - Impact analysis: changes in land use, forest treatments etc.
  - Other forest products -> berries, coverage of grass, lichen, ...
- Biomass models -> biomass (carbon) in growing stock
- Yasso07 model -> soil carbon estimations on mineral soils
  - Requires reliable initial values of soil carbon, no default values
- Output for external soil carbon calculations
- Climate change implementation depends on user
  - Level of tree growth can be changed

**Thank you!**

