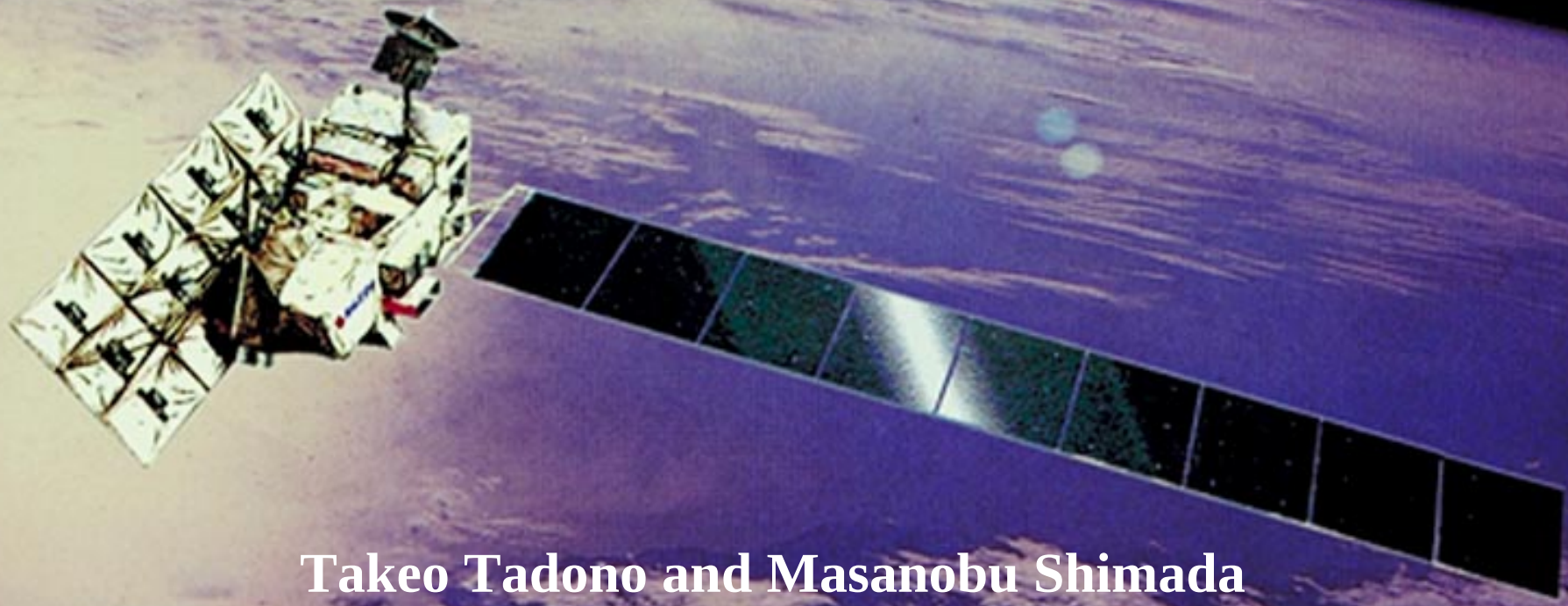
ALOS / PALSAR

- Overviews and Expected Results -



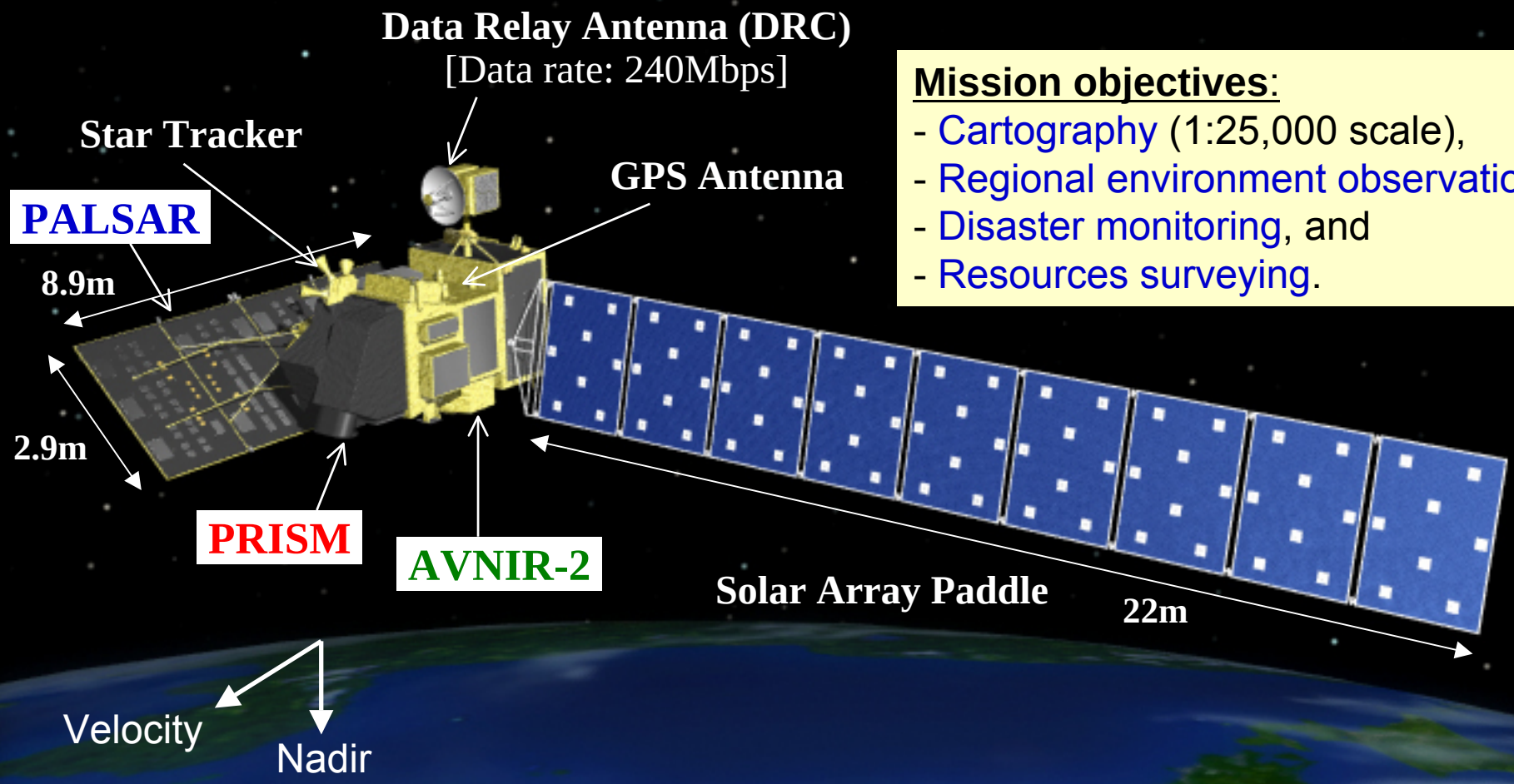
Takeo Tadono and Masanobu Shimada
Earth Observation Research and Application Center (EORC)
Japan Aerospace Exploration Agency (JAXA)

Outlines

- ***The overview of the PALSAR***
  - Launch and deployment of PALSAR's antenna
  - Characteristics of PALSAR
  - Definition of products and accuracy goal
  - Calibration and validation, and data release plans
- ***Example of PALSAR Data Utilization***
  - ALOS Kyoto & Carbon Initiative (K&C Project)
  - Global mosaic
  - Disaster monitoring by SAR Interferometry
  - Hydrology, snow and ice applications
  - Polarimetric SAR analysis
- ***Summary***

ALOS "Daichi"

(Advanced Land Observing Satellite)



Mission objectives:

- Cartography (1:25,000 scale),
- Regional environment observation,
- Disaster monitoring, and
- Resources surveying.

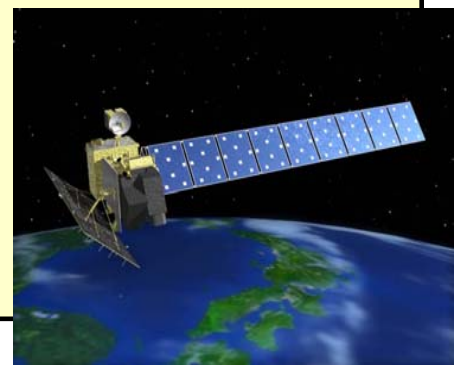
PRISM : Panchromatic Remote-sensing Instrument for Stereo Mapping

AVNIR-2: Advanced Visible and Near Infrared Radiometer type 2

PALSAR: Phased Array type L-band Synthetic Aperture Radar

ALOS Characteristics

Launch Date	10:33, January 24th, 2006 (JST)
Orbit	Sun-synchronous
Local Time at DN	10:30 +/- 15 min.
Altitude	691.65 km @Equator
Inclination	98.16 degrees
Recurrent Period	46 days (Sub-cycle: 2 days)
Revolution	14 + 27/46 (/day), 671 (/recurrent)
Period	98.7 minutes
Longitude Repeatability	+/-2.5 km @Equator
Data Collection	1 DRTS (Data Relay Test Satellite), 240 Mbps HSSR (High Speed Solid state Recorder) + DT (X-band direct downlink), 120 Mbps
Yaw Steering	Off / On
Attitude Error each axis	2.0e-4 degree (determination) 0.1 deg. (maintain)
Satellite Mass	4,000 Kg
Power	7 KW @EOL

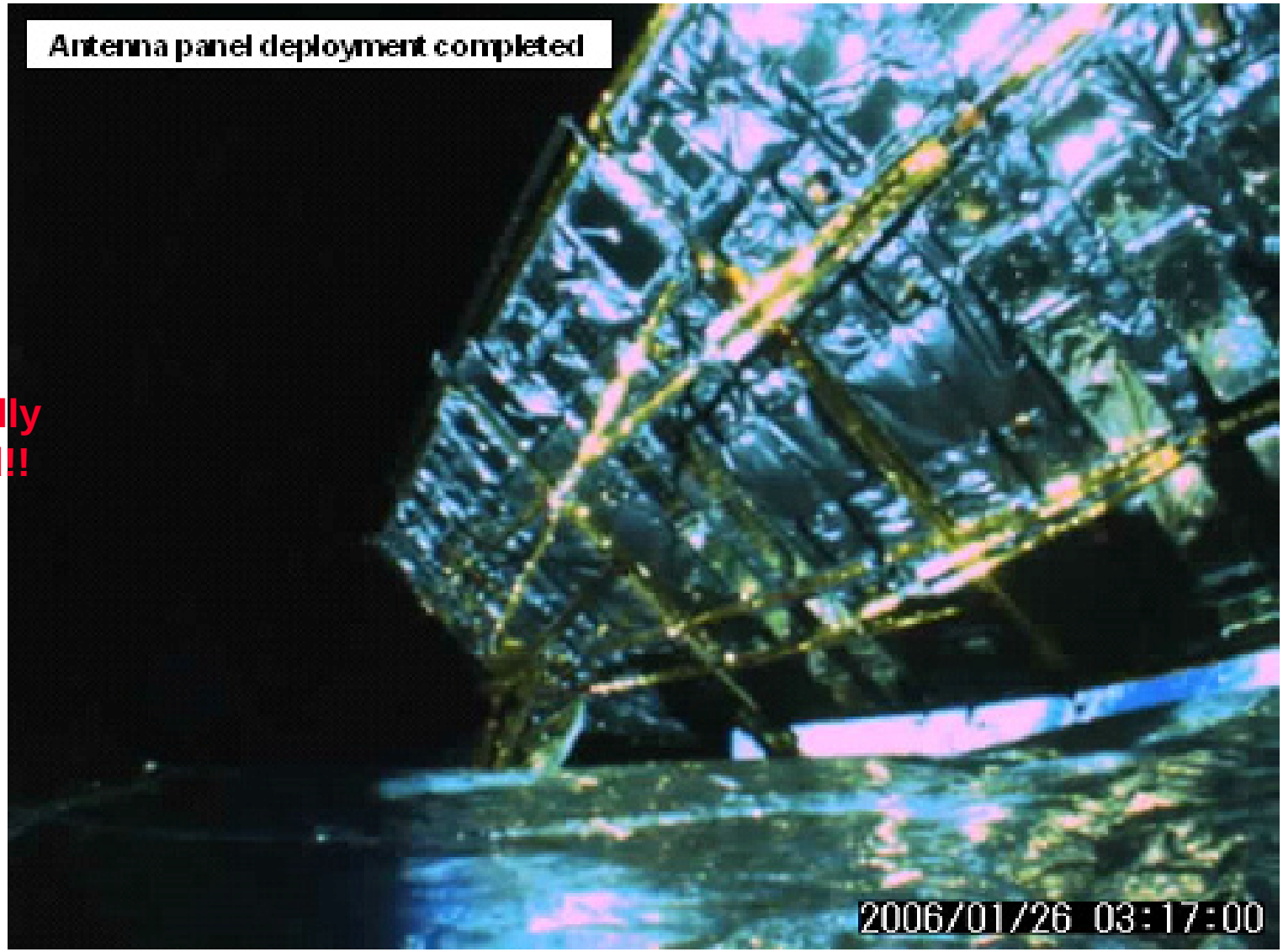


PALSAR Antenna Deployment

1st step
90deg.
Off nadir

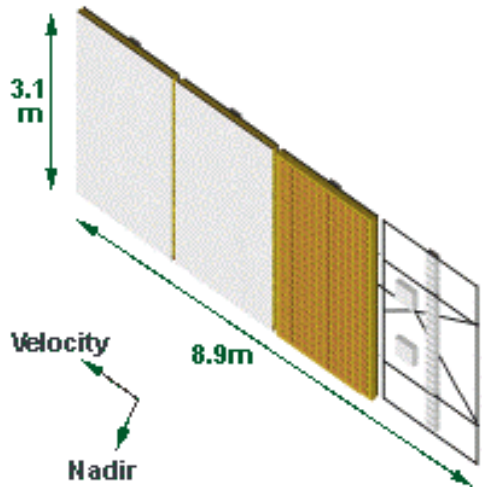
2nd step
Panel

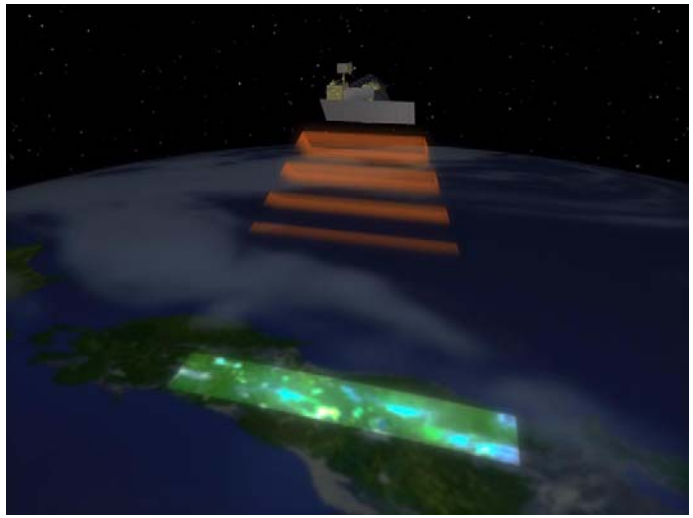
Successfully Completed!!



PALSAR

Phased Array type L-band Synthetic Aperture Radar





L-band (1.27GHz)

Fine Resolution Mode

8.0-60.0 deg.

HH or VV / HH+HV or VV+VH

7.0-44.3m / 14.0-88.6m

40-70km / 40-70km

ScanSAR Mode

18.0-43.0 deg.

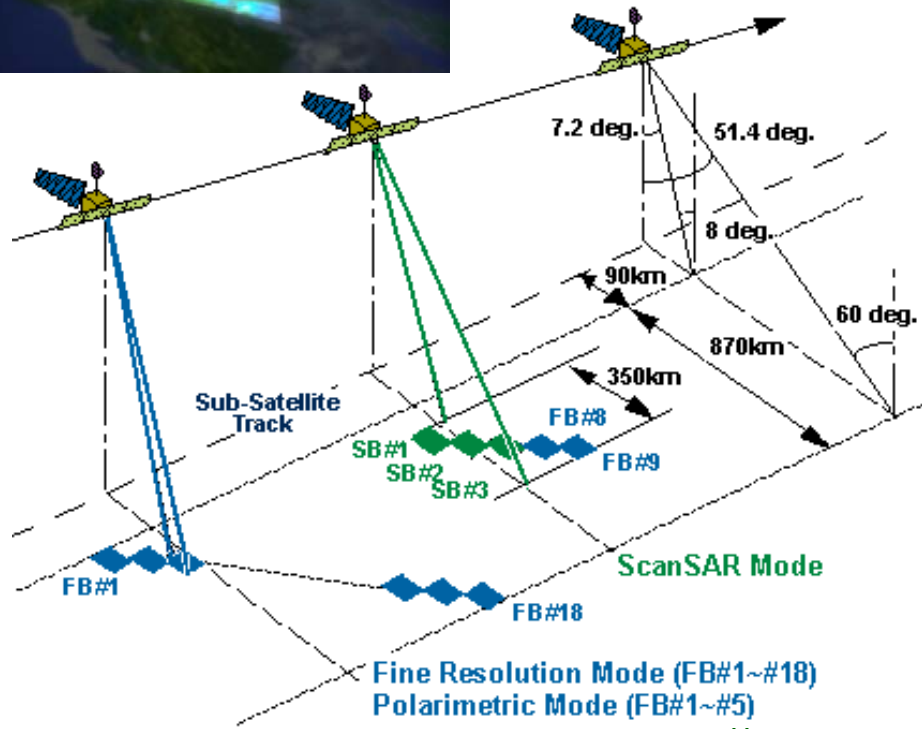
HH or VV / 100m / 250-350km

Polarimetric Mode

8.0-30.0 deg.

HH + HV + VH + VV

24.1-88.6m / 20-60km



PALSAR Operation Modes

*** Total: 132 modes**

Mode	Fine Resolution		Direct Downlink (DT)	ScanSAR	Polarimery
	Single-Pol. (FBS)	Dual –Pol. (FBD)			
Frequency	L-band (1270 MHz)				
Chirp Bandwidth	28 MHz	14 MHz	14 MHz	14/28 MHz	14 MHz
Polarization	HH or VV	HH/HV or VV/VH	HH or VV	HH or VV	HH+HV +VH+VV
Incidence Angle	8-60 deg (typ 39 deg)	8-60 deg (typ 39 deg)	8-60 deg (typ 39 deg)	18-43 deg	8-30 deg (typ 24 deg)
Range Resolution	7-44 m 10m@39deg	14-88 m 20m@39deg	14-88 m 20m@39deg	100 m (Multi-look)	24-89 m 30m@24deg
Swath Width	40-70 km	40-70 km	40-70 km	250-350 km	20-65 km
Bit Length	5 bits	5 bits	3/5 bits	5 bits	3/5 bits
Data Rate	240 Mbps	240 Mbps	120 Mbps	120/240 Mbps	240 Mbps

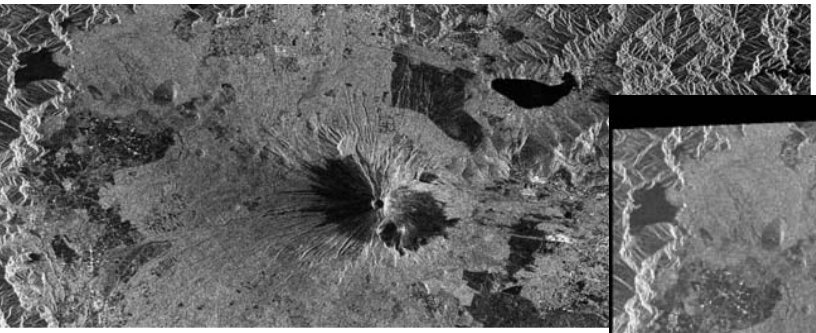
Major operation modes: 6 (9) modes

Mode	FBS	FBD	(DT)	ScanSAR	Polarimetry
Off-nadir angle (deg)	21, 34, 41	41	21, 34, 41	5 SCAN (17-43)	21
Polarization	HH	HH+HV	HH	HH	HH+HV +VH+VV

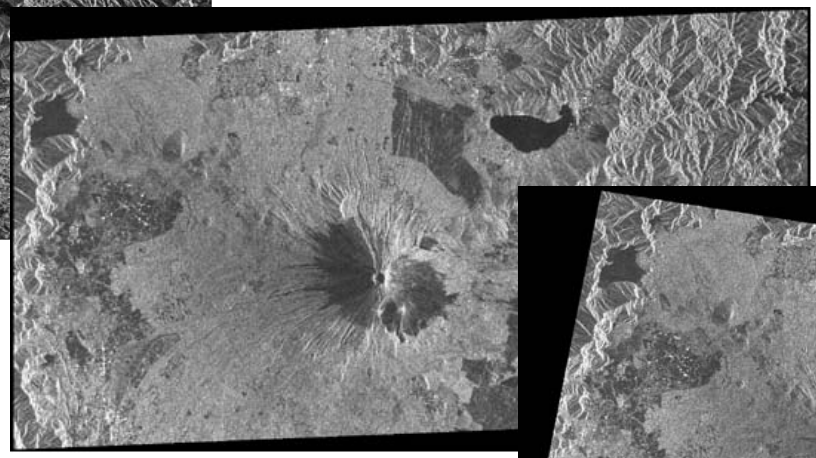
Definition of Products (1/2)

Standard Products : Processed at JAXA Earth Observation Center (**EOC**)

PALSAR – 1.0 : Uncorrected image, scene unit
Raw data + Orbit + Telemetry (384-847MB)
1.1 : Single-Look Complex data on slant range (SLC)
4 bytes IEEE (I+Q) + Ancillary
1.5 : Multi look processed image (Amplitude, Georeference/Geocode)
2 bytes Int + Ancillary (160-280MB@6.25m, 40-71MB@12.5m)

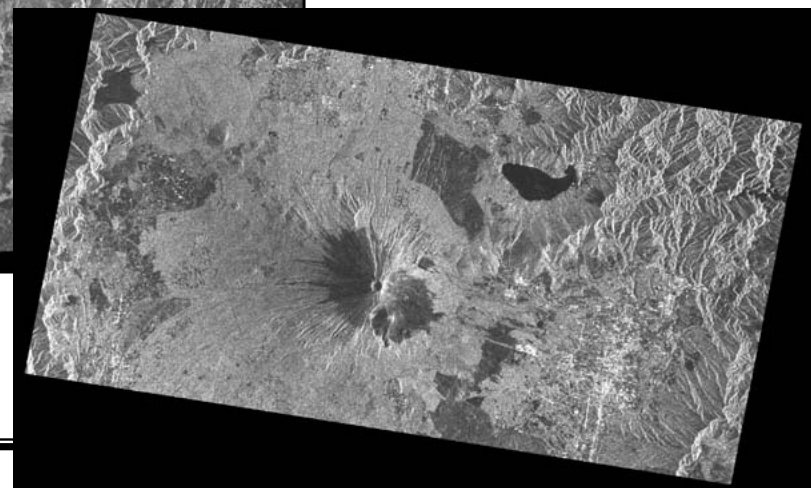


Example of Slant range image.



Geo-reference image.

Geo-coded image.



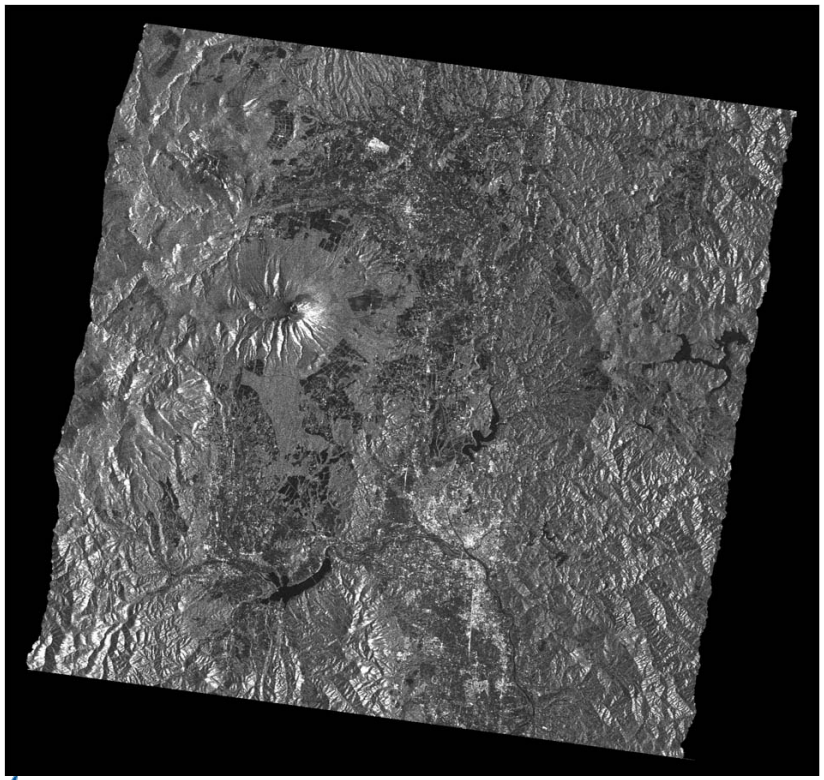
Definition of Products (2/2)

High Level Products : will be generated at **EORC**.

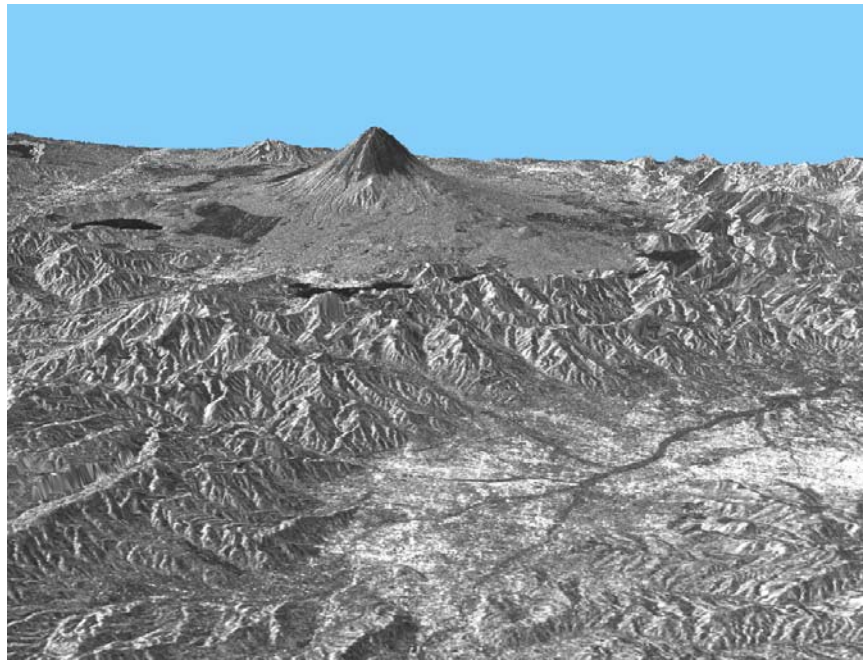
PALSAR : DEM by Interferometry, and Ortho-rectified image

Research Products (tentative) : will be produced at **EORC**.

- Forest and biomass map, Surface deformation, sea-ice, soil moisture, and snow parameter products using **PALSAR** data



Ortho-rectified image.



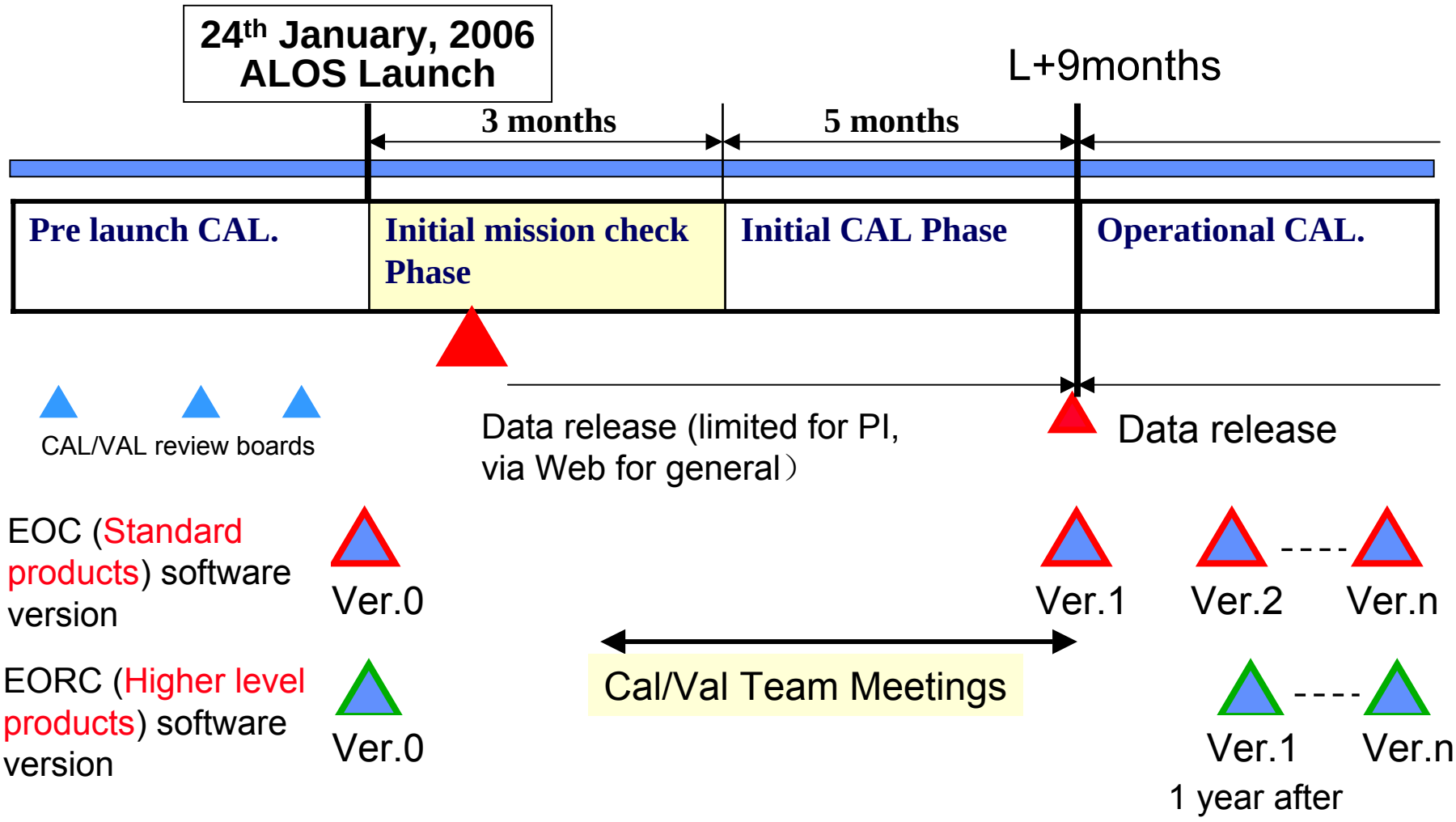
Interferometric SAR DEM of Mt. Fuji derived from JERS-1/SAR.

Accuracy Goal and Achievement

Products	Accuracy Goal		Validation method
Standard Products 1.0 1.1 1.5	Geometry Radiometry	200 m 1.5 dB (abs.) 1.0 dB (relative) 5 deg. (phase)	CR, ARC's location Validation CR, ARC Amazon forest area
High Level Products Ortho-rectified DEM	Geometry Radiometry	50 m (horizon) 30 m (vertical) 1.5 dB (ext. layover)	CR, ARC's location GCP, Reference DEM Validation CR, ARC
Research Products Deformation Forest map Soil moisture Snow map Biomass Sea Ice	Geometry Radiometry	100 m 1.5 dB 5 mm 10 % (abs.) 10 % (abs.) …	Landsat images Amazon images GPS's positions Ground Truth data etc.

CR: Corner Reflector, ARC: Active Radar Calibrator, GCP: Ground Control Point

Cal/Val and Data Release Schedule



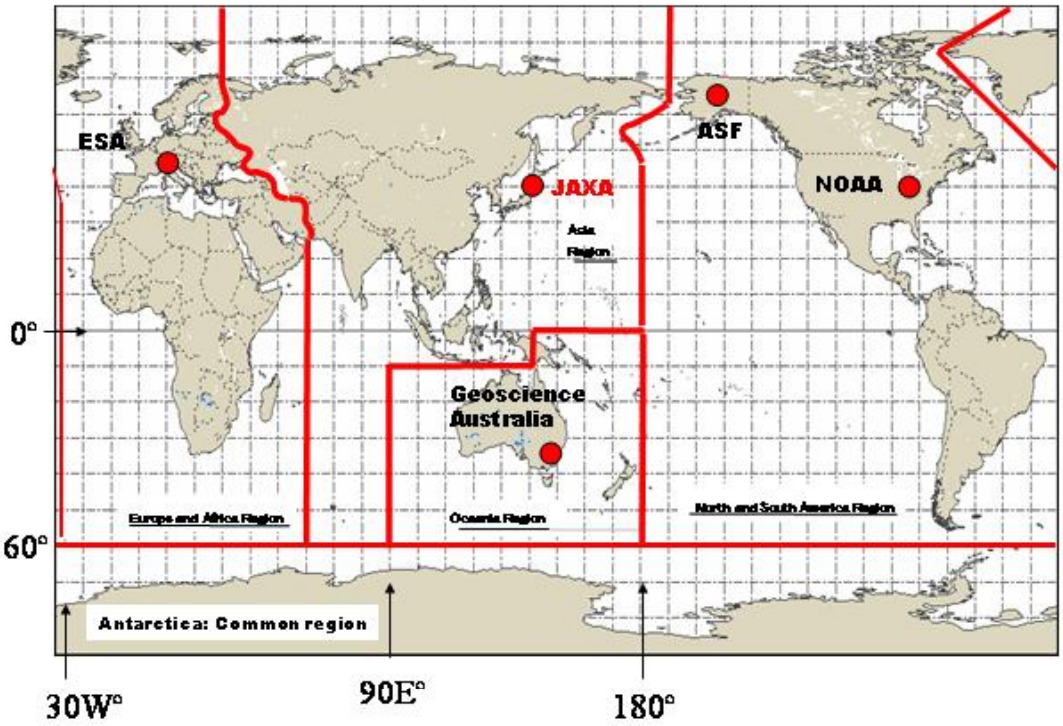
ALOS Data Nodes (ADN)

ALOS Data Node Concepts are

- ✓ to increase capacity for ALOS data processing and archiving,
- ✓ to accelerate scientific and practical use of ALOS data,
- ✓ to increase international co-operation including joint validation and joint science study activities, and
- ✓ to enhance service for potential users of ALOS data.

Each Node is associated with a geographical zone which defines the extent of its area of activity (supporting the physical residents therein as potential ALOS users) as an ADN partner.

-ESA: Europe and Africa
-NOAA/ASF: North and South America
-Geoscience Australia: Oceania
-JAXA: Asia
-GISTDA: Asian Sub-Node



Heritage and objectives

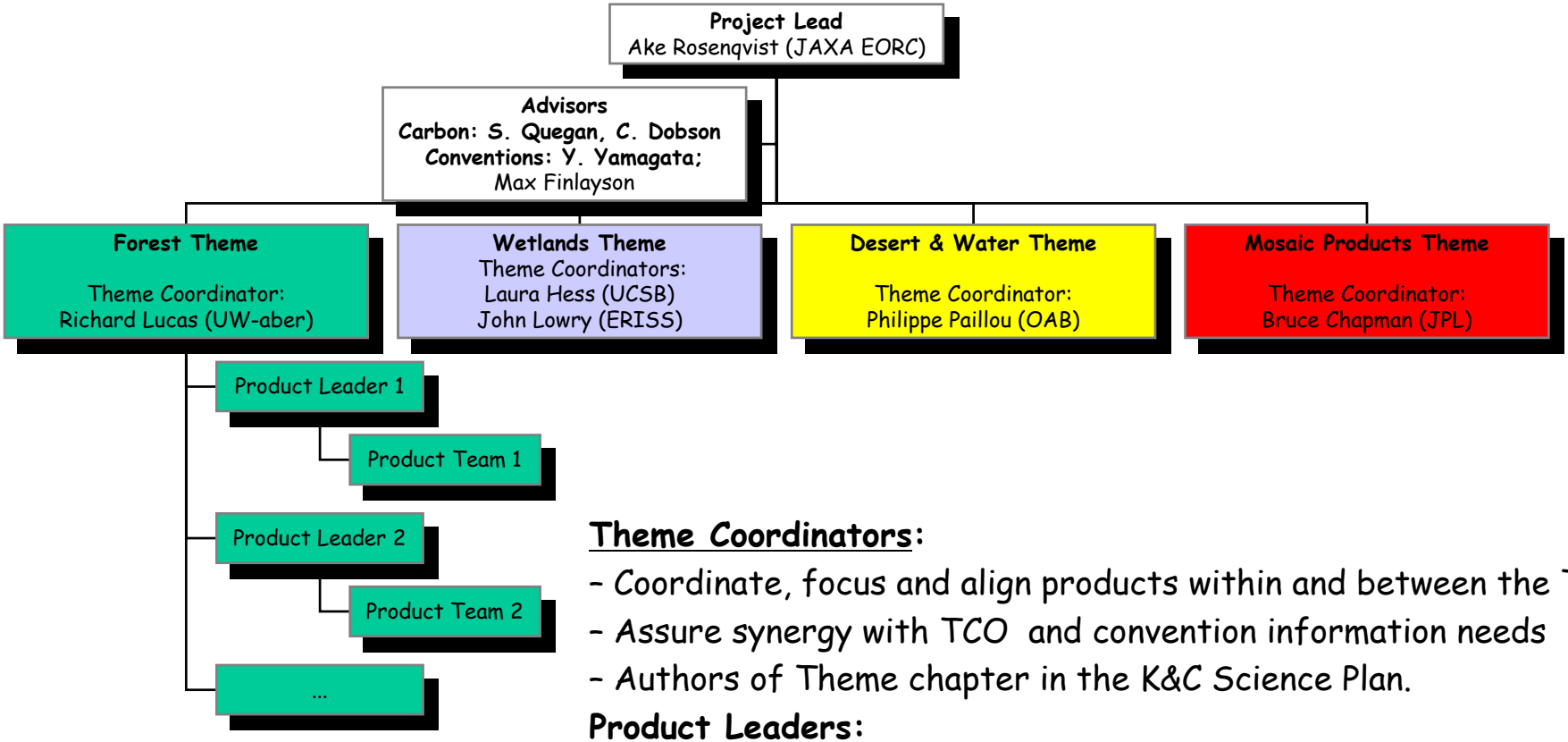
The Kyoto & Carbon Initiative* is an international collaborative project forming the continuation and extension of the **JERS-1 SAR GRFM/GBFM** project into the era of the **Advanced Land Observing Satellite - ALOS** (and as far as possible, ADEOS-II GLI).

Aims to support information needs posed by the "3 C's":

- The terrestrial **Carbon** cycle science community (CO2 & CH4 sources and sinks);
- Multinational Environmental **Conventions** and Declarations:
  - **UNFCCC Kyoto Protocol (Forest and Land Cover Change);**
  - **Ramsar Convention (wetland characteristics and disturbances);**
  - **UN Millenium Declaration & UNCCD (water supply and desertification)**
- Environmental **Conservation**

*Support to Multi-national Environmental Conventions and Terrestrial Carbon Cycle Science by ALOS and ADEOS-II.

K&C Project Organization



Theme Coordinators:

- Coordinate, focus and align products within and between the Themes.
- Assure synergy with TCO and convention information needs
- Authors of Theme chapter in the K&C Science Plan.

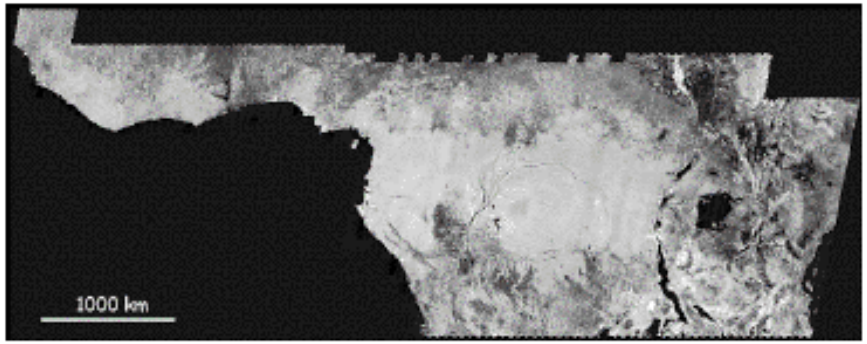
Product Leaders:

- Responsible for the generation of data- or information products.

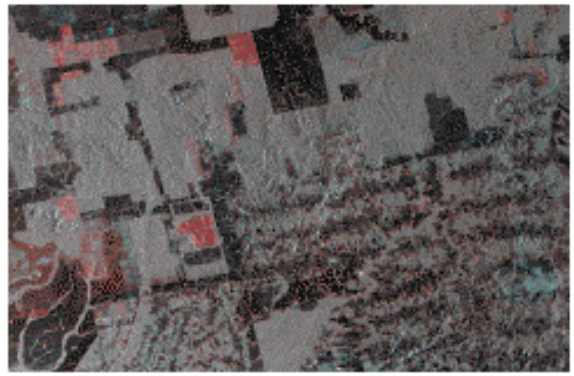
Carbon & Convention Advisors:

- Advice Theme Coordinators and Product Leaders on:
  - carbon cycle science (TCO) information needs;
  - convention information requirements;
  - conservation issues.

Examples of K&C Project Output



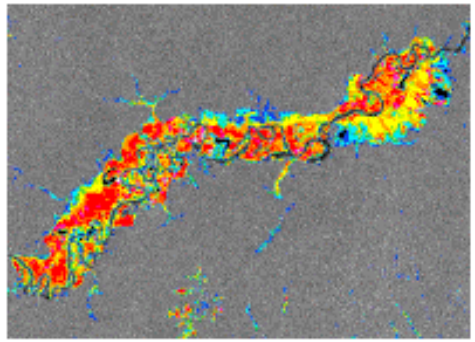
• Global SAR image mosaics @ 100m



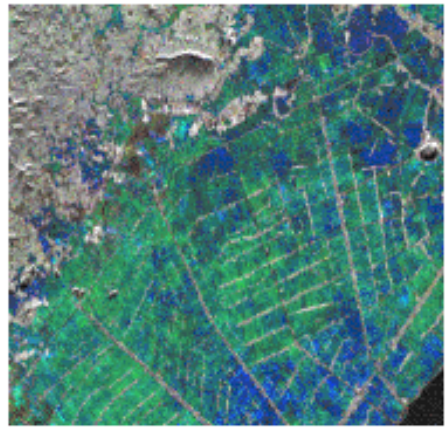
• Annual forest change

The Kyoto & Carbon Initiative

• Global Land Cover classification @ 250m

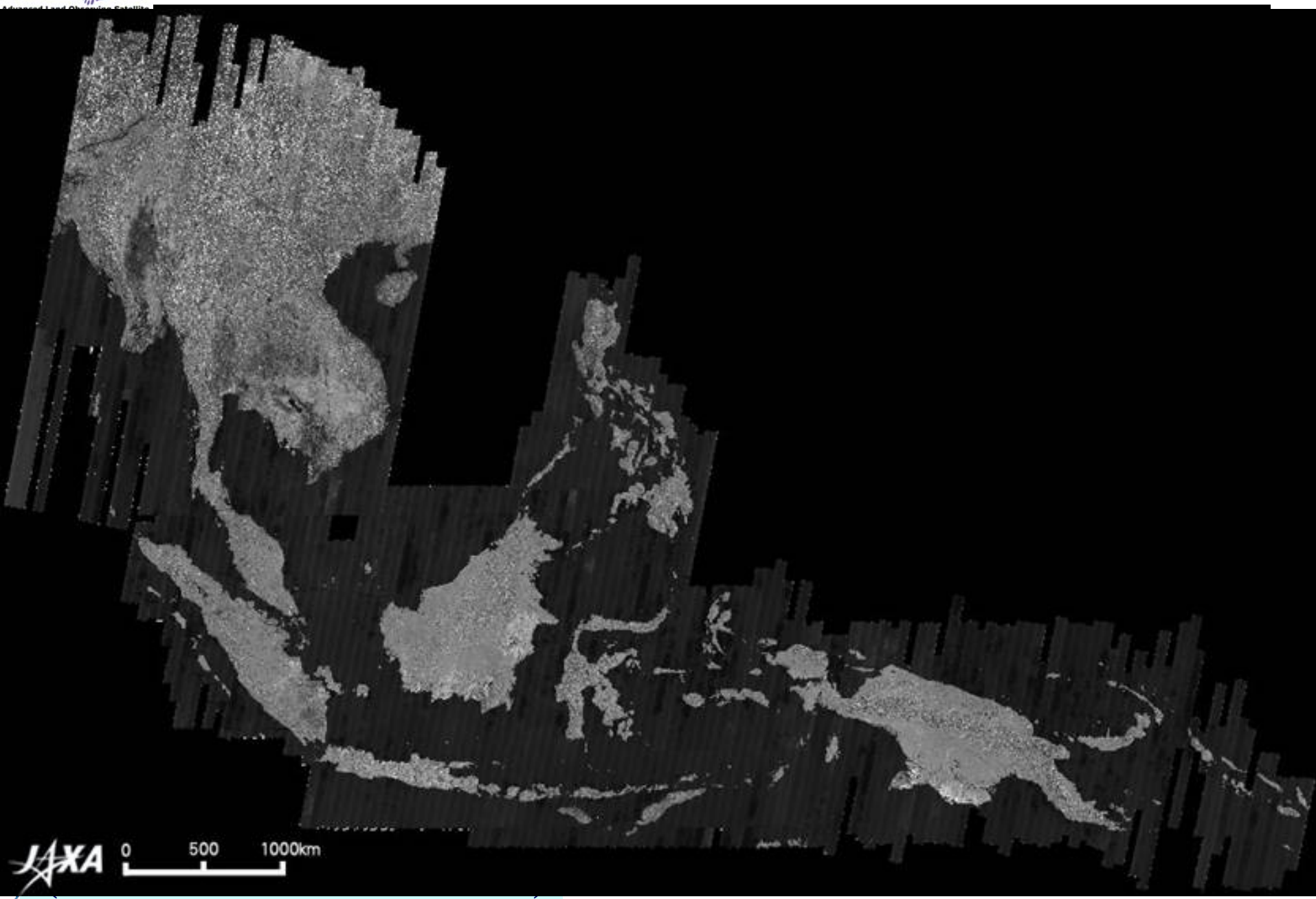


• Flood duration mapping

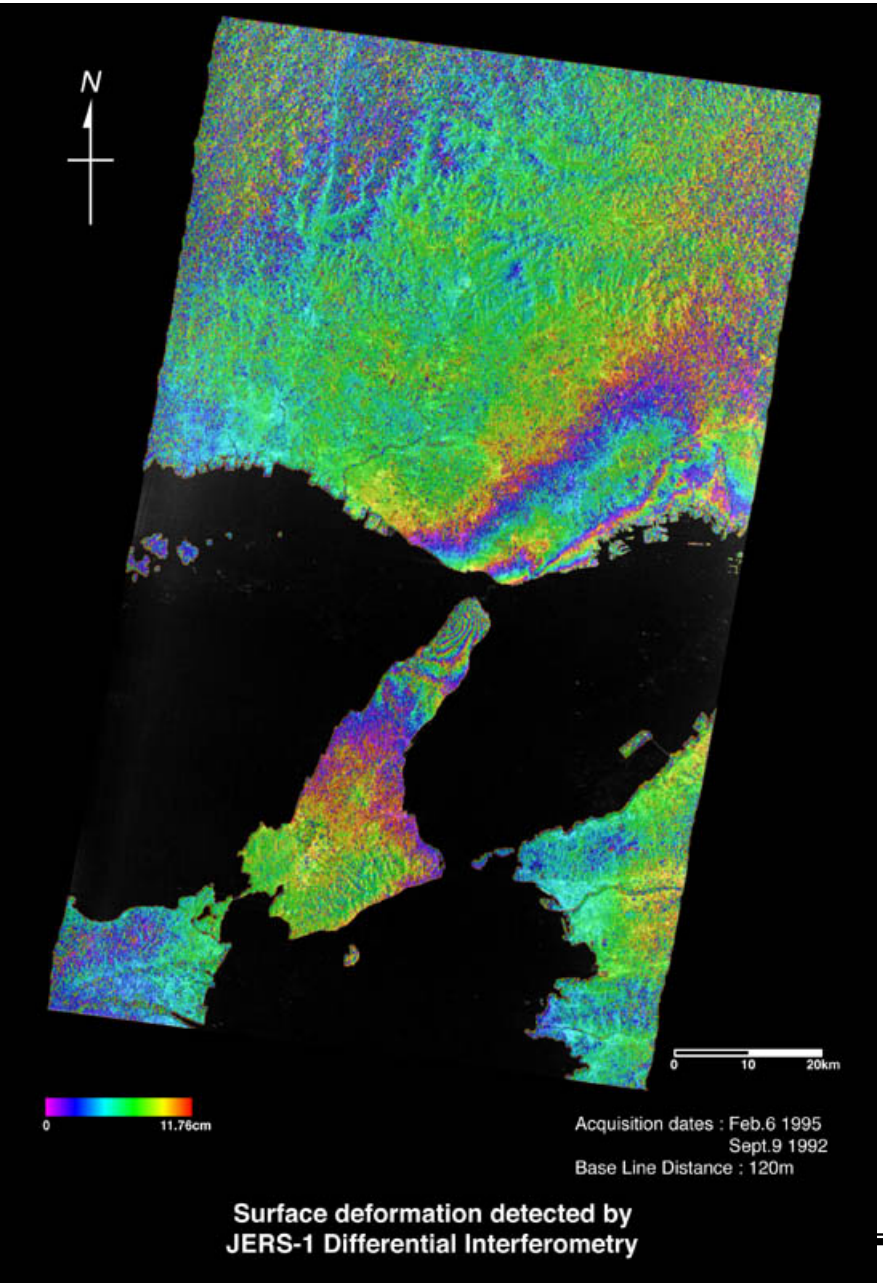


• Rice mapping

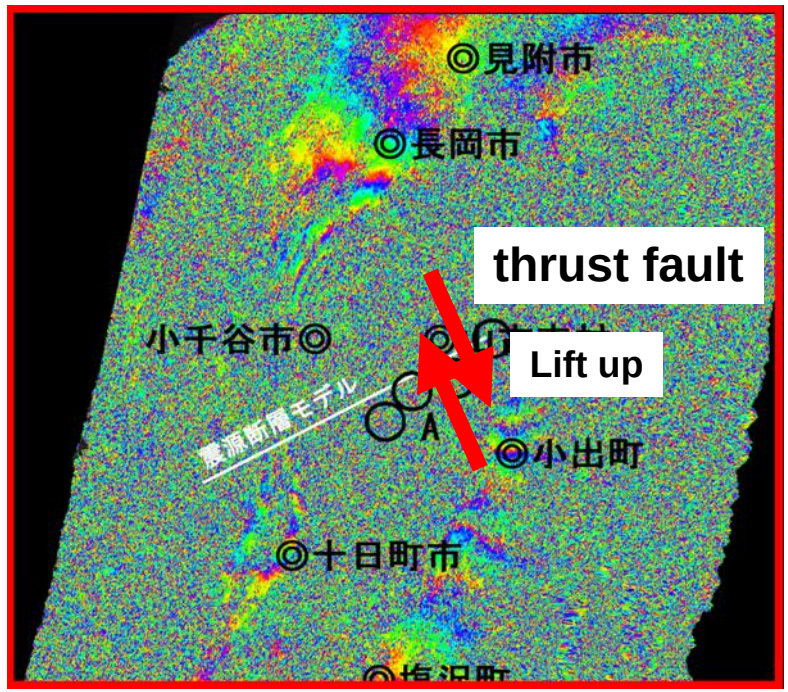
JERS-1 SAR Mosaic in SE Asia



Disaster Monitoring by DInSAR



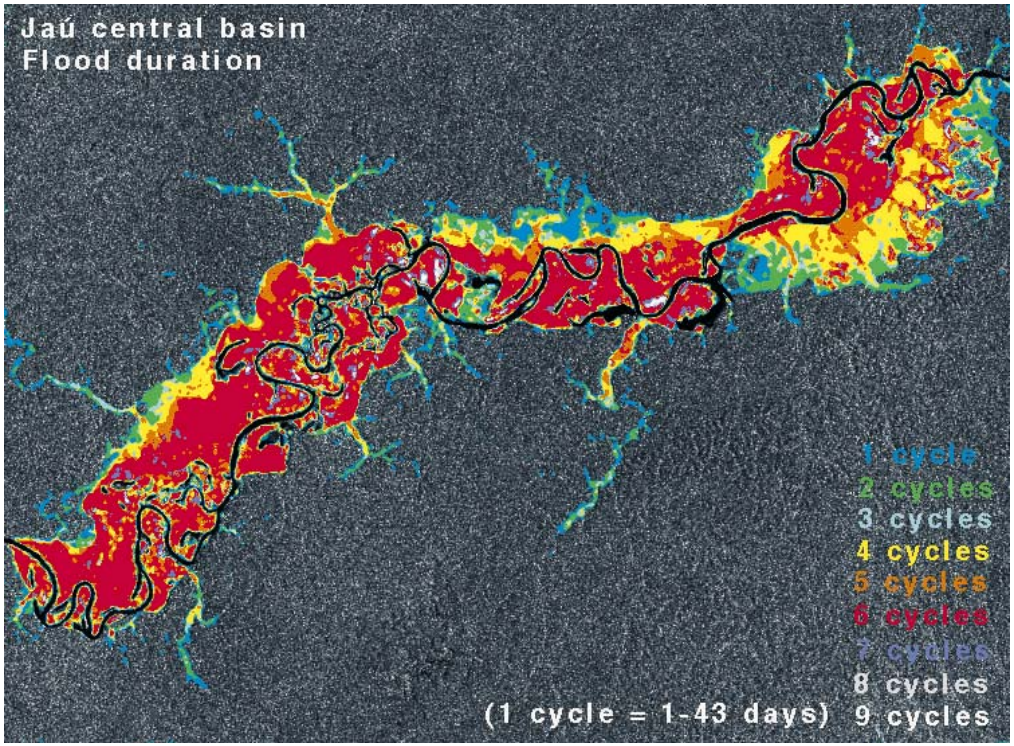
SAR differential interferometry by JERS-1
(Hyogo Pref., Japan, 1995)



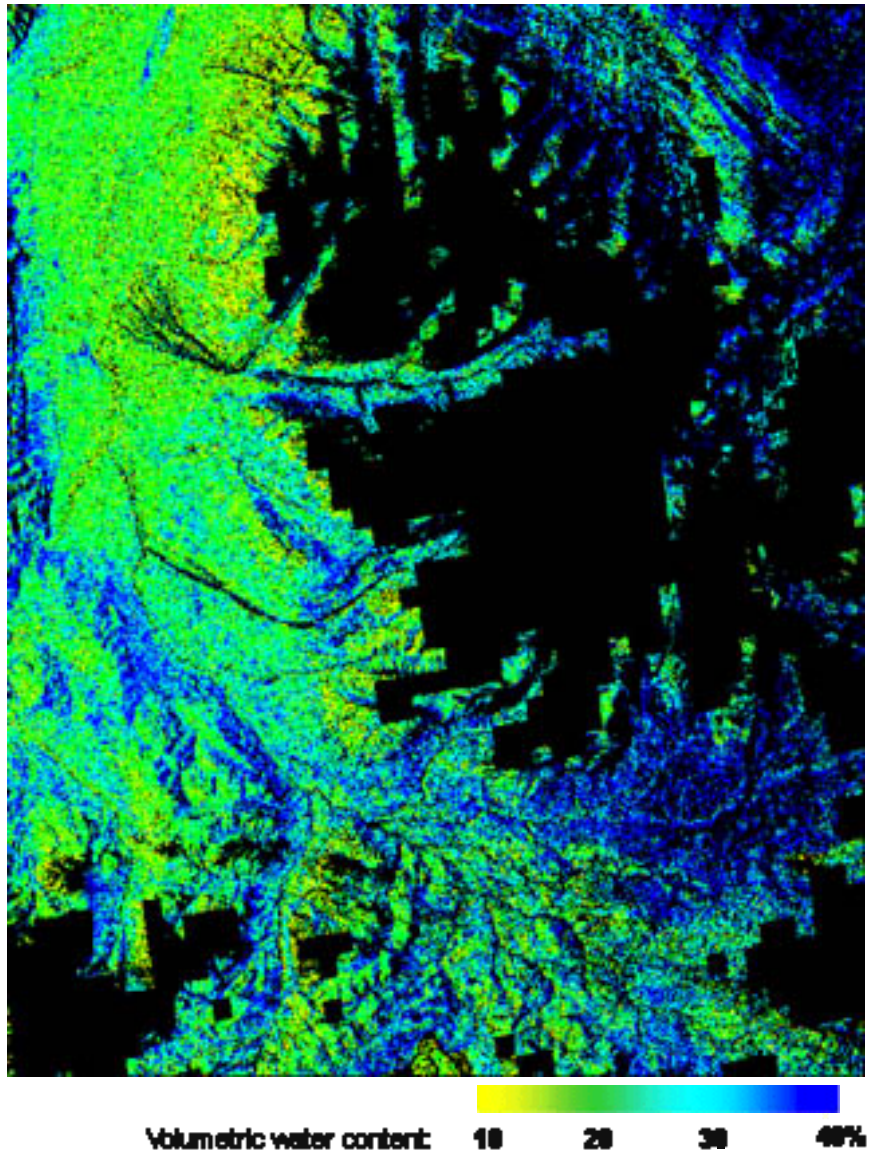
SAR differential interferometry by RADARSAT
(Niigata, Japan, 2004)

L-band SAR has advantage to monitor the mountain area due to longer wave length than C-band as well as X-band.

Hydrological Applications using SAR



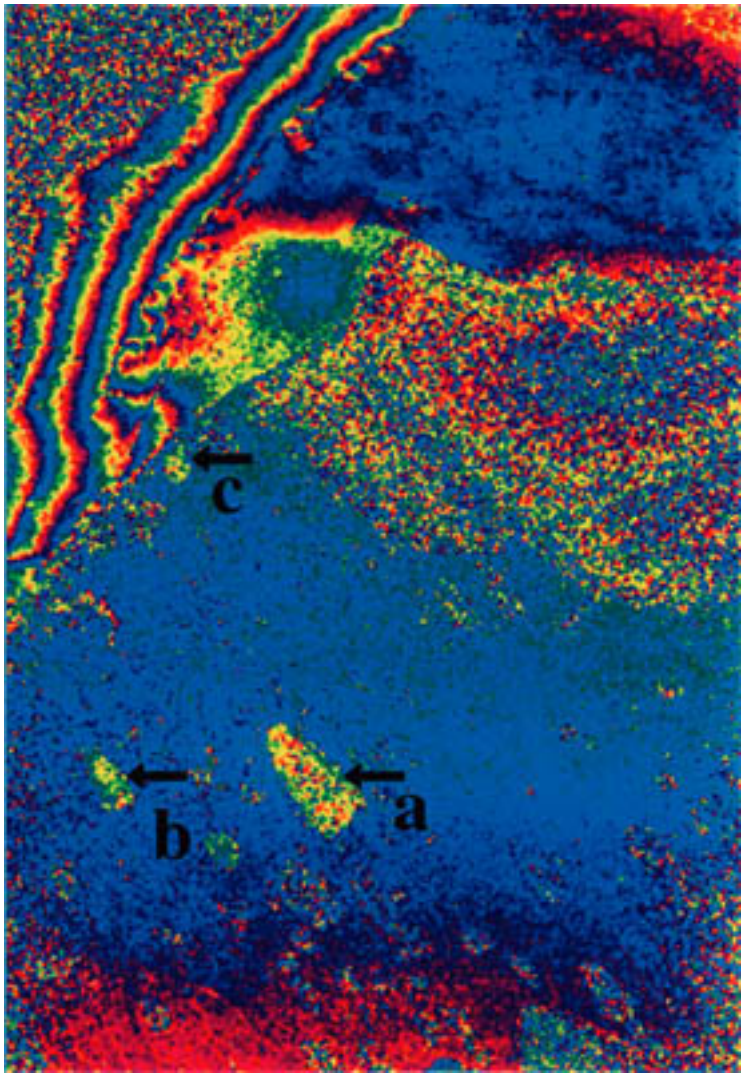
Flood duration by JERS-1 SAR
(Jau River, Brazil)



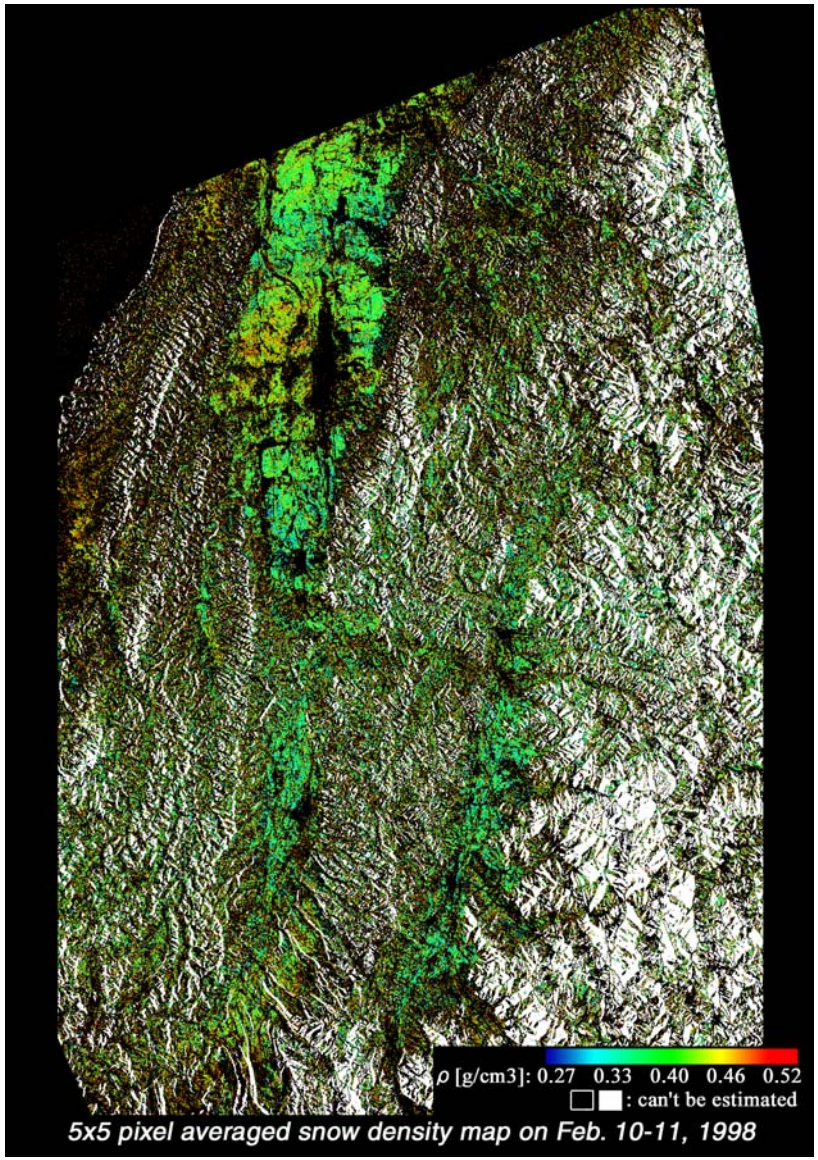
Soil moisture map by JERS-1 SAR
(Tibetan Plateau, China)

Center

Snow & Ice Applications using SAR



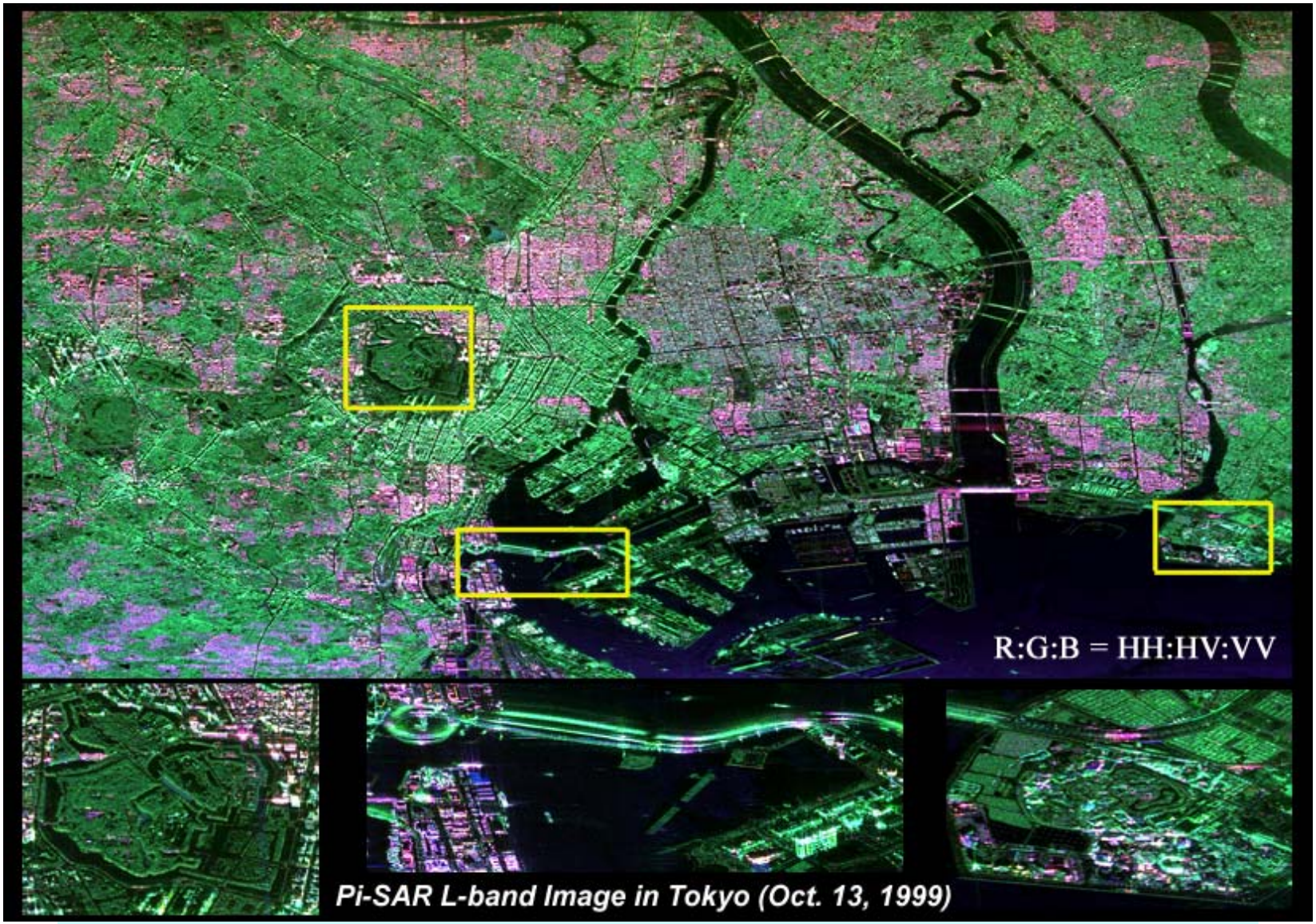
Ice thickness change by JERS-1 SAR interferometry (Barrow, Alaska)



Snow parameter mapping by RADARSAT (Niigata, Japan)

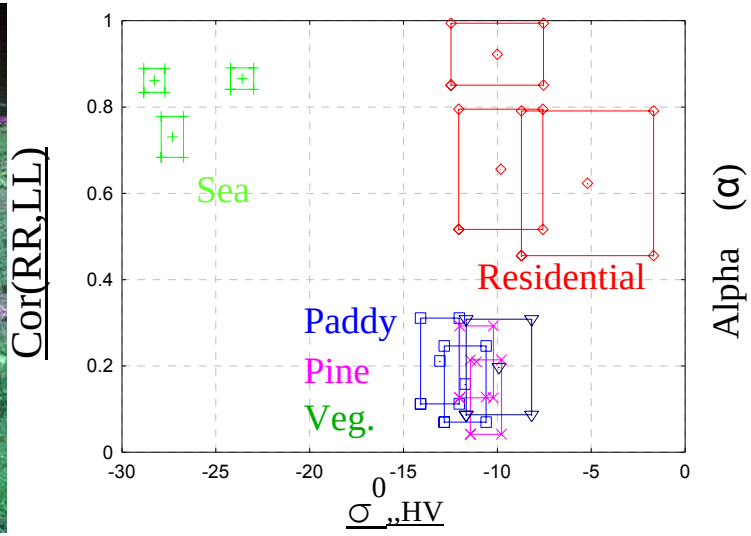
Center

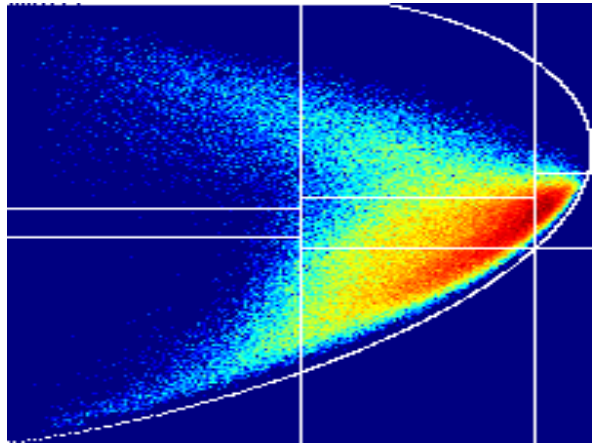
Monitoring Urban Development by Pol-SAR



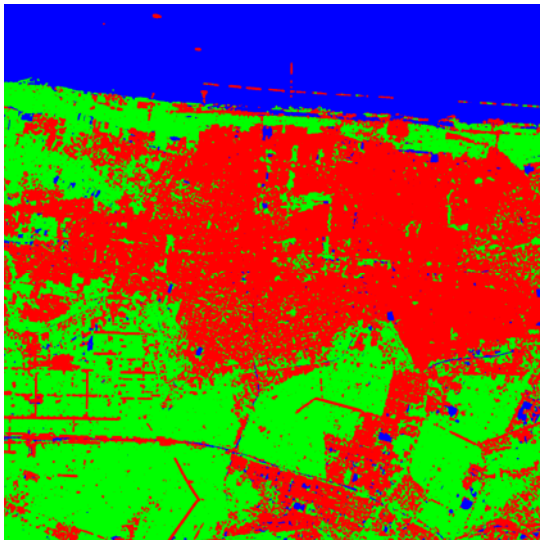
Monitoring coastline development by Polarimetric Airborne SAR (Pi-SAR).
(Tokyo bay area, Japan, Oct. 13, 1999)

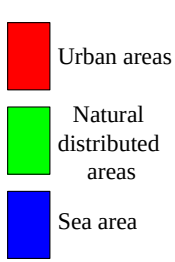
Polarimetric SAR Analysis

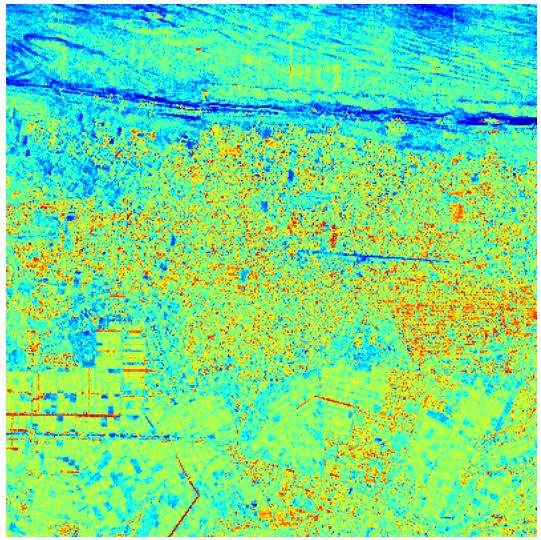




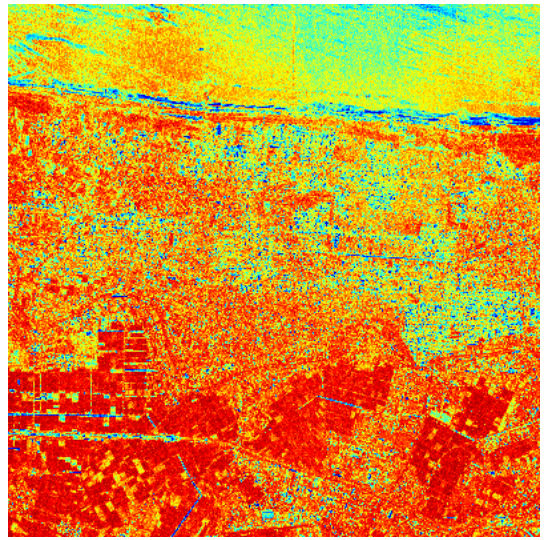
Entropy (*H*)







(a) Entropy (*H*)

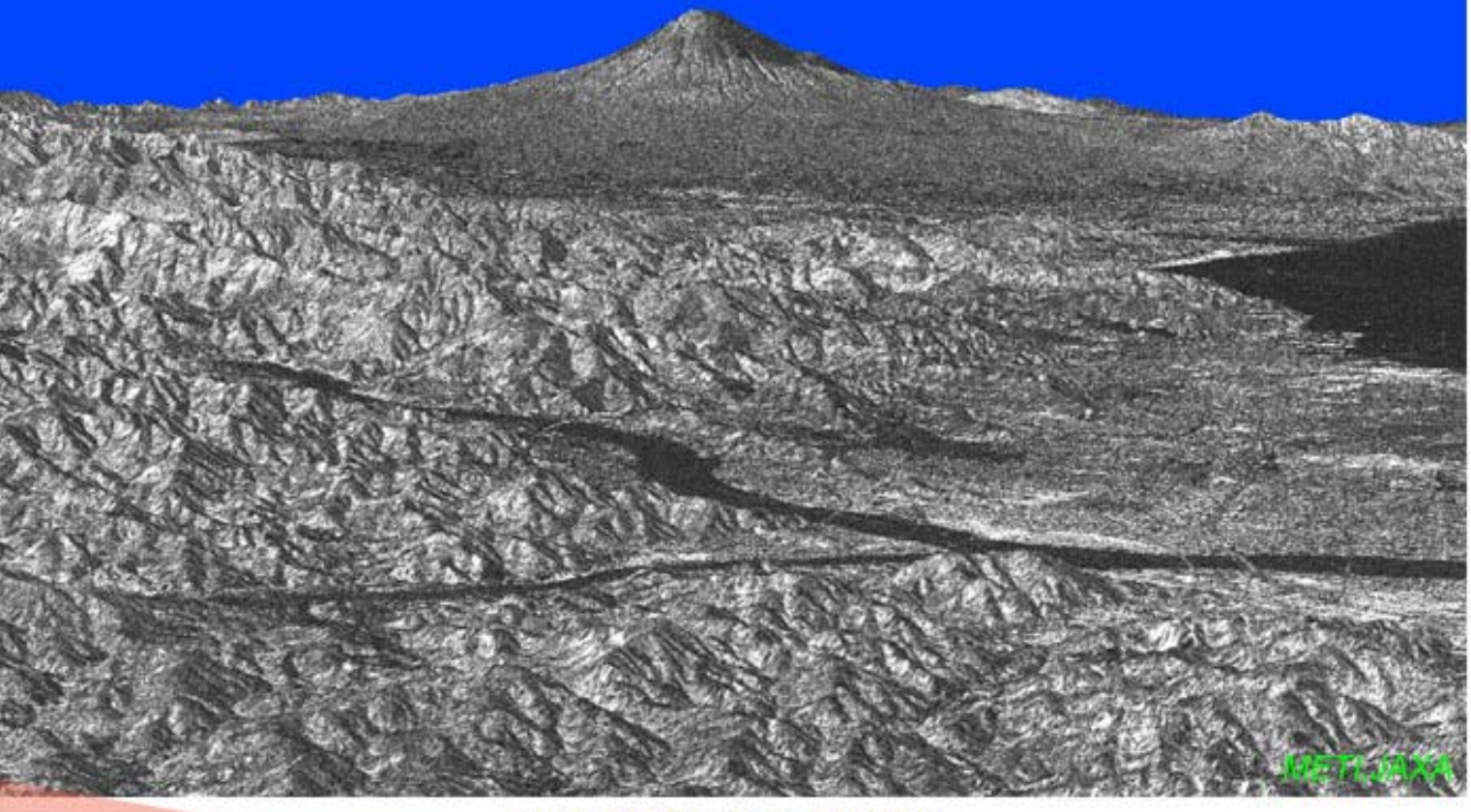


(b) Alpha (α)

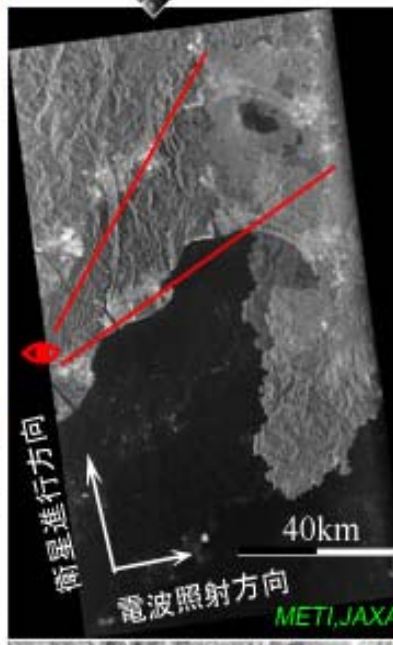
Surface classification using Polarimetric analysis by Polarimetric Airborne SAR (Pi-SAR).
(Niigata, Japan, Aug. 20, 2003)

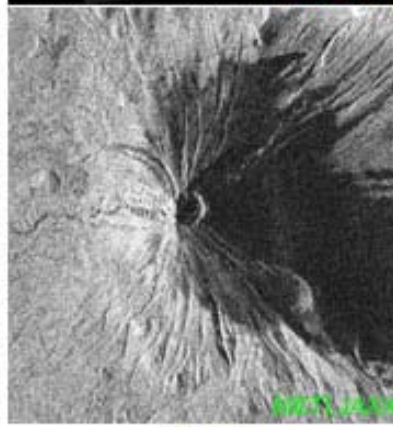
PALSARが観測した夜間の富士山

PALSAR Night View of Mt. Fuji



PALSARが観測した富士山の鳥瞰図





富士山

観測日　：2006年2月15日22時16分

Summary

I introduced the overviews of the ALOS and PALSAR, in particular,

1) characteristics of the PALSAR and its products,
2) examples of PALSAR data utilization, and
3) potentials and advantages of L-band SAR.

For more information related to research, application and science,

- **EORC/ALOS** : New images, data utilization, and technical documents
  http://www.eorc.jaxa.jp/ALOS/index.htm

For satellite and sensors development status,

- **ALOS Project Team** :
  http://alos.jaxa.jp/index-e.html

For data search and general information,

- **EOC/ALOS** : Data search (after launch)
  http://www.eoc.jaxa.jp/satellite/satdata/alos_e.html
- **HQ/Topics** : General information
  http://www.jaxa.jp/missions/projects/sat/eos/alos/index_e.html