

Point to point response to the reviewers

1<sup>st</sup> reviewer

- 1. 135 I would rephrase this slightly to give nuance about the fact that ice can be dated when the peak is present, whereas its age can be constrained in the absence of the tritium peak. I would suggest something like: Previous studies have dated or provided constraints on the age of ice deposits by using the presence (Kern et al, 2009) or absence (Kern et al, 2011) of the tritium peak.**

We rephrased the line according to the suggestion of the reviewer and we added two more references (Borsato et al., 2004; Kern et al., 2018) for the case of the presence of the tritium peak.

- 2. 146: change 'transits to dolomite' to 'transitions to dolomite'**

We changed the phrase according to the suggestion

2<sup>nd</sup> reviewer

Regarding the major comments:

- 1. Site description needs crucial details and more climate information should be also necessary. e.g.: When was the cave discovered? or 2017 is the date of discovery? Can you provide evidence that the firn deposit sampled in 2017 is not an exceptional seasonal phenomenon at this site? (e.g.: did you observed firn in this cave before or after 2017?) Quantitative data (at least estimates) about the annual precipitation amount and the typical snow depth should be provided.**

The year that the cave was firstly investigated was added (lines 40-41, in the revised manuscript). We support the opinion that the firn deposit sampled in 2017 is not an exceptional seasonal phenomenon, based on our observations before and after the sampling year (lines 42-43, in the revised manuscript). A phrase that describes the snow depth and a reference were added (lines 53-54, in the revised manuscript).

- 2. The atmospheric reference data in Fig2A should be updated to 2017 and it should be discussed whether the studied ~2m firn represent a few years of the past ~10yrs. Beside the annual mean tritium values mean 3H activities of the snow season could be also considered as a more suitable benchmark. A related question is that if the ~2m profile cover only few years than the fluctuation between ~1 TU and ~10 TU might reflect some seasonal cycle? It should also be discussed. If this is viable than the inferred accumulation could be ~70cm/yr bringing substantial changes to the discussion.**

We updated the data with our tritium in precipitation measurements of the period suggested (2007-2017 with a gap during 2011) since there are no data at the GNIP database for the same period and for stations in Greece. Also, we added a brief discussion (lines 89-93, in the revised manuscript) for the case the data should represent accumulated ice from the last decade. This addition does not change the whole idea of

the discussion since we suppose, from the data collected, that the accumulated ice is not older than 50 years from the year of the sample collection and thus the minimum annual accumulation rate is about 4 cm y<sup>-1</sup>. So, the rates mentioned in the newly added discussion of about 20-30 cm y<sup>-1</sup> are in consistency with our argument.

- 3. *The discussion could be also improved. Authors should consider the observations from a recent study of one of the previous reviewers:***  
***<https://doi.org/10.1038/s41598-022-15516-9> In addition, I suggest carefully considering the differences between ice deposits from firn and congelation ice. (The usual accumulation of congelation ice is lower by orders of magnitude compared to firn deposits!). It would be interesting, especially the TC readers what is the situation of this firn deposit following the extreme weather of 2018-2019 reported in another study (<https://tc.copernicus.org/articles/15/2383/2021/>) in this journal.***

We added a phrase mentioning the results of the proposed recently published work of Racine et al, 2022, stressing that there are ice caves where the preserved firn may have age up to 4700 years BP (~2700 BCE). Regarding the possibility of updating the situation of the cave at Mt Olympos through the recent years 2018-2019, it is impossible to do so because there wasn't organized any sampling campaign in the cave the recent years.

Regarding the specific comments:

- 4. *line 30: I suggest writing '5 to 10 TU' instead of '5-10 TU'***

We followed the suggestion

- 5. *line 33: I suggest removing „in Canada and Austria” since northern hemisphere is already mentioned in the previous line in the same sentence.***

We removed it

- 6. *line 36: Instead of citing the study from 2011 please consider the follow up study (DOI:10.1017/RDC.2018.96 ) which was able to detect 3H activities corresponding to the „bomb peak” period from the same cave ice core. In addition, 3H activities mirroring the concentration changes of atmospheric precipitation have been reported from a 2.5 m topmost part of Grotta del Castelletto di Mezzo ice deposit (Brenta Dolomites, N Italy) as well. This paper (url: <https://www.academia.edu/download/39282184/Odeec528405fbec31f000000.pdf> ) should be also mentioned here.***

Following the suggestions the lines were rephrased as follows: “Previous studies have dated or provided constrains on the age of the ice deposits by using, the presence (Kern et al., 2009; Borsato et al., 2004; Kern et al., 2018 ) or the absence (Kern et al., 2011) of the tritium peak.”

- 7. lines 62-63: Please change 'ml' to 'mL' (Litre was abbreviated by capital letter at the other occurrences as well.)**

Changed.

- 8. lines 76-78: I think I understood what you were saying, but the sentence is quite long and convoluted. Please consider splitting it up to simple statements.**

We rephrased the sentence as follows: "Instead, tritium concentrations were found to vary only from 0.9 to 11 TU. This range of tritium concentrations could be attributed to different initial tritium concentrations in snowfall, either few years before the sampling year or even older."

- 9. line 85: The sentence sounds strange. The measurements obviously cannot be attributed to anything before the '50s since those were performed after September of 2017. If I can follow the logic the Authors wish to argue that the  $^3\text{H}$  activity levels found in the ice samples could not be attributed to precipitation fallen before the 1950s. Please consider rephrasing.**

Rephrased as follows: "Finally, the  $^3\text{H}$  activity levels, found in the ice samples, could not be attributed to precipitation fallen before the '50s, because in that case higher concentrations remaining from the high tritium concentrations during early '60s should have been preserved into some of the measured samples."

Finally, regarding Figures:

- 10. Figure 1. Please cite the GNIP database here in the caption. Please follow to the instruction of the WISER page: IAEA/WMO (current Year). Global Network of Isotopes in Precipitation. The GNIP Database. Accessible at: <https://nucleus.iaea.org/wiser>**

The capture was changed: "...tritium monitoring stations (IAEA/WMO (2022). The GNIP Database. <https://nucleus.iaea.org/wiser>); other mountains..."

- 11. Figure S4: I suggest moving this field photo from the supplement to the main document. This give an impression about the studied firn deposit.**

The figure S4 was moved to the main document as suggested (Figure 2, in the revised manuscript).