

Review for egosphere-2023-2722

Machguth et al - 50 years of firn evolution on Grigoriev Ice Cap, Tien Shan, Kyrgyzstan

General comments:

The authors report results from a 18m firn core drilled at Grigoriev ice cap. This is especially interesting as it extends the present record of ice cores drilled on this ice cap. Evidence of increased melt is found in the top layers of the ice core when looking at major ions data; but firn temperature, after showing an expected increase in 2018, returns to early century values in 2023. The mechanism proposed to explain this dynamic is the presence of infiltration ice near the surface leading to lateral runoff instead of vertical percolation. The discussion also focuses on the net accumulation rate, which was found to be stable since the 1980s despite the aforementioned meltwater. The authors hypothesize the existence of a compensating mechanism that keeps the accumulation rate stable, such as the increase in precipitation.

The manuscript shows interesting data and the presented hypotheses are generally well supported. Overall it is well written, with some minor exceptions regarding a couple of paragraphs (see specific comments) which could be written in a clearer manner.

In my opinion, there is an issue that needs to be fixed regarding the weather station data: since this data is referenced and discussed many times in the text, it needs to be stated once and for all, and at the beginning of the manuscript, that this data must be taken with caution. It cannot be repeated in every paragraph like it is at present time in the discussion section.

The manuscript would also benefit from a more in-depth discussion regarding the total beta methodology and the major ion results.

Specific comments

L43-44. There is quite a difference in the data from before and after the moving of the weather station. I think this needs to be pointed out and further discussed since this data is frequently mentioned in the manuscript (see also general comments on this data). Engel et al (2012) point out that there is a significant difference in the two time series which should not be considered unitedly.

L61-68 “For the remainder of our study...” I think it would be best to rephrase here to make it more clear why the authors chose to focus on these specific cores. It is mentioned in the following lines, but in my opinion it is not clear that these are the reasons why.

L62. “that is information about...” wording is unclear: are saying that when you say stratigraphy has been reported you mean that for all cores you have information on the presence and position of infiltration and recrystallization ice, but not dust layers?

L82. misspelling of “polypropylene”

L102. From which part of the core did you prepare the samples for beta activity and which depth range did each sample cover? In my opinion, the explanation of this methodology could be slightly expanded.

L116. "the station was accidentally..." I don't understand the importance of reporting on this visit. I would also rephrase this paragraph to make it more immediate which are the time periods with available data.

L136. "only a quarter occurs from October to April" Would it be possible to sustain this claim but with more recent data from the weather station instead of citing a 30 year old paper?

L138. "generally highly correlated" I think this information needs to be better quantified.

Fig.3a I think it would be best to highlight the difference between measurements above and below the background for the total beta activity.

L145. "retention of ^{137}Cs " This statement needs a reference for support.

L149. What is the error on the 12m depth which is arbitrarily assigned? I think it is important as this tie point is crucial in the dating of the ice core, which is thus affected by this error.

Fig4. Error needs to be shown for this data. It is difficult to compare the 3 cores without it. Additionally, Does it really make sense to show here the NH_4 and BC data since there is no comparison with the other ice cores? It is stated that the 2003 core also had glaciochemical data, but none is shown here in comparison, why?

L156. "for all 4 parameters..." This statement needs to be better motivated.

L166-170. I think here it needs to be better explained why you are using Cl/Na ratio and showing SO_4 concentrations. Just better wording to make it more clear.

L266. "for the years 1998..." This needs to be explained better since looking at Fig. 4a there is an apparent increase in air temperature.

L276. In my opinion, the discussion of the difference between 1990 and 2018 data would work better if moved to section 4.3

L276-282. This section is not very clear and could be phrased better to convey the message that dO_{18} is not conserved well probably due to percolating water.

L285. "In general we observe lower..." Is there a significant difference between concentration in the upper and lower part of the core? If so, how much? Are there also differences with respect to concentrations measured in other central Asian cores? I think this discussion would be interesting to add.

L286. "the reason could be..." In my opinion, the discussion would be more clear if the two hypotheses (meltwater-induced relocation and source strength change) were discussed more separately and a little more in-depth.

L288. "concentrations are less depleted" Less, but still depleted with respect to the lower part of the core?