

# Dark Skies and Light Pollution

## A Resource Guide

### [with a section on Radio Interference]

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These days, as human civilization and electric lights spread across the globe, few places on Earth remain truly dark. For astronomers, trying to collect the faint light of distant objects, this “light pollution” from human activity has become a serious problem. Some of our light fixtures are worse than others in terms of the glare and wasted light they produce and the number of colors (wavelengths) they block from celestial objects. Recently, swarms of satellites in low orbit through which commercial companies are competing to provide internet service have also begun to interfere with astronomical observations. In this introductory guide, we list a selection of the resources that describe the efforts of astronomers and environmentalists to educate policy makers and the public about light pollution (and also, in a separate section, the crowding of radio channels needed for astronomy.)

#### Dedicated Web Sites

The International Dark Sky Association: <http://www.darksky.org> The primary organization devoted to the issue of preserving the dark skies and installing good lighting. Their site has lots of educational and informational material, plus help with advocacy efforts.

Dark Skies Awareness Project: <http://www.darkskiesawareness.org/> This is an international site, created during the 2009 International Year of Astronomy, with links that bring together information and educational activities around the world. It was last updated in 2011, but can still be useful.

British Astronomical Association Commission for Dark Skies: <http://www.britastro.org/dark-skies/> (Organization in Great Britain; its site has information sheets, newsletters, examples, links, etc.)

The McDonald Observatory Dark Skies Initiative: <http://mcdonaldobservatory.org/darkskies/>  
(Useful information and a video from the University of Texas' observatory.)  
Globe at Night: <http://www.globeatnight.org/> (A major citizen science project to measure the amount of light pollution, with good instructions and materials.)  
Night Sky Network Light Pollution Information: [https://nightsky.jpl.nasa.gov/news-display.cfm?News\\_ID=745](https://nightsky.jpl.nasa.gov/news-display.cfm?News_ID=745)  
Light Pollution Pages from Florida Atlantic University: <http://cescos.fau.edu/observatory/lightpoll-astro.html> (includes both non-technical and technical materials)

## Light Pollution Articles on the Web

Guides from the International Dark-Sky Association: <http://www.darksky.org/resources/public-outreach-materials/> (see the section on information guides for a clear introduction to the key issues and solutions)

International Astronomical Union Report to the United Nations on “Keeping Dark and Quiet Skies for Science and Society” (Jan. 2021): <https://www.iau.org/static/publications/uncopuos-stsc-crp-8jan2021.pdf> (This is a good summary of a long report, which is discussed below, under Books.)

Bakich, M. “Reclaim the Night Sky” in *Astronomy*, June 2004, p. 39. Features vivid maps showing light pollution around the world. See: <http://www.astronomy.com/-/media/import/files/pdf/c/c/f/alp0604.pdf>

Drake, N. “Our Nights are Getting Brighter and Earth is Paying the Price” *National Geographic*, Apr. 3, 2019: <https://www.nationalgeographic.com/science/2019/04/nights-are-getting-brighter-earth-paying-the-price-light-pollution-dark-skies/>

Harder, B. “Light Pollution: Dark Skies, No More” *U.S. News and World Report*, March 2008: <http://www.usnews.com/science/articles/2008/03/14/turning-out-the-lights.html>

Kluger, J. “Light Pollution Is Getting Worse Every Year. That's Bad For Your Health” in *Time*, Nov. 22, 2017: <http://time.com/5033099/light-pollution-health/>

Lockwood, C. “Heavens Above, Parking Lot Below” (a brief op-ed piece), *The New York Times*, Aug. 30, 2003: <http://www.nytimes.com/2003/08/30/opinion/30LOCK.html>

McCullagh, D. “Didn't There Used to Be Stars?” in *Wired*, Nov. 23, 2001: <https://www.wired.com/2001/11/didnt-there-used-to-be-stars/>

Owen, D. “The Dark Side: Making War on Light Pollution” in *The New Yorker*, Aug. 20, 2007: [http://www.newyorker.com/reporting/2007/08/20/070820fa\\_fact\\_owen?printable=true](http://www.newyorker.com/reporting/2007/08/20/070820fa_fact_owen?printable=true)

Ploetz, K. “Light Pollution in the United States: An Overview of the Inadequacies of the Common Law and State and Local Regulation” in *New England Law Review*, 2002, Vol. 36, #4 (with footnotes for lawyers): <http://www.illinoislighting.org/resources/Ploetz.pdf>

Upgren, A. “Everything You Ever Wanted to Know about Light Pollution” in *Sky & Telescope*, 2006: <http://www.skyandtelescope.com/astronomy-resources/everything-you-ever-wanted-to-know-about-light-pollution/>

Walker, C. & Pompea, S. “A Global Campaign to Save Energy and Fight Light Pollution” (SPIE): <https://www.globeatnight.org/dsr/dsee/Dark%20Skies%20Articles/Global%20campaign%20to%20save%20energy%20and%20fight%20light%20pollution.pdf>

Articles on Light Pollution from *Sky & Telescope* Magazine: <http://www.skyandtelescope.com/get-involved/saving-dark-skies/>

## Web Information on Swarms of Satellites on Low-Earth Orbit

American Astronomical Society page on the issue with updates and links:

<https://aas.org/posts/advocacy/2020/12/impacts-large-satellite-constellations-astronomy-live-updates>

International Astronomical Union Press Release on the Impact of Satellite Constellations on Astronomical Observing (Feb. 2020): <https://www.iau.org/news/pressreleases/detail/iau2001/> (also see the IAU report cited in the previous section)

Lawler, S. “Space-X’s Starlink Satellites are About to Ruin Stargazing Forever” on the *Astronomy* magazine website (Nov. 25, 2020): <https://astronomy.com/news/2020/11/spacexs-starlink-satellites-are-about-to-ruin-stargazing-for-everyone>

Patel, N. “Satellite Mega-constellations Risk Ruining Astronomy Forever” in *Technology Review*, Sep. 2, 2020: <https://www.technologyreview.com/2020/09/02/1007938/satellite-mega-constellations-risk-ruining-astronomy-forever/>

Tyson, A. & Parriott, J. “Dark Skies and Bright Satellites” An editorial in *Science*, 25 Sep 2020: <https://science.sciencemag.org/content/369/6511/1543>

Wall, M. “Astronomers Hope UN can Help Protect Dark skies against Megaconstellation Threat” Oct. 9, 2020 on Space.com: <https://www.space.com/satellite-megaconstellations-threat-dark-skies-un>

Witze, A. “How Satellite ‘Megaconstellations’ will Photobomb Astronomy Images” in *Nature*, 26 Aug. 2020, at: <https://www.nature.com/articles/d41586-020-02480-5>

## Books

Bogard, Paul *Let There Be Night: Testimony on Behalf of the Dark*. 2008, University of Nevada Press. Eloquent essays, by scientists, poets, and others, about the problem of light pollution.

Bogard, Paul *The End of the Night: Searching for Natural Darkness in the Age of Artificial Light*. 2013, Back Bay Books. Prizewinning, literate examination of light pollution and its effects on the spirit as well as the physical world.

International Dark-Sky Association *Fighting Light Pollution: Smart Lighting Solutions for Individuals and Communities*. 2012, Stackpole Books. A manual.

Mizon, Bob *Light Pollution: Responses and Remedies*, 2<sup>nd</sup> ed. 2012, Springer Verlag. Explains the science behind light pollution and suggests objects to observe at different local light levels.

Rich, C. & Longcore, T., eds. *Ecological Consequences of Artificial Night Lighting*. 2005, Island Press. Combines essays by scientists with vignettes from naturalists about how the lack of darkness affects creatures in many habitats.

Walker, Connie, et al. *Dark Skies and Quiet Skies for Science and Society*. 2020, International Astronomical Union. A 279-page report, with both nontechnical and technical sections, outlining the issues and proposed solutions to each of the problems. Likely a definitive resource. Free at: <https://www.iau.org/static/publications/dqskies-book-29-12-20.pdf>

## Children’s Books

Arnold, Marsha *Lights Out*. 2020, Creative Editions. Ages 6-8.

Bogard, Paul *What If Night*. 2020, Keystone Canyon Press. Ages 2-5

Crelin, Bob *There Once Was a Sky Full of Stars*. 2007, Sky Publishing. Ages 4-8  
Cumming, Hannah *The Lost Stars*. 2011, Child's Play International. Ages 4-8.  
Galat, Joan *Dark Matters: Nature's Reaction to Light Pollution*. 2017, Red Deer Pr. Ages 10-18.  
Poppele, Jonathan *Sophie's Night Sky Adventure*. 2015, Adventure Publ. Ages 6-10.

## Articles in Print

Bakich, M. "Can We Win the War Against Light Pollution" in *Astronomy*, Feb. 2009, p. 56. Good overview of the problem and solutions.

Beatty, J. "Saving the Night Sky" in *Sky & Telescope*, May 2010, p. 28. Excellent overview of the work of the International Dark-Sky Association and the efforts to reduce light pollution.

Betz, E. "Protecting America's Last Dark Skies" in *Astronomy*, June 2016, p. 54. Light pollution and the National Park System.

Crawford, D. & Hunter, T. "The Battle Against Light Pollution" in *Sky & Telescope*, July 1990, p. 23. An older review by two pioneers in the movement to deal with the problem.

Crelin, B. "How I Beat Light Pollution in My Hometown" in *Sky & Telescope*, Dec. 2002, p. 40. How an amateur astronomer convinced the town of Branford, CT to pass a law to reduce light pollution.

DiCicco, D. & Beatty, J. "Home Lighting for Amateur Astronomers" in *Sky & Telescope*, Apr. 2002, p. 50. A shopper's guide to outdoor light fixtures.

Flanders, T. "Living with Light Pollution" in *Sky & Telescope*, Feb. 2009, p. 62. On how amateur astronomers can deal with sky glow and excess light by timing their observations or using new equipment.

Hattenbach, J. "Surveying Skyglow" in *Sky & Telescope*, May 2015, p. 34. A review of light pollution and discussion of how citizen scientists can help measure the light in their skies.

Kardel, S. "Cities from Space" in *Sky & Telescope*, July 2014, p. 26. Photos of major cities from space at night and what they tell us about light pollution.

Kardel, S. "How You Can Fight Light Pollution" in *Astronomy*, Dec. 2012, p. 60. Short introduction on how to get involved in your own neighborhood.

Levy, D. "Ten Dark-Sky Years" in *Sky & Telescope*, Sep. 1998, p. 32. On the work of the International Dark-Sky Association.

O'Meara, S. "Dark Nights are Safe Nights" in *Sky & Telescope*, Sep. 1998, p. 84. On ways you can help safeguard the night in your community.

Thessin, R. & Crawford, D. "Your Home Lighting Guide" in *Sky & Telescope*, Apr. 2002, p. 40. Good discussion of how to avoid light pollution on an individual basis.

Thessin, R. & Beatty, J. "Bright Lights Big Problems" in *Sky & Telescope*, Dec. 2002, p. 32. New research about and new designs for street lights to help reduce glare and stray light.

Young, Monica "The New Space Race [and Problem]" in *Sky & Telescope*, Mar. 2020, p. 14. A good discussion of the danger that huge numbers of new reflective satellites (to provide wifi) poses to the darkness of the night sky for astronomers.

## Videos

*Losing the Dark* (2013, 6-min video by the International Dark-Sky Association and Loch Ness Productions): A brief overview of light pollution:  
[https://www.youtube.com/watch?time\\_continue=2&v=dd82jajtFlo](https://www.youtube.com/watch?time_continue=2&v=dd82jajtFlo)

*De-light the Night* (2015, 19-min TED-x Talk by astronomer Diane Turnshek): A personal discussion of light pollution and solutions: <https://www.youtube.com/watch?v=-xSv33prmGY>

*The City Dark* (2012, 60-min documentary shown on PBS) For the full story and excerpts, see: <https://www.pbs.org/pov/citydark/>

*The Earth at Night* (2013, 3-min NASA video using images from the Suomi satellite) Narrated footage showing the Earth at night, with a number of close-ups showing the effect of human lights: <https://www.youtube.com/watch?v=pG4TAAExWK8> (A 30-second version, without narration, called “The Black Marble” is at: <https://www.youtube.com/watch?v=wADkJiMbmTQ>)

*Light Pollution 101* (2018, 3 min, National Geographic) A short primer, well produced: [https://www.youtube.com/watch?v=V\\_A78zDBwYE](https://www.youtube.com/watch?v=V_A78zDBwYE)

*Light Pollution: The Disappearing Darkness* (2017, 43 min, DW Documentaries) A film that examines the effects of light pollution on not just astronomy, but on animals and our health: <https://www.youtube.com/watch?v=9NyQgHGF1NM>

*Preserving Dark Skies* (2010, 3-min video from the McDonald Observatory at the U. of Texas) Nice, narrated primer: [https://www.youtube.com/watch?time\\_continue=27&v=kYCQZJt26zQ](https://www.youtube.com/watch?time_continue=27&v=kYCQZJt26zQ)

### Activities for Teachers and Students

Dark Skies Rangers Lessons: <https://www.globeatnight.org/dsr/> (Led by the team at the National Optical Astronomy Observatories, this is a great sequence of activities for classroom and museum use.)

International Dark Sky Association Material for Teachers: <https://www.darksky.org/our-work/grassroots-advocacy/resources/educators/>

The Quality of Light Teaching Kit (with videos and downloadable materials): <https://www.noao.edu/education/qltkit.php>

Chuck Bueter’s Light Pollution Education Activities (from the Paper Plate Astronomy Site): <http://analyzer.depaul.edu/paperplate/lights.htm>

Walker C. “A Silent Cry for Darker Skies,” 2008 Light Pollution Issue of *Universe in the Classroom*: [https://astrosociety.org/file\\_download/inline/b9265479-56cc-4283-a2a1-8383ba26e99d](https://astrosociety.org/file_download/inline/b9265479-56cc-4283-a2a1-8383ba26e99d)

Crawford, D., et al. “Light Pollution” in *Universe in the Classroom*, Fall 1998 (an overview with activities): [https://astrosociety.org/file\\_download/inline/506ac002-9776-4a89-97d7-0cd7ccacbddb](https://astrosociety.org/file_download/inline/506ac002-9776-4a89-97d7-0cd7ccacbddb)

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### Quiet Skies: Dealing with Radio-wave Interference

Radio astronomer search for “faint” radio static from cosmic objects. Increasingly, the signals they are searching for are lost in the “din” of terrestrial radio communications, particularly the requirements of cellular phones and other modern communications devices that use towers and satellites. Major political battles loom as the demands of business clash with the need to protect certain important channels for radio astronomy. Here are a few selected resources about this topic:

### Web Sites:

Quiet Skies Webpage from the International Astronomical Union from 2009:

<http://www.darkskiesawareness.org/quiet-skies.php>

Committee on Radio Frequencies of the European Science Foundation: <https://www.craf.eu/>

Radio Frequency Interference (from NRAO): <https://public.nrao.edu/telescopes/radio-frequency-interference/>

List of Protected Frequencies: <https://britastro.org/node/9118> (A more detailed and technical discussion is at: <http://www.naic.edu/~rfiuser/smarg-act.html>)

2000 News Release on Winning Some Protection: <https://public.nrao.edu/news/astronomers-win-protection-for-key-part-of-radio-spectrum/>

Be an Interference Detective (an educational activity from the National Radio Astronomy Observatory): <http://www.gb.nrao.edu/epo/interf.html>

### Readings

Carpenter, S. "Lost Space: Rising Din Threatens Radio Astronomy" in *Science News*, Sep. 11, 1999, vol. 156, p. 168. Good summary of the situation at the time.

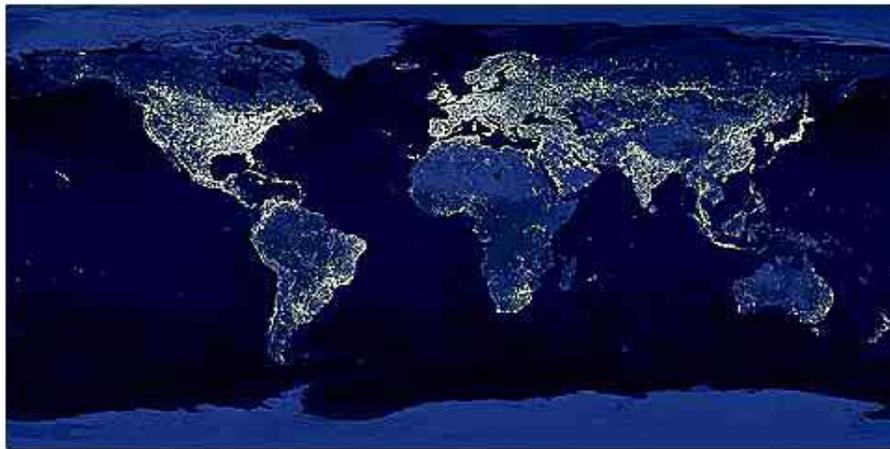
Jackson, C. "The Allocation of the Radio Spectrum" in *Scientific American*, Feb. 1980. Saving the "channels" radio astronomers need from being used for terrestrial purposes.

Pankonin, V. "Protecting Radio Windows for Astronomy" in *Sky & Telescope*, Apr. 1981, p. 308.

Roth, J. "Will the Sun Set on Radio Astronomy?" in *Sky & Telescope*, Apr. 1997, p. 40. Explains the "pollution" of the radio spectrum by human activities.

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The World at Night (from Satellite Imaging)