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Hydrology and Earth System Sciences Discussions

Interactive comment on "Isotope hydrology of dripwaters in a Scottish cave and implicationsfor stalagmite palaeoclimate research" *by* L. Fuller et al.

Anonymous Referee #1

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General Comments: This manuscript provides valuable new cave drip-water hydrological, chemical and isotopic for a cave site in NW Scotland that should be sensitive to Atlantic ocean-driven climate change. The study goes one step further than many previously published monitoring studies because it uses regional empirical relationships between climate parameters and the O isotopic composition of rainfall to "hindcast" the O isotopic composition of cave carbonate deposited during the past 120 years. The match between the "hindcasted" data (using the empirical relationships) and the "real" (or measured) isotopic composition of the calcite deposited during this time interval is encouragingly good, although there is some evidence for a systematic offset, depending on which calcite-water fractionation factors are used. Overall, the study pro-

vides useful new insights into the climate parameters that are likely to be recorded at this ocean margin site and increases the confidence in the use of speleothem-based oxygen isotope records as palaeoclimate recorders. The study also points up some important potential problems that relate to non-stationary relationships between climate parameters and rainfall oxygen isotope values.

Specific comments: The abstract could perhaps be written a little more sharply to more fully reflect the contents of the manuscript.

Page 549: In referring to those records that appear to be "independent of details of the cave environment (e.g. Wang et al., 2001", the authors should point out that a key variable is the magnitude of the O isotope variability within a time-series record. Those pertaining to long periods through the last glacial (e.g. Wang et al., 2001) are always likely to have higher signal to noise ratios that those examples that are confined to the Holocene. In other words there is a rationalo explanation as to why some speleothem records are less sensitive to the "details of the cave environment" and this should probably be stated for the non-specialist.

Page 550: The discussion of the need to monitor drip sites is well made, but it would be useful to give the reader a better sense of what the authors consider to be the minimum level of information that is required from an individual drip-site before meaningful palaeoclimatic information can potentially be derived from any associated stalagmites. For example, is it enough to know that the drip reflects the weighted mean O isotope ratio of the precipitation in the area and that there are no major seasonal biases in its growth? The author's hindcast model required this level of information only?

Page 551: Please indicate the magnitude of the effect of the winter NAO index on the mean annual precipitation in the region.

Page 552: This cave is somewhat unusual because its air temperature changes through the year with a range of 4.7 K. Could this effect have contributed noise to the hindcast model data if there were inter-annual changes in the seasonality of pre-

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cipitation?

Page 554 and Figure 3: Please comment on why the drip water data plot below the Global Meteoric Water Line.

Page 556 and Figure 4: Explain why "the d18O of the cave drip sites appear to vary synchronously through time". What proportion of non-storage water is required at these sites to explain these observations? Is this consistent with the statement on page 560 that "the autogenic drip waters are dominated by a large component of stored water ($<$ 1 year old) which is relatively well mixed"? I suspect this is ok if the storage component is $<<$1 year old.

Page 559: What is the likely error on the chronology attached to the upper 120 years (approx) of stalagmite SU-97-7? Explain, for the reader, what is meant by "cross-correlation with the annual fluorescent lamina width time series".

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 547, 2008.