Reply to B. Zolitschka (SC1: Chronological issues)

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The manuscript represents a major step forward with regard to the reconstruction of humidity variability and as such is of great interest for the scientific community.

→ Thank you B. Zolitschka for that constructive short comment. Please find our contribution to the discussion below. Please allow us to furthermore emphasize here, that the take home message of our manuscript, i.e. overall pronounced dry climatic conditions in Central Europe during the YD are not corroborated by our results, is not affected by the chronological uncertainties.

Aside from the isotopic part of the methods chapter being rather long (two chapters from page 6-12), the chronology has several weak points. On page 2, line 4-6 Gemündener Maar (GM) is mentioned in line with Holzmaar and Meerfelder Maar. These sites with natural eutrophication since the onset of the Lateglacial formed and preserved annually laminated sediments (ALS), which provided a precise time control for lacustrine systems. This is completely different for GM, a lake that remained oligotrophic until World War II and only in the 1950ies was culturally eutrophicated, still without any deposition of ALS. This should be clarified in the text.

→ The ELSA Project hast drilled a total of 17 sediment cores from 4 of the modern maar lakes (some of them presented in Sirocko et al., 2013, 2016), including Ulmener Maar, Schalkenmehrener Maar and Holzmaar. The ELSA core GM1 from Gemündener Maar is characterized by very well visible color and lithology changes, with all abrupt climate events and pollen zones of the early Holocene most clearly visible (Fig. 1 in the current manuscript). Accordingly, GM1 was chosen for this study. We will readily change the text in the revised manuscript in order to clearly differentiate between varve counted archives (e.g. Lake Holzmaar and Meerfelder Maar) and not varve counted ones (e.g. Lake Gemündener Maar, this study), as suggested.

The chronology is a mixture of one radiocarbon date, the age of LST tephra, a TOC increase assumed for the onset of the Holocene and a pollen-inferred age for the PB/BO transition. Except

for the age of the LST all other ages are questionable. 1. radiocarbon age: the age of 11,950 BP is from charcoal and as such potentially can be linked to reworking. One radiocarbon age to date the Lateglacial is not enough! And in general, why is there only one radiocarbon age for the entire record of ~3500 years? At least during the early Holocene there should be enough terrestrial plant macrofossils for a proper dating. 2. How reliably is the TOC increase related to the onset of the PB? This is questionable but might easily be verified by pollen data. 3. The pollen age for the PB/BO transition (10,450 cal. BP) is in disagreement with published ages from Holzmaar (10,800 cal. BP) and Meerfelder Maar (10,740 cal. BP) - see Litt et al., 2009 (Boreas, 38: 679–690). Furthermore, the data to support this are not provided. And this is my major concern: in the manuscript reference is given to unpublished pollen data many times. Without pollen data being provided with the manuscript, not only the chronology remains unsupported by data.

→ Indeed, the Lake Gemündener Maar core is not varve counted (despite it is varved/laminated to a very large extent). However, the Laacher See Tephra represents a perfect time marker, dated by Brauer et al. (1999) to 12,880 varve years BP in nearby Meerfelder Maar. The other time marker used to constrain the age model is the middle of the sharp increase in *Corylus* (hazel) pollen at 6.21 cm. In the revised version of the manuscript we will present a refined age-depth model based on new available pollen results from Lake Gemündener Maar, which provide now a higher resolution than the curves presented in the current manuscript. In the revised age-depth model we use now the sharp *Corylus* increase as time marker for the Preboreal/Boreal transition, which is indeed dated by Litt et al. (2009) to 10,740 varve years BP in the Lake Meerfelder Maar sediments. The offset of 60 years to the varve counted Holzmaar record of Zolitschka (1998), as it is presented by Litt et al. (2009), is within the uncertainty of placing the “onset” of the Preboreal in the Lake Gemündener Maar *Corylus* curve. A single radiocarbon age corroborates this stratigraphy in general, but is not used for the age model. Moreover, we will use the higher resolved pollen results to refine the begin of the Holocene (Younger Dryas/Preboreal transition) to 11,590 years BP, again with regard to Litt et al. (2009) and Zolitschka (1998), and no longer to 11,650 years BP according to Walker et al. (2009). It should be noted that the onset of the Holocene remained at the same depth as hitherto; and this nicely correlates with the TOC increase in the core, as before. Finally, we will readily provide the higher resolved pollen data/curves along with the refined age-depth model in the revised version of the manuscript, as suggested.

Some minor issues:

1. On page 13, line 3ff the authors talk about clear evidence of carbonates. This is not at all evident from Fig. 2D. Moreover, where is the Ca coming from in this rather small catchment area composed of siliceous Devonian rocks?

→ Please note that we argue in our manuscript, "$\delta^{13}C_{TC}$ clearly shows the presence of carbonate … (Fig. 2G)". We further state that this presence of carbonate is not well visible in the TC versus TOC record (Fig. 2D). However, this is just a scaling problem. For reasons of clarity, we will delete the TC curve in our revised manuscript. Ca was most likely primarily introduced into the Gemündener Maar by eolian processes (cf. the abundant literature about carbonate-containing loess in Central Europe).

2. The authors should explain, why they think that the record is representative for GM. Recovered from 20 m water depth (maximum water depth of GM is 39 m) in a small lake (diameter: 300 m), this implies a core from a relatively steep slope.

→ Sediment core GM1 is retrieved from a terrace on the steep slope of the maar at 20 m water depth, exactly in the fan of an underwater erosional gully. The sediments from the Laacher See tephra to the beginning of the Boreal have a sedimentation rate of ~0.33 mm/year. This sedimentation rate is lower than in the eutrophic varve counted lakes of Holzmaar and Meerfelder Maar, but the anoxia changes (causing the color changes) in the Gemündener Maar are very pronounced and occurred within a few years in this maar lake without any inlet and outlet. The Gemündener Maar sediments are, accordingly, not affected by fluvial sediment contributions.

3. In Fig. 2H a threshold of 12 is used for C/N ratios related to autochtonous vs. allochthonous organic matter sources. The reference to Prahl et al. (1980) is related to estuarine sediments. Here the threshold of 10, e.g. Meyers (2003: Organic Geochemistry 34, 261– 289), should be preferred for lacustrine sediments.

→ Thanks for that comment. We will readily change this during the revision of the result and discussion part of the manuscript.

→ Literature

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Zolitschka, B.: A 14,000 year sediment yield record from western Germany based on annually laminated lake sediments, Geomorphology, 22(1), 1–17, doi:10.1016/S0169-555X(97)00051-2, 1998.