VIIRS/[NPP|JPSS1] Ice Surface Temperature Daily L3 Global 750m EASE-Grid 2.0 [Day|Night], Version 2

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Riggs, G. A., Tschudi, M. A., and D. K. Hall. 2022. *VIIRS/**[NPP or JPSS1]** Ice Surface Temperature Daily L3 Global 750m EASE-Grid 2.0 **[Day or Night]**, Version 2*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. **[insert DOI per list below]** [Date Accessed].

VNP30P1D: https://doi.org/10.5067/PUXL0HHMHVP8
VJ130P1D: https://doi.org/10.5067/O3AQFOAWHFQN
VNP30P1N: https://doi.org/10.5067/QH1FCBXVZH57
VJ130P1N: https://doi.org/10.5067/KRF1WG512YZY

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/VNP30P1D, https://nsidc.org/data/VJ130P1D, https://nsidc.org/data/VNP30P1N, AND https://nsidc.org/data/VJ130P1N

National Snow and Ice Data Center

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1 DATA DESCRIPTION

These VIIRS Level 3 data sets are composites of daily ice surface temperature (IST) generated from the respective satellite 6-minute swath data (the V[NP|J1]30 products) into 10° by 10° tiles at a 750 m resolution grid on the EASE-Grid 2.0 North and South polar projections.

Sea IST is computed from VIIRS moderate resolution bands M15 (10.763 µm) and M16 (12.013 µm) using a split-window technique that is consistent with the MODIS Collection 6.1 IST products. Because it is detected with infrared bands, IST is computed for daytime and nighttime over the polar oceans. A cloud flag is included in the data and users should be aware that uncertainty of the IST estimates increases substantially under cloud-covered skies.

VIIRS travels on board the Suomi-NPP and JPSS-1 satellites (the latter was renamed NOAA-20 after it became operational). While VIIRS data from these satellites are stored in separate product series – VNP and VJ1, respectively – the algorithms that produce sea ice surface temperature data in VIIRS Collection 2.0 are consistent between them.

1.1 Parameters

The Scientific Data Sets (SDSs) included in the L3 IST products are listed in Table 1.

Table 1. SDS Details

Parameter	Description and Values
IST_mean	Mean of all V[NP|J1]30 IST observations mapped into a grid cell. Includes some data flags. Data are in K when the scaling factor of 0.01 is applied. 210 – 313: valid range 0: missing 1: no decision 11: night 25: land 37: inland water 39: open ocean 50: cloud 655.35: fill value
IST_stddev	Standard deviation of observed IST values. Data are in K when the scaling factor of 0.01 is applied. 655.35: fill value
IST_obs	Count of valid IST observations, from all the V[NP|J1]30 observations mapped into a grid cell. 0-127: valid range -1: fill value
n_obs	Count of all the V[NP|J1]30 observations mapped into a grid cell. 0-127: valid range -1: fill value
Projection	Attributes for the Lambert azimuthal equal-area projection.

1.2 File Information

1.2.1 Format

These L3 products are provided in HDF-EOS5 format and use NetCDF Climate and Forecast (CF-1.6) conventions for global and local attributes and to geolocate the variables. For software and more information, visit the HDF-EOS website.

1.2.2 File Contents

As shown in Figure 2, each data file includes four data fields (`IST_mean`, `IST_stddev`, `IST_obs`, and `n_obs`) and an ancillary field with the projection attributes. X and Y coordinate arrays are included for the specified projection (`XDim` and `YDim`).

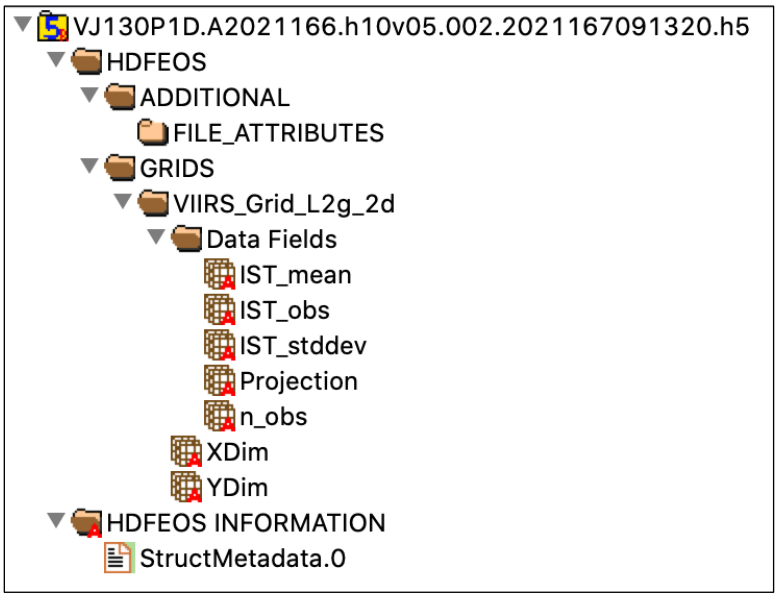

Figure 1. Parameters included in each V[NP|J1]30P1[D|N] file, as displayed with HDFView software. All data fields are two-dimensional except for `Projection`, which is an empty, attribute-only field.

The metadata within HDF-EOS5 data files contain global attributes, which store important details about the data, and local attributes such as keys to data fields. Each data file also has a corresponding XML (.xml) metadata file. For detailed information about metadata fields and values, consult the SNPP/JPSS1 VIIRS Ice Surface Temperature Products Collection 2 User Guide.

1.2.3 Naming Convention

Files are named according to the following convention and as described in Table 2.

File naming convention:

`V[SAT]30P1[D|N].A[YYYY][DDD].h[NN]v[NN].[VVV].[yyyy][ddd][hhmmss].h5`

Table 2. File Name Variables

`SAT`	Satellite designator: `NP` (Suomi-NPP) or `J1` (JPSS-1)
`30P1[D|N]`	Product ID (Day or Night)
`A`	Acquisition date follows
`YYYY`	Acquisition year
`DDD`	Acquisition day of year
h[NN]v[NN]	Horizontal tile number and vertical tile number (see *Grid* section for details)
VVV	Version (Collection) number
`yyyy`	Production year
`ddd`	Production day of year
`hhmmss`	Production hour/minute/second in Greenwich Mean Time (GMT)
`.h5`	HDF-EOS5 formatted data file

File name examples:

`VNP30P1D.A2018210.h10v05.002.2020220224712.h5`

`VNP30P1N.A2018210.h10v05.002.2020220224153.h5`

`VJ130P1D.A2021166.h10v05.002.2021167091320.h5`

`VJ130P1N.A2021166.h10v05.002.2021167081751.h5`

1.3 Spatial Information

1.3.1 Coverage

Poleward of 50°N and 50°S

1.3.2 Projection and Grid

Data files are provided as 10° by 10° tiles of data gridded in the EASE-Grid 2.0 polar azimuthal equal-area projections for the Northern and Southern hemispheres. The tile coordinate system is composed of horizontal and vertical ordered pairs. The northern grid extends from tile h00,v00 in the upper left corner to tile h18,v18 in the lower right corner. The southern grid extends from tile h00,v20 in the upper left corner to tile v18,h38 in the lower right corner. See the EASE-Grid Tile Locations and Bounding Coordinates for MODIS and VIIRS Sea Ice Products technical reference for additional grid information. Note that tiles located over latitudes lower than 50°, if available, will not contain valid IST data. Each individual tile contains a grid of 1,360 rows by 1,360 columns.

1.3.3 Resolution

750 meters

1.3.4 Geolocation

The following tables provide information for geolocating tiles in these data sets.

Table 3. Projection Details

Region	Northern Hemisphere	Southern Hemisphere
Geographic coordinate system	WGS 84	WGS 84
Projected coordinate system	EASE-Grid 2.0 North Lambert Azimuthal	EASE-Grid 2.0 South Lambert Azimuthal
Longitude of true origin	0°	0°
Latitude of true origin	90°	-90°
Scale factor at longitude of true origin	N/A	N/A
Datum	WGS 84	WGS 84
Ellipsoid/spheroid	WGS 84	WGS 84
Units	Meter	Meter
False easting	0°	0°
False northing	0°	0°
EPSG code	6931	6932
PROJ4 string	+proj=laea +lat_0=90 +lon_0=0 +x_0=0 +y_0=0 +ellps=WGS84 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs	+proj=laea +lat_0=-90 +lon_0=0 +x_0=0 +y_0=0 +ellps=WGS84 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
Reference	http://epsg.io/6931	http://epsg.io/6932

Table 4. Grid Details

Grid cell size (x, y pixel dimensions)	750 m
Number of rows	1,360
Number of columns	1,360
Nominal gridded resolution	750 m
Grid rotation	N/A
Geolocated upper left point (m)	`XDim(0)`, `YDim(0)`
Geolocated lower right point (m)	`XDim(1359)`, `YDim(1359)`

1.4 Temporal Information

1.4.1 Coverage

VNP30P1[D|N] data are available from 19 January 2012 to present.
VJ130P1[D|N] data are available from 5 January 2018 to present.

If you cannot locate data for a particular date or time, check the MODIS & VIIRS Data Outages Web page.

1.4.2 Resolution

Daily

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The sea ice surface temperature algorithm in VIIRS Collection 2.0 utilizes a split-window technique to estimate IST poleward of 50ºN and 50ºS. It uses the same method employed in MODIS 6.1 IST products, but with VIIRS-specific coefficients. A major caveat of the algorithm is that it is applicable only to clear-sky conditions. Inadequate cloud-masking may result in significant error in estimating the IST. For a detailed description of the VIIRS IST algorithm, see Tschudi et al. (2016).

2.2 Instrumentation

The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument collects visible and infrared imagery in 22 spectral bands ranging from 0.412 to 12.01 micrometers. Sixteen moderate resolution bands (M-bands), five imaging resolution bands (I-bands), and one panchromatic day-night band (DNB) acquire spatial resolutions at nadir of 750 m, 375 m, and 750 m, respectively (see the VIIRS Bands and Bandwidth Technical Reference for details on wavelength and resolution of individual bands). More details about the VIIRS instrument are available in the VIIRS Sensor Data Record User Guide and the JPSS VIIRS Radiometric Calibration Algorithm Theoretical Basis Document.

VIIRS orbits the globe about 14 times a day and as such, most locations on Earth are imaged at least once per day and more frequently where swaths overlap (at higher latitudes). Suomi-NPP's sun-synchronous, near-circular polar orbit is timed to cross the equator from south to north at approximately 1:30 p.m. local time (and from north to south at 1:30 a.m.). JPSS-1 follows the same

orbit, lagging S-NPP by 50 minutes. Table 5 lists technical specifications for the VIIRS instrument, and the following sites offer tools that track and predict each satellite's orbital path:

- Space Science and Engineering Center (SSEC) Polar Orbit Tracks
- NASA LaRC Satellite Overpass Predictor (includes viewing zenith, solar zenith, and ground track distance to specified lat/lon)

Table 5. VIIRS Technical Specifications

Variable	Description
Orbit	829 km (nominal) altitude, 1:30 p.m. mean local solar time, sun-synchronous, polar, near-circular (Suomi-NPP orbit; JPSS-1 flies on the same orbit, lagging by 50 minutes)
Scan Rate	1.779 sec/rev or 202.3 deg/sec
Swath Dimensions	3060 km (cross track) by ~12 km (along track at nadir) – nearly global coverage every day
Size	1.34 m x 1.41 m x 0.85 m
Weight	275 kg
Power	319 W (single orbit average)
Data Rate	7.674 Mbps (average), 10.5 Mbps (max)
Quantization	12 bits
Spatial Resolution (at nadir)	375 m (Imagery resolution bands) 750 m (Moderate resolution bands)
Design Life	7 years

2.3 Inputs

The V[NP|J1]30P1[D|N] Level-3 data sets are generated from the VIIRS/[NPP|JPSS1] Ice Surface Temperature 6-Min L2 Swath 750m, Version 2 data sets. Intermediate L2G products (V[NP|J1]30PG[D|N]) are generated to contain the stacks of V[NP|J1]30 daytime and nighttime observations, but these are not archived at NSIDC.

2.4 Processing

Swath IST data from the V[NP|J1]30 products are mapped and gridded to 10º x 10º tiles; day and night observations are stored in separate, intermediate L2G products and subsequently in separate L3 products. The day and night observations from the swath products are based on the VIIRS sensor mode (day or night) set for the visible bands in data acquisition. The sensor mode applies to a scan of data and is switched between day and night near the terminator location in an orbit. The terminator (i.e., the border between day and night as visible from space) is defined as a solar zenith angle of 85 degrees.

The Level-3 IST algorithm reads in data from each L2G Day/Night product, and the stack of observations is then parsed for IST observations in the valid range. The mean and standard deviation are calculated and written into the `IST_mean` and `IST_stddev` parameters of the V[NP|J1]30P1[D|N] product. The count of IST observations within the valid range is written into the `IST_obs` parameter, while `n_obs` contains the count of observations including fill values. If there is only a single IST observation, it is output as the mean and the standard deviation is 0. Input grid cells that have zero observations are output as fill value. If input grid cell contains flag values and no IST in the valid range, the output will be the first flag value in the stack of observations.

For a brief description of the IST algorithm see the *Data Acquisition and Processing* section of the V[NP|J1]30 User Guide; for more details see the SNPP/JPSS1 VIIRS Ice Surface Temperature Products Collection 2 User Guide (Riggs et al., 2021).

2.5 Quality Information

Factors that affect accuracy and uncertainty of V[NP|J1]30 IST estimates are propagated through to analysis of the daily mean IST, i.e., no screening of the swath observations is done in the V[NP|J1]30P1[D|N] algorithm. The `IST_obs` and `n_obs` parameters provide information on how many of the IST observations for a day are in the valid range. Reasons for those counts to be different are that there were a mix of observations e.g., clouds or land cells observed from different orbits of the day. The difference between `IST_obs` and `n_obs` can be interpreted as an estimate of the variability of observations in a grid cell.

The V[NP|J1]30P1[D|N] algorithm is different from the MODIS daily IST (M[O|Y]D29P1[D|N]) algorithm, which selected only the “best” observation on a day (Riggs and Hall, 2015) as opposed to the mean of all valid observations. If using both MODIS and VIIRS IST products, the differences in satellites, sensors, and algorithms should be considered.

2.6 Errors

Discriminating between clouds and sea ice cover is very challenging and accuracy of cloud detection over sea ice is difficult to evaluate. Furthermore, accuracy of the cloud mask varies greatly between day and night observations. In daylight, the cloud mask is cloud-biased resulting in greater cloud coverage than may exist. In darkness, the cloud mask is biased toward clear conditions, resulting in lack of cloud coverage when there probably is some. At night the cloud mask accuracy is lower, resulting in greater confusion between clouds and clear observations. This difference in cloud mask accuracy is one of the major motivators to keep the Day/Night products separate. If there is sea ice/cloud confusion (error) in the L2 IST observation, that confusion is propagated into the mean IST calculation.

Some error in geolocation may be associated with projecting from geographic coordinates (latitude and longitude) to the EASE-Grid Lambert Azimuthal equal-area projection. Geolocation error may be notable along coast lines which may appear to shift from day to day between cells of the grid.

3 VERSION HISTORY

Table 6. Version History Summary

Version / Collection	Release Date	Description of Changes
V2 / C2	June 2023	Initial release of VNP30P1[D|N] and VJ130P1[D|N].

4 RELATED DATA SETS

VIIRS data @ NSIDC
MODIS data @ NSIDC

5 RELATED WEBSITES

NASA Goddard Space Flight Center | Suomi-NPP VIIRS Land
MODIS Snow/Ice Global Mapping Project
Earthdata | VIIRS is Here

6 REFERENCES

Riggs, G.A. and D.K. Hall. 2015. MODIS Sea Ice Products User Guide to Collection 6.1. NASA Goddard Space Flight Center, Greenbelt, MD. (See PDF)

Riggs, G.A., M.A. Tschudi, and D.K. Hall. 2021. NASA VIIRS Sea Ice Cover Products Collection 2 User Guide. (See PDF)

Tschudi, M.A., G.A. Riggs, D.K. Hall, and M.O. Román. 2017. Suomi-NPP VIIRS Sea Ice Cover Algorithm Theoretical Basis Document (ATBD). (See PDF)

7 DOCUMENT INFORMATION

7.1 Publication Date

June 2023

7.2 Date Last Updated

June 2023