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LASER ON THE LOIRE

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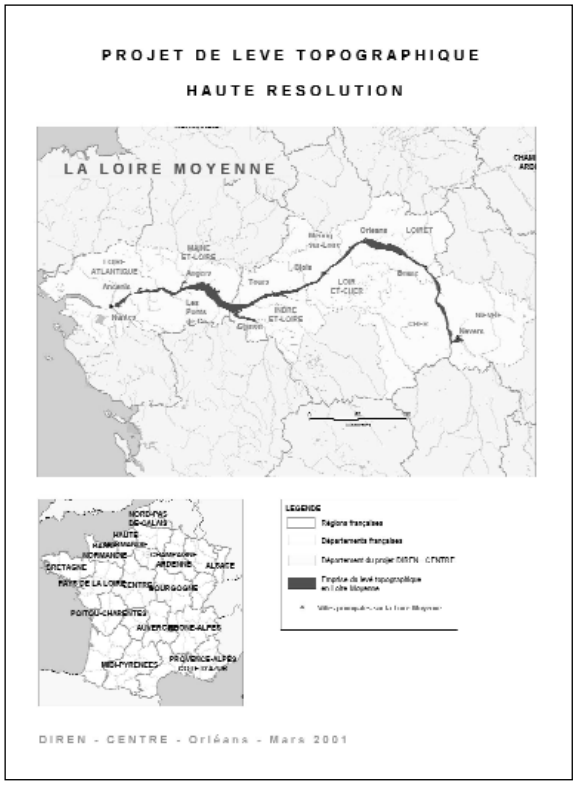
For many of us, the River Loire conjures up visions of ancient castles, historic cities, famous name vineyards and beautiful landscapes Nevertheless, it has its darker side, too, For example, one study estimates that severe flooding of Loire could result in the inundation of more than 13.000 entreprises between Nevers and Angers, endanger 21.000 lives in the city of Orleans alone, and cause damage worth E 6 billion.
To manage and hopefully reduce the risk, an overall plan for the Loire has been developed by DIREN Centre (Direction Régionale de l'Environnement du Centre), the regional body for Central France within the French Ministry of the Environment.
Located in Orléans, DIREN Centre has a specific role in managing water resources in the Loire Basin, operates the flood warning service for the "Loire Moyenne" area, and provides expertise and tools to other bodies involved in river and flood plain management.



Untried technique

As part of its flood warning service DIREN needs accurate hydraulic models and inundation maps. Precise information of the river and its borders are crucial in developing these tools and the technology adopted by DIREN for this purpose was Airborne Laser Scanning. Although largely untried in France, its ability to simultaneously deliver ground (bare earth) and elevation data proved to be the appropriate tool for the job. Armed with this information, the flood models could work on complete flood plain, soil and vegetation data and offer much better predictions of cause and effect.
Expert help was furnished by Netherlands-based TerraImaging – a company with broad experience in Lidar acquisition and river modelling, while a French company, FIT, was sub-contracted to undertake terrestrial survey work and create orthophotos.

Scope

The project covers an area of some 1870 km^2 extending from Nevers to Nantes (see map this page) and is divided into seven sub-areas. The first two sectors covering 680 km^2 (Nevers-Belleville and Belleville-Saint Laurant les Eaux), were flown in less than a week in April 2002 under favourable weather and low water conditions. The remaining areas are scheduled to be

flown imminently. To obtain precise information, DIREN needed raw data classified by ground and non-ground, buildings, vegetation and water. A number of products were to be derived from the laserscanning, i.e:

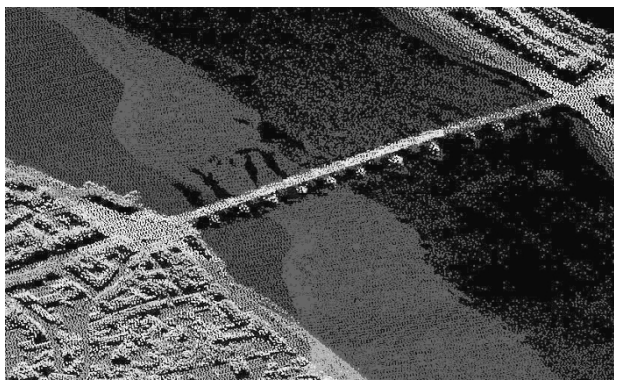
- Raw points (Semis de points brut)
- Digital Surface Model (MNE)
- Digital Terrain Model (MNT)
- Water points (semis de point eau)
- Building points (semis de point "bâti")
- High vegetation points (semis de point "végétation haute")
- Digital Terrain Model in grid format (MNT type grid)
- Ortho Imagery (rectified using Laser elevation data)
- Intensity data

Data acquisition

Data were acquired by an ALTM 3033, one of the latest laserscanning systems from Optech, which measures 33.000 points per second. Raw measurements include the first and last reflection of the laser pulse (first pulse and last pulse) as well as their intensity.
Although the system can be flown at altitudes up to 3000 m, a ceiling of 900 m was chosen for two reasons. the cloud base is frequently low (down to 1000 m), and flying at low altitude improves accuracy and improves the prospect of finishing the job on time.
Finally the flight parameters result in strips with a relatively small width, this is an advantage when modelling relative steep objects like dykes, as the "shading" effect is minimised.
For this project an twin-engined Piper PA-31-350 Chieftain was char-tered from French aerial survey company Sphair. This fully-equipped air-craft is capable of survey sessions of up to six hours.

Data properties and interpretation

The specified minimum point density was one point per four square meters, including areas covered with vegetation. This supported the subsequent creation of an elevation model with xy accuracy better than 50 cm and z accuracy better than 15 cm.
Interpreting the data can be divided into two paths: conventional and novel. The conventional path consisted of classifying ground and non-ground data, based on first and last pulse laser measurements. This was accomplished with the aid of TerraSan, a software package that partly automates the process. Finally, quality control was undertaken to check the completeness and consistency of the classification. Control software and visual checking was employed for this purpose.
The novel path was to carry the classification a step further to cover buildings and vegetation – a move traditionally made difficult for lack of (multi-spectral) image data, the low resolution of those data, and the shortage of software. Using the intensity information from the reflected laser signal



Laserscan Terrain model of a stretch of the Loire

met the first two requirements while the third was accommodated by new software tools from TerraImaging with which to prepare and pre-classify the data and from which to obtain adapted normalised surface models that improve and simplify analysis.
An approach that made use of object-oriented software from eCognition also showed promising results in differentiating between different themes. A Digital Surface Model and a Digital Terrain Model are the final results of the classification, the former containing all information on bare surfaces without bodies of water and the latter containing the DTM plus data relating to buildings, bridges, dykes and vegetation. All thematic data sets were separately delivered to DIREN.

Results and Outlook

With the first phase of the project completed, it is clear that DIREN made the right decision to use laserscanning. The remaining project areas will be mapped shortly, as soon as the water level of the river reduces.
It is equally evident that advanced classification and laserscanning can supply both accurate elevation data for river models and information on vegetation, water, buildings and even terrain roughness.
Given the growing number of floods in recent times, it is expected that the use of airborne laserscanning will further expand to furnish water managers with basic geo-information products that help lessen risk. As the French say: Les crues sont inéluctables, c'est une certitude. On peut simplement en réduire les conséquences.

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For more information on laserscanning please log on to: www.terraimaging.nl/homeF.html