Point by Point Reply for Reviewer 2 and modifications to the text

- Reviewer comment:
  My main concern is that the depth co-registration between chip and ice samples is robust enough to justify the conclusions. The manuscript focuses on three datasets: tritium in the ice, tritium in the chips, and 137Cs in the chips. Based on Festi et al. 2021, drilling was halted because of wet drilling conditions. Could such conditions compromise samples obtained from the chips or the depth registration of the chip samples relative to the ice? I can imagine if the borehole was waterlogged, chips could be mixed across a wide range of depths. Furthermore, if the borehole was waterlogged, was it at all possible to separate water from the chips, and if not, could such water contaminate or dilute data developed from the chip samples? These details, to me, are crucial to ensure that ice and chip measurements are co-registered in depth since the conclusions of the paper are based on the offset in 137Cs and tritium. If the 137Cs and tritium measurements were made on the same exact samples collected as chips, this uncertainty could be somewhat ameliorated. Is that this case? If so, that should be clearly stated.

Reply:

The ice core was extracted during the winter season, mainly working at night, to maintain a low temperature during the drilling activities done by an electromechanical system. There was no water in the borehole, if not the drilling system would not work, and the ice core was recovered dry. The chips were collected by recovery of the cutting in a specific close chamber above the core barrel. The external chips that were not in the chamber were rejected. For these reasons, we can reasonably exclude contamination of cutting from other parts of the hole. The conditions to which Festi et al 2021 refer were only found at the bottom of the ice core, and since this drilling system cannot work if water is present, that is the reason why only 46m of ice core were recovered.

Additionally, cesium and tritium measurements on the chips were indeed done on the exact same samples. The sample was filtered and the filter retaining the particulate matter was used for cesium analysis while the remaining filtered water was used for tritium analysis.

To better clarify these points we added the following text:

At line 90: “The chips were collected in a specific close chamber above the core barrel, which was emptied after the collection of each core sample.”

At line 270: “The low resolution tritium dataset was prepared from the same exact samples which were also used for 137Cs analysis.”

- Reviewer comment:
  I did not think the linkages to the SDI dataset were convincing or added much to the manuscript. It seemed extraneous unless the authors could draw a stronger link/conclusion

based on it. They also do not mention the smaller SDI peak that aligns with the 137Cs peak (though this does not consider depth registration uncertainties between the chip and ice measurements).

Reply:

The SDI dataset was added as it was the only other available information on particulate matter we had on this ice core (besides the Black Carbon dataset published by Festi et al 2021). We think that the fact that no big peak is present in the SDI dataset at the same depth as the cesium main peak indicates that the Cesium peak is not due to an abundance of dust in this layer, and this should be important information since the Cs data is not calibrated on the amount of dust present but on the volume of filtered water, despite Cs being in particulate form. (This was not done as it was not possible for us to quantify the amount of dust deposited on the filter used to prepare the cesium samples.) This is valid under the assumption that the depth registration of the chips is correct.

- Reviewer comment:
  Lastly, I do not think that the author's conclusion that tritium is not impacted by downward relocation is justified without additional independent dating. The authors are only assuming that tritium is not impacted since it is shallower in the ice than Cs137. Such independent dating may be impossible, but just because the tritium is above the 137Ce peak does not mean it has been affected by melt. I'd simply suggest removing this conclusion.

Reply:

We agree with the reviewer and we did not intend to imply that tritium is not impacted by meltwater, but that the impact that meltwater can potentially have on the two radionuclides is different. If relocation of meltwater to adjacent layers is taking place, tritium is more likely to show a broader signal as opposed to a well-defined and constrained peak. Additionally, signal loss may be present if meltwater containing tritium escapes the system. We do not think it is likely to have a shift of the peak if no other evidence of massive melting is present (e.g. lack of bubbles). To better convey the point and avoid misunderstandings we changed the text at line 253 from "Tritium was not affected by the process as it is present in the ice matrix" to "Tritium was less affected by the process as it is present in the ice matrix."