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Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessing the Stability of Surface Lights for use in Retrievals of Nocturnal Atmospheric Parameters" *by* Jeremy E. Solbrig et al.

Anonymous Referee #1

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RE: Assessing the Stability of Surface Lights for use in Retrievals of Nocturnal Atmospheric Parameters

The authors introduce an assessment of the utility of stable nocturnal point sources to extract information related to atmospheric optical properties (e.g., clouds and aerosols). The effort, while incremental in nature, is a necessary step to unlock the full potential of the VIIRS DNB. The work, as presented, provides a good first step towards the understanding of the factors that influence the stability of nighttime lights at scales that have not been analyzed in previous studies (daily vs monthly data).

The paper is very well written and I could not find any spelling mistakes. I found three

major areas of improvement, which I summarize here:

1) Throughout the paper, it is unclear what is the basic requirement for a high-quality nighttime aerosol retrieval using the available sample of stable point source data. While this work is described by co-authors (J. Zhang), it is still unclear what is the minimum required sample to establish an aerosol retrieval for each specific study domain. Would a single pixel-based source be sufficient to estimate nighttime AOD over the regions of interest used (256 x 256 pixels)? Are more stable points needed? If so, what would be required, sampling-wise, in order to ensure a routine retrieval of aerosols using this method. Then, can you comment on how the methodology be scaled up at the region-level and over a sufficiently large global sample (urban-lit areas, only comprise less than 3% of the Earth's land mass). The authors should provide some commentary (and background/statistics/sampling estimates), which would then put the results of this paper into perspective.

2) The authors seem often confound basic terminology of reflectance/and nighttime remote sensing nomenclature, particularly when it comes to surface-related phenomena. In most cases, what they deem "Lunar Geometry" or "Surface Scattering" is formally defined as Lunar-reflectance, Lunar BRDF, as well as surface albedo and reflectance anisotropy. That is, the authors described the surface phenomena as if it is only influenced by lunar phase and satellite/source view-illumination angle of capture, when in reality there are additional factors that are intrinsic to surface conditions, which are virtually ignored.

This lack of understanding stems from the authors push towards characterizing stable point sources of high-intensity radiances >20nW, which are well-above the magnitude of lunar variation (< 10nW). However, previous studies have documented how surface-based phenomena is in fact an influencing factor of stability of stable point sources. For instance:

N. Levin, Q. Zhang, A global analysis of factors controlling VIIRS nighttime light lev-

els from densely populated areas Remote Sens. Environ., 190 (2017), pp. 366-382, 10.1016/j.rse.2017.01.006

M.O. Román, E.C. Stokes Holidays in lights: tracking cultural patterns in demand for energy services Earth's Futur., 3 (2015), pp. 182-205, 10.1002/2014EF000285

Román, M.O.; Wang, Z.; Sun, Q.; Kalb, V.; Miller, S.D.; Molthan, A.; Schultz, L.; Belle, J.; Stokes, E.C.; Pandey, B.; et al. NASA's Black Marble nighttime lights product suite. Remote Sens. Environ. 2018, 210, 113–143.

M.M. Bennett, L.C. SmithAdvances in using multitemporal night-time lights satellite imagery to detect, estimate, and monitor socioeconomic dynamics, Remote Sens. Environ., 192 (2017), pp. 176-197, 10.1016/j.rse.2017.01.005

The most obvious effect not being considered is the influence of snow cover, which will most likely affect the RSD of Study Domains in temperate regions, given the 18-month sample size (Particularly St George UT). See for example Figure B1 in (Roman and Stokes, 2015), which shows how the presence of snow cover influences the stability of point sources for large US cities: https://agupubs.onlinelibrary.wiley.com/action/downloadFigures?id=eft275-fig-0014&doi=10.1002%2F2014EF000285

3) The authors seem to make conclusions about RSD and its dependency to urban-built environments based on simple inferences collected from manual examination of specific areas within cities (e.g., large/tall building located in the San Francisco region, residential sectors, large roads, etc., as noted in page 13, line 32.) The analysis needs to be strengthened by a more quantitative assessment based on a control variable that characterizes the urban built area (e.g., % Urban cover). A dependency between urban density and RSD should be explored in this paper to make a more definitive conclusion.

The datasets are already available to come up with such an assessment. See for example, work by:

T. Esch, W. Heldens, A. Hirne, M. Keil, M. Marconcini, A. Roth, J. Zeidler, S. Dech, E. Strano Breaking New Ground in Mapping Human Settlements From Space The Global Urban Footprint (2017)

T. Esch, M. Marconcini, A. Felbier, A. Roth, W. Heldens, M.Huber, M. Schwinger, H. Taubenbock, A. Muller, S. DechUrban footprint processor-fully automated processing chain generating settlement masks from global data of the TanDEM-X mission, IEEE Geosci. Remote Sens. Lett., 10 (2013), pp. 1617-1621, 10.1109/LGRS.2013.2272953

Also see Figure 12a in, Roman et al., 2018: https://www.sciencedirect.com/science/article/pii/S003442571830110X#bb0125

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