

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

## **Anonymous Referee #2**

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This paper applies the novel optimal estimation method (OEM) for temperature retrieval of Rayleigh lidars to a long-term dataset, finding that it allows retrieval of additional 10–15 km of temperature data above the cutoff height necessary when using the traditional method by Hauchecorne and Chanin (HC).

The optimal estimation method was first applied to Rayleigh lidar profiles and evaluated in great detail by Sica and Haefele, 2015 (SH2015). In the current paper, this method is applied to an updated Rayleigh lidar climatology published by Argall and Sica, 2007 (AS2007).

The purpose of this paper is not totally clear. It reads very technical and is strongly fo-

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cused on the methods, however it does not seem to add substantial new work regarding the methods compared to SH2015. The dataset used is extended from AS2007, and the methods applied therein are repeated. The fact that an additional 10-15 km can be gained must be attributed to SH2015. The scientific value therefore lies in the temperature climatology in this 10-15 km (which I think is rather 5 km looking at Table 4) wide altitude range in the mesopause region (and the fact that finally the gap between Rayleigh and sodium temperatures is closed). However, no detailed geophysical interpretation and discussion on the implication of these newly retrieved data is included, however. The demonstration that a method valid for single profiles is also valid for a long-term dataset does not make a very strong point, in my opinion.

Perhaps by design, the current paper shows very strong resemblance to SH2015 and AS2007, the latter being cited eleven times. Almost all of the work seems to be reproduced from these two papers, either repeating equations, lists or arguments, or reproducing the same figures with updated datasets. For example, equation 1, 2, 5, 6 are taken from SH2015 (eqn. 1, 3, 8, 9), Table 1 and 2 are updated from AS2007, Fig. 3, 4, 5 are reproduced matching AS2007 (Fig. 1, 3, 6). The numbered list in 3.1 is taken from SH2015, the numbered list in 4.2 is rewritten from AS2007 (section 8), section 4.2 is very similar to AS2007 (section 7). Even the same nightly profile (24 May 2012) is used as by SH2015. A lack of structuring also becomes obvious in section 2.2, whose titles read:

2.2.1 HC Method

2.2.2 Optimal Estimation Method

2.3.1 OEM Methodology

2.3.2 HC Methodology

2.4 something about OEM again

Citing Khanna et al. in the HC section (p. 5, l. 15) is confusing. Khanna et al. also claim

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to gain 10-15 km altitude range, so it would perform equally well to your algorithm? If this is so, this should be discussed. However, I think this whole section 2.2 is much better explained in SH2015, so it is unfortunate to repeat here in this way. In all this repetitions it is hard to see what part of this work is original or goes beyond the two former papers. The original achievements should have been highlighted more clearly, and larger parts of the text substituted by citations.

I feel unhappy with the seeding of HC by CIRA-86 (p. 16, l.3), knowing that CIRA is way off as you have shown before. I see that using CIRA for both methods gives them the same starting conditions, (and CIRA is guaranteed to be available in the future..) but this makes it a more academic endeavour, which is fine. In practice however one would seed HC with more realistic SABER temperatures, of which you might have > 10 yrs available, or with the sodium temperatures themselves, of course. This probably means that you could have created the PCL climatology with HC just the same.

I am therefore uncertain about the scientific significance of this work. I list further remarks and question I came across reading below:

Fig. 3 is a replication of AS2007 Fig. 3. Both show lidar minus CIRA, however the sign looks to be inverted, am I correct on this? E.g. Nov, 80 km, there is -15 K in AS2007 but +15 K here.

Fig. 4: this seems to be an unfortunate colorbar. In Apr-Sep, 30-70 km the contour line says 4 K while the colour definitely says < 0.5 K. As it is the same plot as in AS2007, also in Aug-Sep 80-90 km there seems to be more than 3 K difference to AS2007. What's the explanation for this?

p.1, l. 10: "our new retrieval": Is this algorithm different from SH2015?

p. 2, l. 32: it would be beneficial to the reader to expand the summary paragraph to include the name of the instrument, the reference to the published climatology and a quick walk-through through the sections.

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p. 7, l. 6: “methodology of Argall and Sica (2007)” -> please state again what method this refers to

p. 7, l. 9: “Unlike..” this sentence is hard to follow. What is “our altitude”, which method? Which decrease of initial height? What comparison with OEM climatology in a paragraph under the title “HC Methodology”?

p. 9, l. 2: this sentence could be improved, e.g. the expression “using the OEM were used”. Which nightly mean profiles? Temperature? Then why use nightly mean profiles to calculate nightly average profiles, isn't it the same?

p. 15, l. 22: why don't you use the same ozone profiles?

p. 17, top: you might explicitly name the difference between the CSU and upgraded CSU dataset and why you chose to use both instead of the upgraded one only.

The discussion of the quality of the sodium lidar datasets does not belong to the summary, p. 21, l. 18, but to the earlier section where the difference of PCL to the sodium lidar climatologies is shown. Otherwise the large differences remain unexplained. It then looks like a rather bad comparison.

Text remarks:

p.1, l. 4-6: grammar. understanding “of” the connection of temperature “and” ???. to change -> to changes

p. 2, l. 8: wrong expression: “satellite resolution” -> the resolution of satellite measurements

p. 2., l. 18: (Bills et al., 1991, Krueger et al., 2015)

p. 5, l. 2-6: these two sentences could be combined as they are very similar

Fig. 1: “using the a priori profiles shown in Fig. 1a” -> Fig. 1a does not show an a priori profile, but the difference between two a priori profiles

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Fig. 1: more than 90% -> less than 90% and all other figure captions

p. 9, l. 5,6: repetition “There is a . . . There is a . . .”

p. 10, l. 3: “is it provides” -> is that it provide?

p. 12, l. 6: “almost less than 3 km”: just give the number

p. 20, l. 1 no need for the abbreviation of SH2015 which is used only four times, while Argall and Sica 2006 is used 11 times and not abbreviated.

p. 7, l. 12: what’s a 3’s and 5’s filter?

p. 23, l. 19: iversion -> inversion

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