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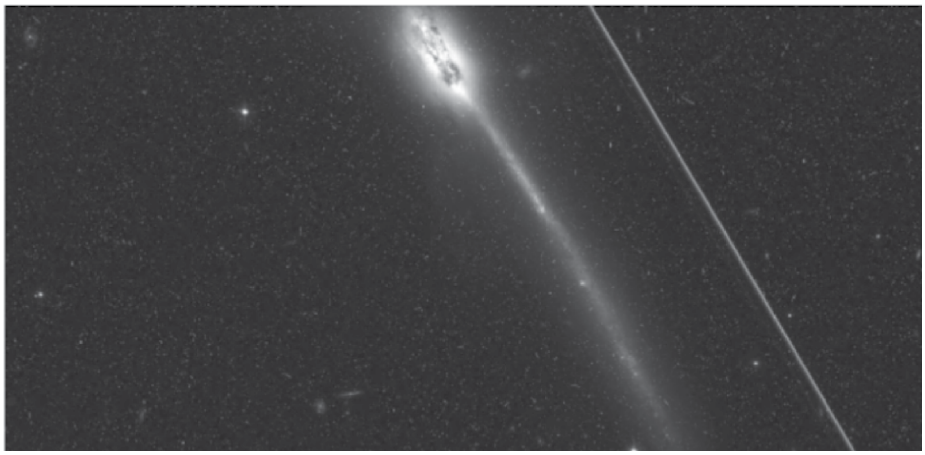
Let there be (natural) light

Light pollution affects every region on Earth, including at the poles and even above us in low-Earth orbit. That isn't news. But the extent of the problem, laid out in our Focus on dark skies, is startling and should turn us all into activists.



On 23 February 2023, Ynys Enlli in north Wales joined a growing list of geographically remote International Dark Sky Sanctuaries, which includes the Pitcairn Islands and !Ae!Hai Kalahari Heritage Park, South Africa. These sites must meet strict criteria for the quality of the night sky and are only designated after extensive monitoring.

While each additional protected dark sky location is a win, we need to address the underlying causes that necessitate intervention in the first place. Our Focus on dark skies looks at just that. The authors not only point out the various problems — and quantify them in some cases — but also highlight solutions and barriers. We invite you to take a look at our online Collection, which also includes relevant articles published earlier.

In our March issue, we start with a World View by Aparna Venkatesan. She takes a holistic view of the sky as both a spatial environment and a timeless cultural heritage. It's vulnerable to all types of pollution, from the light reflected from artificial satellites, to chemical changes to the atmosphere, to threats from space debris. Instead of dealing with these issues individually, Venkatesan argues for a collective solution, with mutual respect, before humans repeat history and colonize space and other planetary bodies.

In his Comment, Fabio Falchi calls on scientists to take action against artificial light at night as he calls out the lighting industry for driving up demand for LEDs by installing two lights per post instead of one, for example. It is a wholly unnecessary practice that increases skyglow and wastes energy. Similarly, the space industry is creating a market for itself by launching unneeded communications satellites. To prevent further degradation of night darkness, mutually agreed and binding limits to the number of planned satellites — and the concomitant creation of space debris — are needed, and soon. As it is a question of sociopolitical will, change is achievable if we all stand together.

We now look more closely at the implications for astronomical observatories from satellite megaconstellations. In a Perspective by John Barentine and co-workers, they consider the aggregate effects of lost telescope time in a more quantitative way. The contribution from space debris to sky brightness is surprising. Satellites cause streaks in images from ground telescopes and, together with increasing sky brightness, mean that additional observations and longer integration times are required. Competition for telescope time will thus increase, as will inequality as poorer departments lose out to better-resourced institutions. Diversity and accessibility cannot improve under these conditions, and although invaluable, human heritage and culture based on the night sky and built over millennia will suffer.

Unfortunately, space telescopes are also affected if they are in low-Earth orbit. Exactly how many Hubble Space Telescope exposures are ruined, Sandor Kruk and co-workers wanted to know. In their Article, a team of citizen scientists helped trawl through the telescope's archive from 2002 to 2021. With a little help from artificial intelligence, the authors determined that 2.7% of the images contained at least one satellite trail (pictured). One image even had four! Given the pace of satellite launches and debris proliferation, by the 2030s that fraction could reach 20–50%. Besides Hubble, other observatories such as CHEOPS and NEOWISE will be similarly affected.

And now back to Earth. The Article by Miroslav Kocifaj and co-workers exposes the difficulty in modelling sky brightness. Computer models can supplement measurements when it comes to assessing night sky brightness by astronomers, city planners and conservationists alike. Light can be absorbed and scattered by particles in the air. The conventional assumption is that aerosol particles are spherical and have diameters on the order of the wavelength of the passing light — known as Mie scattering. But by using varying morphologies, the authors find that Mie scattering leads to a systematic bias that underestimates the skyglow, particularly at low altitudes. Analytic models are computationally expensive, so their approach using more realistic approximations are an improvement for reducing computing time and predicting darkness in areas that are not easily measured.

From these articles, it is clear that our dark skies are brightening and the consequences are stark. But we agree with our authors: we should rise up against it. The recently agreed UN High Seas Treaty to protect international waters should give us hope that the skies can be similarly protected. Events such as the recent appearance of the Aurora Borealis across the UK and down to southern England in late February remind people to look up and be amazed. We should capitalize on the excitement and preserve such wonders for future generations.

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