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Interactive comment on "Speleothem stable isotope reference records for East-Central Europe – Resampling sedimentary proxy records to get evenly spaced time-series with spectral control" *by* I. G. Hatvani et al.

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This manuscript addresses an important issue with paleoclimate records, namely that the time interval between samples is not regular. This issue has been addressed in previous studies such as Schulz et al 1997 (Computers & Geosciences 23 (9), 929–945), Schulz and Mudelsee 2002 (Computers & Geosciences 28, 421–426), Björg Ólafsdóttir et al 2016 (doi: 10.1016/j.cageo.2016.03.001) and Rehfeld et al., 2011 (doi: 10.5194/npg-18-389-2011). In the first three, SPECTRUM, REDFIT and REDFIT-X are used to calculate the spectra and red-noise of unevenly spaced samples while the

fourth provides a thorough comparison of different correlation analysis techniques for irregularly spaced samples.

This study uses two published records of oxygen and carbon isotopes from two speleothems from Hungary and Belgium to illustrate this issue. The authors transform these unevenly spaced series to a temporally equidistant time series suitable for the application of common statistical methods such as correlation techniques. In particular, they compare their reconstructed time series to low-pass filtered meteorological data and the NAO index and conclude that the signal of the latter is recorded in the speleothem time series for certain band-widths.

General comments

How to deal with uneven time-series is an important issue in paleoclimate which has been previously addressed. However, the authors fail to do a more extensive comparison between their approach and other already used techniques.

The length of the manuscript used to interpret what were supposed to be only examples of the technique is, from my point of view, losing the focus of the main objective: providing a technique to deal with uneven time-series (see main aim of the paper in L71-73).

The authors are omitting some fundamental issues of speleothem growth by not including a proper discussion on how the water storage time in the karst may yield an autocorrelated isotopic time-series. This becomes important when interpreting the speleo record in terms of climate variables if the storage component in the aquifer is larger than the cut-off period numerically chosen from the Lomb-Scargle Fourier Transform periodogram.

In addition to this, interpreting paleoclimate records only in terms of spectra analysis is complex if the physical mechanisms at such periodicities is not properly reviewed. For example, how do the authors know that the anti-phase coherence shown in Figure 3

(top panel) for a specific frequency band is related to biological soil activity (L207-209) and not to another controlling factor? Similarly, how do the authors know that changes in the moisture source are the dominant controlling factor in that specific frequency band, as suggested in L252-253? More discussion on this would make the whole Section 3 more robust.

The authors do not use single speleothem records but a composite record. When using composites, the temporal and proxy uncertainties increase, but these are not being dealt with in the manuscript. In addition, isotopic records from individual speleothems from the same cave may vary quite a lot depending on the groundwater history within the aquifer that eventually reaches each of the drip sites. I assume that this was mentioned in previous research but I suggest that if the authors want to use this composite record more information is provided. However, my suggestion would be to analyse both records separately and then compare it to the composite. This alternative approach would highlight potential discrepancies between the records and would make the study more robust.

I wonder if the composite uncertainties have an effect on the periodogram used to decide the appropriate cut-off period if they are considered with an iterative approach. Do significant peaks remain significant? How do these uncertainties affect the spectra analysis of the records when it comes to interpreting in terms of climate variables? This could be also argued for a single speleothem record, as all proxy records have dating and measurement uncertainties.

I do not see any benefit in including the speleothems from Belgium in this study. They are just another example and they're only mentioned in the 25 lines of the discussion section, just before the conclusions. I suggest the authors either omit these records or discuss them more extensively.

Minor comments

L33: Aren't all dating methods "numerical"?

L34: The temporal resolution of the speleothem proxy record will depend on the karst processes at play at that particular drip site. This can hugely vary from sub-annual to centennial resolution and therefore, it is not always possible to obtain a highly resolved temporal record. Regarding the "high spatial resolution"? I'd suggest that "they are well distributed worldwide" instead. Would it be possible to know what are the benefits of using a cubic spline in contrast to other interpolation methods?

L52: I don't understand the concept of "reference records". Why are these records considered to be a reference for their regions? This manuscript does not compare several series from the same region, so I think the usage of this term can become misleading.

L52-53: An additional criteria to select "reference records" according to the authors, should be the overlap with meteo data (you could find accurately dated records close to annual that do not overlap with meteorological instrumental data).

L86: There is no need to include the definition of delta here.

L92: "see section 2.1". That sentence is already part of section 2.1!

L106-109: It doesn't really matter for the purpose of this manuscript but you can obtain a longer PC-based NAO index from the 20CRv2c dataset, which goes back to 1851 (https://www.esrl.noaa.gov/psd/data/20thC_Rean/)

L117-118: I would like to see the periodogram of the original record along with the one from the reconstructed signal early in the text. In contrast, Figure 1 does not provide much information (it is difficult to visually compare both panels). This is related to my comment below for L134.

L244-245: Which period corresponds to a "strong negative NAO mode" and for which frequency-band is this evident?

L134: I would like to see a figure showing the significant powers of bot series (original and reconstructed)

The use of “composition” when referring to a composite series is confusing (for example “precipitation-composition” relationship in L212. Also, in L37, the usage of “composition” seems to mean “proxy records”. Please clarify.

L226: “. . .with the primary climate parameters”, these being?

Fig 5 (and others): could you please mark the cut-off periods below which the spectral analyses are not significant?

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