## Reply to:

# Interactive comment on "Rosalia: an experimental research site to study hydrological processes in a forest catchment" by Josef Fürst et al.

**Anonymous Referee #1**
Received and published: 22 December 2020

**Josef Fürst (on behalf of the co-authors) Feb 16, 2021**
*Replies are formatted in blue, while original referee's text is black.*

Dear anonymous reviewer,
thank you for your thorough review and your effort to help improve our contribution. I understand your concerns and agree with most of them. I am confident that we can resolve the issues that you pointed out. Please find detailed replies below.

This data publication aims to describe the Rosalia experimental watershed, and introduce the data that is collected between 2015 and 2019. The authors give a very detailed description of all sensors and data storage application used, which I feel came at the expense of more information about the actual watershed and data. The geological background is summarized in one sentence only, and no geologic, vegetation or soil maps are shown, which are key if other researchers are to work with the data.
R: We agree and will provide a soil map in the revised manuscript. The geological background is indeed very uniform which can and will be described in a few sentences. We will provide a more detailed description of the vegetation. Unfortunately, we cannot include the datasets in the data repository because of restricted copyrights for some of those datasets. Nevertheless, some of these are published on other platforms (e.g., LTER) and we will provide links.

No information is given about the process of data cleaning, or the analysis of the isotopic samples in the lab. Since one of the main aims of a data publication is that other people can work with the data after, I suggest that the article is adapted so that such crucial (!) information is described, and other researchers can also work with the data.
R: We will add more information about data cleaning (see reply to the comment on L234 below). Stable isotopes were analyzed using a laser spectroscope (Picarro L2140-i, cavity ring-down spectroscopy).

Some timeseries of the actual data are shown (i.e., of discharge, soil moisture, rainfall, electrical conductivity and the stable isotopic composition of discharge and rainfall), but the presentation of these is very minimal. Furthermore, for or one of the figures the axes were not correctly chosen (i.e., cutting off part of the data), and the figure captions cover only the bare minimum of information.
R: The data repository contains comprehensive documentation and visualization of the time series data in an easily accessible and interactive HTML format. Therefore, we selected only 2 years for the figures in the paper to improve readability. We will add a note to the captions. The characterization of the time series will be extended in the text. The wrong axis scaling of Fig. 5 will be corrected in the revised version!

When reading this article, I stumbled over numerous grammar mistakes, wrong interpunction, colloquial language, use of the imperial system, and sentences that were clearly not formulated in correct English. I felt like I was doing the final reading before submitting, rather than a review.
R: We will pay more attention to a correct and consistent language and style in the revised manuscript. After revision the manuscript will undergo a proof-read by a native English speaker.
Regarding use of the imperial system: this is used only in the naming of the H Flume devices where it is, in our opinion, appropriate. H Flumes are standardized, off-the-shelf devices which are characterized by their depth in ft. Even European vendors and German textbooks on hydrometry (E.g. (Morgenschweis, 2010)) list H Flumes by their depth in ft (and not m). The rating curves for H Flumes have been developed by the US SCS for a range of different sizes and therefore it would not help any reader to write about a 0.305 m or 0.61 m H Flume.

I was surprised that this was the case because from the abstract it sounded like the Rosalia catchment is the flagship of BOKU, and its

documentation thus would deserve adequate attention. In addition to the language of this article, the structure also clearly needs more time and attention. Some definitions and topics are introduced but not fully discussed, and come back multiple times in the manuscript. This does not help the future reader of this article to find the information needed.
I apologize for my lack of in-depth comments to this article, but this article needs more time and attention before an in-depth review can be helpful. I suggest that the authors take this task serious and resubmit after careful re-structuring and rewriting. Documentation for a long-term research site (1875!) should be more comprehensive than this, and should for instance also include a background of the most important findings and the mechanistic understanding of how this watershed functions, in addition to the missing information with regard to data processing as mentioned above.
R: Mentioning that BOKU is using the Rosalia forest since 1875 was not meant to implicitly indicate that data are available for the entire time period. In fact, before we started to extend the site into a full eco-hydrological experimental watershed, it was predominantly used as an educational forest. To avoid any misunderstanding, we will re-structure the text to clearly focus on the monitoring network established and the data recorded since 2015.

Detailed comments:
L21: remove additionally
R: will be removed

L24: one site of how many sites? The discharge gauging stations?
R: at one new discharge gauging station (Q4)

L24: nitrate is capitalized where it should not be
R: will be corrected

L28: remove 'their'
R: will be corrected

L32: Global change impacts, such as climate warming? I don't see how climate itself is a global change impact.
R: will be re-phrased ("climate change")

L33-35: Although I somewhat agree, who realized this? reference needed
R: The importance of vegetation-hydrology interactions is highlighted in Porporato, A. and I. Rodriguez-Iturbe (2002). "Ecohydrology - a challenging multidisciplinary research perspective." Hydrological Sciences Journal-Journal Des Sciences Hydrologiques 47(5): 811-821. The reference will be added.

L35: experimental catchments? remove sites
R: will be corrected

L45: unclear which framework is referred to
R: will be re-phrased: "A recent report on the status …"

L57-65: why is the LTER not introduced together with the other networks?
R: we agree. LTER will be introduced together with the other networks

L74: if the object "was and still is" the word "is" is sufficient to indicate that
R: will be re-phrased: "The overall objective is to implement …"

L76: if this is "a research emphasis" what are other important points?
L79: what are 'point related measurements'?point measurements?
R: point measurements

L76-80: please rephrase this sentence to provide more clarity.
R: will be re-phrased: "Research emphasis is put on deriving effective parameters for scales on which models simulate flow and transport processes (e.g., hillslope, catchment) by upscaling point measurements."

L83: how does the set-up allow for these experiments, in comparison to other sites?

R: BOKU has management options in the forest that are generally not available in private forests where often just the implementation of monitoring stations is possible.
We will incorporate the following information into the revised manuscript: The forest management is performed by the Federal Forests of Austria (Österreichische Bundesforste, OeBf) which is owned by the Republic of Austria. BOKU has the right of access for educational and research purposes. OeBf claims to manage the forest according to sustainability principles, balancing protection of environment, the needs of society and commercial success. Management of the forest is characterized by long production cycles of 100 to 140 years. The main species are the broadleaved beech (fagus sylvatica) and coniferous Norway spruce (picea abies). Natural regeneration is preferred to planting. Fertilisation almost never occurs. Timber harvesting is usually done by means of harvesters and forwarders, at steep slopes cable cranes are used. Management and timber transport are supported by a dense network of forest roads (50m per hectar), suitable for heavy timber trucks. Main threats are snow break, wind throw and bark beetles, the latter affecting mainly coniferous tree species.

L89: "are and will be investigated by a team of researchers" this sounds as if the team is already chosen, and cannot be adapted anymore. This is contrary to what I would expect is the aim of publishing this article, which is to promote other researchers to also use the data that is being published in this publication.
R: With publishing the dataset we are certainly inviting other researchers to use the data too. We will rephrase our statement. "… strategies will be investigated by multidisciplinary teams of researchers".

L89: same comment as with "was and still is" in L77
R: will be re-phrased, see above.

L95-98: since this is such a standard article lay-out, I would suggest that the others consider removing this description.
R: will be removed

L100-101: this sentence is gramatically incorrect.
R: rather 101-103? Will be corrected: "The research watershed has terrain heights from 320 to 725 m asl, and it is characterized by steep slopes (96 percent of the area is steeper …"

L102: 'is' steeper than
R: will be corrected, see above

L111-112: gramatically incorrect sentence
R: will be corrected

**R: The description of the watershed (section 2) will be extended to provide more information on geology, soils and vegetation (see also reply to first comment above).**

L129: the names of the watersheds, and their respective sizes, have not been introduced yet.
R: we will improve this part and redesign Fig. 1 and Table 1.

L30: monitored "with" a spectrometer probe
R: will be corrected

Line 131-135: every sentence starts on a new line.
R: will be corrected

L312(132?): which altitudes?
R: altitudes will be added to table 1.

L136-137: this sentence is redundant because this is mentioned in the figure and table captions.
R: we will avoid such redundancies

L148: please specify what the "DMBS addVANTAGE Pro' is directly when first mentioning it.
R: short description of addVANTAGE Pro will be added.

L154: can the authors be more specific about the treatment samples after being collected by the totalisers or as grab samples? How are these samples stored in the

samplers to ensure that the chemistry and isotope samples can both be analyzed adequately?
R: Regarding precipitation samples, the totalisators are designed in a way to prevent isotopic enrichment by limiting evaporation (Groening et al. 2012 ). The sample bottle is inside a plastic pipe and thus protected from direct sunlight. The tube that connects the sample bottle to the funnel outlet has a small diameter and extends to the bottom of the sample bottle to limit air exchange. For streamflow samples, the ISCO automatic sampler is not a cooled field sampler. Since with 24 sample bottles and daily sampling intervals the first bottle is at maximum 24 days under ambient temperature conditions, there are concerns about evaporation enrichment. For this reason, we manually collect streamflow grab samples each time we visit the field site and compare their measured isotopes to those of the sampling bottle with the longest standing time. Although occasional deviations larger than 0.1‰ d18O occurred, preliminary results especially during summer months indicate no evaporation enrichment problem. Still, we'll adapt the system in future according to a very recent publication (van Freyberg et al. 2020 ).

157: The field courses are organized by students? Or should this be "by students during field courses
R: "by" students during field courses

L158: which other (LiDAR-based) DEMS are available? and, LiDAR is commonly spelled with a lower-case 'i'
R: we will explicitly list all available DEMs. The acronyms Lidar, lidar, LIDAR, LiDAR, and LADAR all mean the same and are in use.

L161: what is a "hydrological" site? A site at which hydrological measurements are being performed? in this case, the word 'hydrological' is redundant, given the sentence that follows.
R: will delete "hydrological"

L163: new line started where not needed.
R: will be corrected

L169: grammatically incorrect sentence. L170: grammatically incorrect sentence
R: we will let a native speaker check the grammar

L168: please use the metric system.
R: Foot is appropriate in this context, see note above

L178: Reference missing for the "Thompson" weir.
R: Yes, it should read "Thomson" weir, which is a "90° V notch sharp crested weir". No primary reference was found so far. We can include a reference to a standard textbook on hydrometry.

L181: is their SDI-12 interface really important to mention in this article? And if so, be specific as to why the SDI-12 interface is preferred.
R: it is not directly relevant for the dataset, but readers might be interested in the sensors that we use. SDI-12 sensors are generally known for their very low power requirements and their standard interface to most data-loggers.

L181-184: Colloquial language. Please rewrite.
R: will be re-phrased

L183-184: please rewrite to make the sentence clearer.
R: will be re-phrased. Measured conductivity tends to show an offset. Nevertheless, the recorded curves show plausible dynamics, e.g., during storm events.

L189: should be "are' possible.
R: will be corrected: … measurements are …

L190: atmospheric deposition of what? Salts, leaves? please be specific.
R: will be adapted: " … blocked by deposition of leaves, pollen, dust or insects, …"

L193: please rewrite to clarify the meaning of the sentence. Also, please quantify and be specific about how the rain measurements are affected, and why they are reliable in this data publication.

R: Specifically, the recommendation that the height of near-by objects, such as trees, should not exceed the distance from the gauge to the objects (WMO, 2008), could not be met at Q1 and Q2. A comparison of rainfall depths at all 7 rain gauges for several events revealed good agreement (*will be quantified in the revised manuscript*), however. Gauge Q1 is affected by interception, which amounts to typically less than 2 mm per event (compared to weighing rain gauges K1 and K2), but monthly precipitation is on average only 75 % of the mean of K1 and K2. At Q2, monthly precipitation is on average 87 % of the mean of K1 and K2. (K1 is close to the highest point of the watershed, K2 at the lowest point – this will be clear after re-design of Fig. 1 and Table 1). Therefore, the data from all rain gauges are useful for the analysis of storm events, where the interception reduces rainfall depth only by a small percentage. For water balance investigations of time periods longer than a week, however, only the gauges not affected by interception should be used. We will include this information in the revised manuscript.

L212: d18O and d2H are already defined earlier in the manuscript. Please use the short-hand notation to make the text more concise, or refrain from defining the shorthand notations.
R: will be corrected

L230: 'using' addVantage Pro?' or does the program also assess the data? If so, please be specific about which protocols are used.
R: for the purpose of this paper, "using" is sufficient.

L234: can the authors be more specific about this data cleaning process?
R: we will provide more information: Cleaning of raw data is done based on visual inspection of the raw data hydrographs. Also anomalies observed during field maintenance visits (1-2 per month) are incorporated.
**Rainfall data** recorded by tipping bucket devices (Q1, Q2, Q3, Q4) are deleted, if the funnel appeared to be (partially) blocked. Also, records for the winter season from November to February are excluded. Weighing rain gauges K1-K3 delivered continuous data since their installation.
**Discharge** at the H Flume gauges Q1, Q2 and Q4 needed careful inspection and editing. First, spikes in the hydrographs (1 or 2 consecutive values significantly higher than the value before and after the spike) were attributed to random events like a leave under the ultrasonic depth sensor and were automatically replaced by linear interpolation. Next, visually detected implausible discharges were edited, replaced by linear interpolation where reliably possible and deleted otherwise. As an example, occasionally during very low flow, single leaves can temporarily (a few hours) get stuck at the narrow outlet of the flume and cause the water level to rise a few millimeters. Such events are clearly visible as plateau-shaped parts of the hydrograph and can be safely replaced by linear interpolation. At these gauges, measurements were so far never disturbed by freezing.
At the weir Q3, two reasons required editing: 1) during very low flow, leaves and grass can occasionally get stuck at the weir crest, causing the water level to rise. Such events can be detected in the images transmitted daily by a surveillance camera and visually in the hydrograph. Such artefacts are replaced by linear interpolation. 2) during longer frost periods, the stilling basin may be covered by ice and therefore the discharge is no longer described by the weir formula. Such situations can be detected by visual inspection of the hydrograph and comparison with the records of temperature. These parts of the records are deleted.
The largest gaps are in the conductivity data at Q1 and Q2 (see separate discussion). Air and water temperature, relative humidity and soil water content did not need any editing and are practically gap-free.

L247: redundant to describe what Figure 5 illustrates, because this is mentioned in the caption. Please refer to the figure in the text itself.
R: will be adapted

L247: hydrographs 'for' July and August 2018
R: will be corrected

L273: could it not also be due to natural preferential flow paths? and if not, why not? and since in L274 the natural pref. flowpaths are mentioned, please be more specific about the limits to the period at which the disturbance affected the measurements.
R: During the first few months after installation, for example, deeper probes reacted faster to rainfall than those close to the surface (Figure 9). This can be attributed to artificial flow paths along the walls of the trench and the cables, or to effects arising from interrupted and destroyed natural macropores like wormholes. However, direct effects due to installation practically disappeared after the first season.

L288: I would expect to find this sentence in an introduction, not in a 'results' section

R: we will provide this information in the introduction and delete from the results section

L298: reference?
R: Feng et al. (2009 ): “Seasonality of isotopes in precipitation: A global perspective”

L300: which stable isotope? oxygen18 I assume?
R: yes, $\delta^{18}O$. will be added to the sentence

L305: I think the spatial data can be introduced where the DEMS are introduced first, and don’t need a separate section dedicated to them.
R: it is more than just DEM, also watershed divides, surveyed creeks and location of sites. We will add a more comprehensive description here.

L311: please avoid one-sentence paragraphs at all times.
R: will be adapted

L314: what are the assumptions to this two end-member mixing model, and are these assumptions valid in the Rosalia catchment? What is the influence of soil water during rainfall events, and what is the EC signature of soil water vs. groundwater?
Section 5.1: please be more specific and actually quantify the results of your baseflow separation (don’t forget to include uncertainties).
L320: please provide a reference for end-member splitting analysis.
L343: please give a measure of how well they match, NSE for instance.
R: L314-343: we will completely re-write section 5. Both examples are probably too complex to be described in this context and we will provide overview presentations in section 5 only. In the meantime, an additional study using the dataset (on the effect of forest access roads on the generation of floods) became available and will be included here. (compare recommendations by Reviewer #2).

L348: please be more specific about the data cleaning process. This is a very important part of the data collection and publication process, and is not mentioned at all in the manuscript.
R: We will remove the statements L233-235 from section 4 and go into more detail here. Please see the reply to the comment on L234.

Table 1: what does 0.2 mm ’events’ or 0.1 mm ’events’ mean? usually, 0.2 mm is the resolution of individual tips.
R: “0.1 or 0.2 mm events” is the terminology used in the documentation of our tipping bucket rain gauges as well as in the data acquisition system. It refers to rainfall events with a total depth of 0.1 or 0.2 mm. Also, our weighing rain gauges provide an output that simulates a tipping bucket rain gauge with 0.1 mm per tip. We felt that the meaning was clear, but will explain it in the text or in a footnote to the table.

Table 1: Does the "tipping bucket device" have any other specification?
R: Yes. It is listed as 1l (1 liter per tip), but apparently this is difficult to read (In the table, we will write 1 liter/tip). It is used as a complementary device at Q1 to measure discharge when it is smaller than the lower limit of a 1-ft H Flume (0.02 l/s). This never happened since 2015.

Table 1: please also mention the size (i.e., area in ha) of the different sites.
R: We will add size and mean height of the watersheds.

Figure 1: The cities on the inset map of Figure 1 are unreadable, and even the font size of the different sites in the main figure are a bit small. The legend nor caption describes what the green shading or crosshatching indicates. What is a "relais" in this context?
R: we will completely redesign Fig. 1 and remove the relais (the relais just serves for broadcasting data from the RTUs to the base station and is not relevant for using the data)

Figure 3: Please use the metric system.
R: would be misleading. See notes above.

Figure 5: y-axis is too low (Q2 peak cut off).
R: will be corrected

Figure 10: "stream water" or ”river water” isotopes rather than river isotopes.
R: will be changed

Figure 11: in its current form, Figure 11 does not add much to the article. The precipitation and discharge timeseries have already been shown in previous figures, and the results of the end-member mixing analyses are not shown.
R: in our opinion, this synoptic display of rainfall , discharge and electrical conductivity does add information about the behavior of the watershed, the Figure might become obsolete in a re-written section 5, as mentioned above.

Figure 12: is this specific discharge or absolute discharge?
R: absolute discharge – as labelled (and will be obsolete or replaced after re-writing section 5).

Morgenschweis, G. (2010) *Hydrometrie - Theorie und Praxis der Durchflussmessung in offenen Gerinnen*, 582 pp., Springer-Verlag, Berlin Heidelberg.