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Interactive comment on "Water vapour profiles from Raman lidar automatically calibrated by microwave radiometer data during HOPE" *by* A. Foth et al.

Anonymous Referee #2

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The manuscript presents a method to derive water vapour profiles from Raman lidar measurements calibrated by the integrated water vapour (IWV) from a collocated microwave radiometer. The results presented in this study evidence the capability of the synergy of Raman lidar and microwave radiometer measurements to provide water vapour mixing ratio profiles under different atmospheric conditions. I think that the topic is within the scope of this journal. From my point of view, one important point which should be assessed is the errors associated to consider a constant calibration factor during the whole campaign, evidencing the advantages of the IWV method again the traditional calibration with radiosondes. The duration of the campaign and the avail-

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ability of radiosondes allow this kind of analysis. In the current state of the paper, only one case has been used to compare the agreement between the different methods (regression, profile and IWV methods). Moreover, although the advantages of used IWV method could be clear, I consider that should be proven the necessity of this method (continues calibration), since it also implies the necessity of two instruments measuring at the same time (which is not positive aspect) to retrieve water vapour profiles.

Next I indicate some specific comments:

Page 6568, lines 19-20: "Its amount in the atmosphere is controlled mostly by . . ." , please add a reference at the end of this sentence.

Page 6570, lines 4-5: Replace " to apply a calibration method which is .." by "to apply a Raman lidar calibration method . . .".

Page 6571, line 3: I miss a short description about the lidar wavelengths involved in the water vapour retrievals.

Page 6571, line 20: Which is the time and temporal resolution for the water vapour profiles from BASIL? I guess that the resolution that the authors give is the one for the raw data.

Page 6572, line 5: "The MWR is a passive instrument that measures atmospheric emission at two frequency bands . . .". In the way that you claim that it seems that it is the general definition of MWR, but it is not true, it is just the characteristics of HATPRO radiometer. So please, clarify this point.

Equation 1: It would be more clarifying to indicate on the right side of the Raman lidar equation for inelastic signals the term correspond to the emitted laser power at wavelength $\lambda 0$.

It is not clear how you reach equation 3 from equation 1 and 2 if you don't mention that the water vapour mixing ratio is proportional to the ratio of water vapour and nitrogen molecular number density.

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Page 6574: The paragraph where the calculus of the particle extinction coefficient is described should be clarified a little bit. In the way that is now written, it is not very clear if you use the backscatter coefficient to infer the extinction coefficient in the whole range or only in the lowest part.

Page 6577, line 11: I guess that both criteria should be fulfilled simultaneously, am I right? Please clarify that in the text.

Page 6577, line 24: please correct: "The relative difference between these methods amount to . . ."

In section 3.1.3 there is not any mention about the assumption in the overlap region with the lidar. There is no any evaluation of the uncertainties of the method due to consider a constant value in the lowest part (400 m for Polly). It would be very interesting this kind of assessment.

Section 3.2: The results shown in Figure 5 are not sufficiently described. There are many vertical gray dashed lines in the plot, however there is a big change in the value of the calibration constant that is indicated by the black and the red line. Please include the discussion and the information that was already indicated in the legend of the Figure. For me it is not clear if all the vertical grey dashed lines (they have different thickness) correspond with changes in the alignment of the system.

Section 4.3: I would like to know the number of radiosondes used in the comparisons, since you are comparing several lidar profiles with the same radiosonde.

Figure 9: It would be also interesting to show the standard deviation of the bias profiles for the different trajectories.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6567, 2015.