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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.

Anonymous Referee #1

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This paper deals with the simulation of the temperature and precipitation signal in an Alpine ice core by means of a forward model informed by three different series of meteorological data. While the model is extremely simple, it captures fairly well the mean features displayed by the ice core record meaning that the many processes neglected were effectively of secondary importance. This is already a remarkable result in itself that illustrate how a simulation can be extremely effective when 1) the main variables are identified 2) field data can be used a) to parametrize the most complex factors and b) to validate the model. Nevertheless the paper may be significantly revised considering the following major and minor points:

Major points:

1) The list of references appears extremely slim. Studies of stable isotopes in precipita-

tions (including both data sets and models) are quite mature and a far better introduction to this field of research should be provided. The references are also not well updated. Just to mention two examples: Wagenbach et al. have already recently reported in Geografiska Annaler: Series A (2012, DOI:10.1111/j.1468-0459.2012.00461.x) how non stationary conditions may affect the interpretation of stable isotopes in alpine ice cores in terms of temperature. Gabrielli et al. have already attempted in J. Glaciol. 2010 (56, 843-853) to reconstruct the snow accumulation over several years in another alpine glacier by means of a similar model and have compared their results with data obtained from a firn core. Briefly, the authors should really try to better present and compare their results with the current state of the art from the literature.

2) The paper would benefit also of a careful discussion of the variables that were a) parametrized or b) neglected. a) How were snow deflation and precipitation gradients taken into account? I believe this was performed through the calculation of the constant C1 but this was never made explicit. The authors should also explain why their calculated C1 is quite low (1.2) when compared to what is reported in bibliography: Kuhn (Journal of Hydrology 282 (2003) 95–103) found 2.15 in Austria; Fischer (Global and Planetary Change 71 (2010) 13–26) reported 1.7; Gabrielli et al. J. Glaciol. 2010 (56, 843-853) found 1.7. Finally, how was the typical systematic errors in measuring precipitations by means of the automatic weather stations taken into account when determining C1? b) If summer melting plays in this glacier a negligible role in reconstructing the accumulation, this should be demonstrated in quantitative terms.

3) One important implication of the results obtained by the presented model is that the so-called “amount effect” does effectively play a secondary role in influencing the stable isotopes variability in this Alpine core. This was perhaps expected but still one may think that, in case of snow events lasting days (as it can often happen in the European Alps during the so-called “stau” conditions) the stable isotopes composition could vary significantly during the snow event. I believe this point deserves to be discussed in the paper.

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4) This paper could be better linked to the companion paper of Mariani et al. (2012) in CPD. Those other findings should be in fact at least briefly summarized also here as the reader should not be obliged to read the Mariani et al. paper to fully understand this paper.

5) “Finally, ice cores record climatic conditions only during precipitation events”. This might not be always the case. Recent results provide evidence that well after the end of the snow events the stable isotopes ratios can change simultaneously to stable isotopes variations determined in in-situ water vapor (Hans Christian Steen-Larsen et al. AGU 2012, Triple water vapor isotopic (H218O, HD16O, H217O) measurements above the Greenland Ice Sheet and importance for understanding the atmospheric hydrological cycle in the Arctic”).

6) The last section of the paper (4.6) needs to be expanded as it seems a bit rushed and unclear with respect to the previous sections. Otherwise it would probably be better just to cut it.

Minor points:

6113-8- “is reasonably high”. How much? How significantly? 6113-11- I disagree. While precipitation can exhibit a very local signal this is unlikely the case of the temperature fields. 6113-17 “desublimation”. Condensation? 6113-27 “above processes”. Which processes? 6114-20 ..reached a depth of 125 m.. 6116-24 “20CR overestimated the number of precipitation days (>0.1 mm)”. This threshold might be too low. Could reanalysis highlight precipitations that just evaporate before reaching the ground? 6123-7 The link between imposed weather conditions and the allowed variations in the calendar day should be clarified.

Interactive comment on Clim. Past Discuss., 8, 6111, 2012.