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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric impact of the 1783-1784 Laki Eruption: Part II Climatic effect of sulphate aerosol" *by* E.J. Highwood and D.S. Stevenson

Anonymous Referee #1

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General comments

This manuscript, along with the companion paper (Stevenson et al) provides a valuable advance in understanding of the atmospheric and climatic impacts of the 1783-4 Laki Craters eruption, Iceland. There is considerable interest in understanding the factors that led to considerable loss of life during, and in the aftermath, of this eruption, certainly on Iceland, and probably elsewhere in Europe. These effects might well be related to the dispersal of gases and particles in the eruption cloud, and or to climatic effects. Additionally, this work is important in making a first step towards evaluation of the likely effects of future eruptions of this type. The results are dependent on a number of modelling parameterisations and assumptions, but the authors carefully outline

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limitations of the study as a specific simulation of the Laki Craters eruption, and in its characterisation of the radiative effects of such a volcanic cloud. The contribution will provide an important benchmark for further work, which is certain to follow. I recommend publication subject to minor revision.

Specific comments

1. Although the authors fully acknowledge that they have not simulated the Laki Craters eruption effects in later sections of the manuscript, in the Title and Introduction, the reader could fail to recognise that the modelling does not take account of contemporary meteorology, and is perhaps better described as a hypothetical scenario for a Laki-like eruption. This does not lessen the value of the manuscript but there is a question of emphasis that could be tackled more directly. For instance, the Title could read something like

Simulation of climate impact of a large effusive eruption: implications for the Laki Craters eruption, 1783-4.

2. In the abstract, is a peak ... mean ... anomaly what the authors intend to say?

3. In the Introduction, mention could be made of the release of H2S in some volcanic eruptions in comparable or even superior quantities to SO2.

4. Also in the introduction, the discussion of the aerosol effect as a GHG could be elaborated in terms of particle size. I was under the impression that, in general terms, the GH effect becomes important for aerosol radii above 2 micron.

5. A general point: dry fog has been used confusingly in the earlier literature on Laki and other volcanic eruptions, referring both to tropospheric and stratospheric aerosol. Whenever known, the nature of such fogs should be qualified.

6. The authors could mention the Central England Temperature dataset which records July 1783 as the hottest July in the record prior to 1981 (I think).

ACPD

3, S555–S557, 2003

7. In section 2, the Mount St. Helens (18 May) 1980 eruption is described as mainly tropospheric. Is this the case? It is certainly nothing like the Laki eruption in character; the mushroom cloud reached about 25 km, and TOMS picked up 1 Tg of SO2 which I presume was mostly in the stratosphere.

8. On page 4, comparison of forcing results with Pinatubo is made. These are not entirely straightforward since the Pinatubo forcings derive from ERBE data (i.e. real measurements that include direct and indirect effects), and are also presumably minimum global forcings because the instrument did not operate poleward of about latitude 40 degrees.

9. Clearly much of the modelling results depends on the aerosol size distribution and selected optical properties. Some discussion of the sensitivities to these parameterisations is provided. I was quite surprised at the 0.05 micron mean size chosen for the tropospheric aerosol, though this is balanced with a wide distribution. Where does this put the effective radius of the aerosol? I have always wondered whether the tropospheric aerosol produced could be coagulating relatively close to source so as to produce a GH effect that might provide an explanation of the high July temperature observations in various parts of Europe. I would be interested to see some additional discussion of this possible effect though realise this may be beyond the scope of the present work.

Technical points There are a few minor typos in the text, and at least in my PDF file, some of the legends and text in the figures were not quite right.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1599, 2003.