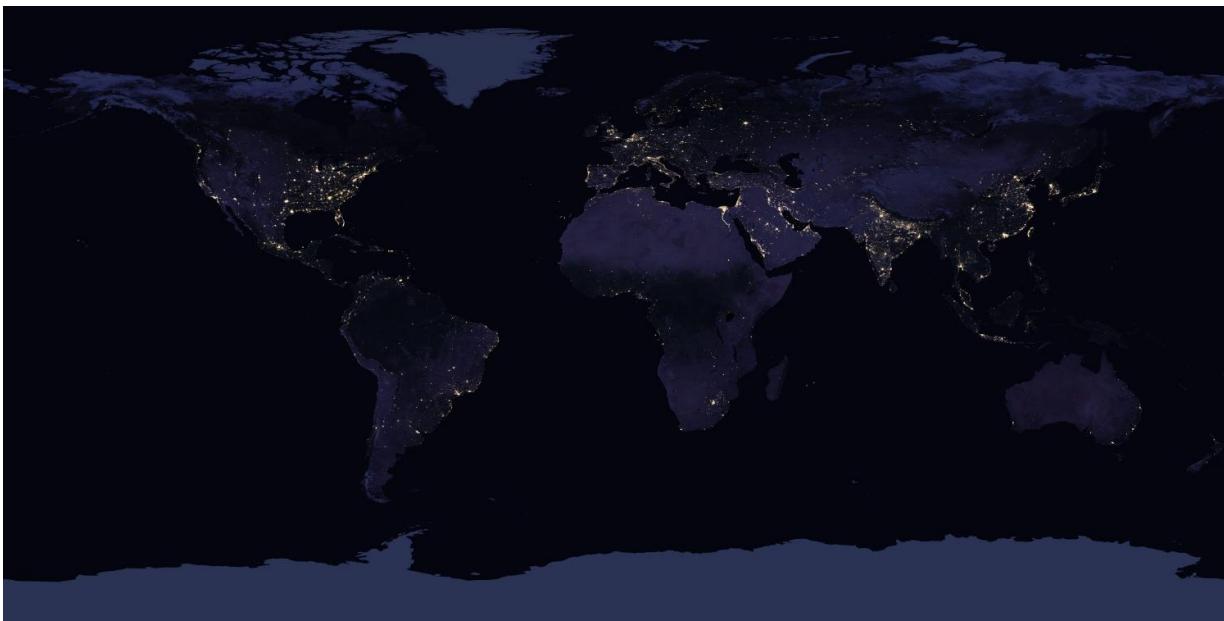


# New night lights maps open up possible real-time applications

April 12 2017, by Michael Carlowicz



This flat-map composite image depicts Earth's night lights in 2016. Credit: NASA Earth Observatory images by Joshua Stevens, using Suomi NPP VIIRS data from Miguel Román, NASA's Goddard Space Flight Center

NASA scientists are releasing new global maps of Earth at night, providing the clearest yet composite view of the patterns of human settlement across our planet.

Satellite images of Earth at night—often referred to as "night

lights"—have been a gee-whiz curiosity for the public and a tool for fundamental research for nearly 25 years. They have provided a broad, beautiful picture, showing how humans have shaped the planet and lit up the darkness. Produced every decade or so, such maps have spawned hundreds of pop-culture uses and dozens of economic, social science and environmental research projects.

But what would happen if night lights imagery could be updated yearly, monthly or even daily? A research team led by Earth scientist Miguel Román of NASA's Goddard Space Flight Center in Greenbelt, Maryland, plans to find out this year.

In the years since the 2011 launch of the NASA-NOAA Suomi National Polar-orbiting Partnership (NPP) satellite, Román and colleagues have been analyzing night lights data and developing new software and algorithms to make night lights imagery clearer, more accurate and readily available. They are now on the verge of providing daily, high-definition views of Earth at night, and are targeting the release of such data to the science community later this year.

Since colleagues from the National Oceanic and Atmospheric Administration and NASA released a new Earth at night map in 2012, Román and teammates at NASA's Earth Observing Satellite Data and Information System (EOSDIS) have been working to integrate nighttime data into NASA's Global Imagery Browse Services (GIBS) and Worldview mapping tools. Freely available to the science community and the public via the Web, GIBS and Worldview allow users to see natural- and false-color images of Earth within hours of satellite acquisition.

Today they are releasing a new global composite map of night lights as observed in 2016, as well as a revised version of the 2012 map ([8 MB jpg](#) | [265 MB jpg](#)). The NASA group has examined the different ways

that [light](#) is radiated, scattered and reflected by land, atmospheric and ocean surfaces. The principal challenge in nighttime satellite imaging is accounting for the phases of the moon, which constantly varies the amount of light shining on Earth, though in predictable ways. Likewise, seasonal vegetation, clouds, aerosols, snow and ice cover, and even faint atmospheric emissions (such as airglow and auroras) change the way light is observed in different parts of the world. The new maps were produced with data from all months of each year. The team wrote code that picked the clearest night views each month, ultimately combining moonlight-free and moonlight-corrected data.

Román and colleagues have been building remote sensing techniques to filter out these sources of extraneous light, gathering a better and more consistent signal of how human-driven patterns and processes are changing. The improved processing moves Suomi NPP closer to its full potential of observing dim light down to the scale of an isolated highway lamp or a fishing boat. The satellite's workhorse instrument is the Visible Infrared Imaging Radiometer Suite (VIIRS), which detects photons of light reflected from Earth's surface and atmosphere in 22 different wavelengths. VIIRS is the first satellite instrument to make quantitative measurements of light emissions and reflections, which allows researchers to distinguish the intensity, types and the sources of night lights over several years.



Composite image of continental US at night, 2016. Credit: NASA Earth Observatory images by Joshua Stevens, using Suomi NPP VIIRS data from Miguel Román, NASA's Goddard Space Flight Center

Suomi NPP observes nearly every location on Earth at roughly 1:30 p.m. and 1:30 a.m. (local time) each day, observing the planet in vertical 3000-kilometer strips from pole to pole. VIIRS includes a special "day-night band," a low-light sensor that can distinguish night lights with six times better spatial resolution and 250 times better resolution of lighting levels (dynamic range) than previous night-observing satellites. And because Suomi NPP is a civilian science satellite, the data are freely available to scientists within minutes to hours of acquisition.

Armed with more accurate nighttime environmental products, the NASA

team is now automating the processing so that users will be able to view nighttime imagery within hours of acquisition. This has the potential to aid short-term weather forecasting and disaster response.

"Thanks to VIIRS, we can now monitor short-term changes caused by disturbances in power delivery, such as conflict, storms, earthquakes and brownouts," said Román. "We can monitor cyclical changes driven by reoccurring human activities such as holiday lighting and seasonal migrations. We can also monitor gradual changes driven by urbanization, out-migration, economic changes, and electrification. The fact that we can track all these different aspects at the heart of what defines a city is simply mind-boggling."



These three composite images provide full-hemisphere views of Earth at night. The clouds and sun glint — added here for aesthetic effect — are derived from MODIS instrument land surface and cloud cover products. Credit: NASA Earth Observatory images by Joshua Stevens, using Suomi NPP VIIRS data from Miguel Román, NASA's Goddard Space Flight Center

For instance, VIIRS detected power outages in the wake of Hurricane Matthew, a major storm that struck the northeastern Caribbean and the southeastern United States in late September 2016. NASA's Disasters

Response team provided the data to colleagues at the Federal Emergency Management Agency; in the future, NASA, FEMA and the Department of Energy hope to develop power outage maps and integrate the information into recovery efforts by first responders.

The NASA team envisions many other potential uses by research, meteorological and civic groups. For instance, daily nighttime imagery could be used to help monitor unregulated or unreported fishing. It could also contribute to efforts to track sea ice movements and concentrations. Researchers in Puerto Rico intend to use the dataset to reduce light pollution and help protect tropical forests and coastal areas that support fragile ecosystems. And a team at the United Nations has already used night lights data to monitor the effects of war on electric power and the movement of displaced populations in war-torn Syria.

In a separate, long-term project, Román is working with colleagues from around the world to improve global and regional estimates of carbon dioxide emissions. The team at NASA's Global Modeling and Assimilation Office (GMAO) is combining night lights, urban land use data, and statistical and model projections of anthropogenic emissions in ways that should make estimates of sources much more precise.

Provided by NASA's Goddard Space Flight Center

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