Reviewer #2 (General Comments)

Retrieving nighttime AOT is one of most wanted satellite operational product to meet many needs from various user communities, not only limited to air quality, weather forecast, and climate sciences. Advancing the previous Johnson et al (2013) study, this paper presents more details of an innovative algorithm to retrieve global nighttime AOT using VIIRS Day/Night Band (DNB). At the frontline of the discipline, this work is scientifically significant. The results are both inspiring and encouraging to the research community that strives to provide more comprehensive satellite observations to form a complete diurnal cycle of global aerosol observations. The paper is well written with easy to follow structure, full technical details and sufficient discussions on retrieval uncertainties. Overall, the paper makes significant contribution to the research field and I recommend its publications at AMT.

We thank Dr. Huang for his comments and review.

Specific Comments:

1) Figure 5: the legend only matches the shape of the markers, but not differentiate colors of the markers.

Response: While including a description of the colors on the legend would be helpful, the description is too long to be placed in a legend on the plot, and is thus left in caption.

2) I am curious on the criteria used to select the four AERONET sites. The paper outlined that the aerosol types are different for the sites but that should not be all I think. Cape Verde might be too small a site for nighttime dust observations, and it appeared to be an outlier in the statistics. Did you ever consider using another dusty site over mainland instead?

Response: The Alta Floresta, Cape Verde and Grand Forks sites are the sites that are included in Johnson et al. (2013). We selected the same three sites so a paired comparison can be made between the method presented here and the method described in Johnson et al. (2013). The reviewer is right that Cape Verde is too small for implementing the variance method as described in this paper, and the Cape Verde site reveals one limitation in the proposed method that we would like to report. The Huntsville site is selected because night time HSRL measurements are available. The HSRL observations are considered as a better data source for validating the VIIRS retrieved nighttime AOTs.

We would like to keep the Cape Verde site for this paper, but the reviewer does have a point. In fact, a regional study is currently on going and we shall have more dusty sites included in that study.

3) I was hoping to see a regional AOT figure with a nighttime aerosol outbreak observed from either CALIPSO or HSRL over a mega city where artificial light source existed to retrieve nightime AOT and compared to HSRL or CALIPSO retrievals at regional scale. Maybe this is out of scope for this paper, but how feasible it is based on your experience with many VIIRS DNB observations already?

Response: Great suggestion. An important note is that it may be difficult to validate AOT estimates from this study with the Version 3 CALIOP level 2 data due to the small spatial coverage of the CALIOP instrument and the highly localized nature of the VIIRS AOT estimates. Also, the uncertainties in total

extinctions/column integrated AOTs from the Version 3 CALIOP level 2 aerosol products are non-trivial. The Version 4 CALIOP level 2 aerosol products are on the horizon and should be released by next year, and may be a good candidate for validation. However, in this study, we want to focus on demonstrating the method and directly comparing with Johnson et al. (2013) before expanding our study to a regional scale. Again, the reviewer has a nice point, and in fact, we have been working on a regional study as suggested. But such a study is outside the scope of this paper and thus is not discussed.

4) Figure 7: what if we plot VIIRS-AERONET(or HSRL) AOT vs. Lunar Fraction? From the limited samples, I feel most of low L.F. samples were having lower VIIRS retrieval biases. But indeed the samples were too few to understand the L.F. impact better. It is intriguing to get sufficient more samples to make the arguments on L.F. impact more robust.

Response: We have performed the study as suggested (see the attached figures).   However, bias vs Lunar Fraction plots (below) show no relationship, therefore discussion focused on Variance vs Lunar Fraction. This will of course be reexamined further in the future.