**Nighttime artificial light detection**

**VIIRS satellite instrument\_ VNP46A2 product**

* **About Mission - Suomi National Polar-orbiting Partnership (NPP)** (Kramer)

NPP is a joint NASA/IPO (Integrated Program Office)/NOAA LEO weather satellite mission initiated in 1998. In honor of the late Verner E. Suomi, a meteorologist at the University of Wisconsin, who is recognized widely as "the father of satellite meteorology." NASA renamed its newest Earth-observing satellite (launched on October 2011), to Suomi NPP (National Polar-orbiting Partnership) in January 2012.

The primary mission objectives are:

1) To demonstrate the performance of four advanced sensors VIIRS, CrIS, OMPS and ATMS (risk reduction mission for key parts of the NPOESS mission) and their associated Environmental Data Records (EDR), such as sea surface temperature retrieval.

2) To provide data continuity for key data series observations initiated by NASA's EOS series missions (Terra, Aqua and Aura) - and prior to the launch of the first NPOESS series spacecraft. Because of this second role, NPP is sometimes referred to as the EOS-NPOESS bridging mission.

This suite of sensors is able to provide cloud, land and ocean imagery, covering the spectral range from the visible to the thermal infrared, as well as temperature and humidity profiles of the atmosphere, including ozone distributions

* **About Instrument - Visible Infrared Imaging Radiometer Suite (VIIRS)**

The VIIRS instrument observes and collects global satellite observations that span the visible and infrared wavelengths across land, ocean, and atmosphere.

VIIRS-derived data products are used to measure cloud and aerosol properties, ocean color, fires, ocean and land surface temperature, ice movement and temperature, and Earth's albedo. Climate scientists are using this data to improve understanding of global climate change.

**Measurement science**

VIIRS consists of 22 spectral bands from the ultra-violet to the mid-infrared, one of which is able to observe nighttime lights, the day night band (DNB). DNB is a panchromatic band which is ultra-sensitive in low-light conditions that allows us to observe nighttime lights with better spatial and temporal resolutions.

The VIIRS sensor was designed to extend and improve upon the series of measurements initiated by its predecessors, the Advanced Very High Resolution Radiometer (AVHRR), the Moderate Resolution Imaging Spectroradiometer (MODIS), and the Sea-viewing Wide Field-of-view Sensor (SeaWIFS).  (Wolfe)

**VIIRS Instrument Performance and Monitoring**

Results from the on-orbit verification in the postlaunch check-out and intensive calibration and validation have shown that VIIRS is performing very well. (Suomi NPP VIIRS , n.d.)

For more up-to-date detailed information on VIIRS Calibration and Validation check this link:

<https://ncc.nesdis.noaa.gov/VIIRS/>

* **About VIIRS** (Kramer)

*Platform:* Suomi National Polar-orbiting Partnership (NPP) satellite

*Instrument:* Visible Infrared Imaging Radiometer Suite (VIIRS)

*Launch date:* October 28, 2011

Designed and manufactured by: Raytheon Santa Barbara Remote Sensing (SBRS)

*Spatial coverage:* Swath dimension 3000km (corresponding to FOV=±55.84º) nearly global coverage

*Spatial resolution:* 0.4km to 0.8km (nadir to edge-of-scan)

*Orbit:* Sun-synchronous near-circular polar orbit (of the primary NPP), altitude = 824 km, inclination =98.74º, period = 101 minutes, LTDN (Local Time on Descending Node) at 10:30 hours. The repeat cycle is 16 days (quasi-8-day).

*Data access source:* EARTH DATA

*Filename:* VIIRS/NPP Gap-Filled Lunar BRDF-Adjusted Nighttime Lights Daily L3 Global 500m Linear Lat Lon Grid

*Product ID:* VNP46A2

*Data temporal extent:* January 19,2012 - ongoing

*Temporal resolution:* daily

*Data lag period:* ~8days

*Native Format:* HDF5

* **Quality Control**

The black marble product VNP46A2 (level 3) is a daily moonlight- and atmosphere-corrected Nighttime Lights (NTL) product called VIIRS/NPP Gap-Filled Lunar BRDF-Adjusted Nighttime Lights Daily L3 Global 500m Linear Lat Lon Grid.

Key algorithm enhancements include: (1) lunar irradiance modeling to resolve non-linear changes in phase and libration; (2) vector radiative transfer and lunar bidirectional surface anisotropic reflectance modeling to correct for atmospheric and bidirectional reflectance distribution function (BRDF) effects; (3) geometric-optical and canopy radiative transfer modeling to account for seasonal variations in NTL; and (4) temporal gap-filling to reduce persistent data gaps.

It contains seven Science Data Sets (SDS) that include- DNB BRDF-Corrected NTL, Gap-Filled DNB BRDF-Corrected NTL, DNB Lunar Irradiance, Latest High-Quality Retrieval, Mandatory Quality Flag, Cloud Mask Quality Flag, and Snow Flag.

Mandatory\_Quality\_Flag in VPN46A2 product

|  |  |  |
| --- | --- | --- |
| Value | Retrieval Quality | Algorithm Instance |
| 00 | High-Quality | Main Algorithm (Persistent Nighttime Lights) |
| 01 | Good-Quality | Back up Algorithm (Temporal Gap-Filling) |
| 02 | Poor-Quality | Back up Algorithm (Outlier Removal) |
| 255 | No Retrieval | Fill Value |

Lightening detection using VIIRS: <https://journals.ametsoc.org/view/journals/wefo/26/3/waf-d-10-05002_1.xml>

*For more information:*

* Black marble website:

<https://blackmarble.gsfc.nasa.gov/>

* NASA's Black Marble nighttime lights product suite paper:

<https://doi.org/10.1016/j.rse.2018.03.017>

* NASA Black Marble product User guide:

<https://viirsland.gsfc.nasa.gov/PDF/BlackMarbleUserGuide_v1.2_20210421.pdf>

* NASA Black Marble ATBD

<https://viirsland.gsfc.nasa.gov/PDF/VIIRS_BlackMarble_ATBD_V1.1.pdf>

* Sumi NPP satellite, mission and unique observations:

<https://www.eoportal.org/satellite-missions/suomi-npp>