LiDAR, Aerial and satellite remote sensing on Vignale

The project

Uncovered habitation remains and the foundations of an Etruscan bridge, excavated since 1960, raised the question of what possibly was to be found on the other side of the crossing of Fosso Pietrisco – an area called Vignale with similar geographic characteristics as the main acropolis of San Giovenale. Could it be another Etruscan village and what about the road – where did it lead?

The Vignale Archaeological Project is working with different survey methods in the ancient areas of San Giovenale in Etruria, Italy. These methods intend to be used as a basis for better understanding of the historical processes that have shaped and influenced the region over a period of 2,500 years. As a natural part of the Swedish research tradition on landscape, our focus has been based on the embroidery of the knowledge already gained around the main site. This is also an important part of our aim of the project - the integration of previously unpublished archaeological data with new methods and findings. Using these new technologies in aerial surveys, in addition to land surveys, ancient features could be further expanded. This means that we not only gained a new overview of the central area, but also more information about the site’s periphery.

This material thus involves conventional aerial photography in addition to various remote sensing techniques such as infrared, thermal photography. The latter technique is a relatively new method of investigation to be used from a low-flying ultra-light aircraft, an asset that our project used during the fieldwork – flown by our own team and conveniently used as a daily tool. An important aspect of this type of field survey is to supplement and develop the already gained knowledge without adding the costs of new extensive excavation ventures.

A hidden landscape comes to life

Various remote sensing techniques were used in order to complement each other. These were however based on several seasons of previously made land surveys made by the team in the area of interest.

Conventional digital photography from the plane was used in order to easier detect ancient installations from the air. Satellite imagery at very high and medium resolution (QuickBird and Astar images, respectively) allowed us to analyze the landscape and to identify potential sites of archaeological interest, by exploiting the synoptic view and the multispectral resolution of such data. The satellite data are also the georeferenced maps for localizing and studying, by means of methods of spatial analysis, archaeological findings, sites and anomalies identified by using the rich aerial and satellite data set.

Near infrared (NIR) photos were also taken parallel to these photos to further enhance variations in the chlorophyll of the green areas covering the site. In this way we could detect shallow underlying structures. The latter was not as effective in itself, but helped as an intermediate tool when identifying structures on photographs with another technique – that of the thermo camera. The results based on these remote sensing techniques were further clarified by performing a second series of ground inspections to verify the provided data. The latter included dating of pottery recovered on the sites and more detailed visual inspections.

The current and last step of our approach involved a LiDAR-survey, provided by Full-waveform scanner, which has been carried out in order to overcome the limits of optical imagery, such as over all, the dense vegetation which covers a large area of the Vignale plateau. Moreover, the very high spatial resolution of DTMs derived from LiDAR survey allowed us to observe and analyze microweak, thus discriminating those micrometrical to geomorphological factors from those of possible cultural interest.

Archaeological results combining conventional, NIR, thermo photography and LiDAR scanning

The recent five years of studying the Vignale plateau and its surroundings, has greatly broaden our knowledge of the area beyond the bridge. Today, ample evidence suggests that we are dealing with a sister acropolis adjacent the already studied main site of San Giovenale. Not only do we see the presence of a settlement around the middle of the first millennium BC, but also a continuation into the Roman period, indicating scatteredhabitation remains among intensively used locates of cultivation. This is further supported by the development of infrastructure, such as ramps, roads, walls and necropolises.

Thermo photography in combination to the LDAR-survey can show the relations between the infrastructure and the areas of habitation. A rough outline of these entities can for example be seen in fig. 2, where the vegetation on the northern slopes of Vignale covered a direct link between the two sites of habitation in San Giovenale. The letter a marks an intricate passage of roads and ramps that directly connects the Etruscan bridge to the plateau of Vignale. The road is best detected through the use of LDAR when, on the contrary, thermal images have been vital to detect remains on the actual plateau. The road connects to the plateau through a ramp just inside a feature that resembles a larger wall crossing the plateau. On the western side of this protective installation, two major areas of habitation can be discerned – area b and c. Ground inspections in area c show evidence of large amounts of pottery and scattered remains of tufa blocks – originally constituting building materials. The thermal images helps us completing the evidence of habitation through a vast amount of sheds, distributed over the entire western point of the plateau. The remains suggest an area of habitation through at least three centuries starting from the sixth century BC.

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