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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of a moderate volcanic eruption on chemistry in the lower stratosphere: balloon-borne observations and model calculations" *by* Gwenaël Berthet et al.

Anonymous Referee #1

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The main purpose of this paper is to present measurements of various NOy family species from several balloon flights through a region of volcanically enhanced aerosol surface area density, then show that the observations are consistent with chemical perturbations calculated by a 3D chemistry transport model driven with reanalysis meteorology. The paper also presents estimates of O3 depletion caused by the volcanic aerosols and discusses chemical perturbations to the inorganic Br and Cl families. The measurements confirm our existing understanding of the role of heterogeneous chemistry in NOy partitioning; this is not new science.

The paper is quite long for the content. The abstract describes what is in the paper, but it is unclear whether the results are new or significant. The Intro describes the

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study as “the chemical impact of a short-term change in the amount of stratospheric sulfate aerosols resulting from one of these ‘moderate’ volcanic eruptions on some key aspects of stratospheric chemistry and on ozone loss”, but the authors’ have not shown how this advances the state of knowledge in this field, which is already well studied. Just how well studied this is, is indicated by the 136 references given and that the majority of them are dated before 2000. The authors may not be aware of relevant recent results. For example, they state that most models used to estimate chemical effects of aerosols are 2D models (p. 15, line 50) but this was true 10 years ago. Recent results using 3D models are overlooked (e.g., a CCM study by Aquila et al, JAS 2013, and a CTM study by Dhomse et al., GRL 2015). These recent papers also confirm our understanding of the role of volcanic aerosols in NOy partitioning by showing good model agreement with observations. This underscores my concern that there is not new science in this manuscript.

The style is verbose and the writing can be confusing. Here is an example (starting line 47, p. 4). We are told that solar zenith angle impacts the retrieved profile so it needs correction with a photochemical model, but then we are told that using such a model would introduce larger errors in the retrieval (so it’s a bad idea to correct?). In the next paragraph they estimate the correction anyway, saying it is only 3%. But then they cite the correction as being a 24% effect on a particular balloon flight. I don’t know what to conclude here, there is no clear message. A paragraph on p. 13 gives a quantitative estimate of the impact of aerosols on O3 depletion using a simulation with varying amounts of aerosols. At the end of the paragraph we are told not to take the results too seriously because the model is missing (presumably) relevant chemical reactions. These two examples illustrate a common problem with the manuscript: a meandering discussion without a clear message. The manuscript, not counting tables, figures, and captions, is more than 10,000 words. This is too long for the presentation of a few balloon profiles and model simulations that show aerosol impacts. The information in Tables 1 and 2 shows percentage disagreements between simulations and observations. This is unnecessary and corresponding figures that show model/data

comparisons are sufficient.

This paper, as is, is not ready for publication. The amount of new material/new science is small and I recommend a much shorter, more concise presentation of the observations and comparisons to simulations. Something half the current length might be appropriate.

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