ALOS-2 Science program Status and Capacity Issue

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JAXA/EORC

Dec. 6, 2013

- Summary

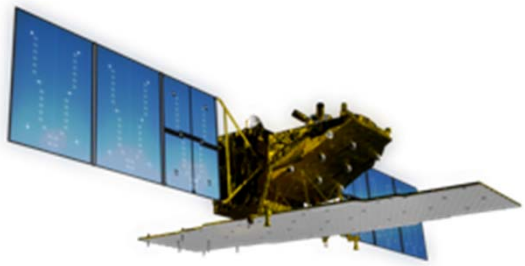
- ALOS-2 PI program started: 379 PI were selected.
- 1st PI meeting held at Tsukuba Epocal on Sept 20 and 21.
- Pi-SAR-L2 observation flights for deisater
- Pi-SAR-L2 PI group was set up.
- PALSAR CVST meeting was held n Nov 25 and 26 at Tsukuba.
- Phase to the ALOS-2

- KC-3: three years activity by Macrh 2013.
- Other scienc eproject by Matrch 2013.

- Needs KC-4 establishment (Biosphere and he cryosphere).

ALOS-2 Research Announcement (RA-4)

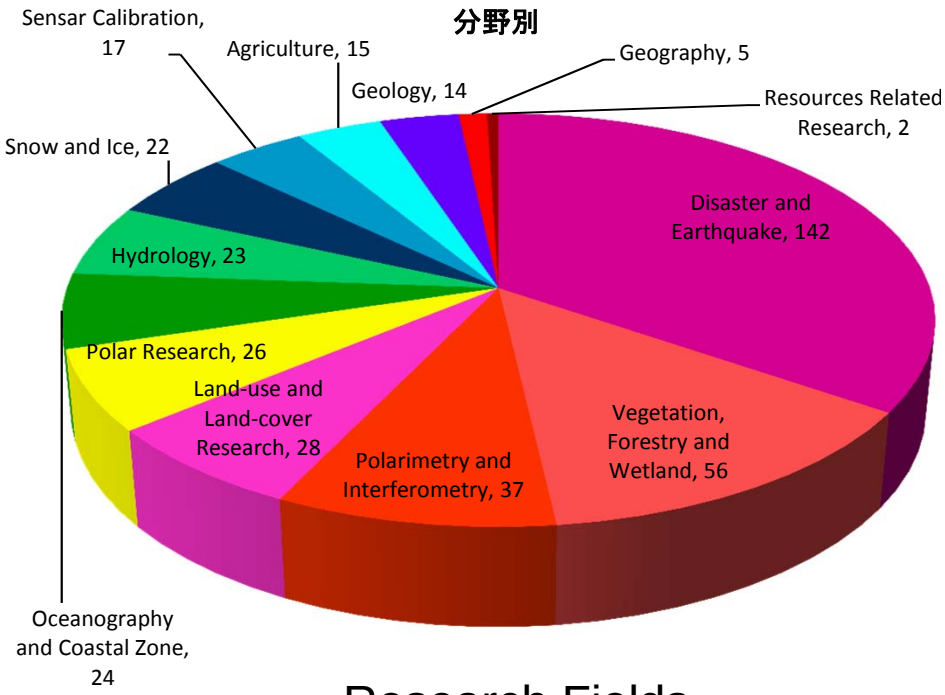
- Released on July 20, 2012
- Window for proposal: ~ Oct. 31, 2012
- Peer review: Nov. 1,2012~Jan. E, 2013
- PI selection on March 8 2013
- Agreements: March 8 2013~March 2013
- PI activities: May 2013-3 years:



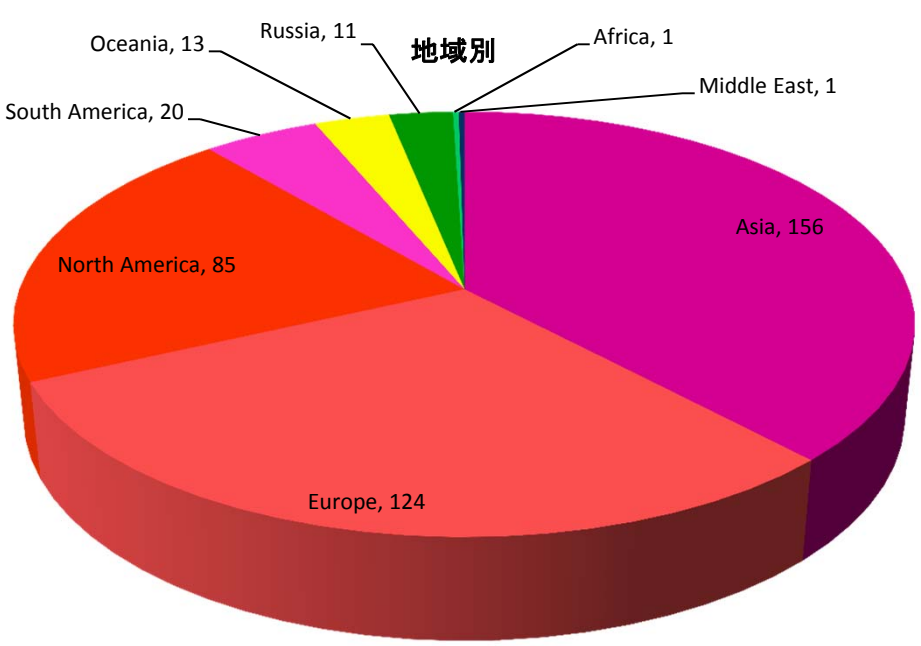
(1) Calibration and Validation, (2) land use and land cover research, (3) topography and geology, (4) terrestrial (vegetation) ecosystem, agriculture and forestry research, (5) climate system, hydrological processes and water resources related research, (6) oceanography and coastal zone related research, (7) disaster and earthquakes, (8) resource exploration, (9) development of spatial data infrastructure, (10) basic studies on scattering and interferometric characteristics,, (11) Polar research, and (12) Ionospheric Researches.

Number of the selected PIs' is 379

Fields	PI	Field	
Disaster and Earthquake	142	Hydrology	23
Vegetation, Forestry and wetland	56	Snow and Ice	22
Polarimetry and Interferometry	37	Sensor Calibration	17
Land Use and Land-cover Research	28	Agriculture	15
Polar Research	26	Geology	14
Oceanography and Coastal Zone	24	Geography	7



Research Fields



Geophysical Areas

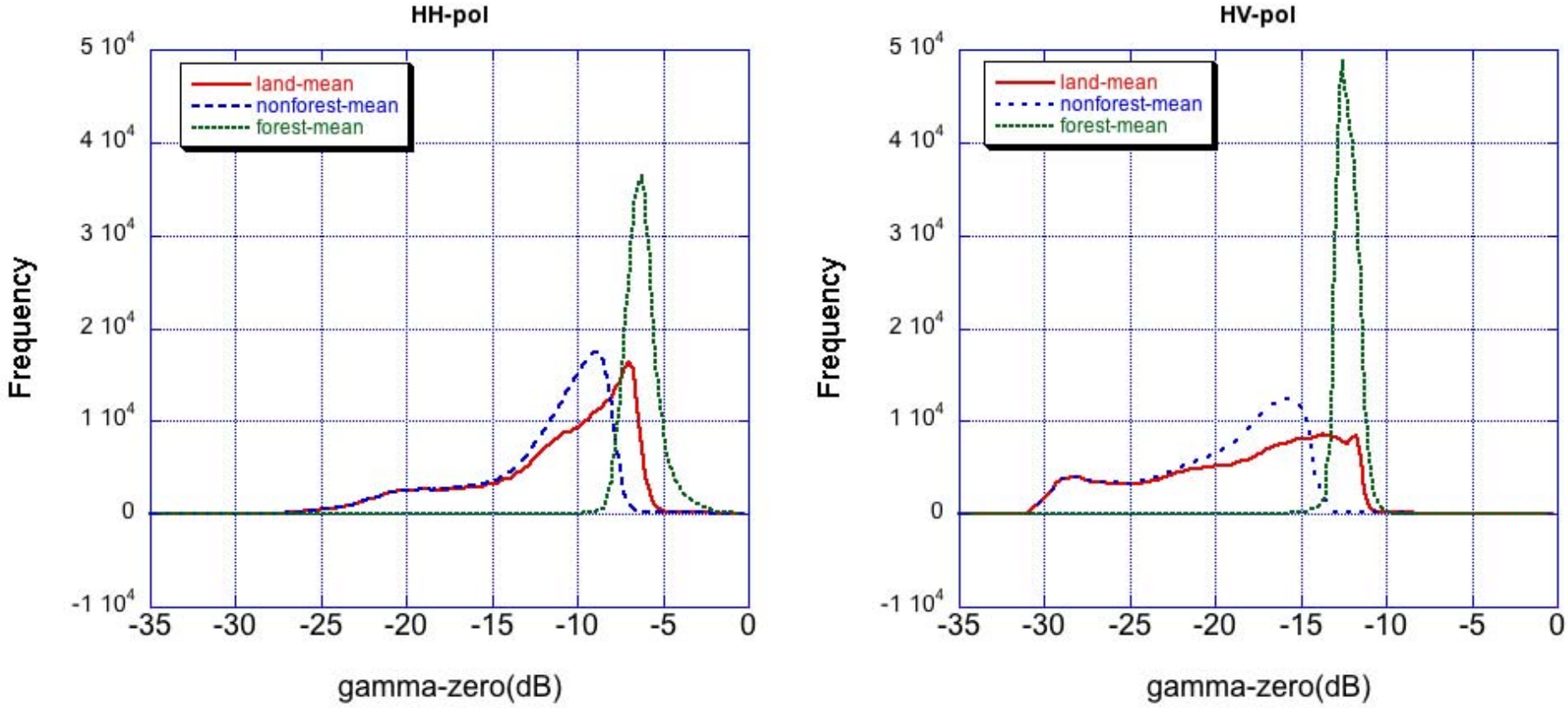
JAXA FNF Status

- Written to RSE under reviewing process
- GEO FOI prepared the MGD showing the strong needs for the RS data (opt and SAR).
- Under preparation for the open (50m). After JAXA approval (Dec. 13, 2013), data will be opened to the public in January 2014.
- FTP downloading the SRTM type of the FTP mechanism.
- New definition of the high-medium and low resolution data, 25 m is the border between them (JAXA definition)
- In future, we wand to pen 25m mosaic data freely (hopefully before that ALOS-2 data first distribution)
- FNF is defined as the first product in the GEO-FOI and needs to be updated for to be more reliable products. So, open access and receiving the comments from the users are highly expected.

Table 2. The number and proportion of tiles from each year used to generate the final ALOS PALSAR mosaics for 2007, 2008, 2009 and 2010.

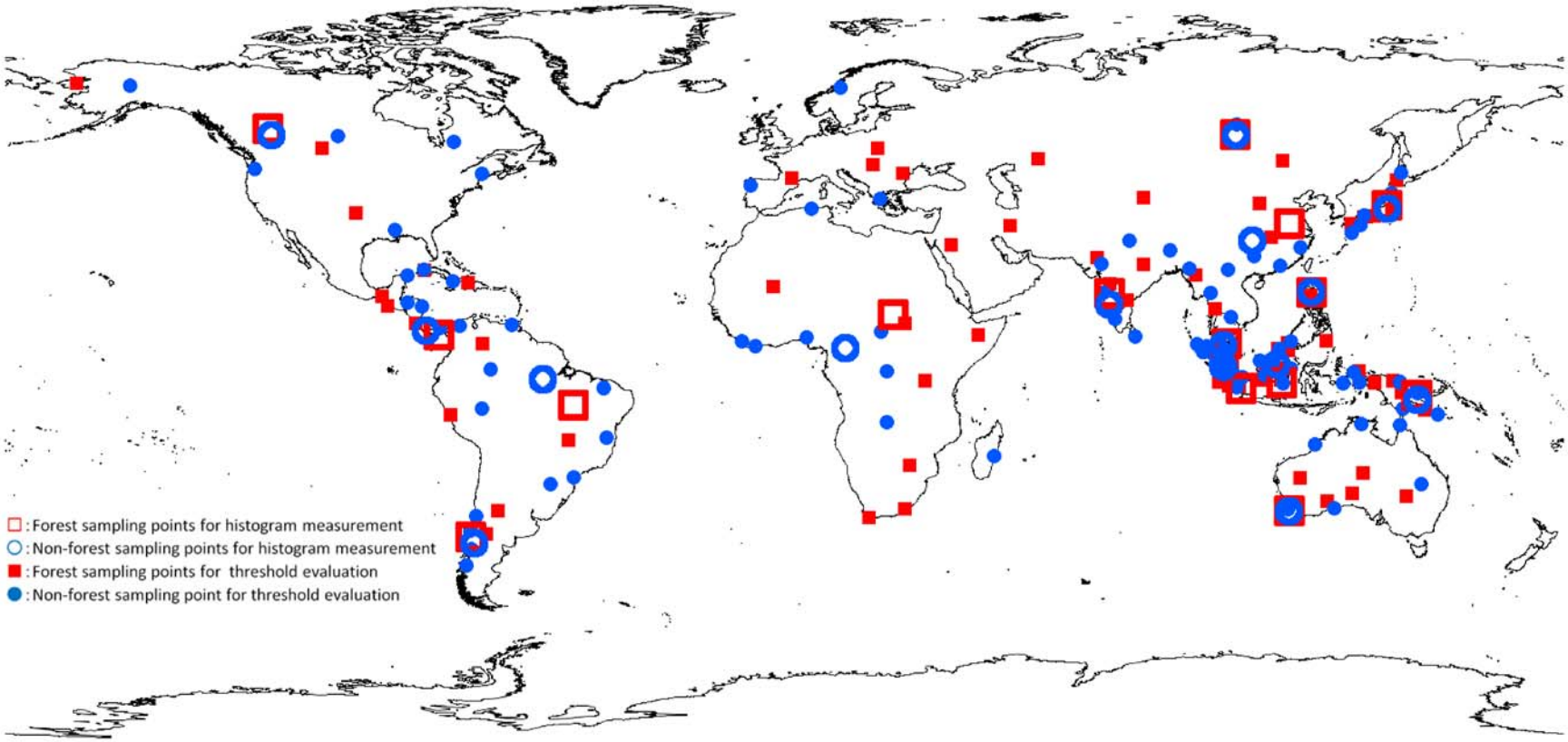
		Observation Year				
Product Year		**2007**	**2008**	**2009**	**2010**	**Total number**
2007	% of tiles	91.04	6.26	2.603	0.098	100
	# paths	3918	434	165	100	4617
	% of area	84.86	9.40	3.57	2.17	100
2008	% of tiles	4.545	93.06	2.219	0.179	100
	# paths	243	4159	157	88	4647
	% of area	5.23	89.50	3.38	1.89	100
2009	% of tiles	0.148	6.153	91.19	2.511	100
	# paths	9	371	4044	303	4727
	% of area	0.19	7.85	85.55	1.89	100
2010	% of tiles	0.252	1.734	3.695	94.32	100
	# paths	15	116	153	4517	4801
	% of area	0.31	2.42	3.19	94.08	100

Histogram of the gamma-zero from the global mosaic data

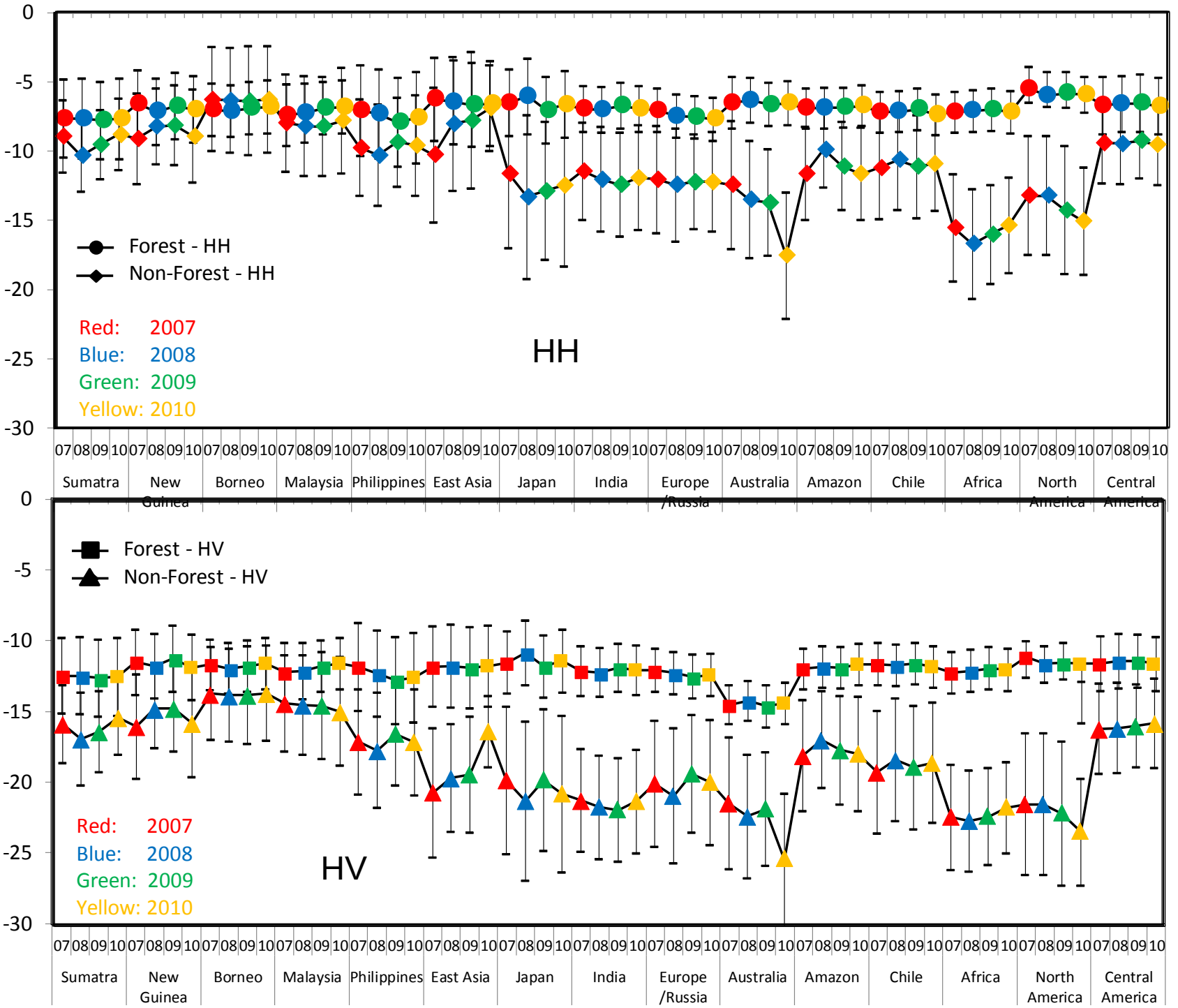


Cross over point is -14 dB

1st Version of FNF was produced in 2010 as the world first SAR based Forest product. This is generally good accuracy. However, more accuracy is necessary.



Distribution of the test sites


0
-5
-10
-15
-20
-25
-30
Forest - HH
Non-Forest - HH
Red: 2007
Blue: 2008
Green: 2009
Yellow: 2010
HH
Forest - HV
Non-Forest - HV
HV
07 08 09 10
Sumatra
New Guinea
Borneo
Malaysia
Philippines
East Asia
Japan
India
Europe /Russia
Australia
Amazon
Chile
Africa
North America
Central America

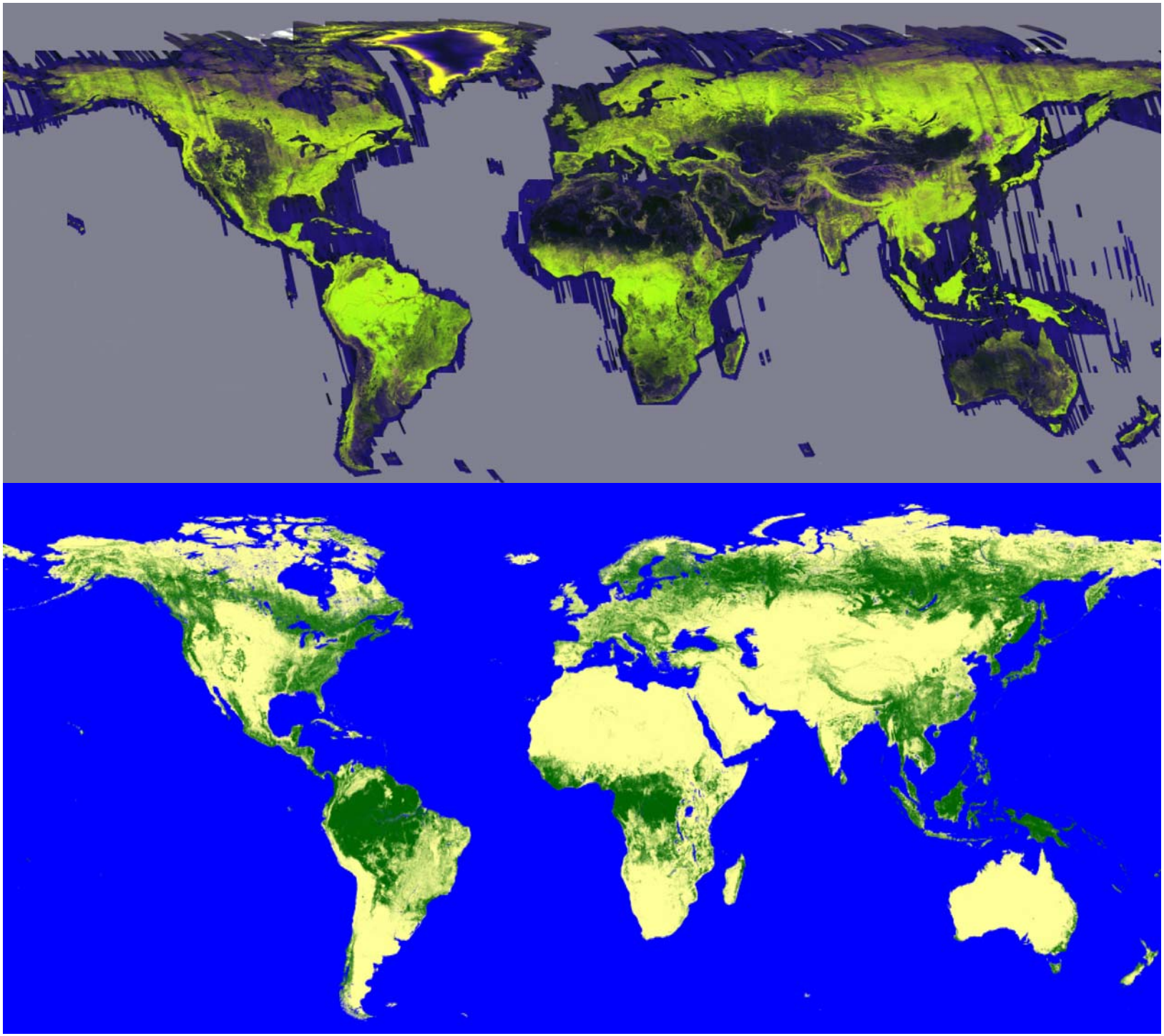


Table 1 . Characteristics of the tiles used to generate the global ALOS PALSAR HH and HV γ^0 mosaics.

Characteristic	Description
Reference location	Latitude and longitude of north west corner
Coordinate system	Latitude-longitude coordinate
Spacing	0.8 arcsec unit providing the spacing at 25m
Resolution of SAR image	36 m (azimuth) x 20 m (range)
Number of pixels and lines	4500pixels x 4500 lines
Data volume	40.5 MB (per tile)
Contents	Normalized radar cross-section, gamma-naught in HH and HV, mask information (ocean flag, effective area, void area, layover, shadowing), local incidence angle, total dates form the ALOS launch (1:30:Jan. 24, 2006:UTC).
No of tiles per year	2007: 27062, 2008: 27163, 2009: 27703, 2010: 27923

-> Down to 2x2 average: 1T byte/year

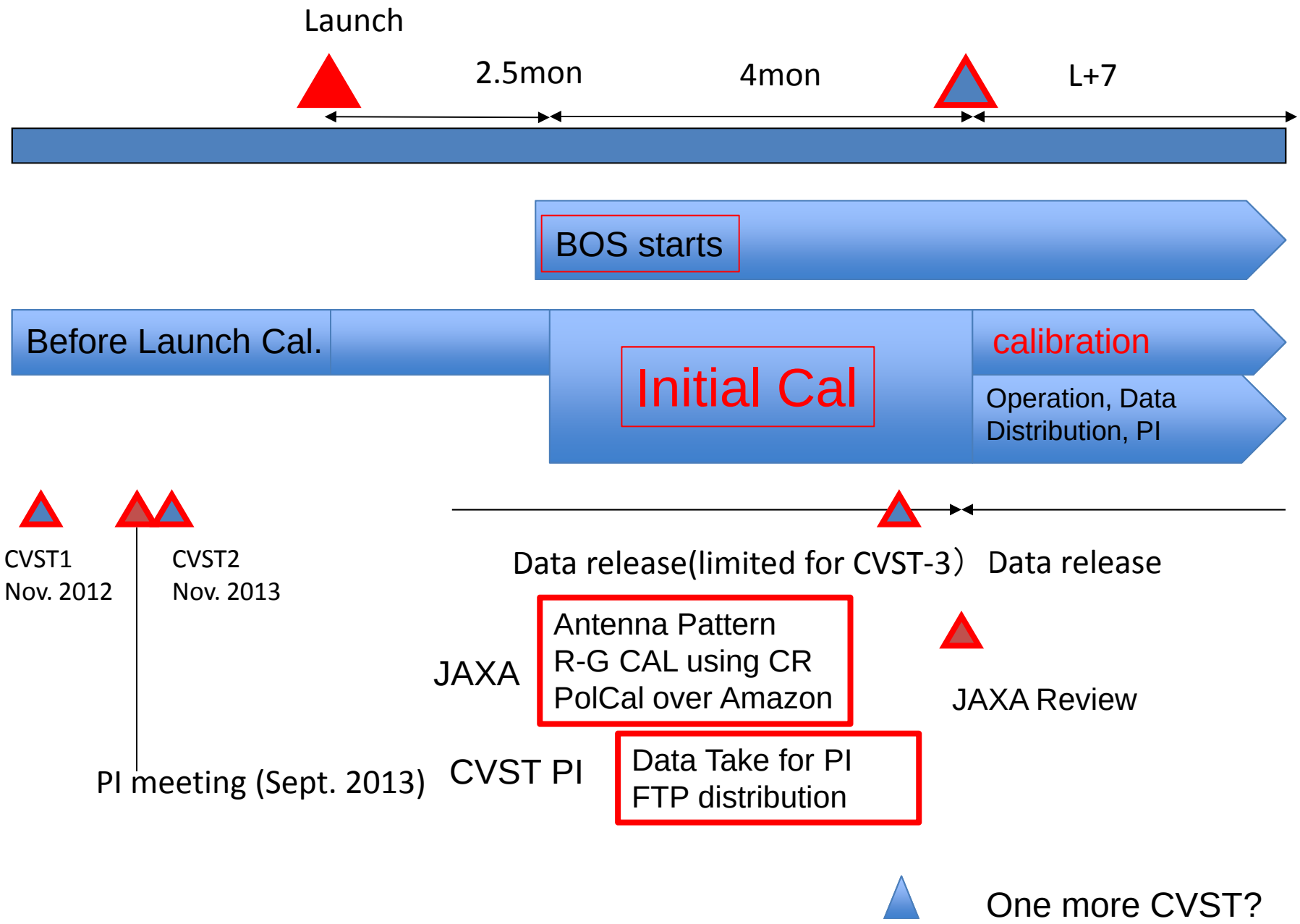
ALOS-2 system characteristics and the status

- Calibration within 6 months
- Antenna pattern Cal
- Geo and radio cal
- Polarimetric calibration , all needs to be within 3.5 months.
- Ionospheric issues.

Improvement from ALOS to ALOS-2

- Higher Resolution
- More Polarizations (Polarimetry)
- Lower NESZ
- Wider Observable range for Quicker Service
- Orbital Maintenance for InSAR (ScanInSAR)
- Duty : 50%

CVST-2 Schedule (Relative Time scale)



PALSAR-2 Information

	Information	URL
1	ALOS-2 Product Format	http://www.eorc.jaxa.jp/ALOS-2/doc/jformat.htm (Japanese) http://www.eorc.jaxa.jp/ALOS-2/en/doc/format.htm (English)
2*	Sample data	http://www.eorc.jaxa.jp/ALOS-2/CVST/data/data_lib.htm

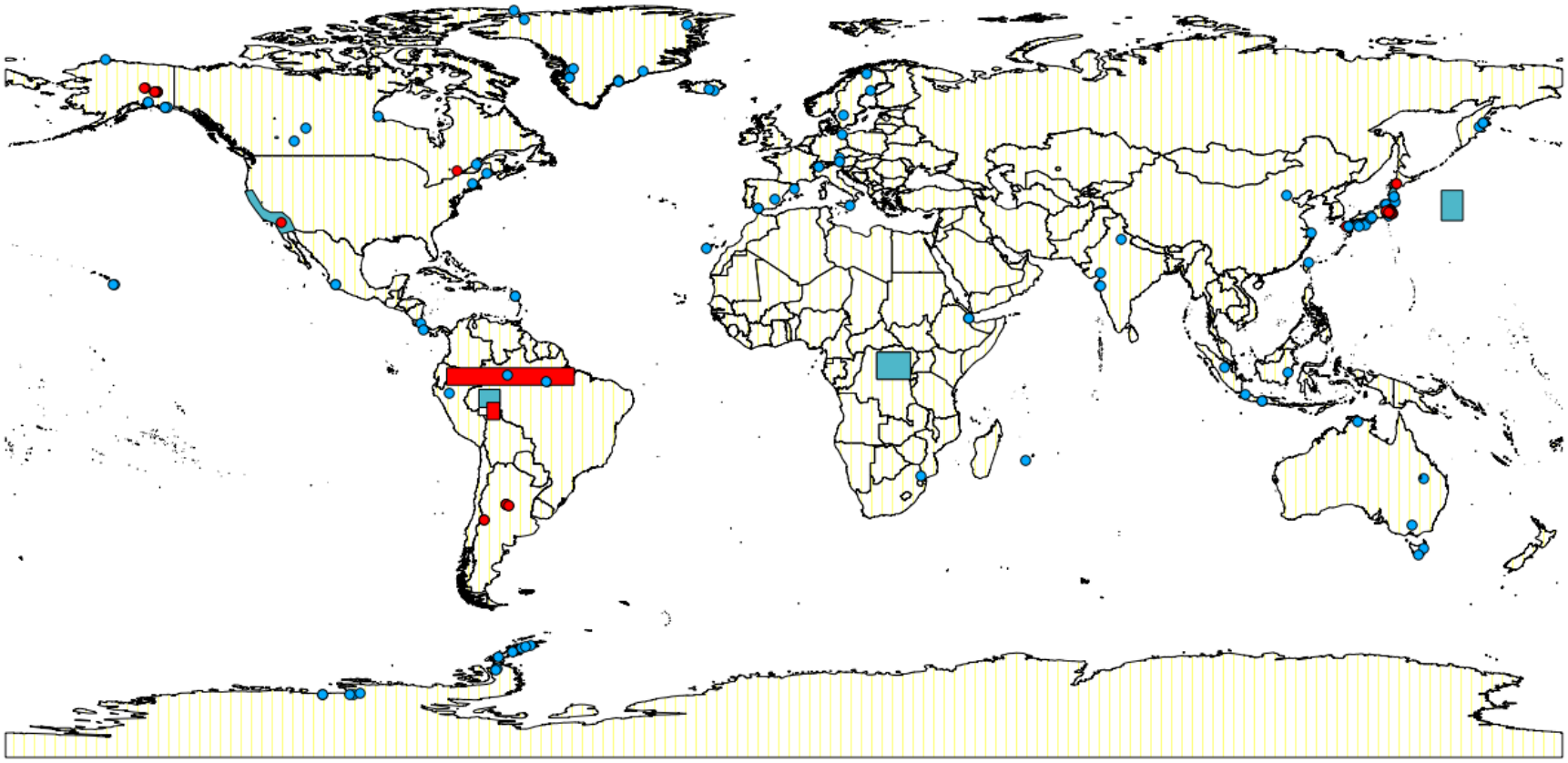
*: Need password

Data Distribution

- JAXA FTP site
- Cal Information use CVST WEB

2.Overview of CVST

CVST All Sites



Red circle and square indicates CR sites (including JAXA Cal sites)

Calibration principle

PALSAR-2 has too many beams for the calibration. In order to finish the initial calibration within 6 months, we need to select the representative beams that can be frequently used under the following conditions.

- **Frequency of use within BOS is high enough over 500 seconds within 2 years.**

- **There is some possibility of use in future**.

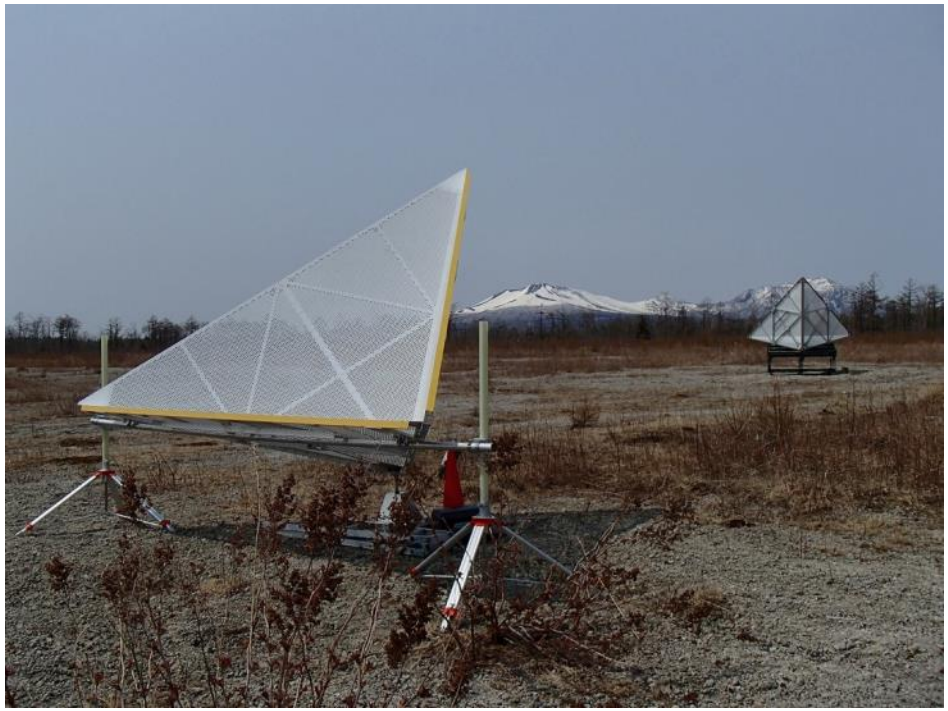
The calibration consists of

- Antenna pattern (elevation and azimuth) determination
- Radiometric calibration using the CR and amazon rain forest
- Geometric calibration using the CR
- Polarimetric calibration using the distributed target and the corner reflectors

Antenna pattern and radiometric calibration
Area: Amazon

Mode	Beam	Numbers	Number of measurements	Asc. Right	Desc. Right
UB(84) right HH	1~24	>3	4/beam	2/beam	2/beam
UB(84) right VV	1~24	>3	4/beam	2/beam	2/beam
FB(28) right HH+HV	1~22	>3	4/beam	2/beam	2/beam
HBQ(42M)	3~7	>3	4/beam	2/beam	2/beam
WB right 28 HH+HV	1~4	>3	4/beam	2/beam	2/beam
WB right 14 HH+HV	1~4	>3	4/beam	2/beam	2/beam
VB right 14 HH+HV	1~3	>3	4/beam	2/beam	2/beam
HBC(42) RCH+RCV ~~LCH+LCV~~	6~9		4/beam	RCH+RCV：1/beam ~~LCH+LCV：1/beam~~	RCH+RCV：1/beam ~~LCH+LCV：1/beam~~

JAXA Calibration Site in Tomakomai, Hokkaido, Japan



Active Radar Calibrator (PALSAR-2) and receiver

ARC

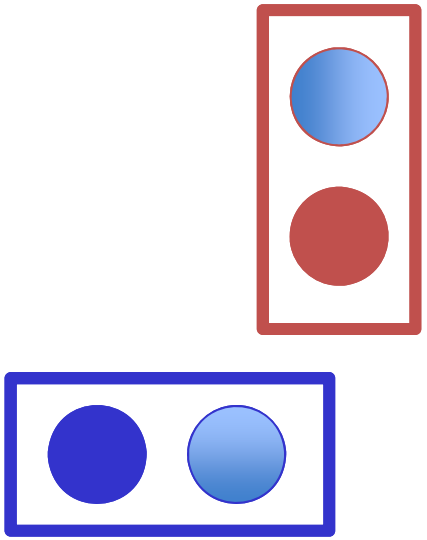
- Geometric calibrator with location uncertainty of 1 cm
- 45 (0, 90 deg) degree rotational ARC.
- Manually controlled for off nadir angle.
- High RCS stability using thermally insulated units
- Wide resistance for temperature and humidity
- ARC mode prepares the H and V phase difference

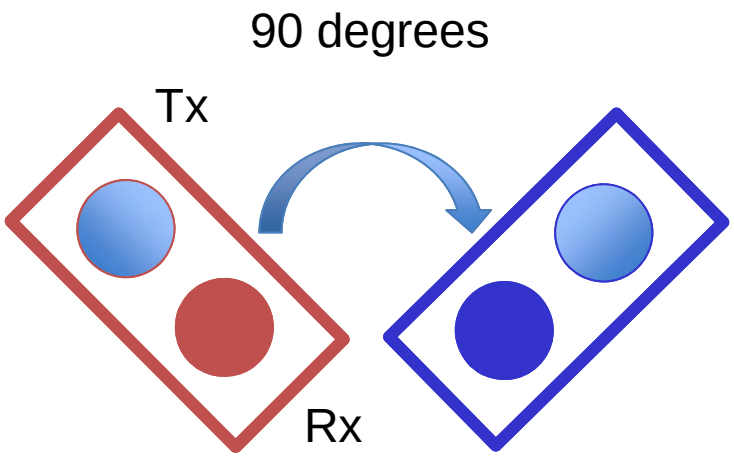
Receiver

	GCx2	Receiver
Frequency band	1215-1300MHz	1215-1300MHz
Off nadir angle	9.9～50.8°	9.9～50.8°
RCS or receiving capability	25dBm2:Spotlight 30dBm2:3m strip 35dBm2:6m strip 40dBm2:10mstrip	100Mhz AD conversion
ALOS tracking	No	No
temperature range	−10～＋50℃	−10～＋50℃
Humidity range	35～100%RH	35～100%RH

Transponder and Signal Evaluator

- Transportable Transponder (Geo-calibration)
- Position Accuracy : 1 cm – radar LOS
- Polarization selective





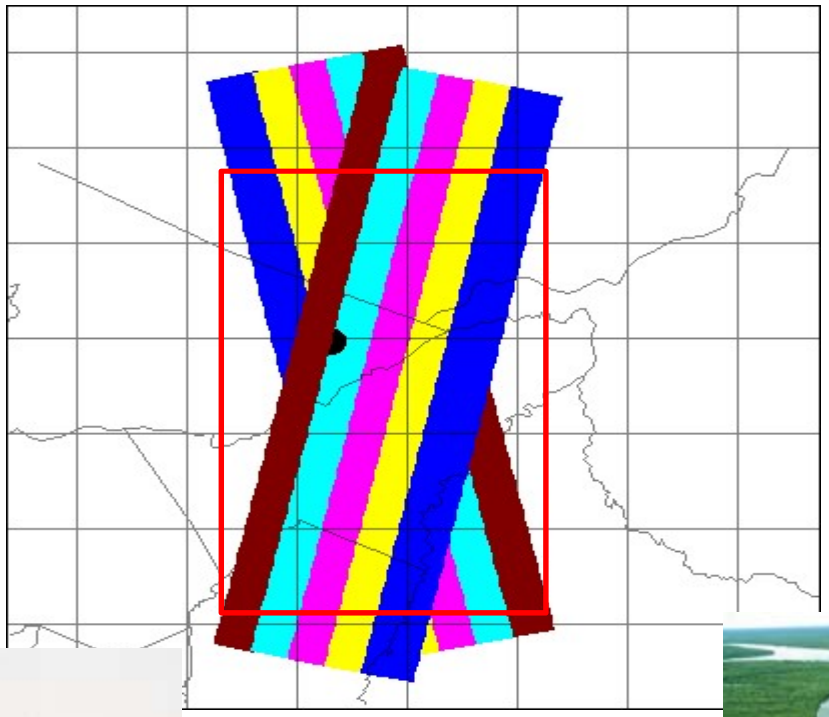
$$\begin{pmatrix} Z_{hh} & Z_{hv} \\ Z_{vh} & Z_{vv} \end{pmatrix} = Ae^{\frac{-4\pi r}{\lambda}} \begin{pmatrix} 1 & \delta_3 \\ \delta_4 & f_2 \end{pmatrix} \begin{pmatrix} S_{hh} & S_{hv} \\ S_{vh} & S_{vv} \end{pmatrix} \begin{pmatrix} 1 & \delta_1 \\ \delta_2 & f_1 \end{pmatrix} + \begin{pmatrix} N_{hh} & N_{hv} \\ N_{vh} & N_{vv} \end{pmatrix}$$

PolCal Sites in Rio Branco, Brazil

- Condition: Faraday Rotation Minimum
- Reference Targets available:> CRs and Natural Forest

Red Rectangle : Rio Branco
Red Area : Site target

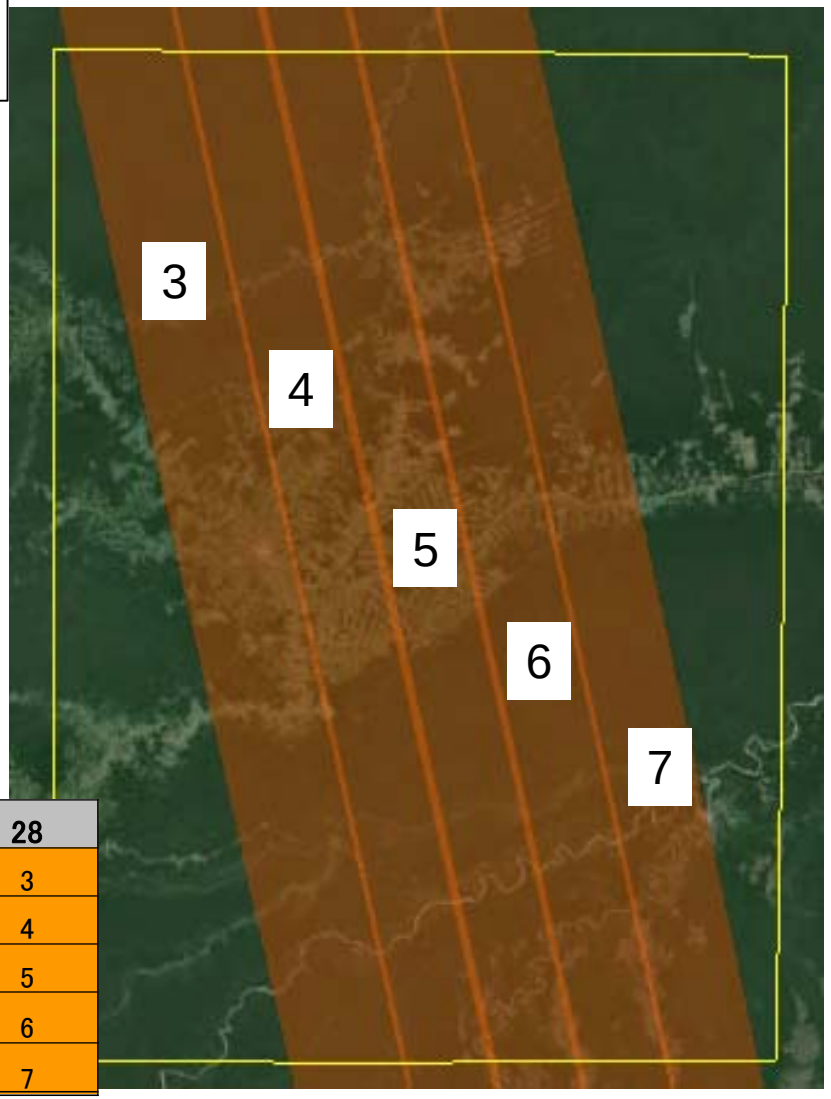
UL -8.000,-68.650
UR -8.000,-65.750
LL -12.000,-68.650
LR -12.000,-65.750



Rio Branco（Ascending.　path28）

左上：　-8.0°　-68.65°
右下：-12.0°　-65.75°

数値はHBQのビームNo



Beam3　cycle6
Beam4　cycle7
Beam5　cycle8
Beam6　cycle9
Beam7　cycle10

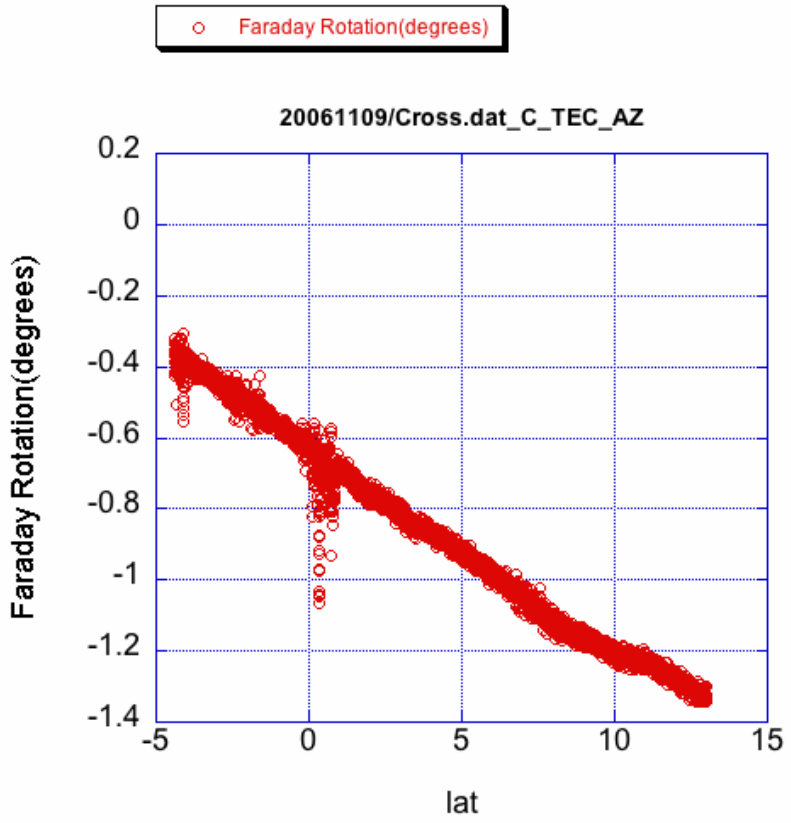
RioBranco

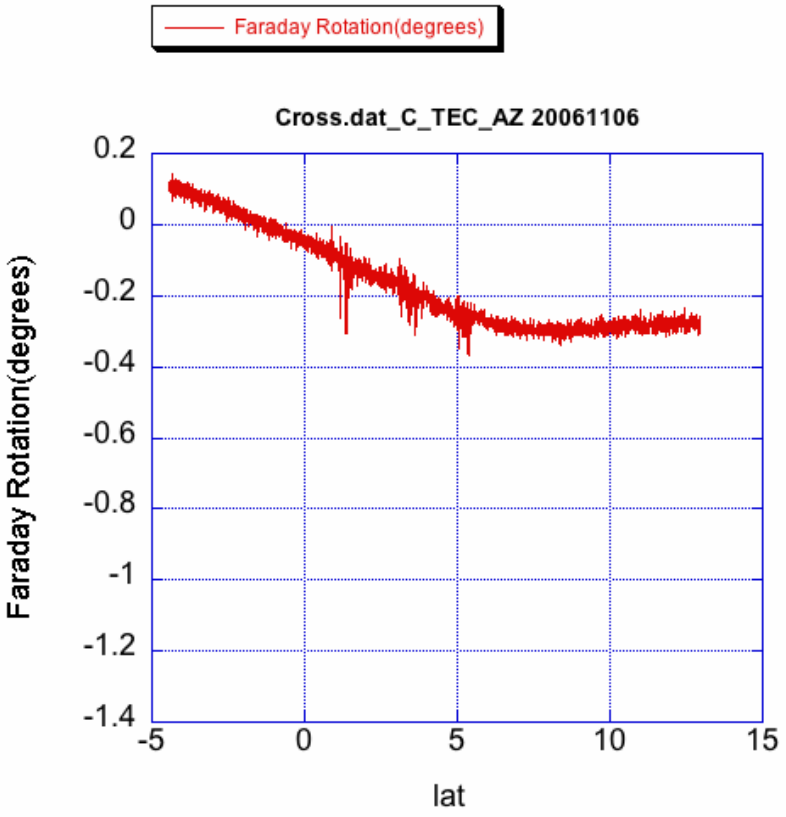
Cycle	Site Name	Area	Mode	28
Cycle 6	RioBranco	S02	HBQ	3
Cycle 7	RioBranco	S02	HBQ	4
Cycle 8	RioBranco	S02	HBQ	5
Cycle 9	RioBranco	S02	HBQ	6
Cycle 10	RioBranco	S02	HBQ	7

2006/11/9

Faraday Rotation(at the Scintillation time)

2006/11/6





All the action items

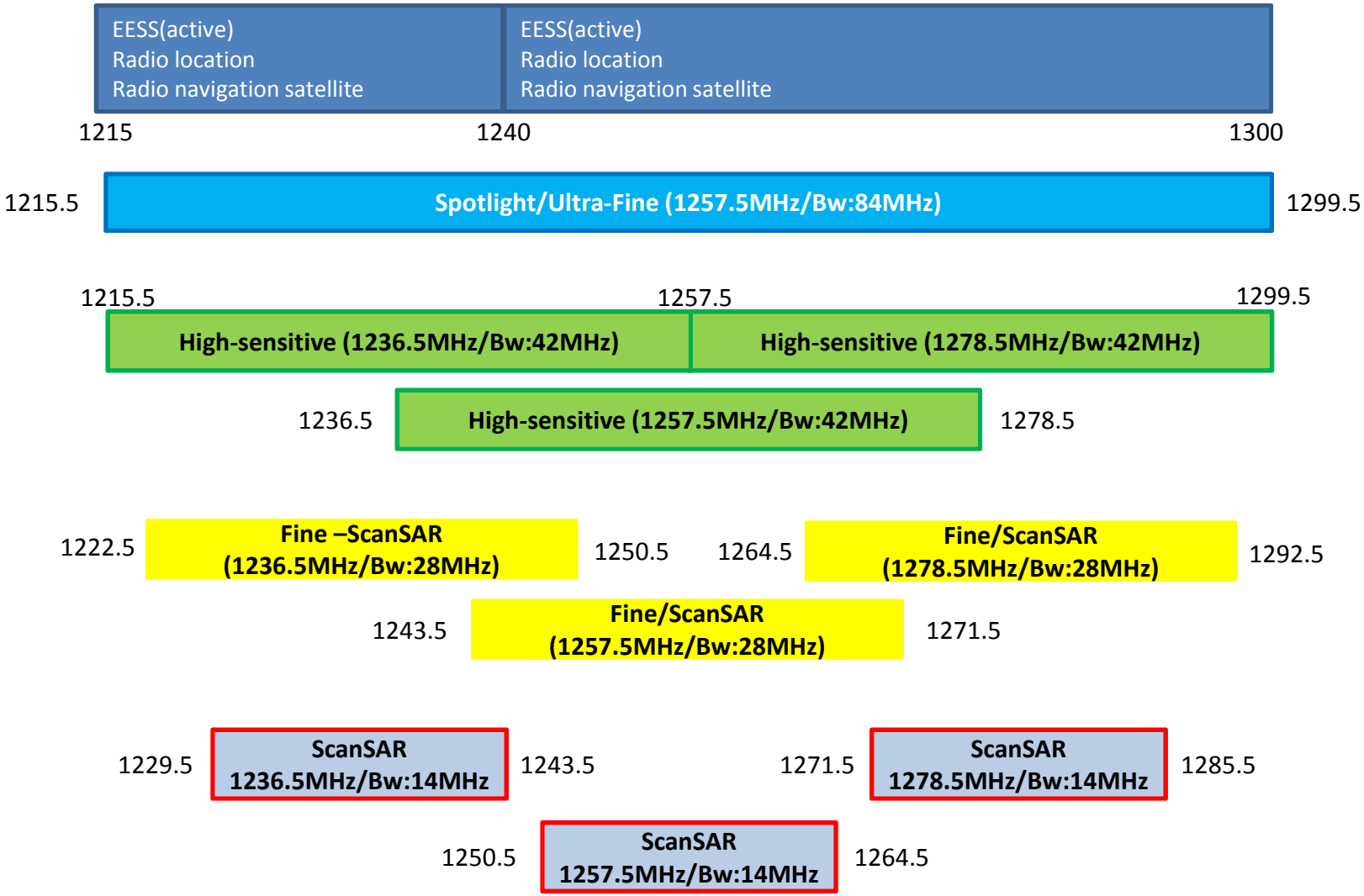
Actions and contents	Status
CVST WEB or FTP need to be set up for all the document and data could be shared within the CVST team	11/e: Done
Set up the mailing list for information exchange	11/16:Done
Time dependent radius of the orbital tube for 500m (deformation)/ 1000m (vegetation) study	12/e
Clarify the noise measurement mode of the PALSAR-2 CAL.	11/13:done
Sharing the detailed mode description (excel)	11/22:done
Overlapped Coverage of the ScanSAR swath and Strip	ALOS-2:doen on Nov. 25, 2013
Observation Request form (From PI) needs to be filled and submitted	12/14, 2012
Sample Data format and sample data	11/e, done on Nov. 25, 2013
Frequency allocation of the PALSAR-2 mode	11/22:done
BOS-J clarification for checking availability of the Yamaguchi-sensei and detailed BO for polarimetry	
Distribution of the only-range compressed data	11/e:NY

Actions	Due
Availability of the 30km 28MHz Pol data more than 50km 42 MHz, incorrect	Done
Allocate the Pol observation at June-October phase in Boreal +Panpas regional campaign> To be included in the future planning	11/e-TBD
Allocate the PolSAR mode for Disaster event	Done (Jan. 2013)
Provision of the orbital determination accuracy:0.2 m for L1+L2	Nov. 25, 2013, :ALOS-2
Clarify the unavailability duration at the orbital maneuvering:1.5min	12/e:Nov. 25, ALOS-2
BOS for cryospheric monitoring: HH+HV better than HH: need to be considered	11/e: Done (Sept. 2013)

Actions-1/2	Due
Operation consideration for ScanSAR + strip at the strip boardre areas	Done?
Circular polarization:What is the polarity ratio?> Not measured.(Variation.. Okada-san)characterize or measure transmit polarization for the compact mode as a function of incidence angle, i.e., axuial ratio and phase	12/E,2013
Frequency selection: Three selections are prepared but not yet decided. (Use the high frequency part (InSAR with PALSAR/PALSAR-2) or selective after the RFI evaluation)	12/E, 2013
Switch off/on of L2 during PALSAR transmission will be decided after the test, while the ALOS-2 wants to switch off the L2 receiver.	12/E, 2013
Use of the nominal orbit for calculation of the CR deployment angle is accepted.	done
Pick up all the Pis' request from the presentation and calculate the CR angle (for Scott)	12/E, 2013
Prepare the FTP site:more data in two months	Done
Signal cross talk due to the Faraday rotation may be severe in 2014 acquisition. FR monitoring using the long strip/distributed POL data is highly recommended.	12/E, 2013
Time series acquisitions for Pol SAR(PolInSAR), Single or Dual SAR or Compact Pol at CALVAL sites needs to increased from Initial Cal to operational Cal phase (i.e., Costa Rica, Hawaii, Harvard, Galcier), where the C-pol site is only in Canada.	12/E, 2013

Actions-2/2	Due
Consider the method for ionospheric disyurbance (Split window)	All
All the data in CVST can be shared within CVST ?	All
Originally, one CVST is planned 5th month after the launch. But, one more CVST-4 needs to be set one or two months earlier.	All
More data takes need to be considered for C-pol (ScanSAR), PolinSAR. Definition is necessary (RC could be dominant mode): definition of cpol: 12/e, 2013	All

THE FREQUENCY RANGES FOR OBSERVATION



PALSAR-2 Products

PALSAR-2 Standard Products

Level	Definition	Format
1.1	Range compression and 1 look azimuth compression are performed. Data is complex data on the slant range coordinate. The phase history is included.	CEOS SAR /GeoTIFF
1.5	After range and multi-look azimuth compression are performed, radiometric and geometric corrections are performed according to the map projection.	CEOS SAR /GeoTIFF
2.1	Orthorectified processing is performed for Level 1.1 data by using DEM.	CEOS SAR /GeoTIFF
3.1	Image corrections such as noise reduction and dynamic range compression are applied to Level 1.5 data.	CEOS SAR /GeoTIFF

Currently Japanese documents only.
http://www.eorc.jaxa.jp/ALOS-2/doc/jformat.htm

English documents will be available soon.

PALSAR-2 Products

Data Size [GByte]

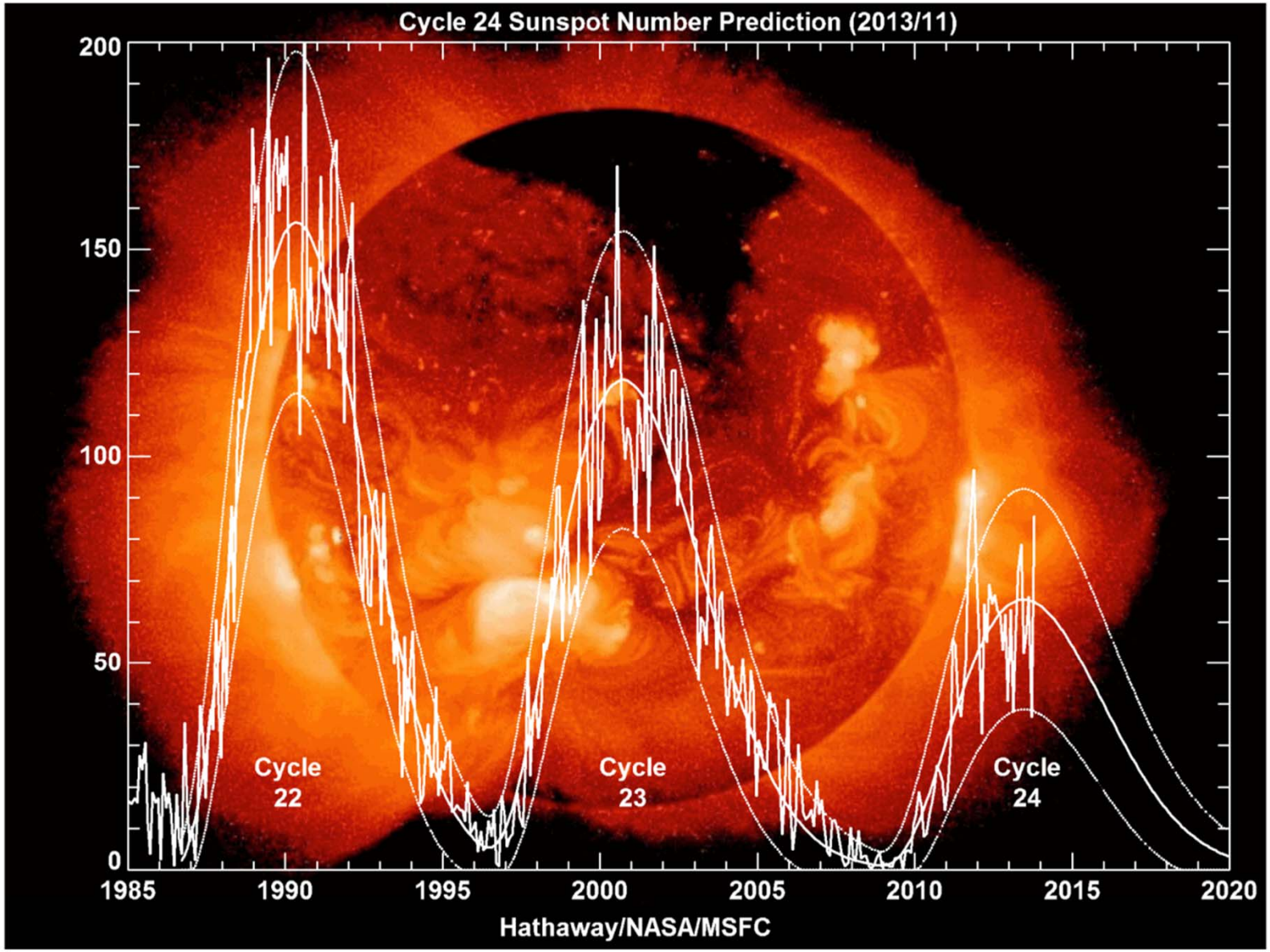
Imaging mode	Spot-light	Stripmap			Full Pol.		ScanSAR					
							350km				490km	
		3m	6m	10m	6m	10m	SPECAN		Full Aperture		SPECAN	Full Aperture
Bandwidth	84MHz	84MHz	42MHz	28MHz	42MHz	28MHz	14MHz	28MHz	14MHz	28MHz	14MHz	14MHz
Pixel Spacing	0.625m	2.5m	3.125m	6.25m	3.125m	6.25m	25m					
L1.1 (Geo-reference)*1	4.3	5.2	2.4	1.0	5.5	2.1	3.5	6.9	27.1	54.1	6.0	46.8
L1.5/L3.1 (Geo-reference)	3.1	1.2	0.8	0.2	0.7	0.1	0.4				0.5	
L2.1 (Geo-coded)*2	6.1	2.4	1.5	0.5	5.7	0.9	0.7				1.1	

***: Size for single pol (doubled for dual pol) except for full pol**
***1: Size for Typical off-nadir angle/scan**
***2: Maximum Size**

Comparison of the JERS-1 SARとALOS PALSAR on data amount/number of scenes(daily)

	Daily Data Amount (GByte)	Daily number of scenes	Remarks
JERS-1 SAR	17.58	193	Based on 1993～1997
ALOS PALSAR	355.69 (20.24)	1,176 (6.10)	Based on 2007-2009
ALOS-2	553.00-> 800MB (31.45)	1,344>?? (6.97)	Simulation

- CAL included
- All the OBS data included.


Cycle 24 Sunspot Number Prediction (2013/11)
200
150
100
50
0
1985
1990
1995
2000
2005
2010
2015
2020
Cycle 22
Cycle 23
Cycle 24
Hathaway/NASA/MSFC