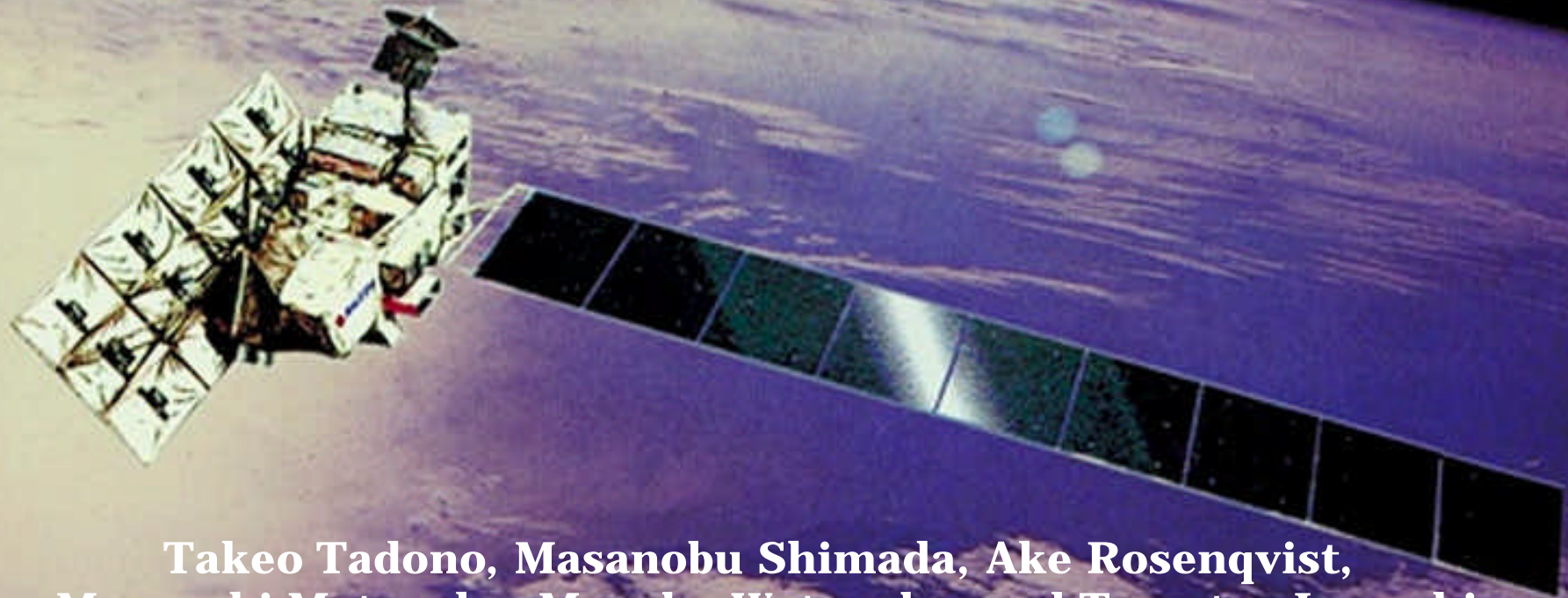


# Data Acquisition Plans of PRISM and AVNIR-2

– *Strategies, Mission Operation Simulation and Its Results* –



**Takeo Tadono, Masanobu Shimada, Ake Rosenqvist,  
Masayuki Matsuoka, Manabu Watanabe, and Tamotsu Igarashi**

***Earth Observation Research Center, National Space Development Agency of Japan***

Phone: +81-3-6221-9073, Fax: +81-3-6221-9113, E-mail: [tadono@eorc.nasda.go.jp](mailto:tadono@eorc.nasda.go.jp)

# ***Contents***

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## ■ ***Introduction***

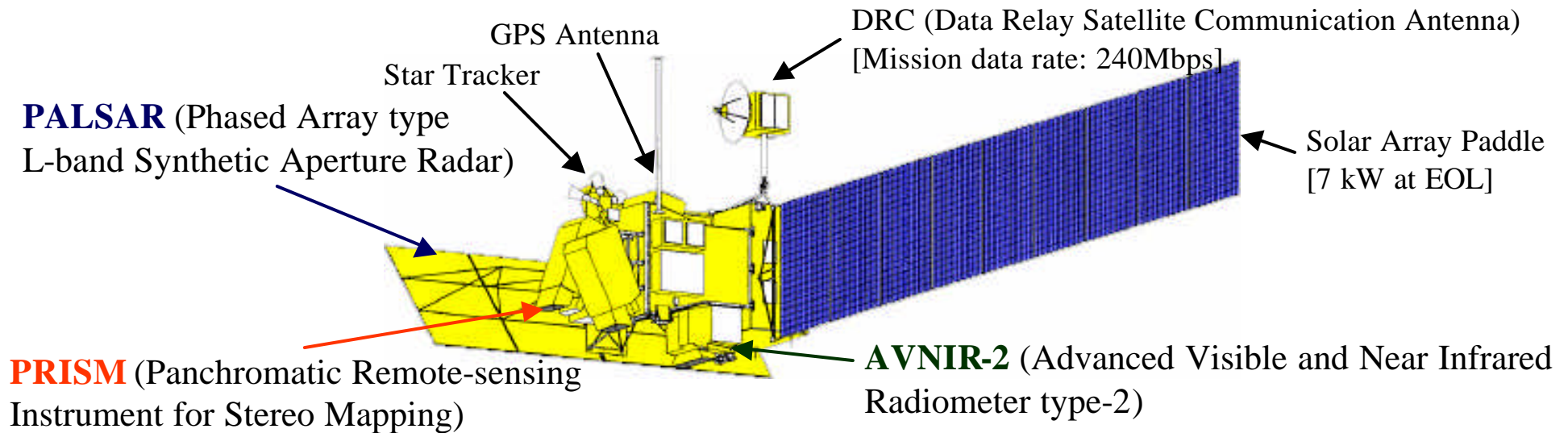
- Characteristics of PRISM and AVNIR-2
- Definition of products

## ■ ***Data Acquisition Plan***

- Calibration and Validation
- Mission operation scenarios
- Mission operation simulations and their results

## ■ ***Summary***

# ***Advanced Land Observing Satellite (ALOS) Mission***

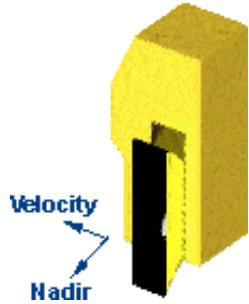


ALOS is one of the largest Earth observing satellites ever developed. Its objectives are to:

- (1) provide maps for Japan and other countries including those in the Asian-Pacific region (**Cartography**),
- (2) perform regional observation for “sustainable development,” harmonization between Earth environment and development (**Regional Observation**),
- (3) conduct disaster monitoring around the world (**Disaster Monitoring**),
- (4) survey natural resources (**Resources Surveying**),
- (5) develop technology necessary for future Earth observing satellites (**Technology Development**).

In 1994, NASDA started a conceptual study of the ALOS satellite system as well as fabrication and testing of remote-sensing instruments. NASDA is currently in the Phase-D stage *i.e.*, development of the Proto-Flight Model (PFM).

## Advanced Visible and Near Infrared Radiometer type 2



Band 1: 0.42-0.50, Band 2: 0.52-0.60

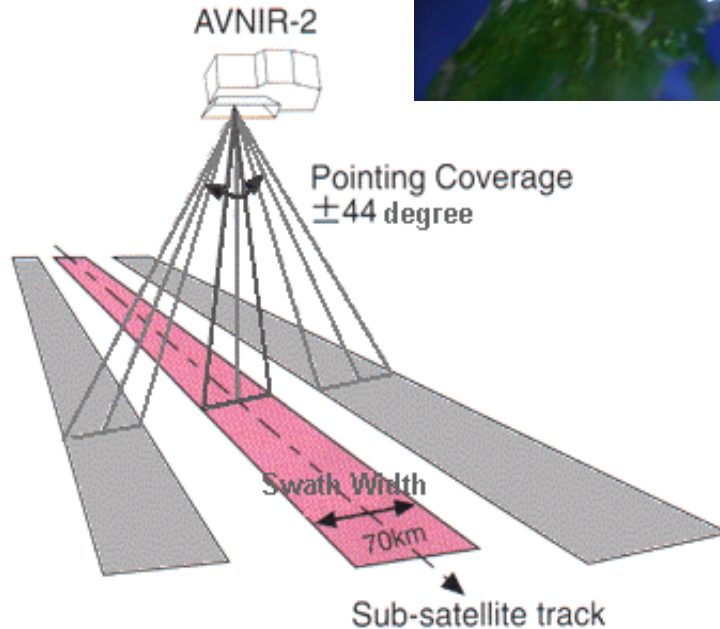
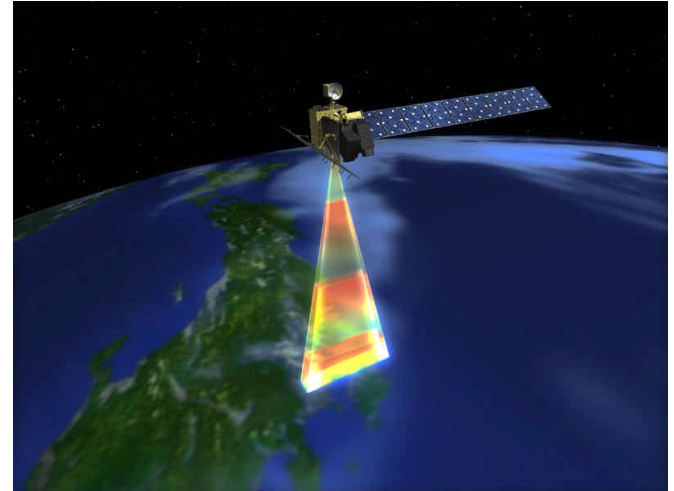
Band 3: 0.61-0.69, Band 4: 0.76-0.89

Spatial Resolution: 10m at Nadir

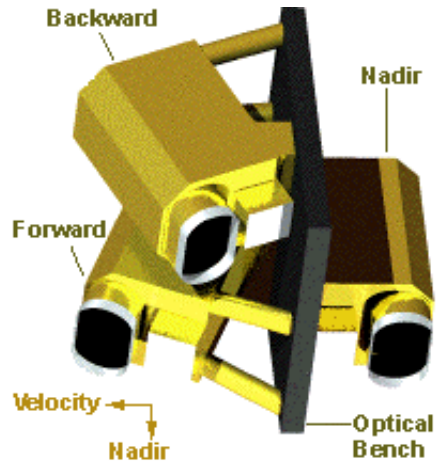
Swath Width: 70km at Nadir

Pointing Angle:  $\hat{A}$  44 deg.

S/N: 200



## Panchromatic Remote-sensing Instrument for Stereo Mapping



0.52-0.77  $\mu$ m

Number of Optics: 3  
(Nadir / Forward / Backward)

Base/Height ratio: 1.0 (F / B)

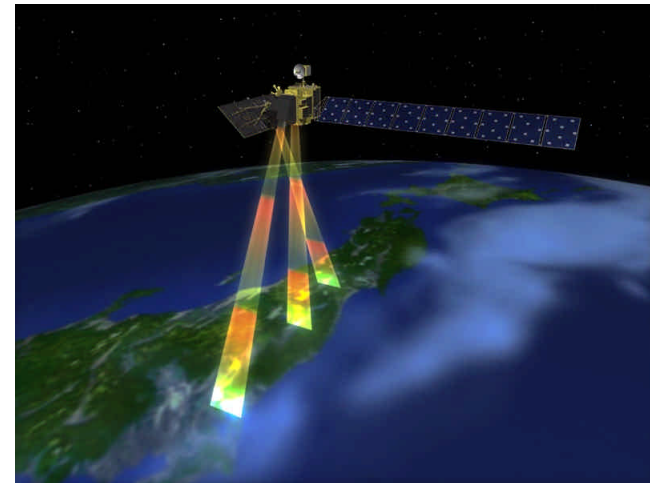
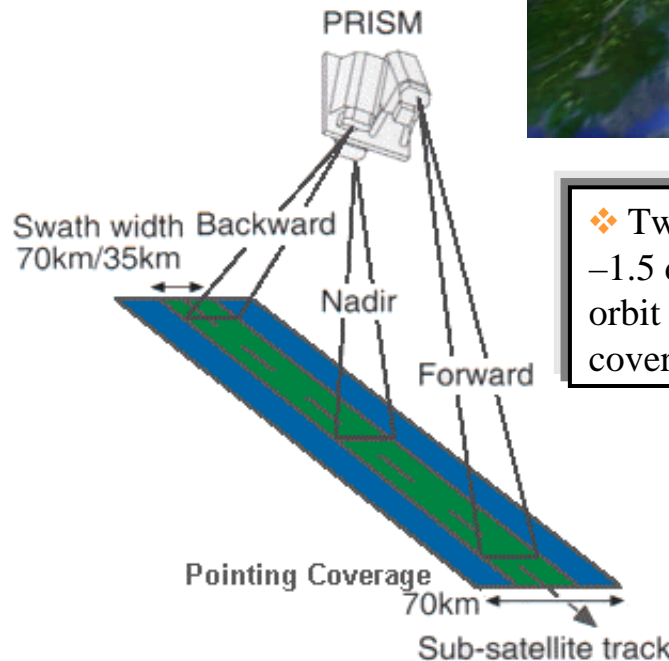
Spatial Resolution: 2.5m at Nadir

Swath Width: 35km at Triplet mode

70km at Nadir only

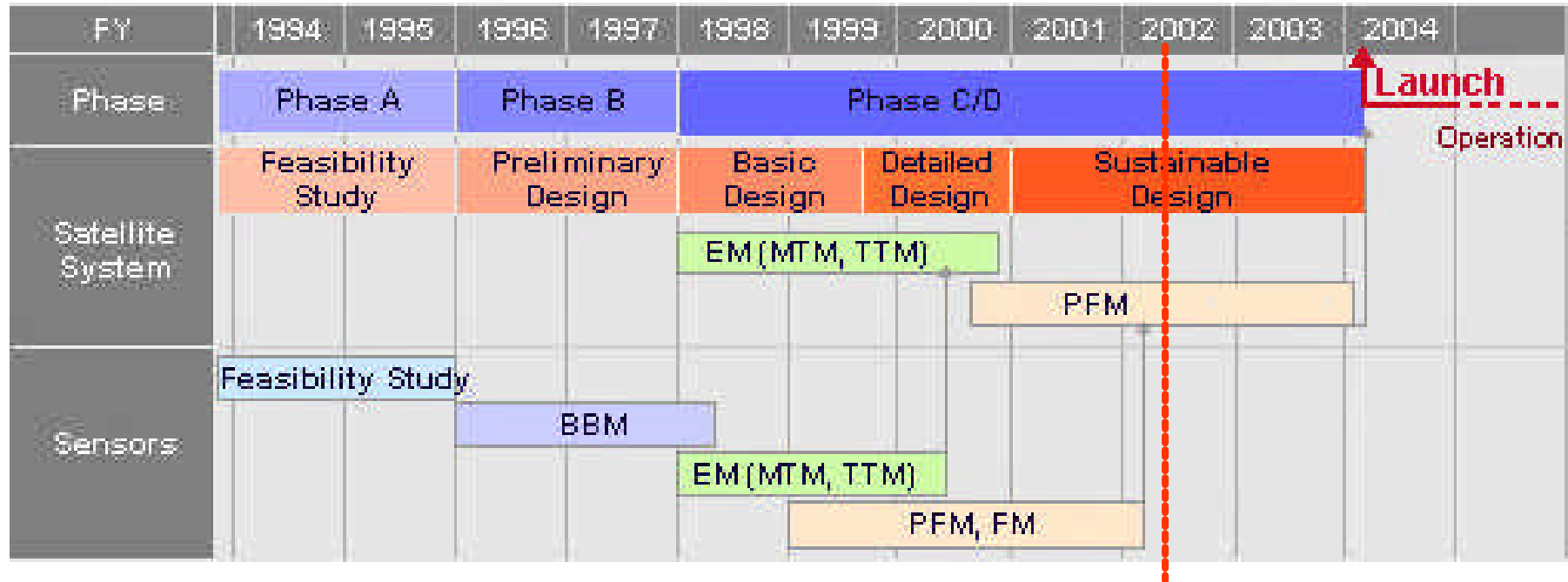
Pointing Angle:  $\pm 1.5$  deg.

S/N: 70



❖ Two times observation (+1.5 and -1.5 deg. pointing angle) in same orbit are necessary to observe whole coverage by triplet mode.

# ALOS Development Schedule



- ❖ Current schedule of the ALOS development and launch is shown above. Our target launch date has been delayed one year due to some Japanese governmental problems.
- ❖ We are now conducting Phase-D, *i.e.*, development of the Proto-Flight Model (PFM) of satellite and sensors, and planning the ALOS operation, data acquisition and processing, as well as calibration of the sensors and validation of products.

# Definition of ALOS Data Products

---

Standard Products : processed in Earth Observation Center (EOC), NASDA

**AVNIR-2, PRISM** – 1A : Uncorrected image, scene unit (Raw data)

1B1 : Radiometrically calibrated image

1B2 : Geometrically corrected image

**PALSAR** – 1.0 : Uncorrected image, scene unit (Raw data)

1.1 : Single-Look Complex data on slant range (SLC)

1.5 : Multi look processed image (Amplitude)

High Level Products : will be generated at EORC.

**PRISM** : Digital Elevation Model (DEM) and Ortho-rectified image

**AVNIR-2** : Ortho-rectified image

**PALSAR** : DEM by Interferometry, (and Ortho-rectified image)

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

- Forest map, Deformation map, Biomass map, Sea-ice map, Soil moisture map, and Snow parameter map using **PALSAR** data
- Land-cover classification map, Albedo map, Vegetation map, Mountain and Glaciers map using **AVNIR-2** and **PRISM**

# ***ALOS Calibration / Validation Plan #1 (tentative)***

There are three calibration and validation phases:

- I. **Pre-flight Calibration Phase (PCP): by launch (L)**
  - ✓ In the phase before the launch, the sensor characteristics are measured on the ground under conditions simulating space. The representative parameters are the input-output relationship, antenna patterns, noise levels, attenuation values, *etc.*
- II. **Initial Calibration Phase (ICP): from L+3 to L+8 month**
  - ✓ Sensors will be activated in all its modes, and sensor parameters will be evaluated quantitatively.
  - ✓ For optical sensors *i.e.* **AVNIR-2** and **PRISM**, the signal to noise ratio (S/N), dark current, linearity, saturation, sensitivity variation, absolute calibration, offsets *etc.* will be evaluated as radiometric calibration. The alignment, sensor distortion, registration between each band, the modulation transfer function (MTF) *etc.* will be evaluated as geometric calibration.
  - ✓ For **PALSAR**, All the antenna beams (23 in total) will be calibrated, and their related SAR mode, including the polarimetry, will be calibrated using Active Radar Calibrator (ARC), Polarimetric ARCs (PARCs) and natural targets.
  - ❖ During two cycles in this phase, **PALSAR** will be operated in Single HH Pol. with 34.3degree off nadir angle for using interferometry.

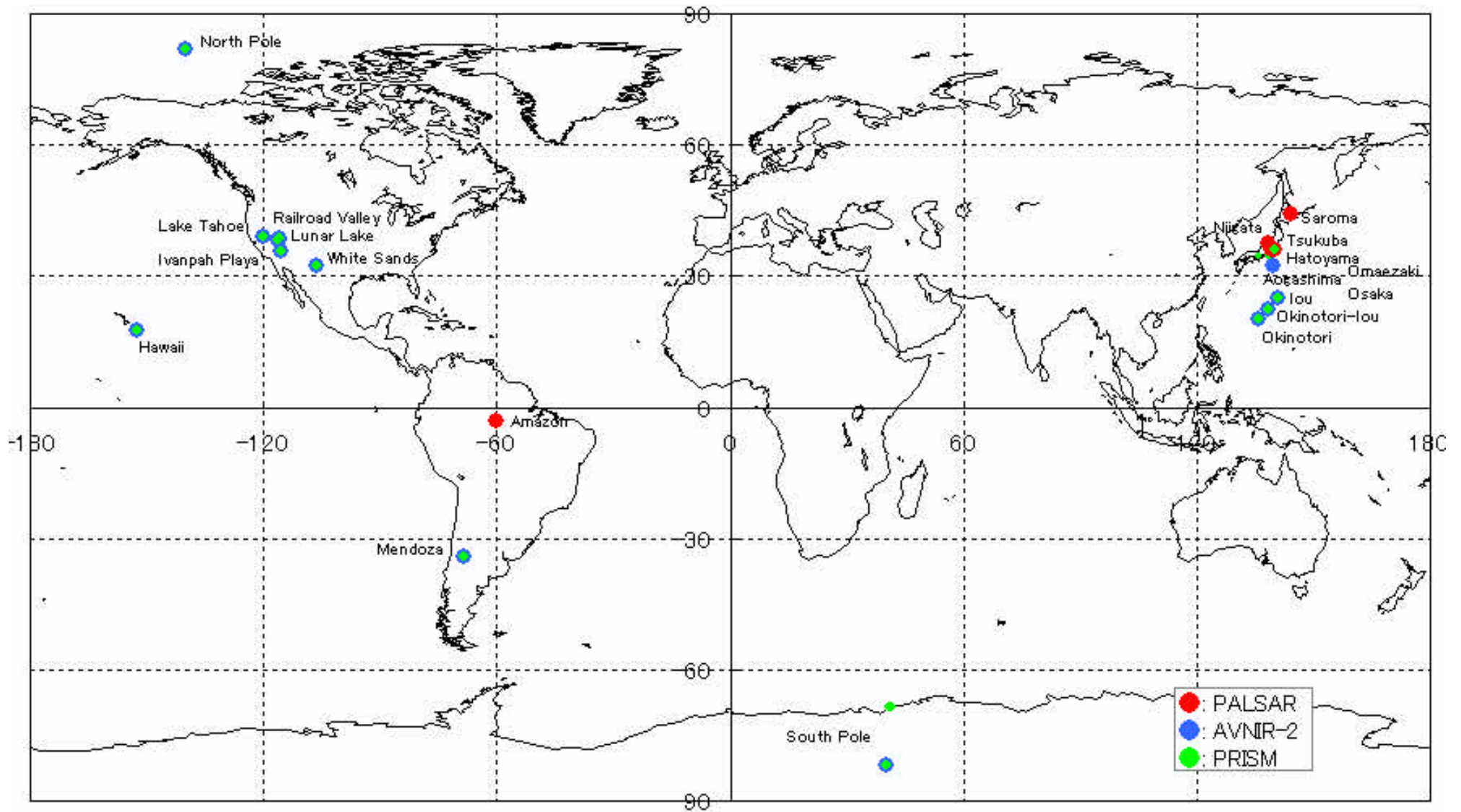


# ***ALOS Calibration / Validation Plan #2 (tentative)***

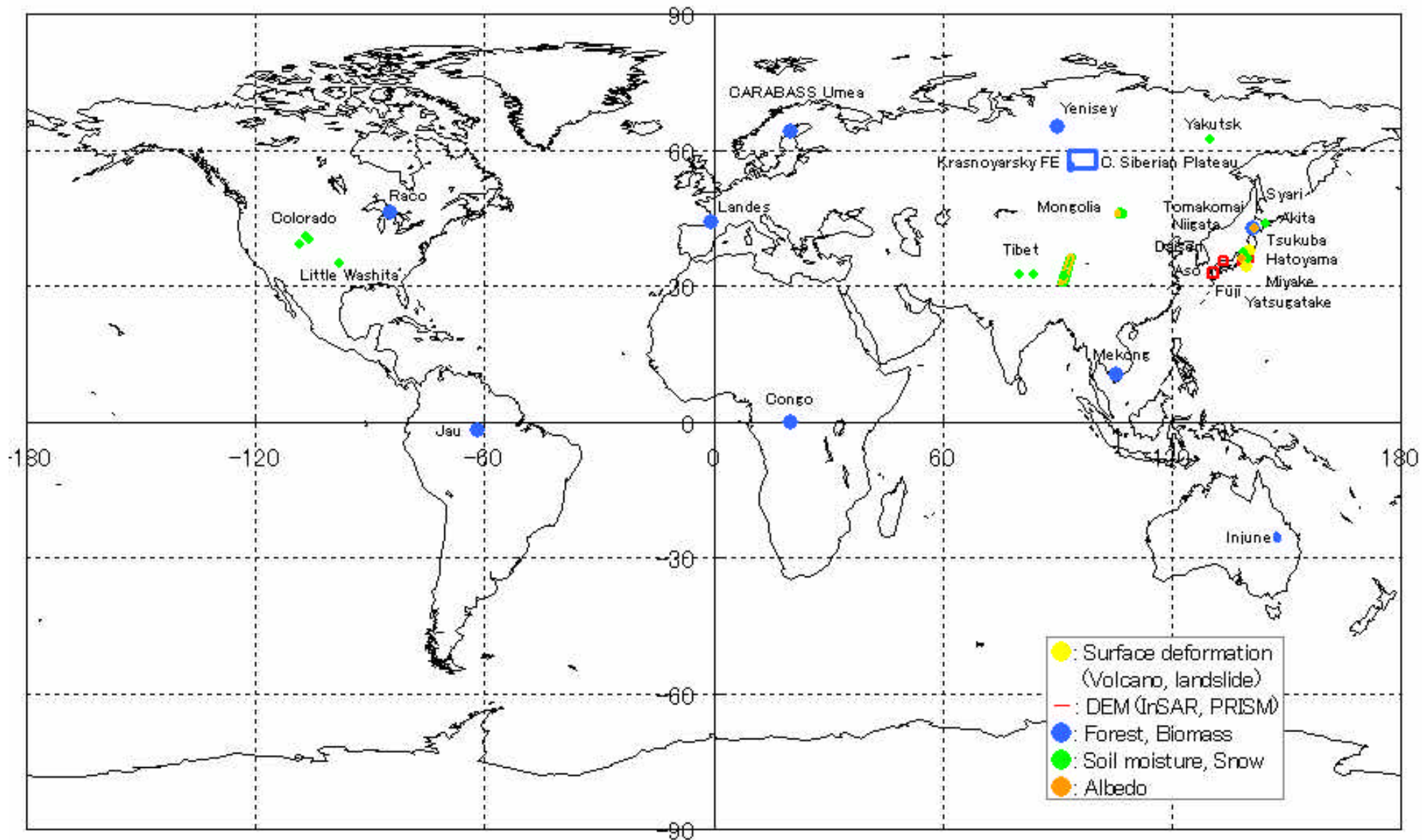
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- III. Routine Calibration Phase (RCP): after L+9 month
  - ✓ All standard products, high-level products and research products will be evaluated routinely based on the methods in ICP, and truth data will be acquired.
  - ✓ The calibration of each sensor will be continuously carried out to evaluate the temporal and seasonal change.
- ❖ One problem is the thermal distortion in an orbit for the geometric accuracy of PRISM.
- ❖ Calibration and validation purpose: High priority in mission operation.
- ❖ High frequency observation will be necessary during one year after launch, then gradual decreases of observation after it.
- ❖ We will setup the **ALOS super sites** worldwide so that the calibration of the sensors and the validation of related products can be effectively evaluated.

# ALOS Super Sites for Sensors Calibration (TBD)



# ALOS Super Sites for Validation of Products (TBD)



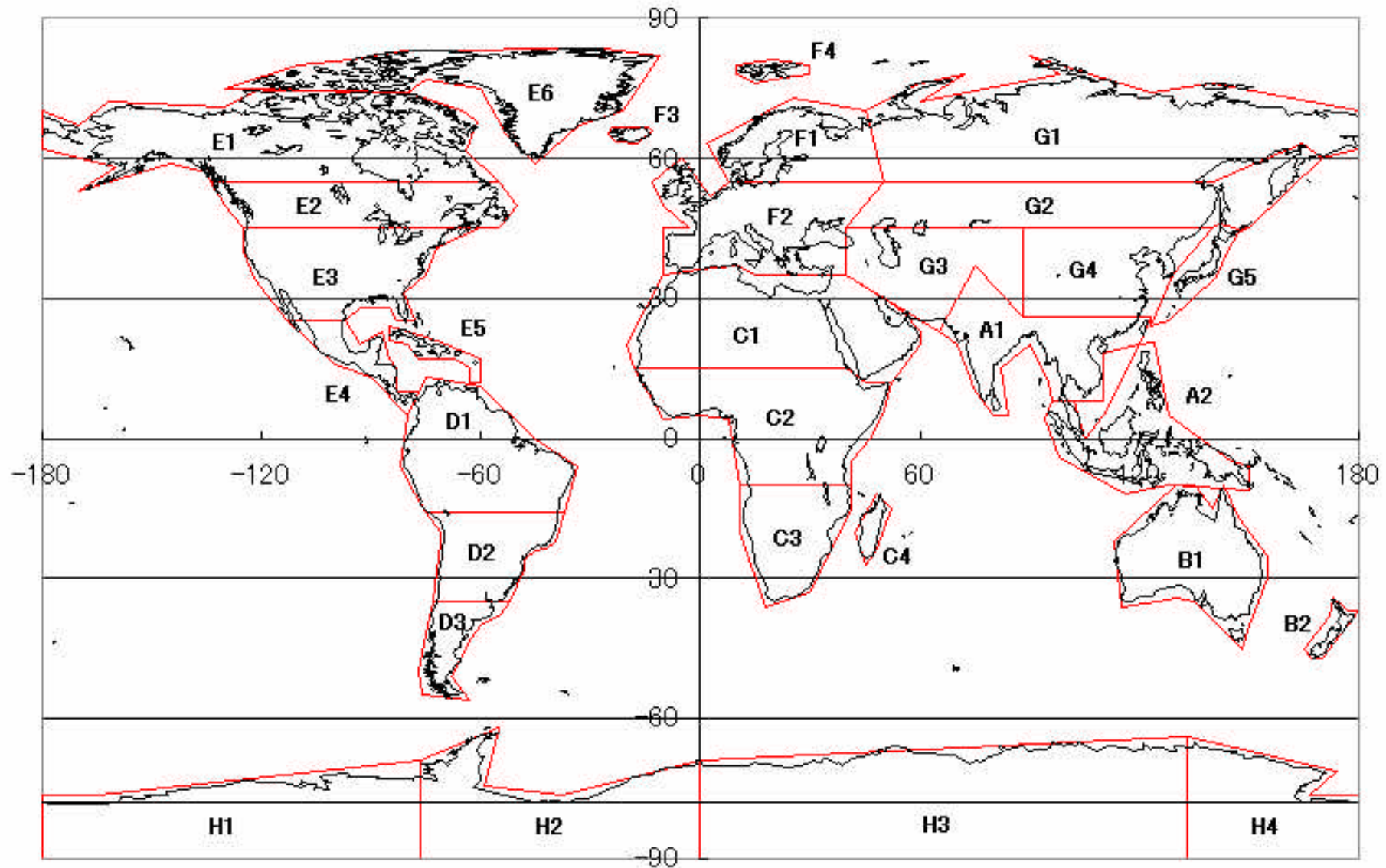
# ***Background of ALOS Operation Plan***

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In the previous mission operation simulation, the problems were revealed on the sensor time allocation:

- I. High priority users were only satisfied. Most of the users were not satisfied including EORC, Principle Investigators (PIs), *etc.*
- II. It is caused by the wide variety of the mission modes (PALSAR with 132 modes), lack of resources due to conflict with PALSAR and optical sensors, and one Data Relay Satellite (DRTS) availability.
- III. It is hoped that one operation scenario (guideline), which should be maximum common to the ALOS users, may improved the data acquisition condition.

# Segmentation for Global Coverage



PRISM/DEM Operation Scenario (TBD)

????? Val 1/1/2012

Region	8	9	10	11	12	1	2	3	4	5	6	7
Rate	5	-15	5	-15	5	-15	5	-15	5	-15	5	-15
Siberia (N)	G1											
Siberia (S)	G2											
Central Asia	G3											
China	G4											
India, SE Asia	A1											
SE Asia	A2											
Australia	B1											
New Zealand	B2											
Iceland	F3											
Svalbard	F4											
Europe (N)	F1											
Europe (S)	F2											
Africa (N)	C1											
Africa (C)	C2											
Africa (S)	C3											
Madagascar	C4											
Greenland	E5											
Canada (N)	E1											
Canada (S)	E2											
USA	E3											
Mexico	E4											
Caribbean	E6											
S America (N)	D1											
S America (C)	D2											
S America (S)	D3											
Hawaii	Island											
Tong	Island											
Samoa	Island											
Guapp	Island											
Azores	Island											
Kanary Islands	Island											
Corros	Island											
Saint Hirts	Island											
Rurin	Island											

Cloud cover (refer to SOSP)

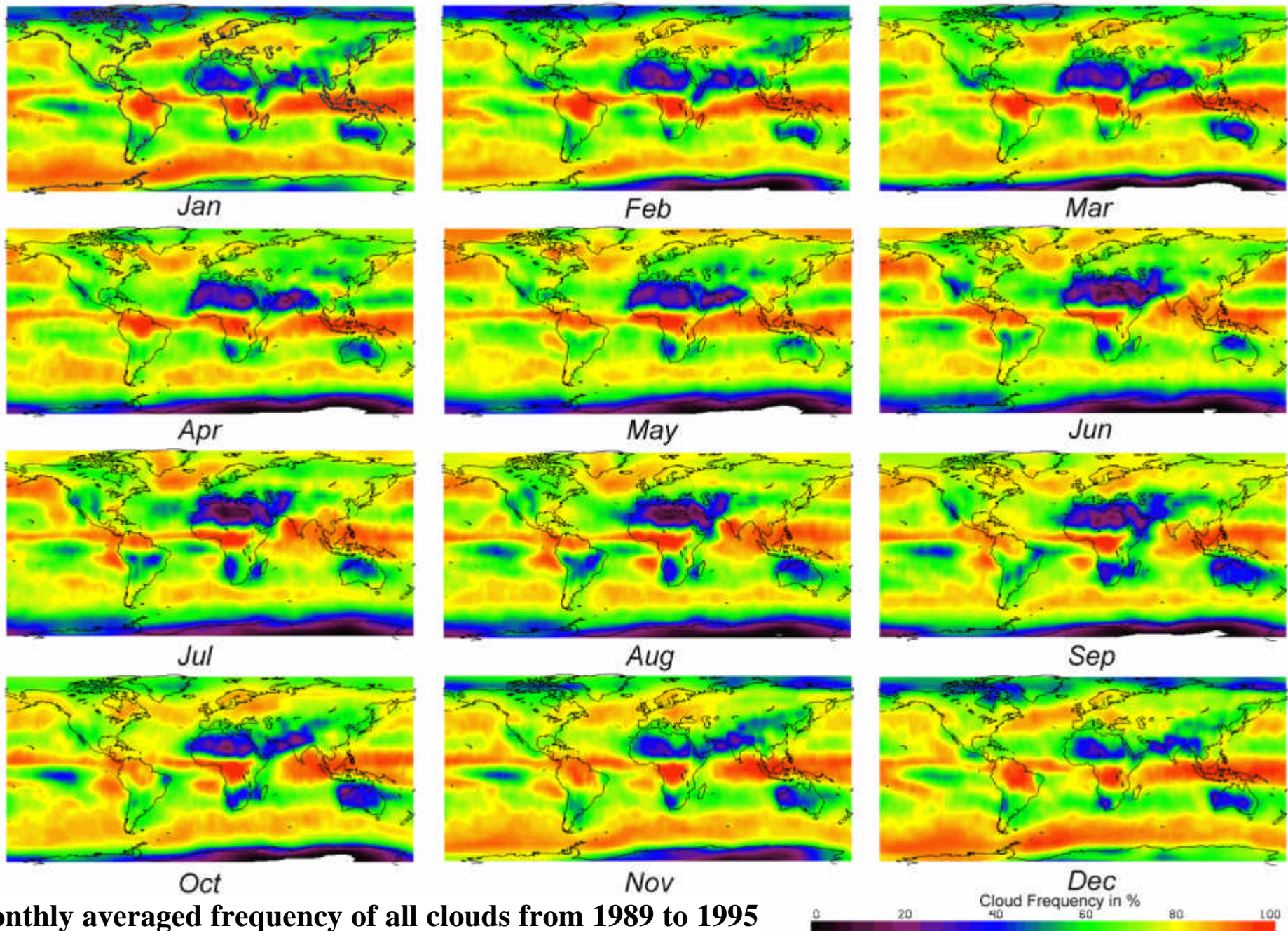
- 200%
- 300%
- 400%
- 200min/1000max

Request frequency

- 21 times
- 24 times
- 21 times only
- 20 times

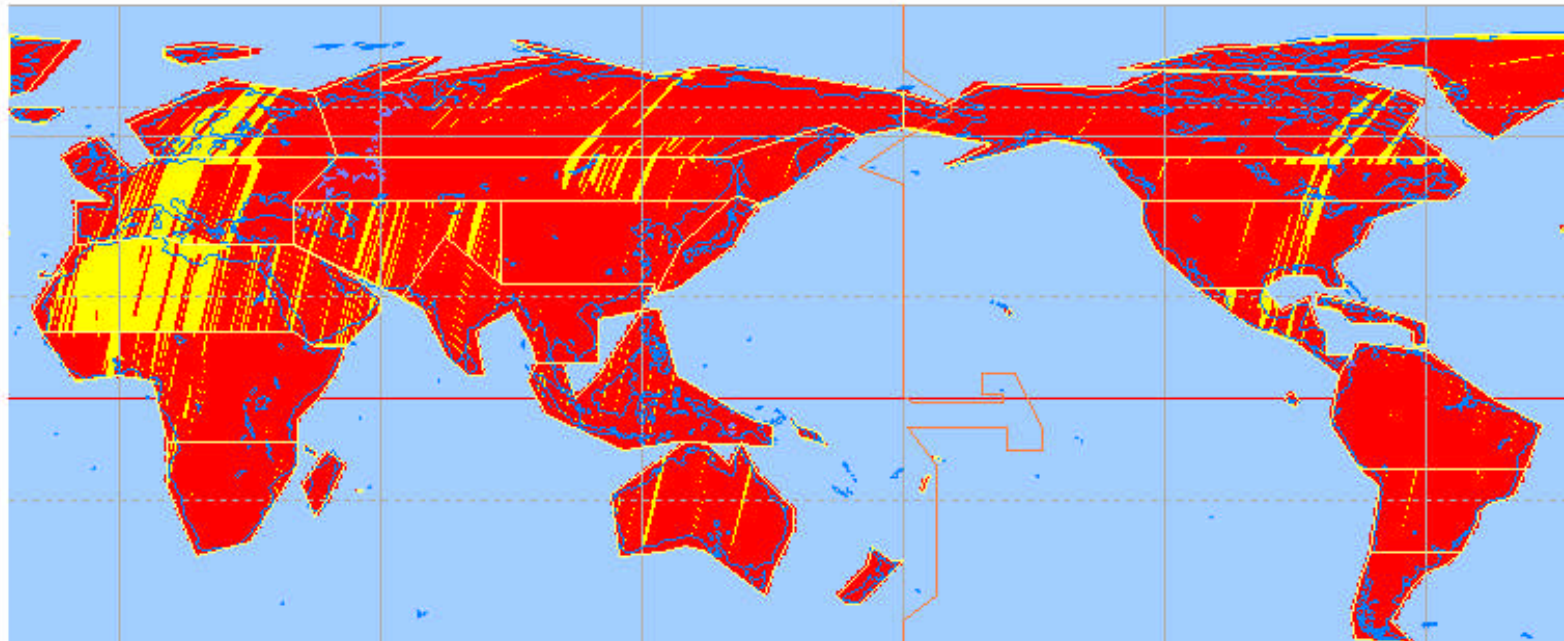
High priority  
Low priority  
due to expected many cloud

# ***International Satellite Cloud Climatology Project (ISCCP)***



**Monthly averaged frequency of all clouds from 1989 to 1995**

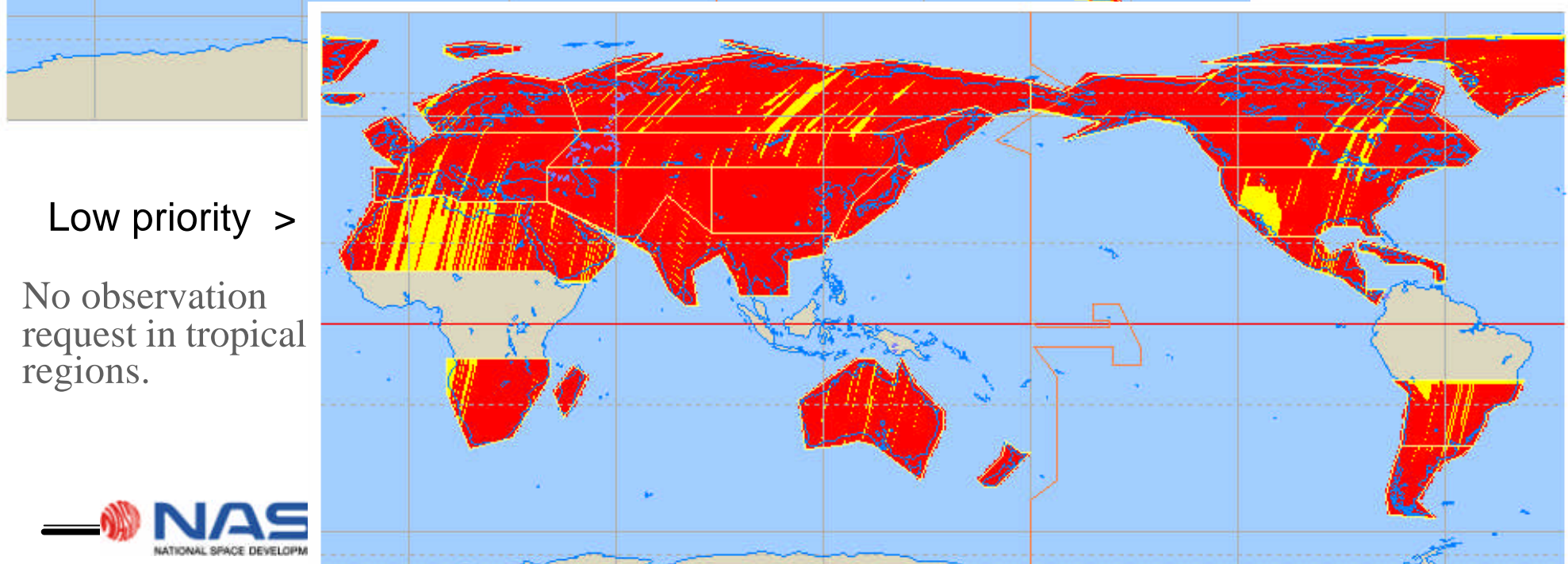
# ***Simulation Result for PRISM (Std. Case, 020409)***



< High priority

■ : requested

■ : planed  
(at least 1 time)



Low priority >


No observation  
request in tropical  
regions.



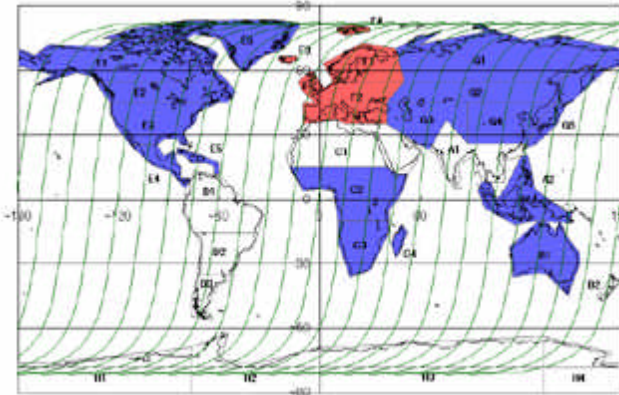
# Operation Scenario for PRISM & AVNIR-2 (Minimum Case)

PRISM & AVNIR-2 operational mode - Descending																	Apr.17, 2002																											
Year		2002												2003												2004												2005						
Month		8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8						
Recursion		1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8											
Pointing (PRISM)		+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5	+1.5	-1.5									
AREA NAME	Code	A/D																																										
S & SE-Asia	A1	DESC																																										
Insular SE-Asia	A2	DESC																																										
Australia	B1	DESC																																										
New Zealand	B2	DESC																																										
N. Africa	C1	DESC																																										
C. Africa	C2	DESC																																										
S. Africa	C3	DESC																																										
Madagascar	C4	DESC																																										
S. America North	D1	DESC																																										
S. America Mid	D2	DESC																																										
S. America South	D3	DESC																																										
N. Canada & Alaska	E1	DESC																																										
S. Canada	E2	DESC																																										
USA	E3	DESC																																										
Central America	E4	DESC																																										
Caribbean Islands	E5	DESC																																										
Greenland	E6	DESC																																										
Europe North	F1	DESC																																										
Europe South	F2	DESC																																										
Iceland	F3	DESC																																										
Svalbard	F4	DESC																																										
N. Siberia	G1	DESC																																										
S. Siberia	G2	DESC																																										
Far East	G3	DESC																																										
China	G4	DESC																																										
Japan	G5	DESC																																										
Antarctica	H1	DESC																																										
Antarctica	H2	DESC																																										
Antarctica	H3	DESC																																										
Antarctica	H4	DESC																																										
Hawaii	Island	DESC																																										
Tonga	Island	DESC																																										
Samoa	Island	DESC																																										
Galapagos	Island	DESC																																										
Azores	Island	DESC																																										
Kanary Islands	Island	DESC																																										
Comoros	Island	DESC																																										
Solomon Islands	Island	DESC																																										
Reunion	Island	DESC																																										

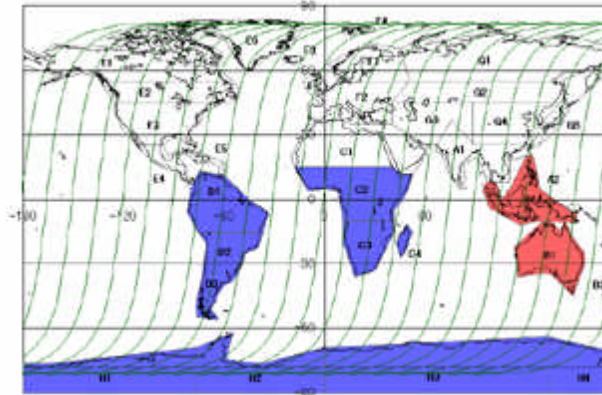
 : PRISM +1.5/-1.5 deg of pointing angle = 1 time / year -> during 3 years

 : AVNIR-2 1 time / year

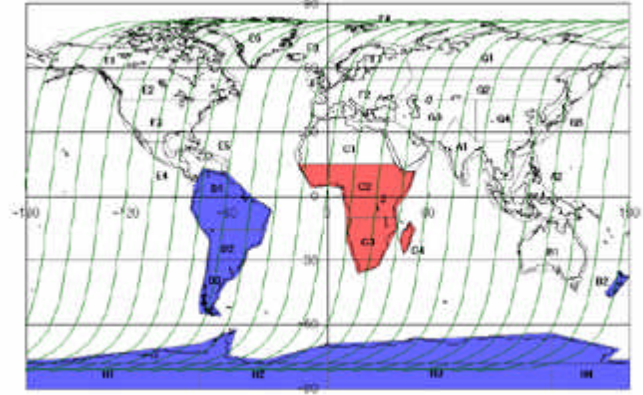
# Operation Scenario for PRISM & AVNIR-2 (Min. Case)



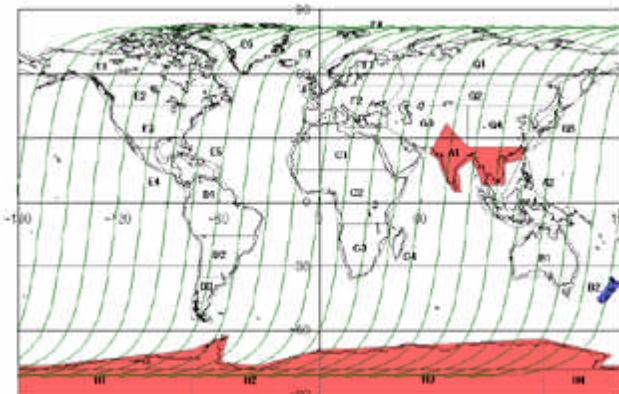
Rec. 1, 9, 17 (08B - 09M)



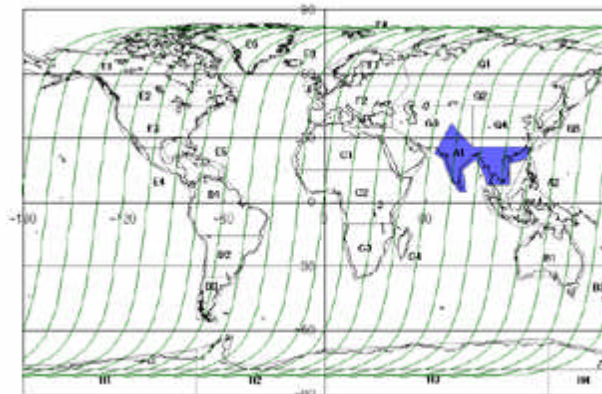
Rec. 2, 10, 18 (09M - 10E)



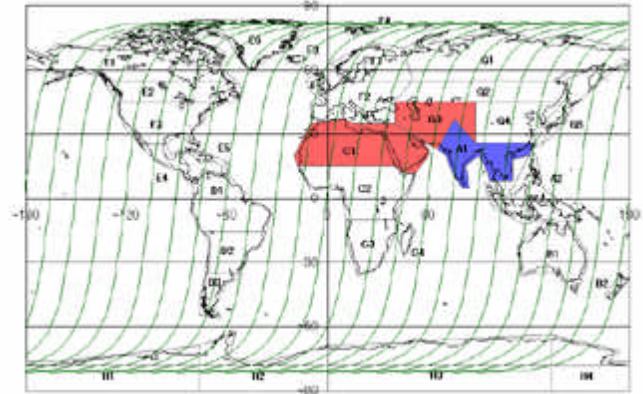
Rec. 3, 11, 19 (11B - 12M)



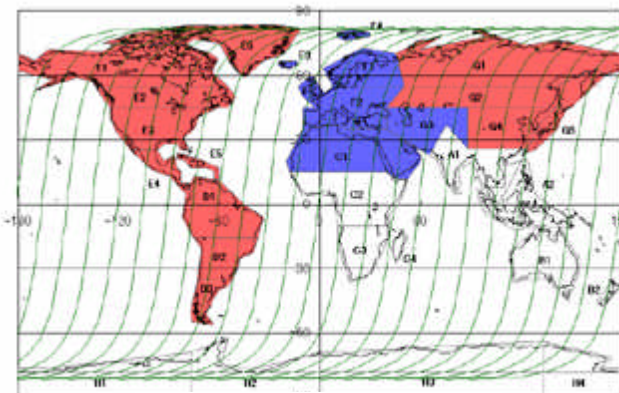
Rec. 4, 12, 20 (12M - 01E)



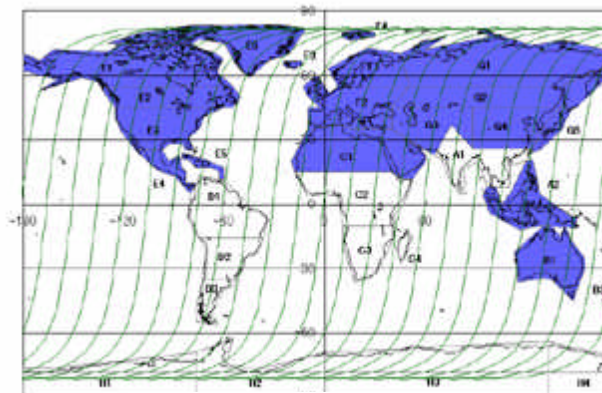
Rec. 5, 13, 21 (02B - 03M)



Rec. 6, 14, 22 (03M - 04E)



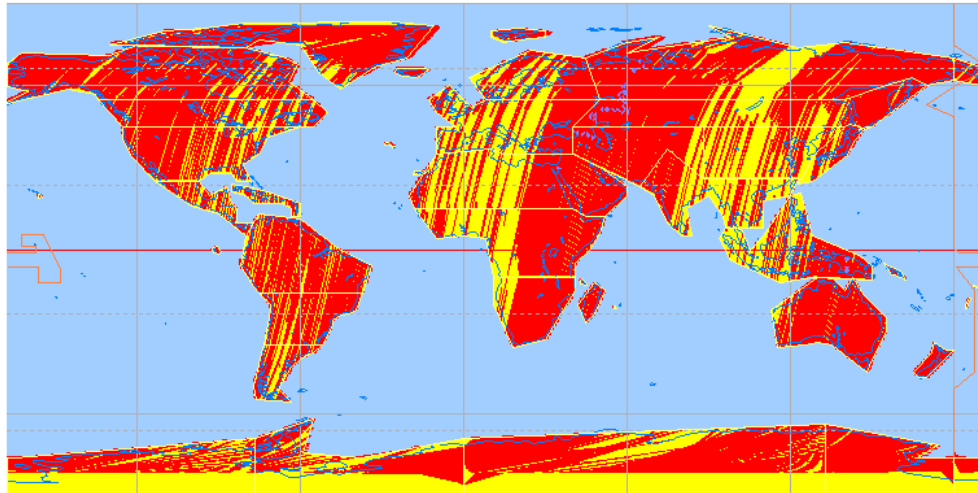
Rec. 7, 15, 23 (05B - 06M)



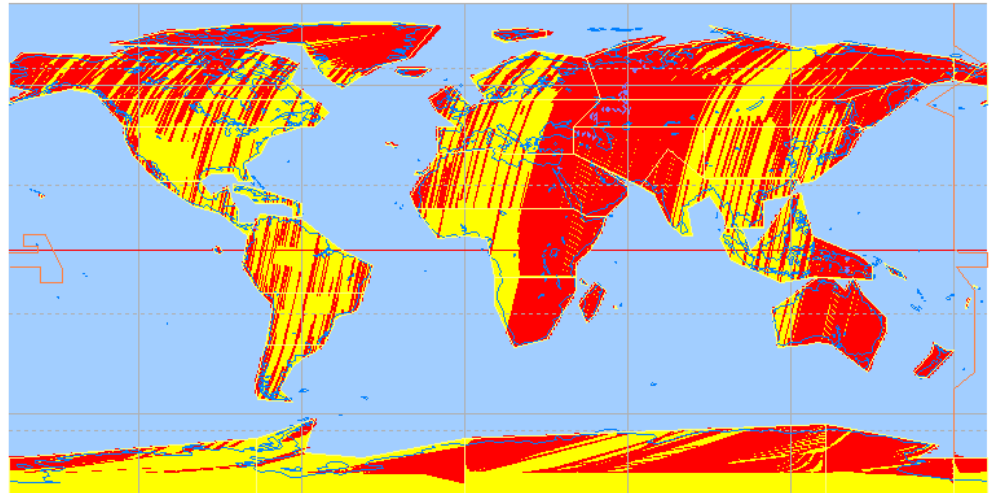
Rec. 8, 16, 24 (06M - 07E)

■ : PRISM  
■ : AVNIR-2

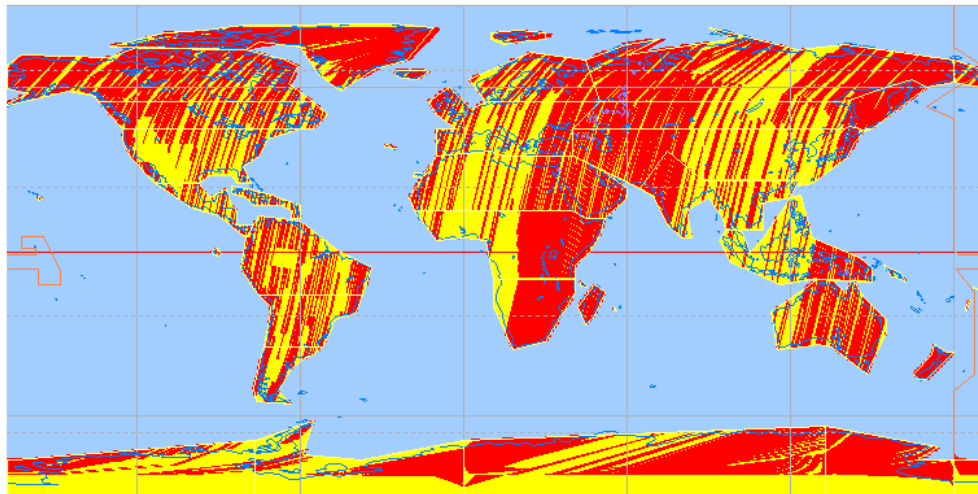
# ***Simulation Result for PRISM (Min. Case, 020424)***



**1st year (Rec. 1 - 8)**



**2nd year (Rec. 9 - 16)**



**3rd year (Rec. 17 - 24)**

■ : requested  
■ : planed  
(at least 1 time)

❖ No planed areas are still appeared due to lack of resources.

# Comparison of Simulation Results : Std vs. Min

Calibration/Validation		Minimum Case (as of 020424)				Standard Case (as of 020409)			
Item	Sensor	Requirement (scene)	Possible acquisition (scene)	Acquisition, complete (scene)	Acquisition rate, complete (%)	Requirement (scene)	Possible acquisition (scene)	Acquisition, complete (scene)	Acquisition rate, complete (%)
PALSAR -whole land	PALSAR	76,479	76,479	72,389	95	76,479	76,479	67,582	88
PALSAR -antenna pattern	PALSAR	84	84	60	71	84	84	44	52
PALSAR -calibration factor	PALSAR	972	972	684	70	972	972	495	51
PRISM Calibration	PRISM	189	135	34	25	1,296	213	34	16
AVNIR-2 Calibration	AVNIR-2	153	135	88	65	648	135	83	61
PRISM -OPS	PRISM	96	96	50	52	504	159	64	40
AVNIR-2 -OPS	AVNIR-2	71	71	55	77	320	75	42	56
Deformation Validation	PALSAR	180	180	58	32	180	180	31	17
DEM(PALSAR) Validation	PALSAR	5,832	5,797	2,616	45	5,832	5,797	1,445	25
Kyoto-Forest map Validation	PRISM	21	21	13	62	124	194	37	19
	AVNIR-2	82	82	78	95	460	234	78	33
	PALSAR	325	325	295	91	361	361	204	57
Soil moisture and Snow Validation	PRISM	9	9	6	67	72	54	12	22
	AVNIR-2	110	110	63	57	616	221	94	43
	PALSAR	441	429	182	42	441	429	166	39
Albedo map Validation	PRISM	624	583	117	20	3,228	1,507	207	14
	AVNIR-2	1,566	733	148	20	9,126	4,214	759	18
Vegetation map Validation	PRISM	45	44	29	66				
	AVNIR-2	21	21	21	100				
<b>NASDA Internal Requirement</b>		<b>Minimum Case (as of 020424)</b>				<b>Standard Case (as of 020409)</b>			
Item	Sensor	Requirement (scene)	Possible acquisition (scene)	Acquisition, complete (scene)	Acquisition rate, complete (%)	Requirement (scene)	Possible acquisition (scene)	Acquisition, complete (scene)	Acquisition rate, complete (%)
PRISM -Ortho/DEM (Default)	PRISM	1,106,814	1,104,170	314,925	29	2,868,042	2,828,421	553,944	20
Kyoto-Wetland map	PALSAR	7,924	1,413	267	19	857	857	183	21
Kyoto-Forest map	PALSAR	880,408	864,368	515,894	60	1,410,507	1,340,484	452,533	34
PALSAR -Ortho/DEM	PALSAR	683,307	676,155	419,130	62	772,880	743,196	275,190	37
Deformation map	PALSAR	205,164	203,658	101,248	50	225,467	216,126	79,002	37
Sea ice map	PALSAR	118,964	118,964	44,129	37	118,964	118,964	21,932	18
Soil moisture map	PALSAR	470	470	37	8	15,429	13,778	0	0
Snow map	PALSAR	4,710	4,500	80	2	1,565	1,092	546	50
Albedo,	PRISM	76,068	75,131	18,629	25	341,420	251,741	73,649	29
Land cover classification	AVNIR-2	19,017	19,017	6,731	35	174,421	127,758	41,830	33
Vegetation, Mountain,	PRISM	12,501	12,501	4,903	39				
Glacier map	AVNIR-2	3,132	3,123	1,858	59				
AVNIR-2 -Ortho (Default)	AVNIR-2	276,678	276,322	121,553	44	79,431	79,431	73,266	92

- ✓ Simulation and analysis are necessary to meet further good results.
- ✓ The mission operation simulator is installed in EORC on May 16.
- ✓ Mission Management Organizer (MMO) of ALOS will be completed in August.

# Summary

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We introduced NASDA/EORC activities for ALOS project in particular,

- 1) PRISM and AVNIR-2 overviews, definition of products,
- 2) current plans of sensors calibration and products validation,
- 3) mission operation scenarios, and simulation results.

Almost of them are now considering. We will inform you them after decided on EORC web site as follows;

➤ **EORC/ALOS** : <http://www.eorc.nasda.go.jp/ALOS/>

For general information,

➤ **ALOS Project** : <http://alos.nasda.go.jp/>

➤ **HQ/Topics** : <http://www.nasda.go.jp/sat/alos/>

➤ **EOC/ALOS** : [http://www.eoc.nasda.go.jp/guide/satellite/satdata/alos\\_e.html](http://www.eoc.nasda.go.jp/guide/satellite/satdata/alos_e.html)

