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Atmospheric
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Discussions

Interactive comment on "Observation of volcanic ash from Puyehue-Cordón Caulle with IASI" *by* L. Klüser et al.

L. Klüser et al.

lars.klueser@dlr.de

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Author reply to comments of Anonymous Referee #1

Comment 1: As a result of the comments of one reviewer in the Quick Response to the Paper submission prior to the publication in AMTD we added the somewhat lengthy paragraph about the method. In our opinion this reduced the readability of the paper. Consequently we do agree with the referee and will substantially shorten section 2 following his/her suggestion in the revised manuscript. Thus section 2 will then only contain a short but precise summary of the method without going too much into detail. The mathematical description of the method, for example, has already been published in another paper (also in AMT).

Comment 2: As outlined in Klüser et al. (2011) the method does not use explicit forward radiative transfer modelling but is based on the spectral shape of the extinction spectra and their correlation to the singular vector decomposition of the observed IASI spectra. Consequently we do not exactly neglect scattering effects as written here, since the spectra contain total extinction. Nevertheless e.g. Ackerman (JGR, 1997) showed that the spectral variability of the scattering component of total TIR extinction is very low (while the scattering component of total extinction can be significant). As our method is sensitive to the spectral variability of ash extinction only, the scattering cannot be neglected but the method is most sensitive to the silicate resonance absorption giving the typical "V-shape" of the extinction spectra. Related to this explanation we also assume that the shift of extinction peaks between Mie theory and measurements reported by Hudson et al. (2008a,b) will result in significant retrieval errors in our method due to the different spectral shapes of the extinction spectra. We could show this effect in the comparison of validation results in Klüser et al. (2011) and Klüser et al. (2012) for mineral dust. Consequently we agree with the referee that, following e.g. Yang et al., Mie approximation is appropriate for retrievals based on forward modelling of radiance, but in the case of our retrieval approach the blue shift of Mie calculations causes large errors. Thus our statement is only valid for this specific SVD based retrieval approach. We will clarify this in the revised manuscript with appropriate references to prior studies.

Comment 3: The reply to this comment is closely related to Comment 2. We agree that for forward modelling size distribution is very important. We furthermore agree that size distribution affects the shape of the spectral extinction of volcanic ash (as well as mineral dust) signal in TIR (e.g. Salisbury and Wald, Icarus, 1992). As a consequence, so far we do not have much confidence in retrieved particle radius and mineralogical composition of our retrieval. The reason is that the retrieval searches for the best correlation of the observations with a linear combination of fitted component spectra. The correlation may as well be the result of a specific composition as of the particle size. Nevertheless the TIR AOD is well represented when the correlation is high - unfortunately perhaps due to "wrong" reasons (composition instead of particle size or vice versa). In combination with the revisions based on comment 2 we will also clarify the effect of particle size distribution in the revised manuscript.

Comment 4: Estimates of Saharan dust emission range from 130 to 1600 Tg/yr (Engelstadter et al., 2006). Chaiten ashfall during first week of eruption 2008: 1.6x10ˆ11kg (Watt et al., JGR, 2009); these numbers will be provided in the revised version. Independent estimates of the ash mass from the PCC eruption (e.g. from other sensors like SEVIRI) are to our knowledge not (yet) available.

Comment 5: We regret that these two different methods applied have not been introduced sufficiently. We will do so in the revised version. Two Lagrangian set ups were chosen to investigate the effective emission height, the source attribution and effective plume height. The kinematic three-dimensional trajectory model FLEXTRA was used at first to attribute the observations of IASI to the PCC eruption or potentially other sources. Therefore ensembles of backward trajectories were calculated released from all IASI observations with increased aerosol optical depth. In doing so the significant majority of the observations could be attributed to the PCCE and the source-receptor relationship proven. The resulting ensemble of trajectories were then used to derive an estimate of the effective emission height at the volcano. Therefore we plotted the trajectory density over PCC in figure 8. Having confirmed PCC source for the ash observations with backward modeling, we applied in a second step the Lagrangian particle dispersion model to perform forward calculations. For the given time range and various altitudes large amounts of particels have been released in the forward mode. The particels matching the observations from IASI in time and space were counted and their travel path analysed. In doing so we can now prove the source-receptor relationship including diffusion and again derive an estimate for the effective emission height (Figure 9) Finally, since two different approaches have been used figures 8 and 9 look different.

Comment 6: We will follow the suggestion of the reviewer in the revised manuscript.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4249, 2012.