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Interactive Comment

Interactive comment on "The initial dispersal and radiative forcing of a Northern Hemisphere mid latitude super volcano: a Yellowstone case study" *by* C. Timmreck and H.-F. Graf

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General: This is an interesting paper with a possibly significant result for the atmospheric impact of super-eruptions. It is the first time that a very large sulfur dioxide mass has been treated with this group of models, and perhaps any model. The aim of the paper is noteworthy, because, even if a super-eruption is a very rare event, volcanic gas injections will occur in the future that are much larger than those we have had in the past few centuries.

The results concerning the spread and radiative impact of the resulting aerosol cloud are intriguing and raise many questions about the way the models runs were set up, and whether the optical depths achieved are realistic. I will concentrate here on some of the more “volcanic” issues, but will cover some other aspects.

Specific comments: A more suitable and informative title would be “The initial dispersal and radiative forcing of a Northern Hemisphere super-eruption aerosol cloud: case study of a mid-latitude source” - or similar.

As the amount of sulfur dioxide introduced into the model is an arbitrary 100x the Pinatubo mass, then apart from the mid-latitude source, the mention of Yellowstone is more-or-less unnecessary. A short sentence on the choice of the mid-latitude source and its longitudinal position being influenced by Yellowstone (with a couple of references to its track-record as a super-volcano) is all that is needed - thus the short sections on Yellowstone eruptions can be omitted. It is not known how such a large, dominantly pyroclastic flow-producing eruption would deliver gas to the stratosphere, therefore such details are best avoided at this stage.

There is no previous work able to inform the authors on how much S gas such a super-eruption may release, but the choice of the 1700 Mt mass should be justified. It may not take a super-eruption to release that much gas! 100 x the mass of the amount of magma released at Pinatubo is a much smaller eruption than the main Yellowstone ones.

I could not follow how the aerosol is generated from this mass of gas - is it a theoretical maximum amount all converted to sulfate aerosol at once? Is there as chronology to the conversion? Other studies suggest that massive S gas emissions will dehydrate the stratosphere, delaying the conversion to sulfate - is this adequately considered in the model set up? Such information is difficult to glean from the paper.

Overall, the result on spreading of the clouds at different times is interesting and may indicate that season of eruption would be a very important factor. The model outcome that the stratosphere cools in the region of the aerosol cloud and above, while below it there is heating, is surprising but intriguing. This result should generate considerable interest and discussion.

Recommendation: The paper can be amended to be clearer on some points and less specific that it is a “Yellowstone” study - it is a theoretical study of a super-eruption aerosol cloud that might be similar to one that Yellowstone could produce.

Comments on Figures: Fig 1 b appears to be a repeat of Fig. 1a. In Fig. 2, YESTDEC, the data appear to be for year 2 after the experiment started, but this is confusing! As the model runs were for one year only, is it necessary to indicate a year at all? I found it difficult to extract much information from the figures in general. Better guidance could be given in the captions.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7283, 2005.