Answers to Reviewer 1

We thank the reviewer for useful comments. They are addressed in detail in the following.

2552/10: One could argue here, that the soil particle size distribution might favour coarser particles in the Sahara than in the Sahelian due to different a kind of weathering, so that the size distributions at dust emission are already different.

Differences are possible. The sentence in the paper was modified in the following way "Besides to possible differences at the source due to different weathering, the different residence times should also result in different size distribution, locally emitted dust being in principle richer in coarse particles than long-range transported.

2555/21 Redmond et al. (2010) report a value range of 1.53 to 1.56. Thus, at first, the assumption of 1.53 is rather at the lower end. Second, all the works cited by the review of Redmond et al. (2010) as reference source for the value of 1.53 (i.e. Haywood et al., 2003; McConnell et al., 2008; Osborne et al., 2008; Schladitz et al., 2009) take this fixed value from the model atmosphere of "World Climate Program (WCP)/IAMAP, A preliminary cloudless standard atmosphere for radiation computation, WMO, Geneva, 1986", which unfortunately doesn't seem to be available any more. Actual measurements – some of them reviewed by Redmond et al. (2010) – seem to point to higher values for the Sahara and lower ones for Asia.

This paragraph was reformulated accordingly to the suggestions of the reviewer. It now reads " The instrument, described in Heim et al. (2008), has been factory-calibrated prior the field campaign using mono-disperse polystyrene sphere latex (PSL) whose complex refractive index ñ is equal to 1.59 – 0*i* at 780 nm, the working wavelength of the GRIMM OPC. The sphere-equivalent optical diameters needs to be converted to sphere-equivalent geometric diameters by taking into account the refractive index of the aerosol under investigation (Liu and Daum, 2000; Collins et al., 2000). The complex refractive index was set to 1.53 – 0.002*i*, in the range of published values available in the literature (Osborne et al., 2008; Schladitz et al., 2009; Petzold et al., 2009; McConnell et al., 2010). Variations of both the real and the imaginary parts in the range indicated by those measurements (1.53–1.56 for the real part; 0.001–0.003 for the imaginary part) have not proven significant in altering the correction factor to be applied to the calibration sphere-equivalent optical diameter values in comparison to the uncertainties in the estimation of the refractive index as well as on those due to Mie resonance oscillations of the calculated scattering intensities. "

2556/5 Are the 10 to 15 % relative to the fine mode extinction or to the total extinction? If the latter, 10 to 15 % shouldn't be neglected.

This discussion has been postponed - and clarified - in section 4.4.

2556/17-18 Why where the particular values for the imaginary part of the refractive index chosen?

The values of the refractive index were chosen on the same basis than discussed in section 2.2.1 which is now dedicated to the discussion of the GRIMM OPC corrections.

2557/2 Was any contamination identified?

No contamination was identified. The sentence has been reformulated to clarify this point. It now reads "Possible contamination from the cabin due to leaks in the air flow circuit was discarded based on a serious screen on the data acquired at low-concentration."

2557/17 Was the mentioned independency of wavelength a result of the measurement or an assumption?

In our paper it is an assumption based on measurements reported in Weingartner et al. (2003).

2561/18-21 The Al concentrations show a high variation for the same latitude between 13 and 16_N. A really good agreement – as stated – doesn't become visible.

The sentence has been modified as follows "the $dN_{1.0}$ particle distribution reflects the spatial distribution of the elemental concentrations which have been obtained by filter sampling and XRF analysis".

2562/4 The correlation of Ca and Mg is readily explained by the presence of dolomite. How about the correlation between Ca and K?

The fact that two elements are correlated in terms of bulk concentrations does not mean that they are found in the same minerals but rather in the same aerosol, as it can be the case due to the possible simultaneous presence of K-bearing minerals (illite, orthose, anorthose) and Ca-bearing minerals (anorthite, calcite, dolomite, gypsum, montmorillonite).

2562/17 As it can be expected, the mass is dominated by Si, not Al (Table 2). Of course, as Al most probably has a close connection to Si, the regression coefficient should be high for both. Please reword.

This has been done. The sentence now reads "The three estimates of the mass are highly correlated (Pearson regression coefficient > 0.96), as Al is one of the major constituents of mineral dust in terms of mass."

2562/27-2563/4 The comparison of this work's elemental concentrations with others measured with a different (and, seemingly, uncharacterized (Formenti et al., 2008)) aircraft inlet seems to be pointless, especially, if the data are uncorrected for the inlet efficiency (not mentioned).

Although a wind-tunnel study of the passing efficiency of the inlet onboard the UK FAAM Bae-146 has not been performed, various field based studies of its performances have been done in terms of mass and number size distributions (Andreae et al., 2000; Chou et al., 2008). So we do not agree with the reviewer on this point. However, whenever possible, we reinforced the possible differences in passing efficiencies as an element of discrepancy. Having said that, in the present case, the differences in passing efficiencies cannot explain (and actually are opposite) to the difference observed in the winter and in the summer season, which we believe being due to the time of sampling more than anything else.

2565/27 Bristow et al. (2010) report an average Fe/Ca mass ratio of 2 for the Bodélé depression with values ranging between 0.8 and 4.5. This variability – also in comparison to Formenti et al. (2008) – leads to the conclusion, that it can't be regarded as source with an uniform composition.

The sentence was reformulated as follows " In particular, the Bodélé depression, considered to be one of the largest single source region in Africa (Prospero et al., 2002; Bristow et al., 2010), is poor in Fe and therefore is characterised by a Fe/Ca ratio ranging between ~1 and 4.5 due to large composition variability (Formenti et al., 2008; Bristow et al., 2010)."

2566/27+28 The ratio between scattering coefficient and particle concentration is not dimensionless. Please add the unit to the "1".

This has now been done.

2570/4 Kandler and Schütz (2007) have not measured or described any chemical composition. Is it Kandler et al. (2007)? These authors report a elemental mass ratio of Fe/Ca=2.1

This mistake has now been corrected.

2570/10 How does wet deposition remove preferentially particles between 0.3 and 1 µm?

There must be some confusion. By comparing the size distributions shown in Figure 10, actually the volume size distribution of flight V028 is depleted in particles larger than 3 µm with respect to the volume distribution measured during flight V018, and not, as the reviewer, in the particle fraction between 0.3 and 1 µm. As a matter of fact, below-cloud scavenging depends on particle size. Even for insoluble particles, removal coefficient are two order of magnitudes larger for coarse than for accumulation mode particles (Seinfeld and Pandis, 1998).

2570/17 How is Ca associated to clay minerals? Kaolinite usually does not contain Ca.

The sentence was reformulated as follows "The Fe/Ca ratio remained invariant, suggesting that both Fe and Ca are associated to particles smaller than 3 µm. This is consistent with the fact that both structural iron and iron oxides are associated to sub micron clay particles, mostly kaolinite (Greenland et al., 1968; Caquineau, 1997), whereas Ca has been previously found as an impurity in the composition of locally-emitted illite clay (Caquineau, 1997)".

2575/12-17 Discussion of the first mode should be skipped. It is speculative, as no data for a potential maximum location are available.

The discussion of the first mode is limited to the observation that a fine mode is evident below 0.6 µm in diameter, and smoothed by the sentence saying "not very well defined because of the lower size cut of the GRIMM OPC". We believe that we should keep this observation for completeness.

2575/18-19 Were the mode center diameters obtained as the maximum of the measured points or by log-function fitting? The latter approach should be more suitable.

The modal center diameters have been calculated by log-normal fitting. A sentence in the paragraph dedicated to the description of the size distribution has been added to clarify this "The position of the modes was modelled by multi-modal log-normal fitting."

2576/2-5 The conclusion from the increase of large particles with decreasing altitude on longer transport pathways of the upper layers doesn't seem to be valid – this behaviour should be expected also after some transport for an aerosol which was homogeneous at the beginning, due to sedimentation of the larger particles from upper towards lower layers.

This is certainly true in general. At the same time it is clear that the dust layer encountered during flight V032 is not homogeneous both in composition and in size distribution and that because it results of turbulent injection of mineral dust of Sahelian origin by a convective system on a pre-existing layer of dust transported from the Saharan desert.

2607/2608 Fig. 10/11: What is the difference between these two types of figure? Which units are really shown on the y-axis

Figure 10 shows volume distributions typical of the case studies encountered during the campaign and described in section 4.3. Figure 11 was removed. The discussion concerning the vertical dependence of the volume distribution of flight V032 has been moved to paragraph 4.3.5. Units on the y-axis have been corrected.

2577/2 Experimental errors should be specified in the manuscript

This also was requested by Reviewer #2 and it has now been done.

2577/16 Only the imaginary part of the refractive index was left as a free variable.

Yes, because we are mostly interested in the absorbing properties of mineral dust.

2678/2-10 Please specify when external and when internal mixing is meant.

Definition of external mixing has been added to the manuscript.

2580/7-8 Can this be proven by microscopy images? It was mentioned above, that electron microscopy was performed on the filters.

The number of figures is already important and we prefer not to add an extra one.

2581/17-19 and 2581/27-2582/2 Size distribution measurements in this work as well in the work of Reid et al. (2008) were performed behind an inlet with a 50 % cut-off at or below 10 µm. A larger variation in particle concentration would be expected particularly for larger particles (e. g., d'Almeida and Schütz, 1983; Jaenicke and Schütz, 1978; Kandler et al., 2009; Mikami et al., 2005), so it might not be detected by these methods. Thus, no conclusions regarding the variability of the full size distribution can be made from these measurements. This should be specified.

A mention of this fact has been added to the discussion.

2582/17 Uncertainties should be given together with the single scattering albedos to address the relevance of the following estimation.

A complete error analysis is now provided.