Report #1

Submitted on 02 Jan 2021
Referee #3: Chani Welch, cwelch@okanagan.bc.ca

Suggestions for revision or reasons for rejection (will be published if the paper is accepted for final publication):

This study uses field sampling and a mass balance model of stable isotopes 2H and 18O to estimate the relative contributions of flood water and groundwater to an artificial lake over one year. The article further illustrates that while groundwater input is an important component of the lake water balance, considering temporary storage of flood water input in the subsurface reduces the magnitude of regional groundwater contribution. The authors have improved the manuscript by incorporating their responses to reviewer comments on the previous version. However, further work is required to clearly draw out the objectives of the study, and clarify the conceptual model of the lake water balance and effects on the calculated water balance.

General comments:

RC3-1. The conceptual model of the lake water balance is not clearly described or consistently applied in the manuscript. For example, the lake is the water source for a bank filtration system (S2.1), but this information is not included in the conceptualization of groundwater – surface water interactions (S2.2) or the identification of water fluxes (S3.4). Presumably, the presence of this system influences both the rate and timing of water loss from the lake, at least at this boundary.
Answer: Done. We improved the description of the conceptual model. To better introduce the conceptual model, we now present the hydrodynamics of the flood event in 2.2 (the conceptual model is thus in 2.3). Also, the impact of the bank filtration system on the location of the groundwater outflows are now specified.

RC3-2. Given the significant limitations to the data and modelling effort, it may be advisable to emphasise throughout the manuscript that the values produced are first-order estimates.
Answer: Done. We emphasized the fact our model yield first-order estimates in Sect. 3.3 and in the conclusion. See response to comment RC3-39 and RC3-74.

RC3-3. The manuscript requires thorough editing in order to improve clarity. I fully appreciate the challenges associated with working in multiple languages. Thorough editing will help draw out the science that is currently getting lost here.
Answer: Done. A thorough editing of the manuscript was done by an English-speaking colleague. Minor corrections were made and marked in red in the manuscript.

RC3-4. I suggest a further check to ensure that all changes indicated in responses to reviewers have been incorporated, as some vital information has been either lost or not included, inclusion of which would strengthen the manuscript (see line by line points below).
Answer: Done. We checked that all responses to reviewers have been incorporated. The following specific comments helped at further improving the manuscript.

Abstract

RC3-5. Line 13-16: The main objective of this study…water supply. Suggest generalizing. Remove “important”.
Answer: Done. We generalized the objective of the study. L13-16 can now read as:

> *"In this study, we demonstrate that isotopic mass balance modelling can be used to provide evidence of the relative importance of bank storage and direct flood-water inputs at ungauged lake systems."*

RC3-6a. Line 17: The lake typically receives… Replace "important" with "substantial".
Answer: Done. It was corrected to "substantial".

RC3-6b. Perennial connection indicates that the connection is always present. The manuscript indicates instead that the connection is established only when lake a topographic threshold is exceeded.
Answer: Done. It was corrected to "ephemeral".

RC3-6c. Suggest revisiting abstract after revision. Streamline and clearly indicate the uncertainty of water budget estimates.
Answer: Done. The abstract was revised at the end of the revision process. The objective was reformulated (see response to comment RC3-5). We now consider that it describes the article correctly.

S1 Introduction
RC3-7. Line 34: What do you mean by "outcome"?
Answer: Done. We were referring to the actual value of the ecosystem services. To clarify, we modified L33-35, which can now read as:

> *"In fact, lacustrine ecosystems can provide a number of ecosystem services, such as biodiversity, water supply, recreation and tourism, fisheries and sequestration of nutrients (Schallenberg et al., 2013). The actual benefits that can be provided by lakes depend on the water quality, and poor resilience to water quality changes can lead to benefit losses (Mueller et al., 2016)."*

RC3-8. Line 51-56: Recently, Haig …. ungauged systems. Condense. Impacts of floods and droughts on what?
Answer: Done. We meant that the isotopic mass balance models can be applied to ungauged lake systems and can efficiently characterize the impacts of floods and droughts on water apportionment. To condense L51-56, we opted to improve the link with the previous sentence. Also, we took the opportunity to better contextualize our work relatively to the previous studies in ungauged systems. We thus rephrased L49-57 as:

> *"In remote environments, such as in northern Canada, application of isotopic methods is particularly convenient, as direct measurements of surface water and groundwater fluxes is difficult or nearly impossible (Welch et al., 2018). Isotopic mass balance models can notably be applied to ungauged lake systems to efficiently characterize the impacts of floods on water apportionment (Haig et al., 2020). While isotopic frameworks were successfully used to assess the relative importance of flood-water inputs to lakes (Turner et al., 2010; Brock et al., 2007), no attempt was made at evaluating the timing of the flood-water inputs and to differentiating between the role of direct flood-water inputs and indirect delayed inputs from flood-water bank storage on a lake's annual water budget."*

RC3-9. Line 58: This objective is not specific enough. Currently, it reads like a case study. Rephrase to specify what is new about your study.
Answer: Done. We rephrased the objective of the study to emphasize the originality of our work. It can now read as:

> *"The main objective of this study is to provide evidence of the relative importance of bank storage and direct flood-water inputs at ungauged lake systems using an isotopic mass balance model."*

RC3-10a. Line 60: "(and bank storage)". Including bank storage?
Answer: Done. By rephrasing the objective of the study, the focus is now on both the direct flood-water inputs and the indirect flood-water inputs as bank storage (see response to RC3-9).

RC3-10b. Although it is unclear whether bank storage is the correct term to apply here. Why do you believe that the process in question is bank storage and not floodplain recharge (or a combination of the two?).
Answer: Clarification. In this study, we aim at quantifying the indirect flood-water inputs as bank storage. To do so, we consider a theoretical scenario in which all the outflowing water from the lake during the flood event eventually discharge back to the lake due to bank storage process. We do not aim at quantifying the impact of floodplain recharge on the annual water budget of the lake. However, the floodplain recharge process is implicitly taken into account in our model by the way we define the isotopic signature of groundwater (δ_G), i.e., the intersection between the LMWL and the lake's LEL. In that sense, we did not make further correction to the manuscript at L60.

RC3-11. Line 61: Is it in an urban area? This is not indicated on Figure 1.
Answer: Clarifications and done. The study site is located in the metropolitan region of Montréal, as defined by the 2016 census of population (Statistics Canada). This information was added to Figure 1. It is noteworthy that L61 was reformulated in an effort to clarify the objective of the study and to condense the introduction. The fact that the study site is located in an urban area is now stated in section 2.1.

RC3-12. Line 67: Generally, the hypothesis comes first. Is this actually an assumption?
Answer: Done. See response to comment RC3-13.

RC3-13. Line 68: "unneglectable". Replace with either important or not negligible, depending on your meaning. Given the presence of a bank filtration system adjacent to the lake, wouldn't you expect the groundwater flux out of the lake to be important?
Answer: Done. As pointed out by the reviewer, this statement seems trivial. We opted to remove L67-68.

RC3-14. Line 74 to end of S1: The introduction may make more sense if you move this section to before Line 58. This would allow you to clearly show what is novel about your study.
Answer: Done. The paragraph was moved to L58.

RC3-15. Line 71: Delete "recurring perennial".
Answer: Done. It was deleted.

RC3-16. Line 73: Delete "indicative". Check that a 100-year flood (more correctly, a flood with an Average Recurrence Interval of 100 years) is generally considered an extreme event**.** With changing climates, floods that were formerly considered to have ARIs of 100 years are being re-classified to higher frequencies.
Answer: Done. The term "indicative" was deleted. Concerning the designation of the flood event, we agree with the reviewer that "100-year flood" should be replaced by a more adequate term, such as "a flood with an average recurrence interval of 100 years". Similarly, the USGS recommends using the term "1-percent annual exceedance probability (AEP) flood" (https://www.usgs.gov/special-topic/water-science-school/science/floods-and-recurrence-

intervals?qt-science_center_objects=0#qt-science_center_objects). The Government of Quebec classifies the 2017 major flood event as “a flood exceeding the recurrence interval of 100 years”. Considering all the above, we corrected L73 to: “Our study period spans a flood event, exceeding the recurrence interval of 100 years, and is therefore an example of the response of the system to a major hydrological events.”

S2 Study Site

RC3-17. Line 89: Was the lake created by sand dredging, or is the sand-dredging on-going as suggested in the responses to reviewers? The latter has implications for mixing in parts of the lake.

Answer: Clarifications and done. We corrected the manuscript to specify that the sand-dredging is still on-going. Also, we agree that the dredging process might contribute to the mixing of the water column in some parts of the lake. However, we expect the dredging to have a small impact on an annual time scale, and we made no modification to the manuscript regarding this concern. In fact, the dredging only takes place during the weekdays and between June to October - no dredging is done during the night, the weekends, and the ice-cover period. Additionally, on-field observations let us believe that the mobilized water volumes by the dredging process are small compared to the lake volume. Although no data is available to quantify the impact of dredging on mixing in part of the lake, horizontal homogeneity across the lake was previously demonstrated by Pazouki et al. (2016). In their study, the authors reported good similarity between depth-resolved physico-chemical profiles ($n = 4$) performed in different zones of the lake during summertime. This information is mentioned in the manuscript (see section 3.2).

RC3-18a. Line 90: How do you know that Lake A is the main water source for the bank filtration system, and not Lake B? Do you have an estimate of the volumes of water extracted from the bank filtration system? How do they compare to the lake volume and the flood-water input volume?

Answer: Clarifications. The evaluation of the water origin at the bank filtration system was the purpose of a previous work (Masse-Dufresne et al., 2019). The pumped volume is about 2 x 10^6 m^3 over the study period (i.e., from February 2017 to January 2018), which corresponds to 43% of the lake volume and 42% of the total flood-water input (in scenario A).

RC3-18b. Also, please include Lake B in this section. Currently it is not mentioned.

Answer: Done. As description of Lake B was added to the section 2.1. We also made an effort at reorganizing the information presented in this section in order to ease the reading and make it more concise. The Ottawa river and Lake DM are now presented first. Then, we focus on Lake A and Lake B and the bank filtration system. We moved all information that is specific to the 2017 flooding event and to our conceptual model in the section 2.2.

RC3-19. Line 93: An assessment of the impact of uncertainty… Perhaps you could delete this sentence and replace it with an error estimate after the lake volume e.g., 4.7 x 106 m3 ± ? m3

Answer: Clarifications. To estimate the initial volume of the lake (4.7 x 10^6 m^3), we made an assumption regarding the slope of the banks. In this context, we designed the sensitivity analysis to consider a realistic range for the bank slopes, rather than an error estimate on the initial lake volume (which is difficult to evaluate). By varying the bank slopes from 20 degrees to 30 degrees, the initial lake volume ranges from 4.84 x 10^6 m^3 (+3%) and 4.32 x 10^6 m^3 (-8%). It would be confusing to present these values as error estimate of the lake volume at L93. Hence, we opted to modify L93 and to only present the lake surface area and depth in section 2.1, as this is the available data. The estimation of the initial Lake A volume in now presented in section 3.4, i.e., where we define the model parametrization. This can read as:

"The initial lake volume (4.7 x 10^6 m^3) was estimated from the observed lake surface area (2.79 x 10^5 m^2) and the maximal depth (20 m) and assuming bank slopes of 25 degrees. Assuming bank slopes of 20 degrees or 30 degrees, a typical range for saturated sands (Holtz and Kovacs, 1981), would result in an estimated initial lake volume of 4.84 x 10^6 m^3 (+3%) and 4.32 x 10^6 m^3 (-8%)."

RC3-20. Line 98: Unless I have missed it, this stream is not mentioned further in the manuscript. Please add some words here to indicate this.
Answer: Clarifications. It was mentioned in section 3.4 (L250-253) that the potential contribution from S1 is neglected in this study. To clarify, we emphasized this assumption at section 2.1.

RC3-21. Line 99-104: Please reword this section to clarify the surface water flows. My interpretation is that water flows from Lake A to Lake D-M through S2 and S3 for 7 months of the year, and for the other 5 months, it flows from Lake D-M to Lake A across the floodplain and in the streams. These time periods are fairly equal, so it seems odd to describe the reversal as temporary.
Answer: Done. We agree with the reviewer that the term "temporary" may be misleading and was thus removed. Additionally, we would like to mention that we simplified the information initially presented at L99-104. All information related to the specific hydrological context of the 2017 major flooding is now presented in Section 2.3, i.e., where the conceptual model is detailed.

RC3-22. Line 105-106: There is no evidence of wells outside the paleochannel in Figure 1c. Where does the evidence come from that this layer is thin? Also, the topographic threshold show on Figure 3 appears to be within the clay as depicted in Figure 1c. Please clarify.
Answer: Clarifications and done. The locations of additional well logs were added to the figure. Note that the Figure 1c was moved in appendix, as modifications to figure were made to clarify the context of the study and better contextualize the study site relatively to the Ottawa River watershed. Also, the topographic threshold was determined from a land survey and corresponds to the maximum elevation along S2 streambed. This information was added to the manuscript in Section 2.1.

RC3-23. Line 107-110: Why is this significant for this study? Does the Ottawa River flow through Lake D-M? Clarify wording. Unclear why it matters that the St Lawrence River is a drinking water source for Montreal and Quebec in the context of this study.
Answer: Clarification. The Lake DM is an enlargement of the Ottawa River at the confluence with St. Lawrence River. We clarified this information in section 2.1. It is important to contextualize Lake DM relatively to the Ottawa River watershed in this study, because the 2017 major flood event was caused by the combination of intense precipitations and snowpack melting over the Ottawa River watershed (Teufel et al., 2019). The latter was clarified in the manuscript.

Teufel, B., Sushama, L., Huziy, O., Diro, G. T., Jeong, D. I., Winger, K., . . . Nguyen, V. T. V. (2019). Investigation of the mechanisms leading to the 2017 Montreal flood. Climate Dynamics, 52(7), 4193-4206. doi:10.1007/s00382-018-4375-0

RC3-24. Line 115: Clarify that water level monitoring at VP is groundwater level. Suggest shortening caption by using correct references for data sources and including them in the data list.
Answer: Done. The that data sources were added to Figure 1 caption upon request of the Editorial support (at the submission stage). However, we agree with the reviewer that a shorter caption would benefit the reading. To do so, we now provide a detailed listing of the freely accessed

geospatial data and the related sources in Appendix. Also, we opted to simply delete the information concerning VP in Figure 1 caption, because it is stated in the manuscript.

RC3-25. Line 124: To me this section reads more as a conceptual model of the Lake A water balance. Consider revising the title.
Answer: Done. The reviewer is correct. The title was corrected to: “2.2 Conceptual model of Lake A water balance”

RC3-26. Line 126: Suggest arranging so that the condition that comes first in the figure also comes first in the sentence – switch figure order or sentence order. I also suggest coming up with a different descriptor than “normal” – as previously mentioned, the time difference between the two conditions appears to be small.
Answer: Done. The sentence order was rearranged so that the “normal period” comes first in both the text and the figure. Also, we opted to modify the descriptors to “groundwater control period” and “flood-water control period”. This modification was done in Figure 2 and throughout the manuscript.

RC3-27. Line 129: Fig 2b?
Answer: Done. It was corrected to: “(Fig. 2b)”. Similarly, L131 was corrected to “(Fig. 2a)”.

RC3-28. Line 130: replace “Contrastingly” with “In contrast”.
Answer: Done. It was corrected to “In contrast”.

RC3-29. Line 131: Replace “neglectable” with “negligible”.
Answer: Done. It was corrected to “negligible”.

RC3-30. Line 128-133: It would be helpful to rewrite this section to clarify your conceptual model of the lake water balance under the two conditions. My current understanding is as follows:

1. Flood-water input. The level of Lake DM rises quickly due to inputs from its larger catchment. Inputs to Lake A include surface water inputs (Is) by overland flow and streamflow (S2 and S3), and precipitation (P). The resulting water level in Lake A is assumed to be higher than the surrounding groundwater; this hydraulic gradient precludes groundwater input (Ig), but increases groundwater output (Qg) above that which occurs due to the bank filtration system. Water is also lost through evaporation (E). *Please clarify if there are streamflow losses during this period as indicated on Line 134, and if so, where.*

2. Otherwise: Without flood-water inputs, the water level of Lake A falls due to outputs to E and surface water outflows (Qs) through S2 and S3, and Qg due to bank filtration system. The water level in Lake A falls more quickly than the surrounding groundwater and so the hydraulic gradient between Lake A and groundwater switches, and groundwater flows into Lake A (Ig).

With the above clarifications, this seems like a fairly reasonable conceptual model. However, it does not quite place the lake in its full hydrological context. It may be reasonable to assume that lake water flows as groundwater NE from Lake A to the bank filtration system, but what is occurring at the other lake boundaries? Are there other areas where lake discharge occurs to the groundwater when flooding is not occurring? Also, given the situation described, it seems reasonable that overland flow infiltrates into the ground on the Lake DM side (SE?) of Lake A as well as being pushed out from Lake A as bank storage. With repeated flooding events, does this not have the ability to create groundwater with very different chemistry and isotopic signature to regional groundwater/groundwater on other sides of the lake that are not subjected to flooding?

Not that the bank storage and floodplain (albeit small) "groundwaters" will have essentially the same isotopic signature, and so are indistinguishable using the tools in this study.
Answer: Clarification and done. The reviewer's understanding of the conceptual model is correct. As suggested, we corrected L134, because there are no streamflow losses during the flood-water control period. Additionally, we reformulated this section to better "place the lake in its full hydrological context". Concerning the isotopic signature of the groundwater in the vicinity of the lake, we present an isotopic framework in section 4.1, where we show the cold-season bias to groundwater recharge. No information regarding the isotopic composition of groundwater was added in the conceptual model.

S3 Methods

RC3-31a. Line 141: Are the level loggers pressure transducers?
Answer: Done. The pressure sensors are piezo resistive ceramic (Al_2O_3) with thermal compensation. Note that a level logger was also installed on-site to measure the atmospheric pressure and perform barometric compensation on the water level measurements. This information was added to the manuscript.

RC3-31b. State the start and end time of the measurement periods rather than just the start.
Answer: Done. The end dates of the measurement periods were also added to the text.

RC3-32. Line 149: What are the further computations you are referring to? Atmospheric pressure corrections?
Answer: Done. We were referring to the isotopic mass balance model, but this information was removed from the manuscript. In fact, we rephrased the information concerning the meteorological data and added the distances between the stations and the study site, as suggested by the other reviewer (see response to comment RC4-4).

RC3-33. Line 154: "close to the surface near the lake edge". State the approximate depth and distance. Also include the timeframe for sampling.
Answer: Done. The samples were collected at approximately 0.3 m below the lake surface and 1 m from the lake shoreline. The timeframe for sampling was between February 9, 2017 and January 25, 2018. This information was added to the manuscript.

RC3-34. Line 163: Does this mean that the direction of regional groundwater flow is from NE to SW? Do you assume that this "regional groundwater" also contributes to Lake A, or is the bank filtration system a complete barrier?
Answer: Clarification. There is a groundwater flow in the NE-SW direction contributing to Lake B, but evidences suggest that it is not contributing to Lake A. In fact, while the bank filtration system is not a complete barrier, the water level of Lake A is higher than the one of Lake B. Hence, no water can flow from Lake B to Lake A.

RC3-35. Line 179-182: Is it necessary to include 17O? Results for this isotope are not reported in this manuscript.
Answer: Done. The reviewer is correct – the results are not reported in the manuscript. In fact, $\delta^{17}O$ does not provide additional information (in comparison to $\delta^{18}O$ and $\delta^{2}H$). Hence, we opted to delete the ^{17}O considerations from L179-182.

RC3-36. Line 186: for lakes?
Answer: Done. It is now specified that these considerations apply to lakes.

RC3-37a. Line 187: Did you perform computations with both types of models? If not, suggest rewording and adding a reference that shows that both models yield similar results.
Answer: Clarification and done. In our study, we only performed a well-mixed model. Arnoux et al. (2017b) reported similar results using both modeling methods. This was clarified in the manuscript by rewording L186-190.

RC3-37b. Do they provide an understanding of groundwater-surface water interactions or estimates of the sources of lake inputs and output flow paths?
Answer: Clarification and done. The reviewer is right - both types of models more correctly provide an estimation of the groundwater fluxes. We corrected as: "*Arnoux et al. (2017c) performed a comparison of both methods and reported that well-mixed and depth resolved multi-layered models yielded similar and showed that groundwater inputs and outputs play an important role on lake water budgets.*"

RC3-38. Line 193: Clarify the term water yield in your study context.
Answer: Clarification. The term "water yield" is not relevant in the context of our study – we mentioned this term as we reported the results of Gibson et al. (2017). We have reworded L191-197 in order to be more concise and strictly present the information that supports our modelling choice.

RC3-39. Line 197. Change "advocated" to "selected". This supports the general point that any quantities are only first-order estimates.
Answer: Done. L197-198 was rephrased (see response to comment RC3-37). The term "advocated" was corrected to "opted to develop". Additionally, we emphasized the fact our model yield first-order estimates by adding the following:

> "*Note that, despite the biases underlying well-mixed models, this approach remains adequate to characterize the relative importance of hydrological processes and is particularly useful to give first-order estimate of water fluxes in ungauged basins.*"

RC3-40. Line 205-206: "during the ice-free period". How do you justify applying it over the whole year then? The manuscript mentions that the lake freezes over. I have not further reviewed the isotopic model development.
Answer: Clarification. The justification to apply the model over the whole year is provided at L207-211, as recommended by another reviewer (see response to comment SC1-12b). This justification reads as:

> *"In this study, the potential impacts of the ice-cover formation and melting are neglected, as the ice volume is likely to represent only a small fraction (<2%) of the entire water body. Moreover, considering the ice-water isotopic separation factor, i.e., 3.1 ‰ for $\delta^{18}O$ and 19.3 ‰ for $\delta^{2}H$ (O'Neil, 1968) and assuming well-mixed conditions, the lake water isotopic variation would be comprised within the analytical uncertainty. Also, flood-water inputs from Lake DM were expected to be much more important and occurring simultaneously with ice-melt during the freshet period."*

RC3-41. Line 236: Which observed values?
Answer: Clarification. We meant the isotopic signature of the lake (δ_L). However, we opted to remove this sentence as it is redundant with the information stated at L241-242 which as added considering the suggestion of another reviewer (see RC1-5).

RC3-42. Line 237: More correctly, the outflow from the lake will be proportional to the difference between the lake water level and the adjacent groundwater level. It would be useful to plot the difference between Lake A water level and the groundwater level to test whether this linear assumption is justified. It is rather unfortunate that the Lake A level data is not available for a longer period, as after high flows there is clearly a difference in the lake water levels, even if they follow a similar pattern. Is there any groundwater level data available on other sides of Lake A? This would also help determine if the Ig and Qg fluxes varied around the lake. Depending on the pumping volume of the bank filtration system, it is plausible that using the groundwater level at VP will overestimate the hydraulic gradient and hence the groundwater flux out of the lake. Again, what role is the bank filtration system playing here? How is the system operated? Continuously?

Answer: Clarification. The reviewer is correct – based on Darcy's Law, the outflow from the lake would be proportional to the difference between the lake water level and the adjacent groundwater level (i.e., the hydraulic gradient). However, there is no groundwater level data available in the vicinity of Lake A (except for the observation wells that are influenced by the pumping at the bank filtration system). It is thus impossible to estimate a realistic hydraulic gradient between Lake A and the surrounding aquifer. In this context, the daily water level was deemed to be the best available proxy to constrain the non-fractionating outflow fluxes (Q) from the lake. Besides, it is important to note that our study was not originally designed to perform an isotopic mass balance model, but we took the opportunity to do so when a major flood event occurred. Otherwise, we would have installed observation wells in the vicinity of the SW bank of Lake A to characterize the groundwater level variations.

Concerning the bank filtration system, it is operated continuously at pumping rates ranging from 4000 m^3/d (in wintertime) to 7500 m^3/d (in summertime). The estimated pumped volume is 2×10^6 m^3 over the study period (i.e., from February 2017 to January 2018). This volume corresponds to 12% and 8% of the total estimated outflow according the scenario A and scenario B, respectively. Typically, only two to four pumping well are in operation, and there is no continuous hydraulic barrier between Lake A and Lake B. Moreover, Lake B water level is lower than Lake A. It is thus expected that a proportion of the groundwater outflows from Lake A discharge into Lake B.

RC3-43. Line 241: Qmin on Figure 3 corresponds to the lowest water level at VP, not the lowest water level measured in Lake A. The lowest level for Lake DM was in November. Clarify.

Answer: Clarification. Q_{min} and Q_{max} correspond to the lowest water level at Lake A. As measurements of water level at Lake A are only available for a short period, we did a reconstruction of Lake A water level from the available measurements. We described the use of Lake DM and observation well VP water levels as proxies for Lake A water level at L342-346 (Section 4). However, we conceive that it would benefit the reading to state this information earlier in the manuscript. Hence, we moved L342-346 to section 2.2 and added the following material to clarify:

> "*Lake A volume variations are estimated from daily water level changes and assuming a constant lake area. As water level measurement are only available for a short period at Lake A, water levels at Lake DM and observation well VP are used as proxies. Water levels at observation well VP were used as a proxy from August 24th, 2017 to October 30th, 2017, while water level at Lake DM was assumed representative of Lake A for the rest of the study period (i.e., from February 9th, 2017 to August 23th, 2017 and from October 31st, 2017 to January 25th, 2018). This approximation is deemed acceptable because the simulation of δL depends on the remaining fraction of lake water f (not the absolute water level), and daily variations of the water levels at Lake A, Lake DM and observation well VP were shown to be similar (see Sect. 2.2).*"

RC3-44. Line 245: It may be helpful here somewhere to simply state the water balance equations for the two conditions.

Answer: Clarification. We agree with the reviewer that it could help to state the balance equations for the two conditions. Hence, we added the following material to section 3.3:

> *"In the context of this study, the balance equations can be simplified based on the conceptual model. During the normal period, $I_S = 0$ and, thus, $I = I_G + P$ and $\delta_I = (\delta_G I_G + \delta_P I_P)/I$. In contrast, $I_G = 0$ during the flood-water control period, $I = I_S + P$ and $\delta_I = (\delta_{Is} I_S + \delta_P I_P)/I$. Note that δ_G and δ_{Is} are the isotopic signatures of groundwater and surface water inputs, respectively."*

RC3-45. Line 250: Unless the source water for S1 also comes from a large catchment at similar latitude, this is a bold statement. I suggest deleting and leaving the reason for excluding S1 to the fact that the flows are tiny by comparison. If you state this on Line 98, there is no reason to mention this stream here.

Answer: Done. As suggested, we opted to delete this statement as it is also explained earlier in the text. See response to comment R3-20.

S4 Results

RC3-46. Line 256: Suggest revising this statement to say that major flooding occurs as a result of springtime snowmelt and minor flooding due to fall precipitation.

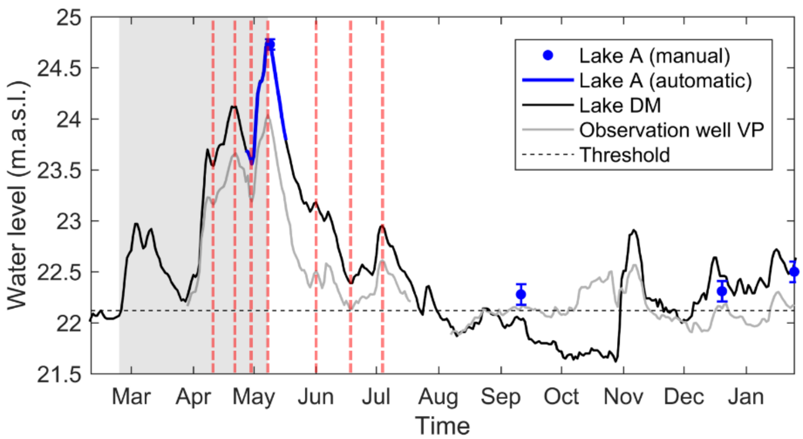
Answer: Clarification. As explained in response to comment R3-23, the 2017 major flood event was caused by the combination of intense precipitations and snowpack melting over the Ottawa River watershed (Teufel et al., 2019). This was clarified in the manuscript.

RC3-47. Line 259: Figure 3?

Answer: Done. The reviewer is correct. However, we now present the "Hydrodynamics of the flood event" in section 2.2, and the figure is now numbered as Figure 2.

RC3-48a. Line 263-265: Are the water level variations synchronous (happening at exactly the same time) or following the same pattern, but with a small lag that could be expected due to travel time? Amend to be clear that data is not available for Lake A up to late July.

Answer: Clarification and done. When we take a close look at Fig. 2 (revised as Fig. 3), there is no phase shift between the peaks of Lake DM and observation well VP daily mean water levels from April to July (see figure below). Considering this, it is possible to think that the time lag < 1 day. However, it is not possible to verify if the water level variations are happening at exactly the same time, as only the daily mean water level is available for Lake DM. Besides, your comment made us realize that L263-265 may be confusing regarding the comparison of the water level variations of Lake A and observation well VP to the one of Lake DM. In this context, we opted to reword L256-274 and present it earlier in the manuscript (in 2.2) to help clarify the conceptual model. We now use the term "follow a similar pattern" to compare the evolution of Lake A and Lake DM water levels. More generally, we now use correlation metrics (R^2 and p-value) to compare the evolution of Lake DM, Lake A and observation well VP during the study period.



RC3-48b. Does the water level measured at VP ever exceed ground level?
Answer: Clarification. The maximum observed water level at VP (24.04 m.a.s.l.) did not exceed ground level (25.2 m.a.s.l.).

RC3-49. Line 267: What is this natural threshold? It needs to be clearly explained earlier in the manuscript.
Answer: Done. As explained in response to RC3-22, the topographic threshold was determined from a land survey and corresponds to the maximum elevation along S2 streambed. This information was added to the manuscript (Section 2.1).

RC3-50. Line 273: What I take from the manual water level measurements is that 1) the water level of Lake A is always higher than the groundwater level measured at VP and 2) Lake A and Lake DM do not always have similar water levels, regardless of whether the water level is above or below the topographic threshold. It would be useful to explain these aspects in the context of the Lake A water balance developed in S2.
Answer: Done. The reviewer is correct – the water level of Lake A is 1) always higher than the one of VP and 2) not always similar to the one of Lake DM. To help clarify the conceptual model, we moved the "Hydrodynamics of the major flood event" in Sect. 2 (before presenting the conceptual model). Also, the considerations from the manual measurements were added to this section.

RC3-51. Line 275: Isn't the actual volume increasing?
Answer: Done. The statement at L275 was modified to: "From February 23, 2017 to May 8, 2017, an overall volume increase is observed at Lake A"

RC3-52. Line 281: Was a manual measurement of Lake A water level taken at the start of the study period? It isn't shown on Fig 3.
Answer: Done. No manual measurement of Lake A water level was taken on April 17, 2017.

RC3-53a. Line 282-286: Unclear the importance of the lake being dredged. Unless there is evidence of a low hydraulic conductivity layer around the edges of the lake, wouldn't you expect hydraulic connection when the lake is situated in alluvial sands? Perhaps rephrase to indicate that gross water fluxes are likely to exceed net water fluxes due to the surrounding geology and measured hydraulic gradients.
Answer: Done. We agree with the reviewer. At L282-286, our intention was to point out that groundwater contribution can be expected for lakes sitting in permeable sediments. To clarify, we reformulate L282-284 to:

"The evolution of Lake A volume and the net water fluxes are not representative of the surface water/groundwater interactions. Indeed, gross water fluxes are likely to exceed net water fluxes at natural and dredged lakes sitting in permeable sediments (Zimmermann, 1979, Jones et al., 2016, Arnoux et al., 2017c),"

Additional references:

Arnoux, M., Barbecot, F., Gibert-Brunet, E., Gibson, J., & Noret, A. (2017). Impacts of changes in groundwater recharge on the isotopic composition and geochemistry of seasonally ice-covered lakes: insights for sustainable management. *Hydrology and Earth System Sciences, 21*(11), 5875-5889. doi:10.5194/hess-21-5875-2017

Jones, M. D., Cuthbert, M. O., Leng, M. J., McGowan, S., Mariethoz, G., Arrowsmith, C., Sloane, H. J., Humphrey, K. K., & Cross, I. (2016). Comparisons of observed and modelled lake $\delta^{18}O$ variability. *Quaternary Science Reviews, 131*, 329-340. doi:10.1016/j.quascirev.2015.09.012

RC3-53b. A critical point that is missing here (and from the lake water balance conceptual model) is where the water goes when it drains from Lake A, whether surface or subsurface. The levels indicated on Fig 3 suggest that, at least in the early stages, the water is not draining to Lake DM.
Answer: Done. Regarding Lake A water levels data after high flow, we would like to mention that the measurements from May 18, 2017 to June 3, 2017 have high uncertainty. On May 29, 2017, we conducted a field campaign and found out that the level logger has been accidently moved by sand-dredging operations. We applied a correction on the water level measurements from May 18, 2017 to June 3, 2017 based on our field observations, but we have doubts about the accuracy of these measurements and we should not have included this part of the timeseries in the figure. In this context, we think that it is difficult to conclude on the difference in water level between Lake DM and Lake A during this period. We have therefore chosen not to present these potentially misleading data in the revised version of the figure. Taking this into account, we believe that it is not impossible that Lake A was draining towards Lake DM after May 8, 2017 (i.e., the flood peak).

To clarify, we added the following material to L284:

"In the context of this study, we conceptualized two main hydrological periods, during which the lake water can either drain towards Lake DM or exit the lake as groundwater output. To balance out these outputs, the inflows to Lake A must therefore be greater than the net water fluxes."

Additionally, we added the following material to the conceptual model:

"Considering that Lake A is sitting in alluvial sands (i.e., a highly permeable material), it is assumed that groundwater inputs (I_G) and outputs (Q_G) contribute to the water budget. Although it is difficult to interpret the location of I_G, it appears evident that Q_G occur along the NE bank of Lake A. In fact, there are subsurface fluxes across the sandy bank that contribute to the bank filtration system or discharge into Lake B, as its water level is lower since the initiation of the bank filtration system (Masse-Dufresne et al., 2019). Besides, it is likely that little to no subsurface fluxes exists in the area between Lake A and Lake DM, where clayey sediments are found.

For the study period, it is conceptualized that the direction of the surface water fluxes in S2 and S3 is from Lake A to Lake DM, except from February 27, 2018 to May 8, 2017. During this period (hereafter referred to as the flood-water input period), the water level of

Lake DM exceeds the topographic threshold, and Lake A would receive surface water inflow (I_S) from Lake DM. Also, it is likely that high water level at Lake A imposed a hydraulic gradient at the lake-aquifer interface, which allowed for Q_G from the lake and inhibited I_G. Then, as Lake A and Lake DM water levels started to decrease (from May 8, 2017), it is assumed that water exit Lake A as surface water outputs (Q_S) or as Q_G towards Lake DM or the aquifer, respectively. Although Lake DM water level exceeded again the topographic threshold from November 2017 to January 2018, the weaker correlation between the water levels suggest that Lake A water level was not controlled by Lake DM, and we conceptualized that Lake A receives no surface water ($Q_S = 0$) from Lake DM during this period (see Sect. 2.2)."

RC3-54. Line 289: It is misleading to say that the shaded area represents flood water inputs. Won't surface water inputs from Lake DM to Lake A be received at all times that the water level of Lake DM is above the topographic threshold? Clarify throughout document and in the figure.
Answer: Done. Two conditions are needed for Lake A to receive surface water inputs from Lake DM. First, Lake DM water level needs to exceed the topographic threshold. Second, the water level of Lake A needs to be lower than the one of Lake DM. The direction of the surface water fluxes between Lake A and Lake DM was clarified in the conceptual model description (see response to comment RC3-53b). Additionally, we revised the period descriptors, as suggested in RC3-26. This was modified in the figure and throughout the document.

RC3-55. Line 298: Why 2016? The rest of the sampling was conducted in 2017.
Answer: Clarification. The regional amount-weighted mean δ_P is calculated from the precipitation volume and isotopic composition. While the isotopic composition of precipitations was available for the study period (February 2017 to January 2018), the volume measurements stopped in October 2017. Hence, the regional amount-weighted mean δ_P could only be estimated for 2016. More importantly, the yearly estimates for amount-weighted mean isotopic composition of precipitations (δ_P) are likely to vary from one year to the other, and a long-term amount-weighted mean is more representative of the regional groundwaters (which mean age is expected to be > 1 year). This is why we compared the 1-year estimate from St-Bruno to the long-term estimate from Ottawa. However, we conceive that it may be confusing to present this information next the isotopic signature of precipitations. Hence, we opted to modify this statement and now compare the long-term amount-weighted means at Vaudreuil (27 km W from the study site) and at Ottawa (140 km W from the study site) with the δ_G estimated from the intersection of the LMWL and the Lake A LEL (see response to comment RC3-58).

RC3-56. Line 309: What is the justification for this? Do the three sample indicate temporal change in the flood-water inputs? How would this affect the calculated water budget?
Answer: Clarification. There is a temporal evolution of the isotopic signature of Lake DM, as demonstrated by Rosa et al. (2016). On an annual timescale, the evolution of the isotopic signature of Lake DM is mainly governed by evaporation. During springtime, the evolution is also expected to be controlled by the contribution of the snowmelt water – the snowmelt quantity and isotopic signature can evolve over time – and an enrichment of the isotopic signature of flood-water can be expected during springtime.

In our study, three flood-water samples were collected. The two most depleted samples were collected on April 19, 2017, while the most enriched flood-water sample was collected on May 10, 2017. The long-term (1997-2008) average, minimum and maximum isotopic signature of Ottawa River water at Carillon (~34 km upstream from Lake DM) for the month of April are -11.19 ‰, -

12.01 ‰ and -10.23 ‰ for $\delta^{18}O$ and -81 ‰, -85 ‰ and -77 ‰ for $\delta^{2}H$, respectively (Rosa et al., 2016). The mean and minimum values compare well with the observed isotopic signatures at Lake DM in our study.

As we collected three flood-water samples, it was difficult to correctly interpret the temporal evolution of the flood-water isotopic composition from late February to May. Hence, we opted to select a constant value of -12.00 ‰ for $\delta^{18}O$ and -83 ‰ $\delta^{2}H$ (i.e., the intersection between the LMWL and the flood-water regression line). The selected isotopic signature is assumed to be representative of the flood-water inputs in the earlier stages of the flood event, i.e., when the evaporation is null. This approach is conservative, as it estimates a minimal flood-water contribution to the lake water budget.

RC3-57. Line 310: Similar to what? Unclear why this is relevant.
Answer: Done. We meant similar to the selected δ_{Is} ($\delta^{18}O$ = -12.00 ‰ and $\delta^{2}H$ = -83 ‰). To clarify, we corrected L310 to:

> *"The long-term (1997-2008) average, minimum and maximum isotopic signature of Ottawa River water at Carillon (~34 km upstream from Lake DM) for the month of April are -11.19 ‰, -12.01 ‰ and -10.23 ‰ for $\delta^{18}O$ and -81 ‰, -85 ‰ and -77 ‰ for $\delta^{2}H$, respectively (Rosa et al., 2016). The mean and minimum values compare well with the observed isotopic signatures at Lake DM during springtime 2017."*

RC3-58. Line 313-Line 320: Suggest considering Jasechko et al. (2017) (doi: 10.1002/hyp.11175) and Welch et al. (2018) (doi: 10.1002/hyp.11396), which demonstrate widespread cold season bias to groundwater recharge in similar climates. Do you have any isotopic data from either of the observation wells?
Answer: Done. We are grateful to the reviewer for this suggestion as it helped strengthening our message. We reformulated Line 313-320 and now consider Jasechko et al. (2017) work's:

> *"The isotopic composition of groundwater (δ_G) can be determined from direct groundwater samples or indirectly from the amount-weighted mean δ_P. However, in highly seasonal climates, there is a widespread cold season bias to groundwater recharge (Jasechko et al., 2017), and estimating δ_G via groundwater samples or amount-weighted mean δ_P may be misleading. In fact, it has been argued that the LMWL-LEL intersection better represents the isotopic composition of the inflowing water to a lake and is thus commonly used to depict δ_G in isotopic mass balance applications (Gibson et al., 1993; Wolfe et al., 2007; Edwards et al., 2004). Concerning the study site, the estimated δ_G is -11.26 ‰ for $\delta^{18}O$ and -77 ‰ for $\delta^{2}H$ (i.e., the St-Bruno LMWL and Lake A LEL intersection). The latter compares well with the mean isotopic signature of groundwaters at Vaudreuil station (-11.1‰ for $\delta^{18}O$ and -78.5‰ for $\delta^{2}H$) (Larocque et al., 2015) and is more depleted than the long-term amount-weighted mean δ_P at Ottawa (-10.9‰ for $\delta^{18}O$ and -75‰ for $\delta^{2}H$) (IAEA/WMO, 2018)."*

Additionally, we used the suggested reference (Welch et al., 2018) in the revised introduction. Modifications were made to better contextualize our study (see response to comment RC3-8).

Finally, we do have isotopic data at the observation wells. However, we do not think it would help to discuss the cold season bias, as they are under the influence of the lake waters.

RC3-59. Line 330: Did you perform significance testing to determine this? If yes, present the results. If not, change the wording.
Answer: Done. No significance testing was done. The term "significantly" was deleted.

RC3-60. Line 357: What are these scenarios (A and B) and what do they represent? It is difficult to interpret the following results without understanding this.

Answer: Done. Scenario A and B are two different simulations of the evolution of the lake isotopic signature (δ_L). In both scenario, the modelled δ_L was fitted on three depth-averaged δ_L (February 9, 2017, August 17, 2017 and January 25, 2018. The modelled δ_L was additionally constrained by a surface water sample during springtime, which is deemed to be representative of the well-mixed water column. In scenario A, we use the sample at the surface of Lake A on May 9-10, 2017 (i.e., $\delta^{18}O \approx -11.20$ ‰ and $\delta^{2}H \approx -76$ ‰) to constrain the model. Similarly, the April 27, 2017 sample is used to best-fit δ_L in scenario B. This was clarified in the manuscript, as well as in Table 1 and Figure 6.

RC3-61. Line 369: Why do you consider these have stopped? Fig 3 indicates that the level in Lake DM remains higher than Lake A until Lake A measurements cease.

Answer: Clarification. See response to comment RC3-53b.

RC3-62. Line 375: How do you reconcile this with the fact that inspection of Fig 6 indicates that the isotopic match is closer for Scenario B?

Answer: Clarification and done. As clarified in response to comment RC3-60, the modelled δ_L was fitted on four points. In Figure 6, the red squares correspond to the depth-averaged δ_L that were used to fit the modelled δ_L. A revised version of Figure 6 now better illustrate the four values that were used to model δ_L for both scenarios. Additionally, the calculation of RMSE ($n = 4$) indicate similar matches for both scenarios.

RC3-63. Line 391: Consider moving the definition of mean flushing time to the methods. It is referred to extensively in the following pages and is hard to find here buried in a paragraph. The flushing time for Scenario B is approximately 30% lower than for Scenario A – is this not a fairly large difference?

Answer: Clarification and done. The definition of mean flushing time was moved to the methods. While we acknowledge the difference between the calculated flushing time for scenarios A and B, we think the results should be considered in the context and objectives of the study. Here, the estimates of the mean flushing time serve as a bulk parameter to discuss the resilience (and vulnerability) of the lake to changes, and a first-order estimate is appropriate to do so. Although there are differences between the two scenarios, both suggest that mean flushing time is within few months.

RC3-64. Line 401: Suggest including explanation provided to reviewer that this sensitivity analysis was conducted OAT.

Answer: Done. L402 was modified and can now read as:

> *"A one-at-a-time (OAT) sensitivity analysis was performed to grasp the relative impact of the input parameters' uncertainties on the model outputs."*

RC3-65. Line 404: This range of δIs does not cover the range of observed flood water inputs.

Answer: Clarification. The reviewer is correct – the tested range in the OAT sensitivity analysis does not cover the range of the three observed flood water inputs. However, it does cover the range of the two samples that were collected during the flood-water control period (see response to comment RC3-56), i.e. the period during which we conceptualized that flood-water inputs contribute to the lake water budget.

RC3-66. Line 408: Given the heat capacity of water, it seems unusual to use this as the only boundary for varying water temperature.

Answer: Clarification. The water surface temperature (T) was not measured continuously and was thus estimated based on the equilibrium method as described by de Bruin (1982), in order to take into account the heat capacity of water. In the OAT sensitivity analysis, we aimed at testing the robustness of the model against this estimated T. To do so, we selected a worst-case scenario, i.e., assuming that the $T=T_{air}$. As the results are similar to the reference scenarios, we concluded that T is not a sensitive parameter.

RC3-67. Line 416: As previously mentioned, this is not the only time when a hydraulic connection appears to form. How does amending this assumption affect the results?
Answer: Done. We are grateful to the reviewer for this comment. It made us realize that this statement was confusing. L416 was corrected and we can now read: *"As expected, the value of δ_{Is} is affecting the modelled δ_L exclusively during the flood-water control period."*

More isotopic data at Lake DM would have been necessary to correctly predict the impact of flood-water inputs at other times.

RC3-68. Line 420: It would be helpful to state specifics for the change in LMWL and δIs/g and water balance.
Answer: Done. The calculated LMWL with the PWLSR method and the estimated δ_{Is} and δ_G were added to L412, which can now read as:

> *"Using the PWLSR method, the LMWL is defined as $\delta^2H = 8.28 * \delta^{18}O + 17.73$, and δ_{Is} and δ_G are estimated at -12.39 ‰ and -11.74 ‰ for $\delta^{18}O$ and at -85 ‰ and -79 ‰ for δ^2H, respectively. Recalculation of δ_{Is} and δ_G was needed, as they were both assumed to plot on the LMWL (see Sect. 4.1)."*

RC3-69. Line 421: What are the impacts on the water budget of holding δIs/g constant? This at least needs to be discussed as a study limitation. Similarly, the assumption of a well-mixed lake needs to be discussed, given the obvious isotopic stratification.
Answer: Clarification and done. See response RC3-56 for expected impact on the water budget of holding δ_{Is}. The limitations concerning the evolution of δ_{Is} and the assumption of a well-mixed lake are discussed in section 5.2. See response to comment RC3-73 for added material concerning the isotopic signature of groundwater.

RC3-70a. Line 435: I suggest deleting this reference to the discussion and including analysis of the likely temporal change in groundwater inputs here in the results (Lines 448-470).
Answer: Done. L448-470 is now included in the results.

RC3-70b. Perhaps you could consider modifying your model to include two different groundwater inputs – one that reflects the regional groundwater, and one that reflects the mixture between flood-water inputs through the floodplain or bank storage and this regional groundwater.
Answer: Clarifications. While we agree that this approach would have been interesting, this is beyond the scope of our study. No data was available to characterize the potential spatiotemporal variability of the groundwater isotopic composition.

RC3-70c. Consider also doing a simple calculation to estimate the potential volume of flood water that could be stored in the subsurface using values for alluvial sands available in the literature (if there are no local measurements) and the maximum depth that the groundwater level lowers in the dry season.
Answer: Clarifications. The reviewer suggests to "estimate the potential volume of flood-water that could be stored in the subsurface". While we agree that such calculation can be useful as a "reality check", there are no information concerning the depth of the groundwater level in the

vicinity of Lake A. Also, in the context of this study, it is known that part of the groundwater outputs is pumped by the bank filtration system or discharges into Lake B. Hence, it is difficult to estimate what volume is stored in the subsurface.

S5 Discussion

RC3-71. Line 509: "expected increases in water levels…" Which water levels?

Answer: Clarification. We mean that river water levels are expected to increase. We reworded (L508-510). It now reads as:

> "*In Quebec (Canada), river stages are expected to increase across various watersheds in response to future climate scenarios (Roy et al., 2001; Minville et al., 2008; Dibike and Coulibaly, 2005).*

RC3-72. Line 521: It is unclear how this study tracks human impacts on the water cycle.

Answer: Done. We corrected "water cycle" to "water resources" at L520 and L521.

RC3-73. Line 535: Another big missing piece in the data currently presented is the lack of water level measurements around the lake and through time that support the hypothesis that groundwater discharges into the lake. See also comment on Line 421.

Answer: Done. We agree with the reviewer that such information should be added as another strategy to improve the effectiveness of our approach. The following material was added to the manuscript at L535:

> *"Groundwater level monitoring and groundwater sampling in the vicinity of the lake could also help to strengthen the conceptual model by providing data to interpret the direction of groundwater fluxes and the variability of isotopic composition through time."*

S6 Conclusions

RC3-74. This section can be made more succinct. Focus on the major findings. No need to repeat volumes.

Answer: Done. We made an effort at addressing this issue. The conclusion is now more succinct and focuses on the major findings. More precisely, we removed the information concerning the modeling methods (L541-543), 2) and the volume estimates (L554-557). We also reworded L548-549 and L557-560 in order to be more concise.

Report #2

Submitted on 19 Jan 2021
Referee #4: Matthew D. Jones, matthew.jones@nottingham.ac.uk

Suggestions for revision or reasons for rejection (will be published if the paper is accepted for final publication):

I enjoyed reading the manuscript by Masse-Dufresne and colleagues.

The paper outlines some interesting and potentially important reasons for understanding ground- and surface-water contributions to lake systems, and makes a case for the use of stable isotopes in modelling these systems.

I particularly liked the cross sections and three dimensional schematics of the lake isotope system, and the linking through of the importance of water quantity, and where it comes from, to issues of water quality.

I think the paper is suitable for publication after a few minor revisions, largely to help further clarify the modelling approach taken such that others can reproduce this approach for similar systems.

RC4-1. In general it would be interesting to know how this model was run i.e. in what software or using what code. Including a link to the code, or an example of the working through the equations which would help reviewers and readers understand more fully the steps taken.
Answer: Done. The model was implemented in Matlab®. As isotopic mass balance model are relatively easy to code or program in various softwares (Excel®, Matlab®, R) and as many isotopic models have been published already by other authors, we think that our code is not a major contribution to the scientific community. Hence, we opted to specify that "the code and data are available on request to the corresponding author".

My more specific points relate to the isotope hydrology work:

RC4-2. Equation 3 – please define delta-0.
Answer: Done. We added the definition of δ_0 to the manuscript.

RC4-3. Line 259 – I think Fig. 3 is meant here?
Answer: Done. The reviewer is correct. However, we now present the "Hydrodynamics of the flood event" in section 2.2, and the figure is now numbered as Figure 2.

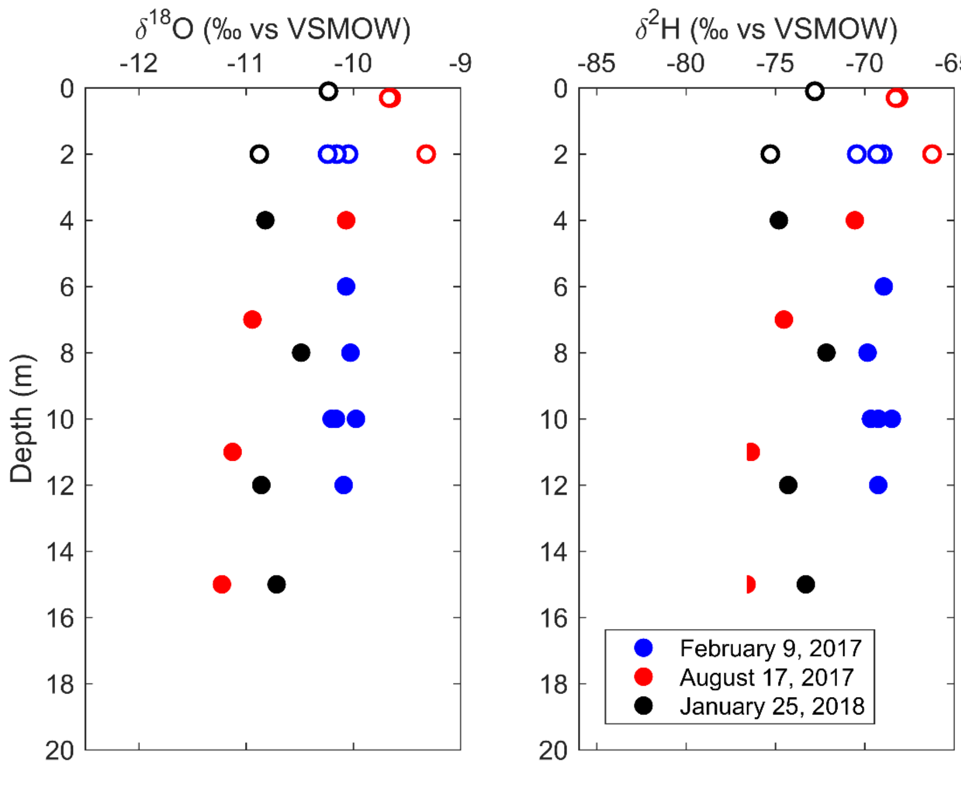
RC4-4. Section 4.2 – where are St-Bruno station and Ottawa in relation to the lake. Could you add these to Figure 1, or state distance and direction to/from lake for each site.
Answer: Done. The distances between the meteorological stations and the study site have been added to the manuscript (in section 3.1). Additionally, we modified Figure 1 and added the location of the different stations and cities.

RC4-5. Figure 4 and its discussion – the flood waters are from Lake DM (as noted in Fig. 5) so is the Flood-water LEL the Lake DM LEL? Is it the lake waters in Lake DM that are more directly affected by snow melt, or would you class the flood waters as separate? Is there any stable isotope data from Lake DM?
Answer: The flood-water samples do correspond to the Lake DM waters. Hence, the Flood-water LEL ($\delta^2H = 5.68 * \delta^{18}O - 12.80$) should correspond to the Lake DM LEL during springtime, but the

latter could differ for other periods as the governing parameters (e.g., RH, T) may evolve over time.

RC4-6. Figure 6 – may be worth changing the legend label for 'delta-L (observed)' – to make it clear that this is an average (mean?) of the blue dots – this is what I interpreted it as anyway.
Answer: The reviewer is correct. It was corrected to "depth-averaged".

RC4-7. As well as showing the range of water isotope data with depth in table 2 and Fig. 6 it would be interested to plot the profiles in an appendix.
Answer: Done. A figure showing the isotopic data with depth was added to Appendix E.



RC4-8. If useful another example of isotope mass balance modelling to understand water balance in artificial lakes (gravel-pits in this case) can be found in:
Jones, M.D. et al., 2016. Comparisons of observed and modelled lake δ^{18}O variability. Quaternary Science Reviews 131, Part B, 329-340.
Answer: We are grateful for this suggestion. We added the reference in section 4:

> *"Indeed, gross water fluxes are likely to exceed net water fluxes at natural and dredged lakes sitting in permeable sediments (Zimmermann, 1979; Arnoux et al., 2017a; Jones et al., 2016)"*