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Atmospheric Measurement Techniques Discussions

Interactive comment on "Investigating the Dust Flux in the Meteoric Smoke Sampler (MESS) Instrument for Sampling Dust in the Mesosphere" *by* Henriette Trollvik et al.

Anonymous Referee #2

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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?

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.

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.

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?

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.

Usually the assumption of an angle of attack = 0° 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.

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

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: Colour scales should be comparable, maybe normalize to ambient density as this is constant between the panels. consider a log colour 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 the mean.

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