Atmospheric Measurement Techniques Discussions

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Comment on amt-2021-310

Anonymous Referee #1

Referee comment on "Estimating the uncertainty of middle-atmospheric temperatures retrieved from airborne Rayleigh lidar measurements" by Stefanie Knobloch et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-310-RC1, 2022

This paper focuses on the retrieval of middle atmospheric temperatures from the backscatter signals of an airborne Rayleigh lidar system. The technique was introduced forty years ago by Hauchecorne and Chanin (1980). It has been in operational use for more than 30 years at a number of stations, e.g. within the Network for the Detection of Atmospheric Composition Change (http://www.ndacc.org). Essentially, the paper re-iterates data analysis considerations that have become standard for many years. So nearly all results presented in the paper have been well known in the scientific community: Ozone absorption needs to be accounted for, or will introduce a bias (Leblanc et al. 1998; Sica et al. 2001). Uncertainties introduced by photon noise, background light, counter non-linearity, Rayleigh extinction are all well known and extensively discussed, e.g., by Leblanc et al. (2016). Lidar return signals have been simulated, and retrieval algorithms have been tested by Leblanc et al. (1998, 2004). Modern optimal estimation algorithms for temperature retrieval from Rayleigh lidar signals are given by Sica and Haefele (2015), and Jalali et al. (2018).

I did not understand the attempt to quantify signal-induce-noise (SIN) in section 4.4. I am not sure if SIN can be detected in this way. A more standard way would be to look at the decay of the background for varied maximum light exposures of the photo-detector.

Unfortunately, overall, I see very little new scientific findings in this paper, and feel that very major revisions are needed, before this is acceptable for publication in AMT.

What is new:

The comparison of observed, simulated, and ERA-5 analysed temperature waves in Fig. 4 is new and interesting. It shows the capabilites of the airborne lidar to observe large gravity waves over one of the worlds hot-spots. This is worth presenting, maybe expanding.

The claim that the skewed Poisson statistics of photon counting introduce a high bias in retrieved density and a low bias in retrieved temperature is new to me, but not explained very clearly. I would expect that this bias would be within the estimated uncertainty, and would only be significant at very low total photon counts. However, it would be interesting to have a more detailed look at this.

In summary, I suggest major revisions for this paper. All the parts that re-iterate well known facts, already described in, e.g., Leblanc et al. (2016) should be dropped, or should be shortened to a few paragraphs. The focus of the paper should be on the new findings, e.g. those I mentioned above. Most AMT readers have little time, so new papers need to be concise and need to present important new findings only.

References:

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