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Estimation of potential surface ponding in agriculture using UAV-SfM

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Why

Among the environmental problems that could affect agriculture, one of the most critical is ponding. It 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 analyze in details the surface morphology.

What

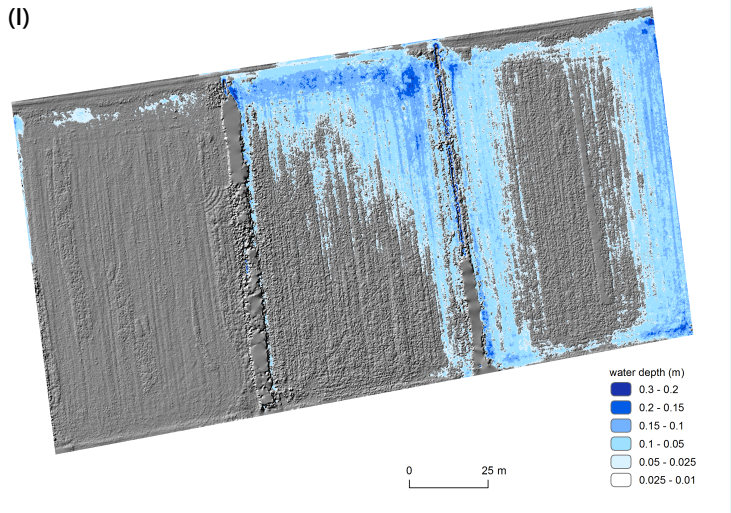
UAV-SfM data are used to obtain high-resolution Digital Terrain Model (DTM) useful to analyze and evaluate the risks of water ponding at farm level. Intensive photogrammetric surveys were carried out using a UAV while a GNSS in RTK (Real-Time Kinematic) mode was used to collect Ground Control Points (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.

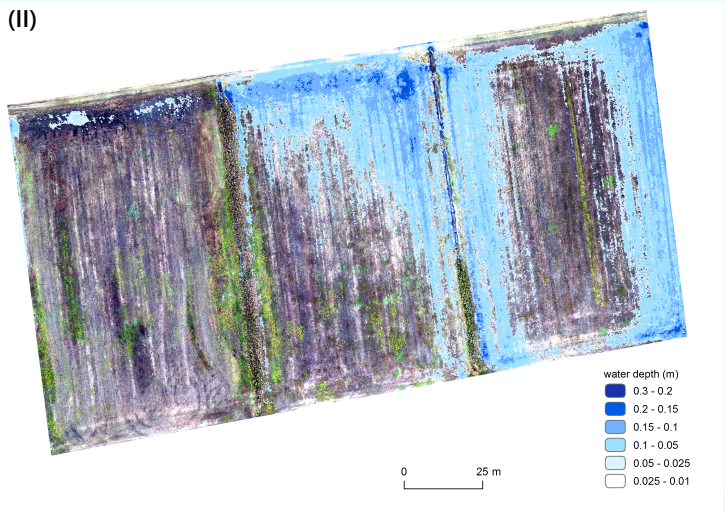
Where

Rovigo
Veneto region (Italy)

45°06'09.5"N | 11°52'12.1"E

Method

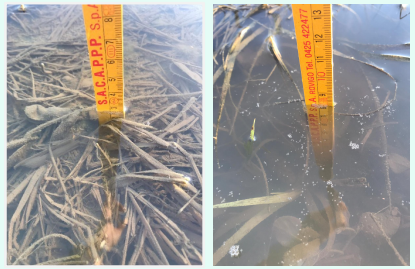




Water depth estimated using the REA algorithm (Tarolli et al. 2019) applied on a 10 cm cell DTM generated from UAV-SfM. The maps show the water depth on the shaded relief DTM **(I)** and the orthophoto **(II)**

Ponding from the sky indicated by arrows

Ponding from the field



Water depth measurements

Measurement of GCPs and CPs through a GNSS

REFERENCE: Tarolli, P, Cavalli, M., Masin, R., (2019). High-resolution morphologic characterization of conservation agriculture. Catena, 172, 846–856, doi:10.1016/j.catena.2018.08.026