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Modelling vine water stress during a critical period and potential yield reduction rate in European wine regions: a retrospective analysis

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Most European vineyards are managed under rainfed conditions, where seasonal water deficit has become increasingly important. The flowering-veraison phenophase represents an important period for vine response to water stress, which is seldomly thoroughly evaluated. Therefore, we aim to quantify the flowering-veraison water stress levels using Crop Water Stress Indicator (CWSI) over 1986–2015 for important European wine regions and to assess the respective potential Yield Lose Rate (YLR). Additionally, we also investigate whether an advanced flowering-veraison phase may help to alleviate the water stress with improved yield. A process-based grapevine model STICS is employed, which has been extensively calibrated for flowering and veraison stages using observed data at 38 locations with 10 different grapevine varieties. Subsequently, the model is being implemented at the regional level, considering site-specific calibration results and gridded climate and soil datasets. The findings suggest wine regions with stronger flowering-veraison CWSI tend to have higher potential YLR. However, contrasting patterns are found between wine regions in France-Germany-Luxembourg and Italy-Portugal-Spain. The former tends to have slight-to-moderate drought conditions (CWSI<0.5) and a negligible-to-moderate YLR (<30%), whereas the latter possesses severe-to-extreme CWSI (>0.5) and substantial YLR (>40%). Wine regions prone to a high drought risk (CWSI>0.75) are also identified, which are concentrated in southern Mediterranean Europe. An advanced flowering-veraison phase may have benefited from cooler temperatures and a higher fraction of spring precipitation in wine regions of Italy-Portugal-Spain, resulting in alleviated CWSI and moderate reductions of YLR. For those of France-Germany-Luxembourg, this can have reduced flowering-veraison precipitation, but prevalent alleviations of YLR are also found, possibly because of shifted phase towards a cooler growing season with reduced evaporative demands. Overall, such a retrospective analysis might provide new insights towards better management of seasonal water deficit for conventionally vulnerable

Mediterranean wine regions, but also relatively cooler and wetter Central European regions. *Acknowledgements: This study was funded by the Clim4Vitis project—"Climate change impact mitigation for European viticulture: knowledge transfer for an integrated approach", funded by the European Union's Horizon 2020 Research and Innovation Programme, under grant agreement no. 810176; it was also supported by FCT—Portuguese Foundation for Science and Technology, under the project UIDB/04033/2020.*