Document for Operation

# Survey Operation Manual for Topographic Mapping Using Satellite Images (for National Base Map)

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Infrastructure Management Department

Japan International Cooperation Agency

Survey Operation Manual for Topographic Mapping Using Satellite Images
(for National Base Map)
Revision history

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[Preface]　General

1.　Introduction

Due to the advances in technological development of sensors mounted on artificial satellites, even such satellite images with a ground resolution of less than one meter are available. Satellite images, with each frame covering a wide range of area and providing sufficient readability for planimetric features according to the ground resolution, are expected to be used in the field of topographic map creation.

On the other hand, the topographic map creation using satellite images has not yet been achieved based on unified specifications because, these images are available with different scales, accuracy levels, and different data formats according to satellite operators, based on the type of satellite images to be adopted. At present, there are no common specifications or standards regarding the quality of survey results obtained.

Against this background, the Survey Operation Manual of JICA for Topographic Mapping Using Satellite Images (for National Base Map) (Draft) (hereinafter referred to as “this Manual”) defines the standard operation methods and quality criteria for measurement results for the technique of photogrammetry using satellite images and is aimed at the efficient topographic map creation in base map survey for approximate scales of 1/5,000 to 1/100,000 to be undertaken overseas by the Japan International Cooperation Agency (hereinafter referred to as JICA).

2.　What is a photographic survey that uses satellite images?

Sensors mounted on artificial satellites can be classified according to the observation bands, types, orbit types, orbit altitude, observation methods, etc.　Some of these sensors that provide images that allow the stereoscopic observation are suitable for topographic map creation through photogrammetry.

In this Manual, the photogrammetry using satellite images shall be performed using satellite images that allow the stereoscopic observation.

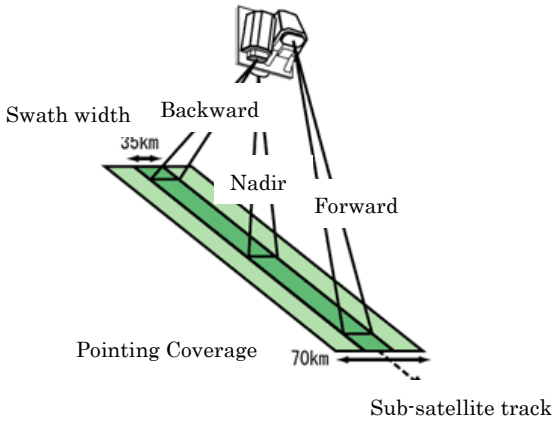


Figure 1　Example of stereoscopic observation sensor (ALOS PRISM)

(Source: http://www.eorc.jaxa.jp/ALOS/about/jprism.htm)

3. Types of satellites described in this Manual

The photogrammetry using satellite images is realized through the application of theories and techniques of aerial photorammetry. The differences of satellite image-based photogrammetry from aerial photogrammetry mainly come from the sensor characteristics (observation bands, ground resolving powers, and geometric projection models).

This section provides the outline of satellites described in this Manual and summarizes the sensor characteristics and data processing levels of imaging products.

- Outline of major satellites
  - IKONOS

    A satellite operated by GEOEye (former ORBIMAGE) of the U.S. (transferred in 2006 from Space Imaging of the U.S.) and the first privately-run high-resolution satellite with a success in the operation (launched September 25, 1999) which still remains in continuous service.
  - QuickBird-2

    A satellite operated by Digital Globe of the U.S. and the second privately-run high-performance satellite launched in October 2001 after IKONOS. This satellite offers the highest spatial resolution (61cm, nadir) of all the satellites currently in service.
  - OrbView-3

    A satellite operated by GEOEye (former ORBIMAGE) of the U.S. and a privately-run high-resolution satellite launched in June 2003. The resolution is one meter.
  - SPOT-1/2/3/4

    An earth observation satellite of SPOTImage of France. Only archived images are available from SPOT-1 and 3 because they are already out of service. The sensors that allow the stereoscopic observation have a panchromatic resolution of 10 m.
  - SPOT-5

    The latest model of the SPOT-series earth observation satellites of SPOTImage of France, which have been used for wide-ranging applications. SPOT-5 has a spatial resolution of 2.5 m, equivalent to those of other high-resolution satellites. SPOT-5, equipped with a high-resolution stereoscopic sensor (HRS), is expected to contribute to providing high-definition elevation data obtained from it.
  - ALOS

    A Japanese satellite launched in 2006 for the purposes of cartography, regional observation, disaster monitoring, and resource surveying. Equipped with AVNIR-2, a high-resolution multi-spectral sensor; PRISM, a stereoscopic sensor that allows three directional views (nadir, forward, and backward); and PALSAR, an all-weather synthetic aperture radar, ALOS is expected to contribute to creating 1:25,000 topographic maps of the entire world.

The following table lists the specifications of the major satellite sensors.

| Satellite name | In service | Sensor name | Type | Resolving Power | Recurrence period (subcycle) | Swath width |
|---|---|---|---|---|---|---|
| IKONOS | 1999.09 ～ | PAN | PAN | 0.82～1.0m | 11days (2days ) | 11km |
| | | MS | MS | 3.3～4.0m | | |
| QuickBird-2 | 2001.10 ～ | PAN | PAN | 0.61～0.72m | 20days (1 ～ 4days ) | 16.5km |
| | | MS | MS | 2.44～2.88m | | |
| OrbView-3 | 2003 | PAN | PAN | 1m（nadir） | 16days (3days ) | 8km |
| | | MSS | MS | 4m（nadir） | | 8km |
| SPOT-1/2/3 | 1986～ 2002 1990～ 1993～ 1997 | HRV/P | PAN | 10m（nadir） | 26days (3days ) | 60km |
| | | HRV/XS | MS | 20m（nadir） | | 60km |
| SPOT-4 | 1998～ | HRVIR-M | PAN | 10m（nadir） | 26days (3days ) | 60km |
| | | HRVIR-X | MS | 20m（nadir） | | 60km |
| | | VEGETA-TION | MS | 1km（nadir） | | 2250km |
| SPOT-5 | 2002.02 ～ | HRG | PAN | 2.5m/5m(nadir) | 26days | 60km |
| | | | MS | 10m（nadir） | | |
| | | HRS | PAN | 10m（nadir） | | 120km |
| | | VEGETA-TION | MS | 1km | | 2250km |
| ALOS | 2006.10 ～ | PRISM | PAN | 2.5m（nadir） | 46days | 35km |
| | | AVNIR-2 | MS | 10m（nadir） | 46days (2days ) | 70km |
| | | PALSAR | SAR | 10m/100m | | 70km/ 250km – 350km |

HRG：High Resolution Geometry

HRS：High Resolution Stereo

PRISM：Panchromatic Remote-sensing Instrument for Stereo Mapping

AVNIR-2：Advances Visible and Near Infrared Radiometer type 2

PALSAR：Phased Array type L-band Synthetic Aperture Radar

PAN：Panchromatic sensor

MS：Multi-spectral sensor

SAR：Synthetic aperture radar

- Data processing levels of major satellite image products

Generally, the satellite image products consisting of more than one product types are provided according to the correction level to be applied.

The following table summarizes products by correction processing level.

| Processing level | Description of processing |
|---|---|
| Level 0<br>(Uncorrected) | Raw-data products that have not undergone any data correction processing, with additional information required for correction. Intended for users with specialized knowledge and facilities for image processing. |
| Level 1<br>(Radiometric correction) | Products that have undergone minimum correction required due to the sensitivity characteristics of sensors. No correction of geometric distortions has been applied. Intended mainly for users who perform specialized image processing. |
| Level 2<br>(Geometric correction) | Products that have undergone radiometric correction and correction of geometric distortions such as errors in satellite orbital locations and attitudes and the Earth's rotation, curvature, etc. |
| Level 3<br>(Map projection) | Products that have undergone radiometric and geometric corrections and projection to map projection planes. The locations of images are identified using the satellite attitude and orbit information and sometimes using ground control points (GCPs). |
| Level 4<br>(Orthographic correction) | Products that have undergone a correction of distortions due to topographicy using the elevation data and transformation to orthographic projection. These products, having high location accuracy, can be overlaid on maps. They can be used also as image maps. |

The following table lists the products for each of the major satellites corresponding to the processing levels.

| | IKONOS | QuickBird-2 | OrbView-3 | SPOT-1/2/3/4/5 | ALOS |
|---|---|---|---|---|---|
| Level 0 | - | - | - | - | Level 1A |
| Level 1 | - | Basic Imagery | BASIC Express | Level 1A | Level 1B1 |
| Level 2 | - | - | BASIC Enhanced | Level 1B | Level 1B2R |
| Level 3 | Digital Geo Images | Standard Imagery | OrbView BASIC 1:50k OrbView BASIC 1:24k | Level 2A (GCP not used) / Level 2B (GCP used) | Level 1B2G Level 1B2D |
| Level 4 | Digital Ortho Light Images / Simple Digital Ortho Images | Orthorectified Imagery | - | Level 3 | - |

## 4. Operation Manual for Photographic Survey Using Satellite Images

### 1) Purpose and scope

This Manual, related to the base map survey to be implemented by JICA, describes the standard operation methods for phjotogrammetry using satellite images to be implemented based on Article 10 (Special Exceptions) of the Work Specification for National Base Mapping (February 2022), contributing thus to unifying specifications, standardizing results, and assuring required accuracy.

### 2) Organization of this Manual

This Manual specifies the standard operation methods, devices to be used, and other necessary items for base map survey through photogrammetry using satellite images.

In addition to articles and operation criteria, this Manual also provides explanations in order to facilitate understanding of photogrammetry using satellite images as a survey technique and promote and popularize the use of this technique. The overall organization of this Manual is as follows:

(1) Part 1 General

Part 1 specifies the purpose of this Manual, conditions for performing photogrammetry using satellite images, handling of data, etc.

(2) Part 2 photogrammetry Using Satellite Images

Part 2 specifies the work processes of operation, creation methods, etc. for photogrammetry using satellite images as well as their limit values (standard values).

(3) Part 3 Materials

Part 3 provides the standard forms for accuracy control for photogrammetry using satellite images as well as reference documents and major specifications of satellite images.

## Part 1 General

(Purpose)

Article 1 This Manual, related to the base map survey to be implemented overseas by the Japan International Cooperation Agency, describes the standard operation methods for photogrammetry using satellite images to be implemented based on Article 10 (Special Exceptions) of the Work Specification for National Base Mapping) (February 2022) and thus contributing to unifying specifications, standardizing results, and assuring required accuracy.

[Explanation]

The following shows Article 10 of the Work Specification for National Base Mapping.

(Special Exceptions)

Article 10 The instruments and the survey methods other than those specified in the Specification may only be used in parts of the works subject to the approval of JICA and provided that their use will not cause any problems to ensure the required accuracy and maintain the work efficiency.

2. The survey methods, references, items, processes, etc. specified in the Specifications may only change with the approval of JICA.

(Application of the Work Specifications of JICA for National Base Mapping)

Article 2 The Work specifications of JICA for National Base Mapping shall apply to items not specified in this Manual.

[Explanation]

This manual specifies only items pertinent to photogrammetry using satellite images. Items not specified in this Manual shall comply with the specifications in the Work Specifications for National Base Mapping (2022).

(Photogrammetry using satellite images)

Article 3 The Photogrammetry using satellite images refers to the creation of topographic maps through the photogrammetry using satellite stereo pair images in overseas base map survey. This process includes the acquisition of satellite images, control point survey, signalization for aerial photos and pricking, field verification, aerial triangulation and related operation planning, process control, and accuracy control.

(Devices, etc. to be used)

Article 4 The major equipment provided for the execution of the photogrammetry using satellite images shall include the following device or one with an equivalent or better performance:

(1) Digital stereoplotter

A digital stereoplotter refers to a system consisting of a computer program, computer, and peripherals and shall have functions to create and display stereo models from digital photos that allow stereoscopy, and obtain and record map information in digital format and a performance that ensures the prescribed accuracy.

<Article 4 Operation criteria>

1. The digital stereoplotters shall have the following configuration and functions:
   1) A digital stereoplotter shall consist of a computer, stereoscopic device, display, and 3D mouse or XY handle and Z device, etc.
   2) A digital stereoplotter shall be able to capture target satellite images and perform aerial triangulation.

(Operation plan)

Article 5 The organization that executes survey (hereinafter referred to as the "executing organization"), before starting the operation, shall make an appropriate operation plan on the operation method, major devices to be used, personnel, schedule, etc. and submit the plan to JICA for approval. The same procedure shall be necessary to make changes in the said operation plan.

(Process control)

Article 6　The executing organization must perform the adequate process control based on the operation plan specified in the previous article.

2.　The executing organization must report the progress status of operation to JICA as required.

(Accuracy control)

Article 7　The executing organization must perform the adequate accuracy control to ensure the accuracy of survey and create and submit an accuracy control record to JICA, based on the survey result.

2.　The executing organization must perform the required inspections at the end of each process of operation and at appropriate times.

(Formats of materials and results, etc.)

Article 8　The materials, results, etc. related to the photogrammetry using satellite images shall be created in standard forms.

# Part 2 Photogrammetry Using Satellite Images

## Chapter 1 General

### Section 1 Outline

(Outline)

Article 9 Photogrammetry using satellite images refers to the creation of topographic maps through photogrammetry using satellite stereo pair images in overseas base map survey. This process includes the acquisition of satellite images, control point survey, signalization for aerial photos and pricking, field verification, aerial triangulation and related operation planning, process control, and accuracy control.

(Work processes and their order)

Article 10 The standard work processes and their order shall be as follows. Either of these may be changed or partially omitted if instructed or approved by JICA.

(1) Operation plan
(2) Establishment of control points
(3) Setting of aerial photo signals and pricking
(4) Preparation of satellite images
(5) Field verification
(6) Aerial triangulation
(7) Digital plotting
(8) Digital data compilation
(9) Field completion and digital data compilation for field completion
(10) Structured compilation
(11) Data file creation

(Application of specifications for aerial photogrammetry)

Article 11 Items 1 through 3, 5, and 7 through 11 of the previous article shall comply with the specifications in the Work Specification for National Base Mapping.

## Chapter 2 Photogrammetry Using Satellite Images

### Section 1 Preparation of satellite images

(Acquisition plan for satellite images)

Article 12 The data acquisition plan shall be made in view of the following conditions:

(1) The base-altitude ratio shall conform to Article 108 of the Work Specification for National Base Mapping.

(2) The selection of satellite images shall conform to Article 109 of the Work Specification for National Base Mapping.

(3) The data shall be obtained under favorable weather conditions in a period when images with sharpness necessary and sufficient to interpret planimetric features and create digital terrain models can be obtained.

<Article 12 Operation criteria>

1. The satellite images taken in the past (archives) shall be used in view of influences of secular changes on measurement accuracy and required quality of resultant topographic maps and the use of such images shall be discussed with JICA.
2. The plan shall include alternative means to be used when photographing is not completed in the planned photographing period.

[Explanation]

1. The following table lists major satellite image products available for use in photogrammetry using satellite images.

| Name | Product name | Resolution | Remarks |
|---|---|---|---|
| IKONOS (Pan) | Geo Ortho Kit | 1.0m | RPC model data included |
| QuickBird-2 (Pan) | Basic Imagery | 0.61～0.72m | Orbit information data included<br>RPC model data included |
| OrbView-3 (Pan) | OrbView BASIC Enhanced | 1.0m | RPC model data included |
| SPOT-5 (HRG-P) | SPOT Scene Level 1A/1B/2A | 2.5m | Orbit information data included |
| SPOT-1/2/3 (HRV Pan) | SPOT Scene Level 1A/1B/2A | 10m | Orbit information data included |
| SPOT-4 (HRVIR Pan) | SPOT Scene Level 1A/1B/2A | 10m | Orbit information data included |
| ALOS※ (PRISM) | PRISM Level 1A/1B1/1B2 | 2.5m | Orbit information data included<br>RPC model data included |

※ This information is derived from materials disclosed as of October 2006 and therefore subject to change in the future.

２． The following table lists the relations between the satellite images and applicable map scales.

| Satellite data name | 1/100,000 | 1/50,000 | 1/25,000 | 1/10,000 | 1/5,000 | 1/2,500 |
|---|---|---|---|---|---|---|
| OrbView-3 | ○ | ○ | ○ | ○ | - | - |
| SPOT-1/2/3/4 | ○ | - | - | - | - | - |
| SPOT-5 | ○ | ○ | ○ | - | - | - |
| QuickBird-2 | ○ | ○ | ○ | ○ | △ | △ |
| IKONOS | ○ | ○ | ○ | ○ | △ | △ |
| ALOS | ○ | ○ | ○ | - | - | - |

Notes:

1. ○: Usable if there are GCPs　　△: Usable but subject to further conditions
2. The information about ALOS is based on the future accuracy attainment plan as of October 2006.

(Image acquisition and checking)

Article 13　A satellite image acquisition plan shall be supplied to the satellite operator and images shall be obtained.　The images shall undergo quality checking promptly after they are obtained.

<Article 13　Operation criteria>

The images shall be checked for the following items:

1) Conformity of resolutions
2) Conformity of image acquisition times
3) Conformity of image acquisition ranges
4) Conformity of image quality (color tones, brightnesses, clouds, noises, shadows, etc.)

[Explanation]

The cloud coverage, etc. of new images taken may not meet the requirements.　The quality inspection described in this chapter shall only check that the required products complies with the specifications and shall not check such non-conformities that cannot be easily eliminated under the contract conditions.

## Section 2 Aerial Triangulation

(Aerial triangulation)

Article 14 Aerial triangulation of satellite images refers to the measurement of the image coordinates of control points and tie points through the digital photogrammetric method and performing adjustment calculation on the image coordinates to obtain the exterior orientation parameters (sensor location and attitude) or the rational polynomial coefficient (RPC).

<Article 14 Operation criteria>

1. The satellite image orientation shall be performed through the methods of directly using satellite orbit information (sensor location, attitude, etc.), RPC models, or performing the 2D affine transformation without the satellite information.
2. The arrangement and number of control points and tie points used in aerial triangulation shall conform to Article 136 of the Work Specifications for National Base Mapping.
3. The tolerances of residual errors in control points and intersection residual errors of tie points in the same block shall conform to Article 141 of the Work Specifications for National Base Mapping.

[Explanation]

1. A Rational Polynomial Coefficient (RPC) model refers to a model using a rational polynomial that indicates transformation from ground coordinates to image coordinates and is also called a Rational Function (RF) model. RPC is an acronym for Rapid Positioning Capability or Rational Polynomial Coefficient which means a parameter obtained based on satellite orbit information or sensor model information.

2. If the satellite image orientation is performed using a sufficient number of control points, even a Parallel Projection model or Direct Linear Transformation (DLT) model can offer equivalent orientation accuracy to an RPC model.

## Part 3 Materials

### 1. Reference documents

The materials used to create this Manual are as follows.


- "Guidelines for Topographic Map Revision Using High Resolution Satellite Images (Draft)," March 2003, Geographical Survey Institute
- 「"Public Survey Operation Manual for Digital Ortho Creation," January 2004, Geographical Survey Institute, Geographical Survey Institute Technical Document A・1-No.289
- OrbVew-3 Commercial Satellite Imagery Product Catalog, http://www.geoeye.com/products/imagery/orbview3/default.htm
- IKONOS image price list, http://www.spaceimaging.co.jp/product/pro05.html
- QuickBird image price list, http://www.hgiis.com/order/order_jp.html
- SPOT image price list, http://www.spotimage.co.jp/html/_511_512_535_.php
- Web site of Remote Sensing Technology Center of Japan (RESTEC), http://www.restec.or.jp/top.html
- "Creation of Topographic Maps Using Satellite Images (Possibility of Creating Large-Scale Maps)," March 2005, International Development Institute of Japan, a New Technology Special Work Group Report
- "Satellite Image Mapping (Line Sensor Version)," March 2000, Association of Precise Survey and Applied Technology, APA No.75-9
- Test field for accuracy verification of aircraft-mounted sensors http://jsprs.iis.u-tokyo.ac.jp/testfield/
- 「"Evaluation of Accuracy of 3D Model from QuickBird Stereo Imagery," Geographical Survey Institute, Takahiro SHIMONO, Takayuki NAKAMURA Shoichi OGI, and Mayumi NOGUCHI
- "Verification of Revision and Realtime Revisionn of 1:25,000 Topographic Maps Using Advanced Land Observing Satellite (ALOS) Data (3rd Year)," Geographical Survey Institute, Takayuki NAKAMURA, Mayumi NOGUCHI, and Takahiro SHIMONO

## 2. Satellite Image Distributor Information

The following table lists the URLs of general sales agents for satellite images described in this Manual.

| Satellite name | General agent | URL |
|---|---|---|
| IKONOS | Japan Space Imaging Corporation | http://www.spaceimaging.co.jp/ |
| QuickBird-2 | Hitachi Software Engineering Co., Ltd. | http://hitachisoft.jp/index.html<br>http://www.hgiis.com/index_jp.html |
| OrbView-3 | NTT Data Corporation | http://www.nttdata.co.jp/<br>http://www.geocontents.jp/index.html |
| SPOT | Tokyo Spot Image Co., Ltd. | http://www.spotimage.co.jp/ |
| ALOS | Remote Sensing Technology Center of Japan (RESTEC) | http://www.restec.or.jp/ |

## 3. Specifications of satellite images

Tables 2 through 7 mention the major satellite image products. The prices in these tables are applicable as of October 2006. The latest prices must be checked with the distributors.

- IKONOS

Table 2 List of major products of IKONOS (overseas images)

| Product name | Type *1 | Resolution | Price *2 | Location accuracy | Minimum order area |
|---|---|---|---|---|---|
| Digital ortho images | Panchromatic | 1m | 6500 yen/ $km^2$ | Not applicable (around a few meters to 100 m) | New collection: 121 $km^2$ Archive: 121 $km^2$ |
| | Multispectral | 4m | | | |
| | Pan-sharpened | 1m | 8000 yen/ $km^2$ | | |
| Simple digital ortho images | Panchromatic | 1m | 12000 yen/ $km^2$ | Horizontal error: ±15 m (1σ) | |
| | Multispectral | 4m | | | |
| | Pan-sharpened | 1m | 15000 yen/ $km^2$ | | |

*1 The types are described as follows:

Panchromatic: Single-band monochrome (panchromatic) images

Multispectral: Three or four-band color (multispectral: blue, green, red, and near-infrared) images

For the three-band type, either blue, green, and red or green, red, and near-infrared should be selected.

Pan-sharpened: Three or four-band color images enhanced to high resolution through synthesis of panchromatic and multispectral images.

For the three-band type, either blue, green, and red or green, red, and near-infrared should be selected.

*2 For the new collection, an additional fee of 400,000 yen is required.

- QuickBird-2

Table 3 List of major products of QuickBird-2

| Product name | Type *1 | Resolution *2 | Price *3 | Location accuracy | Minimum order area |
|---|---|---|---|---|---|
| Basic Imagery | Panchromatic | 0.61m ～0.72m | 1,006,400 yen/scene | 14m (RMSE) | One scene (About 272 km2, nadir) |
| | Multispectral | 2.44m ～ 2.88m | 1,115,200 yen/scene | | |
| | Simultaneous purchase of panchromatic and multispectral images | | 1,332,800 yen/scene | | |
| Standard Imagery | Panchromatic | 0.6m or 0.7m | 3,700 yen/$km^2$ | 14m (RMSE) | New collection: 64 $km^2$ Archive:25 $km^2$ |
| | Multispectral | 2.4m or 2.8m | 3,700 yen/ $km^2$ | | |
| | Simultaneous purchase of panchromatic and multispectral images | | 4,600 yen/$km^2$ | | |
| | Pan-sharpened | 0.6m or 0,7m | | | |
| Orthorectified Imagery 1:25,000 | Panchromatic | 0.6m or 0,7m | 14.800 yen/ $km^2$ | 7.7m (RMSE) | 150 $km^2$ |
| | 3-band color | 2.4m or 2.8m | | | |
| | Multispectral | 2.4m or 2.8m | 16,300 yen/ $km^2$ | | |
| | Simultaneous purchase of panchromatic and multispectral images | | 19,200 yen/ $km^2$ | | |
| | Pan-sharpened | 0.6m or 0.7m | | | |

*1 The descriptions of the types are as follows:

Panchromatic: Single-band monochrome (panchromatic) images

Multispectral: Four-band color (multispectral: blue, green, red, and near-infrared) images

3-band color: Either blue, green, and red or green, red, and near-infrared should be selected.

Pan-sharpened: Four-band color images enhanced to high resolution through synthesis of panchromatic and multispectral images.

*2 For Basic Imagery, the resolution varies according to the photographing angle.

For Standard and Ortho-rectified Imagery, the resolution can be selected.

*3 For new collection, an additional fee may be required.

Standard: No extra charge; Priority: 50% of basic price

- OrbView-3

Table 4 List of major products of OrbView-3

| Product name*1 | Type | Resolution | Price (per km²) | Location accuracy CE/LE 90% | Minimum order area |
|---|---|---|---|---|---|
| OrbView BASIC Express | Panchromatic | 1m | $ 10 | ≤60m/60m | New collection: 192 km2 (3 contiguous scenes) |
| | Multispectral | 4m | | ≤65m/65m | |
| | Stereo (Panchromatic) | 1m | $ 34 | ≤60m/60m | |
| OrbView BASIC Enhanced | Panchromatic | 1m | $ 10 | ≤25m/44m | |
| | Multispectral | 4m | | ≤37m/51m | |
| | Stereo (Panchromatic) | 1m | $ 34 | ≤25m/44m | |
| OrbView BASIC 1:50k | Panchromatic | 1m | $ 17 | ≤25m/8m | |
| | Multispectral | 4m | | ≤30m/12m | |
| | Stereo (Panchromatic) | 1m | $ 43 | ≤25m/8m | |
| OrbView BASIC 1:24k | Panchromatic | 1m | $ 19 | ≤12m/5m | |
| | Multispectral | 4m | | ≤15m/10m | |
| | Stereo (Panchromatic) | 1m | $ 48 | ≤12m/5m | |

*1 The description of the types is as follows:

Express: The radiometric-corrected data including satellite remote measurement (orbit and attitude) data and rational functions

Enhanced: The satellite remote measurement data, rational functions, and corrected GPS data as well as meta-data necessary and sufficient for performing strict aerial triangulation

1:50k: Has equivalent accuracy to 1:50,000 topographic maps. Geometric-corrected and projected with tie points used as reference.

1:24k: Has equivalent accuracy to 1:24,000 topographic maps. Geometric-corrected and projected with GCPs used as reference.

- SPOT-1/2/3/4

Table5 List of major products of SPOT-1/2/3/4

| Product name | Type | Resolution | Price (tax included) | Location accuracy | Minimum order area |
|---|---|---|---|---|---|
| Level 1A<br>Level 1B<br>Level 2A | Panchromatic | 10m | 294,000 yen per scene, 420,000 yen per scene (new collection) | - | 1 scene (Approx. 60km x 60km) |
| Level 1A<br>Level 1B<br>Level 2A | Multispectral | 20m | 294,000 yen per scene, 420,000 yen per scene (new collection) | - | 1 scene (Approx. 60km x 60km) |

Note: Request-based observation in Japan has ended. Overseas programming requests (new collection) can be made under the following conditions:

Regular observation request: Free

Priority observation request: 577,500 yen

Rush delivery (shipped next day): 91,350 yen

Scene center position: Can be moved.

- SPOT-5

Table 6　List of major products of SPOT-5

| Product name | Type*1 | Resolving power | Price (tax included)*2 | Location accuracy | Minimum order area |
|---|---|---|---|---|---|
| Level 1A<br>Level 1B<br>Level 2A | Multispectral | 10m | 521,850 yen/scene<br>647,850 yen/scene (new collection) | - | 1/8 scene (Approx. 20km x 20km) |
| | Panchromatic | 5m | | | |
| | Pan-sharpened | 5m | 1,029,000 yen/scene<br>1,155,000 yen/scene (new collection) | | |
| | Panchromatic | 2.5m | | | |
| | Pan-sharpened | 2.5m | 1,550,850 yen/scene<br>1,676,850 yen/scene (new collection) | | |

*1　The descriptions of the types are as follows:

Panchromatic:　Single-band (panchromatic) images

Multispectral:　Four-band color (multispectral: green, red, near-infrared, and short wavelength infrared) images

Pan-sharpened:　Three-band color images enhanced to high resolution through synthesis of panchromatic and multispectral images.

*2　For new collection, an additional fee may be required.

Regular observation request:　Free

Priority observation request:　577,500 yen

Rush delivery (shipped next day):　91,350 yen

- ALOS

Table 7 List of major products of ALOS (PRISM and AVNIR-2)

| Product name*1 | | Type | Resolving power | Price*2 | Location accuracy | Minimum order area |
|---|---|---|---|---|---|---|
| Level 1A | | Panchromatic (PRISM) | 2.5m | Regular Price 25,000 yen/scene | - | One scene (nadir: about 35 km x 70 km, three-directional view: 35 km x 35 km) |
| Level 1B1 | | | | | | |
| Level 1B2 | G | | | | | |
| | R | | | | | |
| | D | | | | | |
| Level 1A | | Multispectral (AVNIR-2) | 10m | Specific-purpose Price 50,000 yen /scene | - | One scene (nadir: about 35 km x 35 km) |
| Level 1B1 | | | | | | |
| Level 1B2 | G | | | | | |
| | R | | | | | |
| | D | | | | | |

*1 The description of processing levels is as follows:

Level 1A: Not corrected (data extracted from observation data); includes the information required for correction.

Level 1B1: Radiometric-corrected

Level 1B2: Geometric-corrected. The correction options are as follows:

G: Projected on maps (Geo-coded)

R: Projected in orbit direction (Geo-reference)

D: Corrected for slanting errors using DEM with rough spacing

*2 Standard price: Charged if the purchaser (organization) uses the data for in-house use.

Specific-purpose price: Charged if the purchaser manufactures and sells irreversible, high-value added products made from standard processing data.

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