Solid Earth
Discussions

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Interactive comment on "Water- and land-borne geophysical surveys before and after the sudden water-level decrease of two large karst lakes in southern Mexico" *by* Matthias Bücker et al.

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Received and published: 5 July 2020

1. General Comments
I have carefully and interestingly read and reviewed the manuscript (MS). The authors present an interesting multi-method case study on two lakes in Mexico using water borne geophysics. Especially the sudden lake water level drop as well as the application of multiple methods are highlights of this study. The results are very well prepared and technically on a high level.

Besides my positive impression, there are a few points to be addressed.

The authors present studies on two lakes - Metzabok and Tzibana. If feasible, I suggest to incorporate some more general discussion on how these lakes are connected. Are there any general conclusions/interpretations that apply to both lakes or is it even possible to connect the subsurface structure? For example, there is no clay interpreted in lake Metzabok whereas major parts of the subsurface in lake Tzibana is related to clay rich sediments.

It is not easy to find a red line in the MS. This is partly due to the fact that all profiles on lake Metzabok are discussed one by one. And, subsequently the results for lake Tzibana are shown. I suggest to strengthen the explicit motivation why both studies were performed. Possibly a road-map can be formulated indicating why which method was used and how the survey was designed to address the scientific questions. As I understand the study aims at few aspects (1) detect depth to bedrock (2) understand sudden lake level drop and related subsurface conditions such as Karst collapse and (3) combined interpretation of various methods (especially TD-IP phase data evaluation for the first time in sedimentary studies).

I suggest to elaborate more on the benefit of using TD-IP and evaluating the phase data for the two lake studies, since this is not very common. If feasible elaborate more in detail how the phase data relates to subsurface physical properties in general.

2. Specific comments

- I understand that the focus is on the geoscientific interpretation using a multi-disciplinary approach. However, I do miss some technical aspects of the study with respect to method and inversion. For example some typical survey parameters (e.g. anchored or continuous TEM system; typical measurement errors).

  Moreover, there is currently no data visualized (Only the TD-IP lab data). I suggest to include a section with data, and possibly also with inversion model re-

sponse (If feasible, for example in an appendix). Of course this should not distract from the study itself.

- From my experience, the TEMfast device sometimes shows significant distortions using small loop configurations. Did you observe any data distortions especially since a very small configurations was used? And, did you for example compare some land based soundings using a larger transmitter to validate that the very small layout gives correct transient data? In this respect, I also suggest to show at least some data.

- A conductor is indicated below the limestone towards the east in Fig. 7a. Please discuss this feature if it can be related to any geology such as fracture zones or if this is an artifact (probably related to distorted late time transient data). A slightly similar feature is also seen in Fig. 9 towards the south.

- Does the ZOND software actually invert for coincident loop or for a central loop receiver? For very early times the central loop transients differ from coincident loop data.

- The TEM data might be effected by 2D effects especially considering rather steep slope angles towards the edges. possibly include some discussion such as "multi-dimensional effects in TEM data were not considered as the TEM survey lines were not along strong bathymetry or steep slopes".

- P315 - Obviously the p-wave velocity is less than expected. Can you elaborate why a lower vp < 2000 m/s was observed in the SRT measurements.

- P350 - I suggest to include a table that summarizes the specifications of each method such as resolved physical parameter, DOI, pro/con of each method. Such a table would also summarize the used methods a bit and emphasize the integrative approach.

- P-365 - For TEM a water-depth of 20 m depending on the water conductivity is not necessarily a limitation. Please correct this statement.

- For all interpretation a smoothness constraint inversion is used. Do you expect a smooth transition from the sedimentary layers to the limestone. In this respect, is a smoothness constraint inversion appropriate to image the geological situation here?

- As water-borne TEM studies are still quite rare, I miss some references to recent water borne TEM studies. For example, we recently applied boat-towed TEM to image a hydrothermal target on the Azores. In this study we gathered around 600 soundings using the TEM system (initially developed by Mollidor et al.) in a continuous mode. There are also other very recent studies. These can be included as references, if the authors find them suitable:
  - Yogeshwar, P., Küpper, M., Tezkan, B., Rath, V., Kiyan, D., Byrdina, S., ... & Viveiros, F. (2020). Innovative boat-towed transient electromagneticsâĂŤInvestigation of the Furnas volcanic lake hydrothermal system, Azores. Geophysics, 85(2), E41-E56.
  - Lane Jr, J. W., Briggs, M. A., Maurya, P. K., White, E. A., Pedersen, J. B., Auken, E., ... & Adams, R. (2020). Characterizing the diverse hydrogeology underlying rivers and estuaries using new floating transient electromagnetic methodology. Science of The Total Environment, 140074.

3. Technical corrections
The MS is very well written and the language is very good. All figures are well prepared with well readable fonts. Therefore, I only have a few technical corrections:

- P70 - the term reference data is misleading. I do not see that the data is actually used as reference data. Better - "additional/complementary data for comparison with the water borne data"

- Please check that all abbreviations are defined, e.g. ERT etc.

- P140 - explain or remove the skip parameters (skip-1 skip-2 etc.)

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2020-75, 2020.