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Retrieving Geomorphological information from Oblique Landscape Photographs. A robust method based on Geoinformatics

C. Chalkias[1], K. Kalogeropoulos[1], E. Papadias[1]
(1) Harokopio University, Department of Geography, El. Venizelou 70, 17671, Athens, Greece, xalkias@hua.gr

Background

Maps, illustrations and photographs of landscapes have been essential methods to visualize and analyse Earth features and processes (Dykes, 2008). The creation of traditional geomorphological mapping requires intensive fieldwork, qualitative interpretations of remotely sensed imageries (e.g. aerial photographs) and topographic maps, as well as quantitative assessments using detailed orthophotomaps or/ and satellite images (Verstappen, 2011). In most of the cases, oblique landscape photographs are used only for the general interpretation of the area under investigation.

Objectives

In this study, we present a new method for the generation of geomorphological information from various landscape oblique photographs with the use of an open freely available tool, the WSL monoplotting tool. In order to test this method we used historical photographs as well as recent oblique photographs from unmanned aerial vehicles (UAVs – Drones). Another aim of this paper is to evaluate the limitations, the prerequisites and the assumptions of the proposed method.

Methods

1. The use of historical landscape photographs and the WSL monoplotting tool.

Landscape is been under continuous changing by natural but also human powers through time. Although historical photographs contain valuable information about these changes, in most cases extraction of accurate spatial data is either very difficult and demanding, or not possible at all. Monoplotting tool, developed by WSL (Bozzini et al. 2012), offers a solution aiming to produce georeferenced vector data directly from pictures which then can be integrated in traditional GIS procedures and systems. For testing the tool we utilized a picture taken in 1937 from the temple of Poseidon at Cape Sounio, Greece. The tool requires also a georeferenced map and a Digital Elevation Model (DEM). With the use of Monoplotting tool we digitized various landforms from the Historical photograph as well as elements recognized in modern images. The results have rather acceptable accuracies (~ 5m - 50m). Inaccuracies were produced due to: a) difference between the spatial resolution of the basemap and the DEM, b) inaccuracies in the evaluation of control points and c) due to inaccuracies in the identification of real location of the shooting point of the historical photograph which is probably the main challenge of the method.

Figure 1. Digitizing of a landform from historical photograph within the environment of Monoplotting tool.

2. The use of oblique images from of modern UAVs - drones to create detailed geomorphological datasets.

The recent years the unmanned aerial vehicles (UAVs-Drones) have overwhelmed the market and have become widely available, by being cheaper. They permit an operative observing of large areas in a very short time compared to conventional techniques (Jordan, 2015; Madjid et al., 2018). Thus, drones have become an important tool for scientists and researchers around the world and they are used for many purposes besides military like archaeology, farming-precision agriculture, natural disasters management, structural safety inspections and geographic mapping. An aspect of this last use of drone is the Geomorphological / Landform mapping. They can provide a broad, aerial perspective of a

variety of earth features (Tziavou et al., 2017). The proposed methodology consists of the following steps: a) Construction of a trigonometric network, the points of which will act as ground control points (GCPs), in the photographs that the low-cost drone will take. The points should cover as far as possible the entire study area, and will be accurately measured with the proper GPS equipment b) The next step is the use of drone in order to take various oblique photographs of the study area, c) selection of the proper images in order to include the landforms under investigation d) Import of these images into the WSL Monoplotting Tool, e) linkage between oblique images and background rectified image with the use of the GCP and g) digitizing of the landforms and export to a GIS platform.

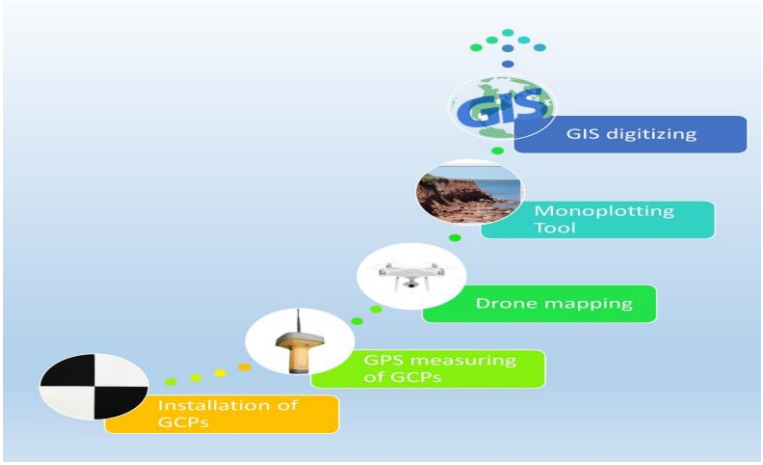

Figure 2. Digitizing landforms from UAV captured oblique images.

Results - Conclusions

The results are promising and the methods can be used to retrieve geomorphological information from historical photographs and thus to illustrate geomorphological changes as well as to create relatively low-cost recent geospatial datasets with the used of UAVs. The potential uses of the method are numerous including in general gemorphological mapping and evaluation of past landforms in order to analyze and visualize Earth surface features and processes. Given the increasing interest in using historical photography, and with the recent high use of Geoinformatics in Earth Sciences, the proposed method can be used to accurately classify landscape photographs in order to evaluate earth procedures and changes.

The article concludes that the proposed approach has a huge potential, although some limitations exist relating to the accuracy of the results as well as the pre-required information about the photographs of the landscape.

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