

Title: High-Resolution Boundary-Layer Detection Lidar for Spaceborne Applications: Parameter Design, Theoretical Simulation, and Airborne Validation

This manuscript presents parameter design, simulations and two aircraft experiments intended to support future spaceborne lidar missions targeting planetary boundary layer height detection. The engineering content is of interest, and an initial framework is built. However, the link to a spaceborne lidar is weak at this point and the framework is far from mature with associated uncertainties not evaluated at a realistic level.

Major comments:

Different units are used for radiance in Fig. 2 and 3 and they are not equal. The range of radiance values differ by an order of magnitude, consistent with the different units used in these figures. However, the range of 0.002-0.012 is from Fig. 3 while units are from Fig. 2 on line 204. That means a much smaller range (upper end 0.012 vs. 0.12 W/m²/nm/sr) was used to determine background photon count rate. If the upper end is supposed to be around 0.12 W/m²/nm/sr, the maximum of background photon count rate should be around 7500 kHz instead of 750 kHz given on line 205. The simulations using 250 kHz would need to be rerun and reevaluated.

The setup of MODTRAN simulations is oversimplified (Fig. 3). In addition to albedo, radiance varies with parameters such as solar zenith angle, view geometry and aerosol model. The sensitivity of radiance to these parameters should be tested to provide a more realistic assessment.

The intended orbit and local time of the proposed spaceborne lidar is never stated, the choice of which can change the noise budget significantly and the scientific goals that can be achieved. In the manuscript, noise assessment is benchmarked against MERSI-LL aboard the FY-3E, which is an early morning orbit. Without more details regarding the proposed lidar, it is difficult to judge if the noise assessment is thorough.

Eq. (2). Potential impact of multiple scattering should be discussed here.

The Hainan experiment is more of demonstration of challenging scenarios rather than any improvement of BLH detection in difficult environment, which should be acknowledged in the summary section.

Minor comments:

Line 200: Detailed assumptions on parameters used to run MODTRAN should be given.

Line 214-215: Why only one day of data was used for each season? Was there any evidence to support that statistics is as robust as using a full year of data?

Line 402: number missing before kHz

Fig. 9 was mentioned in text before Fig. 8. Switch their figure number.

Fig. 11(b). what do red and blue lines indicate, respectively?

Fig. 16. This figure does not meet publication quality. Resolution is too low and font size should be increased. Caption is not complete.

Line 576: this is an overstatement. The existence of clouds and complex aerosol conditions are common in nature, which can pose significant challenges for BLH detection as authors have shown with their Hainan experiment. A paragraph is necessary in the conclusion section to be clear about limitations.