Review of a manuscript for *Climate of the Past*

What climate signal is contained in decadal to centennial scale isotope variations from Antarctic ice cores? by Munch and Laepple

Overall:

In this manuscript the authors present a method for calculating a timescale dependent SNR for an array of climate proxy records with a common climatic signal and a physical mechanism(s) behind.

For a particular case presented, the study uses ice cores based isotopic records and accounts for the effects of stratigraphic noise, diffusion in firn and timescale uncertainties elaborating the respective power spectral densities for the background climate signal and the aforementioned contributing noise factors. The proposed technique is then applied to ice core arrays from DML and WAIS. Opposite timescale behavior of SNR for the two core networks is linked to the homogeneity/heterogeneity of distillation trajectories between the two regions associated, for example, with the effects of sea ice on isotopes in precipitation.

In general the paper is clearly written and results are well presented. Moreover, my general impression over this study, is that this was one of the rare cases I had so far as a reviewer that can be published almost "as is". When reading the manuscript, I left a number of remarks/suggestions/question marks that I planned to list later when writing this review, yet it turned out in the end that almost all of them the authors have already addressed in Discussion and Conclusions.

This study is certainly recommended for those who deals with multiproxy archives – this is an explicit demonstration of a value of a single proxy (ice core) record and a clear warning against overinterpreting single spikes/events on the shorter timescales. Therefore, I consider the manuscript deserves to be published after some very minor modifications to the content if the authors/editor finds them relevant.

Minor comments

Page 2, line 5: "…to a first approximation, changes in isotopic composition are only recorded in the ice if there is snowfall." Recent studies suggest the effects of air (and hence water vapor) exchange across the firn –air interface in between the precipitation events may have a larger impact on the final d18O in snow than previously thought, see for example Stenni et al., 2016 , 10.5194/tc-10-2415-2016. It actually increases the role of SAT variability throughout the accumulation season even given the intermittency of precipitation itself.

Page 6, line 4: Please provide a ref to eq. (7)

Page 6, line 9: "… for display purposes… smoothed using a Gaussian kernel". Still the motivation is not clear, would it be possible to see an unsmoothed signal (in the letter of response for example). What is the kernel bandwidth used?

Page 11, lines 10-20. Quality of ERA precipitation needs to be briefly discussed. How reliable are the estimates based on this variable?

Page 14, lines 30-33. The effects of sea ice on the modelled isotopic composition of precipitation in Antarctica can be found in the studies by Noone , e.g. Noone, D., and I. Simmonds (2004), Sea ice control of water isotope transport to Antarctica and implications for ice core interpretation, J. Geophys. Res., 109, D07105, doi:10.1029/2003JD004228. The authors are recommended to see if these results can be used to elaborate more on the potential controls of the different patterns in SNR found between the two study regions.

Page 19, lines 3-5. The authors present the winter and summer precipitation results. It is highly recommended to do the same analysis for the fall and spring seasons. The semi-annual oscillation (SAO) tends to modulate the seasonal distribution of precipitation depending on the strength of the semiannual harmonic. In addition, for West Antarctica (though shown for Faraday only in Broeke et al., 2000, part 4) the sea ice extent in the Amundsen and Bellingshausen seas (also linked with SAO strength) was shown to modulate the seasonal precipitation too. One can speculate that a long term variability in the strength/position of the low in contraction phase of the SAO (March and September) can actually be one of the mechanisms responsible for disruption of the coherence between the isotopic records on the longer timescales.

See in the series of earlier publications by Van den Broeke

Van den Broeke, M.R. 1998a. 'The semiannual oscillation and Antarctic climate, part 1: influence on near-surface temperatures (1957–1979)', *Antarctic Sci*., **10**(2), 175–183.

Van den Broeke, M.R. 1998b. 'The semiannual oscillation and Antarctic climate, part 2: recent changes', *Antarctic Sci*., **10**(2), 184–191.

Van den Broeke, M.R. 2000. 'The semiannual oscillation and Antarctic climate, part 3: the role of near-surface wind speed and cloudiness', *Int*. *J*. *Climatol*., **20**(2), 117–13

Van Den Broeke, M. (2000), The semi-annual oscillation and Antarctic climate. Part 4: a note on sea ice cover in the Amundsen and Bellingshausen Seas. Int. J. Climatol., 20: 455-462. doi:10.1002/(SICI)1097-0088(20000330)20:4<455::AID-JOC482>3.0.CO;2-M