

Interactive comment on “Detecting of Cave Floor Ice Dynamics based on Selective Cloud-to-Cloud Approach” by Jozef Šupinský et al.

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On behalf of the author's team, I would like to thank the Reviewer #2 for the effort providing a long list of valuable comments and recommendations to improve the submitted manuscript. The supplement material of the Reviewer #2 is exhaustive to be addressed in a short time within the discussion stage of the reviewing process. However, we are gradually revising the text and figures to better communicate our arguments. We will reply to all comments and re-submit the revised manuscript version within the required time frame of the journal. For now, we present our standpoint to the two main issues raised by the Reviewer #2.

The first issue was related to the novelty of the conducted research. We agree with

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the conclusion of the Reviewer #2 that by incorporating all comments into presented manuscript the content would change considerably. However, we oppose to the argument that the presented method of the selective cloud-to-cloud approach (sC2C) is well established and the manuscript does not add any improvement or novelty. It has perhaps been insufficiently emphasized and argued in the Introduction chapter to convey the uniqueness and the added value of the conducted research. The main aim of our manuscript was to define a methodological framework for generating time-series of 2D/3D surfaces representing the cave floor ice from terrestrial laser scanning data collection. By monitoring the cave floor ice, we mean the surface of the ice on the cave floor and surface of rock debris covering the cave floor ice underneath. This goal is clearly described on page 2 line 32 - page 3 line 2 and the aim is already emphasized in the abstract page 1 line 11-13. Based on this, we argue that the aim of the article is clearly stated, and we have not found a publication presenting the same approach of registration single scan missions from a TLS mapping into a unified coordinate system for generating a database of 3D surface time-series. Our sC2C approach is novel in the way of how we achieved the transformation of individual laser scanning missions into a unified coordinate system without using reflector targets. Such an approach enables to derive DEMs/3D mesh and to assess ice volumes changes within the cave at unprecedented spatial and temporal resolution. The sC2C approach is based on several separate procedures, which are presented in the methodical part of the manuscript within chapter 3 and portrayed in Figure 5. An overview of the approaches designed to the generating a time series database from individual scan missions is described on page 2 line 20 - 30. We accept that this paragraph could be supplemented by other relevant works to better emphasize the difference and novelty of our method. The basic features and characteristics of the proposed approach are summarized on page 18 line 19-30.

To our best knowledge based on the review of the published research in the manuscript, a similar workflow has not been described or used in monitoring the dynamics of the ice surface on the cave floor using terrestrial laser scanning. We will supplement the

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revised manuscript with a thorough review of the state-of-the-art in this field. Nevertheless, we would appreciate if the Reviewer #2 could help us with examples of published works which he or she considers similar to our method, so that we will be able to better support our argumentation.

The second main issue of the Reviewer #2 was to explain and interpret the factors inducing/determining the changes of the cave floor ice which is recorded by the time-series of 3D surface models. Accomplishing such task would lead to better understanding of the recorded process of ice dynamics. However, this is not the ambition of the submitted manuscript. The Reviewer #2 concluded that to explain the processes of ice changes in the cave requires observation, monitoring, and recording of various factors in the exterior and in the interior of the cave. For example, quantity of all ice accumulations, temperature of the air and of the ice, hydrology, precipitation, air circulation, type of species and density of vegetation (related with evapotranspiration), tectonics and geological structure of massif, morphology of the cave and immediate surrounding, connection with other part of the cave system. Instead of addressing these issues, we realized that as first it is important to define and demonstrate a suitable methodological approach to detect subtle changes of the cave floor and evaluate the cave floor ice dynamics during a certain period in a reliable way, minimizing the uncertainty associated with measurement accuracy and mutual orientation of the scans. This problem defines the content of the submitted manuscript.

Given the various issues related to the cave surroundings, its morphology, and individual cross-sections demonstrating the change over a time, a link to an interactive web application will be implemented into the revised manuscript. Link to this application is available now:

https://geografia.science.upjs.sk/webshared/Laspublish/Ladnica/Silicka%20ladnica_All.html

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-82>, 2019.