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Estimation of potential surface ponding in agriculture using UAV-SfM

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Among the environmental problems that could affect agriculture, one of the most critical is ponding. Ponding is the water storage on the surfaces in concavities or small depressions, due to soil saturation. It can seriously affect crops and the management of agricultural landscapes. It is caused by prolonged rainfall events, soil type, or by wrong mechanization practices. Indeed, the increased pressure of heavy machinery can cause topsoil compaction or a subsoil hard pan directly under the ploughing depth, inducing run-off, soil loss and waterlogging. In order to better understand this issue, and therefore provide suitable solutions to reduce ponding risk, it is necessary to represent in details the surface morphology. In the last decade, a range of new remote-sensing techniques have led to a dramatic increase in terrain information, providing new opportunities for a better understanding of Earth surface processes based on geomorphic signatures. Among these, the Unmanned Aerial Vehicles (UAVs) combined with the Structure-from-Motion (SfM) photogrammetry technique represent undoubtedly the most interesting advance in the Earth observation and understanding of Earth surface processes. UAV-acquired imagery may provide a low-cost, rapid, and flexible alternative to airborne LiDAR for geomorphological mapping.

In this work UAV-SfM data are used to obtain high-resolution Digital Terrain Model (DTM) useful to analyze and evaluate the risks of water ponding at farm level in a mid-size agricultural Mediterranean catchment in northern Italy. Intensive photogrammetric surveys were carried out using a UAV while a GNSS in RTK (Real-Time Kinematic) mode was used to collect Ground Control Points (GCPs) and Check Points (CPs), fundamental for georeferencing process and SfM error analysis. The potential water depth was calculated using the Relative Elevation Attribute (REA) algorithm, a methodology successfully used in other contexts (Tarolli et al. 2019). The detection of more pronounced concavities and convexities allowed an estimation and mapping of the potential ponding conditions, thus providing a useful indication for a better environmental management in agriculture.

References

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