Review of Tsushima et al., "Reconstruction of recent climate change in Alaska from the Aurora Peak ice core, central Alaska"

For *Climate of the Past*

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General comments

The authors present a new ice core record from central Alaska, and attempt to interpret changes in stable isotope ratios and accumulation rate primarily in terms of the Pacific Decadal Oscillation. Overall, I applaud the authors for their work in developing this dataset; there is a great need for additional ice core records from the North Pacific region that can be used accurately to reconstruct ocean/atmosphere variability over the past millennium. Alpine ice cores such as these are a significant logistical and analytical challenge. The data the authors present appears to have been collected and analyzed with great care; I have no serious concerns about data quality or the laboratory analytical techniques used. I do have several fundamental problems with the author's data interpretation (namely time scale construction, layer thickness correction for ice flow, climate correlation analysis) such that I do not believe that the conclusions reached are sufficiently justified by the data analysis. I will detail each of the catagories below.

Specific comments

Time scale

- One of my significant concerns is the impact of melt on the isotope and chemical stratigraphy of the core, and hence the time scale development. Although they mention it in the abstract, the authors present no evidence of understanding the melt process itself (i.e., caused by sensible heat or radiation, or both), and the extent to which isotope/chemical homogenization or migration occurs. Please confirm how the melt feature percentage was calculated. In general, I do not see how melt and melt percolation can occur to the same depth every summer; thus, it seems difficult to use it as an accurate guide. In Fig. 2, there are several instances of large (100%) melt evenst in winter snow, suggesting significant percolation or incorrect interpretation. Also, there are many isotope minima that are not considered winters, yet are of equal magnitude to other winter peaks. Also, Figure 2 clearly shows an increasing trend in melt percentage, yet only a small 30-50 m) portion of the record is shown in detail. Does the increasing melt amount have a differential effect on isotope/chemical stratigraphy?
- The use of volcanic markers in the time scale development seems very limited in use. There have been hundreds of volcanic events in the region over the past 100 years, so it seems extremely difficult to ascribe one sulfate peak to a specific 1992 event. Moreover, I do not understand why Katmai shows only a Cl/Na and not a nssSO4 signal.
- There is a limited tritium profile presented, with an apparent peak. However there is no justification given as to why this has to be the 1963 peak. Without context (ie., a longer tritium record) or comparison of tritium values to other ice core records in the region, it seems a stretch to be sure this is 1963.

Accumulation record/flow model

- The ice flow model used in this case may be overly simplistic for the glaciological situation. The Dansgaard-Johnson flow model applies to divide conditions, so if there is significant horizontal movement there can be large error induced in model results. The accumulation profiles shown in Figure 4 have a very large trend throughout the record which could very well be a result of flow conditions. The authors need to present a much more thorough glaciological analysis to convince me that the correction applied to the annual layer thickness data is accurate.

Climate analysis

- Given my above concerns with the time scale development and ice flow correction to the accumulation record, it is difficult to move towards comparison of the isotope/chemical timeseries with climate data. In any paleoclimate record, chronology is the fundamental component of any subsequent comparison.
- Isotope/temperature correlations – why did the authors choose 6 year running means for correlation analysis? This will necessarily increase any correlation coefficient, such that in their case there are significant correlations with every station (Fig. 5). This does not appear to be physically plausible, as coastal and interior sites have much different temperature histories. If annual averages are used, what do the correlation statistics look like? The correlation between accumulation (disregarding my concerns above) and precipitation also are difficult to interpret – why a correlation only between Aurora Peak and coastal sites? It is a large logical leap, and incorrect in my opinion, to go from these correlation analyses to interpreting the ice core record in a broader climatological context.
- Comparison of accumulation trends in the ice core record to station data is not supported by the accumulation record construction, in my opinion.
- Correlation between the PDO index and isotopes is weak at best, and shows no obvious features in common. There is no discussion as to why this would be the case in the first place – is there a significant link between interior temperatures and the PDO? Precipitation on the coast and PDO?
- The analysis presented in Figure 7 I do not understand. It seems that the authors have simply reduced a nearly 100 year temperature and isotope record to three points, found a correlation of the three points, and then are using that to argue for a relationship for the whole record. The logic of this approach is not clear to me.

Introduction

- a more thorough summary of previous work, state-of-the-art, present gaps in knowledge, and what specific contribution this paper intends to make would be helpful. The description presented is very much limited to previous work by Japanese groups, and ignores the wealth of data and interpretation that has occurred from ice cores and other paleoclimate records in the eastern North Pacific.

<u>Specific comments</u>

- the value of Table 2 is not clear to me – how does this add to the discussion, and where/how is it used?

- Table 3 – the value here is also not clear – what is the time period before 1900 used in the analysis? Is it consistent?