**Climate
of the Past
Discussions**

Interactive comment on "Millennial-length forward models and pseudoproxies of stalagmite δ^{18}O: an example from NW Scotland" *by* A. Baker et al.

Anonymous Referee #2

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In their article "Millennial length forward models and pseudoproxies of stalagmite d18O", Baker and coauthors formulate and discuss a model for water transport through soil / peat, epikarst and karst. While their main focus is on the formulation and verification of the model using stalagmites from a Scottish cave, part of their work is dedicated to the documentation of the stalagmite isotopic properties as well as the current state of the cave. They also show that there does not seem to be a strong connection between climate field variables, such as precipitation, and the isotopic properties of the stalagmites.

Their model, while being just complex enough that it should be able to capture a wide spectrum of stalagmite formation, fails utterly at reproducing many properties of the stalagmite time series under investigation. Most obvious is the absence of prolonged

excursions to relatively isotopic heavy compositions in the pseudo proxy time series. Additionally, the spectral properties are quite different: while the pseudoproxy time series show mainly fast fluctuations, the actual stalagmite data shows large variations on the multi-decadal scale. However, the authors do offer explanations at least for the isotopic heavy composition during the episode in the 17th century: as often, stationarity of the processes creating the proxy signal from the climate field variables cannot be assumed, and here even rejected through comparison with output from the stationary model. It may very well be that speleothemes from other caves with more stable properties can be described using this model. Unfortunately, the authors here focus on a cave system where the model does not (and, judging from the described properties) cannot work.

However, as with any ongoing research their effort remains commendable. The formulation of a *simple* forward model for speletheme formation is highly necessary and a step that is definitely needed in the palaoeclimate community, both for data-model-comparisons (through data assimilation and / or forward modelling of proxies) and palaoeclimate reconstructions (though the models need to be inverted for this).

Personally I find the article to be very readable. The descriptions of the cave system and its properties make the subject accessible to people having no real geological background. The model is introduced through considerations of the processes of water transfer through soil / peat and karst, providing enough information to understand selection of parameters. The article would gain from an example where the model-data comparison does indeed work, as even in the calibration period there seem to be substantial differences between the speleothemes' response and the model output. Alltogether, I find the results to be interesting enough from a modelling point of view that I would not object publication of this article. Judging from the objectives from CP's homepage ("simulation of past climate and model-based interpretation of palaeo climate data" and "theoretical and empirical studies of processes in and feedback mechanisms between all climate system components" to which one could also count the

response of proxies) the article does seem to fit within the scope of the journal.

Due to the main problem (the model output does not look like the real thing at all, at least to me), I think it will benefit from a rewrite / extension:

- detailing the mismatches in the spectral domain of pseudo proxy and speleotheme time series

- showing an example where the pseudo proxy does indeed reproduce the behaviour of the speleotheme (not just "right order of magnitude")

- or a stochastic extension of the model including nonstationary parameters of the model to reproduce the slow(er) variations of the speleotheme data

Additionally I have some remarks and questions apart from the one above:

When formulating a pseudo climate time series, the precipitation / temperature that are fed into the stalagmite model, did you really construct data with an annual cycle (especially for the input data RANDOM)? If so, please state it and also mention the method.

On p. 889, you try to explain the spin up phase of the stalagmite model (I guess) since the GCM is 2kyears long and should have settled after a millennium and the other input time series have no spin up phase. You should either stress this (more) or use longer input time series, hide the first 400 years (or so) of the output and mention the spin up of the KarstFOR.

Other, minor, remarks and questions regarding the article:

p 887 l3 "higher growth rates in drier conditions" counterintuitive to me

p 880 l3-5 How are the correlation when using only the first (or last) half of the NOAA reanalysis?

p881 l26 delete comma after F1 ?

p 883 mention which model corresponds to which panel in fig. 4

p 889 l9 "100 mum" should have the correct unit symbol μm.

Interactive comment on Clim. Past Discuss., 8, 869, 2012.