Interactive comment on “Mineralogy and mixing state of North African mineral dust by on-linesingle-particle mass spectrometry” by Nicholas A. Marsden et al.

Detailed Response to Anonymous Referee #3

Abstract, line 6-7: specify the temporal resolution required
The sentence now states:
but also because of the lack of an efficient method to report the mineralogy and mixing state of single particles with a time resolution comparable to atmospheric processes lasting a few hours or less.

Abstract, line 19-20: please clarify the sentence
Now reads:
In most cases, the difference in composition between particles within a sample was continuous, rather than a collection of particles with discrete mineral phases.

Page 2, line 8: “observations”
Corrected.

Page 2, lines 16-22: this section is confusing; you speak about soil to aerosol partitioning and atmospheric ageing, but this is not very clear
Now reads:
the abundance of mineral phase has a strong grain size dependence, with quartz occurring in the coarse fraction and clay minerals dominating the fine fraction, but the size distribution is modified during emission \citep{Perlwitz2015}, so that ratios of mineral phases in the lofted mineral dust aerosol may not be completely representative of that of the source soil.

Page 2, lines 23-28: also this section is confusing since it mixes considerations on the temporal and spatial resolution of dust mineralogy

Removed the reference to temporal resolution in this paragraph.

Page 3, line 22: the reference by Kok et al. (2017) is not appropriate here since the Kok et al. paper is mostly on the effect of particle size but not mineralogy
Removed reference.

Section 2.1 please add information on the temporal resolution and measurement un-Certainties
We have clarified the potential sampling rate in the following sentence:
The instrument is capable of providing size resolved composition measurements for up to 200 particles per second in the size range approx. $0.4-2.5\mu m$

Added the following paragraph regarding measurement efficiencies.
Laboratory evaluation of the fiber-coupled laser system indicate that the detection efficiency peaks at 0.25 with spherical particles \cite{Marsden2016a}, but the overall efficiency of the instrument also depends on ablation efficiency with respect to particle composition. In a study of nominally pure mineral samples,

\cite{Marsden2017} reported the number of optically detected particles that produced a mass spectra (i.e. ablation efficiency or hit rate) of 0.29 and 0.14 for illite and kaolinite respectively, but was also dependent on the amount of impurities such as Titanium. Furthermore, from the authors own experience, it likely that pure quartz may have an ablation efficiency close to zero and is not considered in our analysis, but is unlikely to be a major component in the fine fraction in any case. The potential maximum overall efficiency of the LAAPTOF measurement of clay mineral ranges from 0.0725 for pure spherical particles particles of illite, to 0.035 for pure spherical particles of kaolinite. The exact efficiency of the instrument is not known in most situations because the size, shape and composition of the particles would have to be known a priori for accurate calibration.

We have also included the following in the conclusions section:
Despite the fact that the technique provides incomplete coverage in terms of particle number, elemental composition, and mineralogy; it was possible to clearly detect regional differences in the mineralogy in single particles of suspended soil and ambient transported dust.

Sect. 2.1.1, 2.2.2, 2.1.3: please reorganize these sections to clarify the methodological aspects, while the aspects mostly linked to discussion of data should be moved to Sect.3 (“Results”)
We have reorganized much of the method section. However, we retain the crystal structure and sub-composition of pure minerals as our method (rather than results) despite the fact there is some discussion of the methodology. This is because we want to make a clear separation of the methodological and scientific aspects of the measurements.

Sect. 2.2: which is the impact of the differences in the sampled size distribution compared to LAAPTOF?
We have added this statement to the start of results section 3.1:
The resulting particle concentration and size distribution is dynamic but is typically on the order of $1000cm^{-3}$ with a particle size mode at $200nm$ (See supplement S2), which is below the lower size cut of the LAAPTOF, but not the filter collection. Although the two measurement techniques are not performed on the exact same particle sizes, both measurements represent the fine fraction $(<2.5\mu m)$ of the samples, due to the size distribution of the dispersed dust.
Sect. 2.4: the vicinity of the measurement site to the airport runway has an effect on measurements?
The airport was down wind of the sampling. There were only a handful of flights per day, and while some carbonaceous aerosols were detected in association with aircraft activities, they had no impact of the mineral dust in the measurement.

Page 10, line 8: “to analyse”
We have changed this sentence.

Results and Discussion, sections 3 and 4: I invite the authors to consider if some of the aspects in Sections 2.1 should not be moved here and also if the whole presentation of results and the discussion should not be reduced a little bit in length and also made more readable for a non-advanced reader. The text is fact very dense and complicated in some points in my opinion and it could be probably simplified.

Thank you for your advice. We have combined the results and discussion sections in order to reduce the complexity and length of the text. We now have a longer, but lighter conclusion section that is more accessible to the non-advanced reader, whilst maintaining the detail in the results/discussion.