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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Meridional transport and deposition of atmospheric ^{10}Be" *by* U. Heikkilä et al.

Anonymous Referee #1

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General assessment

This paper presents a model study quantifying the contribution of different 10Be production areas to the 10Be deposition at the surface. It especially studies the occurrence of a potential polar enhancement of 10Be deposition that would compromise the interpretation of ice core 10Be records in terms of 10Be production changes. With these goals (which are essentially met in the paper) it represents an important contribution to the fields of atmospheric transport as well as paleoclimate. To accomplish the objectives of the paper the authors use a full fledged state-of-the-art atmospheric circulation model including a 10Be production as well as an aerosol transport and deposition scheme. They run the model for two different latitudinal production distributions in order to test the sensitivity of 10Be deposition to such spatial production changes without

changing climate conditions. The main result is that the spatial distribution of 10Be deposition remains essentially unchanged. This approach seems to be a straightforward way to address the problem, however, a few more details are missing to absolutely assess the representativeness of the model results:

1. A more detailed comparison of the modeled deposition fluxes with current data is missing. This is addressed in only one sentence on page 16831 but appears to be essential to see how representative the model results are for the real world. This has been addressed in a little more detail in a previous paper (Heikkilä et al., ACP, 2008) but I would urge the authors to include those and other data in this study (e.g. in Table 2 and Fig.2). Most important in this respect appear to be 10Be fluxes from ice core studies such as the data by Stanzick, 1996, cited in the precursor paper. Similar data also exist for Dronning Maud Land, Antarctica, which should be available to the authors.

2. I personally miss a more detailed description of the aerosol deposition scheme in the model section as well as the potential influence of this scheme on the results. The relative contribution of wet versus dry deposition becomes essential for the interpretation of 10Be records in low precipitation areas such as the polar ice sheets. E.g. the differences of the results in this study and the study by Field et al., 2006 may be related to either atmospheric transport or wet and dry deposition en route. For the comparison between the two different runs within this paper this seems not so essential because the relative contribution of the two deposition effects remain the same for an unchanged climate. Maybe, this should be stated explicitly.

3. In addition, I think it would be instructive to plot the modeled latitudinal distribution of the stratosphere-troposphere 10Be flux together with the deposition at the surface to illustrate the effect of tropospheric transport more clearly. The spatial distribution of the stratosphere-troposphere exchange is shortly mentioned in the Introduction but not further quantified in the Results.

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Interactive Comment

Apart from these more structural comments, I disagree with the statement made in the paper that the stratosphere would be well mixed in this model. Table 2 shows that 10Be produced in the northern stratosphere essentially does not reach the southern polar region and vice versa. This suggests that the 10Be produced in the stratosphere may be well mixed within each hemisphere but that the interhemispheric stratospheric exchange appears to be slow (typically on the order of 4 years) compared to the stratospheric-tropospheric exchange in each hemisphere. This should be addressed in the revised version of the manuscript.

In summary the paper represents an interesting and important contribution and should clearly be published in ACP after appropriate revisions as suggested above.

Specific comments

Introduction

Page 16821 line 15: "to such an extent that the 10Be mixing ratio in the air..."

Model description

Please add more details on the aerosol deposition scheme.

Page 16824 line 18: are 5 years spin-up time really enough when the interhemispheric mixing time of the stratosphere is of similar length?

Results

Here a model-data comparison would be important to assess the credibility of the model results.

Page 16826 line 17: is the higher change in polar latitudes something like a polar enhancement? Please discuss.

Page 16827 line 4 "in the Laschamp run are not ..."

Section 3.2.: this could be merged with the discussion of the atmospheric concentra-

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tion.

Page 16831: here a more detailed data-model comparison would be in place

Page 16832 line 2 (and Table 2 and 3): why does the differentiation for production in different latitudes in the stratosphere only exist for the Laschamp run? If in any way possible this differentiation would be helpful for the control run too and could be added to Table 2 and 3.

Page 16833 line 6: the statement that the stratosphere is well mixed (between hemispheres) seems to be in contradiction with Table 2 (see comment above). Is such a slow interstratospheric exchange a problem for the short spin-up time of the model?

Figure 2: here some measured data points (especially from ice cores) would be helpful in Fig. 2a. Fig 2c is hard to decipher.

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