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Predicted changes in precipitation and temperature under different climate change scenarios and their impacts on vine development in NE Spain

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Vines are one of the crops that may suffer more negative impacts under climate change, due not only to changes in temperature but also due to water available. Some of the most direct effects of climate variability on grapevines are the changes in the onset and timing of phenology events and changes in the length of the growing season changes, which may have further effects on grape quality. In addition, changes in water availability may imply significant impacts on grape quality and production. The aim of this research was to project the changes in vine phenology of some grape varieties cultivated under rainfed conditions under different climate change scenarios. The research was focus in a viticulture area of long tradition located in the north east of Spain, which have a Mediterranean climate. Temperature and precipitation changes under two Representative Concentration Pathway (RCP) scenarios –RCP4.5 and RCP8.5- were simulated based on an ensemble of models. The high intensity rainfall recorded in this area makes that a significant amount of water is lost by runoff, making the effective rainfall smaller than the total rainfall, which mainly fall out of the growing cycle. Water losses by runoff were predicted using the WEPP model and changes in evapotranspiration were estimated according to the predicted changes in temperature, wind speed and solar radiation for the same scenarios. Dates of different phenological phases of two varieties (Chardonnay and Cabernet Sauvignon) were evaluated during the period 1996-2012. Predictions for 2030, 2050 and 2070 were made based on the observed phenological dates and the heat accumulation needed to reach each stage and the water available recorded in different periods along the growing cycle. An advance of all phenological dates was predicted, higher for veraison and maturity than for the earlier stages and higher for the red than for the white variety. These changes resulted in a shortening of the periods between phenological dates. The results also showed a decrease of productivity with decreasing water available, particularly between bloom and veraison and between veraison and harvest. Under the RCP4.5 scenario, for 2050, veraison may be advanced about 10 days and 14 days, while for maturity the advance may be up to 21 days, respectively for the white and red variety. For 2070, veraison is projected to be advanced 12 and 14 days, while maturity could be advanced up to 17 and 21 days, respectively for both varieties. Under the RCP8.5 scenario, the advance by 2070 could be up to 28 days for veraison and up to 38 days for maturity. Yield may be reduced in 106 and 75 kg/ha, respectively for the white and red variety, for increasing water deficits of 10 mm during the period between bloom and veraison.