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Interactive Comment

Interactive comment on "Particle size distribution factor as an indicator for the impact of the Eyjafjallajökull ash plume at ground level in Augsburg, Germany" *by* M. Pitz et al.

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Reply to anonymous referee #1

We thank the referee #1 for the helpful comments to our paper. In the following, we repeat the statements of the referee #1 and present back-to-back the replay to the comment on behalf of all co-authors.

"The number in investigated cases (one from volcano and one from Saharan dust) is relatively small. It should be concluded (Chap. 4) that further investigation of such natural contributions to PM mass concentrations and comparison with independent analyses methods are necessary to show the accuracy of this source apportionment

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method.”

As the manuscript is addressed to the special issue of ACPD “Atmospheric implications of the volcanic eruptions of Eyjafjallajökull, Iceland 2010" and is also related to another paper submitted to this special issue (Schäfer at al., 2011) we focused it mainly on this event. We added one analysis of a known Saharan dust event in Augsburg (Bruckmann et al., 2008) to demonstrate that also other natural dust events could detected by this method. Nevertheless, we agree with the referee that further investigations in comparison to other independent methods are necessary to demonstrate the accuracy of the used method and add this suggestion at the end of chapter 4.

“In Chap. 2.3 the availability or source of the PMF method should be added.”

We add the web link in chapter 2.3 where the PMF software and user guide is available free of charge.

“The application of the PMF method on the basis of particle size distribution should be described in more detail (not only by citation) to present novel concepts, ideas and tools.”

We added information on novel aspects of using PSD data instead of particulate chemical composition data in chapter 2.3.

“The original data used for PMF are never demonstrated (in Fig. 2 the mass fractions in dependence from particle size diameter are shown). It would help to do it.”

As mentioned in chapter 2.3, in total 64 size channels were used for PMF analyses. It is a huge data set and presenting the descriptive statistics for every size channel would result in a very big table. Instead of that we show in figure 3 the hourly particle volume size distribution averaged over the years 2005 to 2010 in comparison to the volume size distribution during the period of the volcanic ash plume impact.

"What does it mean here: Hence, for an interpretation of the PMF factors obtained from particle size distribution data additional data are necessary. – later you discuss it.”

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The sentence in chapter 2.3 is more general and relates to the PMF method on PSD data in all. Fortunately we have such additional data and therefore the interpretation of the detected factor profiles was relatively simple in our study (please refer also to Gu at al., 2011). This is the issue which we discuss later. However, to make it more clearly, we changed the sentence in chapter 2.3 to: "Hence, for an interpretation of the PMF factor contributions and factor profiles obtained from particle size distribution data additional data like gaseous pollutants and meteorological data are helpful to allocate the PMF factors to possible sources."

"A discussion of the origin for the quantification of the errors of the results of source apportionment by PMF is required. The error discussion and error values should be included in the discussion and conclusions also."

The EPA PMF software gives the user the possibility to estimate the stability of the PMF results using a so called bootstrapping technique. Bootstrap model generate new data sets (at least 100) by randomly selecting non-overlapping blocks of samples with the same dimensions as the original data set. Each new data set is decomposed into profile and contribution matrices and these results from the bootstrap model will then be compared with the contribution of the base factors. The comparison will be assessed by correlation coefficients above a user-specified threshold normally set to 0.6. The observed factors from every bootstrap model run are considered as mapped with a given base factor if the correlation coefficient is above the selected threshold and the respective bootstrap factor correlates best with the same base factor. The summary of all bootstrap model runs allows the user to review the PMF factors to evaluate the stability and robustness of the statistics given by the PMF method. In our study, all 100 bootstrap runs of the long range transported dust factor are mapped, showing that the PMF results are stable. We conducted an intensive literature search regarding PMF errors but unfortunately, to our knowledge there is no other possibility given in the literature to quantify PMF model errors using particle size distribution data. Nevertheless, we are grateful for this comment and added a note for the reader in

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chapter 2.3 regarding bootstrap model for testing stability and robustness of the PMF results.

"In general it should be checked where it makes sense to present values with digits after the dot (e.g. page 16426)."

For the particle mass concentration we give now only integer values.

"Use in the appendix the unit μg m-3 as in the rest of the manuscript also."

In the appendix we discuss the apparent mean density which is normally given in literature in g cm-3, whereas the particle mass concentration is given in μg m-3. We used this convention consistent in the whole manuscript.

"Use consequently the term 'particle mass concentration'. Sometimes the term particle density is used."

We have carefully read the entire manuscript and use now consequently "particle mass concentration" instead of "mass concentration". However, the term "particle density" has totally different physical meaning than "particle mass concentration" and we didn't find any text passage where both terms are interchanged.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 16417, 2011.