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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Importance of tropospheric volcanic aerosol for indirect radiative forcing of climate" *by* A. Schmidt et al.

Anonymous Referee #1

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The manuscript titled 'Importance of tropospheric volcanic aerosol for indirect radiative forcing of climate' by Schmidt et al presents modeling results regarding the importance of tropospheric aerosol in producing CCN particles and its impact on cloud properties. The authors use a modal approach to model aerosol microphysics in a global model. Based on a volcanic sulfur emission inventory they demonstrate tropospheric volcanic aerosols have a great potential to affect our understanding of both natural and anthropogenic aerosol indirect forcing, specifically, aerosol cloud albedo effect. The message is clear and of interest for the community. The manuscript is also well written and generally easy to read. I recommend the publication of this manuscript after the authors address the following comments.

Major Comments:

1. The structure of the manuscript may be modified to accommodate a discussion section. This is raised because the manuscript in its current form contains quite a few scattered discussions at several different places and they are related subjects. These discussions are generally interesting and relevant for the manuscript. However, the current arrangement may divert the attention of readers not familiar with technical details of these discussions. It is therefore in my opinion sensible to create a discussion section to go over the discussed points in a concentrated fashion. Another, maybe more important, reason to do so is that the materials presented and the collusions reached in the manuscript do need more discussions on the validity of the assumptions and other technicalities (see later comments). 2. It has been increasingly clear that the assumption for a 'pure' cloud albedo effect, i.e. LWP being fixed, is probably not a very good one in reality. As such, latest investigations often use online aerosol-cloud interaction calculations to get a more realistic estimate of cloud albedo effect, including feedbacks. The current study is an offline calculation. Though the aerosol microphysics is quite advanced the way to reach the forcing numbers is a little crude. I am not objecting this kind of analysis. Instead, in my opinion the authors need to clearly state these shortcomings. For example, the authors seem to take the monthly mean grid CDNC and apply it to a cloud climatology to calculate cloud albedo forcing. If it is indeed what is being done it needs to be stated for clarity. 3. Regarding equation 1, it is not clear what CDNC is used. PI-vol?PI-no vol? or a fixed number? Or is it changing for every model run? This is a critical issue that needs clarification. And, is the recontrol always 10 μm in calculating albedo forcing? Are all the forcing numbers reported here annual and global mean? Also, from the model-observation comparison the uncertainty (or bias) with the model is quite significant in light of what is being tracked down in this study. Would be beneficial to include this uncertainty into consideration? 4. Minor Comments: 1. Page 8010, line 10: consider adding 'estimated based on our methodology'. The assumptions of the methodology shall be clearly stated as suggested in major comments. 2. Line 15 page 8012: it is worth to note that the Hawaiian study seems to report volcanic aerosol impact 6000km away from the source. 3. Line 4, page

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8016: why 2000 dust is used while other fields are from 2004? In the same paragraph, does the model treat aerosol mixing at all? 4. Equation 1, page 8019: due to many factors effective radius does not respond to CDNC in a theoretical 1/3 power law. It is the upper limit, which may be worth noting here. 5. Starting at line 20, page 8023: the emission may be quite different between the Hawaiian study and what is used in this manuscript. This may be worth noting. 6. 3RD paragraph on page 8024 and 2nd on page 8025 are good discussions that may be moved to the discussion section. 7. Starting at line 20, page 8029: this example is a little out of place. Again, putting this kind of discussion in a right place would make both the manuscript easier to read and the discussed points more outstanding.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 8009, 2012.