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Interactive Comment

Interactive comment on "Observations of a stratospheric aerosol veil from a tropical volcanic eruption in December 1808: is this the "Unknown" ∼1809 eruption?" *by* A. Guevara-Murua et al.

M. Toohey

mtoohey@geomar.de

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I read this manuscript with great interest, it's exciting to see such historical observations be brought into the modern literature and discussed.

I have a few unsolicited minor comments, which I hope the authors can consider as they revise the manuscript.

pg 1903, line 20: It might be worth noting here that these estimates of the sulfur loading and/or aerosol optical depth related to the 1809 UE (I'll call is 1809 UE, out of habit) are based on ice cores. Probably more weight should be given to multi-ice core composites, such as used by Crowley and Unterman but also Gao et al., (2007, 2008), than to single-ice core estimates like that from Zielinski (1995).

The Crowley and Untermann (2013) data set is provided as AOD in 4 latitude bands. Calculating the global mean from these bands, I get a maximum global mean AOD for 1809 as 0.27-0.28, i.e., the same as quoted for the Crowley (2008) study.

pg 1903, line 25: The comparisons of the magnitude of sulfur loading or AOD for 1809 UE vs. other eruptions check out with the estimates of Gao et al., (2007, 2008) except for Pinatubo, for which Gao et al. (2007) estimate a global sulfate aerosol load of 30 Tg, vs. 22 Tg for 1809 UE. So I don't think 1809 UE was "more than three times" the sulfate loading of Pinatubo.

pg 1904, line 28: The explanation of the reason for stronger poleward aerosol transport in the winter hemisphere is not quite correct. Mixing and meridional transport in the stratosphere are driven by the breaking of planetary-scale Rossby waves in the midlatitude stratosphere, which occurs predominantly in the winter hemisphere since these waves cannot propagate upward through the easterly winds of the summer hemisphere stratosphere.

pg 1905, line 10: concerning the impact of season on the radiative impact of tropical eruptions, the authors may be interested in our study (Toohey et al., 2011) which investigated this very thing in model simulations. We found that tropical eruptions in NH winter have a greater radiative impact (in terms of AOD or clear-sky SW radiation anomalies) than eruptions in other seasons. This would imply that the 1809 UE eruption, if it occurred during NH winter 1808/09 as the authors and others have suggested, was well timed for maximum radiative impact given its magnitude of stratospheric sulfur injection.

pg 1915, line 25: The fact that the Greenland/Antarctic deposition ratios are larger for 1809 than Tambora might be consistent with a $\sim$6 month seasonal difference between the two eruption, but it's a difficult argument when the location of UE 1809 in unknown: conceivably the reported stronger NH deposition for 1809 UE could be because it was

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located in the NH, i.e., still tropical but north of the equator compared to Tambora which is at ∼8S. And related:

pg 1915, line 28: In Toohey et al. (2013), we looked at the ratios of Greenland vs. Antarctic sulfate flux depositions for tropical (15N) eruption simulations, with eruptions in January and July. The ratios we got (see Fig 7.) are in agreement with ice core estimates (from Gao et al., 2007) for 1809 UE. With the model we see stronger deposition to Greenland, on average, for January eruptions compared to July, but the ensemble variability overlaps for this eruption magnitude. I think the hemispheric deposition ratios are an interesting point to mention in regards to the 1809 UE, but some discussion of uncertainites may be warranted. I hope this this is an issue which will see more attention in future research in general.

References:

Crowley, T. J. and Unterman, M. B.: Technical details concerning development of a 1200 yr proxy index for global volcanism, Earth Syst. Sci. Data, 5(1), 187–197, doi:10.5194/essd-5-187-2013, 2013.

Crowley, T., Zielinski, G., Vinther, B. M., Udisti, R., Kreutz, K., Cole-Dai, J. and Castellano, E.: Volcanism and the little ice age, PAGES Newsl., 16(2), 22–23, 2008.

Gao, C., Oman, L., Robock, A. and Stenchikov, G. L.: Atmospheric volcanic loading derived from bipolar ice cores: Accounting for the spatial distribution of volcanic deposition, J. Geophys. Res., 112(D9), doi:10.1029/2006JD007461, 2007.

Gao, C., Robock, A. and Ammann, C.: Volcanic forcing of climate over the past 1500 years: An improved ice core-based index for climate models, J. Geophys. Res., 113(D23), doi:10.1029/2008JD010239, 2008.

Toohey, M., Krüger, K., Niemeier, U. and Timmreck, C.: The influence of eruption season on the global aerosol evolution and radiative impact of tropical volcanic eruptions, Atmos. Chem. Phys., 11(23), 12351–12367, doi:10.5194/acp-11-12351-2011, 2011.

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Toohey, M., Krüger, K. and Timmreck, C.: Volcanic sulfate deposition to Greenland and Antarctica: A modeling sensitivity study, J. Geophys. Res. Atmos., 118(10), 4788–4800, doi:10.1002/jgrd.50428, 2013.

Zielinski, G. A.: Stratospheric loading and optical depth estimates of explosive volcanism over the last 2100 years derived from the Greenland Ice Sheet Project 2 ice core, J. Geophys. Res., 100(D10), 20937–20955, doi:10.1029/95JD01751, 1995.

Interactive comment on Clim. Past Discuss., 10, 1901, 2014.