Review of „Retrieval of Temperature from … by optimal estimation method“ by Mahagammulla Gamage, et al.

The paper describes the temperature retrieval by lidar using the optimal estimation method. Four different cases (each day / night and clear / cloudy) from Payerne station are used to demonstrate the feasibility of the method. While the OEM method for temperature retrieval is not entirely new and the first and third bullet point of the conclusions may be found elsewhere, the paper as a whole contents enough information for publishing. It is generally well written and well structured. The 4 selected cases are new and demonstrate the usage of the still not too far spread OEM technique.

I have a short list of questions and remarks to the author which should be clarified prior to publishing:

You show a complete error analysis for the OEM technique, which I found convincing. However, to better judge these results it would be very interesting to have a similar error estimation for the traditional Raman technique. Especially in your case 1 fig. 4 it seems as if the Raman result is only plotted up to 12 km although in the manuscript a change of vertical resolution in this altitude is mentioned (page 11). Can you comment on this?

Do you assume the same overlap for both channels? Why do you need the overlap? Do you really think to be able to retrieve the overlap with the required precision to obtain aerosol extinction information? In this case an error analysis would be required, otherwise revise your wording. I think for this paper such an effort is not necessary – as the particle extinction is the same for the high and low channel, hence the temperature from the OEM should not depend on the extinction?

Page 11 and Fig. 5: your error analysis is nice and one of the strong selling points of this paper. However, in the current form I cannot reproduce the values. A bit more information is required, how the values were obtained.

Minor points:

Page 1 quote Mahagammulla Gamage: I think in the introduction it is not necessary to quote a paper which is still under preparation. You may choose another quote here

Page 3: (and elsewhere) is d sigma / d Omega really the ATTENUATED cross section? I am not sure, as you have Gamma^2 as extinction term in your eq. 1.

Page 4: explain x_a in eq. 7.

Page 5: minus sign in eq. 8 is missing

Page 9: 2 times “from” in line 14

Page 10, fig. 1: is the units of your analog signal MHz, how did you convert it?

Page 11: line 13: reduced

Page 13: line 4: agrees, line 4: deviates

Page 19: a lidar ratio of 5sr is already quite small, can you estimate an error for the lidar ratio?

Page 20: line 8: “by” missing … that by the OEM method; line 9: I don’t understand the “temperature range” – I thought the OEM only depends on K and K_a?

Page 21: line 11: what do you mean be “uncorrected” PRR measurements?