Waves and Wine: Advanced approaches for characterizing and exploiting micro-terroir (Invited)

Susan S. Hubbard[1], Katherine R Grote[3], Phil Freese[4], John E Peterson[1], Yoram Rubin[2]

1. Earth Sciences Division, Lawrence Berkeley Natl Lab, Berkeley, CA, United States.
2. Civil and Environmental Engineering, UC Berkeley, Berkeley, CA, United States.
3. Geology, Univ Wisconsin, Eau Claire, WI, United States.
4. Vilafonte Winery, Stellenbosch, South Africa.

Development of viticultural strategies that are focused on promoting uniformly high quality wine grapes requires an understanding of the properties that influence wine grape development. Our objective is to explore the spatial and temporal variability of above and below ground factors that can influence grape variability at the block scale (or micro-terroir) using a combination of conventional point measurements and non-invasive geophysical approaches, and to use that information to guide the development of new vineyards or the management of existing vineyards. Climate clearly plays a dominant role in determining the success of certain viticultural regions or vintages. However, wine grapes of the same variety, which are grown in the same microclimate region and cultivated and made into wine using identical practices, can lead to remarkably different wines when the grapes are grown on different types of soils. The soil texture controls soil water availability, which greatly influences grapevine physiological status, vegetative and reproductive growth, and ultimately red wine grape quality.

One aspect of our research has focused on developing surface geophysical methods, particularly ground penetrating radar (GPR), to characterize soil texture variability and to monitor vineyard water content. Through testing the approaches in three California wineries, we find that analysis of GPR groundwave and reflected waves enable mapping of shallow soil water content in high resolution, with acceptable accuracy, and in a non-invasive manner, and that use of multiple GPR methods and frequencies offer the potential to characterize the soil in 3-D space. We use the dense data to explore spatial and temporal correlations in soil water content, soil texture, and vegetation vigor and the associated implications for vineyard management.

We also describe a new zonal-based vineyard development strategy that honors the natural variability of the site, or the micro-terrior. The approach uses a combination of advanced characterization techniques (including airborne imagery, microclimate, and surface geophysical data) with statistical approaches to identify vineyard zones that have fairly uniform soil, vegetation, and micrometeorological parameters. Obtained information is used in simple water balance models that can be used to design block-specific irrigation parameters. This effort has illustrated how straightforward numerical techniques and commercially available characterization approaches can be used to optimize block layout and to guide precision irrigation strategies, leading to optimized and uniform vegetation and

winegrape characteristics within vineyard blocks.

Recognition and incorporation of information of small scale variabilities into vineyard development and management practices could lead to winegrapes that better reflect the microterroir of the area. Advanced approaches, such as those described here, are expected to become increasingly important as available land and water resources continue to decrease, as spatially extensive datasets become less costly to collect and interpret, and as the public demand for high quality wine produced in environmentally friendly manner continues to increase.