Reviewer #4 (General Comments)

The paper presents a method for the retrieval of aerosol optic thickness (AOT) using VIIRS day/night Band (DNB). This work is a successor of Johnson et al (2013). The retrieval of aerosol properties during night is important for the understanding of aerosol daily cycling and all aerosol effects during night, thus the paper is significant for aerosol community. The authors try to compare the new retrievals with Johnson et al (2013) using AERONET and HSRL measurements, however, due to the limited validation samples, the statistical parameters can be easily affected by any known/unknown factors. Thus I suggest that the authors extending the study period. Major comments are listed below:

We thank the reviewer for his/her comments and suggestions. Again, as we mentioned in our responses to other reviewers, we agree with the reviewer in that an extended study period is needed to draw further conclusions on potential error sources. First, we consider this paper primarily a demonstration of concept. Second, we have adopted these from Johnson et al. (2013) so a paired comparison can be made between the two methods, and wish for this comparison to remain the focus along with the concept demonstration. Third, the short study periods are selected to ensure the relative stability of artificial light sources. For a longer study period, the seasonal variations in artificial light sources will need to be accounted for, which is beyond the topic of this paper and is a subject of our next planned study. Also, to gain enough data samples for the error source analysis, doubling of the study periods for the selected sites is less likely to be sufficient, especially after AERONET data availability for the chosen sites and additional cloud screening. In fact, we attempted to increase the study period as suggested by the reviewers and ran into these issues. We are currently working on a new study that explores the method on a much large spatial domain, which should give us a data sample that is sufficiently large enough to explore the mentioned error sources. The following discussion has been added at the end of Section 4:

"A major caveat regarding the previously discussed sensitivity studies that has been mentioned is sample size. While these sensitivity studies appear to be relatively inconclusive, the study period has not been extending to achieve statistical robustness for a few reasons. The first is that the primary goals of this study are to demonstrate the efficacy of the variance method and to compare the results directly with the results presented in Johnson et al. (2013). Second, the short study periods are selected to ensure the relative stability of artificial light sources. For a longer study period, the seasonal variations in artificial light sources will need to be accounted for, which is beyond the topic of this paper and is a subject of our next planned study. Third, a regional scale study is underway that will increase the sample size by an order of magnitude; this should be sufficient enough for conclusions regarding error sources to be made."

Specific Comments:

1) The key equation for this work is Eq (5) by using the "spatial derivative" of Eq (4), the authors explain that ΔI_{sat} *and* ΔI_a *are the pixel-to-pixel changes, my understanding is the "spatial derivative" refers to the difference between two different pixels, which makes sense to understand how to derive Eq (5) from Eq (3) and (4). However, later, the authors explain that* Δ *refers to the stand deviation of a block of pixels, that is a given artificial light source, the authors should explain how to derive Eq (5) from Eq (3) and (4) using stand deviation of a block of pixels;*

Response: The standard deviation is the measure of the difference in radiance between the "pixel" with the mean value and the "pixel" with the value that is 1 standard deviation from the mean. Therefore, it is another way of looking at the spatial derivative from the statistical domain. Language has been added to the paper to make this clearer.

2) One of the key assumption to derive Eq (5) from Eq (4) is the value of D, Ip and so on are spatially invariant within an artificial light source, some references like what Johnson et al (2013) did for ignoring the rsÌE˘ r term or some sensitivity studies are needed to see how good this assumption is;

Response: It is difficult, if not impossible, to decouple the diffused radiance (D), the path radiance (Ip), and the reflected direct and diffuse downward moon light using VIIRS measurements alone. A full exploration can be done with the use of a radiative transfer model with the moon light as the input source, which is not currently available. But the bulk uncertainties can be indirectly inferred from the comparison of the VIIRS retrieved and ground-based AOT, as shown in this paper. We will explore the issue once a moon-based radiative transfer model is available, which is currently being developed by one of the coauthors.

3) Eq (6) is not mathematically derived from Eq (5), the correction parameter C is introduced due to additional non-mathematical reasons, thus "Solving Eq (5) for τ *given Eq. (6)" is very confusing;*

Response: Language has been changed to make it clear that correction term C is added after algebraic manipulation.

4) The sensitivity study highlights the influence of satellite viewing angle. In figure 4, the authors using cosine of satellite zenith angle between 0.5-1, which actually ignoring the observation direction, however, the satellite may observe differently from east or west with the same cosine value, especially for the artificial lights, the authors should clarify this problem.

Response: Language has been added to clarify that this may be an issue, however, as with other sources of error such as seasonal variability and sudden changes in radiance e.g. fire, we leave this to a future study with a much larger sample size.

Minor Suggestions:

1) Some of the figures should be re-plotted, for instance, the colors in Figure 5 are not matched. The size of the triangles in Figure 7 is not so distinguishable.

Response: The differences in symbol color on figure 5 are noted in the figure caption as the description is too large to be placed in a legend. The difference in triangle size to indicate lunar fraction has been increased.