

Interactive comment on “Physically based summer temperature reconstruction from ice layers in ice cores” by Koji Fujita et al.

Anonymous Referee #3

Received and published: 11 November 2019

Fujita et al., Physically based summer temperature reconstruction from ice layers in ice cores

General Comments: This manuscript presents a new way to reconstruct past temperature from ice cores. Encouragingly, this method relies on the melt features that can frequently confound the estimation of temperature using more traditional methods of variations in oxygen (and potentially hydrogen) isotopes. The manuscript tests the method on a range of ice cores which are widely differentiated both geographically and in elevation. The data encapsulated in Figure 8 indeed looks very encouraging.

Line 31-32 – are there any more recent references to melt features being used to characterise temperature? Apart from a couple in the 2000's, these references are 20 or more years old. Also – using the term ‘ice layer’ or ‘ice layer thickness’ is confusing.

C1

Are you talking about melt layers in the ice? Layer thickness in ice cores usually refers to annual layer thickness.

Where are your methods where you outline the analysis of the ice cores you used, and thus how they were dated. The annual layer dating of these cores is critical to this project since you are trying to reconstruct summer mean temperature.

Was there a reason to not use ERA5 rather than ERA interim? ERA 5 would provide a smaller grid size, and therefore parameters like 2m temp may be more realistic. ERA 5 is likely far more relevant to a study looking at calibrating grid data with specific ice core sites.

How were the ‘ice layers’ or melt layers differentiated from bubble free layers that may have formed via other means? E.g. bubble free layers in ice cores have been observed at various sites and have been differentiated from melt layers via their appearance (Feyveresi et al., 2018, The Cryosphere 12:325-341) and even via analysis of their noble gas chemistry (Orsi et al., 2015, J. Glaciology doi:10.3189/2015JoG14J237). These layers can result from surface crusts that have been retained and buried, and the surface crusts may have formed via wind scouring, or other atmospheric processes like inversions. These are not melt processes. The study needs to provide some detail of how melt layers were discerned from other layers in the cores - perhaps including some photos?

Specific Comments: I suggest some proof-reading to improve the English. There are numerous instances of missing words, e.g. first sentence of the abstract “...relied on the statistical analysis...”, line 29 ‘because the relationship...’.

What does ‘firn albedo setting’ mean in the abstract? Perhaps explain briefly here.

It would be useful to provide some more detail about the nearby stations used in Table one – e.g. elevation, length of observations, not only distance but also direction from the ice core site.

C2

Can you split the data in figure 8 into four separate graphs on the one figure? It would be preferable to see the four sites more clearly. Another option would simply be to make the x axis far longer (although still covering the same temp interval) so that it is easier to differentiate the four sites. It is hard to see the orange and pink dots.

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-97>, 2019.