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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A perturbed parameter model ensemble to investigate 1991 Mt Pinatubo's initial sulfur mass emission" *by* J.-X. Sheng et al.

Anonymous Referee #1

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The authors performed a spectrum of 2D model simulations of the post Pinatubo period, varying the injected mass of volcanic sulfur dioxide (SO2) and its vertical distribution, in order to find the suite of parameters that results in the modeled SO2 and aerosol distribution closest to observations.

This is an interesting manuscript for the stratospheric aerosol modeling community, and I suggest some changes to increase the interest of this work for a larger community.

General comments

- I am concern that the results are applicable only to this particular model (AER-2D and SOCOL-AER), since other models have already found different optimiza-

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tions, which might be very different from the one for SOCOL-AER (for example in Aquila et al. (2012; 2013) the best results are obtained with an SO2 injection between 16-18km). I think that this manuscript would improve and become relevant for a more general public if the authors elaborated more on what is causing the difference between model simulations. Why are particle size distributions different among simulations? Is it a matter of different relative humidity at higher or lower altitudes, or does a less broad distribution foster more coagulation? Can the life time of the stratospheric aerosol be evaluated in each case? What causes the difference in life time, the injection altitude or the faster sedimentation due to larger particles? I would also be interested in knowing more about the difference between the 2D and 3D model results. Why do the vertical profiles in Fig. 5 look so much better in the case of the 3D model? Which process is involved?

- It would be useful to plot Table 1 on a graph, for instance using scatter plots relating the observed and modeled values of SO2, effective radius, aerosol burden, and extinction coefficient, color coded by, for instance, SO2 injected mass and/or altitude. I would also find interesting and clear to see a Hovmöller diagram (time by latitude) of the zonal mean stratospheric AOT vs time. One of the big problems for simulations of the Pinatubo aerosol is capturing the early southward transport of the volcanic clouds, and such a diagram would show with set of parameters (especially altitude) would lead to the better result.

Specific comments:

- p4603 L20: 2006 is not very recent
- p4604 L11: With respect to which quantity was AER 2-D one of the best models? What it both for background and volcanic aerosol?
- p4605 L20: How does SOCOL-AER simulated the stratosphere? 39 vertical layers are not many: is the stratosphere well resolved? Is the QBO included?

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- p4606 L6-10: It is not clear from the manuscript for how long was the SO2 injection prescribed in the model, and on which day. The authors argue for the applicability of the 2D model that the SO2 e-folding time of 25 days is comparable to the zonal transport around the globe of 25 days. From this reasoning, then the 2D model should be initialized after 20 days. However, the e-folding time marks when already 2/3 of the SO2 has been transformed into aerosol, therefore also sulfate aerosol should be included in the initialization.
- p4608 L12: Are the authors calculating both the error in magnitude and spatial distribution? If the simulated maximum of SO2 concentration is comparable in magnitude to the observations, but slightly north than the observations, how is that calculated in this metric?
- p4612 L22: With respect to what Is the BDC in SOCOL faster? AER-2D or observations?
- p4614 L25: The overestimates in modeled extinctions are with SOCOL or with other models? I don't think that this work allows to make conclusions on other model performances.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4601, 2015.