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Regional mapping of vine water status based on collaborative observations

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Monitoring vine water status at the regional level is a major issue[1], and yet there are few appropriate tools available on this scale[2]. Collaborative collection of observations is an interesting alternative but depends on data of sufficient quantity and quality being collected[3]. The ApeX-Vigne project demonstrates that this approach is suited to the mapping of vine water status at the regional level.

A simple method to estimate vine water status

ApeX-Vigne is a mobile application that provides a quick diagnosis of the water status of a vineyard plot using the apex method. This method is based on the fact that the vegetative growth of the vine slows down in the presence of water deficit, and then stops completely when the deficit becomes more severe. The level of growth of the apexes (the tips of the shoots) is thus an indicator of the level of water deficit. The apex method consists in characterizing the vegetative growth of a vineyard plot by observing 50 shoots. Each apex is classified into one of three vegetative growth categories: full growth, stunted growth, or arrested growth (Figure 1).



FIGURE 1. Data input screen for the ApeX-Vigne application to collect observations on the vegetative growth of the vine.

The method can then be used to calculate a simple index, iG-Apex, which gives an indication of the vine water status. This method is presented in detail in Pichon *et al.* (2020)[4]. It should be noted that the apex method is suited to the characterization of moderate to severe water deficit, corresponding to underlying leaf water potentials of between -0.2 MPa and -0.8 MPa. When the water deficit exceeds -0.8 MPa, all apexes exhibit arrested growth. Hence, the method cannot distinguish between severe water deficit (favorable to the production of quality wines) and very severe water deficit (which can lead to leaf drop, for example). In the case of non-irrigated vineyards, this method is often used to characterize the date of onset of water deficit and the speed at which it becomes established. For irrigated vineyards, it is mainly used to determine the date of the first irrigation.

Technical architecture for the collaborative collection of observations

The ApeX-Vigne application has been developed by the Institut Français de la Vigne et du Vin and Institut Agro Montpellier. It is available free of charge in French on iOS (https://apps.apple.com/gb/app/apex-vigne/id1612236678) and Android (https://play.google.com/store/apps/details?id=ag.GB.apex). It will be made available in English on the same platforms in 2023. It is used by wine-sector professionals (winegrowers, winemakers, vineyard employees, consultants, etc.) who see it as a tool to facilitate the implementation of the apex method at the plot level. Their motivation for using the app is primarily "self-serving"[5] as it addresses their own need to quickly diagnose a plot. The technical architecture of the ApeX-Vigne project (Figure 2) allows these geolocated observations to be pooled and then centralized in a database. Collaborative maps can then be produced at different spatial scales (appellation, department, region, etc.). It should be noted that these maps are particularly relevant in the case of non-irrigated vines, for which the water deficit is mainly determined by the variability in the water-holding capacity of the soils and not by the quantity of water supplied.

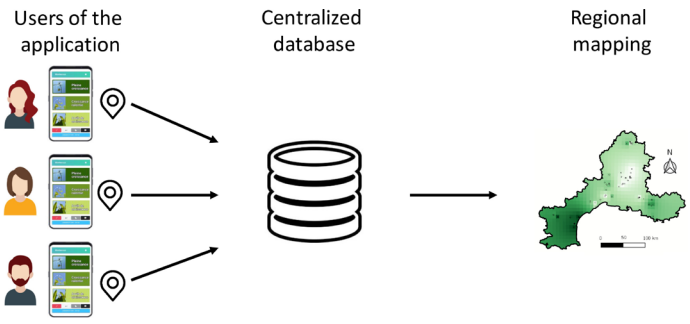


FIGURE 2. Overall diagram of collaborative collection of observations as part of the ApeX-Vigne. project.

The translation of this article into English was offered to you by Moët Hennessy.

Widespread adoption by wine-sector professionals

Since its official launch in 2019, the ApeX-Vigne application has mainly been used in vineyards in the south of France, where monitoring vine water status has the highest stakes. It has also been used in most other French wine regions (Bordeaux, Champagne, Burgundy, Loire Valley, etc.) though with fewer collected observations. In the south of France (Languedoc, Roussillon, Côtes du Rhône, Provence) (Figure 3a), 1,849, 2,072, 1,294 and 3,898 observations were collected in 2019, 2020, 2021 and 2022 respectively. The particularly dry weather conditions of the 2022 vintage certainly explain the large number of observations collected that year. These observations were made in all wine regions in the south of France, with higher density of observations in some areas, e.g. the south of the Rhône valley (Figure 3b).

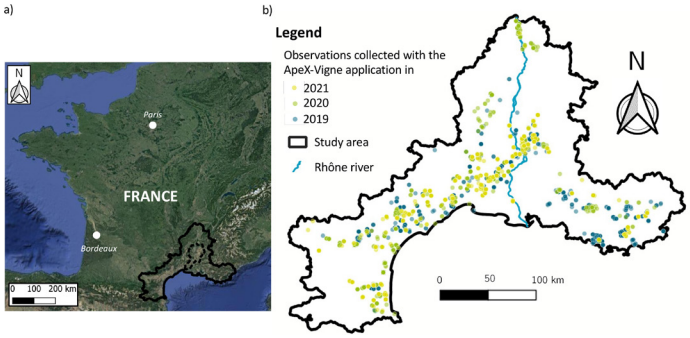


FIGURE 3. Location of observations collected with the ApeX-Vigne application during the 2019 to 2021 seasons in the south of France.

The spatial density of the observations collected was particularly high when regional players (technical institutes, farmers' groups, etc.) were involved. In some cases they promoted the collective dynamic of winegrowers using the ApeX-Vigne application, in other cases they invited their consultants to collect observations as part of their weekly vineyard monitoring. These results seem to show that participation in a collective project is also a motivation to contribute to the ApeX-Vigne project, confirming the self-serving motivation of the participants.

Regional mapping of vine water status

This relatively dense spatial distribution of the collected observations makes it possible to produce an interpolation map of iG-Apex values on a given date at the scale of the wine regions in the south of France. For example, during the week of 13 to 19 July 2020, 250 observations were collected. A study of the iG-Apex values shows that they are not randomly distributed but clearly organized in space. The interpolation map (Figure 4) highlights areas with lower iG-Apex values, corresponding to areas of higher water deficit. For example, also between 13 and 19 July, the central area shows iG-Apex values that are mostly below 0.4 while the south-west area has higher iG-Apex values, in some cases greater than 0.6. The map therefore shows a water deficit gradient between these areas.

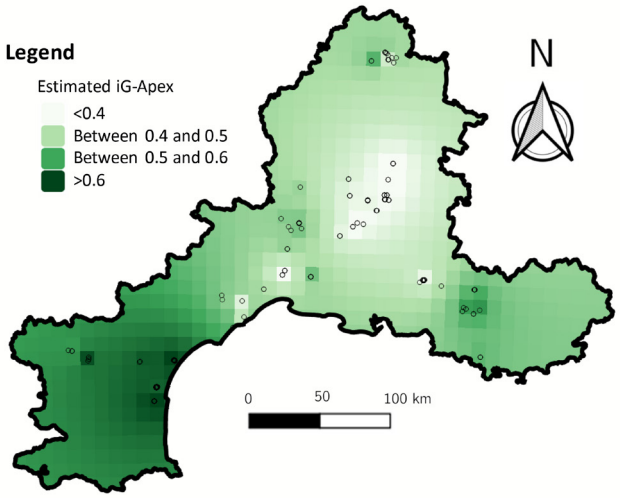


FIGURE 4. Example of an interpolation map of regional iG-Apex observations collected between 13 and 19 July 2020.

These results show that the quantity and quality of the collaboratively collected data are sufficient to produce an iG-Apex map and describe the vine water status at the scale of a large wine region. Mapping iG-Apex for a smaller region (e.g. an appellation) with higher spatial resolution can also be considered in some cases, but this requires a high spatial density of observations. This high spatial density can only be achieved if regional players (e.g. appellation unions) take action to encourage participation by winegrowers, winemakers and consultants. ■

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