APPENDIX 5

OVERVIEW OF
THE ADVANCED OPTICAL SATELLITE
(ALOS-3) MISSION

1. Introduction

The Advanced Optical Satellite (ALOS-3) is the next high-resolution optical mission as a successor of the Advanced Land Observing Satellite (ALOS, "Daichi") in Japan Aerospace Exploration Agency (JAXA). ALOS-3 is now under developing in the Critical Design Review (CDR) phase, and to be launched in JFY 2020 as current plan. The major mission objectives of ALOS-3 are

(1) to contribute safe and secure social including provisions for natural disasters, and

(2) to create and update geo-spatial information.

The wide-swath and high-resolution optical imager (WISH, as a tentative name) is designed to be achieved the mission objectives and consists of the panchromatic band and multispectral bands by six channels.

2. Specifications of ALOS-3 and Instrument (WISH)

Figure 1 shows in-orbit artificial image of ALOS-3, and Table 1 summarizes the current specifications of the satellite. The satellite's orbit is kept as the sun-synchronous and sub-recurrent with 10:30 am of local sun time, but the repeat cycle is 35 days from 46 days of ALOS's one. This is enhanced observable frequency at middle and high latitude areas, however small pointing angle observations are necessary to cover the entire area in low latitudes.

Table 2 summarizes the current specifications of the WISH, which is considered to improve and enhance a fine resolution and global observation capabilities achieved by the Panchromatic Remote Sensing for Stereo Mapping (PRISM) and the Advanced Visible and Near Infrared Radiometer type-2 (AVNIR-2) onboard ALOS. For example, the ground sampling distance (GSD) is 0.8 m of WISH's panchromatic band compared with 2.5 m of PRISM, and 3.2 m for multi-spectral bands with 10 m of AVNIR-2, even the observation swath widths are same as 70 km at nadir, respectively.

For multi-spectral observation, two channels are added from AVNIR-2 i.e. Coastal and Red Edge that will contribute to bathymetry and environmental monitoring in coast regions, and to activation level monitoring in forests, vegetation and agricultural areas. The data quantization is also improved to 11 bits/pixel from 8 bits/pixel of PRISM and AVNIR-2. This improvement will contribute to obtain better image quality. On the other hand, this accrues a huge amount of mission data, therefore the Optical Data Relay Satellite (JDRS) that is also under developed, will be used to downlink them from space to ground.

Unfortunately, along-track stereo observation by multi-sensors like PRISM had not been selected, however the satellite has the body pointing capability within 60 deg. in cone-shape from nadir that will contribute in an emergency observation if a natural disaster happens for example. More detail about observation modes is introduced in Section 3.

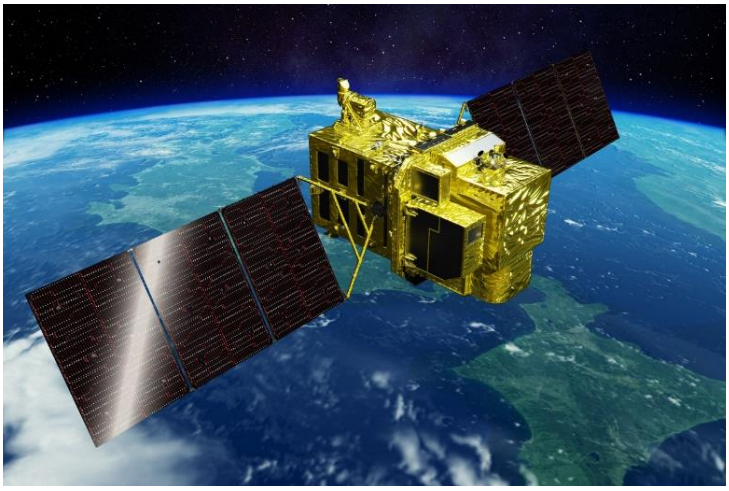


Fig. 1 ALOS-3 in-orbit image.

Table 1 ALOS-3 specifications (under designed).

Items		Specifications
Orbit	Type	Sun-synchronous sub-recurrent
	Altitude	669 km at the equator
	Local Sun Time	10:30 am +/- 15 minutes at the descending node
	Revisit	35 days (Sub-cycle 3 days)
Instruments		- Wide-swath and high-resolution optical imager (WISH, as a tentative) - Dual-frequencies Infrared sensor (hosted payload)
Ground Sampling Distance (GSD)		- Panchromatic band of WISH (Pa): 0.8 m - Multispectral band of WISH (Mu): 3.2 m (6 bands)
Swath width		70 km at nadir
Mass		Approx. 3 tons at launch
Size		5 m×16 m×3.5 m on orbit
Duty		10 mins / recurrent
Design life time		Over 7 years

Table 2 ALOS-3 WISH current specifications (under designed).

Items	Specifications
Panchromatic band (Pa)	
GSD, Swath width	0.8 m, 70 km at nadir
Wavelength	0.52-0.76 micrometers
MTF, SNR	0.1, 200
Quantization	11 bits / pixel
Multispectral band (Mu)	
GSD, Swath width	3.2 m, 70 km at nadir
Wavelength (micrometers)	Band 1: 0.40-0.45 (Coastal) Band 2: 0.45-0.50 (Blue) Band 3: 0.52-0.60 (Green) Band 4: 0.61-0.69 (Red) Band 5: 0.69-0.74 (RedEdge) Band 6: 0.76-0.89 (NIR)
MTF, SNR	0.2, 200
Quantization	11 bits / pixel
Mission data rate	Approx. 4 Gbps (after onboard data compression: 1/4 (Pa), 1/3(Mu))
Mission data downlink	- Direct Transmission: Ka and X-band - *via.* the Optical Data Relay Satellite
Pointing	< 60 degrees by body pointing

3. ALOS-3 Observation Modes

Based on the satellite agility within 60 deg. pointing capability, five observation modes are prepared to meet various user requirements. The details are as follows.

3.1. Stripmap observation mode

ALOS-3 can normally perform observation covering 70 km in width and 4,000 km in along-track direction as the stripmap observation mode. To increase the acquisition frequency, the images will be taken by less than 25 deg. pointing angle in cross-track direction (GSD < 1m) when the satellite track is in oceans. Fig. 2 (a) shows an example of the stripmap observation.

3.2. Point observation mode

If the user has a certain ground point or an area of interest (AOI), ALOS-3 can observe there using pointing capability within 60 deg. This mode will be used for natural disaster monitoring, for example. Fig. 2 (b) shows an example of the observable coverages by 60 deg. pointing in cross-track direction.

3.3. Observation direction changing mode

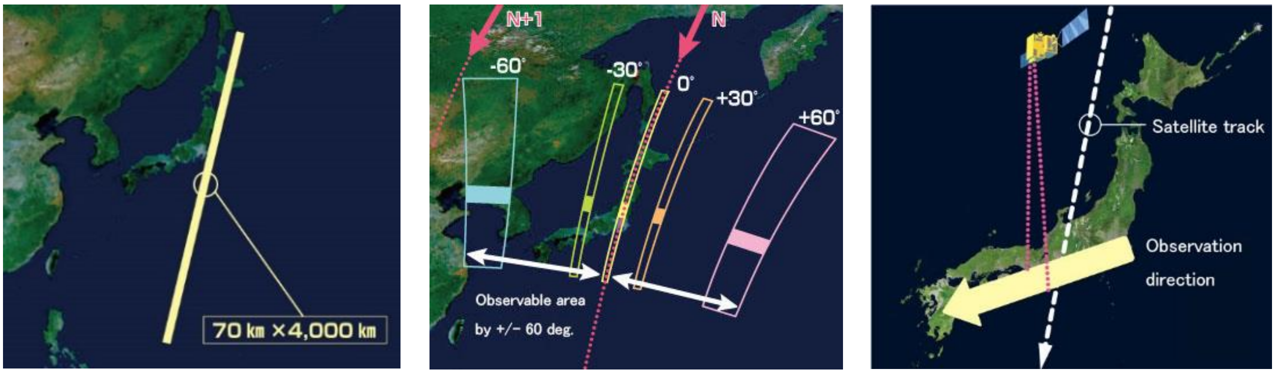
ALOS-3 can observe any given point by the pointing capability up to 60 deg. in all direction against the satellite nadir. This will be used when the large natural disaster happens. In the case of Japan, it can be activated within 24 hours after receiving the request. This will be used when the large natural disaster happens e.g. the expecting Nankai Trough large earthquake. Fig. 2 (c) shows an example of the observation direction changing mode to obtain information if the Nankai Trough large earthquake occurs.

3.4. Wide-area observation mode

This mode can cover in wide-ranging area of 200 km (in along-track direction) x 100 km (in cross-track direction) by satellite's single orbital passage. This will be also used when the large natural disaster happens.

3.5. Stereoscopic observation mode

To acquire stereo-pair images, two ways have been proposed: 1) in single orbital path, and 2) combining two stripmap observations by nadir view and backward view in neighboring path after three days that is sub-cycle revisit orbit. The way 1) will be however not sufficient base-to-height ratio (B/H) to derive terrain information. As the advantages of the way 2), that is possible to set suitable B/H, and can acquire images over large area. However, this will depend on weather conditions i.e. cloud covers, to success acquisition of the stereo images within short period as a disadvantage.



(a) Stripmap observation mode.

(b) Observable area coverages by point observation mode from some nadir path ("N" in this example).

(c) Observation direction changing mode.

Fig. 2 Example of ALOS-3 major observation modes.

4. Standard Product

Table 3 summarizes the definition of the standard product of ALOS-3. The image data will be provided in CEOS format or GeoTIFF format.

Table 3 The definition of ALOS-3 Standard product (under designed).

Level	Definition	Note
1A	Raw data	Frame subset and uncompressed data
1B1	Radiometric system corrected data from level 1A product	Separate to individual CCD unit. No map projection and resampling.
1B2	Radiometric and geometric system corrected data from level 1A product with Rational Polynomial Coefficient (RPC) file. Option R: Geo-referenced, G: Geo-coded	Scene-frame unit. Select: Map projection, Resampling, Pixel spacing
1C	Simple ortho-rectified image using existing Digital Elevation/Surface Model (DEM/DSM). Option R: Geo-referenced, G: Geo-coded	Scene-frame unit. Select: Map projection, Resampling, Pixel spacing