

Interactive comment on “Stable isotopes in cave ice suggest summer temperatures in East-Central Europe are linked to AMO variability” by Carmen-Andreea Bădălută et al.

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Received and published: 8 April 2020

Dear editor and reviewers,

On behalf of the authors, we thank you for the time spent on reading our article and for the constructive comments. In the attached document we present our point-by-point responses to the comments and the subsequent modifications of the text.

Response to reviewer #2

Comment: Besides comments directly highlighted in the corrected pdf, I have only one point that in my opinion could/should be better addressed. What is missing is a wider

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discussion comparing other results recently obtained in ice cave core campaigns conducted in other regions of Europe. For instance, a very recent and interesting paper by Sancho et al. 2018 “Middle-to-late Holocene palaeoenvironmental reconstruction from the A294 ice-cave record (Central Pyrenees, northern Spain)” gives interesting results in highlighting a link with NAO in this area. Do you think there could be or there is also a link with the NAO in the ice accretion of this cave? The paper would benefit in terms of interest for a wider audience if comparison with other studies will be presented from ice cave coring programs. The ice cave community is not so big and thus not many papers dealing with such evidence exist. It wouldn't be a huge effort to discuss other results in this field, but a great improvement to the paper with a small commitment.

Response: Indeed, there are but a very few reconstructions of past climate variability, and the one by Sancho et al. (2018) is singular in Western Europe. We have deliberately left this record out of discussion as we 1) were focusing on summer climate variability and 2) strongly support analysis of paleoclimate records not by archive or proxy type, but by the climate variable they are recording and the season these variables represent. The ice in the A294 cave records winter climate conditions (the ice in the cave formed by snow diagenesis (and to a lesser extent water freezing), strongly influenced by NAO variability. Now, the NAO is influencing European climate during winter (Hurrell et al., 1995; Bojariu and Paliu, 2001), having an almost imperceptible influence of summer climatic conditions (also some annually-sensitive records “see” the NAO influence, likely due to the fact that they incorporate winter signals). Nevertheless, we have expanded the introduction to include information on more ice-caves studies. The text now reads: “In such caves, ice forms either by freezing of water or direct snow deposition in the entrance shafts (e.g., Mavlyudov, 2018). Several studies have shown that these deposits host a wealth of information on past climate variability. Thus, Persoiu et al. (2017) and Sancho et al. (2018) have shown that proxies in cave ice forming during winter months record changes in temperature and moisture sources, likely influenced by the dynamics of the North Atlantic Oscillation. Other studies have used pollen and

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plant macrofossils recovered from cave ice to reconstruct past vegetation dynamics (Feurdean et al., 2011; Leunda et al., 2018) while others used the accumulation rate of ice as indicators of past climatic variability (e.g., Kern et al., 2018) or atmospheric processes (Kern et al., 2009). Studies of ice caves in southern Europe have also highlighted the sensitivity of cave glaciers to summer climatic conditions (Colucci and Guglielmin, 2019; Colucci et al., 2019, Persoiu et al., 2020)."

Comment: P1 L31 – I would say that temperature and precipitation are of course important, but specifically the ones we have for the longest period. . . other parameters would be important as well, but we don't possess long records.

Response: Yes, indeed. We have changed the text: "Especially important are high-resolution reconstructions of the past variability of different climatic variables – seasonal air temperatures, precipitation amounts, moisture sources – that allow for direct comparisons with the dynamics of natural forcing and further deciphering the mechanisms of past and present climate dynamics."

Comment: P2 L15-20 Here the authors already give conclusions. . . I would prefer to read here the goals of this work and find the conclusions at the end of the manuscript.

Response: We have rephrased the text according to the suggestion. It now reads: "Here, we present a reconstruction of summer climate variability and large-scale circulation drivers during the last 1000 years in East Central Europe based on the $\delta^{18}\text{O}$ and $\delta^2\text{H}$ values measured along an ice core drilled in Focul Viu Ice Cave (Western Carpathian Mountains, Romania).

Comment: P4 L 30 Precipitation and not Precipitations. Response: Corrected.

Comment: P4 L37 it is "now", "low" or "no" winter accumulation ? I guess it is "low", in such a way the sentence is reasonable. Response: Typo. Corrected to "no" from "now" so that the text reads "no inflow of water and thus no winter ice accumulation". The point here is that ice in winter forms as dripping water freezes to form layers of ice on

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top of the existing ice block. Cold winters result in frozen soils and cap rock above the cave and hence no infiltration, resulting in lack of winter ice accumulation.

Comment: Figure 1a - letters and font are too small, impossible to read them... omit "Mts" for the mountain chains which is unuseful. Response: We have corrected figure 1.

Comment: Figure 5 legend of scale is missing. Response: Thank you for spotting this, we added the legend.

In addition to these corrections we have updated and visually improved all figures and the spelling and grammar of the main text was checked and corrected by a native speaker of English.

References cited (apart from those cited in the main text)

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Interactive comment on *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2019-141>, 2020.

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