Terroir and climate: the role of homoclime matching

Terroir et climate : le rôle de l'adéquation homoclinale

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Introduction

Climate is an important component or determinant of terroir, especially at the regional level. One can define three levels of terroir. These are the macro– or regional scale, which applies over tens of kilometres of the landscape. The second level is the meso- scale, which applies over kilometres or hundreds of meters, at the individual vineyard scale. The third level of terroir is at the micro- level, and it applies to individual vines, or parts of them. This is measured over a scale of meters to centimetres.
Over two thousand years of experience of observing terroir, and more recently by scientific studies, man has shown that the principal determinant of terroir at the regional scale is that of climate. At the meso-scale, the principal determinants of terroir are topographical features such as slope or aspect. At the micro level, where differences may be seen from vine to vine, the influences are primarily those of the soil.
One can therefore identify appropriate methods of study for terroir at these three levels. For the macro scale terroir the appropriate analysis is that of climate, in particular temperature and rainfall, and typically using long term average data. For the second two levels of terroir, that being meso- and micro-, modern research approaches use GIS (Geographic Information Systems). The use of GIS typically involves imagery showing soil or vine attributes.

Climate by variety interactions

Many centuries of experience have demonstrated that wine grape production is dominated by very strong variety by temperature interactions. Many studies have shown that temperature is the principal component of the climate that dictates wine style and quality. Temperature is also important in determining the phenology of the grape vines.
There are many examples of this strong variety by climate interactions in the Old World, including for example Pinot noir in Burgundy, Chardonnay in Chablis and Cabernet Sauvignon in Bordeaux. Emerging wine regions in the New World have also developed such reputations, and perhaps one of the most dramatic has been that of Sauvignon in the Marlborough region of New Zealand.
It is this temperature by variety interaction which is at the heart of the terroir on the macro scale.

Measurement of temperature

In our studies we have found the mean January (July) temperature (MJT) to be the most useful index for temperature description. Within any one region and for a known degree of continentality, MJT is highly correlated with heat degree days (HDD) as commonly used. The mean January or July temperature is in many grape growing regions equivalent to the mean temperature of the warmest month. We have used this index in our calculations to compare regions, and also to predict global warming effects.

Homoclime matching

A database has been collected of over 12,000 climate stations internationally, of which some 650 are viticultural regions. For the viticultural regions, we have a list of varieties grown, from various sources, and knowledge of where some varieties produce distinguished wines. The data base always includes temperature and rainfall, and often humidity, evaporation, sunshine, and wind speed.
For many countries climate data is now available in « gridded » format. That is, values are estimated by interpolation in between climate measuring stations, taking into account elevation, aspect, distance from

oceans and latitude and longitude. For Australia, temperature and rainfall data is available on a 2 km by 2 km grid matrix.
Homoclime matching is done by selecting a region of interest, then searching globally for other regions with similar temperature and rainfall. For example, preliminary studies have shown that the island state Tasmania of Australia is climatically very similar to New Zealand. Figure 1 shows an outline of Tasmania overlaid on New Zealand, with scale and latitude matched. Since both places are islands washed by the Great Southern Ocean, one might expect the climate to be similar.
At present the Tasmanian wine industry is very small, around 1,000 ha, much less than that of New Zealand's 20,000 ha. New Zealand is a very successful cool climate wine exporting nation. Might Tasmania emulate some of this success.?
Therefore one might ask if there are regions in Tasmania with the same climate as those which have achieved international reputations in New Zealand, for example Martinborough and Marlborough, both of which have achieved distinction for Sauvignon and Pinot Noir.
These climate data sources are interrogated for similarity to the region for which the homoclime is sought. Normally this is achieved by using 8 month maximum and minimum temperature curves, and also rainfall distribution for 12 months. This allows us to identify new vineyard regions with climate similarity to nominated regions.
Close temperature homoclimes of Martinborough NZ have been found in Tasmania at White Hills, near Launceston, and for Marlborough NZ near Bicheno, Tasmania. The advantage of homoclime searching is that land costs are much lower in new than established regions. In Tasmania, suitable land can be bought for less than € 5,900 per ha, whereas in regions like Marlborough the cost is around € 90,000 per ha. Quite a difference when one considers that the climate may be the same.
Incidence of downy and powdery mildew, and Botrytis, and frost can also be predicted using climate data, so that these risks may be calculated for any new region.

The impact of global warming

Homoclime analysis is particularly useful if the climate stays constant but there is increasing evidence that for the last three decades or so temperatures have been increasing around the world, and already impacts have been seen on grape and wine production. This has included changed distribution of pests and diseases in Europe, as well as earlier harvests and higher maturity grapes.
The majority of the world climate scientists are agreed on this, see the results of the International Panel for Climate Change IPCC at www.ipcc.ch. Models of various CO_2 emission scenarios show that all wine regions will be affected, and they will be very different places at the end of this century from what they were at the beginning. Projections are that northern hemisphere countries will be more affected than those in the south, and that Tasmania and New Zealand will be regions least affected, but that is no solace for anyone.
Various atmospheric models (based on various levels of greenhouse gas emission) predict changes in mean temperatures from 1.4 ºC to 5.8 ºC. up until 2100. The average increase of the models presented by IPPC is 1.5 ºC for 2050, and 3.0 ºC by 2100.
Considering Mean July Temperature (MJT), for a number of well known French regions, we can see that there is surprisingly small difference between them. The MJT values are: Avignon in Provence 23.3 ºC, Béziers in Languedoc–Roussillon 23.0 ºC, Vaucluse in Rhone 22.8 ºC, Bordeaux 20.6 ºC, Dijon in Burgundy 19.7 ºC, Nantes in Val de Loire 19.2 ºC, Strasbourg in Alsace 19.2 ºC, and Reims in Champagne 18.9 ºC.
Even if we consider the average projected increase by 2050 of 1.5 ºC, Bordeaux MJT will be 22.1 ºC, like Gard in Languedoc; Dijon will be at 21.2 ºC, warmer than the present Bordeaux and almost at Lyon (21.4 ºC) in Beaujolais, and Champagne will be almost as warm (20.4 ºC) as the present Bordeaux. These effects are not restricted to France, they apply equally around the world. For example, in Australia, the following values of Mean January Temperature (equivalent to July in Northern Hemisphere) apply to some well known wine regions: Loxton in the Riverland 23.0 ºC, Nuriootpa in the Barossa Valley 21.4 ºC, Margaret River 20.4 ºC, Coonawarra 19.6 ºC, Tamar Valley, andTasmania 17.2 ºC.
The impacts on regional terroir will be extreme. As the temperature increases, any one region will not be able to make the same wine style/quality with the varieties which helped make it famous over the last 200 or so years. In other words, « terroir» will change, and with it the image and reputations of wine regions, and be threatened. In most cases new varieties might be introduced, but what of the image. Is it possible that in future the Bordeaux region might loose its reputation for Cabernet Sauvignon, to be replaced one for

Grenache? This is an extreme example, but the 2003 European heat wave of 2003 was an extreme event, and is a warning of how the future might be.

Conclusion

With modern computing facilities, and readily available data, it is simple to seek temperature and rainfall homoclimes of vineyard regions, or macro-scale terroirs. This technique is being used commercially. However, projected changes to global climate may well see commercial viticulture on the move, towards the poles and higher elevations.

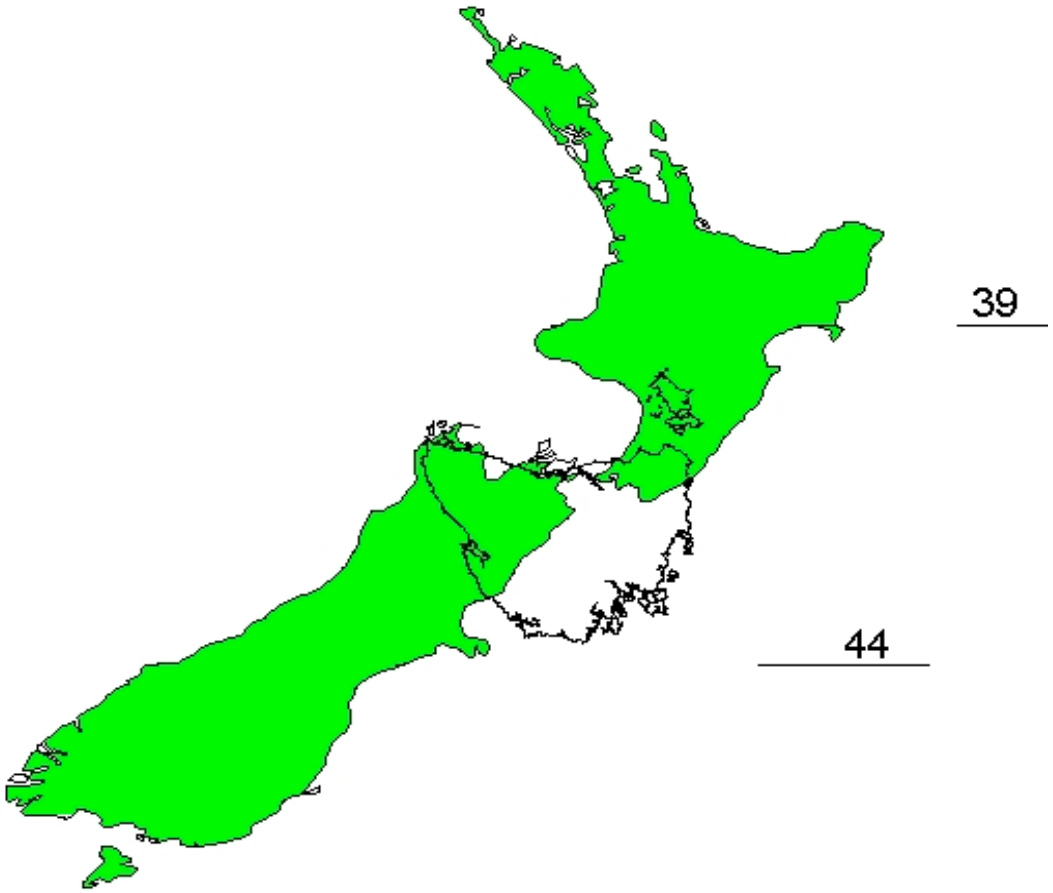

Figure 1 - Tasmania and New Zealand plotted to the same scale and latitude.