

Interactive  
Comment

## ***Interactive comment on “Influence of model resolution on the atmospheric transport of $^{10}\text{Be}$ ” by U. Heikkilä and A. M. Smith***

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The paper examines the effect of different model domains/resolutions on the transport of tracers such as  $^{10}\text{Be}$  and  $^{210}\text{Pb}$ , and compares the model behaviour with the available observations. While the results of the study are potentially publishable, the conclusions seem a bit shaky since the model setups used have not been chosen well: for instance the T63L47 model has both a different horizontal and vertical resolution to all the other setups. In addition, this model has a different vertical resolution to the other middle atmosphere-resolving model (T42L39) so attribution of differences between them is difficult. I would recommend publication if the authors can fill in the gaps between some of these GCM setups with more model runs using different setups (e.g.: a T42L47 for direct comparison with T63L47, or perhaps T21L39 for direct

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comparison with the T42L39). I realise that running large GCMs is a non-trivial task, but I think the authors are trying to answer too many questions (horizontal resolution, vertical resolution, effect of model lid height) with just 4 GCM setups. At the moment the authors have produced some interesting results, but attribution to horizontal/vertical resolution/lid height is on shaky ground.

We chose the resolutions shown in this study mainly based on the availability of the necessary initial data. These data are available for nearly any combination of horizontal and vertical resolution for the ECHAM5 model but unfortunately only for a limited number of combinations for the HAM aerosol module. The combination T63L31 is available which allows for a fairly direct comparison of a high-top and a low-top model configuration. We added these results into the analysis and figures of the manuscript. Unfortunately the T42L47 and T21L39 resolutions are not supported.

Other comments: line 64 & elsewhere: "spacial" appears repeatedly- should be spatial According to dictionaries both spellings are accepted. We have however changed the spelling to 'spatial'.

line 70: I think a very short evaluation of the stratosphere is needed here, comparing diagnostics such as frequency of sudden stratospheric warmings vs observations

Reviewer #2 made us aware of a number of relevant studies which address the impact of model resolution on model climate, middle atmosphere dynamics and stratosphere-troposphere exchange, in comparison with observations. Roeckner et al., 2006 performed a careful validation of the ECHAM5 model climate against reanalysis with varying resolution. They found that increasing model resolution reduced errors, yet both horizontal and vertical resolution had to be increased consistently. These other studies and their main findings have been included into the Introduction.

Table 2: the stratospheric residence times seem very short compared to e.g. age of air which can be years. What is the reason for this?

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We are only able to define mean stratospheric residence times, i.e. stratospheric burden divided by stratospheric production. Stratospheric residence times vary largely, being ca. 3-5 years in polar stratosphere (e.g. Waugh and Hall, 2002). The average residence time of  $^{10}\text{Be}$  atoms in polar stratosphere is shortened by the maximum of production rate there. There is always freshly produced  $^{10}\text{Be}$  present which shortens the mean residence time. The modelled residence time is well in agreement with the observed lag of ca. 1 year between cosmic ray intensity (showing production variability) and snow deposition (e.g. Pedro et al., 2011). This explanation is included into the text (section Budgets and residence times, 2nd paragraph).

Figures 2-7: I found it hard to compare the model and observations by eye using this method. Instead of four geographical maps per figure it would be easier if the authors simply plotted 4 sets of model setups vs observations, so one can see the correlations and spread and more easily see where the different model resolutions make a difference.

This was suggested by both reviewers. We are now showing a scatter plot (Figure 7) of observed and modelled data, including correlations and RMSE, and discuss it in section 'Deposition fluxes', last paragraph.

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