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Interactive Comment

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

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General comment:

The paper presents a hydrological forward model, which simulates speleothem d18O time series based on several climatic input variables, such as temperature, precipitation and the d18O value of precipitation. This enables to compare the simulated time series with the natural speleothem data and, thus, to test whether the speleothem contains a climate signal. This is an interesting and – for the speleothem community – novel approach, which definitely deserves publication.

The presented model contains two principal water stores – a surface peat store and the epikarst – which seems to be adequate for the study site in NW Scotland. The details

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of the model are well described, and the paper is generally very well written.

I have only one general problem with the paper as it is: In recent years, substantial progress in modelling speleothem growth rates (e.g., Mühlinghaus et al., 2007) and stable isotope signals (e.g., Mühlinghaus et al., 2009; Romanov et al., 2008; Dreybrodt and Scholz, 2011; Scholz et al., 2009) has been achieved. Both stalagmites show a weak correlation between d18O and d13C indicating that disequilibrium isotope fractionation may play a role for these samples. This is also suggested by the very long drip intervals of up to 30 minutes.

I understand that previous work has not suggested a large influence of disequilibrium isotope fractionation at UAT, and modelling these processes is definitely beyond the scope of this paper. However, as one major result of the paper is that the described model is not able to explain the observed speleothem data, the potential effects of disequilibrium isotope fractionation processes should at least be discussed and other modelling work should be mentioned.

Specific comments:

p. 872, line 18 ff.: In the summary of recent cave drip water modelling approaches, the paper of Wackerbarth et al. (2010) should be included.

p. 876, lines 18-20: The annual range of cave temperatures of 4.7°C seems relatively large. Is this the result of strong cave ventilation? This may also give rise to disequilibrium isotope fractionation.

p. 884, line 6 ff.: I am not familiar with the IsoGSM model. Is this a historic global simulation of the d18O value in precipitation (i.e., a spatial time series for the period 1979-2007) or a model that can be forced with (past) climate data in order to obtain a simulated d18O time series for a particular location? Some additional information would be definitely helpful here.

Section: 4.2: The description of the simulation of the input climate data was not easy

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to follow for me. For instance, which probability distribution was used for simulation of the RANDOM data set? Furthermore, I do not understand the statement that "we do not adjust the d18O input data for changes in temperature and precipitation" (p. 887, lines 20-21). Does this mean that the rainfall d18O time series are exactly the same for all three models? If so, this may also be an explanation for the observed difference between the modelled and the actual d18O values.

Fig. 8: Maybe I have not completely understood the approach, but why does Fig. 8b show so many different lines? I would have expected either three (one for each model) or twelve lines (4 for each model). Please provide more information about the different colours and line styles used in the figure.

References

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