

from Nordic Forest Research SNS



The forest illustrated as a three-dimensional point cloud based on image mapping of overlapping airborne photographs.
Illustration: Johannes Breidenbach/NIBIO.

Combined data: revolutionizing forest planning

With more precise information, better decisions can be made. The revolution in inventory technology has made forest data reliable at ever smaller scales – from region-wide assessments of forest resources, down to detailed imaging of individual trees.

A key to the information revolution is the combination of field data from national forest inventories (NFI) and three-dimensional remote sensing data. The new SNS-supported network CARISMA will strengthen the already strong cooperation in this field among Nordic inventory teams.

– CARISMA will help us to maintain and increase the research advantage in the Nordic NFI teams by streamlining our research activities. A formal motive of the network is to avoid duplicating work and conducting parallel research, and to optimise the invested R&D

efforts in the respective countries, says Johannes Breidenbach at the Norwegian Institute of Bioeconomy Research, and coordinator of the CARISMA network.

CARISMA stands for “Centre of Advanced Research for the innovative use of 3D remote sensing in mapping of forest and landscape attributes



Johannes Breidenbach: 3D techniques are currently making rapid technical advances. Photo Lars Sandved Dalen/NIBIO

based on national forest inventories”. It is one of the five CARs (Centres of Advanced Research) to be supported by SNS for the period 2016–2020. Besides NIBIO (Norwegian Institute of Bioeconomy Research), the network centres on an experienced team from Luke (Finland), SLU (Sweden) and the University of Copenhagen (Denmark). Other SNS countries and organisations will also be invited to contribute to workshops and specific tasks.

Combining 3D and field data

News and Views has, over the years, touched on the topic of laser scanning of forest resources, a field where Nordic research has been at the forefront (see for example an interview with Erik Næsset in News & Views No. 6, 2010). But, who would have believed a few years ago that anyone could press a button and look



at detailed forest information for a single stand anywhere in Sweden or Norway?

The last decade has seen extremely rapid development of inventory technology, not least through the implementation of airborne and satellite laser scanning. Developments in computing have also opened the door to more data from different sources being translated into accurate estimates of forest attributes. This allows the forest to be looked at in three dimensions, instead of the “old” two-dimensional remote sensing techniques.

– Traditional 2D optical remote sensing techniques are reaching the limits of their developmental potential, whereas 3D techniques are currently making rapid technical advances, says Johannes Breidenbach.

The Nordic national forest inventories have a long history. Beginning in 1919, Norway was in fact the first country in the world to initiate a nationwide forest survey (Landskogtakseringen).

Finland carried out its first national forest inventory in 1921–1924, and Sweden followed with the launch of Riksskogstaxeringen in 1923. The inventory is traditionally based on field sampling, but what has changed is the inclusion of data from other sources, including remote sensing.

– The NFI teams invest considerable research funds into not only answering questions such as “how much” on national scales but also “where” forest and tree resources are on local scales. The combination of NFI field data with 3D remote sensing is a key technology in this respect, says Johannes Breidenbach.

Publicly available forest maps

The operational use of laser scanning has gone from local tests to national coverage. Sweden and Denmark have now been completely scanned from the air, and so have most of Norway and Finland. All four countries also use or plan to use 3D data from image matching for mapping forest characteristics. In short order, the

information has become publicly available, and anyone can now zoom into maps and access information pertaining to timber volume, productivity, tree height etc. at the single stand level.

The very large amount of data from laser scanning could not have been used so efficiently without the field data obtained in the national forest inventories. The so called ground-truth that the NFI data constitutes provides the reference which is subsequently used to interpret the data from the 3D point clouds, and then translated into tree height, volume, and diameter or tree species.

Many applications

The improved small-scale information is invaluable for planning. The list of applications is long and includes municipalities that need local information on carbon stocks and changes for local action plans, forest companies requesting information on cutting potential in small areas and planning of afforestation and intensive

Forest maps on the web

Over a short period, the Nordic countries have started to produce maps for planning purposes based on the combination of NFI field data and 3D remote sensing. Some of these maps are publicly available; others can be accessed only by those authorised, for example forest owners.

Sweden – Basic Forest Data

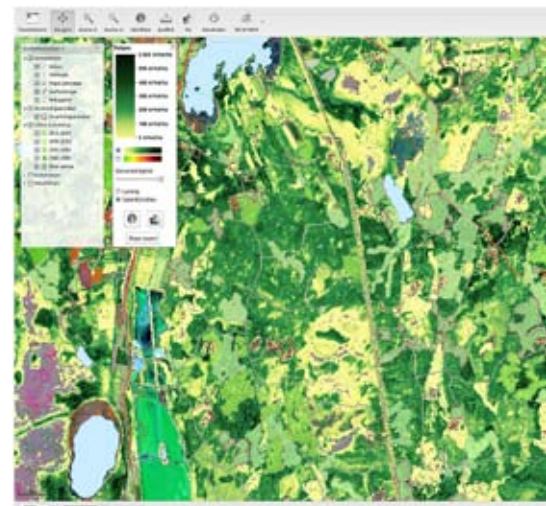
Laser scanning combined with national forest inventory data has been used to produce a forest attribute map of the entire country. Currently (spring 2016), only a few areas along the treeless mountains remain unmapped. The forest variables are published as digital maps on the public website www.skogsstyrelsen.se/skogligagrunddata and via E-services for individual private forest owners.

Norway – Skogressurskart

Forest resources map is a dataset which overviews the forest resources in Norway. It is based on existing maps, terrain models, 3D remote sensing data and national forest inventory field data. The maps can be viewed on-screen at www.skogoglandskap.no/kart/skogressurskart.

Finland – regional maps for private forest owners

Laser scanning inventories are carried out regionally and maps are available to private forest owners through www.metsaan.fi.



↑ Sweden. “Skogliga grunddata” where the public, besides forest attributes, can access information such as nature and cultural conservation and information about registered clearcuts.

biomass extraction, and the influence on social aspects such as recreation and economics, especially in areas of higher population density.

However, there is still a need for further improvements. Johannes Breidenbach gives some examples:

– We need to optimise the selection of remote sensing types, parameter settings and processing, and we need to know more about estimates of change and the use of time series of remote sensing data. Further, we need to disseminate this know-how to the forestry sector and the forest administration.

Conference, workshops and reviews

The CARISMA steering group will meet annually to coordinate the upcoming work plan, which will include several workshops for knowledge transfer. An international conference will be organised half-way through the funding period in order to gain international feedback and to disseminate results. The many outcomes will include review papers

that summarise the state of the art of the methods that are considered.

– We also trust that Nordic-based companies will profit from our network and the experiences from workshops and conferences. The researchers involved are in frequent contact with Nordic companies that provide remote sensing data, and many of these companies are active on a global scale, says Johannes Breidenbach.

CAR: Centre of Advanced Research for the innovative use of 3D remote sensing in mapping of forest and landscape attributes based on national forest inventories (CARISMA).

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Participants in the core group: Luke (Natural Resources Institute Finland), University of Copenhagen, NIBIO (Norwegian Institute of Bioeconomy Research) and SLU (Swedish University of Agricultural Sciences).

Read more: CAR website <http://www.nibio.no/en/prosjekter/carisma>

About 3D remote sensing

Three-dimensional (3D) remote sensing data have proved to be highly correlated with key forest parameters such as timber volume, biomass, and diameter distributions.

Nordic forest inventories are based on intensive field work. However, the precision of many important variables, such as timber volume, can be improved considerably using 3D remote sensing data, especially for smaller areas.

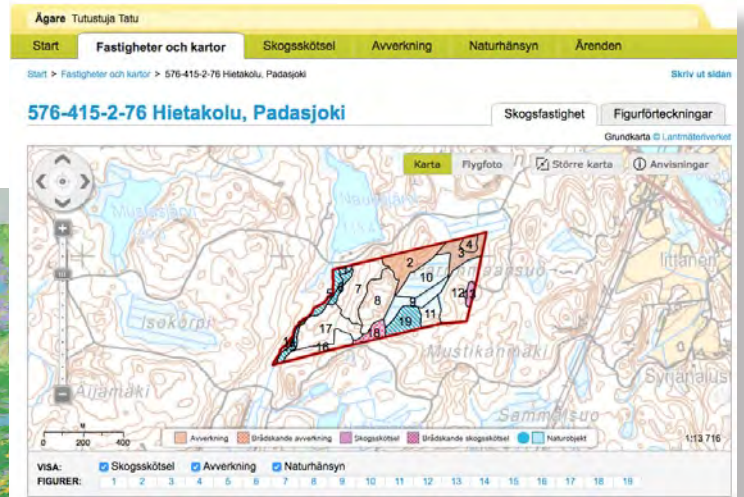
Due to hardware and software improvements, 3D remote sensing data are becoming available at low cost for use in national forest inventories.

Examples of 3D remote sensing data are digital photogrammetric image matching (IM) as part of regular aerial photo campaigns (Norway) and national airborne laser scanning (ALS) campaigns in Denmark, Sweden, Finland and Norway.

Canopy height data can be obtained more frequently by space-borne remote sensing sensors, such as Synthetic Aperture Radar (SAR).



Finland: The Finnish service “My forest” gives detailed forest data at the stand level.



Maps based on NFI and traditional optical remote sensing

Finland <http://www.paikkatietoikkuna.fi/web/en/map-window>

Norway http://www.skogoglandskap.no/kart/SAT-SKOG/map_view

Sweden: <http://skogskarta.slu.se>

Norway: “Skogresurskart” showing productivity variation in a Norwegian landscape.

Shortcuts

Sweden

Trees improve groundwater recharge

There has been a long-standing debate about the impact of trees on groundwater resources. The scientific paradigm has until now been that trees always consume more water via transpiration and interception than other vegetation. A new study published in Scientific Reports on nature.com shows, however, that trees are beneficial to groundwater in seasonally dry soils. The trees open up soil pores, thus helping water to penetrate more deeply. However, when there are too many trees, more water is used than is gained, so an intermediate planting density should be the aim.

Source: www.slu.se

Denmark

Map guide for African tree species

A new version of a tree guide for selecting trees in Africa was published last year. The map shows the distribution of potential natural vegetation across different landscapes, and is expected to help managers to make better decisions pertaining to suitable tree species. The map was developed by the Department of Geosciences and Natural Resource Management at the University of Copenhagen together with the World Agroforestry Center and other partners. The map covers eight eastern and southern African countries.

Sources: ign.ku.dk and www.vegetationmap4africa.org

Sappeli mahogany, a tree in the guide

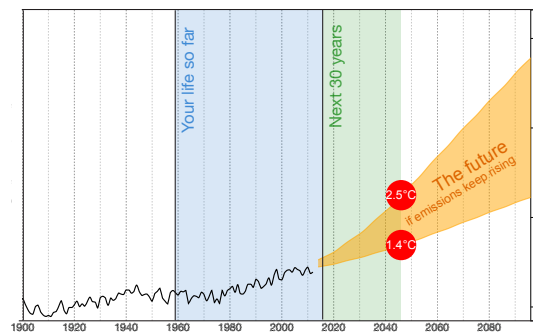
Photo: Robert Sharp, Wikipedia commons



Finland

How hot in your lifetime?

Climateguide.fi is a comprehensive web-guide explaining climate change through visualisations and learning modules. For example, how hot will it get in your lifetime? Enter your birth-year and click. Check out more visualisations on <http://climateguide.fi>.



An editor born in 1959 has experienced almost 0.5° higher temperature during his life-time so far. If he lives another 30 years, he may face a temperature 2.5° above pre-industrial levels.



New call for networks

SNS and EFINORD have announced a new joint call for networks. The total budget is 1 million SEK and the application deadline is 1 June 2016.

More information can be found on

<http://www.nordicforestresearch.org/calls/networks/>

Picture: Another forest network. Areal roots of *Hedera helix*. Photo: Mats Hannerz

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More info about SNS:

www.nordicforestresearch.org

News & Views is a newsletter from SNS containing short, popularized articles covering Nordic forest research and forestry. Articles presenting SNS-supported activities are prioritized. The newsletter is published eight times per year, and is available for download from the SNS and Scandinavian Journal of Forest Research websites.



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