

# ***Interactive comment on “Bipolar volcanic synchronization of abrupt climate change in Greenland and Antarctic ice cores during the last glacial period” by Anders Svensson et al.***

## **Anonymous Referee #3**

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The paper presents the results of bipolar volcanic synchronization, which is a challenging task, and discusses bipolar phasing of DO events. Utilizing 80 volcanic eruptions during the second half of the last glacial period recorded in both Greenland and Antarctic ice cores, age control of the multiple bipolar ice cores is greatly improved. The paper confirms the previously proposed centennial-scale lag of Antarctic temperatures after abrupt Greenland temperature changes during DO events. The improved age control provided by this study significantly reduces the duration of the lag. This new important finding will give better constraints to climate modeling and contribute to further understanding of the mechanisms of DO events. The improved age control will also have a wide range of applications not only in ice core studies but also in other fields of

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geophysics and geochemistry.

I have a concern about how the bipolar volcanic signals are pinpointed. The criteria need to be more clearly explained. I have the following questions and comments regarding this.

1. Lines 201-203: To my eyes, the inner two spikes are not very clear. The second one from the left does not seem to be seen in the EDC core.
2. Lines 209-211: I don't see the 12.17ka peak in the EDC core.
3. Line 236: "the bipolar volcanic matching pattern is easily recognized". I'm not convinced. Please explain how the bipolar volcanic signals are selected. For example, why is the spike around 16.3 ka not selected?
4. Lines 241-242. In the WDC core, there are small acidity peaks around 15.63 ka and 15.71ka. Couldn't one of these peaks correspond to the 15.68 ka peak in Greenland? Are these peaks too far from 15.68ka?

I have other minor comments and questions.

1. Lines 32-34: Where in the main text is "more coherent Antarctic water isotopic signals" discussed?
2. Line 65: Does Steinhilber et al paper really use  $^{36}\text{Cl}$  for bipolar synchronization? The paper does use  $^{10}\text{Be}$ . But  $^{36}\text{Cl}$  measurement needs large samples and it is usually difficult to use  $^{36}\text{Cl}$  for synchronization. Am I wrong?
3. Line 164: Please give more details about "high-resolution. What are the resolutions of the stable water isotope records?
4. Lines 175-179: I think wind-scouring is another factor affecting the low accumulation Antarctic sites particularly during colder periods.
5. Line 190: It would be nice to show GI-2 in Fig. 1 for readers who are not so familiar

with GIs.

6. Line 216: To my eyes, the EDML water isotope data seems to be increasing during 12.75-13.10 ka.

7. Lines 227-232: I agree that this study gives no support for the Hiawatha crater to have formed around the onset of YD/GS-1. But I don't understand that undisturbed stratigraphy can deny the Hiawatha crater hypothesis. Is the stratigraphy at NEEM really expected to be disturbed by the Hiawatha event which was 378 km away from NEEM? I'm not very sure about this.

8. Line 244: It is difficult to see from Fig. S3A that the spike is a triplet.

9. Lines 246-247: I could not understand this sentence. Is this a typo?

10. Lines 255-257: I could not understand this sentence. Please explain in more detail.

11. Line 280: Figure numbers seem to be wrong. Do you mean "such as GI-8 and GI-12 (Figs.S7B and S10B). For the GI-9 onset (Fig.S8B)"?

12. Lines 291-296: Larger variability in Antarctic ice cores could be also due to wind scouring. At low accumulation interior sites, wind scouring increases the noise in water isotope records.

13. Lines 324-327: Please explain how the local cycle of sublimation-condensation affects the alignment of the water isotope records.

14. Line 337: Please explain more about the logarithmic definition of deuterium excess for readers who are not so familiar with water isotopes.

15. Line 363: I'm confused. Why is there small uncertainty in the relative phasing? Isn't the uncertainty zero if oxygen and hydrogen isotopes were measured in the same samples? If they were measured in different samples, I would expect almost negligible uncertainty.

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