Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
https://doi.org/10.5194/amt-2021-229-RC1, 2021

Comment on amt-2021-229

Anonymous Referee #1

Referee comment on "Differential absorption lidar measurements of water vapor by the High Altitude Lidar Observatory (HALO): Retrieval framework and validation" by Brian J. Carroll et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-229-RC1, 2021

Review for "Differential absorption lidar measurements of water vapor by the High Altitude Lidar Observatory (HALO): Retrieval Framework and validation" by Brian J. Carrol et al.

This paper describes the retrieval strategy for water vapor profiles using the HALO lidar instrument. Data from HALO and validation of the data is presented.

Overall, this paper, as part of a series of planned papers, provides a detailed overview of the HALO instrument which can measure any two of the three including water vapor, methane, and aerosol backscatter using the DIAL and high spectral resolution lidar measurement techniques. This series of papers will be important touchstones for the HALO instrument which has the potential to play an important role in atmospheric science field campaigns.

Detailed Comments:

Line 120: Because of issues with the dropsondes, quantitative water vapor profiles between the DIAL and radiosondes could not be done. This is a major weakness of this paper. Can the authors speak to future plans for DIAL/Sonde comparisons?

Line 185, the DIAL equation.

The references:

- A. Theopold and J. Bosenberg, "Differential Absorption Lidar Measurements of

Atmospheric-Temperature Profiles - Theory and Experiment," J Atmos Ocean Tech 10, 165-179 (1993).

- Bosenberg, "Ground-based differential absorption lidar for water-vapor and temperature profiling: methodology," Appl Optics 37, 3845-3860 (1998).

developed a methodology for the DIAL technique that accounts for the Doppler-Broadened Rayleigh scattering. In this development, one can not simply use a modified cross section to account for the Doppler broaded molecular scattering. How do the authors justify using the DIAL equation with the modified cross section and how does that compare with the results from the above two references?

Line 204 What is the physical reason for the 1.5 exponent in the delta r term?

Line 240: How was the random error plot generated i.e. what random errors are included here.

Line 264: If detection is limited to 15 m due to the electronics, how can you get a 1.5 m resolution?

Line 284: Having the instrument paper would be a useful compliment to this paper. I am not sure about the reference here to an as yet unpublished paper. Could you say more about the status of this instrument paper?

Line 314: Please add a reference for self-broadening calculations.

Line 379: How do the choice of the OD theshold values affect the retrieval? Will non-experts in lidar be able to do this manual inspection and can this be automated?

Line 413: Do you have any evidence that using the surface reflection over land or the reflection for cloud tops can be used to retrieve the water vapor mixing ratio in the lowest range bin? With what accaurcy can you expect to retrieve water vapor inthe lowest range

bin over land or cloud top?

Line 436: How do errors in the assumed temerpature profile affect the accuarcy of the Doppler correction factor and overall water vapor retrieval?

Line 475: When reporting the accuacy of the water vapor retrieval near the surace of less than 15% -- was this only over water? If so please state.

Unfortantely, the issue with the dropsondes results in the validation consisting of one profile comparison with the DLH profile that resulted from a spiral desent of the aircraft. The comparison of the first range bin of the HALO with the DHL and the comparison of the pericitable water vapor show good agreement, but comparison with the DHL and HALO have a 400 m offset, coparison with the pwv from satellite based measurements will result in a dry bias for the HALO instrument since it misses the pwv above the aircraft, and comparsion of the satellite profiles and HALO are qualitative at best due to the spatial reolution of the passive sensor. This results in a non ideal set of measurments for validation. While this paper is still publishable and, I feel, should be published, I hope to see follow on validation efforts based on sonde profiles.