Vision-1 Imagery: User Guide

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Vision-1 Imagery User Guide

This user guide provides essential information regarding all Vision-1 products and services. It contains the following information:

- Qualitative description of the Vision-1 offering, its performance, and available products
- Technical description of product quality and usage
- Product format and naming
- Product ordering and delivery

We would like this document to be as useful as possible. If you feel that information is missing or unclear; or for any other feedback you may have on the content and format, please e-mail us at: UKIntelligence-ImagerySupport@airbus.com

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1 Introduction to Vision-1

Launched on 16th September 2018, Vision-1 provides complementary imaging capacity to the existing Airbus Earth observation constellation, delivering orthorectified products with resolution up to 87cm as standard.

The table below outlines the main characteristics of Vision-1.

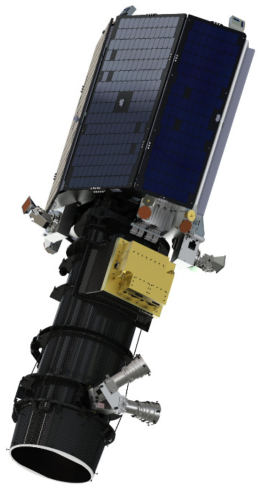

Figure 1-1: Impression of Vision-1 (S1-4 satellite)

Satellite mission name	S1-4	Satellite imagery offer name	Vision-1
Launch	16th September 2018	NIIRS class	5
Orbit	Sun-synchronous, 10:30AM ascending node, 583km altitude	Viewing angle	Standard: ± 20º Extended: ± 45º
Period/Inclination	96.2 minutes/97.5º	Revisit capacity	1 – 8 days depending on latitude
Optical system	Newtonian telescope, with complex pick-off prism & folded refractive relay with Focal length 6.666m, corrected across-track FoV of ± 1.1°, 42cm primary mirror, and an f-number of 15.9	Targeting accuracy	< 500m for nadir and non-nadir acquisitions
Spectral bands	PAN: 450-650 nm Blue: 440-510 nm Green:510-590 nm Red: 600-670 nm Near Infrared: 760-910 nm	Orthorectified product location accuracy at nadir	<12m CE90 (variable according to reference)
Detectors	4 x CCD array assembly cross track	Instrument TM link rate	500Mb/sec
Ground sampling distance (nadir)	Panchromatic: 0.87m Multispectral: 3.48 m	Mission lifetime	Design lifetime of 7 years
Product resolution	Panchromatic: 0.87 m Multispectral: 3.48 m	Main X-band down/uplink station	Guildford (UK)
Swath width	20.8km at nadir	Programming and production	Airbus Intelligence Guildford (UK)
Dynamic range at acquisition	10 bits per pixel	Satellite control centre	SSTL, Guildford (UK)

Table 1-1: Main characteristics of the Vision-1

As the Panchromatic and Multispectral data are simultaneously acquired, imagery can be provided as single products or as a bundle delivered together in a single, non-merged product. Pansharpened products combine the visual coloured information of the multispectral data with the details provided in the panchromatic data, resulting in a single higher resolution colour product.

1.1 Vision-1 Image Quality Characteristics

The instrument consists of a 4 x CCD array assembly cross track. The layout is illustrated below.

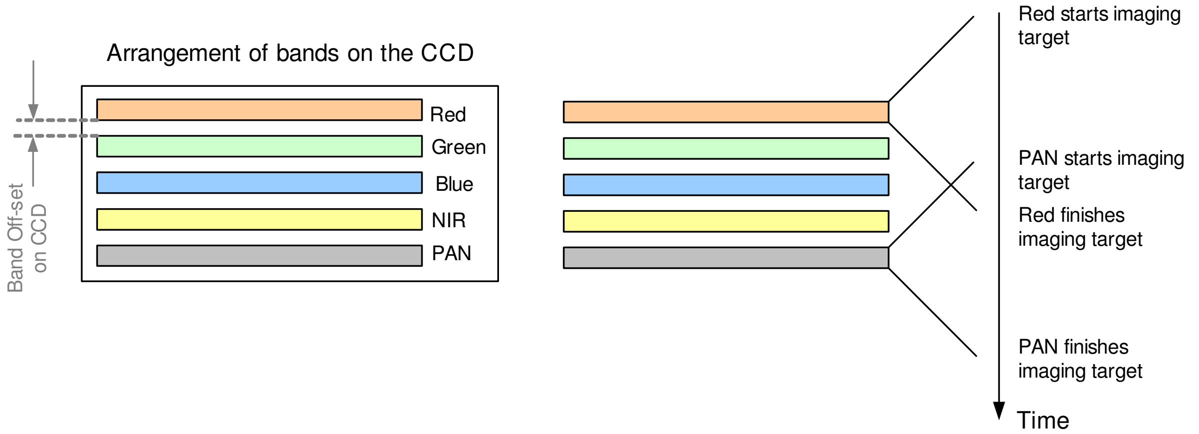

Figure 1-2: Vision-1 sensor band arrangement on one CCD

The table provides further specifications on image product quality and sensor performance that are considered relevant to the user. All figures stated here with respect to imager radiometry, MTF and Signal-to-Noise (SNR) are those currently provided after a number of initial on-ground and in-orbit calibration procedures and measurements. Further in-orbit measurements are planned to ensure continued image data quality throughout the lifetime of Vision-1.

Geometry and Resolution	
GSD at Nadir	MS: 3.48m; PAN 0.87m
Satellite MTF per band	MS: > 20%; PAN: > 10%
Planimetric accuracy of Orthorectified Product	< 12m CE90 absolute accuracy using GCPs placed on Airbus OneAtlas BaseMap and using the Airbus WorldDEM4Ortho Digital Elevation Model
MS Band co-registration	< 0.3 MS pixels CE90 (minimum requirement)
MS-PAN Band co-registration	< 0.3 MS pixels CE90 (minimum requirement)
Radiometry	
Absolute calibration accuracy	All bands < 5%
Satellite SNR per band, using default gains at the given reference radiance	All bands: > 150 @ 100 W $sr^{-1} m^{-2} \mu m^{-1}$

Table 1-2: Expected product and sensor image quality performance indicators

2 Acquisition Mode

Vision-1 imagery is collected in strip mode (also sometimes known as “mono”).

Strip mode is the standard imaging mode of the Vision-1 system. Images are acquired in push-broom fashion at a range of view angles up to 45° off-nadir. Acquired strips of variable length are divided into individual tiles of approximately 465 km^2 (at nadir). The acquisitions may be delivered as either strips or scenes according to the requirements of the user.

3 Vision-1 Image Processing

3.1 Spectral Bands and Spectral Response

Vision-1 acquires images using five spectral bands as indicated in the table.

Band Name	Min Wavelength, λ_{min} (nm)	Max Wavelength, λ_{max} (nm)	Centre Wavelength, λ_{Centre} (nm)	Spectral Bandwidth (nm)
Panchromatic	450	650	550	200
Blue	440	510	475	70
Green	510	590	550	80
Red	600	670	635	70
NIR	760	910	835	150

Table 3-1: Vision-1 spectral bands

The spectral response at any wavelength is defined as the ratio of light power measured at the sensor to that input at the telescope entrance. The relative spectral response of the instrument is shown in the figure.

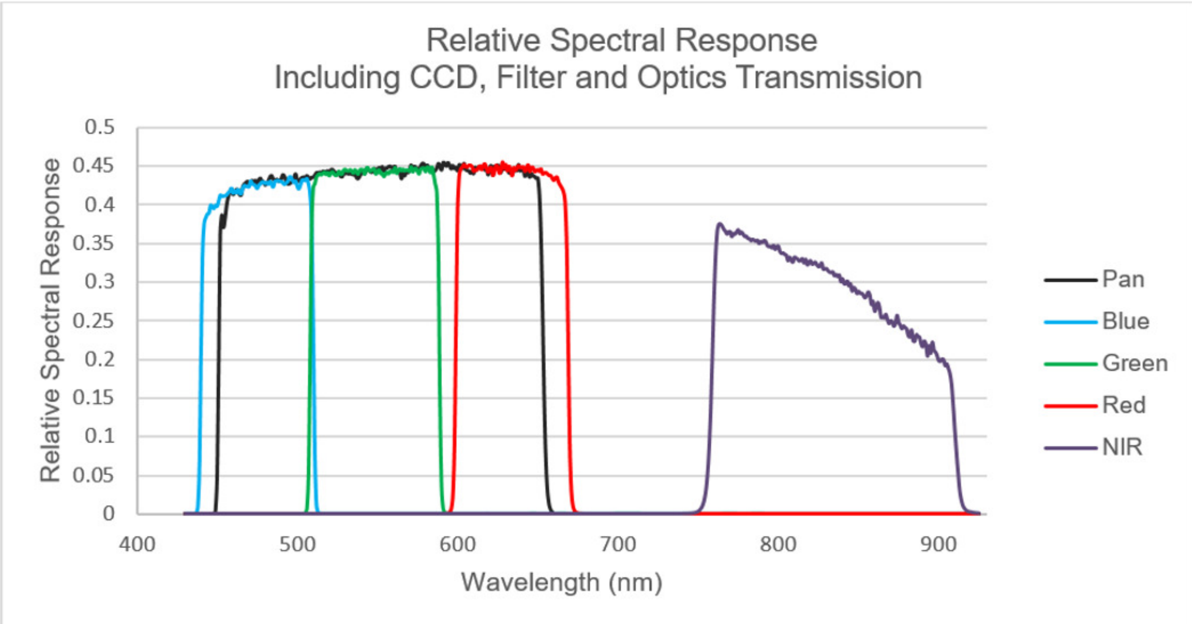

Figure 3-1: Vision-1 relative spectral band response

3.2 Radiometric Processing

There are three levels of radiometric processing that may be applied to any optical satellite data, according to the level preferred by any given application.

The initial raw measurement performed by the satellite is converted to a radiance value (via the sensor calibration). <u>This is the processing level at which standard Vision-1 products are supplied</u>.

This can then be converted to 'Top-Of-Atmosphere' (TOA) reflectance as measured from space, thus considering the reflectance measurement as filtered by the atmosphere. This level of radiometric processing is currently not provided as part of the standard Vision-1 product.

TOA reflectance may be further corrected to consider the transfer of reflected light through the atmosphere to obtain direct spectral information at the ground level. This is known as 'Bottom-Of-Atmosphere' (BOA) or 'Top-Of-Canopy' (TOC) reflectance. This level of radiometric processing is also not provided as part of the standard Vision-1 product.

3.2.1 Radiance

Different radiometric artefacts may affect the raw acquisition data as it is collected. The main issues are high frequency noise due to the differential sensitivities between detectors (pixel equalisation) and low frequency variations in the field of view (vignetting, etc.). After correction for this detector PRNU (Photo Response Non-Uniformity), the dark signal and relative gain of each detector are characterised and monitored at regular intervals throughout the satellite's life to maintain good equalisation according to the nominal TDI level or electronic gain.

After the above corrections, the measured DN value still does not truly account for the light power incident on the imaging telescope at the time of image acquisition. Losses occur during transmission at different stages of the acquisition chain (optics, filters, etc.). These losses are considered to be the same for each band with some evolution during the satellite lifetime. The related correction is thus modelled by a simple linear function on each band. This 'absolute' sensor calibration provides offset and gain corrections for each band, allowing the final transformation of values to fully represent the TOA radiance incident on the sensor. Absolute calibration coefficients are updated at regular intervals throughout the satellite lifetime.

In general, to convert DN values to (TOA) spectral radiance (L), the following linear formula is applied per band (b):

$$L_b = DN_b * GAIN_b + BIAS_b$$

All 16-bit encoded scaled radiance Vision-1 products are supplied with a common gain provided within the xml metadata (PHYSICAL_GAIN) for each band of 0.01 and a common bias value (PHYSICAL_BIAS) of zero.

The physical unit of TOA spectral radiance (L) is $W.st^{-1}.m^{-2}.\mu m^{-1}$

Under *clear sky* conditions (assuming few dynamic factors affecting the lower atmosphere), the radiance value may be considered to be comparable to the ground surface radiance at the given acquisition angle.

3.2.2 TOA Reflectance

Whilst Vision-1 data products do not currently provide reflectance values, conversion to reflectance is an important part of many processing applications.

The reflectance (ρ) for a given spectral band (ρ_b) is the fraction of the incident solar illumination (or irradiance) reflected by the Earth to the sensor. A value 0 represents full absorption (black), and a value of 1 represents complete reflection (perfect white). Note that, in reality, apparent reflectance may exceed a value of 1 when considering specular targets or on slopes facing towards the Sun.

The measured Top of Atmosphere (TOA) radiance is first calculated from the delivered data via the calibration coefficients described above. This can then be transformed to a TOA reflectance measurement.

The TOA radiance of the acquired scene varies as a function of the incident solar illumination – i.e. the local elevation of the Sun at the time of image acquisition. Converting to TOA reflectance minimises this dependency and makes cross-comparison of different products possible.

The TOA spectral radiance (L_b) can be converted to TOA spectral reflectance (ρ_b) by applying the following formula:

$$\rho_b = \frac{\pi\, L_b\, d^2}{E_{0b}\, \cos\theta_s}$$

Where:

E_{0b} = solar spectral irradiance at the imager for band b
θ_s = solar zenith angle at the time/location of acquisition = (90 – solar elevation) °
d = Sun-Earth distance at the time of acquisition in units of AU

The value for the solar elevation at acquisition is provided in the image metadata (SUN_ELEVATION) and this can be converted to solar zenith angle by subtraction from 90°.

The Sun-Earth distance at the time of acquisition (*d*) is also provided in the image metadata (EARTH_SUN_DISTANCE). 1AU is described as the mean distance of the Earth from the Sun in metres. In reality, the value for *d* varies only very slightly during the year.

Solar spectral irradiance, E_{0b}, (commonly known as ESUN) is a constant value specific to each band of the Vision-1 imager. It is determined by using well know models of Solar Irradiance with the measured spectral transmission of the imager for each incident wavelength. It has units of $Wm^{-2}\mu m^{-1}$. The applicable values for Vision-1 are provided in the following table.

Band	PAN	BLUE	GREEN	RED	NIR
ESUN, E_0 ($Wm^{-2}\mu m^{-1}$)	1828	2003	1828	1618	1042

Table 3-2: Solar spectral irradiance for each Vision-1 band

3.2.3 TOC Reflectance – atmospheric correction

In order to calculate TOC reflectance, some modelling of the Earth's atmosphere at the time of image acquisition is required. In general, in-situ measurements of the atmosphere are unavailable and determining the best atmospheric correction to use is a complex matter.

In short, atmospheric correction can be considered two-fold:

1. Correction of the systematic contribution of the atmosphere

   This corresponds to the effect of the atmosphere when viewing on a perfectly clear day. It corrects for the known effects of gaseous nature of the different layers of atmosphere due to molecular (Rayleigh) scattering and the corresponding loss of relevant illumination (particularly in the longer wavelengths) responsible for the bluish tinge noted in TOA imagery. Spatially, this contribution is nearly uniform across the whole of the image and it can be computed per image using various standard atmospheric models (e.g. the LOWTRAN family – MODTRAN, ATCOR etc. or 5S-6S – SMAC etc.).

2. Correction of a number of dynamic factors affecting the lower atmosphere

   There are a number of far more unstable atmospheric phenomena that exist in the lower atmosphere (fog, haze, thin cloud etc.). Their contribution to the atmospheric absorption/scattering of incident solar radiation is never homogenous across any image scene and this type of atmospheric correction is generally investigated on the pixel level.

   At present, no atmospheric correction is offered for Vision-1 products although some relevant parameters are provided within the xml metadata for input to a chosen model (e.g. Solar Azimuth, Solar Elevation and View and Incidence Angles).

3.3 Geometric Processing

Initial geometric corrections are applied to Vision-1 data using attitude and ephemeris measurements at the time of imaging, in combination with the bespoke Vision-1 geometric sensor model. The main corrections applied are:

- Combination of all sub-swaths across the field of view
- Application of the geometric sensor model
- Co-registration of all spectral bands (multispectral and panchromatic)
- Projection using WGS84/UTM

Furthermore, non-orthorectified projected products are supplied with a rational polynomial coefficients (RPC) file, and standard orthorectified products are created using the Airbus WorldDem4Ortho (WD4O) DEM; with GCPs placed using the Airbus One Atlas BaseMap as reference for additional positional accuracy.

Detailed information describing the use of RPCs, related metadata, and terminology related to image projection and orthorectification is provided in Appendix A at the end of this document.

4 Available Products

Vision-1 products may be considered as ready-to-use. They are easily integrated in GIS and/or transformed into thematic information whilst combined with other satellite, airborne or ground information.

All Vision-1 products are corrected for non-uniformity, sensor radiometry and distortions, using internal calibration parameters, ephemeris and attitude measurements

Spectrally, image products may be provided as one of the following options:

1. **Bundle (BUN)**
   BUN products provide both the 4-band multispectral, and the panchromatic data from the same acquisition in a single product package. Data is provided in either GeoTIFF or Jpeg200 format, with pixel sizes of 3.48m and 0.87m for MS and PAN data respectively.
2. **Pansharpened (PMS)**
   Pansharpened products combine the spectral information of the lower resolution multispectral bands with the high-resolution detail provided within the panchromatic data, resulting in a single 0.87m colour product. Two PMS product options are available:
   - 4-band 16-bit Pansharpened (PMS4)
   - 3-band 8-bit natural colour Pansharpened with DISPLAY radiometry (PMS3)
3. **Multispectral only (MS4)**
   The single multispectral product includes four multispectral (colour) bands: Blue, Green, Red and Near Infrared. The product pixel size is 3.48m.
4. **Panchromatic only (PAN)**
   The Vision-1 panchromatic product includes data contained within a single high-resolution black and white band. It covers wavelengths between 450 and 650nm within the visible spectrum. The product pixel size is 0.87m.

Geometrically, four options are available:

1. **Primary/Sensor**
   The Primary product contains the geometric processing level closest to the natural image acquired by the sensor. This product restores perfect collection conditions: the sensor is placed in rectilinear geometry, and the image is clear of all radiometric distortion. Geometrically, the product is band registered and provided in sensor geometry, synthesised on a single linear push-broom array.

   It should be noted that, as the data is acquired in the S-N direction, sensor geometry for Vision-1 means that, if not displayed correctly using rpc or tiff world file, the image can appear as if it is flipped in the along-track direction.

   This product is optimal for those clients familiar with satellite imagery processing techniques who want to apply their own production methods (orthorectification or 3D modelling for example). To this end, RPCs are provided with the product to ensure full autonomy and simplicity for users.
2. **Projected**

The projected product is created by the application of an additional mapping process to project the image onto an Earth cartographic system at a fixed altitude. The image is georeferenced without the application of a Digital Elevation Model (DEM) and supplied with the RPC model file, which is supported by many existing software products from standard GIS to expert photogrammetry.

This means that image products are directly compatible with GIS environments and can be easily orthorectified using the customer’s own reference data.

The projected product is mapped onto the Earth using a standard reference datum and projection system at a constant terrestrial altitude, relative to the reference ellipsoid. By default, the map projection system is WGS84/UTM. Other projection systems are also available for the creation of customised products.

3. **Standard Orthorectified**

The standard orthorectified product (sometimes called the Precision Ortho) is a georeferenced image in Earth geometry, including the application of a DEM and GCPs. It is created via a fully automated procedure.

The orthorectification procedure eliminates the perspective effect on the ground (excluding buildings) to restore the geometry of a vertical shot. The Standard Ortho product is intended for those users who wish to use the data directly for their given application. As such, it can be ingested directly into a Geographic Information System and used immediately. This processing level facilitates the management of several layers of products, from several different sensors, while reducing localisation gaps that can be caused by different viewing angles or relief between the various layers.

The Standard Ortho product is created using our accurate sensor model. Height information is provided via the Airbus World DEM for Ortho (WD4O) DEM; and precision is improved via GCPs applied using the Airbus Intelligence One Atlas BaseMap as reference. In areas where WD4O is unavailable, the SRTM DEM is used instead.

4. **Tailored Orthorectified**

In addition to the standard orthorectified product described above, when different specifications are needed, Airbus Intelligence can also provide on-demand, custom orthorectification, using projection, height and/or reference information provided by the client as required. Each Tailored Ortho product is subject to a feasibility study and specific delivery timeframes

5 Product Format, Structure and Naming

5.1 Product Format

The final format of delivered Vision-1 image products includes:

- Masking (black fill) of pixels outside of the region of interest (ROI) polygon and/or raster trimming to the ROI bounding box (depending on the geometric product level provided).
- Tiling of image data: For ease of data handling, images beyond a certain size are split into smaller image tiles within the same product package.
- A choice of output image file format. Vision-1 data is available in two file formats: Jpg2000 and GeoTIFF (16-bit, or 8-bit for the 3-band pansharpened product).
- Multispectral band order: Each multispectral image product contains bands in the following order:

  B1 = BLUE

  B2 = GREEN

  B3 = RED

  B4 = NIR

5.2 Product Structure

Vision-1 imagery is provided with other supplementary files in a .zip archive with structure as indicated in the figure.

ZIP <PRODUCT_ID>.zip	
First <FOLDER_ID>	
<ROOT_NAME>_R<M>C<N>.tif/jp2	*Product GeoTIFF or JP2 file (R<M>C<N> in case of tiled products only)*
<ROOT_NAME>_R<M>C<N>.tfw	*Product Tiff World file (present if delivered image is GeoTIFF, (R<M>C<N> in case of tiled products only)*
<ROOT_NAME>_Preview.jpg	*Product quicklook JPEG*
<ROOT_NAME>_Preview.kmz	*Product quicklook Kmz file*
<ROOT_NAME>_Icon.jpg	*Product Thumbnail JPEG*
<ROOT_NAME>_Meta.xml	*XML product metadata*
<ROOT_NAME>.rpc	*RPC file (provided with SEN and PRJ customer products)*
Second <FOLDER_ID>	*Second folder provided in case of a BUNDLE product, in which case two folders are provided; one each for the multispectral (MS4) and the panchromatic (PAN) products*

Figure 5-1: Vision-1 product file structure

In summary:

- Bundle products (BUN) contain two imagery folders within the delivered archive – one each for the multispectral and panchromatic versions of the data. Otherwise, imagery is provided within a single folder inside the archive.
- Where image data is over a certain size, the image is broken into a number of individual tiles, whose relative position is indicated using a system of rows and columns.
- Tiff world files are provided with products supplied in GeoTIFF format

- Rational Polynomial Coefficients (RPC) files are provided with products that are not orthorectified (SEN and PRJ).
- Smaller copies of the original imagery are also provided for use as general quicklooks or for ingestion into user catalogue systems:
    - Preview.jpg
    - Preview.kmz
    - Icon.jpg
- A single xml metadata file provides further detailed information to the user

5.3 Product Naming

The product naming strategy uses two root ID names: <PRODUCT_ID> and <FOLDER_ID>. With this in mind, delivered products take the generic structure:

<PRODUCT_ID>.zip

<FOLDER_ID>

Product Files

The <PRODUCT_ID> and <FOLDER_ID> take the general form as follows.

<PRODUCT_ID>

<NAME_ABBREVIATION>_<PRODUCT_TYPE>_<IMAGING_START_TIME>_

<PROCESS_LEVEL>_<JOB_ID>_<NUM_PRODUCT>

e.g.

VIS1_BUN_201903281558305_ORT_123456_ABCD

And

<FOLDER_ID>

<NAME_ABBREVIATION>_<SPECTRAL_PROCESSING>_<ORDER_ID>_<AOI_ID>

e.g.

VIS1_MS4_23-00004-001_Kent1

Where Table 5-1 provides definitions of terms:

Name Section	Description	Format/Example/Options
<NAME_ABBREVIATION>	Abbreviation of given satellite name	VIS1
<PRODUCT_TYPE>	3-letter abbreviation to indicate the overall spectral product type. Note: In the case of BUN products, this will have a different value to that of the <SPECTRAL_PROCESSING>	PAN, MS4,, BUN, PMS3, PMS4

	described within the <FOLDER_ID>	
<IMAGING_START_TIME>	UTC start time of the originating image acquisition.	Format: YYYYMMDDHHMMSS E.g.20190801103021
<PROCESS_LEVEL>	This is the processing level of the given product, either projected or orthorectified using GCPs	Full res. Quicklook: QLK Primary: SEN Projected (not ortho): PRJ Precision Orthorectified: ORT
<JOB_ID>	Internal Airbus processing ID. This is unique to every version of every product	Format: NNNNNN E.g. 123456
<NUM_PRODUCT>	4 digit hex identifier associated with the original strip acquisition ID	Format: XXXX E.g. 1A2B
<SPECTRAL_PROCESSING>	3-letter abbreviation to indicate the spectral product type delivered within the folder	PAN, MS4, PMS3, PMS4
ORDER_ID	String limited to 12 characters providing a link to the original data order	Format: YY-NNNNN-NNN E.g. 23-00004-001
AOI_ID	Short name identifying the AOI used to crop the output product. If no AOI is provided, it will be assumed that the whole strip is intended as output. In this case "00" will be used. Limited to 12 characters.	Format: Free format according to the original customer AOI E.g. Kent1 Alternatively, this will be "00" in case no AOI is provided

Table 5-1: <PRODUCT_ID> and <FOLDER_ID> detailed description

Each folder then contains a number of individual product files. Each file has a <ROOT_NAME> and an optional suffix according to the following naming structure, and further described in the table below:

<ROOT_NAME>

<NAME_ABBREVIATION>_<SPECTRAL_PROCESSING>_<IMAGING_START_TIME>_<PROCESS_LEVEL>_<JOB_ID>_<NUM_PRODUCT>

e.g.

VIS1_MS4_201903281558305_ORT_123456_ABCD

File Name	File Type	Applicable Products	Comment
<ROOT_NAME>_Meta	.xml	All	Main metadata file. The contents of this file will be tailored according to the delivered product
<ROOT_NAME>	.rpc	SEN PRJ	RPC file provided with non-ortho products to allow customer orthorectification using a chosen DEM/DTM

<ROOT_NAME>_R<M>C<N>*	.tfw	All customer products delivered as GeoTiff	Tiff World File. Not relevant for products delivered as JPEG-2000
<ROOT_NAME>_R<M>C<N>*	.jp2/.tif	All	Contains the delivered imagery in JPEG-2000 or GeoTiff file format (according to the original order).
<ROOT_NAME>_icon	.jpg	All	Jpeg thumbnail/icon file
<ROOT_NAME>_Preview	.kmz	All	Kmz quicklook
<ROOT_NAME>_Preview	.jpg	All	Jpeg quicklook

*Note that _R<M>C<N> only features in the data product name when tiled products are delivered. The values M and N refer to the row and column number used to define the relative display location of each tiled image product file. Numbering starts from 1, with R1C1 defined at the upper left of the delivered AOI.

Table 5-2: Vision-1 product files

5.4 Metadata File Description

Products are supplied with an .xml metadata file containing information pertinent to the delivered imagery. The main content and format is described in the following table.

Section	Description	Useful Information
Metadata_Id	Description of metadata format and relevant schema. Provided with version number	A different schema for each product type.
Dataset_Id	Contains the core dataset name and paths to quicklook and thumbnail	e.g. VIS1_MS4_20210922164114_ORTP_S122448_2b10
Production	Dataset production and ownership information	Production date, provider details and copyright information.
Data_Processing	Basic information about the product processing.	Products information on the radiometric and geometric processing, version information and details of the reference data and re-sampling applied.
Quality_Assessment	Describes the geometric quality of the delivered product.	Provides *RMSE* and *CE90* values. This section is only relevant for orthorectified products.
Coordinate_Reference_System	describes the CRS applied in the product generation.	CRS EPSG code, type and name.
Geoposition	Details of the upper left corner	Upper left corner position and the x and y dimensions per pixel
Raster_CS	Defines the sub-pixel position of the upper left map coordinates.	Can be types *POINT* or *CELL* (usually *POINT*)

Dataset_Frame	The position of each corner of the dataset	Provided in degrees long/lat
Raster_Encoding	Describes the raster encoding of the image data. Also provides details of any tiling.	Contains product bit depth, data type, byte order and internal tile sizes for the TIFF/JP2 data files
Data_Access	Provides the file format, compression, and relative file path to the image data file	File type can be GeoTIFF or JPG2000. File path is relative to the location of the metadata file.
Raster_Dimensions	Basic dimensions of the delivered image file raster, including details of any tiling provided.	NCOLS, NROWS, NBANDS, NTILES
Image_Interpretation	Contains information on the band order and any gain/bias values to apply, with units	Band order is BLUE, GREEN, RED, NIR, corresponding to bands 1 to 4. Physical gain values are always 0.01 for Vision-1, with a bias of 0.0. Units are standard reflectance $W.m^{-2}st^{-1}m^{-6}$.
Image_Display	Provides band statistics and the no_data pixel value.	Provides values per band for: • Min/max value • Standard deviation • Mean
Dataset_Sources	Various information on the source acquisition data used in the product derivation.	Includes: • source acquisition ID • Acquisition information - Imaging start/stop date & time - Incidence and viewing angles - Sun azimuth and elevation angles - Earth-Sun distance in AU • Sensor location at time of imaging - Sensor altitude (m) - Sensor azimuth and elevation (°)

Table 5-3: DIMAP metadata file description

6 Products, Services and Options

6.1 OneTasking

Commissioning imagery from Vision-1 is fast and easy using the Airbus OneTasking service.

The Vision-1 operations team conducts feasibility studies based on the information provided by you. Once the tasking is active they closely follow open tasking requests, adjusting priorities as necessary.

One Tasking offers **two** tasking options for Vision-1:

ONEPLAN	ONESERIES
Obtain qualified coverage within an agreed timeframe You select your timeframes, dates and preferred sensor – we ensure you receive the right qualified coverage, perfectly matching your project milestones.	**Get coverage on a regular basis** Whether you are dealing with long-term changes or highly dynamic situations, One Series brings you the required intelligence at the frequency you choose. For highest frequencies, our cloud cover commitment ensures you pay only for the most useful results.

Table 6-1: One Tasking Summary

	ONEPLAN	ONESERIES
Timeframe	Customer selected	Customer Selected, including frequency
Cloud Cover	≤10% or ≤ 5% with uplift	
Min AOI	100km^2	100km^2 50 km^2 if five revisits or more
Max AOI	Subject to feasibility study	
Acquisition Mode	Mono	
Roll Angle	±0-20° as standard, or custom to ± 45°	
Level	Regular	Regular

Table 6-2: Overview of One Tasking options

6.1.1 OnePlan

Obtain qualified coverage within an agreed timeframe

With OnePlan tasking, you select the timeframe(s) required and your requirements are assessed through a feasibility study.

Timeframe	From 7–365 days
Start Date	Any day during the upcoming year.
Minimum Order Size	100km^2
Max Bounding Box	Subject to feasibility study
Cloud Cover	≤10% ≤ 5% Subject to feasibility study
Acquisition Notification	Acquisition notification will be sent to the customer regardless of the cloud cover.
Acquisition Mode	Mono
Roll Angle	± 0-20° as standard, or custom to ± 45°
Feasibility	Diagnosis on the probability of collecting the AOI in full
Service Level	Regular
Delivery Lead Time	Standard

Table 6-3: OnePlan Parameters

If the AOI is not collected in full and on specification within the acquisition window, the customer is given the choice to either:

- Extend the acquisition period, or
- End the tasking activity.

If the option is taken to end the tasking activity, all validated images will be delivered over the AOI. (Please note that any validated images must be purchased.)

Tasking parameters

The tasking parameters when selecting the OnePlan option include:

- The acquisition period. For a single acquisition, you may indicate your preferred collection period, with start and end dates. For instance, if you indicate 01/01/20 – 31/03/20, it means that you want the image to be acquired during the first three months of 2020.
- The acquisition mode: Mono
- The roll angle: < 20°, < 45°. The standard viewing angle is 20°, and is recommended for Ortho products. Note: the smaller the maximum viewing angle is, the longer the required collection window. The amount of additional time required depends on the latitude of your area of interest and your tasking choice. Please contact the Imagery Support Team for more information about how the viewing angle will affect your specific order.

- The maximum cloud cover accepted: The standard value is 10%. If you need a lower cloud cover commitment, 5% cloud cover is an option for a 25% uplift on the order value.

6.1.2 OneSeries

Routine coverage on a regular basis

OneSeries aims to provide regular information over a specific area. Your requirements are assessed through a feasibility study.

Cloud Cover	≤10% ≤ 5% Subject to feasibility study
Acquisition Notification	By default notification sent when imagery is less than 25% cloud cover.
Acquisition Mode	Mono
Incidence Angle	0-20° as standard, or custom
Feasibility	Diagnosis on the probability of collecting the AOI in full
Service Level	Regular
Delivery Lead Time	Standard

Table 6-4: OneSeries Routine Parameters

If the AOI is not collected in full and on specification within the acquisition window, the customer is given the choice to either:

- Extend the acquisition period relevant to the missed observation, or
- End the tasking activity.

If the option is taken to end the tasking activity, all validated images will be delivered over the AOI. (Please note that any validated images must be purchased).

Tasking parameters

The tasking parameters when selecting the OneSeries option include:

- The acquisition mode: Mono
- The maximum roll angle applicable to your monitoring (< 20°, < 45°). As with OnePlan, the standard viewing angle is 20°, and is recommended for Ortho products.
- The maximum cloud cover accepted: As with OnePlan, the standard value is 10%. If you require a lower cloud cover commitment, 5% cloud cover is an option for a 25% uplift on the order value.
- Any other requirements you might have, for example specifications for snow or haze.

6.2 Cloud Cover Warranty

Optimising Vision-1 satellite tasking in accordance with weather forecasts ensures that resources are used as efficiently as possible. We propose image tasking with cloud cover less than 10% or 5% over the Area of Interest (AOI) of the order. Cloud cover does not include cloud shadow or semi-transparent haze.

6.3 Feasibility Study

The feasibility study is performed by our expert tasking team in order to determine whether the data can be acquired within the parameters provided by the customer.

In particular, the OnePlan and OneSeries feasibility studies focus mainly on the desired acquisition timeframe compared to the required location, the size of the AOI, imaging angles, and cloud constraints.

To fully assess feasibility, we ask the customer to provide details of where, by when and for which application the imagery is required. With this information, the Tasking Team issues a proposal that includes advice and recommendations that clearly indicate:

- The feasibility study diagnosis: feasible/difficult/very difficult
- The estimated area coverage: %
- New proposed parameters when relevant.

The feasibility study proposes the best programming parameters in order to successfully collect the area on time and on specification. However, the customer will always have the freedom to select which option they prefer.

On completion of the feasibility analysis, the Tasking Manager issues a feasibility report, proposing alternatives if the feasibility suggests potential difficulties for your proposed imaging campaign.

6.4 Our Service

The service level offered in the event of a new acquisition order is detailed in the table.

	Regular Service for OnePlan and OneSeries Routine
Ordering	Monday-Friday 09:30-16:00 (GMT/BST) through Imagery Support Team.
Response	24hrs from receipt of customer request (within normal working hours). Feasibility study included dependent upon simplicity of the request.
Customer Modification/ Cancellation after Order Confirmation	Cancellation and modifications and modifications can be made, with a possible penalty. All validated images are invoiced. Upon acceptance of tasking proposal, cancellation or modification shall be sent to the Imagery Support Team at least 2 working days before the image acquisition. If cancellation occurs after validated images have been acquired/delivered these must be purchased
Tracked	Notification sent at each step of the tasking order - see Table 8-1 for details.
Delivery	**Standard** Standard < 2 working days from reception at Airbus, i.e. Monday-Friday from 09:30-16:00 (GMT/BST).

Table 6-5: One Tasking specifications

7 Product Ordering

Vision-1 data can be ordered by contacting our UK Imagery Support Team via ukintelligence-imagerysupport@airbus.com.

For information on our terms and conditions, including order cancellation, modification and other information, please refer to our *General Supply Conditions of Satellite Imagery Products*, which can be found on our website.

8 Product Delivery

8.1 Order Completion and Delivery

Once an order has been received the following notifications will be provided at the stages identified in the table below.

Notification Name		Notification Summary
Archive Order Confirmation		Confirmation that a Vision-1 Archive order has been registered successfully.
Tasking Order Confirmation		Confirmation that a Vision-1 Tasking order has been registered successfully.
Tasking Cancellation Confirmed		Confirmation that a Tasking order has been cancelled.
Tasking End Notification		Notification that the end of a Tasking order is approaching and option of extension of imaging period.
Acquisition Notifications for Tasking Orders:	**Rejected**	Notification that image has been acquired and has been rejected by Airbus.
	Proposed	Notification that an image has been acquired and although it may not exactly meet the initial specifications, may meet user needs. Requires validation or rejection from the user.
	Validated	Notification that an image has been acquired and validated as meeting the agreed criteria of the order.
	Coverage	Where multiple scenes are required to cover an AOI a summary notification will be sent to provide an update on the current status of the order.
Delivery Notification		Summary of delivery of Vision-1 product with access instructions.

Table 8-1: Order Notifications

After Airbus has successfully collected all of the appropriate data, we will process and deliver orders within two working days for standard products.

Processing timelines for all Tailored Ortho products do not begin until all imagery is collected and all the necessary support data (DEMs and GCPs) are received. The timeframe to obtain DEMs and GCPs depends on the geographic location of the area of interest. Large orders may require additional processing time. As such, delivery timelines for these products will be proposed as part of the original order quotation.

Depending on the delivery method selected, the order will either be posted to an FTP site or shipped.

Image data products will be provided according to the format described in section 5.1.

Please contact our Imagery Support Team at any time during the order process for further information, or to check on the status of your order.

8.2 How to Open Your Product

QGIS or other processing software may be used to open a Vision-1 product and access the image coordinates and metadata. Most commercial off-the-shelf software is able to read, georeference and process (orthorectify, etc.) Vision-1 products. Be aware that the various software packages may use different methods to georeference Vision-1 products.

Georeferencing is achieved by reading the GeoTIFF header, TFW worldfile, or XML metadata file for products in GeoTIFF.

Airbus has been working with major image processing software providers to ease the ingestion of Vision-1 data into their systems.

8.3 Technical Support and Claims

Whether you are looking for specific metadata, need to know how to use the RPC file, have questions about the format you need, think your image does not look right, cannot open a file, or anything else, we are here to help. For any question, advice or problem, please contact the Imagery Support Team.

Appendix A: Image Projection and Geo-referencing

A.1 Image Projection

A geographic projection is a simple mapping projection based on a geodetic datum and ellipsoid model of the Earth to convert the coordinates to a planar system as angular coordinates. Geographic projections are related to WGS84 geodetic datum/ellipsoid in decimal degree angular unit, with pixels regularly posted in latitude/longitude.

A mapping projection is based on a geodetic Coordinate Reference System (CRS) and uses a map projection model to convert the coordinates to a horizontal plane as Cartesian linear coordinates. Mapping projections are related to National Mapping Agencies or International Authorities. The default parameter values are those registered in EPSG. The linear unit is the metre.

A number of CRS mapping projections are available for orthorectified image products. Please contact us to confirm availability of any specific orthorectification requirements.

A.2 Image Geo-referencing

A geographic projection is a simple mapping projection based on a geodetic datum and ellipsoid model of the Earth to convert the coordinates to a planar system as angular coordinates. Geographic projections are related to WGS84 geodetic datum/ellipsoid in decimal degree angular unit, with pixels regularly posted in latitude/longitude.

A.2.1 Metadata relating to Geo-referencing

Information pertaining to image geo-referencing is provided in the product metadata, the Tiff World File and the RPC file (for Primary and Projected products) to allow good image geolocation. Some useful information within the product metadata is presented in the following table.

DIMAP Metadata fieldname	Description	Also Present in Tiff World File
NCOLS	Number of image columns	
NROWS	Number of image rows/lines	
NBITS	Bit depth of provided image file	
NBANDS	Number of spectral bands	
X_RES/Y_RES	Product pixel dimensions in the X and Y directions (metres)	Yes
ULXMAP/ULYMAP	X and Y position of the upper left corner (metres)	Yes
CRS_CODE	Horizontal co-ordinate system code (e.g. EPSG: 32652)	
CRS_TYPE	Type of co-ordinate system used (e.g. PROJECTED)	
CRS_NAME	Horizontal co-ordinate system name (e.g. WGS 84 / UTM zone 52N")	

Table A-1: Metadata fields pertaining to image geo-referencing

Tiff World Files are provided with GeoTIFF Vision-1 products. The Tiff World File describes the geo-referencing through an affine transformation with six parameters in the form:

$x' = A_x + B_y + C$
$y' = D_x + E_y + F$

Where:

x'/y'	- calculated x/y co-ordinate of the pixel on the ground
x/y	- pixel column/row number
A	- pixel size in the x-direction (XDIM in the DIMAP metadata)
B/D	- rotation about the y and x axes respectively
C	- x co-ordinate of the upper left corner of the image (ULXMAP in the DIMAP metadata)
F	- y co-ordinate of the upper left corner of the image (ULYMAP in the DIMAP metadata)
E	- the negative of the pixel size in the y-direction (YDIM in the DIMAP metadata)

The above-described value for E is negative due to a difference in the position of the origin between the image and the ground co-ordinate system. In the image, the origin for the y position is the upper left corner and y increases as we move down and away from this origin; but for the map, y co-ordinate values increase as we move upwards.

Values for the rotation terms, B and D are always set to zero, as no rotation is needed.

Values for C and F are taken as the centre of the upper left image pixel.

The Tiff World File itself is a short ASCII file containing six lines, giving the six parameters in the following order (one per line).

Parameter	Example
A	3.5
D	0.0
B	0.0
E	-3.5
C	269290.0
F	3249365.0

Table A-2: Content description and example of the Tiff World File

The Rational Polynomial Co-efficient (RPC) file is provided with Primary and Projected image products to allow orthorectification by the customer, using COTS software. The RPC model is an analytical model which provides a per-pixel relationship between the ground and the image via a set of 20 term cubic polynomial functions that relate given geographic co-ordinates on the ground (lat, long, alt) to image co-ordinates (column, line), all of which have been normalised to the centre of the image via:

$lat_{CN} = (lat - LAT\_OFF) / LAT\_SCALE$
$lon_{CN} = (lon - LONG\_OFF) / LONG\_SCALE$
$alt_{CN} = (alt - HEIGHT\_OFF) / HEIGHT\_SCALE$

For any given (lat, long, alt) position on the ground, the translation RPC equations are defined as:

$$col_{CN} = \frac{\sum_{i=1}^{20} SAMP\_NUM\_COEFF_i \cdot \rho_i(lat_{CN}, lon_{CN}, alt_{CN})}{\sum_{i=1}^{20} SAMP\_DEN\_COEFF_i \cdot \rho_i(lat_{CN}, lon_{CN}, alt_{CN})}$$

$$lin_{CN} = \frac{\sum_{i=1}^{20} LINE\_NUM\_COEFF_i \cdot \rho_i(lat_{CN}, lon_{CN}, alt_{CN})}{\sum_{i=1}^{20} LINE\_DEN\_COEFF_i \cdot \rho_i(lat_{CN}, lon_{CN}, alt_{CN})}$$

Where CN refers to centre normalised co-ordinates and the numerators and denominators are each 20-term cubic polynomial functions of the form:

$$\sum_{i=1}^{20} C_i \cdot \rho_i(lat_{CN}, lon_{CN}, alt_{CN}) =$$

$$\begin{aligned}
&C_1 \ldots\ldots\ldots + C_6 \cdot lon_{CN} \cdot alt_{CN} + C_{11} \cdot lat_{CN} \cdot lon_{CN} \cdot alt_{CN} + C_{16} \cdot lat_{CN}^3 \\
&+C_2 \cdot lon_{CN} \ldots\ldots\ldots + C_7 \cdot lat_{CN} \cdot alt_{CN} + C_{12} \cdot lon_{CN}^3 \ldots\ldots\ldots + C_{17} \cdot lat_{CN} \cdot alt_{CN}^2 \\
&+C_3 \cdot lat_{CN} \ldots\ldots\ldots + C_8 \cdot lon_{CN}^2 \ldots\ldots\ldots + C_{13} \cdot lon_{CN} \cdot lat_{CN}^2 \ldots\ldots\ldots + C_{18} \cdot lon_{CN}^2 \cdot alt_{CN} \\
&+C_4 \cdot alt_{CN} \ldots\ldots\ldots + C_9 \cdot lat_{CN}^2 \ldots\ldots\ldots + C_{14} \cdot lon_{CN} \cdot alt_{CN}^2 \ldots\ldots\ldots + C_{19} \cdot lat_{CN}^2 \cdot alt_{CN} \\
&+C_5 \cdot lon_{CN} \cdot lat_{CN} + C_{10} \cdot alt_{CN}^2 \ldots\ldots\ldots + C_{15} \cdot lon_{CN}^2 \cdot lat_{CN} \ldots\ldots\ldots + C_{20} \cdot alt_{CN}^3
\end{aligned}$$

These co-efficients are represented in the RPC file as follows (where n = an integer between 1 and 20):

LINE_NUM_COEFF_n
LINE_DEN_COEFF_n
SAMP_NUM_COEFF_n
SAMP_DEN_COEFF_n

The new centre normalised (column, line) co-ordinates and then transformed back to standard image co-ordinates, beginning at (1, 1) in the upper left corner, via:

col = col_{CN} ** SAMP_SCALE + SAMP_OFF*
lin = lin_{CN} ** LINE_SCALE + LINE_OFF*

A.3 Acquisition Angles

A.3.1 Incidence and viewing angles

Figure A-1 illustrates the difference between ground incidence and satellite view angle for any Vision-1 image acquisition.

The incidence angle (β in the figure) is the angle between the ground normal and satellite look direction. As the angle is measured with respect to the ground normal (regardless of satellite view direction), this angle will always be positive.

The view angle (α in the figure) is the angle measured between the satellite look direction and nadir. In its purest form as a complement to the ground incidence angle but measured with respect to the satellite nadir line, this angle will also always be positive.

Each of these angles may be projected onto two planes normal to the ground and in the along and across-track directions and this is how both of these angles are presented in the product metadata.

For example for the viewing angle, we have:

- VIEWING_ANGLE_ACROSS_TRACK (degrees)

  The across-track contribution to the viewing angle (from satellite roll)

- VIEWING_ANGLE_ALONG_TRACK (degrees)

  The along-track contribution to the viewing angle (from satellite pitch)

These angles may be either positive or negative as they are each measured with respect to a plane. A left-looking image (with respect to the satellite direction of travel) will have a negative across-track viewing angle. A rearward looking image will have a negative along-track viewing angle.

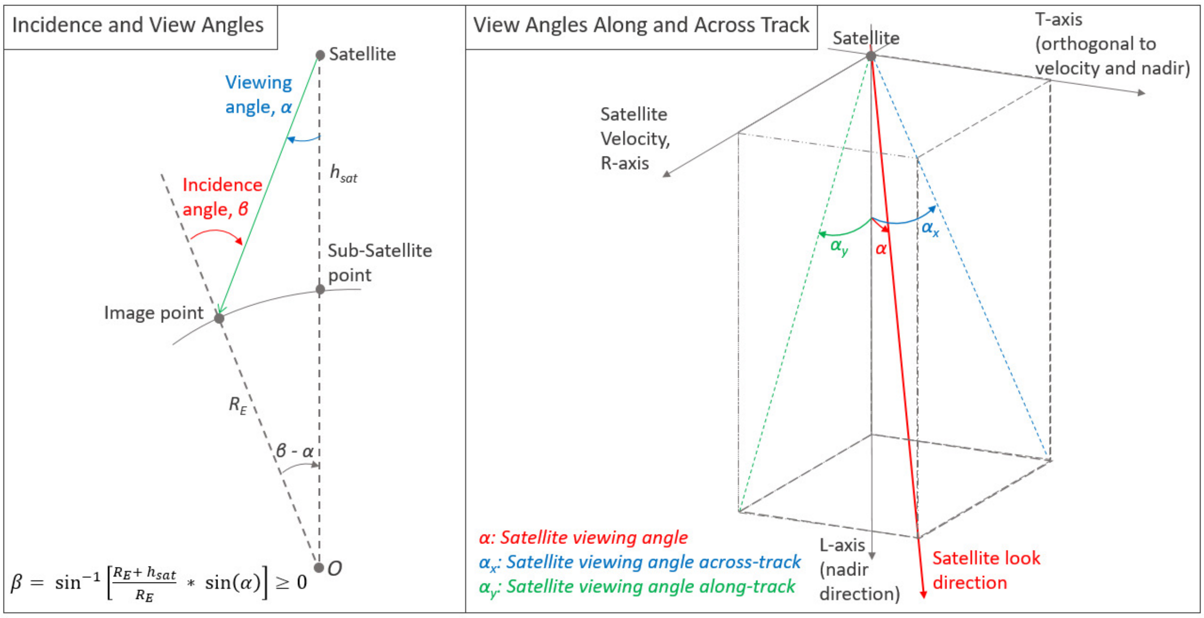

Figure A-1: Definitions of incidence and view angles in general (left); and projected along and across track (right)

A.3.2 Sensor azimuth angle

The sensor azimuth angle Az_{sat} is the angle between the meridian indicating the north passing through an image point and the line joining the same image point with the satellite nadir point. For Vision-1, the sensor azimuth angle is given for the point at the centre of the imaged scene and is given in degrees. The potential range for this angle is 0 - 360° in the clockwise direction. It is illustrated in the figure below.

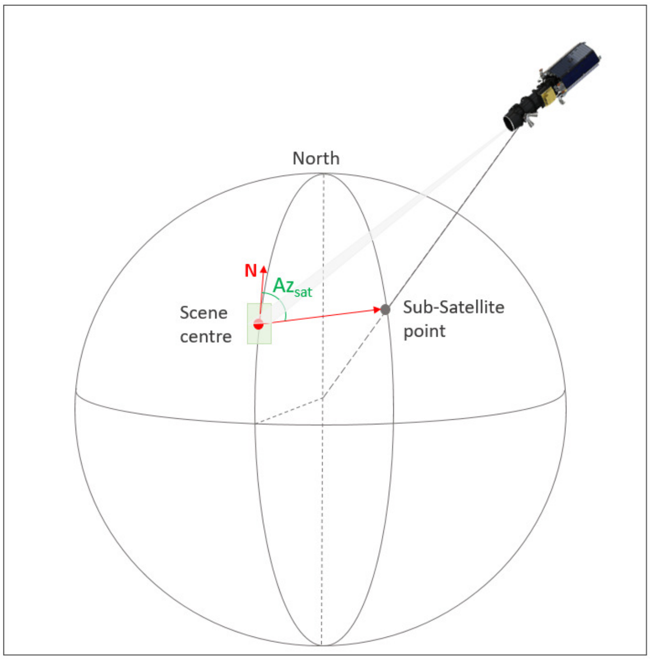

Figure A-2: Definition of the sensor azimuth angle

A.3.3 Solar Angles

The solar azimuth and elevation angles (Az_{sun} and El_{sun}) are calculated in the local Earth frame, which uses orthogonal axes defined by the local North, local East and local normal to the ellipsoid. They are defined in the product metadata by the fields SUN_AZIMUTH and SUN_ELEVATION.

Additionally, the solar zenith angle (θ_{sun}) is the complement of the solar elevation.

$$\theta_{sun} = 90° - El_{sun}$$

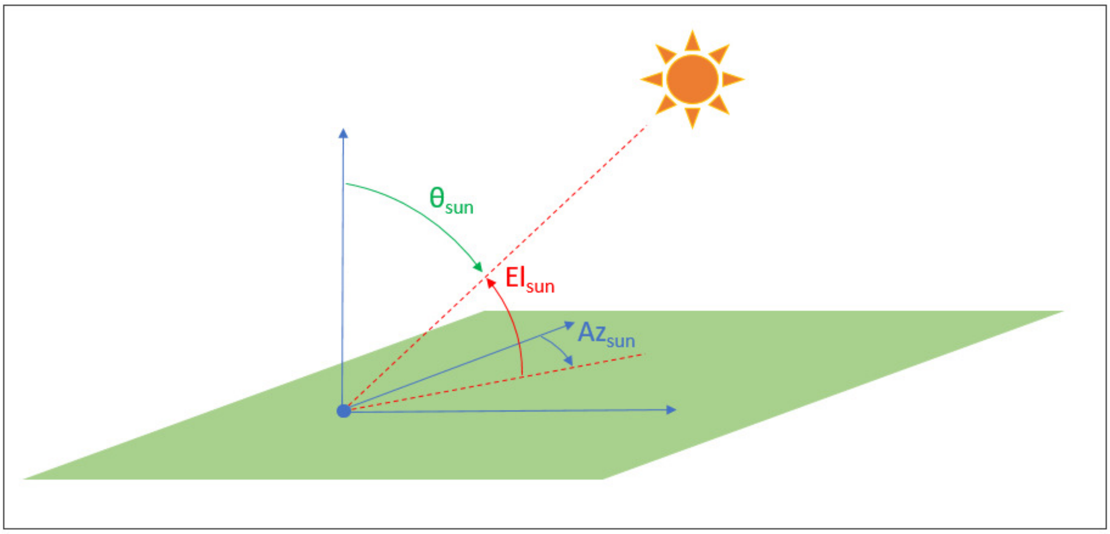

Figure A-3: Solar incidence angles

Appendix B: List of Abbreviations, Acronyms and Terms

Term	Description
AOI	Area of Interest.
Attitude	The angular orientation of a spacecraft as determined by the relationship between its axes and a reference line or plane or a fixed system of axes. Usually, 'Y' is used for the axis that defines the direction of flight, 'X' for the 'cross-track' axis perpendicular to the direction of flight, and 'Z' for the vertical axis. Roll is defined as the angular rotation around the Y-axis; pitch is the angular rotation around the X-axis; yaw is rotation around the Z-axis.
ASCII	American Standard Code for Information Interchange. A commonly used coding for text files.
Azimuth	An angle describing the arc of the horizon measured clockwise from the north point to the point referenced, expressed in degrees. Azimuth indicates direction, and not location
BOA	Bottom of Atmosphere. A lesser used term for TOC.
CCD	Charged Coupled Device used to capture the charge deposited
CE90	Circular Error of geographically corrected (Projected or orthorectified) image products, with a confidence level of 90% (considering positioning accuracy on both x and y-axes). It indicates that the actual location of an object is represented on the image within the standard accuracy for 90% of the points.
CN	Centre Normalised. The central pixel of the image becomes the “origin” or central point to which all other points are referenced.
COTS	Commercial Off The Shelf
CRS	Co-ordinate Reference System
DEM	Digital Elevation Model. A 3D model that includes the maximum altitude at each point. Includes canopy and other ground structures.
DN	Digital Number.
EPSG	A list of geodetic parameters used for performing geometric transformations on EO data.
GCP	Ground Control Point. Used in the positional refinement of orthorectified data products.
TIFF/GeoTIFF	Geographic Tagged Image File Format. A public domain metadata standard allowing georeferencing information to be embedded within the image TIFF file
GIS	Geographic Information System. A system designed to capture, store, manipulate, analyse, edit, manage and present all types of geographic data.
GSD	Ground Sample Distance. The distance on the ground between two neighbouring pixels at acquisition
EO	Earth Observation
ESUN	Solar Spectral Irradiance calculated for a specific waveband on a sensor with a specific measured spectral transmission. Provided in units of $Wm^{-2}\mu m^{-1}$
EULA	End User Licence Agreement. Describes the permitted use of purchased Vision-1 imagery.
Incidence Angle	Angle between the ground normal at the observed point on the ground and the line of sight of the imaging sensor. It is different from the view angle.
KML	Keyhole Markup Language. An XML notation for expressing geographic annotation and visualisation within internet-based, two-dimensional maps and three- dimensional Earth browsers. KML was developed for use with Google Earth, which was originally named

	Keyhole Earth Viewer. It was created by Keyhole Inc, which was acquired by Google in 2004. KML is an international standard of the Open Geospatial Consortium.
KMZ	A compressed KML file. It will open directly with Google Earth and some other GIS software.
MS	Multispectral. Indicates remote sensing using between 2 and 20 spectral bands.
MS4	Four band multispectral image data
MTF	Modulation Transfer Function. A measure of image sharpness provided to an image by the imaging sensor.
Nadir	The point on the ground vertically beneath the sensor
NIR	Near Infra-Red. A region of the electromagnetic spectrum spanning wavelengths in the range 700 – 3000nm approx.
NIIRS	National Image Interpretability Rating Scale. A subjective scale used to rate the quality of VHR imagery (satellite or otherwise). It defines 10 levels of image quality/interpretability based on the types of ground cover that can be correctly identified by an operator.
Ortho/Orthorectified	An orthorectified image product (an ortho product) has been corrected for geographic position (including height) and may be directly overlaid upon a map.
PAN	Short for Panchromatic. Covering a wide range of visible optical spectra.
Pan-sharpening	The practice of using the highest resolution Panchromatic band in conjunction with the other lower resolution multispectral bands to increase the apparent spatial resolution of a multispectral image product
Planimetric Accuracy	The positional accuracy of the image projected on an Earth mapping system and reset with a DEM (vertical reset) and, optionally, GCPs (horizontal reset). Planimetric Accuracy depends on the intrinsic accuracy of the external data (DEM and GCP) and is used to describe georeferenced image products
PRNU	Photo Response Non-Uniformity. A measure of the differing pixel responses across a CCD detector array.
Quicklook	A subsampled version of the original image product to allow efficient browsing of the image data (for example within a catalogue)
Radiance	A measure of radiant intensity per unit of a projected source area in a specified direction. The unit is the rate of transfer of energy (Watt, W) at sensor input, per square metre on the ground, for one steradian (solid angle from a point on Earth's surface to the sensor), per unit wavelength being measured
Reflectance	Reflected radiance expressed as a fraction of incident radiance. Reflectance provides a standardised measure, which is directly comparable between images. Reflectance is unitless and thus is measured on a scale from 0 to 1 (or 0–100%). Top-of-Atmosphere (TOA) reflectance does not attempt to account for atmospheric effects
Resolution (Spatial Resolution)	A measure of the smallest angular or linear separation between two objects that can be resolved by the sensor. Not the same as spectral resolution.
Resolution (Spectral Resolution)	A measure of the smallest difference in wavelengths that can be resolved by the sensor. Not the same as spatial resolution.
RMSEP	Root Mean Squared Error of Planimetry. Describes the square root of the mean horizontal distance between all photo-identifiable GCPs and their respective twin counterparts acquired in an independent geodetic survey (reference dataset)
ROI	Region of Interest. See AOI.
RPC	Rational Polynomial Coefficients. An RPC file is provided to assist in the correct geolocation of projected Vision-1 products
Sensor Model	A mathematical representation of sensor state/position at the time of image collection. The algorithm accounts for refraction, position, orientation, velocity, and viewing directions along the sensor array through the camera. It calculates the transformation

	between 3-D ground space and image line and sample coordinate points, and vice versa. Every image has unique sensor model parameters that reflect the location and orientation of the sensor at the time the image was collected.
SLA	Service Level Agreement.
SNR	Signal to Noise ratio. Measures the radiometric accuracy of an image.
Spectral Band	An interval in the electromagnetic spectrum defined by two wavelengths, frequencies, or wave numbers. E.g., the Vision-1 BLUE band ranges between 440 and 510nm.
SRTM	Shuttle Radar Topography Mission. A DEM for use in the production of orthorectified data products.
Swath	The width of an image on the ground, which will increase with view angle. The Vision-1 swath is 20.8km at nadir
TDI	Time Delay Integration. A time delay integration charge-coupled device (CCD) is widely used for observation of high-speed moving objects undetectable by classic CCD. This technique senses charge patterns and shifts them across the charge-coupled device (CCD) array in sync with the movement of the image, to integrate more light from the scene
TOA	Top of Atmosphere
TOC	Top of Canopy
UTC	Universal Time Co-ordinated. A universal timing standard; never adjusted for daylight savings.
UTM	Universal Transverse Mercator. A projection system that divides the Earth into 60 zones (UTM zones), each 6 degrees of longitude wide. A secant transverse Mercator projection is used in each zone.
VAP	Value Added Product. Often known as level 4 processing. Product data may become unrecognisable in comparison with the original data source.
VHR	Very High Resolution imagery below 1m
Viewing Angle	Angle between the satellite nadir line and the line of sight of the imaging sensor. It is different from the incidence angle. If pitch and roll are independently controlled for imaging, the view angle will take both of these into account.
WD4O	World DEM for Ortho. The Airbus compiled DEM product used to orthorectify Vision-1 products as standard.
Zenith	The point in the celestial sphere that is exactly overhead. The opposite of nadir.