Reply to the Reviewer 1:

Thank you very much for revising the manuscript and for valuable comments, which significantly improved the article. In the course of correcting the manuscript, we strictly followed the suggestions provided by the Reviewer.

Revisions have been made in response to particular comments:

General comments:

Figures should be enhanced by including units on the y-axis.

Figures 2 and 6 have been enhanced with units on the y-axis (see below).

Several statements need to be supported by citations to existing literature or the current results. The introduction requires more background detail and citations of previous dendroclimatological studies in the region.

More background details and citations from previous dendroclimatological studies have been added to the Introduction chapter:

This article presents a long time scale temperature reconstructions for the Dachstein Mountains area localised in Northern Limestone Alps in Austria. The Alpine region has been used for palaeoclimatic studies since many decades. This is the result of beneficial factors that favour the undertaking of such research. The most important of these is the influence of the thermal conditions of the environment, which significantly limit the growth of plants and thus enable temperature changes to be reflected in the annual tree-rings. From the Alpine area predominantly originate dendroclimatic reconstructions based on tree-ring width and the maximum latewood density. Among them are also multi-century analyses, extending back many hundreds of years (Schweingruber et al., 1987, 1988; Büntgen et al., 2005, 2006; Esper et al., 2007; Corona et al., 2010, 2011; Kuhl et al., 2024). On the other hand, chronologies based on stable isotope measurements have been constructed less frequently to date (Treydte et al., 2001; Gagen et al. 2006; Hafner et al., 2014). Moreover, they rarely reach back a thousand years (Kress et al., 2014). However, more than a millennium-old stable isotope studies are known from other territories (Churakova-Sidorova et al., 2022; Büntgen et al., 2021). In turn, in Alpine area reconstructions that use dendrochronological data together with other proxies, such as lake sediments, also occur (Trachsel et al., 2012). Sometimes historical information is used to trace climate fluctuations in the past as well (Casty et al., 2005; Meier et al., 2007).

Currently, only correlations with temperature are presented for each proxy. The analysis should be expanded to include an examination of the relationships with other climate variables, such as precipitation and drought indices.

In addition to correlations with temperature, the analysis has been extended to examine relationships with other climatic variables:

Obtained chronologies of the tree-ring width, maximum latewood density, stable carbon and oxygen isotopes were compared with climatic records. For this purpose, various meteorological parameters were applied. The mean monthly temperature (TEM) data originated from neighbouring meteorological stations and was gridded for the area of Schwarzensee Lake (Auer et al., 2005, 2007; Efthymiadis et al., 2006; Chimani et al., 2013). Homogenised mean monthly sunshine duration (RAD) derived from the meteorological station of Kremsmünster (Auer et al., 2007). Total monthly precipitation (PRE) dataset was based on homogenized precipitation series from adjacent meteorological stations and was gridded at 10-minute resolution (Efthymiadis et al., 2006). Self-calibrating Palmer Drought Severity Index (scPDSI) was calculated using as input the interpolated monthly precipitation and temperature observations with a resolution of 10 minutes longitude by 10 minute latitude (van der Schrier et al., 2007). Vapour pressure (VAP) record contained the spatial monthly averages calculated using area-weighted means for Austria. It was based on the CRU TS high-resolution multivariate gridded data set (Harris at al., 2020). The Standardized Precipitation-Evapotranspiration Index (SPEI) came from the Global SPEI database which offers long-time, robust information about drought conditions with a 0.5 degrees spatial resolution and a monthly time resolution. It is based on monthly precipitation and potential evapotranspiration data from the Climatic Research Unit of the University of East Anglia. This database provides SPEI time-scales between 1 and 48 months and SPEI time-scale used during presented study was 1 month (Beguería et al., 2014). In total, the meteorological records employed for this research encompassed monthly averaged data for temperature (1780–2000), solar radiation (1884–2000), monthly sums of precipitation (1800–2000), monthly averaged self-calibrating Palmer Drought Severity Index (1800–2000), vapour pressure (1901–2000), and Standardized Precipitation-Evapotranspiration Index (1901–2000).

While the comparison with other temperature reconstructions is interesting, the unique contribution of this multi-proxy chronology compared to reconstructions based on a single proxy needs to be clarified. Namely, what specifically does the combination of TRW, MXD and stable isotopes provide beyond TRW or MXD alone?

"The difference may be in the low frequency or long-term trend."

Information has been added explaining the benefits resulting from using different tree-ring parameters for reconstruction - stable isotopes of carbon and oxygen beyond TRW and MXD alone:

An undeniable advantage of the analyses presented here is the employment of a number of various proxies, including carbon and oxygen stable isotope chronologies, which allow low-term weather trends to be preserved. In comparison with them, the most commonly used tree-ring width or maximum latewood density reflect more temperature fluctuations in the high-frequency domain. Therefore, the applied approach makes it possible to trace thermal changes more accurately over millennial time span and, consequently, to better place contemporary climate warming in historical framework. Results demonstrated here has therefore the potential to improve temperature reconstruction and its temporal reliability. This constitutes an exceptionally favourable situation that distinguishes this work from most previous studies conducted using chronologies of tree-ring width and maximum density of latewood.

The climate analysis and comparison with other records should be improved. References to major climate periods or events (e.g. Late Antique Little Ice Age, Medieval Climate Anomaly, Tambora Eruption) ***could put the temperature fluctuations in a broader context****.*

References to major climate periods and volcanic events were added:

In the obtained reconstruction the effect of volcanic events which could significantly reduce temperature value is also evident. Despite the fact that the area of Schwarzensee Lake is located far from volcanically active regions, however, severe eruptions periodically alter weather conditions, even on a global scale. Taking into account only strong events characterized by an explosivity index equal to or greater than 4 (Siebert and Simkin, 2002) and the fifty coldest years in the entire Schwarzensee temperature reconstruction, 13 of these are could be related to the impact of volcanoes. Although it is rather difficult to unambiguously ascribe cold years to a particular eruption however, probably temperature decrease which appeared in years 1020, 1032, 1040, 1281, 1290, 1587, 1813, 1814, 1815, 1816, 1912, 1913, 1933 were triggered by them. Observed interrelationship is apparent especially for the younger part of the data because for earlier time periods there is a lot of uncertainty due to imprecise dating of the oldest volcanic eruptions. The above comparison is based on the data available on the website https://volcano.si.edu/.

Other global climate fluctuation, such as the Medieval Warm Period or the Little Ice Age, can also be identified in the reconstruction from Lake Schwarzensee. The time span of temperature increase that coincides with the

Medieval Warm Period is evident and covers the years 975–1275 CE. In contrast, the period of the Little Ice Age, defined approximately between 1450 and 1850 CE, is shorter in the Schwarzensee temperature reconstruction and comprises the years 1475–1625 CE. However, on the basis of the research carried out, it is difficult to determine the reason. This shift might be induced by the stable carbon isotope chronology, as it shows an increasing trend between 1600 and 1800 CE, maybe related to the fact that the stable isotope carbon chronology, in addition to temperature, depends strongly on the solar radiation of the summer months. The cause of the upward tendency in reconstructed temperature between 1650 and 1800 CE may also be moisture conditions as the time interval between 17th and 19th centuries was a wet period and all the chronologies used for reconstruction correlate to a greater or lesser extent with such climate parameters as precipitation, VAP, scPDSI, and SPEI indexes (Table 1).

The drivers may be also the range of months employed in the temperature reconstruction (May–August), which differs from many others previously performed studies, often taking into account only the summer period. The lack of perfect matching between the commonly used dates of Little Ice Age and the reconstruction derived from Lake Schwarzensee may also be the result of local environmental conditions that did not coincide with global temperature changes. The Intergovernmental Panel on Climate Change Third Assessment Report concluded that the Little Ice Age is largely independent regional climate change, rather than a globally synchronous increased glaciation and the timing and the areas affected by temperature decrease vary significantly (IPCC, 2022). The differences may also be explained by the combination of multiple proxies in the Schwarzensee reconstruction, in particular the usage of stable isotopes of carbon and oxygen, whose chronologies have the potential to capture more low-frequency variability compared to chronologies based on tree-ring width and maximum latewood density, which in turn, focus on the variability in the short-term domain. It should be emphasised that the undeniable advantage and innovative aspect of the presented research is the application of four different chronologies owing to which Schwarzensee reconstruction has the unique potential to reflect long-term temperature trends.

Stable isotopes have the potential to capture lower frequency variability compared to TRW and MXD, but this potential is not fully explored.

In the revised version of the manuscript, the potential of the Schwarzensee reconstruction to capture long-term temperature trends is emphasised several times, also when discussing the differences between the presented results and other palaeoclimatic reconstructions, as well as global trends in temperature change such as the Medieval Warm Period and Little Ice Age.

Comparisons could be made with additional non-tree ring reconstructions, such as Casty et al. 2005 (https://doi.org/10.1002/joc.1216) and Meier et al. 2007 (https://doi.org/10.1029/2007GL031381).

The suggested studies, i.e. Casty et al. 2005 and Meier et al. 2007, were mentioned in the Introduction chapter, but a more detailed comparison of temperature reconstructions was made only with reference to the most similar dendrochronological results. A comparison with many previous palaeoclimatic studies would have increased the volume of the article too much, disrupting its proportions. In this article, the authors wanted to present mainly the research results obtained, and broader comparisons as well as reconstructions based on the various research results could be the subject of further papers.

Specific comments:

Lines 38-39: Note that soil moisture is also an important driver of tree growth.

Required information has been added:

The changes of physio-chemical properties of growth-rings are influenced by solar radiation, temperature, precipitation, soil moisture, and atmospheric humidity.

Lines 43-55: Consider adding a figure with a map showing the geographical location to provide more context.

Map showing the geographical location of Schwarzensee Lake has been added:

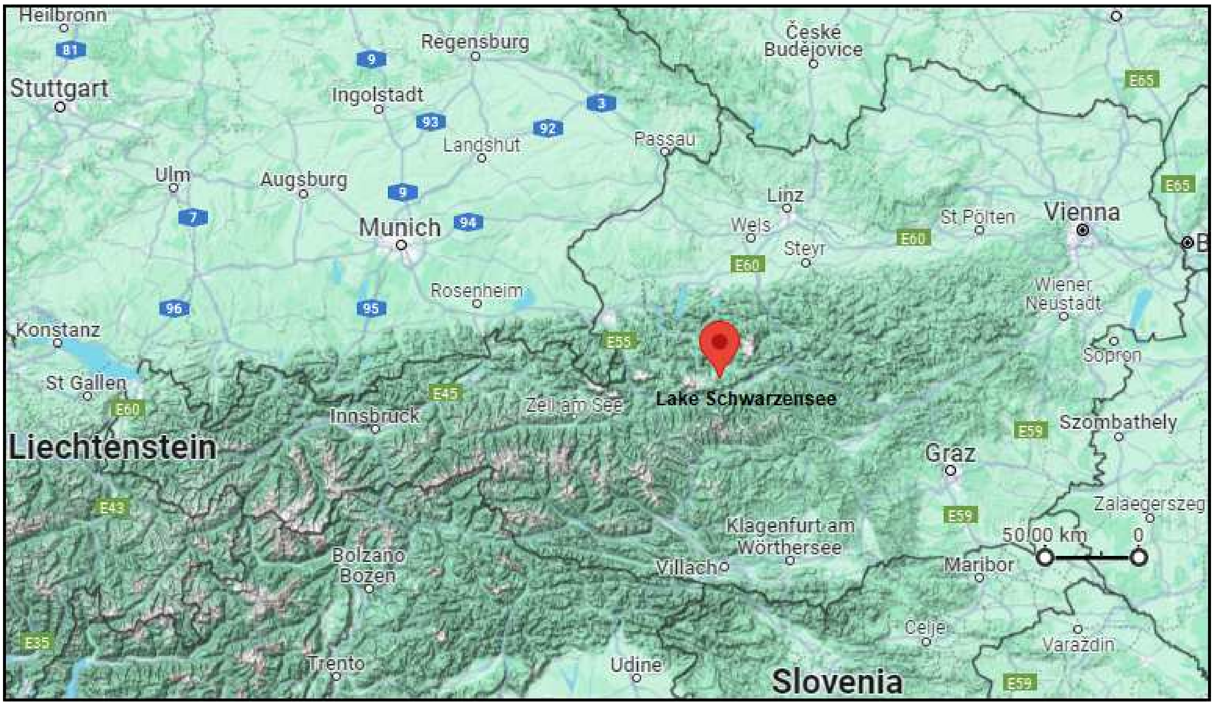


Figure 1: Map showing the geographical location of Schwarzensee Lake. Google Maps (2024) https://www.google.pl/maps/place/47%C2%B031'00.0%22N+13%C2%B049'00.0%22E/@47.5166703,12.4983074,8z/data=!4m4!3m3!8m2!3d47.5166667!4d13.8166667?hl=pl&entry=ttu

Line 46: Clarify the elevation site.

Required information has been added:

Schwarzensee Lake is situated in mountain area and located almost at an elevation of regional timberline (47°31′ N, 13°49′ E, 1450 m.a.s.l.).

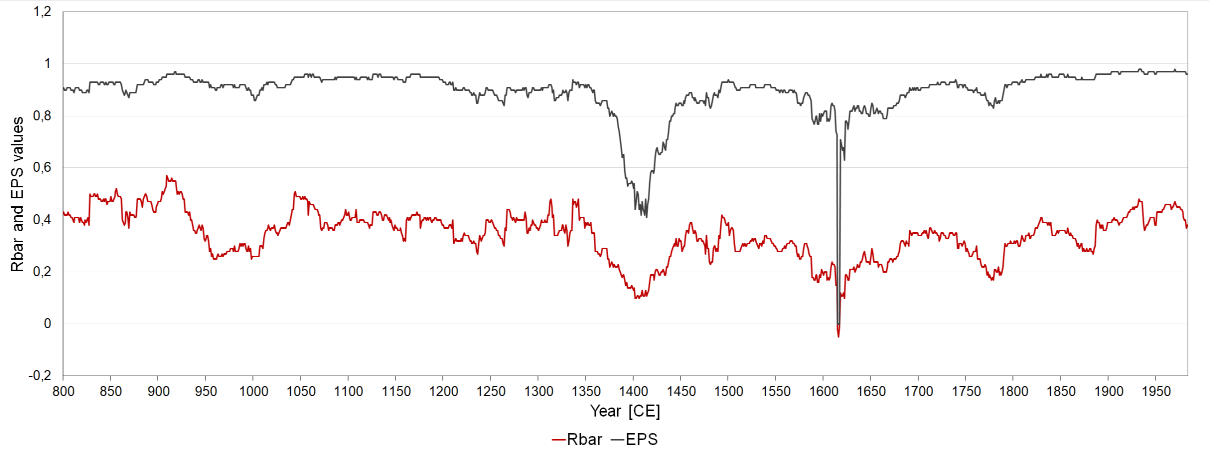
Lines 85-86: Explain why Figures 2, 3, and 4 end in the year 2000 when the study goes to 2018.

Required explanation has been added:

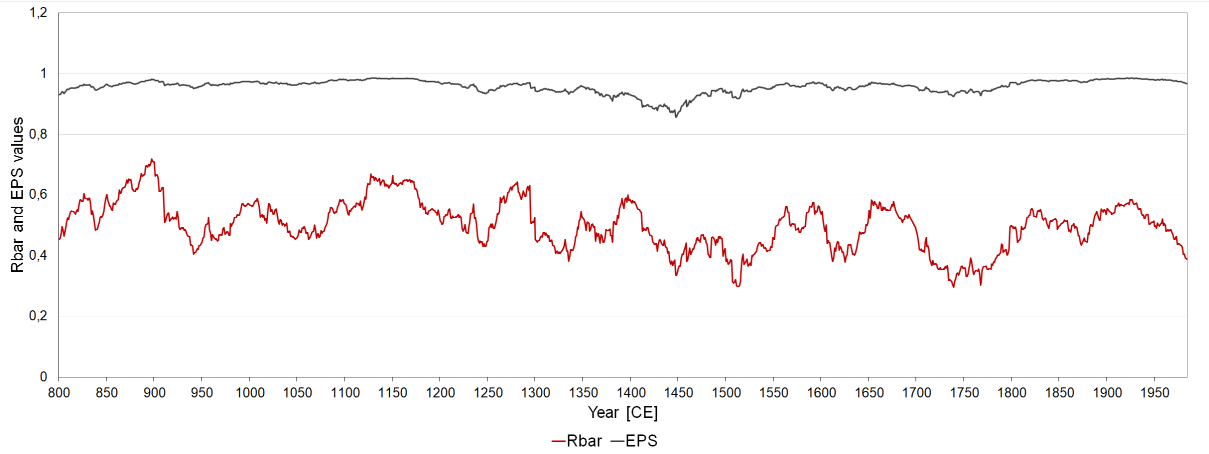
Moreover, 80 spruce and larch samples were bored from the trees growing around the lake in 1999 (Grabner et al., 2007). However, along with the development of subsequent chronologies there was a need for the new samples. Therefore, additional 40 cores from the living trees was collected in years 2009 and 2015. Nevertheless in this case, the increment cores taken had an smaller inner diameter than during first sampling carried out using dry wood borers. Hence, the climatic reconstruction presented here reaches to the year 2000 CE, as some of the measurements were conducted using cores of bigger diameter only due to the larger amount of wood available for preparation.

Lines 135-137: It would be helpful to show the EPS, r-bar statistics in a supplementary figure.

Figures showing EPS and r-bar statistics have been added:



Supplementary Figure 1: Expressed Population Signal (EPS) and mean inter-series correlation (Rbar) values calculated for the Schwarzensee maximum latewood density (MXD) data set employed for the chronology created using two-curve, signal-free RCS method showing EPS (black) and Rbar (red) computed over 50-year windows, lagged by 25 years. Chronology of maximum latewood density was constructed with application of the ARSTAN program (Cook and Krusic, 2005).



Supplementary Figure 2: Expressed Population Signal (EPS) and mean inter-series correlation (Rbar) values calculated for the Schwarzensee tree-ring width (TRW) data set employed for the chronology created using one-curve, RCS method showing EPS (black) and Rbar (red) computed over 50-year windows, lagged by 25 years. Chronology of tree-ring width was constructed with application of the ARSTAN program (Cook and Krusic, 2005).

Lines 215-216: The finding of higher correlations between TRW and temperature in June and September agrees with previous work such as Leal et al. 2007.

The sentence has been added:

The finding of high correlations between TRW and temperature in June and July agrees with previous work such as Leal et al. 2007.

Lines 230-240: The moderate correlation coefficients may be due to the long-time windows used. Consider analysing 1900-2000 to demonstrate stronger correlations, using the remaining period for verification. Correlations further back in time can be less precise also for a decrease of the observation quality.

Climate analysis for the period 1901-2000 CE has been added and is shown in Table 1:

	$\delta^{13}C$						$\delta^{18}O$						MXD						TRW					
	TEM	PRE	VAP	PDSI	SPEI	RAD	TEM	PRE	VAP	PDSI	SPEI	RAD	TEM	PRE	VAP	PDSI	SPEI	RAD	TEM	PRE	VAP	PDSI	SPEI	RAD
January	-0,22	0,01	-0,18	0,11	-0,05	0,18	0.05	0.10	0.08	0.15	0.07	0.00	0.12	-0.10	0.09	0.07	-0.10	0.02	-0.06	0.18	-0.07	0.14	0.17	-0.14
February	0,01	**0,22**	0,04	0,20	0,20	-0,11	-0.01	0.08	0.03	0.10	0.00	0.06	-0.02	0.07	-0.02	0.03	-0.01	0.04	0.12	0.09	0.13	0.19	0.11	-0.08
March	-0,12	0,09	-0,07	0,11	0,13	-0,05	0.02	-0.09	0.02	0.01	0.01	-0.03	0.13	0.09	0.04	-0.02	0.07	0.04	-0.09	0.07	0.01	0.11	0.06	-0.16
April	0,03	0,10	0,08	0,18	0,03	0,19	0.17	-0.04	0.15	-0.04	-0.06	0.09	**0.26**	-0.11	**0.22**	-0.08	-0.17	**0.27**	0.00	0.08	0.07	0.15	0.07	-0.04
May	0,14	-0,20	-0,04	0,09	-0,25	0,17	**0.30**	-0.11	**0.24**	-0.09	**-0.21**	**0.23**	**0.35**	**-0.21**	**0.22**	-0.14	**-0.31**	0.17	**0.16**	-0.14	0.10	0.06	-0.12	0.17
June	0,19	-0,12	0,04	0,00	-0,15	**0,28**	0.10	-0.04	-0.07	-0.16	-0.06	0.11	0.13	0.09	0.17	-0.09	0.10	-0.15	**0.29**	-0.10	0.17	-0.05	-0.16	**0.35**
July	**0,42**	-0,15	**0,35**	-0,08	**-0,26**	**0,54**	**0.50**	**-0.52**	0.19	**-0.35**	**-0.54**	**0.65**	**0.45**	**-0.20**	**0.30**	-0.16	**-0.32**	**0.39**	**0.23**	-0.08	0.12	-0.05	-0.11	**0.27**
August	**0,51**	**-0,30**	0,25	-0,18	**-0,27**	**0,41**	**0.35**	-0.19	0.10	**-0.37**	**-0.19**	**0.25**	**0.67**	-0.13	**0.51**	**-0.22**	**-0.24**	**0.27**	0.02	-0.12	-0.07	-0.11	-0.08	0.06
September	-0,05	0,01	-0,08	-0,10	-0,11	-0,03	0.06	-0.10	0.09	**-0.33**	-0.07	0.05	**0.48**	**-0.37**	**0.36**	**-0.30**	**-0.38**	**0.31**	0.09	-0.09	0.05	-0.11	-0.13	0.08
October	0,03	0,09	0,00	-0,03	0,07	-0,01	0.01	-0.06	-0.03	**-0.31**	-0.04	0.15	-0.02	0.08	-0.08	-0.19	0.03	**0.19**	0.11	-0.07	-0.01	-0.16	-0.11	0.10
November	-0,23	0,20	-0,09	0,11	0,22	-0,17	-0.11	0.13	-0.16	-0.18	0.08	-0.05	0.19	0.10	0.09	-0.11	0.13	**0.26**	0.04	0.07	0.00	-0.13	0.08	0.06
December	0,11	-0,08	0,16	0,07	-0,04	-0,07	-0.03	0.10	0.07	-0.10	0.08	-0.13	0.10	0.11	0.03	0.02	0.13	-0.02	-0.03	-0.18	-0.04	-0.14	-0.12	-0.03

Table 1. Correlations with climate parameters. Bootstrap correlation were calculated in DENDROCLIM 2002 between climate data: mean monthly temperature (TEM), total monthly precipitation (PRE), mean monthly sunshine duration (RAD), monthly averages of vapour pressure (VAP), self-calibrating Palmer Drought Severity Index (PDSI), and Standardized Precipitation-Evapotranspiration Index (SPEI), and tree-ring parameters: Schwarzensee tree-ring width (TRE), maximum latewood density (MXD), stable carbon ($\delta^{13}C$), and oxygen ($\delta^{18}O$) isotope chronologies. Significant values at the 0.05 levels are marked in bold. Analyses were undertaken over a common period 1901–2000 CE.

Also, I suggest examining correlations with precipitation, humidity, scPDSI, and SPEI using interpolated CRU data for 1900-2000.

Required information has been added:

The obtained chronologies of tree-ring width, maximum latewood density, carbon and oxygen stable isotopes were compared with climatic variables. For this purpose, correlation coefficients were calculated between the individual chronologies and temperature, precipitation, solar radiation, VAP, SPEI, scPDSI variables. In order to be able to better compare the results obtained, all calculations were carried out over the period 1901-2000 CE, as this was the maximum range of the chronologies used for the study and part of the climate data. The results are presented in Table 1. As an effect of this calculations, it was observed that weather parameters influenced individual chronologies in different way and with various strength. Because temperature fluctuations over time are the most interesting parameter in the context of ongoing climate change, a reconstruction of the thermal conditions of the environment was therefore carried out in the work presented here. Temperature is also the only parameter that significantly affects all analysed proxies, so all chronologies from the Schwarzensee Lake area could be used for its reconstruction. This decision made it also possible to apply a multi-proxy approach in the study. A combination of several proxies was aimed to increase the amount and the quality of palaeoenvironmental information derived from tree-ring data. Due to the employment of several tree-ring parameters to reconstruct a single environmental variable it was possible to reduce the noise associated with each of the proxies and to enhance the climate signal. Moreover, the incorporation of stable isotope chronologies into research allowed better identification of reconstructed long-term trends, compared to studies using only TRW or MXD, which better reflect the changes in the high frequency domain.

Lines 234-235: Show the climate correlation analysis between temperature and the final combined proxy chronology.

Required Figure has been added:

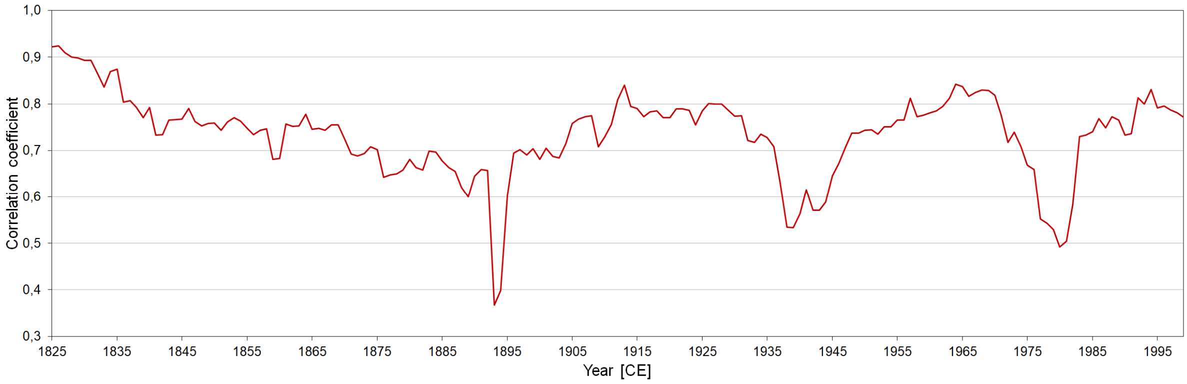


Figure 3: Moving interval bootstrap correlation coefficients computed in DENDROCLIM 2002 program for mean monthly temperature averaged for May–September period calculated between meteorological record and reconstructed data. A base length of 25 years was progressively slid through the years from 1800 CE to 2000 CE. The figure shows significant values at the 0.05 level.

Line 247: Show precipitation and hydroclimate correlation analyses to support this statement.

Required correlation analysis has been added in Table 1:

For Schwarzensee TRW chronology the strongest correlation was observed between the width of tree-rings and the temperature and solar radiation values (Table1).

Line 265: Consider showing this correlation analysis in a supplementary figure.

Required correlation analysis has been added in Table 1:

Similar like for TRW and MXD, for the stable carbon isotope chronology the high values of correlation were achieved between the isotopic ratio and the temperature of the vegetation period. Nevertheless, the correspondence with sunshine level was also strong (Table 1).

Lines 263-280: Good explanation of temperature signal, however previous Alpine isotopic studies found stronger drought signals. Show the correlations with all variables to prove temperature signal.

The correlations with various meteorological variables is shown in Table 1.

Line 283: Show the summer precipitation correlation analyses.

Required correlation analysis has been added in Table 1:

In comparison with other proxies, the stable oxygen isotope chronology provided a more mixed signal. In the case of $\delta^{18}O$ chronology the high coefficients of correlation were obtained for temperature but a strong relationship was also observed for total monthly sum of precipitation, monthly averages of vapour pressure, self-calibrating Palmer Drought Severity Index, Standardized Precipitation-Evapotranspiration Index and mean monthly sunshine duration (Table 1).

Line 314: State "significant correlations" to emphasize if the correlations are significant or not.

The sentence has been corrected:

Linear correlation coefficient computed for this season was significant and amounted to 0.459, 0.483, 0.537 and 0.354 for carbon, oxygen, MXD and TRW chronologies, respectively.

Line 234: In the method the authors should explain how the individual proxies have been merged into a final multi-proxy methodology.

The explanation has been added:

Reconstruction of MJJAS temperature was calculated with a multiple linear regression using as predictors $\delta^{13}C$, $\delta^{18}O$, MXD and TRW, according to formula:

$$MJJAS=2.8708*\delta^{13}C +1.7606*\delta^{18}O +32.0744*MXD +5.5888*TRW +80.1884$$

In Figure 2, it looks like the multi-centennial variability of the carbon isotope differs from the other proxies, driving the warm phase from 1650 to 1750 CE in the temperature reconstruction. This should be better explained, since this warm phase overlaps with the Little Ice Age, known to be a cold period in Europe and the Alps.

The explanation has been added:

In the temperature reconstruction presented here, a time span of temperature increase that coincides with the Medieval Warm Period is evident and covers the years 975–1275 CE. In contrast, the period of the Little Ice Age, defined approximately between 1450 and 1850 CE, is shorter in the Schwarzensee temperature reconstruction and comprises the years 1475–1625 CE. However, on the basis of the research carried out, it is difficult to determine the reason. This shift might be influenced by the stable carbon isotope chronology, as it shows an increasing trend between 1600 and 1800 CE, maybe related to the fact that the stable isotope carbon chronology, in addition to temperature, depends strongly on the solar radiation of the summer months. The cause of the upward tendency in reconstructed temperature between 1650 and 1800 CE may also be moisture conditions as the time interval between 17th and 19th centuries was a wet period and all the chronologies used for reconstruction correlate to a greater or lesser extent with such climate parameters as precipitation, VAP, scPDSI, and SPEI indexes (Table 1).

The drivers may be also the range of months employed in the temperature reconstruction (May–September), which differs from many others previously performed studies, often taking into account only the summer period. The lack of perfect matching between the commonly used dates of Little Ice Age and the reconstruction derived from Lake Schwarzensee may also be the result of local environmental conditions that did not coincide with global temperature changes. The Intergovernmental Panel on Climate Change Third Assessment Report concluded that the Little Ice Age is largely independent regional climate change, rather than a globally synchronous increased glaciation and the timing and the areas affected by temperature decrease vary significantly (IPCC, 2022). The differences may also be explained by the combination of multiple proxies in the Schwarzensee reconstruction, in particular the usage of stable isotopes of carbon and oxygen, whose chronologies have the potential to capture more low-frequency variability compared to chronologies based on tree-ring width and maximum latewood density, which in turn, focus on the variability in the short-term domain. Therefore, it should be emphasised that the undeniable advantage and innovative aspect of the presented reconstruction is the application of four different chronologies owing to which obtained reconstruction has the unique potential to reflect long-term temperature trends.

Line 330: Explain why the climate correlation time window analysis was narrowed for the final chronology but not for the individual proxies.

In the revised version of the paper, a narrowed climate correlation time window analysis for individual proxies has also been added (Table 1). In particular, the narrowing of this window for the final chronology is due to the lack of correlation between the carbon chronology and the MIJJAS climate data in the 1960-2000 CE time interval and results from the large uncertainty in the meteorological measurements performed in the early 1800s.

Line 424: Specify which panel of Figure 3 is being referred to.

The explanation has been added:

In the case of the reconstruction carried out for the whole Alpine region (graph at the bottom of the Figure 6), the lowest temperatures were recorded in the 14th century, at the end of the 16th century and during the 17th century (Trachsel et al., 2012).

Line 430-435. Nice result, but it should be noted that the high correlation pattern is probably driven by the high frequency, as all the other correlations are based on TRW and MXD, which point to a common high frequency signal. The difference may be in the low frequency or long-term trend. The new reconstruction seems to have a long temperature rise that the other reconstructions are not able to capture as they are based on TRW and MXD.

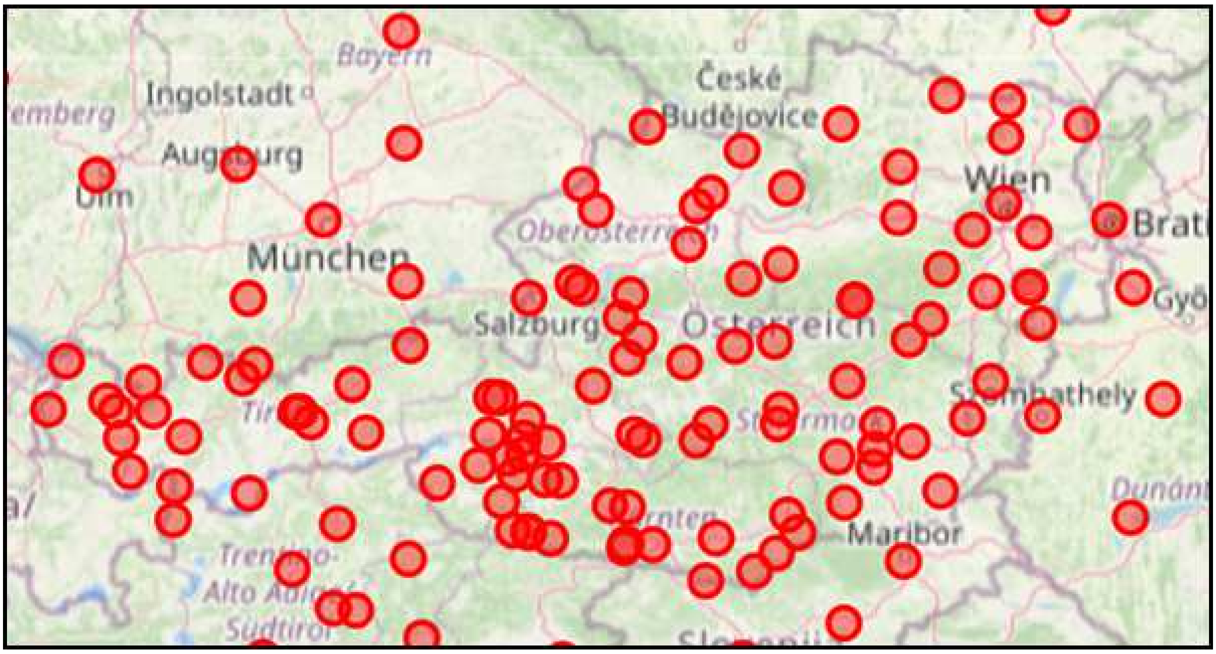
The information has been added:

The high correlation rate obtained for this comparison points to a common short-term variability. The reason for this is most probably the employment of TRW and MXD measurements in both Schwarzensee and Alpine reconstructions. Nevertheless, owing to the addition of stable isotopes of carbon and oxygen the new reconstruction seems to reflect a low-frequency signal that the other studies are not able to detect as they are based on TRW and MXD data only.

Figures:

A new introductory figure should be added showing the location of the study area and meteorological stations to provide an important geographical context.

Map showing the geographical location of Schwarzensee Lake has been added (see above). However, the location of the meteorological stations has been omitted as their placement would have obscured the image of the map:



Location of the meteorological stations.

In Figure 1, the y-axis scale should be included to allow proper interpretation of the data.

The y-axis scale has been added:

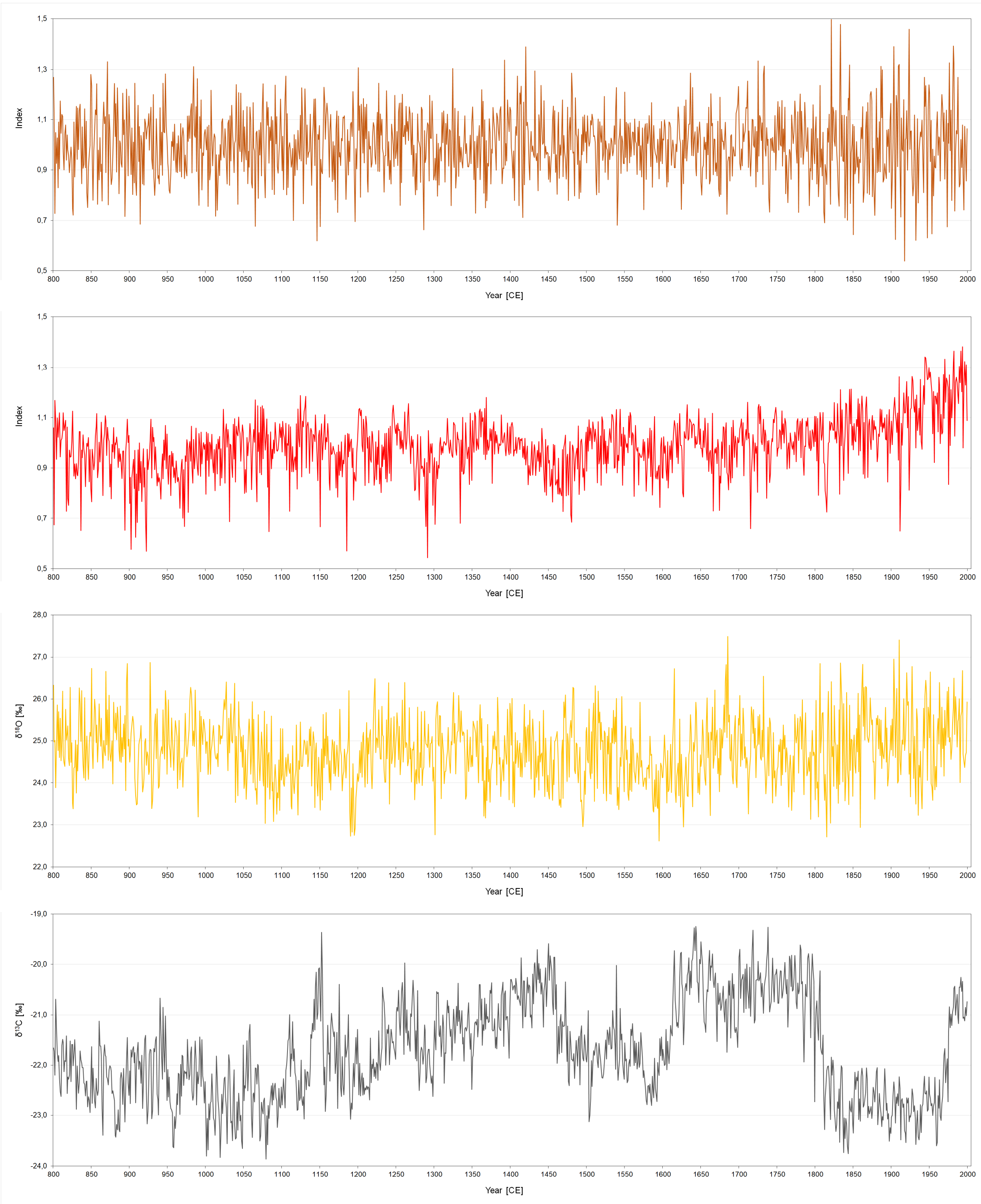


Figure 2: Schwarzensee chronologies: stable carbon isotope ($\delta^{13}C$–grey) chronology, stable oxygen isotope ($\delta^{18}O$–yellow) chronology, maximum latewood density (MXD–red) chronology, and ring-width (TRW–brown) chronology.

Figure 2 shows a very good agreement between the measurements and reconstruction, clearly demonstrating the proxy record accuracy.

Thank you very much for this comment.

Table 3 is a bit confusing in its current form. Consider adding the time windows analyzed in the first row to clarify the periods represented. Also use either R2 or r consistently for the correlation metrics.

Required information has been added and table has been corrected:

Table 4: Statistics calculated in Reconstats program used to evaluate the quality of the model applied for climate reconstruction – reduction of error (RE), coefficient of efficiency (CE), coefficient of determination (R^2), and Pearson correlation coefficient (r). Third column presents significances of the statistics in the 95 % and 99 % confidence intervals.

Validation period (1840–1959):	RE=0.410 (p<0.001)	RE_95=0.046, RE_99=0.084
Validation period (1840–1959):	CE=0.409 (p<0.001)	CE_95=0.023, CE_99=0.056
Calibration period (1840–1899):	R^2=0.540 (p<0.001)	R^2_95=0.161, R^2_99=0.207
Verification period (1900–1959):	R^2=0.546 (p<0.001)	R^2_95=0.065, R^2_99=0.111

For Figure 4, adding y-axis scales and directly labelling the different temperature reconstructions on the plots would improve clarity and interpretation. Relating the observed temperature fluctuations to known climate periods, such as the Medieval Climate Anomaly and Little Ice Age, would provide helpful context for the trends. The reconstructions in Büntgen et al. 2011 and Büntgen et al. 2016 show the patterns as they are the same reconstruction, (Figure 2 Büntgen et al. 2016)

Figure 4, adding y-axis scales and directly labelling the different tree-ring based temperature reconstructions on the plots would improve clarity and interpretation. Relating the observed temperature fluctuations in these reconstructions to known climate periods, such as the Medieval Climate Anomaly and Little Ice Age, would provide helpful context. The reconstructions Büntgen et al. 2011 and Büntgen et al. 2016 show similar patterns, as they reflect the same tree-ring reconstruction (Figure 2 of the Büntgen et al. 2016 paper).

Required corrections have been introduced:

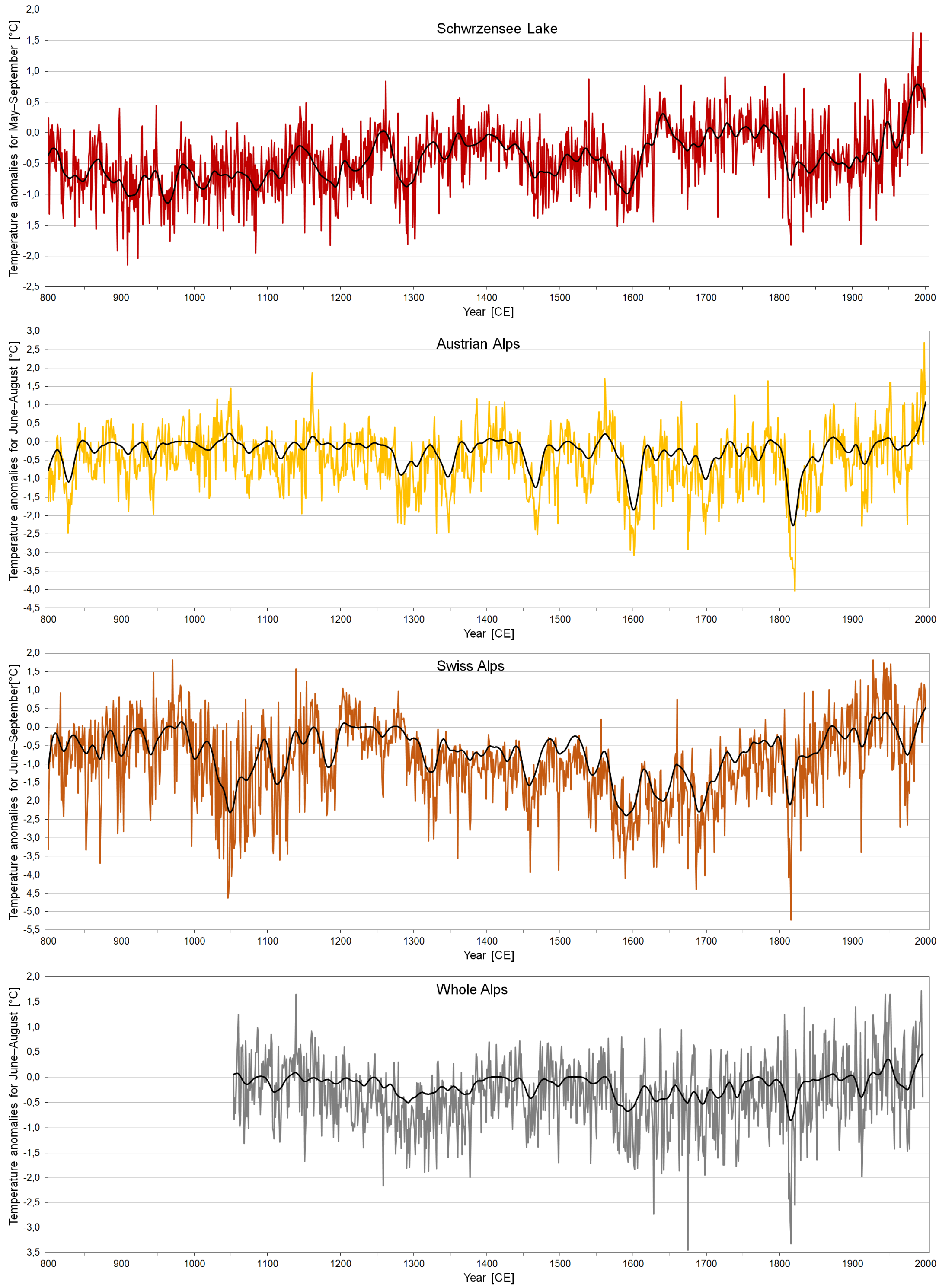


Figure 6: Comparison of the temperature reconstruction from Schwarzensee area with the other research. Red line– temperature anomalies for May–September (1901–2000 CE) for Schwarzensee Lake reconstructed on the basis of tree-ring width, tree-ring maximum latewood density and stable carbon and oxygen isotopes; yellow line–temperature anomalies for June–August (1961–1990 CE) for Austrian Alps reconstructed on the basis of tree-ring width (Büntgen et al., 2011); brown line–temperature anomalies for June–September (1901–2000 CE) for Swiss Alps reconstructed on the basis of tree-ring maximum latewood density (Büntgen et al., 2006); grey line–temperature anomalies for June–August (1901–2000 CE) for whole Alps reconstructed on the basis of tree-ring width, tree-ring maximum latewood density and lake sediments (Trachsel et al., 2012); black lines on each graph present the reconstructed values smoothed using spline fit with 50% variance cutoff at a wavelength of 25 years.