PALSAR CAL VAL report to K&C updated for the CVST6 meeting

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JAXA/EORC

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Contents

- •Accuracy goal and verification method
- •Characterization（Raw data evaluation）
- •Algorithm（Key points）
- •CAL/VAL Procedure
- •Accuracy Evaluation（Radiometry，Geometry）
- •Image Quality（IRF、Ambiguity，etc）
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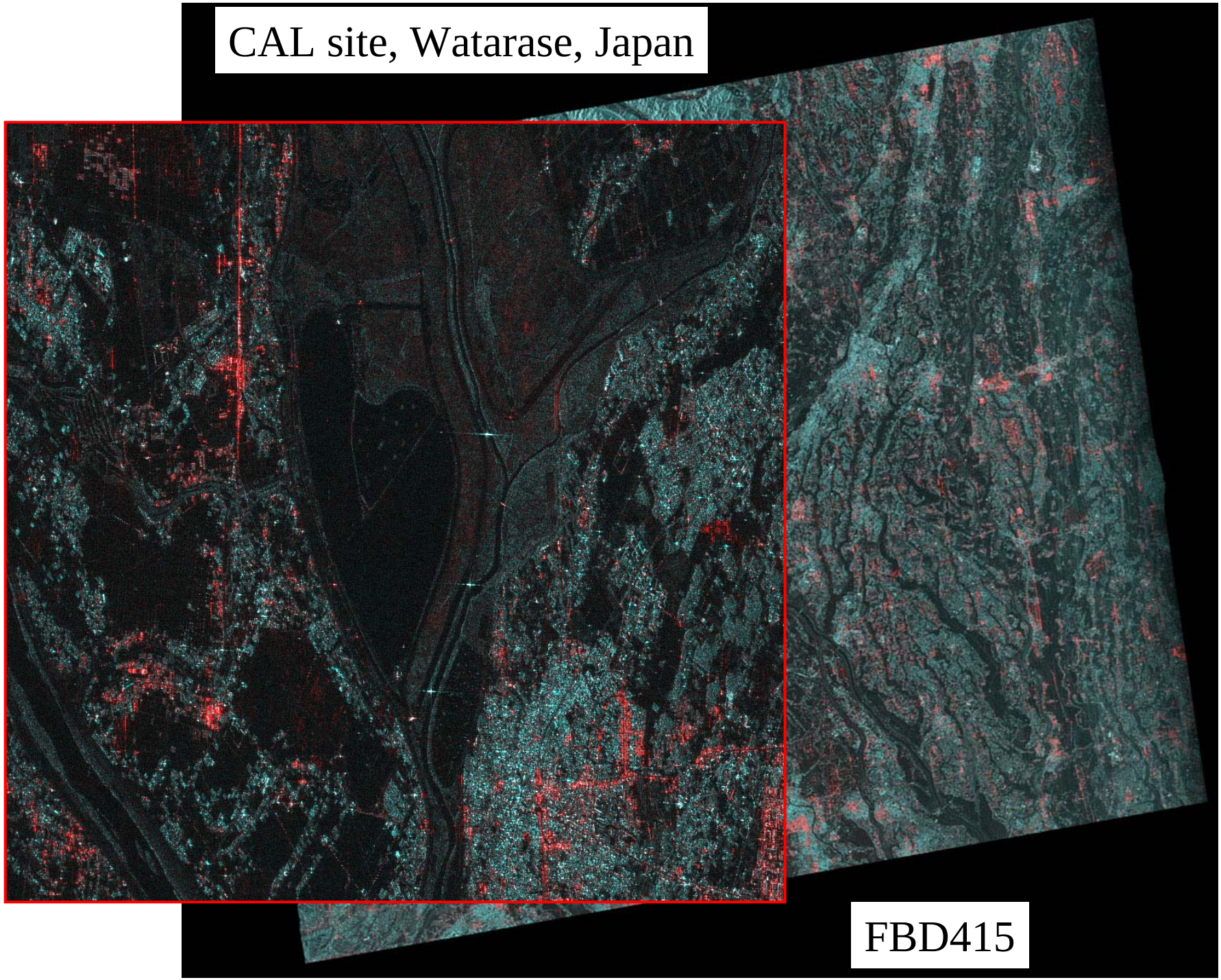
- •High level products（Ortho、InSAR DEM）
- •Research products（Surface deformation，Mosaic）
- •Summary 2

- •Reference：Initial CALVAL Plan, Initial CALVAL procedure

After CVST5

JAXA CAL/VAL review meeting was held on Oct. 23 2006.
Data distribution started on Oct. 24 2006.
3 dB were added to the attenuators of SCANSAR (#2~5) on NOV. 9 (To suppress the saturation rate).
Solar flare arrival and Light-load Mode of the ALOS resulted the operation pausing and widening the orbital tube (more than 3km). Orbital tube of 500 m was recovered by Feb. 1 2007.
Monitoring the surface deformation at Iwo island, Japan.

Software
Doppler frequency estimator for SCANSAR will be restored to Clutter-lock method.


CAL site, Watarase, Japan
FBD415

1. Accuracy Goal and verification method（PALSAR）

Products	Goal	reference
Standard products –1.1 –1.5	geometry 100 m radiometry 1.5 dB（abs.） 1.0 dB（relative） 0.2 dB(amp VV/HH) 5° （phase error VV/HH）	CR, ARC's positions CR, ARC CR, ARC、Amazon CR
High level products –Ortho –DEM	geometry 50 m（horizontal） radiometry 30 m（vertical） 1.5 dB（ex. layover）	CR, ARC's positions GCP,DEM CR,ARC
Research products Surface deform mosaic soil moisture snow map biomass map sea ice	geometry 100 m radiometry 5mm 1.5 dB	Landsat image GPS Amazon image

2.Distribution schedule standard products：9 mo. After launch（Limited Uncaled data distributed in cal/Val phase）
high level products：One year after the launch
resercah procuts: One year after the launch

2 Characterization

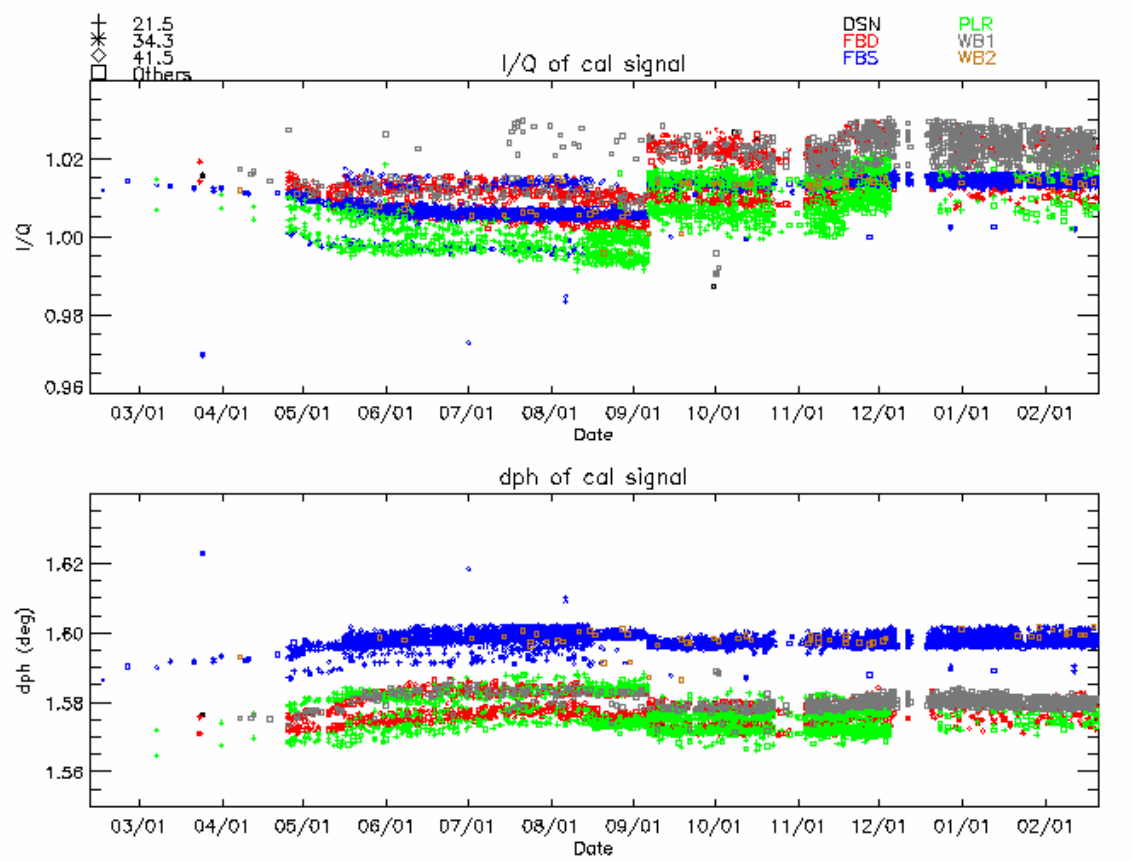
Collects the important information of the PALSAR calibration trough the statistical evaluation of the PALSAR raw data. Following is the sample info.

Stability
Saturation property
Interference from the radar

	FBS	**FBD**	**PLR**	**WB1**	**WB2**
I	16.049	16.188	16.254	16.245	16.041
Q	15.850	15.973	16.078	15.950	15.835
Gain diff. of I/Q	1.007	1.010	1.001	1.015	1.008
Phase diff. of I/Q(deg)	1.598	1.579	1.577	1.581	1.597
SNR (dB)*	8.4235 (8.6698)	3.3580 (6.9575)	8.7118 (8.5104)	7.9256 (9.4869)	8.7332 (8.3310)
Chirp rate (Hz/s)*	-1.03158E+12 (-1.03159E+12)	-5.15923E+11 (-5.15926E+11)	-8.50977E+11 (-8.50993E+11)	-5.15903E+11 (-5.15904E+11)	-1.03159E+12 (-1.03159E+12)
Saturation	Attenuator for basic mode is well adjusted.				
Interference	In general, it became smaller than JERS-1 (Tr power) Some times, wider band signal observed.				

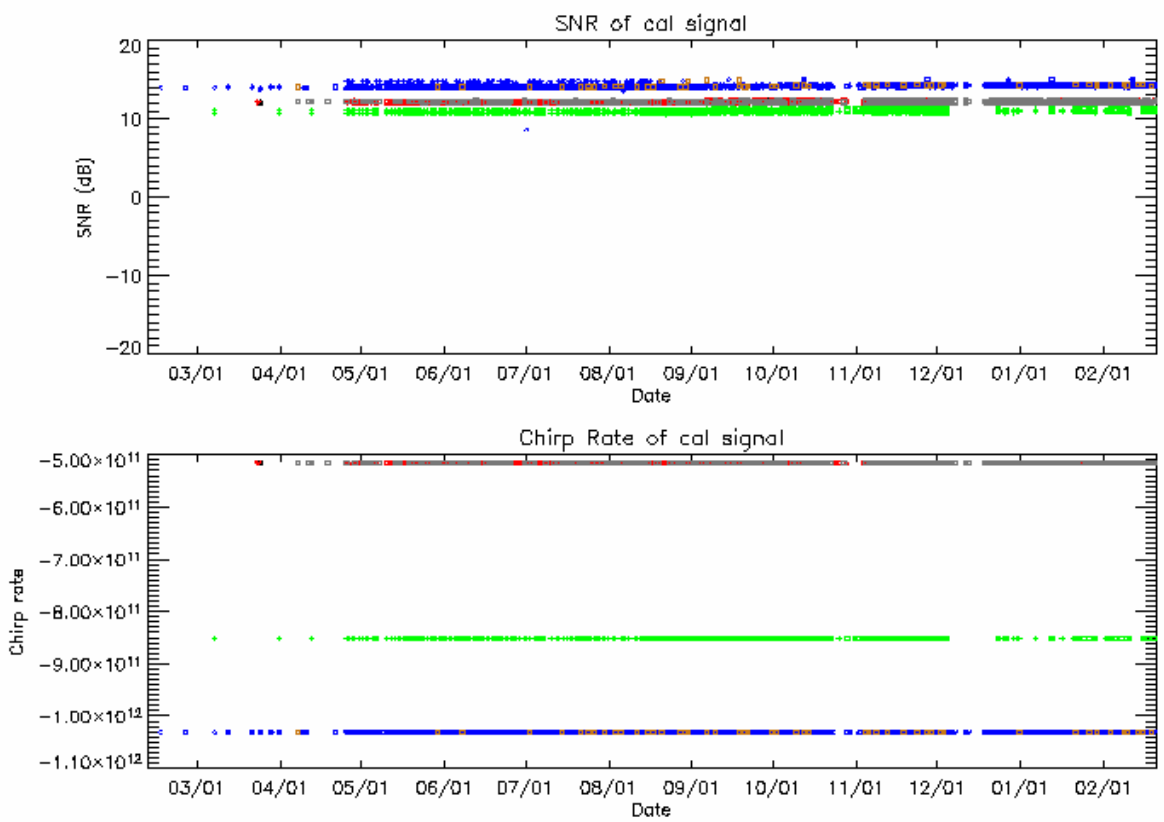
*:above values are as of March 5 2007, the lower is at CVST5

Long history of the calibration data (1/3)



	I/Q	dph (deg)
FBS	1.010	1.598
FBD	1.013	1.578
PLR	1.006	1.576
WB1	1.022	1.580
WB2	1.011	1.598

Long history of the calibration data (2/3)



Δk

	SNR (dB)	Chirp rate	
	Average	Average	Std. dev.
FBS	14.144	−1.03159E+12	2.5E+07
FBD	12.175	−5.15926E+11	2.2E+07
PLR	10.953	−8.50993E+11	4.0E+07
WB1	12.158	−5.15904E+11	1.2E+07
WB2	14.250	−1.03159E+12	5.1E+07

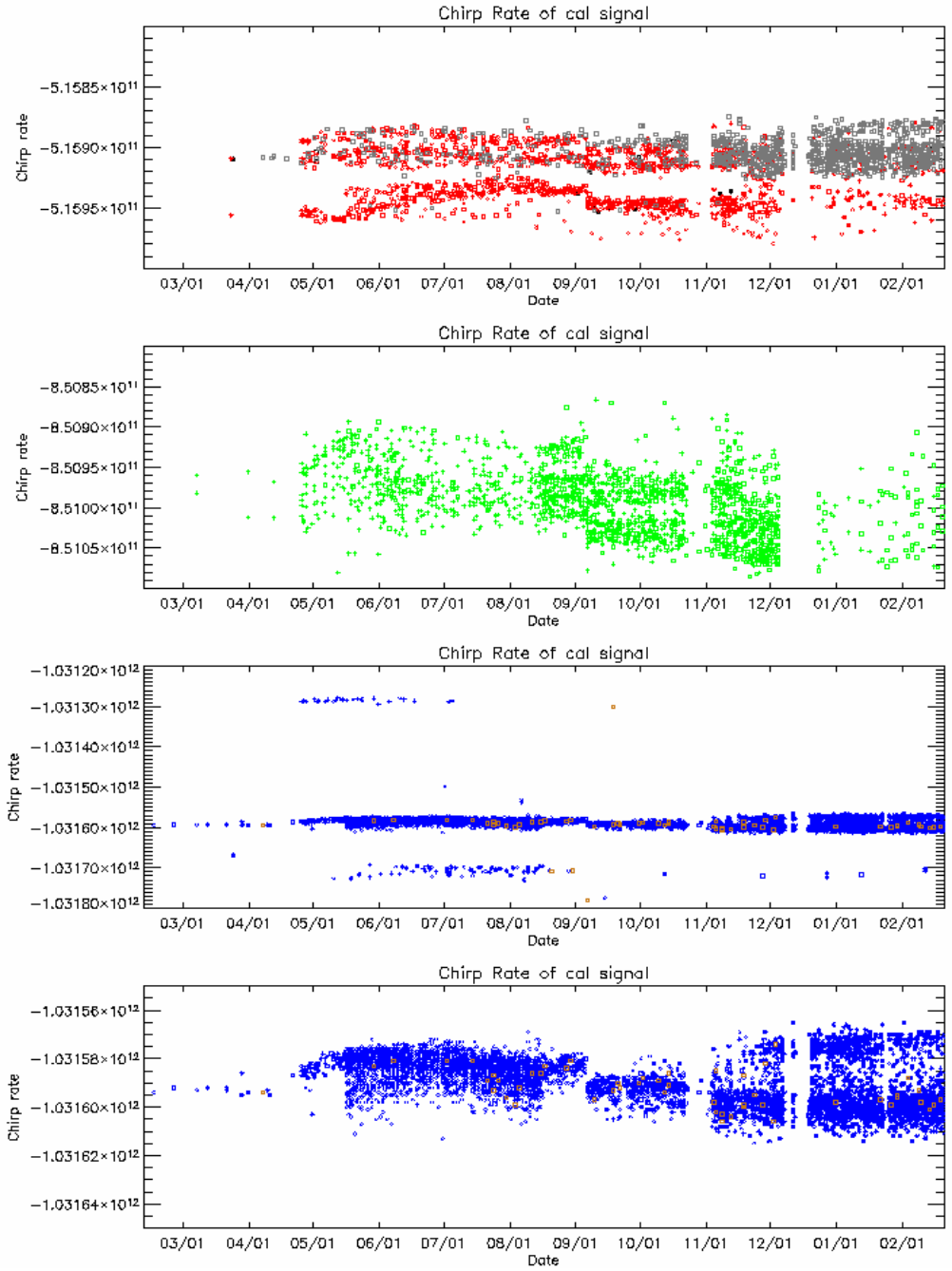
Requirement for the chirp stability: phase difference at the pulse edge < 1.0 degrees

$$2\pi \frac{\Delta k}{2}\left(\frac{\tau}{2}\right)^2 \leq \frac{\pi}{180}$$

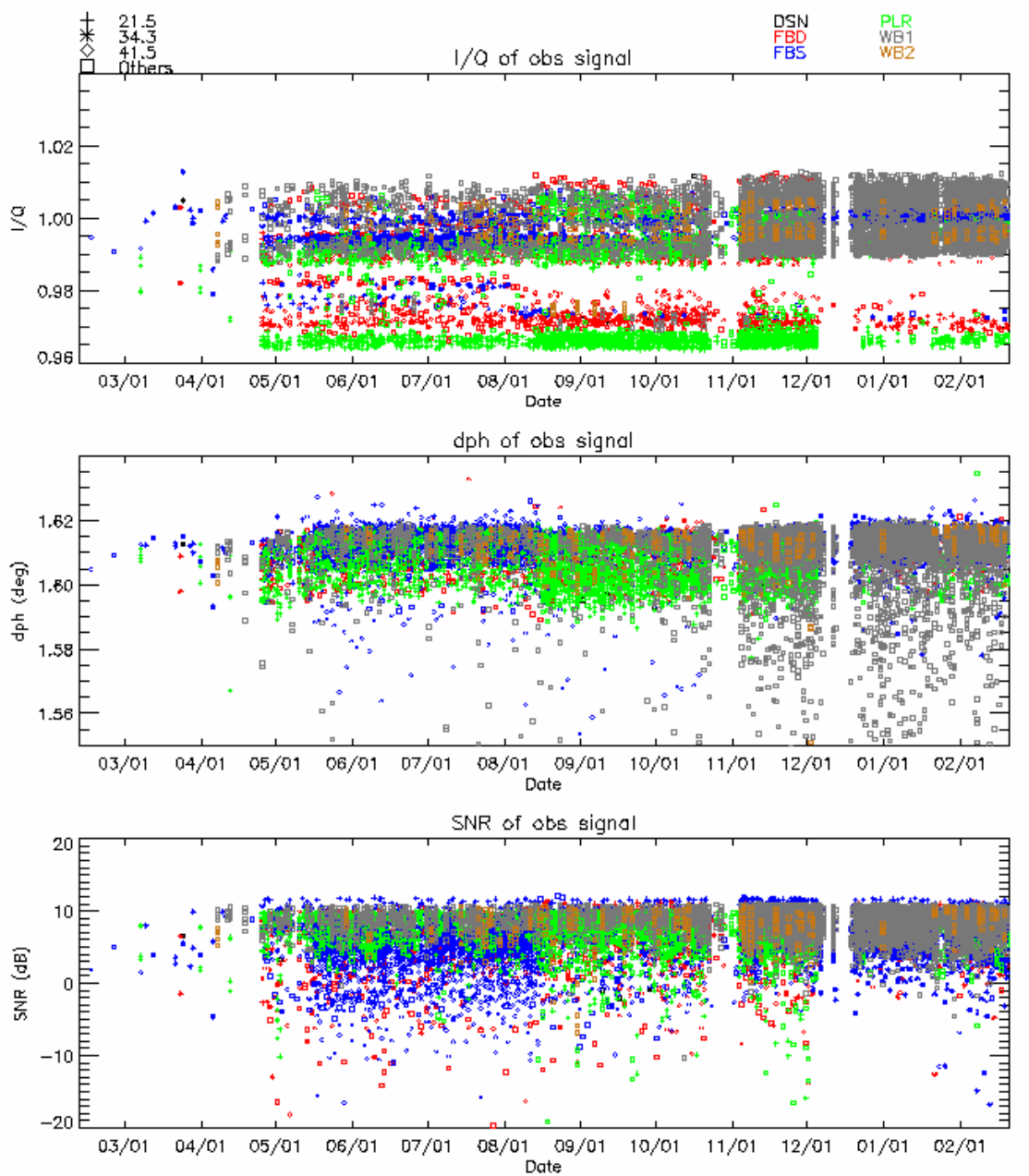
Chirp signal is very stable.

Δk	:	3.0E+7	: FBS, FBD, SCAN
		8.6E+7	:POL

Long history of the calibration data (3/3)



Long history of the observation data



SNR:land

	SNR (dB)
FBS	8.6698
FBD	6.9575
PLR	8.5104
WB1	9.4869
WB2	8.3310

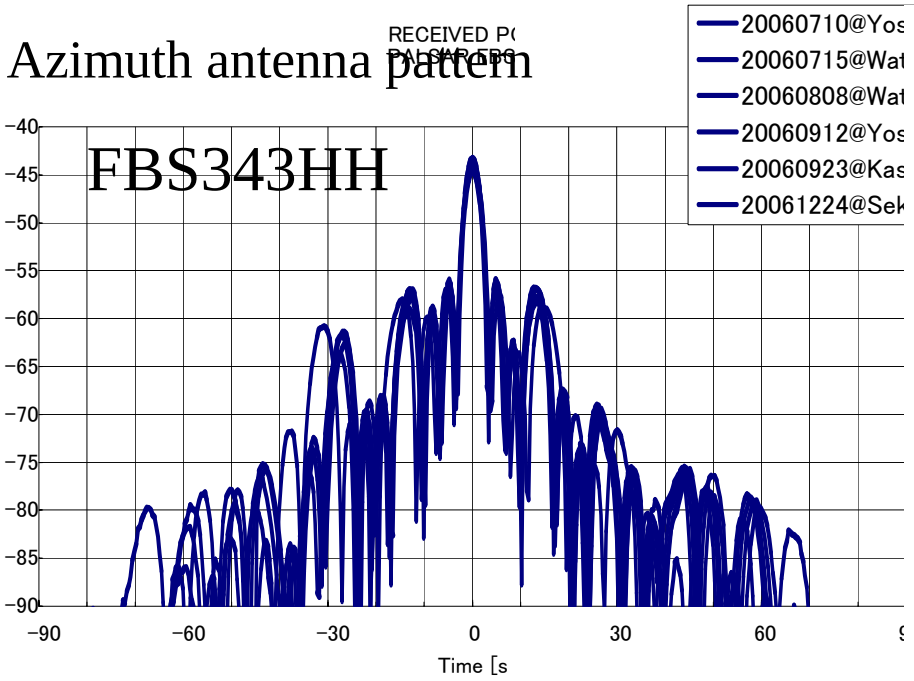
Total Image:

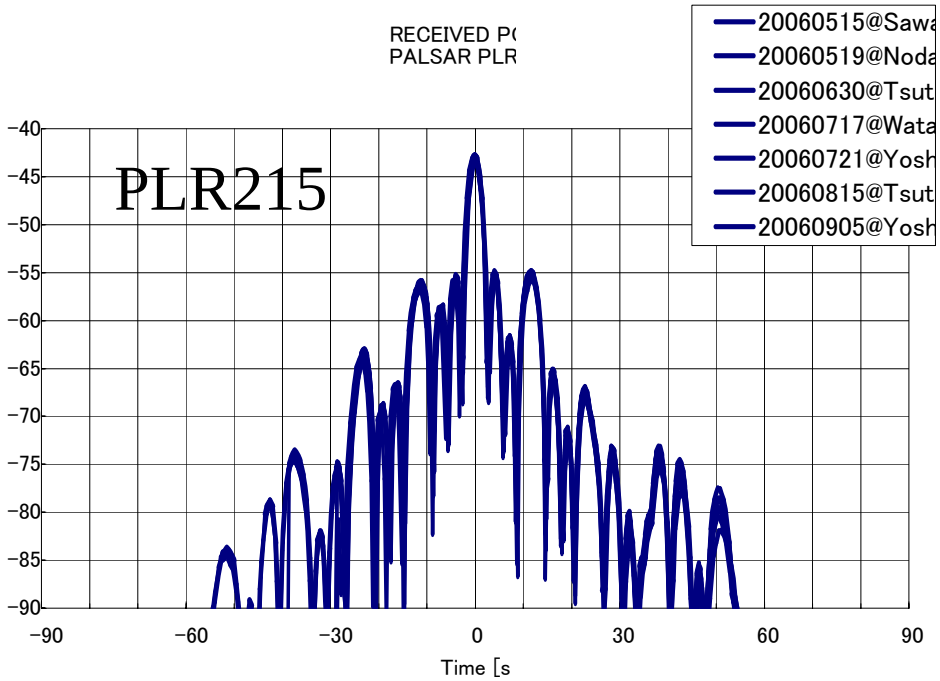
	I/Q	dph (deg)	SNR (dB)
FBS	0.9956	1.6131	5.8575
FBD	0.9844	1.6098	2.1261
PLR	0.9803	1.6066	7.0564
WB1	0.9987	1.6072	8.5219
WB2	0.9965	1.6117	7.6134

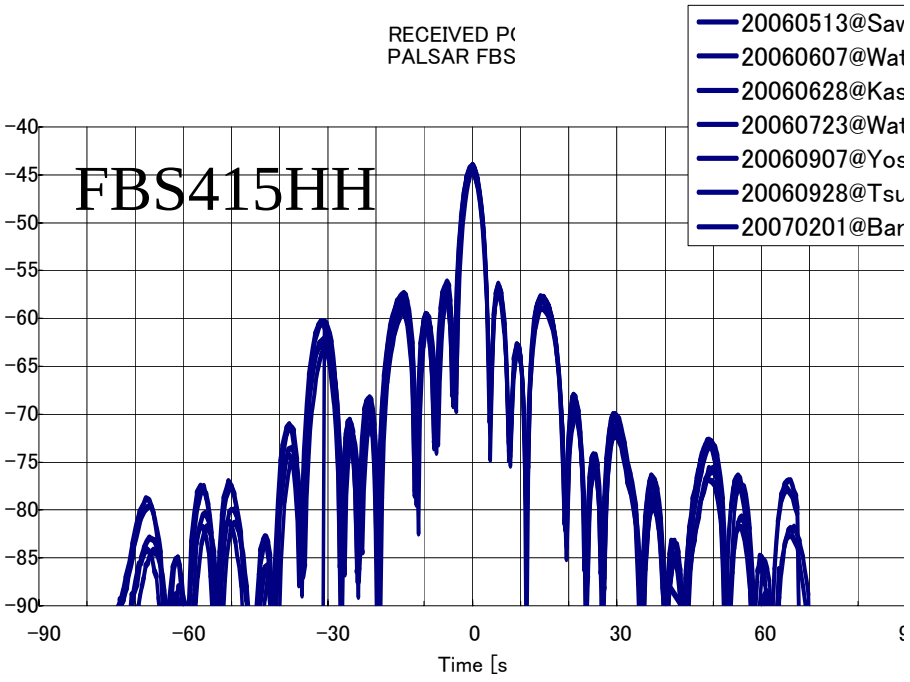
Saturation Rate

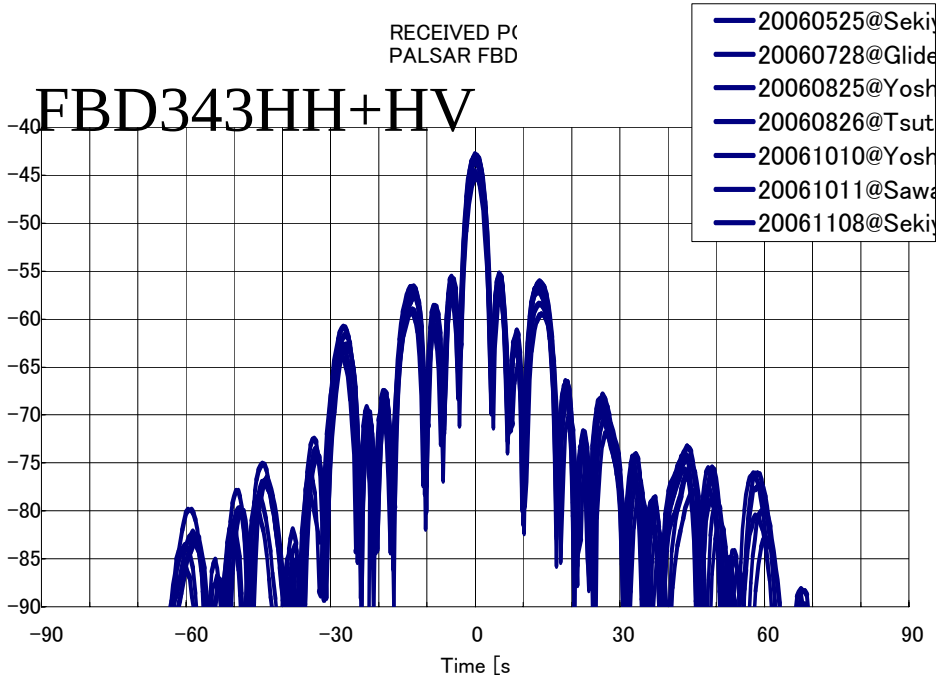
Mode	Offn_angle	Attenuator					Saturation Rate(% ave.)				
		HH(0)	HV(1)	VH(2)	VV(3)	(-4)	HH(0)	HV(1)	VH(2)	VV(3)	(-4)
FBD	34.3	25	16	16	25	-	1.0	1.2	0.1	0.7	-
	41.5	25	16	16	25	-	1.0	1.3	0.4	2.2	-
FBS	21.5	30	-	-	30	-	1.3	-	-	0.1	-
	34.3	25	-	-	25	-	1.2	-	-	0.1	-
	41.5	25	-	-	25	-	2.0	-	-	0.9	-
PLR	21.5	30	21	21	30	-	1.6	1.1	2.4	0.8	-
WB1	271-5	25	27	26	25	24	1.0	0.8	0.8	1.0	1.3
WB2	271-5	25	27	26	25	24	1.1	1.4	1.3	1.8	1.9

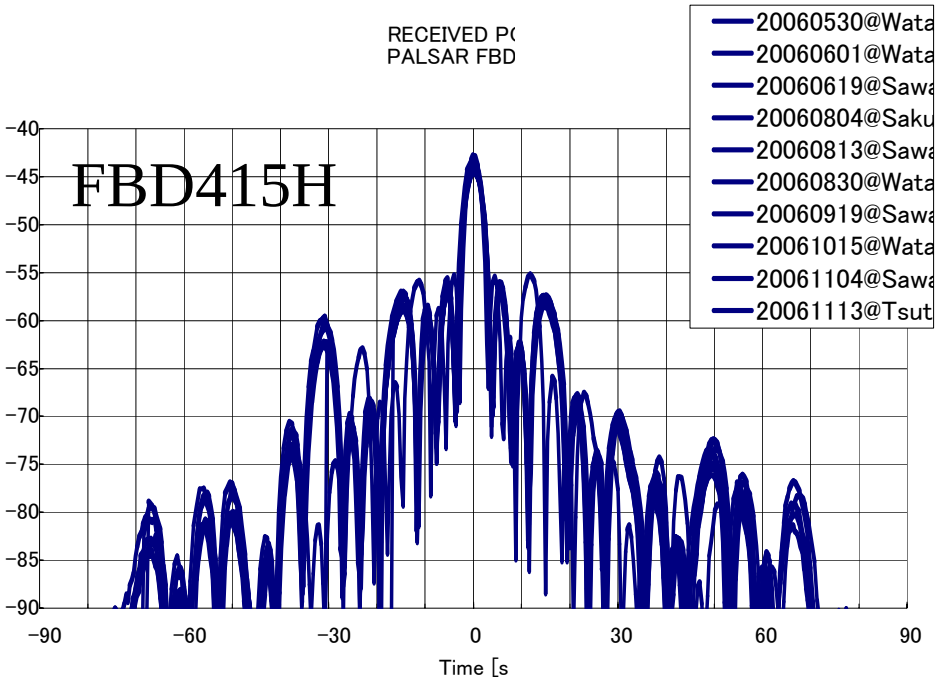
Azimuth antenna pattern

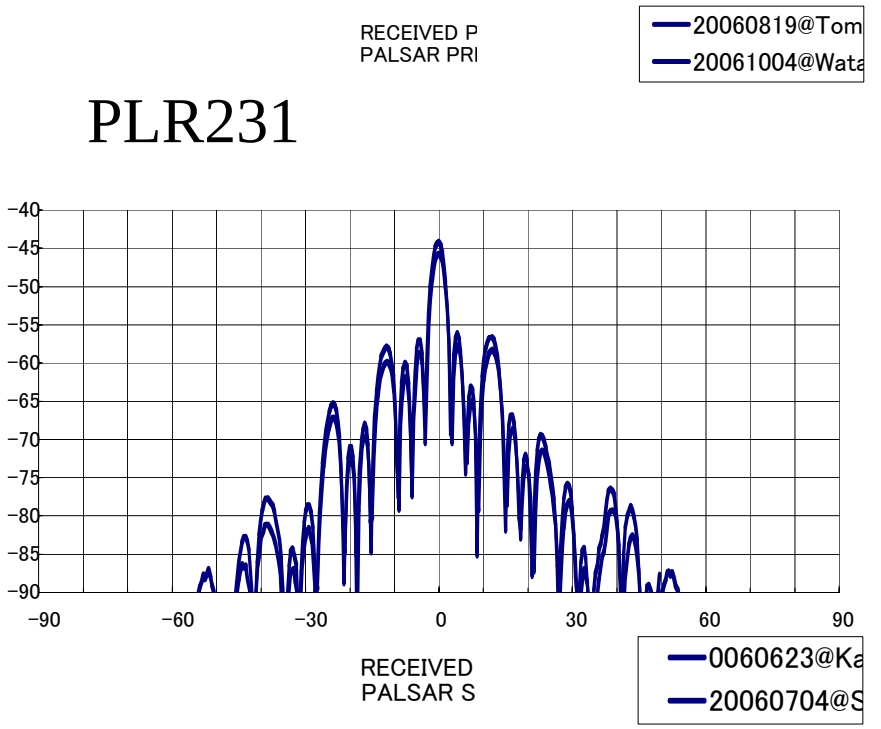









RECEIVED P(
PALSAR FBD
20060530@Wata
20060601@Wata
20060619@Sawa
20060804@Saku
20060813@Sawa
20060830@Wata
20060919@Sawa
20061015@Wata
20061104@Sawa
20061113@Tsut
FBD415H
−40
−45
−50
−55
−60
−65
−70
−75
−80
−85
−90
−90
−60
−30
0
30
60
90
Time [s


RECEIVED P
PALSAR PRI
20060819@Tom
20061004@Wata
PLR231
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−60
−65
−70
−75
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−85
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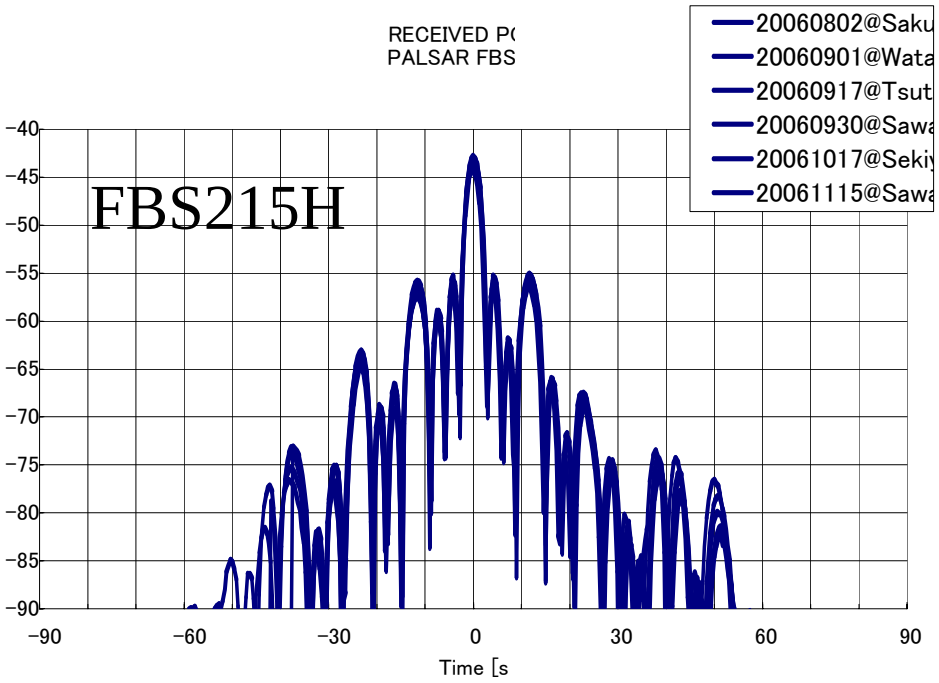
RECEIVED
PALSAR S
0060623@Ka
20060704@S


RECEIVED P(
PALSAR FBS
20060802@Saku
20060901@Wata
20060917@Tsut
20060930@Sawa
20061017@Seki
20061115@Sawa
FBS215H
−40
−45
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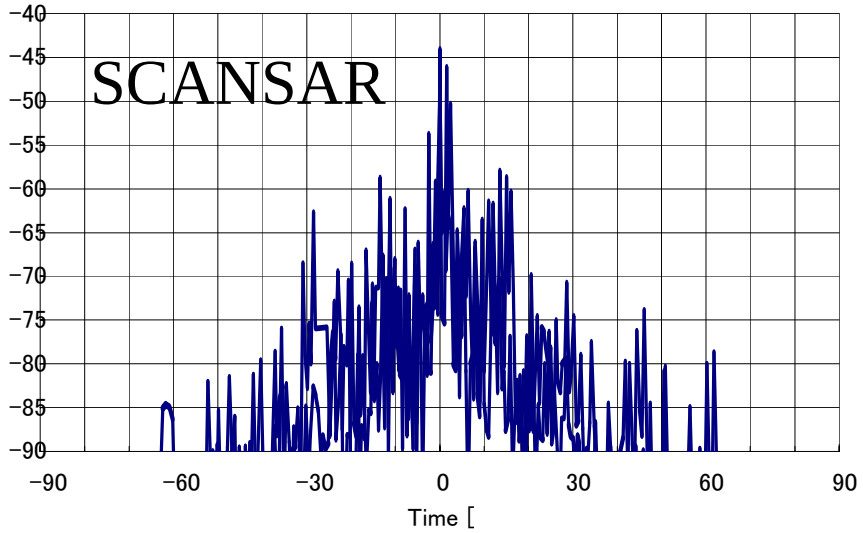
Time [s


SCANSAR
−40
−45
−50
−55
−60
−65
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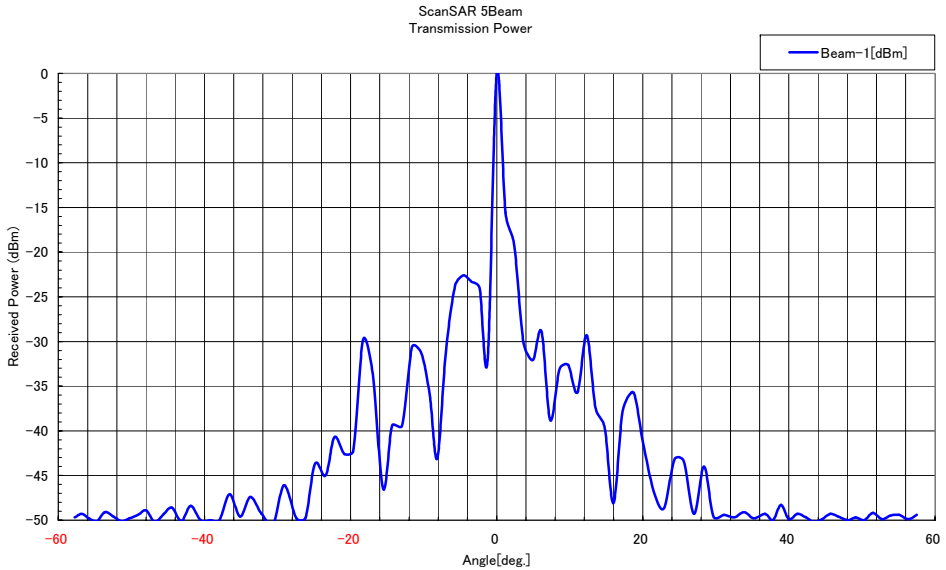
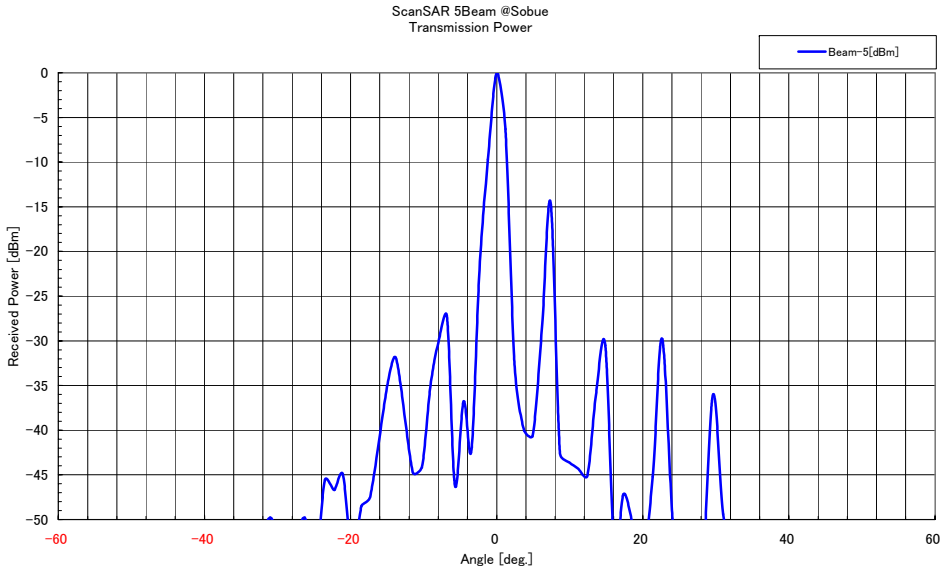
−75
−80
−85
−90
−90
−60
−30
0
30
60
90
Time [

Azimuth antenna pattern (SCANSAR)





3 Summary of the characterization

•Since MGC was selected as the primary mode, characterization becomes stabilized.
•Saturation rate is reduced, and image quality becomes better.
•Interference less observed, and it can be suppressed by a filter.
•Transmission power is stabilized.
•Property changed slightly on Sept/B. (It does not cause the image quality)
•Image quality of beam 34.3, shows better performance than 41.5.
•Antenna pattern does not change.

•Generally, the saturation level reduced to the satisfactory level. But, high intensity target saturates the image.

4 Algorithm

Radiometric correction

- Raw data scaling

$$\mathbf{V}_{raw}^{i,j} = \frac{1}{\sqrt{G_{AGC}(T)\cdot G_{STC}(t)\cdot\left(P_t/\overline{P}_t\right)}\{1-S_a(t,T)\}}\left[\left(\mathbf{v}-\overline{\mathbf{v}}\right)\frac{\sigma_l}{\sigma_q}\right]^{i,j} E^{i,j}$$

$$E = \begin{pmatrix} \sigma_V/\sigma_H & 0 \\ 0 & 1 \end{pmatrix}$$

- Antenna Correction (Before azimuth correlation)

$$\overline{\mathbf{V}}_{rg}^{i,j} = \frac{R\sqrt{\sin\theta_{inci}}}{G_{ele}^{i,j}\left(\phi_{off},beam\right)}\mathbf{V}_{rg}^{i,j}$$

- Power

$$P_{i,j} \cong a\frac{G_{\mathbf{ele}}^{\mathbf{2}}}{R^{\mathbf{2}}\sin\theta_{inci}}\sigma_{i,j}^{0} + N_{i,j}$$

- POL mode

$$\mathbf{S}_{ij} = \mathbf{R}^{-1}\cdot\mathbf{F}^{-1}\cdot\mathbf{Z}_{ij}\cdot\mathbf{F}^{-1}\cdot\mathbf{T}^{-1}$$

i, j : transmission and reception pol.
Noise is not subtracted.

v_{raw}:raw data voltage
v_{rg} : volt after range corr.
p : power
S:caled scattering matrix
Z : uncal scattering matrix

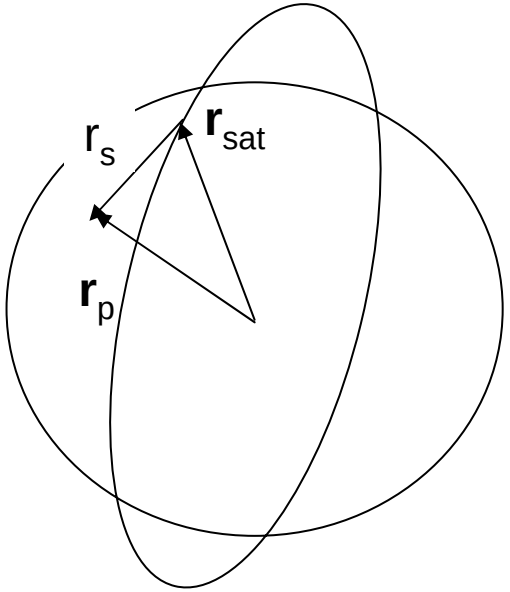
R : slant range
θ_{inci} : incidence angle
ϕ_{off} : off nadir angle
σ^0 : sigma-naught

Calibration target
G_{ele} : antenna pattern
R,T : distortion matrix
a : coefficients

Accuracy Target : Error : < 1.5 dB, location error < 100m

Geometric conversion

Doppler model depends on yaw(ψ),pitch(θ), and integer n. observation position depends on rs.



Determine attitude and Doppler model

$$\sum\left(Uw\left(f_{d,r}\right)+n\cdot f_{prf}-f_{dm,r}\left(\theta_p,\psi_y,r_s\right)\right)^2\rightarrow min.$$

位置の決定

$$r_s=\frac{c}{2}\left(\frac{i}{f_{sample}}+\frac{nn}{f_{prf}}+\Delta t\right)$$

range

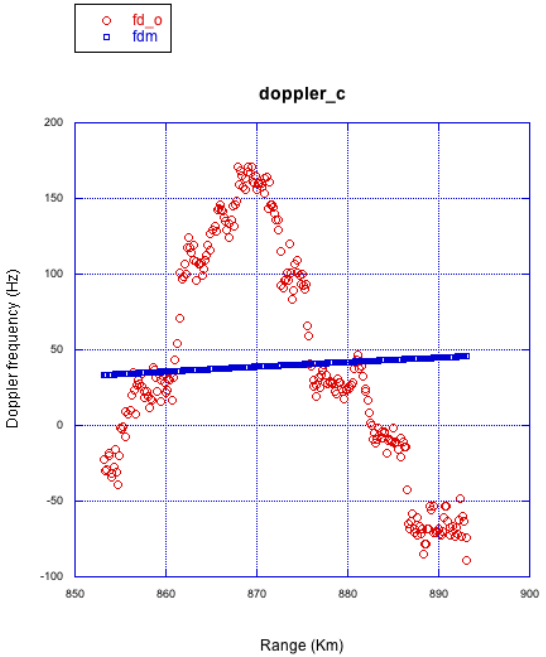
$$f_d\cong A_0+A_1\cdot r_s$$

Doppler frequency

$$f_d=\frac{2f_0}{c}\mathbf{v}_s\cdot\frac{\left(\mathbf{r}_p-\mathbf{r}_s\right)}{\left|r_p-r_s\right|}$$

$$x_p^2+y_p^2+z_p^2\frac{R_a^2}{R_b^2}=1$$

Position determine（iteration）



f_d:Doppler measurement, f_{dm}:Doppler model、E(ϕ,θ,ψ), rotation matrix , r_s: slant range, r_p:position vector(x_p,y_p,z_p), r_{sat}:satellite position, r_n:normal vector, f_{prf}:pulse repetition frequency, R_a,R_b: equatorial radius, polar radius, (GRS80)

5 Calibration and validation

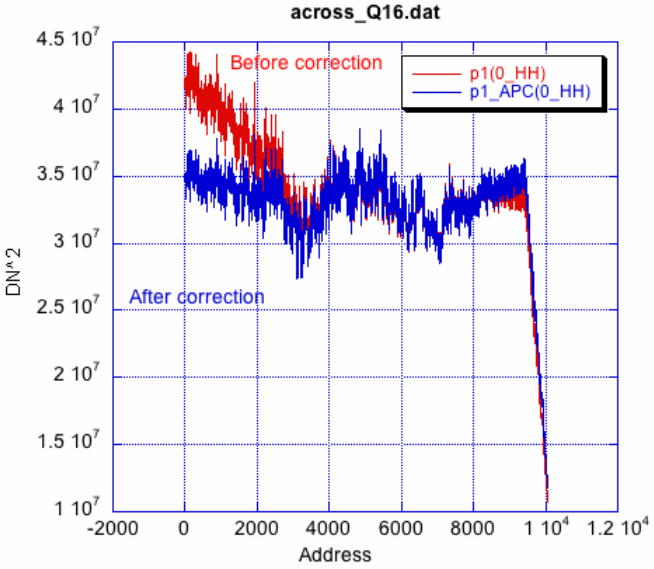
Items	Item	method
Radiometry	Antenna elevation pattern	•Amazon data analysis •modeling
	Calibration factor	•Tune suing CR、PARC •Tune gain difference among beams.
	Distortion matrices	•CR、forest area
Geometry	Range time offset	•CR、PARC
	Azimuth time offset	•CR、PARC

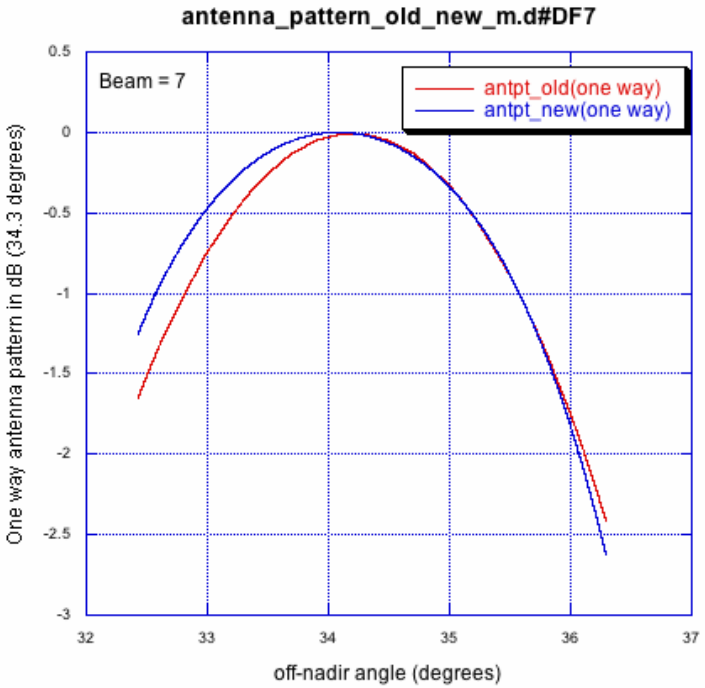
Antenna pattern estimation

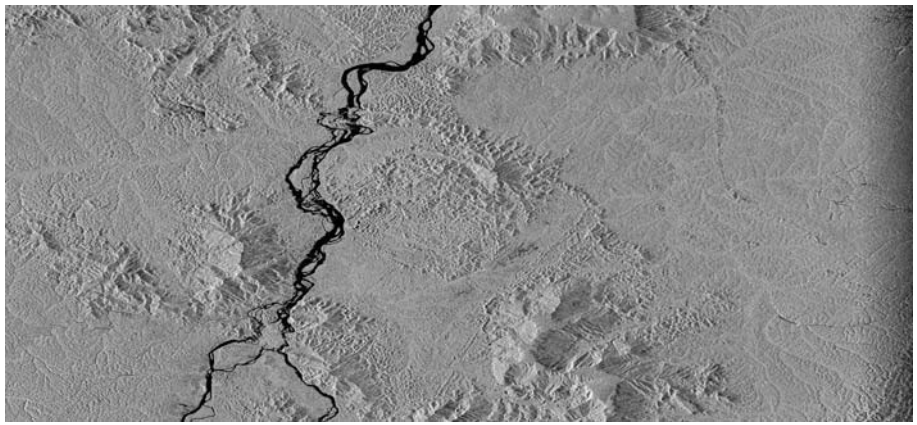
$\gamma^0(\sigma^0/\cos(\theta))$= 定数

- Extract uniform area (Filtering)
- Quadratic equation
- Update antenna pattern dB

$$G(\theta) = a + b(\theta - \theta_0)^2 + c(\theta - \theta_0)^4$$





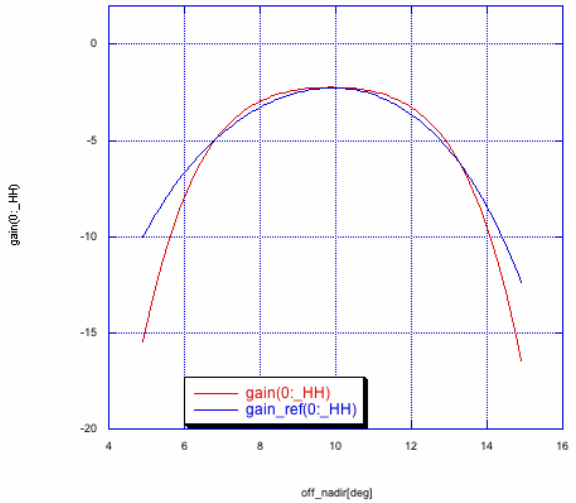


Before

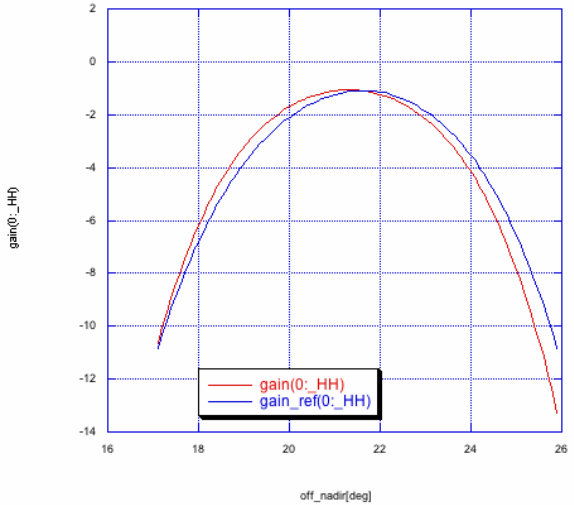
After

Antenna pattern measurement from the Amazon data

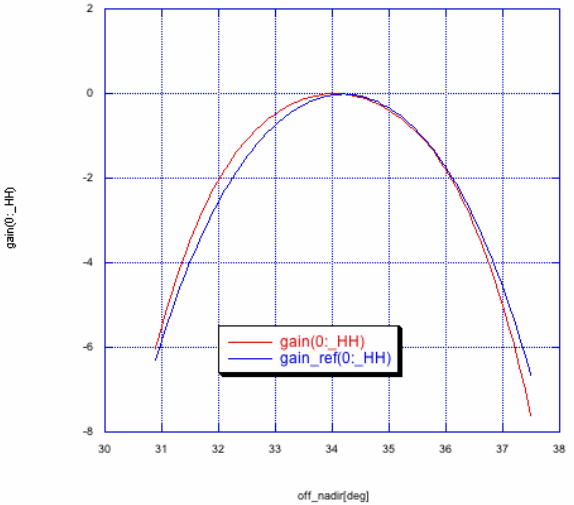
9.9



21.5

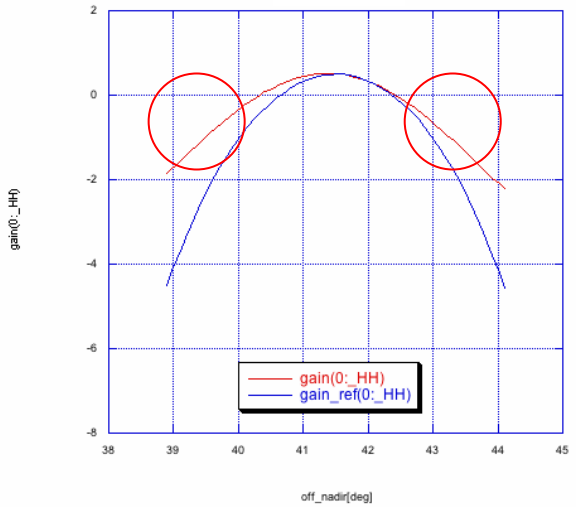


34.3

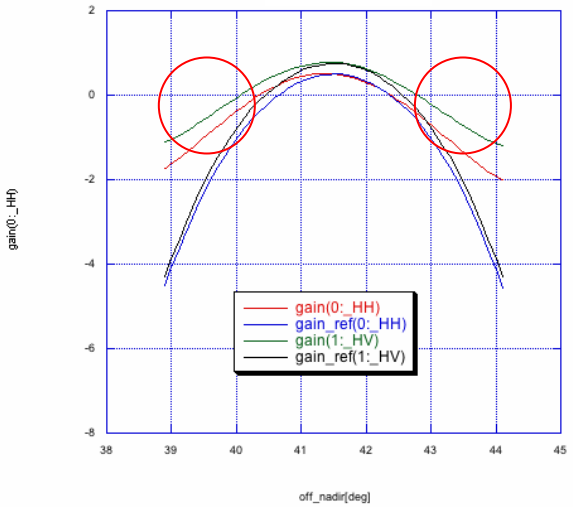


due to the range ambiguity

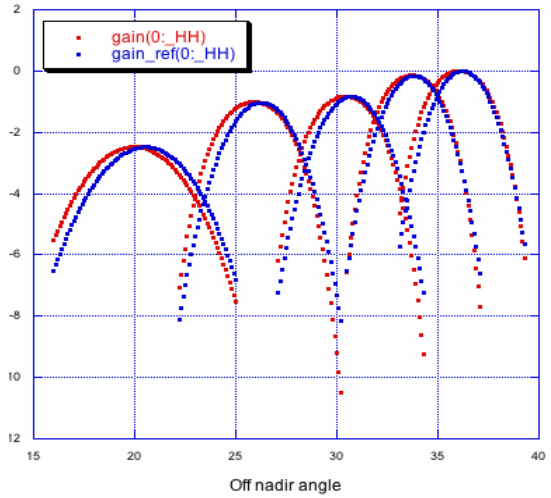
41.5



41.5D

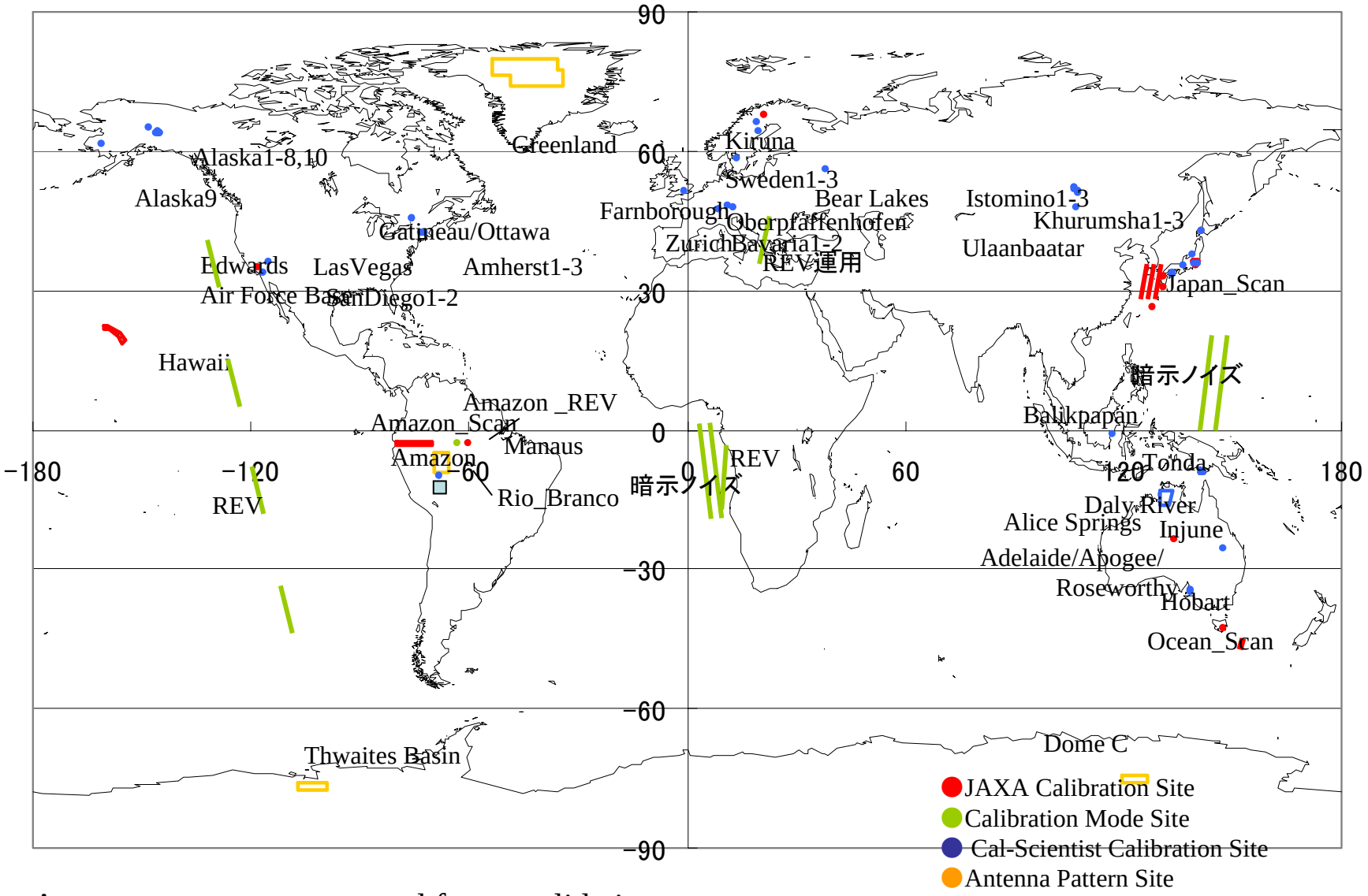


SCANSAR



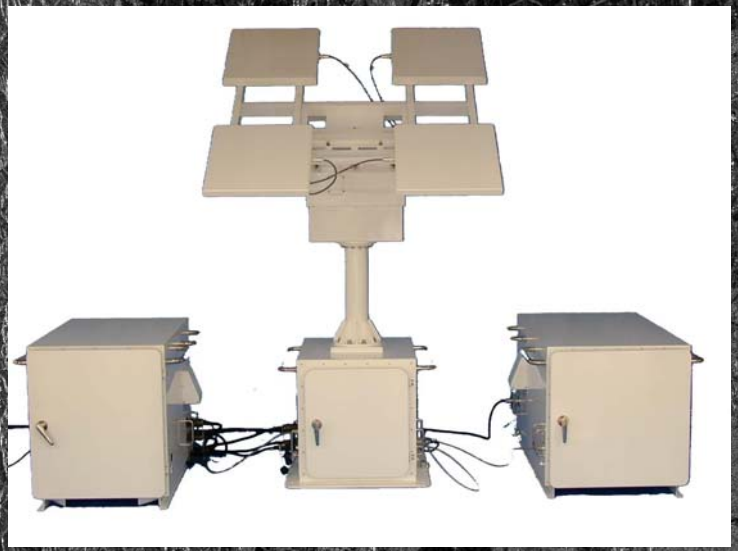
Blue: ground measurement, red: in-flight data (Amazon)

PALSAR calibration site

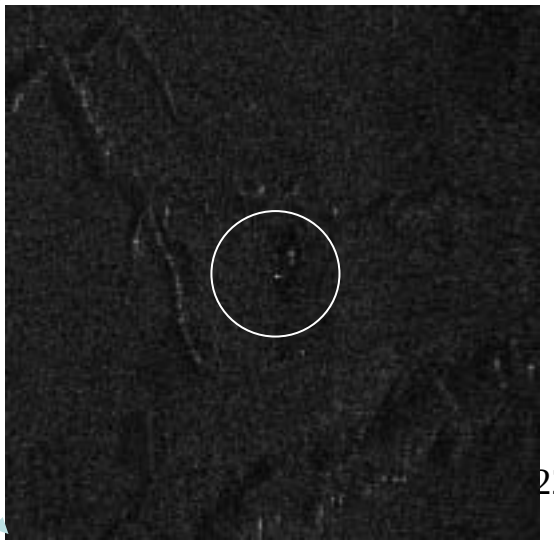


Amazon : antenna pattern, cal factor validation
CR and PARC : Cal factor, position determination

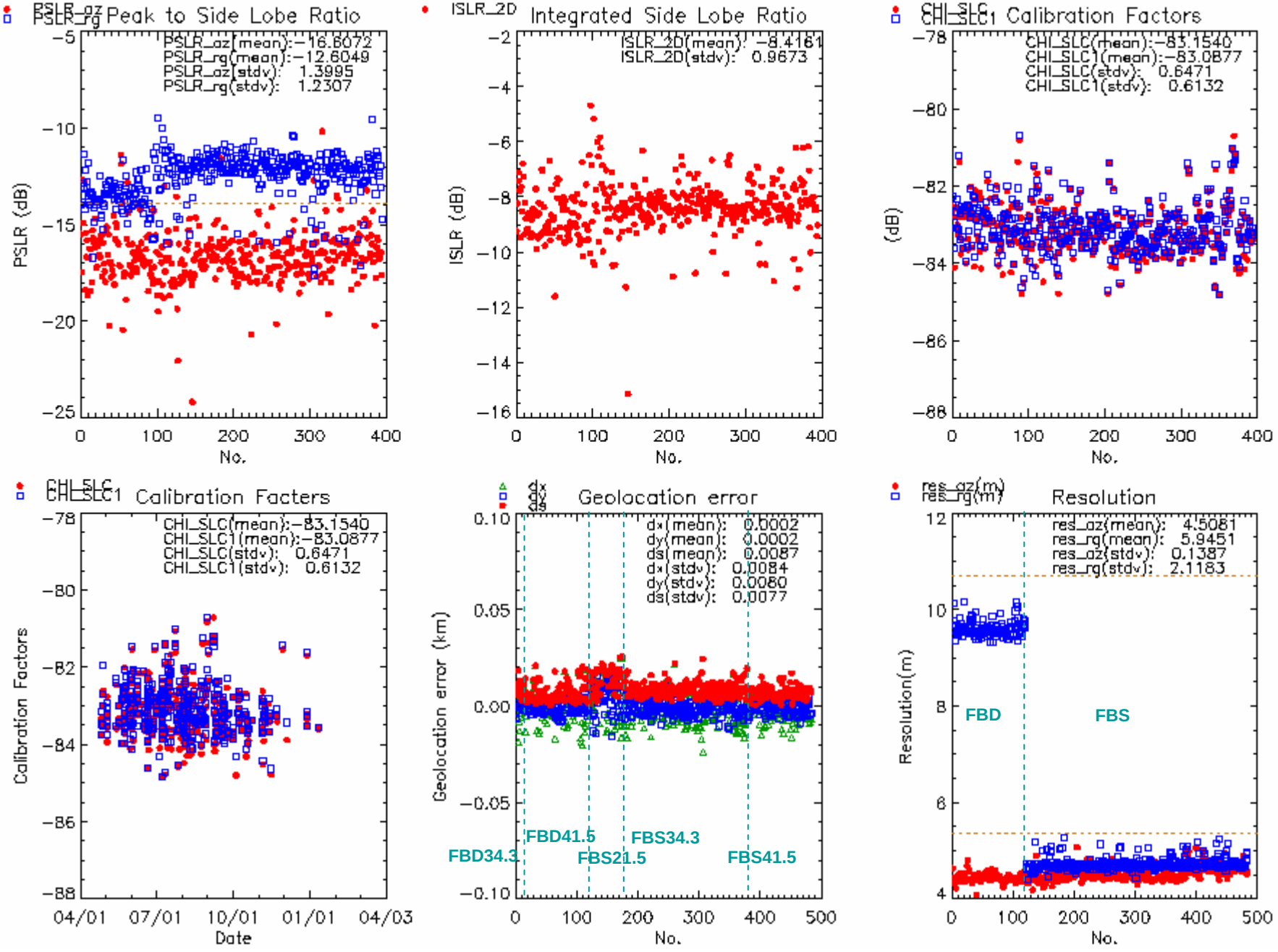
CAL instruments



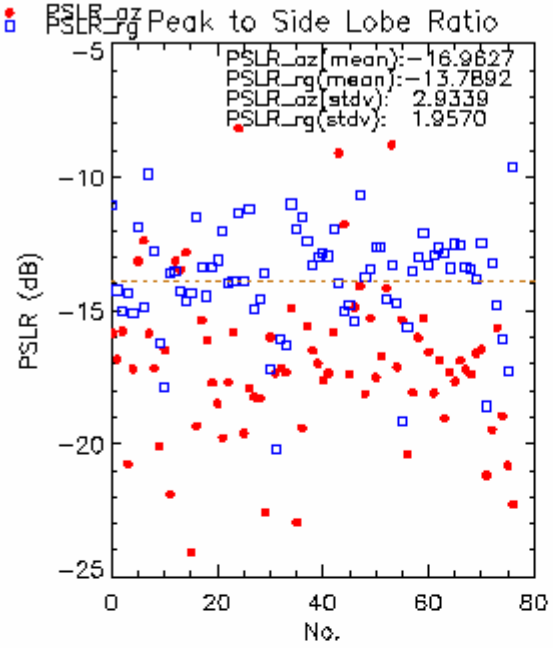
	ARC	PARC
Frequency band	1256～1284MHz	1256～1284MHz
Off nadir angle	9.9～50.8°	9.9～50.8°
RCS	15～60dBm²	15～60dBm²
RCS stability	<±0.1dB	<±0.1dB
ALOS tracking	Yes(program tracking)	Yes(program tracking)
Max. Rec. power	-44.5dBm	-44.5dBm
Max. trans. Power	22.5dBm	22.5dBm
temperature range	-10～＋50℃	-10～＋50℃
Humidity range	35～100%RH	35～100%RH

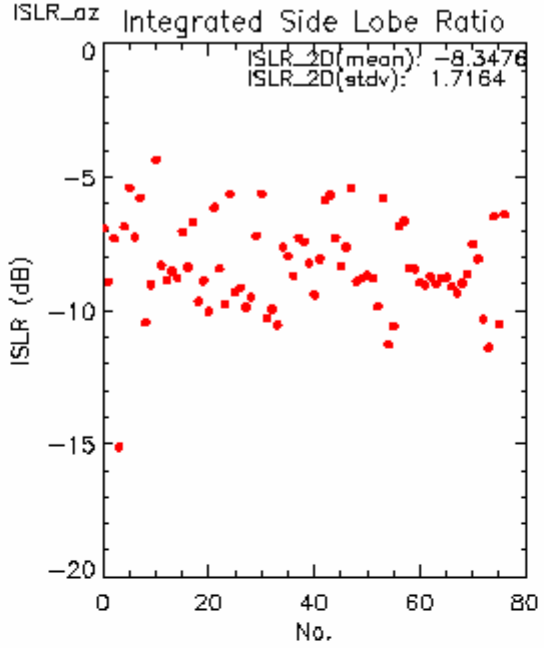


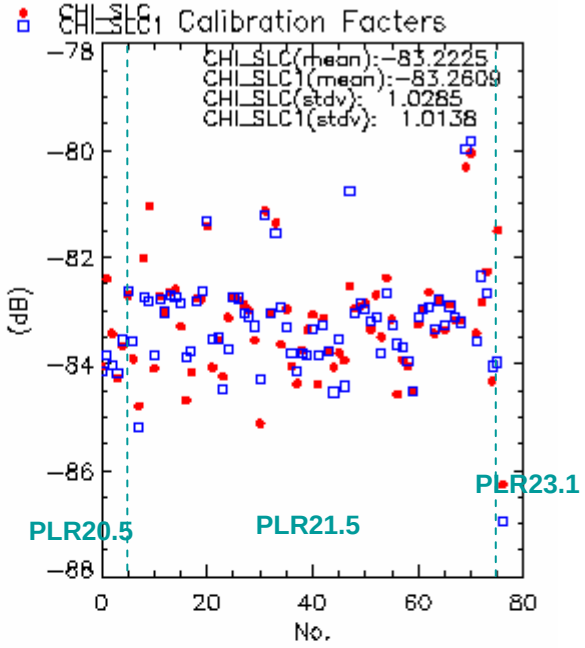
FBS/FBD Evaluation Results

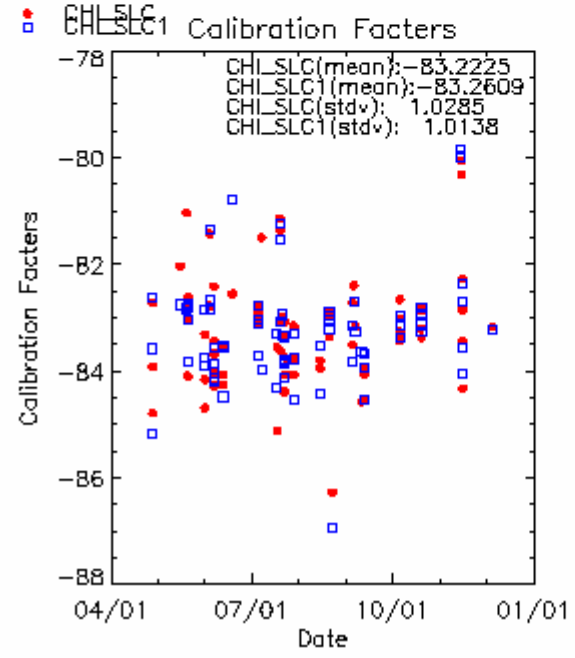


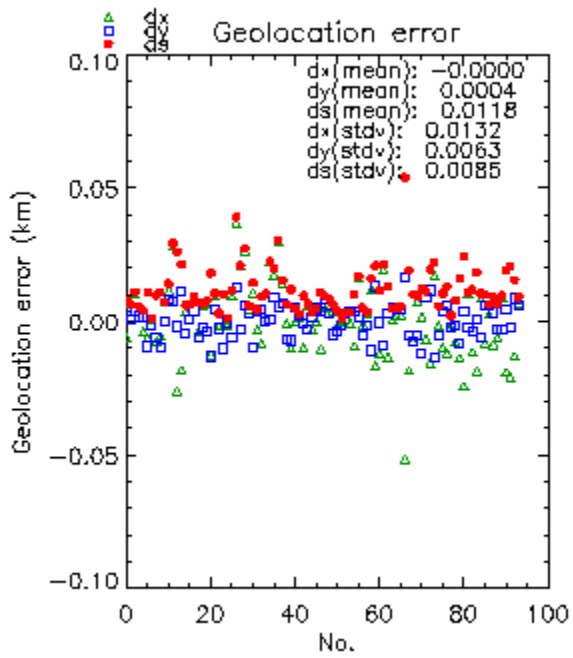
PLR Evaluation Results(1/2)

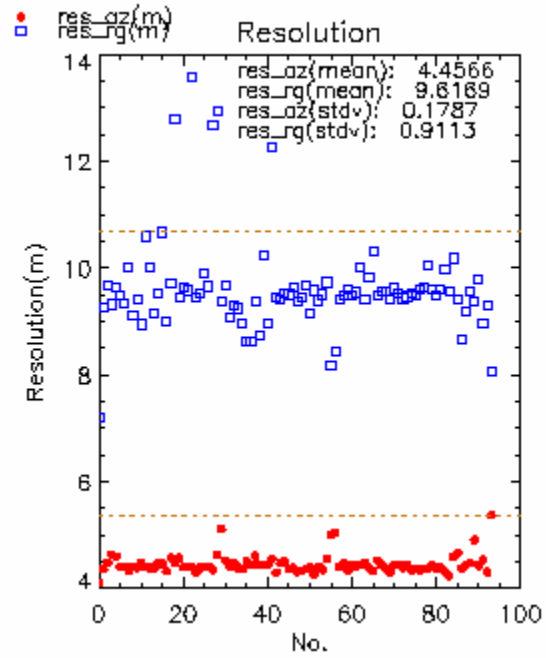




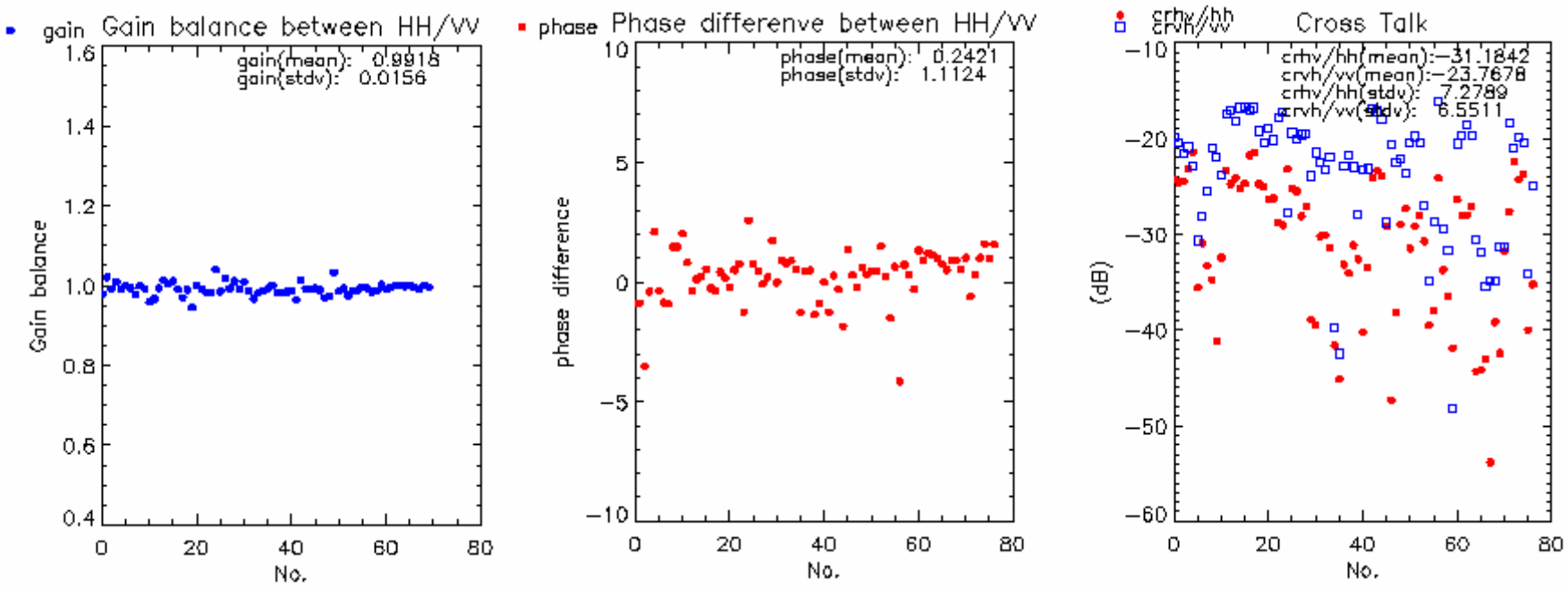




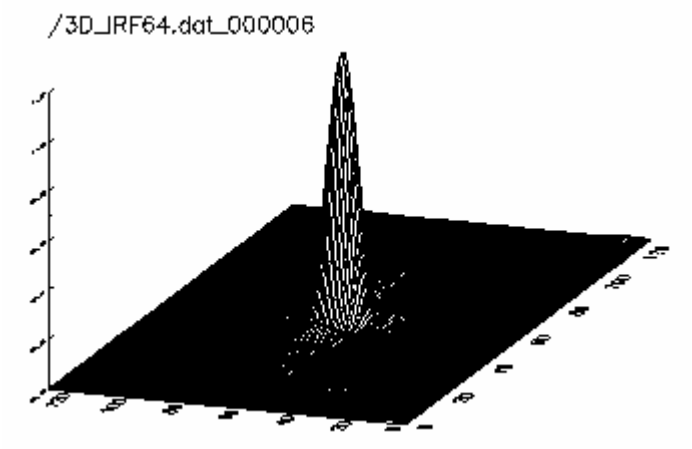




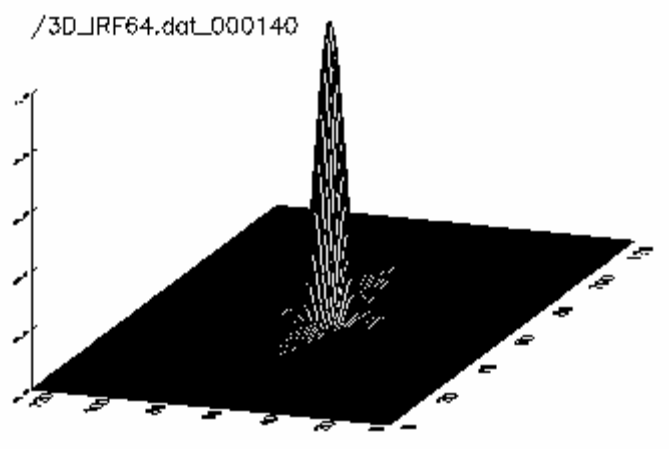
PLR Evaluation Results (2/2)



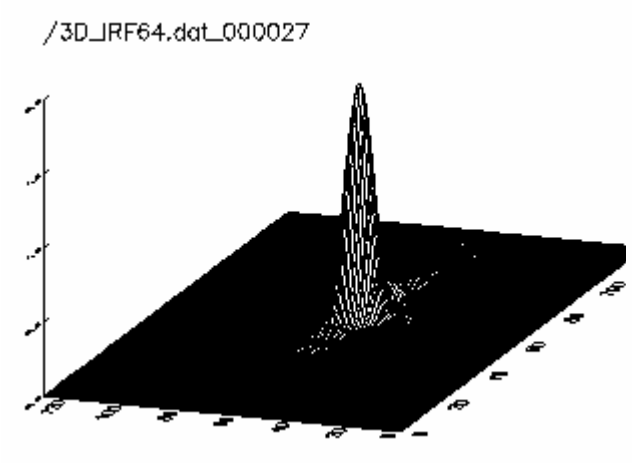
IRF of CR at different mode（FBD/FBS）



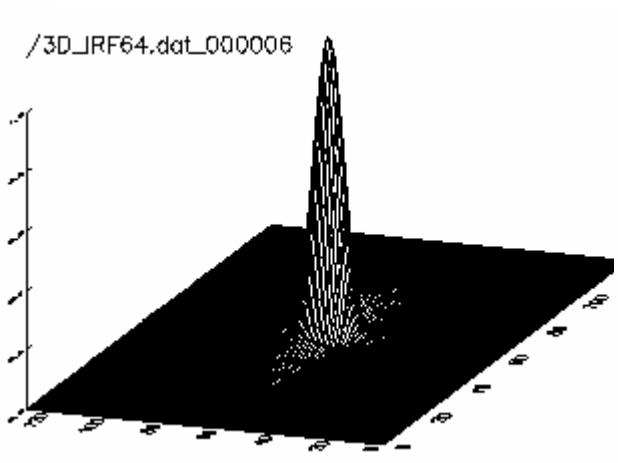
FBD34.3H
20060728/Tomakomai_J03



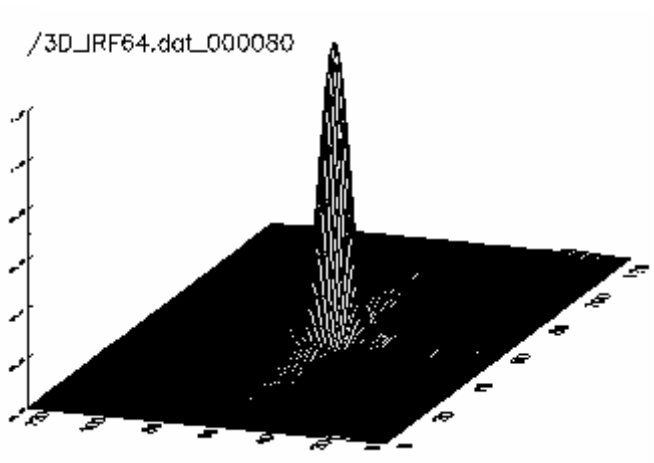
FBD41.5H
20060823/Maising



FBS21.5H
20060620/Tomakomai

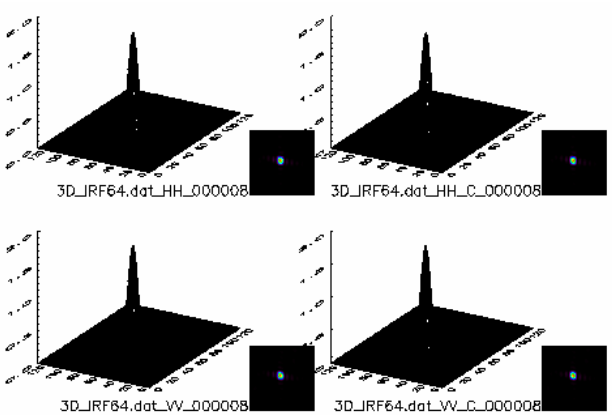


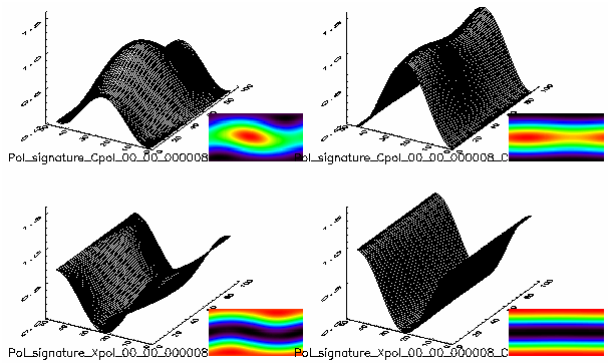
FBS34.3H
20060427/Watarase_J04



FBS41.5H
20060708/Alaska6_24

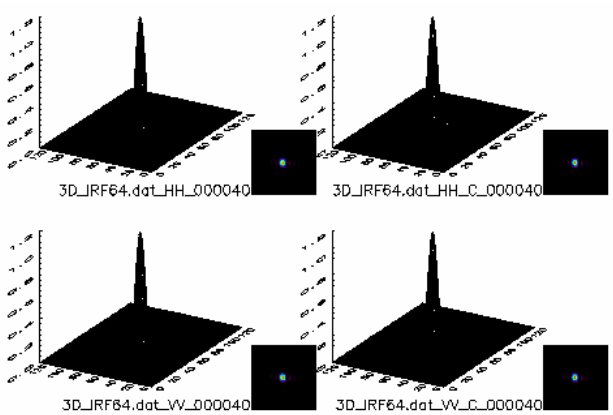
IRF of CR and Polarimetric signatures（PLR）

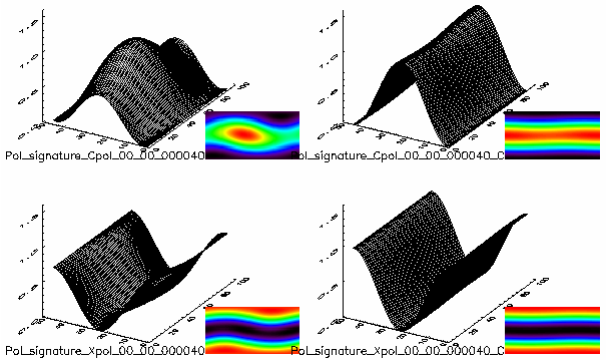




PLR21.5
20060515/Tutumi_J04

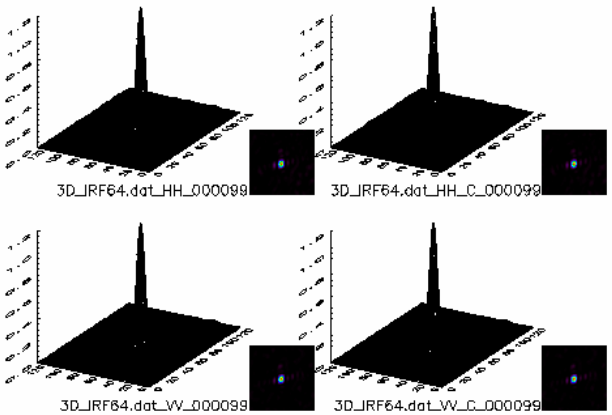
Before After

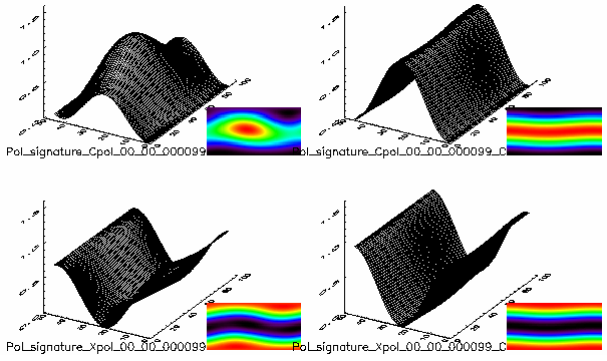




PLR21.5
20060603/Sweden1_3

Before After

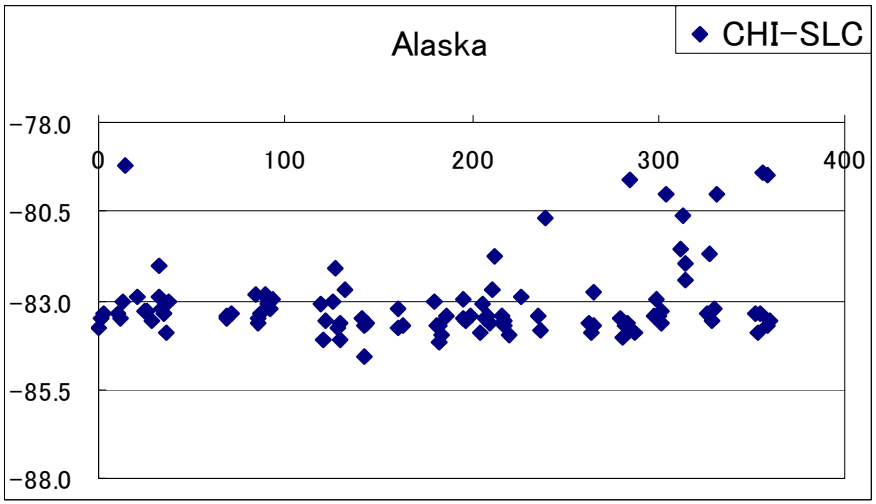


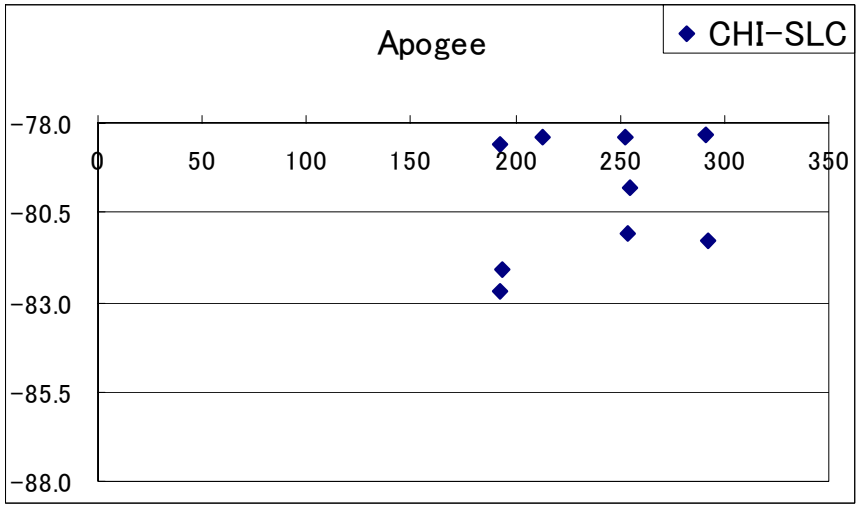


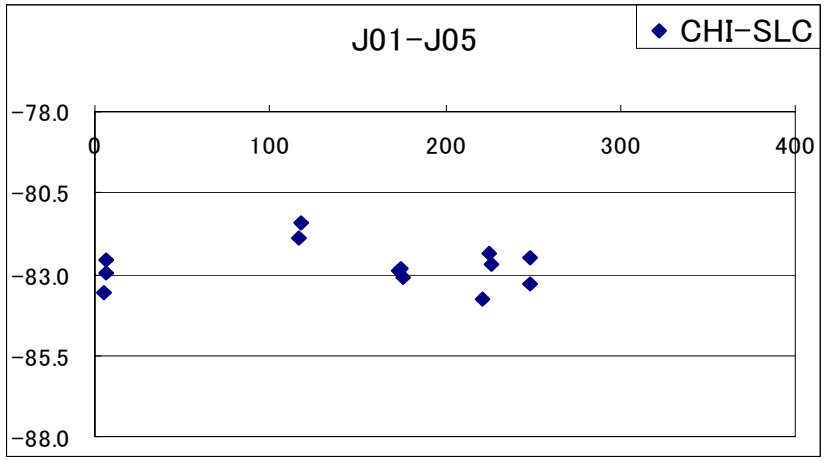
PLR21.5
20060728/Alaska1

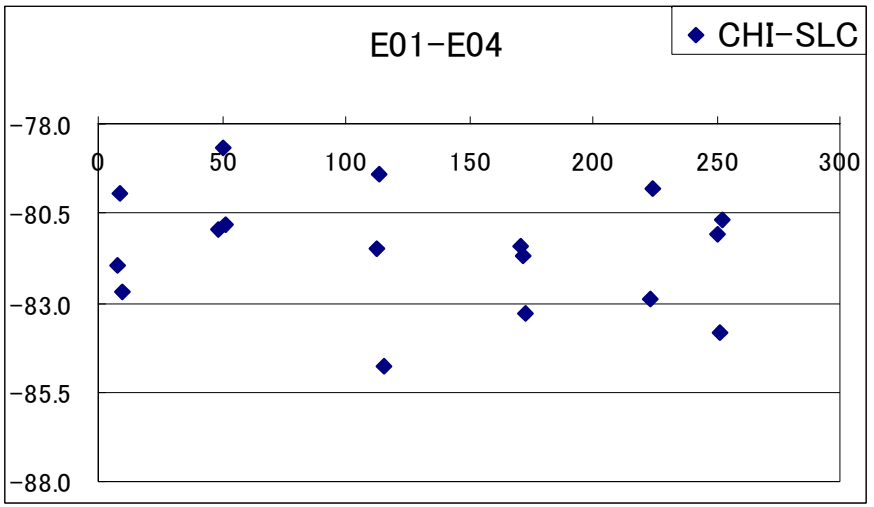
Before After

Site dependence of Cal factor (1/2)

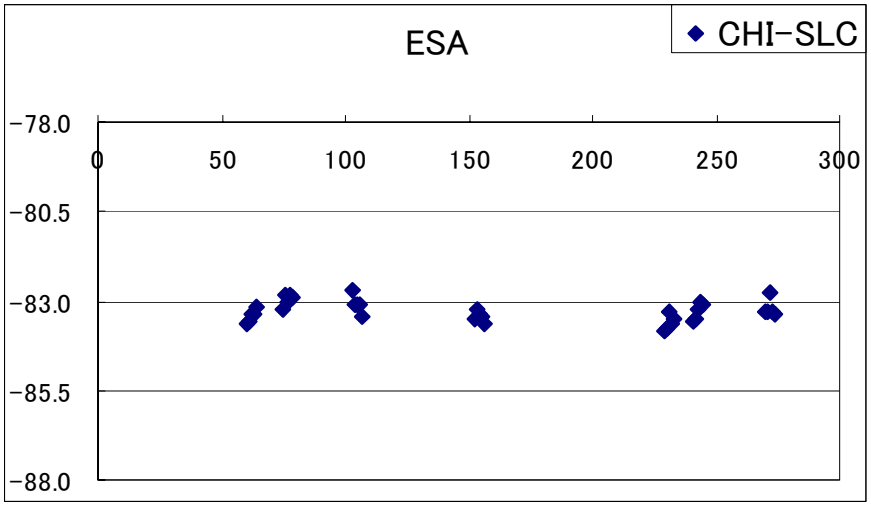


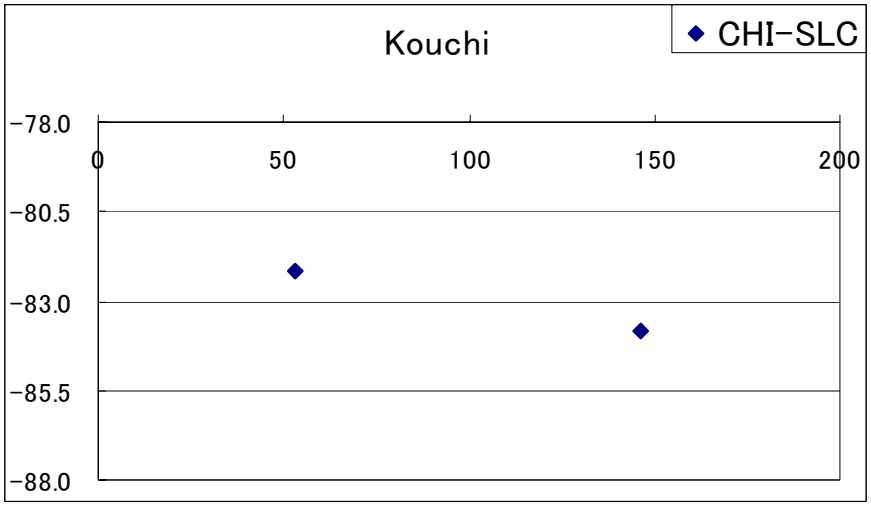


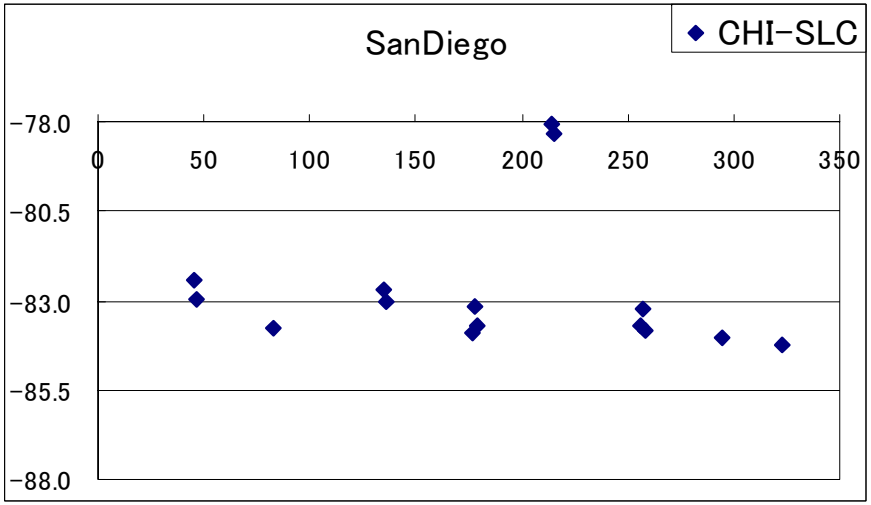


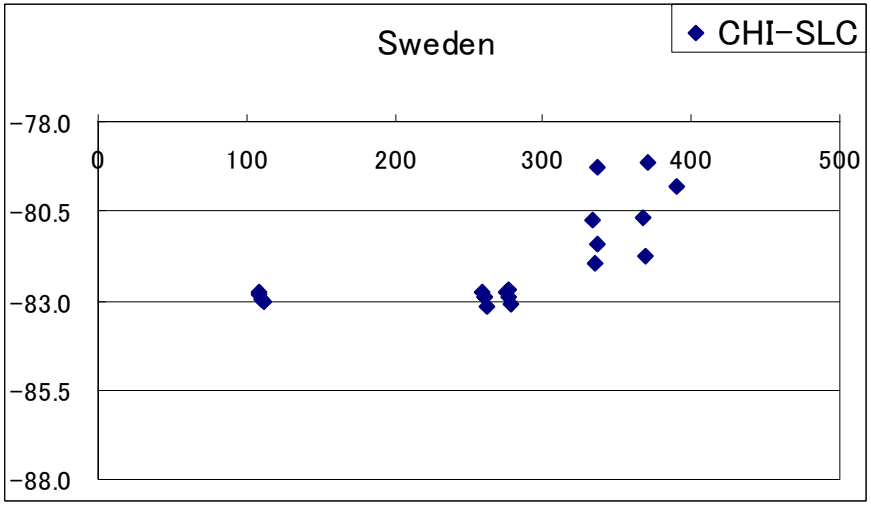


Site dependence of Cal factor (2/2)



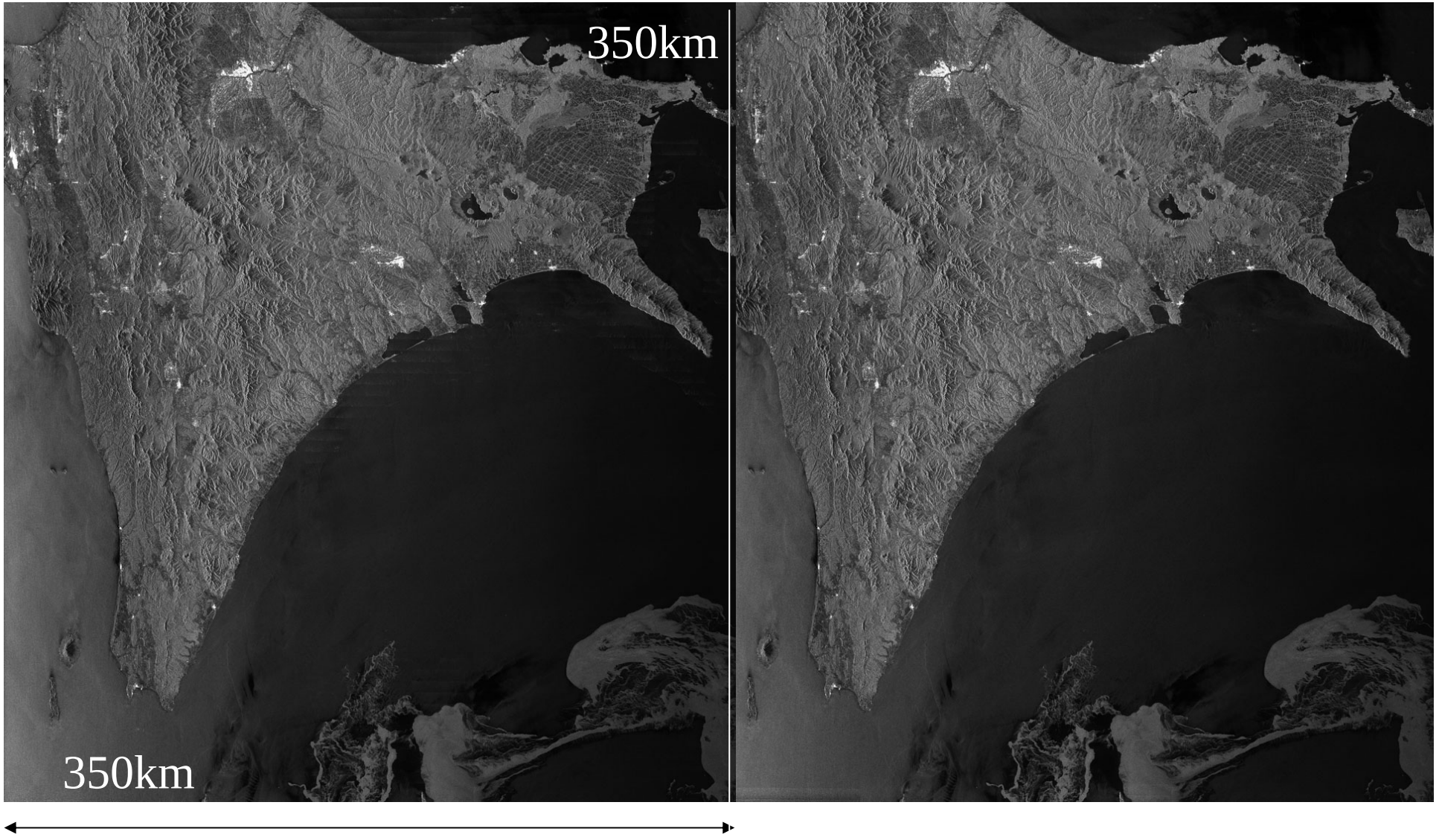






Azimuth ambiguity

No azimuth ambiguity



No filter:2006/4/18

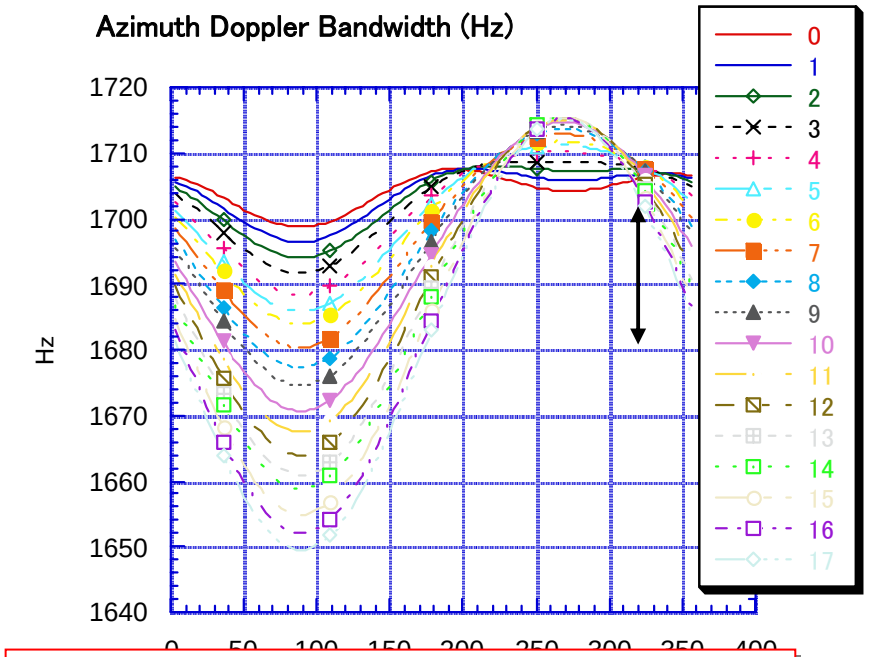
Azimuth filtered

prf observed

scan no.	#1	#2	#3	#4	#5
prf	1694	2375	1718	2164	1923
prf*1.2	2052	2052	2052	2052	2052

Ambiguities sometimes appeared in #1, 3, and 5 SCANs

Sampling theorem -> prf>band width or prf>1.2*BW

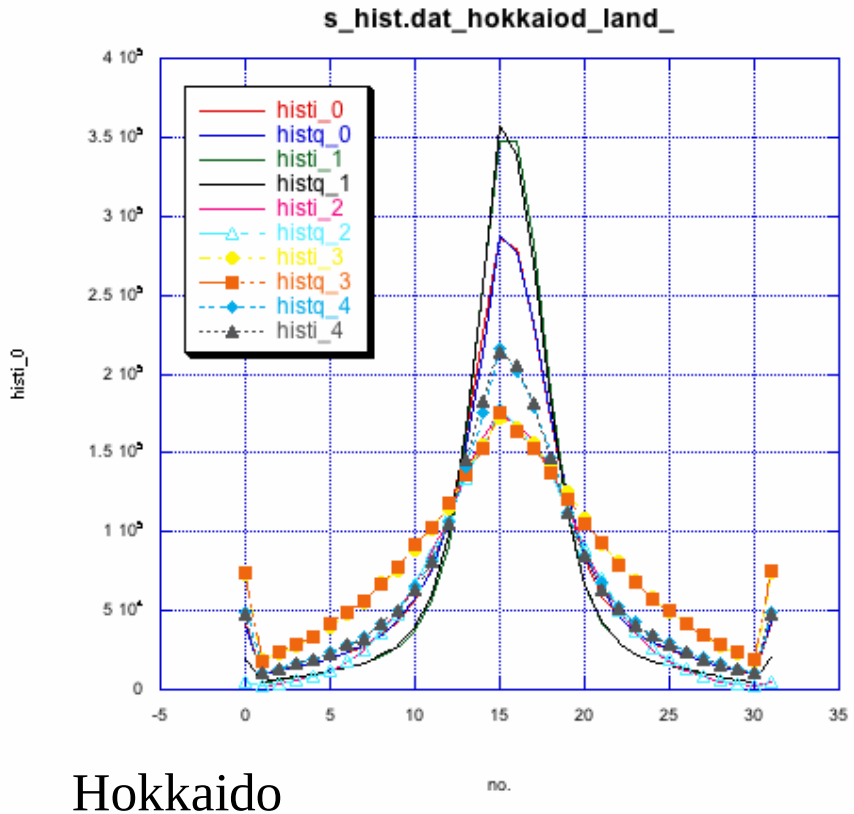


1650Hz<Bandwidth<1710Hz

No. of scans	Long/short	Number of looks
3	Short	6.54, 9.73, 7.42
4	Short	4.82, 7.13, 5.44, 7.12
5	Short	3.6, 5.35, 4.08, 5.34, 5.03
3	Long	3.21, 3.94, 3.01
4	Long	2.35, 2.89, 2.20, 2.82
5	Long	1.85, 2.27, 1.73, 2.21, 2.13

Number of looks

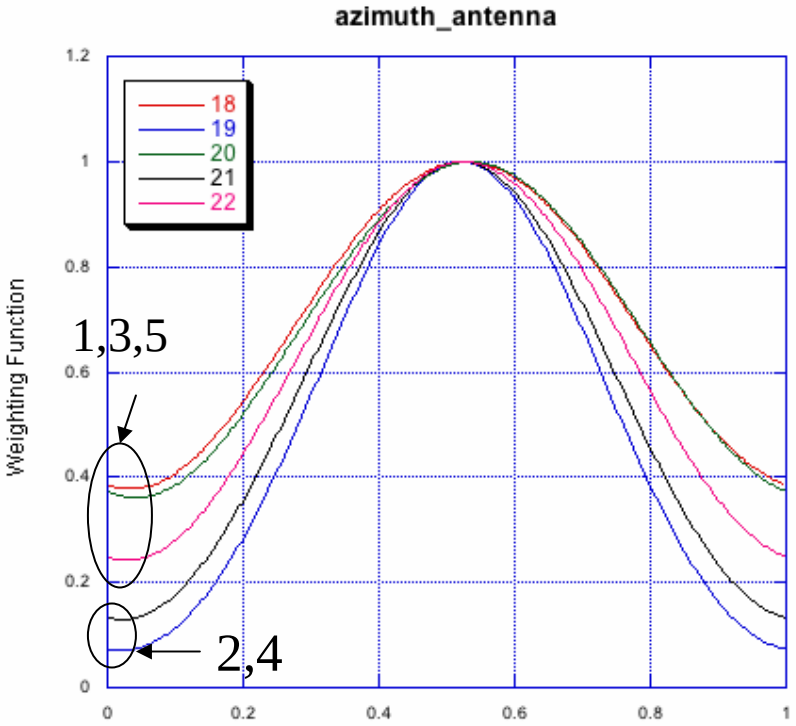
Histogram



Hokkaido
Dates 2006/4/18

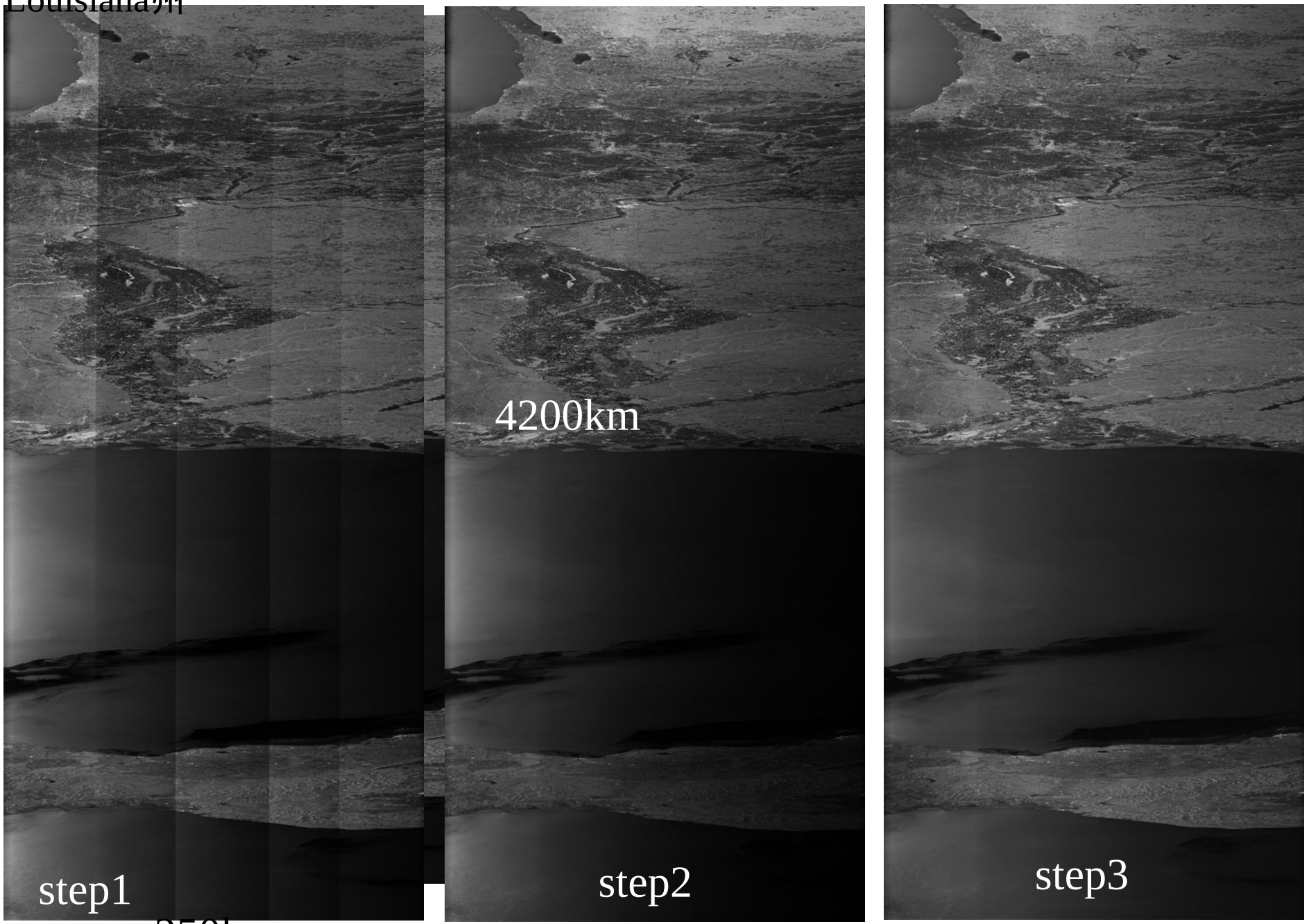
All scans
saturation rates < 5%

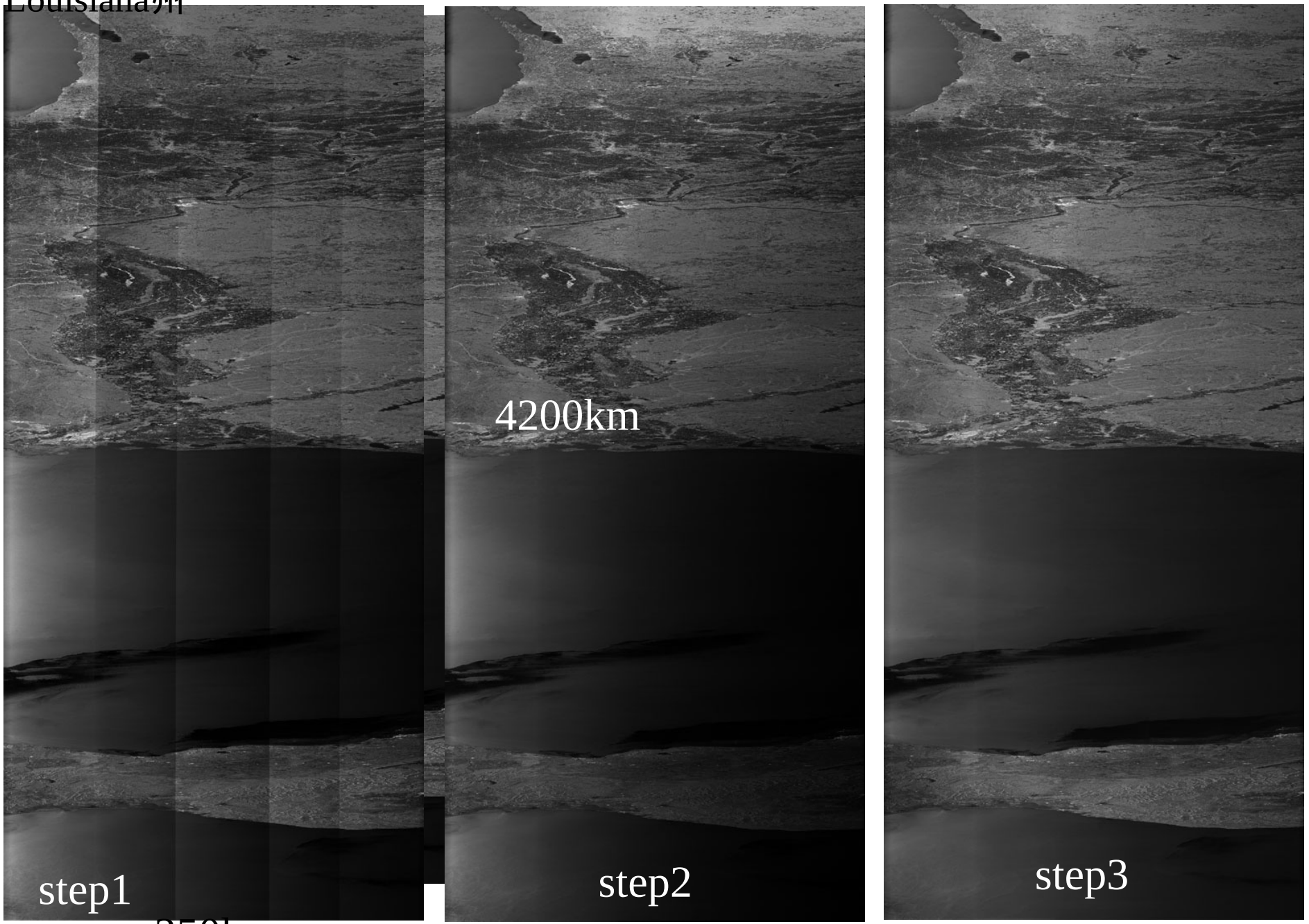
Azimuth spectrum of the SCANSAR data



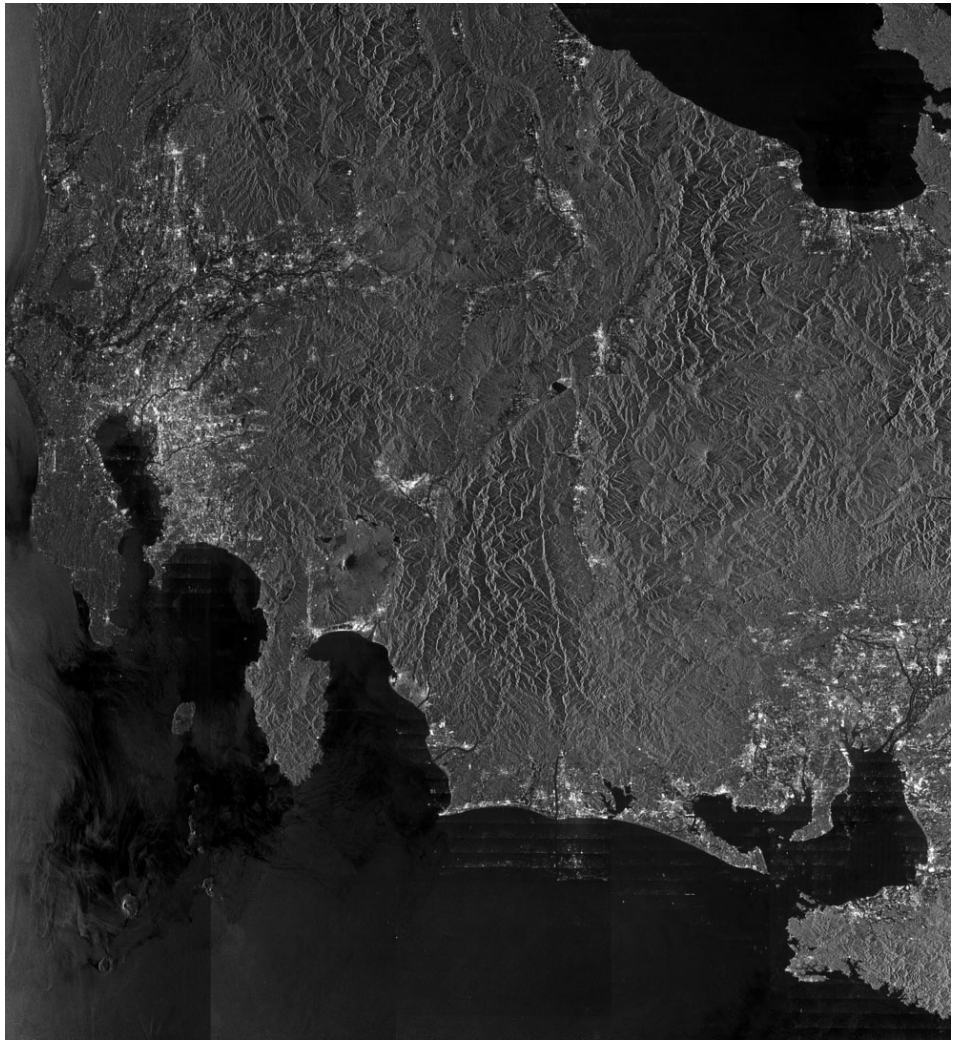
Smaller PRF shows high return from the edge and possible under sampling

Filtering reduces the azimuth ambiguity and resolution -> change of prf?

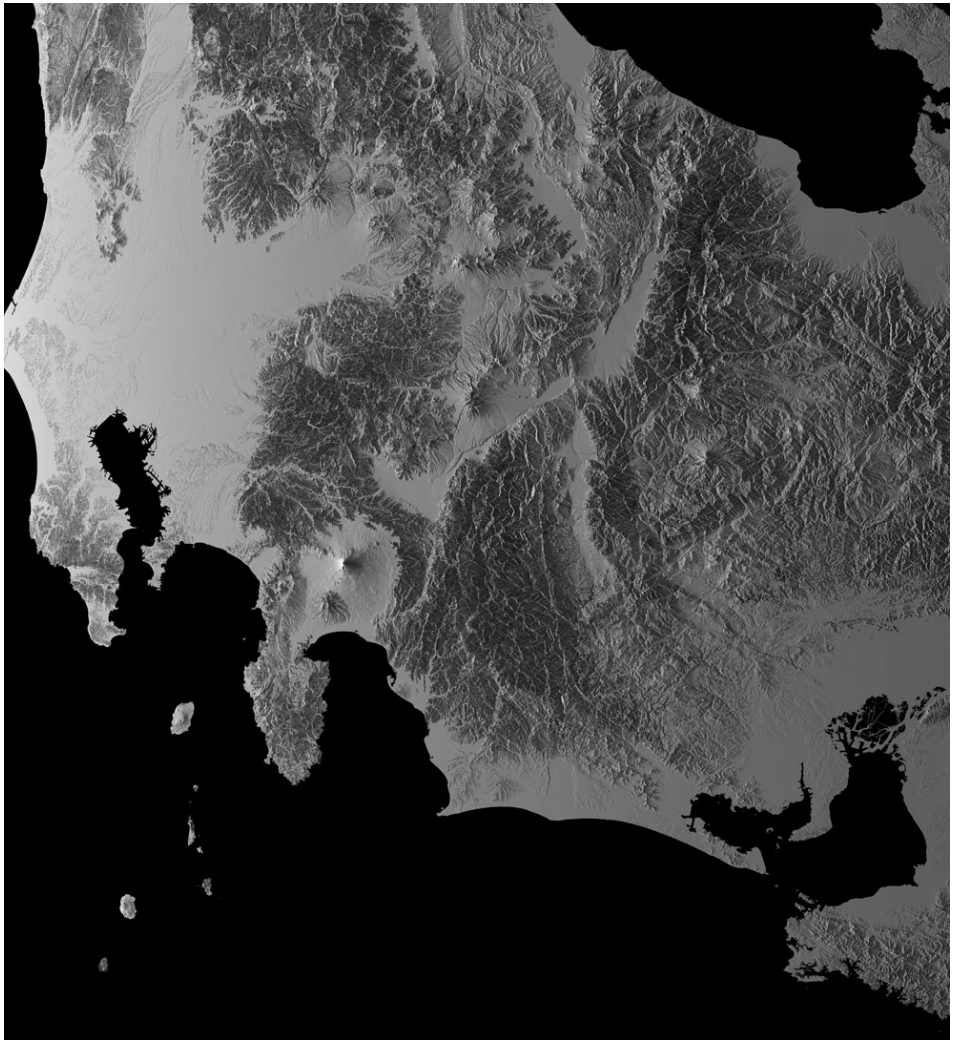

Louisiana州
4200km
step1
350km
step2
step3


Louisiana州
4200km
step1
350km
step2
step3

SCANSAR Evaluation



Amplitude（WB1）



Simulation（WB1）

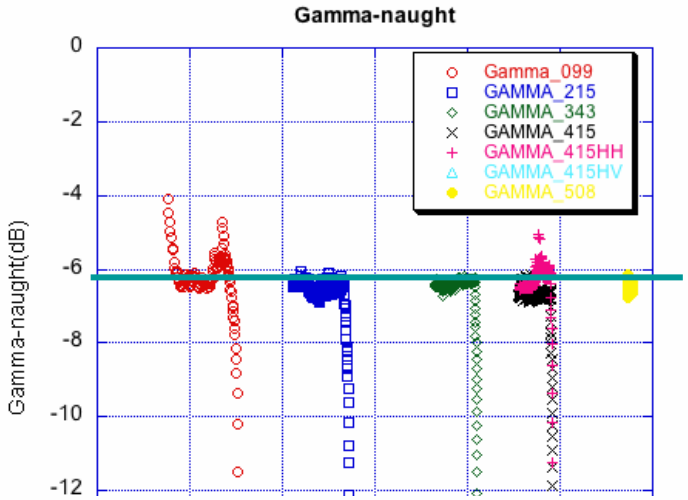
Geometric evaluation of the SCANSAR products

No	date	Ra offset	Az offset	Ra rms	Az rms
1	2006/4/28	-1.1	-0.6	0.1	0.5
2	2006/6/8	-0.4	-0.9	0.2	0.5
3	2006/7/4	-0.5	-1.1	0.2	0.5
4	2006/9/13	-1.2	-0.6	0.1	0.5
5	2006/9/24	-0.4	-0.8	0.2	0.5
6	2006/10/22	-0.3	-0.7	0.3	0.5
7	2006/11/6	-0.9	-0.8	0.2	0.6
8	2006/11/30	-0.6	-0.6	0.2	0.5
mean		-0.675	-0.7625		

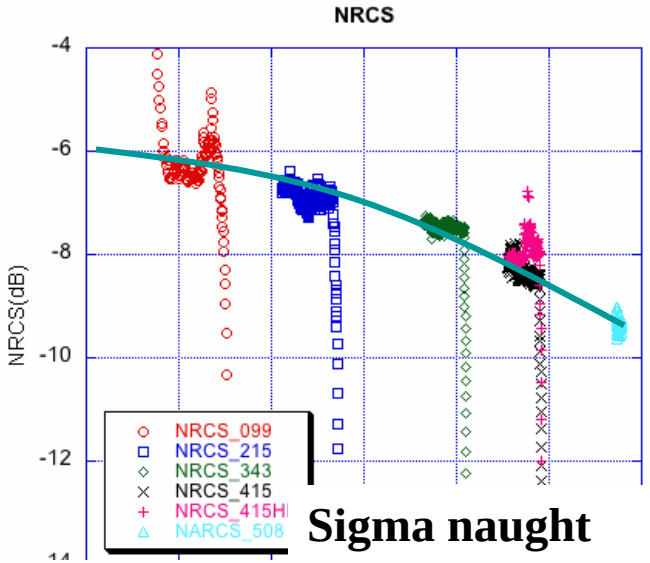
unit: pixel space by 100m

To be updated

Evaluation of calibration : Incidence angle dependency of the Amazon sigma-naught, and noise equivalent sigma zero

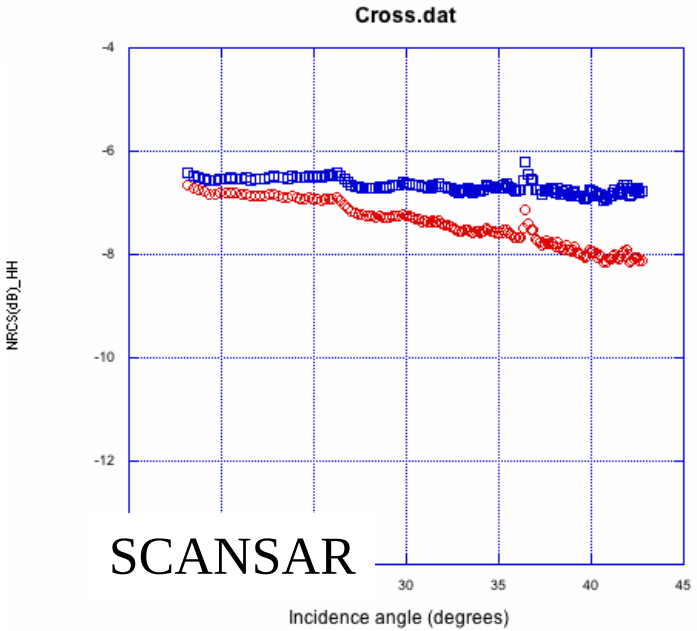


Gamma naught

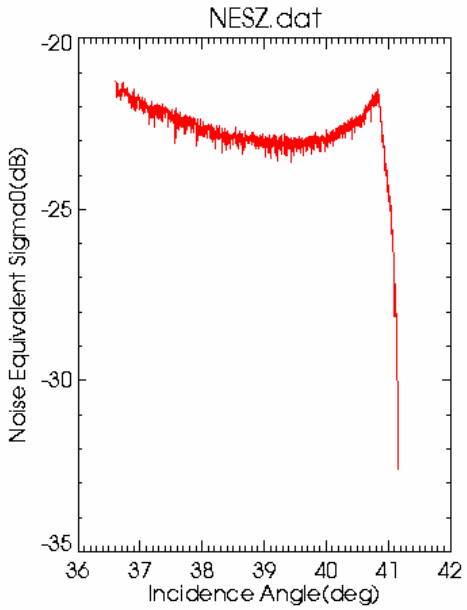


Sigma naught

antenna/Greenland/FBS343H/RSP041/20060715



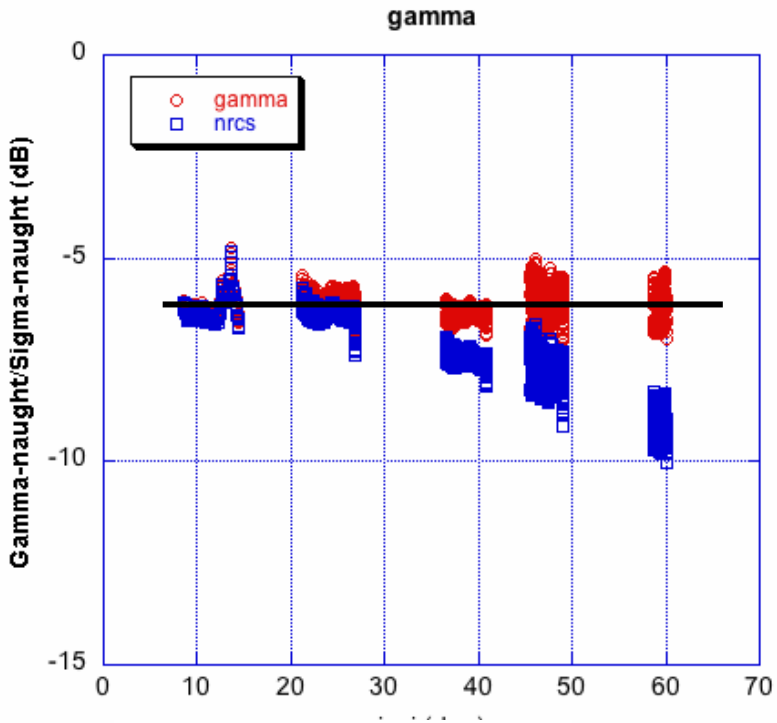
SCANSAR



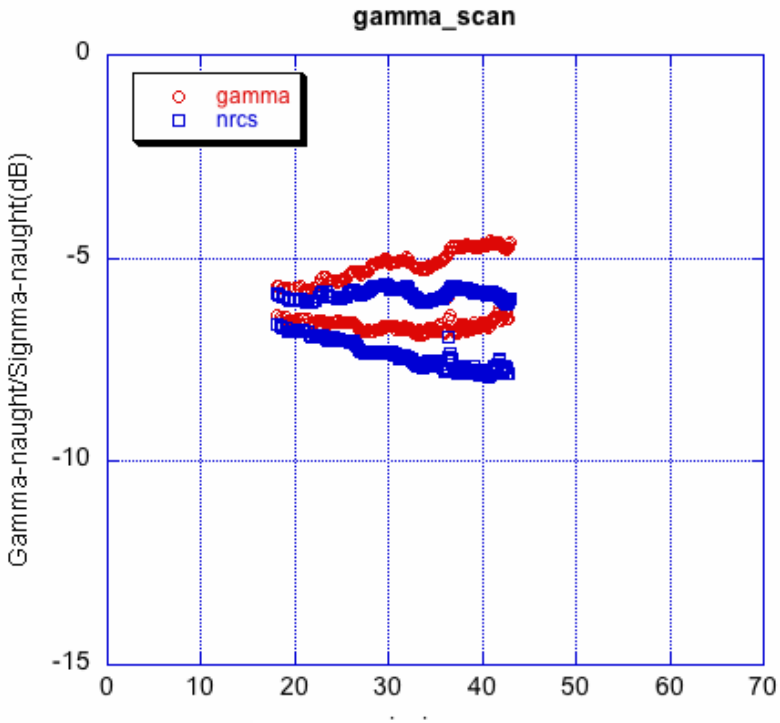
-23 dB

Sigma-zero verification: using the Amazon data through NRCS and Gamma-zero.

gamma-naught (sigma-zero/cos(incidence angle)) : independent of incidence angle and almost equal to -6.5 dB.



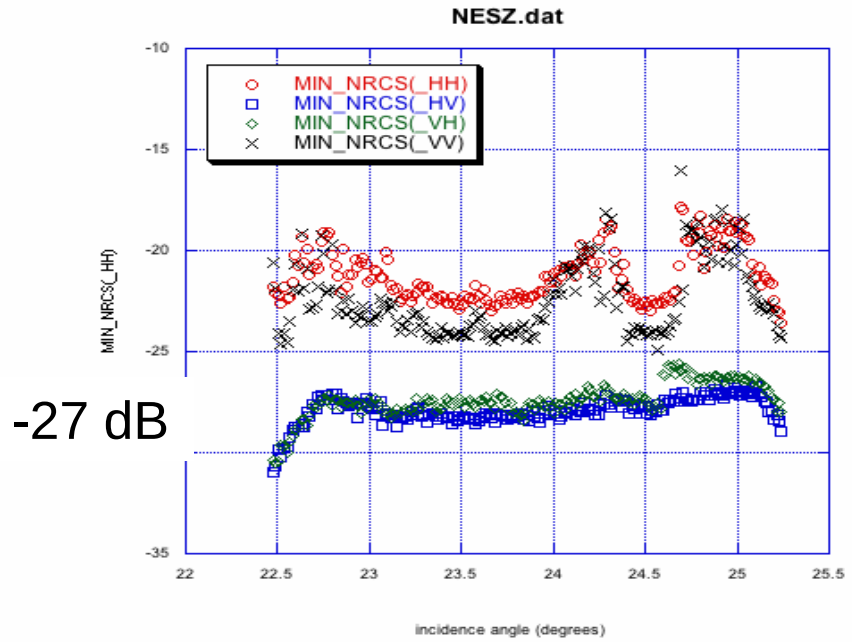
STRIP mode



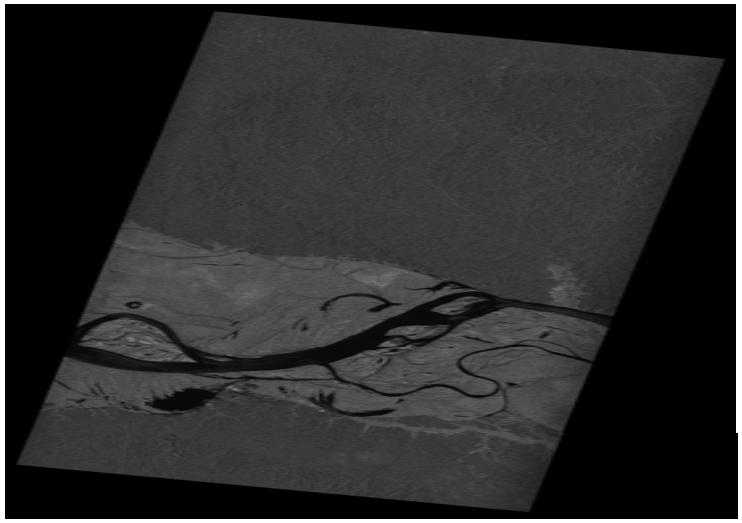
SCANSAR mode

Noise equivalent sigma-zero

Measured from the image:-34dB was measured, min. among spaceborne SAR

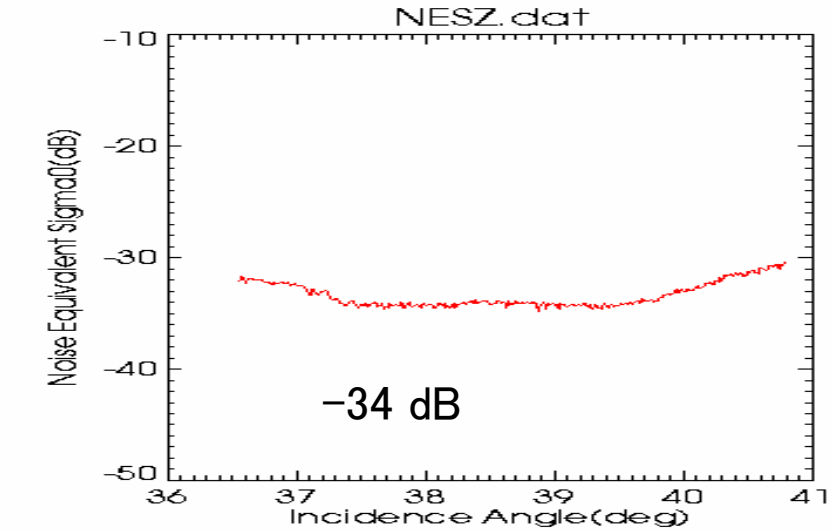


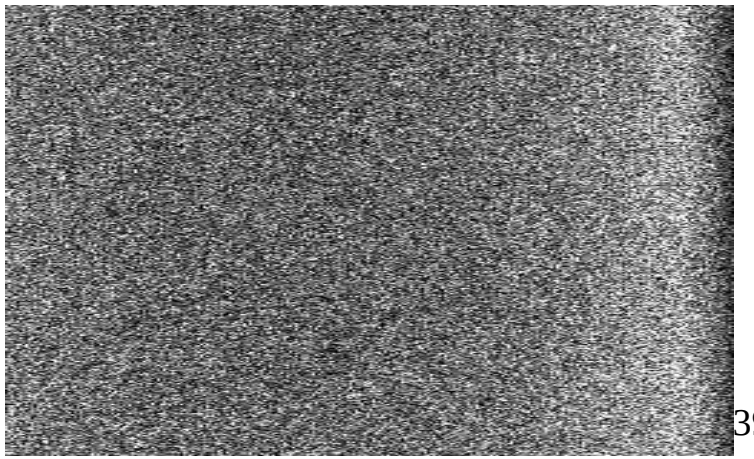
-27 dB



Amazon (Polarimetry)

Pchk/FBD343-0/20070216/RSP603/





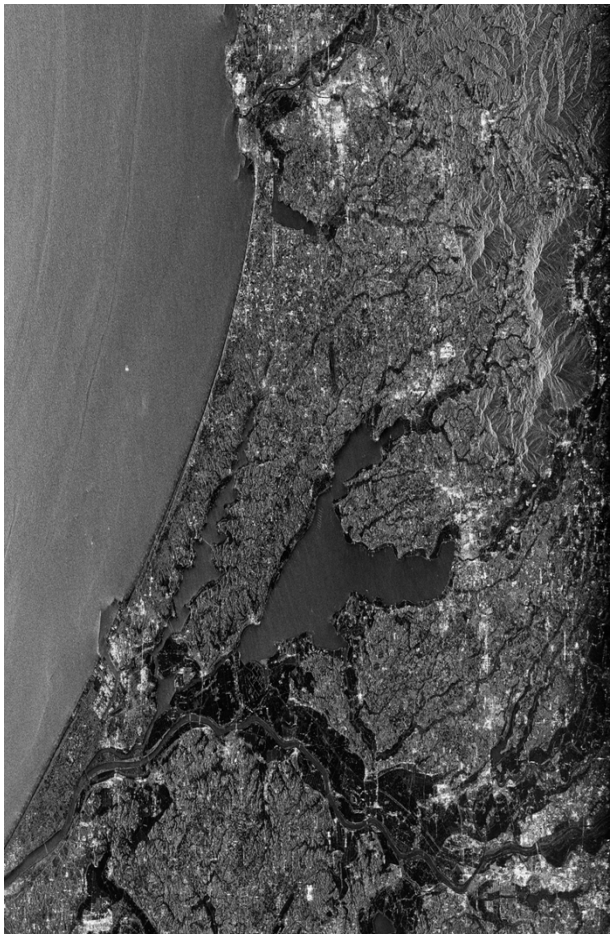
Hawaii (FBD+HV 34.3)

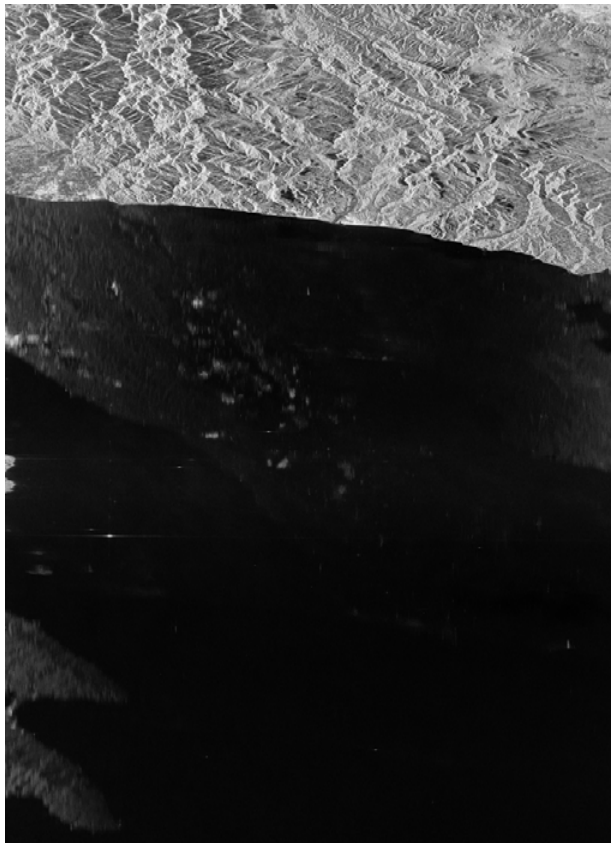
PALSAR calibration results (summary)

items	values	NOD	spec	remarks
geometry	9.3m(RMS:distance)***	615	100m	all modes
radiometry	0.64dB****/0.17dB*	478/16	1.5dB	all modes
polarimetry	VV/HH amp ratio(dB):0.02dB(0.04) VV/HH phase diff.(deg):0.321(1.01) cross talk :31~40dB	79 79 79	0.2dB 5deg 30dB	POL
NESZ	-34dB		-23dB	all modes
resolution(m)	azimuth :4.49m(0.1m) range(14MHz):9.6m(0.1m) range(28MHz):4.7m(0.1m)	478 478 478	4.5m 10.7m 5.4m	all modes
side lobe(dB)	PSLR(azimuth) : -16dB PSLR(range) : -12.5dB ISLR : -8.6dB	478 478 478	-10dB -10dB -8dB	all modes
ambiguity	azimuth:zero range:~23dB@ image end		16dB** 16dB	all modes

note)数値は平均値，括弧内は標準偏差,＊スウェーデンサイトのみの結果,**70km幅,***1m改善,****:0.1dB改善

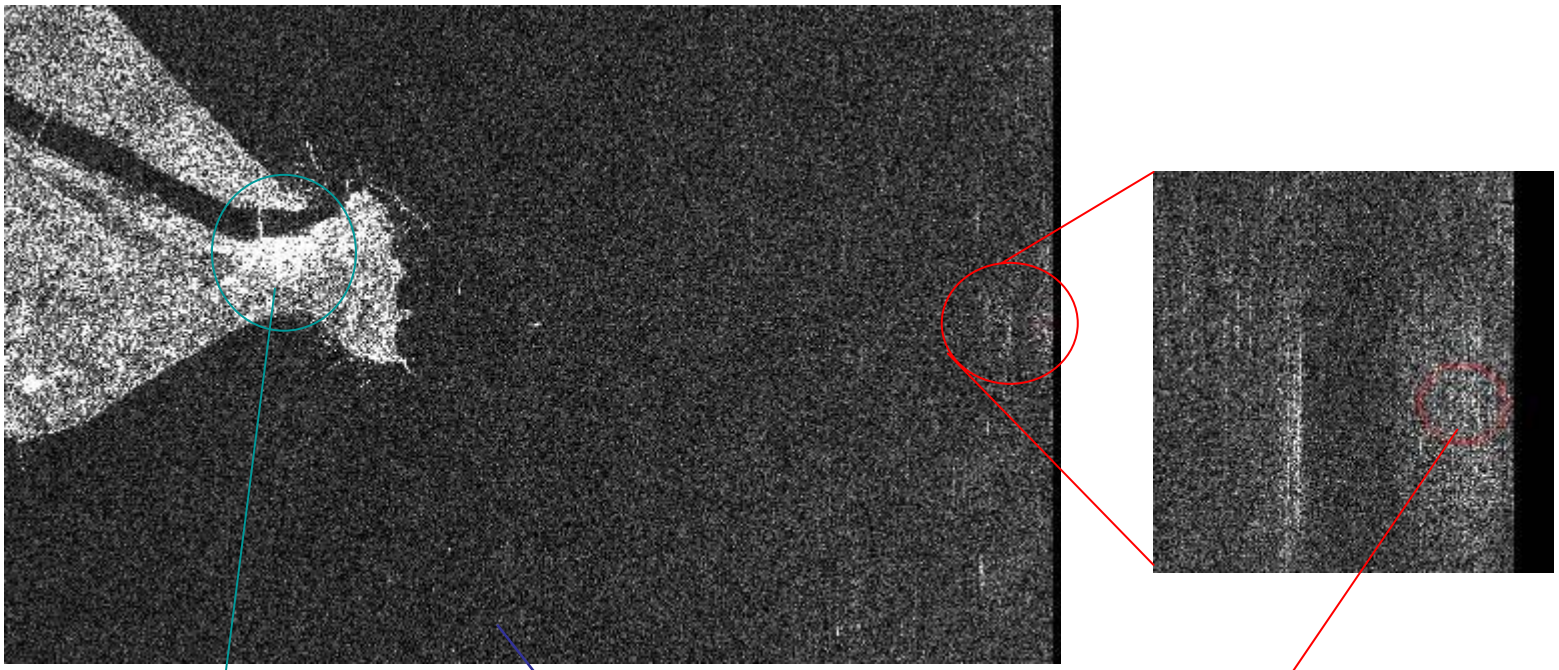
Ambiguities





FBS21.5	FBS34.3	FBS41.5
RA=not measured	RA=13 dB~22 dB	RA=17 dB

Noise evaluation

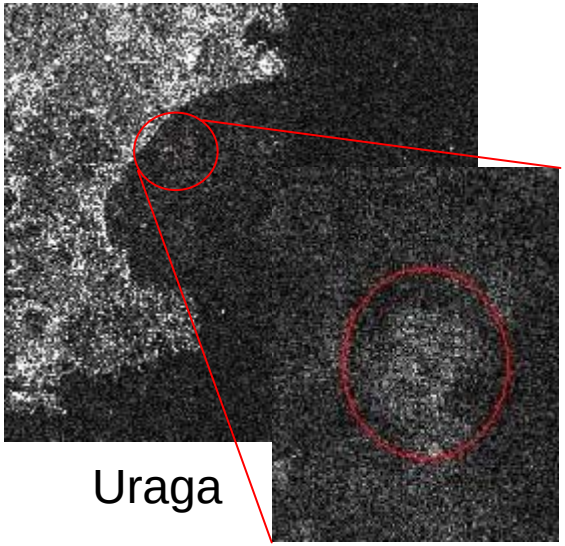


2006/12/25 FBS34.3H RSP58 (Bousou)

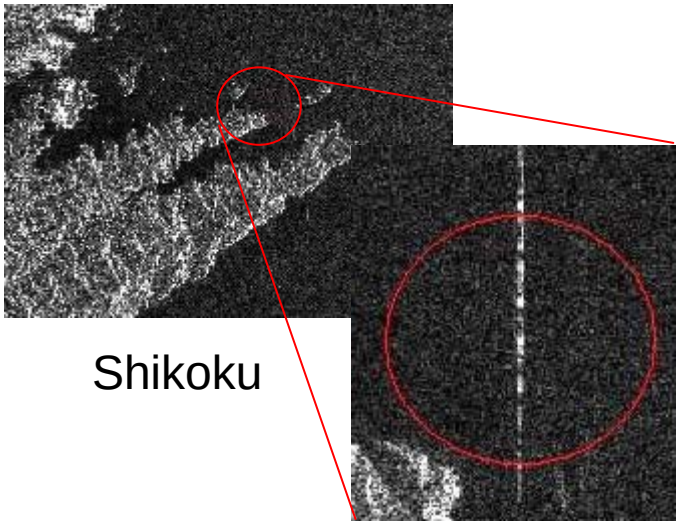
City=2.30E+13

Sea=5.40E+10

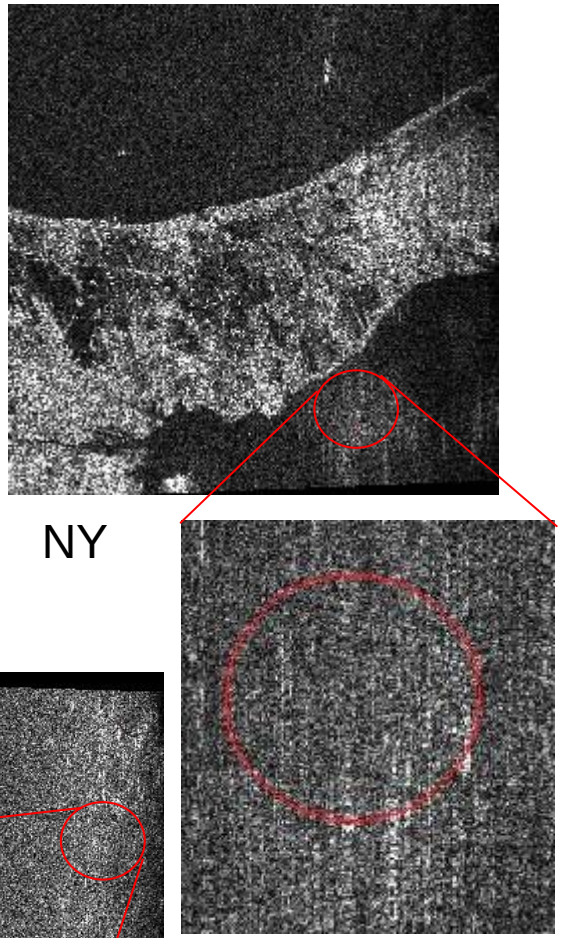
Noise=6.50E+11



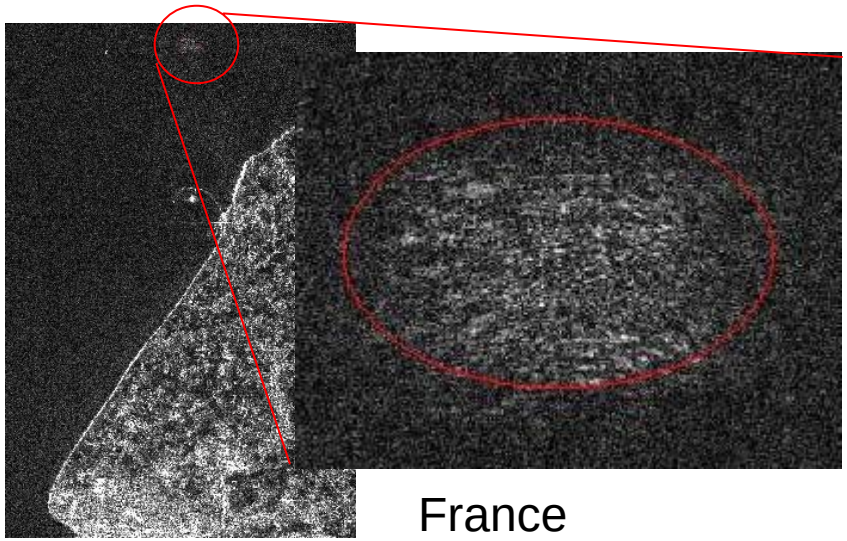
Uraga



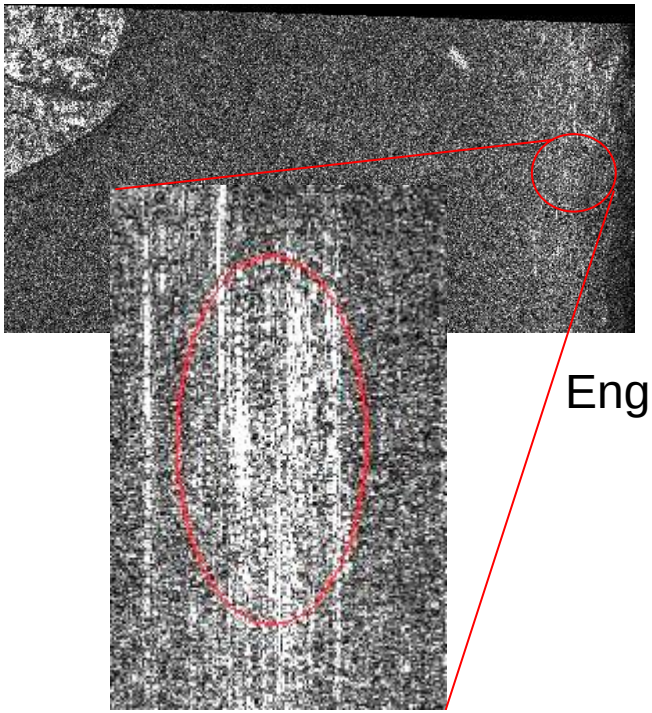
Shikoku



NY



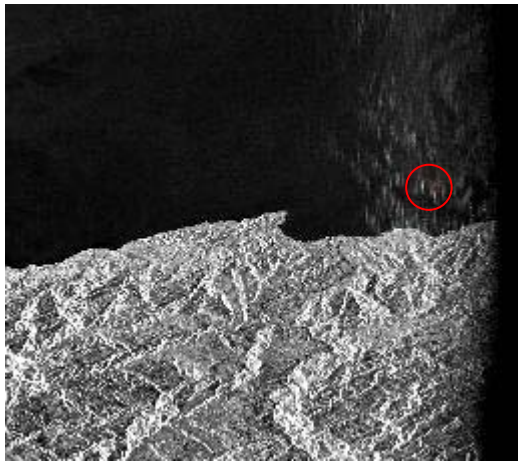
France



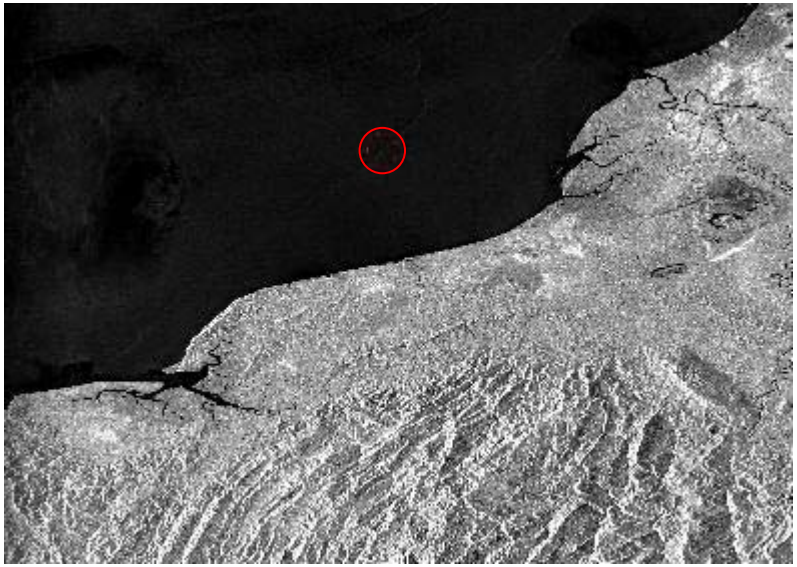
England

Obs. Date	MODE	RSP	Area	City	Noise	Sea	SA(dB)
2006.9.12	FBS343	58	Uraga	2.50E+13	1.10E+11	5.70E+10	−24.2
2006.12.25	FBS343	56	Bousou	2.30E+13	6.50E+11	5.40E+10	−16.5
2006.12.28	FBS343	67	Shikoku	2.30E+14	8.90E+11	1.30E+11	−24.1
2006.12.30	FBS343	657	England	6.80E+13	4.00E+11	1.30E+11	−22.5
2007.1.4	FBS343	660	France	7.20E+13	2.50E+11	1.10E+11	−25.0
2006.12.24	FBS343	129	NY	2.80E+14	1.50E+12	2.10E+10	−22.5

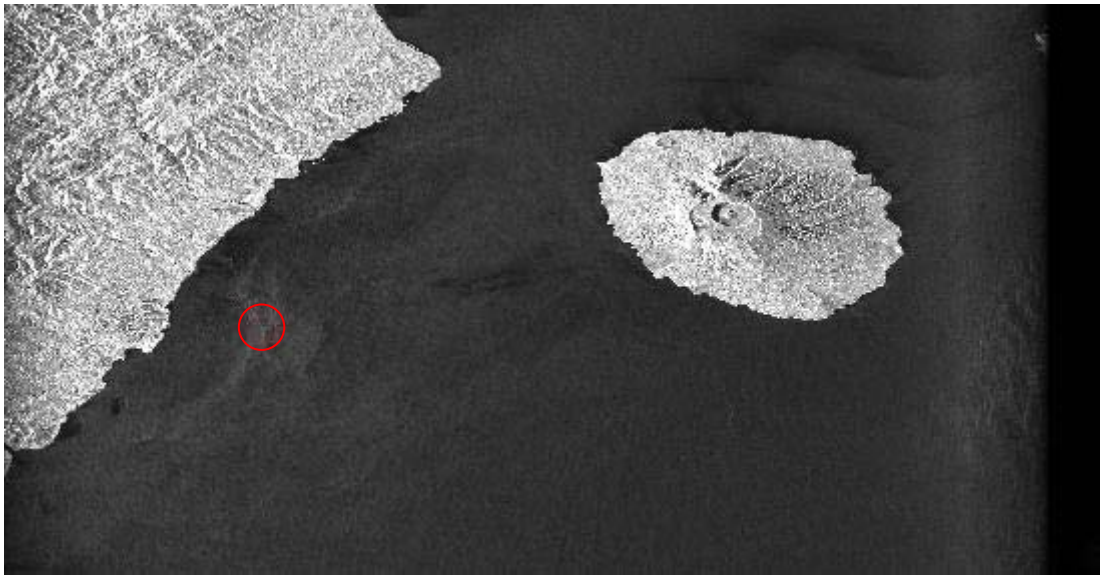
RSP361



RSP362



RSP365



RSP364

Range ambiguities

Date	Mode	RSP	Region	DN	DN Ave at ambiguity	DN ave at the ocean	Ambiguity ratio (dB)	Note
	FBS343	361	New ginia	12795	3279.77	1665.53	-13.04	KC
	FBS343	362	New ginia	18168	2602.16	1087.16	-17.69	KC
	FBS343	364	New ginia	25501	2276.73	871.66	-21.66	KC
	FBS343	365	New ginia	19145	1553.94	752.6	-22.96	KC

Conversion to sigma-naught

$$\sigma^0{}_{sigma-sar,Q16} = 10 \cdot \log_{10}\left\langle DN^2 \right\rangle + CF_1$$

$$\sigma^0{}_{sigma-sar,slc} = 10 \cdot \log_{10}\left\langle I^2 + Q^2 \right\rangle + CF_1 - A$$

CF	mean(dB)	std (dB)
CF_1	-83.0	0.67
A	32.0	-

Parameter summary

factors	Values
Range time offset	-0.31539μs
Azimuth time offset	-2.239ms(Strip) -67ms(SCAN)
Polarimetric distortion matrices PLR215	(1.000000e+00 ,0.000000e+00) (-2.804701e-02,-2.933507e-03) (3.164040e-02 ,-1.038148e-02) (9.352351e-01 ,4.073565e-01) (1.000000e+00 0.000000e+00) (-3.699034e-02,8.453709e-04) (2.115907e-02 ,5.648345e-03) (7.249998e-01 ,5.535966e-04)

6 Calibration summary

•PALSAR was calibrated using the Amazon data and the point target data, and achieved the accuracy measure of geometry（10m<100m）、radiometry（0.7 dB <1.5dB）, both meets the specification, and polarimetry meets the specification that（CEOS SAR）（HV gain variation-0.018dB＜0.2dB、phase variation -1.7 degrees＜5 degrees）。

•Image quality：appears 17 dB range ambiguities at 41.5 degrees. Electric properties at 34.3 and 21.5 degrees exceed 41.5.

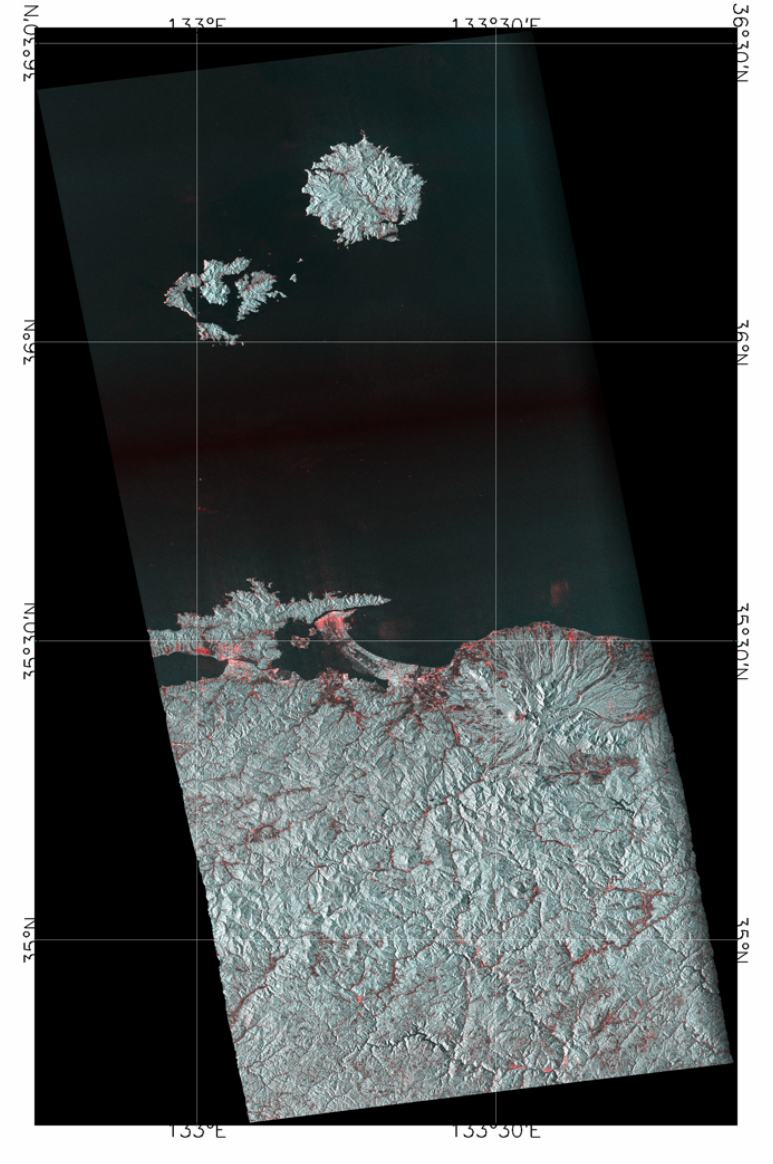
•Range ambiguities were measured world widely. The worst values for FBS343 was 13 dB. The average was 23 dB.

•Conversion method from DN to sigma-naught and position were prepared.

7 High level products

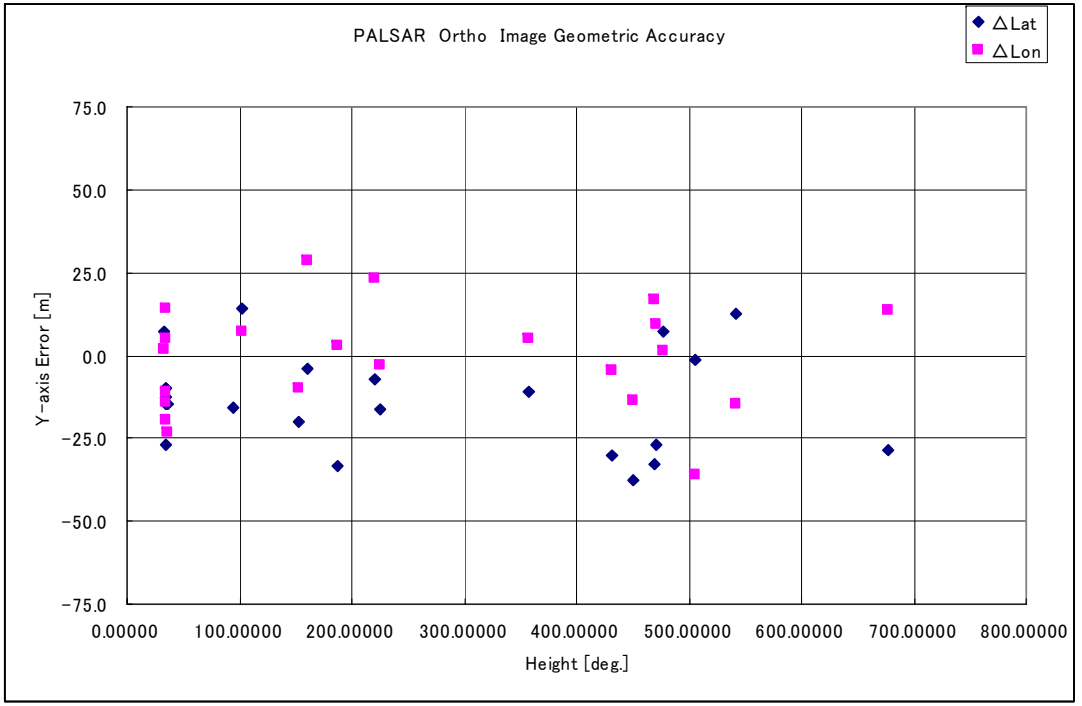
Products	status	target
Ortho rectified	Meets the accuracy req.	March 29 2007
InSAR DEM	Meets the accuracy req.	March 29 2007
Surface deformation	Meets the accuracy req.	March 29 2007
Mosaic	Meets the accuracy req.	March 29 2007

■PALSAR high level products ■Geometric evaluation of Ortho products



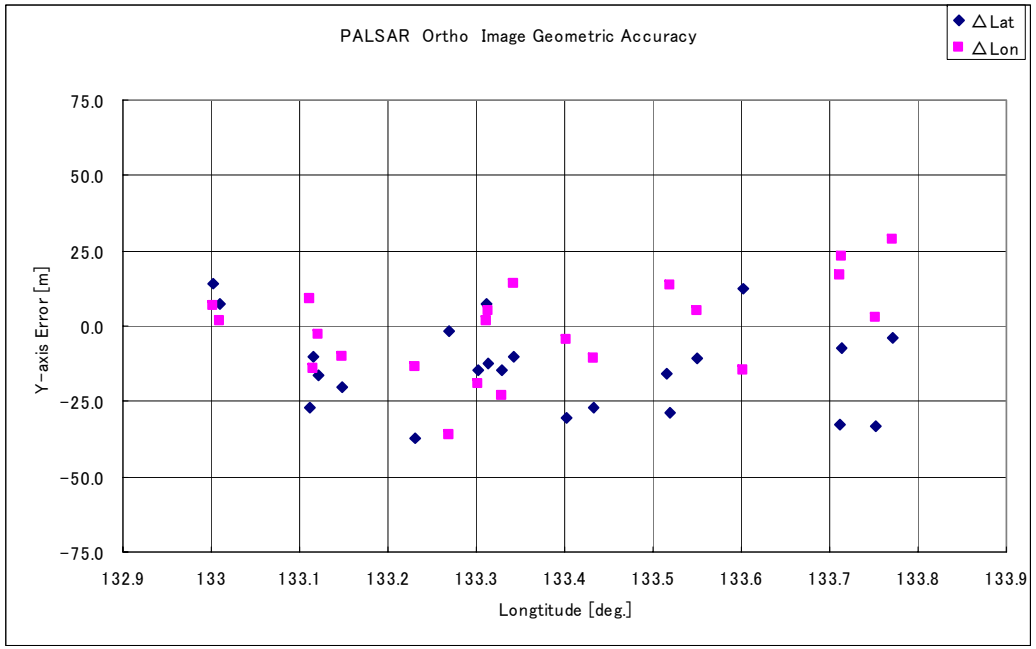
Ortho product (HH,HV,HV)

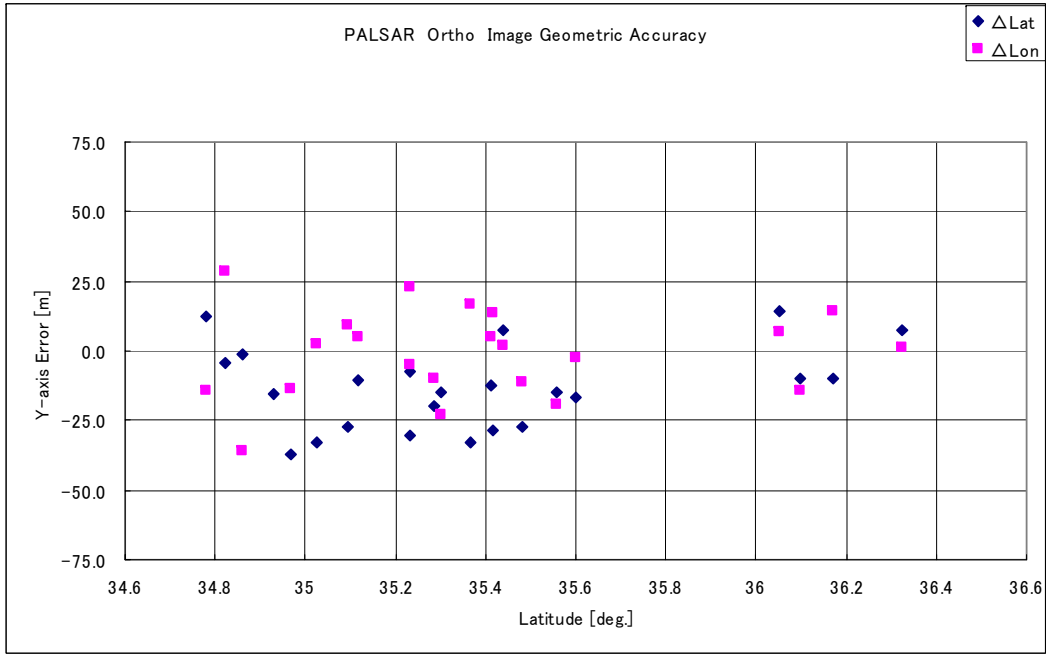
PALSAR mode :FBD41.5H
RSP : 421
Area : Mt. Daisen
OBS. Date : 2006/8/4
Image : Ortho (sar_Q16_g_HH)
Pixel Spacing : 12.5m
Map Projection : EQR
Processor : SIGMA-SAR ver20060809
DEM : Digital Map 50m Grid (Elevation)
Reference : Digital Map 25000 (Map Image)



RESULT

	Lat.	Lon.
mean	-13.6m	-0.9m
Min.	-37.4m	-36.0m
Max.	14.1m	28.7m
Std. Dev.	15.2m	15.8m

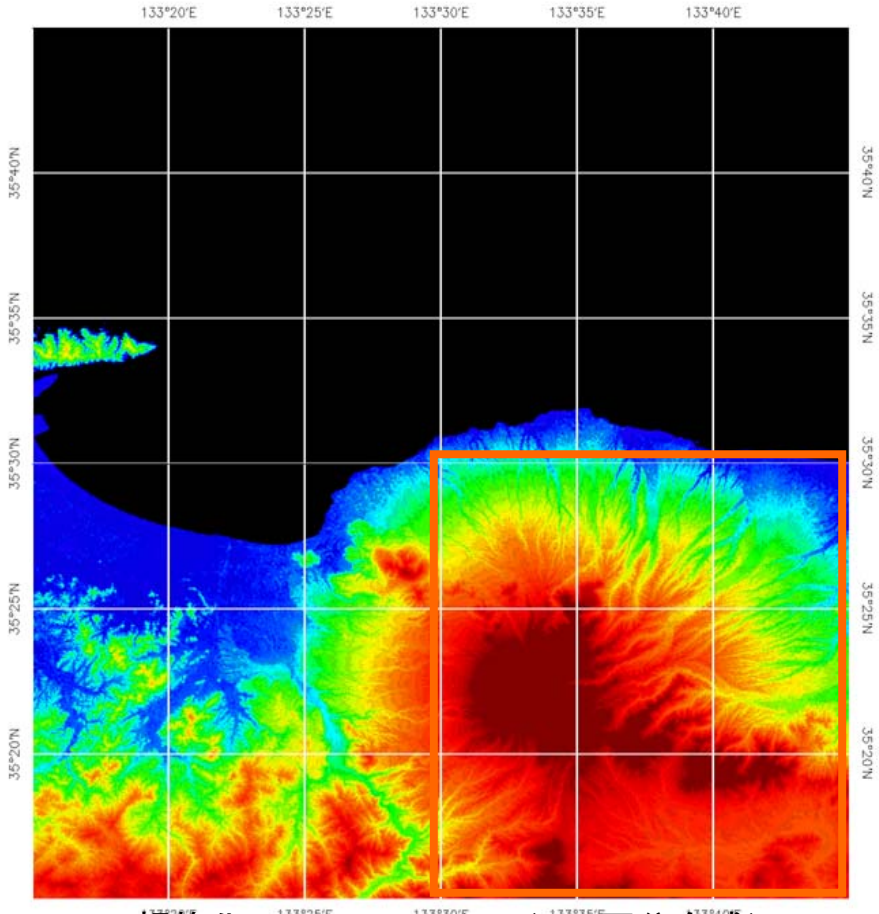




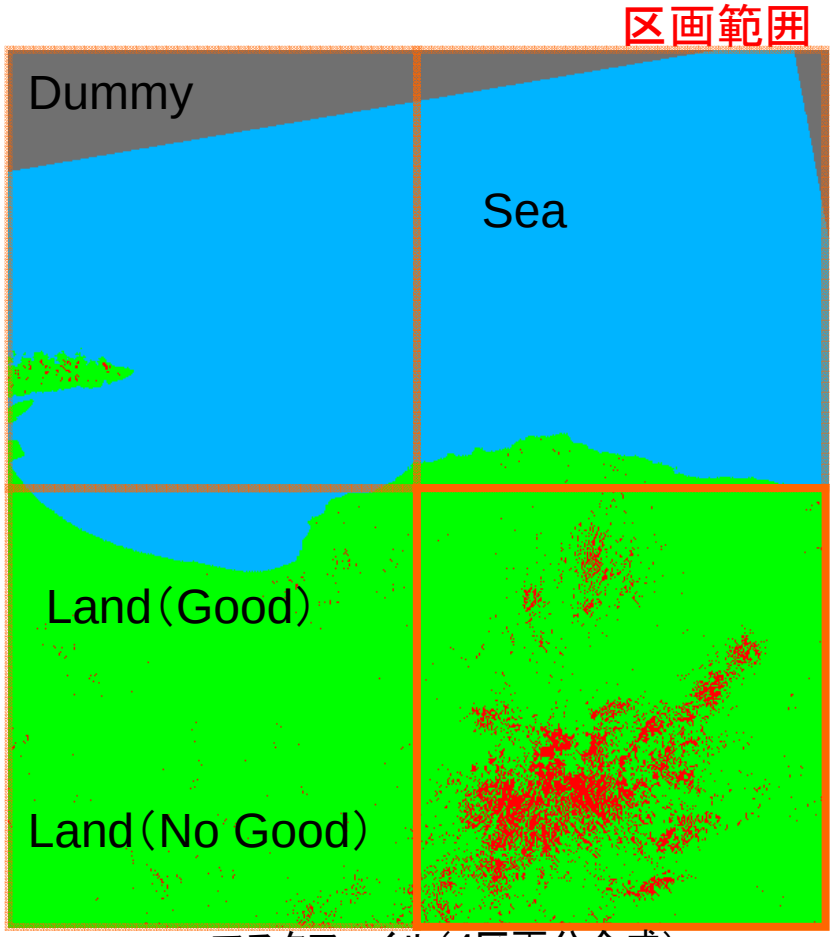
■PALSAR research products(DEM)■

DEM
- Stacking the InSAR DEM
- 4 samples

Area : Mt. Daisen in JAPAN
Mesh size : 1.5sec.(≒50m)
Area Size : 600pixle × 600line
Map Projection : EQR
Processor : SIGMA-SAR ver2006021901
Reference : Digital Map 50m Grid (Elevation)



規格化DEM50mメッシュ（4区画分合成）



マスクファイル（4区画分合成）

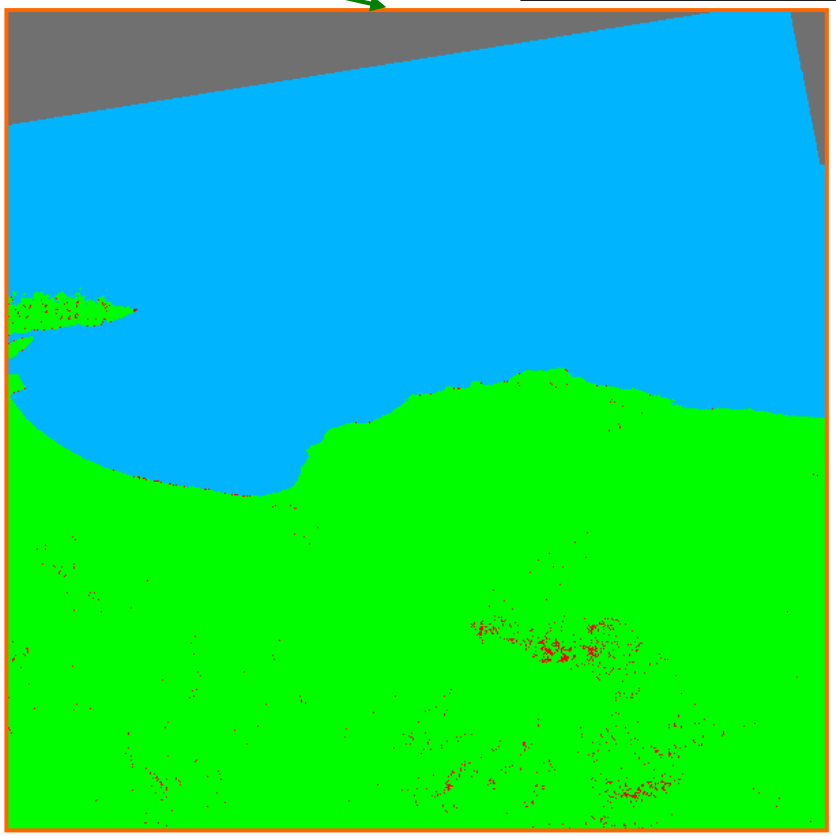
InSAR DEM B
PALSAR mode :FBS41.5H
RSP : 421
OBS. Date : 2006/9/19 & 2007/2/4
Baseline Distance (Bp) : 158.5～147.3m

InSAR DEM A
PALSAR mode :FBD41.5H
RSP : 421
OBS. Date : 2006/5/4 & 2006/6/19
Baseline Distance (Bp) : −467.7～−541.8m

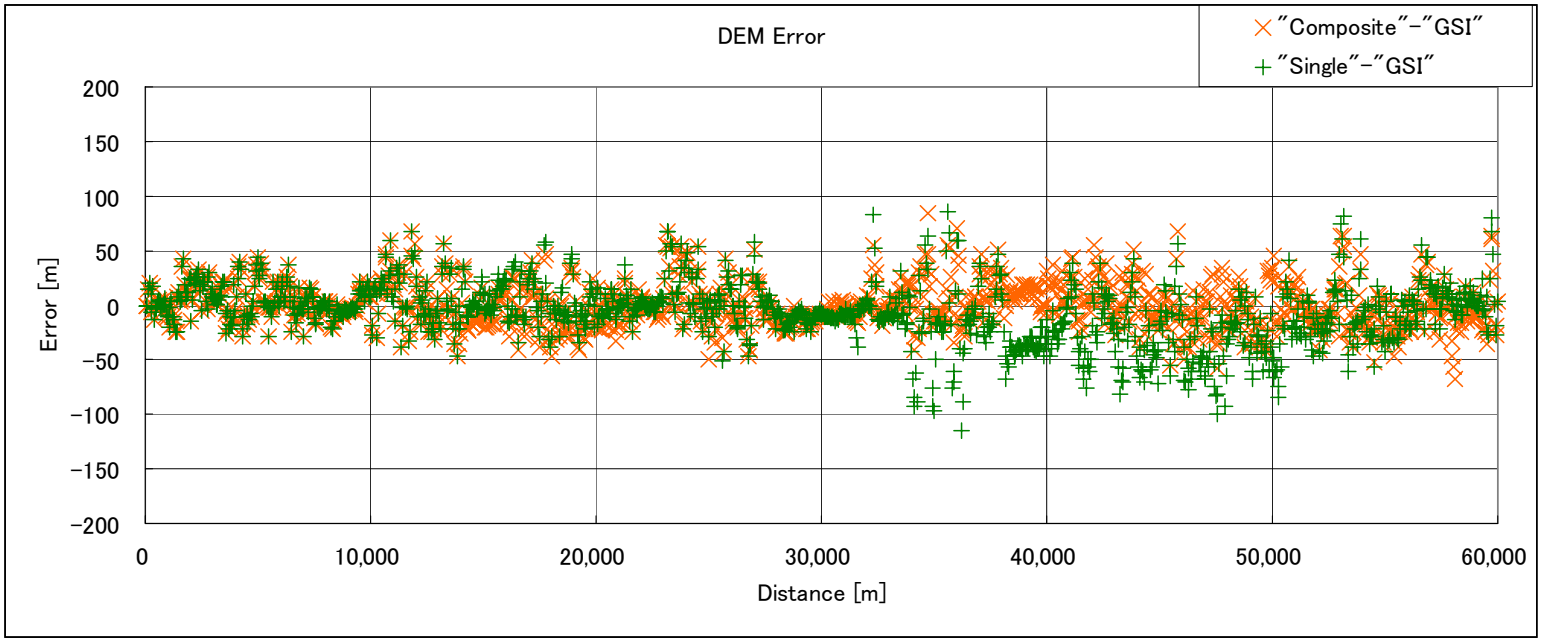
InSAR DEM C
PALSAR mode :FBD34.3H
RSP : 417
OBS. Date : 2006/8/28 & 2006/10/13
Baseline Distance (Bp) : −537.6～−516.7m

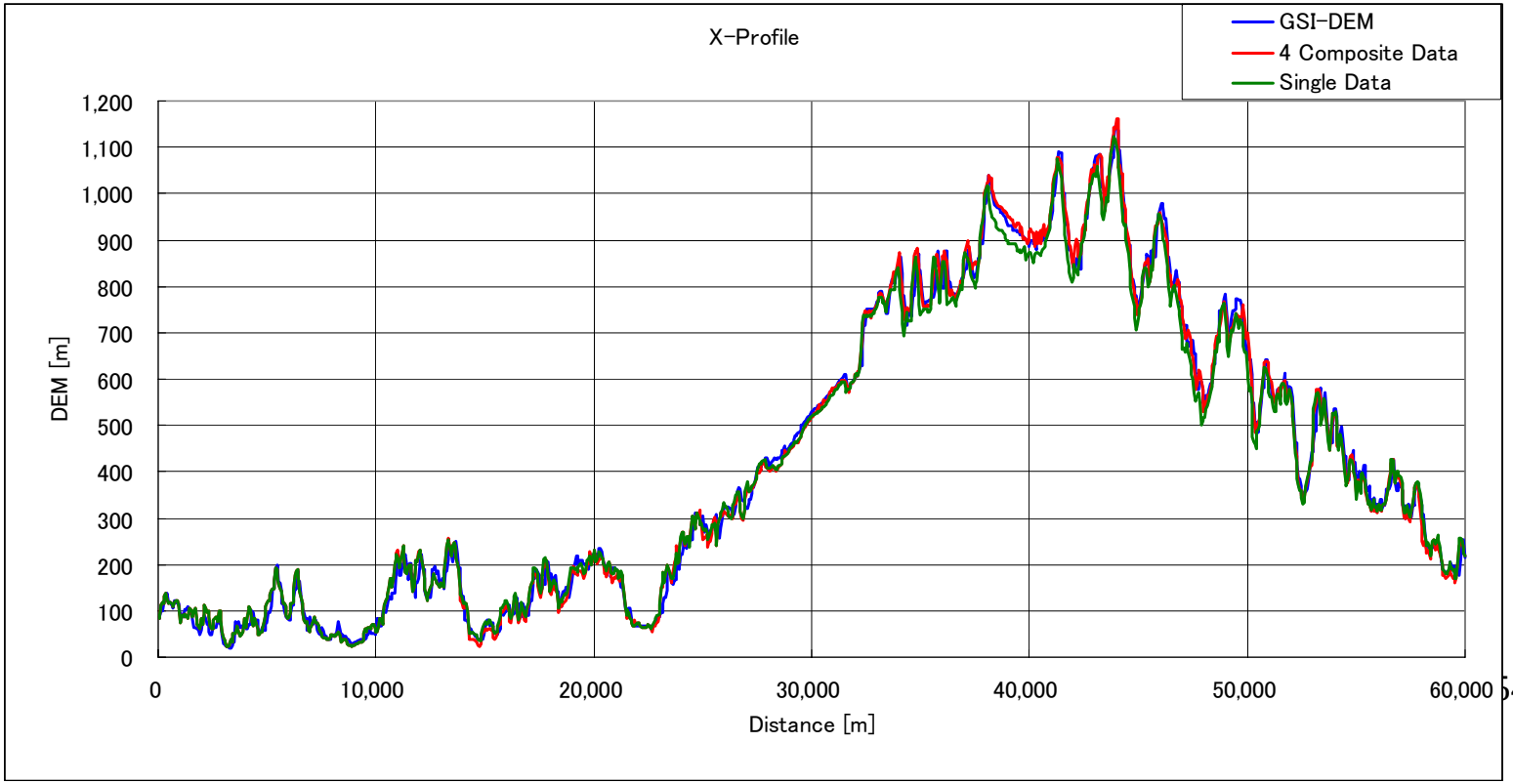
InSAR DEM D
PALSAR mode :FBS34.3H
RSP : 417
OBS. Date : 2006/5/28 & 2007/1/13
Baseline Distance (Bp) : 549.7～446.5m

Single InSAR DEM



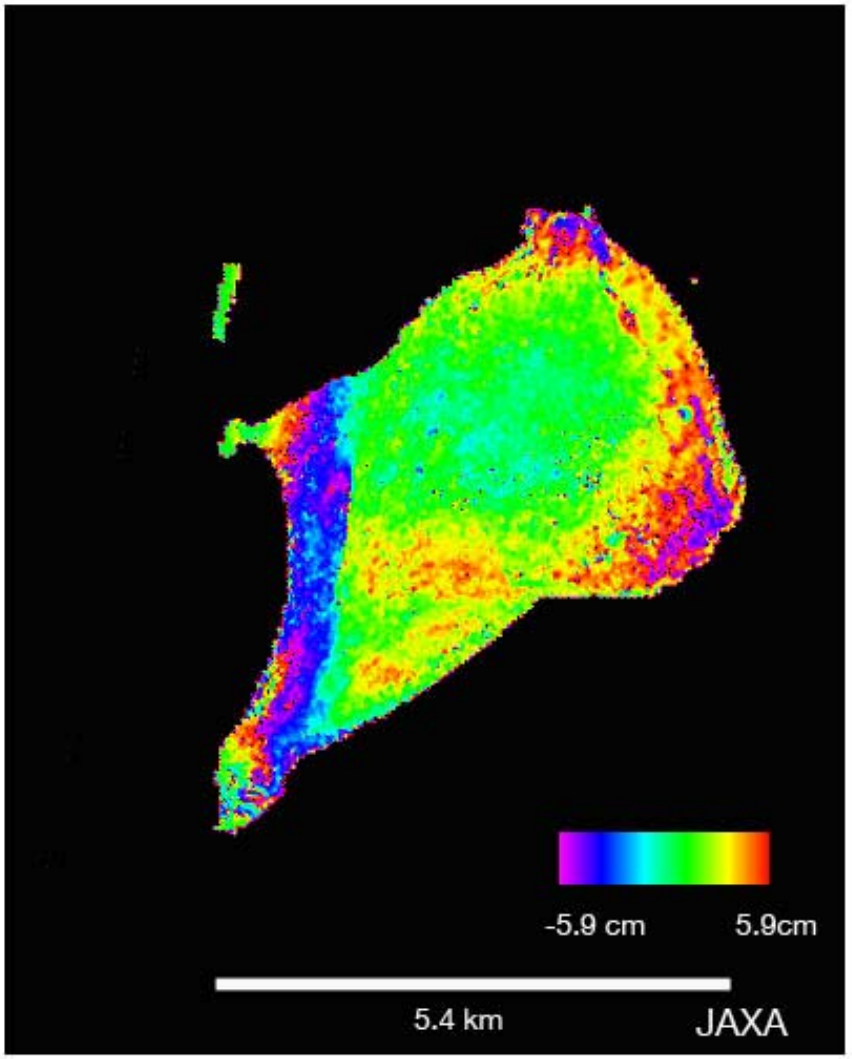
4 InSAR DEM Composite

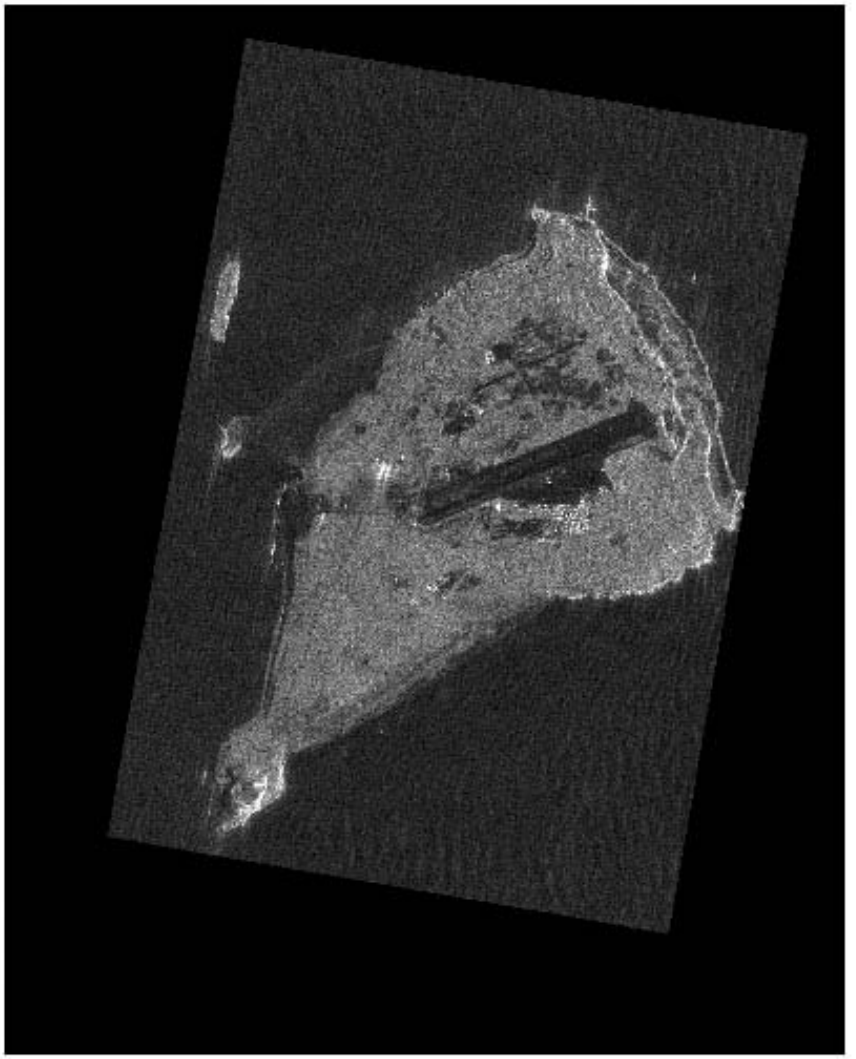

DEM Error
"Composite"−"GSI"
"Single"−"GSI"
200
150
100
50
0
−50
−100
−150
−200
Error [m]
0
10,000
20,000
30,000
40,000
50,000
60,000
Distance [m]


X-Profile
GSI-DEM
4 Composite Data
Single Data
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
DEM [m]
0
10,000
20,000
30,000
40,000
50,000
60,000
Distance [m]

RESULT

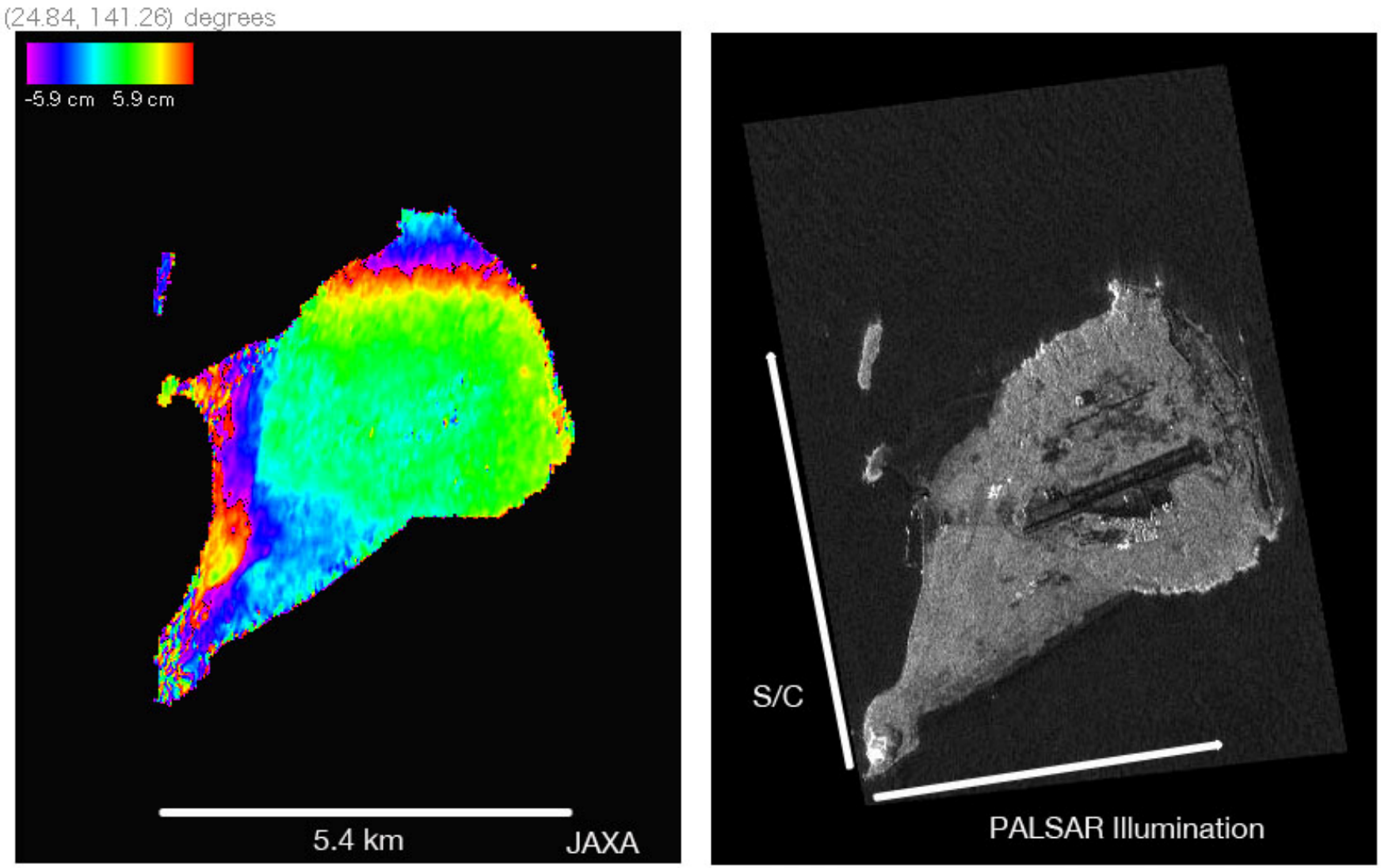
		Single InSAR DEM	4 InSAR Composite DEM
X-Profile	Average [m]	−6.2	0.3
	Std.Dev. [m]	27.2	20.9
	Maximum [m]	86.0	85.0
	Minimum [m]	−115.0	−67.0
All Area	Valid_rate(FLAG=0) [%]	47.08	49.62
	Dummy_rate(FLAG=1) [%]	6.45	6.45
	Non-DEM_rate(FLAG=2) [%]	**2.80**	**0.34**
	Sea_rate(FLAG=3) [%]	43.66	43.60
	True-Valid_rate [%]	94.38	99.33
	Average [m]	−4.74	−3.18
	Std.Dev. [m]	11.38	11.48
	Maximum [m]*	30.00	30.00
	Minimum [m]*	−30.00	−30.00





Surface deformation of Iou Island observed by PALSAR FBS 415HH

Dec. 27 2006 - Nov. 11 2006, Baseline 2.15 km



Surface deformation of Iwo-jima Island observed by PALSAR FBS41.5_HH

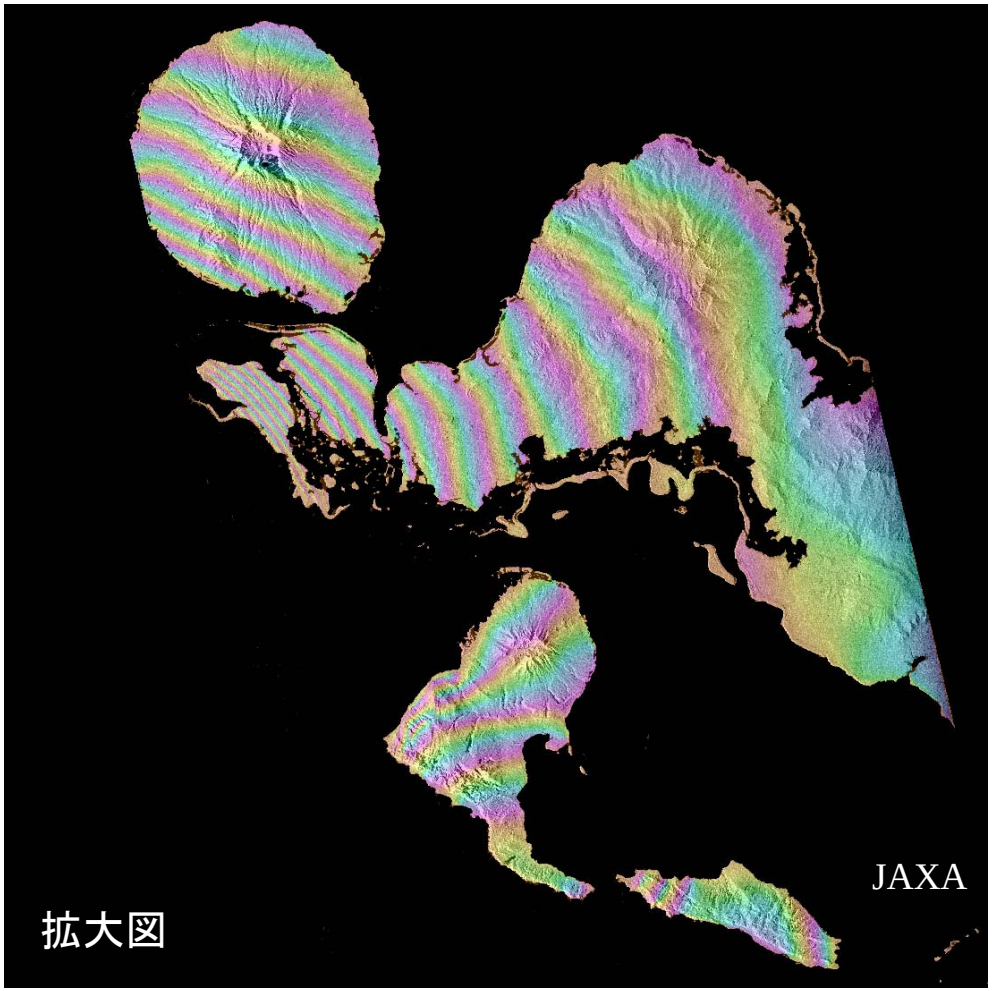
Feb. 11 2007 - Dec. 27 2006, Baseline : 0.7 km

資料3-2　ソロモン諸島地震関連(2)

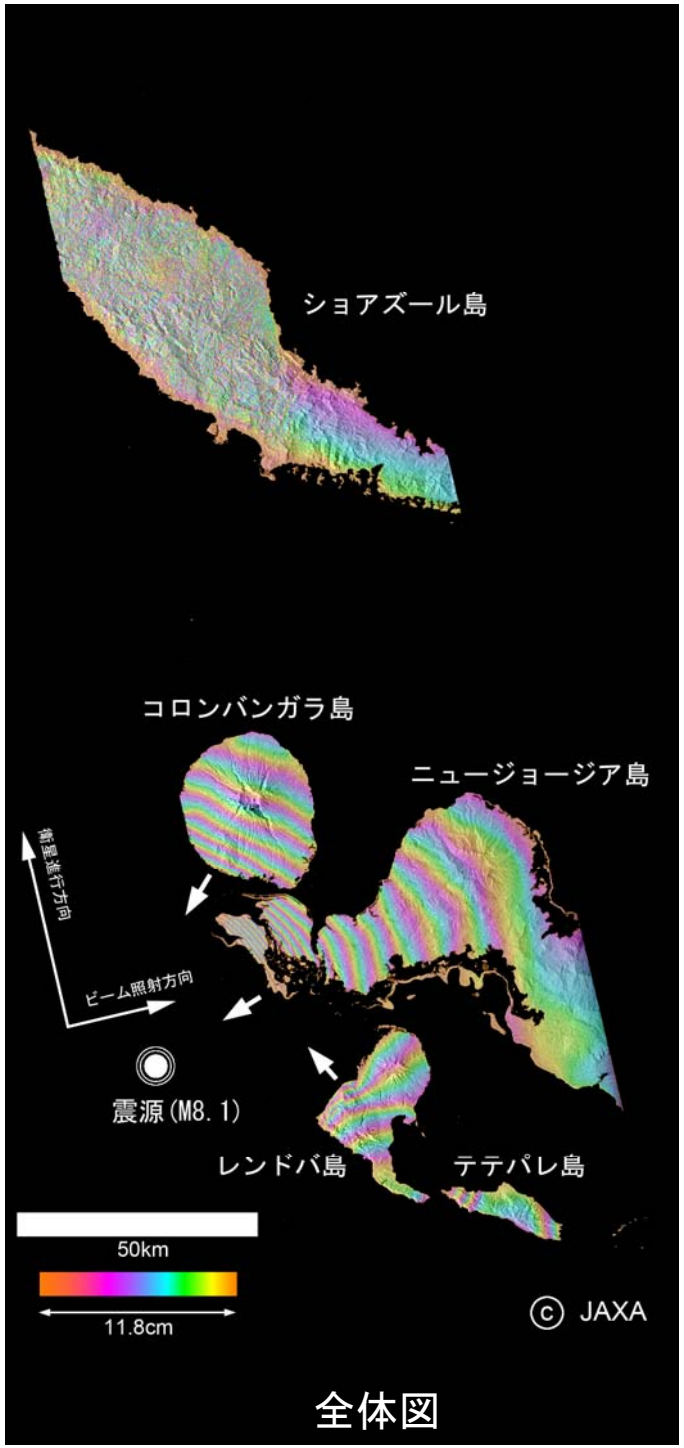
４月１６日と３月１日の
干渉処理によりソロモン地震（４月２日発生、
M8.1）による地殻変動を抽出した。

ニュージョージア島は島全体が西上方に最
大2.2m隆起した。

外務省HPより

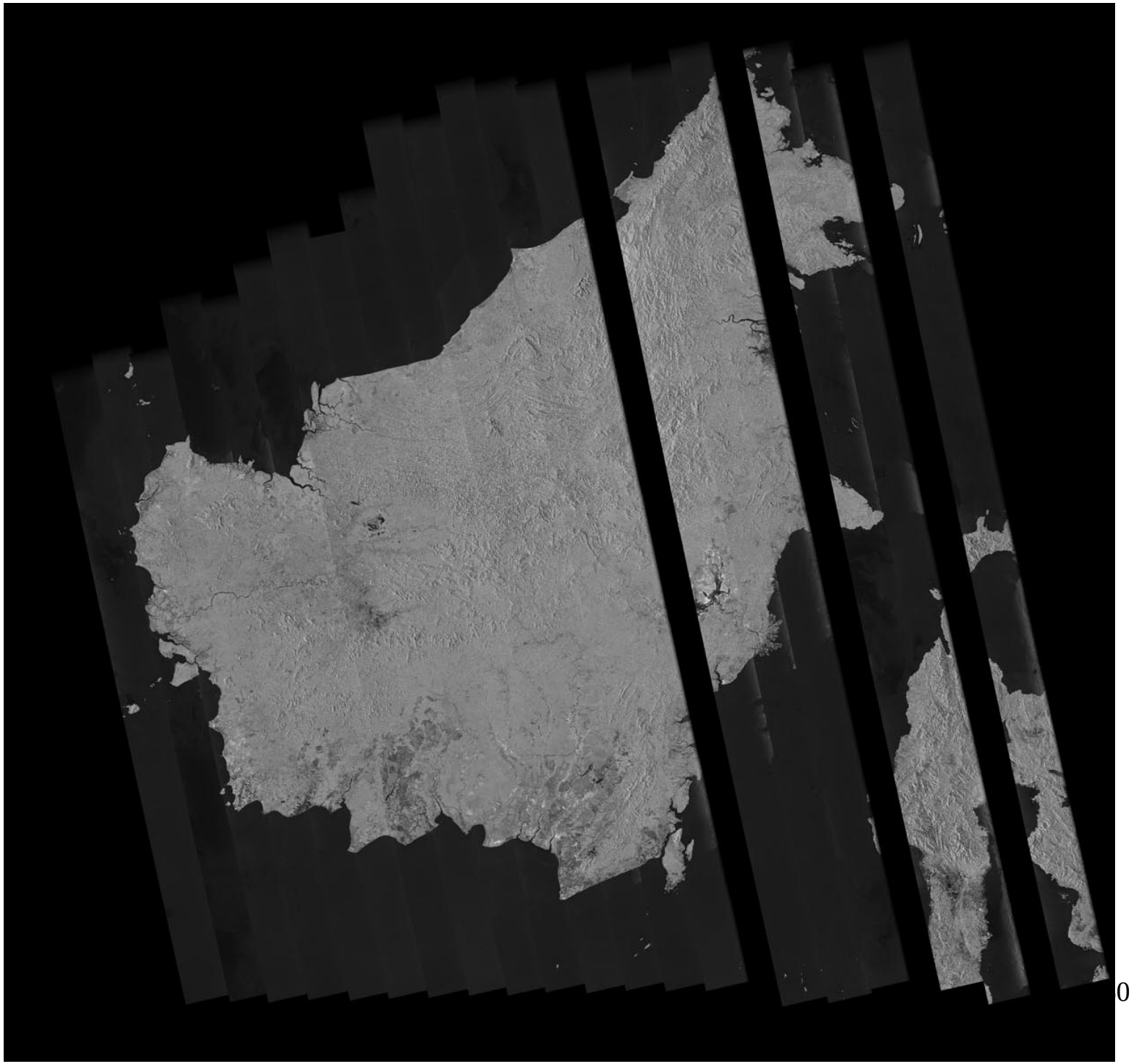


拡大図



全体図

Research products : Mosaic



Evaluation items	Goal accuracy	mesasurements
Radiometry ●Attenuator chracteristics（STC/AGC） ●Antenna pattern（azimuth・range） ●Noise level ●Fundamental chrcatreistics saturation SNR I-Q orthogonality I-Q gain ballance Tranmission chirp chracteristics Doppler measurements Statbility of the trammission power Isolation of cross polarization ●absolute calibration ●sigma-naught ●polarimetric calibration ●simultaneous datatake with PiSAR ●resolution ●Chirp signal time change	 0.1dB/step ＜ 0.1dB以下（azimuth、range） ＜ NEσ^0 -21 dB（@34.3） ＜ 5% ＞ 5 dB（生データ） 90+-5° ＜ 0.2dB TBD Hz/sec以下 ＜ 50Hz ＜ 0.6 dB（1 revolution） ＞ 25 dB ＜ 1.5 dB <1.5 dB HH/VV<0.2 dB, phase of HH/VV<5deg. 8/19, 10/4 10m<2look ーーー	 NA <1dB -28 dB@ amazon pole Meets left at MGCMGC 8dB(FBS),PLR(8dB)、FBDは3dB 90+1.6 degrees 0.03dB --- Same to the left 0.03dB（separating 7 mins.） 26 dB (HV-HH) 0．7dB 0．7dB VV/HH:ー0．018 dB以下, phase：-1.7度 In evaluation Meets the left ーーーー
geometry ●geometric accuracy	 200 m以下	 10m（13m）：mean (std. Dev.)
Image quality ●radiometry PSLR（range、azimuth） ISLR SA（range、azimuth） Effective number of looks interference ●geometry resolution（IRF3dB dwon width） Geometruc evaluation	 <ー10 dB <ー5dB ＞ 20dB ＞ 20dB ーーー ーーー <5m（azimuth）、<10m（range） <200m	 -16dB（Rg）、-12dB（Az） -8dB 17dB(RA), non measurable(Az)：41．5 Non-measurable（RA、AZ）：34．3 Weaker than JERS-1 ＜ 10m Mets the left 8m（5m）：mean and std. Dev.

Summary(2)

High level products generation: Ortho images and InSAR DEM were successfully generated, meeting the goal accuracy. Continue to evaluate the products for more robust product generation.

Research Products generation: confirmed that the generation of the surface deformation capability using the PALSAR. Generated the SAR mosaic experimentally.