Review of the Light-weight Observatory Sounding clouds and aerosol, LOONISL a balloon lifted platform for atmospheric aerosol research by Valero et al. (2026)

The interplay between aerosols and clouds in the atmosphere is certainly a topic of great importance and measurements are highly lacking to uncover it. In this paper, Valero et al. (2026) described a set of lightweight instruments mounted on a balloon platform to study aerosol, clouds and trace gases providing a cost-effective approach to address the research questions. Using a set of existing and validated instruments (ECC, POPS) together with other sensors with more questionable scientific performance, the authors show a case study from the BISTUM campaign to demonstrate how the instruments can be used to study cloud-aerosol interactions. However, the study lacks a clear demonstration that the variations between aerosol and cloud concentrations really reflect true atmospheric processes rather than potential instrument artefacts. In addition, the paper does not dive into the many more data that were gathered during these campaigns, which is puzzling. Other measurements presented in this paper (ozone, CO) do not really help the authors in their scientific demonstrations but there are rather listed as quasi-independent measurements. While I believe that the LOONIS platform could indeed be an interesting system to study atmospheric aerosols and clouds, the authors have not provided enough information to demonstrate it. Thus, I do not recommend this paper for publication at this stage and more work is needed.

I will provide a more detailed review of this manuscript below.

1. The title mistakenly spells aerosol as “aeorsol”
2. The abstract starts with “High-altitude aerosol research” but most of the measurements shown here are in the lower troposphere.
3. L1: “trace substances”. Can you please clarify this term?
4. L10: I do not believe that this paper fully proves the capability of the instruments shown to study cloud-aerosol interactions
5. L26: “while aircraft-based measurements provide horizontal transects.” Not always since many aircraft campaigns have used spiral flight patterns to profile the atmosphere
6. L37: Some recent literature reviews are missing such as Dumelié et al. (2024) who showed rapid response capabilities to study volcanic eruptions and wildfires. Dumelié, N., and Coauthors, 2024: Toward Rapid Balloon Experiments for Sudden Aerosol Injection in the Stratosphere (REAS) by Volcanic Eruptions and Wildfires. *Bull. Amer. Meteor. Soc.*, **105**, E105–E120, https://doi.org/10.1175/BAMS-D-22-0086.1.

7. L73: The structure of the sentence describing the BISTUM campaign could be improved by separating it into two parts.
8. Figure1. The rational for placing the instruments in this configuration is not fully explained.
9. Table 1. It is not clear why some instruments are “optional” and others are not.
10. Table 2. The FLW-122 Thermal flow device is included with the UCASS to improve the calculation of the concentration based via flow measurements rather than relying on ascent rate derived from GPS data. However, it is not clear to me how the device is further validated for balloon flight applications. Were there pressure tests conducted to further characterize flow measurements of this device relative to other systems?
11. A fundamental aspect of developing a system for atmospheric study is to demonstrate how balloon operations fit in different countries. L92-93 provide very limited information about balloon operation in Europe but the legislation might be different in other countries. Does it mean that the system can only operate in Europe which would limit the science that can be addressed ?
12. L95. The UCASS instrument, to my knowledge” has not been validated for atmospheric measurements. But I also realize that very limited sensors have been used for cloud measurements. Nevertheless, additional efforts are needed to further validate the system, and the installation of a flow meter is probably only one aspect of the problem. While L108-116 describes some comparisons between the UCASS and other sensors for dust, it is not clear how this can be extrapolated to study water or ice clouds.
13. L124. It is not clear why the author mentioned that the flow sensor is only valid up to 7.5km. Please further explain
14. L137. How did the validation of the UCASS were done with theoretical calculations. Why not use traditional aerosols such as PSL to perform the calibration ?
15. POPS paragraph. It is not clear why a refractive index value is introduced here while it is explained that POPS is calibrated with PSL. Please clarify.
16. L162. What do you mean by “clean environment”, do you have a quantitative number for the presence of aerosols?
17. The section on the impactor does not provide any references. Did you build the system or was it purchased from a private company ? Some references or documents about the impactor should be provided.
18. The alphasense CO-B4 results are not surprising and does not really add much to the study but rather confirm that these systems cannot be used for atmospheric applications. I’m wondering if this section should remain or be included in supplementary materials.

19. L235. SEM/EDX. The paragraph on SEM/EDX is interesting but does not really address some of the important limitations of the technique. Indeed, the technique is highly dependent on the operator and can only be used to detect a part of the aerosol population on the filter which may not be representative of all aerosols present. In addition, the author does not really explain how composition measurements can be used to help with other measurements and correct issues with calibration, especially with OPC measurements.
20. At the end of section 3, the authors have still not fully explained the science objectives for developing LOONIS and the science questions they will address in this paper. There is limited rational to explain how the campaign location was picked up and if the deployment aimed to study convection. We have the impression that the instrument and platform were picked up before looking for science questions and motivations. I believe that the authors need to strengthen the motivation of science for their work.
21. L268. The authors mentioned that "This choice allows for a clear characterization of aerosol nucleation processes…". However, there is no instrument on the platform that allows them to measure freshly nucleated particles (few nm) since POPS starts making measurements at 150nm.
22. L295-L305. This paragraph would be more easily explained if described in a schematic.
23. Figure 5. Why the authors do not show data above 2.5 km
24. L325. Please further explain this sentence. How Schon et al. (2024) noted that the UCASS recorded higher concentrations only in the range 2.12-2.36 micron?
25. Figure 7. Is there a way to derive an error bar for the LWC profiles?
26. Figure 8. One of the main conclusions of the paper is related to this figure which seems to indicate that POPS and UCASS are anticorrelated, suggesting that some aerosols may have served as CCN for cloud formation when RH>100%. Why might it be possible, the authors do not really discuss potential artefacts of POPS in cloudy conditions. It is also surprising to see that the upper part of the cloud which undergoes lower RH is also the place where most of the aerosols seem to be depleted. Could the author provide an explanation?
27. Figure 10. There is a large bias between the two versions of UCASS. Is there a reason for that?
28. Ozone analysis is somehow out of the place in this study and should be removed and included in supplementary materials. Otherwise, it would be interesting to discuss how ozone variation between 0-2500 m relates to other variables.