

## ***Interactive comment on “Unraveling the hydrological budget of isolated and seasonally contrasted sub-tropical lakes” by Chloé Poulin et al.***

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We thank the reviewer for his work on our manuscript, and for his detailed prescriptions. The reviewer criticized the lack of clear presentation of our objectives, and the structure of the manuscript that he considers difficult to follow. He also did not understand in what purpose we used stable isotopes, and to what extent our study was different from previous ones on remote areas. He has specific recommendations. First, he suggests re-writing the introduction section in order to clarify the research question and the objectives. He also recommends developing the theoretical background of the stable isotope method and adding more references. Finally, he proposes to develop

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the Materials and Methods section by moving all the section 5.1 in this section, and to clarify our use of Lake Ihotry from Madagascar as a test of our method. We understand how several paragraphs can be considered as misplaced, thus precluding a good understanding of our study. We will be ready to work on improving the text following his recommendations.

We agree with the reviewer that several previous studies were able to determine the hydrological budget of tropical lakes, even when difficult to reach, and that some of them also used satellite altimetry data. However, all these studies dealt with relatively small basins, and were based in general on extensive data sets and continuous monitoring. For instance, Liebe et al. (2005) and Rodrigues et al. (2012) (cited in the paper), estimated small reservoir storage capacity with altimetry data. Gal et al. (2016) calculated a hydrological budget with altimetry data, but with regular water height measurements (data we do not have in our study). Alternative methods such as the Thornthwaite-Mather procedure (Steenhuis and Van der Molen, 1986; Collick et al., 2009) are also efficient for estimating water budgets in remote areas, but require precise precipitation data, which remains unavailable in many areas. By contrast, we want to emphasize the huge surfaces of the catchments of the two lakes Iro and Fitri (195 000 and 96 000 km<sup>2</sup>), with only one meteorological station. It is thus impossible to interpolate data at this scale. Standard hydrogeological approaches are thus highly unconstrained in such a case, and isotopes may help to obtain a first order hydrologic budget. Calculating the mean evaporation/inflow ratio of a lake from a simple mass balance equation has been already applied in a number of studies (Gat, 1978; Gibson et al., 1993; Gibson, 2002; Yi et al., 2008). However, the seasonal variation of isotopic composition was generally not discussed in studies despite very few available data over a year (Mayr et al., 2007; Yuan et al., 2011; Brooks et al., 2014). This may induce large error on the results, especially in catchments with seasonal climate contrast (Gibson, 2002).

In our manuscript, we describe a simple method to circumvent this difficulty, by combining isotopes with altimetry data in order to assess uncertainties on the influx and

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outflux calculation. This approach requires only point data collected during the dry season, and is thus most appropriate for isolated tropical lakes with difficult access during the wet season. Recently, Cui et al. (2018) reviewed a number of case-studies where detailed hydrographic and isotopic monitoring were obtained on different lakes under various climates, in order to identify the most representative period for sampling during the seasonal cycle in each case, in the hope of obtaining a representative long term perspective on the lake water balance. We see our study as fully complementary to this approach.

We also take good note that introducing lake Ihotry from Madagascar only in the discussion was too late, and thus confusing. We used our results previously published on this lake as a benchmark test of our method, and did not want to place those results on the same line as the new data produced on the Chadian lakes during this study. However, the reviewer is right that this should be introduced and explained earlier in the paper.

We are willing to take into account all the reviewers recommendations to clarify our manuscript. We will re-write the introduction section in order to better put forward our research questions and objectives, and better develop the theoretical background of our use of the stable isotopes method. We will develop the Material and Method section to clarify our use of Lake Ihotry from Madagascar. In this section, we will also move all the section 5.1 to explain our scientific approach, in order to facilitate understanding of the discussion section.

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