

T paper

This is a review paper presenting speleothem records covering terminations (T) with the aim to (i) synthesize the available speleothem records covering T II, TIIIA, TIII, TIV and TV, (ii) description of their proxy quality, and (iii) Evaluation of the leads and lags of the records.

The impact of a review paper depends on a well-organized structure and clear figures and tables. Unfortunately, the revised version is lacking clarity and a clear structure. For instance, the selection criteria for the stalagmites remain unclear, which is also related to the fact that the quality of the main table is still very bad.

I think the criteria are set out sufficiently. I don't necessarily agree with all the criteria (e.g. combining multiple speleothem records is designed to improve timings/comparisons, etc., not make them worse), but I appreciate the need for some sort of consistency when screening records. You should consider removing T-IV and T-V altogether – the two records from each (from SE Asia/EASM only) add nothing, and you cannot compare records between regions. The very imprecise chronology of the Green Cathedral record (T-V) also does not help the cause.

The table definitely needs a makeover. Please consider presenting only the most essential metadata information for the main text and keeping the current expanded version for the supplementary data. A landscape (rather than portrait) format might work best for the supplementary (full) version (or both).

This is also true for some of the figures, particularly for Figure 2, which would stretch over three pages in a publication.

For Figure 2, please:

- in your textbox descriptions of each plot, just use the cave names to avoid clutter. Add the description of what each proxy series represents in the caption. Also, the textboxes are placed over the time series in places – please avoid this.
- best not to combine blue and green (for readers with colour resolution problems). See <https://www.nature.com/articles/nmeth.1618>
- offset the U-Th dates/error bars vertically in a better way so that symbols/bars do not superimpose one another.
- provide the full description of the insolation metric of Tzedakis et al. 2017 for your first plot (and x-ref to this caption in the following plots) and specify the unit of measurement. Also, offset the maximum insolation value in each case from the upper x-axis by expanding the y-axis range, and consider using the same y-axis range for each plot so amplitude differences in the metric between terminations can be compared more readily.
- be more generous with information in the caption. A figure and caption should be 100% self-contained as much as possible (i.e. all the essential information for interpretation should be provided with the need to consult the main text).

The major weakness, however, is the discussion about similarities and differences between the Terminations (chapter 5), which should be the most important part of the review. The absolute timing and nature of Terminations in the speleothems is key to understand the interplay between external (orbital parameters) and internal (e.g., glacial boundary conditions, ocean circulation, carbon dioxide) climate forcing mechanisms. These important aspects are not really discussed in paragraphs 5.1 and 5.2, which are very short compared to the preceding paragraphs. This surprises me, since the authors state in the introduction that “we evaluate the whether there are consistent leads and lags in the manifestation of terminations across different aspects of the climate systems and different regions as tracked by speleothem proxy records.”.

Given the authors' intent, it is reasonable to expect the Discussion section to be central to the paper, so I agree with the reviewer that this part needs more work and better organisation. For example, I do not see the point in comparing NISA for T-II with Sofular for T-III (lines 613 onwards). The main features of similarity and difference for how speleothems are recording local/regional climate through each termination, and why this might be the case, should be the focus. Do the apparent leads and lags makes sense? Are they confounded by uncertainties in the age models being used (not to mention the fact that some papers use more than one age-model algorithm)? It is from these observations that deficiencies in the current state of knowledge can be highlighted. Therefore, I urge you to carrying out the most plausible and meaningful comparisons between the speleothem records for each termination (still looking at regional differences), bearing in mind the dating constraints.

Chapter 5 is rather poorly organized and it is very difficult to follow their arguments and selection criteria. To give an example: the sequence of events for Termination II in speleothems is shown in Figure 4, whereas only insolation changes are displayed as one external forcing factor. What about other key-forcing factors, such as AMOC, IRD or carbon dioxide? Changes in the intensity of the AMOC, for instance, are responsible for cold/dry snaps during Terminations (YD-like events), and they should be discussed in greater detail as they are one important aspect of almost all Terminations.

Whilst this was not requested in the first round of reviews, I believe adding additional information in the figures is useful for contextualising the comparisons you are making. The difficulty of assigning chronologies to ice-core and marine records is not trivial so you should make this clear when introducing these time series in the text. For example, time series from the marine record would be useful – e.g. a benthic and SST from the same core (=same chronology) from the Iberian margin).

In Figure 7, the x-axis ranges should be extended to capture the complete error bars, and I would recommend either excluding the 'start of insolation' indicator, or apply it to the first derivative of the insolation metric, which appears as though it will show an uptick in insolation as the termination kicks in.

Also, here and through the paper, please be consistent with expressing time (both age and duration): it should be expressed in ka or kyr respectively (with 1 decimal place where necessary, but not more), and not in years (e.g. lines 629 and 643).

Figure 7 is only of limited use as the authors focus solely on oxygen isotope magnitudes, whereas growth phases (important for some alpine sites and related to cold snaps) are not included. In addition, the amplitude of the few existing paleotemperature estimates is also not included. The sequence of events in Figure 7 is therefore incomplete and rather selective.

I agree it is useful to include in Fig. 7 growth phases and temperature estimates as suggested by the reviewer (incorporate these into the main text) but urging caution regarding interpretation of any single speleothem records of growth/interruption.

More importantly, it is still unclear how the timings, durations and amplitudes of these events/intervals were calculated.

Please specify these in the text or figure caption where applicable.

Not to mention that the chronologies of the records in Figure 4 are based on different chronology building approaches.

I agree that this is an issue, but it cannot be dealt with in this paper (it's a separate and long overdue study itself).

Though one could find some information in the table, some of the records shown in figure 4 are not included in Table 1 (e.g., Siebenhengste, Schneckenloch, Diamante).

Please rectify

Furthermore, my initial concern regarding a more scientific and statistically sound approach to calculate ages for the onset/end of the termination and timing of dry/cold or warm/wet phases were not addressed in the revised manuscript. This is still a major weakness, particularly because the authors give sometimes extremely precise age estimates for some terminations, such as “~6985 years from the initial weak monsoon event to monsoon recovery”.

See comment above re expression of time in ka/kyr, and add uncertainties in quadrature when specifying durations (although some age models seem to underestimate interpolation uncertainties!).

Overall, I think that the current manuscript is not suited for publication in CoP as it reads more like an initial draft. In my first review, I had hopes that the authors would revise their manuscript thoroughly, but they missed this opportunity, leaving me with no choice but to reject it. However, a review on the timing of terminations in different speleothem records is overdue and I would encourage the authors to revise and resubmit their manuscript to CoP.

I agree – with a little more work, this ms can make a useful contribution