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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Quantifying flood-water impacts on a lake water budget via volume-dependent transient stable isotope mass balance" *by* Janie Masse-Dufresne et al.

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While this paper is a detailed look at a small man-made (or influenced lake), it isn't clear what the overall usefulness is to others working on larger and more complex lake systems. The manuscript is overall relatively well written, but there are many parts that aren't always clear. Most importantly there is no discussion outside of the local issues of the lake, which makes this a very site specific study.

There are also many line by line points that need to be made. These are as follows:

Line 43: The reference to Klove et al, 2011 is to Groundwater Dependent Ecosystems

(GDE) and lakes are not the same thing as GDEs, they are a subset of GDEs in most, but not all cases. This reference should be something specific to lake systems. GDE also refer to streams wetlands and other non-lake surface waters. For example, Rosen 2015 would be a better reference. Rosen, M.R., 2015, The influence of hydrology on lacustrine sediment contaminant records. In Blais, J.M., Rosen M.R., Smol J.P. (eds) Environmental Contaminants: Using natural archives to track sources and long-term trends of pollution. Springer, Dordrecht. 5 – 33 p. https://DOI.org10.1007/978-94-017-9541-8_2 Line 44: "few decades"... references only list the last decade. you could add: Herczeg AL, Leaney FW, Dighton JC, Lamontagne S, Schiff SL, Telfer AL, English MC (2003) A modern isotope record of changes in water and carbon budgets in a groundwater-fed lake: Blue Lake, South Australia. Limnol Oceanogr 48:2093–2105 if you want to go back two decades.

Line 56: .... "but occur over a 1 km long area." Do you mean 1 km "wide" area? The length of the river or canal is of no importance, it is the width that will make it hard to measure flux. Please change to "wide"

Line 58: "The democratization of isotope mass balances in Quebec...." What does the "democratization" of isotope mass balance mean? Was this auto corrected from the original word to be used. I hope so, as I had no idea that isotopes were political! Should the word be "demonstration"? Not really sure what is going on here.

Line 60-70: It would be good to include Herczeg et al (2003) here as well as they determined changes in isotopic composition due to groundwater pumping, this also shows how transient changes can affect the isotopic composition of lakes.

Line 78: There is no hypothesis indicated in this manuscript. The objectives are clear but there is no indication of what mechanisms they propose may be important. A hypothesis should be added.

Figure 1. Water courses shown don't match up with the description. There is supposed to be one inlet and outlet to Lake A, but at least two inlets are shown (or outlets). Flow

directions are needed on the other streams (canals?) shown. The reorienting of the North arrow is somewhat confusing, probably needed. All sampling is done in one corner of the lake, why was this done? Presumably the lake is well mixed? Samples taken near the shore, like LB-S1 could have some evaporation signature in them. Was this accounted for? If Lake DM really has a name (Deux-Montagnes), then the name should be put on the map with the (DM) in parentheses. One might also argue to use the French for the whole name, Lac des Deux Montagnes. Lake B also appears to be called Lac Val des Sables in google earth, is this not correct?

Line 116: "All water levels are reported relative to a reference water levels measured on February 9, 2017" One reference water level or many? Please fix, this is a combination of both.

Line 118 change to ". . .over the Ottawa River watershed. . ."

Line 125-126: ". . ..synchronous with those of Lake DM (Fig. 2) from late February to late July 2017". How do you know water levels are synchronous from Late February when water level measurements weren't begun until April? This can't be known. Given the sparse data in figure 2, and the non-synchronous relation between the observation well and Lake DM in the autumn, this can't be conclusively known. In addition, some of the well peaks appear to actually occur before the lake level rises, which is a bit strange. In any case, more information is needed to be able to say this. It may be true for the flood period, but that would be expected. The low flow period doesn't appear to be completely synchronous. While it may be true that Lake DM controls Lake A water level during flood periods and/or high water periods, there is no data presented that shows that Lake A water levels are synchronous with Lake DM during low flow or low water levels. Clearly the groundwater is not synchronous during September to November. Section 3.1 Field measurements section. There is no mention of calibration for the water level loggers. Without calibration how do you know they were synchronous or that they water levels were the same? Please give all the calibrations that were done on instruments and isotopic analyses. Section 3.2 Water sampling and analytical tech-

niques: Other than ion balances, was any other QA/QC done? This needs to be stated. In addition, were isotope measurements compared with standard mass spectroscopy? Ring cavity measurements have been shown to be in error in some cases and should be viewed with some skepticism unless comparison is made to standard mass spectroscopy or the methodologies listed below have been followed. See Wassaner et al (2014) and Sengupta (2014) for examples. Also, were any samples taken under ice? Ice will fractionate the isotopic composition and make the mass balance different. Has this been accounted for? It also isn't clear why methods are included for water quality sampling. These data don't appear to have been used in this manuscript, so it simply takes up space. Please remove the methods for chemical sampling and concentrate only on the isotopic measurements. Perhaps more detail about replicates and comparisons to mass spectroscopy measurements can be done to alleviate concerns over the accuracy of the ring cavity measurements. References: Sengupta, S., 2014, Pros and Cons of Laser Based Isotope Measurements of Water and Real Time Vapour Samples: A User's Perspective. Gond. Geol. Mag., V. 29 (1 and 2), pp.45-51 Wassenaar, L.L., Coplen T.B., Aggarwal, P.K., 2014 Approaches for Achieving Long-Term Accuracy and Precision of δ18O and δ2H for Waters Analyzed using Laser Absorption Spectrometers. Environ. Sci. Technol. 2014, 48, 2, 1123-1131. Line 170: "The water and stable isotope mass balance of a well-mixed lake can be described. . ." The authors haven't actually demonstrated that the lake is well mixed. A figure showing the lake profiles should be presented. Line 198: So, evaporation was held constant for the entire month. Particularly in the spring, that is a brave assumption. This seems to be the coarsest time step. Why was this needed? Line 208: limiting isotopic composition (Gibson et al., 2015). This is not a common term. Although this can be found in the reference listed, it should be detailed more here. Line 216: " The above-mentioned equations are computed on a daily time step to calculate the isotopic composition of the lake (δL)." Yet, some parameters have monthly time steps. How do you reconcile that? Does this mean the monthly time steps aren't that important, or should it all be done monthly? This seems like a limitation to the daily time step. Line 218: It has been

stated a few times that the lake is well mixed, but this has not been demonstrated with any measurements. The reader needs evidence that the lake is well mixed, particularly over the time period of measurement, which is over the springtime period, when mixing may not be complete. Line 223: "Assuming homogenous hydraulic conductivity of the sediments" This is a big assumption and likely not accurate overall, but in a sandy aquifer, might be a reasonable assumption given other errors in the model. This should be explained more. Line 259 and 263: This is a pet peeve of mine, but "since' is a time word and shouldn't be used to replace "because", please change to "because" everywhere in the manuscript when it is not used as a temporal term. Line 269: change to ". . ..lead to overestimation. . ." Line 270, so is the potential underestimation of groundwater exchange underestimated here? Or was something done to account for this. Please explain. Line 290-295: Why not just measure the GW input? Why does it need to be estimated from the intersection with the LEL? Also, although the evaporation process is the same between flood water and lake water (having the same slope) that is not unusual. What is unusual is that they don't intersect at the same place, so the floodwater is a different source from the recharge from GW or rainfall. There do appear to be five lake values (one of which appears to be unevaporated floodwater) that fall on the floodwater line, so there is some influence from floodwater on the isotopic composition of the lake. This should be address more fully. Line 331-332: The authors say: "Lake A volume variations are estimated from water level records assuming a constant lake area. When not available, the surface elevation of Lake A is assumed to be equal to the water level at other observation points." I don't understand what this means. Unless this is a pit lake with perfectly straight vertical sides, the Lake area will increase as elevation increases and it will take more water for fill shallower stage heights as the lake gets bigger. Please explain if this is not true for this lake. Furthermore, water levels in a well cannot be used unless there is no GW flow to the lake. If the groundwater level is the same as the lake level, then there will be no flow to the lake and the flow is stagnant. Has this been observed? If not, this GW elevation should not be used as a surrogate for lake level. Figure 2 actually show that

Lake A water level is at no time equal to Observation well VP, and is generally higher than the well elevation, except in late summer, suggesting the lake is losing water to the well except when precipitation slows down and the lake level lowers. Lake DM, which is a possible surrogate for Lake A elevation, is also never equal to the elevation of well VP, except on the rising limb of the floodwater. Therefore, the well VP elevation is not a good surrogate for lake A elevation and should not be used as such, unless a better explanation can be given. Line 338-340: This also a time of groundwater input (at least following the Lake DM elevation compared to Well VP). Is this considered in the fluxes? Line 359: So, here the vertical profiles are volume-weighted, which suggests the sides of the lake are not vertical, if they were then you wouldn't need to volume-weight them. But above you say you use a constant lake area to get the volume. Which is it? Line 382-384: you do have 3 vertical profiles; you could have at least estimated how big a difference using a stratified model using some max and min values for the isotopes. It also isn't clear from the discussion above this if the direction of groundwater low, in or out of the lake is considered, as the water level data suggests in changes through the modeling period. Table 2: A small point, but I'm not sure why commas are used in this table. Scientific notation usually uses a period even for large numbers. Europeans use commas for decimals and then periods for large numbers, so I'm not sure what style is being used here. I would prefer these to all be periods not commas. A larger point for this table is that the sensitivity analysis doesn't appear to use very wide values to check how sensitive the variables are. A change of 0.5 per mil for oxygen is not that far outside the error of the measurement. It looks like most of the differences looked at are between 10 and 20 percent. Is that reasonable, what is the variability of the rainfall amounts over time. Granted E isn't likely to have a large range, but some of the variable could have larger ranges than are estimated here. Line 414: What about groundwater influx at this time? Ok, I see discussed in the next section.

Line 440: Table 3 provides the relative importance of the hydrological processes for that year that was measured, not for an annual timescale. Measurements for all parameters weren't done for the whole year as well. This should be modified.

Line 485: tG the mean flushing time by groundwater isn't included in equation 13 and is instead written as tf, which I assume is the time of flushing (by groundwater). This needs to either be explained better, if I don't understand this, or the notation needs to be corrected. Everywhere else it is tf.

Figure 9. The caption also has reference to tG is this a different variable or is it tf?

The climate change part of this paper is somewhat of a throw away suggestion. There is really no data or simulations that support either conclusion and the modeling doesn't appear to help either. Given the possibility of either more or less flooding the conclusions seem pretty obvious.

While the model and the system are relatively well characterized it isn't clear what this gives other scientists other than a look at a local system. How can this be used in other lake systems and can a lake with fewer measurements or larger area or volume be characterized using this model? It would be good if some bigger questions were answered rather than just the local questions that have no real interest to scientists or the public outside of the area.

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