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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the vertical distribution of smoke in the Amazonian atmosphere during the dry season" *by* F. Marenco et al.

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Response to Referee #2

We wish to thank the reviewer for his or her positive comment on this paper and his or her advice on how to improve it. In what follows, we address the points suggested by the reviewer:

Introduction: Amazonia vs. Southern Amazonia: we will reword the introduction accordingly.

Methodology – choice of reference value: the reviewer asks how the reference in the far

range of the lidar profiles is chosen and why. This has been done using a new and non-standard method, which is dictated by the nadir-viewing geometry of the experiment (as opposed to zenith-viewing which is usually used with ground-based instruments). This method was described in a previous paper (Marenco, 2013), and a few examples using actual and simulated data were shown in that paper to justify the use of this method. Basically, the problem is that the forward solution in this geometry and at this wavelength is extremely unstable, to the point that it can't be used when an aerosol layer is deep and the extinction is large. The main concepts of the method are summarised in the manuscript (section 3.2), and the full detail can be found in Marenco (2013). Marenco et al (2014) also illustrates the application of the method in a comparison with CALIPSO retrievals, whereas in the present paper we use it on a larger scale. The method makes use of the slope method for a first estimate of the extinction coefficient at the reference interval. This is equivalent to the assumption of a well-mixed layer, but in that paper it is demonstrated that the method gives reasonable results if the reference is chosen within an aerosol layer avoiding its boundaries. The reviewer also asks to better specify the 50% uncertainty set for the reference value. This number cannot be evaluated from the measurements and needs therefore to be assumed. We have chosen a 50% statistical error (1-sigma) to indicate the possibility that we have a very large misjudgement of the reference value. Note that this is equivalent already to a very large total error (3-sigma=150%). As the results show, fortunately, however large this error it quickly decreases to very small values when moving inwards towards the lidar.

Methodology – choice of reference value: the reviewer asks if we use a priori information (e.g. surface observations) to set the reference value. The answer is "no": lidar data only are used, and it cannot be otherwise because the aerosol is variable in time and space, the airplane travels thousands of km, and few ground-based sites are available in this region. In Marenco et al (2014), however, the reviewer can find a comparison of measurements with the unconstrained method and measurements constrained with AERONET: the constrained measurements fall within the estimated error

range. The reviewer also asks if we “change everything until in clear air regions the Rayleigh value is obtained”. The answer to this second question is as follows: (1) the reference value is selected independently of Rayleigh scattering; (2) in the first iteration (see section 3.1), the lidar ratio only (not the reference value) is varied until Rayleigh scattering is matched in clear air; (3) then a second iteration (section 3.2) is done using the selected reference and the average lidar ratio that was found in the first iteration.

Comparisons of the method with the Manaus lidar and CALIPSO: we unfortunately have not done coordinated measurements with the ground-based lidar, but we have indeed a comparison with CALIPSO that can be found in Marenco et al (2014). In the revised version of the paper, we shall remind readers of this previous use of the inversion method.

P. 31742 L. 5-18: Thanks. We shall add the reference suggested and mention ice-smoke interactions.

P. 31745 L. 3: Both photon counting and analogue are used in the Leosphere lidar, and they are glued at pre-processing. Gluing is done by choosing an overlap area based on photon-counting thresholds, and normalising the signals to each other in that area.

P. 31749 L. 10: We are unsure what is the doubt expressed by the reviewer. For each vertical profile, we use the maximum of the extinction coefficient (the peak extinction) and the columnar aerosol optical depth (AOD) and then use the formula indicated in the paper to evaluate the layer depth. We cannot find the typesetting error suggested. This definition of layer depth yields quite stable results (i.e. less noisy than FWHM).

P. 31754 L. 11: This description will have to be reformulated as suggested by referee #1. In any case, if a plume has small horizontal or vertical dimensions and the model resolution is coarser, then it is more likely to be captured at the nearmost gridpoint than if the resolution is high.

Figure 12: When preparing the new version of the manuscript, we will consider the

possibility of moving the discussion earlier than in the conclusions. Thanks for this suggestion.

Technical suggestions: fully agreed.

Many thanks for your time!

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 31739, 2015.