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Climate of the Past Discussions

Interactive comment on "Simulating the temperature and precipitation signal in an Alpine ice core" *by* S. Brönnimann et al.

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Broennimann et al., address the problem of accumulation weighting of ice-core signals on the specific example of alpine Grenzgletscher ice-core. I think the manuscript is a useful addition to better understand alpine ice-core signals and it fits in the scope of Climate of the Past. However, I find the present version of the manuscript slightly superficial, especially in the light of the more systematic studies on this topic published for polar ice-cores. I recommend publication after the following points were considered:

Major points:

1.) The manuscript is not well connected to the literature: Recently, important and systematic studies concerning the problem of precipiation weighting on ice-cores were

published. I'm aware of work from Louise Sime (Sime et al., 2009 and 2011) for the Antarctic Penisula and Persson et al., 2011 for the Greenland ice-sheet but there might be follow up papers. The revised manuscript should discuss them.

2.) The results are limited to a single alpine core: While the paper clearly demonstrates that an interpretation of the Grenzgletscher ice-core signal as accumulation weighted temperature is sensible, one also has to take into account that inevitably, a number of choices were made which lead to artificial skill. Specifically these are

-Decision on the time period (here 1979-1993) -Searching for the most likely location of September 1979 = fitting of c1 -Choice of a smoother (if this is not calculated from the diffusion model) -Wiggle matching of the winter O18 values -calendar year vs. cold point year

I understand that these steps are necessary, but given the amount of choices and the limited degrees of freedom in the single dataset, I would feel more comfortable if the model would also be tested on other cores in the Alpine region. Possibilities would be either repeating the whole procedure on another core, or at least predicting the correlation between annual temperature and the isotopic signal in other cores (e.g. as Persson et al., do for Greenland ice-cores). For example, one could present a map of the correlation of O18fwd and T_annual in Section 4.4. This would be useful for the interpretation of other alpine cores and provide a test for the model by comparing the predicted correlation at other core-sites to the observed correlation. I'm not aware how many other records exist, but at least the good correlation at Fiescherhorn core should provide a test.

3.) The last part of the paper; Monte Carlo resampling and the proposal of a potential reconstruction technique by searching analogues seems unfinished. It should be either reworked or removed; The relation of weighted and annual temperature will ultimately depend on the covariance structure of temperature and precipitation; It is unclear if a weather generator with 15 day windows keeps this structure as I could also imagine

coherency of precipitation and temperature on the interannual scale. I'm not yet convinced by the proposal of reconstructing climate by searching the closest analogue; it is an interesting idea, but the limitations and possibilities would have to be tested on a larger parameter space and not just on one example. Further, it would be desirable to present the theory behind it (what e.g. covariance between temperature and precip. determines the quality of such a technique).

Specific comments:

P6118, Line 24: A sentence of the interpretation of c1>1 would be useful; assuming perfect precip data, c1 should be <1.

P6119, Line 6: Where do the 30cm come from? Is this calculated from the Johnson model using the local temperature and accumulation rate or is this just a guess? I don't think the results are sensitive on this choice but adding a clarification for the reader might be useful.

P6120: Line 17: For accumulation, isn't the calendar year forward model by definition the same as a direct comparison of the annual averages?

P6124: Line 26; I don't understand why the model is not affected by the problem of stationarity; I agree that the forward model, when the accumulation and temperature are known, is unaffected but these are the cases which are not so relevant for paleo-reconstructions when we aim to reconstruct climate from ice-cores. Any further conclusion, e.g any conclusion derived from the Monte Carlo sampling has to assume that precipitation, temperature and their covariance are stationary.

References

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Persson, A., P. L. Langen, P. Ditlevsen, and B. M. Vinther. 2011. "The Influence of Precipitation Weighting on Interannual Variability of Stable Water Isotopes in Greenland." Journal of Geophysical Research: Atmospheres 116 (D20): n/a–n/a. doi:10.1029/2010JD015517.

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