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Title: Using a convection-permitting climate model to predict wine grape productivity: two case studies in Italy

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Summary

The manuscript explores the impact of convection-permitting climate model data on assessing wine grape productivity. The analysis utilizes observed wine productivity data from two consortia located in Italy. First, the climate data are compared with both meteorological observations and reanalyses to evaluate their quality. Second, single and multiple regression analyses are conducted to investigate the potential of climate-related indices to “predict” wine productivity. The results show correlations between bioclimatic indices (in particular temperature-based indices) and wine productivity, suggesting their potential use in assessing future changes.

General comments:

The manuscript is well written, data and methods are described adequately; the topic treated adheres to the journal’s scope. In my opinion, the manuscript would benefit from a more extensive discussion comparing the findings to previous similar studies or applications of CPM climate data in agriculture. Additionally, providing in-depth comments on the potential impact of this research, particularly its implications for future grape productivity, would underscore the relevance of the study.

My general assessment is that the manuscript doesn’t have any relevant flaws that prevents its publication. My recommendation is to accept the paper, provided that the specific remarks below are addressed.

English is not my native language and I have no comments on it.

TITLE

I suggest to modify the title, e.g., from “Using a convection-permitting climate model to predict wine ...” to “Using a convection-permitting climate model to *assess/estimate* wine grape productivity: two case studies in Italy”.

In fact, the authors make use of single/multiple regression to explain the variance of wine productivity data and not to predict them.

ABSTRACT

General comment

lines 7-9: “Viticulture is tied to climate, it influences the suitability of an area, yield and quality of wine grapes. Therefore, traditional wine-growing regions could be threatened by a changing climate. Italy is at-risk being part of the Mediterranean climatic hotspot and judged in 2022 the second-largest exporter of wine worldwide.” I suggest removing this sentence as the opening statement. It is redundant in the Abstract but appropriate for the Introduction section.

Specific comments

Line 13: “and both *the* Regional and *the* Convection-permitting...” which models? If not detailing them, use the article “a” instead of “the”.

Line 14: “The potential of CPMs”, which CPMs? One CPM or multiple CPMs? Remove the “s”

line 17: “of CPM, became” remove the comma “,” which currently lies between the subject and the verb

line 17: “of CPM, *became*” mixed use of present and past. Please change to “becomes”

1. INTRODUCTION

General comment

The Introduction is adequate and presents the state-of-the-art and the innovative approach of the research (from line 50 to the end of the section). As stated previously and for the reasons claimed by the authors in the Introduction (see lines 65-66: “Single and multiple regression approaches are used to determine the extent to which bioclimatic indices *can explain changes* in wine grape productivity at the local scale”), I suggest modifying the title by removing the word 'predict' and replacing it with a more generic term such as 'assess' or 'estimate.' In fact, predicting implies providing the accuracy of the predictions, including associated errors and uncertainties, rather than just the R-squared value of the regression.

Specific comments

line 21: I would start the Section with the first sentence of the Abstract, which I found redundant in that context.

Line 21-22: “Wine-growing has a strong socio-economic impact and is one of the principal agricultural economic activities in Italy, that in 2022...” I would change to “Wine-growing has ... in Italy. In 2022...”

line 22: “world's leading wine producer (49.8 million hl)” Can the authors provide any reference to support this statement?

line 22: “and second” change to “and the second”

line 27: “than the global average (Bernetti et al., 2012;...” Can you provide a more climatic-sound references to support such sentence? Further, these two references could be moved below (i.e., line 28)

line 31: “when frost events are still frequent” I think the word “still” can be removed to streamline the sentence

line 33: “are expected to experience important shifts in viticulture suitability that can consequently causes a decline in production” “causes” or “cause”? What is the subject? “shifts” or suitability?

Line 26: “developed” change to “computed” or something else

line 48: modify “) (“

line 65: “are used to determine the extent to which” change to “are used to determine to which extent”?

2. Data and Methods

General comment

I think it should be explained better why the authors used Aladin/Arome model outputs rather than SPHERA or other regional CP reanalyses. Can the authors stress the differences in the experimental design of numerical simulations? As stated in the manuscript, Aladin model is fed by ERA-Interim data, whereas SPHERA is fed by ERA5. Which is the difference? SPHERA are started frequently (once a day?) and receive boundary conditions every hour. What about the Aladin/Arome numerical architecture? The authors should give the audience a taste of the differences without delving into the suggested bibliography.

Specific comments

Figure 1: In both the digital and hardcopy versions of the manuscript, the geographical locations of the two consortia are difficult to discern from the images. Could the authors provide larger images and/or magnify the map of Italy?

Line 102: “at regional level between 1994 and 2000; at national scale while” change to “at the regional level between 1994 and 2000; at the national scale while”

line 103: “at national scale while from 2000 to 2005” sentence not clear. Perhaps just remove “while”

line 112: remove the acronym “NMHSs” since it is used only once

line 124: “SPHERA reanalysis” change to “The SPHERA reanalysis” or just “SPHERA”

line 124: SPHERA is validated against a gridded dataset made of independent rain-gauges. ERA5 data are used as a benchmark. Please specify better

line 138:

line 139: “” is missing at the end of the text

line 163: “but also take” change to “but also takes”

line 199: “Tests performed to investigate...are not impacted by the resolution chosen for the remapping (not shown)” I think the authors should give more details about the tests performed. At least they should say whether the tests were performed on the remapping strategy (i.e., the algorithm) or on the resolution (i.e., the final grid spacing). Please expand this point and give some details

line 205: “weighing” please replace with “weighting”

line 214: “SPHERA and E-OBS time series together provide a range within which the CPM and the RCM time series are expected to fall, similar to a ‘confidence interval.’” I disagree; can the authors support this statement by providing evidence?

Line 2017: I don’t get why E-OBS are used within the parenthesis

Line 221: too many “()”

3. Results

General comment

I don’t see why many Figures/Tables that are commented in this Section are taken from the Appendix (e.g., lines 255, 258, 261, 265, 267, 277, 298, 306, 316). This doesn’t help the readability of the manuscript. I encourage the authors to rethink this section. For example, it should start from line 269 “Figure 2 and Figure 3 show the ten bioclimatic...” and the first

sentence “The precipitation and temperature time series of both...” could be moved elsewhere in the manuscript (Discussion or Appendix). Alternatively, some tables/plots shown in the Appendix could be streamlined (e.g., Table A 4 which has many columns and rows) or simply removed and their content moved into the text (e.g., Table A 6, Table A 8). Table 2 is hard/difficult to read. I wonder whether a plot could help its readability. I suggest the authors to reconsider it. If they decide to keep it, I suggest to remove the RMSE column, since it is not commented in the text. Further, it is shown the RMSE% which is more informative since the ranges of bioclimatic indexes are very different.

Specific comments

line 276: “(Table 2)” remove empty space

line 296: “CNI with model simulations” change to “CNI with model **climate** simulations” or simply “CNI with climate simulations”, in fact, SPHERA is a model simulation too

lines 302-306: I would like to see this paragraph in the Discussion section, where it is more pertinent

lines 325-330: as above

Table 3: Can the authors discuss why, in MON, the variance of E-OBS is 44% for the SR case and 32% for MR? Is it related to the poor quality of E-OBS data (in MON) as argued previously? This happens also for RCM although to a smaller extent (32%→29%). I would like to see a plausible explanation in the Discussion section

4. Discussion and conclusion

General comment

I think this section lacks a critical review of the results found in comparison with previous studies. It looks like a summary of the manuscript. If no or few previous studies are found, it should stressed the novelty of the study and highlighted the potential and limits of CP model data in assessing productivity.

Further, the main advantage of using CPM data is the removal of any parameterisation to model convection processes. Indeed, it is well known they provide more accurate precipitation estimates than RCM data (e.g., lines 53-55). However, you found that wine productivity is mostly related to temperature-based bioclimatic indexes rather than precipitation-based one. Do the authors have any comment on it?

Specific comments

line 401: “This could be link” replace with “This could be linked”

Data availability

Author contribution

Competing interests

Acknowledgments

References

line 573: incomplete reference

Appendix A

Figure A2 provided in poor quality when on hardcopy

Studies cited above:

none