Current Status of the ALOS-2 Operation and PALSAR-2 Calibration Activities

Takeshi Motohka, Ryo Natsuaki, Yukihiro Kankaku, Shinichi Suzuki, Masanobu Shimada (JAXA)

Osamu Isoguchi (RESTEC)

ALOS-2: Advanced Land Observing Satellite-2
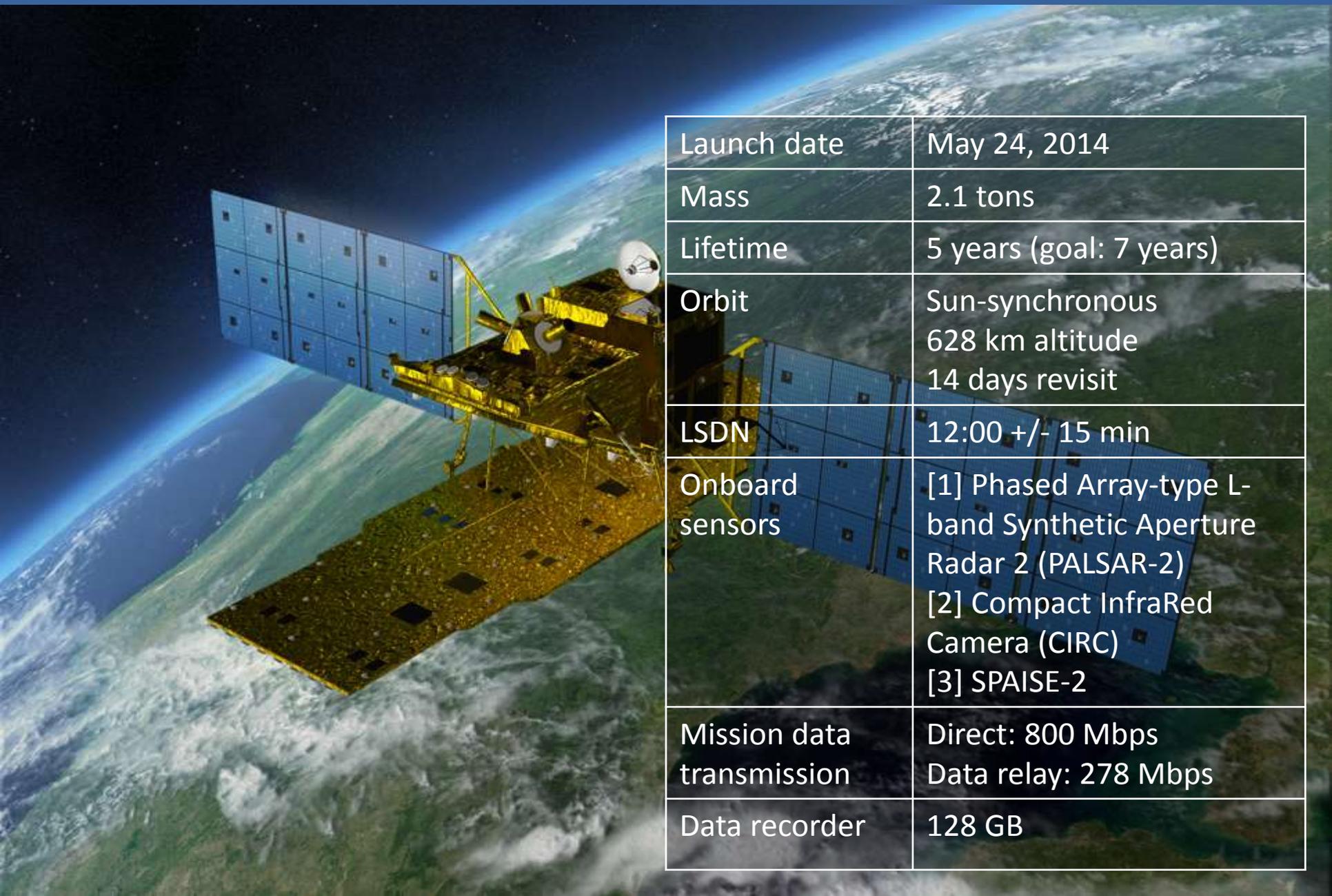
Launch date	May 24, 2014
Mass	2.1 tons
Lifetime	5 years (goal: 7 years)
Orbit	Sun-synchronous 628 km altitude 14 days revisit
LSDN	12:00 +/- 15 min
Onboard sensors	[1] Phased Array-type L-band Synthetic Aperture Radar 2 (PALSAR-2) [2] Compact InfraRed Camera (CIRC) [3] SPAISE-2
Mission data transmission	Direct: 800 Mbps Data relay: 278 Mbps
Data recorder	128 GB

ALOS-2: Advanced Land Observing Satellite-2

Mission Objectives

Disaster monitoring

Earthquake
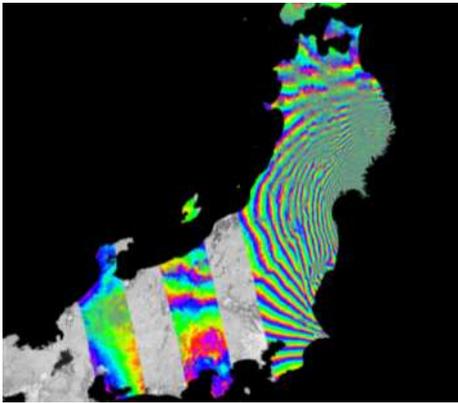
Volcano
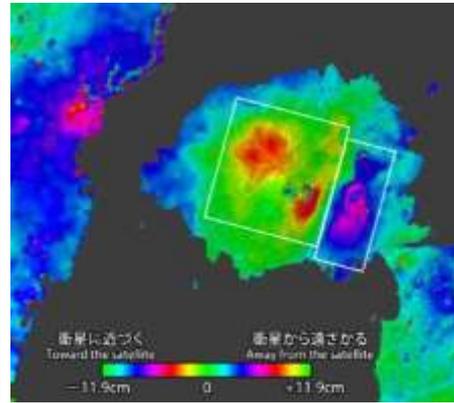
Flooding
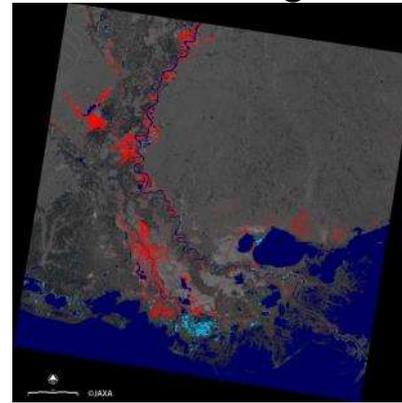
Ocean
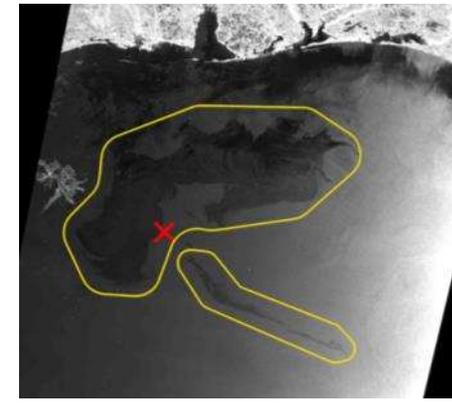
Environment and land management

Forest and wetland
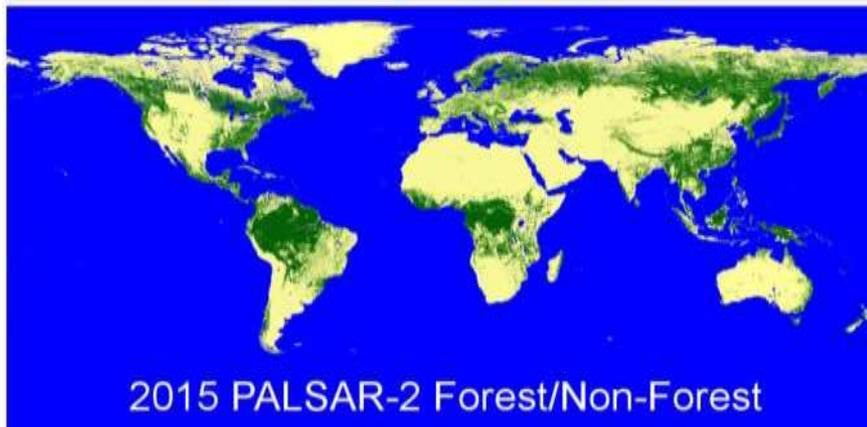
Ice
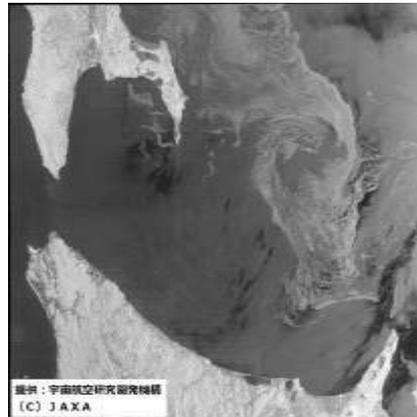
Agriculture & natural resources

2015 PALSAR-2 Forest/Non-Forest
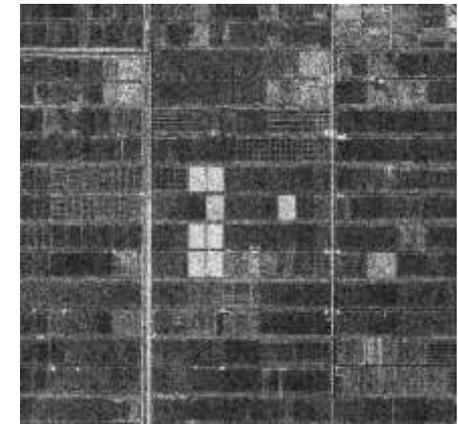
History of Japanese L-band SAR Satellites

	JERS-1 SAR 1992～1998	ALOS PALSAR 2006～2011	ALOS-2 PALSAR-2 2014～
Transmit power:	~1.5 kW	~2 kW	**~6.1 kW**
Resolution:	18 m	10 m / 100 m	**3 m** / 100 m
Swath width:	75 km	70 km / 350 km	50 km / **490 km**
Polarization:	Single	Single, Dual, Quad	Single, Dual, Quad
Obs. direction:	Right	Right	**Right or Left**
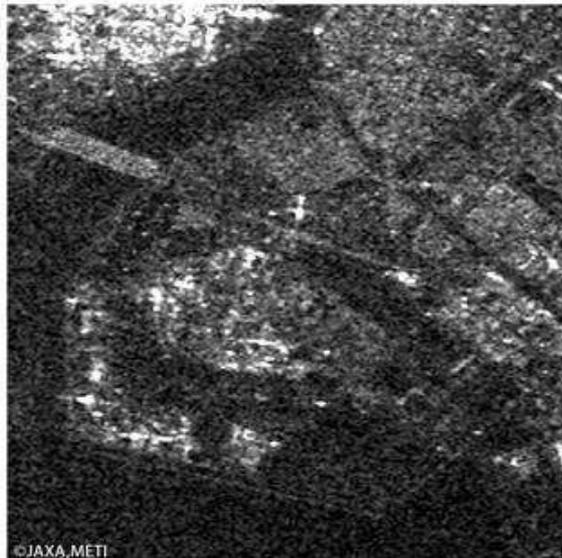
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Current status of ALOS-2
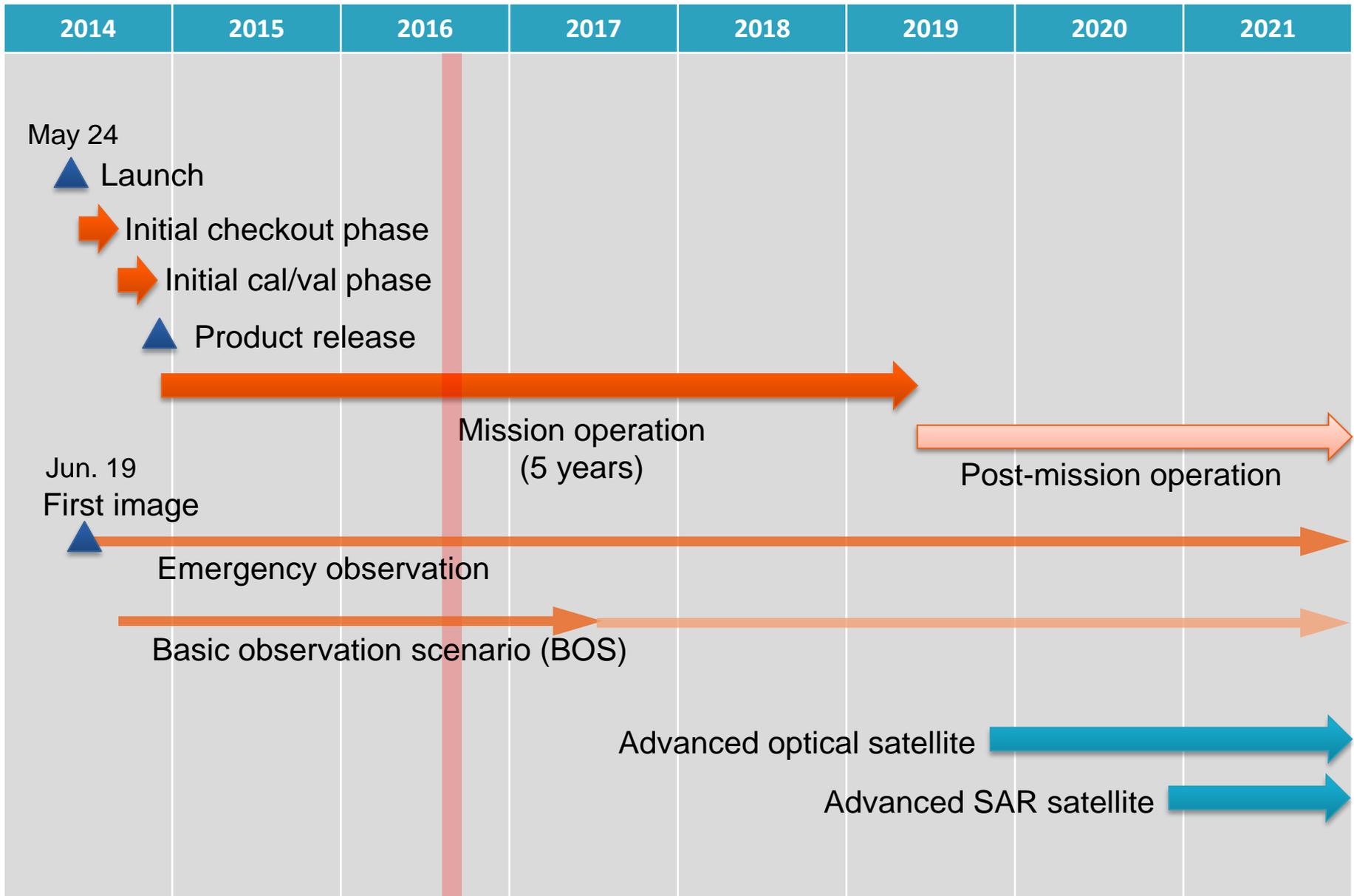
Status of the ALOS-2 systems

- The ALOS-2 bus and sensor systems are correctly running over 2 years after the launch.
- Monitoring and prediction values of power generation by solar array paddles are in good agreement.
- A large amount of propellant is remained.

✓ **Power generation of solar array paddles**
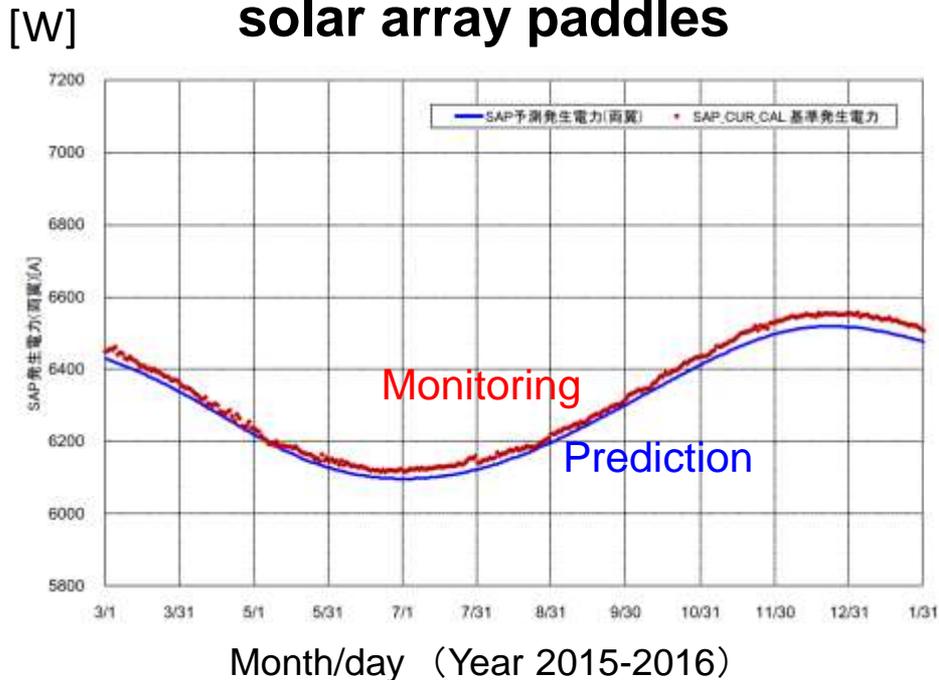
✓ **Amount of remaining propellant**

[W]

[kg]

Monitoring

Prediction

Month/day （Year 2015-2016）

May. 1, 2014   May. 1, 2015   May. 1, 2016
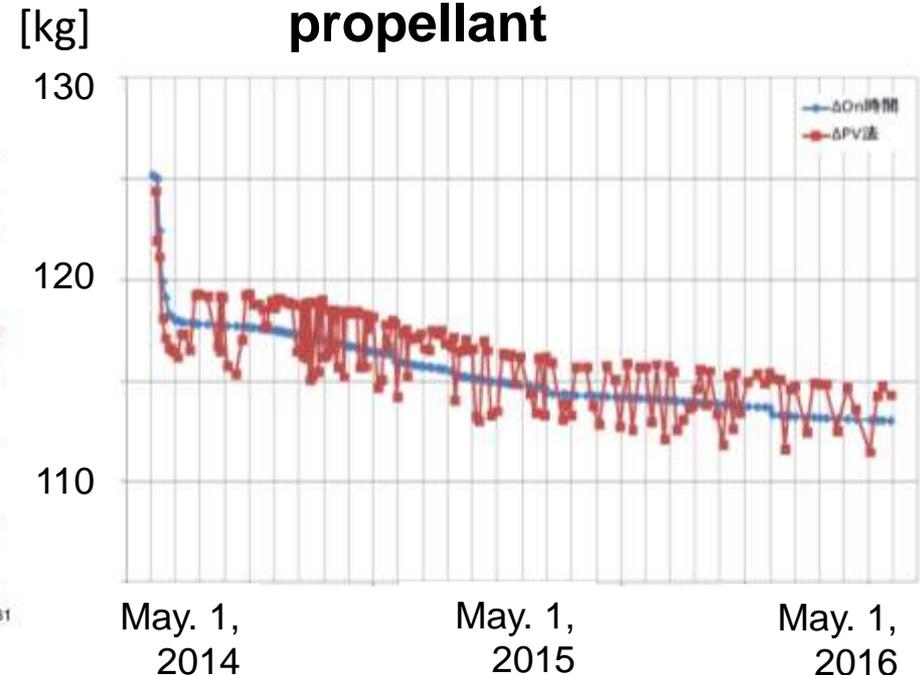
Status of the ALOS-2 systems

✓ Orbit determination accuracy (relative) keeps below 10 cm

✓ Performance of automonous orbit control

500-m radius tube

Reference orbit
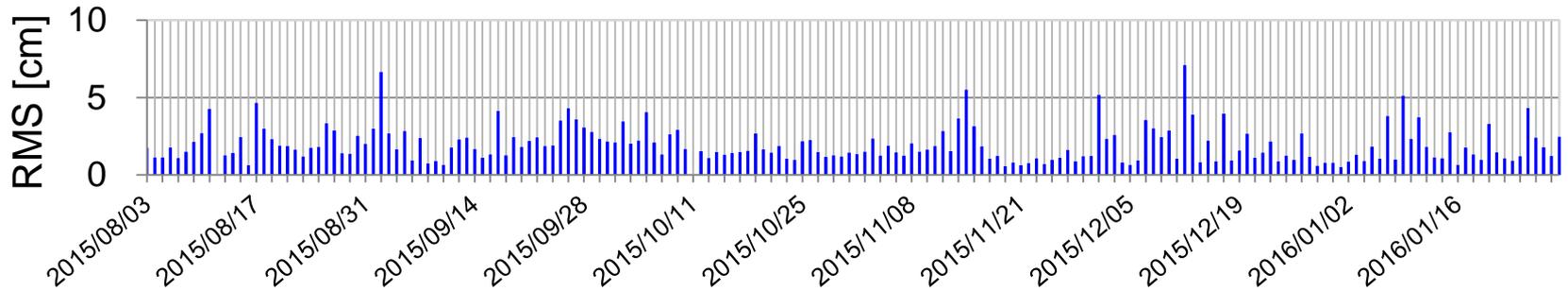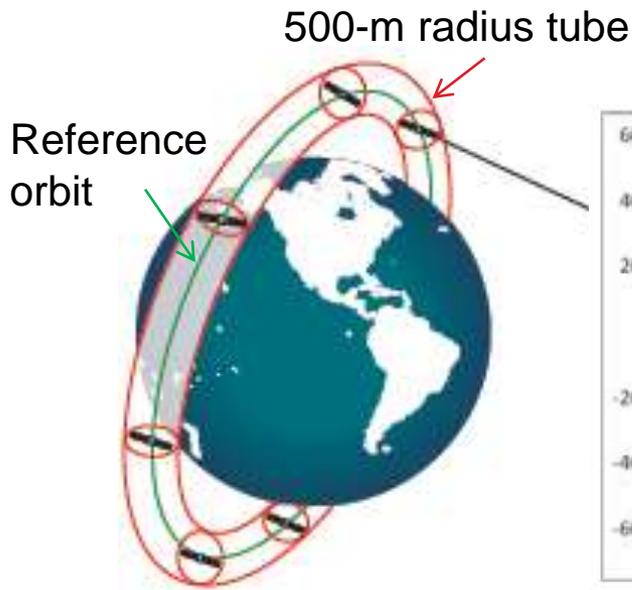
Satellite position
May, 1 to 31, 2016
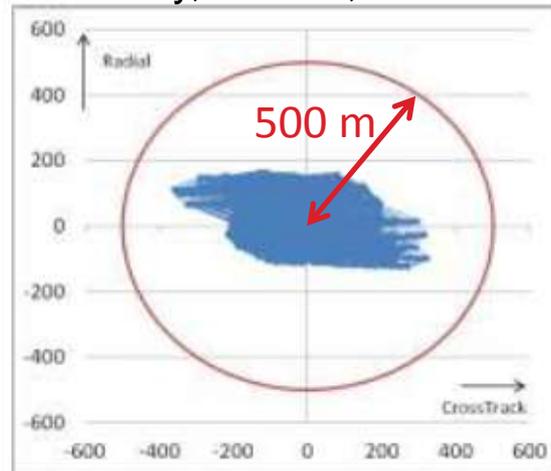
500 m

Year	Percentage within 500 m radius*
2014 (Oct. 1~)	100 %
2015	100 %
2016 (~May 31)	100 %

* Except for debries avoidance maneuvers

Status of PALSAR-2

- The condition of PALSAR-2 is checked by the internal calibration mode.

  ✓ The functions of transmit and receive sub-systems such as phase-shifters and attenuaters are checked every about 3 months.

  ✓ The transmit pulse replica, transmit power, noise level of raw signals, calibration of A/D and range offsets, and so on, are checked before and after observations.

- Currently, there are no anomalies and PALSAR-2 keeps stable performance after the launch.

Pulse replica (Feb. 9, 2016)

Thermal condition of a TRM
(Mar. 1-May 1, 2016)
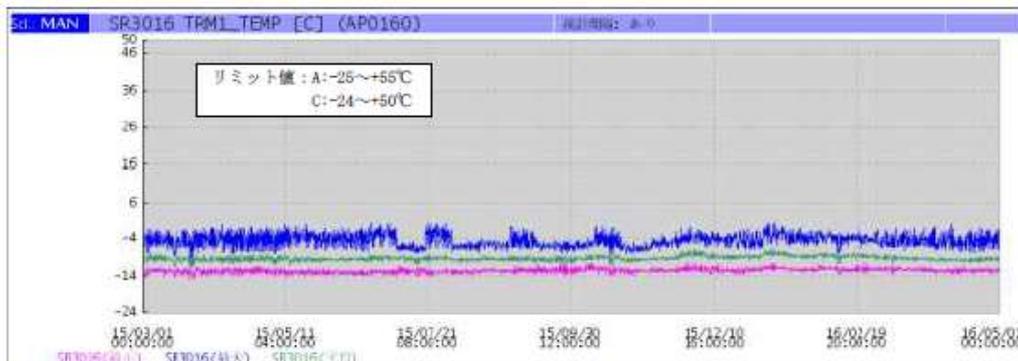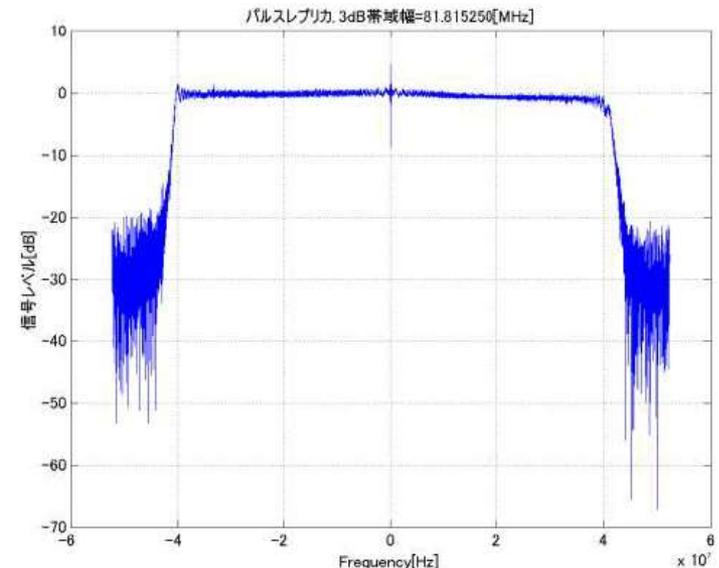
Status of PALSAR-2 standard products

- Evaluation of the PALSAR-2 standard products is regularly performed by using the images over the calibration sites (mainly Japan and Brazil) and Amazonian forests.

- The standard deviation of radiometric calibration factor is less than the system requirement (1 dB) but we are now try to reduce the value by checking and modifying the product generation algorithms.

3m CR

average = -81.924 dB
standard deviation = 0.909 dB

Legend:
- SBS000
- UBS291
- UBS324
- UBS354
- UBS382
- UBS406
- UBS427
- UBS447
- UBS464
- UBS480
- HBQ250
- HBQ280
- HBQ304
- HBQ327
- HBQ349
- FBD282

X-axis: Number of data
Y-axis: Calibration Factor [dB]

Basic Observation Scenario (ALOS-2 BOS)

- The PALSAR-2 observations are performed according to the BOS. The BOS has two separate plans for Japan and the rest of the world.

- Success rate of the BOS is 70-90 %. Missing observations are mainly due to insufficient downlink resources, conflict of observation requests, and internal calibration or orbit tuning operations.

- Downlink data volume of PALSAR-2 is approx. 14 TB/month.

- We are now considering the revision of the BOS from 4th year to improve the success rate.

Global BOS (3rd year)

1 year = 26 cycles

■3st Year

Cycle	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Year						2016年													2017年							
Month/Day	08/01	08/15	08/29	09/12	09/26	10/10	10/24	11/07	11/21	12/05	12/19	01/02	01/16	01/30	02/13	02/27	03/13	03/27	04/10	04/24	05/08	05/22	06/05	06/19	07/03	07/17
Descending (site)	Glacier Super Site	Glacier Super Site	D+W+F	Glacier Super Site	sub-Arctic Super Site	Crustal Wetland Deforest	Global 3m (3/3)		Crustal Wetland Deforest	Global 3m (3/3)		Crustal Wetland Deforest		sub-Arctic Super Site	Crustal Wetland Deforest	Crustal&Forest		Crustal Wetland Deforest	Crustal&Forest		Crustal Wetland Deforest	Crustal&Forest		Crustal Wetland Deforest	sub-Arctic Super Site	Crustal Wetland Deforest
Descending (obs)			W2(2)R		V2(2)R	W2(2)R	U2(6)R	U2(7)R	W2(2)R	U2(8)R	U2(9)R	W2(2)R		V2(2)R	W2(2)R	F2(5)R	F2(6)R	W2(2)R	F2(7)R	F2(5)R	W2(2)R	F2(6)R	F2(7)R	W2(2)R	V2(2)R	W2(2)R
Descending (obs2)	F2(6)L	F2(6)L		F2(6)L																						
Ascending (site)	North Pole Crustal	Pole	World 1-1(10m)				World 2-1(10m)				Pole	South Pole	World 1-2(10m)			GR Super Site	GR Super Site	Global FP6m (3/5)						World 2-2(10m)		
Ascending (obs)	W2(2)R	W2(2)R	F2(7)R	F2(5)R	F2(6)R		F2(7)R	F2(5)R	F2(6)R		W2(2)R	W2(2)L	F2(7)R	F2(5)R	F2(6)R	FP(6)R	FP(5)R	FP(4)R	FP(3)R	FP(7)R				F2(7)R	F2(5)R	F2(6)R
Ascending (obs2)		W2(2)L									W2(2)L					F2(6)R	F2(6)R									

Data acquisition status

Coverage of PALSAR-2 observations during Aug. 2014 to May. 2016

Global 10 m resolution, HH/HV pol.

Beam F2, Ascending, Right
(Global land observation)

Beam F2, Descending, Right
(Deformation, Forest, Ice)

図 8-1　F2-5〜F2-7/右観測/昇交軌道/HH+HV 『グローバル観測』

図 8-2　F2-5〜F2-7/左右観測/降交軌道/HH

Coverage of PALSAR-2 observations during Aug. 2014 to May. 2016

Global ScanSAR (350km-swath/100m-res.), HH/HV pol.

Beam W2, Ascending, Right
(Polar regions)

Beam W2, Descending, Right
(Deformation, Forest, Ice)
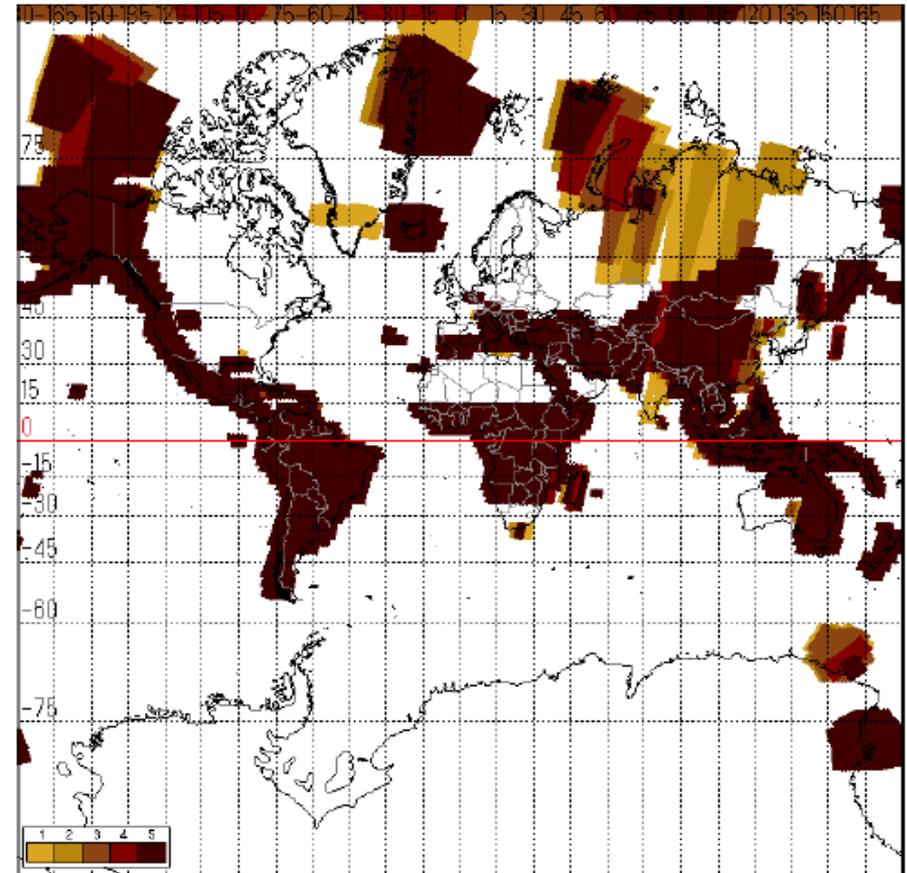
Data acquisition status

Coverage of PALSAR-2 observations during Aug. 2014 to May. 2016

6m resolution with full-polarimetry

Beam FP6, Ascending, Right
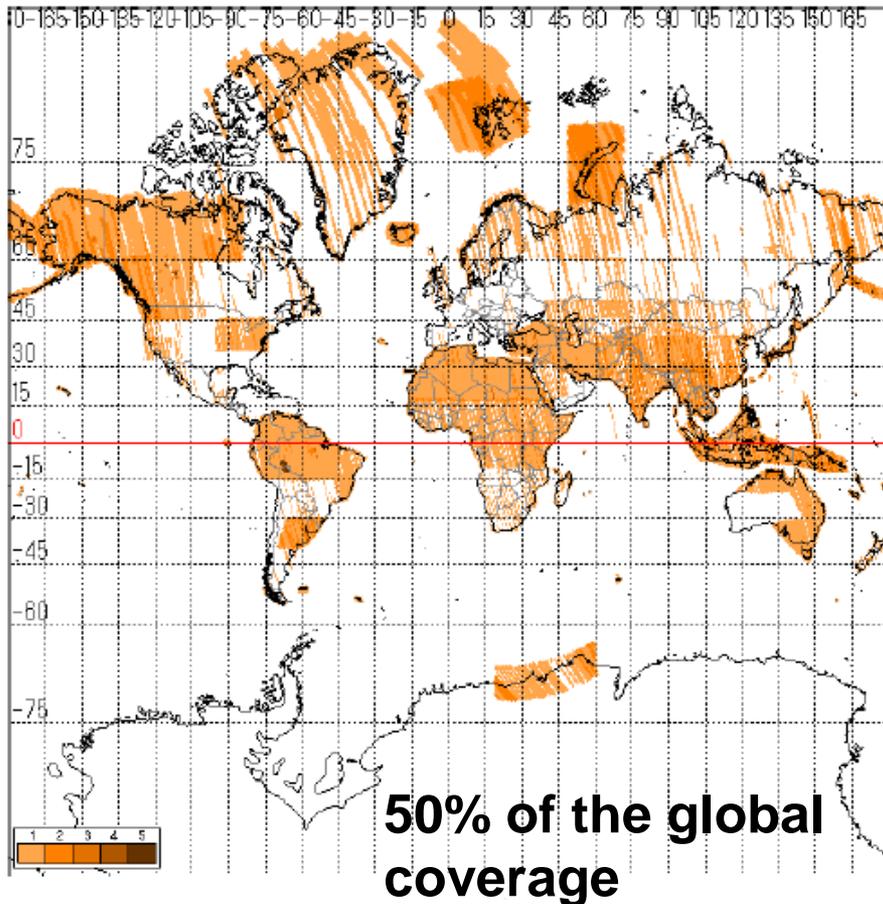
3m resolution with HH-pol.

Beam U2, Descending, Right

50% of the global coverage

55% of the global coverage
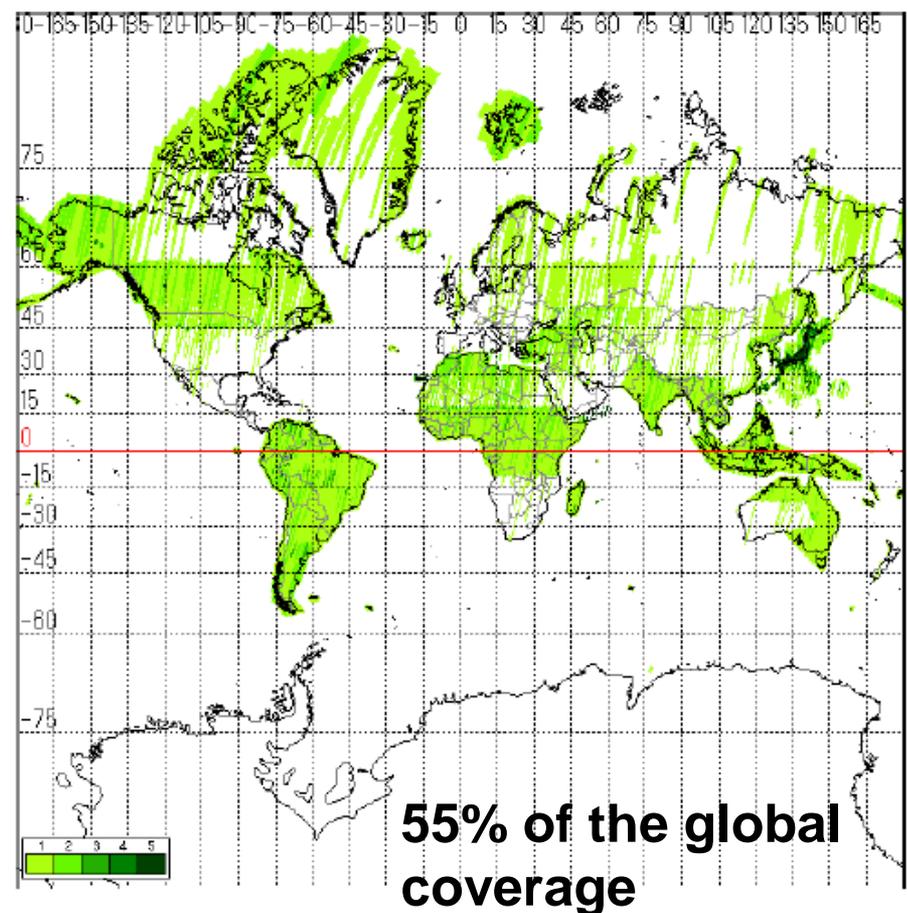
Data acquisition status

Coverage of PALSAR-2 observations during Aug. 2014 to May. 2016

Japan disaster basemap observations with 3 m res. HH-pol.

Beam U2, Ascending, Right | Beam U2, Descending, Right | Beam U3, Descending, Right
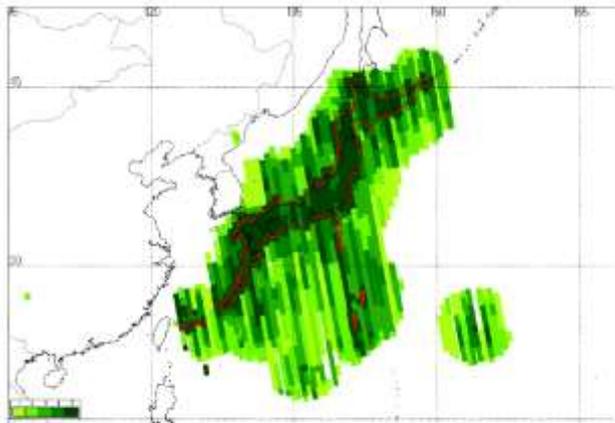
図 7-3-1 観測回数マップ（アセンディング U2(6-9)R）
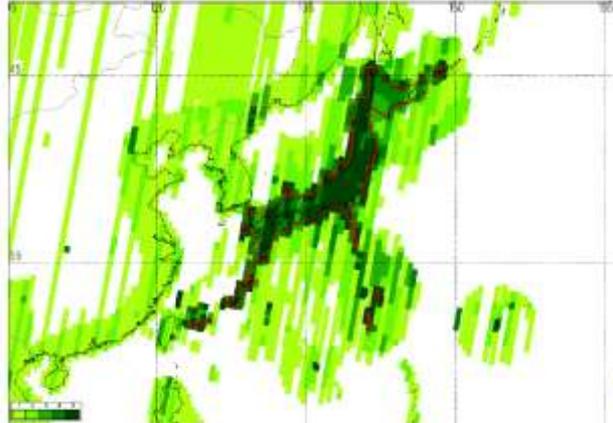
図 7-3-2 観測回数マップ（ディセンディング U2(6-9)R）
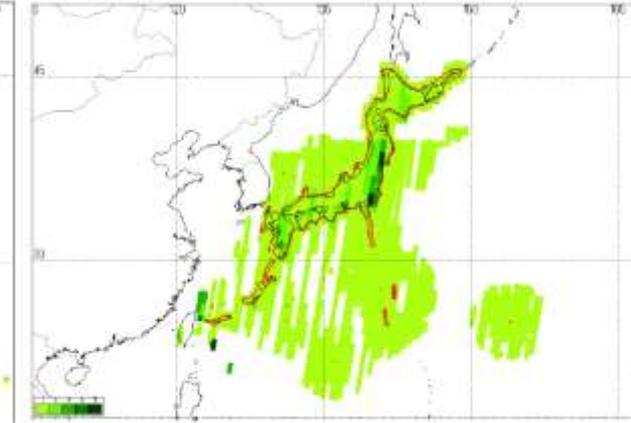
図 7-8 観測回数マップ（ディセンディング U3(10-14)R）

Beam U2, Ascending, Left | Beam U2, Descending, Left | Beam U3, Descending, Left
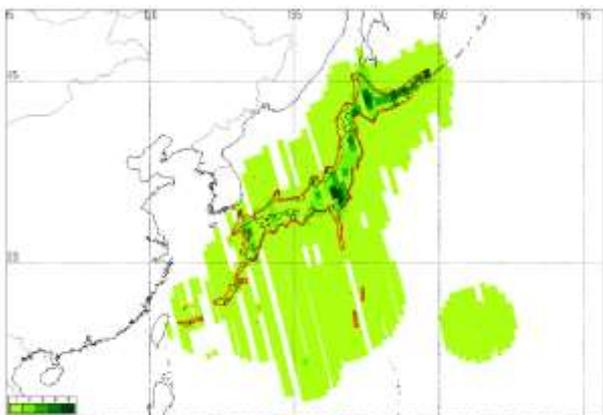
図 7-4-1 観測回数マップ（アセンディング U2(6-9)L）
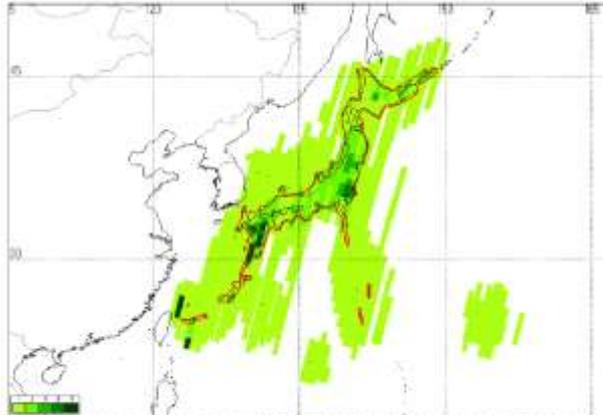
図 7-4-2 観測回数マップ（ディセンディング U2(6-9)L）
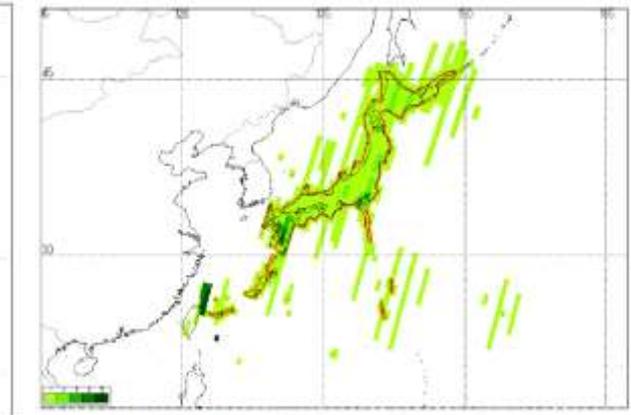
図 7-9 観測回数マップ（ディセンディング U3(10-14)L）

Emergency observations

- 254 emergency observations were performed from the launch of ALOS-2 to Aug. 4, 2016.

	Earthquake	Volcano	Flood, Heavy-rain, Landslide	Others[*]	Total
Japan	23	69	46	1	139
World	26	3	75	11	115
Total	49	72	121	12	254

* Oil spill, Forest fire, Glacier lake, etc.

- Obtained data and analysis results were provided to disaster management organizations, International Disaster Charter, Sentinel Asia, etc.

Example of emergency observations

- On August 24 and 31, 2016, an emergency observation with PALSAR-2 was performed in response to the magnitude-6.2 earthquake in central Italy on August 24, 2016 at 1:36 (UTC).

Interferogram acquired before (September 9, 2015; UTC) and after (August 24, 2016; UTC) the earthquake.
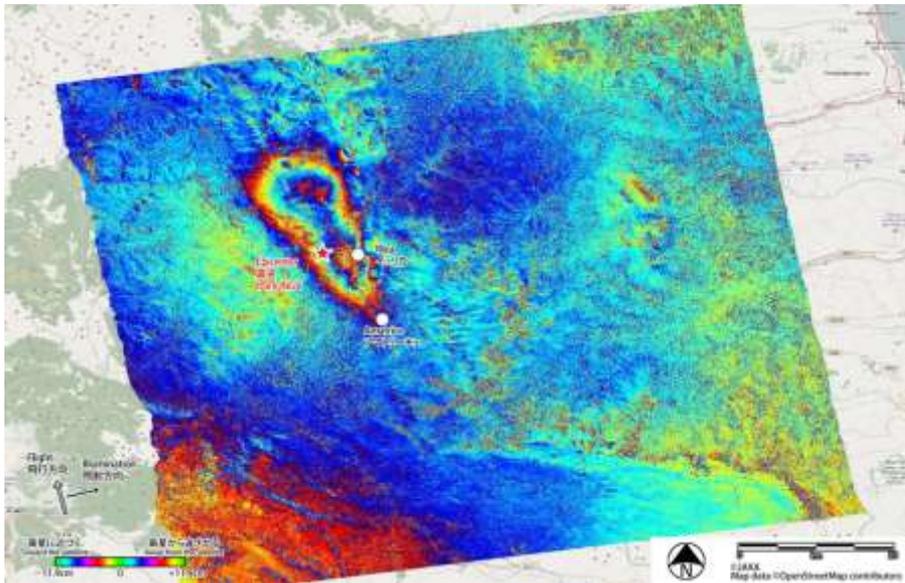
Damage proxy map of Amatrice generated by the interferometric coherence change analysis.
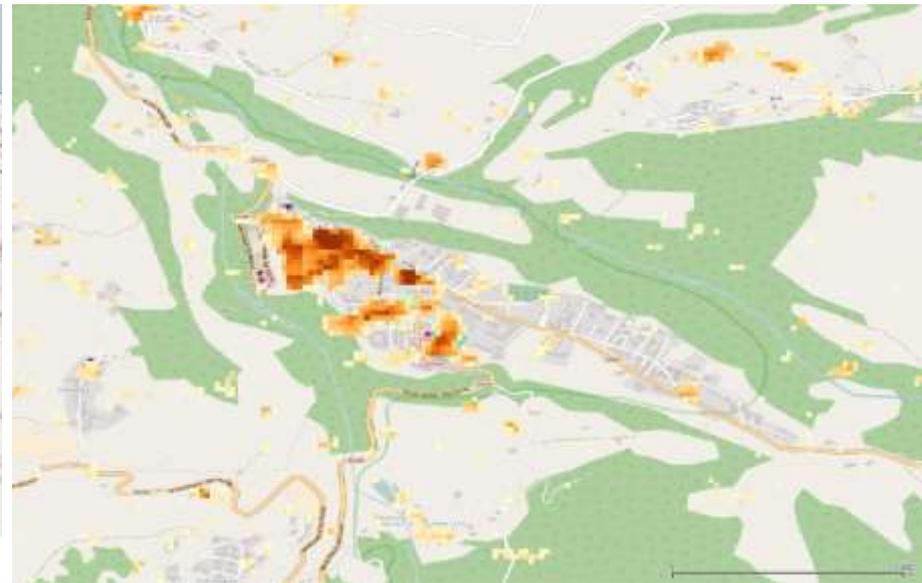
Summary

- The ALOS-2 and PALSAR-2 keep good performance over 2 years after the launch.

- The PALSAR-2 standard products are regularly evaluated. The performance is almost not changed from the initial calibration phase in 2014.

- A lot of data have been obtained according to the BOS and emergency observation requests for disaster monitoring.