Roman military settlements in the Northwest of the Iberian Peninsula.
The contribution of historical and modern aerial photography, satellite imagery and airborne LiDAR.

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The origins of a discipline
The relationship between Roman military archaeological and aerial photography is not new in the interpretative context of the Roman Peninsula. In the early 20th century, R. Métilas and J. García Alcaide published a photographic flight over Numantia (González Reguero 2007: 239). Some of the camps of the famous epic siege could then be identified. The military are involved in the aerial surveying of several archaeological sites in the following years, including the republican camp of Caesares el Viejo (Almagro 1938-1957).

After World War II the Spanish government commissioned to the USAF two stereoscopic aerial photography missions over the country (1956-7). The second one, named “Vuelo General de España Serie B” (USAF AST 54-18906), was repeatedly employed by archaeologists and it allowed the discovering of new camps as those of Castellar de Tírig (Llamazares 1965) and Villadorada (Medina Ramírez 1966).

During the decades of 1990 and 2000 aerial photography also played an important role in the revival of the Roman military archaeology in Spain. The planning of flights sensitive to the archaeological methodologies allowed the discovery of new camps as well as the detailed study of some others that had previously revealed (Olmo 1995; García Meriño 1996; Perdices 2011). The popularization of aerial and satellite photography, geographic Information systems (GIS) or airborne LiDAR opens now a new phase in which low-cost specific methodologies start to multiply (Menéndez, González et al. 2013). However, its application in Iberian Roman military archaeology is still at a very early stage.


Towards a new low-cost methodology
In areas that are usually densely forested, the identification of archaeological features is still very problematic (Roomes 2009). The introduction of airborne LiDAR has helped to overcome this problem because of its unique capability to penetrate forest canopies, making it possible to document the underlying topographic surface and identify any cultural remains (see Gupta and Crowley 2015).

The identification of archaeological features using LiDAR-derived DTMs is very dependent on visualization techniques that can enhance our perception of anthropogenic features. Different methods have been proposed, from simple thresholding to more complex classifications like View Factor (Richards et al. 2002), Local Relief Models (Hess 2010). These visualization techniques have been compared (Rechnitz et al. 2007; Coates et al. 2012; Stilie et al. 2012) and the results confirm that no single visualization method outperforms the others in all types of terrain. Therefore, a combination of these techniques is the only way to obtain the maximum volume of information on potential archaeological structures.

Among the more effective are the trend removal procedures (Rechnitz 2006, Stilie et al. 2012) based in the theoretical assumption that when a smoothed surface is compared to its original, local small-scale topographic features are extruded from large-scale landscape forms.

Other case study sites

In Spain there is an almost complete LiDAR coverage, which means that we have a large database of historical aerial photography to work with. We can make a truthful detection of Roman camps, using the same methodology as the aerial photography, although in a lower resolution.

Some camps detected after reviewing USAF 1956-7 historical aerial photography: Cornado (1), Monte da Moutola (2) and Monte da Culla (3)

The use of PNOA aerial photography
Since 2004, the Plan Nacional de Ondulaciones Aéreas (PNOA) aims to obtain Digital aerial orthophotos of the entire Spanish territory with a resolution of 25 or 50 cm and with an annual temporal resolution adapted to each autonomous region (http://esgeometria.com/). While these data are freely available in Spain, in Portugal a comprehensive coverage of digital orthophotos with 50 cm resolution was recently made available by the Portuguese Geographic Institute (http://www.ipge.pt) through web mapping services.

The open source Jtsk DTM has allowed us to develop a systematic survey method, especially effective in the mountainous regions of Asturias and León, where dense vegetation canopies. Sometimes the ancient remains are not visible and can be remotely detected. Other times the traces can be traced due to the differential accumulation of materials. After locating these potential sites we planned our archaeological field survey.

This way we discovered many camps mostly in the past: Moyapán, Pozo de Frailes, El Mouru, Valbona. A Granda das Xarras, A Roda, A Pedra D’Orta, Chao Carrubera, Pico de Onteniente, Sierra de Canastra. A Pico Xyons (González, Menéndez et al. 2008, 2011; Menéndez, Blanco et al. 2011).

A CASE STUDY: IDENTIFICATION, CHARACTERIZATION AND ASSESSMENT OF A RAZED ARCHAEOLOGICAL SITE AT CAMPOS (PORTUGAL)

1. Documentation:
While studying the XVIIth century fortification system in the Spanish-Portuguese frontier, references to the existence of fortified sites were detected in Campos (Blanco-Rotea 2015: 478-485), in the southern bank of the river Minho.

2. Toponymic analysis:
Two interesting micro-place names where detected reviewing old topographic military maps: and .

3. Extensive and intensive field survey:
Although we surveyed the area, no archaeological trace could be detected. The construction of a industrial park in the 1980’s has completely transformed the whole place.

4. Photointerpretation of historical aerial photos:
This situation led to the acquisition of historical aerial photographic data from the Portuguese Geographic Institute (1946) and the Portuguese Army (1956-7). The photointerpretation of these data from the 1940 and 1950 decades allowed the detection of a square structure with a southern appendix which was very similar to some modern watchtowers and fortlets previously documented in the Minho valley. However, it was surrounded by a bigger enclosure, quadrangular in shape and with no parallels in modern times.

5. Morphological analysis:
A closer study of the enclosure revealed that it was composed of two different alignments, being white-coloured the inner perimeter and darker the external one. The accumulation of moisture was probably showing the existence of an ancient and defensive system. The playing card layout of the structure also resembled a Roman camp, but its northern defences were gone long time before the 1940’s. Perhaps they were destroyed during the construction of the modern age fortlet.

6. Photogrammetric analysis:
Since the archaeological structures are completely razed, the only way to obtain further valuable archaeological information is employing Structure from Motion (SfM) photogrammetric techniques on the historical aerial photos. In this way, we can obtain new cartographic data, like Digital Surface Models (DSM) and orthophotos. From there, we have made new photointerpretation (2D, 3D and stereoscopic) trying to identify the various positive and negative microtopographies of the camp.

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