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Climate of the Past Discussions

Interactive comment on "April–August temperatures in the Czech Lands, 1499–2012, reconstructed from grape-harvest dates" *by* M. Možný et al.

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Referee 1 We would like to thank Anonymous Referee 1 for very valuable comments contributing to the improvement of the paper.

The manuscript entitled "April-August temperatures in the Czech Lands, 1499-2012, reconstructed from grape harvest dates" written by Mozny et al. provides an interesting set of proxy-based past temperature data for Czechia. The manuscript is in general well written and in accordance with scientific standards. Even though the idea of reconstructing temperature conditions in the past based on grape harvest dates is definitely not new (as authors write in line 5, page 2: "GHDs have been used for reconstruction of temperatures series" in many countries) the manuscript might be worth to be published

in Climate of the Past due to (1) the innovative statistical tool of variance scaling used to optimize capturing extreme temperatures (2) the remarkable fact that there are no temporal gaps in the time series. RE: Thanks for the positive evaluation of our paper.

Prior to publication authors should address the following issues: (1) Please, carefully double-check the reference list. I flew superficially over the reference list and detected several mistakes and especially inconsistencies in the reference styles. I highlighted them in the pdf version attached (no claim of completeness). RE: References were checked and corrected in agreement with instructions for references in Climate of the Past.

(2) I am not always convinced by the structure of the manuscript. E.g. lines 30-33, page 6; lines 1-2; page 7 and lines 8-18, page 8 are not presenting the results but discussing them. I suggest shifting those paragraphs to the Discussion section. RE: Accepted, these paragraphs were moved to Discussion.

(3) In the Discussion section the link to the results of the present work is partly missing. RE: Accepted, key results and benefits were highlighted in Discussion as folllows: "The Czech April–August temperature reconstruction was based on a series of continuous GHDs for 1499–2012 and using the innovative statistical tool of variance scaling to optimize capturing extreme temperatures. This reconstruction indicates more readily extremely warm years than cold ones; the percentage of warm extremes confirmed from GHDs (61%) is significantly higher compared to cold extremes (39%)."

Specific comments are to be found in the pdf file attached. RE: All specific comments to the article were included based on pdf file attached.

Referee 2 We would like to thank Anonymous Referee 2 for very valuable comments contributing to the improvement of the paper.

Mozny and colleagues present a new, continuous record of Grape Harvest Dates for the Czech lands back to 1499. The paper is well structured and merits publication in a

peerreviewed journal. The authors should make sure that the data will be available with publications in a archive (e.g. NCDC/NOOA). This accompanying publication highlights strengths and weaknesses in usefull way. RE: Thanks for the positive evaluation of our paper. Data will be made available in the archive (NCDC/NOOA).

Considering the focus on data compilation and reconstruction methods, more attention should be paid to this part of the study. See remarks in the PDF attached. There is need for better documentation of the newly recovered archival sources, compilation methods, data corrections for Julian calendars etc. RE: Accepted, added to the new version (data type and their contemporaneity; correction for Julian calendar in Area and data) as follows: "The new Czech GHD series is composed from grape harvest dates recorded in contemporary manuscripts (1499–1844) and those observed in institutional phenological network (1845–2012). Documentary data earlier than AD 1584 have been re-dated to the Gregorian calendar by adding 10 days to the previous Julian calendar."

Defining annual values as the median dates in years with more than one year seems a reasonble choice. However, the composition of the time series would be much more reliable with deeper analyses presented concerning the spatial variablity of GHD in one year. See PDF for more comments. RE: Spatial differences between the wine districts is very small (documented in the new version using standard growing degree-days, Huglin Index and average growing season temperature index) as follows: "The entire Czech wine region falls in a Region I according to standard growing degree-days (GDD), representing climate type Cool by Huglin Index (HI) and cool climate maturity by an average growing season temperature index (GST)." Moreover, another sentence was added to explain the spatial variability of GHDs: "While until 1844 the spatial differences in GHD among individual places achieved in average 1–3 days, further increase in the number of sites in phenological network (cf. Fig. 2b) led to differences of 1–8 days."

The discussion of socio-cultural events (eg war periods) in relation to the moving correlations could be nicely illustrated in Fig. 9. These incidents may partially explain

the variability (or drop) in moving correlations. Consider adding the events on the figure. RE: Accepted, the new version of Fig. 9 was presented with identification of four socio-cultural events – see also additional explanations to the figure caption: "Vertical columns A–D identify periods in which GHD's might have been influenced by social and political processes discussed in the text: A – a series of bad grape yields, B – the Thirty Years' War, C – the War of the Austrian Succession and the Seven Years' War, D – a series of bad grape yields."

All comments included in the file attached were included into revised manuscript.

Referee 3 We would like to thank O. Nordli (Referee 3) for very valuable comments contributing to the improvement of the paper.

Mozny and colleagues present a well written article on the subject, April-August temperature reconstruction based on wine harvest dates (WHD). They also follow sound statistics in line with a newly published article by Danny McCarrol et al. (2015), see their reference list. It is amazing that it is possible to cover this long period 1499-2012 with continuous WHD data. Certainly it has taken much time to discover and compile all data used in the article. This reconstruction will have the potential to be widely used, also by historians. The present article is well suited to be published in the Climate of the Past with only minor revisions. RE: Thanks for the positive evaluation of our paper.

However, I am missing analysis of the spatial differences between the wine districts used. Had it been possible to adjust the harvest dates for these differences if they exist? Certainly those differences are known by a dense network of climate stations in Czech Republic. RE: Spatial differences between the wine districts is very small (documented in the new version using standard growing degree-days, Huglin Index and average growing season temperature index) as follows: "The entire Czech wine region falls in a Region I according to standard growing degree-days (GDD), representing climate type Cool by Huglin Index (HI) and cool climate maturity by an average growing season temperature index (GST)." Moreover, another sentence was added to explain

the spatial variability of GHDs: “While until 1844 the spatial differences in GHD among individual places achieved in average 1–3 days, further increase in the number of sites in phenological network (cf. Fig. 2b) led to differences of 1–8 days.”

Further comments:

Introduction: The authors present a well written and informative introduction showing that they know the subject very well. RE: Thanks for positive evaluation of Introduction.

Methods: P4L22 and many other places: May be explained variance should be substituted by variance accounted for, as regression analysis does not “explain” anything. RE: Accepted, corrected in the entire article.

P5L11: I suggest that the formulas for RE and CE should be written also in this article, although there is a reference in the text. RE: Accepted, added the formulas for RE and CE in Section 3 Methods.

Arena and data: P2L32: The annual mean temperatures and precipitation in the wine growing district are given, but why not the mean temperature for the period in question: April-August. (It is also necessary to give the period for the temperatures). RE: Accepted, corresponding text was corrected as follows: “The mean annual temperature achieves 8.7°–8.9°C (15–15.3°C for April–August season) and the mean annual precipitation totals are 480–540 mm (255–280 mm for April–August season) for the 1961–2000 period in the area studied.”

P3L24: What is meant with target climatology should have been explained. I think this article will be read by researcher crossing professional borders, in particular historians, so it might be important to explain nomenclature for people outside our profession. RE: Accepted and explained in Section 2 as follows: “Mean Czech temperatures for 1800–2010 (Brázdil et al., 2012a, 2012b), were used as a target climatological series for temperature reconstruction during the pre-instrumental records from GDHs.”

Results: P5L21: .. earlier harvest dates .. Earlier that what ? RE: Accepted and

corrected as follows: “Fluctuations of GHDs in the Bohemian wine-growing region during the 1499–2012 period indicate that earlier harvest dates (12 days earlier than the 1961–1990 mean) were found in 1991–2012 (Fig. 3).”

P6L4-5: Durbin-Watson test (DW). The abbreviation should be defined. Used in line 9. RE: Accepted, added the formulas for DW in Section 3 Methods.

P6L5-9: It seems strange that autocorrelation is no problem within each of the sub period, whereas it is a problem within the whole period. How can this be? This should be explained. RE: There was a formal mistake in calculation of DW value for full period. The corrected value of DW (1.9) was newly included in Table 1. This means that there is no problem in DW test in any calibration period.

P6L14: Insignificant – in what context. I think the last sentence in this passage should be deleted. RE: Accepted, the corresponding sentence was deleted.

P6L18-19: LR . . .confirm the general assumption . . .. This is not only an assumption: it follows from the theory of LR (as also the authors present). Reformulation is needed. RE: Accepted and corrected as follows: “The corresponding values for the LR model are –1.9°C (1919) and 2.5°C (2000) respectively and they showed that the regression reconstruction is biased towards the mean and underestimates the true variability of the target data.”

P6L32-33 - P7L1: ..to capture negative extremes, dry and hot conditions . . . The whole sentence is not clear to this reviewer. Please reformulate. RE: Accepted and corrected as follows: “This reconstruction indicates more readily extremely warm years than cold ones; the percentage of warm extremes confirmed from GHDs (61%) is significantly higher compared to cold extremes (39%). This finding is interesting in the light of comparison with a number of hydroclimate reconstructions (drought, precipitation) based on dendro-climatological data (Büntgen et al., 2011; Bronisz et al., 2012; DobrovolnÃ¡ et al., 2015).”

P7L15: .. increasing trend.. ? Probably the authors mean positive trend. If they really mean increasing trend, this has to be better explained. RE: Accepted and corrected as follows: “Temperature fluctuations show great interannual and interdecadal variability and a positive trend for the instrumental part of the series from the 19th century onwards, particularly pronounced since the 1970s.”

P8L10-14: A shift to lower correlation when the PHENODATA was introduced. Why? Is the quality of the PHENODATA lower than for the preceding data. Should be discussed in Ch 5. RE: Accepted and supplemented as follows: “Decreases in running correlations between Czech April–August temperatures and other proxy-based temperature central European reconstructions in the mid-18th century and at the end of the 19th century (slightly earlier for the tree-ring group) appear to a greater or lesser extent in all five groups of the reconstructions compared (Fig. 9, D). This indicates that there may be some problems in the quality of the GHD series for these periods. Warmer and wetter weather in August–September in the mid-18th century caused a higher incidence of fungal diseases on hops and vines, which influenced the timing (early harvest) and yields (MožnÃ¡ et al., 2016). Effective synthetic pesticides and fungicides were not used until the early 1920s. The approach to vine growing and fermenting grapes changed in the late-19th century, affecting later harvest dates (Kilián, 2012). Vine-growers experimented for several years with harvesting a few days later, since sunny weather in October may have helped augment sugar content.”

Discussion P9L2: Should be Fig.9 (not Fig. 6). RE: Accepted and corrected.

P9L8-9: .. Fail to reflect the critical period .... starting 1580... But in Fig. 8 we see low temperatures in this period, so why has the reconstruction failed for this period. Do you think that the temperatures should have been still lower than those reconstructed? RE: Accepted and corrected as follows: “The recent Czech reconstruction shows a temperature decrease in a critical period for wine production in the late 16th century (Fig. 9, A) (Brázdil et al., 2013). Starting in the mid-1580s, a number of years produced small amounts of wine, of very inferior quality.”

P10L6: I cannot see any inconsistency around year 1600 from Fig. 9, but the other years listed seems OK (again not Fig. 6). RE: Accepted and corrected as follows: “Possible inconsistencies in the two reconstructions based on biophysical series are disclosed for the years around 1675, 1730, 1770, 1900 and 1980 (Fig. 9).”

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