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Inter-annual climate variability and productivity models for grapevines in Portugal

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Grapevines are a major crop in Portugal, constituting an important source of income for local farmers. The Mediterranean type climate of the country strongly influences the growth and development of this crop, and ultimately the yield. Therefore, for several (9) Portuguese regions over 19 years (1986-2004), the inter-annual variability of grapevine productivity and climate data (mostly temperature and precipitation on a monthly basis) was analyzed in order to define mathematical models based on statistically significant correlations between those variables. One particular region (Vila Real, close to Demarcated Valley of Douro) was studied in more detail using the daily data available. For that purpose, a number of derived indices was calculated (e.g., number of days with positive minimum air temperature or maximum temperature above 25ºC, number of days with precipitation higher than 10 mm). Close relationships between temperature, precipitation and relative air humidity were then found to influence productivity. In fact, a high-quality mathematical linear model based on these variables was found for Vila Real. Those analyses also enabled the verification of monthly climatic conditions, which are or not favorable for growth and development of grapevines; results indicate a clear relationship between the vegetative cycle of grapevines and their basic climatic requirements. After validation, this model may be used for predicting future yields in the region and, using data from an atmospheric model, it was also possible to project a future scenario for the productivity in the period (2030-2050), based on an specific emission scenario (A1B). Lastly, in order to isolate the large-scale atmospheric circulation patterns most favorable/unfavorable to wine productivity, years with extremely high (e.g., 1989) and extremely low yields (e.g., 1987) were selected and the corresponding dynamical conditions were analyzed in more detail.