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Climate of the Past
Discussions

Interactive comment on "A tree-ring perspective on temporal changes in the frequency and intensity of hydroclimatic extremes in the territory of the Czech Republic since 761 AD" *by* P. Dobrovolný et al.

P. Dobrovolný et al.

dobro@sci.muni.cz

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We are thankful to both reviewers for their critical comments and suggestions, which we thoroughly considered. Most of them may be incorporated in the revised manuscript. At this moment - before editor's decision - below we refer to the most serious objections and we try to explain some miss-understandings.

Comments to Referee #1:

Referee #1: ". . . the oak TRW data they use are simply not up to the task and are not responsive enough to hydroclimate. I cannot see how these data could lead to any confidence about the "trends" in hydroclimatic extreme in the CR."

Response: To our knowledge, there is no other countrywide oak tree-ring width dataset of similarly high replication and spatiotemporal extent. Moreover, it is well known that the growth-climate response of Central European oaks is generally lower than the temperature signal often found in conifers from upper or northern treeline ecotones. However, oak represents the most important deciduous species for the development of multi-centennial or even multi-millennial long tree-ring composite chronologies for large parts of Central Europe, because this species accounts for most of the historical timber (e.g. Tegel et al. 2010). Moreover, many recent studies successfully used living and historical oak samples to reconstruct year-to-year and longer term changes in local to synoptic-scale spring-summer precipitation totals and/or drought variations (Kern et al. 2009; Büntgen et al. 2010, 2011b; Cooper et al. 2013; Wilson et al. 2013; Rybníček et al. 2015b). The reported climate sensitivity in all these studies did not exceed correlation coefficients of 0.5 significantly. In this regard, we are convinced that our newly developed dataset of 3194 oak (Quercus spp.) ring width samples from living and historical oaks from all over the Czech Republic represents a sound basis for providing a robust perspective on temporal changes in the frequency and intensity of hydroclimatic extremes back to 761 AD. It should be further noted that we deliberately restricted all time-series analyses and subsequent climatological interpretations to the high-frequency domain only, where the signal-noise ratio is generally enhanced.

Referee #1: Ultimately, the main question that must first be better addressed is what environmental factors are driving the extreme annual values in the oak TRW chronologies. With a calibrated signal of only 18-20% to precip/SPEI, one must not forget that 80% of the variability in the chronologies is explained by something else.

Response: Although a multitude of factors has been applied to assess the growth-climate response patterns of the Czech oak composite tree-ring width (TRW) chronology, i.e. negative and positive TRW extremes were compared with instrumental mea-

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surements back to 1805AD, with documentary-based temperature and precipitation reconstructions between 1804 and 1500, as well as against documentary evidence before 1500 AD.), we deliberately did not calibrate the new extreme year proxy record to any meteorological target. Nevertheless, we could demonstrate that negative TRW extremes coincided with above-average March–May and June–August temperature means and below-average precipitation totals. Positive extremes coincided with higher summer precipitation, while temperatures were mostly normal. Mean sea level pressure (SLP) over the European/North Atlantic sector suggested drought for the negative oak TRW extremes, whereas the positive extremes corresponded to wetter conditions overall. More consistent patterns of synoptic SLP were found for negative rather than for positive extremes.

Referee #1: If the authors plotted the chronology ensemble and the main hydroclimate parameters, how many extreme years (positive and negative) actually agree between the proxy and actual data – not many I would guess. Response: A total of 26 years with negative TRW extremes were identified in the 1805–2010 period. While MAM and JJA Czech precipitation totals and SPEI-1 values were significantly below mean ($p < 0.05$), temperatures did not diverge significantly from normal patterns. Moreover, temperatures fluctuated on a broad scale in both seasons (Fig. 4). Thus negative extremes correspond to dry conditions, when tree growth stress is particularly related to the shortage of available precipitation. In contrast, the climate patterns 25 for the 23 years with positive extremes were less pronounced. Only JJA precipitation totals and SPEI-1 show the above-mean values that might indicate a surplus of moisture and favourable conditions for oak growth. Both MAM and JJA mean SLP fields in extremely negative (positive) seasons in the instrumental period indicate circulation patterns that are highly favourable to the occurrence of dry (wet) conditions in CE (Fig. 5). For negative extremes, a statistically significant increase of SLP in a large part of Europe in spring emerged in comparison with the reference period. The positive pressure anomaly diminished somewhat in the summer months. Positive pressure anomalies signal below-mean precipitation totals and above-mean temperatures in both seasons.

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This corresponds to the characteristic prerequisites for drought occurrence in CE.

Referee #1: Although hydroclimate might be the dominant factor, it still only explains 20% of the TRW variability. . . . Much more is needed to try and model better the controlling factors of the inter-annual.

Response: See our earlier responses. We agree that the role of environmental factors that are driving extreme TRW years should be better explained in the text.

Referee #1: I assume the authors have also examined more secular scale changes in the TRW data, when appropriately detrended, and I wonder if these data would be simply be better at decadal and longer time-scales?

Response: We deliberately restricted all time-series analyses and subsequent climatological interpretations to the high-frequency domain only, where the signal-noise ratio is generally enhanced. Developing a high-frequency, extreme year record of oak growth back to 761 AD is actually the focus of this paper.

Referee #1: Perhaps consider more comparison to extremes in other TR records such as Brazdil (2002) and further afield records (including Oak and conifer records from Germany??) and possibly the gridded multi-proxy (but dominated by historical data?) precipitation/ hydroclimate products of the Luterbacher group (e.g. Pauling etc).

Response: Further comparison beyond documentary evidence will be added.

Comments to Referee #2: We appreciate the list of papers that will definitively help updating the present "state of the art" and discussion parts. Detailed information on the study area, as well as a full list of the reconstructed extreme years is now provided in the revised manuscript. With respect to referee #1, we also added a more straightforward comparison of our findings against previously published results from independent studies. Moreover, we expanded the critical discussion about the complex interplay of direct and indirect climatic effects on radial oak growth across Central Europe.

Interactive comment on Clim. Past Discuss., 11, 3109, 2015.

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