

Global Offshore Lighting Grids

By Christopher D. Elvidge, Tilottama Ghosh, Namrata Chatterjee, Mikhail Zhizhin, Paul C. Sutton, and Morgan Bazilian

We present the first comprehensive multiyear global mapping of offshore lighting structures derived from low-light imaging satellite observations collected at night. The sensor is the day/night band (DNB) flown as part of the NASA/NOAA Visible Infrared Imaging Radiometer Suite (VIIRS). The product merges two operational nighttime light products: VIIRS boat detection (VBD) data and VIIRS cloud-free nighttime lights (VNL). The two products are spatially complementary, making it possible to fill gaps through a merger. Both product sets have an average DNB radiance layer, and the merger involves preserving the higher of the two average radiances. A wide range of lighting structures are present, from fishing grounds, platforms, anchorages, gas flares, transit routes, and the glow surrounding bright lighting onshore. The richness in the numbers and types of offshore lighting structures traces back to the DNB spike detector at the core of the VBD algorithm. The VNL algorithm uses outlier removal to filter out biomass burning, an essential process for mapping electric lighting onshore. The outlier removal drops about 80% of the offshore lighting detections. We expect the new product will lead to an improved understanding of fishing grounds, offshore light pollution, and supply chain disruptions at anchorages, thereby aiding in the development of more sustainable and efficient practices.

The following global datasets are available at this URL:

https://eogdata.mines.edu/wwwdata/downloads/Ocean_Lighting_2012_2022/

1. VNL_offshore_average_rade9_2012-2022_20240314.zip
Offshore VIIRS nighttime lights (VNL) average day/night band radiance 2012-2022. 15 arc second grid in GeoTIFF format. The grid was made on 20240314.
2. VBD_pct_n_detect_2012-2022_20240314.zip
Percent frequency of VIIRS boat detection (VBD) from 2012-2022. 15 arc second grid in GeoTIFF format. The grid was made on 20240314.
3. VBD_n_detect_2012-2022_20240314.zip
Tally of VIIRS boat detections (VBD) 2012-2022. 15 arc second grid in GeoTIFF format. The grid was made on 20240314.
4. VBD_merge_VNL_average_rade9_2012-2022_20240314.zip
Offshore lighting VIIRS average day / night band radiance from VBD and VNL 2012-2022. 15 arc second grid in GeoTIFF format. The grid was made on 20240314.
5. VBD_average_rade9_2012-2022_20240314.zip
Offshore lighting VIIRS average day / night band radiance from VBD. 15 arc second grid in GeoTIFF format. The grid was made on 20240314.
6. VBD_2012_20222_cvg_match_vnl.zip
Offshore VIIRS day/night band observation tally. 15 arc second grid in GeoTIFF format.

ABOUT THE AUTHORS

Christopher Elvidge

Senior Research Associate, Director of Earth Observation Group

Christopher D. Elvidge has decades of experience with satellite low light imaging data, starting in 1994. He pioneered nighttime satellite observation on visible lights, heat sources including gas flares and wildfires, as well as bright lit fishing vessels. He led the development of these nighttime remote sensed products with images from DMSP, JPSS, and Landsat satellites. These data are very popular and used globally in both public and private sectors.

Tilottama Ghosh

Research Associate, Earth Observation Group

Tilottama (Tilo) Ghosh is a Research Associate with the Earth Observation Group at the Payne Institute for Public Policy. She completed her PhD in geography from the University of Denver in March 2010. Her training and educational background in geography, demography, economics, remote sensing, and Geographic Information Systems (GIS) helped to shape-up her interests, career and passion. Her research interests include human geography, nighttime lights remote sensing, sustainable science, and spatio-temporal research using remote sensing, and Geographic Information Systems (GIS).

Namrata Chatterjee

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Namrata Chatterjee is a Satellite Modelling Researcher at The Payne Institute for Public Policy. She is working with data provided by the SNPP satellite flown by NASA and NOAA. She detects boats with the help of VIIRS day/night band (DNB) which collects low light imaging data in the visible to enable the detection of moonlit clouds. She is pursuing her Ph.D. in Geography from the University of Denver. Her research interests lie in human-environment geography, nighttime lights remote sensing, sustainable science, urban planning, and Geographic Information Systems (GIS). Namrata's Ph.D. work is finding ways to include light pollution as a proxy measure for United Nations' Sustainable Development Goals. She has two years of teaching experience (2019-21) in India and training in GIS.

Mikhail Zhizhin

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Mikhail Zhizhin, M.Science in mathematics from the Moscow State University in 1984, Ph.D. in computational seismology and pattern recognition from the Russian Acad. Sci. in 1992. Research positions from 1987 to 2012 in geophysics, space research and nuclear physics at Russian Acad. Sci., later at NOAA and CU Boulder. Currently he is a researcher at the Earth Observation Group at Colorado School of Mines. His applied research fields evolved from high performance computing in seismology, geodynamics, terrestrial and space weather to deep learning in remote sensing. He is developing new machine learning algorithms to better understand the Nature with Big Data.

ABOUT THE AUTHORS (continued)

Paul C. Sutton

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Dr. Sutton's research interests are in the general area of sustainability science, ecological economics, urbanization science, and population geography. Much of his research involves the use of nighttime satellite imagery for mapping and measuring population distribution, economic activity, anthropogenic impact on the environment, and urban sprawl. Dr. Sutton is also interested in the mapping and valuation of ecosystem services. Future research activity will involve the development of spatially explicit maps of carrying capacity at various spatial scales and developing metrics of urban metabolism to establish baseline measures in the field of urbanization science.

Morgan Bazilian

Director, Payne Institute and Professor of Public Policy

Morgan Bazilian is the Director of the Payne Institute and a Professor of public policy at the Colorado School of Mines. Previously, he was lead energy specialist at the World Bank. He has over two decades of experience in the energy sector and is regarded as a leading expert in international affairs, policy and investment. He is a Member of the Council on Foreign Relations.