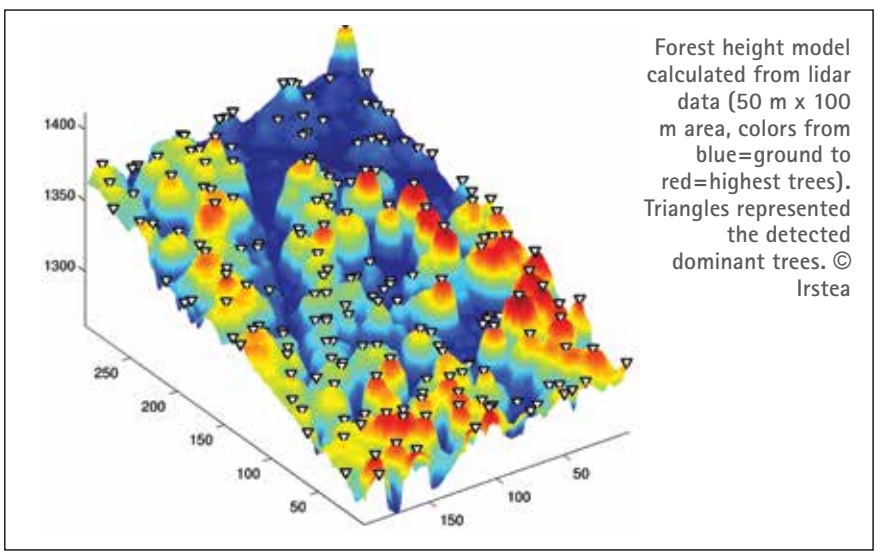
Mountainous forests comprise some of Europe's most stunning, yet inaccessible landscapes. A comprehensive understanding of such remote terrain is thus integral to their exploitation as timber resources. Technology pioneered by a regional initiative will re-map these environments, supplying foresters with detailed resources to make critical business decisions.

Hi-tech surveillance of alpine forests to improve sustainable forest management

Under an EU regional funding initiative – INTERREG IV Alpine Space –mountainous geography has been identified as a joint theme for research, undertaken by several member states. Granted a 130 million Euro budget, the Alpine Space Programme seeks to "to overcome the disadvantages of location factors and to promote the Alpine Space as a dynamic economic region in Europe". Running from 2007-2013, one specific industry targeted for economic rejuvenation under its auspices is forestry which, in such climes, is subject to distinct strategic vulnerabilities.

"Mountain topography introduces some major problems" explains Jean-Matthieu Monnet, a French participant in NEWFOR (NEW technologies for a better mountain FORest timber mobilization), a project entering its second year. Steep gradients, cliffs, unpredictable weather and sinuous road systems all pose hazards, which are frequently difficult to negotiate. "Consequently, it's expensive to acquire information about these regions. Low accessibility makes it difficult to accurately estimate volumes, or species of trees. Large vehicles used in forestry processes, and for mobilising felled wood for export, also face varied obstructions". Cable cranes (systems of pulleys and line wires, linked to a tractor), skidders (tractors used to pull pole-length timbers across the ground) and forwarders (vehicles used to carry logs) are the most common methods of retrieval, but all have limited range, and need infrastructure to support them.

Without data on which decision makers can base their strategies, the region's assets run the risk of becoming uncompetitive – or negated altogether. "Over the past decades, sylviculture, labour and harvesting costs have increased" comments Monnet. "Managers are very conscious of efficiency. If timber costs are outweighed by the expense of extraction, entire areas may be abandoned by enterprise." Each partner country (Austria, France, Germany, Italy and Slovenia) contains mountainous regions of between 10-150 thousand square kilometres, with forest proportions between 45 and 67% , and faces surprisingly familiar concerns.



Forest height model calculated from lidar data (50 m x 100 m area, colors from blue=ground to red=highest trees). Triangles represented the detected dominant trees. © Irstea

"In each country, people have begun to generate tools and conduct experiments to address similar risks, but often in isolation" observes the French researcher. "There is no discussion between them, although they share common problems – and opportunities." In response, a key aim of NEWFOR is the creation of adaptable, robust support tools. Aligned with universally agreed benchmarks, outputs are discouraged from becoming functionally limited to specific, narrow contexts by the diversity of participants. "Generating models which prove generally effective, yet contain the requisite flexibility is a real test" says Monnet. "Now these parties are connected, however, their activities provide a stimulus to collaborate on shared solutions." This inter-reliance also acts to provide an intensive, trans-European testing-ground for their pioneering deliverables.

As its moniker implies, NEWFOR is positioned at the technological vanguard to fashion these nascent assets. "Remote sensing technologies such as LIDAR (Light Detection And Rangin) have become very popular over the past decade" says Monnet, who has gained expertise in this field at his home institution, the National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA). Using laser pulses emitted from an aircraft, which are measured after they reflect back from the ground, these data reconnaissance operations can be used to build up a detailed picture of what lies beneath impenetrable, verdant canopies of growth.

Initially operated by NASA, this prolific technology has also evolved to such an extent that its sensors can simultaneously discern characteristics of the trees themselves, with the measurements synthesised to create a data-rich map. "The resultant images are like aerial photos, but provide far more quantitative information" illustrates Monnet, "including the contours of the terrain and the vertical structure of the forest, which makes the estimation of growing stock possible."

Critically, he argues, airborne surveillance can provide the missing link between high level policy and its enactment, with major consequences for sustainability. "In France, the government previously decided that, according to national statistics, growing stock was increasing – so they accordingly raise harvesting targets" he recalls. "However, it can be hard to pinpoint where the excess lies, hence from where it can be culled. Without this awareness, operatives

AT A GLANCE

Project Information

Project Title:
NEWFOR: NEW technologies for a better mountain FORest timber mobilization

Project Objective:
The project aims at improving forest timber evaluation and mobilisation in alpine areas. The project considers the whole wood supply chain, from forests to wood yards, with a particular emphasis on new remote sensing technologies and geographical information systems.

Project Duration and Timing:
3 years, September 2011 to 2014

Project Funding:
The project is funded by the European Regional Development Fund (ERDF) in the framework of the Alpine Space Program, which is the EU transnational cooperation programme for the Alps. Total budget of the project is 2,419,400 EUR, including an ERDF grant of 1,809,484, EUR.

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PROJECT PARTNERS

The project brings together researchers and managers from the six alpine space countries. The NEWFOR consortium includes 14 institutes:

Austria

- BFW. Federal Research and Training Centre for Forests, Natural Hazards and Landscape – Department of Natural Hazards and Alpine Timberline (http://bfw.ac.at)
- Stand Montafon – Forstfonds (www.stand-montafon.at)
- TORG. Office of the Tyrolean Regional Government – Tyrolean Forest Service (www.tirol.gv.at/wald)
- TU Wien – IPF. Vienna University of Technology – Institute of Photogrammetry and Remote Sensing (www.ipf.tuwien.ac.at)

France

- FCBA. Technological Institute for Forestry, Cellulose, Construction Timber and Furniture (www.fcba.fr)
- Irstea. Grenoble regional center, Mountain Ecosystems Research Unit (lead partner, www.irstea.fr)

Germany

- LWF. Bavarian Forest Institute – Forest Management Department (www.lwf.bayern.de)

Italy

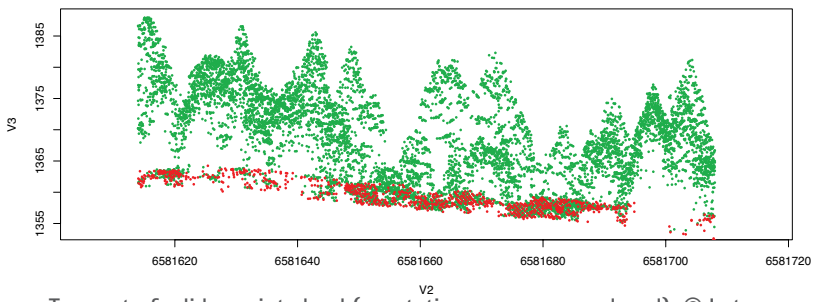
- ERSAF Lombardia. Regional Agency for Development of Agriculture and Forestry (www.ersaf.lombardia.it)
- PAT-SFF. Autonomous province of Trento : Flora and Fauna Department (www.foreste.provincia.tn.it)
- TeSAF. Università degli Studi di Padova – Dipartimento Territorio e Sistemi Agro-Forestali (www.tesaf.unipd.it)
- UNITO. Università degli Studi di Torino – Dipartimento di Agronomia, Selvicoltura e Gestione del Territorio (AGROSELVITER) (www.agroselviter.unito.it)

Slovenia

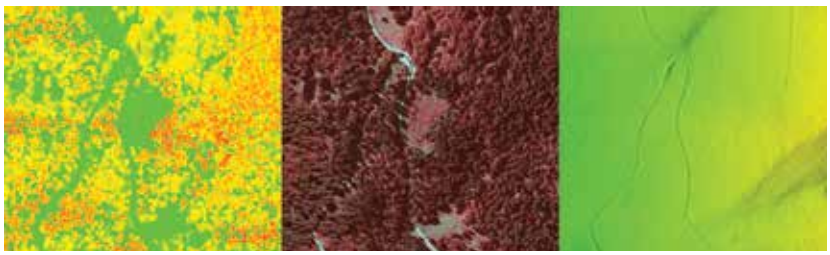
- SFI. Slovenian Forestry Institute (www.gozdis.si)
- SFS. Slovenia Forest Service (www.zgs.gov.si)

Switzerland

- WSL. Swiss Federal Institute for Forest, Snow and Landscape Research – Research Programme Forestry and Climate Change (www.wsl.ch)



Transect of a lidar point cloud (vegetation: green, ground: red) © Irstea



3 images of the same area. Left: forest height model calculated from lidar data (green=ground, red=highest trees), middle: Infra red colored optical image, right: shaded digitial terrain model calculated from lidar data (green=low altitude, yellow=high altitude).© Irstea

may use familiar routes and access points – accelerating regional depletion. Some forests are over harvested; some under. To manage a total system effectively, you need to isolate the growing stock, and marry national – and even global – policies with local realities".

In its forthcoming semester, another exciting NEWFOR concept – mapping utilising a drone, or Unmanned Aerial Vehicle (UAV) – will be explored. These are typically far cheaper to employ than larger aircraft, and also encounter fewer bureaucratic obstacles to their usage. Moreover, cruising at low altitude, they can be flown in all seasons, and perceive significant amounts of detail. NEWFOR's version uses a commercially available digital camera, set into the craft's fuselage, and is steered using a handheld remote control device, coupled with autopilot functionality. Monet anticipates that these could be "responsively deployed – for example, to gain specific information about pest invasions, like bark beetles, and natural hazards (e.g. avalanches, rockfalls or landslide), which could unexpectedly arise." Due to their economy, regular UAV sorties could be an apposite means of obtaining regular assessments of such phenomena. The study intends to push the units to their limits – assessing their maximum reach, visibility, and launch and landing requirements above what is often perilously uneven ground. Although the UAVs may be too complex for foresters to calibrate and operate, specialist teams of pilots could well emerge to cater for their needs.

Throughout the study's duration, LIDAR will be tested, and compared against data gathered on the ground, to establish its validity. Mapping systems will ultimately be consolidated via an online platform, WebGIS, which is presently in development, but will be handily accessible to industry workers using portable terminals. To ensure end user relevance, local forest managers have been engaged to help academics appreciate and fulfil their real needs throughout trials. Impressively, the technology can automatically extract road networks for inclusion in its graphic display, detecting features that might prohibit entry into the forest for heavy vehicles, such as tight turns and slopes. Thus, the project "may also assist in future road and transport planning", reckons Monnet. Although initial acquisition costs may be greater, there are exciting peripheral benefits such as this which, overall, add value throughout the monitoring chain. Indeed, there's also a chance that such versatile methodologies could ultimately help Europe to catch up with the initial leaders in this high-flying technology – Scandinavia and the USA, whose systems cannot entirely rise to meet the operational challenges posed by alpine peaks.★