

Interactive comment on “Application of isotopes and water balance on Lake Duluti–groundwater interaction, Arusha, Tanzania” by N. P. Mduma et al.

Anonymous Referee #1

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Referee report on HESS 2016-176: Application of Isotopes and Water Balance on Lake Duluti-Groundwater Interaction, Arusha, Tanzania By Mduma et al.

The manuscript uses tracer data (major chemistry and stable isotopes) to characterize the surface-groundwater exchange and the water balance of a specific Lake in Tanzania. Unfortunately the manuscript is characterized by several major shortcomings that do not warrant publication in a scientific journal. The reasons are detailed down below.

1. Lacking scientific background

The scientific background disregards existing work in the field, is much too general and not to the point of the actual study. It only contains local investigations (many of

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them also in grey literature) and most of them in groundwater. There is virtually no study on a lake water balance or on lake-groundwater exchange included that would prove that the authors are aware of the actual methodology to be used. Starting with the pioneering works of Joel Gat there are many examples in the literature that used environmental isotopes to characterize lake water balances and also the exchange with surrounding groundwater.

2. Wrong assumptions in the isotopic mass balance

As a consequence of a missing scientific background there are major shortcomings in the applied methods that produce totally wrong results. The most alarming mistake is included in equation 7: It is simply wrong that the isotopic composition of lake water can be derived by simply adding isotopic concentrations of inflow, precipitation and evaporation. It is known from literature that the isotopic enrichment of an evaporating water body is a complex process and depends on various factors. The fundamental equations are given in various scientific papers, with Gat & Browser (1991) being only one example. And even if a traditional mixing approach was applicable (this could eventually be for other tracers, e.g. major ions), tracer concentrations would have to be weighted by the amounts of the different components.

3. Uncertain laboratory procedures for major ions

It is acknowledged that the authors are from a developing country with limited laboratory resources. However, the applied methods are only briefly described and no estimation on the error of the procedures is possible. Which “multi-parameter meter” was used for the onsite field measurements? Why were some major ions measured by a multi-parameter spectrometer (K, NO_3 , SO_4) and others by titration (Ca, Mg, CO_3 , Cl) and Na by a flame photometer?

4. Non-necessary freezing of isotope samples

Samples for stable water isotopes are stable for many years if they are filled without

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headspace and kept in tight bottles. Why were the samples for isotopes frozen in glass bottles? How was breakage prevented during freezing? How was tightness guaranteed during freezing and volume expansion? In the freezer a leakage will cause sublimation and additional fractionation. If studies like this are published, other researchers will perhaps freeze their samples too which causes non-necessary problems for them.

5. Violated assumption of complete mixing of the lake water body

The authors admit themselves that mixing inside the lake was poor, because concentrations varied between different locations and different depths. Nevertheless they assume complete mixing and used single mean values for the lake water balance. For this they form averages of various samples collected in the dry and wet season. But fractionation by evaporation is higher at the lake surface and groundwater inflow occurs at certain depths only. In addition, no exact sampling dates are given, it seems that samples were averaged arbitrarily, when is a wet season sample a wet season sample?

6. Poor interpretation of tracer data

The interpretation of the measured major ion chemistry is not convincing. Only for some ions it is argued that concentration in the lake is higher than in groundwaters due to evaporation, but this is principally true for all ions. Also anthropogenic inputs are only related to high SO₄ not to other ions. A positive correlation of SO₄ with NO₃ is no indication for oxidation of organic matter, there may be many other factors playing a role here, primary production inside the lake is only one. But also the isotopic data interpretation of figure 6 is limited: First of all a straight line through all sampled data does not make sense, because different types are mixed. Second, the "local meteoric water line" stems from samples virtually sampled at many different locations across Tanzania. They produce a very large scatter and cannot be related to the samples of the present study.

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