The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2020-217-AC1, 2020

The Cryosphere
Discussions

Interactive comment on "Pervasive diffusion of climate signals recorded in ice-vein ionic impurities" *by* Felix S. L. Ng

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Received and published: 24 October 2020

Initial response to Reviewer 1

Thank you for your appraisals and careful and detailed review of the manuscript, and for providing a range of valuable suggestions for improving it, including phrases that can be used directly in the revision.

In the revision, I plan to show some examples of ice core records in a new figure, probably early on in the manuscript. As you pointed out, this will help non-specialist readers. Besides showing the length scale and typical character of the peak signals, the figure will help motivate the choice of the doped peak amplitude used in the numerical experiments. Probably I won't comment on the variability and trends observed

on the records, as these may generally reflect a combination of palaeoclimatic and post-deposition changes. Also I wish to avoid giving readers the misimpression that the simulated decay of cB in the manuscript necessarily explains the reduction of variability with depth that has been pointed out for some of the records. This is because cB in the model refers only to the vein component of the bulk ionic concentration, whereas the bulk concentration in the ice core records is the total concentration (potentially) consisting of vein, grain boundary and matrix contributions.

Many of your other suggestions will be taken up. I will adjust the caption of Figure 1 to explain how the schematic relates to position in the ice sheet. I will add a list of model variables, although I have not decided whether this is best done by a separate table or by extending Table 1. There are different perspectives regarding the choice of "we" versus "I"; my preference is to use "we" in this manuscript. Where cB = c*Phi is introduced, I will clarify that this equation is valid because cB in the model refers to the vein component of the bulk impurity concentration, and excludes contributions from microinclusions and grain boundaries.

I appreciate your comment about the age span and it is useful to know how much this parameter interests ice core scientists. I will try to write more about this parameter, by highlighting some of the ideas that you expressed in your review. The discussion is going to be brief, limited to a short passage, because the model runs assume steady-state forcing for the age depth scale and does not tackle the inverse problem of calculating the ice flow with varying accumulation rate and temperature histories (see lines 276-278), and so the deep results are also strongly dependent on the assumed approximate age-depth scale (lines 363-364) and can only provide a rough indication of the age span. To put this another way, the results apply strictly to the "model ice core" and not necessarily to the actual data in the EPICA Dome C core. Before the time-dependent problem has been solved, it is best to be cautious and not to interpret too much into what the specific age span values (especially at depth) in Figures 6 and 7 imply for the climate histories retrieved from the cores. In the passage to be added, I will try to mention these caveats as well as the insights.

It is possible to rescale the age span axis in Fig. 7f to show the behaviour of the black and grey curves at depth. I have decided not to do this, not only for the reason given in the last paragraph. In the simulation runs yielding the black and grey curves, the signal amplitudes have actually diminished to almost zero at $t > 400$ ka (Fig. 7d). At such large ages, only those age span results for the runs with diffusion suppressed (the blue and orange curves) are worth showing, because there is still some signal amplitude, and Fig. 7f is currently scaled to portray those curves.

A full response addressing your comments point-by-point will be given later during the revision stage.

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