



## Climate variability inferred from physical principles of stalagmite growth – the case of GIB04a modern Gibraltar stalagmite

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The knowledge about the basic physical and chemical processes governing the stalagmite growth has increased significantly during the last years. A very detailed instrumental climate record has been compared with the basic climatic parameters reconstructed from a stalagmite (Gib04a) collected from a carefully selected site in the New St. Michaels Cave on the Gibraltar Peninsula (Matthey D., Lowry D., Duffet J., Fisher R., Hodge E., Frisia S., 2008, *A 53 year seasonally resolved oxygen and carbon isotope record from a modern Gibraltar speleothem: Reconstructed drip water and relationship to local precipitation.*, *Earth and Planetary Science Letters*, 269, 80-95). The authors demonstrate a very good correlation between the known and the recovered signal for the period between 1951 and 2004. We use the climatic and isotope data recorded between 2004 and 2008 at the same stations as input parameters for a numerical simulation and model the stalagmite growing at this location. Our “numerical stalagmite” resembles the shape of the collected one very closely. Both stalagmites have the same equilibrium radius, and very similarly shaped growth layers. Also the modeled amplitude of the  $\delta^{13}\text{C}$  variation along the laminae is close to the one of Gib04a. In a further step we invert growth rate and equilibrium diameter of Gib04a using the procedure outlined in Kaufmann G., Dreybrodt W., 2004, *Stalagmite growth and paleo-climate: an inverse approach.*, *Earth and Planetary Science Letters*, 224, 529-545, and try to reconstruct the record between 1953 and 2004 from the morphology of Gib04a. We obtain a good agreement for the diameter, the temperature and the drip rate. On the other hand the predicted values for the  $P_{\text{CO}_2}$  in the soil are much higher than the measured ones.

These results show that our model is able to predict stalagmite growth, morphology and isotope profiles successfully even for time scales in the order of years, but it also shows that further efforts are necessary to describe the processes in the karst layer above the cave and their influence on the speleothems.