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APPLICATION OF STRUCTURE FROM MOTION PHOTOGRAMMETRY TO MULTI-TEMPORAL GEOMORPHOLOGICAL ANALYSES: CASE STUDIES FROM ITALY AND SPAIN

Abstract: DEL SOLDATO M., RIQUELME A., TOMÁS R., DE VITA P. & MORETTI S., *Application of Structure from Motion photogrammetry to multi-temporal geomorphological analyses: case studies from Italy and Spain.* (IT ISSN 0391-9838, 2018).

The study of the geomorphological evolution of landscapes is one of the most important tasks needed for assessing the natural and man-made geohazards and risks affecting a territory. In the last two decades, instrumental and computational advances have allowed the development of effective remote sensing methodologies, such as those based on Synthetic Aperture Radar (SAR) Interferometry or change detection techniques (Tomás & Li, 2017). These techniques have enhanced the possibilities of making geomorphic observations and modelling. Specifically, Earth Observations (EO) techniques using airborne or satellite platforms have increased the ability to map and monitor geomorphological processes. In such a framework, historical landscape data, such as those available from aerial photographs taken since the early 1940s, are key instruments for studying the geomorphological evolution of a territory.

In this work, the application of the *Structure from Motion* (SfM) technique to analyse the geomorphological evolution of sample areas by historical aerial photos is tested, examined, and discussed. Towards this aim, multi-temporal analysis by means of three-dimensional (3D) land models of four test areas reconstructed through the application of the SfM technique using available aerial images was performed. Although it is well known that SfM requires a considerable number of digital images and a significant overlap between them, the challenge of this approach was to reconstruct 3D land models using a reduced set of analogical aerial photos for satisfactory results. The resulting 3D reconstructions succeeded in recognizing and studying the geomorphological evolution of the test areas, represented by: a) a region in southern Italy affected by landslides; b) a territory in central Italy affected by badland-type intense erosional phenomena; c) a sector in northwestern Italy with open-pit mining activity; and d) a coastal zone affected by changes in its coastline. Despite some disadvantages that arose during the application of the SfM technique, the proposed methodology has been shown to be useful for geomorphological analysis. This can be considered an alternative to the use of analogical and digital stereoscopic techniques to recognize geomorphological shapes and analyse Earth surface evolution and the effects of different anthropic activities.

KEY WORDS: Structure from Motion technique, aerial images, geomorphology, DTM reconstruction, historical data.

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INTRODUCTION

In the last decades, climate change has increased the risk of extreme weather events that control geological disasters, such as landslides, erosional processes and floods, which cause related geomorphological and environmental changes. The monitoring and back-analysis of a territory play a key role in avoiding recurrences and mitigating disastrous effects, such as economic and social losses and casualties due to the occurrence of geohazards (Raspini & *alii*, 2018; Del Soldato & *alii*, 2018a; Solari & *alii*, 2018), which can be fostered by climate change (Crozier, 2010). During 2004-2010, more than 2,600 landslides were recorded worldwide, with over 32,000 casualties (Petley, 2012). During the same period, more than 4,700 fatal flood events were recorded, causing tens of thousands of victims (Guha-Sapir & *alii*, 2015). These statistics highlight the need for monitoring, mitigating, and avoiding such disastrous effects on the population and their associated economic and social impacts.

The existing approaches for the geomorphological