

## Winemaking and radar

### A penetrating result

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#### Using radar to measure soil moisture will produce better wine

**FINDING** the right soil-moisture levels for temperamental vines is one of the trickiest challenges which winemakers face. Too little water and the crop withers. Too much and the vines develop vigorous leaves at the expense of their fruit. And in some of the world's great winemaking regions, such as California, geological variations mean that the ability of soil to retain or lose moisture can change within distances of a few metres.

Monitoring the soil's water content is not only difficult, but tedious. Current techniques involve drilling sample holes at numerous locations within a vineyard. This is costly and time-consuming. It also carries the risk of producing an inaccurate picture of the overall distribution of moisture, as the spots chosen for sampling may be considerably damper or drier than the soil just a few metres away. But now, a group of researchers at the University of California, Berkeley, led by Susan Hubbard, are lending a high-tech hand to California's grape-growers. They have adapted ground-penetrating radar (GPR) to map moisture levels in vineyards.

GPR is not a new technology. Over the past three decades, it has been developed to locate buried objects such as electrical cables, tanks and pipes. It has also been employed to study archaeological sites without digging them up, and so destroying them. As its name suggests, it works by broadcasting a radar wave into the ground and interpreting (as any radar does) what is reflected back. In GPR's traditional applications, the wave bounces off buried surfaces, revealing a picture of the subterranean world. But a variant of the technique, which involves measuring changes in the speed of the reflected wave, can reveal information about moisture. That is because radar signals move faster in dry soils than in wet ones.

Dr Hubbard and her colleagues have been trying their idea out at the Robert Mondavi and Dehlinger Wineries in northern California, by pushing a small GPR unit in a wheelbarrow between the rows of grapes. Their research has shown that it is, indeed, possible to build a high-resolution "moisture map" of a vineyard, revealing with great precision the areas that need more, or less, irrigation.

According to Dr Hubbard, GPR could allow farmers to manage their vineyards more effectively by identifying areas with uniform blocks of soil and matching them to particular grape varieties. Cabernet sauvignon, for instance, is best planted in drier soils, while chardonnay does best in damper ones.

Another of the researchers, Yoram Rubin, reckons that using GPR this way could also help to combat agricultural pollution by reducing the run-off that results from excessive irrigation. It could even make harvest-time less of a chore, as grapes produced with the same amount of moisture are likely to mature for harvesting at the same time. Using GPR, it seems, water will be converted into wine more efficiently than at any time in history.