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Climate of the Past Discussions

Interactive comment on "Variability of sulfate signal in ice-core records based on five replicate cores" *by* E. Gautier et al.

Anonymous Referee #2

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The manuscript discusses the issue of multiple ice coring for extraction of a volcanic record at the Antarctic Dome C location. The manuscript represents a substantial amount of dedicated and careful work and the results are of interest to a large community and relevant in the context of climate change, constraining of volcanic forcing, IPCC, etc. The manuscript is generally well structured and written, the figures are relevant and referencing is appropriate, except as mentioned below.

General comments:

I urge the authors to study a recent publication by Gfeller et al., that is also concerned with multiple ice coring at a single site, although at a higher accumulation site in Greenland. That study is concerned with both seasonal and inter-annual variability of the cores. Whereas seasonality is probably irrelevant for the present study, it may be

of interest to try out the approach of Gfeller et al. for the longer term variability, i.e. the volcanic record. In particular, the representativeness parameter as introduced in Gfeller et al. would be interesting to derive for the Antarctic cores. The requirement for applying the the Gfeller approach is that the sulfate concentrations are similar to log normal distributed (Gfeller et al., figure 3). I am uncertain about if that is the case for the Antarctic sulfate records with their volcanic spikes, but in the Gfeller et al. study the method works for conductivity that is often similar to sulfate, so it should be worth investigating. You already have a common timescale for your five cores based on your synchronization, so the analysis should be fairly straight forward.

It is important that you provide a table or a column in table 2 showing your best estimate of the volcanic flux and sulfur deposition for each eruption, i.e. that you somehow provide the mean of the five cores including the error/uncertainty estimate. This is the number that is important for geographical deposition interpolations, databases, and modelers. In other words, your main result for a larger community.

Are there no existing datasets you can compare your results to? What about the EDC volcanic record of Severi et al., 2007? It would make much sense to see how the sulfur fluxes of an independent study compare to your results. Do they fall within your error estimates? One could even discuss the effect of the EDC deep core being drilled further away from your closely spaced cores (again following the approach of Gfeller et al.)

Specific comments:

Peak discrimination method:

1) I wonder why you determine the background based on 1m long sections when you sometimes have volcanic spikes covering almost half of that interval length? In figures 3b and 8 this approach appears to result in too high background determinations for core 1? I would suggest to work on longer sections.

2) To determine the background, why do you use the mean across 1m intervals rather than the median? The median is much more efficiently discriminating outliers (in your case volcanic spikes).

3) It would be good to show the derived background together with the data over a longer section of the ice core, so we can better visually judge how well the background determination works.

Section 2.1: Please sketch/explain the lateral pattern of the five drill locations. Are the 5 cores drilled along a straight line on the snow surface? In that case, the distance between cores 1 and 5 would be 4m and not 1m?

P. 3981, l. 6: I suggest to replace 'global' with 'local' as global has a different meaning in the context of volcanism.

Figures 3 and 8: Many coloured straight lines are shown close to the background level. If those represent the background level estimates then please mention in caption.

Figure 4: The depth scale is wrong. In ice cores you rarely have both linear depth and age scales.

In figure 6, I am somewhat puzzled by the logarithmic fit to the data points. The fit suggests that the more ice cores you drill, the more volcanic events you will find. With no upper limit. That is not convincing. Instead, I would expect something similar to the representativeness parameter of Gfeller et al., with an upper limit for (infinitely) many cores.

References:

Gfeller et al., The Cryosphere, 8, 1855–1870, 2014.

Severi et al., Clim. Past, 3, 367–374, 2007.

Interactive comment on Clim. Past Discuss., 11, 3973, 2015.