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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional radiative impact of volcanic aerosol from the 2009 eruption of Redoubt volcano" *by* C. L. Young et al.

Anonymous Referee #3

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General Comments

The paper addresses an actual topic namely the impact of volcanic ash on atmospheric radiative fluxes on the regional scale and is within the scope of ACP. It combines satellite retrievals, dispersion modelling and short- and longwave calculations with a radiative transfer model.

Unfortunately, the paper lacks from the quality and the style of the presentation of the results and needs a major revision before it can be published in ACP.

The paper basically presents a one-dimensional sensitivity study concerning the effects of volcanic ash layers of different optical thickness, different vertical extensions, and different chemical composition over domains of different surface albedo.

I would therefore propose the following structure of the paper. 1. As already done the results of the satellite retrievals during the Redoubt volcano eruption should be presented to constrain the input parameters used later on for the sensitivity runs. 2. A sufficient explanation of the radiation scheme should be given. A detailed explanation of the input data that was used for the radiative transfer should follow. 3. Then a well-structured presentation of the results of the sensitivity runs should be given.

I do not see the necessity to include the results of the HYSPLIT model especially as long as they show only poor agreement with the observations.

This would also help to shorten the paper to make it easier to read.

Abstract:

The abstract is too long; the revised one should concentrate on the major methods and findings of the study.

Section 2.2:

What is the meaning of 'ash reduction level'?

Section 2.3:

What is the spectral resolution of the model? I am sure that this is information is given in the original papers but it is necessary to a have a short explanation of the methods, the required input data, and the spectral resolution of the model.

What means 'we considered conditions representative of the Arctic environment' and 'a subarctic winter atmospheric profile'? It would be helpful to have a figure with the profiles of the prescribed variables.

Section 2.4:

The authors have to include a table or a figure that gives the wavelength dependent refractive indices that were used for the study. These are basic input data and have

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to be documented in detail to give other groups the possibility to compare their own results with those of the present study.

Is the surface albedo prescribed wavelength dependent? Please give numbers.

The assumptions about the sulphate and the ash aerosol have to be explained more precisely. Are sulphate and ash treated as external mixtures? What about condensation of sulphuric acid on pre-existing ash particles? What means sulphate solutions around 70%? What means ratios of fine and coarse mode? Are those ratios based on mass or on number?

Section 2.5:

Page 26701, line 5: What means 'The change in F_{net} is the flux divergence, or the change in the net flux between layers of thickness z'? Is that a mixture of a mathematical formulation and its approximation by numerical methods?

In equation 7 the variables $DARF_{TOA}$and $DARF_{surface}$ are defined. Please use these variables instead of 'DARF at TOA' or 'SW DARF at the surface' later on in the text. This makes the paper easier to read.

Section 3.1:

Maybe it is due to the different scaling of the sat pictures and the model results but I have the impression that the HYSPLIT model is not able to describe the ash dispersion in the right way. E.g. figure 4d shows ash transported into northerly directions where the figure 4c shows observed ash transport to the south. Please prove that I am wrong.

A comparison of model results and sat data requires that the figures show at least approximately the same area and have the same scaling. Otherwise the figures are misleading.

Page 2607 line 9: The figure indicates flight levels not heights.

Section 3.2:

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Maybe one should add that the extinction coefficient is normalized by number density. Wouldn't it be better to give the extinction coefficient normalized by mass?

I think sections 3.3.1 and 3.3.2 would be easier to follow if a figure would be added that gives the vertical distribution of the ash or of the optical properties. Both sections are written in a narrative style and need a better structure. Maybe a sketch that summarizes the different effects as vertical plume structure etc. could be added.

Section 4:

Page 26713, lines 14-29: The whole section is misplaced. It might be shifted to the introduction.

Table 1:

Please check the table; I think the model parameter for the number 0.18, 0.38 and 0.58 is missing. 'Realistic sun angles' as source of input makes no sense.

Table 2:

Please check 'between 0.16 and 0.58' and '∼2.5 -7 km' in the table heading. Different number are given elsewhere in the text.

Table 4:

I think it makes no sense to compare the results of this study with the one of Ritter (2005) as long as the latter study does not contain basic information as the vertical placement of the ash plume amongst other missing information.

Figure 1:

This figure should be rescaled to show only the area that is indicated by the red circles.

Otherwise the figure is hard to read.

Figure 2:

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The labels of the axis are hard to read.

Figure 3:

The figure has to be rescaled. Please depict the same area that is shown in Figure 2. The heading of the figure is too long. Please reduce it to the facts and move explanations to the corresponding sections. What means 'a duration of 1 h'. What means 'ash column height to flight level 650'?

Figure 4:

The figure caption is quite long. Information is partly doubled. Figure 4b, 4c, and 4d must show the same area. The number on the axis and the colour codes are hard to read.

Figure 7:

The figure caption is too long. Wavelength axes have to be rescaled.

Figure 8:

Shorten the figure caption. An R^2 value for three data points is meaningless (same holds for figures 12 and 14).

Figure 9:

Figure caption is too long, reduce it to the facts. Skip 'in the plot'.

Figure 15:

What is the difference of opacity and AOD?

In general the number of figures could be reduced. Why not combining Figures 8 and 12, respectively, 10 and 14 into one figure?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 26691, 2011.