PALSAR and Calibration update

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KC11

Jan. 14 2008

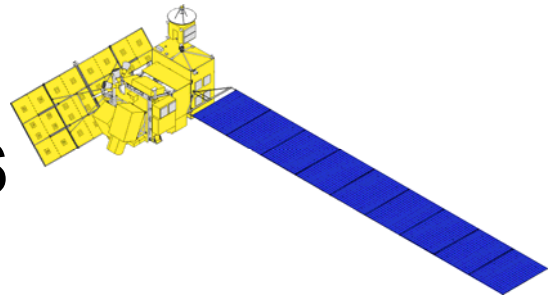
JAXA/TKSC

Contents of my talks

1. PALSAR status
2. JAXA-NASA meeting on use of TDRS
3. Polarimetry (bit shift fr 23.1)-> recovered
4. New strategy for ALOS BOS in ALOS post operation phase
5. Calibration update
6. Mosaic updates
7. ALOS-2 information

1. A/Is

ALOS Spacecraft status



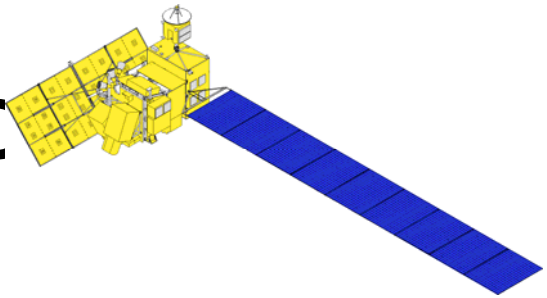
- The satellite bus subsystems and the three mission instruments are in good health.
- The ALOS passed two years and a half on orbit with successful operations.

The ALOS will attain the missions design life for three years.

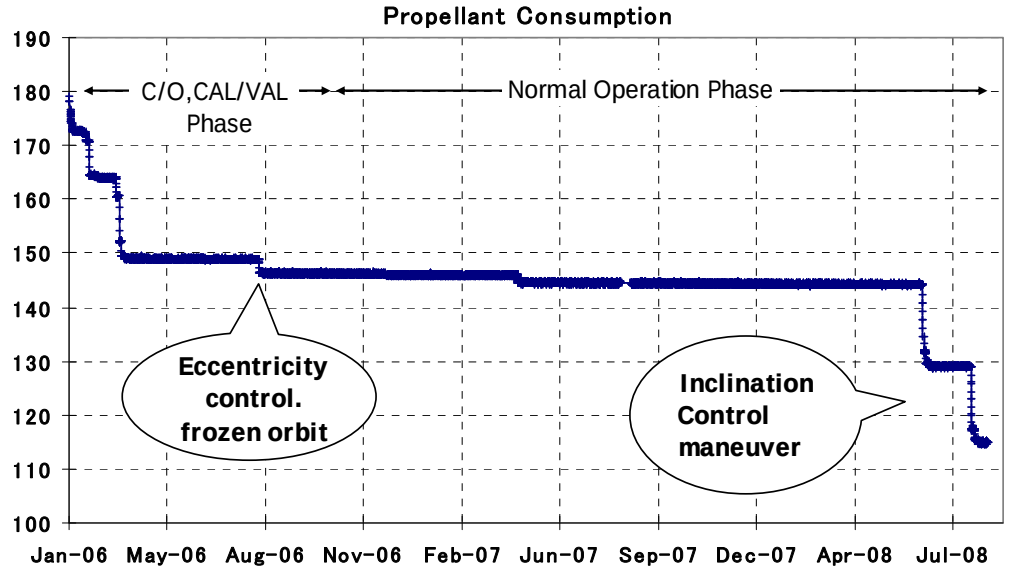
- The recent satellite event,
  - ✓ ALOS/TDRS Inter-Operability Technology Test.
  - ✓ Inclination control maneuver.

(The control of Local sun time at descending node (Ts))

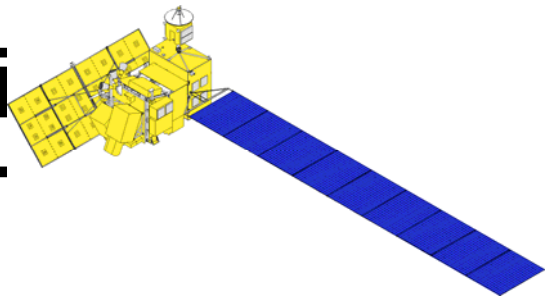
Subsystem (TT&C,AC



- **Telemetry, Tracking & Command : good**
  Direct USB & inter-satellite SSA communications
- **Attitude and Orbit control system : good**
  All functions & mode transitions operate well.
  RSP control :within ±0.5km.（Spec.±2.5km）
  The inclination control maneuver has completed.
  About 30kg of propellant has been used for the inclination control.
  The remaining propellant is 115kg. This quantity can achieve long-term mission more than 5 year.



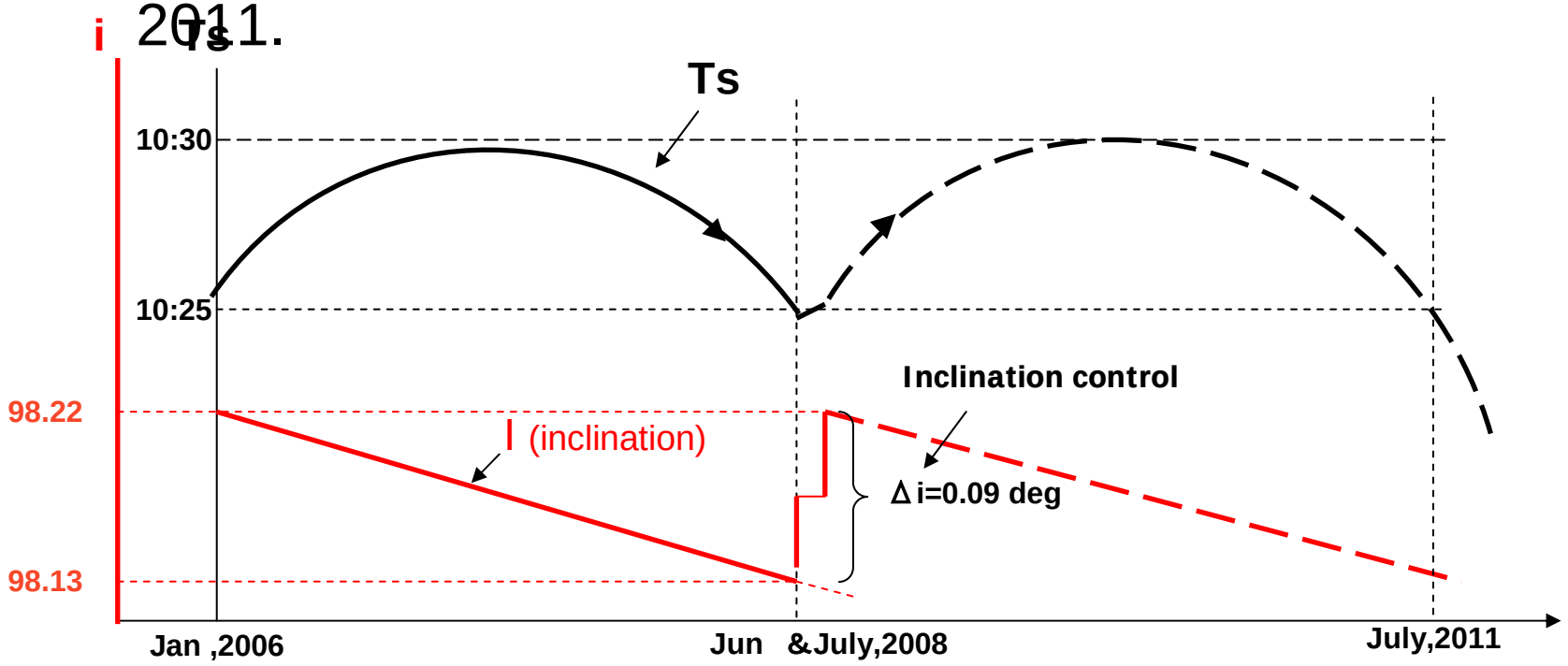
Control of Local sun ti
at descending node (



The outline shows the change of Ts and inclination.

The control of Ts was a range about five minutes from 10:25 to 10:30. (Spec,10:30 ± 15minutes）

The next inclination control maneuver plans around the summer of 2011.



JAXA-NASA meeting on ALOS-TDRS

Project will start on Nov. 2009.

F10 will be used for down linking ALOS data to EOC through

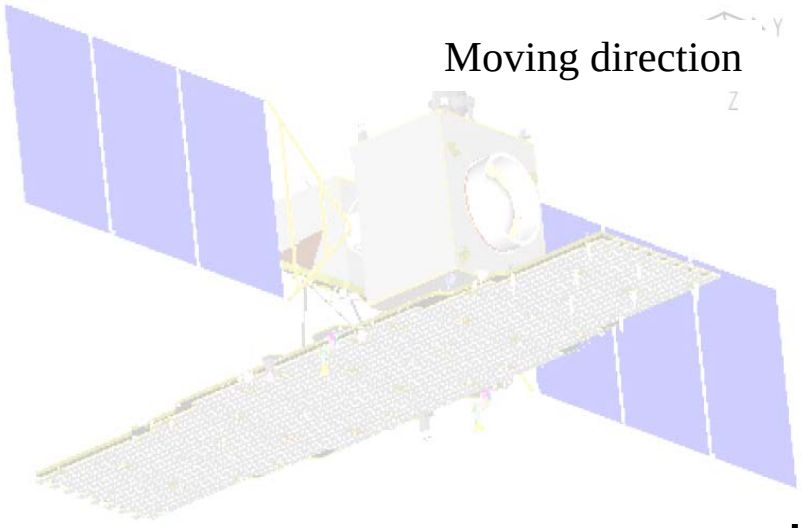
Whitesands and ASF electrically.

Data take increase ratio is under estimation.

Needs LOA between JAXA and NASA

ALOS-2

2009.01A
JAXA/ALOS-2



Artistic view

orbit	type	sunsynchronous
	height	~630km
	LST	12：00（local noon） descending
Designed life		Five years
Launch	time	Winter, JFY2012
	Launcher	H-2A
satellite	mass	2 ton type
	paddle	2 paddles
Mission data		Direct transmission and Ka band DRTS
SAR frequency		Lband (1.2 GHz)
Main observation modes	High resol.	1～3m、swath25km
	Basic obs.	3m、swath：50km
	Wide obs.	100m、swath：350km
Main target areas		Deformation, volcano, change detection, resource finding.
		Forest, Sea ice, river, rice field monitoring

Features of ALOS-2

- High resolution SAR based observation system
- Similar Observation duties of ~30% to ALOS/PALSAR.
- Improving the observation response (once per day)
  - ✓ Both side capability
  - ✓ Enlarged incidence angle of 8~70 degrees.
- Frequent orbit inclination maintenace for successive interferometry
  - ✓ All the orbits will be within 500m tube of the reference orbit
- Reducing the RA by
  - ✓ up/down chirp and phase modulation for (0/π)
- High band data transmission
  - ✓ Direct transmission：840Mbps（6 times of ALOS）
  - ✓ Communication with DRTS：278Mbps（similar to ALOS）

ALOS-2搭載SAR

項目＼観測モード		高分解能モード	基本モード	高感度モード		中分解能モード		広域観測モード
中心周波数		1257.5MHz						
観測入射角		8～70deg						
観測帯域幅		84MHz	84MHz	42MHz		28MHz		14MHz
空間分解能	Rg	3m以内	3m以内	6m以内		10m以内		100m以内
	Az	1m以内	3m以内	6m以内		10m以内		100m以内
観測幅		Rg×Az 25km×25km以上	50km以上	50km以上	50km以上	70km以上	30km以上	350km以上
偏波		単偏波	単偏波/2偏波	単偏波/2偏波/CP	FP	単偏波/2偏波/CP	FP	単偏波及び2偏波
偏波分離度（暫定）		N/A	30dB以上	30dB以上	30dB以上	30dB以上	30dB以上	30dB以上
データレート	ヘッダー等を含む 全入射角範囲 最大値	800Mbps以下 単偏波観測時	800Mbps以下 単偏波観測時	800Mbps以下 CP観測時	800Mbps以下 FP観測時	400Mbps以下 2偏波観測時	400Mbps以下 FP観測時	400Mbps以下 2偏波観測時
NESZ 規定偏波		-24dB以下 単偏波観測時	-24dB以下 単偏波波観測時	-28dB以下 CP観測時	-28dB以下 FP観測時	-26dB以下 2偏波観測時	-28dB以下 FP観測時	-26dB以下 2偏波観測時
S/A	Rg 規定偏波	25dB以上 単偏波観測時	25dB以上 単偏波観測時	23dB以上 CP観測時	ライク偏波：25dB以上 クロス偏波：20dB以上	25dB以上 2偏波観測時	ライク偏波：20dB以上 クロス偏波：10dB以上	25dB以上 2偏波観測時
	Az 規定偏波	20dB以上 単偏波観測時	25dB以上 単偏波観測時	20dB以上 CP観測時	23dB以上 FP観測時	23dB以上 2偏波観測時	23dB以上 FP観測時	20dB以上 2偏波観測時

空間分解能：赤道上、観測入射角37degを含むシーン内での性能。広域観測モード以外は1ルックで定義。
観測幅：基本モードのみ全入射角範囲で50km以上。それ以外のモードは赤道上、観測入射角37degを含むシーン内で規定。
偏波 ：CP：45deg直線偏波あるいは円偏波を送信し、H,Vで受信。FP：HH+HV+VH+VV。
データレート：DS-PAC方式（暫定）を用いたデータ圧縮後のデータレートで規定。
NESZ：赤道上観測入射角37degを含むシーン内中心で規定。
S/A：赤道上、観測入射角37degを含むシーン で既定。

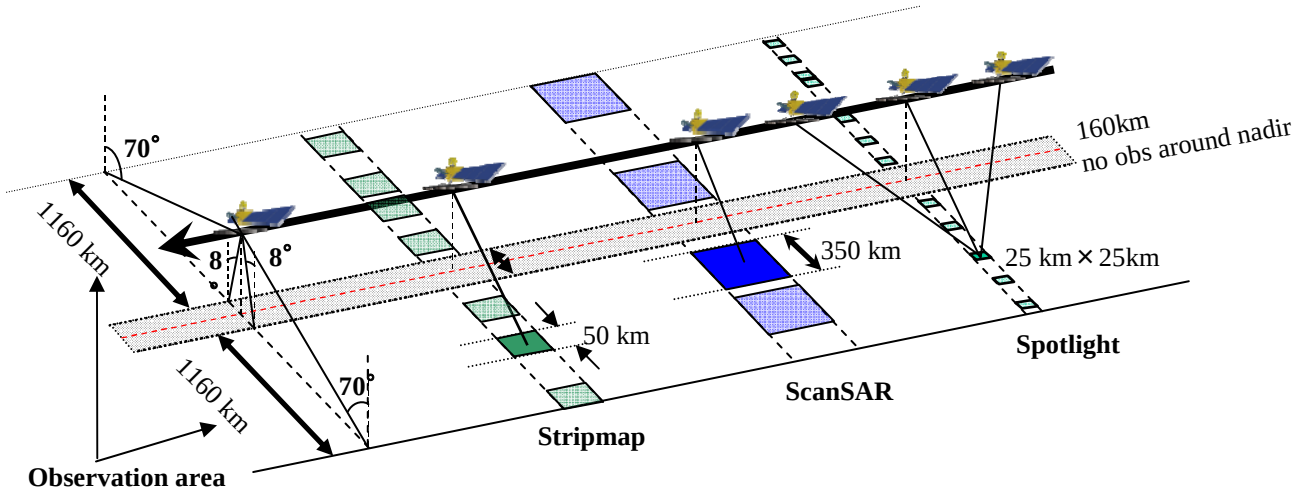
ALOS-2 SAR observation modes

SAR observation modes and performance

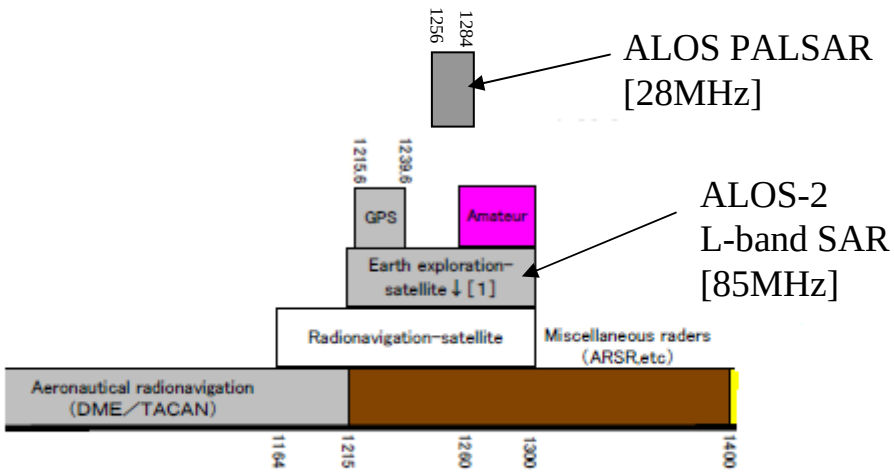
parameter \ mode		Spotlight	Stripmap (High Resolution)	Stripmap (High Sensitivity)	Stripmap (Conventional)	ScanSAR
Frequency		1257.5MHz				
Incident angle		8 to 70 degree				
Bandwidth		84MHz	84MHz	42MHz	28MHz	14MHz
Res.	Rg	3m	3m	6m	10m	100m
	Az	1m	3m	6m	10m	100m
Swath		25km(Rg)*25km(Az)	50km	50km	70km	350km
Polarimetry		single	single,dual	single,dual,CP,FP	single,dual,CP,FP	single,dual
NESZ		-26dB	-24dB	-28dB	-26dB	-26dB
S/A	Rg	25dB	25dB	23dB	25dB	25dB
	Az	20dB	25dB	20dB	20dB	20dB

Performance @ incident angle 37deg

CP: Compact Polarimetry, FP: Full Polarimetry (HH+HV+VV+VH)



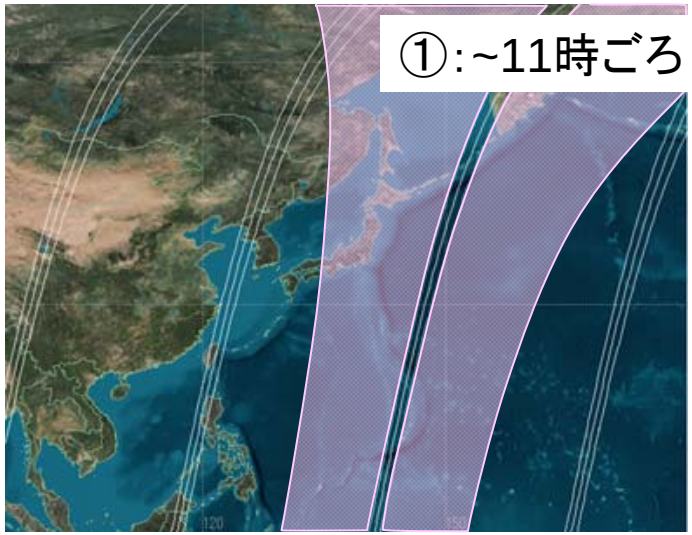
L-band SAR RF issue

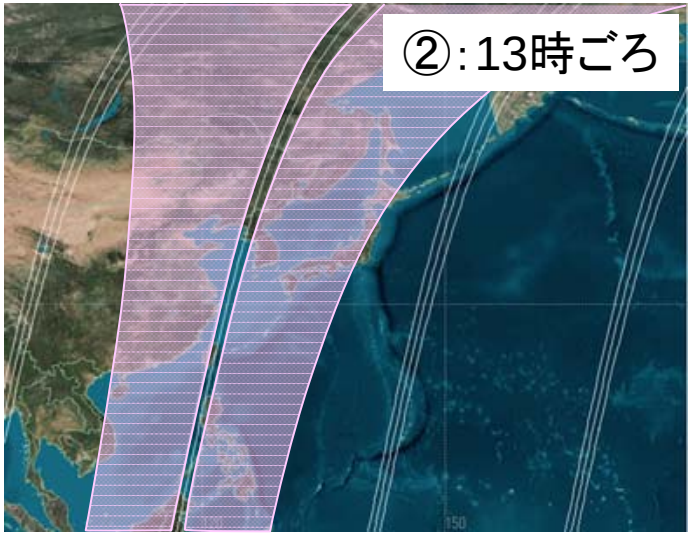


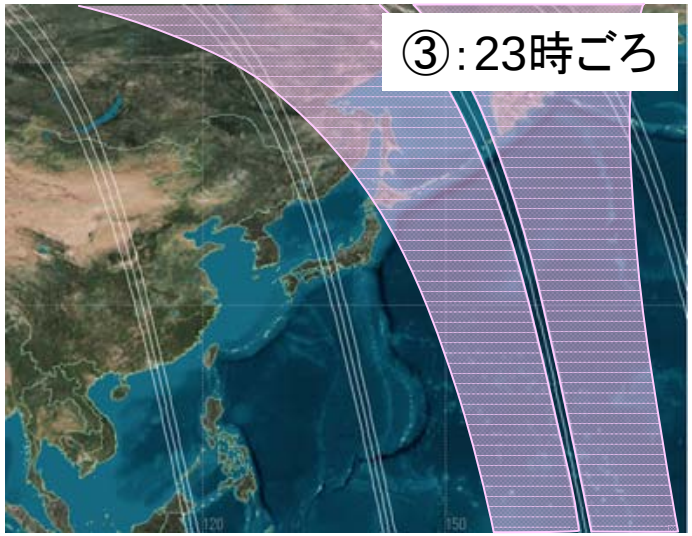
- Coordination started with the RF authority of Japan (Ministry of Internal affairs and Communications)
- Need coordination with GPS communities to use full range [1215-1300MHz] for ALOS-2 L-band SAR
- JAXA may ask NASA support for coordination with US GPS community

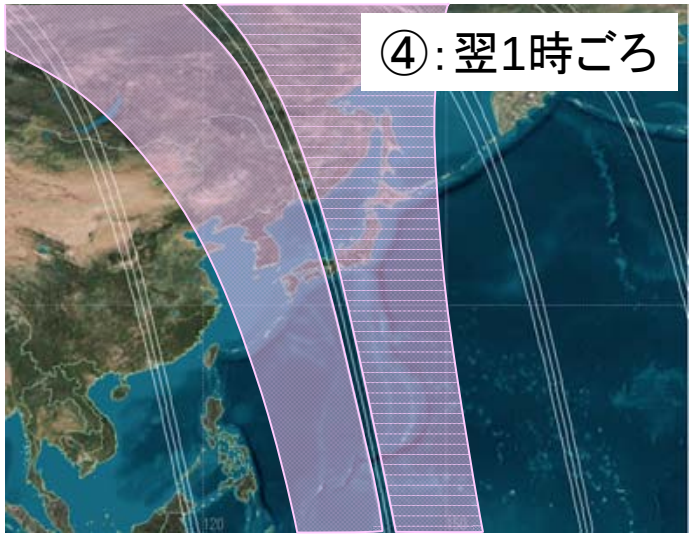
One day observation area by ALOS-2 (one day)

1日に、ほぼ1～4回の観測がSAR衛星1機で可能









- 観測可能範囲(ピンク)の内、50km幅を観測可能
- 観測可能範囲は日によって東西に平行移動するため、左図は一例である。

Polarimetry Failure

Recently, it happens that the polarimetric mode of 23.1 degrees suffers bit-shift (or byte swap) phenomena that the data can not be synchronized with the 10% of probability.

This phenomena is under investigation for the possible causes however no deterministic solution gained.

The data, however, can be read by modifying the synchronization and decoding algorithms.

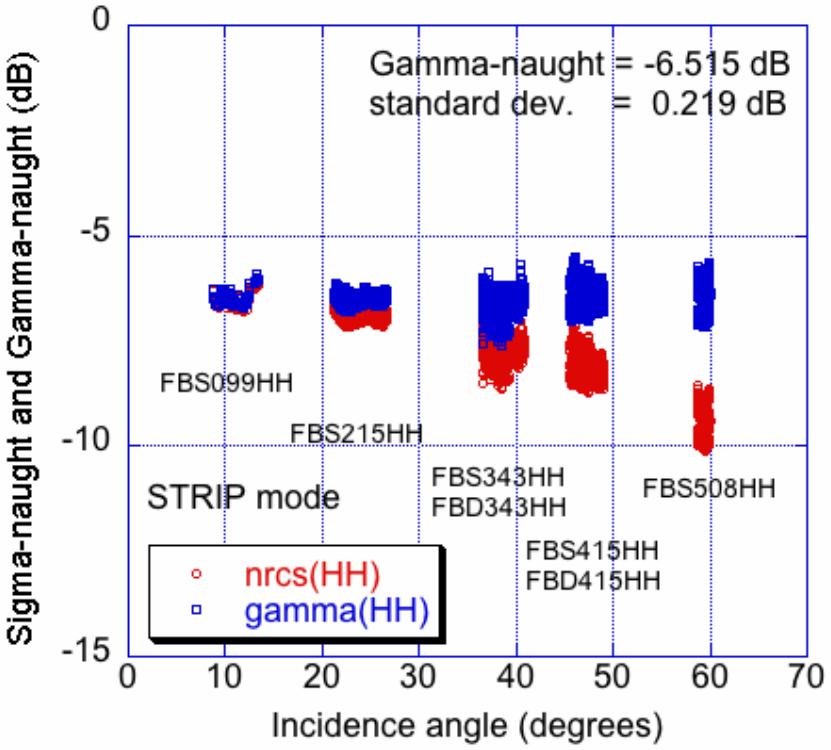
Calibration Updates

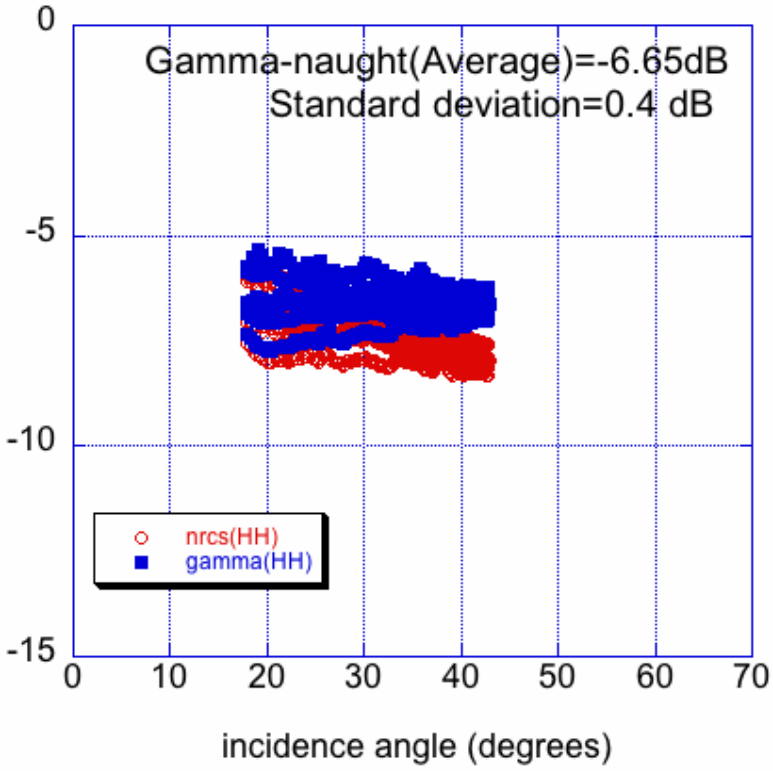
Calibration of the PALSAR Fine (FBS + FBD) was conducted using the three year CR and Amazon rain forest data.

It shows that

Validation of cal results: using the Amazon forest data

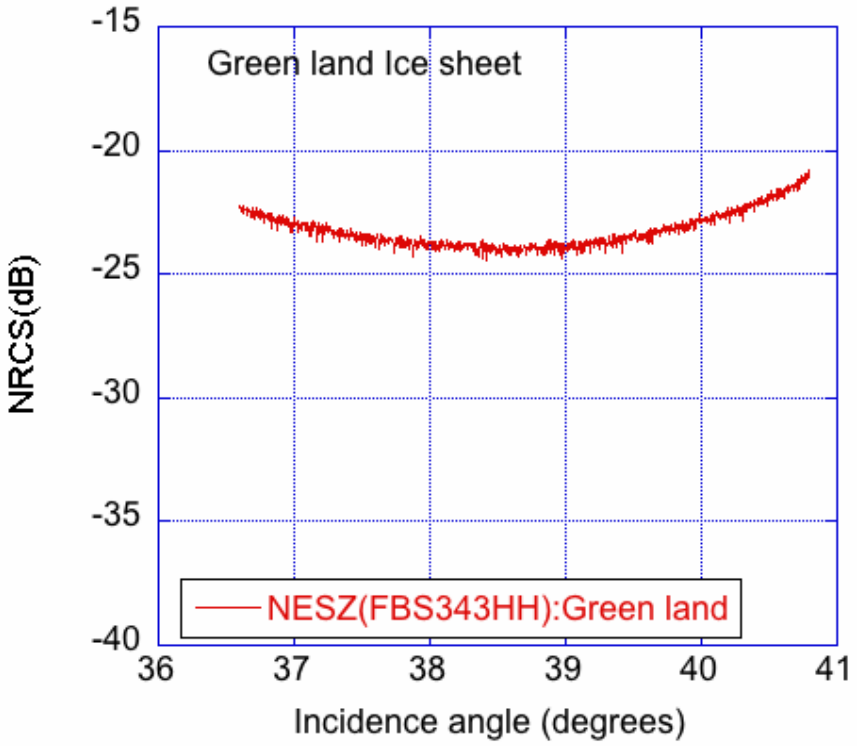
0.22 dB (FBS) and 0.4 dB(SCAN)

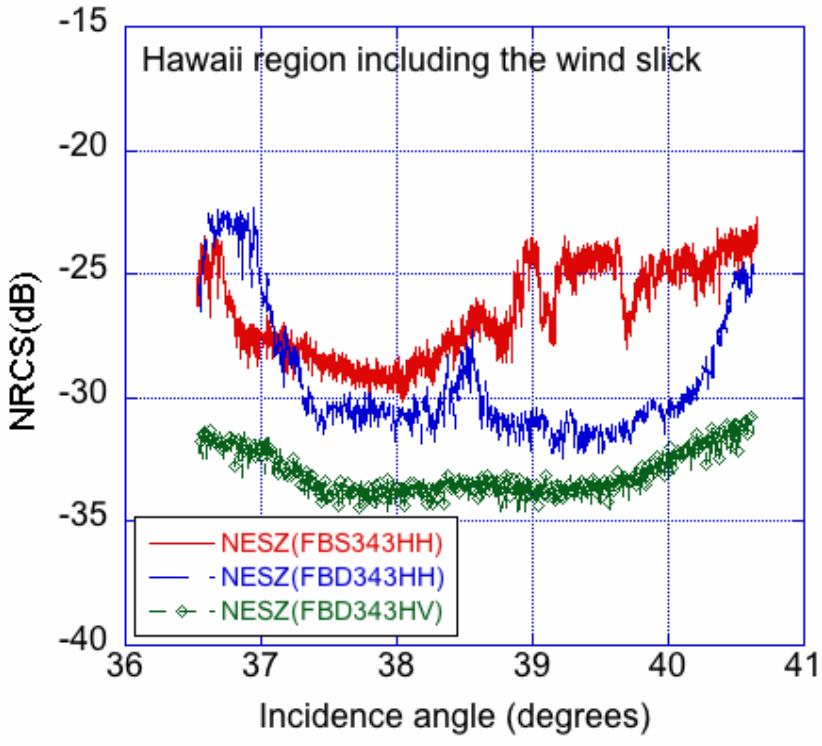




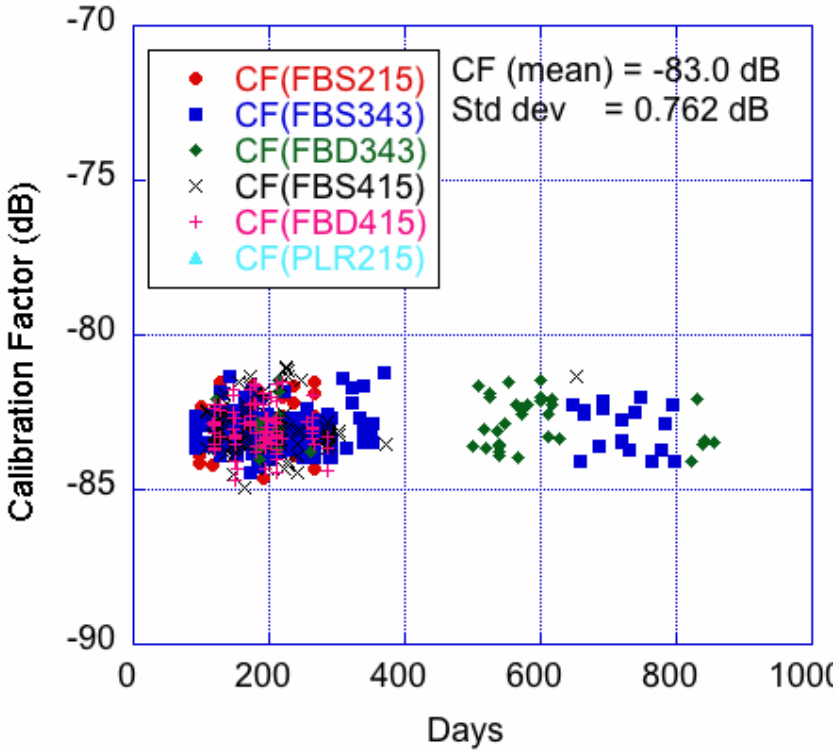
NESZ :

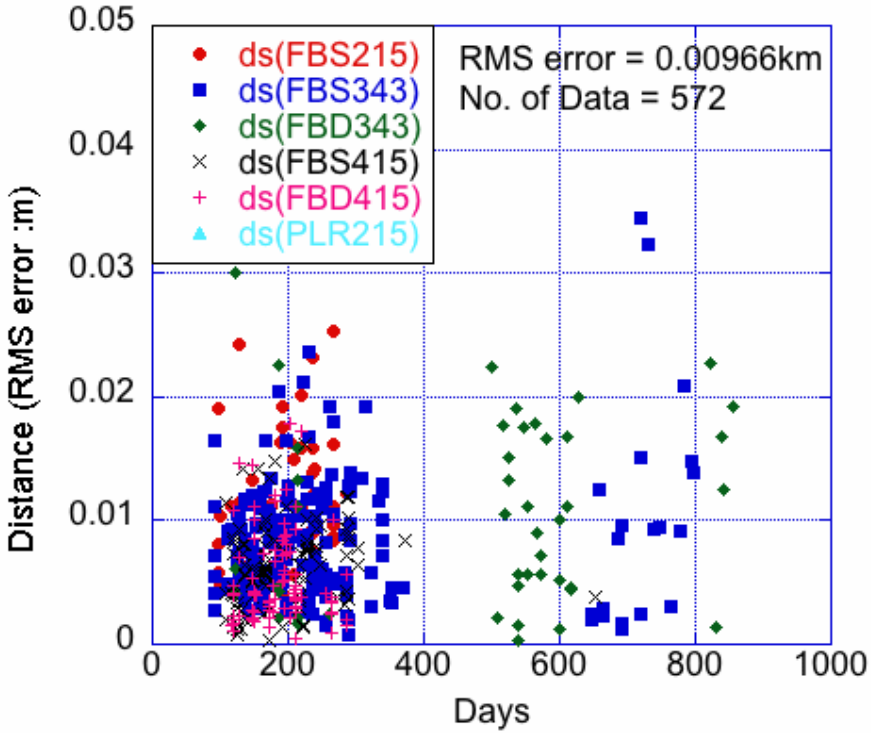
FBD HH ~ - 31 dB, FBD HV ~ -34 dB

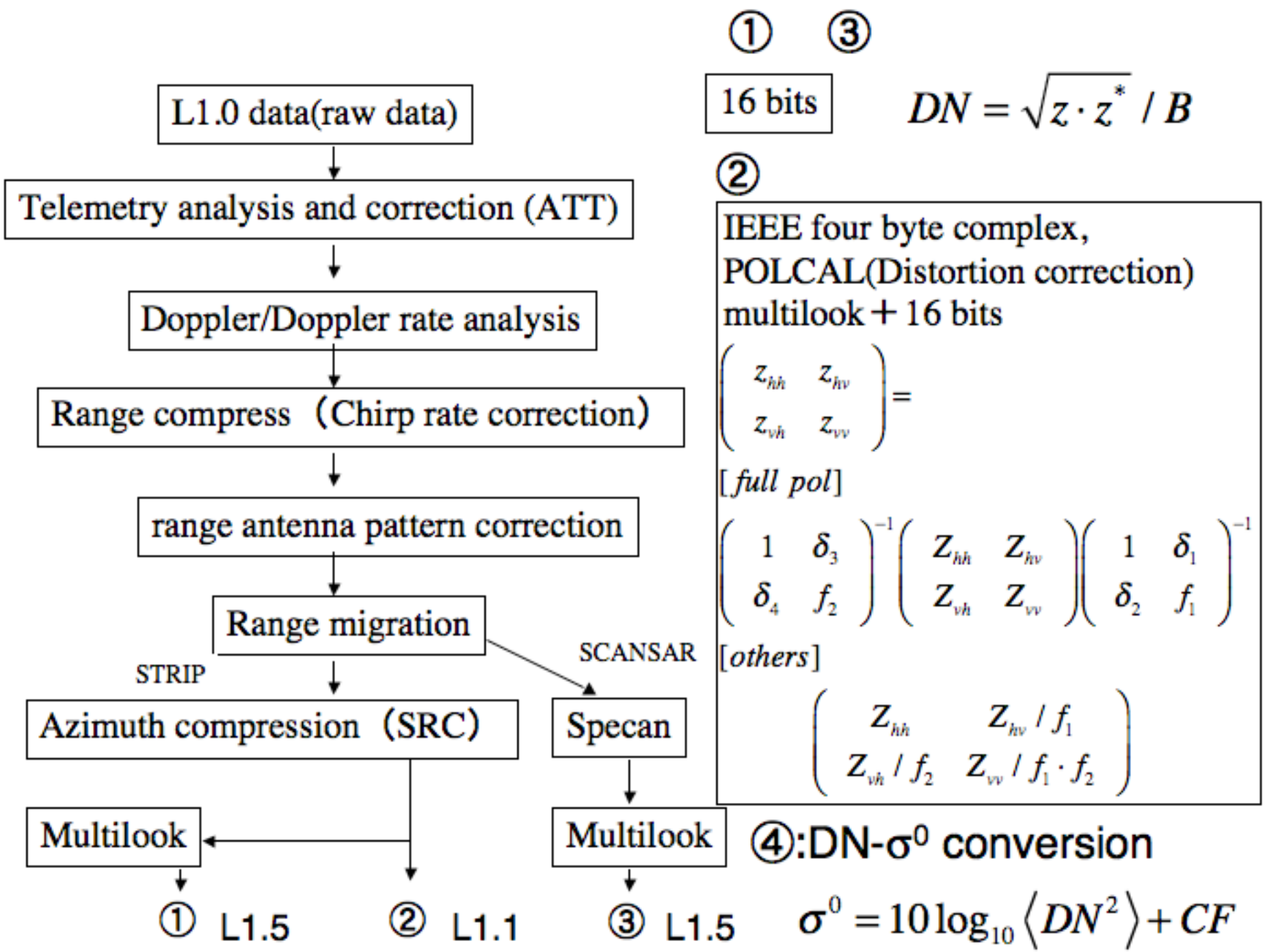




Calibration Factor and location error measured using the CR






L1.0 data(raw data)
Telemetry analysis and correction (ATT)
Doppler/Doppler rate analysis
Range compress （Chirp rate correction）
range antenna pattern correction
Range migration
STRIP
SCANSAR
Azimuth compression （SRC）
Specan
Multilook
Multilook
① L1.5
② L1.1
③ L1.5
① ③
16 bits
$DN = \sqrt{z \cdot z^*} / B$
②
IEEE four byte complex,
POLCAL(Distortion correction)
multilook＋16 bits
$\begin{pmatrix} z_{hh} & z_{hv} \\ z_{vh} & z_{vv} \end{pmatrix} =$
[full pol]
$\begin{pmatrix} 1 & \delta_3 \\ \delta_4 & f_2 \end{pmatrix}^{-1} \begin{pmatrix} Z_{hh} & Z_{hv} \\ Z_{vh} & Z_{vv} \end{pmatrix} \begin{pmatrix} 1 & \delta_1 \\ \delta_2 & f_1 \end{pmatrix}^{-1}$
[others]
$\begin{pmatrix} Z_{hh} & Z_{hv} / f_1 \\ Z_{vh} / f_2 & Z_{vv} / f_1 \cdot f_2 \end{pmatrix}$
④:DN-σ⁰ conversion
$\sigma^0 = 10 \log_{10} \langle DN^2 \rangle + CF$

We have installed the new version of PALSAR processing software that improves radiometric accuracies synthetically using the Corner Reflector responses and Amazon forest data for the following two points

1) Calibration of the HV for FBD343 and FBD415
2) Minor calibration updates for the other incidence angles (PLR215, FBS415, FBS508)

After the processing date (January 7 2009), the normalized radar cross section of any of the polarization component can be obtained by the following formula with single calibration factor, i.e.,

$NRCS(dB) = 10*\log_{10}(<DN^2> + CF$ (1.5 product)
$NRCS(dB) = 10*\log_{10}(<I^2+Q^2>) + CF - 32.0$ (1.1 product)

where CF = -83.0.

Before this processing date, the calibration factor (CF) can be given as follows;

Date	Before Jan 6, 2009	After Jan 7 2009
FBS099HH	-83.16	-83.0
FBS215HH	-83.55	-83.0
FBS343HH	-83.4	-83.0
FBD343HH	-83.2	-83.0
FBD343HV	-80.2	-83.0
FBS415HH	-83.65	-83.0
FBD415HH	-83.19	-83.0
FBD415HV	-80.19	-83.0
FBS508HH	-83.30	-83.0

Change of expression

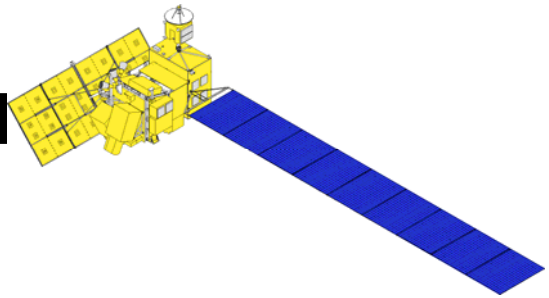
- The mosaic data is expressed in gamma-naught from Sept/E 2008, while the mosaic data was in NRCS before.

- Advantage: incidence angle independency
- Disadvantage: calculation of the incidence angle is difficult

- Future service
- Updating the previous product (1st SE mosaic) in gamma-naught and with the following info.

- Add:
- Mask data
- Local incidence angle map
- Date map

Inclination control maneu

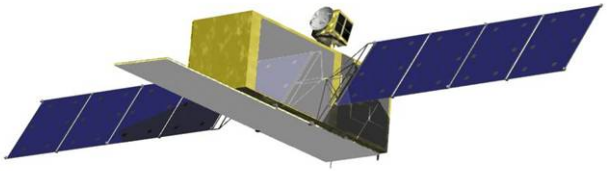


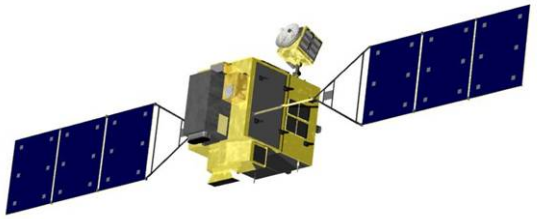
- A purpose to reduce a change width of time at descending node (Ts).
- It was conducted twice in June and July, 2008.
- Although the ALOS orbit was deviated from RSP ±2.5km for a week (Spec. RSP ±2.5km) after inclination maneuver,it has successfully returned within RSP±500m.

	⊿i START	Deviate from RSP ±2.5Km	within RSP±500m
First ⊿i	11 Jun.	12 Jun. ～17	23 Jun.～
2nd ⊿i	30 Jul.	31 Jul. ～5 Aug.	4 Sep.～

ALOS follow-on (2 SAR + 2 OPT)

- **Satellite**
  - SAR satellite
    - GSD: 3m (strip map), 3m*1m (spotlight)
    - Swath: 50km
    - L-band
  - Optical satellite
    - GSD: 1m (Pan), 4m (Multi-spectral)
    - Swath: 50km
  - First satellite: launch target JFY2012
- **Goal : High resolution land observation**





AI to this meeting

1) KC extension will be two years synchronizing to the PD/node agreement refinement.

2) Make a scientific report + statement on what was discovered through this scientific activity.

3) Clarify the PALSAR acquisition requirement. How much % of the ALOS resource are required for this project?