Use of multispectral satellite for monitoring vine water status in mediterranean areas

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Introduction

A model of Stem Water Potential (SWP) estimation based on multispectral satellites Sentinel 2 datas has been developped after a 3 years campain on cv Syrah N in the Minervois area (Laroche Pinel E., 2021). A large scale monitoring was organized in different locations and on different varieties in the mediterranean areas in 2021 to confirm the accuracy of the model.

Material and method

26 vineyards, with 10 varieties (Cabernet sauvignon N, Chardonnay B, Cinsault N, Grenache N, Roussanne B, Sauvignon B, Syrah N, Tibouren N, Vermentino B and Viognier B) in 8 different locations in different areas (Aude, Hérault, Pyrénées-Orientales and Var) were monitored from mid june to end of August, all vineyards without coverplants.
Field SWP measures were realized with the Scholander pressure chamber, and simultaneously, SWP estimated maps were realized using Sentinel 2 datas.
Comparisons between field SWP measures and estimated SWP were done with couple of datas with then than 5 days difference.

A data base with 68 couples of measures was thus created comparing field measures SWPm (the average of 4 to 6 SWP on different leaves) and estimated (SWPe : the average estimated SWP of the field) from Week 25 (S25) to Week 35 (S35).

Main results red varieties

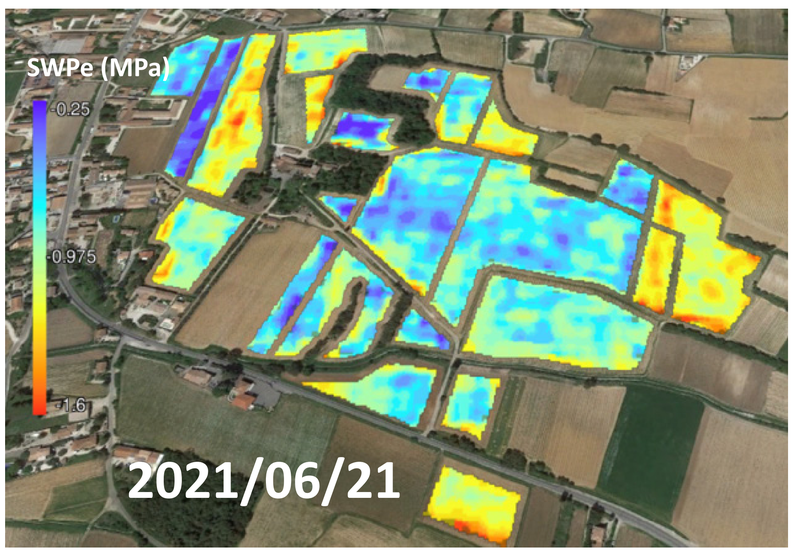
On red varieties (n=53) , correlations between SWPe and SWPm were at the level expected by the model. 62,3 % of the measures were estimated with less than 20% differences.
The highest differences between SWPe and SWPm occurred during early measures (S25 and S26) and on very heterogeneous vineyards.

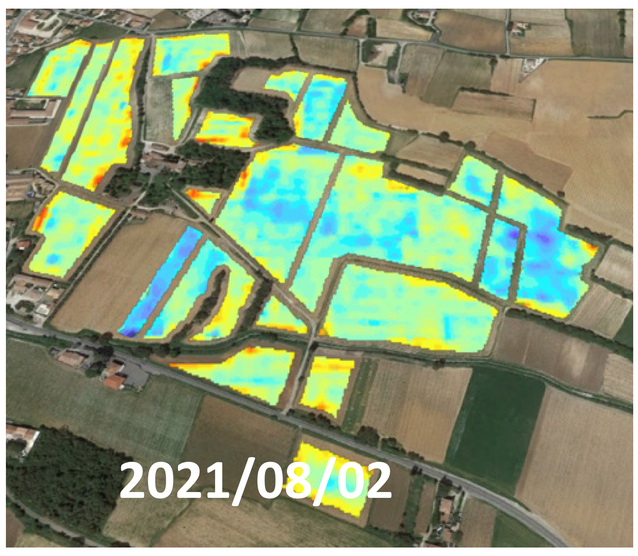
Differences SWPe vs SWPm	Number of measures on red varieties	
<10%	16	30,2%
10 - 20%	17	32,1%
20-30%	7	13,2%
30-40%	6	11,3%
> 40%	7	13,2%
Total	53	100,0%

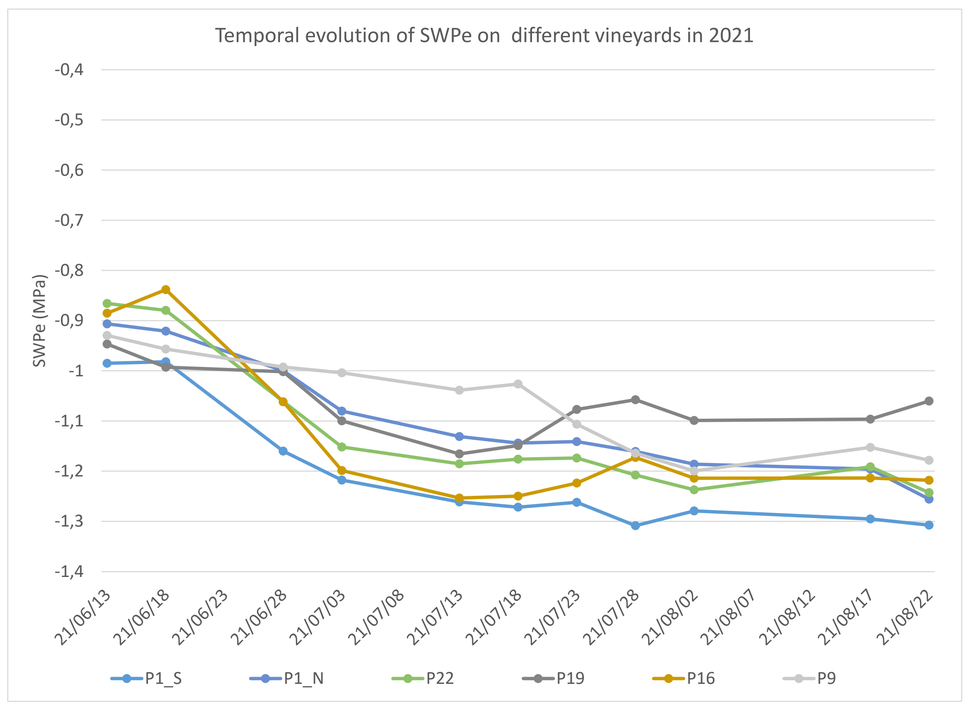
Main results white varieties

On white varieties (n=15) , correlations between SWPe and SWPm were quite low. Only 40 % of the measures were estimated with less than 20% differences with SWm.
High differences between SWPe and SWPm were observed during early measures (S25 and S26) but also on a Viognier B vineyard with no specific heterogeneity.

Differences SWPe vs SWPm	Number of measures on white varieties	
<10%	3	20%
10 - 20%	3	20%
20-30%	3	20%
30-40%		
> 40%	6	40%
Total	15	100%







Discussion

The comparison between SWPm and SWPe compared 5 local measures to the estimated average of SWPe of a vineyard, calculated from each 10 m pixel individual SWPe. In heterogeneous vineyards, this could introduce a bias. In these conditions, the estimation of SWP by Sentinel 2 datas using the model was conform to the model specifications on red varieties, excepted for early measures just after flowering. The model needs to be reinforced at these early dates by more field measures.
On white varieties , the correlations were not so good. Because of the lower number of comparisons (15), this must be confirmed by further comparisons, because most abnormal differences were observed on one Viognier B plot.

Conclusion

On red varieties under mediterranean conditions (large 2-2,5 m rows, bare soils after flowering), the SWPe model applied to Sentinel 2 datas (13 spectral ranges, 10 m resolution) can generate maps with a correct estimation of SWP). The model needs to be reinforced by more field measures during the early stages, just after flowering.
On white varieties, the number of comparisons ws not high enough to lead to a definitive conclusions: the program will be applied again in 2022.

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