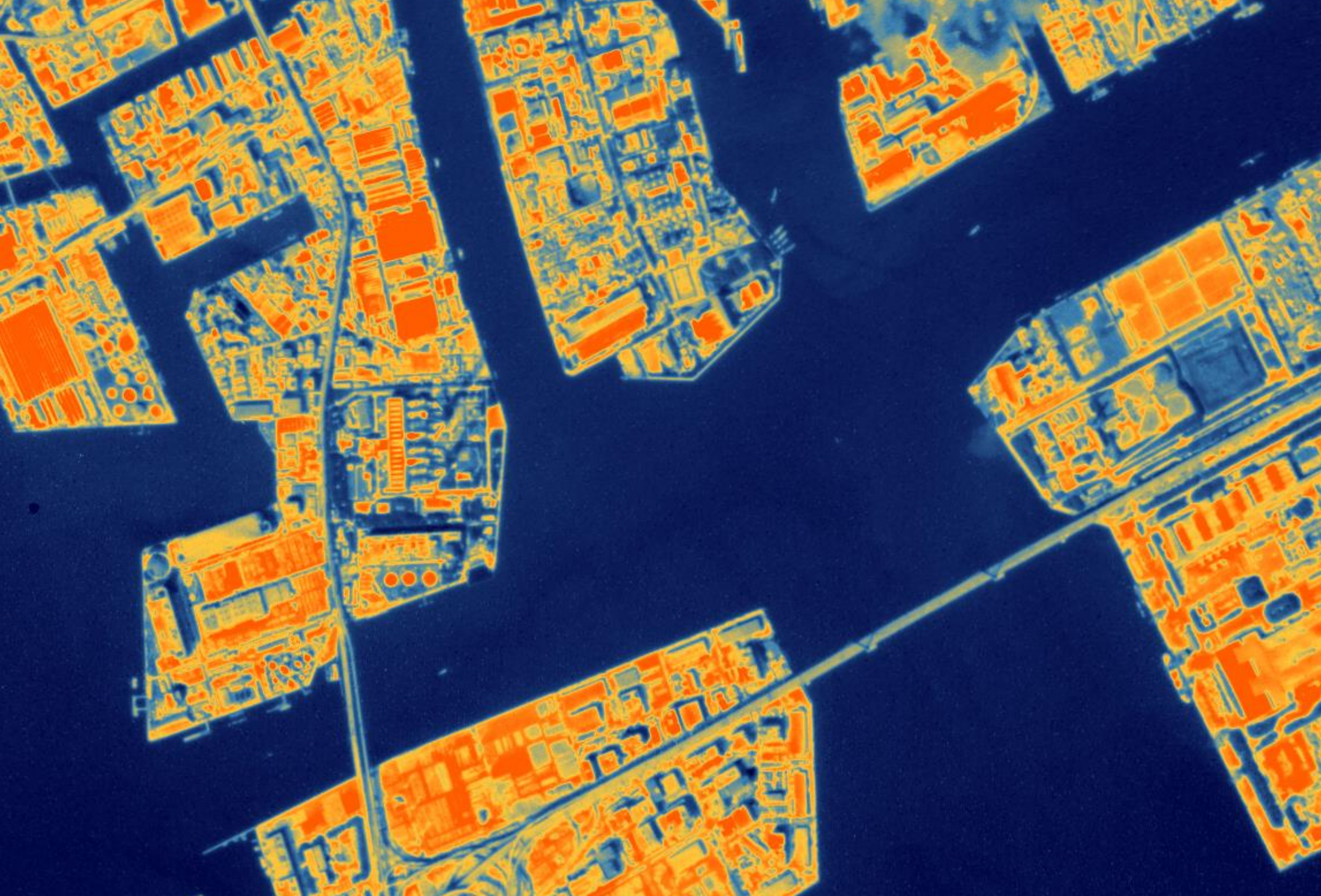

SatVu

Imagery User Guide

V 2.1 – May 2026

1. Introduction

This document describes SatVu's satellite thermal imagery products. It provides an overview of the SatVu constellation and its image collection capabilities, outlines image processing specifications, and defines the available product levels. The document is intended for customers and users who are evaluating or working with SatVu's thermal imagery products.

This guide forms part of the Specification at https://www.satellitevu.com/specifications, as may be amended from time to time.

2. SatVu Constellation Overview

SatVu's HotSat satellite constellation is designed to deliver the highest resolution commercial thermal satellite imagery currently available. To date, two satellites have been launched: HotSat-1 in 2023, HotSat-2 in 2026.

SatVu recognises that satellite thermal imagery, particularly within the Mid-Wave Infra-Red (MWIR) part of the spectrum, enables a range of advanced capabilities relevant to applications including environmental monitoring, defence, and intelligence. Accordingly, the HotSat sensors are specifically designed to deliver the performance attributes described in Table 1 .

Table 1. Constellation Overview

Satellite Name	First Generation - HotSat 1-2
Ground Sample Distance (GSD)	3.5 m (nadir) to 6.4 m (45° ONA) at 500 km nominal orbit
Sensor Type	Mid-Wave InfraRed (MWIR)
Acquisition mode	Video based imaging with Forward Movement Compensation (FMC)
Orbit/Inclination	Polar
Altitude	~500 km
Off-nadir angle (ONA)	0-45°
Revisit frequency at 40° latitude	1 day (45° max ONA) to 2 days (30° max ONA)
Spectral Bands (nm)	**Night**: 3700 - 4950 | **Day**: 4325 - 4950
Dynamic Range	14 bit
Geolocational Accuracy	15m CE90 (0-30° ONA)
Swath (standard scene size)	4.5 km (across-track) x 3.5 km (along-track)*

* Projected scene will vary depending on angle, reported values for nadir imaging

3. Data Products Introduction

SatVu's very high-resolution thermal products are derived from the HotSat constellation, operating in the mid-wave thermal infrared band. Two product levels are delivered: **Primary** and **Surface Brightness Temperature (SBT)**, designed to support different post-processing requirements and end-use applications.

3.1 Primary

The **Primary** product is intended for advanced users requiring minimally processed imagery that is radiometrically corrected while preserving the original image geometry. It is optimised to provide maximum flexibility for users to apply their own corrections and calibrations. The product delivers all image frames along with the associated calibration parameters.

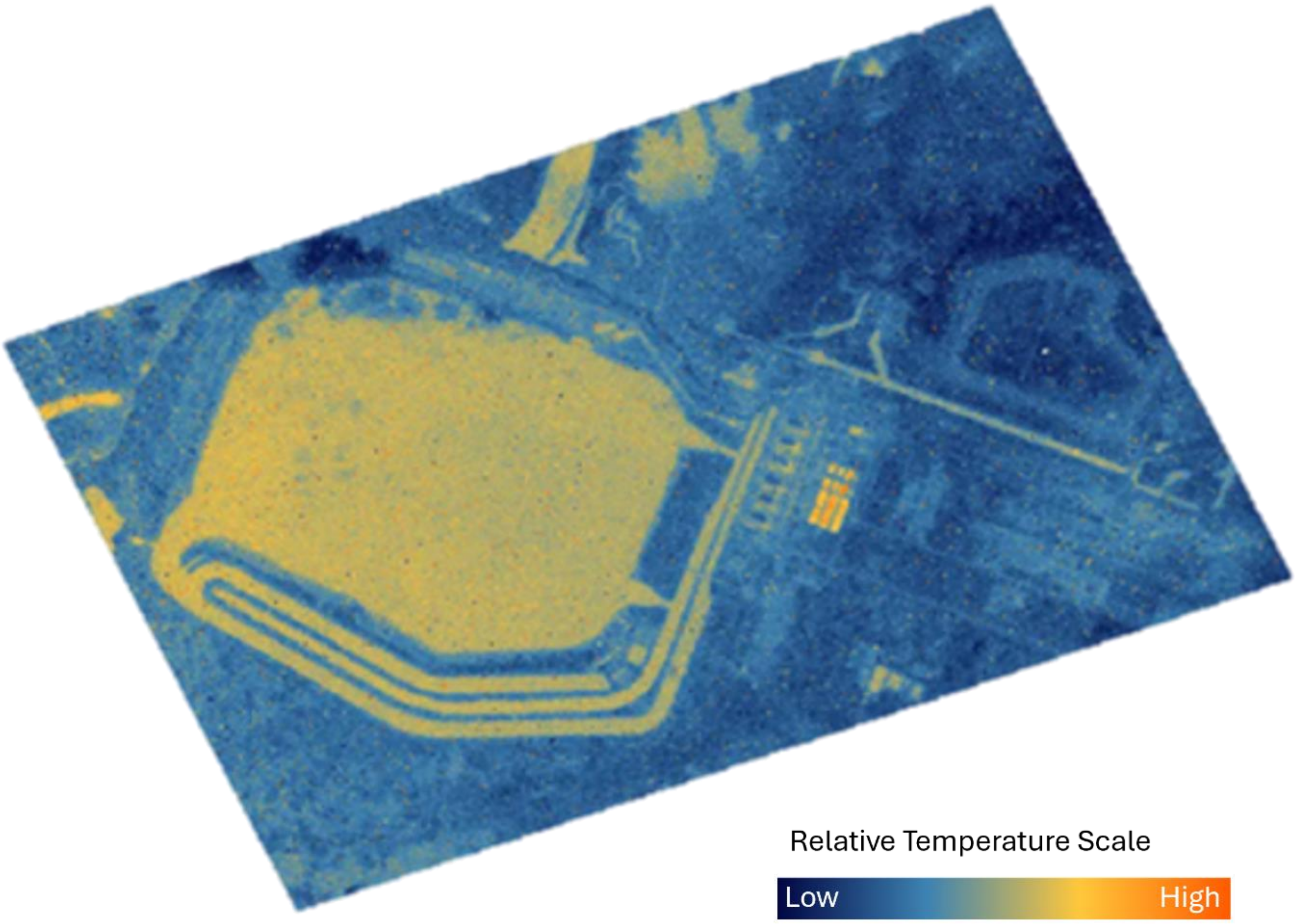

Figure 1. Primary single frame scene, projected using the embedded Rational Polynomial Coefficients (RPCs)

3.2 Surface Brightness Temperature

The **Surface Brightness Temperature (SBT)** product is intended for users requiring imagery optimised for immediate visual interpretation. The product provides orthorectified imagery that has been both geometrically and radiometrically corrected, making it suitable for monitoring and decision-making in defence, disaster response, and general remote sensing applications.

SatVu delivers a stacked image product in which radiometric corrections are applied to all frames within an imaging sequence. These frames are co-registered to a single orthorectified reference frame, after which the median pixel value across the image stack is calculated. This process produces an image with reduced noise characteristics.

The resulting image provides per-pixel values representing brightness temperature at the bottom of the atmosphere. In general, brighter pixels correspond to higher temperatures. This approach enables more consistent signal comparison over time and is particularly valuable for time-series analysis.

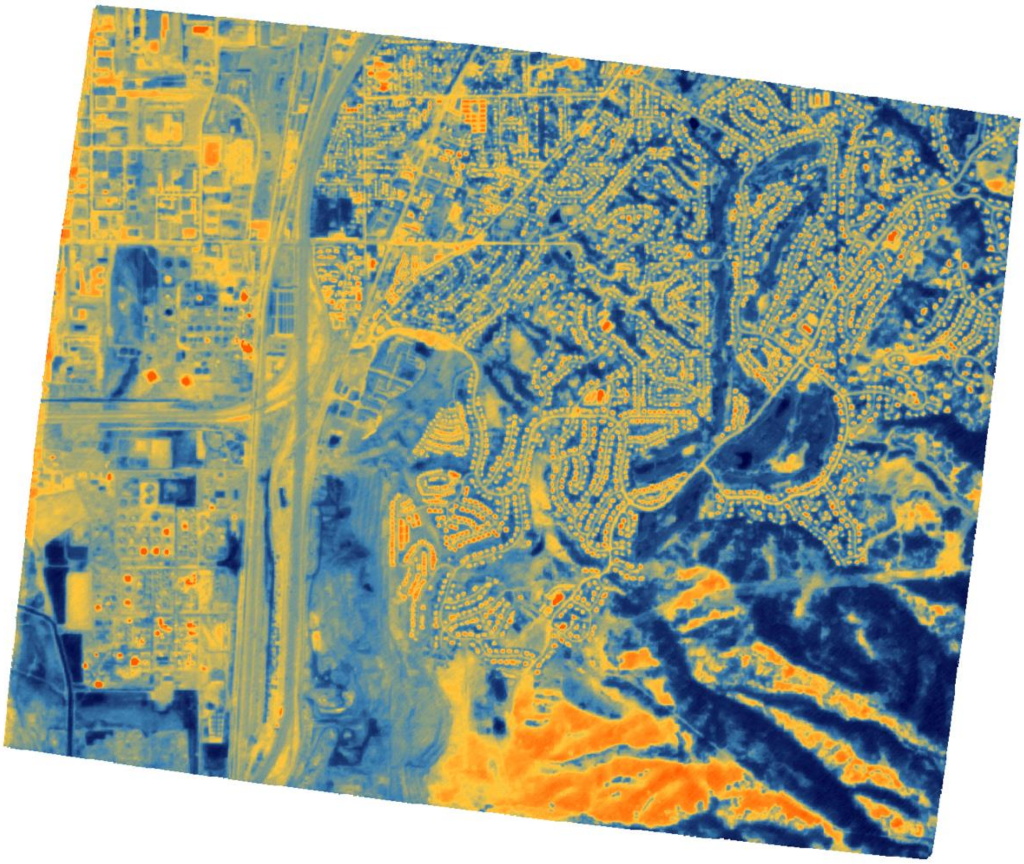

Figure 2. Surface Brightness Temperature Scene showing enhanced signal to noise characteristics over a single primary frame, orthorectified and projected onto an elevation model

3.3 Data Products Summary Comparison

Table 2. Data products and use cases

Primary	Surface Brightness Temperature
Optimised for custom processing: • Pixel values delivered as Digital Numbers (DNs) • All frames delivered (up to 25 per second) • Radiometrically corrected • Additional ancillary data delivered (AOCS, RPCs, UDM, atmospheric correction coefficients)	**Optimised for photo interpretation and time series analysis:** • Pixel values delivered as surface brightness temperature (Kelvin) • Quantification of signal variability within and between scenes • Georeferenced 15m CE90 • Orthorectified
Value proposition: • Near to "as collected" data • High degree of processing flexibility • All data and correction factors delivered to enable custom corrections	**Value proposition:** • Improved signal interpretability • Orthorectified for ease of use • Consistent comparison across time-series datasets
Use cases: • Applications requiring tailored processing by advanced users • Moving object detection	**Use cases:** • Monitoring of high-value industrial asset activity • Anomaly detection • Pattern-of-life interpretation and time-series analysis • Within-scene difference calculations

4. Data Products Processing

4.1 Processing overview

The image processing workflow comprises a series of stages designed to generate the two SatVu product levels. A defined sequence of image processing and geometric modelling steps is applied to SatVu imagery. Detailed descriptions of the individual processing steps are provided in Section 4.7.

Initial processing applies sensor-level and radiometric corrections to the raw image frames, followed by the derivation of atmospheric correction parameters. Georeferencing is then performed. Subsequent processing steps are applied according to the selected product level to generate either the Primary or the Surface Brightness Temperature (SBT) product, as illustrated in Figure 3.

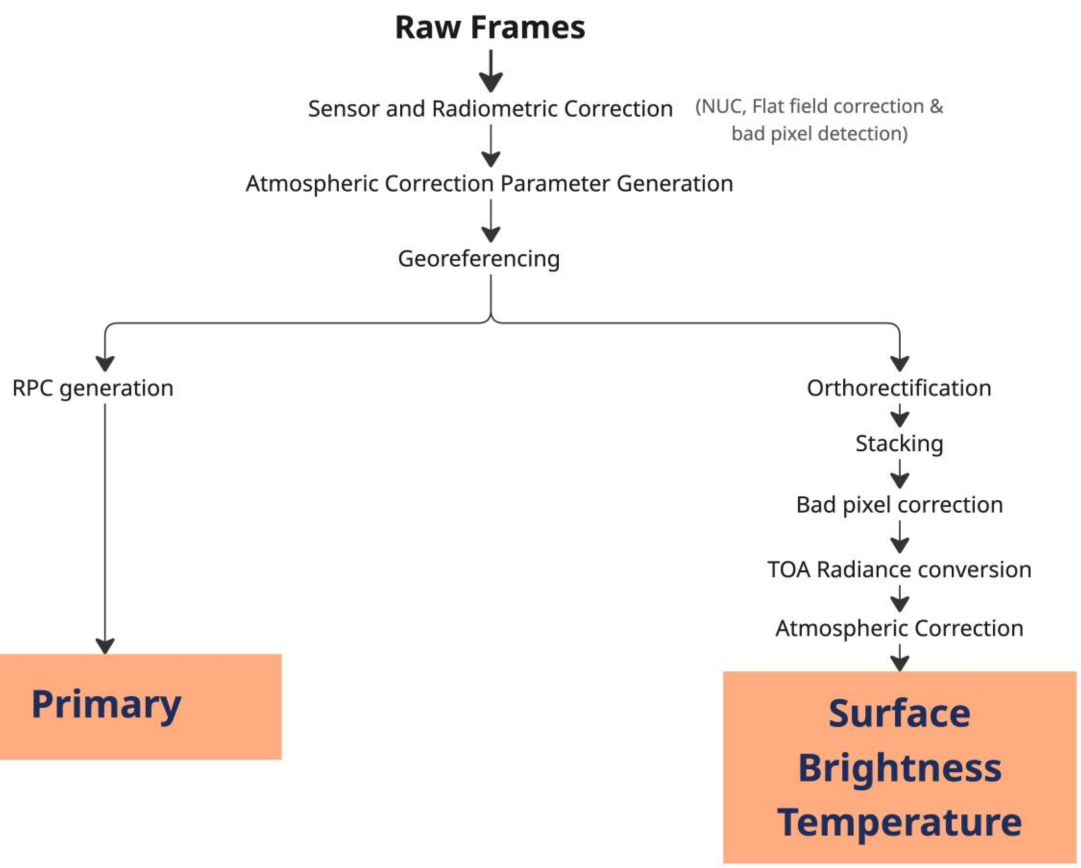

Figure 3. Overall Image Processing workflow

4.2 Imaging modes

The default imaging mode for the HotSat sensor is the acquisition of short image sequences ("snap videos") consisting of up to 25 frames captured over a one-second interval. The HotSat platform employs forward motion compensation (FMC), in which the satellite points at and continuously observes a target location throughout the acquisition period. This mode enables the capture of up to 25 frames per second (FPS) over a one-second acquisition window. The platform is agile and capable of retargeting between acquisitions over angular ranges of up to ±45°.

Each frame is processed through a radiometric processing chain that converts raw sensor data into image frames with a series of radiometric adjustments applied to improve image quality.

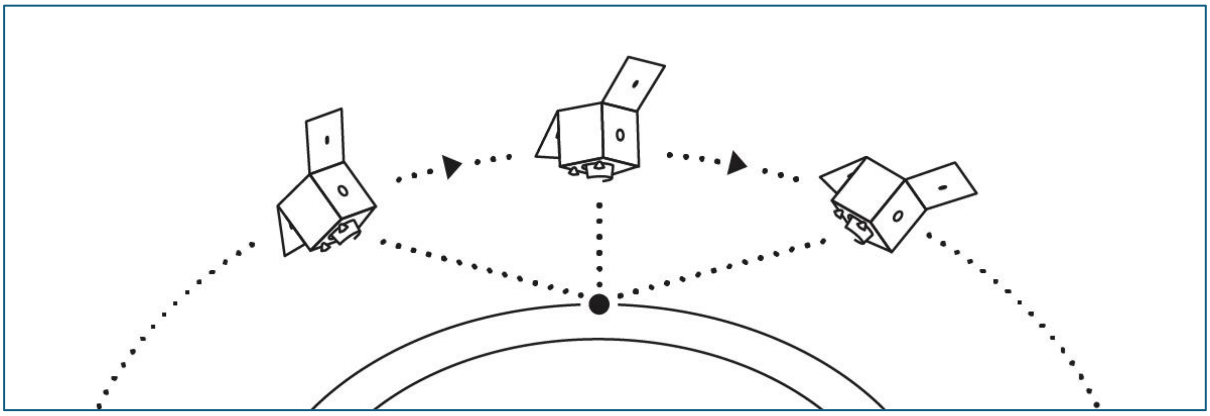

Figure 4. Forward-Motion Compensation Diagram

4.3 Geometric Processing

4.3.1 Initial Georeferencing

SatVu first derives an initial georeferencing solution for each frame using the sensor model together with onboard Attitude and Orbit Control System (AOCS) telemetry, which provides the satellite position and attitude at the time of acquisition. This uses the pointing knowledge of the instrument's onboard sensors, providing at the baseline from which subsequent tie-point-based refinement is performed. If sufficient tie points cannot be generated, this telemetry-based solution is retained.

4.3.1 Refined Georeferencing

Where sufficient image texture is present, geolocation accuracy is improved through refinement of the initial georeferencing using tie points derived from Sentinel-2 Level 3 Quarterly Mosaic products hosted on the Copernicus Data Space Ecosystem.

Sentinel-2 imagery provides absolute geolocation accuracy of less than 12m confidence[1]. The use of these reference datasets enables improved geometric alignment of HotSat imagery. Further details regarding geolocation accuracy and associated processing methods are provided in additional documentation available on request.

[1] Collection 0 Level-1C. Sentinel Online (2021). https://sentinels.copernicus.eu/web/sentinel/sentinel-data-access/sentinel-products/sentinel-2-data-products/collection-0-level-1c.

4.3.2 Orthorectification using an elevation model

Orthorectification is performed using the Copernicus Digital Elevation Model (DEM), a digital surface model available in multiple product variants. SatVu utilises the global GLO-30 product, which has a pixel spacing of 30 m, selected based on its performance characteristics and global coverage.

When using the GLO-30 DEM for orthorectification, certain limitations may arise due to differences between the DEM pixel spacing and the spatial resolution of a given HotSat acquisition. Additionally there could be errors as a result of upsampling from 30m to 5m in certain situations. The selection of the DEM is subject to change in the future.

For users intending to perform their own orthorectification, SatVu recommends:

- Constraining acquisition parameters to lower off-nadir angles, particularly over mountainous or high-relief terrain
- Using higher-resolution elevation models with pixel spacing comparable to that of the HotSat acquisition
- Selecting the Primary product to support custom processing workflows.

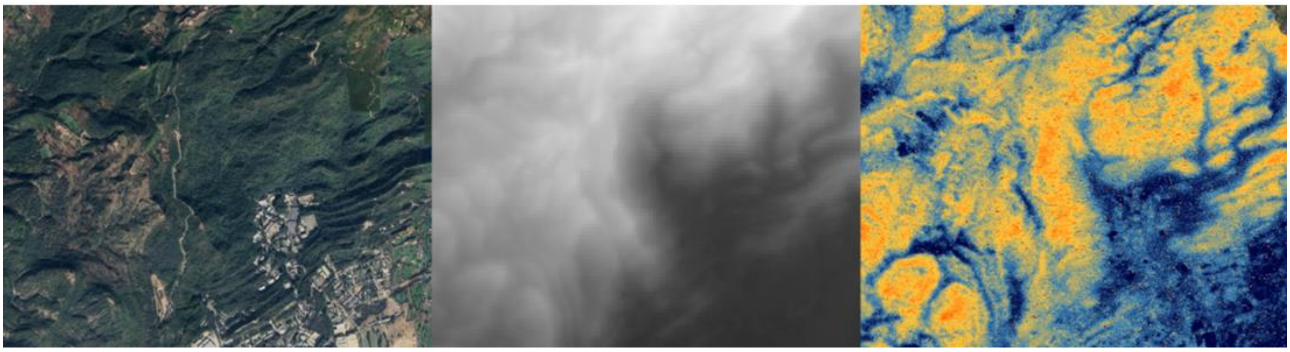

Figure 5. In areas of high relief, and when acquisition off-nadir angle is high, orthorectification can lead to pixels and areas appearing stretched

4.4 Radiometric processing

Radiometric correction applies a defined set of processing steps to address detector non-uniformity and bad pixels, producing radiometrically corrected imagery. Radiometric processing may include the following operations:

- Saturation detection
- Non-uniformity correction
- Flat-field correction
- Bad-pixel detection
- Bad-pixel correction
- Digital number inversion

The non-uniformity correction (NUC) adjusts the response of individual elements within the detector array to reduce variability and improve uniformity in response to incoming mid-wave infrared (MWIR) radiation. An example of the application of non-uniformity correction is shown in Figure 6.

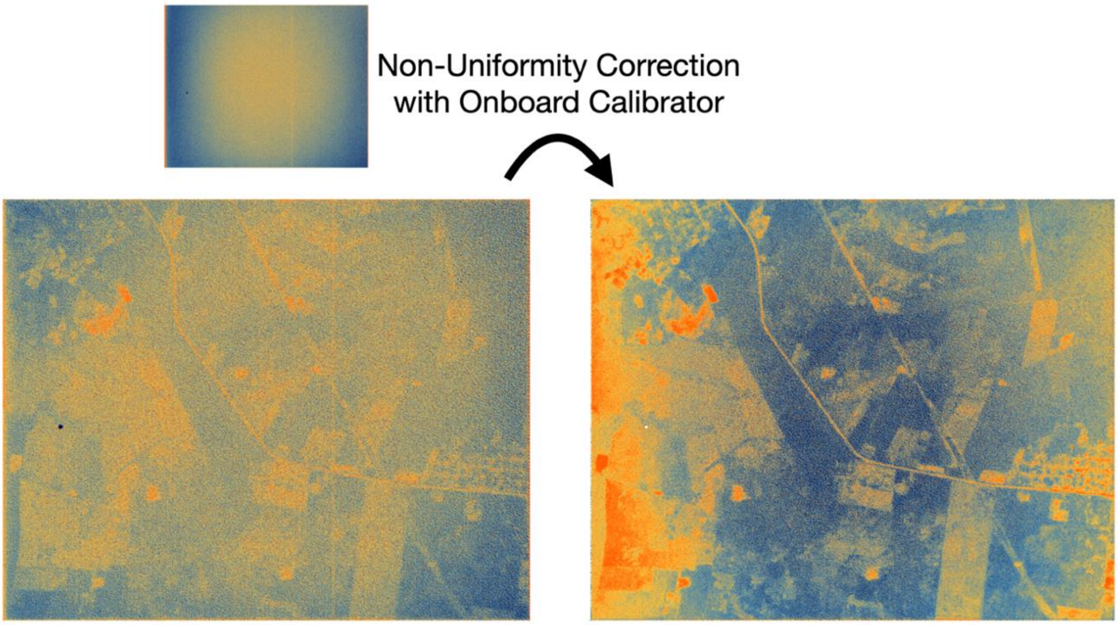

Figure 6. Applying non-uniformity correction

Data from the onboard calibrator is used to conduct NUC, improving the visual appearance of the imagery. This process may still include residual signal contributions from instrument self-emission, which can vary within an image and between successive acquisitions.

To further mitigate the effects of instrument thermal self-emission, an appropriate flat-field image is selected and applied as an additional offset correction to the Earth-view image. This step provides an enhanced radiometric correction beyond that achieved through non-uniformity correction alone.

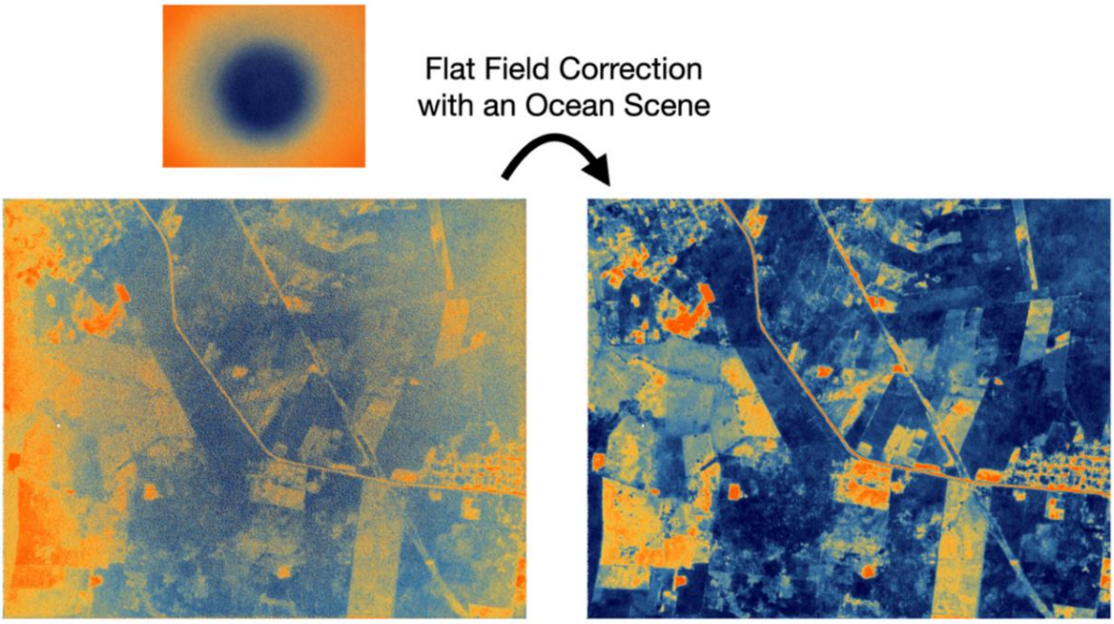

Figure 7. Applying flat field correction

Additional details describing the individual processing methods and their sequencing are provided in the Algorithm Theoretical Basis Document (ATBD). While radiometric correction will always be applied, the effectiveness can vary and will depend on acquisition parameters.

4.5 Cloud Cover Mask Generation

Cloud masks are generated using a fully automated algorithm designed to detect optically "thick" cloud cover. The algorithm is intended to identify clouds that fully obscure the underlying surface and does not currently detect haze or thin cloud layers.

The cloud masking methodology is tailored specifically to thermal imagery. It leverages external ancillary datasets to predict expected surface thermal conditions. These predicted conditions are compared against the observed thermal imagery to identify cloud-related anomalies. Subsequent processing steps iteratively refine the predicted thermal conditions to improve the accuracy of the final cloud mask.

The cloud mask achieves a reasonable success rate in accurately classifying pixels as cloud or clear. Under clear or moderately cloudy conditions, classification accuracy is generally improved.

Known limitations exist in cloud detection over water bodies and in polar regions, where water or snow surfaces may be misclassified as cloud. In addition, application of the algorithm to night-time imagery generally results in more consistent classification accuracy than daytime acquisitions.

Note: In some cases, the model may assign high confidence to an incorrect classification. Such instances indicate conditions under which additional training data may be required to improve model performance and reduce anomalous behaviour. Users are encouraged to report observed issues to support ongoing model refinement and performance improvements.

4.6 Geometric and Radiometric Validation

When performing georeferencing refinement for each image using tie points, a series of automated quality control checks are applied to identify and reject invalid or unreliable solutions. The refinement process is aborted under the following conditions:

- Insufficient number of tie points are identified
- The refined camera model produces a poor distribution of residuals among the tie points
- The resultant image geometry deviates significantly from that predicted based on the viewing geometry

The overall accuracy of the georeferencing process and associated camera models has been independently validated. A reference database of urban imagery containing dense sets of manually identified **ground control points** is used to verify that performance remains consistent across software versions. In addition, automated image matching against reliable third-party reference datasets, including Sentinel-2 imagery, is performed across a broader subset of the catalog to evaluate performance under a wider range of acquisition conditions.

The night-time radiometric calibration applied to generate the Surface Brightness Temperature product has been validated through comparison with measurements from the Visible Infrared Imaging Radiometer Suite (VIIRS) onboard the Suomi-NPP satellite. VIIRS is a multi-spectral instrument operated by NOAA and includes three MWIR bands that spectrally overlap with those of HotSat.

The outcomes of these validation activities will be captured in the Product Quality Assurance Report (PQAR), which will be published and updated as the product matures.

4.7 Data Processing Steps and Product Level

Table 3 describes the geometric and radiometric processing steps applied to each SatVu data product level: **Primary** and **Surface Brightness Temperature (SBT)**.

Table 3. Data processing steps

Processing Step	Description	Primary	SBT	SBT Maritime & low texture
Non-uniformity correction	Non-uniformity correction (NUC) coefficients are derived from uniform images acquired using the onboard calibrators. This step adjusts raw sensor data to compensate for variations in the response of individual detector elements to incident radiation. An example of the input and output of the NUC process is shown in Figure 6.	✓	✓	✓
Flat field correction	Flat-field correction reduces signal variations introduced by the optical chain. This is performed by applying an ‘offset adjustment’, derived from a cloud-free ocean view, to each individual image pixel. An example of the input and output of the flat-field correction process is shown in Figure 7.	✓	✓	✓
Bad pixel & bimodal bad pixel detection	Bad pixel detection identifies individual detector elements in the sensor that do not respond correctly to incoming radiation. These faulty pixels produce abnormal values that cannot be fixed through standard calibration, and their locations are flagged for subsequent correction.	✓	✓	✓
Atmospheric correction parameter calculation	Atmospheric parameters are estimated based on conditions at the time and location of acquisition, including atmospheric temperature, water vapour, and gas concentrations. These parameters are derived from atmospheric profiles, weather models, or auxiliary satellite data and characterise how radiation is absorbed and emitted as it propagates through the atmosphere.	✓	✓	✓
Initial Georeferencing	Initial georeferencing estimates the image location on the Earth’s surface using the sensor model and onboard satellite position and attitude telemetry.	✓	✓	✓
RPC generation	An RPC model, encoding the updated sensor model, is created	✓		

Tie point generation	Image tie points are detected between the HotSat acquisition and the Sentinel-2 reference dataset to refine the initial line-of-sight estimate. Feature detection is performed on both datasets, and candidate matches are filtered to remove outliers. Note: If tie points cannot be reliably generated, raw pointing knowledge is used.		✓	
Refined Georeferencing	The generated tie points, camera distortion model, and a DEM are utilised to derive the georeferencing solution	✓	✓	
Orthorectification	The sensor model and DEM are used to project the imagery onto the Earth's surface in the appropriate Universal Transverse Mercator (UTM) coordinate system.		✓	✓
Stacking	Individual frames are co-registered and combined to produce a single orthorectified image.		✓	
Bad pixel correction	Bad pixel correction replaces the values of identified faulty pixels by interpolating from neighbouring valid pixels.		✓	✓
Top-of-Atmosphere (TOA) Radiance Conversion	Digital numbers are converted to at-aperture radiance using HotSat's radiometric model and spectral response		✓	✓
Atmospheric correction	The calculated atmospheric parameters are applied to remove atmospheric effects from the measured thermal signal. This step accounts for absorption and scattering by gases, aerosols, and water vapour, converting top-of-atmosphere radiance to bottom-of-atmosphere (BOA) brightness temperature.		✓	✓

5. Data Products specifications

5.1 Primary Product Specification

The processing applied to this product is limited to essential adjustments only, consisting of an initial radiometric correction applied to ensure visual uniformity.

Each dataset includes the delivery of up to 25 frames captured within a one-second acquisition window. In addition, Attitude and Orbit Control System (AOCS) telemetry, Rational Polynomial Coefficients (RPCs), User Data Masks (UDMs), and other ancillary data are provided as metadata to enable users to perform tailored downstream processing. Each frame is radiometrically corrected to ensure the delivery of reliable and accurate image data.

Table 4. Primary product attributes

Product Attribute	
Product Components and Format	Up to 25 frame files (within a 1 second acquisition) - Image TIFFs or NITF Thumbnail - PNG Image Overview - PNG Index Frame – CSV file Metadata - GeoJSON Usable Data Mask – Image TIFF
Information Content	
Image Configurations	1-band thermal DN image
Sensor Type	Mid-Wave Infrared (MWIR)
Product Framing	Scene Framing; Sensor orientation
Spectral bands (nm)	**Night**: 3700 - 4950 | **Day**: 4325 - 4950
Processing	
Number of frames	Up to 25 frames (per 1 second acquisition)
Data Type	14-bit unsigned integers
Geometric Corrections	Sensor model encoded into Rational Polynomial Coefficients (RPCs)
Radiometric Corrections	NUC, Flat Field Correction
Atmospheric Corrections	Atmospheric transmission, upwelling and downwelling radiance parameters generation
GSD	3.5 m (nadir) to 6.8 m (45° ONA)

Data File Size	25 frames: 64 Mb average

Attitude and Orbit Control System (AOCS)

The AOCS data comprises of telemetry describing the satellite's position, velocity, and attitude at the time of acquisition. This data enables analysts to derive the geographic coordinates of imaged targets.

Rational Polynomial Coefficients (RPCs)

RPCs are mathematical models that describe the relationship between a geometrically raw sensor image and corresponding real-world locations. The provided RPCs enable users to orthorectify imagery using a custom or higher-resolution Digital Elevation Model (DEM), if required.

Primary Usable Data Mask (UDM)

The Primary UDM provides per-pixel information describing data quality. The UDM is delivered as a bitmask in which individual mask categories are combined into a single pixel value.

For example, a pixel that is simultaneously "Bad Pixel" and "No Data" will have a value of 9 = 1 + 8.

Table 5. Primary product usable data mask values

Value	Meaning	Description
1	**Bad Pixel**	This pixel had an unreliable response to light at the time of observation. If possible, an interpolated value is provided instead, otherwise the pixel will also be marked as 8 No Data.
2	**Cloud Cover**	The Earth's surface is fully obscured by cloud.
4	**Saturated**	The light received pixel exceeded the maximum value that the detector on board the satellite can measure. The reported value is an underestimate of the true light level.
8	**No Data**	No value can be provided for this pixel. There are several causes of this, such as pixels being outside the imaged area, or bad pixels for which no interpolated value could be provided.

5.2 Surface Brightness Temperature Product Specification

The Surface Brightness Temperature (SBT) product provides orthorectified, radiometrically calibrated MWIR imagery optimised for visual interpretation and consistent signal comparison over time. The imagery is corrected for atmospheric effects and terrain-induced distortions and is delivered in a cartographic map projection. The daytime filter is deployed by default to significantly reduce the amount of solar-reflected radiation in daytime captures. Pixel values are delivered as Brightness Temperature in kelvin at the surface level.

For each collection, up to 25 frames are selected and stacked. The median pixel value is calculated across the stack to improve image quality, leveraging the satellite's forward motion compensation capabilities. Noise correction is applied using a bimodal filter, which adjusts noisy pixels by comparison with surrounding pixel values.

Georeferencing accuracy is maintained under nominal operating conditions, however it is not guaranteed for scenes acquired with view angles greater than 30° or for acquisitions above 85° latitude.

This product is designed to provide values at the ground surface level; cloud contaminated pixels can return incorrect values.

Table 6. SBT product attributes

Product Attribute	
Product Components and Format	Stacked Image File – Image TIFF Metadata – GeoJSON Usable Data Mask – Image TIFF Thumbnail – PNG Image Overview – PNG
Information Content	
Image Configurations	SBT image
Sensor Type	Mid-Wave Infrared (MWIR)
Product Framing	Scene
Spectral bands (nm)	**Night**: 3700 - 4950 | **Day**: 4325 - 4950
Processing	
Data Type	32-bit floating point
Geometric Corrections	Orthorectified
Radiometric Corrections	NUC, Flat Field Correction, Noise Correction, Atmospheric Correction
Horizontal Datum	WGS84
Map Projection	EPSG:3995 for latitude >= 84°

	EPSG:3031 for latitude <= -80° UTM projection for latitudes <=84° and >=-80°
GSD	3.5 m (nadir) to 6.8 m (45° ONA)
Geometric Accuracy	15m CE90 (0-30° ONA)
Data File Size	Stacked image: 15 Mb average

SBT Maritime & Low Texture Imagery

Low texture within the image is represented by texture-less features within the scene like cloud, snow, or water (exceeding 70% of the scene footprint). For such imagery collections, multi-frame stacking is not performed. In this case, a single frame is delivered with a georeferencing accuracy of 200 m.

The outcome of geometry refinement using tie points and multi-frame stacking is reported within the product metadata. The specifications applicable to this type of imagery are provided below.

Table 7. Surface Brightness Temperature - Maritime & Low Texture

Product Attribute	
Product Components and Format	Single Frame Image File – Image TIFF Metadata – GeoJSON Usable Data Mask – Image TIFF Thumbnail – PNG Image Overview – PNG
Information Content	
Image Configurations	SBT image
Sensor Type	Mid-Wave Infrared (MWIR)
Product Framing	Scene
Spectral bands (nm)	**Night**: 3700 - 4950 | **Day**: 4325 - 4950
Processing	
Data Type	32-bit floating point
Geometric Corrections	Orthorectified
Radiometric Corrections	NUC, Flat Field Correction, Noise Correction, Atmospheric Correction
Horizontal Datum	WGS84
Map Projection	EPSG:3995 for latitude >= 84°

	EPSG:3031 for latitude <= -80° UTM projection for latitudes <=84° and >=-80°
GSD	3.5 m (nadir) to 6.8 m (45° ONA)
Geometric Accuracy	AOCS CE90: 200m (0-30° ONA)
Data File Size	Single-frame image: 15Mb

Surface Brightness Temperature Usable Data Mask

The Usable Data Mask (UDM) provides per-pixel information identifying bad pixels, defined as pixels with values outside the valid data range. The UDM is delivered as a bitmask in which individual mask category values are combined into a single pixel value.

For example, a pixel flagged simultaneously as "Saturated" and "No Data" will have a value of 12 (4 + 8).

Table 8. SBT Product Usable Data Mask Values

Value	Meaning	Description
2	**Cloud Cover**	The Earth's surface is fully obscured by cloud.
4	**Saturated**	The light received pixel exceeded the maximum value that the detector on board the satellite can measure. The reported value is an underestimate of the true light level. In a stacked product if any pixels averaged are masked as saturated, the value will be the same.
8	**No Data**	No value can be provided for this pixel. There are several causes of this, such as pixels being outside the imaged area, or bad pixels for which no interpolated value could be provided.

6. Imagery acquisition

6.1 Tasking overview

SatVu provides multiple options for requesting new imagery, depending on user requirements and collection constraints. Customers may access SatVu's tasking services programmatically via the API or Python SDK, or through a graphical user interface.

The SatVu platform supports two tasking products: **Standard Tasking** and **Assured Tasking**.

6.2 Tasking products

Standard Tasking

Standard Tasking allows users to define tasking parameters, including target geometry, acquisition timeframe, off-nadir angle, cloud cover threshold, and day or night acquisition mode. For Standard Tasking orders, SatVu generates an optimal collection schedule based on the specified parameters.

If an acquired image does not meet the requested parameters, SatVu will attempt to collect imagery again at a subsequent scheduled opportunity, subject to availability.

Assured Tasking

Assured Tasking allows users to select a specific satellite pass over a defined point of interest. The acquisition time, date, estimated off-nadir angle range, and ground sample distance (GSD) range are predefined by the selected pass geometry.

SatVu captures and delivers imagery based on the selected pass, regardless of cloud cover conditions.

Both tasking products are available through the SatVu API, Python SDK, and graphical user interface. Additional details on tasking workflows and parameters are provided in the SatVu documentation.

Table 9. Tasking products summary

Parameter	Standard tasking	Assured Tasking
Location	User defined	User defined
Priority	Standard	Must Collect
Date	User defined range, minimum 7 days	User selected pass
Off-Nadir angle	User defined (0-45°)	Based on selected pass
Imaging mode	User defined (day, night, both)	Based on selected pass
Cloud Cover	User defined (15 – 100 %)	100 %

Delivery	When order parameters are met Always*
Coverage	Guaranteed 3 km^2 around user defined location (entire scene is delivered).
Capture-to-Delivery	Within 72 hours from acquisition, 95 % of the time.
Cancellation and Modification	Assured Orders: • ≥ 24 hours before acquisition time: Free cancellation. • < 24 hours before acquisition time: Not supported. Standard Orders: cancellation and modification are supported until the order is scheduled for acquisition. Once an order enters the collection plan, no further changes are possible - customers can monitor order status via the SatVu Platform. In practice, lock-in typically occurs within 48 hours of acquisition, though exact timing may vary.

* SatVu uses commercially reasonable efforts to capture all requested imagery; however, environmental and operational conditions outside SatVu's control may affect the ability to acquire an image, and no minimum capture rate is guaranteed. The Assured product has limited capability during the preliminary phase of operations.

7. Glossary

Altitude and Orbit Control System (AOCS)

The Altitude and Orbit Control System (AOCS) creates and manages the telemetry logs and information for images captured and downloaded from the satellites.

Atmospheric Correction

Atmospheric correction is the process of correcting for the effects of the atmosphere on images taken by satellites or airborne sensors. This uses an atmospheric model and is susceptible to variation to the atmosphere during an acquisition. This process is important because atmospheric constituents like water vapor, aerosols, and gases can distort the signals captured by sensors.

Azimuth

From the scene target point on the ground, the Azimuth is the angle between true north and the sub-satellite point / nadir (point on the ground directly below the satellite). Measured clockwise from north in degrees (0-360).

Calibration

For a thermal imager or radiometer this is often carried out by placing the instrument to view a reference blackbody target. The blackbody target will then be set to a range of temperatures to build a Signal Transfer Function relating the instrument measurement with that from ITS-90.

CE90

Circular Error (CE) is a metric used to define the quality of the geometric accuracy of an image, where 90% of the points in the image are within the stated accuracy

Cloud Cover (%)

The percentage of the scene obscured by clouds. Cloud cover can affect the quality and usability of satellite images.

Digital Elevation Model (DEM)

A Digital Elevation Model (DEM) is a digital 3D ground model, including the maximum altitude in every point, with human superstructures and canopy.

Elevation Angle

The angle of the object (such as the sun) above the horizon from the perspective of the target point of the scene. It is measured from the horizon in degrees (-90 to 90), with negative values indicating the object is below the horizon.

Feasibility Check

A feasibility check is the process of evaluating if the tasking order with provided parameters can be captured. The check enables better planning of acquisitions by evaluating the current satellite position, its orbit, weather conditions and other forms of data to inform if the tasking order is like to be successful.

Forward Motion Compensation (FMC)

Forward-motion compensation (FMC) mode allows the satellite to point and stare at a particular location over a prolonged period and is used to capture still images or video at up to 25 frames per second (FPS), providing up to 60s of video for a particular target at extreme roll angles.

GeoJSON

GeoJSON is an open standard format for communicating geospatial data. It is based on the JavaScript Object Notation (JSON) text-based data interchange format, often used in web applications for mapping and spatial data exchange.

Georeferencing

Georeferencing is the process of relating the coordinate system of an image to a geographic coordinate system, which allows you to see the image in its correct location on the globe.

Geospatial Data

Information associated with a specific location on the Earth's surface, including coordinates, maps, and satellite imagery.

GeoTIFF

Geographic Tagged Image File Format (GeoTIFF) is a file format which is widely used for Earth observation data because it allows spatial information to be included with raster data.

Ground Control Point (GCP)

Ground Control Points are specific, identifiable, and clearly marked locations on the Earth's surface with geographic coordinates used to align satellite imagery during the process of georeferencing.

Ground Sample Distance (GSD)

Ground Sample Distance is the distance between two consecutive pixel centres measured on the ground. It is impacted by the off-nadir angle, with a higher off-nadir angle resulting in a higher GSD.

Metadata

Metadata is the information that describes the content, quality, condition, and other characteristics of the geospatial data, helping users understand and use the data appropriately.

Mid-wave Infrared (MWIR)

Mid-wave infrared (MWIR) is the portion of the electromagnetic spectrum which contain the SatVu imaging wavebands.

Nadir

Nadir represents the point directly below the satellite, where the sensor is looking straight down at the Earth's surface.

Non-Uniformity Correction (NUC)

Non-uniformity Correction (NUC) is the process of placing a uniform source in the field of view of the thermal imaging detector to enable the gain and offset for each pixel to be normalised.

Off Nadir Angle (ONA)

The angle between the nadir (directly below the satellite) and the point on the ground being imaged, used to describe the sensor's position relative to nadir.

Onboard Calibration

The onboard radiometric calibration system comprises a rotatable mechanism housing two heatable, high-emissivity flat radiometric targets ("paddles") and two spectral filters that can be positioned in the optical path between the detector array and the Earth-viewing telescope as required. The calibration paddles, which can be heated up to 50 °C, are imaged during dedicated calibration views to support radiometric calibration and Earth-image processing, improving image quality and enabling the conversion of raw digital numbers into physically meaningful units of spectral radiance and brightness temperature. The same mechanism also contains a night filter, which passes MWIR radiation for use during night-time acquisitions when solar reflection is absent, and a day filter, which suppresses solar-reflected MWIR radiation by cutting off wavelengths below approximately 4.2 µm and is therefore used during daytime Earth-view observations.

Order

An order represents a customer request for imagery from the SatVu platform. This could be an order from the Catalog, or a Tasking order. Each order has a unique ID and can be viewed or managed in the SatVu platform.

Orthorectification

The process of correcting the sensor, satellite/aircraft motion and terrain-related geometric distortions in satellite or aerial imagery to accurately represent the Earth's surface.

Parallax Shift

Parallax shift is the apparent shift in position of an object when the observer's position changes.

Portable Network Graphics (PNG)

Portable Network Graphics (PNG) is a widely used image storage format which can be easily viewed across a range of computer operating systems.

Point of Interest (POI)

The Point of Interest (POI) is the specific location or feature on the Earth's surface that is of interest within a scene, or for tasking the satellite.

Polar Orbit

A polar orbit is a low-Earth orbit in which a satellite passes above, or nearly above, both poles of the body being orbited on each revolution. Polar orbits provide near-global cover and are particularly valuable for consistent monitoring of both the Arctic and Antarctic regions.

Raster Data

Raster data is a spatial data format that represents geographic phenomena as a regular grid of discrete cells (pixels), where each cell contains a numeric value corresponding to a measured or classified attribute at that location.

Radiometric Processing

Radiometric processing represents the variety of techniques that involve correcting, converting, or calibrating pixel values of a raster dataset to a desired solution from its current or native state.

Scene

A frame captured by a satellite or sensor, characterised by a specific AOI at a given time.

Signal

Signal measured by the HotSat payload uses digital number units. This pixel response is proportional to the radiance delivered to each pixel (see signal transfer function).

Signal Transfer Function (SiTF)

Signal Transfer Function describes the relationship between measured signal and a calibrated apparent radiance. This dependence is not restricted to solely digital number and may include additional terms such as the focal plane array temperature or integration time.

Spatial Resolution

The size of the smallest object that can be detected in an image, where higher resolution means finer detail. For satellite imagery, the spatial resolution is often represented by the Ground Sample Distance (GSD) (see above).

Spatial Temporal Asset Catalog (STAC)

Spatial Temporal Asset Catalog (STAC) is a standard specification used to store and describe geospatial information.

Spectral Resolution

The ability of a sensor to distinguish between different wavelengths of light, allowing for the identification of various materials or phenomena. The SatVu sensor captures the mid-wave infrared (see MWIR above) region of the electromagnetic spectrum.

Spectral Response Function (SRF)

The Spectral Response Function (SRF) maps the signal arriving at the sensor, to signal readout from the sensor. This is wavelength dependant based on the integral of the spectral radiance of signal. A unique spectral response will be present for each optical path for a system where multiple lens paths or filters may be in use.

Sun Azimuth

From the scene target point on the ground, this is the angle between true north and the sun. Measured clockwise from north in degrees (0-360).

Sun Elevation

The angle of the sun above the horizon from the perspective of the target point of the scene. It is measured from the horizon in degrees (-90 to 90), with negative values indicating the sun is below the horizon.

Tasking

Satellite tasking is the process of requesting a new image collection. Users can task a SatVu sensor to capture a new image by specifying a location, time frame, and other parameters.

Temperature

Temperature can be described through two mechanisms: thermodynamic temperature (Kelvin) and practical temperature (degrees Celsius).

Thermal Imagery

Imagery that captures the infrared radiation emitted by objects, used to measure differences in thermal signatures on the Earth's surface.

Thermal Self Emission (TSE)

Thermal Self Emission (TSE) refers to the radiation of energy from structures within the sensor itself.

Usable Data Mask

The Usable Data Mask (UDM) is a file that provides information about “bad pixels” which are defined as pixels with values outside the valid range and combines the values of the mask categories. The Usable Data Mask also provides information about saturation, pixels providing erroneous information and “No Data” values too.

8. Appendix

8.1 Metadata Overview

SatVu provides metadata conforming to Version 1.0.0 of the SpatioTemporal Asset Catalog (STAC) specification (https://stacspec.org/en/), a JSON-based format for describing and cataloguing geospatial datasets.

Each data product is described as a single STAC Item, which includes information on the time and method of observation, the viewing geometry, and the geospatial extent of the data product. The STAC Item contains multiple STAC Assets, one for each of the data files within the product, describing the file format and, where applicable, the summary statistics of the data.

SatVu's Catalog API implements the STAC API standard, which allows users to search and explore the STAC metadata for SatVu's entire catalog of data products. STAC Item

Version 1.0.0 of the STAC Item specification is used. This is documented at:

https://github.com/radiantearth/stac-spec/blob/v1.0.0/item-spec/item-spec.md

https://github.com/radiantearth/stac-spec/blob/v1.0.0/item-spec/common-metadata.md

8.2 Image Identification

The name of each SatVu image is designed to be unique, concise, informational, and easy to understand while allowing users to visualise product level information.

The name of each downloaded image product is made up of the following elements:

<acquisition_date>_<acquisition_time>_<satellite_id>_<productlevel>.<extension>

Example:

20230813_072500_HS2_SBT.tif

In the case of the Primary Product, the image will be identified with additional information indicating the collected Frame number. Date and time represented with YYYYmmdd_HHMMSS format.

<acquisition_date>_<acquisition_time>_<satellite_id>_<productlevel>_<frame_id>.<extension>

Example:

20230813_072500_HS2_PRM_0001.tif

8.3 Primary Data Product Metadata

Table 10. Primary STAC Core Fields

Field	Type	Description
type	string	Always "Feature" for STAC Items
id	array	Unique identifier for the item
collection	string	Collection identifier, always "primary" for primary products
stac_version		Version of the STAC specification used

stac_extensions	array	List of STAC extensions used by this item
geometry	object	GeoJSON geometry describing the spatial extent of the data
bbox	array	Bounding box coordinates [min_lon, min_lat, max_lon, max_lat]
properties	object	Metadata properties describing the data
assets	object	Links to data files and metadata
links	array	Links to related resources

Table 11. Primary STAC Extensions

Extension	Purpose
view	Provides viewing geometry information (azimuth, off-nadir angles)
projection	Contains coordinate reference system and shape information
eo	Earth Observation extension for spectral band information
processing	Processing software and algorithm information

Table 12. Primary Temporal Properties

Field	Type	Description
datetime	string	Acquisition time in (UTC)
created	string	Processing completion time in (UTC)

Table 13. Primary Spatial and Geometric Properties

Field	Type	Description
gsd	number	Ground Sample Distance in meters
proj:epsg	integer	EPSG code for the coordinate reference system
proj:shape	array	Pixel dimensions [height, width]

Table 14. Primary Viewing Geometry Properties

Field	Type	Description
view:azimuth	number	Sensor azimuth angle in degrees
view:off_nadir	number	Off-nadir viewing angle in degrees
view:sun_azimuth	number	Solar azimuth angle in degrees
view:sun_elevation	number	Solar elevation angle in degrees

Table 15. Platform and Instrument Properties

Field	Type	Description
platform	string	Satellite platform identifier
processing:software	string	Processing software version

Table 16. Primary Custom Properties

Field	Type	Description
satvu:filter	string	Filter type applied during acquisition (e.g., "night")
satvu:geometric_calibration	boolean	Whether geometric calibration was applied
satvu:radiometric_calibration	boolean	Whether radiometric calibration was applied
satvu:atmospheric_model_transmission	number	Atmospheric transmission coefficient
satvu:atmospheric_model_upwelling	number	Atmospheric upwelling radiance component
satvu:atmospheric_model_downwelling	number	Atmospheric downwelling radiance component
eo:cloud_cover	number	Percentage of cloud cover

Table 17. Primary Metadata Assets

Asset	Description
frame_index	CSV file containing additional frame specific metadata not included on the frame asset
overview	PNG overview image of the entire acquisition
thumbnail	PNG thumbnail image for quick preview
metadata	Type - ‘data’ or ‘metadata’
frame{NNNN}	Primary data file for frame NNNN (GeoTIFF format)
frame{NNNN}_udm	Usable Data Mask for frame NNNN

Table 18. Primary Per Link Fields

Property	Description
href	URL to the linked resource
rel	Relative path
type	MIME type of the linked resource
title	Human-readable description of the link

8.4 Surface Brightness Temperature Data Product Metadata

Table 19. Surface Brightness Temperature STAC Core Fields

Field	Type	Description
type	string	Always "Feature" for STAC Items
id	string	Unique identifier for the item
collection	string	Collection identifier, always "primary" for primary products

stac_version		Version of the STAC specification used
stac_extensions	array	List of STAC extensions used by this item
geometry	object	GeoJSON geometry describing the spatial extent of the data
bbox	array	Bounding box coordinates [min_lon, min_lat, max_lon, max_lat]
properties	object	Metadata properties describing the data
assets	object	Links to data files and metadata
links	array	Links to related resources

Table 20. Surface Brightness Temperature STAC Extensions

Extension	Purpose
view	Provides viewing geometry information (azimuth, off-nadir angles)
projection	Contains coordinate reference system and shape information
eo	Earth Observation extension for spectral band information
processing	Processing software and algorithm information

Table 21. Surface Brightness Temperature Temporal Properties

Field	Type	Description
datetime	string	Acquisition time in (UTC)
created	string	Processing completion time in (UTC) - retrocompatible
created_at	string	Processing completion time in (UTC)

Table 22. Surface Brightness Temperature Spatial and Geometric Properties

Field	Type	Description
gsd	number	Ground Sample Distance in meters
proj:epsg	integer	EPSG code for the coordinate reference system
proj:shape	array	Pixel dimensions [height, width]

Table 23. Surface Brightness Temperature Viewing Geometry Properties

Field	Type	Description
view:azimuth	number	Sensor azimuth angle in degrees
view:off_nadir	number	Off-nadir viewing angle in degrees
view:sun_azimuth	number	Solar azimuth angle in degrees
view:sun_elevation	number	Solar elevation angle in degrees

Table 24. Platform and Instrument Properties

Field	Type	Description
platform	string	Satellite platform identifier

processing:software	string	Processing software version

Table 25. Surface Brightness Temperature Custom Properties

Field	Type	Description
satvu:filter	string	Filter type applied during acquisition (e.g., "night")
satvu:geometric_calibration	boolean	Whether geometric calibration was applied
eo:cloud_cover	number	Percentage of cloud cover
satvu:multiframe_stacking	boolean	Defines if stacking has been applied

Table 26. Surface Brightness Temperature Raster Properties

Asset	Description
scale	Multiplicative factor applied to convert pixel values to physical units (Kelvin).
offset	Additive value applied after scaling to obtain calibrated temperature.
sampling	One of area or point. Indicates whether a pixel value should be assumed to represent a sampling over the region of the pixel or a point sample at the centre of the pixel.
data_type	Numeric format used to store pixel values (e.g., UInt16, Float32).
bits_per_sample	Number of bits representing each pixel value.
nodata	Pixel value indicating missing or invalid data.
statistics:mean	Average surface brightness temperature across valid pixels.
statistics:minimum	Lowest recorded pixel value in the raster.
statistics:maximum	Highest recorded pixel value in the raster.
statistics:stddev	Standard deviation of pixel values, indicating temperature variability.

Table 27. Surface Brightness Temperature Metadata Assets

Asset	Description
overview	PNG overview image of the entire acquisition
thumbnail	PNG thumbnail image for quick preview
image file	Data file (GeoTIFF format)
image_udm	Usable Data Mask

Table 28. Surface Brightness Temperature Per Link Fields

Property	Description
href	URL to the linked resource
rel	Relative path
type	MIME type of the linked resource
title	Human-readable description of the link