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Climate of the Past Discussions

Interactive comment on "Bunker Cave stalagmites: an archive for central European Holocene climate variability" *by* J. Fohlmeister et al.

Anonymous Referee #1

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Fohlmeister et al. present a new multiproxy record of Holocene climate in central Europe from several well-dated stalagmites from Bunker Cave, Western Germany. Specifically, the authors used oxygen and carbon isotopes in the speleothem calcite to reconstruct past changes in temperature and rainfall (O and C), and also vegetation density (C) above the cave site. In addition, the authors also used Mg/Ca ratios to provide additional evidence for Holocene shifts in karst hydrology (and hence rainfall). Results show that the detrended proxies all agree quite well with each other through the Holocene, suggesting that the higher-frequency variability in all three proxies was dominated by a single mechanism, namely shifts in climate. Moreover, a strong resemblance between the speleothem d18O and other records from central Europe and the North Atlantic, in-

dicate that the climate signal preserved in the Bunker Cave stalagmites was regionally synchronous during the Holocene.

This paper will make an important contribution to the paleo community, as it provides one of the first well-dated and high-resolution records linking the North Atlantic with central Europe during the Holocene. The only aspect I think is lacking a bit is a more thorough explanation of the climatic links between the North Atlantic and central Europe, and the inherent influences on precipitation d18O at the cave site – i.e. how exactly are shifts in North Atlantic temperatures translated into Bunker Cave d18O? For example, is it purely a temperature/rainfall amount signal? Could there have been shifts in storm tracks (and hence changes in moisture source and/or transport pathways) during the Holocene temperature perturbations, possibly through changes in the NAO?

What about seasonality? The authors mention that evapo-transpiration is responsible for removing ~40-50% of the annual precipitation from the aquifer, but is it safe to assume that this was the case throughout the Holocene? In fact, Boch et al. (2011) suggested that some of the observed d18O variability in stalagmites from the northern Alps during D-O events may be explained by shifts in seasonality, given the large modern seasonal amplitude of precipitation d18O in the region. Granted the climate changes during the Holocene were not nearly as large as through D-O events, but the underlying mechanism(s) linking the North Atlantic with central Europe may have been somewhat similar. Also, it might be worth adding some additional information (to section 2.1) regarding the seasonal changes in rainfall amount and d18O at the study site.

I would also suggest the authors be a little more specific regarding the temperature influences on the speleothem d18O – i.e. there is no mention of the cave drip-water temperature (and hence outside temperature) influence on the speleothem d18O during calcite precipitation.

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Minor Comments:

-As outlined above, I would suggest adding some additional information to section 2.1 outlining the modern seasonal pattern of rainfall amount and d18O.

-I found myself a little confused as to how the authors prescribed the top of BU4 to be 1997 and the top of BU1 to be 100 yrs BP. For example, the authors explain (in section 3.3) that for the age-depth modeling they used the Th/U and 14C measurements, but they do not really explain how the 14C measurements were used exactly. I am assuming it was used to constrain the bomb-peak and hence used a tie point. Also, the DCF for the top sections of BU1 and BU4 outlined in section 4.2, is missing from Table 2.

- How was the chronology constructed for BU4 where it does not overlap with BU1 (i.e. $\sim$1.5-5 ka)? Was it simple linear interpolation between the Th/U dates?

- The decreasing trend in d13C during the mid-late Holocene is interesting to me. The authors attribute this decreasing trend to the "development of a denser vegetation cover above the cave". Is there an explanation for this? According to the d18O, temperature/rainfall remained relatively constant (besides the centennial-scale shifts) through the Holocene.

Suggested technical corrections:

-Pg 1689, line 23: suggest replacing "in particular" with "particularly".

-Pg 1690, line 3: remove "respectively".

-Pg 1696, line 5: add "us" after "allow".

-Pg 1696, line 10: add "us" after "enables".

-Pg 1699, line 5: change "in average" to "on average".

-Pg 1699, line 6: insert "therefore" before "represents" and remove "thus".

-Pg 1699, line 29: remove "are".

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-Pg 1700, line 11: “extrem” should read “extreme”.

-Pg 1718, figure 3: missing y-axis label (i.e. d13C) in panel C.

References:

Boch R, et al. (2011) NALPS: a precisely dated European climate record 120-60 ka. Climate of the Past 7:1247-1259.

Interactive comment on Clim. Past Discuss., 8, 1687, 2012.