Atmospheric Measurement Techniques Discussions

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# Review of "CAMP: a balloon-borne platform for aerosol particle studies in the lower atmosphere" by Pilz et al.

Anonymous Referee #1

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Referee comment on "CAMP: an instrumented platform for balloon-borne aerosol particle studies in the lower atmosphere" by Christian Pilz et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-175-RC1, 2022

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Pilz et al. present in their manuscript a newly developed platform to measure aerosol properties on tethered balloon system. The platform, called CAMP, is especially designed to operate in environmentally challenging areas such as the Arctic. Vertical profiles of aerosol properties are indeed important parameters needed for all kinds of studies and model improvements and are indeed generally under-sampled (especially in the Arctic). The work therefore presents an important contribution to the experimental atmospheric science community, it is well written, and therefore, the manuscript is suitable to be published in AMT. However, some important technical details/comparisons are missing and need to be added before final acceptance. The manuscript also lacks a detailed error analysis of the entire setup, which is a prerequisite for publication in ATM. In addition, a few further (minor) clarifications and suggestions for improvements are listed below. Overall, I recommend major revisions.

Detailed comments:

- As a technical paper, a detailed drawing of the CAMP system should be added which should include details on sizes/scales, tubing, tubing length, flow rates, etc. It would also be helpful to have a summarizing technical table of the different sensors with sampling rate, sensitivity, flow rates, etc.
- Please add a few more important details on the inlet. How does it perform at high wind speeds? Is there an (apparent) size cut? Is it heated? How does it preform under cloudy conditions?
- The performance of the different sensors was evaluated individually but not with the sensors installed inside the CAMP system (if I understood it correctly). The particle losses could be much different. It is therefore warranted to add a detailed loss analysis (theoretically or experimentally) of the entire CAMP system (from the inlet to the sensor).
- Line 10: I would replace "to capture" with "to probe"

- Line 13: Maybe add “of aerosols” behind “measurements”
- Line 20-24: Since this is a technical paper, the last part of the abstract could be shortened by just stating that “first example profiles will be discussed to elucidate the performance of the system”.
- Line 39: Add “observations” behind “aircraft”.
- Some of the acronyms are not properly explained/introduced. For example, BELUGA or TROPOS.
- Throughout the text: the country of the manufacturer is usually added next to the company name and instrument model.
- How was the height determined? Is there a GPS sensor or pressure installed?
- Figure 2: Is this a volume equivalent diameter? Could the difference in CPC3 and CPC4 also originate from different diffusional losses due to different tubing/flows? Please add information on the used tubing.
- Sect 2.2: At what wavelength does the POPS operate?
- Figure 3 and 4 could be combined to a 2-panel figure since they are both related to the POPS to save some space.
- Figure 4: Please add error bars.
- Line 199: Where do these constants come from? Provided by the manufacturer or found in the literature?
- Line 215 (and later in the text): What is the reasoning behind writing 1.25^-1 and not 0.8?
- Line 248: The sentence on the 10% uncertainty due to the missing coarse mode needs a reference.
- Figure 6 and line 266: What is the reasoning of forcing the linear regression through 0? You could miss constant off-set between the different sensors. What kind of R-value do you show? What is R_adj?
- Line 273: “application” -> “deployment”
- Section 3 is a bit confusing and needs some slight refurnishing and a few clarifications. First, you mention that the system was tested in January and February 2019 but then you eventually only show one day of measurements. You could (a) show the entire comparison, e.g. how the instruments compared to the ground-based observation (as scatterplots) or how the CAMP system behaved under really cold conditions (which is not really shown but claimed) or (b) you reduce this section to just the one example day.
- Line 290: What was the mean and STD of RH during the flights?
- Line 295-299: As mentioned above, this finding is not really shown. How did you determine the 25%? Was it constant with time? Was it observed in all the instruments? What are the reasons?
- Figure 7 is also only for the 15$^{th}$ of February. As such it should be moved with its discussion to Section 3.3
- Figure 8, 9, 10 and 11 are not really CAMP-related and could be moved to the SI. Figure 10 and 11 could also be combined.
- Figure 12 and 13 are important as they show the first successfully recorded profiles. A few suggestions for improvements:
  - You could add the corresponding ground measurements to the figures as well (e.g. mean +/- std at height 0).
  - Maybe it is better to replace the label N_150 by N_>150 (since everything larger than 150nm was measured).
- To demonstrate that the CAMP system is also capable to measure under harsh conditions (one of the main features), the temperature and RH-profiles should be shown as well (in the main text or at least in the SI).
- Line 396: It is slightly inconsistent that you talk about eBC but you mainly show the particle light absorption coefficient in your profiles.
- Paragraph starting with line 408: These claims are not really shown in your result section. Please revise.
- I would suggest to rename Sect. 4 to “Summary and outlook”

- The last two paragraphs of the conclusion section could be shorted and combined. For example, by stating that first successful profiles were recorded (even with some interesting science in it!) and what the future will bring (analysis of your profiles recorded at Melpitz or in the Arctic). Please keep in mind that AMT is a technical journal. What will further technical improvements could you think off? What would be the next steps in terms of instrument development?