

Interactive comment on “ ^{36}Cl bomb peak: comparison of modeled and measured data” by U. Heikkilä et al.

U. Heikkilä et al.

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Interactive comment on “ ^{36}Cl bomb peak: comparison of modeled and measured data”; by U. Heikkilä et al.

Anonymous Referee #1 Received and published: 1 February 2009

1 General remarks

-I am missing some information about the model setup. In particular: Was the meteorology nudged to reanalysis data? Is the sea surface temperature climatological or does it follow the observed sea surface temperature? This is crucial for the year-to-year variability of precipitation. Is the variation of the precipitation rates in Figure 5 in agreement with observations?

The meteorology was not nudged to reanalysis data. We used observed sea surface
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temperature and sea ice data from the AMIP project to create the climatology. To our knowledge there are no precipitation observations from the period of 1952-1972 for the ice drilling sites. ECHAM5's ability to reproduce the observed precipitation rates world-wide is largely discussed in Hagemann et al, 2005. The model is successful in reproducing the large-scale pattern of precipitation world-wide. This is now also mentioned in the manuscript text.

-Did you use historic or climatological aerosol emissions? This might be important for explosive volcanic eruptions, which significantly influence the stratospheric aerosol load - and therefore also the surface area which the ^{36}Cl can attach to.

We used the aerosol emissions which are representative for the industrial time, especially the year 2000. The aerosol load during the modelled time was somewhat lower than in the recent times. What is relevant for Cl-36 is that enough sulfate is available for Cl-36 to attach to. This should be the case even if the bomb-produced input of Cl-36 exceeded the natural input by several orders of magnitude. Turco et al., Rev. Geophys. Space Phys., 1982 estimated a stratospheric sulfate budget of 0.16TgS , roughly $3\text{E}33$ atoms. A total mass of bomb-produced Cl-36 of 80 kg corresponds to $1\text{E}27$ atoms, meaning that there is always plenty of sulfate available.

2 Specific comments

• I suggest to mention the natural sources of ^{36}Cl in the introduction.

We added a reference to another study where these are mentioned.

• “between 1960 and 1964” (p2505 l17): According to Table 1, there were significant tests in 1962. Can this explain why Synal et al. obtain a longer residence time?

Synal et al. used a different input function and assumed no Cl-36 input during this period. Whichever assumption is true, the residence time of 2 years was estimated from the measured fallout curve. The shorter residence time (1.7 yrs) obtained from the

modelled fallout is very likely to be caused by a slight overestimation of the downward transport by the model which is a well-known issue.

• accumulation rate at Guliya: First it is referred to as “quite low” and a few sentences later as “relatively high”.

Corrected.

• “reach the natural level”; I would say that none of the locations, and in particular not Berkner Island, is back to pre-1952 levels in 1975.

That is correct and has been changed in the text.

• How exactly do you calculate the slope and residence time? Can you give a formula? The units are confusing. The slope of the graphs would usually have the units [atoms/m²]. I guess residence time is the time until which the curve has dropped to 1/e?

Yes, the residence time is simply estimated following the assumption of an exponential fallout, i.e. $N = N_0 \exp(-k t)$, where k is $1/\tau$, τ being the residence time. We plot the fallout curve on a logarithmic scale and calculate the slope $k = (\ln(N/N_0_2) - \ln(N/(N_0_1)))/(t_2 - t_1)$. On a logarithmic scale the units are not of importance, only the steepness of the slope. We gave a "slope" in years in Table 2, which is actually not correct. It is now corrected to "residence time" in years.

• Table 2: integrated mass = extrapolated to the whole globe (as I understand from the text). Please add this to the caption. Are the model values presented here already scaled?

Yes, we assume that the scaled input is correct and present only results using it. It is also mentioned now in the caption.

• “The integration was performed coarsely” (p2509 l10) - what does that mean?

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We mean that no sophisticated method such as linear regression was used because of the rather few data points and possible errors in them. We removed this rather confusing sentence.

• deposition flux at Dye3: That the global bomb input estimated here agrees well with the previous Dye3 estimates of 80 kg, is only because it has been scaled to those 80kg, isn't it? The agreement is less good for the actual Dye3 values calculated here (55/70 kg). Or do you mean 55/7080?

The previous estimates of the global input were scaled to the Dye-3 fallout (around 80 kg). In the present work the global input was scaled to match 8 observed fallout curves from latitudes from 79S to 65N. The fact that the previous global input estimated from one single location is similar to the estimated input of this work means that the amplitude of Dye-3 fallout is very representative for the global fallout.

• Are the simulated precipitation rates taken at the model surface layer (although the model orography is usually much lower), or at the pressure level corresponding to the station height? Please specify.

The precipitation is integrated over the whole atmospheric column and therefore not taking into account the often too low orography. This is now also specified in the text.

• Fig. 2, 4, 5: It is not clear whether the tick marks identify the beginning of a year or the middle of a year. The (simulation) data points, which are annual mean values, are plotted in the middle of 2 tickmarks in Figures 2 and 4, but directly at the tickmarks in Figure 5. It would be good to have this consistent, as the reader might want to compare the year-to-year variations from Figures 4 and 5.

Corrected.

• I suggest that the animations are placed on the ACP website. For me, the link in the document did not work because the underscores were not recognized - I had to enter the link manually.

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We will try to place the animations there.

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