Questions & Answers Session

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Kellie Stokes (estokes@usra.edu) or Ranjay Shrestha (ranjay.m.shrestha@nasa.gov).

Question 1: Apart from QGIS, what other software can be used to analyse nighttime lights?

Answer 1: Any software that is able to handle multi-band raster data can be used to analyze nighttime lights, e.g. IDL/ENVI, ArcGIS, GRASS. Black Marble data can also be manipulated without a GUI using programming languages like C, R, Python, Matlab. The Hierarchical Data Format version 5 (HDF5) is the NASA selected format of choice for standard science product archival and distribution and is the underlying format for HDF-EOS5, including the Black Marble product suite (VNP46A1, VNP46A2). You can convert this to a GeoTIFF as well using the tool on the Black Marble site. https://blackmarble.gsfc.nasa.gov/Tools.html

Question 2: Could you provide the full reference of the Levin et al (2020) paper on nightlights referred to on slide 18?

Answer 2:

Noam Levin, Christopher C. M. Kyba, Qingling Zhang, Alejandro Sánchez de Miguel, Miguel O. Román, Xi Li, Boris A. Portnov, Andrew L. Molthan, Andreas Jechow, Steven D. Miller, Zhuosen Wang, Ranjay M. Shrestha, Christopher D. Elvidge. 2020. "Remote sensing of night lights: A review and an outlook for the future." Remote Sensing of Environment. Volume 237 [doi:10.1016/j.rse.2019.111443]

https://www.sciencedirect.com/science/article/pii/S0034425719304626

Question 3: Temporally, has the transition to LED streetlights in some places noticeable using the VIIRS DNB data?

Answer 3: Yes, transitions to LEDs can be perceived as a decrease in radiance. This is because the VIIRS DNB is less sensitive to the "Blue Pump" spectral wavelength region at (~495nm). For examples of this identified effect see references:

Stokes, Eleanor C., and Karen C. Seto. "Characterizing urban infrastructural transitions for the Sustainable Development Goals using multi-temporal land, population, and nighttime light data." *Remote Sensing of Environment* 234 (2019): 111430. https://www.sciencedirect.com/science/article/abs/pii/S0034425719304493

Kyba, Christopher CM, Theres Kuester, Alejandro Sánchez De Miguel, Kimberly Baugh, Andreas Jechow, Franz Hölker, Jonathan Bennie, Christopher D. Elvidge, Kevin J. Gaston, and Luis Guanter. "Artificially lit surface of Earth at night increasing in radiance and extent." Science advances 3, no. 11 (2017): e1701528. https://advances.sciencemag.org/content/3/11/e1701528

Question 4: Is VNP46A2-Gap Filled publicly available?
Answer 4: Yes, through LAADS DAAC repository. https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/products/VNP46A2/ . Note products are being generated from the start of the mission (Jan 19, 2012) to present day. You can check how far the NASA processing system has completed the full historical archive (which will soon reach present-day) using the above URL, and click under 'Data Availability'.

Question 5: Black Marble is available on a daily frequency... Are all geographic regions available on a daily basis or just partial?
Answer 5: Daily Black Marble products are available globally over land (over ocean in the future). In the near-future (mid-2021), NASA will also produce and distribute monthly, and annual composite time series products.

Question 6: Great products. I was wondering if there would be examples in rural areas? How would the images be influenced by elevation?
Answer 6: Suomi-NPP is sensitive to very low light conditions so it can be used to do analysis over rural areas. The images are terrain-corrected, so the influence of elevation on radiance is limited. However, like with urban buildings, light could be blocked by high mountains from off nadir view angle looks.

Question 7: How strong do fishing lights need to be to be detected? Are single smaller squid fishing boats with rows of lights about 12m length detectable?
Answer 7: The fishing lights can be detected as long as the scene is cloud-free and the radiance is larger than 1 nW/cm-2sr-1. Users should pay careful attention to the effect of lunar reflected ocean-forward scattering (known as the lunar glint effect), since that creates bright artifacts. The SDS layer "Glint_Angle" provided in the VNP46A1 produced can be used to identify, moon-contaminated pixels over water.

Question 8: What AOI is used to mask water for level 2 and 3 products for VNP46Ax?
Answer 8: The Standard NASA VIIRS land water mask is used to mask out water. This is the same water mask (available within the VIIRS Level 1B product) used by all standard products for VIIRS.

Question 9: Are near coastal areas still visible or just land?
Answer 9: Currently the VNP46A2 only covers land, but has been expanded by a 1-pixel buffer (~ 500 m) to partially cover near-coastal areas.

Question 10: How long will it take for the generation of VNP46A2 product to the current date?
Answer 10: Production of the VNP46A2 product has thus far reached 2018 and will continue processing at 10X (i.e., 10 global days are produced every 24hrs) until it reaches the present day (2020-YTD). Absent any issues with NASA's Land Science Investigator-led Processing System (SIPS), we should reach the present date by late-December. You can check how far the NASA's Land SIPS has completed the full historical archive (which will soon reach present-day) using this URL, and clicking under 'Data Availability': https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/products/VNP46A2/

Question 11: If I heard you correctly, on slide 17 you mentioned a factor of 256 (256 times more "..........") when comparing the attribute Radiometric Quantization (6 bit for DMSP/OLS vs 13–14 bit for VIIRS DNB).
Can you please clarify how you get the factor of 256?
Answer 11: A 6 bit quantization has 2^6 values (64). A 14 bit quantization has 2^{14} (16384) radiometric values. Therefore, VIIRS has a 2^8 times larger radiometric range (256)

Question 12: Since the VNP46A2 are not available yet (at least not 2018 onwards), is there a way to have access to the VNP46A2 algorithm?
Answer 12: See answer to question 10. You can also look at our ATBD paper - https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarble_ATBD_V1.1.pdf, which describes the entire algorithm process in Figure 2.

Question 13: Could you explain the basic differences between the VNP46A1 product and the Sensor Data Records available at the CLASS from NOAA (SVDNB, also available at a daily-basis)? As far as I'm aware, both are equivalent to TOA data, but it is not clear if they share the same processing routine.
Answer 13: The NOAA SVDNB, is equivalent (using slightly different calibration methods and data processing approaches) to the NASA Level1 products, which are used as input for NASA's Black Marble. Please refer to this ATBD document: https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/science-domain/viirs-L0-L1/. Specifically, the Day/Night Band 6-Min L1B Swath 750m for Suomi-NPP (VNP02DNB) and NOAA-20 (VJ102DNB.) Operationally, NOAA can predict in real time. The quality can be slightly reduced due to the short date latency. NASA Collection 2 will use a more improved calibration method.

Question 14: It seems VNP46A2 is only from 2012 to 2018 (Julian Date 199) for now. When can we get more recent images?
Answer 14: See question 10.

Question 15: Do we have access to LAADS and USGS archive through Google Earth Engine?
Answer 15: Not certain about other products, but the Black Marble products are not yet accessible through Google Earth Engine. To know the accessibility of other data products served through LAADS through GEE you can contact LAADS support - MODAPSUSO@lists.nasa.gov. We are looking to include in GEE in the future.

Question 16: I would like to know if there are any plans to provide the VNP46A1/A2 data at the google earth engine platform in the near future.
Answer 16: We do have plans to provide access to the Black Marble products as well as GEE based tools such as generating time-series and image composite for the scientific community to use the product in a variety of applications. Stay Tuned!

Question 17: Are these black marble data free of cost for download of any region from the NASA website?
Answer 17: Yes, this data is free of cost and available via LAADS (downloadable). The data are also available in near-real time via LANCE.

Question 18: Searching on https://ladsweb.modaps.eosdis.nasa.gov/ for VNP46A2 did not produce any results but had many results for VNP46A1. (land/coastal AoI in southern Myanmar in January 2020). What is the reason for the unavailability of A2 level data?
Answer 18: See question 10.

Question 19: If I understand well, Black Marble data is basically blind to the blue part of the spectrum since the spectral answer of the VIIRS DNB sensor does not cover this area. This means that the conversion to 3000K or 4000K LED of public lighting cannot be studied with this product, correct?
Answer 19: This type of conversion is likely unobservable if the two LED spectra primarily differ in the <450nm part of the light spectrum. Because VIIRs is a single channel, you cannot say a decrease is due to LEDS.

Question 20: Can you please show us how to open this data? Or is there any upcoming training related to processing such data? Thank you in advance!
Answer 20: Currently, as the data is in HDF5 format, you would need to convert it into format such as GeoTiff if you want to open the data in image processing software such as ArcGIS. We have provided you a tool to convert HD5 to GeoTiff through our website -
https://blackmarble.gsfc.nasa.gov/Tools.html. The HD5 data file can also be opened by software HDFView.

Question 21: Is it possible to download monthly/annual composites?
Answer 21: Currently the Black Marble data is only available as a daily product. NASA has plans to produce and distribute monthly, and annual composite products. In the interim, using our exercise tools, we also provide examples on how to access the data, which can be expanded to aggregate the results to any multi-date composite (e.g., weekly, 8-, 16- 30- day composites). In the near-future (mid-2021), NASA will also produce and distribute standard monthly, and annual time series products. You are

able to composite with the daily. Daily will be more useful for users (freedom, flexibility to create an average as you see appropriate for your uses). NASA is investing in new services for this new product for better analysis. The tools end up being used more than downloading the data.

Question 22: Can you kindly confirm that VNP46A2 has temporal range availability 2012-YTD? and if so, is that global?
Answer 22: See question 10.

Question 23: Why is there a difference between the official and black marble data in slides 45-46?
Answer 23: This divergence is expected since the NTL-based estimates are capturing different electricity end uses than PREPA's official reports. The restoration of street or exterior lighting, which accounts for a large portion of the satellite-derived signal, often lags behind the restoration of essential energy infrastructure (e.g., schools and hospitals (interior lighting)), as well as commercial electricity. This, in effect, creates a temporal bias in the satellite-derived products (particularly during relief and recovery stages) relative to official reports.

Question 24: Hello, the spatial resolution of this COVID night time data seems higher than VNP46A2? Is it Black Marble HD? Where to find it? Is it available worldwide?
Answer 24: Black Marble HD is not currently available publicly but stay tuned--our team is working on tools to make this new approach for integrating HD data available in the future using a cloud-based platform.

Question 25: What are the differences between VNP46A2/VNP46A2c/VNP46A2-DB in the online archive?
Answer 25: VNP46A2c is for browse imagery (https://landweb.modaps.eosdis.nasa.gov/cgi-bin/NPP/browse/NPPbrowse.cgi), VNP46A2-DB is backup database (used offline for code diagnostic purposes only.) A2 is a standard product we are using today. We are creating additional for tool development the processing browse imagery in the system itself. This is in an attempt to be an operational tool. https://worldview.earthdata.nasa.gov serves it up as imagery.

Question 27: Can you explain a little bit about the calibration measure about the black marble?

Answer 27: Please refer to this ATBD document:
https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/science-domain/viirs-L0-L1/. Specifically, the Day/Night Band 6-Min L1B Swath 750m for Suomi-NPP (VNP02DNB) and NOAA-20 (VJ102DNB.) NOAA 20 seems to be a bit more stable.

Question 29: What data is used to fill the gaps in the Gap Filled layer?
Answer 29: There are quality flags addressing this. There are gaps, but we are trying to reduce the latency.

Question 30: Do you know when the annual Black Marble products will be released?
Answer 30: This is still a work in progress. The current estimate is Mid-2021. Monthly and Annual products will be introduced as part of VIIRS Collection V002 reprocessing. Monthly should be available in NRT (near real time).

Question 31: How do you change lat and long in the script?
Answer 31: You can change variables - "lat" and "lon" (line # 18 and 19) in the script. You can do this in the other pixels related to the exercise. Downloaded data can be used for any region in Puerto Rico, you just need to adjunct the lat-long. Keep in mind the angular effects outlined in the presentation.

Question 32: Is there an R version of this Python script?
Answer 32: We do not have the R version of the script. Please stay tuned.

Question 33: Do the NASA Black Marble and NOAA VIIRS products use the same tiling coordinate system? Is this same system used by any other sensors?
Note Black Marble uses a unique linear latitude/longitude (or geographic) grid consisting of 460 non-overlapping Land tiles which measure approximately 10°×10° region.
Answer 33: Please refer to Section 3.3 of our Product User's Guide for more info: https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarbleUserGuide_V1.1.pdf. We hope that this new format is easier to use than the standard (MODIS-based) Sinusoidal projection and tiling system. This tile format is also easier to pull into a GIS.
https://blackmarble.gsfc.nasa.gov/tools/BlackMarbleTiles.zip
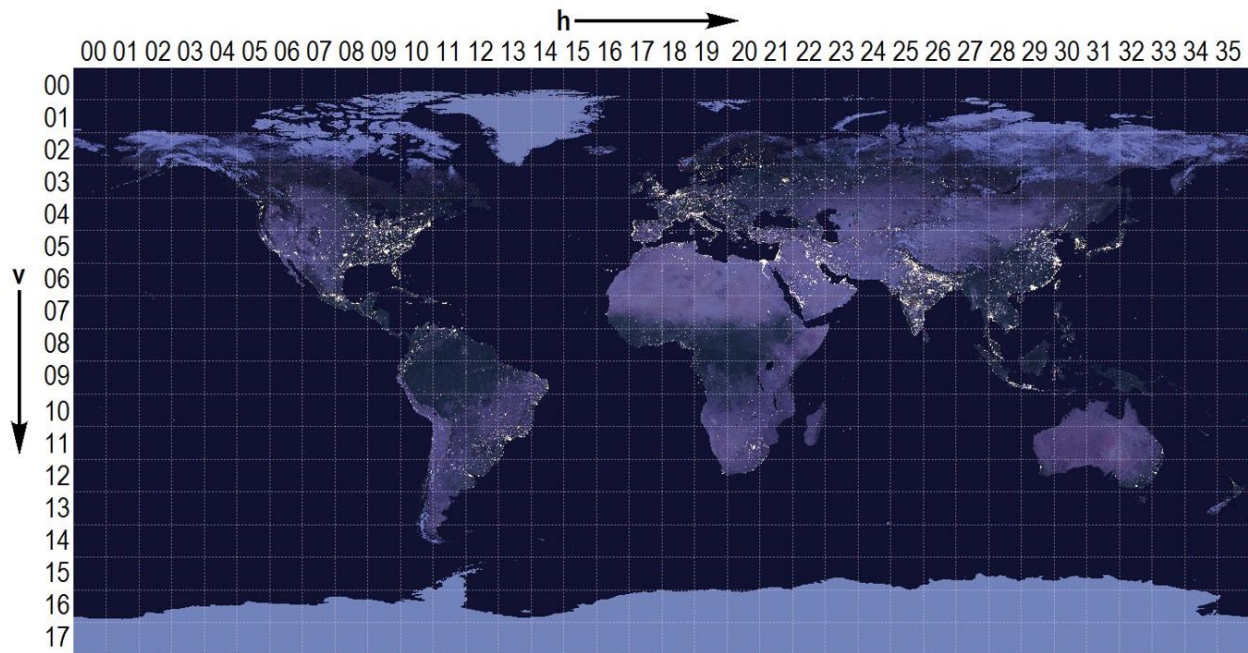
Question 34: Does the data include radiations varying by sources (to the extent sources can be captured)? Trying to think if we can distinguish traffic, commercial, industrial, and house lights.

Answer 34: We can not distinguish between sources of light. A work in progress. Consulting with users. We decided to include all the light data. We chose not to filter the data beforehand. We filter the moon and atmosphere. As a new product we wanted to give all the data.

Question 35: How do you eliminate other factors impacting the night lights data besides the increasing number of refugees in the Aleppo and El Zaatari case?

Answer 35: In the ATBD you can read about natural sources that may affect radiation fluctuations and how we try to minimize their impact on the signal. To control for other social, demographic, economic factors that impact the signal you must bring in ancillary data. The path of lighting is rescattered by the atmosphere. Reflectivity of the surface can be an issue to you must pay attention to this. You should bring in control variables in order to identify a single effect.

Question 36: Are there any works on harmonizing the DMSP with VIIRS to create a longer and comparable time series from 1992 to present?

Answer 36: Yes, see the following references

https://www.tandfonline.com/doi/abs/10.1080/15481603.2020.1848323

https://www.nature.com/articles/s41597-020-0510-y, note this paper degraded VIIRS radiances to DMSP digital numbers, so there is a loss of quality.
We hope the VIIRS data now can be used as the new reference. There

Question 37: I have a question about using the Black Marble data products for studying change in nightlights during COVID-19 lockdowns as well. Since the VNP46A2 product is not available for download through LAADS DAAC for this time period, are the VNP46A1 products an adequate substitute?
Answer 37: You can potentially use VNP46A1, but you need to be careful with the quality of the observation. You need to refer to the quality flags such as DNB quality and cloud covers. VNP46A1 will not be corrected for clouds, moonlight, vegetation, etc.

Question 38: Do I still need to observe the temporal aspect (16-day period) when I want to compare night-time lights between two days to ensure the sensor angle is the same?
Answer 38: If you compare images with the similar sensor angle, it will significantly reduce uncertainty due to angular variation, especially in urban areas with tall buildings or mountainous areas. In some contexts, like over fields/ wetlands/ low-building applications, there will be less differences between view angles.

Question 39: Can you elaborate on the use of different flags? How are these used for the analysis of the dataset? Is there a manual for this?
Answer 39: Flag index will tell you the quality of the observation. You can check out the user guide to learn more on these quality flags -
https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarbleUserGuide_V1.1.pdf
At a minimum, look at Mandatory Quality flags.
Without the flags it is just a raw data.

Question 40: How can Black Marble be used in the study of Energy Access and is there a methodology for that? Please point me to such if yes.
Answer 40: You can look at the research on Satellite-based assessment of electricity restoration efforts in Puerto Rico after Hurricane Maria
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0218883
Or this paper, which looks at electrification over India:
https://www.sciencedirect.com/science/article/abs/pii/S0034425719304493

We look forward to more studies on this.

Question 41: Can the brightness/intensity of received radiance also indicate the land surface temperatures for example in urban settings?
Answer 41: No, VIIRS-DNB is measuring radiation in the visible range. It is best to treat as 2 diff phenomenon.

Question 42: How good is the Black Marble products in detecting within city heterogeneity in night lights? For example, if we have slums in a city, will the black marble product be able to differentiate those areas versus non-slums (business districts), provided the night light intensity is different?
Answer 42: It will be difficult to distinguish sub-pixel signals, but if the areas are expanded across multiple pixels, we may be able to observe variations in the night light intensity. Most of these areas are less than 1 km. Combination with other higher resolution data
See this ref:
https://www.sciencedirect.com/science/article/abs/pii/S0034425719304493

Question 43: If the calibration differs from collections, could we still compare collections between them?
Answer 43: Not recommended to cross collections for science. For DMSP, there are models for inter-calibrating the different series to create a more consistent time series, but these models are post-hoc models and vary in quality depending on the region. For VIIRS-DNB, there is onboard calibration so the time series will be consistently calibrated across time. But for diagnostic purposes, comparing collections to evaluate refinement.

Question 44: Please explain the snow flag. Is it correct that 0 means no correction, and 1 means a correction was applied? If it was applied, I presume it is a function of snow cover (perhaps measured by percent snow versus bare ground), and perhaps snow brightness (dirty snow versus clean snow). How do you measure cover and cleanliness? Are raster versions of those data available? Addendum to question on snow: When I say raster version, I mean a raster dataset of percent snow cover, and a raster dataset of snow cleanliness.
Answer 44: You can look at our user guide for snow flag indicators -
https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarbleUserGuide_V1.1.pdf

Snow flag - 0 : no snow, 1: snow
Snow cover product -
https://viirsland.gsfc.nasa.gov/Products/NASA/SnowESDR.html. Note that this is daytime snow cover and snow may melt before the nighttime image is acquired. It is up to you if you want to use snow contaminated data. If studying light pollution, we did not want to over

Question 45: Do you have advice and guidance on using the VNP46A1 product, which is not corrected for lunar illumination and atmospheric effects?
Answer 45: You can refer to our user guide
https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarbleUserGuide_V1.1.pdf
A1 is the product that helps us ensure you can reproduce the results of A2. We also want to help save you the time to process and grid the VIIRS DNB imagery, e.g., by providing the Black marble data in Worldview: https://t.co/YyvTobc1cT?amp=1.

Question 46: Do we need to apply a threshold by X nW cm-2 sr-1 to remove background noise?
Answer 46: **No**. You could apply a certain threshold to exclude background noise - but you would also need to be careful if you want to detect outages, these thresholds might remove those outage pixels as well. Min det radiance
We do not want to specify the thresholds for you so you can decide the level of detection appropriate for your application.

Question 47: Does converting to GeoTiff reduce the quality of the data?
Answer 47: No. The conversion retains the 16 bit.

Question 48: Is there a way to filter search results for VNP46A2 data in LAADS by cloud cover or other quality parameters?
Answer 48: We are not aware of any such filter parameters. If you have any technical questions regarding the LAADS data portal, you can reach out to them -
MODAPSUSO@lists.nasa.gov.