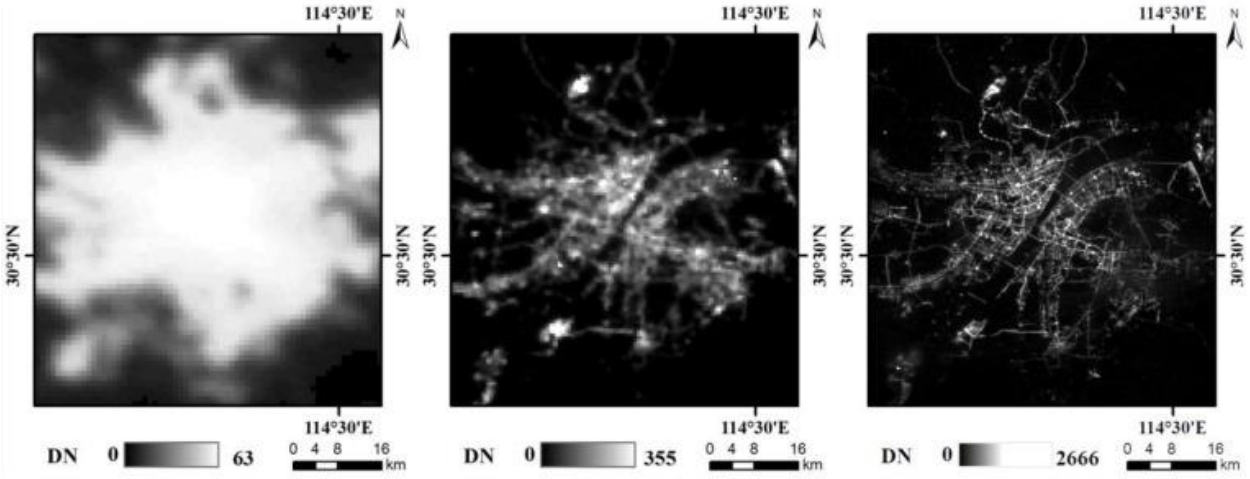
EO-FIN

Nighttime Light Monitoring



Nighttime imagery from DMSP-OLS, NPP-VIIRS and Luojia 1-01 in Wuhan, China: (a) is DMSP-OLS in 2013, (b) is NPP-VIIRS in May 2018; (c) is Luojia 1-01 on 13 June 2018. (Source: Jiang, W., He, G., Long, T., Guo, H., Yin, R., Leng, W., Liu, H. and Wang, G., 2018. Potentiality of using Luojia 1-01 nighttime light imagery to investigate artificial light pollution. Sensors, 18(9), p.2900.

Product Category

☐ Land Use	☐ Natural Disaster	☐ Coast Management	☐ Earth's Surface Motion
■ Land Cover	☐ Climate Change	☐ Marine	

Financial Domain(s)

■ **Investment management** ☐ **Risk analysis** ☐ **Insurance management** ☐ **Green finance**

User requirements

UN16: Nighttime light monitoring.

Description

Nighttime light plays a crucial role in various Earth science studies and practical applications. By filtering out unwanted sources like moonlight and other interferences, we can effectively track and analyse artificial lights from human activities, such as street and building lighting. Hence, monitoring nighttime lights can serve various purposes, including measuring the extent and characteristics of urbanization processes, estimating economic growth at both national and subnational scales, mapping global poverty, and population density, and evaluating access to electricity and electrification. Generally, there are three remote sensing sensors for nighttime light, and each of them has advantages and disadvantages. DMSP OLS provides long-term data from the early 1970s until 2011, however, it has low spatial (2.7km) and radiometric (6bits) resolutions. The VIIRS Day/Night Band (DNB) represents an enhancement over the previous DMSP OLS system, offering improved spatial and radiometric resolution. VIIRS provides spatial resolutions of 375 and 750 meters (depending on the band), and daily temporal resolution, and delivers more comprehensive global coverage with higher-quality data. In addition, there is NASA's Black Marble product which is an enhancement product of DNB by applying atmospheric and angular corrections and applying an algorithm to remove moonlight contribution. One of the advantages of using DMSP-OLS and VIIRS-DNB is that the World Bank provides a data archive called The Light Every Night dataset that is published on Amazon Web Services including tutorials about using the dataset. The last product is Luojia 1-01 which was produced by Wuhan University in 2018 and has the advantage of higher spatial resolution (130m) but it lacks the high temporal resolution of DNB by having data every 15 days. Furthermore, there is inconsistency in the data available on the portal, as the most recent observations are only up to March 2019, and in certain regions of the world, the data is even earlier. Finally, using land cover data can be useful to concentrate the service for urban areas only.

Spatial Coverage Target

Regional

Data Throughput

Rapid tasking	☐ High	■ Low
Data availability	☐ High	■ Low

Product specifications	
Main processing steps	The dynamic change of nighttime light is the main indicator of the change in human activities. Therefore, time series nighttime light data is essential for

Product specifications	
	related applications. Apply masks and filters to remove unwanted data or sources of interference. This may involve masking out areas with heavy cloud cover or masking out natural sources of light, such as moonlight, to focus on artificial light sources. Conduct calibration processes to convert the digital numbers in the nighttime light imagery to radiance or reflectance values, making the data suitable for quantitative analysis. Generate time series data by compiling and comparing nighttime light data over various periods. This enables the monitoring of changes in artificial light patterns over time. Conduct statistical and spatial analyses to interpret the data and derive insights related to urbanization, economic activities, energy consumption, and other factors. Create visualizations and maps to present the nighttime light data in a clear and informative manner.
Input data sources	Optical: DMSP OLS, VIIRS DNB, Luojia 1-01 Radar: N.A Satellite-based products: N.A Supporting data: Land cover data such as ESA CCI Land cover (20m resolution)
Accessibility	DMSP OLS, VIIRS DNB: freely and publicly available from NASA. Luojia 1-01: available from Wuhan university
Spatial resolution	Luojia 1-01: 130m VIIRS DNB: 750m DMSP OLS: 2700m
Frequency (Temporal resolution)	Luojia 1-01: 15 days VIIRS DNB: Daily DMSP OLS: Annual
Latency	Luojia 1-01: NA VIIRS DNB: Daily DMSP OLS: Archive
Geographical scale coverage	Globally
Delivery/ output format	Data type: Raster/Vector/Charts File format: GeoTIFF/Shapefile /PDF
Accuracies	Thematic accuracy: N.A Spatial accuracy: 1.5-2 pixels of input data
Constraints and limitations	■ Cloud presence ■ The lower spatial resolution of the products ■ Natural light sources like moonlight can interfere with the detection of artificial nighttime light. ■ May not be sensitive enough to detect low-intensity light sources accurately, which can lead to underestimation of nighttime light in less densely populated areas.
User's level of knowledge and skills to extract information and perform further analysis on the EO products.	Skills: Ample Knowledge: Ample