**Revised Version 1 of the Manuscript**

«Multi-scale Measurements of Mesospheric Aerosols and Electrons During the MAXIDUSTY Campaign»

We thank the referees for very useful comments. Below is an overview of changes done in the revised version. Minor typographical errors pointed out by the referees are not listed here but have been corrected.

**Changes due to comments from referee #1**

The current paper is focussed around measurements, and it has become evident that the "big picture" is somewhat lost in the current version of the manuscript, as pointed out by the referee. The investigations made in the current work is motivated by the need of a better understanding of what structures (if any) are typical on length scales down to ~10 cm. This is the same as a typical UHF PMSE Bragg-scale, and would be interesting for that reason among others. Also, as the MAXIDUSTY (MXD) payload arguably had one of the more complete setups for investigating aerosols and electrons simultaneously, it seems natural to include a discussion of the correlation between these species, as relatively few works have done the same. One of the main goals behind this is to better understand PMSEs, but is also a good demonstration of experimental capabilities to study blobs and holes in the dusty plasma; which may be useful for a number of inquiries into ordered structure around the mesopause. We also point out that the effect of the aerodynamic environment on the measurement is an interesting by-product of our studies, and that special care needs to be taken in any in-situ probing of this height region. We have altered/added a paragraph on p.2/l.28 – p.3/l.13 that aims to communicate the points above in a better manner than in the original manuscript.

***On aerodynamic effects***: For the MUDD probe, having three probes offers a few advantages; more probes means a faster sampling/sweeping of the 12 potential modes (corresponding to mass bins of meteoric smoke/fragments). This means that we can, in the case of MXD, get a three times higher altitude resolution of the size distribution of meteoric smoke embedded in ice, which is desired. As the probe share one potential mode with another probe, one can in principle correct for differences due to aerodynamic effects (however, in Antonsen et al (2017) the size distribution was calculated in regions which were fairly homogeneous and calm). Also, as is the motivation behind having two identical DUSTY probes, it offers the possibility to look at small horizontal scales. As large ~10 nm particles are not influenced by the aerodynamic shock front (as discussed in e.g. Horanyi et al. (1999), Hedin et al (2007), Antonsen and Havnes (2015)) it should be possible to infer structures at these small horizontal scales – if they exist. To our knowledge, there are no studies discussing observations of such short horizontal scales, and MXD is one of few payloads for mesosphere studies that facilitates for such measurements. The conclusions to draw from finding differences on short scales is perhaps a bit difficult to communicate in a short paragraph, but we hope that inferring holes and 'blobs' of charged aerosols on these small scales can be used in studies of e.g. UHF PMSE. In this paper we feel it is important to underline that large differences on these scales are not necessarily true variations in the dusty plasma, but probably due to small particles. This conclusion would be more difficult to come to if we did not employ more than one dust detector. We feel the justification in Section 3 Paragraph 2 and discussions in the following paragraphs communicates the points above well.

***On other available measurements***: Other probes that have not been discussed are Positive Ion Probes, Capacitance probes, the miniMASS dust mass spectrometer and the ICON neutral mass spec.
- The ICON data is currently being studied, and understanding the data is arguably more difficult than understanding the normal plasma and dust probes. As the first results are being presented only later this year, we do not want to include ICON in the manuscript.

- miniMASS measurements were corrupted by photoelectrons as an unfortunate geometry and insufficient shielding couldn't prevent sunlight to hit the detector. No dust could be inferred unambiguously.

- The Daughter Payload module was a proof of concept and did not produce publishable data (the first data from a regular flight [G-Chaser] is being presented later this year).

- The capacitance probe on MXD-1 functioned well, but only above ~84 km due to a relatively low electron density. For MXD-1B, one of the probes give useful data from ~76 km, which confirms that the electron density measurements by Faraday rotation are sound; i.e. what frequency will give the best result (added a note on this in section 4.2). One of the capacitance (high freq) probes did not however work nominally on MXD-1B, and according to M. Friedrich, it may indicate that the boom did not employ correctly (specified this in 4.2, Private Comm. Friedrich).

- The positive ion probes worked nicely for both flights, and give densities which are consistent with the calculated electron densities, however, indicate that the electron density from mNLP is probably slightly overestimated in the cloud region. Added a sentence on this on p.14/l.15.

***On topics 'beyond the scope…'***: We have done only a low resolution 3D-simulation of the aerodynamic environment which is not sufficient to predict the MXD flow patterns. A thorough 3D-simulation, probably using Monte Carlo statistics as the flow is more or less rarefied below ~90km, is demanding and is thus not addressed. Added a sentence on this p.16/l.17-21. Regarding p.26/l.3-4, we are currently working on a manuscript using the identical DUSTY probes to infer the structure of small holes and blobs in the dusty plasma, but the results are not ready or necessarily well fitted to include in the present discussion. Added sentence on p.26.

***On the concern regarding PMSE***: This is a very good point which needs to be addressed. The strength of MAARSY is that it can resolve PMSE more or less three-dimensionally with a height resolution of ~300 m (see also figure of typical MAARSY plot below). Although some interpolation is done in the horizontal dimensions, we feel that the PMSE measurements should be representable for a region very close to the rocket payload. Edge effects of PMSE and very localized effects in the dusty plasma are of course topics which must be addressed with caution. We have added a new paragraph on p. 20-21 trying to justify our use of the radar, together with technical specifications.

**Changes due to comments from referee #2**

Unfortunately, there is some noise of currently unknown source in the electron current data for MXD-1B. The noise is at wavelengths close to 1.2 m (see figure 2 below) and affects neighbouring spectral regions as well. Due to this, it is difficult to get a reliable PSD for the shorter scales, and the transition between inertial and viscous subranges are unclear for the electron data.

We have however included a global PSD for the dust data at this point. Although a global wavelet power spectrum is preferable, we have utilized a Welch PSD estimate for the cloud region instead, as it is much less computationally demanding, and offers a very good frequency resolution. We have only included the global spectrum for MXD-1B, as it had a strong PMSE throughout the entire dust cloud region. The radar Bragg-scale is more or less at the end of the Bachelor/Kolmogorov subrange which may indicate that the turbulent energy dissipation comes from relatively recent/ongoing turbulence. We added a short discussion about this on p. 18. This discussion can also be longer, however, turbulence is not one of the main topics of the current manuscript.

**Other Changes**

Section 4.2, paragraph 2: Added a sentence about how electron density is calculated and possible error. Added ref. Hoang et al.

p.1: Removed 'nucleation threshold'. Added 'allows for nucleation of ice…'

p.3. Secondandy changes from G1 and G0 can from most cases be neglected due to the difference in secondary producing area. The area of G1 and G0 is approximately 18 percent of the area og G2, and since the secondary charge producing part of this is ~28% (Havnes and Næsheim (2007)), the correction would only be a few percent. In the size calculations done in the companion paper we take this into account.

Section 3: There is now only a mention of coning. There is a weak variation due to precession, but throughout the cloud layer (83-88) the angle of attack changes so little, that no significant variation is found).

Section 3: Added about the iteration method. And the artefacts (due to a 1/0 ratio in one of the iterated eqs.)

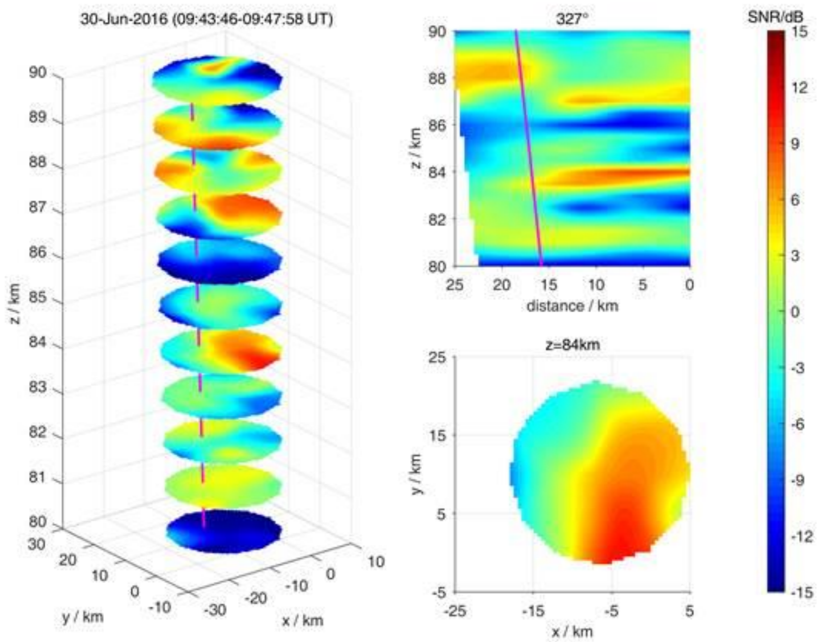


**Figure 1**: PMSE measurements during MXD-1 showing the horizontal slices.

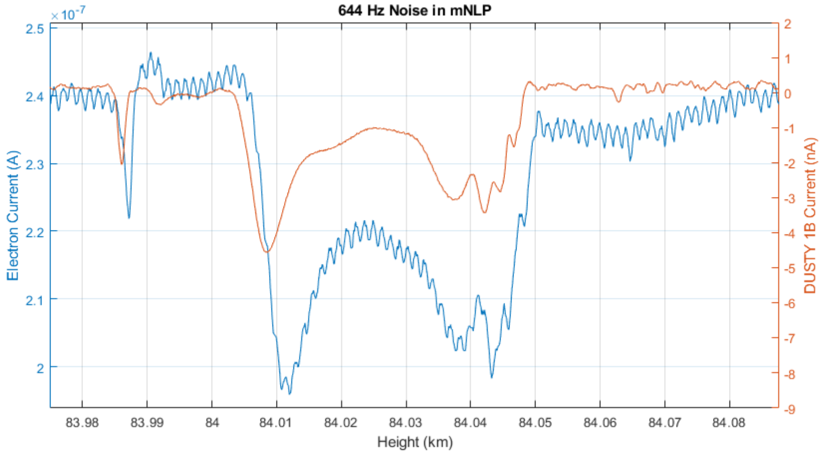


**Figure 2**: Close-up of 6V NLP current vs. DUSTY currents indicating a strong 644 Hz noise component.