Answers to comments of Reviewer 1

We thank Reviewer 1 for his/her review, which adds value to our manuscript. Comments are addressed below. Each comment by the reviewer is first recalled (in italics), then the corresponding authors replies are given.

Specific comment 1
The overall structure of the manuscript could be better organized. For example, the technique detail of dataset reconstruction (section 4) may be moved upfront; discussion about the previous datasets (section 2) could be combined with the result (section 5) and shortened by highlighting the main difference or limitations as compared to this new reconstruction. Section 3 may better be combined with section 6, so that the discussion of the dataset specificities does not seem to come out of nowhere and section 6 does not appear to be too short.

Authors reply
We thank the reviewer for this comment. To clarify the manuscript we restructured the sections and merged section 6 with section 3 as proposed by the reviewer. We would like however to keep a separate section on previous datasets (section 2) before introducing our method specificities and then the results (section 5).

Specific comment 2
As the essential tool for this reconstruction, the AER model should be introduced in a separate section with sufficient details, for example its spatial-temporal resolution, the microphysical processes of nucleation\condensation\evaporation\ coagulation and how were they apply to simulate the evolution of volcanic aerosol cloud, as well as the limitations of the model.

Authors reply
The AER model is now described with more information in a specific section. Details in the microphysics are given in referenced technical papers (e.g. Weisenstein et al., 2007).

Specific comment 3
In section 4.2.4 the authors used the Plumeria model to extract the information about the altitude of injection "when enough eruption parameters are known". What parameters were the authors referring to? What's the advantage of using the Plumeria model? In the end, for how many eruptions the altitude were calculated from the model, and which ones were based on the Pinatubo vertical distribution?

Authors reply
Eruption parameters include mass and composition of ejecta, duration of eruptions, and previous eruption rate estimates. This information is added to the manuscript. Using the Plumeria model allows to get estimates of the neutral buoyancy height of an eruption cloud when the mass flux can be roughly assessed. This was applied to 10 eruptions (see Table2).

Specific comment 4
In section 5.2 paragraph #2, the authors stated "using different SO2 injection altitudes does not change the aerosol distribution to a large extent". What "distribution" do the authors refer to? It seems to be discussing latitudinal distribution but isn't this section meant to discuss the altitudinal distribution? In addition, to what extend is a "large" change, isn't 10-15% reduction in tropical loading (and 8-13% increase in mid-latitude) per 4 km a significant change?

Authors reply
We refer here to the altitude distribution, but afterwards (from "Sensitivity studies…") discuss the implication of the injection height of the latitudinal distribution. This is now clarified in the text. We agree that a 10-15% change in aerosol loading for a given latitudinal region can be considered as "important" even if it is not dominating the uncertainties in the latitudinal distributions. Text is now modified accordingly.

Specific comment 5
In the last paragraph of section 7, it would be great to see the authors address how the reconstruction with microphysics-based model could be further improved, rather than a broad perspective on the overall development of volcanic forcing indices, which is more or less well perceived.

Authors reply
We thank the reviewer for this comment. We added a part on microphysics-based model potential improvement in the outlook paragraph.

A few minor comments

1. *Page 979 line 20, what does "injection in the AER-2-D model was made depending on the exact latitude of the volcanoes inside one or two bands in the 15◦ N-15◦ S" mean exactly?*

Authors reply
Sentence is rephrased to: "were made in the 15°S-0° and 0°-15°N region for southern and northern hemisphere tropical eruptions respectively.

2. *Page 979 line 25, please explain why did this reconstruction assign the signals identified only in one hemisphere to high latitude in NH but mid-latitude in SH.*

Authors reply
This methodology was chosen due to the latitudinal distribution of known climatically relevant volcanic eruptions: NH extra tropical eruptions often (although not only) occur at latitudes close to 60°N (e.g: Iceland, Alaska), SH extra-tropical eruptions at latitudes closer to 40°S (e.g: Chile, New Zealand). Potential local eruptions in Antarctica are hence not taken into account here

Text is now modified for clarification.

3. *Page 983 line 29, "limitations in the model prevent a precise testing and analysis of this influence", please specify what the limitations are.*

Authors reply
Model vertical resolution (1.2km) and uncertainties in transport make a validation difficult. Sentence added to the manuscript.

4. *Page 985 line 7-11, "Results from the Sigl et al (2013). . .. . .and the Serua(1693) and Unknown (1809) eruptions with larger values in the Southern Hemisphere if we use the sulfate deposition they obtained from Pinatubo to derive new hemispheric factors" , please explain the second part of this discussion in a more clear way.*

Authors reply
Discussion rephrased to:
" Sigl et al. ,(2013) provide sulfate deposition values in both Greenland and Antarctic for the Pinatubo eruption. From this information we can derive new calibration factors (linking deposition fluxes to aerosol mass for each hemisphere) and re-calibrate Gao (2008) deposition fluxes. Results would then indicate that the Huaynaputina (1600) eruption led to an almost even hemispheric aerosol distribution (slightly to the south) and that the Serua (1693) and Unknown (1809) eruptions led to larger aerosol amounts in the Southern Hemisphere."