Geophysical Research Abstracts
Vol. 18, EGU2016-766, 2016
EGU General Assembly 2016

Topographic changes detection through Structure-from-Motion in agricultural lands affected by erosion processes

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Throughout the world, soil erosion by water is a serious problem, especially in semi-arid and semi-humid areas (Cerdà et al., 2009; Cerdan et al., 2010; García-Ruiz, 2010). Although soil erosion by water consists of physical processes that vary significantly in severity and frequency according to when and where they occur, they are also strongly influenced by anthropic factors such as land-use changes on large scales and unsustainable farming practices (Boardman et al., 1990; Cerdà 1994; Montgomery, 2007). Tillage operations, combined with weather conditions, are recognized to primarily influence soil erosion rates. If, on one hand, tillage operations cause uniform changes based on the tool used, on the other, weather conditions, such as rainfalls, produce more random changes, less easily traceable (Snapir et al., 2014). Within this context, remote-sensing technologies can facilitate the detection and quantification of these topographic changes. In particular, a real opportunity and challenge is offered by the low-cost and flexible photogrammetric technique, called 'Structure-from-Motion' (SfM), combined with the use of smartphones (Micheletti et al., 2014; Prosdocimi et al., 2015). This represents a significant advance compared with more expensive technologies and applications (e.g. Terrestrial Laser Scanner - TLS) (Tarolli, 2014). This work wants to test the Structure from Motion to obtain high-resolution topography for the detection of topographic changes in agricultural lands affected by erosion processes. Two case studies were selected: i) a tilled plot characterized by bare soil and affected by rill erosion located in the hilly countryside of Marche region (central Italy), and ii) a Mediterranean vineyard located within the province of Valencia (south eastern Spain) where rainfall simulation experiments were carried out. Extensive photosets were obtained by using one standalone reflex digital camera and one smartphone built-in digital camera. Digital Terrain Models (DTMs) derived from the smartphone reveled to be comparable to DTMs derived from the reflex camera. The results underlined the effectiveness of SfM for detecting topographic changes in agricultural lands affected by erosion processes, even when pictures are taken from a smartphone. This methodology could be very useful for farmers and/or technician for post-event analyses of erosion processes to implement technical measures to mitigate the problem of soil erosion by water.

Acknowledgements
The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 603498 (RECARE project)

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