Author final comment to the paper Pfister et al., Wine must yields as indicators of May to July climate in Central Europe, 1416–1988

Dear Editor, this is the point-by-point response to both reviewer's comments and suggestions. We thank the reviewers for providing such thorough and constructive feedback on our manuscript. We believe the revisions we have made have substantially improved the clarity, rigor, and impact of our paper. ***It turned out that we couldn't convert files with track changes to PdF. The solutions we found were incompatible with our system. Therefore, we had to look for another solution:*** **The referee's comments are shown in black (Carlo Mateus**) und ***black italics*** (***Olivier Planchen).*** Our responses are shown in blue and the added or modified texts are shown in blue italics.

Main concerns

Regarding the quality of the writing in English, please ask confirmation from an English-speaking colleague

The text was checked by a professional translation service

Enlarge figure 07

The figure was enlarged

Title: I suggest slightly changing the title to reflect the contents of the paper clearly: Wine must yields as indicators of May to July climate in Central Europe, 1416–1988'

I wish to emphasize the geographical relevance of the study sites. Indeed, the integration of the regions of Eastern France into a study on central Europe is not systematic from one publication to another, even though it is justified by the climatic regionalization of Europe. This choice is therefore of particular interest in the article by C. Pfister et al.

The original geographical designation in the draft was 'Europe'. Following the first reviewer's intervention, Mateus, the designation was changed to 'Central Europe'. There is no generally accepted definition of this term. As I understand reviewer 2 he suggests to extent it to "Eastern France" in view of Metz, which has the longest series of wine must. However, Metz is only 20 km from the German border and can therefore be considered part of Central Europe. This makes even more sense, as the Metz series is significantly correlated with the German, the Swiss and the Luxembourg series (Table 4).

We therefore agree with reviewer 1:

Wine must yields as indicators of May to July climate **in Central Europe**, 1416–1988'

Line 17: "This sentence requires a reference; therefore, it must be removed from the abstract and included elsewhere in the manuscript (e.g. Introduction). In addition, only data from 1416 is being used as a proxy.

This sentence was omitted and an improved version below was included on lines 78-79: This study explores to which extent narrative and accounting data from documentary data on both crop size and sugar content may provide a proxy for spring and summer temperatures before the period for which GHDs are available.

It must be clearly stated why there is no analysis of data after 1988. What are the reasons? Data availability? It would be interesting to include the recent warmer decades in the analysis if data are available.

The following explication is added (lines 71-74):

The paper ends with the transition to the more rapid anthropogenic warming after 1988. As the world has warmed, the growing season has lengthened and phenological events have occurred earlier. Furthermore, mean quality has increased considerably (Altwegg 2023, Altwegg and Pfister, 2024) and yields would have risen steadily were it not for market-based control measures. Additionally, grape varieties better suited to the new climate are being cultivated (Neumann and Matzarakis, 2011; Holzkämper et al., 2013). Rising temperatures will not necessarily decrease the risk of late frosts. Water scarcity is likely to become a problem in some regions and an increase in the risk of pests is to be expected (Van Leeuwen et al., 2024). Therefore, data on wine production from after 1988 cannot be compared with data from previous centuries.

Line 76: briefly specify the relevant results.

This study has shown that narrative documentary data on both crop size and sugar content may provide a proxy for spring and summer temperatures prior to the availability of instrumental measurements-

Line 241 to 242: An additional figure 02 was introduced with permission of the handling editor

Figure 02 A display of the annual wine must crop collected for a private owner between 1658 and 1757. This visual monument was painted at a wall in today's Viticultural Museum in Ligerz (Canton Bern) by order of the supervisor. Data in barrels of 845-

litres. Photo Heidi Lüdi Pfister, Viticultural Museum Ligerz (Canton Bern

The following numbers of the figures 03 to 10 were adjusted.

Line 370-392 Statistical methods. Please make sure to use a statistical textbook/peer-reviewed publications to add references to the used methodologies: Low order polynomial, ordinary least squares, orthogonal polynomials, Kolmogorov–Smirnoff test and detrending techniques. Adding references is important to ensure the description of experiments and calculations is sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results).

The following text has replaced the existing text

To produce homogenised time series of wine must production, expressed as deviation in percentage from the long-term mean, we applied the following methods. In each interval i, we calculated the mean value of the must-series and called it m_i. In each interval, we fit a straight line or n-th order polynomium to the data using ordinary least squares (Draper & Smith, 1998). We used orthogonal polynomia since it increases numerical stability (Draper & Smith, 1998). We subtracted the fit from the data, resulting in residuals r_{ij}, where i is the interval and j is the year.

We calculated the ratio of the residuals to the interval's mean value and expressed it as a percentage:

$$S_{ij} = \frac{R_{ij}}{m_i} \times 100 \qquad (1)$$

We obtained wine must production data in an already contiguous series for the Swiss Plateau. For these series, a linear fit was used to remove the trend. We also obtained a set of series for southern Germany, where the former was detrended linearly and the latter with a fifth-order polynomial. A single series of wine must data from the Swiss Plateau covering just 1967–1990 was also processed using fifth-order detrending. Data from Germany for 1847–1988 showed a gap during the Second World War, but we made up for that using data from Johannisberg (covering 1933–1947) for the overlapping years 1933–1939. A linear transformation for the overlapping years was calculated, and the Johannisberg data for years 1940–1947 were transformed with it. Then, the filled-in data were tested for statistical similarity in the periods from 1920–1957 and 1958–1988 using the Kolmogorov–Smirnov test (Conover, 1999). In detail, the null hypothesis that both datasets are drawn from the same population was tested. The result showed that the null hypothesis could be strongly rejected, implying that the data from the two periods were not drawn from the same population – that is, they were very different. We next detrended and converted the interval-mean to percentages using break years at 1879 and 1988. It seemed

the resulting 46 series was not variance stationary, with a suggested break near 1950, and a similar procedure was followed for data from Switzerland (1837–1989), except there were no gaps to fill. Also, here, break years were specified as 1879 and 1958.

It would be great to cross-reference the results of the analysis of the historical documentary data with references on future effects of climate change on wine grape production in terms of quantity, quality, and resilience of the wine regions included in the study area.

This suggestion would go beyond the scope of this paper.

The paper ends with the transition to the more rapid anthropogenic warming after 1988, (see also lines 71-74.

Technical corrections

Line 38: Europe, not Europa.

Line 40: table, not Table. o-K

Line 265 (table): Luxembourg

The corrections were made

It should be distinguished between the term "Moselle" designating the river and "Mosel" designating the wine-region

The corrections were made throughout the text

Figure 07 now Figure 08: The Figure was enlarged

Figure 09 (former Figure 08): Decimal points must be used instead of commas in the Y axis:

The figure was corrected