

The manuscript by Broda et al. describes a new balloon-borne system for vertically resolved observations of aerosol optical properties. As the authors explain, this system incorporates low-cost sensors and can be operated on tethered balloons, UAVs, and radiosondes, meaning that the system can be reusable. This study is well aligned with current research needs for cost-effective in-situ observations that can support the validation of ground- and satellite-based lidars. I would therefore recommend publication of this manuscript after considering the following minor comments.

General comments:

- 1) Considering the horizontal displacement between lidar and the AeroSonde, I would say that the orography of the region would play an important role on the stratification of elevated layers. Therefore I would recommend that the authors include an orographic map of the region, and further explain why they assume that the horizontal displacement can be neglected. This assumption is also made for the wind field (assumed to be horizontally homogeneous), which based on the orography could be wrong.
- 2) The lidar processing section has a remarkable level of detail which is really appreciated and provides an example for other research papers dealing with lidars.
- 3) It would be beneficial for the discussion of this manuscript if the authors could discuss whether AeroSonde could be improved with integration of additional sensors e.g. particle sizer for coarser particles

Specific comments:

- 1) Lines 26–28: ‘Ground-based and satellite-borne lidar systems have been widely employed to retrieve extinction, depolarisation, and absorption profiles (Mulena et al., 2024; Lin et al., 2023; Chen et al., 2024; Mhawish et al., 2020).’. In the cited references there is no evidence that lidar was used to retrieve absorption profiles. It would be great if the authors can provide a reference for this, otherwise remove the absorption profile.
- 2) Lines 115–117: This section includes both remote-sensing and in-situ instruments. I suggest clarifying this distinction in the introductory sentence, as the lidar and sun photometer are remote-sensing instruments, whereas the Aethalometer, nephelometer, and LAS are in-situ instruments.
- 3) Line 148 and 513: remove parenthesis inside parenthesis
- 4) Line 195: Please clarify the use of MHz in the analog–photon-counting merging procedure. I assume that 5–10 MHz refers to the photon-counting count rate rather than the signal frequency.
- 5) Lines 254–255: Was this assumption tested by the authors considering the complex terrain (elevation variations) of the region?
- 6) Figure 2a: Several points between PM₁₀ = 10–20 µg/m³ appear to deviate from the fitted regression curve. Have the authors investigated these outliers and their possible origin?
- 7) Line 418: Aerosonde > AeroSonde for consistency
- 8) Figure 7b and 10b: Would a logarithmic axis improve the visualization and make the different particle-size ranges more easily distinguishable?

9) Lines 467-469: This appears to be the first mention of the AERONET quality criterion applied to the SSA retrievals. I suggest introducing this criterion earlier in the data section.