Spatial-temporal climatic trend analysis in viticulture

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Objectives

Objective of this research is to conduct analysis of climate variables during the last five decades on two study sites and elaborate the simulated future climate model for five decades; indeed, one study site is Valencia wine region - Valencia DO and the other is Brda region in Slovenia. Furthermore, the influence of the Mediterranean sea on the climate will be analysed with its consequences on research areas in local scale. Climate variables taken into account in this research are daily air temperature, daily precipitation and daily sun hours. In addition, the analysis of bio-climatic indexes Huglin and Winkler will be conducted for the same period.
The results of this research will be used to elaborate a climate model for the future period for each site separately. The future climate scenarios will be generated for scenarios rcm 4.5 and rcm 8.5 for the CMIP5 climate model. The results will give us two different climate models for future five decades, one for each study site.

Introduction

Agriculture and viticulture were severely affected by the climate change, particularly during the last decades. Particulary temperature and precipitation parameters were affected. Changes in viticulture, especially in variety and changing position of vineyards, can be noticed worldwide. The location of weather stations are shown on Figures 1 and Figure 2.

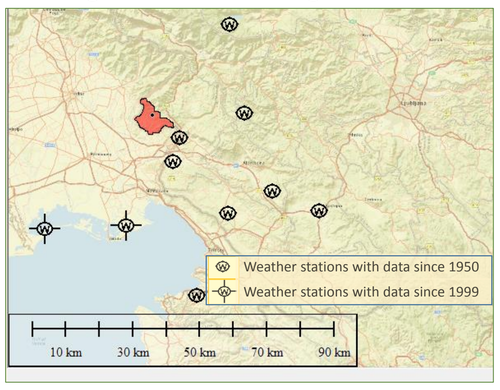

Figure 2: Weather stations in Brda

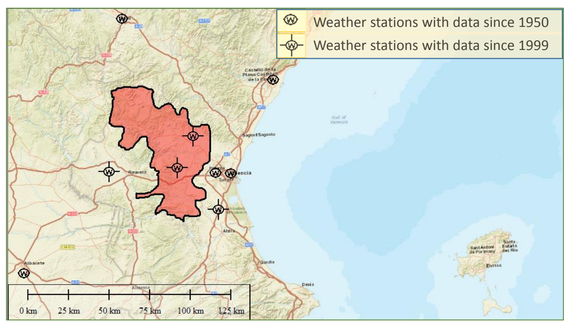

Figure 1: Weather stations in Valencia DO

The consequences of climate change in viticulture areas affect wine quality and yield. The solution is adaptation. Numerous analyses concerning climate change in viticulture on regional scales were already conducted. Nevertheless, only few analyses were made addressing the climate change in local scales. In this project, the spatial-temporal variability analysis of climatic parameters is elaborated in local scale in two viticulture sites.

Study area

Brda is located in Slovenia, next to the Slovenian-Italian border, about 20 kilometres northern from Italian city Trieste with the surface of 72 square kilometres (Figure 3), with the mild-Mediterranean climate. The second study site **Valencia DO** is located on the north from the Valencia city on the eastern Spanish coast.

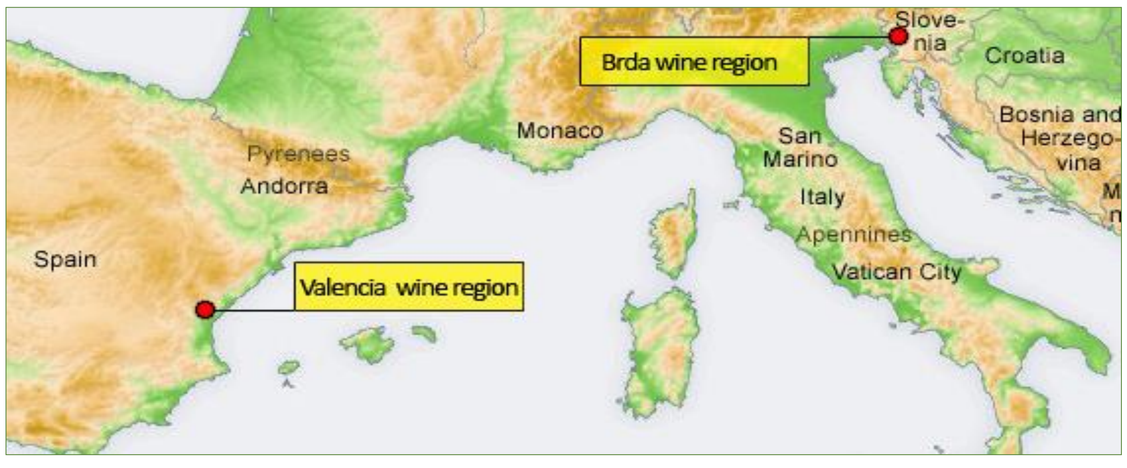

Figure 3: Location of Valencia and Brda study sites

The local climate has mild winters with average high temperature of 14°C and long warm summers with average high temperature of 28°C in July and August.

Materials and methods

Data were obtained from weather stations distributed in and in surroundings of study asites (Figure 4).
Used climate parameters measured on stations: daily air temperature measuring three times per day (max., min. and mean), daily sun hours and daily precipitation.

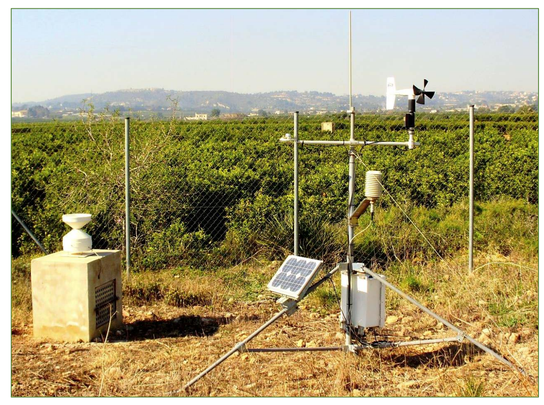

Figure 4: Weather station on viticulture site

To calculate bioclimatic indexes Huglin and Winkler (Figure 5), the annual set of temperature data were used under the condition, there were no more than 7 consecutive days with missing temperature data. In case of more than 7 consecutive days with missing data in one year, the bioclimatic indexes were not used in analysis.

$$HI = \sum_{1\,apr}^{30\,sep} \frac{(Tmean - 10) + (Tmin - 10)}{2} \cdot k$$

Very cold	≤ 1500
Cold	1500-1800
Cool	1800-2100
Warm	2100-2400
Hot	2400-3000
Very hot	>3000

$$WI = \sum_{1\,apr}^{31\,oct} (Tmean - 10°C)$$

Region 1	850-1389
Region 2	1389-1667
Region 3	1671-1950
Region 4	1951-2220
Region 5	>2221

Figure 5: Huglin (HI) and Winkler (WI) bio-indexes with their classes, which define the most suitable variety of vine

Results and utilities

The results refer to four weather stations, two for each study site.

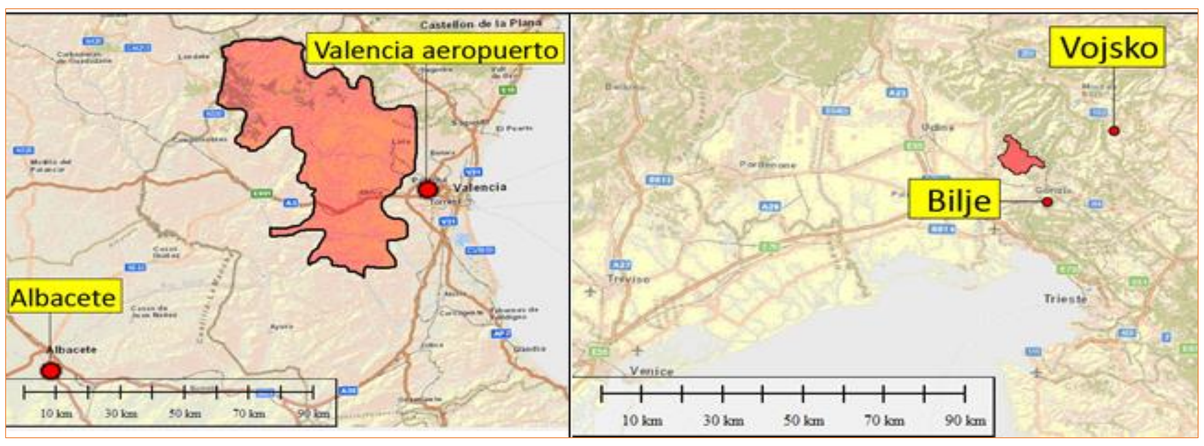

Figure 6: Location of four weather station chosen for analysis

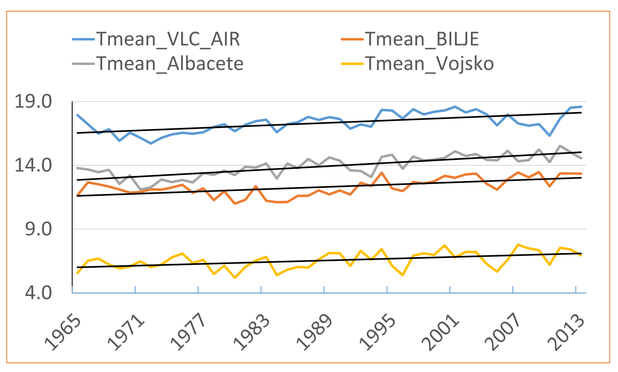

Figure 7: Progress of mean temperature during studying period [°C]. The trend is higher in Valencia DO site. VLC_AIR stands for Valencia airport weather stgation

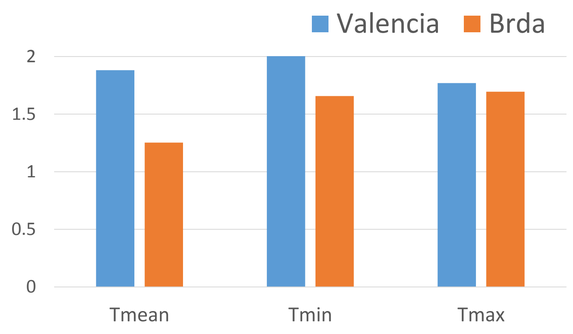

Figure 8: Comparison of increase of mean, minimal and maximal temperature on both study sites [°C]

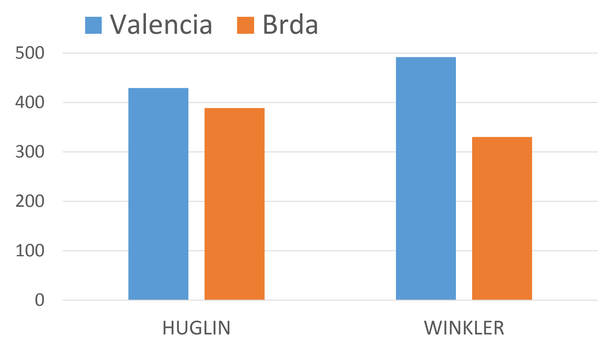

Figure 9: Comparison of increase of bioclimatis indexes at both study sites

The increase of temperature and bioclimatic indexes was noticed on both study sites during the study period (Figure 7), still the temperature and bioclimatic indexes trend is higher at Valencia DO site (Figure 8 and Figure 9). Future temperature trend is expected to increase on both study sites, particularly Valencia DO. The outcome of the research will provide the future climate data on local scale and will consequentially be beneficiary for future vine adaption due to future climate conditions.

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