Atmos. Chem. Phys. Discuss., 11, C8430–C8432, 2011
www.atmos-chem-phys-discuss.net/11/C8430/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The influence of eruption season on the global aerosol evolution and radiative impact of tropical volcanic eruptions" *by* M. Toohey et al.

Anonymous Referee #2

Received and published: 1 September 2011

This is an interesting, well-written study investigating the sensitivity of both Pinatubo and super-eruption-magnitude eruptions to the season in which the eruption occurs. The authors show that both the aerosol optical depth and the clear-sky shortwave radiative flux perturbations are sensitive to the season of the respective eruption. The study also suggests that the all-sky shortwave radiative flux anomalies are only sensitive to the season if the eruption is of super-eruption size. The paper advances our understanding of explosive volcanic eruptions and provides useful insights as to how sensitive metrics such as aerosol optical depth are to eruption season. I have minor comments for the authors to consider and I recommend publication following minor revisions.

General comments

1) Page 22448, Line 13: You state that the model has no QBO. I think for the scope of your study it is fine to use a climatology; however I feel you should state the limitations of your approach a bit better. What differences (if any) would you expect in terms of e.g. aerosol size distribution, AOD, sulphate deposition, etc? Maybe, you could discuss (qualitatively) and contrast your method to the studies that looked at the impact of the QBO?

2) Page 22455: Your study suggests that a January eruption (of Pinatubo-magnitude) results in the largest cumulative AOD when compared to an eruption commencing in any other month. You do explain you findings by means of the smaller effective radius resulting from a January eruption. However, I do struggle in understanding your explanation of the smaller effective radius by means of the sulphate burden. My main concern arises from the units of kg per km2 that you assign to the term "sulphate burden" (see for example Fig. 6). According the IPCC the term "burden" is defined as "the amount of a gaseous substance or particulates in the atmosphere at a given time" with units of mass of substance (e.g. kg of SO4). Can you please explain what you mean by "burden" and why it has units of kg per km2? Do you mean "mass fraction" or "loading".

To me it sounds as the key differences is the vertical distribution of the sulphate mass; you do explain that with tropical upwelling; however you also show that an October eruption shows the lowest "sulphate burden at 10 hPa" – why is that?

Also, is the above also true for the E700 eruption?

3) You use a aerosol microphysics model; but you do not discuss any aerosol microphysical processes in detail – I am wondering whether looking at the differences in aerosol microphysical processes could help to explain the lower effective radius seen for a January Pinatubo-magnitude eruption? It it really down to dynamics only?

4) It might be worth checking the work by Harris & Highwood (2011) in JGR – given your findings, can you put your results in context? What implications arise?

Minor comments

- It is hard to see the y-axis scales in Fig. 6. Can you please revise this Figure and increase the axis scales?

- Page 22446, Line 18, “using prescribed aerosol effective radius”; I think these authors use a prescribed aerosol dry effective radius when initialising their simulation; however the aerosol is allowed to grow after that (depending on relative humidity) – it might be worth checking with these authors; the way it is phrased at the moment sounds like the effective radius is fixed in their simulations.

- Page 22446, Line 20, “impact of tropical volcanic eruptions . . .” impact on what?

- Page 22450, Line 13, please spell out AVHRR the first time you use it

- Page 22451, Line 1, AOD abbreviation already used earlier, please check

- Page 22451, Line 21, remove () around SW

- Page 22456 Line 1 “higher mean height of aerosol burden” – see my comment above, I really struggled to make sense of this when I first read it

- Page 22461, Line 18, say January eruption or something like that instead of “certain season”

Additional References:

Harris, B. M., and E. J. Highwood (2011), A simple relationship between volcanic sulfate aerosol optical depth and surface temperature change simulated in an atmosphere - ocean general circulation model, J. Geophys. Res., 116, D05109, doi:10.1029/2010JD014581.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 22443, 2011.