South East European Virtual Climate Change Center

A CLIMATE CHANGE IMPACT ASSESSMENT ON A SMALL SCALE: SERBIAN VINEYARD REGIONS

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ABSTRACT

An assessment of the impacts on agriculture that altered climate conditions in South East European region might have is performed. A focus is given to vineyard regions in Serbia. The climate projections were obtained from interactively coupled atmosphere-ocean regional climate model RCM-SEEVCCC for three periods: 1961-1990 (experiment 20c3m), 2001-2030 (A1B scenario) and 2071-2100 (A2 scenario). A statistical bias correction method is applied to correct the model error, which utilizes daily values of minimum, maximum and mean temperatures and precipitation. Corrected model results are used for calculation of several climate indicators important for grape growing (beginning/duration/ending of growing season period, GDD, first frost date, etc.), and Heliothermal, Dryness and Cool Night Index that collectively define a Multicriteria Climatic Classification System (Géoviticulture MCC System) for grape growing regions worldwide. Results obtained for Serbian vineyard regions show that, on average, growing season start date will shift to beginning of March by the end of the century. Longer duration of growing season and higher temperatures in the period 2070-2100 may lead to increase of GDD by 1000 degrees. Results obtained for first autumn frost date, including the number of frost days lead to a conclusion that the rest period will be affected by warmer winters. Changes in water supply and overheating could lead to changes in vineyard positioning or in grapevine varieties selection. From presented results it can be concluded that present climate conditions in vineyard regions will shift to higher altitudes (1000m) by the end of the 21st century.

STUDY AREA

Serbia is on Balkan peninsula, on southern part of temperate zone between latitudes 41°50'N and 46°10'N. Wine is mainly grown at altitudes from 80 to 500m. Most Serbian viticultural regions are suited for growing very early, early, medium and late ripening, while in southern part (Metohija) even very late ripening varieties can be grown.

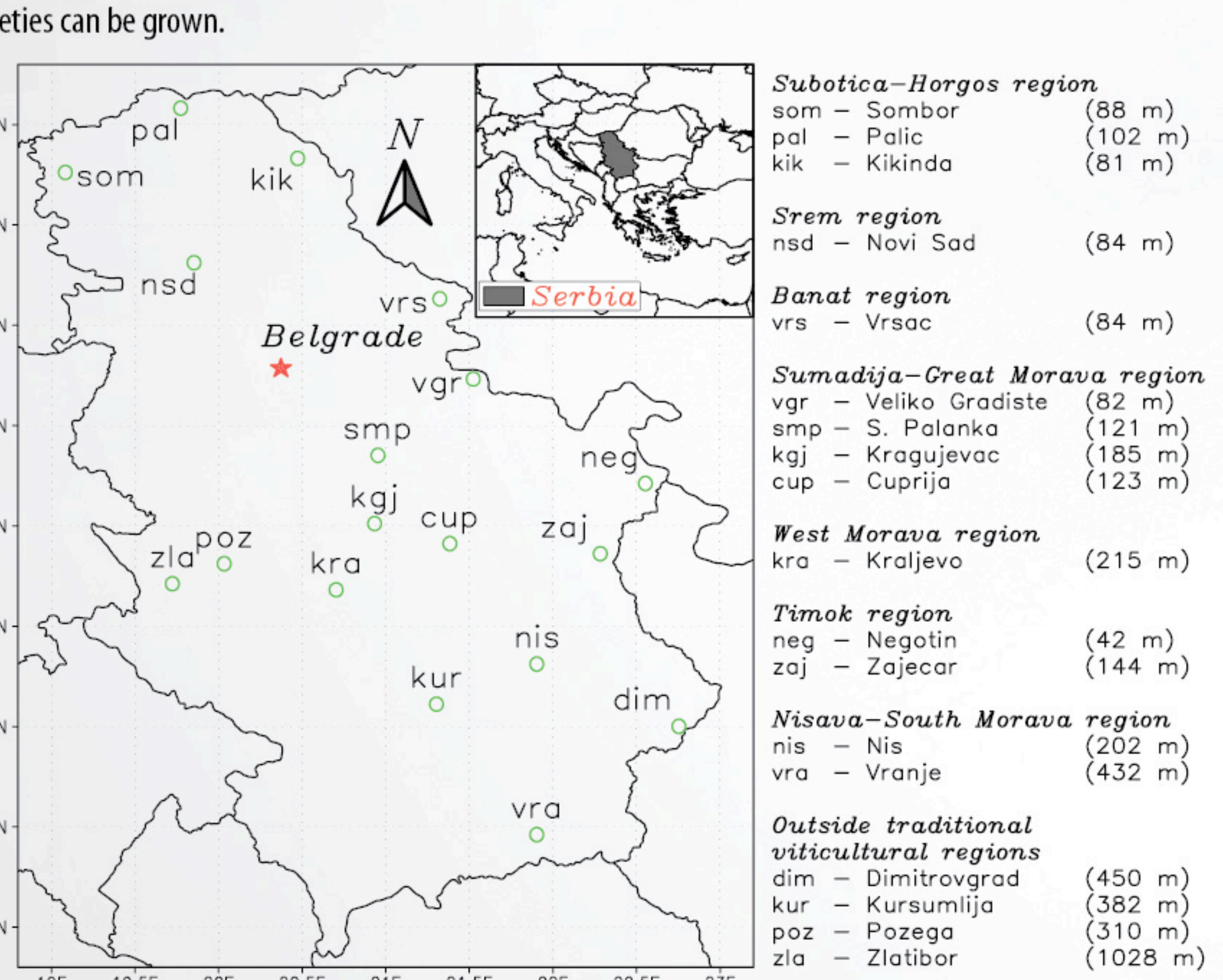


Figure 1. Locations of climatological stations and their associated viticultural regions

STATISTICAL BIAS CORRECTION

Following results show study of climate change impact on small areas. Daily data of temperature and precipitation were necessary for calculation of presented parameters. These are the reasons why it was necessary to apply Bias correction method for each station separately and using smallest possible interval in calculation of distributions (0.1C for temperature and 1mm for precipitation). Using model and observed data for period 1961-1990 correction is performed for daily mean, maximum and minimum temperature, and daily precipitation. For temperature data it is assumed that during one month they follow Normal distribution. For precipitation data is assumed that during growing season follow Gamma distribution and that model data set and observations must have the same number of dry days. Main idea of the method is to adopt that model data and observed values have the same probability density function. For temperature data correction functions are made for each station and each month separately and for precipitation for growing season and each station separately. Observed values are compared with model results of the nearest model point.

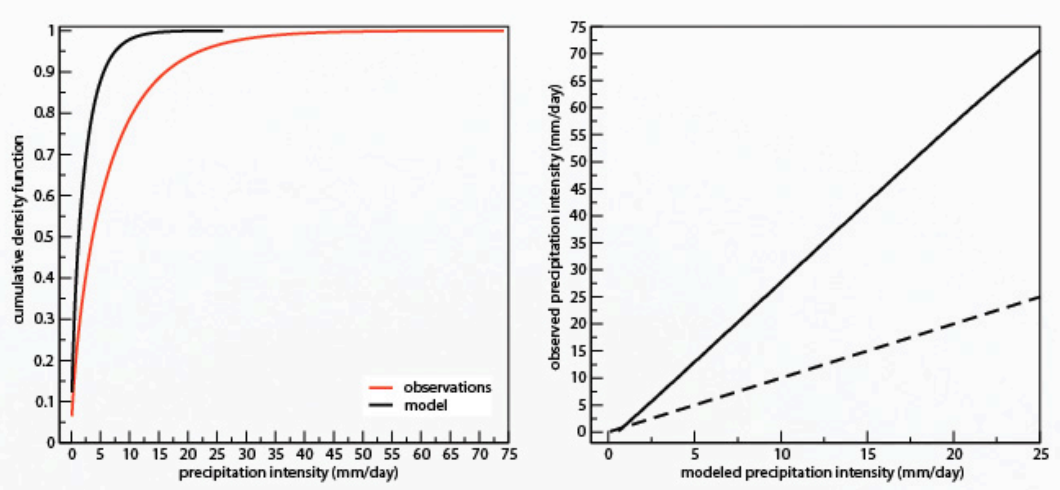


Figure 2. CDF (left) and correction function (right) for precipitation for station Kikinda

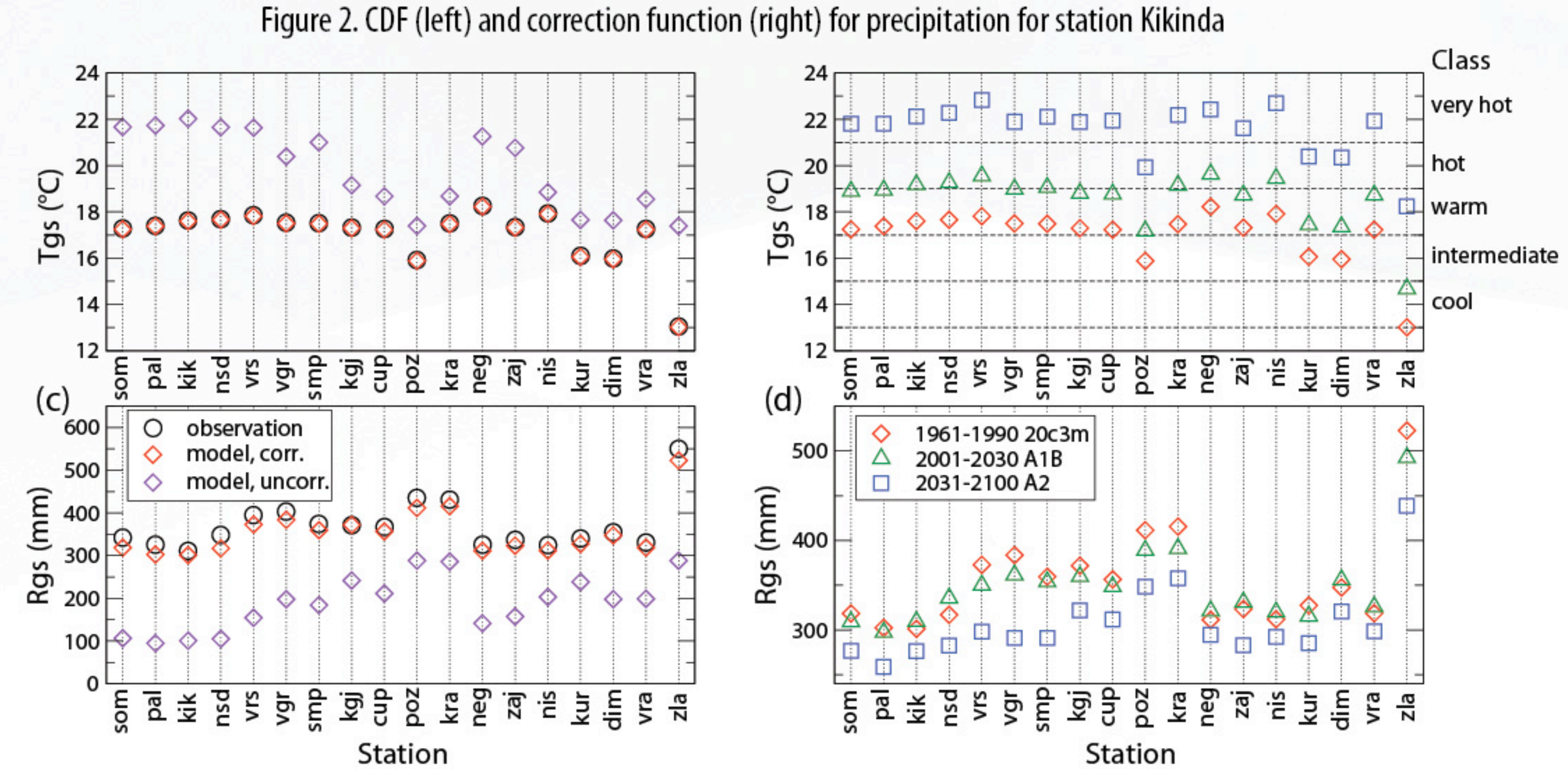


Figure 3. Growing season mean temperature and cumulative precipitation

Obtained corrected model values show very good agreement with observed data. Applying correction functions on future climate simulations (2001-2030 and 2071-2100) we are allowed to assume that this way model data are not contaminated with model bias.

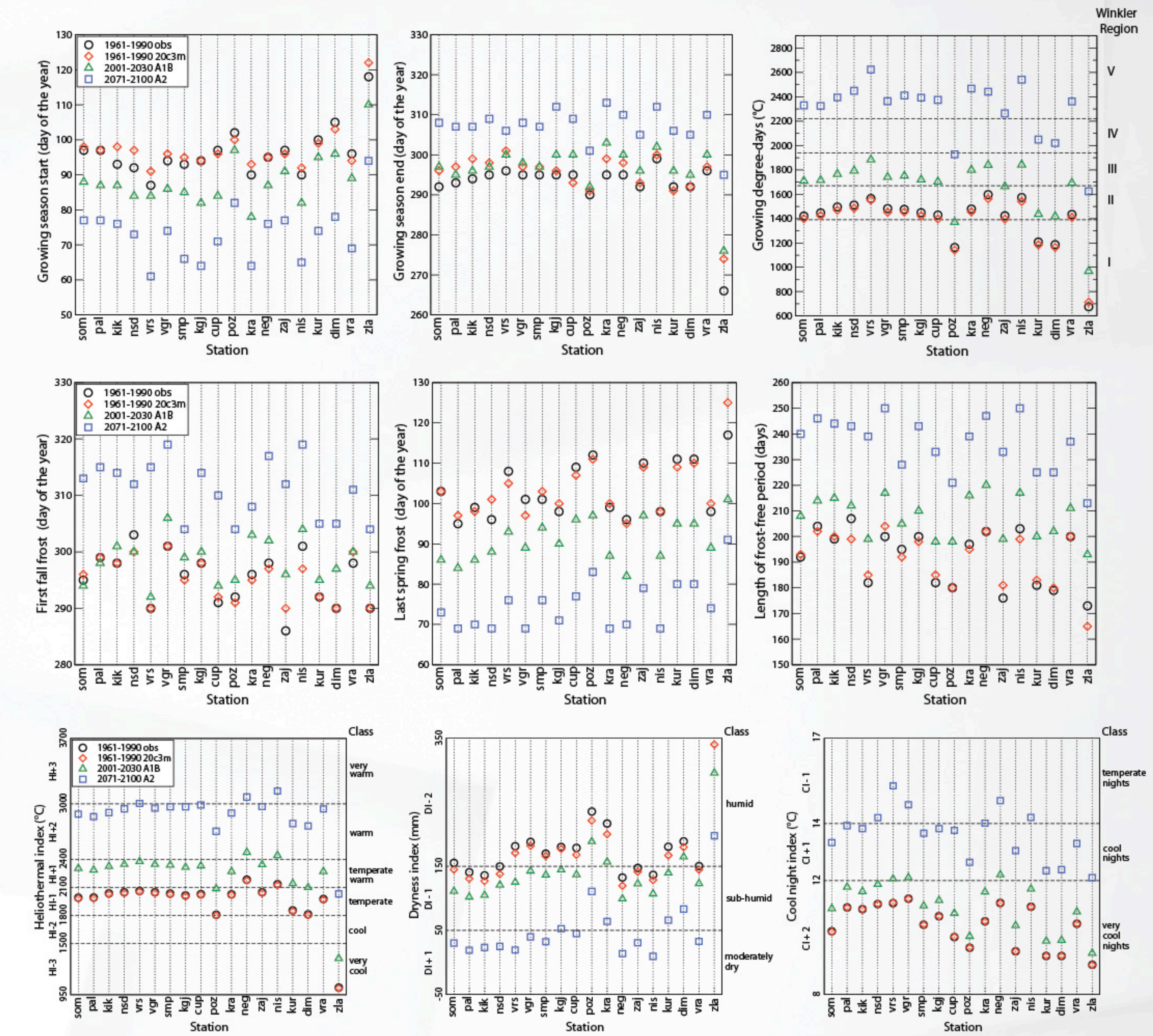
REFERENCES

Tonietto, J., Carbonneau, A., 2004. A multicriteria climatic classification system for grape-growing regions worldwide. Agric. Forest Meteorol. 124, 81–97.
Piani, C., Haerter, J.O., Coppola, E., 2010. Statistical bias correction for daily precipitation in regional climate models over Europe. Theor. Appl. Climatol. 99, 187–192.

NOTE

Presented results are taken from submitted paper Ruml.et al, On the use of regional climate models: Assessment of climate change impact on viticulture in Serbia.

RESULTS



CONCLUSIONS

According to the obtained change trends it is likely that no significant disturbances in Serbian viticulture will occur over the next few decades, but considerable changes are expected by the end of the 21st century. Warmer and prolonged growing season with greater heat accumulation and longer frost-free period with decline in frost frequency likely will affect the yield and ripening potential of grapes and induce shifts in varietal suitability and wine styles. Projected changes may bring on the need for additional vineyard irrigation, but also open up the possibility that marginal and elevated areas, previously too cool for cultivation of grapevines, become climatically suited for viticulture.

The results obtained in this study will provide a useful guideline for the planning of future vineyard development in Serbia and creating the concrete adaptive strategies for exploiting the positive effects and for avoiding, preventing or reducing the negative effects of climate change on viticulture in Serbia.

Another outcome of presented study is a valuable data set of corrected values of daily temperature and precipitation series from EBU-POM simulation runs that can be further used as input in crop, hydrological or any other model for assessing climate change impact in Serbia. Our study showed that climate model outputs should not be directly translated into forcing fields for impact models.