Earth Syst. Sci. Data Discuss.,
https://doi.org/10.5194/essd-2020-184-RC2, 2020

Open Access Earth System Science Data Discussions

Interactive comment on "δ^{13}C values in stalagmites from tropical South America for the last two millennia" *by* Valdir Felipe Novello et al.

Anonymous Referee #2

Received and published: 5 September 2020

This paper presents 10 new speleothem ∂13C records included in a new dataset of 25 speleothem ∂13C records meant to characterize the last 2ka (in fact the last 1.4 ka) over tropical South America. This series of data is used to reconstruct a general pattern of the climate evolution during the medieval climate anomaly and the little ice age. Main results show that low ∂13C values are related to high C3 plant density in the soil above the cave and highlight a breakdown between monsoon variability and local hydroclimate after 1750 CE based on the establishment of an index associated to mean hydrologic conditions.

Main focus of the paper was to test the influence of local hydroclimate, temperature and changing vegetation types on the carbon isotopes. The use of C stable isotope in speleothems has been poorly explored with complex interactions among the dif-

ferent drivers which makes difficult the climatic or environmental interpretations and I acknowledge the attempt of the authors. However none of these drivers (temperature, hydroclimate and vegetation cover) is really discussed for each record and general conclusions are often based on specific observations without in-depth argumentation. I feel concerned by the fact that if temperature inluence is eventually discarded, there is little evidence of what would be the expression of a local hydroclimate and the associated vegetation types. Indeed no information was given by the authors about the vegetation cover that is supposedly at the origin of the ∂13C and the absence of calibration makes the demonstration rather poor. When I started to look for such information through the original publications, I found that vegetation was defined at only 3 records upon 25 (I had no access to Utida et al 2020) mixing up biome with composition of the vegetation type or physiognomy. For example the record of Tamboril is located within a Âń Native semi-deciduous forests. . .Âż, Paraíso is Âń densely covered by rainforest Âż and Mata Virgem is Âń located in the Eastern regions of the tropical Savannah known as 'Cerrado' and the Amazon Forest Âż. For the last one, it is impossible to know whether the Cerrado or the Amazon forest is characterizing the area. These are two different biomes, and the reader would like to know about the vegetation type that grows above the cave, as for instance gallery forest, grassland with Cactaceae, campo limpo. . .etc).

Under such poor descriptions of the vegetation cover, I have difficulties to believe the conclusion Âń Most locations were dominated by C3 plants over the last two millennia Âż. Finally the authors concluded that the dataset was able to show that δ18O and δ13C generally co-varied except at Tamboril cave and did not discuss the soil richness which was first expressed as a significant factor for ∂13C. Neither was discussed the composition of the local/regional vegetation types that grow today above the cave. Information are mixed up and some main points presented at the beginning of the ms are simply abandonned when reaching the discussion part. For instance, at Jaragua cave a decrease of 9 ‰ in the δ13C values was interpreted as Âń resulting from a combination of changes above the cave, including: changes in the predominant vegetation type from C4 to C3, increase of organic matter and soil horizons Âż which does not

bring any strong information about the results. Moreover the breakdown between ∂18O and ∂13C after 1750 CE could also be due to deforestation and/or high fire activity. A comprehensive bibliography about the vegetation change and fire history of the different study areas is missing for the discussion. This paper needs a complete revision adding more precise information to support the interpretations and the conclusions. A proper discussion would also include the description and calibration of the vegetation and their influence on the obtained results. For these reasons I do not recommend this ms for publication.

Specific issues and comments

-Line 60 : importance of the tree roots : what about the herbs ?

-Line 86 what about the CAM plants which are abundant in some regions covered by the data set ?

-Line 127 last glacial

-Most of the sites located in the Caatinga show high abundance of Cactaceae which are C3 plants but do not represent dense forest neither rich organic soils.This should be mentionned and taken into account in the discussion.

-Comparisons with ∂18O records show that there is little difference with the ∂13C records regarding the climate interpretation and the authors come to the same conclusions except for the last centuries. Consequently, the gain of the ∂13C analyses in speleothem records is not clear.

-Some interpretation/conclusion sound fuzzy. For instance at Jaragua cave a decrease of 9 ‰ in the δ13C values was first interpreted as Âń resulting from a combination of changes above the cave, including changes in the predominant vegetation type from C4 to C3, increase of organic matter and soil horizons Âż. Later in the paper the vegetation hypothesis is abandonned and the decrease was finally related to temperature and atmospheric CO2.

-How do we know that Âń Most locations were dominated by C3 plants over the last two millennia and are characterized by speleothem δ13C values more depleted than -6 ‰ Âż as no description of the vegetation is given? Also Line 87 Âń Variations in soil δ13C values and their evolution over time are controlled by carbon inputs from vegetation, which is proportional to the organic matter amount and vegetation density; Âż was promising but without any description of the vegetation it is difficult to evaluate the influence of the plant composition on the ∂13C.

-Line 209-213 Cerrado is also a tropical forest so what do you mean by Âń Tropical Forest Âż ? also in the legend of figure 1 Rainforest/Atlantic forest, Atlantic forest is a biome that includes many vegetation types among them the rainforest (with no majuscule). What is the legend referring to ? Also line 289 what do the authors mean by Âń a tropical forest Âż ? is it a rainforest or a seasonal forest or a dry forest or a semi-deciduous forest or a cloud forest?

-Line 211 the 3 sites that are called Âń andean sites Âż are located in very different environmental conditions : Huagapo, 3850 m asl should correspond to a high elevation grassland as the tree line never climbed further up than $\sim$3500 m in the last 3000 years, Umajalanta 2650 m asl Âń monsoon-related convection and condensation over the Amazon Basin Âż which corresponds to a cloud forest, Palestina, 870 m asl, the transition between rainforest to cloud forest.

-Line 228-230 Are you saying that Cerrados and rainforest have the same ∂13C ? Âń The vegetation domains of Tropical Forests (Rainforest/Atlantic forest) and Cerrado include the speleothems with the lowest δ13C values (mean of -8.9 ‰ and -8.5 ‰ respectively),.. Âż

-Line 232 Appendix Fig A2 What is meant by highland records ? they are located in three different vegetation covers (see above). Then the ∂13C should be different for each of these vegetation types. Why isn't it so ?

-Line 235-238 then it is not correlated with vegetation as it was explained at the begin-

ning of the manuscript?

-Line 248 etc MCP-PCA could also include the degree of opening of the vegetation types that grow above the cave in the discussion.

-Line 254 this could have been shown also with ∂18O ?

-Line 278 denser vegetation : this could be checked

-Line 290 I disagree here because in the Caatinga there is no C4 plants, a high density of C3 deciduous trees plus the Cactaceae (C3 carbon metabolism).

-Line 291 TR5 add the vegetation type/ the environment of the cave

-Line 291-303 : the ∂13C relates to climate and evaporation ? not anymore with soil thickness ? and what about plant assemblages ? these last two points are not discussed (also line 333) when they were listed as main factors of ∂13C variability earlier in the ms.

-Line 311 C3 plants do show a broad range of physiognomies in the Tropics Line 311 : this was not really demonstrated in the ms neither in Novello et al 2019

-Line 313 If ∂13C reflects hydroclimate, why analysing the Carbon stable isotope as ∂18O proved to be efficient in that field?

-Line 334 after 1750 CE, may be consider deforestation ? which could eventually introduce a discussion on the vegetation cover ?

Line 336 which vegetation changes and where ?

Line 337 vegetation responds to other influence. . .yes I thought it was soil thickness ? Although here it is the temperature that is inferred.

Line 349 so again not related to vegetation

Line 354 This could be an important issue to consider for instance when comparing with other compilation

Line 354 356 I do not agree with this conclusion. The predominance of C3 plants on the study sites was not shown.

Line 363 365 what is the novelty here ? it was already showed by ∂18O

Line 366-367 and deforestation ?

Tables and Figures

Table 1 Add at least the biome in front of each site and the vegetation type that grows above the cave.

Table A1 add the length of the speleothem

Figure 1 Legend figure 1 : Cerrados with S

Figure 2 what don't we see 25 points ?

Figure A1 is not lisible

Figure A2 : what do you call a vegetation domain ? a biome ? a vegetation type ? anyway this is none of the category represented here. It is not possible to relate the ∂13C to the vegetation cover. This point needs further development in your argumentation.

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-184, 2020.