

Interactive comment on “Water stable isotopes ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) in the Peninsula of Yucatan, Mexico” by Eduardo Cejudo et al.

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General comment

The paper needs a careful revision because the topic and the objectives of this study are not well presented in the introduction, the results are poorly described, and some discussion sections are disconnected from the rest of the manuscript.

REPLY: We appreciate the comments and we have considered all of your suggestions. Overall, we agree with all of the comments from Referee #1 because our paper presents information that contributes to the knowledge of the study of water isotopes, beyond its application in the region. Our most important result is the meteoric wa-

C1

ter line. We cannot be conclusive with the data in hand but we can hypothesize as far as the data and the existing literature allow us to do. We restrict ourselves to the statements supported by our data.

The Anonymous Referee # 1 suggested us that it should include a clear objective and we have rewritten the section so the Objective is well presented (Page 2, lines 51-53)

Furthermore, I think the manuscript would benefit from a careful revision of English, due to the presence of some awkward terms.

REPLY: We have completed edition for proper English language, grammar, punctuation, spelling, and overall style by one or more qualified native English-speaking editors.

Specific comments

- The current introduction section (lines 22-39) presents basic definitions and a generic explanation of the first applications of stable isotopes in tracer hydrology. I think the authors should narrow down the introduction to the specific topic of the manuscript, and clearly identify the research gaps (more recent references should be added as well). Furthermore, section 1.1 only highlights research gaps, specific of a study area, whereas the readers of Hydrology and Earth System Sciences could be more interested in a manuscript with a focus that is not only strictly-related to the specific study site. REPLY: We appreciate the suggestion and we rewrote the Introduction section with less general information about isotopes, narrowing down to what we consider essential information and recent references. In order to be of ample interest for readers of HESS and other in the world, we have deleted the section 1.1, so our contribution is not very parochial. We stress that we aim to “contribute with to the state of the art of meteoric water isotopes that will assist in ecohydrological, paleoclimatic, physiological and other research, not only in Mexico, but also in the Great Caribbean Area and other locations with similar latitudinal and geological conditions” (Page 2, lines 51-53)

- The main and the specific objectives of the manuscript are not clearly presented.

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I think the authors should reformulate lines 50-57 (page 2). REPLY: Completed and rewritten with the above mentioned corrections and suggestions from the Reviewer (Page 2, lines 51-57).

- I think the manuscript lacks a table summarizing the isotopic data compiled by the authors (e.g., water type, sample size, sampling location and period, and descriptive statistics should be reported in the manuscript). REPLY: Thank you for the keen observation. Table 1 has been added and it summarizes the main characteristics of the isotopic data compiled: n, States, Locations, Sources (References), Range of dates, Water types, Aquifers, Hydrogeological sub-regions, Altitude (m.a.s.l.) and $\delta^{18}\text{O}$ - $\delta^2\text{H}$ Provider).

- The results reported in the figures are poorly described in the text (particularly Fig. 4-7). Probably the manuscript would benefit from a separation of the results (I encourage to expand the description of the findings) and the discussions (these should be re-organized). REPLY: We appreciate and consider the comments. We have included better description of the findings of the results presented in the figures, but we prefer to maintain the format as Results and Discussion together as they are now, because we can present the data and immediately discuss and present our arguments and interpretation with the data on hand. The specific comments for some section are answered lines below, responding each specific comment.

- Section 3.3 introduces for the first time that there are sap isotopic data sampled in the study area, but they are not reported in the manuscript. Since this discussion is quite disconnected from the previous and the following sections, I suggest to remove it from the manuscript. REPLY: We apologize for the mistake in the sub-heading number. We understand the suggestion of removing the section as the reviewer considers it "disconnected from the previous and the following sections". We prefer to maintain the section because not only contributes to support the objective (presents most of the existing data of stable water isotopes), but also allow us to present an interpretation of what could be happening in regards of water used by plants, namely the use of soil wa-

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ter as other published literature have found. In order to attend the observation "they are not reported in the manuscript", we have mentions sap isotopic data in the introduction (Page 2, lines 46-49). Discussion (Section 3.4, Page 7, lines 194-212) contrast and compare the finding in the YP with other reports regarding water transpired by plants in karstic aquifers and other ecosystems. We kindly ask to consider our arguments and discussion, properly connecting all section of the manuscript regarding the integration of water isotopic data for studies of water balances and ecohydrology.

- Section 3.5 (but it should be 3.4) also seems quite disconnected from the other sections in the manuscript, and most of it (particularly lines 199-212) is not very meaningful. REPLY: We understand the comment and mostly agree with it. We have re-structured the complete section as a section of the discussion named "3.5 Stable isotopes for better groundwater management" before future research, as the use of water stable isotopes helps to fill gaps in information regarding sustainable groundwater in karstic areas with large extraction volumes. Thanks for the observation and we expect the Reviewer finds satisfactory the modification (Page 7 Lines 214-223).

- Page 3, lines 73-75: It is unclear how the authors evaluated evaporation lines, and why they used evaporation lines for interpolation (spatial or temporal interpolation?) and comparison with the isotopic composition of groundwater. REPLY: We apologize for the misunderstanding; we present groundwater evaporation lines that include data with both $\delta^{18}\text{O}$ and $\delta^2\text{H}$ data, and in cases where only one number was provided (for instance $\delta^{18}\text{O}$ in Perry papers) we provide a "theoretical" deuterium value by interpolating the expected $\delta^2\text{H}$ using the existing evaporation line. We have reworded Section 2.1 and provided a reference of the use of linear interpolation so it is clear what we present in the Supplementary material 2 (Lines 71-76). In addition, the results and Discussion section mentioning the evaporation lines (Page 5, Lines 145-162) is extended to provide deeper interpretation of Figure 6.

- Page 5, lines 138-139: It is unclear how the authors could conclude that groundwater has a fast recharge by the examination of just few data reported in Fig. 5. REPLY: The

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Reviewer is right on the observation that, with so little data, we cannot be conclusive. We did not express this sentence as a proved fact, we are merely hypothesizing of what this data set suggest and would be required to verify. We have rewritten the paragraph so it is now an observation based on the data we currently have and compared to published research with similar outcomes (Page 5, Lines 139-143)

- Page 5, line 143: How did the authors determine that the groundwater follows the reported evaporation lines? I suggest to the authors to consider their results in light of recent findings reported in Benettin et al. (2018). REPLY: We thank the Reviewer for providing such valuable reference. We have rewritten the paragraph presenting our point of view and support it based on the results published by Benettin and discuss our limited dataset under the light of those findings (Page 5, Lines 148-162)

- Pages 5-6, lines 155-160: Based on the data and results reported in this manuscript, the inferred processes seem very speculative. I think the authors should remove these sentences or report the proper references supporting their statements. REPLY: We agree with the Reviewer and we removed those sentences since we have provided our argument in Page 5, Lines 136-143. Thanks for the observation.

- Figure 1: Where is located the state of Campeche? Please report the label in the map. Change completed. State labels included and slight changes in legend nomenclature.

- Figure 7: Please increase the size of the labels. Change completed

- Figure 8: Symbols representing concessions are too small. REPLY: Considering the comments and focusing on the objective, the authors have agreed on removing figure 8 and all the associated text through the manuscript.

Technical corrections:

- Page 1, line 15: Please replace “pore-waters” with “soil waters”. Change completed

- Page 1, line 25: “ δ -plot” Probably the authors mean “a dual-isotope plot”. Change completed

C5

- Page 2, line 47: “is a representation”. Change completed

- Page 2, line 55: Please explain the acronym “RMWL”. Change completed

- Page 3, line 82: Please remove “Quantum GIS” and refer only to “QGIS 3.8”. Change completed

- Page 3, line 84: It should be “Inverse Distance Weighted”. Change completed

- Page 3, line 91: “studied less”: Please revise this awkward sentence. REPLY: Change completed. The sentence is now “whereas meteoric water (27%) and lakes (27%) have been less sampled and analysed.” (Page 3, line 88-89)

- Page 4, line 95: It is unclear what the authors mean with “that matrix”. REPLY: We wanted to describe the environment or compartment in which the water samples were collected. For example, soil water or groundwater. We have rewritten the sentence “sampling efforts have been focused on that compartment of the hydrosphere” referring to aquifers. (Page 4, line 95). Thanks.

- Page 5, line 135: It should be “analyses”; however, the sentence is quite unclear. REPLY: Thank for noticing this. We wanted to say, “Groundwater has been slightly more intensively sampled and most reports represent single samples analysed for specific purposes”. We have corrected the sentence (line 137).

- Page 8, line 228: Please replace “cycles” with “years”. Change completed

References Benettin P., Volkmann T.H.M., von Freyberg J., Frentress J., Penna D., Dawson T.E., Kirchner J.W., 2018. Effects of climatic seasonality on the isotopic composition of evaporating soil waters. *Hydrology and Earth System Sciences*, 22(5), 2881–2890. DOI: 10.5194/hess-22-2881-2018

Table 1. Summary of the main characteristics of the isotopic data compiled in the Peninsula of Yucatan, Mexico.

| Category | Descriptor |
|--|------------------------|
| States | 3 ^a |
| Data points (locations) | 170 ^a |
| Data sources (references) | 17 |
| Range of dates | Aug 1973 - Aug 2018 |
| Aquifers | 3 ^a |
| Administrative region | 4 ^a |
| Altitude (m.a.s.l.) | 0 - 210 |
| Isotopic composition of water (‰) ^b | |
| Meteoric $\delta^{18}\text{O}$ (n=128) | -2.74 (-9.7, 0.83) |
| Meteoric $\delta^2\text{H}$ (n=124) | -11.36 (-67, 17.33) |
| Groundwater $\delta^{18}\text{O}$ (n=213) | -3.19 (-8.82, 6.81) |
| Groundwater $\delta^2\text{H}$ (n=199) | -18.66 (-58.52, 28.17) |
| Seawater $\delta^{18}\text{O}$ (n=7) | 0.77 (-0.3, 1.5) |
| Seawater $\delta^2\text{H}$ (n=7) | 7.56 (4.4, 14.0) |
| Coastal lagoon $\delta^{18}\text{O}$ (n=2) | 2.1 (1, 3.2) |
| Coastal lagoon $\delta^2\text{H}$ (n=2) | 5.39 (-0.29, 11.07) |
| Lake $\delta^{18}\text{O}$ (n=126) | 1.8 (-5.4, 5.82) |
| Lake $\delta^2\text{H}$ (n=110) ^c | 4.69 (-39, 23.21) |
| Mangrove $\delta^{18}\text{O}$ (n=1) | 6.1 |
| Mangrove $\delta^2\text{H}$ (n=1) | 29.2 |
| $\delta^{18}\text{O}$ - $\delta^2\text{H}$ analyses provider | 11 ^d |

^a See in Figure 1

^b Isotopic data are in per mil (‰) mean, minimum and maximum.

^c Missing $\delta^2\text{H}$ data interpolated from evaporation lines. See Supplementary Material 2.

^d ARES Division, Johnson Space Center; Atomic Energy Commission Contract AT (30-1)3204; Auburn, Alabama (ANIMAL); Department of Geological Sciences, University of Florida; Geoscience Mass-Amherst; Instituto Mexicano de Tecnología del Agua; National Geophysical Data Center, Boulder - Colorado; Stable Isotope Facility of the University of California at Davis; Stable Isotope Laboratory Environment Canada; Texas A&M Galveston; Yale University.

Fig. 1.

C7

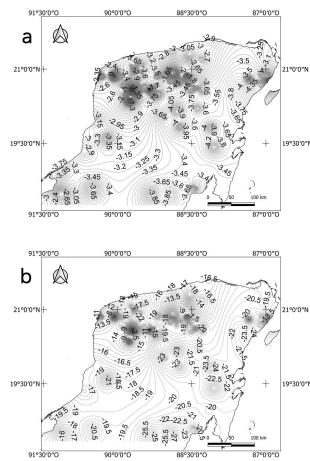


Figure 7: Groundwater isotope maps of the Peninsula of Yucatan. a) $\delta^{18}\text{O}$ and b) $\delta^2\text{H}$.

Fig. 2.

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