

Monitoring and modeling of forest ecosystems: the Estonian Network of Forest Research Plots

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Abstract. Forest research has long traditions in Estonia that can be traced back to the 19th century. Data from long-term forest experiments are available since 1921. The first studies mainly focused on silvicultural treatments and application of such data for understanding and modeling ecological processes was limited. The Department of Forest Management of the Estonian University of Life Sciences started to develop the Estonian Network of Forest Research Plots (ENFRP) in 1995. Since then, plots have been continuously re-measured with 5-year interval. Approximately 100–150 permanent sample plots were measured annually. In 2014, the long-term research network consisted of 729 permanent sample plots, of which 699 have been re-measured at least once, 667 plots – twice and 367 plots – three times. The total number of trees recorded in the network database amounts to 130,479. The plots are systematically distributed throughout the country. Detailed dendrometric measurements including tree spatial distribution are part of the survey protocol. Initially the network was set up to produce suitable data for development of individual tree growth models for Estonia. The significance of the network for the Estonian forest research is continuously increasing and nowadays ENFRP is recognized as an important national research infrastructure.

Key words: Estonia, forestry, observational study, modeling.

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Introduction

Assessment of field observations for forest research in Estonia can be traced back to the 19th century. Long-term forest measurement series as continuous and representative datasets for particular cases have been available since 1921. These longitudinal experiments were designed to study particular silvicultural practices or forest growth and yield, in general. Such studies provide quite limited data with substantial spatiotemporal gaps (Sims *et al.*, 2009a) for

forest modeling or for studying forest ecosystem functioning nowadays at advanced research level.

Long-term data series have unique value in forest research as it is tempting to replace actual time with chronosequence. Both, longitudinal and chronosequence studies have several disadvantages and can be substituted with an interval study (Zhao *et al.*, 2014). Permanent sample plots being continuously re-measured over a long time periods are a valuable source of forest information but they have high

costs of maintenance, long waiting time for results and there is a risk of abandonment in future. Also, rare events, like extreme conditions and extreme treatments, cannot be studied only on these plots. In addition, permanent sample plots can be combined with interval plots to study more specific research questions or rare events.

The Department of Forest Management of Estonian University of Life Sciences started to set up of the Estonian Network of Forest Research Plots (ENFRP) in 1995. The initial aim of the network involved data collection for single-tree growth models to be used in Estonia. Nowadays the network functions also as a basic infrastructure for forest research in Estonia. Approximately 100–150 permanent sample plots are measured or re-measured annually. The plots are distributed throughout Estonia. Detailed dendrometric tree-wise measurements including spatial tree distribution are part of the survey protocol. The data assessment methodology of the ENFRP is continuously improving.

The objectives of this paper are: (1) to present the network design and data assessment of ENFRP, (2) to share the experience of setting up ENFRP and (3) to present the data usage and other studies from ENFRP.

Background for ENFRP

Estonian forest resources

The total forest land area in Estonia amounts to 2.2 million ha, covering 51.1 % of the country's territory (Raudsaar *et al.*, 2014). The woodland cover has been continuously increasing during the last fifty years due to the afforestation of abandoned agricultural lands. In 2013 (Raudsaar *et al.*, 2014), 25.3% of the forest area was dedicated to nature conservation. The total volume of growing stock accumulated in Estonian forests is 458 million cubic metres and has a tendency to increase. Estonian forests are part of the hemiboreal zone (Shorohova *et al.*, 2009), where Scots pine (*Pinus sylvestris* L.),

Norway spruce (*Picea abies* (L.) Karst) well as birch species (*Betula pendula* Roth and *B. pubescens* Ehrh.) are the most common and economically important tree species. Aspen (*Populus tremula* L.), grey alder (*Alnus incana* (L.) Moench) and black alder (*A. glutinosa* (L.) Gaertn.) frequently occur in mixtures with conifers or other broadleaved species.

Forest Modeling Information System (ForMIS)

Field data collection should be assisted by advanced data storage and management system for end-users and modellers (Eastaugh *et al.*, 2013). ForMIS (<http://formis.emu.ee>) is a platform to provide and share forest research data and to attract researchers from different disciplines to conduct interdisciplinary research on forest ecosystems. ForMIS guarantees professional data storage and management of all Estonian long-term forest research plots. In addition to the research data, ForMIS system includes three other datasets: (1) growth and yield tables from different countries, (2) dendrometric formulas and (3) forest growth functions. The maintenance of such a key database is considered to be of national importance in most of the countries today (Sims *et al.*, 2006).

The extensive databases of different research programmes stored in ForMIS have already provided scientists with much useful information (Sims *et al.*, 2006; Sims, 2009). Nevertheless, combining data from earlier research series with recent survey records is of high importance in long-term forest research (Sims *et al.*, 2009a). Considering end-user needs and current data requirements for modeling older data can be successfully used in deriving general theoretical concepts or testing small-scale phenomena's (Eastaugh *et al.*, 2013). Therefore there is a clear need for the network of forest plots to be monitored over long time periods, which eventually will result in an optimal set of empirical data for the derivation, validation and comparison of various forest models.

Earlier long-term forest data series in Estonia

Empirical measurements for forest research in Estonia started in the 19th century while nature of experiments and forest data presence/availability were greatly influenced by institutional re-arrangements. Therefore, three major periods can be distinguished: (1) the period of establishment of university level forestry education in Tartu University from the beginning of 20th century until 1940, followed by (2) the period of research studies and management applications tested at a large scale, carried out by the Estonian Forest Research Institute, Estonian Agricultural Academy and The Centre of Forest Management Planning until the beginning of 1990's and (3) the period of project-based forestry research since 1990's. Data series are almost impossible to restore from the first period and can be partly recovered and re-measured from the second period. Data from the third period is usually derived from temporary measurements of short-term studies.

The best samples of earlier forest research are cultivated test stands of different natural (e.g. *Quercus robur* L., *P. sylvestris*) and introduced tree species (e.g., *Larix* sp.). The purpose of these stands was to test the ecological value of the species and to monitor effects of silvicultural treatments like planting density or thinning intensity. Still, they were mostly established by the initiative of Baltic landowners (large estates) and for practical aims. Therefore, the results of the tests were not detailed measurements, but rather general descriptions and management guidelines.

Systematic field experiments for forest research purposes began after the establishment of the Järvselja Forestry Training and Research Centre in 1921 (Mathiesen & Riisberg, 1932; Siim & Kangur, 2013). The Järvselja experimental forest (58°16'N, 27°18'E) is located in South-Eastern Estonia near Lake Peipus. The set of Järvselja old field experiments comprises several different long-term forest monitoring, research

and experimental series: (1) long-term growth and yield study plots initiated by Andres Mathiesen (Kasesalu, 2003; Kangur *et al.*, 2005), (2) thinning experiments initiated by August Karu and Lembit Muiste (Tullus & Reisner, 1998), (3) growth and yield studies of exotic tree species (Kasesalu, 1993) and (4) *Q. robur* growth and yield test stands (Kasesalu, 1993). There are other projects from this era, but the above-mentioned ones contain digitalized data series and are still existing.

All agricultural sciences, including forestry education were transferred from Tartu University to the Estonian Agricultural Academy, after its establishment in 1951. With a specific focus on forest research, the Estonian Forest Research and Nature Conservation Institute was additionally established in 1969. The research focus was set to large scale studies on (1) thinning, (2) re-cultivation of post mining areas and wastelands, (3) fertilisation of infertile forest sites and drainage in wetland forests and (4) forest tree breeding and selection. Forest inventories and forest management planning related to long-term studies were carried out by the Estonian Agricultural Academy and the Estonian Forest Management Planning Centre.

Starting from the 1990's until today forestry research studies are carried out with project-based funding. In 1996 the Estonian Forest Research and Nature Conservation Institute was merged with the Estonian Agricultural University (previously Estonian Agricultural Academy and current Estonian University of Life Sciences). The main research topics with the long-term data collection objective are (1) forest monitoring on the Estonian Network of Forest Research Plots, (2) breeding, silviculture and growth of fast growing broadleaved tree species, (3) forest disturbance studies and (4) forest nature protection and nature restoration studies.

Design of ENFRP

The design of the ENFRP follows the idea of INKA forest permanent sample plots

(Gustavsen *et al.*, 1988) developed at the Finnish Forest Research Institute. The first spatially explicit monitoring plots in Estonia were established by Urmas Peterson in the Pikknurme and Aakre forest districts in 1995 and 1996. These two study sites contained more than hundred plots each. During the two following (1997–1998) years, approximately 60 new similar plots were established in the Sagadi forest district and in several other areas in southern Estonia. During the first four years various mensuration instruments and techniques were tested and as a result, an optimal survey protocol was developed. Finally, in 1999 a nation-wide network of long-term forest monitoring plots was designed. In general, ENFRP plot locations are connected with the grid of European Forest Monitoring Programme ICP level I plots. Figure 1 shows the geographic location of plots.

The network of ENFRP was designed following these principles (Kiviste & Hordo, 2002):

- 1) The long-term measurement series of individual trees is an important prerequisite for forest growth modeling;
- 2) The main forest types, development stages and tree density classes in Estonia should be represented by the plots;
- 3) The plot locations should be based on a systematic grid covering Estonia. Precise locations should be selected randomly in the forest stand surrounding the grid point;
- 4) Tree measurements should be accompanied by tree locations;
- 5) The plots should be large enough to capture tree growth, competition and mortality patterns of the forest stand;
- 6) The ENFRP network design should overlap with already existing and with planned study sites of other research projects to ensure efficiency and added value.

The ENFRP plots are circular sample plots. A single plot includes at least 100 trees from the upper storey. Therefore we use the principle of variable plot size and the corresponding radius of 15, 20, 25 or 30 m depending on stand density and other stand characteristics on site. In the beginning, smaller trees belonging to the mid- and understorey were surveyed in plots with a smaller radius (8 or 10 m), concentric with main sample plot. Every sample plot is re-measured after a five-year interval. According to our survey protocol, the stem diameter at breast height (measured at 1.3 m above root collar) is recorded for every tree in two perpendicular directions.

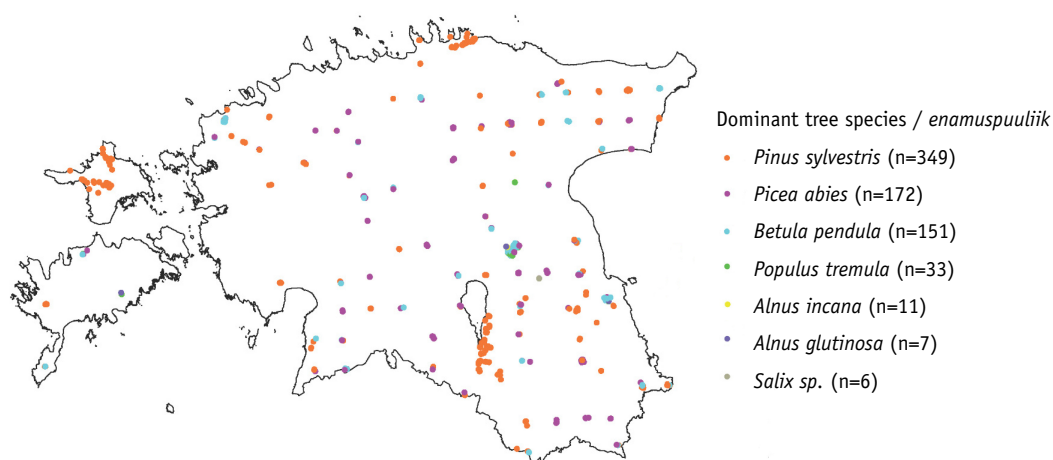


Figure 1. Location of ENFRP plots. In brackets is number of plots.

Joonis 1. Metsa kasvukäigu püsiproovitükkide paiknemine. Sulgudes on proovitükkide arv.

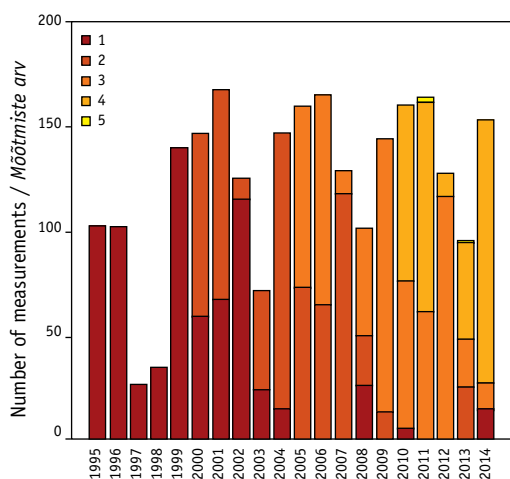


Figure 2. Number of plot measurements by the year of the measurement and following the sequence of re-measurements in ENFRP.

Joonis 2. ENFRP mõõtmiste arv mõõtmisaasta ja korduvmõõtmiste arvu järgi.

Total tree height and height to crown base are measured only for a subsample of trees while the height to the first dead branch is also recorded for mature coniferous trees of a subsample. Living and dead trees, snags, coarse woody debris, bushes and ingrowth as well as stumps of recently cut trees are recorded spatially explicitly. In addition, the age of different tree species by cohorts is estimated from tree-ring cores extracted from trees outside the plots. Tree damages and causes of tree mortality are assessed and recorded for the trees within the sample plot. Within each plot thickness of soil organic layer is measured at 12 locations.

The ENFRP plots are not the “blind plots” for forest owner. All forest owners are informed about the plots on their land and forest owners have agreed to inform the ENFRP about their planned forest management activities on the plots.

Several additional studies have been carried on the ENFRP plots. On all plots, forest naturalness was assessed in 2006–2010 (Laarmann *et al.*, 2009). Since 2012, ground vegetation and soil properties are being assessed. The ground vegetation is

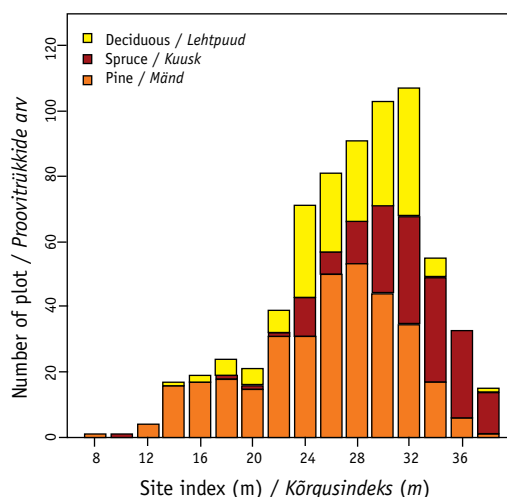


Figure 3. Distribution of plot measurements by site index and tree species in ENFRP.

Joonis 3. ENFRP proovitükkide arv kõrgusindeksi ja puuliigi järgi.

sampled in a subplot of 400 m² inside the main plot using the description method developed by Kent & Coker (1992). Soil horizons (soil profile) and soil physical and chemical properties are described for every plot.

Results of ENFRP

ENFRP data

By 2014, 729 permanent sample plots were fully established as part of the network of long-term forest monitoring plots, of which 699 have been re-measured at least once, 667 twice and 367 three times (Figure 2). Five plots have been re-measured even four times. The total number of trees recorded in the network database amounts to 130,479 including live, dead and trees removed during harvesting operations, which results in 376,252 measurement records.

The majority of plots are located on mesotrophic, meso-eutrophic and nemoral forest sites. Distribution of stands by site index (SI_{100} – mean stand height at the age of 100 years), (Figure 3) is left skewed with most of the plots being in the range

of 22–34 m. Fertile sites on mineral soils are represented more in the network than infertile sites. Left-side skewness might be due to oligotrophic peatland and heathland Scots pine forests, where the tree height maximum is around 18 meters.

The tree species composition on the ENFRP plots, based on standing volume, is presented in Figure 4. Scots pine plots are found mainly in pure stands, while Norway spruce and deciduous species occur in various species mixtures.

Figure 5 shows relationships between stand variables on the ENFRP data set. Lines show dynamics of individual sample plots, representing interval studies. Colour indicates the main tree species on a plot. Scots pine shows the highest variation in dynamics of height and basal area.

Experiences from long-term forest measurements

The need for forest long-term data series is evident considering interdisciplinary environmental research, national importance and scientific relevance. Valuable observations have been diligently collected by several generations of scientists, providing information about forest structure, growth

and yield, disturbances and ecosystem dynamics in the different forest types (Sims *et al.*, 2009a). Still, the real value of the particular set of long-term field measurements will become evident when the detailed history of the data collection is available.

Three different aspects need to be considered, when planning to employ the data from old field measurement series. First, there can be changes in experimental design and measurement prescription due to changes in study policies. These changes can have a major effect on previously collected data maintenance and lead to changes in funding principles or termination of planned measurements. A second important issue is the high variability in measuring equipment, and assessment techniques. In the case of long-term measurements, the experiment management and ownership are likely to change, which may also have an effect on measurement continuity. In addition, the field crews are changing over time and new assessment techniques develop. It is important to record the changes made in measuring techniques, to be later considered, to avoid systematic errors. Thus, equipment calibration information and the detailed descriptions of the measurement techniques should be an integral part of data recording. The third and sometimes the most important issue is the advancement in data analysis and understanding. More often, this leads to changes in data recording and storing. Changes in data management and maintenance in subsequent survey protocols must be addressed.

Routine inspection of the empirical data for measurement errors is essential for ensuring data quality for future use. Testing measurement data for outliers is a useful method to detect errors. Statistical methods are susceptible to outliers and measurement errors; however there are no good methods to distinguish outliers from errors. It would be a mistake to remove outliers automatically from data sets. According to Hordo (2011), 83% of tested

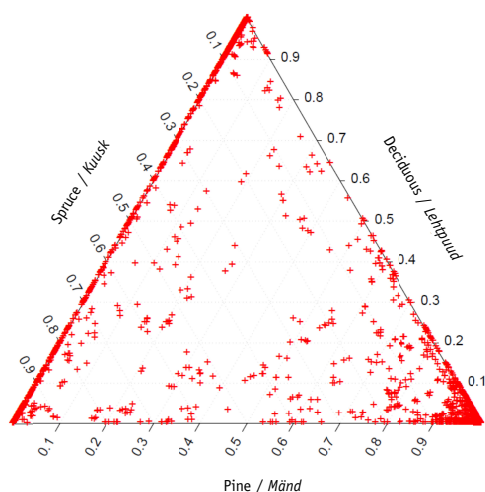


Figure 4. Tree species composition of plots in ENFRP.
Joonis 4. ENFRP proovitükkide liigiline koosseis.

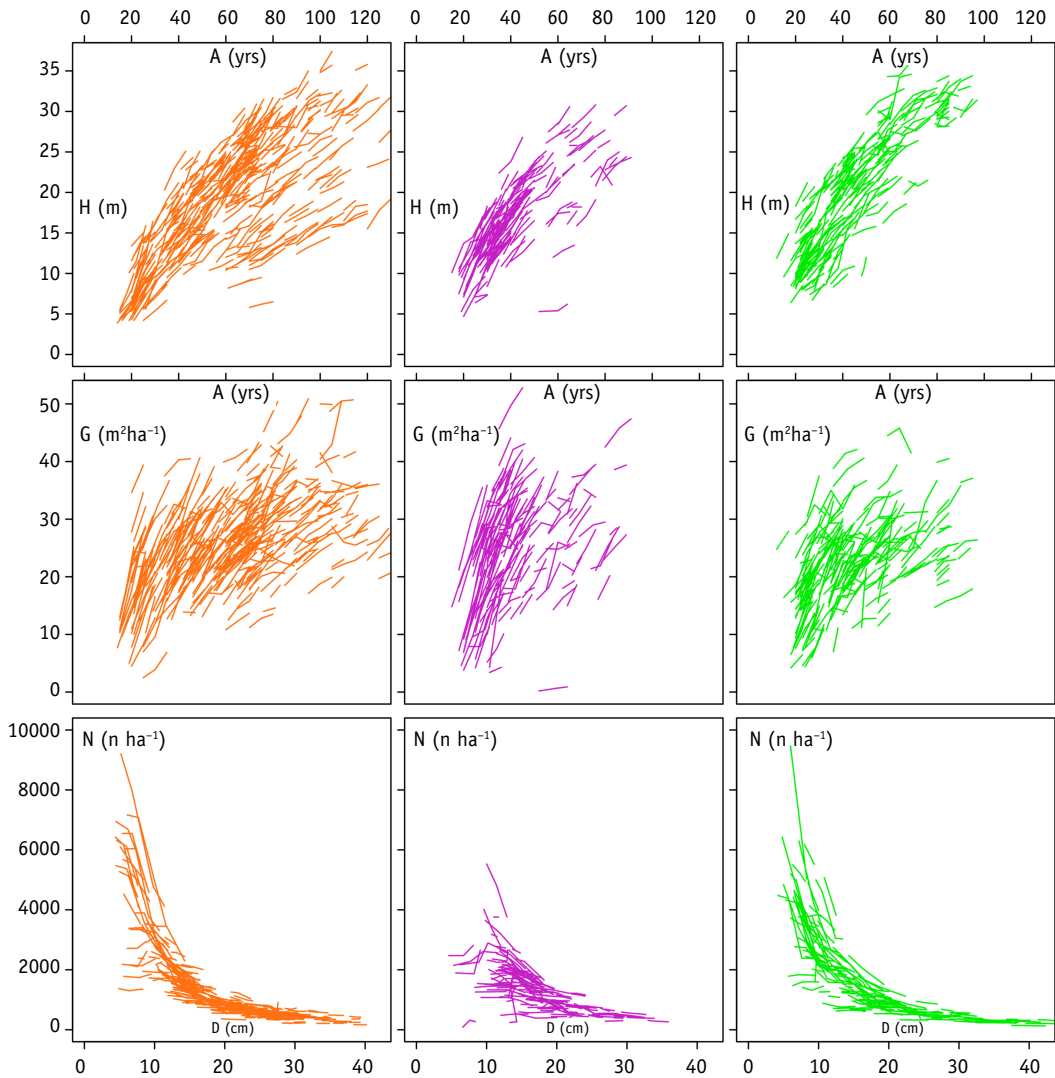


Figure 5. Stand height (H), basal area (G) and density (N) dynamics on stand age (A) or diameter (D) by tree species (1. column – Scots pine, 2. column – Norway spruce, 3. column – deciduous species) on ENFRP data set.

Joonis 5. Puistu kõrguse (H), rinnaspindala (G) ja tiheduse (N) dünaamika sõltuvalt puistu vanusest (A) peapuuliikide kaupa (1. veerg – harilik mänd, 2. veerg – harilik kuusk, 3. veerg – lehtpuuliigid) ENFRP proovitükkidel.

ENFRP outliers were not measurement errors. Outliers mostly highlight a natural variability or are the result of disturbance in a forest stand. Re-measurements accompanied by outlier detection is a powerful tool for detecting measurement errors.

One common problematic issue in employing a long series of forest data is

the inconsistent measurement interval due to the previously listed reasons. Irregular measurement intervals in forest growth studies are quite common. They occur when previously abandoned research plots are “revived”. The re-measurements are continued after long time period for which no observations are available. Very often,

Table 1. Summary of studies employing the ENFRP data.

Tabel 1. Uurimisteemad, kus kasutatakse ENFRP andmeid.

Study with ENFRP data Uurimisteema nimetus	Status and development Uurimisteema seisund ja edasiarendamine	Reference Viited
Generalized diameter distribution model for Estonia	Generalized diameter distribution model can be used in practical forestry applications, but it needs updating with the new data.	(Kiviste <i>et al.</i> , 2003; Merenäkk, 2002)
Tree height-diameter equation for Estonia	The height-diameter model is used in practical forestry applications in Estonia.	(Kiviste <i>et al.</i> , 2003)
Spatially explicit height-diameter model for Scots pine in Estonia	The model selection needs to be supplemented by extensive cross-validation with Estonian NFI data, especially due to the unbalanced spatial distribution of the experimental plots.	(Schmidt <i>et al.</i> , 2011)
Bayesian calibration, comparison and averaging of six forest models, using data from Scots pine stands across Europe	Bayesian methods greatly reduce uncertainties in complex models and provide a robust way of predicting forest growth that accounts for both parametric and model structural uncertainty. However, a small piece of ENFRP data set was used in the study.	(van Oijen <i>et al.</i> , 2013)
Estimating tree survival in Estonia	Preliminary tree survival models need the updating with more recent data.	(Sims <i>et al.</i> , 2009b; Kiviste <i>et al.</i> , 2005)
Stand mean height in young naturally regenerated stands	Is used for estimating mean height for juvenile stands in Estonia.	(Padari <i>et al.</i> , 2009)
Comparative modeling of stand development in Scots pine dominated forests in Estonia	The study compares results of stand simulation using fixed interval increment functions and algebraic difference functions with variable interval lengths.	(Kangur <i>et al.</i> , 2007)
Validation of the Finnish stand simulator MOTTI on ENFRP data	Calibration should be considered as a prerequisite to implement the MOTTI system in Estonian forestry practice.	(Lilleleht <i>et al.</i> , 2011)
Annual growth variation of Scots pine in Estonia and Finland	Analysis of tree ring data from ENFRP provides opportunity to link growth and stand dynamic models with climatic factors.	(Hordo <i>et al.</i> , 2009; Hordo <i>et al.</i> , 2011; Henttonen <i>et al.</i> , 2014)
Forest naturalness and tree mortality patterns in Estonia	Deadwood quantity and spatial distribution, recent mortality rate and causes of mortality together are good indicators of forest naturalness and should be used in assessing and conserving biodiversity.	(Laarmann <i>et al.</i> , 2009; Sims <i>et al.</i> , 2014)
Performance of foliage mass and crown radius models	Additional crown cover and LAI measurements with canopy analysers or digital hemispheric photographs are needed at ENFRP.	(Lang <i>et al.</i> , 2007)
Edge bias correction for spatial forest structure reconstruction of ENFRP data	Different methods were tested and in future spatially explicit analysis and modeling is necessary to use density functions and histograms of structural summary characteristics instead of arithmetic means.	(Lilleleht <i>et al.</i> , 2014)

the observed time interval between re-measurements does not match the desired modeling interval. This is the case also with several of the old Estonian measurement series. During the late 1990's it was decided systematically "to revive" the old field plots, most of which had been abandoned for 20–60 years, but where the data was available and plots still present on the field. In Estonia old series from Järvselja Training and Experimental Forest Centre were "revived" during 1994–2009. In 2000 it was decided to focus on all existing long-term forestry study series all over Estonia.

Studies based on ENFRP

Tree-wise data collected at the ENFRP network have been used in numerous studies for solving a wide range of questions raised by researchers and decision makers (Table 1). In a broader perspective, the data and knowledge produced can be divided into three categories: (1) analysing the effects of global processes in greater detail than can be done with National Forest Inventory or forest management data, (2) developing a system of individual tree growth and survival models that can be used in a decision support system and (3) development of regional and local growth and yield models.

The repeated measurements and continuous monitoring is a particular strength of ENFRP. They allow us to study various changes at regional scale and to tie them with global changes. On the other hand, the detailed nature of the data also offers opportunities for specialised pilot studies. Hordo *et al.* (2009, 2011), for example, systematically analysed stand dynamics from tree ring data collected in the network in relation to climatic factors. In addition, a test of Bayesian methods for model calibration across Europe (van Oijen *et al.*, 2013) and a validation of the Finnish Forest Growth Simulator MOTTI (Lilleleht *et al.*, 2011) for Estonian conditions have been carried out. Lang *et al.* (2014) used ENFRP data for testing the new methods of remote sensing of forest ecosystems.

One of the main aims in establishing of the network was to collect data for constructing individual-tree based forest growth models for Estonia. Pilot studies concerning individual tree survival/mortality models (Kiviste *et al.*, 2005; Laarmann *et al.*, 2009; Sims *et al.*, 2009b) have been conducted.

For developing local tree/stand growth models for practical forestry and research, the network data has been used to a large extent. Examples include diameter distribution models (Merenäkk, 2006), diameter and height relationships (Kiviste *et al.*, 2003; Schmidt *et al.*, 2011), inter-tree competition (Raudsaar, 2003; Sims *et al.*, 2009b; Maleki *et al.*, 2015), individual-tree and population diameter and height growth models (Kangur *et al.*, 2007). Other studies based on the network data include an analysis of measurement errors/outliers (Hordo, 2005) and the development of an information system of dendrometric data and algorithms (Sims, 2003, 2004; Sims *et al.*, 2006).

The ENFRP measurement protocol has been a basis for other studies addressing specific research objectives, e.g. post-mining afforestation (Laarmann *et al.*, 2015), forest naturalness restoration (Laarmann *et al.*, 2013) and SMEAR Estonia.

From monitoring to modeling

Considering different modeling purposes, there are several options for data validation and manipulation, which very often seem to be overlooked or are not fully exploited. Often these methods are collectively referred to as a "black box". Figure 6 presents a schematic description of the principal data preparation processes between monitoring and modeling.

Within the monitoring network system the monitoring plot is still the basic unit for a consistent representation of forest ecosystem functions, structure and variability. Still, when using plot data it is important to keep in mind that they represent only a sample of spatiotemporal reality.

There is a set of different causes that are necessary to be followed and considered,

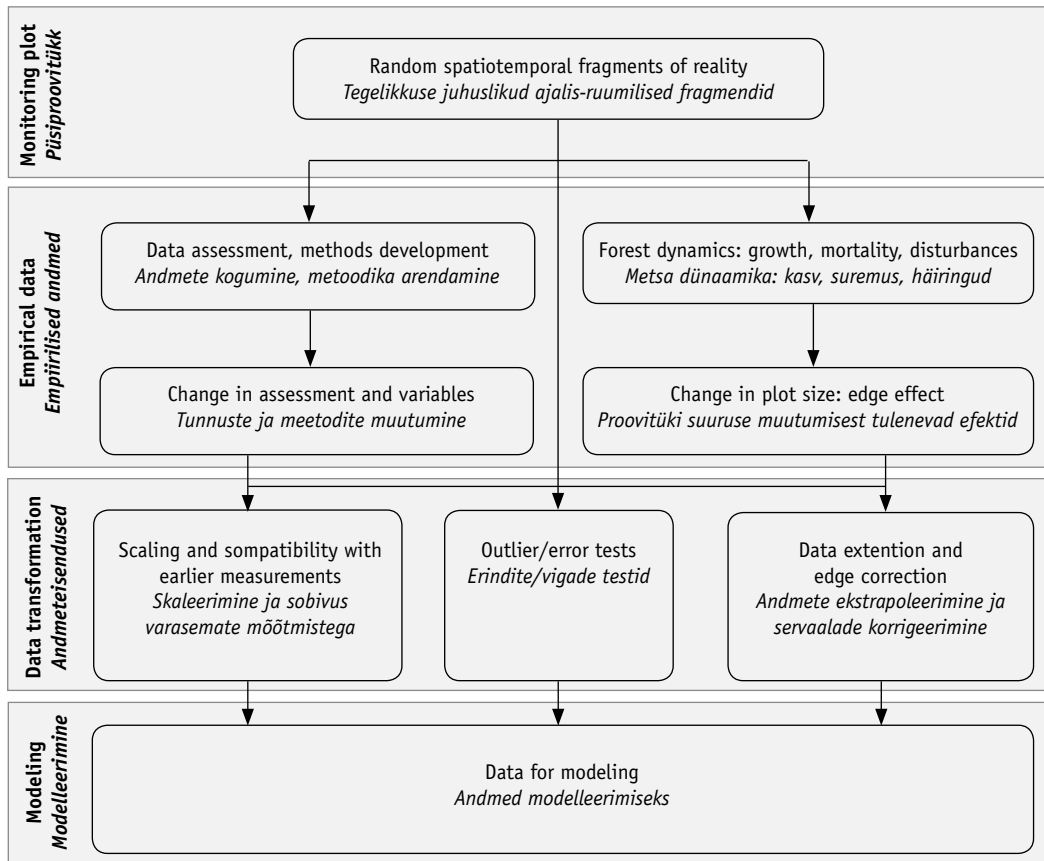


Figure 6. The principal scheme of data preparation processes for forest modeling.

Joonis 6. Andmete ettevalmistamise põhiskeem metsa mõõtmistest modelleerimiseni.

when planning to employ the empirical data from long-term field measurement series (Tewari & Gadow, 2012). First, due to new developments in assessment methods, there are expected changes in experimental design and survey protocols. The monitoring network was, for example, built on the basis of the ultrasonic distance measuring technology of the 1990's. This technology has been improved and the efficiency of plot measurements will now rely on the effective use of electronic measurements of tree locations. The advances in the technology of data recording, processing and storing have an important impact on data quality and modeling opportunities. The question of data management and

maintenance is expected to follow the basic rules of recording principal changes made in re-measurements. From a modeling perspective the data from re-measurements in time add a valuable temporal dimension. Natural and anthropogenic disturbances can, suddenly and drastically, modify forest structure in or around the plots creating a situation where survey protocols must be adapted. The structural development and stand dynamics are expected to be captured on the monitoring network within the measurement protocol requirement of having at least 100 trees on a plot at all re-measurements. This requirement is assured by specifying a dynamic radius in the re-measurements of network plots. The dynamic

radius is not causing any direct discrepancies in measurements or in detailed variables. The problem arises when considering the spatial arrangements of the trees on a particular plot edge, especially when this edge together with the plot size is varying in time.

Conclusions

The Estonian Network of Forest Research Plots comprises data from repeated measurements of 729 monitoring plots. At the moment, 699 plots have been re-measured at least once, 667 plots – twice and 367 plots – three times. The total number of tree measurements recorded in the network database amounts to 376,252 stumps, living and dead trees. The network is based on a systematic design and includes all important tree species and forest types in Estonia. The Estonian Network of Forest Research Plots is a basic infrastructure for forest research in Estonia. The data of the network has been successively used in practical forestry as well as to answer various forest modeling related questions at different spatial scales. The maintenance of the network is a challenging task as there is no permanent funding for the ENFRP. A project-based approach is not the perfect solution for an observational study network and a better alternative should be found to ensure continuous long-term maintenance for the future.

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Metsaökosüsteemide seire ja modelleerimine metsa kasvukäigu püsiproovitükkide võrgustiku abil

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Kokkuvõte

Metsateadusel on Eestis on pikk traditsioon ja ajalugu, mida saab jälgida tagasivaates kuni 19. sajandini. Mõnede metsanduslike pikaajaliste katsete andmed on säilinud alates 1921. aastast. Need olid peamiselt metsakasvatustliku eesmärgiga katsed raievõtete uurimiseks ning paraku on selliste andmete kasutamise võimalused ökoloogiliste protsesside mõistmiseks ja modelleerimiseks piiratud. Eesti Maaülikooli metsakorralduse osakonnas alustati metsa kasvukäigu püsiproovitükkide võrgustiku rajamist 1995. aastal. Püsiproovitükke mõõdetakse järjepidevalt viieaastaste vahemikega. Igal aastal mõõdetakse kokku 100–150 püsiproovitükki. 2014.a. seisuga on võrgustikus 729 püsiproovitükki, millest 30 proovitükki

on mõõdetud üks kord, 32 proovitükki kaks korda, 300 proovitükki kolm korda, 362 proovitükki neli korda ja 5 proovitükki viis korda. Mõõdetud puude koguarv on 130 479 ja puude mõõtmiste koguarv 376 252. Püsiproovitükid paiknevad süstemaatiliselt paigutatuna kogu Eesti alal. Mõõtmised on seotud puude täpsete asukohtadega, mis tagab ka piisavad võimalused puistute struktuuri analüüsimiseks. Metsa kasvukäigu püsiproovitükkide võrgustikul on Eesti metsateaduse jaoks laiem tähendus kui vaid kasvukäigu uurimine, võrgustik on omalaadne infrastruktuur, millele tuginevad paljud väga erinevad metsaökosüsteemide uuringud.

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