Anonymous referee #2

The article is very interesting and valuable, providing a lot of important information about the weather and climate in the Czech Lands in the 15th century. That is why I suggest its publication in the journal *Climate of the Past*; however, it still requires some corrections and clarifications.
RESPONSE: We would like to thank the anonymous referee #2 for generally positive evaluation of our study as well as several comments, which we are trying respond to below.

Main weaknesses:

1. In the Introduction part, I suggest including a short summary of the present state of the art knowledge about 15th-century weather and climate in the Czech Lands (now the Czech Republic).

RESPONSE: In lines 41-44 we mention following: "However, surviving Czech documentary evidence before the 16th century is sparser, permitting description of only some weather/climatic patterns and HMEs in certain years (Brázdil and Kotyza, 1995, 1997), which were used, for example, by Brázdil et al. (2017a) to analyse severe famines in the 1280s, 1310s, and the early 1430s in the Czech Lands in relation to weather and climate conditions." We hope, that here we characterise what is available until now for the 15th century in the Czech Lands and what was done, i.e. "description of only some weather/climatic patterns and HMEs in certain years" and their further use for the analysis of "severe famines in the 1280s, 1310s, and the early 1430s".

2. I suggest significantly shortening Section 2, as it is definitely too long and detailed, and is only loosely connected with the main subject of the paper, although it gives some background on the political, social and economic situation.

RESPONSE: The description of the political, social and economic situation in the Czech Lands during the 15th century only encompasses 39 lines from the total 553 lines of the manuscript. We believe this to be necessary to understand the many factors that undoubtedly influenced the availability and number of documentary sources, from which weather/climatic reports were derived. We believe, that in historical climatology papers we should at least partly (as here) take in account related historical situation for complex evaluation of the analysed topic (see e.g. lines 514–530, where historical context is necessary). Moreover, another referee Dr. Neil Macdonald commented this chapter as follows: "A good section that explains why the different sources are found, and the socio-economic context to the records, which is often over looked." These are reasons, from which we would like to preserve Sect. 2 in its original extent, because Climate of the Past has readers not only among climatologists.

3. The Discussion part can be improved by comparison of the presented results for Czech Lands with the available weather and climate information (many quantitative reconstructions based on both documentary evidence and natural proxies) from the neighbouring area of Poland (see Ghazi et al. 2023, https://doi.org/10.1016/j.jhydrol.2023.129778; Przybylak et al. 2023, https://doi.org/10.5194/cp-19-2389-2023, the last item is cited in the paper, only generally), because, as result from the reviewed paper as well as Luterbacher et al. (2010), both areas are very well correlated, in particular in case of winter air temperature. Also, because both areas are included in Central Europe, in the case of the ModE-RA paleoreanalysis data used in the paper. It should also be remembered that the 15th-century reconstructions from ModE-RA are entirely modelled data without any assimilation of data from this region. For Europe, only one series of data

from the Low Countries (Van Engelen et al., 2003, see https://mode-ra.unibe.ch/climeapp/) was used for the period from October to March. The situation is better for the warm half-year, for which proxy data (mainly tree-ring widths) are mainly available from SW Europe and Fennoscandia; however, no data are available from Central Europe, the entire Eastern Europe, and SE Europe.

Luterbacher J., Xoplaki E., Küttel M., Zorita E., González-Rouco J. F., Jones P. D., Stössel M., Rutishauser T., Wanner H., Wibig J., Przybylak R., 2010, Climate Change in Poland in the Past Centuries and Its Relationship to European Climate: Evidence From Reconstructions and Coupled Climate Models. In: Przybylak R, Majorowicz J, Brázdil R, Kejna M (eds) The Polish Climate in the European Context: An Historical Overview, Springer, Berlin Heidelberg New York, 3-39.

RESPONSE: Following the referee's comment on the matter of Polish papers, we added the proposed papers and their results into the first paragraph of Sect. 6 Discussion as follows:

"Many of the weather events and anomalies, as well as the derived temperature/precipitation indices, reported herein for the Czech Lands were also documented in other European regions or countries, such as Germany (Glaser, 2008), the Low Countries (van Engelen et al., 2001, 2009), the Burgundian Low Countries (Camenisch 2015), Poland (Przybylak et al., 2023) and the western-central European area (Pfister and Wanner, 2021). Interpretation of a number of severe winters, extending to March or April in the Czech Lands during the 1430s (cf. Fig. 2), together with the occurrence of floods (also, in part, windstorms and convective storms), confirm the severe character of the cold 1430s in Europe, as described by Camenisch et al. (2016). Similarly for Poland, Przybylak et al. (2023) mentioned a higher frequency of cold and very cold winters for the 1430s as-well as their higher wetness (*cf.* Fig. 2). Another similarity between the Czech Lands and Poland concerning of moisture regime is dictated mainly by summer indices. Pfister et al. (2024), analysing wine must quality as a reflection of weather patterns for Germany, Luxembourg, eastern France, and the Swiss Plateau in 1420–2019 CE, identified the years 1470–1479 as having the highest average quality on the decadal scale, which is correlating well with warm summers in the 1470s in Poland (Przybylak et al., 2023). On the other hand, years of poor wine quality in 1453–1466 and 1485–1494 were attributed to prevailingly cold and wet summers (Pfister et al., 2024). In the subsequent paper dealing with wine must yields for 1416–1988 CE, Pfister et al. (2025) identified as "good harvest" years those between 1416 and 1425 and further 1471–1473. Of the years of drought and low water levels in medieval Hungary (Kiss and Nikolić, 2015; Kiss, 2017), dry patterns in the Czech Lands tallied with those that they highlight in 1473, 1479 and 1482. The year of 1455, with a warm summer, was probably dry there too. Concerning floods as an opposite extreme to droughts, from identified 18 flood years in the Czech Lands 14 such years (i.e., 77.8%) agreed with flood years selected for Poland by Ghazi et al. (2023)."

Concerning of comparison with other indices as proposed by the referee, we included a new paragraph connected to Fig. 10 as follows:

"Quantitative verification of Czech indices for DJF and JJA temperatures and JJA precipitation used in Fig. 10 can be also performed for temperature and precipitation indices from the Low Countries (van Engelen et al., 2001, 2009). Although the temperature indices were defined on different scale (from 1 to 9) and for differently defined seasons (November to March for DJF and May to September for JJA patterns), they show strong and statistically significant ($p < 0.05$) Spearman rank correlation with the Czech indices particularly for DJF temperatures (0.89) and JJA precipitation (0.83) and naturally slightly lower correlation for JJA temperatures (0.54). Comparison of Czech temperature indices with those derived for Western and Central Europe by Pfister and Wanner (2021) gives a lower correlation for DJF temperatures (0.75) and a higher correlation for JJA temperatures (0.62) than with Low

Countries, but statistically significant in both cases ($p < 0.05$). Much smaller number of JJA precipitation indices did not allow to compare both considered datasets.
As for above comparison of Czech with van Engelen et al. (2001, 2009) and Pfister and Wanner (2021) indices is necessary to note, that temperature indices from both datasets show clearly higher frequency of very cold and extremely cold DJFs than of very warm and extremely warm DJFs. Similarly, there appeared also significantly higher number of hot and extremely hot JJAs compared to very cold and extremely cold JJAs. However, this feature does not reflect properly climatic patterns of the 15th century, but it rather points out to a specific extreme-oriented feature of documentary indices (Brázdil et al., 2005)."

As for the referee's point It should also be remembered that the 15th-century reconstructions from ModE-RA are entirely modelled data without any assimilation of data from this region we add that we are aware of the limitations of ModE-RA data for the 15th century. We agree that the resulting reanalysis is primarily defined by the results of the model used especially for winter. For this reason, we also provide the SD ratio (see Sect. 4 Methods, lines 176–179). In Sect. 5.4 we point out that high SD ratio values indicate generally higher uncertainties associated with the use of ModE-RA data. Nevertheless, we believe that the reanalysis is a valuable source of information on the climate of a significant part of the 15th century, as it provides physically consistent estimates of several climate variables at monthly resolution. Furthermore, the added value of this data source, e.g., for analysis of past hydrometeorological extremes, has been demonstrated in several studies (e.g., Valler et al., 2024; Brönnimann et al., 2025).
New references:
Brönnimann, S., Franke, J., Valler, V., Hand, R., Samakinwa, E., Lundstad, E., Burgdorf, A.-M., Lipfert, L., Pfister, L., Imfeld, N., and Rohrer, M.: Past hydroclimate extremes in Europe driven by Atlantic jet stream and recurrent weather patterns, Nat. Geosci., 18, 246–253, https://doi.org/10.1038/s41561-025-01654-y, 2025.
Ghazi, B., Przybylak, R., Oliński, P., Bogdańska, K., and Pospieszyńska, A.: The frequency, intensity, and origin of floods in Poland in the 11th–15th centuries based on documentary evidence, J. Hydrol., 623, 129778, https://doi.org/10.1016/j.jhydrol.2023.129778, 2023.
van Engelen, A. F. V., Ijnsen, F., Buisman, J., and van der Schrier, G.: Precipitation indices Low Countries, in: Poster Abstracts of the Millennium Milestone Meeting 3, edited by: Young, G. and McCarroll, D., Cala Millor, Mallorca, 62–63, 2009.

Minor weaknesses

1. lines 176-177 – not clear the area for which SD was calculated, Central Europe, or a smaller area encompassing only the Czech Lands?,

RESPONSE: The corresponding sentence was corrected as follows: "Using the ClimeApp application (Warren et al., 2024), we calculated for Central Europe (45–55° N, 5–25° E) the standard deviation (SD) ratio, which helps clarify the differences found from the above tests using ModE-RA reanalysis."

2. lines 458-460 – I suggest rewriting these sentences slightly, taking into account the information given at the end in point 3 (Major weaknesses),

RESPONSE: We wrote in the cited lines following text: "Furthermore, this is completely independent source in this study, as no data from the Czech Lands prior to 1500 CE has been assimilated in ModE-RA dataset. One disadvantage is that the density of different types of proxies is relatively low in the 15th century and the re-analysis is dominated by the ensemble mean of the atmospheric circulation model in this period (see Hand et al., 2023 and Valler et

al., 2024 for more details)." We believe that nothing is wrong in our statements and we do not know what kind of a slight correction the reviewer expects.

3. lines 487-488 - this is a very well-known volcano eruption (Kuwae in Vanuatu), only the precise date is not established yet. The most probable date is 1452/1453 CE; however, in literature, other dates are also given, most of which fall in the 1450s. Kuwae was one of the largest eruptions in the past millennium,

RESPONSE: We do not believe that there is an adequate consensus on the topic of origin (Ballard et al., 2023). It is worth noting that the 1452/53 event is more prominent in Northern Hemisphere records, and it has therefore been suggested that it was the result of an extratropical eruption (Burke et al., 2023). The Kuwae event, which previously was placed in 1452/53 (Gao et al., 2006), is thought by some to have originated in 1458/59 (e.g., Gautier et al., 2021) – which has, in part, been corroborated very recently by Antarctic ice core data (Ro et al., 2025). This latter study by Ro et al. (2025) also raises the possibility of two independent but concurrent eruptions around 1458 – making the story even more complex. As we are not tephrochronologists, we prefer to not attribute the eruption(s) directly (and doing so/not doing so does not change the story of our manuscript). Nonetheless, we tried slightly change the corresponding paragraph (lines 485-493) as follows:

"Despite some uncertainties in the identification and timing of large volcanic eruptions, particularly in the 1450s (Bauch, 2017; Esper et al., 2017; Abbott et al., 2021; Ro et al., 2025), their cluster in Fig. 6b coincides well with temperature fluctuations in Europe. In JJA temperatures by Luterbacher et al. (2016) (Fig. 8a), a significant cooling appeared in 1453 as a response to an eruption of debated origins in 1452/53 (e.g., Ballard et al., 2023; Burke et al., 2023), previously attributed by Gao et al. (2006) to the Kuwae volcano eruption in Vanuatu. The cooler Czech summers in 1453–1454 identified in the documentary sources (cf. Fig. 2) followed this eruption. The volcanic cooling persisted for about the next 15 years, and its Northern Hemisphere extent was demonstrated in several TRW proxy reconstructions (Esper et al., 2017), but it did not appear further in the Czech JJA temperature indices (cf. Fig. 2). Strange atmospheric phenomena visible all over Europe in September 1465 as the result of a volcanic dust veil, but dated to 1464/1465, were described by Bauch (2017). The persistence of the cold period may be related to another Southern Hemisphere eruption in 1457 or 1458 (Abbott et al., 2021). Moreover, the recent analysis of Antarctic ice core data by Ro et al. (2025) mentions the possibility of two independent but concurrent eruptions around 1458."

New references:

Ballard, C., Bedford, S., Cronin, S. J., and Stern, S.: Evidence at source for the mid-fifteenth century eruption of Kuwae, Vanuatu, J. Appl. Volcanol., 12, 12, https://doi.org/10.1186/s13617-023-00138-1, 2023.

Burke, A., Innes, H. M., Crick, L., Anchukaitis, K. J., Byrne, M. P., Hutchison, W., McConnell, J. R., Moore, K. A., Rae, J. W. B., Sigl, M., and Wilson, R.: High sensitivity of summer temperatures to stratospheric sulfur loading from volcanoes in the Northern Hemisphere, Proc. Natl. Acad. Sci. USA, https://doi.org/10.1073/pnas.2221810120, 2023.

Gao, C., Robock, A., Self, S., Witter, J. B., Steffenson, J. P., Clausen, H. B., Siggaard-Andersen, M.-L., Johnsen, S., Mayewski, P. A. and Ammann, C.: The 1452 or 1453 A.D. Kuwae eruption signal derived from multiple ice core records: Greatest volcanic sulfate event of the past 700 years, J. Geophys. Res., 111, D12107, https://doi.org/10.1029/2005JD006710, 2006.

Ro, S., Hur, S. D., Ekaykin, A., Han, Y., Ro, C.-U., Hong, S.-B., Lee, M. J., Chang, C., Lee, S., Moon, J., Jung, H., Veres, A., Lee, A., and Hong, S.: Origin of the 1458/59 CE volcanic eruption revealed through analysis of glass shards in the firn core from Antarctic Vostok station, Commun. Earth Environ., 6, 828, https://doi.org/10.1038/s43247-025-02797-x, 2025.

4. lines 492-493 - it seems that that eruption can also be attributed to the Kuwae volcano; see what Abbott et al. (2021) wrote in the Introduction part of the cited paper: *'The large sulfate-loading eruption during the 1450s CE has most commonly been attributed to the formation of the submarine Kuwae caldera offshore of Vanuatu in the South Pacific.'*

RESPONSE: Our expression in lines 492-493 says: "The persistence of the cold period may be related to another Southern Hemisphere eruption in 1457 or 1458 (Abbott et al., 2021)." We are just citing what is presented in Abbott et al. (2021) on page 565, i.e. we do not see to join it with the Kuwae volcano. Otherwise please see our expression to the preceding point 3.