Comments on

“Adjusting particle-size distributions to account for aggregation in tephra-deposit model forecasts”

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The paper presents a study of the modelling of volcanic ash in the atmosphere, with a particular focus on the effect of ash aggregation on depositional pattern. Several eruptions are investigated in order to find the parameters controlling aggregation, which give best fits of the deposits. To this aim, the authors employed Ash3d, an Eulerian model that calculates tephra transport and deposition through a 3-D, time-changing wind field.

Despite the differences in the magnitude and styles of the eruptions studied, the parameters describing ash aggregates are found to be similar for all the events.

The phenomenon investigated is interesting and very relevant for the volcanic hazard associated with ash dispersal in the atmosphere and it presents important novelties for operational model forecast. For this reason, I think that the manuscript falls into the scope of Atmospheric Chemistry and Physics and it is scientifically sufficiently sound to be published, once some points detailed below are clarified, in particular concerning the way the grain size distribution has been discretized.

- Lines 174-179. While in most of the literature the Suzuki relation is described as the distribution of mass in the column, in the original paper it is defined as “probability density diffusion”. This probability is related to the mass concentration of particles leaving the column at height z in the unit time, and it is different from the concentration of particles along the column.

- Lines 189-193. In Wilson and Huang a,b and c are the principal axial lengths and not the semi-axes, and the values were measured for more than 155 particles. I am also not sure that the average value of the shape factor of 0.44 is reported in the Wilson and Huang paper.

- Section 3.2. It is not clear to me the choice of the bins for the discretization of the TPSD. Why bins of 0.5phi are used for the non-aggregated particles and bins of 0.1phi are used for the aggregated? If the settling velocity and the depositional process is sensitive to bins of 0.1phi for the aggregates, I think this should be true also for the non-aggregated particles. It is also reported that aggregates are described by a Gaussian size distribution, but the amount of fine ash assigned to different size bins, reported in Table 4, is not representative of a Gaussian distribution. The values should be computed using the error function:

$$F(mu+x\ sigma)-F(mu-x\ sigma) = erf(x/sqrt(2))$$

- Section 3.3. I think that the first and third indexes, defined in Table 3, should not have the square root (exponent ½).

- Section 3.4. Aggregate size. Why is the range for sigma_agg so small? Is it supported by observations or experiments? This doubt is also due to the results, showing a small sensitivity of the results with such a small range.
- Section 4.1. It is not clear why some points are excluded from the analysis in Figure 10b and 10c. In the caption it is written that for panel (b) "grey dots lay outside the range of downwind distances covered by trend lines in Fig. 6", and are excluded from the calculation of Delta^2. I don't understand why the trend lines are involved in the point-by-point index, and also why Figure 6 should be used. Also for panel (c) the caption is not clear, referring to Delta^2_area, while the figure is reporting a value for Delta^2_downwind. In any case, I think that the criteria to exclude points from the measures of the fit should be discussed more in the main text.
- Lines 322-325. It is stated that adding turbulent diffusion "visually improve the fit". For this reason, I think it would be useful to quantify how much the fit is improved, through the different statistical measures of fit presented in the paper. It is also interesting to note that the numerical results seems to show a diffusion in the results, and this is probably due to a numerical diffusion associated with the Eulerian approach. Is it possible to quantify or discuss the effects such diffusion, in relation with the grid-size?
- The choice to neglect diffusion in the model is justified by the decrease in run time from 30 to 10 minutes for operational conditions. It would be interesting to compare this time with the characteristic timing of the depositional process.

Other minor comments and typos:

Line 258. "decreases the PERCENTAGE of erupted mass".
Line 425. "particles from THE vent"
Table 1: Delete UTC in start time for Spurr, Ruapehu and Redoubt. It is already reported in the field name (Start Time UTC).

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