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Atmospheric Measurement Techniques Discussions

Interactive comment on "Temperature and water vapour measurements in the framework of NDACC" *by* B. De Rosa et al.

Anonymous Referee #1

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This article presents the uncertainties associated with the BASIL lidar following its entry into the NDACC network. The lidar operated on a weekly basis between November 7, 2013 and October 5, 2015. The announced accuracies for the lidar system are extremely high with biases of 0.1 K and 0.1 g kg-1 for measurements between the surface and 15 km altitude for water vapour, and between the surface and 50 km altitude for temperature. These values are obtained for a temporal resolution of 2 hours and a vertical resolution of 150 m, both day and night.

While the BASIL instrument is of undeniable interest to the international scientific community, it is not presented here in a relevant way.

I find that biases are underestimated and the approach to estimating them needs to be clarified. The main points that make me doubt the results are listed in the following:

- The profiles used to calibrate the lidar are not explained, how many times this calibration had to be repeated during the measurement period. How stable is the calibration over time? Is there not an influence of the aging of the components, of the effects of temperature, for example during the succession of seasons?

- If the lidar has been calibrated compared with modelling data, is it not normal that the biases are small? AIRS, IASI, radiosonde and model data are not independent. AIRS and IASI operate on a similar way with average kernel leading to $\sim$2x higher vertical resolution for IASI. Radiance data are assimilated into the model, just like radiosonde data, so the reference profiles are not independent.

- How can such low biases be explained given that the profiles referred to are associated with much higher biases. For example, statistical studies on a large number of radiosondes have shown bias in the order of 0.4 g kg-1 and 0.5 K. For IASI we are on 0.5-1 g kg-1 and 0.5-1 K depending of the kernel averaging function.

- Why limit yourself to 4 case studies? This considerably limits the investigation and makes the statistical study unrepresentative. The argument developed at the beginning of section 6.1 is not relevant.

- The BASIL lidar has integrated the NDACC network which already contains other water vapour and temperature lidars. It would therefore relevant to compare the accuracy of these different lidars with that of BASIL.

- To improve the clarity of the study, 2 sets of profiles should be defined. The first set would be dedicated to calibration and the second to the study of biases and standard deviations.

The authors place their work so heavily that they forget the existence of works conducted by other teams around the world. There were other NDACC publications, other cross-comparison exercises using Raman technology, very extensive studies on the representativeness of radiosondings and comparisons to modelling.

Specific comments

Abstract. It must be revised after taking into account the previous remarks. Repetitions should be avoided (L17). The end of the abstract is reminiscent of circular reasoning. Can an absolute bias be negative?

Introduction P2L21. The cost of a radiosonding is about 250 €Ìs a lidar competitive at this level, especially for the upper troposphere and stratosphere? P3L5. Perhaps there is an overlap factor? P3L10-11. Not necessary because it is not a paper topic.

Section 2 It would be interesting to have a table that summarizes the main characteristics of the lidar. P3L28 and 29. Typography

Section 3.1 P5L5. There are much earlier references. P5L12. For numerical weather forecasting, IASI inversions are not used, radiances are assimilated directly.

Sections 4.1, à 4.3 These sub-sections are already very well known, it is enough to highlight the sources in order to simplify the article. The important point is the calibration which needs to be clarified. The choice of a two-parameter temperature adjustment function must be justified. This type of adjustment does not guarantee optimal accuracy, it is preferable to use functions with 3 parameters, especially with a wide temperature range. It is surprising to obtain such low biases with this type of function.

The method developed by Auchecorne et al. is already well described and the error sources have been seriously studied and evaluated. Instead, errors should be discussed in this section because the results are very dependent on the lidar used (e.g. the optical filtering technique used). The methods developed by the pioneering authors are to be considered but applied to the BASIL lidar. There is no reason to achieve the same levels of error.

Section 4.2.2 P9L20. How is this altitude interval justified? This is a critical point to reduce the uncertainty random and it must be justified for each lidar. P10L6. Maybe a little less, 80 km on average? P10L10. It is not the good term P10L23. It is mainly

due to the stability of the equation which limits the error propagation. Equation 16. Subscripts are missing Equation 17. Idem. Are you sure about this relative RMS calculation? You do a simple average on RMS. P12L12. What type of interpolation? P12L13. The bias is signed, so it is not absolute. P13L14-15. Already explained above. The first paragraph of section 6.1 should be put before. P14L6. How are such values calculated? P14L21. What type of numerical filter? P21L9. There have already been cross-comparison studies of IASI and Raman lidar that reveal such differences in the ABL; differences due to the characteristics of IASI. Maybe you should talk about it.

Section 6.3. This paragraph is cumbersome to read and could be greatly reduced with a better synthesis.

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