Review of ‘A Compact Rayleigh Autonomous Lidar (CORAL) for the middle atmosphere’ by Kaifler and Kaifler

General comments

This paper describes a novel autonomous lidar for temperature retrievals in the middle atmosphere that will assist studies of atmospheric processes on a wide variety of timescales. The description of the architecture and methods employed conveys that the instrument is an advance for the field and is able to enhance opportunities for data collection through automation. This description will be of interest to other workers in the field of middle atmosphere lidar by providing a practical basis on which to tackle the vexed issue of maximising the scientific return from high power-aperture product lidars.

I recommend the work for publication after the authors address the specific and technical comments below. These comments are made from the perspective of someone familiar with the practicalities of middle atmosphere lidar in order to engender into the manuscript additional information to more adequately describe the system and methods employed. The standard of presentation and grammar of the manuscript is very good, the figures and tables are appropriate and concise, and the methods used and their description are sound. Overall, I regard that addressing the following comments will constitute a minor revision of the manuscript as significant rewriting and figure changes are not needed.

Specific comments

Abstract: The third sentence indicates that the first studies with CORAL show the impact of a strong gravity wave event on stratospheric circulation. I initially took this to mean that this paper included this analysis, but after re-reading the Discussion section I see that this is done in earlier papers. I suggest that the 3rd sentence of the abstract be modified to make this clearer (e.g ‘First studies using CORAL data have shown for example…).

L87. Please quantify the typical shot-to-shot beam pointing stability of the laser beam after divergence and comment on how this compares with the field of view of the telescope and the divergence of the transmitted beam.

L102. What is the blocking level of your Raman filter at 532 nm?

Section 2.2. Given that the arrangement of the receiver and transmitter are bistatic and that the field of view of the telescope is small (370 μrad), the effect of any significant change in focus will depend on how the response function of the field of view changes and the response function of the field of view. How is the field of view of the telescope practically determined (theoretically or measured)? Please comment on the stability of the telescope focus (e.g. the significance of changes due to thermal effects) and how you determine best focus. Please also comment on if and how you can determine the significance of any range-dependent effect on the retrieved temperature profiles due to focus change.

L98 (or thereabouts). Please indicate what the expected altitude for full overlap between the fields of view of the transmitter and receiver (presumably below 14 km).

Table 1. What is the quality of the surface of the telescope in terms of RMS surface deviation (in wavelengths) from an ideal paraboloid?

Section 2.3.1. Given that the arrangement of the receiver and transmitter are bistatic, I expect that clouds cause the conscan method to optimise the overlap for lower altitudes. Is that correct and might this cause any issues with data collection? Do you use any data in cases of cloud (even thin cloud)?

Section 2.3.1. While you have a cloud-monitoring camera (discussed later) it would seem that introduction of a pellicle beamsplitter in the telescope before the fiber would allow you to monitor the quality and stability of the received beam (e.g. as done in Innis et al., 2007 - https://doi.org/10.1117/1.2801411). Could you please comment on the usefulness or otherwise of such an arrangement for data quality control.

Figure 8b. What is the range and time separation for the SABER profile relative to the lidar measurement? Why not show a measurement centred on the time of the ECMWF profile, or is the SABER profile more coincident? What is the source of the ECMWF profile (forecast or analysis) and what is the horizontal grid resolution of the ECMWF data and separation from the measurement site?

Section 4. Given that you can be seeding at altitudes of 100 km or above (e.g. Fig. 12b and line 355), do you take into account the change in the mean molecular mass of the air in the MLT region, and if so, how?

Figure 12. Is the seeding altitude at the top of the retrievals in panels (b) and (c) or has allowance been made for convergence of the retrieval?

L352. You are describing your retrieval method in fairly general terms and I would recommend that you are more specific, referencing earlier work as necessary or expanding Section 4 to more fully explain the particular criteria and assumptions that you are using. What are the coincidence criteria that you apply in the use of satellite data for seeding? Do you account for bias in the seed temperature? The averaging kernels of the MLS measurements are coarse compared to SABER in the MLT. When would you use MLS measurements to seed the profiles? How do you determine what effective height to assign to the seeding temperature obtained from MLS given that the vertical resolution of the lidar data is much less than the averaging kernel of the MLS retrieval (8-10 km)? Is the 100-108 km altitude range within the recommended upper limit for scientifically useful MLS data at your site. Is there a suitable MLS profile you can show in Fig. 8?

L360. Can you please indicate what the SNR threshold for the far-channel corresponds to as a relative uncertainty in pseudo-density (e.g. section 1.2 in Wing et al., 2020 - https://doi.org/10.3390/atmos11010075 and Alexander et al., 2011 - https://doi.org/10.1029/2010JD015164 who use 20% and 10% for their seeding threshold, respectively)?

L379. By reference to earlier analysis of CORAL data, please indicate if any significant tidal signatures are present in the MLT data in Fig 12c and what characteristics of the temperature variations allow you to conclude a 5-7 hour period internal gravity wave is present (e.g. downward phase progressions or narrow duty cycle, perhaps highlighting with dashed lines).

Technical comments

L12. Define ECMWF (done at L280, so will need to adjust at that point too).

L37. CORAL likely needs to be defined (again).

L38. ‘atmospheric’ rather than atmosphere.

L39. Consider a gender-neutral alternative to manpower (e.g. ‘human effort’).

L70. Define DLR.

L71. Define DEEPWAVE.

L77. Depending on the style requirement of the journal, may need to spell out 8’ as 8-foot. If this is a standard size, perhaps indicate 8-foot ISO container, and define ISO.

L105. photomultiplier (as one word)

L106. interference filter

L421 IFS is spelled out unnecessarily (see L280).