Overview of the Advanced Land Observing Satellite-4 (ALOS-4) mission

*Takeshi Motohka[1], Yukihiro Kankaku[1], Satoko Miura[1], Shinichi Suzuki[1]

1. Japan Aerospace Exploration Agency

We introduce the overview and current status of Advanced Land Observing Satellite-4 (ALOS-4) under development by Japan Aerospace Exploration Agency (JAXA). ALOS-4 is an earth observation satellite equipped with an L-band synthetic aperture radar (SAR) which Japan has developed for three generations of satellites, JERS-1, ALOS and ALOS-2. The mission objectives of ALOS-4 are as follows,
(1) Highly accurate monitoring of ground deformation and subsidence for not only a posterior damage assessment but also detecting anomalies at an early stage. Observation frequency throughout Japan should be increased from about 4 times/year by ALOS-2 to more than 20 times/year by developing technologies for wide-area and high-resolution observation.
(2) Continuation and enhancement of the ALOS-2 mission such as all-weather disaster monitoring, forest monitoring, sea ice monitoring, and ship and ocean monitoring, and also exploring new applications such as monitoring of large infrastructures.
To achieve these objectives, new technologies are adopted for ALOS-4 that greatly improve its functions and performances compared to ALOS-2. Table 1 shows the comparison of the main specifications of ALOS-4 and ALOS-2. The L-band SAR system (PALSAR-3) increases the observation swath width while keeping the resolution and image quality of ALOS-2 by receiving several beams simultaneously using Digital Beam Forming (DBF). PALSAR-3 has three types of observation modes: Spotlight mode, Stripmap mode (3/6/10 m resolutions), ScanSAR mode, and the performance of the major observation modes often used in ALOS-2 are as shown in Table 2. To remove ionospheric disturbances in Interferometric SAR (InSAR) analysis, a new mode for observing two separated frequency bands in the L-band 84 MHz is provided. Besides the SAR system, there are many new developments for the satellite systems such as high-speed data downlink, large capacity of data recorder, improvement of orbit determination accuracy, and extended design life. The same orbit and observation geometry as ALOS-2 are selected to provide the InSAR capability between ALOS-2 and ALOS-4 data and the high continuity of user’ s applications developed for ALOS-2, and long-term analysis capability over 10 years. As of February 2018, ALOS-4 is in the detailed design phase, and launch of the satellite is planned in JFY2020.

Keywords: Synthetic Aperture Radar (SAR), Satellite, Remote Sensing, ALOS

Table 1 Main specifications of ALOS-4 and ALOS-2

		ALOS-4	ALOS-2
Designed life time		7 years	5 years
Sensor system		PALSAR-3, SPAISE3	PALSAR-2, SPAISE2, others
Size (X, Y, Z)		10.0 m x 20.0m x 6.4 m	9.9 m x 16.5 m x 3.7 m
Mass		~2,990 kg	approx. 2,100 kg
Electricity	Solar array	7,200 W~ (7 years EOL)	approx. 5,300 W (5 years EOL)
	Battery	380 AH	200 AH
Mission data downlink		3.6 Gbps / 1.8 Gbps	~800 Mbps
Data recorder		approx. 1 TByte	approx. 128 GByte
Orbit	Type	Sun-synchronous sub-recurrent	Same as left
	Altitude	628 km (above the equator)	
	LSDN	12:00	
	Revisit cycle	14 days	
	Inclination	97.9 deg.	

Table 2 Specifications of PALSAR-3 major observation modes (Stripmap 3 m/10 m and ScanSAR)

Modes	Stripmap 3 m		Stripmap 10 m		ScanSAR
Center Frequency	1257.5 MHz		1236.5 / 1257.5 / 1278.5 MHz		
Bandwidth	84 MHz		28 MHz / 28+10 MHz		28 MHz
Resolution	3 m x 3 m		10 m x 10 m		25 m x 25 m
Swath	200 km	100 km	200 km	100 km	700 km
Polarization (H/V linear)	1, 2	1, 2, 4	1, 2	1, 2, 4	1, 2
Available incidence angle range	30-56 deg.	8-70 deg	28-56 deg.	8-70 deg.	8-70 deg.
NESZ	< -20 dB *1		< -28 dB *2		< -20 dB *3
Range S/A	> 15 dB *1		> 20 dB *2		> 15 dB *3
Azimuth S/A	> 15 dB *1		> 20 dB *2		> 15 dB *3

*1: incidence angle 30-44 deg.
*2: incidence angle 28-42 deg.
*3: incidence angle 19-60 deg.

