SPACE AND TIME VARIABILITY OF GRAPEVINE PHENOLOGY IN EUROPE

Grapevine *(Vitis vinifera* L.) is cultivated in Europe since five thousand years (Forni, 2012) and during this long period it was exposed to a wide climatic variability with conditions ranging from hot phases (e.g. the Roman optimum) to cold ones (e.g. the Little Ice Age).

This work aims to evaluate the effects of European climate variability and change on grapevine cv Chardonnay phenology along the recent period (1981-2012) which was characterized by two homogeneous thermal phases divided by an abrupt shift occurred at the end of the 80s (Werner et al, 2000, Mariani et al, 2012). This goal was pursued applying the operational phenological model of the Iphen project (Mariani et al., 2013) to daily European thermal fields and analyzing the deriving behavior of grapevine phenology (cv Chardonnay) .

Since 2006 the Iphen Project (http://cma.entecra.it/iphen/index_EN.html) periodically produces and broadcast Italian maps of phenological analysis and forecasts for grapevine and other relevant natural and cultivated plants such as Olive tree, Cypress, and Locust tree. Maps are the result of the match between phenological modeling and observational data gathered by the volunteer network of the Project. The Iphen phenological model is based on the accumulation of thermal resources - Normal Heat Hours (Mariani et al., 2013, Mariani et al., 2012) and the whole set of grapevine phenological stages (vegetative and reproductive) is simulated as the overcoming of specific thresholds of cumulated thermal resources. Phenological stages are expressed following the international BBCH scale (Meier, 2001).

The model, calibrated and validated for the Italian area, is here applied the whole European continent on the base of daily temperature fields, obtained by means of geostatistical techniques from free weather station data gathered and broadcasted by NOAA-GSOD (https://data.noaa.gov/dataset/global-surface-summary-of-the-day-gsod).

A first validation of the simulation at the continental scale is obtained by comparison with the phenological data collected all over Europe during 2012 by the COST Action FA1003 – *Grapenet: East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding*. Eight COST observational sites provided phenological monitoring for Chardonnay in 2012, ranging from Spain to Ukraine, from Cyprus to Czech republic.

With reference to observational data, the model showed a Mean Absolute Error of 2.75 days in the simulation of the day of occurrence of the phenological stage of beginning of flowering (BBCH 61).

Afterwards, the model was run on the whole 1981-2012 period and maps of the day of occurrence of phenological stage BBCH 61 were produced for each year. The model simulation was limited up to 1000 m of elevation, in order to focus on high quality viticulture. Average data for the two sub-periods 1981-1987 and 1988-2012 and the difference between the two, are presented in figure 1. In order to rightly interpret the results it must be taken into account that the simulation for countries of South Mediterranean and Middle East is negatively affected by the scarcity of meteorological data.

The comparison between the phenological behavior of the two sub-periods shows a general advance of recent phenology, more relevant in Koeppen's Cfb climate areas (Oceanic climate, e.g.: France and Germany) and Csa ones (Mediterranean climate, e.g.: Portugal, Spain and Italy). This is

explained by the reinforcement of Westerlies after the 1987 climate shift which determined both the strengthening of anticyclonic conditions over the Mediterranean and an higher degree of Oceanicity ove central-western Europe. The final consequence was the presence of milder temperatures with an advanced phenological development clearly shown by the variational map of figure 1.

Furthermore, it is interesting to highlight the northward shift of the limit of commercial viticulture, represented by the 180-185 doy limit for flowering in the two phenological maps and coherent with results presented by Mariani et al. (2012).

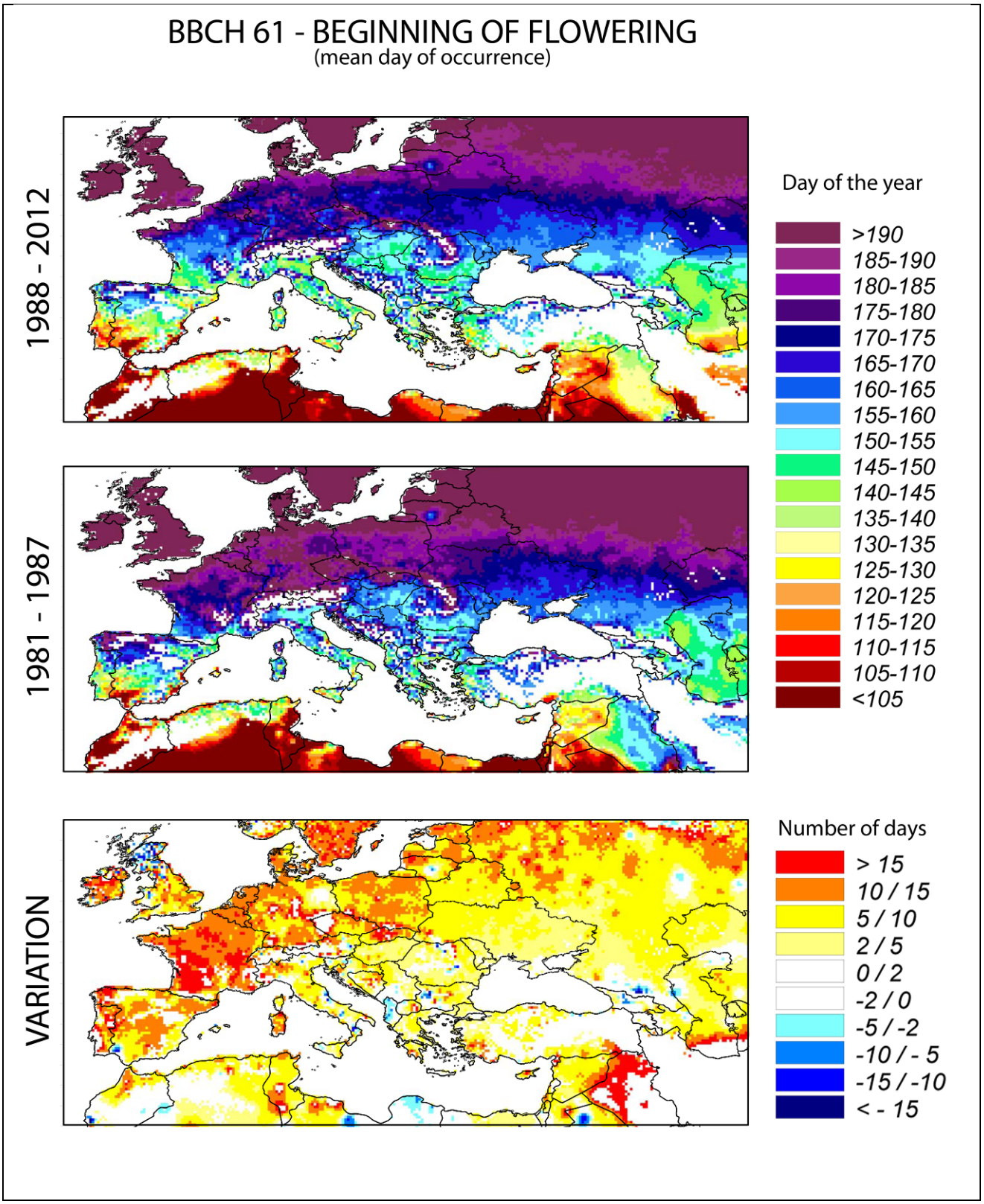

Figure 1 – Mean day of occurrence of beginning of flowering (phenological stage BBCH 61). Maps for period 1988 – 2012and 1981 – 1987 b) are presented. The difference between the two periods, expressed in number of days is also shown. A positive number of days stands for advance of the recent period.

References

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