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Climate of the Past Discussions

Interactive comment on "Simulated European stalagmite record and its relation to a quasi-decadal climate mode" *by* G. Lohmann et al.

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This is an interesting manuscript that attempts to couple output from an isotope enabled GCM with the Wackerbarth et al stalagmite isotope model. Such an approach is highly novel, as it approaches an integrated, process based atmosphere – soil - groundwater – cave climate – calcite fractionation model of stalagmite d18O.

This potential novelty is compromised by the fact that the manuscript only provides limited and inconsistent information on both input datasets and modelled output. The authors show selected data for both, they identify a quasi-decadal d18O signal in the modelled stalagmite series and then presented selected data in an attempt to provide a climatological explanation. A more thorough data presentation and analysis is needed.

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Interactive Discussion

Discussion Paper

In order to adequately review this manuscript, I would have needed to have data presented on the following.

1) Time series and spectral analyses of all GCM output used to drive the 'Wackerbarth model'. Selected series are shown in Figure 1, but no spectral analyses. Is there a quasi-decadal signal in any of the model inputs? If not, then the observed quasi-decadal periodicity would have to have its source within some part of the Wackerbarth model. This would be an important finding.

2) Time series and spectral analyses d18O at different stages of the Wackerbarth model need to be presented e.g. at the modelled soil water, unfractionated dripwater, and fractionated calcite stages, at least. Figure 4 only shows cave temperature.

3) A sensitivity analysis of the Wackerbarth model to the initial model configurations chosen is necessary. It seems unlikely that the quasi-decadal d18O signal is introduced into the stalagmite as a simple climate input signal, if it is not present in the input series. Rather, could it be a non-linear amplification of the climate input that occurs at quasi-decadal timescales. Possible sources of non-linearity include groundwater recharge (P-E), within the karst hydrology, or as part of the calcite fractionation processes. If the quasi-decadal signal is a result of a process that modelled within the Wackerbarth model, then this is very interesting, but a sensitivity analysis is necessary to show how likely or frequently the quasi-decadal signal would be introduced with different model configurations.

In the data interpretation, the authors selectively show data, with little justification of how they have come to these plots. In particular, to enable an adequate review, I would recommend the following.

1) An explanation of why only years when stalagmite d18O>-5.2 per mil are shown. This choice needs to be justified and results for other stalagmite d18O data also shown as a comparison.

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2) Consistent presentation of lags. The authors show correlation maps for all of 0, 1 and 2 year lags, but never consistently. Any lag used should be consistent, and related to the authors' understanding of processes, if it is related to groundwater hydrology.

3) The authors only show spatial field correlations with SST. It is not clear why SST was chosen over other equally plausible fields such as temperature or d18Op or 500mb pressure.

I think with a more consistent and logical approach, some important process based insights could come from this research. In particular, understanding the source of quasi-decadal periodicity in stalagmite records is essential for their use in determining low-frequency climate variability. The weakest part of the Wackerbarth model is its highly simplified karst hydrology (effectively a simple adjustable lag function) but this can be turned to an advantage here, as it rules out karst hydrological processes as a source of quasi-decadal periodicity in stalagmite d18O.

One final recommendation is that the authors include more information on the Wackerbarth model, maybe as a table or table and figure, so that the non-expert reader can see the components on the model and in particular the initial parameterisation. Ideally, the table could show a series of realistic model parameterisations and the associated spectral analysis of modelled stalagmite d18O, to show the consistency of the quasi-decadal signal.

Andy Baker, 12/9/12

Interactive comment on Clim. Past Discuss., 8, 3513, 2012.