

The Interreg Alpine Space project NEWFOR: a synthetic overview



GRAPHIC DESIGN

Nicole Sardat (Irstea)

COORDINATOR

Frédéric Berger (Irstea)

e-edited Irstea 2014

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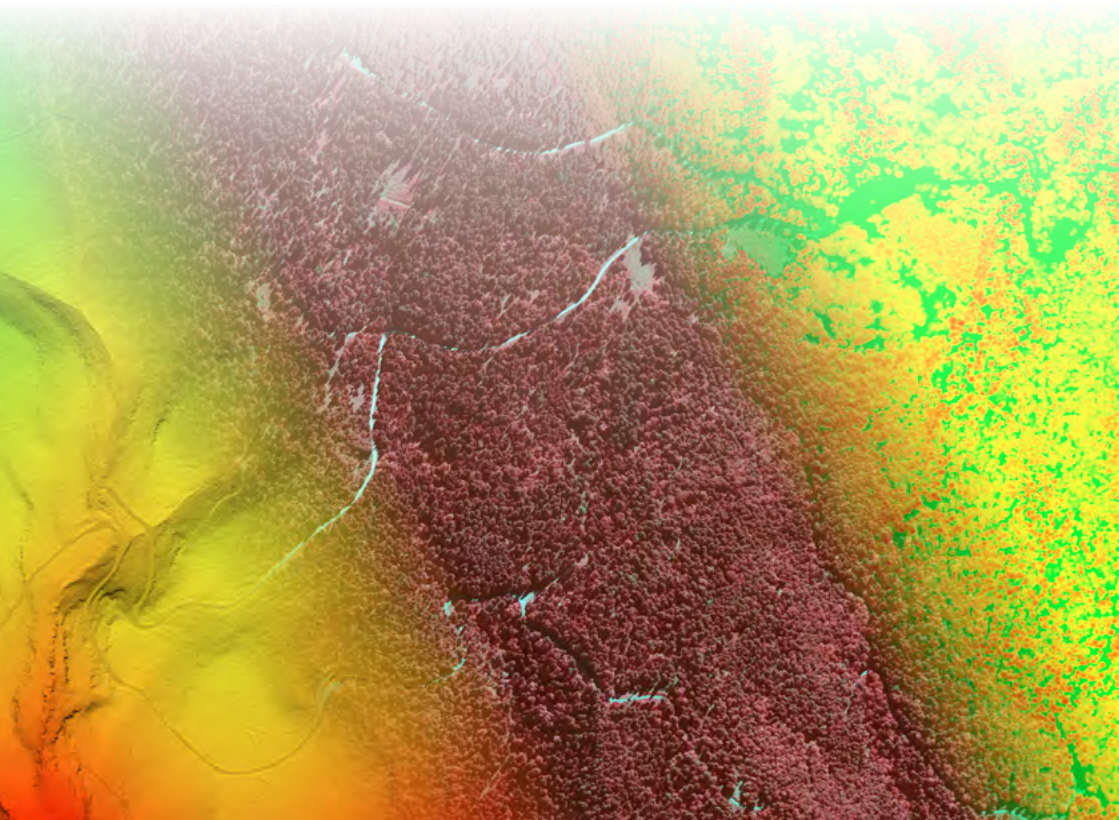
Interreg Alpine Space project - NEWFOR

Project number 2-3-2-FR

NEW technologies for a better mountain FORest timber mobilization

Priority axis 2 - Accessibility and Connectivity

This project has been co-funded by the European Regional Development Funds,
and achieved under the third call of the European Territorial Cooperation
Alpine Space Programme 2007-2013.



The context



Although forests represent a key resource of mountain environments, their valorisation is hampered by accessibility constraints that prevent an efficient mapping, management, harvesting and transport of wood products.

Forests fulfil multiple functions in mountainous areas. They have an ecological function as host of many habitats and species. They also are a leisure area for social activities such as hiking, skiing... From the economical perspective, the production of renewable resources like timber and fuelwood has positive effects both at global scale, with climate change mitigation, and local scale with rural employment and the development of a regional value chain. The objective of preserving and improving the development of mountain forests is a point of public interest. However, managing forests in mountain territories is a difficult task as topography and climate set strong constraints inside a complex socio-economical framework.

In particular, a precise mapping of forest biomass characteristics and mobilization conditions (harvesting and accessibility) is a prerequisite for the implementation of an efficient supply chain for the wood industry. The available information is currently insufficient to provide, at reasonable costs, the required guarantees on the wood supply and on its sustainability. With the recent development of new remote sensing technologies and modelling tools, major improvements regarding the evaluation of the forest growing stock and accessibility are now possible. Upon this highly valuable information, decision-making tools must be built to optimize the investments in forest infrastructures required for a cost-effective wood supply while securing the sustainable management of forests, and to support the implementation of an efficient European policy for mountain forest management.

Objectives of the project



According to this context and based on the use of new technologies (LiDAR: light detection and ranging, Unmanned Aerial Vehicle,...) for forest and topography characterization, the project NEWFOR is dedicated to enhance and develop tools and adapted policies for decision making in the field of a sustainable and adaptive mountain forest resources management facing the sustainability of mountain forest ecosystems services.

So, the main objective of the NEWFOR project is the improvement of mountain forest accessibility for a better economical efficiency of wood harvesting and transport in a context of sustainable forest management and wood industry in changing climate.

The 14 partners involved in the project consortium tackle this objective within five thematic workpackages (wp):

Forest resources and LiDAR

Recent developments in LiDAR technology, combined to other available data sources (aerial photographs, aerial photo series by Unmanned Aerial Vehicles...), are now allowing a precise and fine mountain forest resource quantification, qualification and mapping. Integrating this technology will provide an innovative response to the challenges of a precise and robust knowledge on the available growing stocks. The project aims at testing and developing tools that will help forestry end-users to benefit from this technological advance.

Forest accessibility

After the identification of forest resources, the second step of an efficient forest management is to evaluate the accessibility to these resources. In mountain areas, topography is the main constraint to a technical and economically efficient exploitation. The project demonstrated how to use topographic LiDAR data coupled with geographic information systems (GIS) for an optimal planning of forest harvesting and logging while taking current and scheduled accessibility of forest resources into account.

Forest and industry connectivity

Once the forest resources and accessibility are characterized, then remains the issue of the connectivity between wood piles in the forests and wood yard of mills. This link is often neglected but is crucial for a comprehensive assessment of the wood supply efficiency.

Costs and benefits evaluation

NEWFOR aims at developing decision-making tools dedicated to the definition of strategies for sustainable mountain wood supply chain. To fulfil this objective, tools for identifying forest resources, their accessibility and connectivity to the wood market are first considered separately. In order to achieve the demarche, and to choose the optimal strategy, it is necessary to evaluate the whole workflow from the economical aspect by comparing the costs and benefits of each possible strategy.

Logistical planning strategy

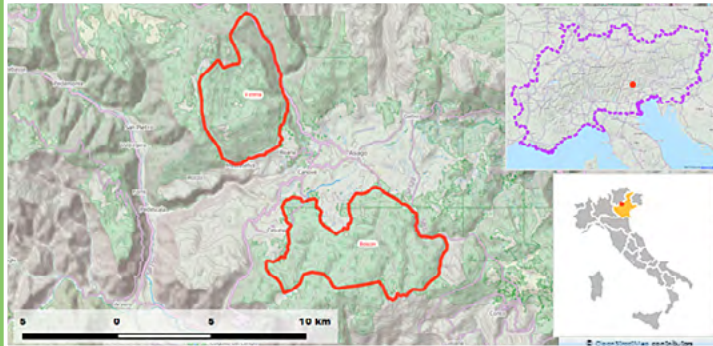
There is a need to frequently adjust the planning of forest management to new economical evidence as well as to unforeseeable developments. Such an adaptive management needs to balance ecological, social and economic factors. The final objective was to provide forest managers and decision makers with reliable information for the evaluation of technical and economical conditions for their decision-making on timber supply chain logistical planning and land use strategies.

These five themes have been implemented in the pilot areas selected by the partners of the project.



Pilot areas

Asiago plateau



LOCATION

Asiago, Veneto region

TEST SITE

Boscon (32 km²)

Verena (23 km²)

HEIGHT RANGE

1200 - 1650 m.a.s.l.

FOREST TYPE

Pure conifer high stands

Mixed high stands

Beech coppices

The Asiago plateau (Vicenza) is situated in a karstic plain area on the esalpic range of the north-eastern Alps, and these characteristics make it the ideal site for the project purposes.

The test site is divided into two areas: the bigger one, called "Boscon", has an extent of about 32 km², and it's mostly characterised by spruce stands (*Picea abies* (L.) Karst.) (some of them have been planted after World War II), silver fir (*Abies alba* Mill.) and beech (*Fagus sylvatica* L.), both pure and mixed. In the "Verena" area, approximately 23 km² wide, spruce and silver fir stands represent the majority of tree composition, with less than 10% of the extent occupied by beech and larch (*Larix decidua* Mill.).

The structural variability present in the forests of the area is very high, going from evenaged to unevenaged, from high stands to coppices and making this site particularly suitable for the study and development of different methodologies to extract structural parameters through LiDAR. Both areas are identified as productive forests in the management plan and the quite gentle morphology already allows the usage of heavy machinery (harvester, forwarder) and traditional logging systems and cable yarding.

REFERENCE PARTNER

University of Padova,
T.E.S.A.F. Department

The Clöise forest reserve

Within the “Boscon” area, compartments D116 and D117 (approximately 17 ha wide) constitute a special reserve for the study of structural biodiversity and no forest operations are allowed. A specific monitoring permanent plot of 1 hectare size, covered mostly by spruce and silver fir, have been studied as a reference for the LiDAR data acquired for the same area.



SUMMER SCHOOL

In the period in between the 20-27 July 2014, an international group of 30 students participated to the NEWFOR summer school held close the “Verena” study area.

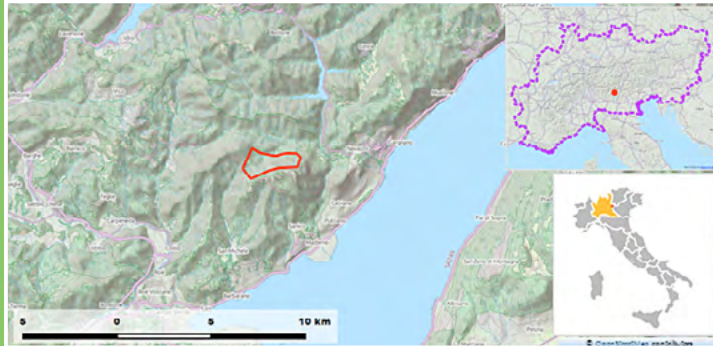
In one week, the participants have been briefly introduced to the LiDAR usage within a case study, in which different groups had to deal with all the aspects connected to forest structure and road planning.

Logging control through UAV flights

An experimental flight has been carried on after a planned logging activity, in order to estimate the real timber extraction from the site. The elaboration demonstrated that the usage of Unmanned Aerial Vehicles can provide for quick and cheap surveys, within control or database update activities.



"Gardesana Occidentale" Regional Forest



LOCATION

Gardesana Occidentale
Regional Forest ,
Lombardia region

TEST SITE

Archesane valley (2 km²)

HEIGHT RANGE

800 - 1270 m.a.s.l.

FOREST TYPE

Broadleaf mixed forests
Broadleaf mixed coppices

REFERENCE PARTNER

ERSAF Lombardia
u.o. Innovazione e
ricerca dei sistemi
forestali e naturali
(Gargnano-BS)

The most extended public regional forest of Lombardia is located in the west-side of Garda lake, across the pre-Alps. Gardesana Occidentale Forest, with more than 11.000 ha is a part of Alto Garda Regional Park.

The forest has an average altitude above 600 m.a.s.l., with maximum elevation of 1976 m.a.s.l. (Caplone peak).

The landscape is unique, with striking panorama on the lake and stunning view on forest and rocky slope of valleys.

Broadleaved, coniferous and mixed stands are characterized by the prevalence of black pine, ash, maple, manna ash, oak, beech, scots pine, spruce and mountain pine. On the cliff is common to find a lot of endemic plants.

The main goal of regional forest and park is to protect these flora and the typical mountain fauna, such as: chamois, eagle, capercaillie, black grouse and sporadically bear and lynx.

The test site has an extent of about 2 km², and it's mostly characterised by maple (*Acer pseudoplatanus* L.), ash (*Fraxinus excelsior* L.), hornbeam (*Ostrya carpinifolia*) and beech (*Fagus sylvatica* L.).

The structural and species composition variability of the area is very high, from coppice to high stands and making this site particularly interesting for the study and development of different methodologies to extract structural parameters through LiDAR from broadleaved forest stands.

Broadleaved forests and LiDAR data

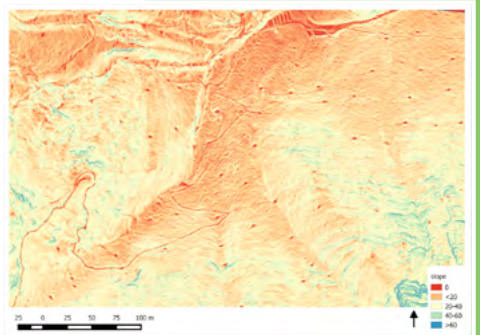
The test site Gardesana was selected to test the LiDAR technology in mixed deciduous forests. The results are obviously worse than the use of the laser scanner on coniferous stands, because the extraction of individual trees from the crown model is more difficult operation. So we decided to collect the parameters to the ground as done in other sites but then applying area-based methodology to extract variables LiDAR. It is however difficult to collect information about the dominated layer of the forest. One solution would be to work directly on the LAS point cloud.



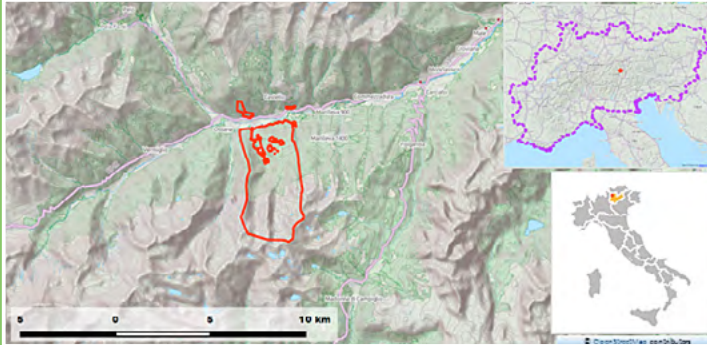
Charcoal production

Among the different proofs of the past management of the Gardesana area, LiDAR gave the possibility to identify the distribution of the old charcoal production sites.

Indeed, as already demonstrated in many archeological studies, this new technology could be an auxiliary tool to detect the location of historical remnant of human presence. The Digital Terrain Model (DTM) elaborated from the point cloud can give us information about the slope of the terrain. Where the values are very low this underlines flat zones, for example roads, tracks or pastures.



A.S.U.C. Pellizzano



LOCATION

Pellizzano – Trentino province

TEST SITE

Forest property of Pellizzano
(11,38 km²)

HEIGHT RANGE

930 m – 2767 m.a.s.l.

FOREST TYPE

Pure or mixed spruce and
larch stands

natural mixed spruce-fir
stands

REFERENCE PARTNER

Forest Service of the
Autonomous Province
of Trento

The pilot area

The forest property of the A.S.U.C. (Separate Administration of the Civic Uses) of Pellizzano is located in the Sole Valley in the endalpic range of the central Italian Alps.

It covers a total area of 1.640 hectares, of which 706 hectares are productive forests, 430 ha are non-productive forests, 500 ha are pastures, shrub, rocks and other soil uses.

The exposition is North, on metamorphic and magmatic rocks, with consistent depositi morenici del Quaternario, determining mainly terre brune soils with very high fertility.

Since 1960, the property is managed in accordance with forest management plans of the duration of 10 years, based on forest inventory conducted by traditional callipering; in 2012 a new forest inventory was conducted by sampling plots.

Timber production is very important in Pellizzano, so it was chosen as a pilot area to develop methodologies for extracting structural parameters through Lidar and calculating the distribution of timber volumes at different scale.

Productive forest

Productivity is very high, with an annual increment of 8,5 m³/ha on average, reaching 12 m³/ha in the best locations. The mean growing stock is about 350 m³/ha, but it reaches 500 m³/ha in several forest units. Big trees (over 50 cm diameter-DBH) are 62%.

The annual yield is 3.000 m³.

Silvicultural goals

The management target is to produce good quality timber, maintaining and improving the natural regeneration, the diversity in the composition and the structure of the stands, and the timber production capacity. Therefore, clear cutting are generally avoided.

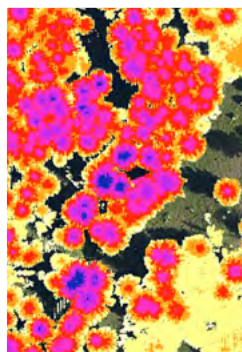
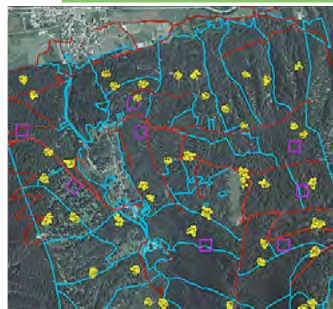
Particular attention is given to the protection of the habitat of capercaillie and to the maintenance of landscape and touristic value.



Silvicultural treatments maintain and improve habitats for Capercaillie also in production forest

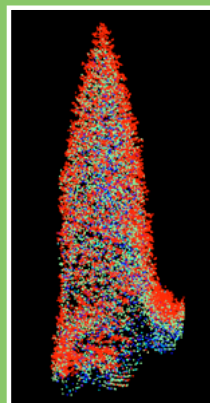
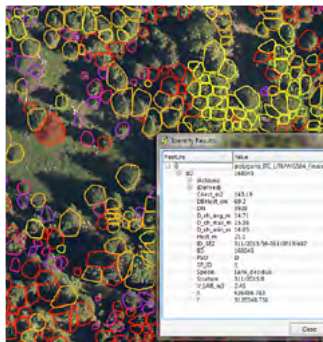
Testing new technologies and developing methodologies

1. A traditional forest inventory was conducted, based on 368 plots over 10 forest strata
2. About 5000 trees were detected on the field, to measure their position and main parameters
3. 8 areas of one hectare were totally callipered, to measure the volume by traditional way
4. Inside the 8 areas, 8 circular areas were measured more in deep per single tree
5. A Lidar flight was done over the whole area. Also hyperspectral data and orthophoto images were taken



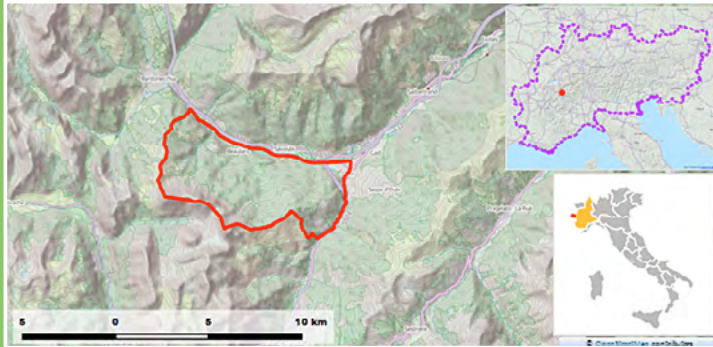
6. Tree crowns were detected; LAS and CHM data were elaborated to find forest parameters such species, diameter and volume of each detected tree

7. Results were compared with field data



High density point cloud of a subalpine spruce

Susa Valley



LOCATION

Oulx, Piedmont region

TEST SITE

Cotalivier (39 km²)

HEIGHT RANGE

1050 - 2850 m.a.s.l.

FOREST TYPE

Pure conifer high stands

Mixed conifer high stands

The Cotalivier study area is about 4000 ha and is located on the right bank of the Upper Susa Valley (Piedmont), between Oulx and Bardonecchia. It's a North facing slope ranging from the montane belt (about 1000 m a.s.l.) up to the treeline (about 2200 m a.s.l.). The forest is composed by *Pinus sylvestris* at lower elevation, *Picea abies* at intermediate elevations and by *Larix decidua* at higher elevations. This tree species variability reflects also a high structural diversity: pine and spruce stands are more homogeneously structured, but larch stands range from sparse wood pasture with few big trees to dense and young stands. Herbs and shrubs are locally abundant when the openness of the stand permits their persistence.

The morphology of the territory in terms of slope and roughness is sometimes very harsh, thus productive forests and protective forests are both present. The more productive and accessible sites has always been characterized by intense forest exploitation, but the topography limited the use of a massive mechanization. The field plots ($n = 33$) are randomly distributed within supposed homogeneous structural types, this stratified sampling design is aimed at cover a high variability in species composition and forest structure.

REFERENCE PARTNER

University of Torino,
D.I.S.A.F.A. Department

Real data - Forest cuts

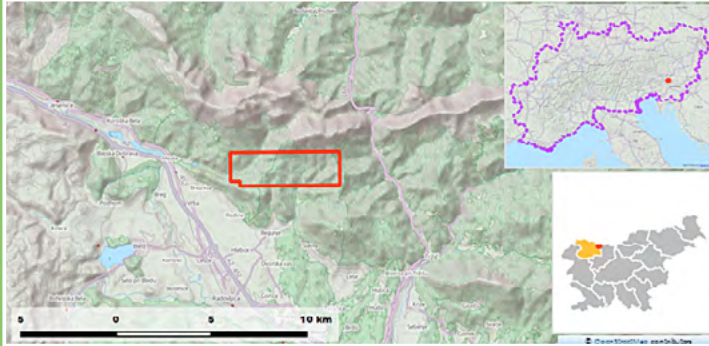
4 sample plots (about 5000 m²) were harvested:

- 1 Larch – clearcut (53 harvested plants)
- 1 Spruce – thinning (26 harvested plants)
- 1 Spruce – thinning (27 harvested plants)
- 1 Spruce + Scots Pine – thinning (31 harvested plants)

All the felled trees were measured to get some “real” data, which have been compared to LiDAR and field data to further evaluate the accuracy of these two different survey approaches.



Begunjščica



LOCATION

Slovenia, Gorenjska region

TEST SITE

Begunjščica (9,79 km²)

HEIGHT RANGE

650 - 1350 m.a.s.l.

FOREST TYPE

Uneven aged stands
(in mixed stands conifer
dominate)

The pilot area is located in the northern part of the Gorenjska Region in and around one of the longest mountain ridges in Europe, named Karavanke. This region has relatively high altitudes (its highest peak is 2236 m), rugged terrain, and many mountain backs, ridges and tops which descend into the valley with steep, sometimes precipitous slopes. These slopes are cut by a number of gullies and ravines that end in narrow valleys, through which the water flows into the lowlands in the form of strong, torrential mountain streams.

The predominantly alpine climate has distinctive temperature extremes, an annual amount of precipitation of 1700 – 2500 mm, and has an average yearly temperature of 4 – 6 °C with occasional, stormy winds.

The area is characterized by extreme biodiversity, and has extensive areas in Natura 2000. It also has a number of smaller protected areas and natural values which are eliciting great interest for recreational activities and the development of tourism, also because of the nearby urban and tourist centres. The Karavanke Mountains are depending on the relief conditions, in different degrees exploited for forestry, agriculture (mostly pasture), and as stated earlier, tourism and recreation that is centred around hiking.

The pilot area extends across two narrow and steep valleys: the Završnica Valley is orientated West to North-East and the one of the Draga Valley is South to North.

REFERENCE PARTNER

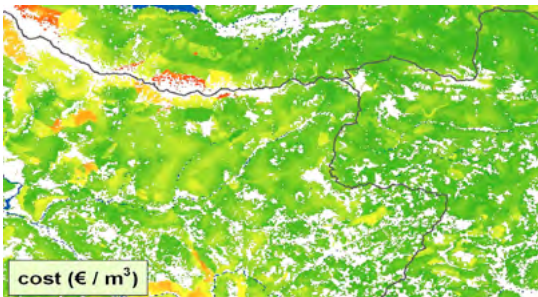
Slovenian Forest
Service

Cost calculating tools

SWEIS

SWEIS is a flexible and adaptable methodology based on:

- 1) the use of geo-reference socio-demographic databases and databases of natural resources which are incorporated into a geographic information system;
- 2) the minimum spatial unit of analysis at the sub-national level;
- 3) a modular, flexible, and open frame which includes information relating to the wood energy from different sources. Due to the high level of detail of the input data, the resolution of the SWEIS output is a 25m cell. The 25m raster data supports a very high spatial detail of analysis, which makes the information adequate for the local operational planning level, and not only for strategic planning. SWEIS also includes data on energy consumption and the possibility of computation of the balance sheet, and displaying the flowing areas of woody biomass to customers – taking into account the cost of cutting and skidding to a truck road.



xTi

xTi is a cost calculating tool developed by the Slovenian Forest Service. It is a tool whose output consists of:

- 1) time consumption, separately for felling and skidding of wood;
- 2) felling and skidding costs for an individual worksite. The tool provides customers with relatively accurate values of harvesting costs which can be used for negotiations with providers of forestry works. Also, the profit from forests can be calculated on the basis of the data output of the tool xTi.

Slovenia Forest Service

is a public institution, established by the Republic of Slovenia, which performs public forestry service in all Slovenian forests, irrespective of ownership.

At state level it is organized with its central unit in Ljubljana. At regional level in 14 regional units, and at local level it has 69 local units and 396 forest districts. The Slovenia Forest Service also comprises 10 hunting reserves with special purposes.

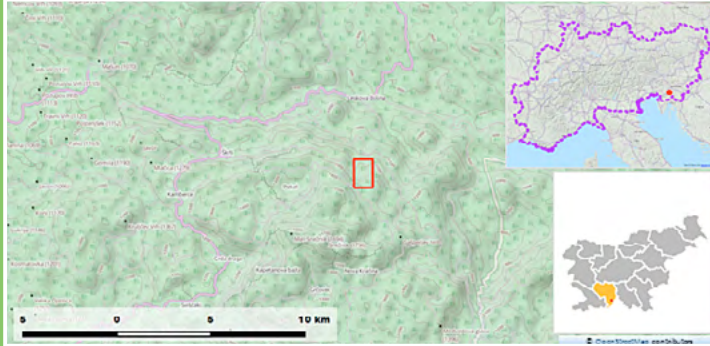
In 2014 the Slovenia Forest Service celebrated its 20th anniversary.

MISSION

Preservation and close-to-nature development of Slovenian forests and of all their functions for their sustainable and good management and use as well as nature conservation in forest space for the good of present and future generation.



Leskova dolina



LOCATION

Snežnik Mountain

TEST SITE

Leskova dolina (52 km²)

HEIGHT RANGE

850 - 1650 m.a.s.l.

FOREST TYPE

Mixed high stands

Beech stands

Spruce stands

Test site is located in predominantly forested landscape of Leskova dolina in the Dinaric Mountains of southwest Slovenia (center of area approximately located at Longitude = 14.46°, Latitude = 45.62° in WGS84 datum). The karst geology on the site is characterized by numerous sinkholes and limestone outcrops, resulting in very diverse micro-topography. Soils, predominantly Lithosols, Leptosols, Cambisols and Luvisols, are derived from the limestone parent material, and soil depth can vary between 0 and 300 cm, depending on micro topographic position. Precipitation is evenly distributed throughout the year with mean annual precipitation of 2150 mm. Mean temperature is 6.5°C, late spring and early autumn frosts are common.

Forest covers 97.6% of the study area with prevalent vegetation community of Dinaric silver fir–European beech forest (*Omphalodo-Fagetum* s. lat.) with European beech (*Fagus sylvatica* L.), silver fir (*Abies alba* Mill.), and Norway spruce (*Picea abies* (L.) H. Karst.) as the main tree species. Sinkholes shape, size and distribution have significant impact on the forest soil and hydrological characteristics (Vilhar & Simončič, 2012; Vilhar et al., 2005, 2010), and consequently on the tree stand. In such karstic conditions with high number of sinkholes, the forest management needs to be adapted to very rough as well as sensitive terrain.

REFERENCE PARTNER

Slovenian Forestry
Institute

Ice storm

In the period between 30.1. and 6.2.2014, ice storm disturbed forests on the lower part of the Snežnik Mountain and the Leskova dolina plateau between 850 to 1250 m.a.s.l. Storm killed a significant number of trees, reducing basal area and stand densities. The storms also removed the canopy cover, uprooting of trees were also present. Both abiotic and biotic factors (mountain, slope, tree size, and species) influenced patterns of tree damage and mortality.

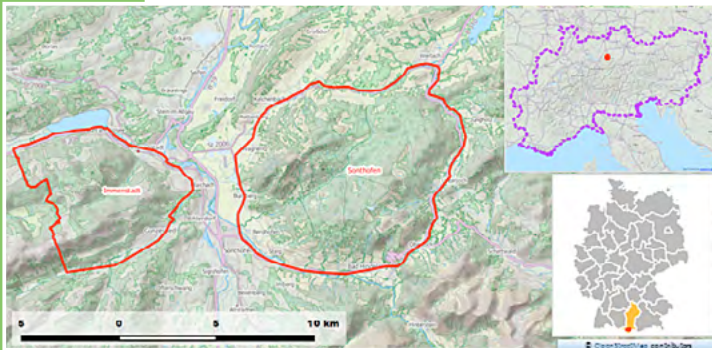


LiDAR data

Lidar data was acquired by a private company using a Eurocopter EC 120B helicopter between 400 and 600 m relative flight height and a full-waveform laser scanner Riegl LM5600 using 180 kHz frequency of laser impulses. Point density was 30 points/m² with an average footprint of 30 cm.



The "Allgäu" district: Immenstadt and Sonthofen



LOCATION

Allgäu district, Bavaria

TEST SITE

Immenstadt (42 km²)

Sonthofen (92 km²)

HEIGHT RANGE

700 - 1750 m.a.s.l.

FOREST TYPE

Pure conifer high stands

Mixed high stands

The pilot region consists of two areas located in the most southern part of Bavaria and Germany – the "Allgäu" district near the border to Austria. Both areas lie closely together, divided by the valley of the river "Iller". In the following the both areas are referred to as "Immenstadt" (4200 ha) and "Sonthofen" (9200 ha), named after the both cities situated near by the respective areas.

The region is the biggest skiing center in Germany and is highly attractive to visitors and tourists due to the manifold and beautiful landscape scenery of its mountains, lakes and natural monuments. Tourism plays a very important role for this region. Another important economic factor is agriculture dominated by dairy farming. Besides this economy in this region in general is middle-class-oriented with focus on mechanical and electrical engineering and food processing.

Climate in the region is warm temperate and frequently weather is influenced by "Föhn" – a warm mountain wind. The yearly precipitation lies between 900mm and 2.500mm. Due to extensive relief rainfall floods are a common phenomenon in this region.

Natural forest vegetation shows a relatively clear sequence. Beginning in the western part with beech-fir forest communities at about 400m sea level followed by beech-fir-spruce, fir-beech-spruce, spruce-beech-fir and spruce-mountain pine communities in high mountain areas. Above are the alpine natural pastures that climb up to the rock regions.

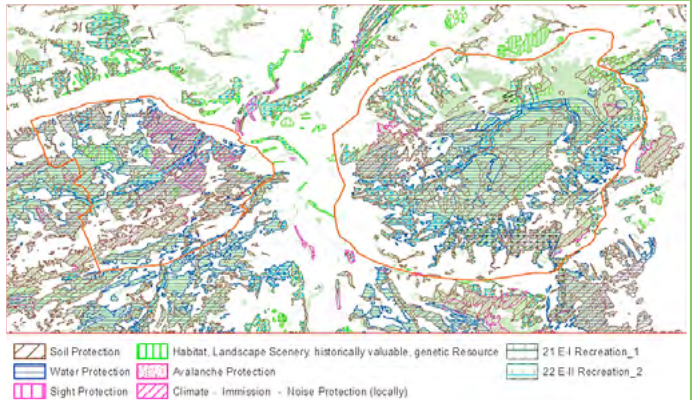
REFERENCE PARTNER

Bavarian Forest Institute,
Department of Forest
Management

Forest functions

Besides the statutory protective functions (fixed by law) forest function plans define forest functions and necessary forest structures more in detail. The figure below shows that practically the whole Immenstadt region and the overwhelming part of the Sonthofen area is covered by one or more of these functions.

All functions as described in the plan can be found in both areas. In many cases forest stands are covered by two or even more overlapping functions. Large parts of both areas are also part of "Landscape protection areas".



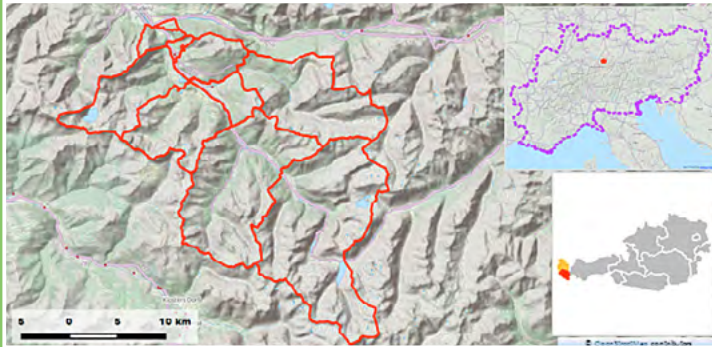
Available data

During the WINALP project a map of natural forest communities (forest types) for the alpine region was derived by newly developed quite enhanced modeling methods.

Digital terrain models (DTM) with resolution down to 1m were provided by the Bavarian institute of Digitizing, Broadband and Surveying (LVG). For further processing through NEWFOR project partners also ALS raw data were provided by the LVG. The ALS data were obtained from three flight campaigns during the years 2005, 2006 and 2008.

The most precise inventory data were provided by the state forest organization. They were collected from 2010 to 2011 by systematic relascope sampling (200x200m). Data for the municipal forest of Immenstadt are from the year 2004. Inventory sampling was done only within older standings – on an area of roughly 100 ha. Neither coordinates of singular points nor individual stems are known. For further processing data was compiled for the particular standings. As data for the neighborly forests in private ownership were not available, they were calculated on base of the data from the municipal and state forests.

Montafon Forstfonds



LOCATION

Montafon, Vorarlberg region

TEST SITE

Montafon

HEIGHT RANGE

600—1900 m.a.s.l.

FOREST TYPE

Pure spruce stands,

Mixed mountain forest

Stands with beech, fir and spruce

REFERENCE PARTNER

Stand Montafon Forstfonds

TU-Wien

The Stand Montafon Forstfonds is an alpine forestry enterprise. It administers and manages about 70% of the forested area (8400 hectares) in the Montafon valley, which is located in the southern part of the Vorarlberg province, the westernmost federal state of Austria. The Stand Montafon Forstfonds belongs to an association of all the municipalities in the Montafon valley.

The Montafon is surrounded by the Silvretta and the Rätikon mountain ranges in the southwest and the Verwall in the northeast. As an alpine valley its altitude ranges from 600 m in the valley floor up to over 3000 m.

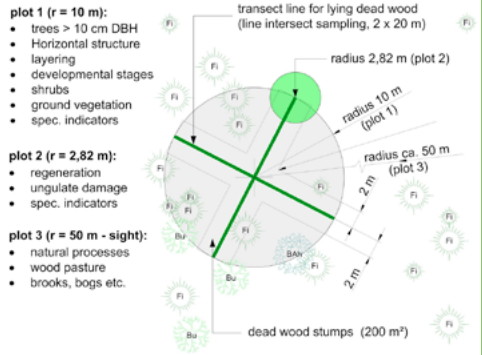
The Montafon covers approximately 533 km² of which 50% are alpine meadows, 23% are forests, 20% are alpine wasteland and 7% are agricultural and urban land. There are 18.000 inhabitants in ten valley communities, among which Schruns is the main village.

According to the Alpine forest classification the Montafon valley is located in the interalpine spruce/fir area. The forests of the Stand Montafon are to be found to a large extent in predominantly steep terrain at 1200 m above sea level and higher. These forests provide vital protection against avalanches, rockfall, debris flows and landslides to the villages and infrastructural facilities. Besides the essential protective function, the forests in the valley also serve for timber production and play an important role for tourism and recreation, as well as landscape and nature conservation.

Long-term forest monitoring

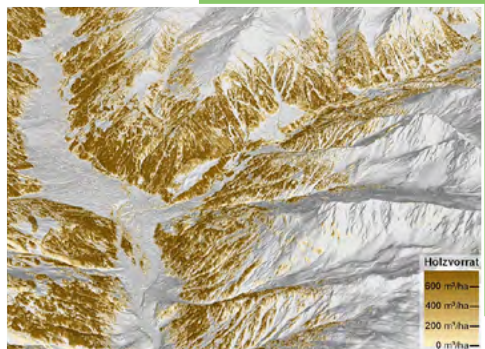
The Stand Montafon uses a forest inventory with 500 permanent plots as a basis for long-term forest monitoring system. These plots serve also as a reference data source for many ALS-based studies to assess forest structure of Alpine forests.

The overall goal of the current inventory is to provide the basis for the strategic forest resource planning. To achieve this goal the concept of the remote sensing supported forest inventory is further developed and will be integrated into the operational forest inventory. Therefore, the in-situ measurements are adapted in a way that they can be used in combination with RS data in an optimal way (e.g. use of fixed plot sizes that are fully callipered instead of angle gauge plots). On the other hand, the available administrative units (i.e. forest stands) are in the process of being changed into site-specific units representing different growing conditions. This stratification should be strongly supported by remote sensing data.

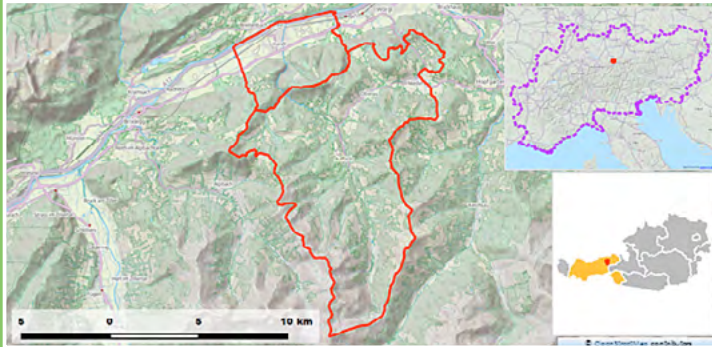


New volume maps from LiDAR data

For the Montafon region a biomass map was derived from laserscanning data whereas the regression model was calibrated based on a large number of local forest inventory data (approx. 500 sample plots). Based on the operational integration of 3D remote sensing data into the forest inventory it is expected that the number of in-situ measured inventory plots can be reduced to a sparse network of forest inventory plots, which will be used for calibration of the regression models. Due to the decrease of the plot number and the followed decrease of the costs the positional accuracy of the remaining plots will be improved. This, in turn, will provide an appropriate in-situ data set for a combined analysis of 3D remote sensing data.



Tiroler Unterinntal



LOCATION

Tiroler Unterinntal, District
Kufstein

TEST SITE

Wildschönau (97,4 km²)
Kundl (21,9 km²)

HEIGHT RANGE

500 - 2.300 m.a.s.l.

FOREST TYPE

Spruce - fir - beech stands
Spruce - fir stands
Larch - fir stands
Special sites

REFERENCE PARTNER

Office of the Tyrolean
Regional Government,
Tyrolean Forest Service

For the implementation of the “forest roads – satnav – project” two bordering municipalities in the east of Tyrol named Wildschönau and Kundl had been chosen as pilot areas. Both test sites stand out due to their variety and density of forest roads.

With a surface of about 97 km² including 5.170 hectare of forest the Wildschönau is one of the biggest municipalities in Tyrol. More than half of Wildschönau's forest has protective functions. From the annual timber harvest of 35.000 bank meter, 70% of the logging is being realized by cable way. 170.483 running meter forest roads were recorded in the Wildschönau in 2012.

Kundl is with 970 hectare forest in a total area of about 22 km² quite smaller than the Wildschönau. Nearly half of its forest has protective functions. In 2011, the annual timber harvest was 2.070 bank meters, 70% of the logging had been realized by cable way. 30.209 running meter forest roads were ascertained in Kundl in 2012. Kundl was selected as pilot area because it is a bordering municipality to Wildschönau. Therefore the connection of the Tyrolean forest road data and public roads could be tested. Furthermore in Kundl there is one of the biggest sawmills in Tyrol. Both pilot areas have about 35 running meter forest roads per hectare (2012).

Historical wood tracks

Forestry has a special historic importance for the two communities in the Tyrolean test site. Like many other rivers in Tyrol the Wildschönauer Ache was used for log driving, from the densely forested side valley to the Inn valley. The tracks of the historic woodcutters can be followed on a spectacular trail from the Wildschönau through the Kundler Klamm (gorge). Today more than 550 forest owners manage their forests, making wood transport much easier but still challenging.

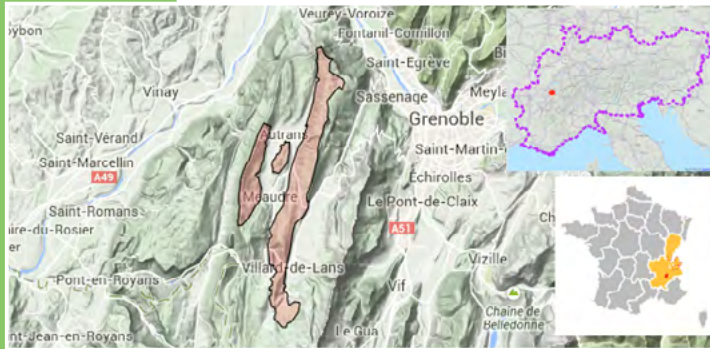


Getting to a woodpile by using a satnav

When talking about round timber transports in Tyrol one can talk about a sort of unique practice. Local foresters do not only advise private forest owners in respect of logging. To find the most efficient way to get from a public road to a woodpile deep in the woods all timber haulers are being instructed by the local foresters. What if tablets or smartphones could be used for optimizing routes, making optimized freights possible, reducing transport costs? To meet this challenge specific satnav software for wood hauling purposes had to be developed. That needs additional information like streets categories according to their trafficability or turning options for trucks and trailers, to make Tyrolean forest road data usable for route guidance systems. Software's test run had been realised at the Newfor test sites – Wildschönau & Kundl.



Quatre montagnes



LOCATION

Isère, région Rhône-Alpes

TEST SITE

Quatre Montagnes (56 km²)

HEIGHT RANGE

350-2400 m asl

FOREST TYPE

Pure coniferous stands

Mixed high stands

Mixed stands with coppice

The West and East parts are mainly located on karst soils. The central part (Bois Claret) has better site quality. Western part displays coniferous stands downslope where soil is deeper. Mixed and coppice stands are present on poor quality sites in the upper parts. The central part is constituted of private forests (coniferous plantations). The western displays several forest types, coniferous stands (Norway spruce, silver fir, scots pine), mixed stands and coppice stands on limestone pavement. Forests stands are highly variable due to the topography, geology and silviculture, which makes it a very interesting test site to assess the performance of forest parameter estimation from remote sensing data. The road network is very dense and local practitioners are interested in the comparaison of skidder accessibility results and their terrain knowledge.

REFERENCE PARTNER

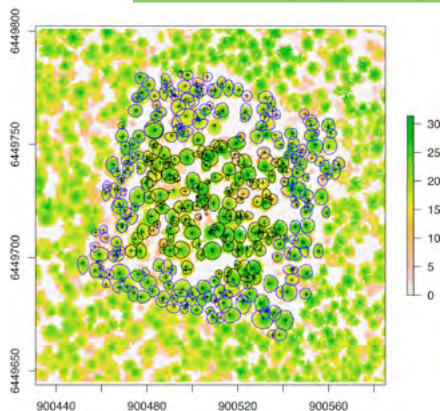
Irstea Centre de Grenoble,
UR EMGR



New forest maps from LiDAR data...

In the private forests, three martelosopes of 1 ha surface had been previously implemented for the training of foresters regarding sylviculture. Measures on those plots were updated during the Newfor project and used to test single tree detection and species classification from airborne laser scanning data.

In the whole area, a statistical inventory of 96 forest plots of 15 m radius was implemented in order to calibrate ressource estimation models. The resulting ressource maps were then transfered to public and private forest managers in the framework of the revision of the Territorial Forest Convention.

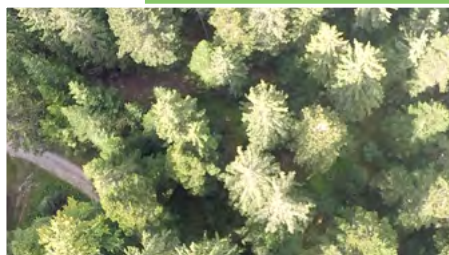


La cordelière martelosope, tree positions and crown limits overlayed on the lidar Canopy height Model

... used for communication and management

Field data and resource maps produced in the framework of the project were used by two student groups from AgroParisTech which conducted projects about :

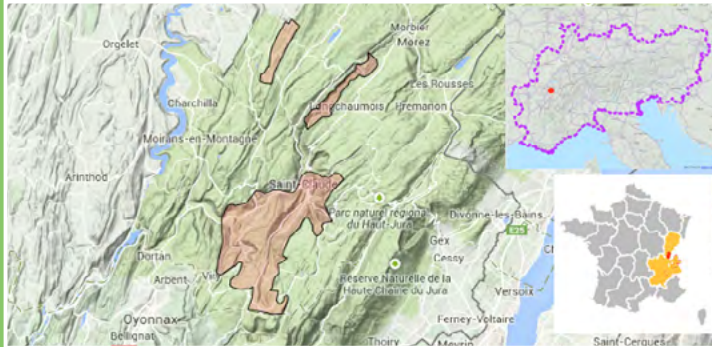
- Forest typology in public forests from remote sensing and field data.
- Private forests in the Bois Claret – under-harvesting and Lidar resource estimation.



Flyer designed for private foresters

Forest typology in the Méaudre public forest obtained from remote sensing data

Jura



LOCATION

Jura, région Franche-Comté

TEST SITE

Saint Claude (106 km²)

Prénoval-Les Piards (9 km²)

HEIGHT RANGE

330-1280 asl

FOREST TYPE

Mixed high stands

Mixed stands with coppice

Broadleaved high stands or coppice

Coniferous stands

In the Saint Claude area, the topography is highly variable with some steep slopes, and plateaus with high rugosity. This results in highly variable stands, with coppice stands on poor quality sites, mixed and coniferous stands in better sites. This makes it an interesting test site for the assessment of the robustness of resource estimation models. The topography induces high accessibility constraints for some compartments and there is a strong demand for the evaluation of the forest accessibility, including cable yarding potential.

The Prénoval-Les Piards area is a highly documented experimental forests of the French Forest Office. The topography is rather rough. The stands are uneven-aged stands of Norway spruce and silver fir.

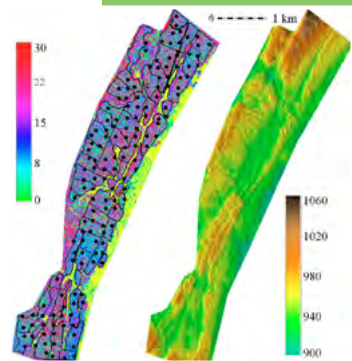
REFERENCE PARTNER

Irstea Centre de Grenoble,
UR EMGR



LiDAR maps evaluated at the compartment level

In the experimental forest of Prénovel, compartments have been fully callipered which makes it possible to assess the precision of ressource estimation models at the compartment level. Results show that the basal area and stem density values obtained from airborne laser scanning estimation models have a precision similar to a full-calliper field inventory.



Forest inventory and digital terrain model

Capercaillie habitat

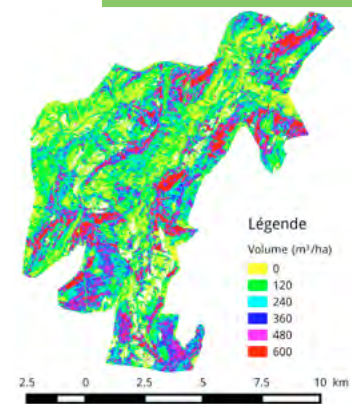
The Jura study area hosts some of the last Capercaillie populations in France. LiDAR data is also a promising tool for the characterisation of bird habitats and optimisation of forest management related to biodiversity protection.



©Claude Lepennec

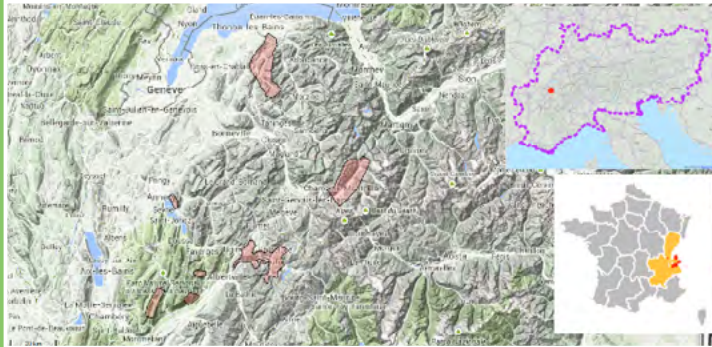
New forest maps from LiDAR data

In the test site of Saint Claude, 60 plots of 15 m radius were inventoried in order to calibrate ressource estimation models. Resulting maps were transferred to the French Forest Office and private stakeholders.



Volume map

Savoie and Haute-Savoie



LOCATION

Savoie and Haute-Savoie,
région Rhône-Alpes

TEST SITE

Chablais savoyard (100 km²)

Chamonix valley (98 km²)

Beaufortain (83 km²), Grésy
(11 km²) and Tamié (7 km²)

HEIGHT RANGE

460-2190 m asl

980-2970 m asl

350-2400 m asl

FOREST TYPE

Pure conifer high stands

Mixed high stands

Broadleaved high stand and
coppice stands

REFERENCE PARTNER

Irstea Centre de Grenoble,
UR EMGR

The Chablais site is mainly located on the communes of Bellevaux, Lullin, Vailly and Reyvroz. Valleys and gentle slopes are mainly occupied by pastures. Forests are generally mixed forests of European beech, silver fir and Norway spruce. Spruce is found at higher altitudes. Some coniferous plantations are present. The southern and eastern part have higher altitudes and steeper slopes.

The bottom of the Chamonix valley is relatively flat and located at 1000 m a.s.l. It is mainly a urban area. Slopes are forested with coniferous trees (mainly Norway spruce) up to the timber line. Stands are mostly uneven-aged, as forests are only extensively managed due to accessibility constraints. The slopes on both sides of the valley are very steep. The road network is not dense and there is a strong will to develop cable yarding.

Grésy: mainly broadleaved stands (various species at low altitude, mainly beech in the upper parts).

Tamié: mainly coniferous and mixed stands.

Beaufortain: some broadleaved and mixed stands downslope, mainly coniferous trees in higher altitudes.

The Grésy and Beaufortain areas display very steep slopes, there is a high demand for the assessment of cable yarding potential.

Irstea
Lead partner



Office of the Tyrolean Regional Government
Tyrolean Forest Service

Austrian Research Center for Forests



Stand Montafon Forstfonds

Regional Agency for Development
of Agriculture and Forestry



Autonomous Province of Trento
Flora and Fauna Department

Technological Institute for Forestry,
Cellulose, Construction Timber
and Furniture



Slovenian Forestry Institute

Bavarian Forest Institute
Department of Forest Management



University of Turin

University of Padova



Vienna University of Technology
Institute of Photogrammetry
and Remote Sensing

Slovenia Forest Service



Swiss Federal Institute for Forest, Snow and
Landscape research – Research Programme
Forestry and Climate Change

Interreg Alpine Space project - NEWFOR

Project number 2-3-2-FR

NEW technologies for a better mountain FORest timber mobilization

Priority axis 2 - Accessibility and Connectivity

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