

## RECONSTRUCTING MONTHLY RAINFALL AND TEMPERATURE USING STALAGMITES COMBINED WITH A MATLAB-BASED STATISTICAL MODEL

### 1. Background

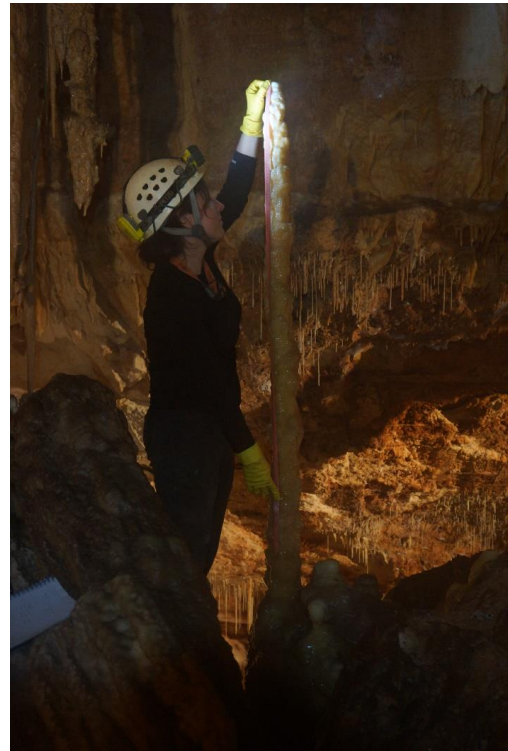
Stalagmites have become the go-to climate proxy for terrestrial areas. Their amenability to high-precision dating combined with the possibility of high temporal resolution means that stalagmites are providing climate information for areas that have eluded previous attempts. However, despite recent advancements in microanalytical techniques, most stalagmite records consist of decadal- to centennial-scale oxygen isotope data. Durham has developed a solution to this issue: a Matlab-based statistical model that extracts monthly-scale information from lower temporal resolution oxygen isotope data. **The aim of this project is to use the model to create a monthly-scale temperature and rainfall records from a published lower resolution stalagmite oxygen isotope record from any location of interest.** The new record would then be interpreted in terms of regional and global climate.

### 2. Aims and methods

The aim of this project is to produce new monthly-resolved temperature and rainfall climate proxy data from existing low latitude records by using the Matlab-based Durham Stalagmite Seasonality v2 (DSS v2) model already existing monthly-scale stalagmite records. The exact scientific questions to be answered will depend on the student interests. Essentially any published record can be used.

### 3. Scientific approach

This project will use a Matlab-based model to reconstruct monthly-resolved temperature and rainfall data for a location of the student's choosing. The DSS v2 model has been developed previously at Durham, and the student not only has the opportunity to create these new data, but also has the opportunity to further develop the code. Currently, the code requires the following inputs: i) a low resolution oxygen isotope dataset, ii) a low resolution regional temperature dataset



*Fig 1. Selecting stalagmites in Leamington Cave. The stalagmite data for this study has already been generated.*

(from a borehole, tree rings, glacier, etc.), iii) local meteoritic rainfall oxygen isotope ratios (obtainable from local GNIP sites, and iv) some cave monitoring data such as cave temperature. Seasonality is an aspect of the climate story that is notoriously difficult to reconstruct. For example, a decadal-scale proxy may suggest that the temperature cooled across a climate event, but in reality perhaps summer temperatures increased slightly but winter temperatures decreased considerably. The DSS v2 model can provide these rare data.

### 4. Training

As a PhD student in the Durham Earth Sciences Department you will become part of a vibrant research culture in which ~70 postgraduate students work on a wide range of Earth Science research projects. In particular, you will closely

collaborate with the academic staff, postdoctoral researchers and fellows, and postgraduate students in your research group. Training will be provided on time-series analysis, statistics, and scientific writing, and you will learn how to analyse and interpret palaeoclimate datasets. Additionally, there will be training opportunities within a regional network of stalagmite researchers.

#### 5. Further reading & information

Baldini, J. U., Lechleitner, F. A., Breitenbach, S. F., van Hunen, J., Baldini, L. M., Wynn, P. M., ...Fohlmeister, J. (2021). Detecting and quantifying palaeoseasonality in stalagmites using geochemical and modelling approaches. *Quaternary Science Reviews*, 254, Article 106784. <https://doi.org/10.1016/j.quascirev.2020.106784>

Baldini, L., Baldini, J., McDermott, F., Arias, P., Cueto, M., Fairchild, I., ...Richards, D. (2019). North Iberian temperature and rainfall seasonality over the Younger Dryas and Holocene. *Quaternary Science Reviews*, 226, Article 105998. <https://doi.org/10.1016/j.quascirev.2019.105998>.

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