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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals" *by* Tianfeng Chai et al.

Anonymous Referee #1

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General comments

The paper "Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals" by Chai et al. discusses the inversion results for the Kasatochi 2008 event [ash] using a combination of the HYSPLIT model, providing the TCMs, and MODIS satellite data. Although inverse modelling studies for volcanic eruptions following similar methodologies are not new, the results for this eruption and the sensitivity studies presented here provide useful information to the reader and therefore supports its publishing in ACPD.

Specific comments

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Discussion paper

1) Page 2, first paragraph: although not strictly needed, it would be good that it includes additional references on the impacts on the aviation industry as well as references on the residence times of the fine ash fraction.

2) Page 5, line 13: how was the particle size distribution estimated? It would be good to know the rationale behind the selection of the four bins, their sizes and percentage of distributions. Is that based on measurements? Estimates from another study? Please comment or add reference. This may include a comment on why the largest one considered is 20 um in relation to the satellite sensitivities and what limitations will this pose when it is the whole fine ash fraction (< 63 um) that may potentially affect aviation.

3) Section 2.1 and Section 2.5 line 26: it is clear that the observation uncertainties play a significant role in the inversion. It would be valuable to add more discussion on the uncertainties and errors in the observations in either of the sections (and explain how the estimate of the observational errors are assumed to be 0.5 x am + 0.3 g/m2) with special emphasis on the cloud top since this parameter is used to define the three options for model to observations adjustment. This is obviously of importance for the second option, where the cloud top is critical and fixes the only model level that will be used in the matching.

3) Section 2.3 and 3: the definition of the three options to match the model to observations clearly affects the results. It seems that using the three layers approach, whereby ash above the cloud top is allowed, improves the results. Have the authors considered using option 1 but also allowing that the layer above the cloud top is also considered?

4) Section 2.5, line 20. What is the basis for the selection of this a priori emission rate and vertical distribution?

5) Setion3: before starting to discuss Figure 3 (line14) please add (move) lines 24 to 25 so that the user knows what simulations (using GDAS or ECMWF data) the authors are referring to.

6) Section 3, line 19: why do the authors finally use the a priori error variances of 2.8 x 10**5 kg/s? I see no justification in the text and that would mean that either of the two error variances shown would be usable.

7) Section 4.2 and following: in line 29 the authors state that Stein et al. (2015b) estimated the uncertainties for the Rank to be of 0.1. However, in all the tables and most of the discussion is based on those numbers, we see the ranks (and all the statistical metrics) to have to significant decimals. How can then we judge the performance of the different MA, M0 and M1 options when often is the second decimal that varies?

8) Could the authors give a better justification of why the zero mass loading pixels correspond to infinite cloud top heights?

9) Comparing the simulations with assimilated data (including G2) to G2 observations does not provide real insight since we are comparing assimilated results with the data used in the assimilation procedure. I think it is more useful to base the discussion comparing with G3 onwards if G1 and G2 are assimilated and with G2 onwards if only G1 is assimilated.

Technical corrections

1) Figure 2: please add in the caption that those are the TCMs obtained with the GDAS input data

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