ALOS-2/PALSAR-2 Calibration and Validation Results

Ver. 2018.08.07

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1. Update of the calibration factor (CF)
2. Evaluation results for PALSAR-2 standard products after the software update

Version history of PALSAR-2 product processing software

Version	Release date	Changes
002.023	28-Mar-17 7:00 (UT)	• Updated range antenna patterns. • Updated radiometric calibration parameters. • Updated polarimetric calibration parameters.
002.024	5-Jun-18 7:00 (UT)	• Updated radiometric calibration parameters for Stripmap 6-m full polarimetry mode (beam number 3 and 7). • Fixed the radiometric calibration parameter for ScanSAR mode (28 MHz band width). • Improved inter-scan amplitude correction of ScanSAR mode.

1. Update of calibration factors in version 002.024

- Calibration factors for Stripmap 6-m full-polarimetry and ScanSAR 28 MHz mode were updated.

  - **Stripmap 6-m full-polarimetry**
    - ✓ Calibration factors for beams **FP6-3** and **FP6-7** were lowered by 1 dB based on the accumulated evaluation result.

  - **ScanSAR 28 MHz mode**
    - ✓ It was found that calibration factors were 3 dB higher due to software error. The error was fixed from this version.
    - ✓ ScanSAR 28 MHz is mainly used for observations over Japan. The other global regions are observed by using ScanSAR 14 MHz, and it is not affected by this issue.

PALSAR-2 radiometric calibration

For L1.5 and L2.1

$$\sigma^0 = 10\ \log\langle DN^2 \rangle + CF$$

For L1.1

$$\sigma^0 = 10\ \log\langle I^2 + Q^2 \rangle + CF - A$$

σ^0:	Backscattering coefficient (Sigma zero) [dB]
DN:	Digital number (= raw pixel value)
CF and A:	Calibration factor [dB]

Detailed information on calibration factors determined by JAXA CalVal observations
ver. Jun. 5, 2018

Current version

Product ordering time for AUIG-2			Sep. 11, 2014 ~ Sep. 28, 2016, 7:00 UT	Sep. 28, 2016, 7:00 UT ~ Mar. 28, 2017, 7:00 UT	Mar. 28, 2017, 7:00 UT ~ Jun. 5, 2018, 7:00 UT	Jun. 5, 2018, 7:00 UT ~
Version of the processing software			000.001 ~ 002.021	002.022	002.023	002.024
CF [dB]	Spotlight	all	**-81.1**		**-83.0**	**-83.0**
	Stripmap [3 m]	U2-6	**-81.6**			
		U2-7	**-81.2**			
		U2-8	**-81.6**			
		U2-9	**-81.7**			
	Stripmap [6 m]	FP6-3	**-81.0**		**-84.0**	
		FP6-4	**-81.7**		**-83.0**	
		FP6-5	**-82.8**			
		FP6-6	**-82.5**			
		FP6-7	**-80.8**		**-84.0**	
	Stripmap [10 m]	F2-5	**-82.4**		**-83.0**	
		F2-6	**-82.4**			
		F2-7	**-81.9**			
	ScanSAR [14 MHz]	W2	**-79.0**	**-83.0**	**-83.0**	
	ScanSAR [28 MHz]	W2	**-82.0**	**-86.0**	**-86.0**	
	the other		**-83.0**	**-83.0**	**-83.0**	
A [dB]	all		**32.0**			

2. Evaluation results for PALSAR-2 standard products after the software update

- Version of the PALSAR-2 product processing software: 002.024* (Products ordered after Jun. 5, 2018, 7:00 UT via AUIG-2)
- **No anomaly is detected and good accuracy is maintained.**

* Version of the processing software can be found in the field No. 12 of file descriptor record (CEOS format).

Summary of evaluation results of ALOS-2 PALSAR-2 standard products [1/3]

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Items		Observation modes	Results	Number of data	Requirements
Geometric accuracy [m]		Stripmap and Spotlight	6.38 m (L1.1) 6.73 m (L2.1)	233 129	≦20 m
		ScanSAR	60.77 m (L1.1) 29.33 m (L2.1)	7 8	≦100 m
Radiometric accuracy [dB]	Evaluation using corner reflectors	Stripmap and Spotlight	0.48 dB (1σ) (mean CF: -82.99 dB)	195	≦1.0 dB
	Evaluation using images over Amazonian forests	Stripmap and Spotlight	0.41 dB (1σ) (mean γ^0: -7.50 dB)	30 scenes	
Polarimetry	VV/HH amplitude ratio	Stripmap 6m (polarimetry)	1.000 (σ=0.012)	24	≦1±0.047
	VV/HH phase difference [deg.]		0.137 deg (σ=0.962)		≦5 deg
	Cross talk [dB]		-41.90 dB (σ=5.264) [HV/HH] -41.56 dB (σ=4.953) [VH/VV]		≦-30 dB

Summary of evaluation results of ALOS-2 PALSAR-2 standard products [2/3]

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Items		Observation modes	Results	Number of data	Requirements
Resolution [m]		Spotlight	Az. 0.85 (σ=0.078) Rg. 1.68 (σ=0.012)	5	Az. 1.00 x 1.1 Rg. 1.78
		Stripmap 3m	Az. 2.81 (σ=0.020) Rg. 1.71 (σ=0.018)	105	Az. 2.75 x 1.1 Rg. 1.78
		Stripmap 6m	Az. 4.02 (σ=0.031) Rg. 3.51 (σ=0.028)	54	Az. 3.75 x 1.1 Rg. 3.57
		Stripmap 10m	Az. 4.97 (σ=0.067) Rg. 5.33 (σ=0.065)	41	Az. 5.00 x 1.1 Rg. 5.36
Sidelobe (dB)	PSLR	All	Az. -16.26 (σ=2.31) Rg. -12.73 (σ=0.51)	205	≦-13.26+2.00 dB
	ISLR	All	-9.10 (σ=1.73)		≦-10.16+2.00 dB

Summary of evaluation results of ALOS-2 PALSAR-2 standard products [3/3]

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Items		Observation modes	Results	Number of data	Requirements
NESZ [dB]		Stripmap 3m (U2)	-36.6 (HH)	3	≦-24.0 dB (scene center)
		Stripmap 6m (FP6-3～7)	-36.0 (HH) -46.0 (HV)	5	≦-28.0 dB (scene center)
		Stripmap 10m (F2)	-41.1 (HH) -49.2 (HV)	3	≦-26.0 dB (scene center)
Ambiguity [dB]	Azimuth	All	14-23 dB (ave. 20dB)	7 scenes	≧20-25 dB
	Range	All	Not visible	7 scenes	≧20-25 dB

Evaluation results of geometric accuracy

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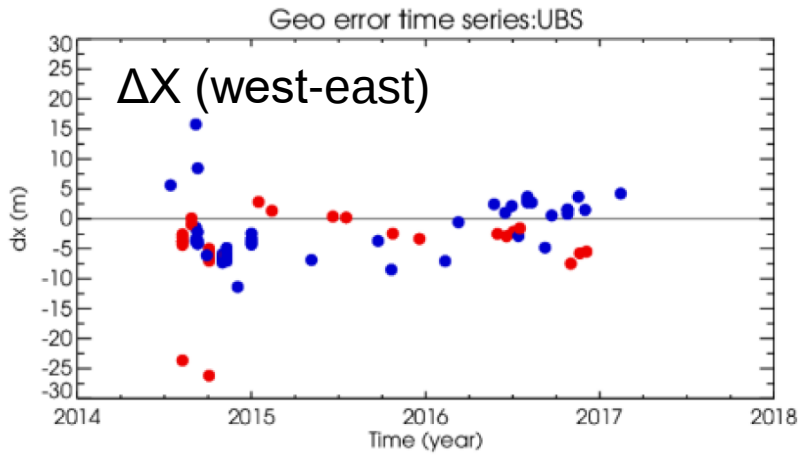
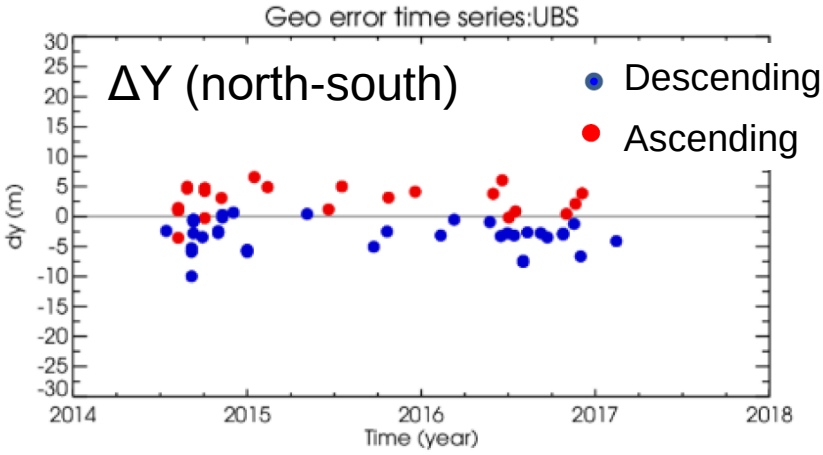
Differences between point target responses in SAR images and in situ GPS measurements

Mode	ΔX (west-east) [m]			ΔY (north-south) [m]			n
	mean (bias)	SD	RMS	mean (bias)	SD	RMS	
Spotlight	-5.86	4.23	7.42	2.27	2.32	3.31	13
Stripmap 3 m (U2-6~9)	-1.39	3.63	3.89	-2.61	2.82	3.85	89
Stripmap 6 m (FP6-3~7)	-4.24	3.66	5.62	3.69	1.64	4.07	68
Stripmap 10 m (F2-5~7)	-3.90	3.57	5.32	-2.45	3.17	4.03	38

Timeseries plot of Stripmap 3 m





Evaluation results of radiometric accuracy – calibration factor (CR) [1/2]

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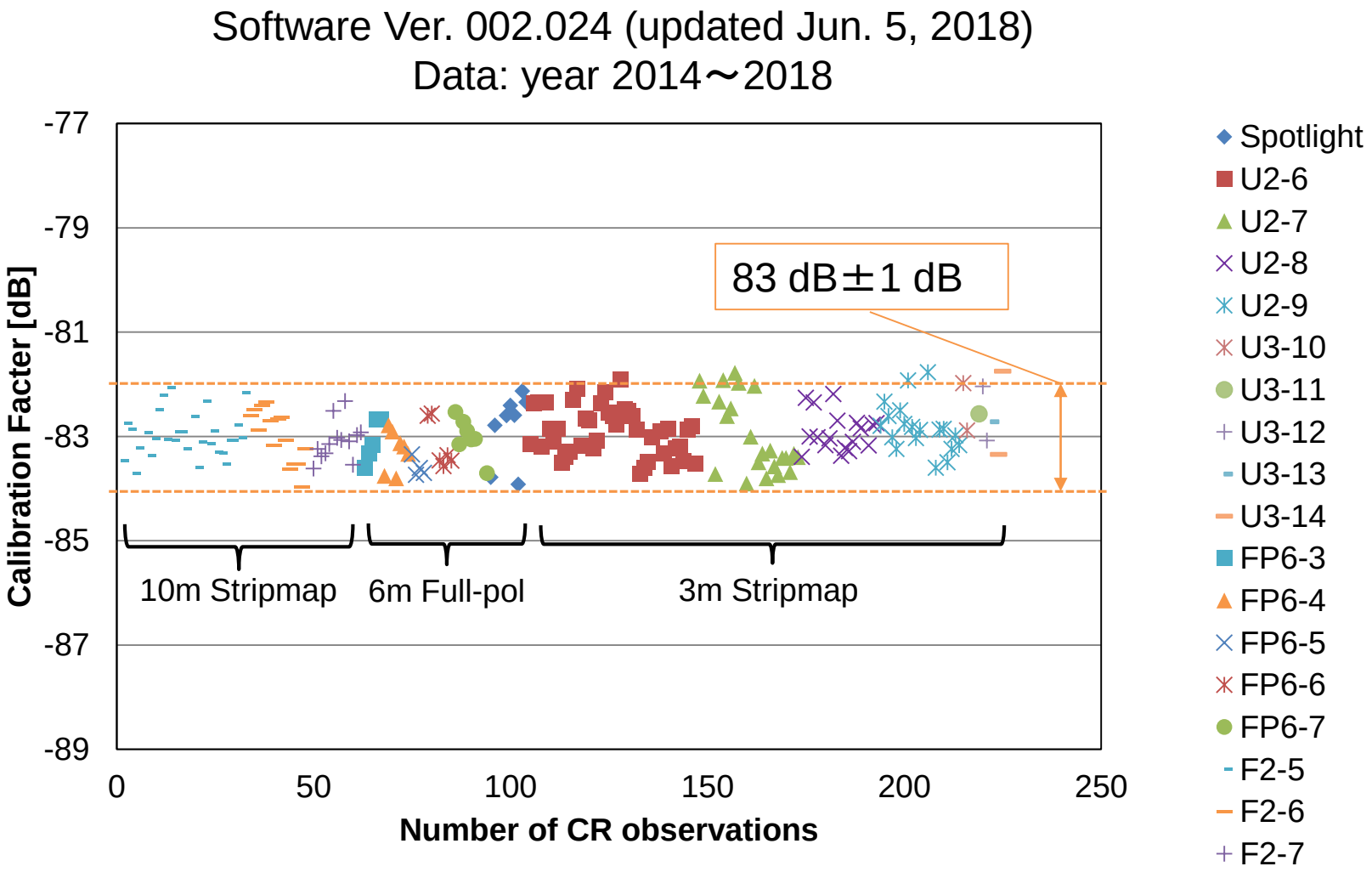

Evaluation results of radiometric accuracy – calibration factor (CR) [2/2]

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Mode	Mean [dB]	SD [dB]	RMS to -83 dB [dB]	n
Spotlight	-82.82	0.67	0.69	8
U2-6	-82.91	0.46	0.47	42
U2-7	-83.03	0.70	0.70	22
U2-8	-82.91	0.37	0.38	18
U2-9	-82.90	0.40	0.42	18
FP6-3	-83.09	0.41	0.43	5
FP6-4	-83.27	0.39	0.49	7
FP6-5	-83.60	0.18	0.71	4
FP6-6	-83.17	0.46	0.50	6
FP6-7	-83.02	0.37	0.37	7
F2-5	-82.97	0.42	0.42	30
F2-6	-82.99	0.51	0.51	15
F2-7	-83.09	0.37	0.38	13
ALL	**-82.99**	**0.48**	**0.48**	195