



Monitoring meteorological spatial variability in viticulture using a low-cost Wireless Sensor Network

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In a long-term perspective, the current global agricultural scenario will be characterized by critical issues in terms of water resource management and environmental protection. The concept of sustainable agriculture would become crucial at reducing waste, optimizing the use of pesticides and fertilizers to crops' real needs. This can be achieved through a minimum-scale monitoring of the crop physiologic status and the environmental parameters that characterize the microclimate. Viticulture is often subject to high variability within the same vineyard, thus becoming important to monitor this heterogeneity to allow a site-specific management and maximize the sustainability and quality of production. Meteorological variability expressed both at vineyard scale (mesoclimate) and at single plant level (microclimate) plays an important role during the grape ripening process.

The aim of this work was to compare temperature, humidity and solar radiation measurements at different spatial scales. The measurements were assessed for two seasons (2011, 2012) in two vineyards of the Veneto region (North-East Italy), planted with Pinot gris and Cabernet Sauvignon using a specially designed and developed Wireless Sensor Network (WSN).

The WSN consists of various levels: the Master/Gateway level coordinates the WSN and performs data aggregation; the Farm/Server level takes care of storing data on a server, data processing and graphic rendering. Nodes level is based on a network of peripheral nodes consisting of a sensor board equipped with sensors and wireless module. The system was able to monitor the agrometeorological parameters in the vineyard: solar radiation, air temperature and air humidity.

Different sources of spatial variation were studied, from meso-scale to micro-scale. A widespread investigation was conducted, building a factorial design able to evidence the role played by any factor influencing the physical environment in the vineyard, such as the surrounding climate effect, canopy management and relative position inside the vineyard.

The results highlighted that the impact of agrometeorological parameters variability is predominantly determined by differences between within-field and external-field. These results may provide support for the composition of crop production and disease model simulations where data are usually taken from an agrometeorological station not representative of actual field conditions. Finally, the WSN performances, in terms of monitoring and reliability of the system, have been evaluated considering: its handiness, cost-effective, non-invasive dimensions and low power.