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Climate of the Past Discussions

Interactive comment on "Volcanic synchronisation between the EPICA Dome C and Vostok ice cores (Antarctica) 0–145 kyr BP" *by* F. Parrenin et al.

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Original text in normal font + answer in bold font

This discussion paper takes the approach of matching outstanding volcanic signals in the EDC cores and Vostok cores to synchronize the time scales of two of the longest Antarctica ice cores, up to 145 kyr. This is a remarkable effort, given the diversity/ variety of datasets based on different measurements and uncertainties associated with depth determination. The results extend the coverage of 0-45 kyr in a previous work (Udisti et al., 2004). The paragraph beginning at Line 15 of Page 4110 refers to matching records from different hemispheres. Even though the intent is to discuss the possibility or probability of finding the Toba signal in these Antarctica ice core as a match for the (possible) GISP2 Toba signal, such an undertaking (matching bipolar records)

would be even more arduous and is clearly beyond the scope of the paper. I would like to see the search for Toba in Dome C, Vostok, and possibly in other Antarctica cores, to be framed in a different way, rather than in the context of bipolar ice core record matching.

We now introduce the Toba super-eruption in a different way.

My main concern and criticism is with the methodology part of the paper, on the selection and determination of volcanic "tie points." While the tie points between cores from the same location and based on the same type measurements (Tables 1 and 2; Figures 4A and 5) sound and look quite reasonable, pairing of volcanic events/signals in cores from different locations may be very difficult to justify. For example, the first 3 rows in Table 4 are volcanic signals separated by a few meters in each core; how was the pairing achieved? It appears the spacing (along either depth or time scale) of the signals in the two cores is an important consideration, when selecting and determining tie points. I would guess that other factors (e.g., magnitudes of signals and spikes) were also considered. However, no objective, or even subjective, criteria are presented and explained to justify the tie points in Table 4. It seems to me the explanation in the paragraph beginning at Line 9 on Page 4117 is inadequate as to how the Table 4 tie points are selected and, more critically, tied or matched with those in the other core. I would like to know what "patterns of peaks" were used and how the patterns may be deemed sufficiently unique or specific. Most Antarctica ice core volcanic records show an average frequency of a few (2 to 5) volcanic signals per century. As a result, patterns in a millennium scale may quite possibly be mismatched. (Ideally, specific or identifying patterns should be established with highly resolved and well dated records, prior to being employed for transferring the time scale of one core to another.) What assurance or justification could be offered for the matching of patterns present in bore cores? I question the method of selecting tie points, not because I don't agree with the main synchronization results of using the tie points and the conclusions from analyzing the synchronized climatic records. I think the authors, by using the synchronized records,

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have demonstrated the value of temporally coherent records from different locations. One example is the conclusion that, very likely, temporal variations of snow accumulation at Vostok and Dome C (and by extension, much of the central East Antarctica Plateau) are synchronous.

Please see our updated sections 2.2.3 and 4. in the new manuscript. But this complex problem of creating an automatic and objective synchronisation method is clearly beyond the scope of the current manuscript. Note that such a mathematical method has (to our knowledge) never been applied for synchronising ice cores from different sites, while several such volcanic synchronisations have been published.

I find Figure 7 very difficult to view.

We now split this figure into three different pages for better readability.

I also have a question about a technical point. Offsets, due to several practical reasons, from the "true" depth are described and estimated (Page 4112). What, if anything, has been done about the offsets in this paper? Are they simply accepted as depth uncertainties?

We are not sure the understand the question. Depth offsets have indeed been estimated where possible based on the volcanic synchronisation between adjacent ice cores. For EDC, we suggest in future studies to transfer the EDC96 datasets to EDC99 using our volcanic synchronisation, as we did in the current study. For Vostok it is not possible because our synchronisation is not exhaustive enough due to the lack of conductivity measurements on, e.g. the 3G and 4G ice cores. We hope that the top of the 5G ice core will eventually be measured. Concerning e.g. the construction of age scales by glaciological models, our study could indeed help to quantify the uncertainty attached to the depth measurement.

We thank reviewer 1 for his careful review of the manuscript.

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