



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-1451-RC1>, 2023  
© Author(s) 2023. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## **Comment on egusphere-2022-1451**

Anonymous Referee #1

---

Referee comment on "Viticulture extension in response to global climate change drivers – lessons from the past and future projections" by Joel Guiot et al., EGU sphere,  
<https://doi.org/10.5194/egusphere-2022-1451-RC1>, 2023

---

Summary: The manuscripts is focused on estimating the impact of global external climate drivers on potential viticulture in the Mediterranean region in the last few millennia and the present century. The tool is an emulator of the relevant climate variables that summarizes a set of available climate simulations with global Earth System models together with available temperature and precipitation reconstructions for this region. Both sources of information are combined in a Bayesian framework.

The main conclusion is that the most important climate driver in the past has been the volcanic activity. In the future, greenhouse gas warming will constrain the areas for potential viticulture. To my knowledge, these conclusions agree with previous studies on the attribution of past climate variability.

Recommendation: I found the objectives of the study interesting and although my knowledge of viticulture is limited, I think the results can be useful for climate historians and probably also for stakeholders. On the other hand, I also found the study technically rather convoluted, and I am left wondering if, at least the part of the study referred to future conditions, could not have been more easily conducted by just directly analysing the output of global (and regional) climate simulations and applying, for instance, the VI index to those data. I guess the reader would scratch their head wondering why an emulator and an indirect estimation of the impact of external drivers is needed in the first place.

Also, some technical descriptions remained to me somewhat unclear, but this can be certainly amended. The English would need a slight copy-editing as well.

Main points.

1) I think that the justification of the methodology will not be clear for many readers. The method is rather convoluted, involving an ensemble of simulations with Earth System Models, a statistical downscaling model, a combination of model output and proxy-based reconstructions using a Bayesian framework. Is this complex methodology necessary at all? why not just take the output (e.g. median) of the ensemble of climate models? Is the data assimilation needed to somehow correct the possible errors of climate models?

At least for the future climate projections, this simpler approach will be more logical, as the Earth System Models certainly translate more perfectly the impact of external forcing on the local climate than the emulator.

I can perhaps see some justification for the emulator applied to past climates, but I think the need for methodological framework needs to become more clear for most readers.

2) Some methodological steps are too shortly explained. The climate reconstructions used in the data assimilation step appear almost out of the blue. They should be included in the material and methods section. Perhaps also the data assimilation methodology should be explained here as well.

3) Section 3.3 (independent validation) raises some questions that the text simply glosses over. The text asserts that the agreement between the independently reconstructed PSDI and the model output is good, but Figure 9 does not convey this impression. The assessment is essentially visual, comparing the panels in Figure 9, but the colour coding used does not really help the reader to see the similarities and differences. Admittedly, colour bars are rather subjective, and in my experience some readers find some useful when other readers find them difficult. Here, however, it is difficult to distinguish the colour tones. E/EP for 1300, for example, is just blue everywhere. Would it be possible to use, say, 10 hues that the eye can easily separate? To me, the panels for 1300 BP look very different, also the agreement shown in the panels for 1000 BP and 700 BP is questionable. I believe the authors that the data sets may agree, but the pictorial representation is really not adequate to convince the reader.

Other points

4) ' large ecc, obl close to present value and very negative omega'

those acronyms have not been defined (or I missed them). Is omega the precession ?  
what does a negative value mean ?

5) ' In contrast, the second additional scenario'

By contrast

6) 'Note that this value underestimates the true earth surface temperature because our mean is based on the equirectangular projection which gives too much weight to the high latitudes.'

This is very confusing to me. The fact that the model grid cells do not contain the same area, should not a problem to compute the correct global mean. One needs to compute a weighted average. This is just routine. It looks strange to read that the global mean temperature is around 9 C and justify this results by the different areas of the model grid-cells. I guess, but I cannot be sure, that this does not affect the computation of anomalies and therefore the results. my impression is that the temperature anomaly are also biased. Please, checked this point. In any case.

7) 'The sunshine percentages are obtained by linear regression on temperature and precipitation (Guiot

et al., 2000)'

Models produce downwelling solar radiation at the surface. So why use an indirect approach ?

8) 'Because of collinearity between the predictors (global forcing variables), their dimensionality is reduced using principal components (PC). The nine variables are reduced into five PC explaining together 89% of their total variance.'

Were these time series normalized prior to PCA? If not, the result would artificially depend on the units used, and some variables would be more strongly represented than they should

9) 'This process is known as a data-model assimilation (Goosse et al., 2012). The data are the paleoclimate reconstructions and the model the emulator. Its statistical simplification makes it possible to run it thousands of times in a relatively short computational time as required by the assimilation methods (Widmann et al., 2010). We use a Bayesian approach called the Markov Chain Monte Carlo method (MCMC), which makes it possible to converge towards the best parameters in the sense of probability distribution (Hargreaves and Annan, 2002)'

I think this paragraph is written a bit sloppily, and it will also be unclear for readers not well versed with Bayesian methods. My interpretation is that the model and reconstructions are combined by using the Bayes theorem. This application requires the computation of an integral and for this computation the authors used a MCMC methodology.

More importantly, the need for this data assimilation step remains obscure. Why is it needed at all ?

10) 'anomalies from the pre-industrial period for the 10 spatial boxes and the 9 time slices, obtained from pollen (Guiot and Kaniewski, 2015) and corrected/precised as indicated in Table 1 of the main text.'

I cannot see how the information in Table 1 is helpful in this regard. This table is just a list

of the Biome model output

11) 'the sum of the product of monthly temperature and precipitation for the growing season (Hyl),'

The sum or the product ?

12) ' (HI>1400, DI>-100, Hyl<5100 and Tmin >-17°C).'

Units are missing

13) 'Some of the climate variables needed for these indices were not available from the BIOME4 outputs. However, other variables, such as those associated with the net primary production of plant types are very interesting because they include the CO<sub>2</sub> effect on photosynthesis'

Do they also include the effect of CO<sub>2</sub> on water efficiency ?

14) 'VI = (1 - INPPtrop) / (INPP + IPann + IMTWA + IMTCO) \* Iα'

The VI is validated by just comparing with the present climatology. It is a new index and apparently, there is no other type of validation. How can we be sure that this index can describe changes in potential viticulture well ?

15) ' Fig.6 presents the overall correlations between the emulator outputs and the proxy-based reconstructions.'

The x-data and the y-data are in my understanding not totally independent. The emulator has used the reconstructions in the data assimilation step, so it is not totally surprising that they are correlated . Also the caption is not clear, specially this sentence: Temperature dots correspond to the 10 boxes of the 11 periods between 2500 to present and precipitation data to the two oldest periods (4200 and 3200 yr BP) and the present.' Does it mean ' Temperature dots represent the mean temperature in the 10 boxes in the 11 periods between 2500 BP until present and precipitation dots represent the mean precipitation in the two oldest periods (4200 and 3200 yr BP) and in the present,