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Retired satellites: A chance to shed light

Satellite data is vital to decisions about both environmental and human health. As satellites are replaced and decommissioned, they could be repurposed to spark new scientific insights.

The path and timing of the Suomi National Polar-orbiting Partnership (NPP) and National Oceanic and Atmospheric Administration -20 satellites—part of the larger Joint Polar Satellite System (JPSS)—prioritize the collection of data for numerical weather prediction models (1). Also flying on these satellites is the Visible Infrared Imaging Radiometer Suite's (VIIRS) day/night band (DNB) (2), the only openly accessible instrument currently measuring lights from Earth's surface at night, globally. These nighttime data have enabled scientists to track urbanization, estimate population and gross domestic product, and monitor the impacts of disasters and conflicts (3). However, Suomi-NPP and the JPSS constellation of satellites acquire measurements at about 01:30 am local time, even though human activities substantially decrease after midnight, as do lighting from building windows, vehicle headlights, businesses, and timed streetlights. Late-night lighting disproportionately decreases over developing countries due to energy and cost constraints (4). Because the satellites' orbits were selected to meet high-priority demands, such as weather forecasting, they are missing a wealth of potential information that could be gathered from measurements collected at an earlier local time.

Earth and social scientists have long wanted access to earlier nighttime observations. The launch of follow-on JPSS satellites, beginning in 2022, provides a valuable opportunity. The new satellites are expected to continue measurements at 1:30 am. Meanwhile, the decommissioned spacecraft they replace could be shifted to an orbit at an earlier local time. Collecting imagery at around 10:00 am and 10:00 pm would minimize the risk of cloud cover and match the orbit of two predecessor sensors—the Terra Moderate Resolution Imaging Spectroradiometer (MODIS), which has collected daytime data at 10:30am for 20 years (10), and the Defense Meteorological Program Operational Line-Scan System (DMSP-OLS), which collected nighttime data between 7:30 and 9:30pm for more than 40 years (5).

Additional evening data would deepen understanding of the rhythm of human civilization, much in the same way that daytime sensors—many of which collect data

continuously throughout the day—have illuminated phenomena such as seasonal vegetation, sea ice cycles, wind patterns, ocean currents, land surface temperatures, and precipitation patterns (3, 6). Multiple observations per night would better characterize the stability and angular properties of light sources, improving detection of traffic, power outages (7), conflict (8), illegal fishing (9), and demographic trends.

Reprogramming retired satellites is not standard practice and may require additional planning and investment. However, with replacement JPSS satellite launches planned every 4 to 6 years, each launch will offer another opportunity to repurpose a retired satellite. Future JPSS satellites should be designed to include a “retirement plan” that can provide data to fill knowledge gaps. For researchers interested in the Earth at night and the broader land science community, repurposing decommissioned VIIRS-DNBs would provide crucial data for disaster monitoring, while advancing the science of human activities, their dynamics, and their interactions with the natural world.

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