

Review of Pliemon: 30.01.2026

Early meteorological measurements and observations are valuable in many respects. Long instrumental measurements serve to analyze climate variability in general, climate variability with lower greenhouse forcing than currently, and to put climate change into perspective. Furthermore, shorter instrumental measurements and observations are used for climate field reconstructions, such as in data assimilation. Meteorological measurements date back to the 17th century and, compared to proxy data, offer higher temporal resolution and, in general, lower uncertainty. Accordingly, temperature and other meteorological observations/measurements are of importance to the scientific community and within the scope of Climate of the Past. Although I have numerous concerns, I would like to see this data/paper published after major revisions.

Reply. We appreciate your positive estimation of our work.

Main points:

I tried to separate the points, but in general, they overlap to some extent, as my main point is that the other measurements and observations should also be published in this paper.

1) More historical research:

I would have liked to read more about J.E. Scheibel.

Reply. Done. We added the following information:

Johann Ephraim Scheibel (b. 1736, d. 31 May 1809) seems to be a typical representative of science in the 18th century. Raised in a Protestant family, he spent his life in Wrocław. There he studied and then became a 23-year-old professor at St. Elizabeth in Wrocław. In a way typical of that time, he showed scientific interests in numerous disciplines. His dissertation concerned the friction of solids. He focused on mathematics, astronomy, physics and logic. He also dealt with meteorological phenomena, e.g. rainbows. However, he was also interested in theology and described ancient manuscripts, e.g. he published Codex quatuor Evangeliorum latinus Rehdigeranus (1763). He published in recognised scientific journals of the time, including Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien. Since 1791, he was an external member of the Prussian Academy of Sciences. In 1794, he was elected a corresponding member of the Göttingen Academy of Sciences (Günther, Scheibel Johann Ephraim, in: Allgemeine Deutsche Biographie, vol. 30, Leipzig 1890, p. 693).

As little metadata about the measurements is known, it might help to gain more information, for instance, a hint on the measurement times. Furthermore, more in-depth research in general.

Maybe the obvious hygrometer reading could indicate whether he obtained his

measurement devices from a meteorological network. This would also give an idea or an educated guess of which other measurement devices he used. The knowledge of metadata is important for the homogenization of measurements.

Reply. Thank you very much for your suggestion, which motivated us to recheck the written sources published by Scheibel, this time in more detail. He wrote dozens of texts in Old German that were published in the aforementioned journal, primarily concerning weather conditions in Silesia and Wrocław. Revisiting and translating so many texts was labour-intensive, but as you suggested, one particular text mentioned more precise observation times. Specifically, they were made immediately after sunrise, then at 1:00 or 2:00 p.m. in the afternoon, and again one or two hours after sunset (orig. *Die Beobachtungen werden täglich 3mal angemerkt; des Morgens sogleich nach Sonnen Aufgange, als möglich; Nachmittags zwischen 1–2 Uhr, und Abends ein oder paar Stunden nach Sonnen Untergange* (Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien, 1780, p. 62). With this information, we determined the approximate observation times based on the average sunrise and sunset times in Wrocław for each month of the year (local solar time, LST, was used), see below:

Month	Morning	Midday	Evening
January	8	13 and 14	17 and 18
February	7	13 and 14	18 and 19
March	6	13 and 14	18 and 19
April	5	13 and 14	19 and 20
May	4	13 and 14	20 and 21
June	4	13 and 14	21 and 22
July	4	13 and 14	21 and 22
August	4	13 and 14	20 and 21
September	5	13 and 14	19 and 20
October	6	13 and 14	18 and 19
November	7	13 and 14	17 and 18
December	8	13 and 14	16 and 17

In the next step, using hourly data from the contemporary period (2013–21), we calculated average monthly temperature differences between daily means based on three measurements per day (according to the established list of measurement times in the historical period) and 24 measurements per day (the “real daily mean”). The resultant differences (one value for each month) were applied to correct the historical monthly averages calculated from the three measurements per day. We have applied this method many times, including recently in the paper Przybylak et al. (2024). These corrected data were then used for further statistical analysis, including comparisons with contemporary data. The new series of mean daily data replaced the series calculated using weighted means.

Przybylak R., Singh G., Wyszynski P., Arazny A., Chmist K., 2024, Air temperature changes in SW Greenland in the second half of the 18th century, *Climate of the Past*, 20, 1451-1470, <https://doi.org/10.5194/cp-20-1451-2024>

2) Early measurement errors.

Inhomogeneities are expected in early meteorological measurement series. I

don't want to list references here, but there are numerous papers on the topic.

Accordingly, I would have expected more in-depth research here, as even in the absence of metadata, it is possible to validate the measurements and observations to a certain extent (see the next point).

Reply (also to point 3). You are right, such a possibility indeed exists. Based on your suggestions, we conducted a detailed search for metadata across all available texts by Scheibel published in the newspaper *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien* between 1773 and 1781. We found one overlooked text that provides more detailed information on the methods of performing meteorological observations in Wrocław (also in Silesia) than what we had already provided in the manuscript. The most important for our study is that the observation times are more precise than those shown in the meteorological register (morning, midday and evening)(mentioned in the reply to your point 1). Moreover, we found out that they used a mercury thermometer with a Fahrenheit scale. In the newspaper from 1774 we found information that "The measuring instruments were used in accordance with the instructions" or "All observations were made according to the instructions so that complete and accurate data could be obtained using thermometers ...". In the newspaper from 1775, the following information was given by Scheibel (p. 203): "For accurate measurements, **use a well-calibrated thermometer placed in a sheltered location away from direct sunlight and other heat sources to obtain reliable results.**" Other important excerpts document the reliability and precision of meteorological observations and their documentation: "Data were organized in tables and registers, enabling subsequent analysis of results and drawing conclusions" (Scheibel 1773, *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*); "The results were intended to be used both for local meteorological observations and for broader academic research" (Scheibel 1773, *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*); "Temperature measurements and observations of atmospheric conditions should be carried out daily and recorded at set intervals in the successive months"; "All measurements were taken at regular hours, and average temperatures and wind values were compared with previous observations." (Scheibel 1775, *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*, p. 34). "The data were compared with measurements from other locations to obtain a unified summary of atmospheric conditions. Thermometers recorded temperatures, which were then compared with measurements from previous days, excluding extreme temperatures" (Scheibel 1775, *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*, p. 34). "All barometer and thermometer observations, if both instruments are not properly adjusted, are of no use to us, no matter how much we would like them to be." (Scheibel 1775, *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*, p. 204). The analysis of texts published by Scheibel revealed that, during the period under study, meteorological observations were also carried out under his supervision in several (probably 6) other places in Silesia (e.g., Żagań and Jelenia Góra). The above quotes show that the observers, who were members of the Silesian Patriotic Society, were trained and equipped with calibrated instruments and with instructions on making observations (some of the quoted texts are only fragments of these instructions). Members of this Society (including Scheibel) studied scientific literature on an ongoing basis, including information on the latest meteorological instruments and their applications. The information provided here clearly demonstrates that Scheibel and other members of the Society were exceptionally diligent researchers who meticulously analysed their measurements on an ongoing basis. This means that the meteorological data presented and published in the *Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*, including the air temperature analysed in this article, are reliable. After correcting historical daily means calculated from three measurements per day to the real average daily values, they can also be compared with contemporary data.

The data were digitised by two individuals who alerted us to possible errors. We also initially assessed the data. This preliminary analysis resulted in corrections being made to only two erroneous values, which resulted from obvious typographical errors. In the next step, a more detailed check was conducted, also based on suggestions from Professor Stefan Brönnimann. To check for outliers in the temperature data, the differences between all series (midday minus morning, roughly DTR; midday minus evening; and evening minus morning) were calculated, as well as day-to-day differences across all three series. For the first category of calculations, 3SD were used as the threshold values for temperature differences, i.e., 15.9, 11.7, and 13.8 °C, respectively. No values were recorded that exceeded these thresholds. However, we verified the feasibility of differences of slightly less than 3SD (the highest were 13.3 °C, 11.1 °C, and 12.8 °C, respectively) by analysing air mass inflow directions, cloud cover, and atmospheric pressure. All of these differences were explained by changes in these meteorological parameters. For example, large winter warming was usually caused by a shift in circulation from the eastern or northern sector to the western or southern sector. Toward the end of winter, this also occurred on cloudless days (anticyclones) with no advection, or with weak advection from the south or west. At this time, the solar factor shows the greatest differences when it is associated with weak advection from the north or east sectors. Cooling in winter, on the other hand, is caused by the opposite circulation conditions to those described above. Such large temperature differences also occur in summer, when cooling is caused by circulation changing from the southerly/easterly sectors to the westerly/northerly sectors, and the opposite for warming. A similar effect due to solar radiation during cloudless days (great warming) and nighttime georadiation is also observed. In summer, large differences between observation dates occurred when circulation shifted from southern/eastern sectors to western/northern sectors (cooling) or vice versa (warming). The summertime effects of low cloud cover and intense solar radiation in anticyclonic situations are similar to those in winter.

As mentioned, we also examined the day-to-day changes in the three analysed air temperature series (morning, midday, and evening). For this purpose, we again used the 3 SD threshold, but this time we calculated it for each month separately. This is necessary because of significant SD changes throughout the annual cycle. The SD values were taken from Table 2. We found 23 cases exceeding 3SD. All of them were checked using the same procedure described earlier for checking changes within days. Only for one value did we find no justification in the analysis of the weather conditions preceding and following it. The value was corrected by looking at neighbouring values. This can also be considered a typographical error rather than a measurement error.

In addition to the above methods for data quality checking, we also compared data from Wrocław with data from (i) other Silesian stations (Jelenia Góra and Żagań), for which Scheibel also provided mean monthly data for 1773, 1774 and mid-1775 and (ii) the series of mean daily data from 1779–81 from Warsaw (see our answer to your point 4).

In summary, the quality control of the Wrocław data presented here verified that the data are high-quality, reliable and accurate. It confirms that the efforts made by Professor Scheibel to ensure that the meteorological observations he conducted in Wrocław, as well as in other stations in Silesia (under his supervision), were reliable and credible and thus yielded robust results.

3) Inclusion of other meteorological measurements and observations:

I do not understand why the other records are not published (see Fig. 2).

This would also improve the paper's quality, as you could compare the different measurements and observations to determine whether they are climatologically

sound. For instance, checking the diurnal temperature range on clear, non-precipitation days could provide insights into measurement times, where the measurement device is mounted, whether it is shielded, etc. Or by comparing air pressure with temperature.

Reply. The remaining meteorological elements will be the subject of a separate article. They require considerable work to be compared with contemporary data. Furthermore, analysing them in this article would undoubtedly result in excessive length. We have already digitised this data, and it was used to check the validity of outliers in the temperature differences between all series (midday minus morning; midday minus evening; and evening minus morning), as well as day-to-day changes across all three series (see our reply to point 2). The manuscript has been amended to reflect this.

4) Different structure:

For me, the current state of the paper does not convince me that one should trust the data; put differently, a validation is missing or appears later in the text.

Accordingly, a better approach would be to validate the measurements using available possibilities (contemporary and modern measurements). After that, the time series and others could be presented and discussed.

Reply. Thank you for this suggestion. We have verified the results by providing metadata (see responses to points 1 and 2), which clearly demonstrate the high reliability of the meteorological observations and the observers' extensive knowledge.

In addition, we compared temperature and pressure data from Wrocław with those from Żagań and Jelenia Góra (~100 km from Wrocław) for the years 1773 and 1774. Scheibel published these data in tables in the newspaper *Ökonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*. Daily, he calculated the average of three measurements, then used those averages to calculate the monthly means. In the mentioned tables, only monthly means are available. The mean annual temperature in Wrocław was 0.2 °C higher than in Żagań and Jelenia Góra. Pearson correlation coefficients between Wrocław on one side and Żagań and Jelenia Góra on the other side were very high ($r=0.99$). Mean annual values of atmospheric pressure in Wrocław and Żagań (130 and 105 m a.s.l., respectively) were exactly the same, while in Jelenia Góra (350 m a.s.l.), pressure was ~3 hPa lower (higher elevation of the station), which is close to the average decrease of pressure in the free atmosphere (below 1 km; 1.2 hPa/100 m).

For the years 1779–81, it is also possible to compare the mean daily temperatures between Wrocław and Warsaw. The distance is greater (about 300 km), but the temperature in Poland is very well correlated (see, e.g., Tables 1 and 2 in Przybylak et al. 2014). Here, Przybylak et al. analysed a series of data for Żagań (within the Mannheim network) and Wrocław (1791–92), as well as Żagań and Warsaw (1781–92) and find correlation coefficients of 0.98 and 0.94, respectively.

Analysis of annual air temperature courses based on mean daily temperatures in Wrocław and Warsaw shows very good agreement across all analysed years. The correlation coefficients calculated from the daily data series for each year and for all three years were the same ($r=0.97$), which is even

higher than the correlation between Żagań (near Wrocław) and Warsaw (0.94) calculated by Przybylak et al. (2014) using data from 1781–92.

The previous answers regarding metadata and the extensive knowledge of weather, climate and meteorological observations exhibited by professor J.E. Scheibel and many members of the Silesian Patriotic Society, and their extensive research on even micro- and topoclimatic conditions (different heights above the ground and in different terrain forms) in the area of Silesia, remove any doubt that the data presented in this article are of very high quality and are reliable for scientific analysis (this was also the aim of Professor Scheibel). This is fully confirmed by our additional analyses that I outlined earlier that compare temperatures in Wrocław and in some stations in Silesia and Warsaw.

Przybylak R., Pospieszyńska A., Wyszynski P., Nowakowski M., 2014, Air temperature changes in Żagan (Poland) in the period from 1781 to 1792. *Int. J. Climatol.* 34: 2408–2426, <https://doi.org/10.1002/joc.3847>

Minor revisions:

Title:

[Line 1; Title]: I personally would shorten and focus on the relevant information:

“Instrumental temperature measurements in Wrocław (southwestern Poland) from 1773 to 1781”. Especially the “based on a newly discovered series of meteorological measurements” should be omitted, as it is not the paper's topic. What should be revised is the phrase “newly discovered”, where “newly” is just redundant. Maybe better: “recently discovered”.

Reply: OK. We propose the following title:

Air temperature changes in Wrocław (southwestern Poland) in 1773–81 based on recently discovered early-instrumental meteorological measurements

Abstract:

In general, the readability of the abstract is low, with most sentences beginning with “The” and a noun. There could and should be more variety in writing the sentences, as the abstract is the most important part of the paper.

[Line 15]: Again, rewrite “newly discovered”.

Reply. The abstract was rephrased.

[Line 16]: “... and its importance for climate analysis.” Either state why it is important or delete this phrase. (For instance, it is important for analyzing long-term climate variability or as additional data in data assimilation reconstructions, and more.)

OK. The sentence was changed to: *The article presents a description of an early instrumental series of meteorological measurements made in Wrocław (SW Poland) in 1773–81 and its importance for improving knowledge of climate and climate change in Silesia, Poland, and Central Europe.*

[Line 19]: If the other meteorological measurements are not the subject of the paper, leave the information about those in the abstract.

OK. We understand that you would prefer to omit this information. This was done.

[Line 24 to 27]: I don't think that the three sentences are relevant enough to be written in the abstract, especially the first two sentences.

[Line 15 to 31]: I, as a reader, would like to know if I can trust the data. Thus, add two sentences about validation with other time series (Berlin or Prague records).

OK. Done.

Introduction:

[Line 44]: "Its main goal is to find, in libraries and archives, historical sources (e.g., written records such as sagas, chronicles, maps and early instrumental measurements) that contain meteorological measurements or weather descriptions and then to record them, preferably in digital form."

I somewhat disagree here. Either write "One of its main goals is to find, ..." or include the other very important part of data rescue, which stands for deciphering, interpreting, and transforming early instrumental readings into modern units.

Reply. OK. Done

[Line 43 to 50]: Somewhere here, I would expect to get information on why it should be important to be interested in early instrumental measurements. In short, why is the work important?

Reply. Thank you for this suggestion. We propose adding the following sentence.

Early instrumental measurements, including the series of air temperatures analysed here from Wrocław dating back to the late 18th century, are primarily important for deepening our understanding of climate and its variability, as well as for calibrating existing climate reconstructions derived from proxy data and models.

Area, Data, and Methods

[Line 112, Fig.1]: Maybe a bit picky, but on the historical map, I would change the red dot to a rectangle over the block to mark where the measurements were performed. This is because then I could zoom in and could get an impression of, if measured outside, possible measurement errors (are buildings reflecting sunlight, and so on...).

Reply. Thank you for this suggestion. The correction was done.

[Line 123]: Keep one date format, i.e., in contrast to line 101.

Reply. Thank you for this suggestion. The correction was done.

[Line 124]: “The quality of this first issue of the newspaper is poor, ...” Reading this, I would expect a clarification of how poor the quality is. Did you have difficulties reading the measurements? If so, how did you address this issue? In general, it would be interesting to read a bit more about the digitization process (readability of the newspaper copies, strategies to avoid unreasonable values, and more). A few lines later, there are a few sentences about it, but it could be more extensive.

Reply. Thank you for this remark.

In the first issue of the newspaper, the text from the other, reverse side shows through, so it doesn't look the best, although the values are legible. Therefore, we decided to include a table with data from the second issue of the newspaper. In the case of the analysed source, which is a publication, there was no problem with data digitisation (data readability is very good).

[Line 127; Fig. 2]: Add an explanation for the columns in English. For instance, the first column shows the month, the second column provides brief weather comments, the third column shows precipitation, ... Also, what “Mo”, “Mi”, and “Ab” mean as referring to the times of the day, morning, midday, and evening.

Reply. Thank you for this suggestion. The following information was added in the caption of Figure 2.

Key to content by column: 1. day of the month and abbreviated day of the week; 2. brief weather descriptions; 3. measurements of precipitation; 4. observed wind direction and force; 5. phase of lunar and calendar; 6. observations of atmospheric phenomena; 7. temperature measurements; 8. atmospheric pressure measurements; 9. humidity measurements; Mo – morning; Mi – midday, Ab – evening

[Line 138; Fig. 3]: Either skip this Figure as it is not that important information to have a Figure for it, or add a second zoomed figure, where one can also see the flag. As it is now, it proves only that one sees the tower, though, at least I can't see a flag.

Reply. Thank you for this suggestion. The second zoom figure was added. However, in our opinion, the view from the observer's window (even without zoom) is important information indicating the surroundings of the measuring point. Therefore, we prefer to leave this Figure.

[Line]: Do you know more about the hygrometer measurement device? Name of the instrument, scale, dimension of the scale, and whether it measures relative or absolute humidity. Also, explain (or cite) why you know that the measurement device was

produced (invented?) by Prof. Johann Heinrich Lambert. Furthermore, how do we know the dimensions of temperature and pressure measurements? Is it a hypothesis by you, or is it explicitly stated somewhere (at least it is not in Fig. 3)?

Reply. We do not have the information you requested regarding the hygrometer device. J. E. Scheibel provided only information about the hygrometer's producer (Scheibel, 1773, *Ökonomische Nachrichten der Patriotischen Gesellschaft in Schlesien*). The information is given in the first issue of the newspaper on 9 January 1773. Units of temperature measurements and pressure are given in the same passage of the text mentioned above.

[Line 142 to 149]: Already mentioned most things in the former point, but I think the following should be made clearer here: What do we know about the instruments and the measurement itself? From where do we know that? And state explicitly what we don't know. For instance, the sentence "No further details about the exposition or precise location of the instrument installation are available." could imply that everything else is known about measurement devices, measurement procedures, and so on.

Reply. Thank you for this suggestion. The entire paragraph (below Fig. 3) has been changed, and all available information about the measuring instruments used, including units, has been provided. The information was taken mainly from two notes written by Scheibel:

1. **Scheibel J.E., 1773, Kurze Anweisung, wie diese Tafel zu verstehen und zu lesen sey, Oekonomische Nachrichten der Patriotischen Gesellschaft in Schlesien, 9 January 1773, 2-4.**
2. **Scheibel J.E., 1780, Witterungsbeobachtungen zu Breslau. Unmerfungen zu vorstehenden Tafeln, 62-64.**

[Line 152]: There are reasons for choosing this weighted mean formula. Add these reasons.

Reply. Certainly! The Polish Meteorological Service used the weighted average until the early 1970s. This average, used to calculate the average daily temperature, was closest to the "real average" calculated from eight or more measurements per day. Taking two evening readings well compensated for the lack of a 1 a.m. nighttime reading.

Results:

[Line 186]: "The newly discovered series of meteorological measurements for Wrocław for the historical period 1773–81 is quite long (9 years)."

Not really sure what this sentence adds as additional information. And if it is long, compared to what?

Reply. Thank you for this suggestion. The sentence was changed to:

The discovered series of meteorological measurements for Wrocław for the historical period 1773–81 is the third-longest series available for the 18th century.

[Line 190]: “..., we initiate an analysis of climate conditions, focusing primarily on air temperature...”

The analysis is only on temperature. Thus, you are analyzing temperature rather than climate conditions.

Reply. Thank you for this suggestion. The sentence was changed to:

In this article, we begin our exploration of climatic conditions by examining air temperature, the most important climate variable in moderate latitudes, including Poland. Other meteorological elements will be analysed in a subsequent article.

[Line 186 to 192]: In general, this content has either already been introduced or fits better in the introduction or in the Data & Methods section. In any case, it does not introduce the result section.

Reply. We think that a brief repetition in this section functions as a timely reminder for the reader and suggest leaving it. The passage was slightly revised according to your suggestion – see the previous point.

[Line 193, subsection title]: “Yearly, seasonal, and monthly resolution” might be more appropriate, as a yearly and seasonal analysis is also made in this subsection.

Reply. Thank you for this suggestion. The correction was done.

[Line 196]: “On average, in line with expectations, the warmest month was July (19.3 °C) and the coldest was January (-2.5 °C). Only slightly colder than July was August (19.2 °C). On the other hand, the other two winter months (December and February) were much warmer than January, with even positive temperatures of 1.3 and 0.9 °C, respectively (Table S2, Fig. 4).”

Especially the first sentence is trivial, so I would rephrase these sentences in something like:

Figure 4 shows the expected unimodal annual cycle of monthly means, with July (19.3 °C) and August (19.2 °C) as the warmest months and January (-2.5 °C) as the coldest. Compared to January, December (1.3 °C) and February (0.9 °C) appear warmer.

Reply. Thank you for this suggestion. We utilized your proposition.

[Line 207]: Inside the table, instead of “MEAN DAILY” write “DAILY MEAN”.

Reply. Done.

[Line 222]: “The annual cycle based on mean monthly temperature values is clearly better approximated by the temperature observed in evening hours, particularly in the

cold half-year, when the differences are about 0.4 °C (see Table S2, Fig. 4).”

This statement is kind of obvious and can be neglected: the evening temperature better represents the mean temperature than the morning and midday temperatures, which usually better represent the minimum and maximum temperatures. Also, your formula to calculate the mean temperature has a higher weight (two times the evening temperature) than the others.

Reply. Generally, you are right, but remember that we do not know the exact times of each daily observation in historical time; we only have approximate times.

The method we used to calculate the daily average has no impact on the results, as you suggest. As we mentioned earlier, taking the evening temperature twice compensates for the lack of nighttime observations. As a result, the daily mean calculated using the weighted mean is closer to the true daily mean than the daily mean calculated using the simple arithmetic mean from the three available measurements times. The weighted mean was officially used by the Polish Meteorological Services until the 1970s, when observations were not conducted at night.

[Line 225]: “The air temperature was greater in evening hours than morning hours, especially in the warm half-year (see Table S2 and Fig. 4).”

Also, obvious and can be neglected.

Reply. Thank you for this suggestion. The sentence was deleted.

[Line 228]: “The absolute range between mean monthly values measured at midday and morning hours reached 36.8 °C.”

This sentence would need more context, because I don’t understand what the benefit of this information is.

Reply. In climatology, this characteristic is commonly used and is called “absolute amplitude” (range). It provides information on the temperature range observed in a given area and period, with practical implications across many areas of economics and agriculture. Therefore, we prefer to leave this information as it is.

[Line 231]: “On the other hand, the highest single temperature measurement (33.9 °C) was recorded for midday of July 4, 1781 and the lowest (-22.8 °C) in the morning of January 27, 1776.”

Might fit better in the “Daily and sub-daily resolution” section.

Reply. The idea is to inform the reader about the possible temperature range in the area. Usually, for this purpose, we used the highest/lowest observed temperature, i.e. the absolute values of Tmax and Tmin. Hence, this is the appropriate place to include this information.

[Line 233]: “The preliminary analysis of the values revealed that data from midday can be treated roughly as the maximum observed value during the day. On the other hand,

the morning observation seems to represent approximately the minimum temperature value for the day.”

Again, obvious and can be neglected. Because of these sentences, I would wish for a systematic analysis before the results are presented. Including, among others, for instance, a comparison with modern measurements, where one can see what one could expect (annual cycle, etc.). This would also help spot certain measurement errors when comparing, for instance, the diurnal temperature range, which could indicate an unshielded temperature instrument.

Reply. We do not fully share this opinion because these values are not exactly the same as Tmax and Tmin (which are now usually measured by extreme thermometers). Therefore, we used the word “roughly”. Please also remember that, on individual days, particularly in the cold half of the year, it is not obvious. During the cold half-year in Poland, the daily pattern is not always sinusoidal; for example, the temperature may rise/fall throughout the day (advection of warm/cool air within atmospheric fronts). The highest temperature may then occur at any hour of the day. Therefore, we think the statement we propose is reasonable and helpful. We only slightly modified the sentence to:

The preliminary analysis of the values revealed that data from midday can be treated roughly as the maximum observed value for most cases. On the other hand, the morning observation appears to represent approximately the minimum temperature value for the day.

[Line 240]: This hypothesis could be checked easily. Just calculate the diurnal temperature range for the corresponding temperatures of a contemporary temperature record. If there is a significant gap between your new temperature measurements and the compared data in the diurnal temperature range, then there might be an inhomogeneity in the data.

Reply. Due to the new knowledge about methods of meteorological measurements (see metadata) in Wrocław (primarily, the finding of information about shielding of the thermometer in response to this round of reviews), as well as our checking of data quality, our hypothesis proposed in the reviewed version of the manuscript is no longer justified, and therefore we deleted the following sentences:

It cannot be ruled out that these large differences, primarily resulting from changes in the Sun's height during the day, can also be somewhat related to the thermometer having been insufficiently protected against solar radiation (Böhm et al., 2010). Both of these reasons are less important in winter, and, as a result, the smallest temperature differences occur during this season.

We replaced these deleted sentences with: *This is mainly due to greater changes in the Sun's elevation during the day in summer than in winter.*

[Figure 6]. Although the time resolutions differ (daily and monthly), Figures 4 and 6 show the same result. Thus, the conclusions of these Figures are basically similar. Skip one.

Reply. Despite there being many similarities, the annual cycle based on daily data provides many other interesting data. These include peculiarities in the course of the year, such as in Poland, we mention the “cold gardeners' days” (12-14 May) or the “Indian summer” (end of September and beginning of October), etc. It is worth checking whether such anomalies in the annual cycle also occurred in historical times. Therefore, in our opinion, both figures are necessary for a full illustration of thermal conditions in Poland.

[Figure 7]: Label the y-axis differently, “Morning temperature” and accordingly the others.

Reply. Thank you for this suggestion. Corrections were introduced.

[Table 2]: Reconsider this table, as most of the information in this table is already present in Fig. 7. (Higher interquartile range indicates a higher standard deviation and vice versa.)

Reply: Yes, you are right, but precise numbers are very often useful for comparing across months in the analysed series, as well as for other researchers who want to compare their temperature series (standard deviations) with ours. Therefore, we prefer to leave this table here. As you can see, we have already used these numbers to calculate 3SD values to identify potential outliers.

[Figure 9 b]: It would be more reasonable to calculate the monthly mean temperature of a different time period minus the monthly mean temperature of 1773-81. Seeing negative anomalies for the most recent temperature time span is odd.

Reply: We do not agree with your suggestion. According to our knowledge, most works subtract the reference period (for example, 1961-90, in our case 1873-81, 1973-81 and 2013-21) from the study period (in our case 1773-81). Additionally, we also use this method of comparing data with contemporary conditions in our other works analysing Poland's climate in historical periods (e.g., Przybylak et al. 2023). Our application of this method thus maintains uniformity of approach to this issue, so we see no merit in changing anything here. Please also note that the main topic is historical climate, not present-day climate. Drawings must show the direct temperature conditions in the historical period (warmer/colder than today), not the other way around.

Przybylak R., Oliński P., Koprowski M., Szychowska-Krąpiec E., Krąpiec M., Pospieszńska A., Puchałka R., 2023, The climate in Poland (central Europe) in the first half of the last millennium, revisited, *Climate of the Past*, 19, 2389-2408, <https://doi.org/10.5194/cp-19-2389-2023>

[Line 349 to 361] Neglect these sentences and leave it with that ModE-RA and the temperature record show differences. The reason for that is that the conclusions drawn here are not sound and are as follows: only a small number of observations (instrumental and proxy data) are near Wrocław, so one cannot trust the results of ModE-RA and should trust the Wrocław records. The Ensemble Kalman filter-based data assimilation approach also includes a background covariance matrix, which is

calculated from a climate model. Saying that, observations with a lower uncertainty, a high correlation (covariance matrix), and less distance than the length scale parameter (in ModE-RA for temperature in between 1500 and 3000 km) are also assimilated in this grid point. In other words, also measurements from Germany, Austria (Vienna, Kremsmünster, etc...) are assimilated in this specific grid point, although further away. However, they also published a so-called feedback archive, which allows checking which observations “suggest” which value for this grid point. That said, sure, new instrumental measurements are valuable for data assimilation, but the arguments here are not valid.

Reply. Thank you for your suggestion; the passage was slightly rephrased.

[Line 398]: Maybe a bit inconsistent here, as before it was said that the results are different between ModE-RA and the Wroclaw temperature record.

Reply: In detail, there are different results (historical period), but the overall results are consistent, particularly when analysing the temperature differences between historical and current conditions. Please also note that the statement in line 398 concerns the similarity in the change in temperature between the historical and present-day periods, whereas earlier we were describing differences between the two data sources within the historical period.

[Line 406]: “We hope that such an adjustment can be made in any subsequent version of the ModE-RA paleo-reanalysis, because not only has this series been discovered, but so to have others for other historical periods.”

Not sure if the meaning makes sense.

Reply: The sentence was slightly rephrased. We hope that it is clearer now, see text below:

‘We hope that such an adjustment will be carried out in the future, using the newly discovered series of early instrumental meteorological data, “extracted” and digitised from archival and library sources.’

[Line 410]: Write a more comprehensive summary without having a list of points. Also, it should include an outlook for publishing the other meteorological measurements (if not included in this paper; see major concerns of this comment)

Reply. Done.

Thank you very much for carefully reading our article and for your valuable comments, which significantly improved it. In particular, we are grateful for the comments that prompted us to seek further information on the methodology applied in making the measurements, as this yielded the new

sources attesting to the scientific rigour that had been applied to adequately calibrate and screen the instruments. Clearly, this discovery increased the confidence with which we can treat the data. We hope we have adequately addressed most of your comments and suggestions.