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From WW1 to World Files: collaborative work in archaeology through the use of Internet technologies

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KEY-WORDS: WW1, trenches, Unexploded Ordnance, craters, Web-GIS, collaborative platform

INTRODUCTION

The example of two big projects in France will be used to show the use of a collaborative platform (Web-GIS) for the display, dissemination and interpretation of the data. The first example is a 220-hectare project in Northern France for the laying of a high-voltage power cable. The second project, carried out near Lens, aimed at characterizing soil heterogeneity for civil engineering before the construction of a development zone (ZAC), but also at identifying, before the mechanical stripping took place, any obstacles deriving from archaeology, pollution or World War One-related activities. We will show that for both projects located at the forefront of the WW1 front line, war-related remnants play a major role in soil spatial and physical heterogeneities. Beside the massive use of high resolution geophysical technologies, a major advance was the use of web-GIS technologies for the analysis and display of a huge amount of data (geophysical maps, aerial photos, historical battlefield maps). In addition, the platform not only made possible the display of non-geographic data (reports, videos, hyper-links), but also made possible interactions between the different partners by giving the possibility to interact on the maps.

FIELD APPROACH

RTE project

The aim of the RTE (main company delivering electricity in France) project is to lay a high-voltage power cable in Picardy. A series of high spatial resolution geophysical surveys was undertaken over the entire surface of the project (strip of 100 m by 22 km= 220 ha). This project is unique in that it has used a systemic approach, required for understanding complex projects. The different threats associated with different problems were not studied separately, but as a whole, thanks to a set of different geophysical maps. A similar project in terms of size was carried out in Italy, but only for an archaeological purpose (Campana, Dabas 2011). All geophysical methods were towed by All Terrain Vehicles (ATV), enabling high-speed data acquisition together with sub-metric spatial resolutions (ARP® electrical method, AMP magnetic and EMP electromagnetic) and centimeter position accuracy (RTK GPS). This innovative approach enables the assessment of different risks linked to different stakeholders: Unexploded Ordnance (UXO), geological risk (cavities, decompaction zones, etc.), archaeological risk. The data volume to handle consists of approximately 160 million points corresponding to the three

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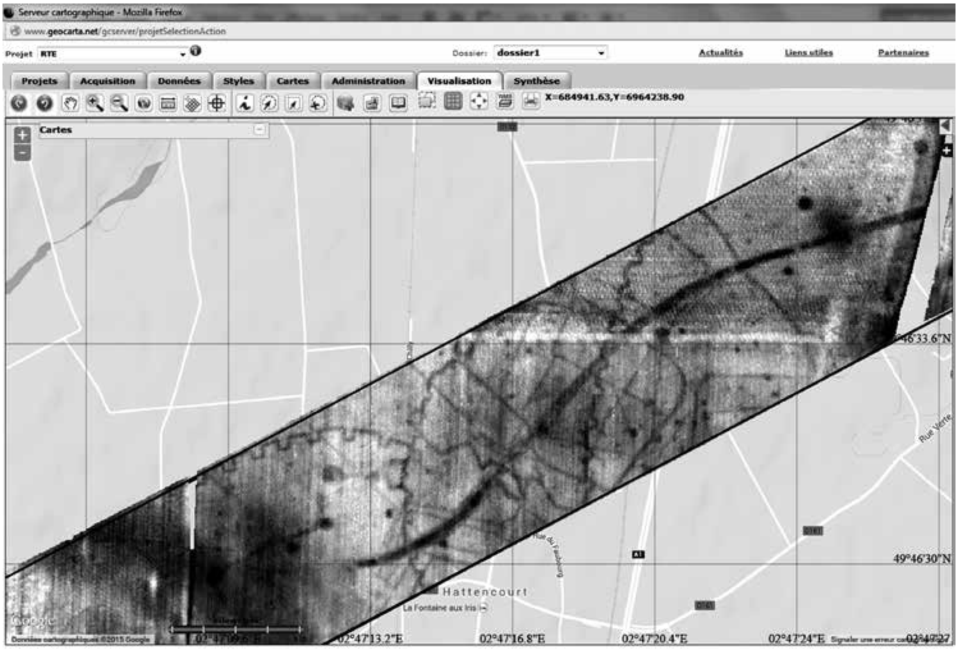

Fig. 1. RTE project: overlay of Google street maps and ARP® apparent resistivity in GCserver

data sets (resistivity at three depths for magnetometry and EMI at six depths). The output of the project was the definition of the best trajectory (50 cm wide, 22 km long) for laying the power line within the 100 m swath, taking into consideration all the threats discovered by the geophysical measurements and of course the engineering constraints for such a project.

Sallaumines project

Sallaumines is a smaller project (18 ha) but the methodology and the goal are identical to the RTE project. The only difference is that the site is situated within a town. The output of the project was to define the best location for different kinds of boring for the following geotechnical missions: lithology, permeability, piezometers and also knowing in advance diverse threats related to possible WW1-related voids, unexploded ordnance (UXO) and potential archaeological remains.

BACK OFFICE APPROACH

Both projects were possible thanks to the use of two types of GIS: i) a real-time data acquisition GIS (GCOffice) developed by Geocarta since 2001, ii) a collaborative web-GIS (GCserver) developed also by Geocarta since 2010. The first software is able to monitor all the data acquisition steps regardless of the geophysical method. Positional data are acquired through the output of a RTK GPS system. This system includes navigation software to guide the operators in the field, following a pre-defined sampling strategy. Quality is also checked in real time together with all

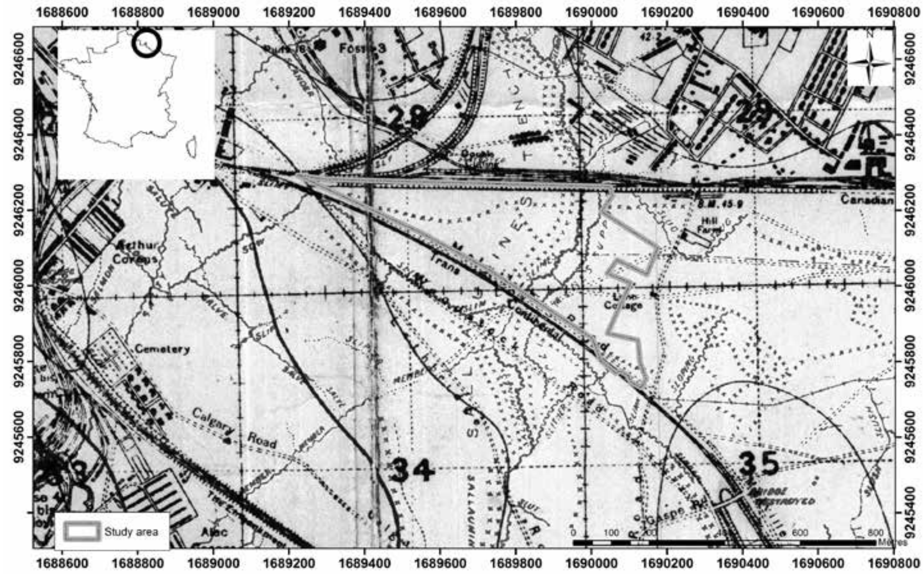

Fig. 2. Sallaumines project: trench maps from December 1917 (white lines) and the extent of the project (black line)

geophysical parameters. The same software is also used after the completion of the survey for the different processing steps in the office.

This software is also used in the field in order to test map quality as well as show the first results to the archaeologists. The procedure turned out to be very laborious for complex projects where several actors are involved. In the RTE project, for example, more than fifty actors were involved and at Sallaumines, more than five types of engineers were interacting with the town municipality. For this reason, it is no longer possible to show individually the results on a screen or through paper maps. Also, the documentation produced by us and the different actors evolves at a rapid pace. Finally, most of the actors do not have the software or skills to visualize data or have the ability to 'play' or even interact with it.

This is why we have developed a web-GIS solution (GCServer) for sharing all documentation and maps through the web with secure access that may be configured as a function of the end user's profile. This platform is also a collaborative platform, because it is possible for every actor to download or upload data, but also to interpret or insert comments directly on the maps which can then be shared with the whole community. The advantage of using a web-based application is that you do not have to install specific software on your computer; all you need is a simple web-browser … and an Internet connection.

Both projects are situated near the WW1 frontline. An analysis of the first geophysical results clearly indicated that most of the anomalies were related to war remains (Fig. 1). Trenches, the most obvious structures, were perfectly delimitated by resistivity, as were shells and mine craters.

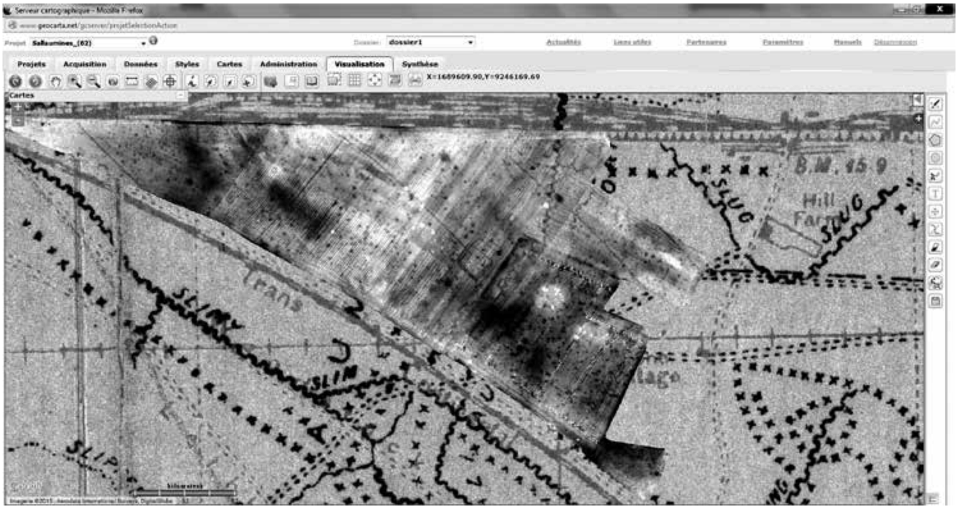

Fig. 3. Sallaumines project: overlay with GCserver of trench maps and apparent resistivity

Archaeological remains of greater antiquity were also discovered. The scope of the paper is not to compare the information brought by each method, but to state that the resistivity maps gave the most detailed information, whereas magnetics and EM maps were usable, but nearly saturated by all the metal artifacts. GPR (Ground Penetrating Radar) could be very successful as well (Saey *et al.* 2015), but its use would not have been economically feasible on such a scale and it would have been hindered by the presence of clay soil.

It became clear that WW1 trench maps were needed to corroborate our results with the written records (or *vice-versa*). Different war maps can easily be found on the Internet and rights to use them can be acquired. Many trench maps of the Western Front, for the period from mid-1915 until the end of the Great War, are available and with a scale, for the most precise of them, perfectly suited for our projects (1:10,000). The most useful of the posted map and aerial images were those from December 1917 (Fig. 2). These maps were subsequently georeferenced and superposed on geophysical maps (Fig. 3). The overlay of the historical maps fits perfectly well with the anomalies found. Interactions between the partners of the project were possible thanks to the online drawing tools and the ability to add text or videos over the maps.

CONCLUSIONS

Both projects have emphasized the benefits of using both GIS in the field and web-based GIS in the office for the management of big land development or archaeological projects. Beside the massive use of high resolution geophysical technologies in the field, the use of web-GIS technologies for the analysis and display of a huge amount of data (geophysical maps, aerial photos, historical battlefield maps) proved to be successful in terms of communication between the different actors, and precision of the follow-up of both projects.

A geophysical survey at Schlumberger's Val Richer residence: between archaeology and the history of science

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KEY-WORDS: Schlumberger, Val Richer abbey, resistivity survey, history of science

The Val Richer (Calvados, France) property, which became the family domain of Conrad Schlumberger, is recognised as being the place of origin of applied geophysics. During the summer of 1912, Conrad Schlumberger tested for the first time a new method designed to map out the electrical resistivity of the subsurface. These encouraging tests led the Schlumberger brothers to develop this type of prospection and to create first an engineering office in 1920 and then the Société de Prospection Electrique in 1926, the Compagnie Générale de Géophysique (CGG) in 1931, the Schlumberger Well Surveying Corporation in 1934, and Schlumberger Limited in 1956, which has become the largest multinational company in the oil service industry (Robin 2003).

A hand-drawn blueprint made by Conrad Schlumberger, which is well known in the geophysics community, describes this experiment (Fig. 1). It shows the electric field distribution together with a hand-written comment describing the difficulties encountered and the solutions retained.

Nearly 100 years after this founding experiment, a research project was initiated at the same place where Conrad Schlumberger's measurements were carried out, with its main objective being to discover the remains of the Val Richer abbey. The Schlumberger family residence is indeed built at the same location as this abbey, right in the heart of Normandy. As a consequence of the destruction resulting from the French Revolution, there are currently no remaining relics.

In 2014, the implementation of a geophysical study made it possible to unite two inseparable stories from Val Richer. By applying the principles developed by the Schlumberger brothers, it was possible to find the location of the abbey's religious buildings, which are now totally destroyed (Fig. 2). The interpretation of the geophysical survey, in the light of archival sources and current knowledge of the

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