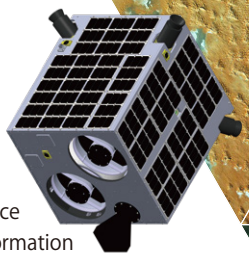
Sensing the world, changing the future.

AxelGlobe



The Power of AxelGlobe

AxelGlobe — Is a new era of earth observation infrastructure. With a resolution of 2.5 m that can even distinguish vehicles on the ground from space. We would be able to see everything on Earth's surface on daily basis. AxelGlobe's value goes beyond just getting the latest information about the world. Also by comparing the data accumulated from the past, AxleGlobe will help to predict the future with key business insights to being more intelligence globally to drive business growth.

Axelspace aims to build the AxelGlobe Constellation, an earth observation network consisting of dozens of GRUS satellites. This will make it possible to capture more than half of all landmass and Oceans on the earth once a day. This is almost applicable in every field of human economic activity and we will be able to obtain this information every day. We launched our first satellite in year 2018 and will continue to increase the number of satellites to add to our GRUS Constellation.

Image captured by GRUS-1B
Capture location: Suez Canal, Egypt Capture time: 08:26 am on April 29, 2021 (UTC)

Image captured by GRUS-1C
Capture location: Laguna de Cajititlán, Jalisco, Mexico Capture time: 05:39 pm on April 28, 2021 (UTC)

Image captured by GRUS-1D (Fukui Prefectural Satellite "Suisen")
Capture location: Tsuruga Bay, Fukui, Japan
Capture time: 01:28 am on April 26, 2021 (UTC)

Image captured by GRUS-1E
Capture location: Chicago O'Hare International Airport, Illinois, USA
Capture time: 04:22 pm on May 2, 2021 (UTC)

AxelGlobe Constellation

As the number of Satellites increases, the frequency of revisits and shooting capacity increase.

Year 2018

Year 2021

Year 2023

Orbital altitude	585km
Shootable time	10:40-11:00
Ground resolution	2.5m
Shooting width	57km or more

AxelGlobe is made for every business to grow by leveraging key business insights. It is the only reliable and robust earth observation web platform.

Everyone can access the latest data 24 hours a day on this web platform.
Enabling getting every information you need for your business quickly and easily.

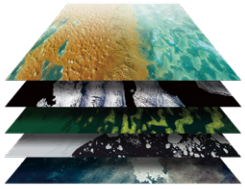
For more information, go to the AxelGlobe website

https://www.axelglobe.com/en/

AxelGlobe

Axelspace provides solutions using satellite imagery data acquired by its proprietary constellation.

Capture Data



Accumulate Data

Provide Solutions

Satellite Image Provision Plan

- A new image will be captured in the specified area and the processed image will be provided as an image product
- Monthly contract (When a new contract starts, it starts for minimum 2 months duration, after that the contract can be renewed every month)
- Plans can be selected according to the number of image products required within a month

About Image Products

- Optical images taken by GRUS are processed with sensor correction, geometric correction, and map projection. Then processed images are provided as image product for key business insights.

Plan	1 Image / Month	3 Images / Month	6 Images / Month
Ground Resolution	Panchromatic: 2.5m		
	Multispectral: 5.5m		
Spectral Bands	Panchromatic	450-900nm	
	Blue	450-505nm	
	Green	515-585nm	
	Red	620-685nm	
	Red Edge	705-745nm	
	Near Infrared	770-900nm	
	Swath	57+Km	
Life Span	5+years		
Bit Depth	12bit		

Supporting the best decisions for industry leaders

Vegetation Analysis

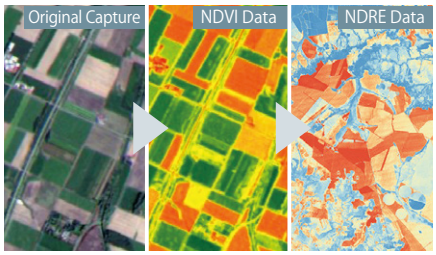
Analyze the growing situation of plants by analyzing satellite images. Harvesting and farming support such as planning and yield forecasting, economic indicators of agricultural products can be created.

Vegetation monitoring

Future index

Agricultural insurance

Check the planted area and growth status from the image by performing analysis, it is possible to grasp the optimum harvest time and when to use water and fertilizers. Also acts as guards for management of forest trees, species judgment, etc.



Infrastructure Monitoring

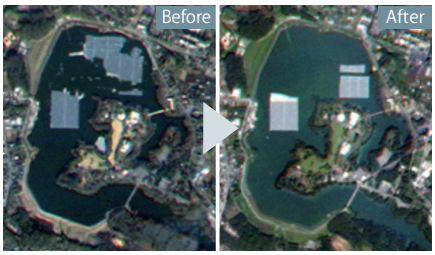
It is possible to shoot a wide range at once, and it is automatically performed regularly. The satellite images taken determine the progress of construction in the target area and also abnormalities can be easily confirmed.

Long-distance pipeline management

Monitoring of mega solar plant

Equipment damage status, range analysis

Floating long-distance pipelines in the open sea Large-scale infrastructure, such as Energy plants and mega solar plants. Satellite images are useful for monitoring land mass and smart cities also.



Environment / Sustainability

Satellite images that can be acquired frequently can detect daily changes. You can see a wide range of situations from a panoramic view from space. This will help in tracking and achieving Global Sustainability goals.

Forest monitoring

Land utilization monitoring

Environmental assessment

Extensive and quick in those remote areas which are difficult and hard to access, Environmental monitoring, Illegal Logging of forest and River bed land encroachment changes can be extracted automatically for environmental safety.

AxelGlobe Image Specifications

Product Summary

These image products consist of AxelGlobe Cells, measuring about 5 km × 5 km per tile. This product is intended for applications that require accurate location information and map projection images. The image product is processed with sensor correction, geometric correction, and map projection. In addition to automatically extracting the ground control points (GCP) from the high positional accuracy base map using our unique matching technology, we also combine conventional methods for areas where the GCP extraction is difficult. In applying correction processing, the location accuracy of the product depends on the GCP used and varies from region to region.

In addition, mask data that indicates areas unsuitable for analysis are provided as an unusable data mask file (UDM file). The UDM marks pixels with missing data, areas falling outside the captured image boundary, or obscured by clouds. The UDM file is available in products produced on Oct. 14, 2020 or later.

Table 1 shows the types and outline of Standard imagery, which is an image product of GRUS satellite provided by Axelspace.

Table 1. GRUS satellite image product types

Product name	Content
Multispectral Image Products (MSI)	This product is processed with sensor and geometric correction. Pixel resolution is 2.5 m in panchromatic image and 5.0 m in multispectral image. Positional accuracy is aimed within 10-meter RMSE range. Relative/absolute radiometric correction is also applied. The pixel value for this data is obtained by scaling the reflectance at the top of the atmosphere to an unsigned 16-bit integer value.
True Color Image Products (TCI)	This product is processed with sensor, geometric correction, and pansharpening. Pixel resolution is 2.5 m. Positional accuracy is aimed within 10-meter RMSE. For visual enhancement purposes, this product has also been post-processed with color-correction technique. A pixel value is scaled into an unsigned 8-bit integer.

Standard Imagery Image Product Details

The Standard Imagery image product contains the contents listed in Table 2.

Table 2. Multispectral Image and True Color Image Product specification

	Multispectral Image Products		True Color Image Products	
Product attribute	**Content**	**Description**	**Content**	**Description**
Product configuration and format	Panchromatic imagery file	16-bit panchromatic imagery data that is divided by AxelGlobe cell. GeoTIFF format or JPEG2000 format. Band assignment: Band1: Panchromatic	—	—
	Multispectral imagery file	16-bit multispectral imagery data that is divided by AxelGlobe cell. GeoTIFF format or JPEG2000 format. Band assignment: Band1: Blue Band3: Red Band5: Near Infrared Band2: Green Band4: Red Edge	—	—
	—	—	Pan-sharpened imagery file	8-bit color-scaled pan-sharpened imagery data that is divided by AxelGlobe cell. GeoTIFF format or JPEG2000 format. Band assignment: Band1: Red Band2: Green Band3: Blue
	Unusable Data Mask (UDM) file	Binary image data that indicates the unusable region. GeoTIFF format or JPEG2000 format. The pixel resolution matches that of the product. Layer assignment: Layer1: No data region Layer2: cloud covered region Digital number assignment: Layer1: Layer2: Invalid data area: 1 Cloud area: 1 Valid data area: 0 Cloud free area: 0	Unusable Data Mask (UDM) file	Binary image data that is indicative of the unusable region. GeoTIFF format or JPEG2000 format.The pixel resolution matches that of the product. Layer assignment: Layer1: No data region Layer2: cloud covered region Digital number assignment: Layer1: Layer2: Invalid data area: 1 Cloud area: 1 Valid data area: 0 Cloud free area: 0
	Metadata file	Metadata for panchromatic imagery file, multispectral imagery file, and unusable data mask file. JSON format.	Metadata file	Metadata for pan-sharpened imagery file and unusable data mask file. JSON format
Product frame	AxelGlobe Cell	Our global grid system is based on the AxelGlobe Cell measuring about 5 km x 5 km per tile. A buffer of about 100m (overlap area with adjacent cells) is added to each of the four sides. If the captured image does not fill the entire area of the cell, the unfilled area will be indicated with black pixels wherein No data value (0) is assigned.	AxelGlobe Cell	Our global grid system is based on the AxelGlobe Cell measuring about 5 km x 5 km per tile. A buffer of about 100m (overlap area with adjacent cells) is added to each of the four sides. If the captured image does not fill the entire area of the cell, the unfilled area will be indicated with black pixels wherein No data value (0) is assigned.
Pixel resolution	2.5m (Panchromatic) 5.0m (Multispectral)	The actual ground sampling distance varies on the collection conditions (mainly due to the satellite roll angle), but a sampling process is applied to the specified pixel size when product is generated.	2.5m	The actual ground sampling distance varies on the collection conditions (mainly due to the satellite roll angle), but a sampling process is applied to the specified pixel size when product is generated.

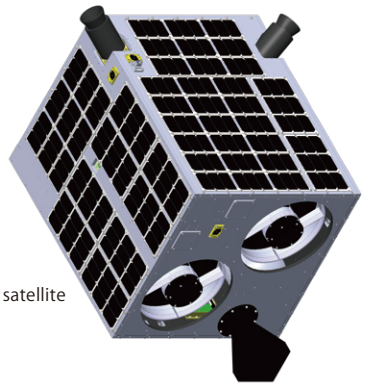
Table 2. Multispectral Image and True Color Image Product specification

	Multispectral Image Products		True Color Image Products	
Product attribute	**Content**	**Description**	**Content**	**Description**
Bit depth	16-bit unsigned integer	GRUS satellite images are stored in the onboard memory as up to 12 quantized bits. Relative DN values obtained directly from the sensor are converted to reflectance value at the top of atmosphere by radiometric correction, and the result is scaled (10,000 times) to a 16-bit dynamic range. (* Refer to 3.2.4 Radiometric correction)	8-bit unsigned integer	GRUS satellite images are stored in the onboard memory as up to 12 quantized bits. Relative DN values obtained directly from the sensor are tone-scaled to 8-bit for visual purpose.
Resampling	Nearest Neighbor	Performs resampling processing using the nearest neighbor interpolation method, which uses the pixel value closest to the reference position. Since it assists to retain the original information, it is suitable for applications that require more rigorous analysis processing.	Nearest Neighbor	Performs resampling processing using the nearest neighbor interpolation method. This method is an interpolation method that uses the pixel value closest to the reference position.
Geometric correction	sensor telemetry	Internal detector geometric correction combining the virtual array with eight imagers	sensor model	Optical distortion correction due to sensor optics
	band-to-band registration	Band-to-band registration correction used to rectify misalignment between bands	band-to-band registration	Band-to-band registration correction used to rectify misalignment between bands
	Geo-rectification	In geo-rectification, the characteristic terrain and features are extracted and paired between the captured image and the existing satellite image data (base map). The extracted terrain and features are matched with the reference points of each base map corresponding to the reference points. Processing is performed to reduce the positional deviation of the entire image with respect to the base map.	Geo-rectification	In geo-rectification, the characteristic terrain and features are extracted and paired between the captured image and the existing satellite image data (base map). The extracted terrain and features are matched with the reference points of each base map corresponding to the reference points. Processing is performed to reduce the positional deviation of the entire image with respect to the base map.
Radiometric correction		Correction of relative value difference of radiometric characteristics between detectors Undetected detector filling for null values from unresponsive detectors Conversion to reflectance values at the top of atmosphere based on calibration factors Scaling reflectance values at the top of atmosphere to 16-bit unsigned integer values (10,000 times)	Radiometric correction	Correction of relative value difference of radiometric characteristics between detectors Undetected detector filling for null values from unresponsive detectors Scaling a 12-bit relative DN value to an 8-bit unsigned integer value by gamma correction
Enhancement	—	—	Dark Object Subtraction (DOS)	The dark pixels in the image are used to reduce noise such as water vapor and dust in the atmosphere. (Applies to images taken after July 7, 2020)
Horizontal geodetic system	WGS1984		WGS1984	
Projection	Universal Transverse Mercator projection (UTM)	UTM is a transverse Mercator projection that divides the earth into longitude zones every 6° eastward from the 180° meridian and projects the central meridian as the central meridian from the spheroid directly into the plane for each longitude band. Zones are determined by the south-west corner coordinates at the start of capture.	Universal Transverse Mercator projection (UTM)	UTM is a transverse Mercator projection that divides the earth into longitude zones every 6° eastward from the 180° meridian and projects the central meridian as the central meridian from the spheroid directly into the plane for each longitude band. Zones are determined by the south-west corner coordinates at the start of capture.

About GRUS Satellite

GRUS is the name of the micro earth observation satellite that constitutes the AxelGlobe constellation. The GRUS satellite is equipped with two telescopes, which contributes to expanding the observation width. As a result, It has achieved both a high resolution of 2.5 m and a wide observation range of 55 km or more.

Table 3 on the right shows the GRUS satellite specifications.



GRUS satellite

Table 3. GRUS satellite system specifications

Item	Contents	
Number of satellite	5 (as of Jun. 2021)	
Orbital altitude	585km, Sun synchronous sub-recurrent orbit	
Equator passage time	10:40-11:00 (local time)	
Spectral band	**Name**	**Wavelength range (nm)**
	Panchromatic	450-900nm
	Blue	450-505nm
	Green	515-585nm
	Red	620-685nm
	Red Edge	705-745nm
	Near Infrared	770-900nm
Ground resolution (at nadir)	Panchromatic: 2.5m or less	
	Multispectral: 5.0m or less	
Swath	55km or more	
Longest collection length	1,000km	
Sensor bit depth	12-bit	

AXELSPACE

Axelspace Corporation
Clip Nihonbashi Building, 3-3-3 Nihonbashi-Honcho, Chuo-ku, Tokyo 103-0023, Japan
Mail: sales@axelspace.com URL: www.axelspace.com