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Airborne multispectral remote sensing data to estimate several oenological parameters in vineyard production. A case study of application of remote sensing data to precision viticulture in central Italy.

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It is widely recognized that environmental differences within the vineyard, with respect to soils, microclimate, and topography, can influence grape characteristics and crop yields. Besides, the central Italy landscape is characterized by a high level of fragmentation and heterogeneity It requires stringent Remote sensing technical features in terms of spectral, geometric and temporal resolution to aimed at supporting applications for precision viticulture. In response to the needs of the Italian grape and wine industry for an evaluation of precision viticulture technologies, the DISAFRI (University of Tuscia) and the Agricultural Research Council – Oenological research unit (ENC-CRA) jointly carried out an experimental study during the year 2008. The study was carried out on 2 areas located in the town of Velletri, near Rome; for each area, two varieties (red and white grape) were studied: Nero d'Avola and Sauvignon blanc in first area , Merlot and Sauvignon blanc in second.
Remote sensing data were acquired in different periods using a low cost multisensor Airborne remote sensing platform developed by DISAFRI (ASPIS-2 Advanced Spectroscopic Imager System).
ASPIS-2, an evolution of the ASPIS sensor (Papale et al 2008, Sensors), is a multispectral sensor based on 4 CCD and 3 interferential filters per CCD. The filters are user selectable during the flight and in this way Aspis is able to acquire data in 12 bands in the visible and near infrared regions with a bandwidth of 10 or 20 nm. To the purposes of this study 7 spectral band were acquired and 15 vegetation indices calculated.
During the ripeness period several vegetative and oenochemical parameters were monitored. Anova test shown that several oenochemical variables, such as sugars, total acidity, polyphenols and anthocyanins differ according to the variety taken into consideration. In order to evaluate the time autocorrelation of several oenological parameters value, a simple linear regression between oenological variables monitored during the season and have been carried out. This statistical analysis shown a significant time autocorrelation of series in particular for sugar content and total acidity.
In order to estimate the empirical relationships between the oenochemical parameters acquired during the ripeness period and the remote sensing variables, a simple regression analysis has been carried out. The remotely sensed data were significantly correlated with the following oenochemical parameters: Leaf Surface Exposed (SFE) (correlation coefficient R2 $\sim$ 0.8), wood pruning (R2 $\sim$ 0.8), reducing sugars (R2 $\sim$ 0.6 and Root Mean Square Error $\sim$ 5g/l), acidity holder (R2 $\sim$ 0.6 and RMSE $\sim$ 0.5g/l), polyphenols content (R2 $\sim$ 0.9) and Anthocyanins (R2 $\sim$ 0.89). Vegetation index that showed better relationship with oenological variables was MCARI_1 (1.2*[2.5*(R800-R670)-1.3*(R800- R550)]. This study demonstrates that the low cost airborne multispectral remote sensing systems like ASPIS can support the precision viticulture. The empirical relationships between oenological parameters and remote sensing data can be applied to obtain thematic and predictive maps. These maps will be simple and effective tools to guide producers in differentiating harvest and winemaking and to improve the quality of wine production.