Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-117-RC3, 2018

Atmospheric Measurement Techniques Discussions

Interactive comment on "A middle latitude Rayleigh-scatter lidar temperature climatology determined using an optimal estimation method" *by* Ali Jalali et al.

Anonymous Referee #3

Received and published: 12 June 2018

This manuscript describes climatology of Rayleigh lidar temperature using an optimal method. The method is not new. It was described in Sica et al. (2015), but this is the first time that an OEM method is applied to a long lidar data set to derive a temperature climatology up to the lower thermosphere. Compared to the classical Hauchecorne and Chanin method, the OEM methods allows extending the temperature profiles upwards by 5 to 10 km that is very interesting for MLT studies and it provides a more rigorous estimation of all uncertainty terms involved in the lidar equation. This paper will be useful for other lidar groups that would like to apˆly such a method. I recommend its publication after taking care of comments below.

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The two main comments are: Page 3, Table 3, 0.2% for uncertainty on air number density taken from CIRA-86 seems unrealistic. Due to the variability of the atmosphere, it should be in the same order than the a-priori uncertainty on pressure profile, around 5%.

Page 11, Figure 5: I do not understand why all error terms (except the gravity) are increasing with height above 60 km. The proposed explanation on page 18 for the increase of the uncertainty due to ozone cross-section is via the upward integration of the transmission integral but above 60 km the transmission is very close to 1 and I do not expect any effect. Please clarify.

Additional comments Page 2, lines 24-25 : Something is missing on the sentence “They also discovered . . .. than the models”. Pleas rewrite.

Page 4 equation (1): B may depend on altitude if there is some signal induced noise and should be written B(z.)

Page 6, line 26: Please define what is the “lidar constant” for non-specialists.

Page 7, line 4: The a priori variance for CIRA-86 is expected to increase with altitude. Climatology is based on less information at higher altitude.

Page 15, lines 20-23: The proposed explanation for the warmer OEM temperature than HC temperature from 40 to 60 km is probably not the differences in ozone profiles that contribute only to 0.05K, one tenth of the observed bias. Is it possible that the smoothing procedure has an impact on the retrieved temperature at the stratopause?

Page 17, line 3-17: I am not sure that the better agreement between sodium lidar and OEM is significantly better than between sodium lidar and HC. First the differences are not so large, HC difference is 1.2 K warmer than OEM difference on average, and second part of the difference may be due to the distance between the sodium lidars and the Rayleigh lidar.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-117, 2018.

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