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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Micrometeorological models applied to growth and production of Grapevine

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The main objective of this longterm study is to develop a tool for assessing in advance the must quality, in order to provide the operators of the viticultural sectors with information to support the decisions about crop management and wine-making, and to improve the organization and management of the vineyard. In addition, a preliminary evaluation of the quality of the must can allow the farmers to evaluate the processes of maturation and the local government to support decisions based on the peculiar meteorology of the year.
The activities have been performed through experimental measurements and numerical simulations. The formers have been conducted during the vegetative vineyard cycle over 3 years (2008-2010) in three sites (Fubine, Cocconato and Castiglione Falletto) located in the same region (Piemonte) but characterized by different pedoclimatic and orographic conditions. In particular, the soil texture in the three sites is different: at Castiglione Falletto and Fubine the soil was loam, while at Cocconato silty clay. Two red grape cultivars, typical of Piemonte, have been selected: Nebbiolo and Barbera. The exposure and the geomorphological characteristics of the three vineyards is different, with slopes ranging from 7 to 17 degrees (with different orientations) and vineyard rows disposed along or against the slope.
The meteorological data provided by the neighboring weather stations (belonging to the regional meteorological network) have been integrated with some measurements conducted “in situ”: air temperature in the vineyards, photosynthetically active radiation and the wind speed measured by three sonic anemometers, a Krypton lamp for allowing to monitor the heat flux between vegetation, soil and atmosphere, and some sensors able to monitor the soil temperature and water content. Other measurements regularly performed have described the phenology of the vineyards and have examined the percentages of the leaves eventually hit by some diseases.
The numerical part has consisted in the implementation of some numerical model simulations carried out with the UTOPIA (Francone et al., 2010), in order to mimic the surface layer of interaction between atmosphere, vegetation and soil (Cassardo et al. 1995). In particular, among all the model outputs, the variables representing the hydrological balance components have been selected, in order to analyze in detail the role of evapotranspiration.
The analysis of the meteorological data has shown that the three sites show strong similarities in the general behavior of the data (for instance, one of the biggest differences is the anticipation of the spring in the 2009, which was warmer and drier than the 2008) but also some differences between the three sites in the studied period. Cocconato site appears to be the driest of the three sites, and this is evident from the simulations of sensible and latent heat fluxes. The energy and hydrological budget components show some minor but significant differences in the three sites, especially durint the rainless months (as August 2009).
In terms of plant pathology, the results appear correlated with the surface layer data. A model able to represent the physiological behavior of the plants affected by specific diseases, such as the downy mildew, has been adapted and used. The result have shown the presence of a correlation between the disease spread and the micrometeorological conditions. Finally, the productivity of the plants has been assessed with the help of a multiregression empirical stepwise model able to link the behavior of the alcohol percentage with the meteorological data.