


THREATS TO DARK & QUIET SKIES BY **SATELLITE CONSTELLATIONS**

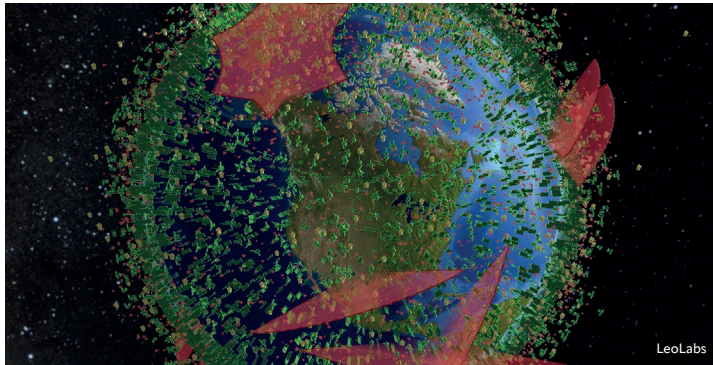


The recent, massive proliferation of commercial satellites in low Earth orbit significantly threatens astronomy unless mitigating actions are taken.

In 2026, there are more than 15,000 satellites in low Earth orbit (LEO) . Recent filings with the International Telecommunication Union suggest a dramatic increase of possibly **hundreds of thousands of satellites in LEO in the coming decade.**

This increases collision risk and the possibility of rendering LEO unusable to all without careful management. Satellites and orbital debris reflect sunlight, leaving streaks across science images. Satellite radio transmissions interfere with radio telescopes as they pass overhead.

The **growth of LEO satellites has a direct impact on professional and amateur astronomy**, and, without appropriate mitigations, it will have a significant and detrimental effect on the dark and quiet sky across the globe, even rendering some observations impossible.



A screenshot of LeoLabs Low Earth Orbit Visualization tracking thousands of operational satellites, defunct satellites, spent rocket bodies, and pieces of debris in orbit around the Earth.



Optical interference of NGC 5353/4 galaxy group from satellite constellation trails.



All ground-based optical, infrared, and radio observatories are affected. Simulations that assume some 60,000 LEO satellites in realistic orbital configurations predict that Vera C. Rubin Observatory, hosting a large optical telescope with a wide field of view that commenced operations in 2024, may be **impacted by at least one satellite streak on up to 30% of observations at the beginning and end of each night.**

OTHER IMPACTS

- The combined effect of current satellites in orbit and the accumulation of space debris may already be causing an approximately 10% increase in the brightness of the night sky compared to natural levels.
- Interference to astronomy from larger structures in space, including space-based solar power systems, LEO space habitats, and larger satellites that connect directly to mobile phone handsets.
- The changing visual appearance of the sky also impacts our cultural heritage and environment.

WHAT CAN BE DONE?

- **Support the bipartisan Dark and Quiet Skies Act** to better understand and mitigate the optical and radio interference impacts of satellite constellations on astronomy.
- **Encourage and support satellite operators and industry to collaborate with the astronomy community** to develop, share, and adopt best practices in interference mitigation, leading to widely adopted standards and guidelines.
- **Provide incentive measures for the space industry** to develop the required technology to minimize negative impacts. Support the establishment of test labs for brightness and basic research into alternate less reflective materials and reduction of unwanted radiation in the radio regime for spacecraft manufacturing.
- **Increase financial support for astronomy to offset and compensate the impacts** on observatory operations and implement mitigation measures at observatories and in software.
- In the longer term, **establish regulations and conditions of authorization and supervision** based on practical experience as well as the general provisions of international law and main principles of environmental law to codify industry best practices that mitigate the negative impacts on astronomical observations. Satellites in LEO should be designed and operated in ways that minimize adverse effects on astronomy and the dark and quiet sky.
- Continue to **support finding solutions to space sustainability issues**, including the problem of increasing space debris leading to a brighter sky. Minimizing the production of space debris will also benefit the field of astronomy and all sky observers worldwide.

US regulations and guidelines do not consider optical astronomy in licensing and inadequately consider radio astronomy. The AAS is working to collaborate with satellite operators, but harm mitigation has largely been voluntary. **Mitigation of harm to astronomy should be a requirement of licensing.**

Cover image: Orion Nebula showing satellite trails in mid-December 2019. Credit: A. H. Abolfath/NOIRLab/NSF/AURA.