Associate Editor Decision: Reconsider after major revisions (19 Aug 2016) by Valier Galy
Comments to the Author:

Dear Dr. Fouinat,
I have now had a chance to carefully read your response to the reviewers' comments as well as your revised manuscript. I concur with both reviewer that – even after substantial improvements during the revision process - the general organization and focus of the manuscript is not optimal. While the data and in depth analysis presented are of clear interest with respect to understanding lacustrine sediment records and the erosion/deposition processes that generate them, it is not clear to me that the manuscript convincingly lays the ground work for using the proposed technique to reconstruct avalanche activity. This in part due to a lack of direct characterization of deposits that could be unambiguously attributed to avalanches. In the end, the comparison of independent proxies of avalanche activity with your CT scan based record (i.e. figure 5) is rather unconvincing. Therefore, in order for the paper to become suitable for publication in Earth Surface Dynamics, I suggest that you consider a significant re-organization of the manuscript and in particular a broadening of the focus of the study, along the lines of what Reviewer #2 suggested.

Sincerely,
Dr. Valier Galy

Dear associate editor Dr. Galy,

My co-authors and I wish to thank you for useful comments on the previous manuscript which were applied in our revised manuscript after the first answer to reviewer comments. We have made major modifications to the manuscript previously submitted to Esurf journal "A new methodology exploring the records of snow avalanches in lake sediments". We changed the scope of the article based on comment 1 from Reviewer #2 and editor's advice. The previous version was focusing on a new methodology in order to identify wet avalanches deposits in high elevation lake sediments. The revised manuscript is now oriented in order to give an interpretation of the sedimentology in terms of the process operating rather than the test of the method. The title is now changed to "A new CT scan methodology to characterize small aggregation gravel clast contained in soft sediment matrix". The introduction and discussion paragraphs were modified according to previous explanation. The introduction is now set up as a presentation of the CT scan method and previous applications in sedimentary studies. We then propose this method to better characterize mass-wasting events characterized by coarse clastic components due to their high transport capacity in lacustrine deposits. New literature was added accordingly. We cite three different transport mechanisms: floods, debris flow and wet avalanches and related underwater lacustrine deposits found in the literature. The revised discussion paragraph is now exposing the event related deposits recovered from our sedimentary record. Based on our results, we identified two different deposits, flood layers and gravel accumulation associated with poorly sorted finer grain size in the annual sedimentation. Based on literature, the latter seems to be related to avalanches deposits. We make comparisons with historical and natural archives (tree rings) avalanches records presented in Fig. 5 and seems in a rather good agreement between historical and tree ring based calendars. This leads to a discussion paragraph on the comparison with other records. The last part of the discussion is based on our CT scan method which is in the end suitable for identification and quantification of organic matter and different grain size clastic sediment. We emphasize the applied methodology opens new perspectives for further natural archives studies as complementary effective tool to existing techniques. My co-authors and I hope the changes in the scope of the manuscript are making the revised version stronger and more appealing to a broader audience. We also wish to thank you to still consider the article as a publication in your journal.

Sincerely,
Laurent Fouinat

Anonymous Referee #2 Received and published: 5 July 2016

1. The paper is set up as a 'new method', with the abstract and parts of the manuscript suggesting that the CT-scan method allows for 'avalanche deposit reconstruction'. But to do this, surely you need one (or more) known avalanche input events which have been cored to examine their sedimentology and make up of organic and clastic debris? (such as the one shown in May 2015 in Fig. 1?) I didn't see this being done clearly. Therefore, this paper does not provide a test of a method, but an interpretation of the sedimentology in terms of the process operating. In my opinion, I think the paper would be better set up to illustrate how CT-scanning can be used to provide new, quantitative information on sedimentary deposits of a high altitude lake basin. This is in the context of interpreting fluvial events, debris flows, and avalanche deposits. I suggest refocusing the piece on the record itself, and interpreting it in terms of geomorphic and sedimentary processes. A paper with that focus would have to rely less on this being a transferable method just for 'snow avalanches', which is a weak part of the manuscript. Also, by doing so one might actually conclude that avalanches are pretty difficult to reconstruct in this deposit (probably because of frozen vs ice-free lake conditions when an event happens). A revised version could then focus more on better explaining and justifying the approach shown in Fig 2b, which seems to allow information on the distribution of organic matter (and its size) and certain clastic grain sizes.

We agree the study lacks a direct observation of an avalanche and related deposit sampling. We have taken sediment cores after the avalanche event on May 1st 2015, but unfortunately no gravels were identified in the samples. As explained in the revised manuscript (l.130-131), the observed avalanche originated from the C1 corridor directed to the upper lacustrine basin where we were not able to sample because of large boulders and absence of fine sediment). The sedimentrary connection is supposed to be null between upper and deeper basin. We agree on the comment that the article does not provide a test of the method based on recognition of specific avalanches deposits. Based on this comment we oriented our subject on the method based on the CT scan to provide quantitative information on high energy sedimentary deposits of high elevation lakes and we change the title. The revised version is now focusing on the identification of flood deposits and mass-wasting events based on the CT scan results. The main changes are the introduction and the discussion paragraphs. The introduction is now exposing the CT scan as a new relevant method through examples of recent studies exploring quaternary sediment structure and quantifying components. The second part of the introduction focuses on the high energy lacustrine deposits likely to transport and deposits coarse grains. These are cited as floods (l.83), debris flow (l.92) and wet avalanches (l.97). The objectives of the study, exposed at the end of the paragraph, are to use of the CT scan methodology as a fast, nondestructive method to obtain quantitative information about sedimentary components, and especially on coarse grains. The application of this complementary to existing methods is applied on the Lake Lauvitel sediment. The watershed presenting steep slopes and specific forms of high energy events seems suitable for the study.

The discussion paragraph was also changed in order to interpret the observed deposits and deduce the mechanism related to those deposits. In the first paragraph (l.262-275), we identify turbidites deposits to link them to flood deposits through grain size analysis. The CT scan method observed some gravels in those flood deposits, and we discuss their origin which is excluded to be related to debris flow based on sediment accumulation. On the second paragraph (l.276-294) we identified sediment layers characterized by fine sediment poorly sorted exhibiting multi modal grain size distribution as well as numerous gravels. This type of deposits was described in the literature as avalanches deposits. We then discuss the different deposition mechanisms which may be involved. The third paragraph (l.296-328) is based on the Fig. 5, presenting historical and natural archives avalanches records found in literature compared to our gravel layers in Lake Lauvitel. The nearest avalanche record is from Corona et al., (2010), and exhibits a precise chronology. The direct comparison seems rather good with tree ring based calendar but ambiguous with the EPA record. This last feature was cited in the natural archives of tree rings which underestimates the total avalanches events by around 60%. In the discussion, the minimum gravel number to identify is based on the comparison with other records. The fourth paragraph (l.329-349) is presenting the limits of the CT scan method in our study, which is the image resolution for small elements identification and the satisfactory but perfectible relationship between manual and numerical counting. The advantages are also cited as identification of different sediment components such as gravel and organic matter in a quantitative method. The end of the discussion focuses on the perspectives of the method itself and growing potential for further studies on quaternary sediments.