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Atmospheric Measurement Techniques Discussions

Interactive comment on "Photocurrent modelling and experimental confirmation for Meteor Smoke Particle Detectors onboard atmospheric sounding rockets" *by* Gabriel Giono et al.

Anonymous Referee #2

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This manuscript addresses the problem of quantifying photocurrents from surfaces of rocket-borne particle detectors. This problem is important since photocurrents can be a large background to the main measurement target of these detectors, i.e. small fluxes of charged particles. The manuscript describes both a modelling approach and a laboratory approach to this issue.

Both approaches suffer from uncertainties. As for the modelling study, this mainly concerns knowledge of the photocurrent yield for relevant surface materials. As for the laboratory study, this concerns both the characterization of optical equipment, lack of sensitivity, and issues with contamination. Due to these uncertainties, these studies fail

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Discussion paper

to achieve truly quantitative results on photocurrents that may be used for quantitative correction of atmospheric particle measurements. Still, these studies are useful in describing the problem of daytime particle measurements and possible pathways towards handling this problem. Also the comprehensive collection of references is useful.

The most important surface material considered in this work is aluminum. This needs some further discussion. There are substantial differences in surface properties (photocurrent yield, reflectance etc.) between freshly cut aluminum (possibly kept under vacuum) and "aged" surfaces that have gone through oxidation. Both kind of surfaces have been used earlier laboratory studies and sounding rocket instrumentation. The authors should discuss these differences and possible effects on their conclusions. This is also important for the comparison to the rocket experiment by Robertson et al. (2014). What surface properties are relevant for that study?

While the results presented in the manuscript remain qualitative, I still would like to see some recommendations to people performing this kind of atmospheric experiments. What strategies would the authors recommend when designing or analyzing daytime studies with such particle detectors. What materials should be used? Should one try to avoid photoelectric effects by placing experiments in the shadow, at least during part of the rocket spin motion? (I assume that there is some trade-off between aerodynamics and photoeffect when it comes to the placement of detectors.) Are there design or analysis ideas that might help to discriminate particle signals from photoelectric signals? The authors should consider to add some recommendations or corresponding discussions to the manuscript.

A more general comment about notation: The authors refer to the notations "meteoric smoke particles" and "meteor smoke particles". Both notations can be found in the literature. However, the notation "meteoric smoke particles" dominates in the literature, and personally I would prefer this term, using a real adjective. It would be great if the relevant mesospheric science community could agree on which notation to use.

Some minor comments:

Abstract, line 18: As opposed to the abbreviation MSPD, the abbreviation MSP has not been defined.

Page 2, line 2: add "to" after "referred"

Page 2, line 4: "subject to" instead of "subject of"

Page3, line 4, and several other places in the manuscript: The authors refer to upcoming sounding rocket campaign PMWE during Spring 2018. By now, this campaign has taken place. I therefore recommend to update these text passages in the manuscript. (However, I would not ask the author to refer to any results from that campaign.)

Page5, line 8: The authors state that molecular oxygen densities can vary by a factor 2 in the atmosphere. They should specify what altitudes they refer to.

Page 5, line 26: It is unclear what is meant by "the height of the corresponding atmospheric column...". The sentence becomes more correct by simply removing the words "the height".

Page 6: The authors argue that atmospheric (molecular Rayleigh) scattering is not important for their study. This is correct. However, simply referring to the absorption and scattering cross section in figure 3 is not sufficient when making this argument. In principle, large amounts of (upwelling) scattered radiation from lower atmospheric altitudes (where the product of scattering cross section and number density is large) could contribute to producing the photocurrent. However, absorption by O2 (< 200 nm) and O3 (> 200 nm) at lower altitudes prevents these contributions from becoming important.

page 8, line 8: It is confusing that the authors talk about transmission when it comes to solid surfaces. I recommend to replace transmission by absorption. Hence Absorption = 1 - Reflectance, rather than Transmission = 1 - Reflectance.

page 9, line 1: Define "quartic equation".

page 9, Section 2.4: Is reflection of radiation from the grid wires included in the simulation? This should be explicitly stated. In that case, how important is reflection from the grid wires? If it is not important, this would be an important message to other instrument modelers: in that case only the shadowing effect of the grids would be important to consider in the radiative transfer.

page 13: In the absence of the contamination issue, the spectral flux of photons to the MSPD would be well defined based on the absolutely calibrated light source and the known transmission curve of the filter. There would be no need for the photodiode. Hence, the reason for using the photodiode is the contamination issue. Do I understand that correctly? This should be clarified in the text.

page 13, line 21: I would not call the wavelength responses as "empirical", rather "assumed" or "estimated".

figure 12: Define "PEEK" in the caption.

page 16, line 9: the authors refer to "two orders of magnitude". Figure 13a only shows a factor 3. Also: The relative decline in photocurrent and photodiode signal is very different in Figure 13 and Figure 14. This does not seem to be consistent. More explanations are necessary.

Table 2: The notation "estimated electrode photocurrent" is confusing. Please clarify.

page 19, line 10: The authors ask for "modern and reliable" measurements of material properties. I do not like the implicit connection of these two words. 40 year old measurements are certainly not unreliable just because they are old. (And modern measurements made in 2017 or 2018 are not necessarily reliable.) Please change the wording.

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