Calibration and Validation of PALSAR (Version 5)

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K&C meeting at JAXA/EORC, Feb.28-March 3 2005

Processor update

SIGMA-SAR processor as of Feb. 28 2005

	prf change	no prf change
Strip	finished	finished
SCANSAR	in progress	finished(except small point)
Browse	in progress	finished

Geometric conversion	ground range/geo-code/ortho finished DEM-> problem
Radiometric conversion	Finished (Scansar in progress)

Satellite Yaw steering

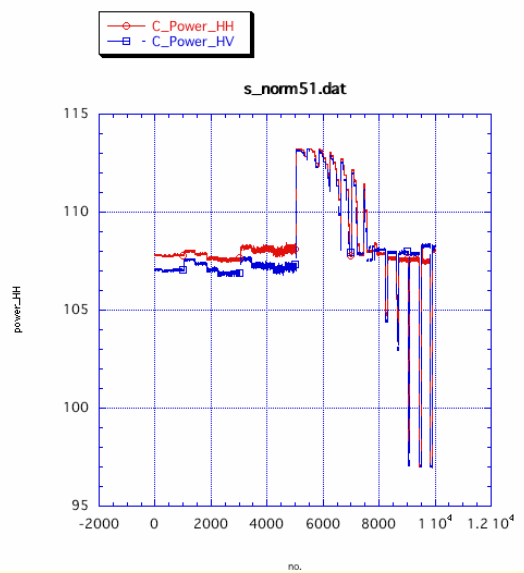
Faraday rotation	To be corrected (for polarimetry) Use database

Several Pulsar data were acquired and evaluated.

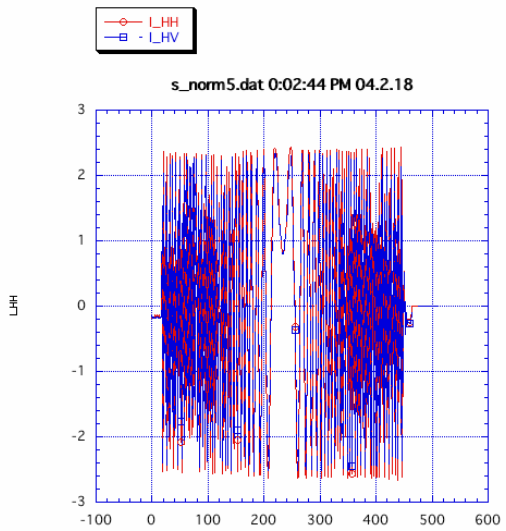
No serious problem were found.

SCANSAR, FBS, FBD, POL modes were evaluated.

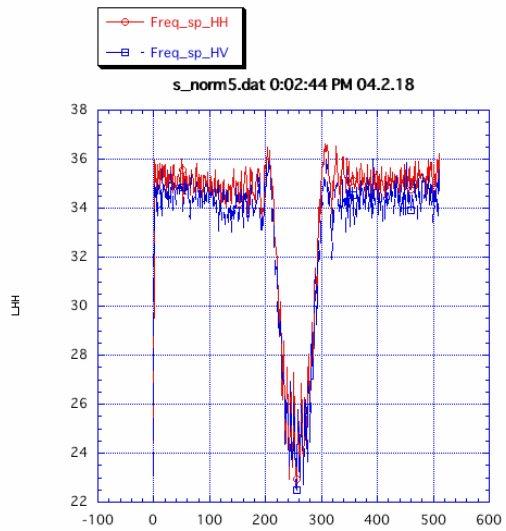
three times from 2004 - 2005



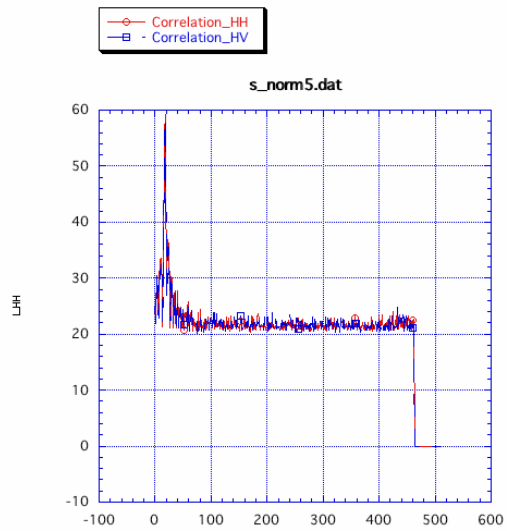
Azimuth pattern of raw data



I (HH,HV) wave

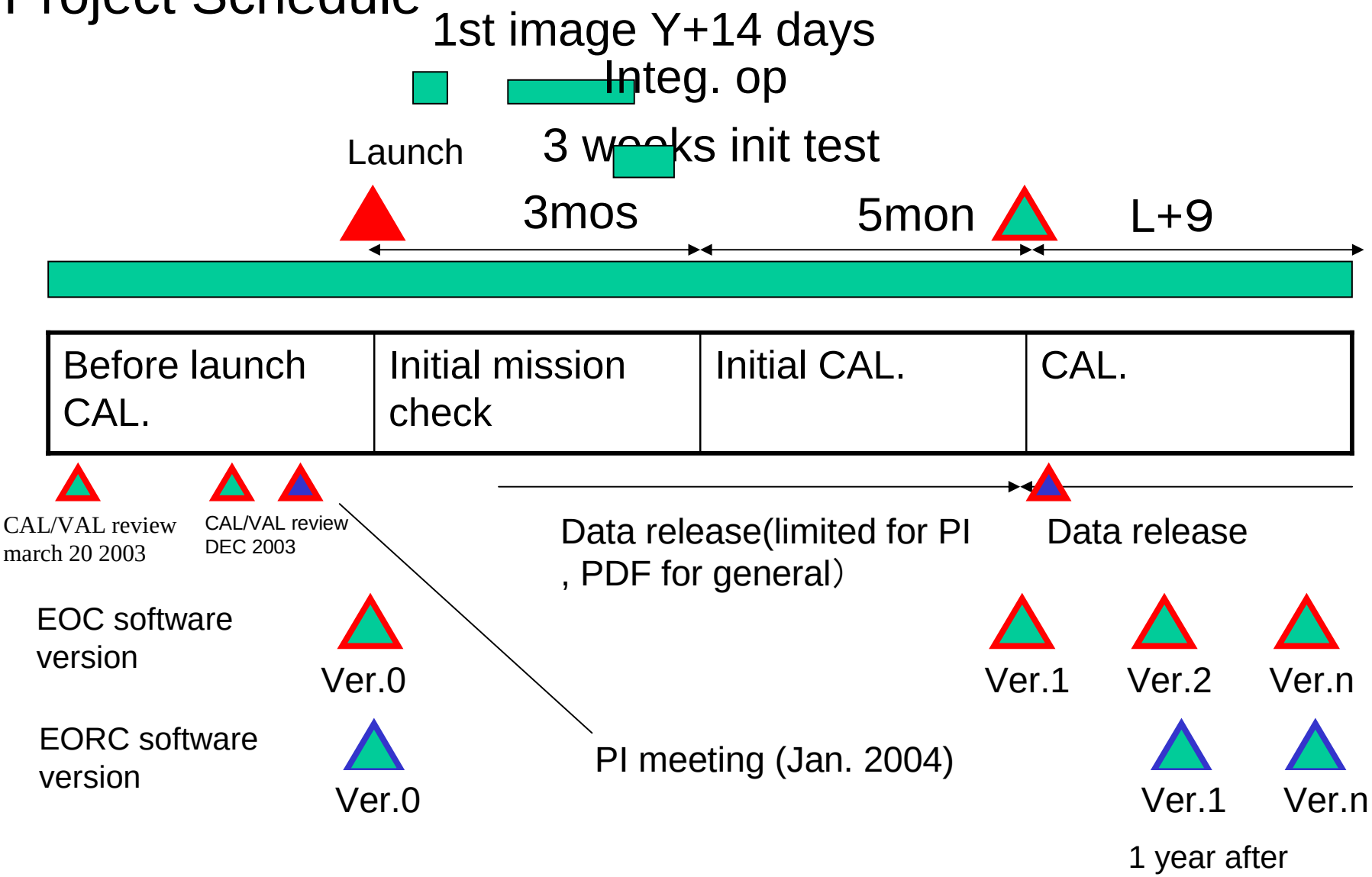


Power spectrum



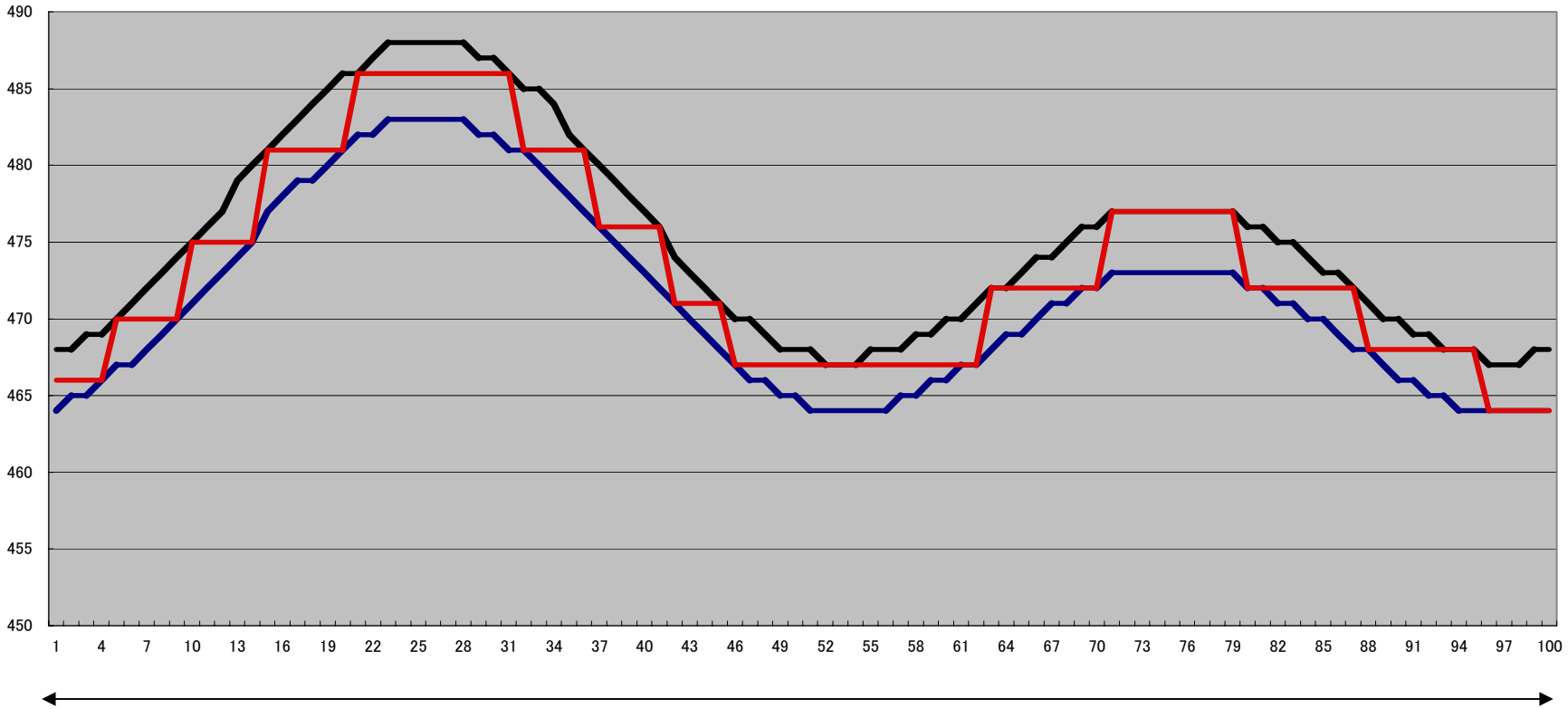
Range Correlaion

Project Schedule



Launch is Sept. 2005

PRI (pulse repetition interval)

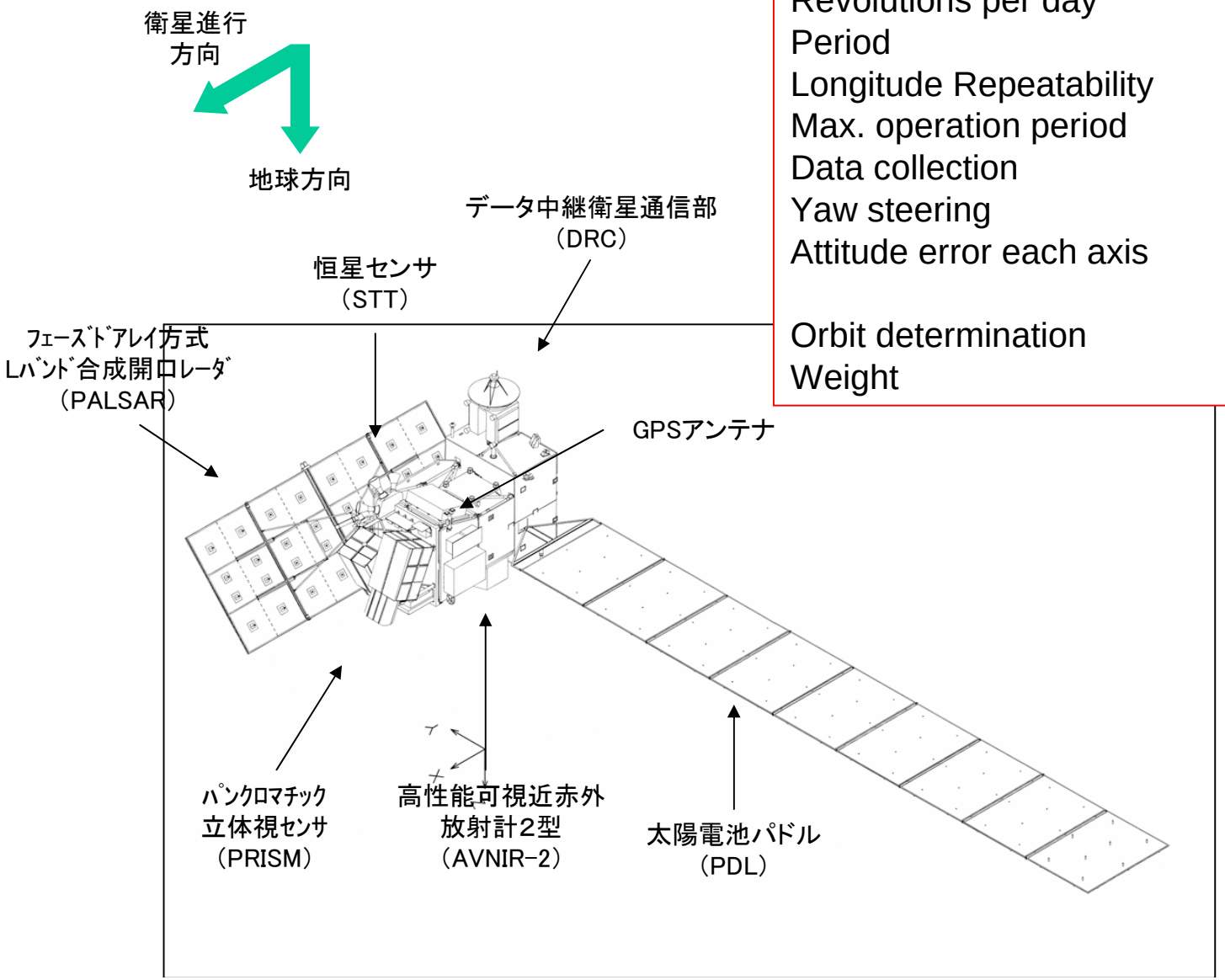


Revolution

7 times/descending or ascending node
3 times/strip (2000 - 3000 km)

ALOS performance, view on orbit

Orbit	sun-synchronous
Local Time at DN	10:30 ± 15min.
Altitude	691.65km
Inclination	98.16 degrees
Revolutions per day	14+27/46
Period	98.7 minutes
Longitude Repeatability	+/-2.5km Equator
Max. operation period	70 minutes
Data collection	1 DRTS+DT
Yaw steering	ON
Attitude error each axis	2.0e-4° (det), 0.1° (maintain)
Orbit determination	1m(20 cm)
Weight	4000 Kg



Features of PALSAR

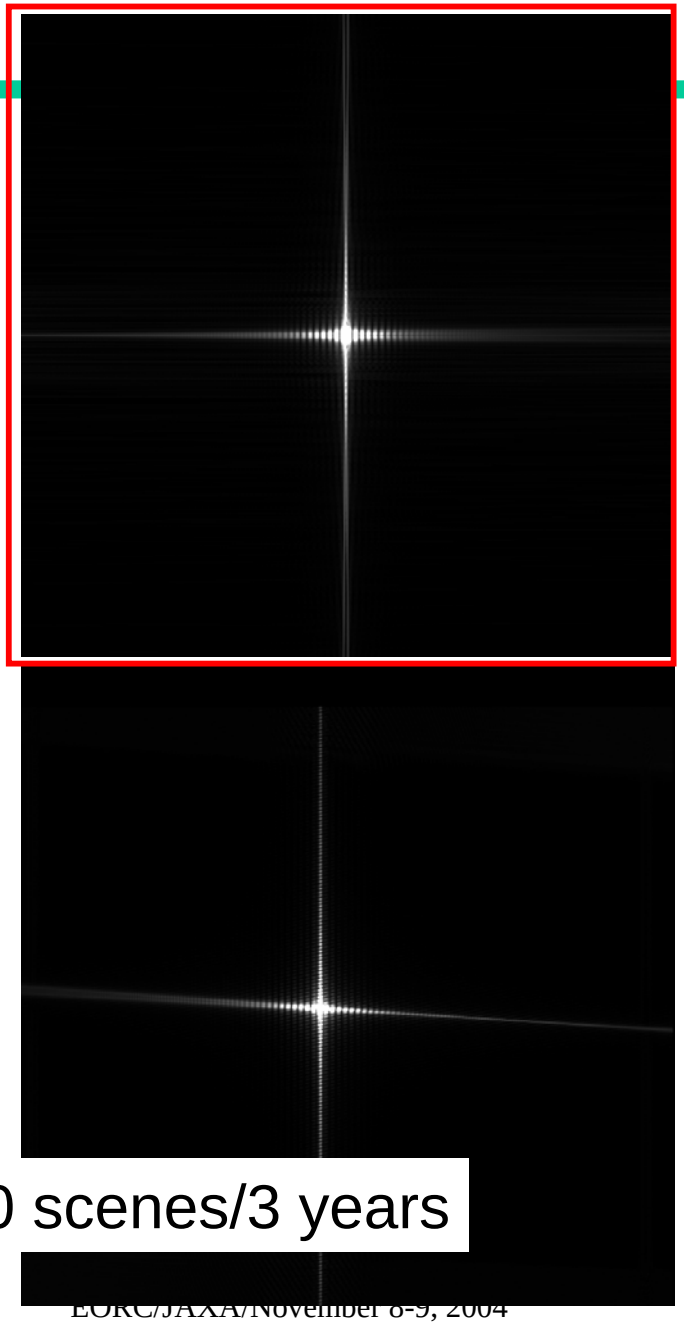
Fine Resolution (28MHz), Dual Pol.(14MHz), Full. Pol., SCANSAR

8.9 m antenna gives finer resolution.
Higher penetration to the Earth

Low processing efficiency, Faraday rotation

Main modes
(off-nadir of 21, 34, 41),
(HH, HH+HV, and full pol.)
5 SCANSAR (short term)

Allocation
Fine Single (23%),
Fine Dual (47%),
SCANSAR (23%),
Full-pol.(7%) ⇒ 70,000 scenes/3 years



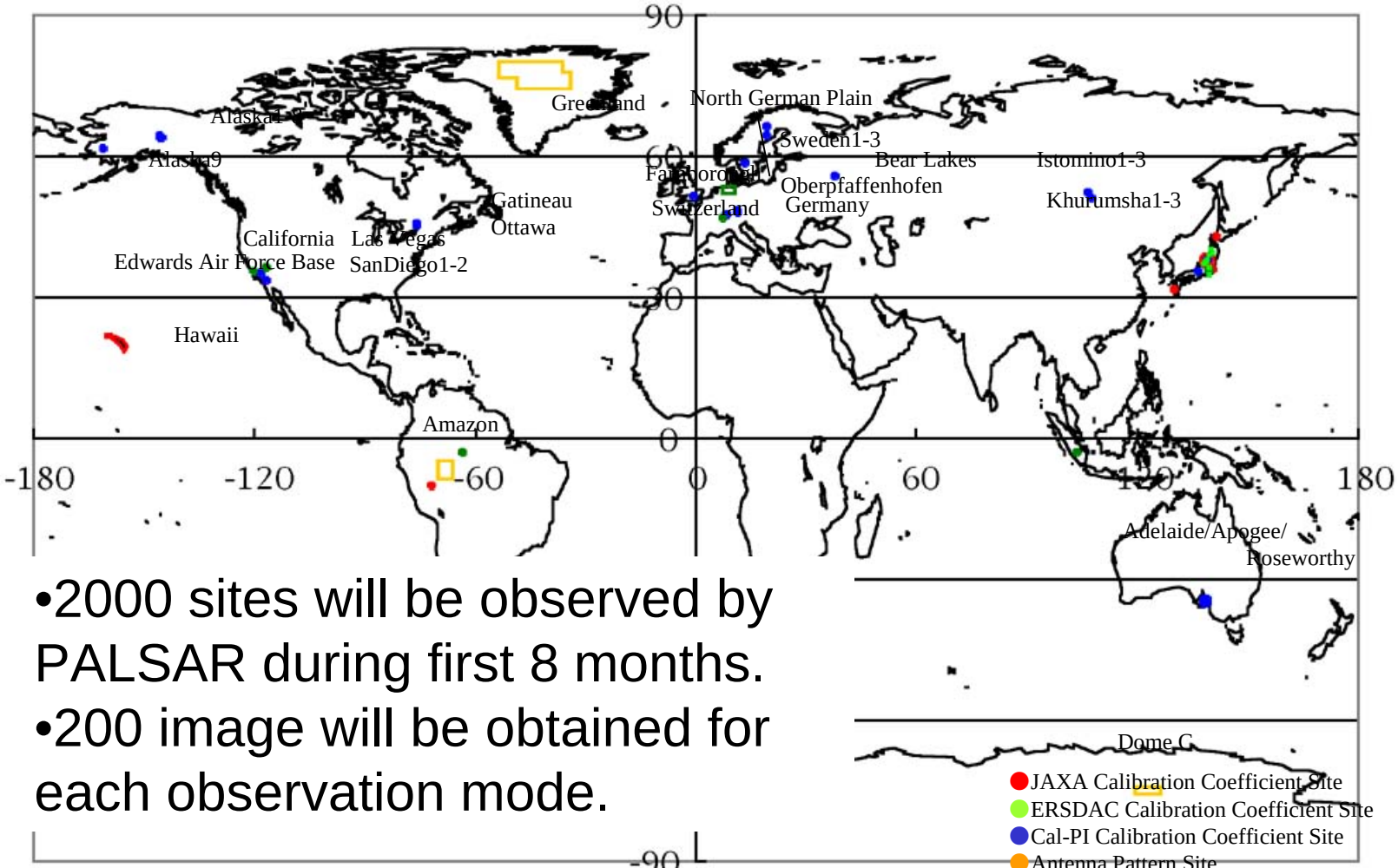
Calibration of PALSAR modes

Out of PALSAR's 132 modes, the following 7 (11) will be calibrated with high priority.

Mode	pol.	incidence angle	data rate
FBS(28MHz)	HH	21, 34, 41 degrees	240 Mbps
FBD(14 MHz)	HH+HV	34, 41 degrees	240 Mbps
DIRECT(14)	HH	21, 34, 43	120 Mbps
SCANSAR	HH	5 SCANs	120 Mbps
Polarimetry	HH+HV+VH+VV	21 degrees	240 Mbps

6(11) modes

PALSAR calibration site



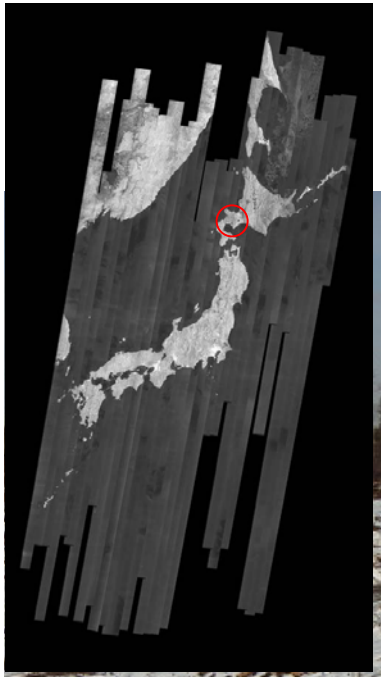
- 2000 sites will be observed by PALSAR during first 8 months.
- 200 image will be obtained for each observation mode.

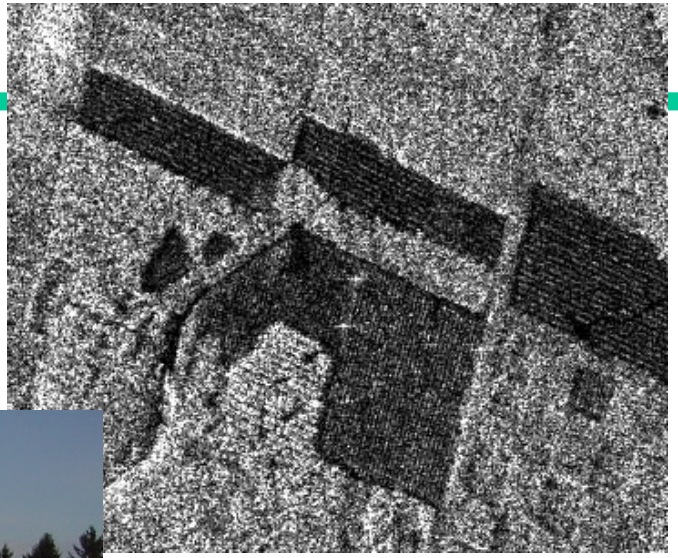
PALSAR Calibration Site(World)

2004/10/12 Update

Tomakomai-Calibration Site

Hokkaido, Japan
Pine, managed Forest





3m trihedral CRx2
1 - descending
1 - ascending
38 dBm2
lat :42.6(deg)
lon:141.7 (deg)
height:

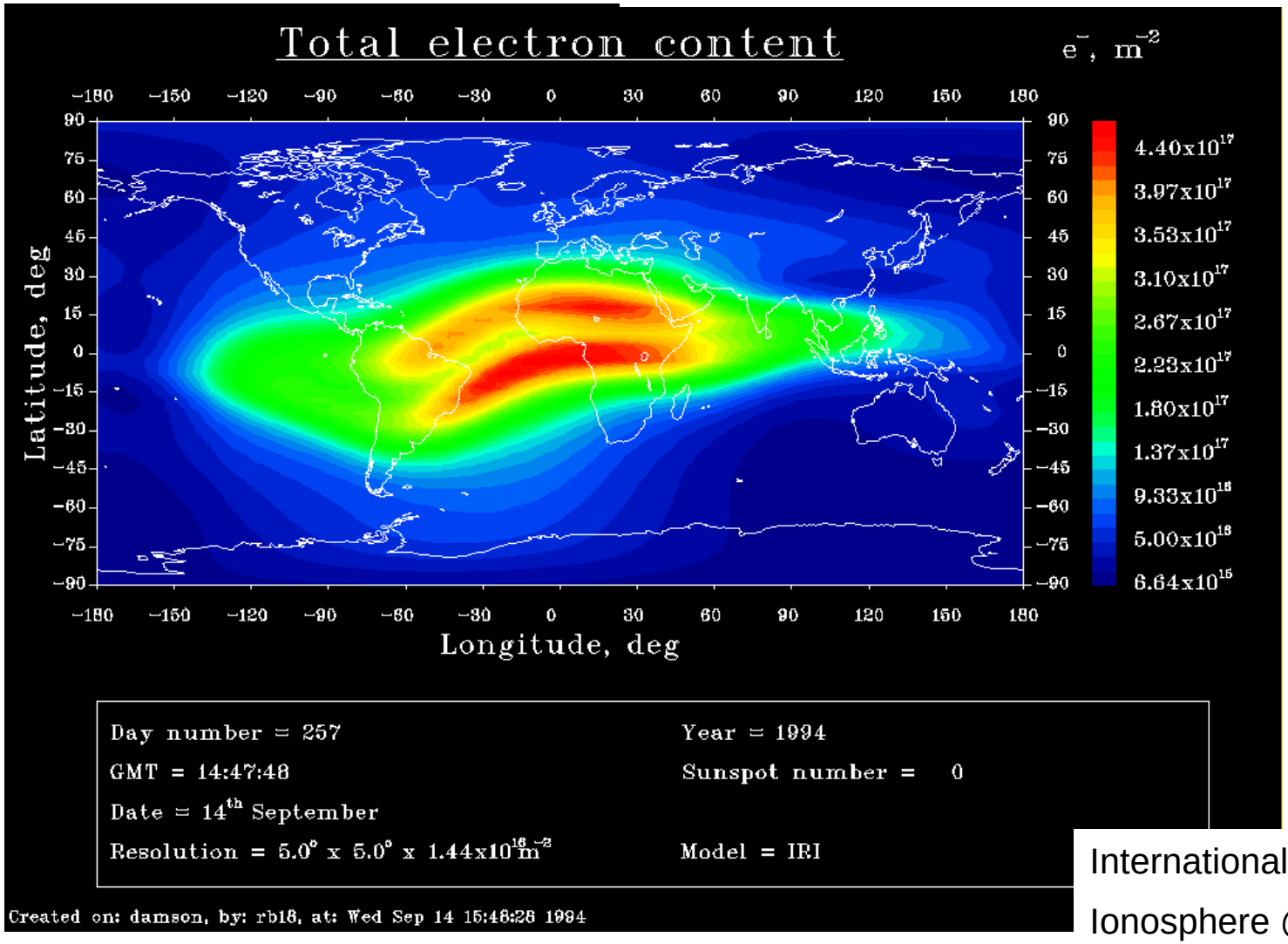
All the PALSAR modes

CAL/VAL and Science team members (PALSAR)

JAXA	PI, Node
JAXA(EORC/Research analysis) Masanobu Shimada, Takeo Tadono, Manabu Watanabe, Ake Rosenqvist, Ryoichi Furuta, Kazuo Ohta, Fumito Watanabe, Tomoko Yoshizawa Etsuko Tashiro Mika Matsumoto Yuki Daimon RESTEC Kazuo Isono, Mai Minamisawa, Shuji Ono, Sango, Sato, Ohtaki JAXA/GS Shinnichi Suzuki and colleagues JAXA/ALOS Norimasa Itoh Kazuto Murakami	Hiroshi Kimura (Gifu Univ.) Masaharu Fujita(Tokyo Met. Univ.) Makoto Satake(Nict) Yoshio Yamaguchi(Niigata Univ.) Hiroyoshi Yamada(Niigata Univ.) Osamu Isoguchi(Tohoku Univ.) Alexander I. Zakharov, Dashi Darizhapov (Russia) Lars Ulander(Swedish Research Agency) David Sandwell(UCSD) Ridha Touzi(CCRS) Kostas Papathanassiou (DLR) Shane Cloude(University of Adelaide) Paul Siqueira (University of Massattuset) Scott Hensley(JPL) Kazuo Ouchi Motoykuki Sato Node Jeremy Nicoll, Wade Albright, Scott Arko (ASF) Patrick Grimont/Pierre Potin (ESA) ERSDAC: Hiroshi Watanabe, Motoi Kumai, Hidekuni Kikuchi, Hiroshi Ohta, Tomonori Deguchi

Ionosphere

Faraday rotation depends on electron density and geomagnetic field.
Error source for polarization data, but might provide new research trigger.



International Reference Ionosphere @ NASA.GSFC

Faraday rotation angle(0<=Ω<=40)

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

$$\left[\begin{pmatrix} \cos\Omega & sin\Omega \\ -sin\Omega & \cos\Omega \end{pmatrix} \begin{pmatrix} 1 & \delta_3 \\ \delta_4 & f_2 \end{pmatrix} \right]^{-1} \left(\begin{pmatrix} Z_{hh} & Z_{hv} \\ Z_{vh} & Z_{vv} \end{pmatrix} - \begin{pmatrix} N_{hh} & N_{hv} \\ N_{vh} & N_{vv} \end{pmatrix} \right) \left[\begin{pmatrix} 1 & \delta_1 \\ \delta_2 & f_1 \end{pmatrix} \begin{pmatrix} \cos\Omega & sin\Omega \\ -sin\Omega & \cos\Omega \end{pmatrix} \right]^{-1} = Ae^{\frac{-4\pi r}{\lambda}} \begin{pmatrix} S_{hh} & S_{hv} \\ S_{vh} & S_{vv} \end{pmatrix}$$

$$\Omega = \frac{K}{f^2} \int_0^h NB\cos\psi sec\theta_0 dh \approx \frac{K}{f^2} \overline{B\cos\psi sec\theta_0} \times TEC$$

N:electron density
K: 2.365e4 in SI units
f:frequency
B:magnetic flux density
θ: off nadir angle
ψ: angle between radar line of sight and magnetic field

650 GB/day

DRTS

Observation request
for EORC/Kyoto members/PIs etc.

Level 0 data processing request

120/240Mbps

ALOS/PALSAR

120/240Mbps

EOC

64-cluster Linux OS processor using
Dual Pentium-4of 3.08 GHz clock
with 8 G Bytes memory
20 T bytes Hard disks

Process goal
<15 mins./scene

Orbital data
GANAL

NASDA
data buffer

EORC

level 0-1.0 converter
processor(1.1/1.5)
Archiver (DTF-2/DLT)
Orbit analysis InSAR

500~5000 scenes/day

Data acquisition

900 scenes/day
(total)

300 scenes/day
(EORC)

Removable
Hard Disk

320B/day
shipping / week
20 TB Hard disk

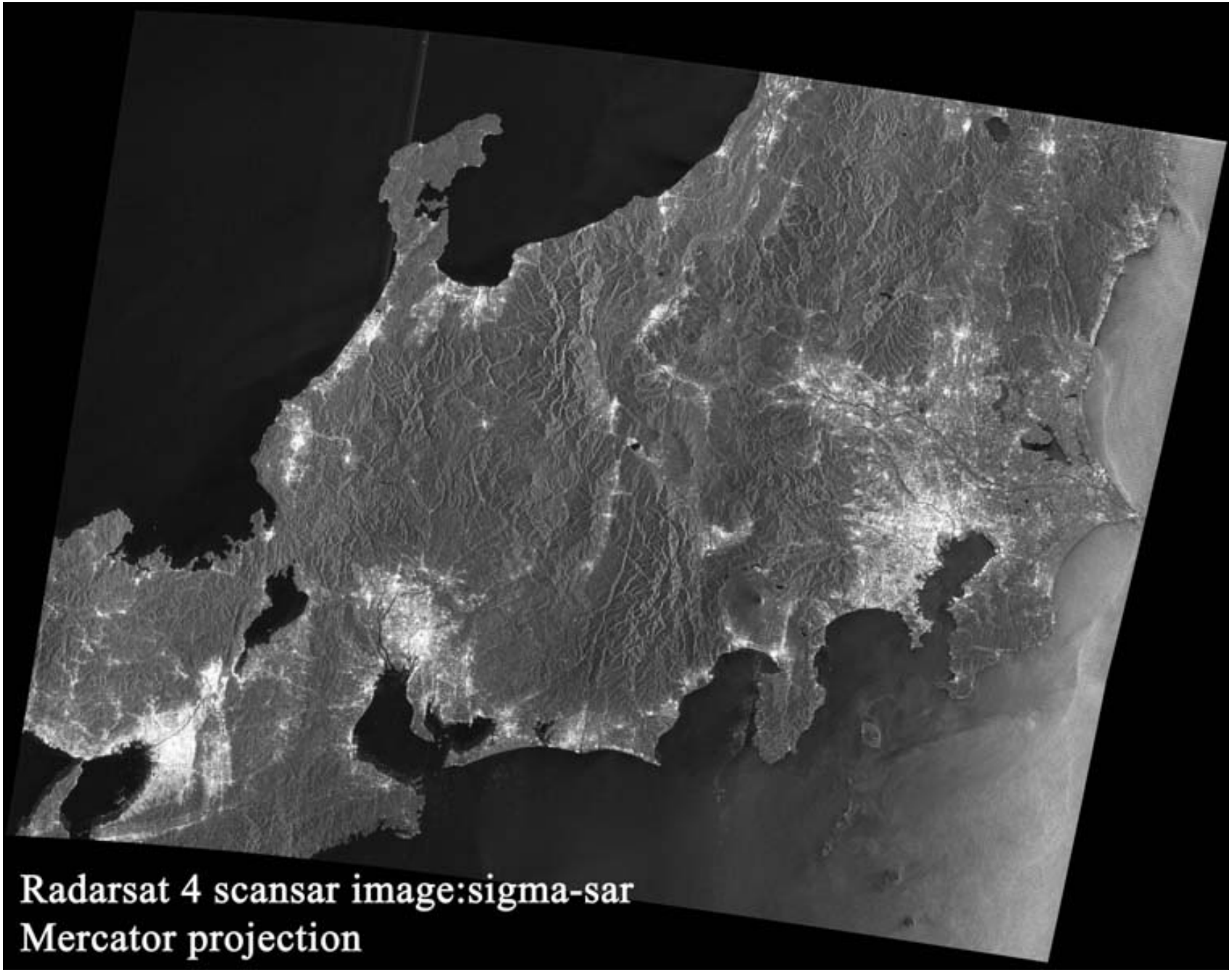
Path processing
for Kyoto members
and shipping them.

High level products

Ortho-Rectified image
Digital Elevation Model
Global forest mosaic
Surface Deformation
Soil Moisture Map
Sea-ice pattern
Desertification pattern
Path products
ScanSAR products

Level 0 : raw data
Level 1.0 : unprocessed data
Level 1.1 :single look complex data
Level 1.5 :amplitude data

EORC processing system(ALOS geophysical and application processor)


Radarsat 4 scansar image:sigma-sar
Mercator projection