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Measuring the Impacts of Light Pollution

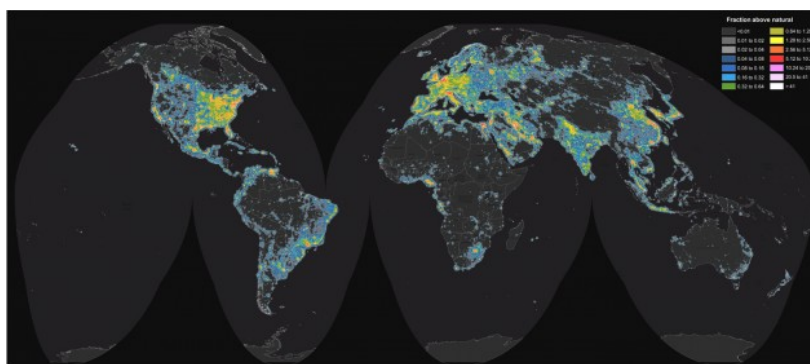
By: Ana V. Aceves | June 16, 2016

1.8K

Light pollution is pervasive, and its impact on people is larger than you might think.

I clearly remember the night I decided I wanted to be an astronomer. It was a cool summer evening when 12-year-old me sat on my front porch and contemplated the universe. I traveled to the edge of the galaxy and explored the known universe. The euphoria I felt at that moment is incomparable.

Growing up in the 1990s in rural California allowed me to experience this life-dictating event—unfortunately, many 12-year-olds may not get the same experience. One third of the human population cannot see the Milky Way at night due to the glow of artificial lights, according to an updated and just-released “New World Atlas of Artificial Night Sky Brightness” that quantifies the global impact of light pollution.



This is a world map of artificial sky brightness as a ratio to the natural sky brightness. The table indicates the meaning of each color level. The brighter the color, the more artificial sky brightness.
Falchi et al.

Moreover, more than 80% of the world's citizens and more than 99% of those in the U.S. and Europe live under an artificial skyglow, or reflected light scatter in the atmosphere from the electric lighting below. This isn't just a problem in megacities and urban areas. For instance, Death Valley is awash with skyglow from Las Vegas and Los Angeles, which are 80 and 150 km away, respectively.

“There's almost no place in some of these countries that looks dark anymore, at least by this atlas's estimates,” said Christopher Luginbuhl (Flagstaff Dark Skies Coalition).

Singapore is the most light-polluted country, where the entire population lives under skies so bright that their eyes can never fully adapt to night vision. Virtually everyone living in Kuwait, Qatar, United Arab Emirates, and Saudi Arabia also experiences this level of light pollution. The countries with populations least affected by light

pollution are Chad, Central African Republic, and Madagascar, with more than three-quarters of their population living under pristine sky conditions.

The atlas was first released in 2001, but this new release is more carefully calibrated and involves better models and computations. "It is no question a big step forward in the scientific study of light pollution," said Luginbuhl.

Gathering data

Fabio Falchi (Light Pollution Science and Technology Institute, Thiene, Italy) and an international team of colleagues took advantage of the newly available, low-light imaging data from the Visible Infrared Imaging Radiometer Suite Day/Night Band sensor on the Suomi National Polar-orbiting Partnership satellite. This satellite orbits at 800 km above the Earth and takes high-resolution photos from the ground at night.

The team also used new precision measurements made at ground level using CCD detectors and handheld Sky Quality Meters (SQMs) made with the help of the U.S. National Park Service and thousands of citizen scientists around the world. These data don't depend on models, so they are very important for the atlas's calibration.

Although this atlas is the second of its kind, Luginbuhl cautions against comparing the two. The old atlas utilized a less-precise set of satellite images and lacked much "ground truth." There have undoubtedly been changes to the amount of light being used outdoors in the last 15 years, but these atlases are not meant to be compared.

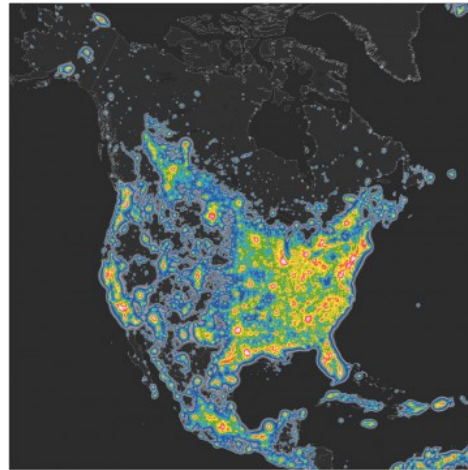
The new atlas by Falchi's team appears in the June 10th issue of [Science Advances](#) and is now [available in print form](#).

Cultural Impact

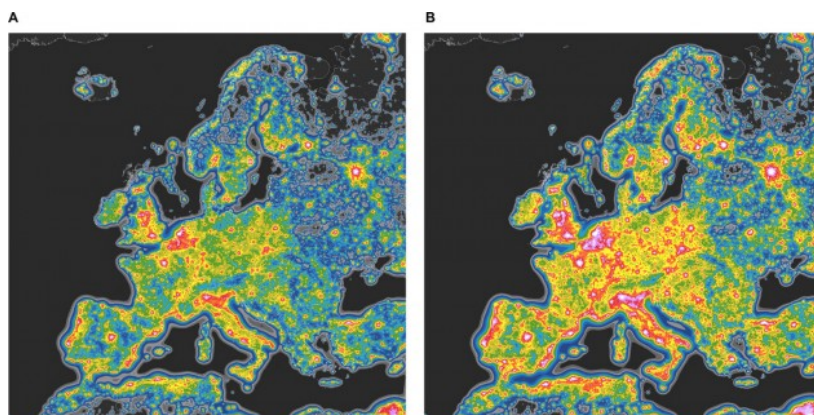
The researchers make a point that light pollution is a concern for everyone, not just astronomers. Biological systems and [human health](#) are also affected by an increase in light pollution. Our internal circadian rhythm — a cycle for sleep and wake patterns, hunger, activity, hormone production, body temperature, and other physiological processes — has been developing over billions of years. Yet we've only been living with electricity since the late 1800s.

The skyglow reported in the atlas is probably below the threshold for directly affecting our circadian rhythms, but the skyglow measurement is from the atmospheric reflection of electric lights in our local environment. Those lights are in many, if not most, cases enough to cause circadian disruption. These include the lights from inside homes and commercial buildings, and even some forms of street lighting.

Biological sciences have begun to show what forms of light and what times of day are most, or least, harmful to our circadian health. This knowledge is being used to produce light sources that are more appropriate for the time of day being used—bright light with high-blue content (fluorescents) in the morning and dim light with low-blue content (low-wattage incandescent) beginning at dusk.



A map of North America's night sky brightness. Note that about half of the U. S. has high levels of night sky brightness.
[Falchi et al.](#)



The image on the left shows the artificial sky brightness of Europe. On the right is what Europe would look like after a transition to LED technology, without increasing the amount of light of currently installed lamps.

[Falchi et al.](#)

Bright lights like fluorescents and LED lights may be significantly contributing to the amount of light pollution. While high-pressure sodium (HPS) lights are yellow and with a low correlated color temperature, LED lights are white, have a higher correlated color temperature, and emit energy in blue and green wavelengths. The American Medical Association has just-released a [policy document](#) blasting the use of blue-rich LED streetlights.

"White LED light threatens to dramatically increase the amount of outdoor lighting. We need to slow down this LED juggernaut and think about it more carefully," said Luginbuhl. Unless the blue-light emission is restricted, switching to LEDs can more than double the night sky brightness as perceived by our dark-adapted eyes.

Moving Forward

Luginbuhl thinks that beyond being a biological problem, light pollution is a societal problem. It's wasted energy that's flooding into space. But culturally, we won't do anything about light pollution unless it matters to more than a few thousand astronomers. He says that when the person down the street thinks, "that matters to me," only then do we have a chance of putting sufficient effort and [resources into fixing the problem](#).

The Light at Night Index (LANI) is a satellite-based evaluation of how efficiently communities in the U.S. with a population of more than 500 use light at night. "The LANI metric is a powerful tool to target communities that would benefit from thoughtful, new lighting installations and to establish priorities in light at night mitigation," said Eric Craine (STEM Laboratory) in a press conference at the 228th meeting of the American Astronomical Society.

While creating the index, researchers found that thoughtful retrofitting of older outdoor lighting can move communities to significantly more efficient use of light. This improves communities' LANI ranking, but more importantly, it also saves them lighting costs and provides maximum protection for dark skies.

"You don't have to be an astronomer to be influenced by a view of a starry night," said Luginbuhl. "And you don't have to know how far a star is to get the basic message that the universe over your head has meaning and perspective to give to human life."

Perhaps if we continue to work to reduce light pollution, we can create a night sky visible enough to inspire more 12-year-olds sitting on their front porches.

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About Ana V. Aceves

Ana currently works at NOVA and occasionally freelances for S&T. She has a master's degree in Science Journalism from Boston University and enjoys telling stories at the intersection of science and everyday experiences, especially when they empower minorities. When Ana isn't writing, you can find her watching shows on Netflix or dancing salsa.

View all posts by Ana V. Aceves →

7 thoughts on "Measuring the Impacts of Light Pollution"



Jay-Eads

June 17, 2016 at 10:30 am

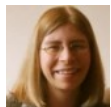
Excellent article. However, I do not see a societal change occurring in terms of light pollution. In my near fifteen plus years of being a serious visual observer and hobbyist, the light pollution issue here in Utah where I live for example, continues to worsen. I would imagine that in my life, I will be able to steer clear of too much light pollution impacting my observing site, which is about 1 1/2 to 2 hours away from my home in a gray zone or a where I get a regular SQM-L ratings in the upper 21.7's to low 21.8's, except when I aim at the Salt Lake to Provo Light Dome on the north-eastern horizon which significantly impacts that reading. I can show since I take a reading in that direction most times I observe, that the number is slowly degrading as the light pollution continues to grow there. I do not see the majority in our society concerned about me as a hobbyist, or about professional astronomers nor in inspiring 12 year olds who might look up. For that matter, most hobbyists and amateurs I know, have no clue or understanding what it means to observe in a dark sky and my experience shows me, that they are content to observe and do public outreach from sites that are heavily light polluted since that is where the public is. Thus though I love the article, I do not see a change coming. If the amateur and hobbyists don't seem to care, why should the public? With astro-photography ever increasing and taking over in the hobby, you don't need pristine dark skies to get very good images of objects above. No, I fear for now, light pollution is here to stay until it has a significant impact on human life and the majority are convinced of that.



carla-mays

June 18, 2016 at 7:23 am

Aren't the A and B images in the last set of images reversed (the right actually showing current artificial sky brightness)?



Monica Young

June 27, 2016 at 9:57 am

Hi Carla-Mays, the image is captioned correctly. Perhaps you're expecting that a transition to LED lighting would reduce light pollution, but the authors (Falchi & others) are actually suggesting the opposite! From their article: "A 4000K white LED light is about 2.5 times more polluting for the scotopic band of the spectrum than is HPS [high-pressure sodium] lighting."



stub.mandrel

June 18, 2016 at 8:39 am

Light pollution is now destroying night-sky views across the UK, so much so that many of us UK astronomers are championing a petition at: <https://petition.parliament.uk/petitions/119428>

I hope it's OK to post that link, if not my apologies and please remove it.

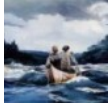
There's also a Twitter conversation using the hashtag #NightBlight associated with mapping of UK light pollution by the CPRE.



Anthony Barreiro

June 18, 2016 at 1:40 pm

It's going to take more than amateur and professional astronomers to build a public consensus to start reducing nighttime light pollution. Ecologists, wildlife biologists, medical doctors, public health and public safety officials, energy conservationists, global warming activists, and lighting engineers all have expressed concerns about our current lighting practices and have called for changes. We need to ally with them. The best first step is to join the International Dark Sky Association, darksky.org.



Bob-Patrick

June 22, 2016 at 12:59 am

Light pollution. Education has got to be a big part of the solution. But that is not enough. People, educated people, who should care just do not seem to care. Being out at night is one of the best natural experiences for all of us. Is there a quick solution in my lifetime (age 66). Not really. Maybe if I outlive my wife then I may be able to move to a dark site. Be a hermit and keep my body strong to handle the equipment. Maybe I should donate my optics to a regional university. Ramble Ramble Ramble.

Good article.

Bob



Steven Schultz

June 28, 2016 at 2:10 pm

This is another excellent article about light pollution. Unfortunately, I foresee an almost insurmountable challenge from the perception held by most folks that nighttime lighting is correlated to safety and security, specifically reduced crime, property damage and theft. I had a small measure of success a few years ago when my complaints to local township trustees about a nightclub that ran a dancing search light cluster resulted in an ordinance requiring businesses to obtain a permit that limited use of such promotional lighting to a specific number of days per year and restricted the hours of operation. But there is a huge gap between combating that kind of light intrusion versus neighbors who feel more secure at night by lighting up their backyards from dawn to dusk with flood light clusters or high wattage mercury vapor "security lights" illuminating their driveways and detached garages. All too often this is a solution supported by local law enforcement agencies. I've tossed in the towel and chosen to flee the excesses of suburban businesses and residential lighting by choosing my telescopes, mounts and astrophotography gear for ease of mobility to the national parks out west .

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