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Climate of the Past Discussions

Interactive comment on "Detection and origin of different types of annual laminae in recent stalagmites from Zoolithencave, southern Germany: Evaluation of the potential for quantitative reconstruction of past precipitation variability" *by* D. F. C. Riechelmann et al.

Anonymous Referee #2

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Review of doi:10.5194/cp-2016-18

Title: Detection and origin of different types of annual laminae in recent stalagmites from Zoolithencave, southern Germany: Evaluation of the potential for quantitative reconstruction of past precipitation variability

Authors: Dana Felicitas Christine Riechelmann et al.

Summary: This article is based on three stalagmites from Zoolithencave in southern Germany and the potential of using these samples for high resolution (annual) reconstruction of climate. Absolute chronology is challenging but important constraints are placed on the sample-growth period. Zoo-rez-1 and Zoo-rez-2 are both very young: i) A C14 bomb signal is visible in Zoo-rez-1; ii) C-14 dated charcoal beneath Zoo-rez-2 is dated (calibrated, 1σ) to between 1671 and 1951 AD. Unfortunately for U-Th chronology, the young age is combined with initial Thorium contamination. C14 measurements in speleothems (3 measurements here) are complicated by the need to know the dead carbon fraction.

However, there are important constraints on the growth period. From the charcoal C14 date it is known that the oldest stalagmite growth layers are less than 345 years old (the charcoal is located beneath the start of the visible laminae).

Multiple measurements/observations are used to show evidence of laminations in the sample (i.e. visible layers, fluorescence and trace-element measurements). Counting of visible laminae in samples 1 and 2 reveal 161 and 165 laminae respectively. The stated aims of the paper are: "i) to test the potential of different analytical methods to detect annual laminae in speleothems, ii) analyze the origin of the different types of laminae, and iii) evaluate their potential as climate proxies".

Opinion: In it's current form I am not in favour of the publication of this article. Below, I give some specific examples of why.

Overall, there is too much material, it is difficult to follow in a logical/critical way and much of it's content is not discussed in a sufficiently robust or well-referenced manner.

The multiple sources of laminations (visible laminae, fluorescence, elemental) are of definite interest, especially given the availability of meteorological data and a tree-ring record in the area (although the location of the tree ring record relative to the stalagmites isn't clear, a map would be useful) covering some of the ~ 170 annual speleothem laminae.

My feeling/recommendation is that a significant amount of material should be pruned/removed (fine for it to be included in a subsequent follow up publication). The smaller number of remaining points for discussion should be dealt with more robustly.

Example of points that I disagree with:

- The arguments and the article in general is often difficult to follow. A feature of too many unnecessary details at times yet missing information or missing logical argumentation for important points.
- e.g. **line 478**: "We interpret annual lamina thickness as a proxy for past precipitation. Thus we correlated the lamina thickness series to instrumental data...". i) use 'rainfall' not 'precipitation' which can be confused with mineral precipitation. ii) Why rainfall alone? What is the evidence? Why not temperature or a combination of temperature and rainfall? Choose which discussion is important and discuss it robustly.
- e.g. **line 490**: "A probable reason for the three stalagmites to stop growing in 1970 could be that further exploration of the deeper parts of the cave started in 1971. Furthermore, the correlation between precipitation of all individual months....was calculated". **Why** should three stalagmites stop growing because further exploration of deeper parts of the cave started in 1971? Perhaps there is a logical explanation, but it isn't given? Justify this point if it is important or remove this statement.

- The above statement (no growth after 1970) contradicts the statement on line 120: "The stalagmite was fed by an active drip when it was sampled suggesting recent growth." These things need to be ironed out so that a more coherent, robust and easy to follow narrative is available to the reader.
- The argument provided for sample growth ending in 1970 is based on $^{14}C - activity$ values from the top section of Zoo-rez-1: "Since the increase in 14C in 244 Zoo-rez is large (compare e.g., Noronha et al., 2015), the peak is near the maximum of the atmospheric 14C values. Thus, we suggest that the highest 14C value corresponds to about 1967 AD and attributed a 5 years uncertainty". In my opinion this is not robust, e.g. how large does the increase in 14C need to be before we can decide that their C14 sample 1.3 is co-eval with the C14 bomb peak? 14C could still be on it's way up? This is another example of where I believe the authors need to make choices: e.g. either focus efforts and discussion on chronology/C14 or acknowledge that there is some uncertainty on chronology (not huge based on the charcoal C14 age) and, instead, focus on other aspects (e.g. trace-elements).
- **Lines 213 to 250** and subsequently **lines 292 to 347** are dedicated to chronology. This is long, doesn't achieve very much and isn't always factually correct. **Line 213 (and table 1**) both state that the corrected age of the U-Th sample closest to the top (0.1-0.6 cm dft) is $4.669 \pm 0.9998\,[ka]$. Clearly this cannot be right - either the uncertainty assessment is wrong or the other conclusions are wrong (e.g. that the sample grew sometime between 345 years ago and 1970). Instead, I would recommend, briefly, focussing on the two pertinent pieces of chronological information: i) a piece of charcoal x cms beneath the laminations in sample 2 is at most 345 years old (in agreement with the lamination counting); and (ii) that the bomb spike is present at the top of the sample. Details of the U-Th chronology should be given too but this should be brief (simply stating the issues of the young age of the sample combined with initial detrital contamination). It could

potentially also provide a 232/230 value for the detrital contamination (relative to bulk earth). Some/all of this should be possible in half the amount of the original text.

- Line 271 indicates a laminae thickness range from 64 to 256μm. Figure 4 seems to show laminations that are > 1mm. Unless I'm misreading figure 4? It could be useful to annotate fig 4 to show what the authors believe is an annual lamination.