Reviewer #3 (General Comments)

This paper presents a newly developed nighttime aerosol optical depth (AOD) algorithm using the VIIRS Day/night Bands, improved from previous work presented in Johnson et al., 2013. This work is very important and significant for aerosol research community. Reviewer #1 and #2 have already pointed out some important major and minor comments. I agree that the sensitivity studies and VIIRS AOD retrieval can be improved by extending data availability and study period, and the authors also recognized that limitation in the manuscript. This paper is scientifically significant and well written, and I recommend its publication at AMT.

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. However, we would like to maintain the current study periods for a few reasons. 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) Although the authors recognized that the rs (r) Ì˙E term (the product of the surface reflectance and the reflectance from the aerosol layer) could be significant for high AOD atmospheric condition, assumed it to be negligible in this manuscript. If I understand correctly, the authors also assumed the retrieved total optical depth over cloud free skies are AOD without subtracting the Rayleigh optical depth from the total optical depth. Even though the Rayleigh optical depth at VIIRS DNB wavelength (~ 0.7 μm) is small, in low AOD atmospheric condition, Rayleigh optical depth can be comparable to the retrieved AOD and this could lead to overestimation of retrieved AOD. However, these two assumptions do not add up to become a combined bias, since one bias occurs in high AOD and the other in low AOD condition. It would be helpful if the authors include the retrieved AOD bias due to these two assumptions in low, moderate and high AOD atmospheric condition.

Response: This is an excellent suggestion. We have added discussions in section 6.

"Also, please note that the uncertainties at the low and high AOD ranges could be dominated by different factors. In a high AOD regime, the ignored $r_s\bar{r}$ term can be significant. In a low AOD regime however, the $r_s\bar{r}$ term can be ignored, while the ignored Rayleigh optical depth can be comparable in magnitude to the retrieved AOT."