Response to Anonymous Referee #2

We thank the reviewer for the constructive review which helps us to improve the manuscript. Our response is given below together with the reviewer comments. The reviewer comments are in *cursive* letters and our response in regular letters.

The paper investigates the movement of particles in a conceptual instrument for collecting dust particles during a sounding rocket flight and later sea retrieval. This is accomplished by combining several models and simulations. For a future deployment, it is important to understand how dust moves from the atmosphere into the instrument and onto the collecting surface.

General comments:
At the present stage of development, the investigation is clearly aiming to find the boundaries of the design, as no closing mechanism or collecting surface is defined. It would be nice to elaborate this more clearly, e.g. which collection principles exists and what are their requirements. What would be other requirements or degrees freedom, e.g. from the rocket and environment?

- We will expand the discussion part of the paper and we will refer to previous works of other groups that made sample collection experiments in order to justify our approach.

Further I would recommend focusing less on the work that has clearly been done, but more on the meaning of it. For example in Fig. 2, the shock sure looks nice but what is it that you want to clarify to the reader, especially as the Mach number is not further discussed? Or the different trajectories in Fig. 5 & 6, what should the reader see in those figures? Even if crude, it would be more helpful to give e.g. the collection efficiency, in a table or figure, to see more clearly which altitude and velocity is preferred.

- We will revise the manuscript following this comment and will discuss the presented figures in more detail.

Why are only 80 and 85 km simulated? The reader is forced through half the paper before knowing in the results section that PMSE are limited to those altitudes. In Rapp and Lübken (2004) the altitude range is given with 80 to 90 km for PMSE with a clear peak at 85 km, while NLCs (large ice particles) peaking between 80 and 85 km. Thus particle size is a function of altitude, with the heaviest being lowest. This was not considered in the present paper and it feels like 90 km is missing in the simulations, especially if one could assume different particle sizes at different altitudes, which would also lead to different ratios of primary and secondary particles.

- The parameters at 80 and 85 km were chosen as the boundaries within which noctilucent clouds are observed and hence large particles exist. We focus on this lower altitude because we expect larger particles that are present there are less influenced by the airflow and more easily collected. The funnel concept is chosen so that the collection area increases and at the same time the ice particles fragment when colliding with the funnel so that their fragments can be collected. We now state this in the introductory sections.

In 4.2.1 it is stated that primary particles (not colliding with funnel) are simulated, but in Figures 5 & 6 plenty of particles hit the funnel? It is further not clear, from the figures if they reach the surface or if they just move out of the plane? As the pressure regime is within the Knudsen flow (if I am not *mistaken), particle trajectories should have more of a statistical outcome? 8 or 9 primary particle trajectories could be not enough?*

- We now address the statistical nature of the calculations. We also include a calculation using more primary trajectories for comparison. In a project paper recently made at UiT, it was found that the Brownian motion influences particle smaller 2 nm, but less so the larger once. From this we expect that the primary particles are sufficiently well described with the presented trajectory calculations for the estimate that we present which includes the large uncertainty of atmospheric conditions. We will clarify in the text how we define the primary and the secondary particles that we discuss.

In the results section a lot of work seems to be swept away by assuming a collection efficiency of unity and calculate the total amount of particles when flying a known collection area through a layer of an assumed density and then vary layer thickness and collection efficiency without taking into account the simulation results or other constraints.

- We will include estimates of the expected collected mass based on the calculation in combination with different assumed dust densities in the atmosphere. We will also discuss the results of the calculations in more detail

Usually the assumption of an angle of attack = 0^o is always wrong, as most rockets do not have attitude control. Maybe this could be more reasoned as insignificant for typical angles of attack in the given scenarios. A slower rocket at higher altitude as proposed might show significantly higher angles of attack.

- We also speculated about angles of attack for different flight conditions but were unable to get a clear statement from the experts on this. Since we have no clear information on the angle of attack it is hard to say whether it will be significant or not. We will point this uncertainty out in the discussion.

If the best results are obtained for lower pressures, could there be a more optimized shape of the funnel?

- The conical shape of the funnel was chosen because it allows us to collect fragments from the entire funnel area. Its dimensions are limited by other dust detectors in the strawman payload. We now mention this in the discussion.

We will thoroughly revise the manuscript considering all the line and figure comments.

Line comments:
Line 11 citations are usually avoided in the abstract
Line 18 Meteor ablation
Line 22 which altitudes specifically
Line 23-24 split sentence, reference for the Faraday cup measurements?
Line 37 rocket conditions sounds odd, measurement conditions or something
Line 56 reference ?
Line 63 Knudsen number introduced not further mentioned in text

Line 92 radius of what
Line 103 PMSE altitudes should be in the introduction, may be reason the rocket velocities
Line 128 what density? more specific
Line 137 & 146 & 157 & elsewhere "rocket height", maybe a bit misleading: "altitude" could be more appropriate.
Line 148 area?
Line 150 maybe split the sentence
Line 185 cm-3
Line 199 the
Line 205 3 different units are given, maybe describe which one would be a good criterion and why.
Line 208 In introduction it was a TEM grid, now a carbon foil, maybe that can be better introduced
Line 209 Figure 10 not Figure 9
Line 232 formatting of citation
Line 238 why not make it larger for even more particles? why is it a reasonable funnel size or aspect ratio (diameter / funnel length)? Why not sample as much as possible? E.g. 80 to 90 km
Line 243 the energies of the particles increase with the square of velocity, why is the number density the dominating factor and why does this not just increase or decrease a probability, e.g. the collection efficiency via number of air molecule collisions?

Figure comments: Figure 1,3,4,5,6,7: could at least one (preferably more) figure use the same scale on x and y? Each figure group has a different scaling.
Figure 1: colour map or scale not suitable as e.g. Ma=1 is hardly visible. The Mach number is not discussed in the text. Why 800 m/s and 85 km? Half the figure is white or black. The lower panel has no axis labels, typo in upper panel.
Figure 3&4: Color scales should be comparable, maybe normalize to amient density as this is constant between the panels. Consider a log color scale.
Figure 5 & 6: Labels missing! Chosen colours make it difficult to distinguish between sizes. 5 nm at 80 km and 3 nm at 85 km, why the change?
Figure 7: plot says 85, caption 80
Figure 10: Maybe plot x logarithmic too and combine both figures? What is meant with impact radius? The lower panel seems to have a distribution, consider plotting the extremes or mean.