Interreg Alpine Space project - **NEWFOR**

Project number 2-3-2-FR

NEW technologies for a better mountain **FOR**est timber mobilization

Priority axis 2 - Accessibility and Connectivity

Workpackage 6: Forest and Industry connectivity

Toward a logistic methodology for the optimisation of timber mobilisation

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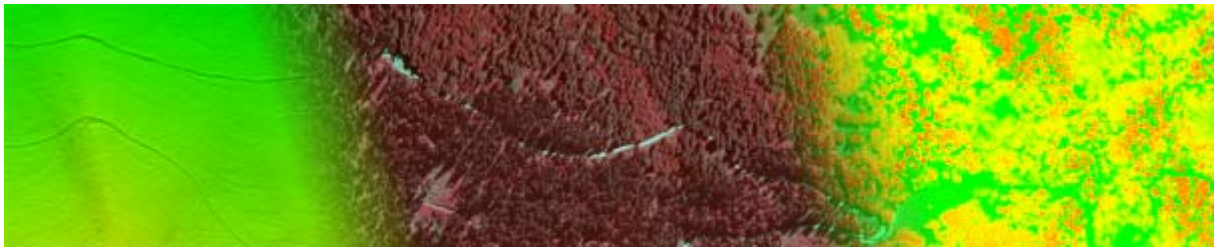

The consortium of the project Interreg Alpine Space NEWFOR

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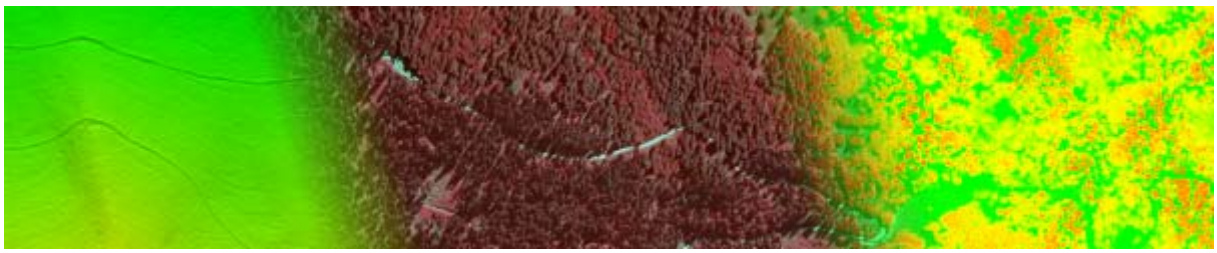

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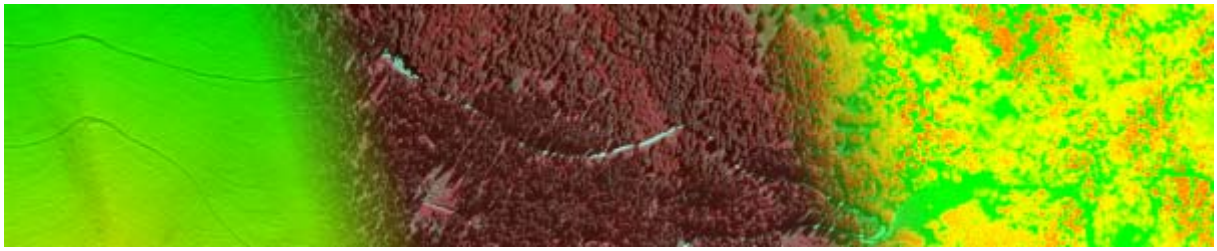


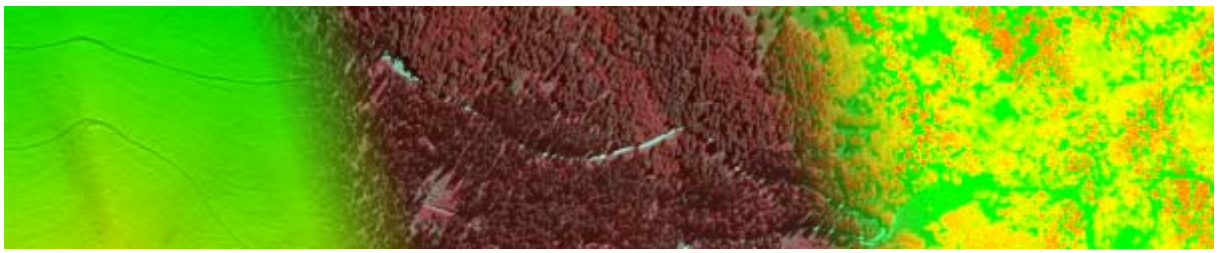
1 ABSTRACT

Haulage needs to be optimised as it represents a big share of the total cost of wood delivered to the mills. One way to improve its efficiency is to use optimisation tools such as routing systems or planning tools. Tests have been made with two existing tools.

The routing system, NavLog, was tried on a test site at Wildschaünau and Kundle in Austria. They revels some key points that are particularly important such as having a good connection between public road data base and Forest road data base to avoid extra mileage.

The optimisation tool was tested with a big transport company with more than 15 trucks. Gains seems possible in terms of additional loads but further works have to be done to better customised the tool for an utilisation in the Alpin context, with specific regulations in each country, specialized trucks, "mountainous" hazards to be taken into account, back haulage opportunities when more common trucks are used, etc.

Another important fact is that a good knowledge of the forest road network is needed as trucks are spending a lot of time driving on these roads with low speed. From the discussion we had in the consortium, we recommend to use the public data base as the most appropriate to integrate Forest road data. Specific rules must be defined to upgrade the data in real time and in a collaborative way.



2 A SYNTHETIC OVERVIEW OF THE INTERREG ALPINE SPACE PROJECT NEWFOR

2.1 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.

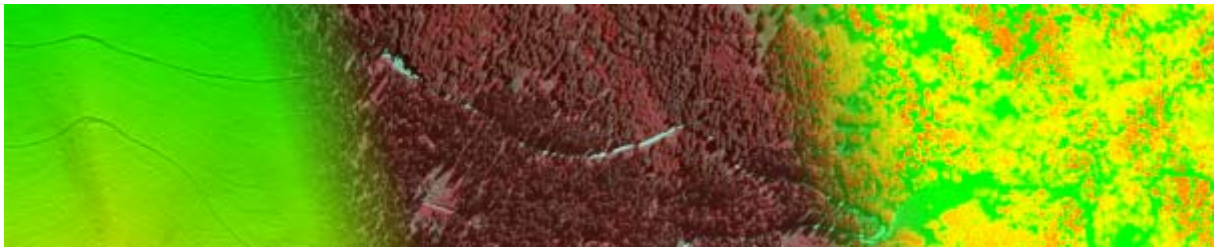
Forests fulfil multiple functions in mountainous areas. They have an ecological function as host of many habitats and species. They also are a leisure area for social activities such as hiking, skiing… From the economical perspective, the production of renewable resources like timber and fuelwood has 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 build 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..

2.2 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 UAVs, …), 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

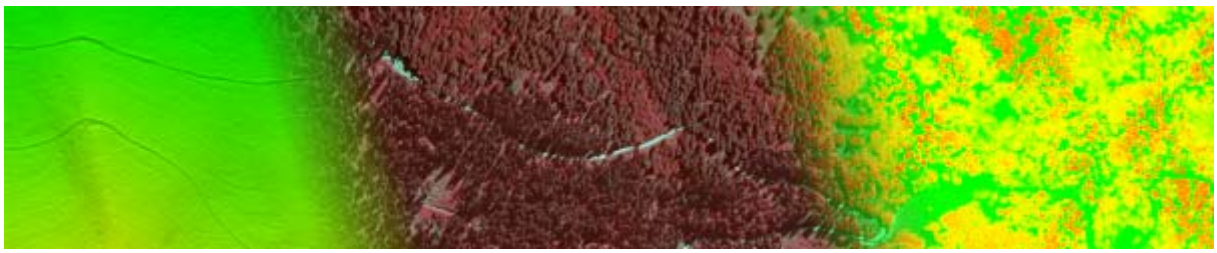
Once the forest resources and accessibility are characterized, then remains the issue of the connectivity between wood piles in the forests and wood yard of mills. This link is often neglected but is crucial for a comprehensive assessment of the wood supply efficiency.

- 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.



3 TEST OF NAVLOG

3.1 OBJECTIVE OF THE TEST

The focus within WP6 is on the connectivity between wood piles in the forests and wood yard of mills. Until now navigation systems that are specialized in truckloads are in use, yet the information is only available on public roads. What is still missing is a functional navigation system that provides all the information needed for a wood transport in the forest, which includes private roads for the most parts.

The development of specific satnav software for wood hauling purposes would implicate advantages like:

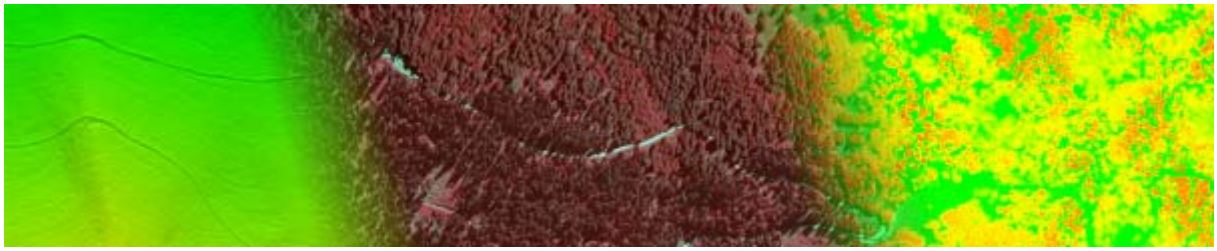
- optimization of the wood transportation inside the forest (optimizing routes)
- making optimized freights possible
- reduction of transport costs

Because in Tyrol the vast majority of timber haulers is being instructed by local foresters to find their most efficient way to get from the public road to the woodpile, also a

- reduction of personnel costs

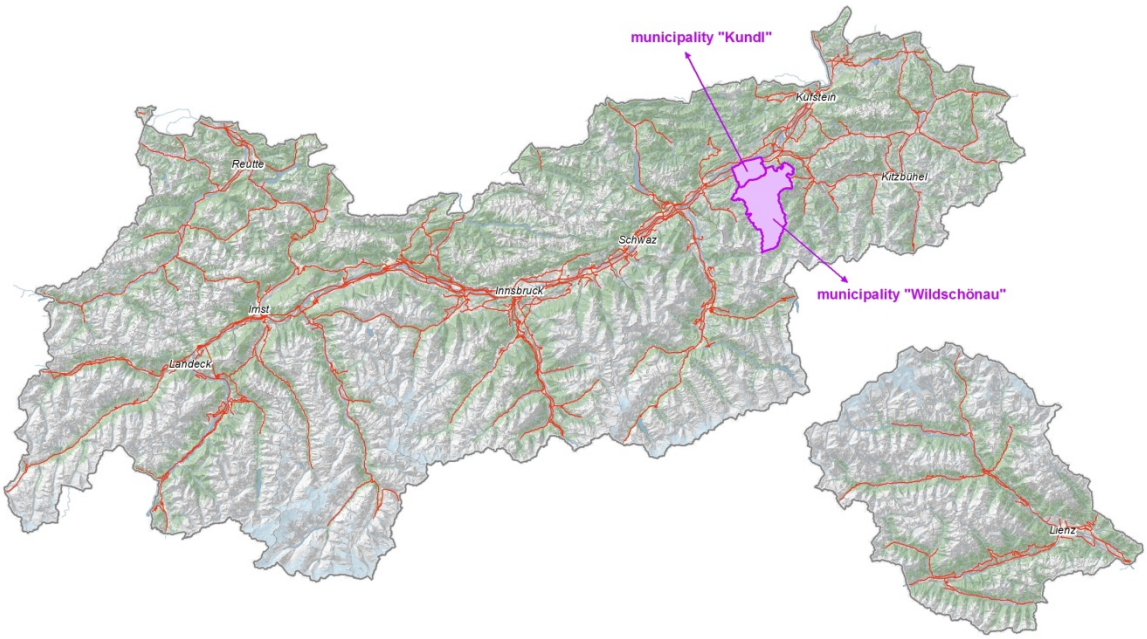
would be possible. Out of 60.000 truckloads annually, almost ¾ of all timber hauls are being instructed by local foresters.

The main objective within the project Newfor was to create a forest road graph that is useable for route guidance systems. For this purpose attributes that are relevant for wood transport navigation systems for alpine terrain had to be defined, furthermore already recorded parameters needed to be evaluated. The definition of minimum criteria for the recording of forest roads had to consider the current state of wood transport in Tyrol. Because in Germany a data format for the exchange of transport relevant parameters already existed, it was the target to create an alpine standard that is compatible with the existing standard of this company called NavLog. Regarding the data processing (acquisition of forest road parameters) a java client developed by company NavLog had been used. To implement the forest road data in a navigation system, company Forstware provided a navigation software called GeoMail. To identify the lacks of the tools in use (NavLog java client, GeoMail) a test run had been carried out at the Newfor test sites Wildschönau and Kundl.



3.2 TEST SITE

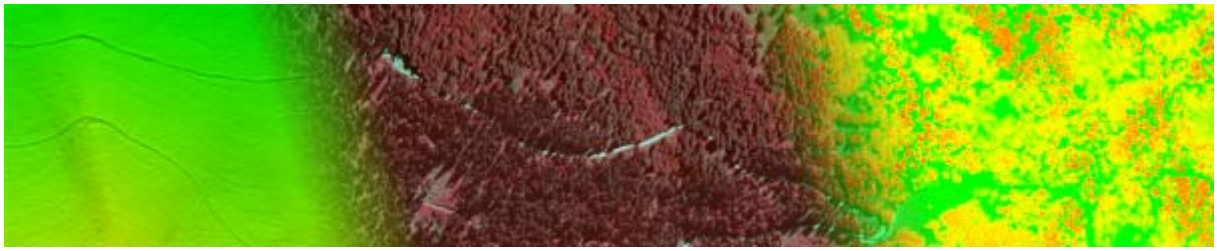
For the implementation of the "forest roads – satnav – project" two bordering municipalities in the east of Tyrol named *Wildschönau* and *Kundl* had been chosen as pilot areas. Both test sites stand out due to their variety and density of forest roads.



Location	Test site	Height range	Forest type
Tiroler Unterinntal District Kufstein	Wildschaünau (97,4 km^2) Kundl (21,9 km^2)	500-2 300 m.a.s.l	Spruce – fir –beech stands Spruce –fir stands Larch –fir stands Special sites

With a surface of about 97 km^2 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 km^2 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).

The NavLog test run had been realised on three days (Wildschönau: 10.07.2014, 22.07.2014), (Kundl: 23.07.2014). Preparations for the test run were done in collaboration with the companies NAVLOG GmbH (java client) and Forstware (software GeoMail). The outcomes of the first data collection with local foresters (way classes, gates, etc.) had been run on a Windows tablet (8.1). Due to the fact that the tablet's integrated GPS was inoperable, an external GPS (GNSS GPS/GLONASS GNS 2000 BT) had been used. The evaluation of the hardware, software and recorded attributes in the field had been realised together with the local foresters.

3.3 METHOD

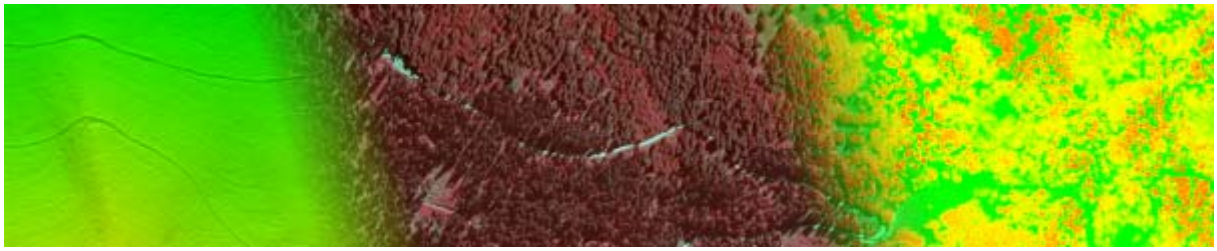
As a tool for the data processing of forest roads a java client developed by company NavLog had been selected. Because in Tyrol a database for the recording of forest roads existed, in a first step it was necessary to select those parameters that are relevant to make the Tyrolean forest road network usable for route guidance systems. As a result a minimum standard for the forest road assessment in Tyrol had been defined.

Started in 1993, an inventory of all Tyrolean forest roads had been realized. Hence, administrative and general data, forestial but also technical data on forest roads is available via an Access data base that is connected to an ArcGIS system. Also a quality standard is being recorded (e.g. data acquisition on basis of maps, orthophotos or laserscan data). By now only government-funded forest roads are being updated.

In regards of **relevance for route guidance systems** the following attributes had been exported from the Tyrolean forest road data base to then be able to edit and evaluate those within the test run:

- **Way classes** (according to trafficability, linear information)
- **Connections** to public roads (point information)

Within the inventory of Tyrolean forest roads so called **way classes** (typology of forest roads) had been defined. The classification of a forest road depends on the trafficability or engine used (trailer, truck, tractor) respectively, as a function of maximum load, longitudinal gradient, lane width and curve radius. The determination of a way class can be seen as an expert's opinion done by local foresters. The way classes which had been exported from the forest road inventory had to be evaluated within the test run.



Trafficability	maximum load	longitudinal gradient [%]	exception	lane width [m]	exception	planum width [m]	curve radius [m]
truck + trailer	axial load 11,5 tons per single-axle or 20 tons per twin-axle	max. 12	max. 14	min. 3,5 - 4	min. 3,3	4,5 – 5,0	12,5 (with widening of lane)
truck	axial load 11,5 tons per single-axle or 20 tons per twin-axle	3 - 12 (without binders); 1 - 12 (with binder)	max. 14	min. 3,5 - 4	min. 3,3	4,5 – 5,0	8 (without widening)
truck, limited trafficability	–	–	max. 16	–	min. 3,3	–	–
tractor	–	3 - 20	max. 25	min. 3	min. 2,80	–	–

Definition of way classes according to trafficability of forest road and engine used (source: Tyrolean Forest Road database)

In order to be able to provide a satnav software for wood hauling purposes, further information needs to be recorded. The following attributes can be seen as a recommendation for the acquisition of forest road data for navigation purposes, determined by the Tyrolean Forest Service. All attributes are integrated in the NavLog System.

- **Gates** (point feature)
- **Parking places for trailers** (point feature)
- **Reversing opportunities** (point feature)
- **Administrative area** (polygon)
- metadata

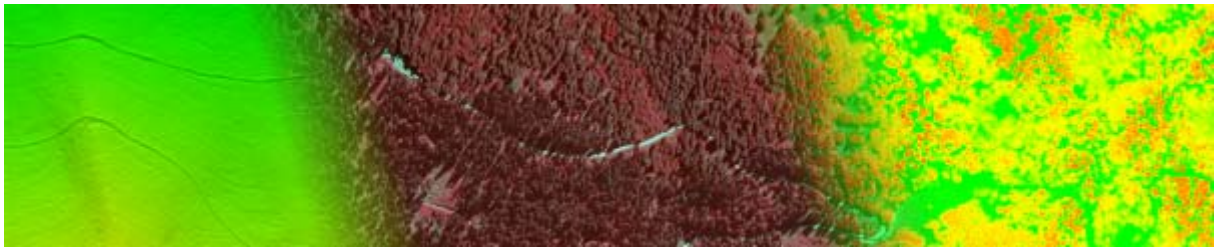
point features - TYPE

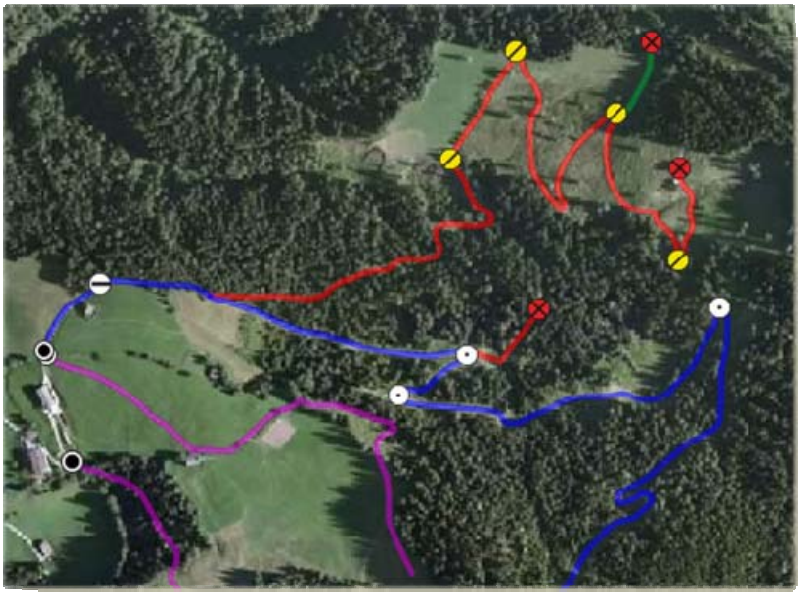
- connection point
- parking places for trailers
- gates
- turning circle (solo truck)
- turning circle (truck + trailer)
- turning bay (solo truck)
- turning bay (truck + trailer)
- dead-end road

Legend items created for the NavLog test run in the Newfor pilot areas.

- connection point
- parking places for trailers
- gates
- turning circle & turning bay (solo truck)
- turning circle & turning bay (truck + trailer)

Symbology used within the NavLog java client. Symbols for reversing opportunities are not equivalent to legend. Furthermore there is no distinction regards the display of turning circles or turning bays.



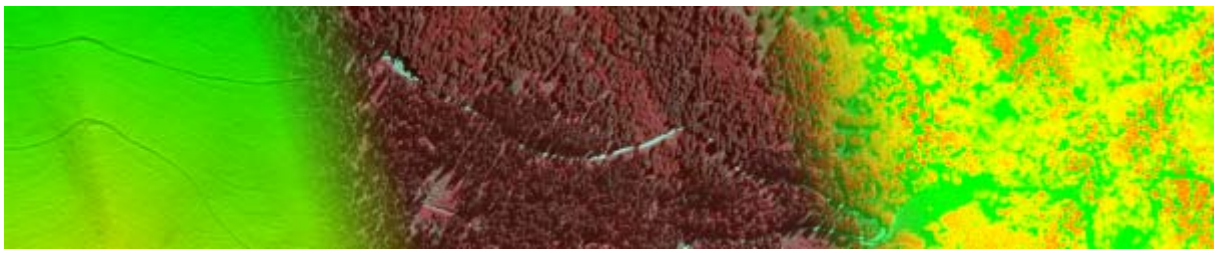


Tyrolean forest road network, showing pilot area Wildschönau
(source: webclient.navlog.de/)

Attribution of forest roads		
Type	**Value**	
reversing opportunities (5)	0	not determined
	1	**WPS** (turning circle for solo truck, minimum diameter 12,0 m)
	2	**WPG** (turning circle for truck + trailer, minimum diameter 20,0 m)
	3	**WIIS** (turning bay for solo truck, total depth min. 12,0 m, width min. 5 m, radius min. 5 m on each side)
	4	**WHG** (turning bay for truck + trailer, total depth min. 25,0 m, width min. 5 m, radius min. 5 m on each side)
	5	dead-end road

Definition of reversing opportunities according to engine used (source: NavLog format description, version 3.1)

Within two days all the above mentioned data had been collected together with the local foresters, responsible in the study areas Wildschönau and Kundl. In a first step all forest roads had been evaluated with regard to their predefined way classes. Also every road axis had been attached with the required information needed for wood hauling purposes. All attributes had been stored in the NavLog data base as point features. The following table presents the time spent in total for the assessment of forest roads in the pilot areas.



Pilot Areas	total length of forest roads imported from GIP [km]	preparing import of GIP data for Navlog-Client [h]	pre-acquisition of information [h]	validation with local foresters [h]	data post-processing [h]
Wildschönau, Kundl	270	25	25	12,5	48,5

Time spent in total for the acquisition of all forest roads within the Newfor test sites. 5 people have been involved in the recording as well as evaluation of the forest roads.

To identify the lacks of the tools in use (NavLog java client, GeoMail) a **test run** had to be realised. As described before two bordering municipalities in the east of Tyrol named Wildschönau and Kundl had been chosen as Newfor test sites. The recorded forest road data was tested on a Windows 8.1 tablet. The technical equipment used for the test run is listed below. The main objective was to test the produced forest road dataset in terms of usage and functionality for forest navigation systems. For the building up of the dataset two graphs had to be connected. The OpenStreetMap (OSM) - graph depicts the public road system, the NavLog graph maps the Tyrolean forest roads. Therefore the test run focused also on the connection of both systems, meaning the shifting from one graph to the other, and in particular bugs concerning route calculation. Furthermore the GPS capability inside the forest (signal strength) and the GeoMail's graphical user interface had to be tested. Outputs of the NavLog test run are summarised below.

Hardware

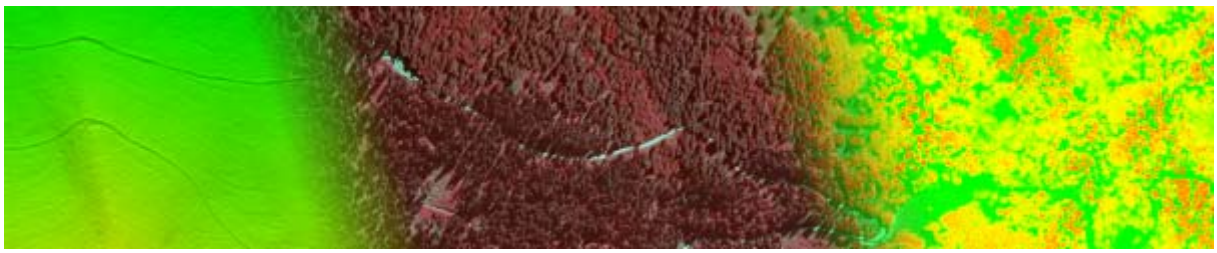
Lenovo Miix 2.8 (Windows 8.1)

GNS 2000 GPS/GLONASS BT-Receiver

Software

Webclient NavLog v06.07.05 (Intergraph - GeoMedia ResPublica)

GeoMail v4.863 (Forstware Informationssysteme)

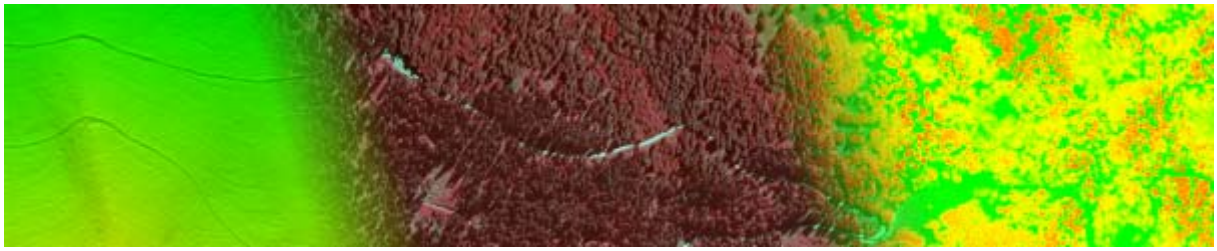


3.4 RESULTS

The following review summarises the outputs of the NavLog test run, which had been realised on three days in the pilot areas Wildschönau and Kundl. Based on the results, recommendations for building up of Web-GIS based applications for making forest road data usable for route guidance systems had been issued. Recommendations are given in the following section.

To realise the test run attributes for more than 270 km forest roads had been recorded together with the local foresters and stored on the NavLog graph as described before. For the building up of the GeoMail dataset (navigation software) company Forstware connected this graph with open street map data (OSM). Meaning that the OSM-graph depicted the public road system, while the NavLog graph mapped the Tyrolean forest roads. It was the objective to test if the **connection** of both systems is working and therefore the shifting from one graph to the other would function successfully. Within the test run there was only one bug concerning the **route calculation**, with focus on the connection of forest and public roads. In the municipality Wildschönau a forest road connection to the public road system was missing. That is why the navigation software showed a route that would have led via a bordering village to get to the sampled wood pile (destination). The starting point was in Oberau (928 m a.s.l.), as destination a wood pile at the end of a forest road (Gschieß, 971 m a.s.l.) had been chosen. Both starting and end point are within the same village. The calculated route would have caused a circuitous way of more than 5 kilometres.

All further errors in route calculation refer to **falsities** on the **OSM dataset**. The OSM data was used for the navigation on public roads. Most of errors had been shown on municipal roads. This is because a street hierarchy is not defined within the OSM graph or exists in an inadequate way. Attributes like street categories or functional road classes are needed to differentiate a road of higher importance from a street of less importance. Only by giving such information navigation can be improved. Using the example of Wildschönau and Kundl, missing street categories leaded to the following falsities. In the range of the OSM graph the navigation software showed two hiking trails as traffic routes. Also the software calculated a route which would have led through a gorge (Kundler Klamm) to reach the destination. In actual fact this road can only be used by bikers or hikers. Moreover the OSM data showed a connection road between the municipalities Wildschönau and Kundl, despite the fact that there is a rift in between which cannot be crossed. By testing the software further mistakes occurred in the range of the OSM data. For the most part of crossroads a voice response was not available, only the calculated routes had been shown on the map. For those crossroads where there was a voice response available, the speech output did not correspond with the suggested route. In some few cases the navigation software suggested to turn off the road where in nature there was no possibility to do so. In summary, it can be stated that the OpenStreetMap data is far **too inaccurate** to use it as a basis for a satnav software **for wood hauling purposes**.



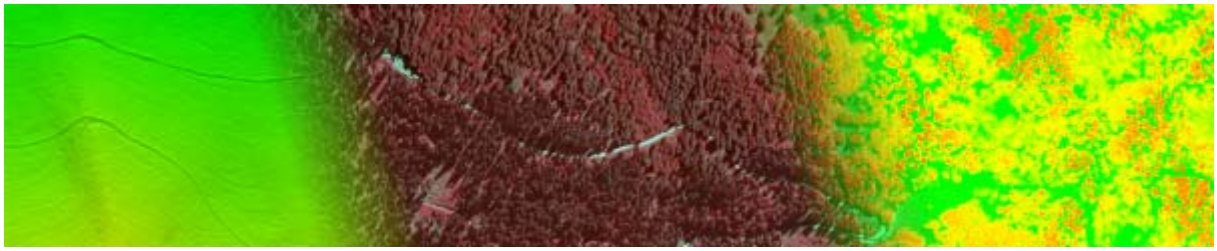
With regard to software's data handling of our recorded forest road attributes the following can be summarized. For all the **point information** that had been collected, like gates, reversing opportunities, etc. **voice response** was **not available**. Also the **legend** for the symbols used to depict the point information was missing. Aside from that the software did not allow to select an **engine** which is **used** to travel a road. With regards to trafficability of forest roads this can be seen as a vast disadvantage, because the Tyrolean way classes (typology of forest roads) are defined by engine used (trailer, truck, tractor).

The software GeoMail was tested on a Windows tablet. Due to the fact that the tablet's integrated GPS was inoperable, an external GPS had been used. At settlement area the **GPS signal** was good, minor deviations (from road) of about 0.5 m had been registered. As assumed the GPS capability inside the forest (signal strength) was insufficient.

In total **48,97 km** public and forest roads had been travelled to identify the lacks of the tools in use (usability of mobile device, software GeoMail, external GPS). Out of 169 observation points in total, **141 viewpoints** had been evaluated within the test run. Observation points were defined on linear (way classes) and point features. Those are:

- Way classes
- Turn uses (at crossroads)
- Connections to public road
- Gates
- Reversing opportunities
- Parking places for trailers

All **way classes** that had been controlled within the test run turned out to be correct. About 30 % of all the **point information** (gates, reversing opportunities, parking places) recorded together with the local foresters is incorrect. These are reversing opportunities for the most part. To be more specific, turning circles had been reduced to turning bays. With regard to **connections** from forest to public roads all information can be evaluated as "correct" or at least "sufficient". Some connections needed to be relocated. Concerning the turn uses it can be summarized that most part of errors relate to the data coming from OSM, for the reasons described before. 20 % of all turn uses on the OSM graph had been wrong. In the range of the NavLog dataset only 3 turn uses turned out to be wrong. One turn use was giving where there was no crossroad or possibility to turn left or right. Furthermore one turn use was missing, both



route calculation and voice response were not given. The last error occurred at a crossroad where both, route calculation and voice response, turned out to be wrong.

3.3 CONCLUSION

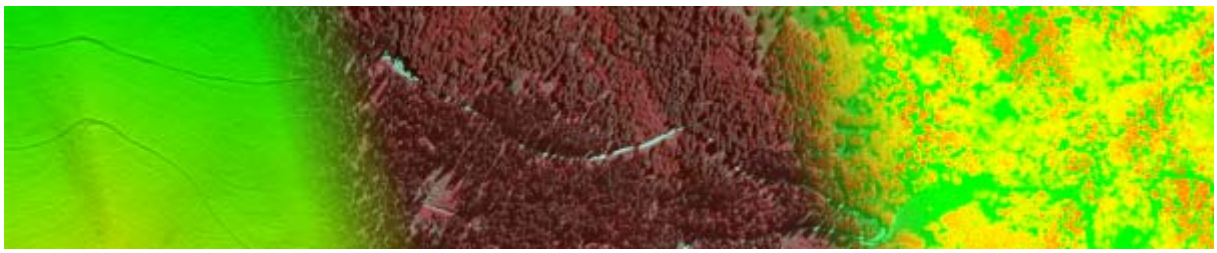
NavLog is an interesting tool whose purposes are to build forest road data base and to make it available for private companies that are developing specific tools for wood logistic such as routing with embedded equipment, logistic online tools…Data are coming from forest private owners. They are free to decide if they want to give data about the forest network inside their property.

But a lot of lacks have been identified both by TORG and French representatives who visited NavLog company (3rd of April 2014).

The analysis of the editing and displaying functions shows insufficient resolutions concerning equipment (stock place, hairpins, parking place…) and line features. Connection with the public road network is not accurate. Restrictions concerning the rural public network are not taken into account. Some roads are missing because some private owners don't want to give information concerning their property.

Information updating is a crucial point in such a tool as, in mountains areas, temporary obstructions are quite frequent due to natural hazards, soil slippery, closed forest road because of maintenance work or harvesting operations. Until now all new data must be validated by forest owners (or their organisations) with a frequency that is not adapted to a day-to-day utilisation by wood carrier. Concept on just-in-time updating in a collaborative way – not only with the forest owners but also with other end-users - should be defined.

During NEWFOR, we were also looking for good practices regarding existing forest road data bases but also public road data bases (as valid supplement). As a good example of success stories TORG focused on the so called Graph Integration Platform (GIP). The GIP is a nationwide reference graph, which provides a digital map of Austria's transport network available to all - public, authorities as well as freelance civil engineers. For further details, please see Annex I. The graph covers all modes of transport (passenger car traffic, public transport, cycling, walking) and is useable for route guidance systems. The main advantage is the centralized data storage with decentralized data updating via a network client. The comparison of the NAVLOG system and the Graph Integration Platform showed us that for Autrian purpose it is more advantageous to develop a routing guidance system for the forest sector based on Graph Integration Platform. The following table shows the pros and cons of both systems.



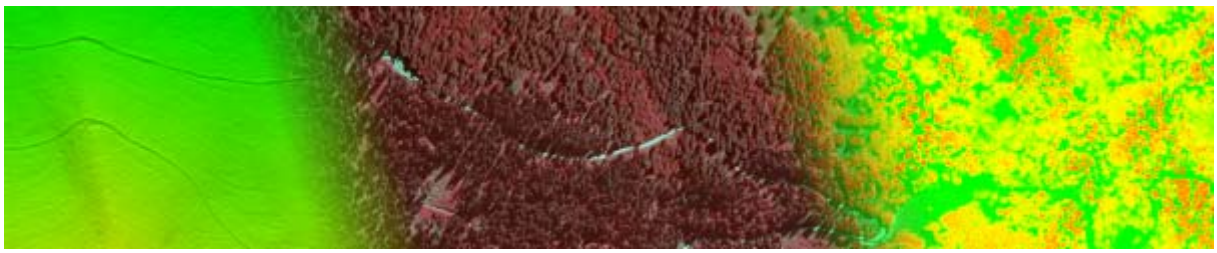
Comparison of 2 different routing possibilities

Evaluation criteria	NAVLOG	GIP
Established standard for route guidance systems - wood transport	+++	-
Homogenous graph, capable of proposing intermodal combinations	-	+++
Complexity regarding route calculation – defining connections to public road	---	+
Consistent accuracy of the graph	-	+
Integration of the rural public road network	-	+++
Possibility for updating the rural public road network data	-	+
Effort on updating forest road network	-	+
Routinginformation also available for external partners (Tyrolean emergency call center)	-	+

This comparison makes it clear that the GIP system has a lot of advantages seeing it as a database for a route guidance system used for wood transport. Due to the fact that the specific parameters for timber transport are not coordinated on a nationwide agreement, we had to create a guideline for the forest road ascertainment in Austria as a prerequisite for the development of a mobile client used for forest road acquisition. Based on a nationwide agreement of all forest services, detailed criteria for the recording of forest road data usable for route guidance systems are being defined. Also we addressed the missing GIP requirements that are needed to make a route guidance system, based on a GIP dataset, usable for wood transport.

Using the Graph Integration Platform as the data base for the processing of Austrian forest roads but also as a basis for route guidance systems offers several advantages:

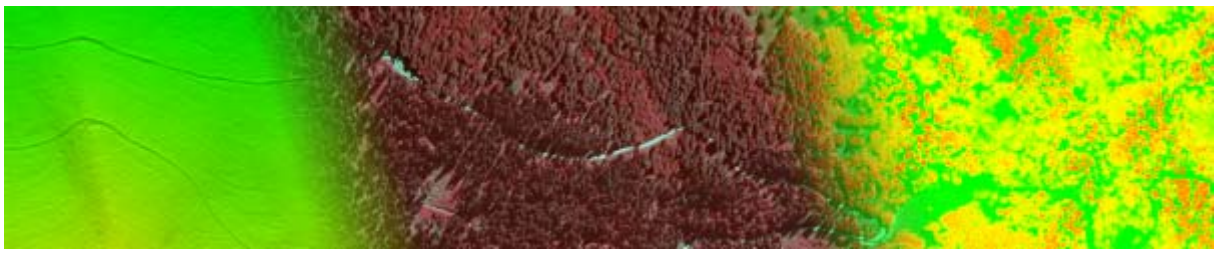
- homogeneous structure regarding geometrical data processing and relevant attributive information
- routing information can be stored on the graph
- integration of the rural public road network (which might be critical for wood transport)
- routing information also available for action forces (e.g., emergency call center)



- less effort on updating forest road network (Web Client)
- data transfer for navigation systems possible

As an outcome of the cooperation between the Austrian Forest Services, the GIP coordinators and the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the guideline “Integration of Austrian forest roads into the GIP” has been realised and was discussed on a national level with the regional forest governments. Not only an interchange of ideas and requirements has been created, the guideline now provides a basis for the data handling of forest roads. A consistent accuracy of the graph can be ensured

In France, quite a similar shift is made with reflection on how to deal with a situation where several regional projects of forest road Data base exist. A common approach using public data provided by IGN (Institut Géographique National i.e National Geographic Institute organization in charge of collecting and providing "public" geographical data in France) is on-going.



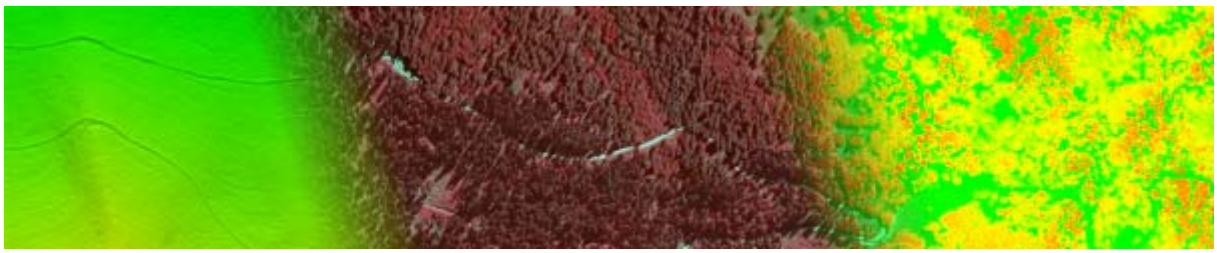
4 TEST OF FLO

4.1 PRESENTATION OF THE TEST

Test of an Optimisation Software

- **Structure of transport companies:**
Generally 1-3 trucks, very few large companies
- **A month-to-month planning…..with urgent day-to-day orders**
  - Manual method
- **No optimisation for the back haulage** (except on very large distances)
- **Local labor: local knowledge**
  - No use of FR database, no available database …
  - In case of difficulty for the final approach: indication by telephone
- **Necessary flexibility in planning**

As result:
- Difficulty for optimisation
- Difficulty to launch common decision tools because of the size of the transport companies



Test of an Optimisation Software

BUT...
We notice an evolution of sawmills and market (see SoA)

- Needs for more just-in-time information (wood available at the roadside, delivered at the mill, ...)
- Bigger sawing capacities = larger supply zone = need to reduce empty back haulage
- Taking into account more and more complex transport regulations

↳ **More precise transport planning is necessary....**

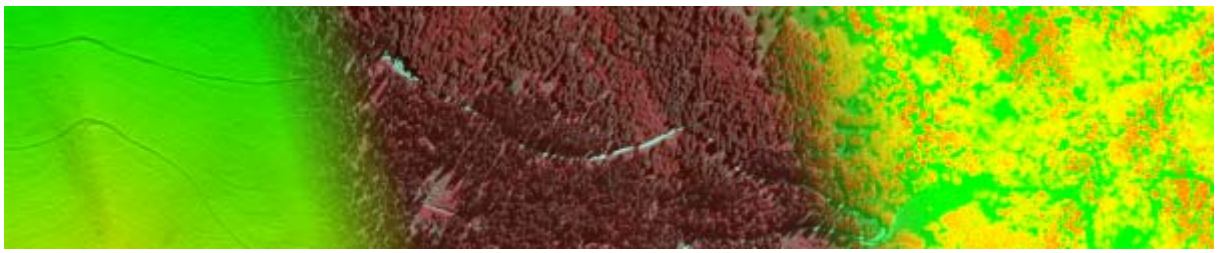
↳ **No information on the "forest" part of the transport** (i.e time spent on forest roads)
This information will be required for the utilisation of optimisation software

Deployment possibilities

Many solutions available in the market... But only few designed for the wood transport.

TOUR OPTIMISER www.touroptimiser.com
PTV SMARTOUR the mind of movement
FLO FOREST LOGISTICS & OPTIMIZATION
acteos
Optimization Software
TourSolver for GeoConcept
DESCARTES
GrfOptWay

European Territorial Cooperation
Alpine SPACE EU co-funded



Test with transport company

Two solutions selected during the analyse of the market:

SmartTour from PTV Loxan

PTV SMARTOUR
the mind of movement

FORCES	WEAKNESSES
Logistics expert	No wood knowledge
Ease of use	Specific transport equipment adaptation
Integration of the French regulations for trucks	Absent of the forest movement phase
Flexibility	

FLO from Trimble

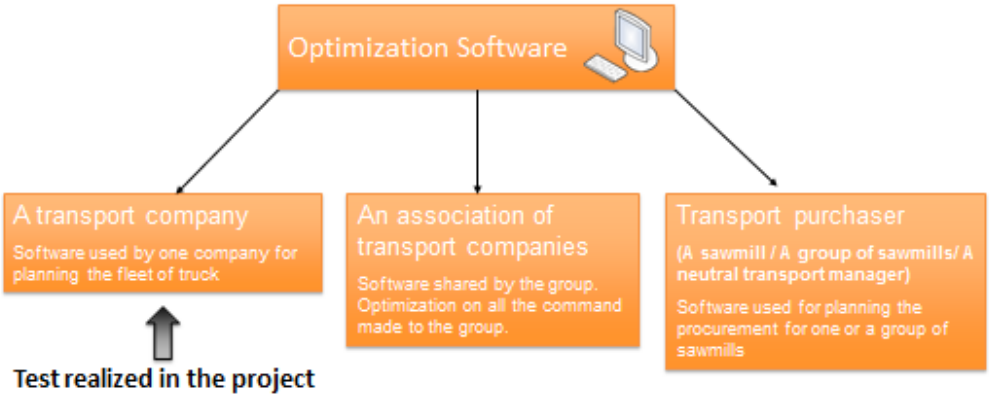
FLO

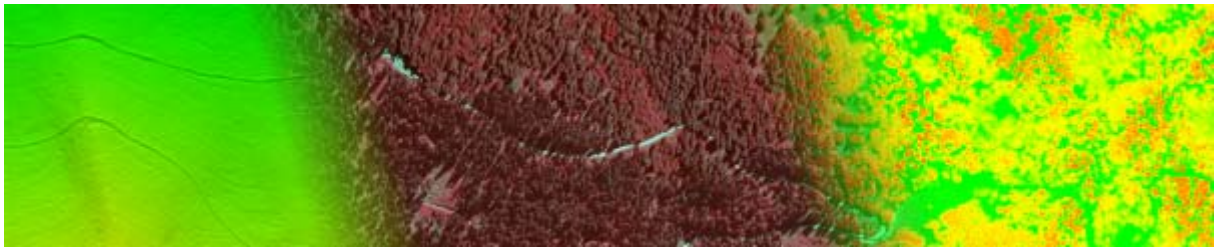
FORCES	WEAKNESSES
Wood logistics expert	Adapted to the North American context
Integrate timber transport constraints	Lack of information on the road network
Consideration of forest approach	No knowledge of the French regulations
Flexibility	

After discussion only FLO was interested and have the time to work with us.

Deployment possibilities

1 of the 3 different approaches identified





Great number of possible combinations (loading sites in the forest, delivery points at mills, and trucks) means better gains from an optimisation. As the size of both 1st transformation mills (and logging companies) and transport companies are generally small, 2 types of organisations may use an optimisation tool in the Alpine context:

- A consortium of transport enterprises
- A consortium of transport purchasers such as sawmills, pulpmills and board mills and other wood procurement companies

Of course, individual big actors (transport companies or mills) can also use such tools with benefits.

We tested FLO tool with such a big company of transport, Société de Tansport Rochatte.

4.2 RESULTS

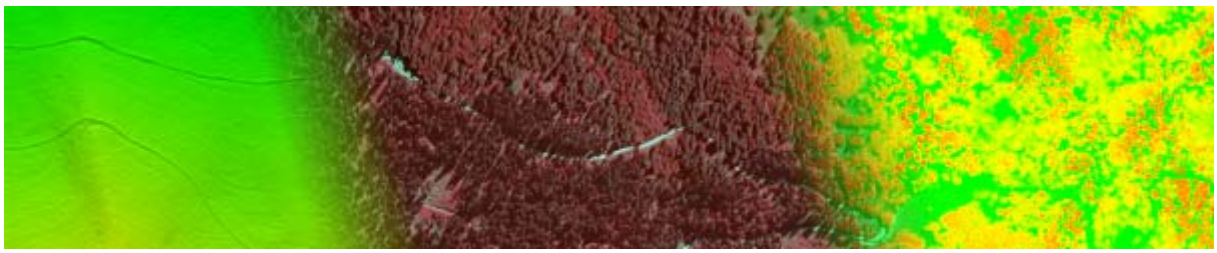
Test of an Optimization Software

- Past data of a French company (Transport ROCHATTE / 15 Trucks)
- Data has been loaded in FLO software

Second result: (on 1 week)

		11/06/2012	12/06/2012	13/06/2012	14/06/2012	15/06/2012
Company	Nb trucks	14	15	13	7	12
	Nb loads	22	25	19	13	20
FLO	Nb trucks	14	15	13	10	11
	Nb loads	22	28	22	17	24

With the same fleet, more deliveries could be made.
FLO doesn't give any information on the total mileage !



Data from a previous week has been loaded in FLO to know the planning that could have been proposed by this tool. The result is a program with much more loads (113 vs. 99) with the same fleet.

A second test was done with the following results:

What have been done ?

- Two weeks optimization analysis
- Past data of a French company (Transport ROCHATTE / 15 Trucks)
- Updating data in the FLO software

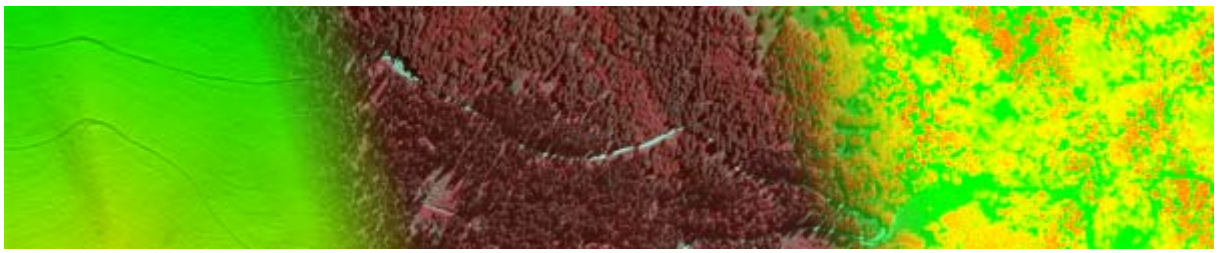
Third result:

Date	Truck available	Loads FLO	Loads Rochatte	% New Loads
11/06/2012	14	25	22	14%
12/06/2012	15	28	25	12%
13/06/2012	13	26	19	37%
14/06/2012	7	19	17	12%
15/06/2012	12	27	20	35%
TOTAL 1 WEEK		125	103	21%
18/06/2012	14	29	22	32%
19/06/2012	15	31	26	19%
20/06/2012	15	25	20	25%
21/06/2012	13	25	19	32%
22/06/2012	14	32	22	45%
TOTAL 1 WEEK		142	109	30%
TOTAL		267	212	26%

Same fleet used, more command made…

A third test was planed with a new methodology: we wanted to work with a more complete data set, taking into account the changes that occurred during a two week period such as new commands or annulation of commands, lack of wood stock in forest, engine failure…… . But unfortunately, it wasn't possible to do it because the personnel of the transport company was not available any more.

FLO was also presented to a big sawmill that have a wood procurement service. The men in charge of the transport were really interested by a test of FLO but once again, finally, they were not available for that.



4.3 CONCLUSION FOR FUTURE INVESTIGATIONS

The tests we conducted don't illustrate all the potential benefits FLO can procure. Further investigations are necessary to have a better picture of the advantages of an optimisation software. That would require a deeper implication of both the software provider and the company that tests the tool.

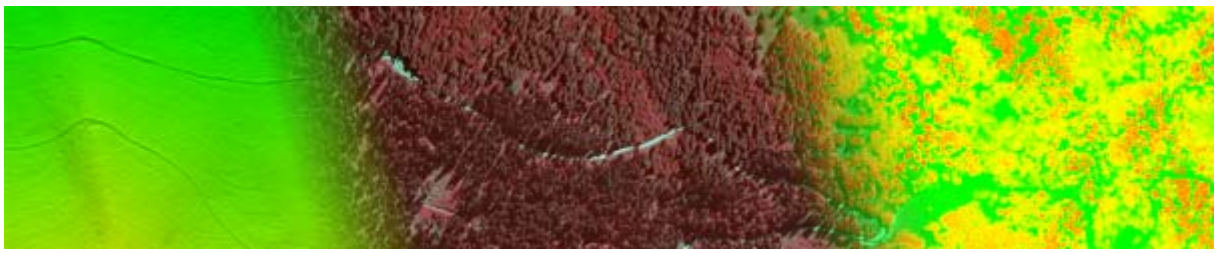
Nevertheless, preliminary results show potential gains in terms of increasing the number of loads when the truck fleet is around 20 trucks. Another result is the more loading and unloading locations you have, the more interesting improvement you get. During NEWFOR very simple simulations have been made and it isn't possible to have figures about gains in terms of total mileage of the fleet. Another restriction in our tests is that we couldn't take into account the real time spent on forest roads as network data are not available on the test area.

Another restriction was that some long distance loading points have not been taken into account in the simulation because the software doesn't take into account the possibility for the driver to stay in a hotel.

We notice also that an optimisation software will need specific parameterisation for a use in the AS because of particular regulations in terms of authorized payload (sometimes according to the type of roads or according to a defined network like in France)

Two other important points have been identified:

- The tool should work in connection with public freight data base so that opportunities of back haulage can be caught (for semi trailer),
- Calculations should be quick, delivering new loading program when changes are occurring such as unreachable piles in the forest, new needs from the mills, truck breakdowns……



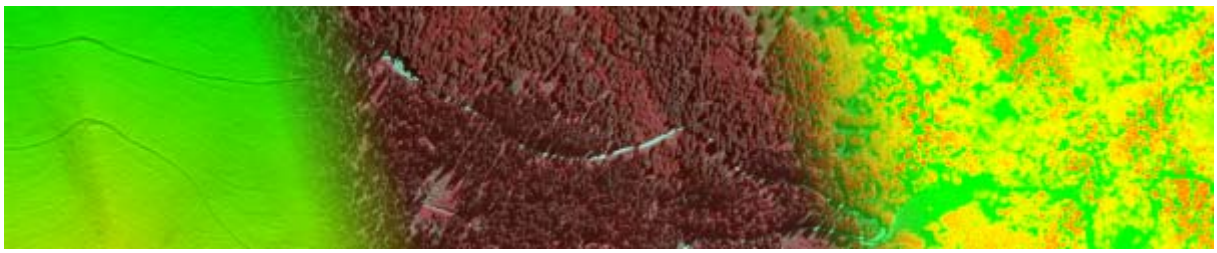
5 CONCLUSION AND PERSPECTIVES

Tests with Navlog and FLO reveal some interesting perspectives to improve the logistic from the forest to the 1st transformation mills. NavLog is a routing system that helps the truck drivers to find the best way to reach the stockpiles in the forest. FLO tests give interesting trends in terms of increasing the number of loads with a given truck fleet. But some lacks have been also identified linked to the fact that those tools have been conceived in other countries with different organisations and so with different requirements.

For both the tools, an important point to deal with is a good integration of forest road data base because the time devoted to drive on the forest road is an important part of the whole truck round in mountain areas (see Annexe II). The accuracy of the location of associated equipments such as places for stocking the wood, turning areas, and a good geographic position of the junction between the public roads and the Forest roads are key points.

Considering the importance of having a good FR data base – accuracy with easy, data upgrading, stable, homogeneous and stable structure of the data base……- the partners focused on the way to integrate forest road data base in existing public tools such as GIP in Austria or BD Topo in France.

The main challenge now is to work with the public organisations (IGN, GIP partners) so that the needs of the forestry sector are taken into account from forest management to wood carriage activities. Specific agreement should be set up so that private companies could develop new tools using public geographic data for routing assistance or for the optimization of wood transportation.



ANNEXE I

Graph Integration Platform

(See also Annexe I in report 2).

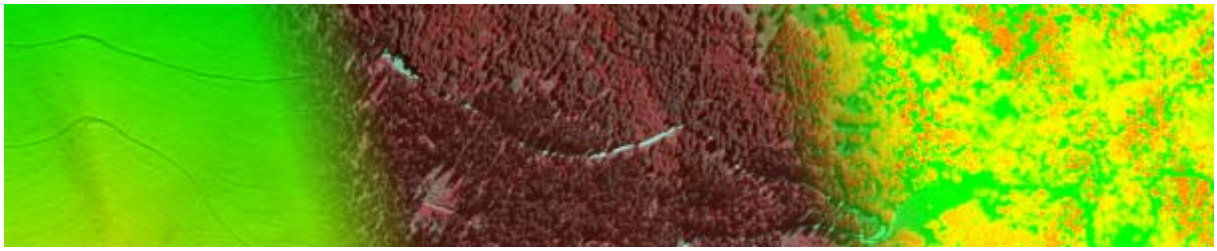
Over recent years Austria's public authorities were using parallel systems for data storage regarding transport infrastructure. The so called Graph Integration Platform (GIP), which has now been implemented across Austria, can be seen as a link that has been missing between these parallel systems.

The GIP is a nationwide reference graph which provides a digital map of Austria's transport network available to all authorities. Hence, no more multiple or parallel data storage systems are needed. As there is only the traffic-relevant information being stored on the graph, also a link to data storage systems of the different disciplines is possible (project partner's specialized data bases, e.g. Tyrolean Forest Road Data Base). All information is being historicized which ensures restorability at all levels.

The greatest improvement the GIP brings along is the centralized data storage with decentralized data updating via a network client. This means that the data owners themselves are responsible for data sovereignty and quality of data. Thus the transport network is continuously updated and a correctness and completeness of the reference graph can be ensured.

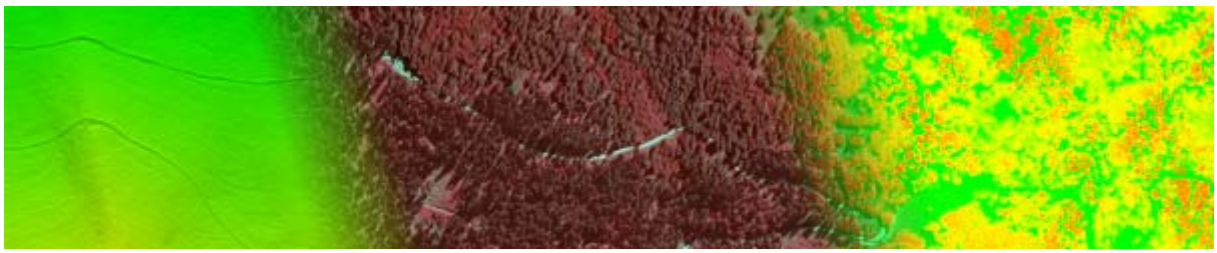
The reference graph is also usable for route guidance systems. It covers all modes of transport (passenger car traffic, public transport, cycling, walking) and is capable of proposing intermodal combinations. The Traffic Information Austria (VAO), which provides calculation of routes and up-to-date traffic data available free of charge, uses the GIP as a basis for the optimization of routes. In terms of Austrian forest roads the following attributes are traffic-relevant and therefore being stored on the graph:

- Code (ID), Name
- Street category (legislative basis)
- Sustainer
- Functional road class (traffic value)
- Usecondition (wayclass according to trafficability, minimal width, maximal inclination,…)
- Form of way
- Turning options
- Parking places for trailers



- Gates
- …

GIP.gv.at is a joint project of the Austrian federal states (Tyrol, Salzburg, Carinthia, Styria, Upper Austria, Lower Austria, Burgenland), ASFINAG (motorway operator), ÖBB Infrastructure (Austrian Railways), the Austrian Federal Ministry of Transport, Innovation and Technology and their partner ITS Vienna Region. The Austrian Association of Cities and Towns is an associated partner.



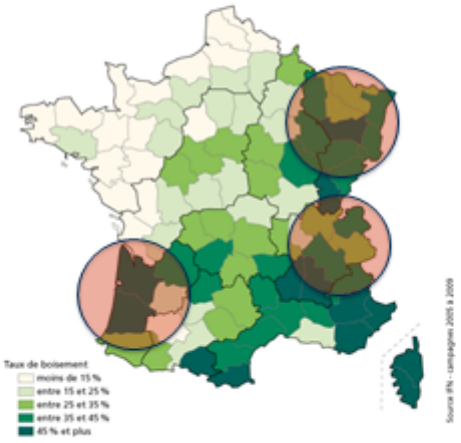
ANNEXE II

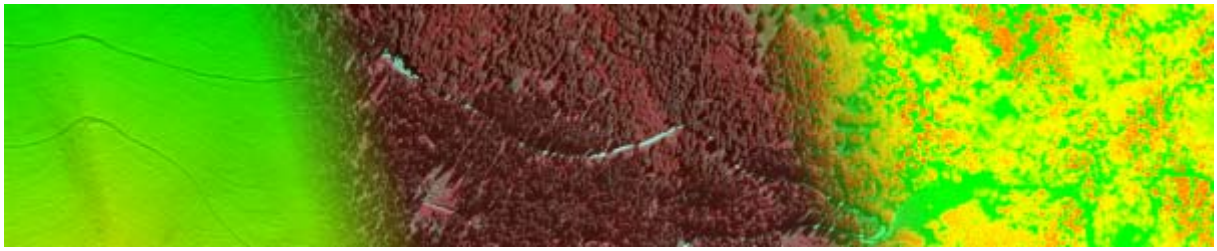
A comparison between wood transport in mountains areas vs flat areas.

Wood Transport Qualification

What have been done:

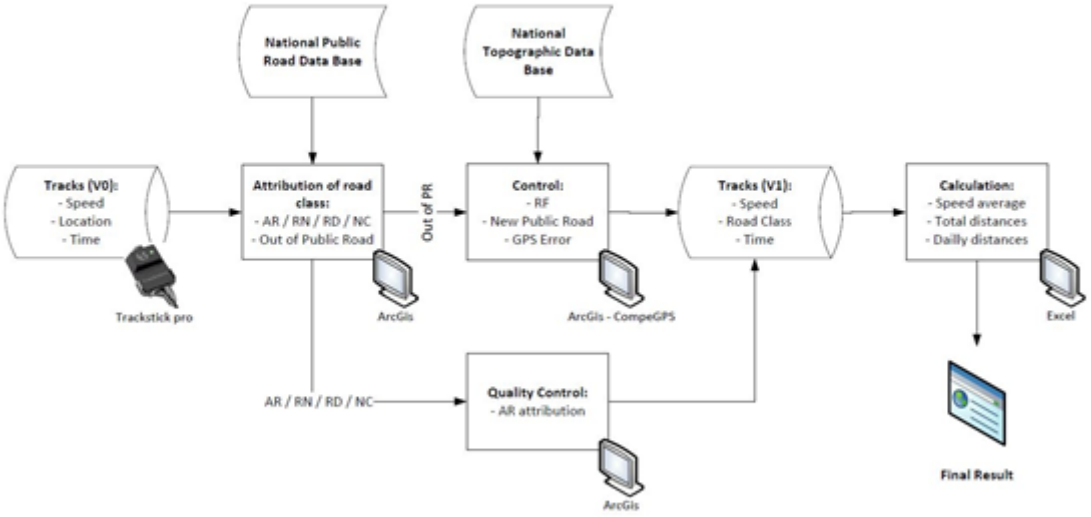
- Put tracking equipment on trucks
- Analyzed of the speed profile in 3 different area:
  - Alpine space
  - South West
  - North East





Wood Transport Qualification

What have been done:



Wood Transport Qualification

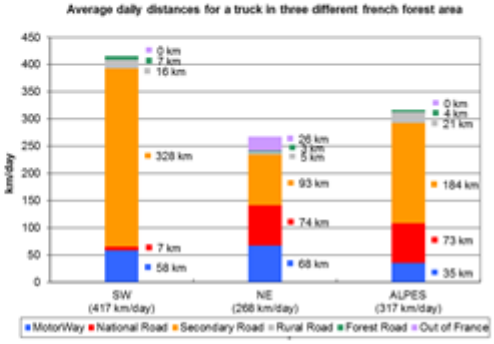
The results:

Speed Profile (kph)

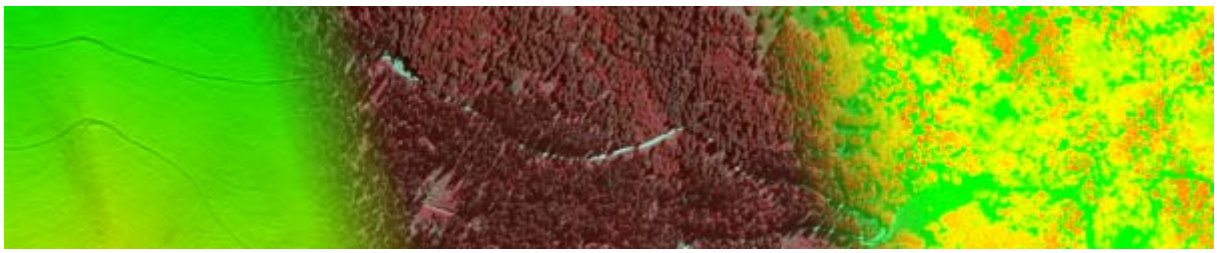
		SO	NE	ALPES
MotorWay	AR	78	79	73
National Road	RN	61	70	65
Secondary Road	RD	59	51	41
Rural Road	NC	39	23	15
Forest Road	RF	33	14	10
Out of France	HorsFrance	NC	42	NC

Distance / 1 day (km)

		SO	NE	ALPES
MotorWay	AR	58	68	35
National Road	RN	7	74	73
Secondary Road	RD	328	93	184
Rural Road	NC	16	5	21
Forest Road	RF	7	3	4
Out of France	HorsFrance	0	26	0
	TOTAL	417	268	317



- A important difference between SW and the Alpine space
  - Due to the nature of the forest
  - The topographical conditions
  - The type of material
- A speed profile who will mainly affect the time in movement



Wood Transport Qualification

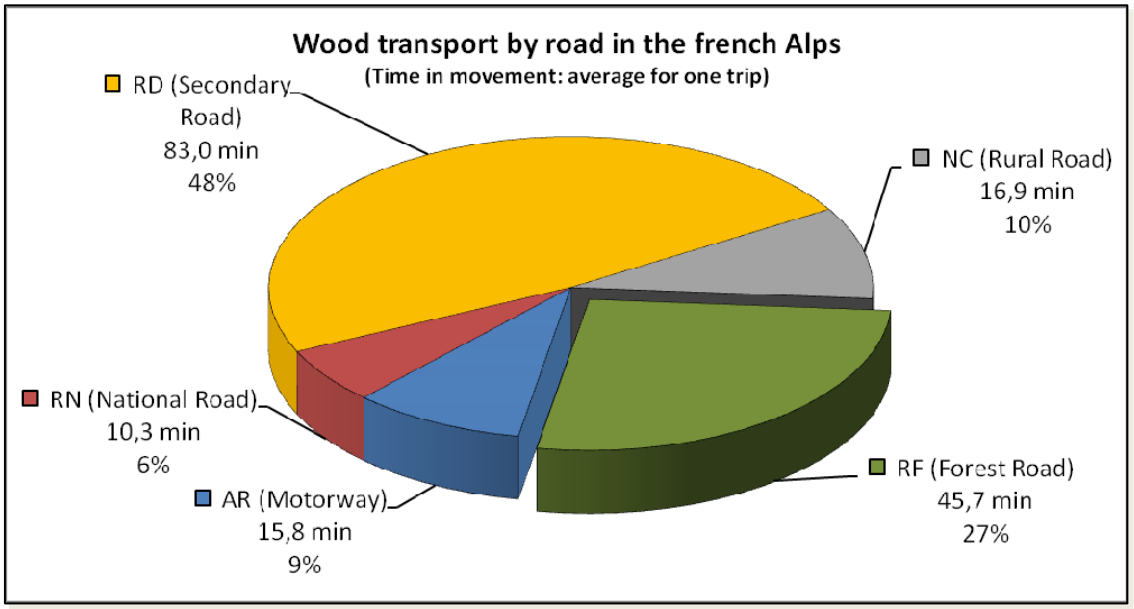
The results: Time in movement…

Trip Analyse (5 trips)

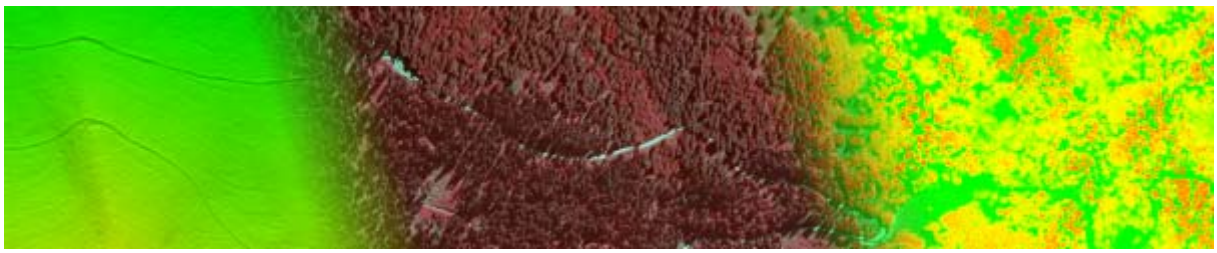
	Average Speed (kph)	Total Distance (km)	Moving Time (min)	Loading Time (hh:mm)	Unloading Time (hh:mm)
MotorWay	77,2	7,0	5,6	01:01	00:37
National Road		0,0	0,0		
Secondary Road	38,9	64,4	100,3		
Rural Road	16,0	5,3	20,8		
Forest Road	9,5	5,2	48,8		
TOTAL		82,0	175,5		

Prospect:

- Can be useful for optimization: precision on speed profile
- To be continued…

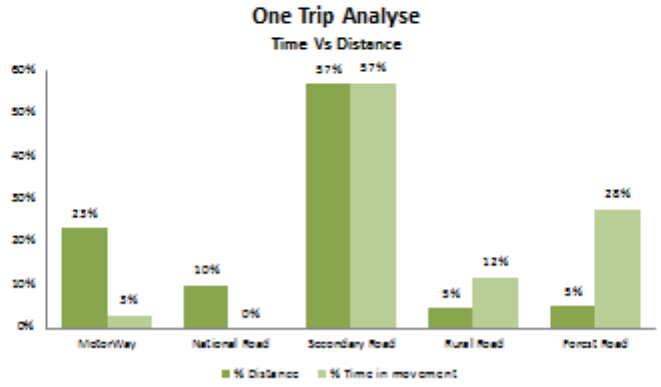


In the French AS, 27% of the driving time is devoted to driving on a forest road.



Wood Transport Qualification

- Prospect:
  - Can be useful for optimization:
    - Precision on speed profile
    - Time for load and unload
    - Anticipation
  - Interest from some professional to argue discussion on transport cost



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