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Effect of multi-level and multi-scale spectral data source on vineyard state assessment via spectral vegetation indices

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Currently, the main goal of agriculture is to promote the resilience of agricultural systems in a sustainable way through the improvement of use efficiency of farm resources, increasing crop yield and quality, under climate change conditions. Climate change is one of the major challenges for high incomes crops, as the vineyards for high-quality wines, since it is expected to drastically modify plant growth, with possible negative effects especially in arid and semi-arid regions of Europe. In this context, the reduction of negative environmental impacts of intensive agriculture (e.g. soil degradation), can be realized by means of high spatial and temporal resolution of field crop monitoring, aiming to manage the local spatial variability.

The monitoring of spatial behaviour of plants during the growing season represents an opportunity to improve the plant management, the farmer incomes and to preserve the environmental health, but it represents an additional cost for the farmer.

The UAS-based imagery might provide detailed and accurate information across visible and near infrared spectral regions to support monitoring (crucial for precision agriculture) with limitation in bands and then on spectral vegetation indices (Vis) provided. VIs are a well-known and widely used method for crop state estimation. The ability to monitor crop state by such indices is an important tool for agricultural management. While differences in imagery and point-based spectroscopy are obvious, their impact on crop state estimation by VIs is not well-studied. The aim of this study was to assess the performance level of the selected VIs calculated from reconstructed high-resolution satellite (Sentinel-2A) multispectral imagery (13 bands across 400-2500nm with spatial resolution of <2m) through Convolutional Neural Network (CNN) approach (Brook et al., 2020), UAS-based multispectral (5 bands across 450-800nm spectral region with spatial resolution of 5cm) imagery and point-based field spectroscopy (collecting 600 wavelength across 400-1000nm spectral region with a surface footprint of 1-2cm) in application to crop state estimation.

The test site is a portion of vineyard placed in southern Italy cultivated on Greco cultivar, in which the soil-plant and atmosphere system has been monitored during the 2020 vintage also through

ecophysiological analyses. The data analysis will follow the methodology presented in a recently published paper (Polinova et al., 2018).

The study will connect the method and scale of spectral data collection with in vivo plant monitoring and prove that it has a significant impact on the vegetation state estimation results. It should be noted that each spectral data source has its advantages and drawbacks. The plant parameter of interest should determine not only the VIs type suitable for analysis but also the method of data collection.

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