

We thank the reviewer for the time dedicated to our manuscript and the detailed comments. We addressed these in our comments below (RC comments in red, AC in black).

Overview and general comments: I have read the manuscript entitled “Unprecedented loss of surface and cave ice in SE Europe related to record summer rains in 2019”. In the manuscript, the authors investigate the ice changes in 5 subsurface glaciers (ice-caves) and 2 of the southernmost European glaciers during 2018-2019 year. Ice measurements in caves were performed using usual methods for ice body changes in ice caves by fixed marks/points in walls and photogrammetry, while glacier changes were evaluated using a drone. The weather during 2018-2019 period was evaluated using E-OBS dataset. The authors conclude that the observed ice loss during 2018- 2019 was caused by extreme rainfalls during spring-summer. This ice melt event was an unprecedented event, not recorded during the last century. The manuscript is interesting to understand the response of ice caves and glaciers to extreme rainfall events. Some minor observations and suggestions must be solved before publication.

Line 1: Title. The term “unprecedented” should be accompanied by a temporal term e.g (“Unprecedented loss of surface and cave ice in SE Europe since the last century. . .or 100-years”)

We thank the reviewer for the appreciation of our work and for the comments and suggestions. We welcome these and used them to improve our manuscript. General and point-by-point responses as well as modifications of the text are below (in black).

Following the reviewer’s suggestion the title has been changed to better reflect the observations and conclusions: **Record summer rains in 2019 led to massive loss of surface and cave ice in SE Europe**

Lines 87 and 94: appear two times “Chionotrypa cave”, I guess the caves have the same name, but maybe the authors could write directly the second name attributed “Chionotrypa (Falakro)” and “Chionotrypa (Olympus)” or, to shorten it, “Chionotrypa-F” “Chionotrypa-O” to avoid repeating the name, as it appears along the text. An acronym for “Velika ledena jama v Paradani” is also recommended or for short like “Velika” or “Paradini”

In the first instance the names appear (lines 87 and 94) the text reads “*Chionotrypa Cave* (Mt. Falakro, hereafter *Chionotrypa Falakro*) and *Chionotrypa Cave* (Mt. Olympus, hereafter *Chionotrypa Olympus*)”. We have removed the parentheses to make the names clearer and further checked the text to make sure that potential ambiguities are solved. We were thinking on adding acronyms, but in the end decided against (with several investigated sites, the text would have been to full of acronyms).

Line 104: change “metamorphosed” by “transformation”

Done

Line 126: The authors indicate that photogrammetry was carried out. In which caves was performed? Maybe the authors should add some additional information about the methods of photogrammetry, given that at the moment is not a usual method applied on ice caves, however, it is a powerful technique to know ice volume changes in caves.

We did so in Chionotrypa Falakro. We took photographs from the same point over successive years and the images were compared in image processing software. We added the following line to the main text:

“For the purpose of this paper, photographs of the upper surface of the ice and snow body in this cave taken from the same spot at the end of the ablation period were compared in order to visually estimate the ice level changes.”

Line 136-142: A table could be helpful showing the resolution, error of MDT generation, and the accumulated error when comparing both models.

The following table was added to the main text

Table 1. Characteristics of the digital surface models and ortophotos obtained for Snezhnika and Banski Suhodol glacierets.

Glacieret	Date of UAV flight	DSM resolution (cm)	Ortophoto Resolution (cm)	Mean error DSM (cm)	Mean error Ortophoto (cm)
Snezhnika	28.10.2018	5	2.1	1.5	0.2
	6.09.2019	22.5	2.8	2.1	0.3
Banski Suhodol	29.10.2018	10.6	4.9	1.9	0.3
	5.09.2019	18.7	4.6	1.6	0.2

Line 144: I have asked an expert colleague in meteorology and he suggests some changes and modifications in relation to the use of the E-OBS dataset.

- One of the main problems of this dataset is related to the extreme events. The resolution of E-OBS is 0.25x0.25, which for mountain areas and rainfall events is too low. The following database has been intensively tested:
<https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5>

We agree with the concern of the reviewer, but E-OBS dataset actually has 2 different resolutions: 0.25 x 0.25 and 0.1 x 0.1. For the current analysis we have used the 0.1 x 0.1 resolution, which is the highest resolution you can obtain. We have opted for the E-OBS data set because it is based on station data provided by each meteorological institute across Europe. Although ERA5 is also a very good and highly used dataset, for the precipitation it is more useful to use the E-OBS data set when we perform analysis over the European region. Moreover, The ERA5 precipitation production process does not include precipitation observation inputs, thus E-OBS has a huge advantage over ERA5 in terms of precipitation. In general, the reanalysis datasets are preferred to observational dataset for regions where observational datasets have a limited coverage. But in the case of Europe, E-OBS offers the best alternative for precipitation.
EOBS data set link: https://surfobs.climate.copernicus.eu/dataaccess/access_eobs.php#datafiles

Line 167: Is it possible to indicate the drop or change in cm or m? Following a similar descriptions of the rest of ice caves where authors describe the drop of ice in cm or m, and then the corresponding volume.

We do not have precise measurements. This has been acknowledged in the revised manuscript: In Chionotrypa Olympus, the surface of the ice is just 6 m below the cave entrance (Pennos et al., 2018) and thus the cave ice deposit responds to climatic variability in a manner similar to surface glaciers. The thermal inversion layer inside this shallow entrance shaft was easily destroyed during the prolonged warm spell, triggering the rapid melt of the surface and sides of the glacier; however, lack of precise measurements prevent us from estimating a figure for the volume of lost ice.

Line 198: Why did the authors use the 1971-2000 period instead of the last one (1980- 2010)?

The reference period is a matter of choice. We choose the period 1971 – 2000 because over the period 1981 – 2010 the global warming signal is much stronger, which might hinder the amplitude of the anomalies. Overall, most of climatological based studies use the period 1971 – 2000.

Line 307 “generate (semi)quantitative” add space.

Done

Figures

Figure 1: Add legend, Red stars: ice caves. Blue stars: glaciers

Done.

Figure 2: It would be nice to show all ice changes from the caves of the study in the graph maybe in a zoomed area.

We tried this, but the differences in resolution would have made the figure somehow awkward, with high resolution (monthly) in Scărișoara, seasonal in the other caves, and annual for the two surface glaciers.

Figure 4: The photos should be labelled as a). b) etc

Done.

Figure 5: The photos should be labelled with a code for a quick identification. Maybe left= 1 and corresponding photos 1a, 1b, 1c, Middle= 2a, 2b, 2c. . .etc. and similar for Figure 7.

Done.

Figure 8: indicate the meaning of background colors (warm, cold...).

Explanations for the color codes were added in the caption.