l. 9/19: I do not see any white spots in Fig. 4. They seemed to be filled blue (0-3 K) now. Please clarify.

You are correct, there is no white color in the colorbar and the color between 0-3 K is purple. This sentence is now removed from the paper.

l. 10/3: I do not see the maximum between 80 and 90 km. The largest variability in this period is observed above 100 km, which maybe should be ignored (but the 80/90% lines are missing). Even then, the variability is generally increasing with altitude (with a lot of temporal variability). You should further repeat which type of waves you expect to see in this plot. But as written above, this figure is not essential for this paper.

We have amended the paper as you suggested, on 9/17 changing the sentence to:

2 to 33 days, *encompassing the scale-range of planetary waves*.

l. 16/15: Maybe I missed the point, but please explain why the LLR channel is not used for the HC method.

Since the purpose of this paper was method validation, the HC method calculations were only done with HLR channel, consistent with AS2007. However, the method simultaneously uses both LLR and HLR measurements to retrieve a single temperature profile from the complete range of measurements. We discuss this in the appear on page 16, line 20.

l. 16/22: Please explain how you derived the +/- 0.05 K difference and why merging the data will provide in a larger error.

We calculated the average from all temperatures between 40 and 60 km for all months and we calculated their standard deviation, which is ± 0.05 K. The merging uncertainty is the topic of Jalali's MSc thesis and discussed in detail there (Jalali, 2014).

l. 16/26: Why is HLR data lacking in the winter months?

The PCL operates needs relatively clear nights for operations. The region of southern Ontario where the PCL is located is typically cloudy due to its location between Lakes Ontario and Erie. It can also be difficult to access the facility in the winter, particularly in its original location at the Delaware Observatory.

I think you answered the question "Why are there fewer observations in winter"I think if you would re-phrase "The differen

l. 17/14 and l. 22/26: Please explain why Na lidars are most sensitive between 90 and 100 km. I would expect their best performance around the maximum of the Na layer at 90 km (i.e. at 85-95 km).

You are right, the best performance of Na lidars is in the region with the maximum density of sodium. Above or below that region the sensitivity of the lidar decreases. Therefore, we changed “90 and 100 km” to ” above 95 km” in the paper.

I don't see this change in the revised m

l. 18/14-15: I am not sure that I understand this sentence. Do you mean the >10 K difference above 100 km? a) This occurs also in summer, b) this is above the 90% line, c) it is even smaller in Fig. 12 (URB). Reference to AS2007 is confusing, because there the winter mesopause is explicitly not covered (“The winter mesopause is above the top altitude of the PCL climatology“).

We are referring to the temperature difference at 90 km (Figure 13, CSU climatology) which is around 15 K, whose value drops to around 10 K (Figure 14) in the upgraded CSU climatology.

Section 4.2: I see the whole comparison with the Na climatologies problematic. If I understand correctly, the Na data are defined as “truth” and a smaller deviation of the OEM data compared to the HC data suggests the OEM data being better. To some extend this is OK, even if the larger differences between the Na data sets limit the validity of this approach. Any closer discussion of differences is – from my point of view – problematic, because the natural variability of all data sets needs to be acknowledged first. Day-night differences in Yuan 2008; covered years disagree in all data sets (but overlap); differences due to incomplete sampling, … On the other hand the authors mainly aim for the comparison of the RMR retrievals, i.e. the problems of comparing climatologies are outside of their scope and the reader gets side-tracked.

If you assume (as we do) the best measurements for comparison we have in London, Ontario in the upper mesosphere and lower thermosphere are sodium lidar temperatures, then we want our climatology to be in agreement with these measurements as closely as the sodium lidar measurements agree to each other (with the tacit assumption that these differences are primarily geophysical). Our OEM climatology passes this crude, but reasonable, metric for agreement.

l. 19/4-5: I do not see that the AS2007 comparison is worse than the OEM-Na comparison shown in Fig. 12-14. Please explain!

For clarity and showing the difference more clearly we listed the temperature differences inside Table 4 since it is difficult to tell these differences from the plots. The numbers themselves show overall an improvement when OEM is used.

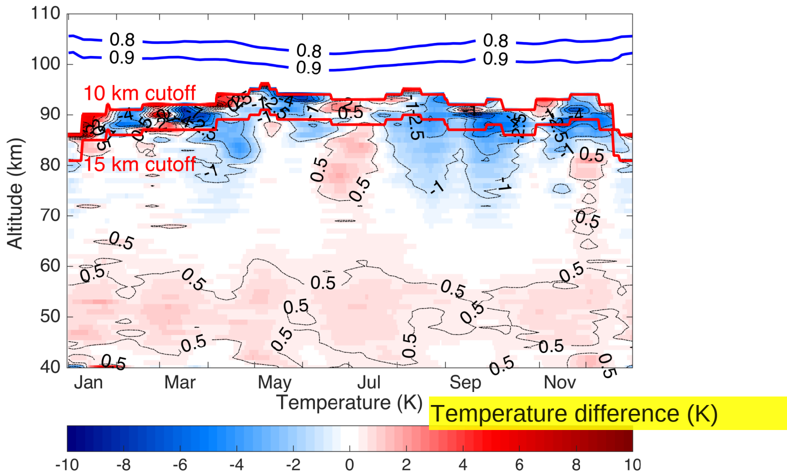

Figure 10. PCL temperature climatology difference between the OEM and HC method using seed pressure. The blue lines show the height below which the OEM temperature climatology is more than 90% (0.9) and 80% (0.8) due to the measurements. The red lines are the 10 and 15 km cutoff height for the HC method.

Please provide a formula: OEM-HC to make clear which way the s

and comparing it with a one-channel (HLR) retrieval in the HC method. The 2-channel OEM method retrieves the dead time for each profile while the dead time in the HC method was an empirically determined constant based on count measurements using a pulsed LED source. In order to compare the OEM with HC temperature climatology, we could have merged the calculated LLR and HLR temperature profiles in the HC method. However, the temperature uncertainty induced by the merging will be more than the ± 0.05 K temperature difference between the OEM and HC climatology (Jalali, 2014).

The OEM temperature above 80 km up to the 10 and 15 km cut-offs is colder than the temperatures obtained using the HC method. The temperature differences above 80 km are mostly due to the sensitivity of the model seed pressure in the HC method. Figure 10 shows that the OEM temperature climatology reaches 5 to 10 km higher in altitude than the HC temperature climatology. The differences between the OEM and HLR are not calculated below 40 km due to the lack of HLR data in the winter months.

Finally, in order to evaluate the effect of the *a priori* on the temperature differences, the same temperature climatologies were calculated using the OEM with the US standard model as the *a priori* temperature profile and the same differences as discussed above were obtained, again demonstrating that the results show little sensitivity to the choice of any reasonable *a priori* profile.

The HC method usually uses a seed pressure value at the highest point of the profile. However, the seed pressure can be substituted by temperature and density and is called the seed temperature (Gardner et al. (1989), equation 86). When a seed temperature is used, the temperature is obtained from the CIRA-86 model, and the measured relative density profile is normalized (typically by a model) to obtain a seed pressure to use in the HC retrieval. The temperature differences between the OEM climatology and the updated HC climatology using the seed temperature (instead of seed pressure) are shown in Fig. 11. Comparing Figs. 10 and 11 reveals that the temperature difference above 80 km between the OEM and the updated HC using

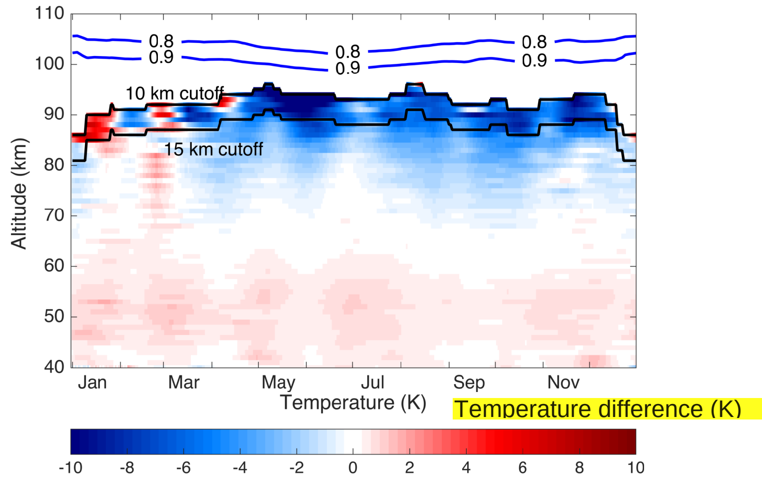

Figure 11. PCL temperature climatology difference using the OEM and HC method using seed temperature. The blue lines show the height below which the OEM temperature climatology is more than 90% (0.9) and 80% (0.8) due to the measurements. The black lines are the 10 and 15 km cutoff height for the HC method.

seed temperatures is larger than the differences between the OEM and the updated HC using seed pressures. However, the differences below 80 km are identical and the small temperature differences between the OEM and HC method are due to the tie-on temperature or pressure value. The difference between the HC climatologies calculated by these two methods highlights the sensitivity to seed pressure at the greatest heights in this method.

Gerding et al. (2008) used coincident Rayleigh and sodium resonance lidar temperature measurements to minimize the seed pressure. For altitudes below the sodium layer, Rayleigh lidar measurements are used to determine the temperature. While having this combination of a Rayleigh and resonance temperature lidar is ideal, most Rayleigh-temperature lidar systems are not co-located with a resonance temperature lidar and hence, the effect of seed pressure is the largest systematic uncertainty at the upper range of the temperature profile determined.

4.2 Comparison with sodium lidar climatologies

The comparison between the PCL Rayleigh temperature climatology using the HC method with sodium lidars was done by AS2007. Their results showed that the average temperature between 83 and 95 km measured by the PCL was between 7 and 7.4 K colder than CSU and URB climatologies, respectively. Using the OEM to extend the PCL Rayleigh lidar temperature climatology to above 100 km provides the opportunity to validate the PCL results against sodium lidar climatologies in the region where the sodium lidars are most sensitive, 90 to 100 km. Sodium lidars directly measure the kinetic temperature without assuming hydrostatic equilibrium or requiring the knowledge of mean molecular mass and molecular cross section variations with height and can be configured to obtain temperatures during both the day and night. She et al. (2000), Yuan et al. (2008), as well as States and Gardner (2000a) have published sodium temperature lidar climatologies in the same latitude range as PCL. Both sites are west of the PCL, but in the case of URB the separation in longitude is less than 8°. The URB and CSU