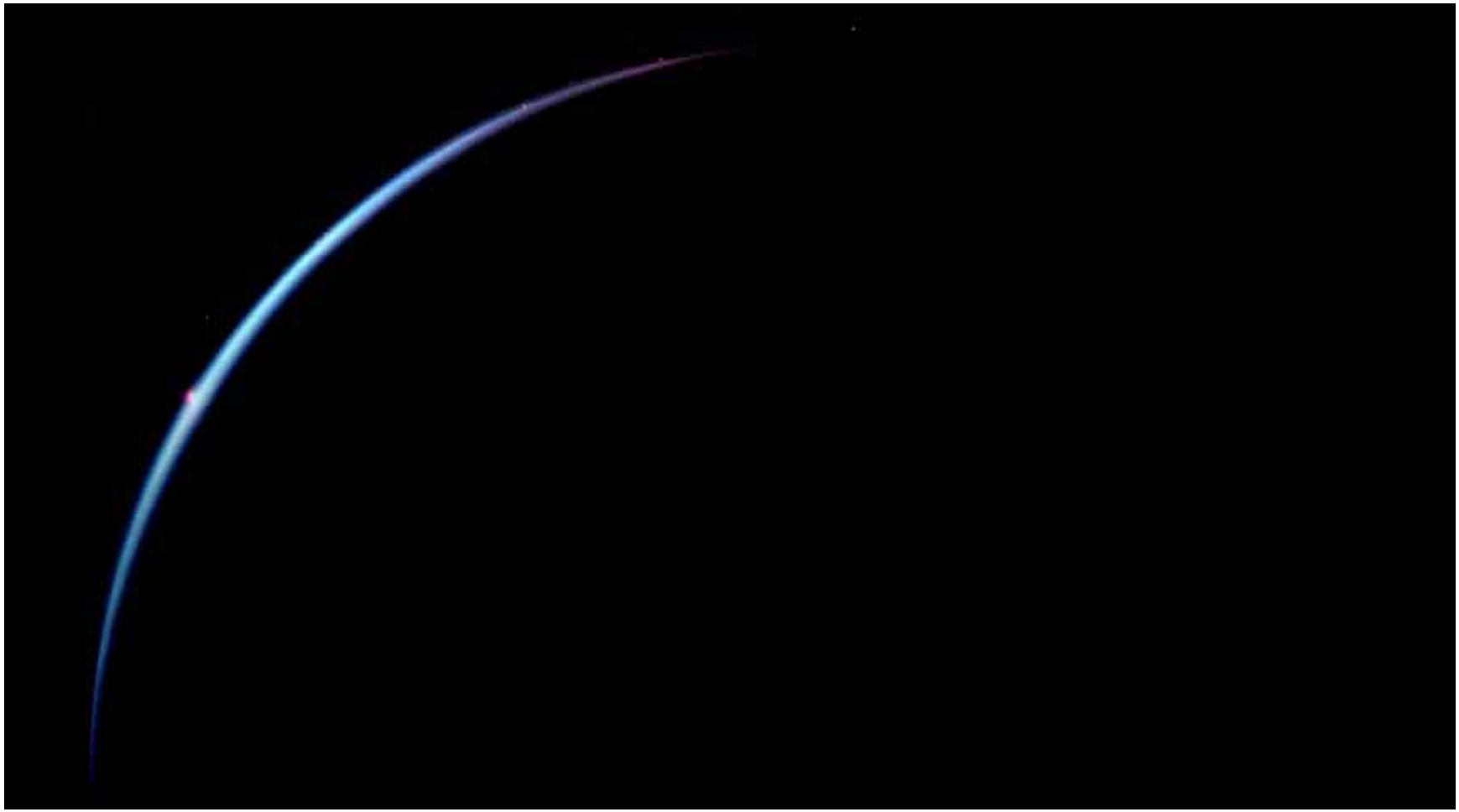
ALOS-2 Observation Scenario

Nov 2013
JPTM
JAXA DPN Report

ALOS-2 project
Japan Aerospace Exploration Agency (JAXA)

ALOS-2 Video



ALOS-2 Mission

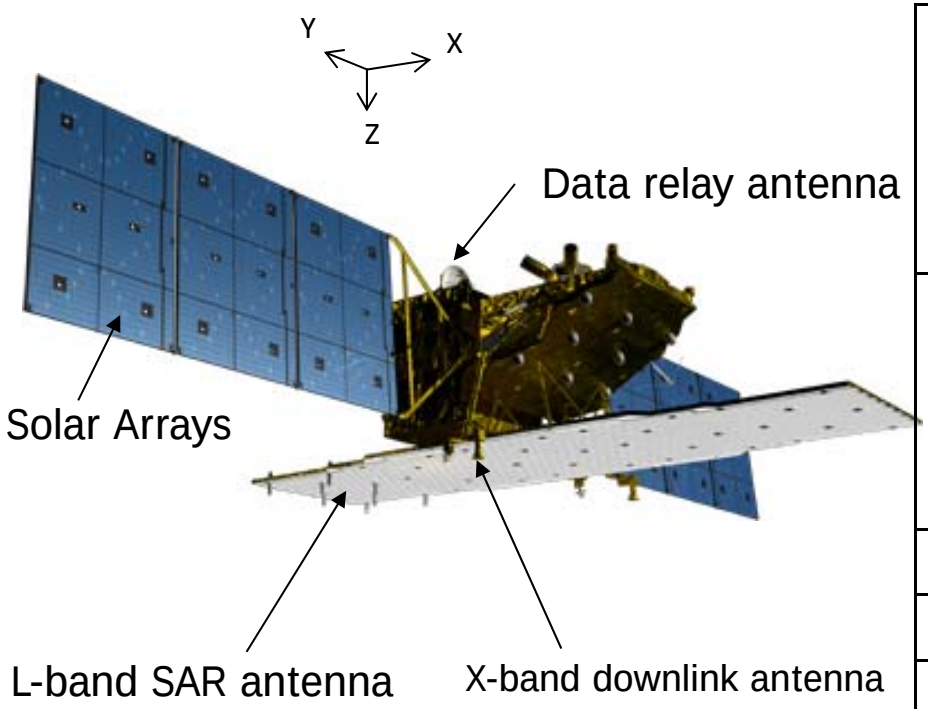
ALOS-2 has superior performance compared with ALOS.
ALOS-2 will achieve significant contributions to:

- **Disaster Monitoring**
  - **quick access to damaged areas and continuous monitoring**
  - **InSAR for deformation**
- **Land Monitoring**
  - **generate systematic archive**
  - **sea ice monitoring**
- **Agricultural Monitoring**
  - **evaluation of irrigated rice fields**
- **Natural Resource Exploration**
  - **detecting oil slick over sea**
  - **analysis of geology and topography**
- **Global Forest Monitoring**
  - **deforestation monitoring**
- **Potential Use**
  - **maritime safety**

ALOS-2 satellite

Phase D

ALOS-2 in-orbit configuration

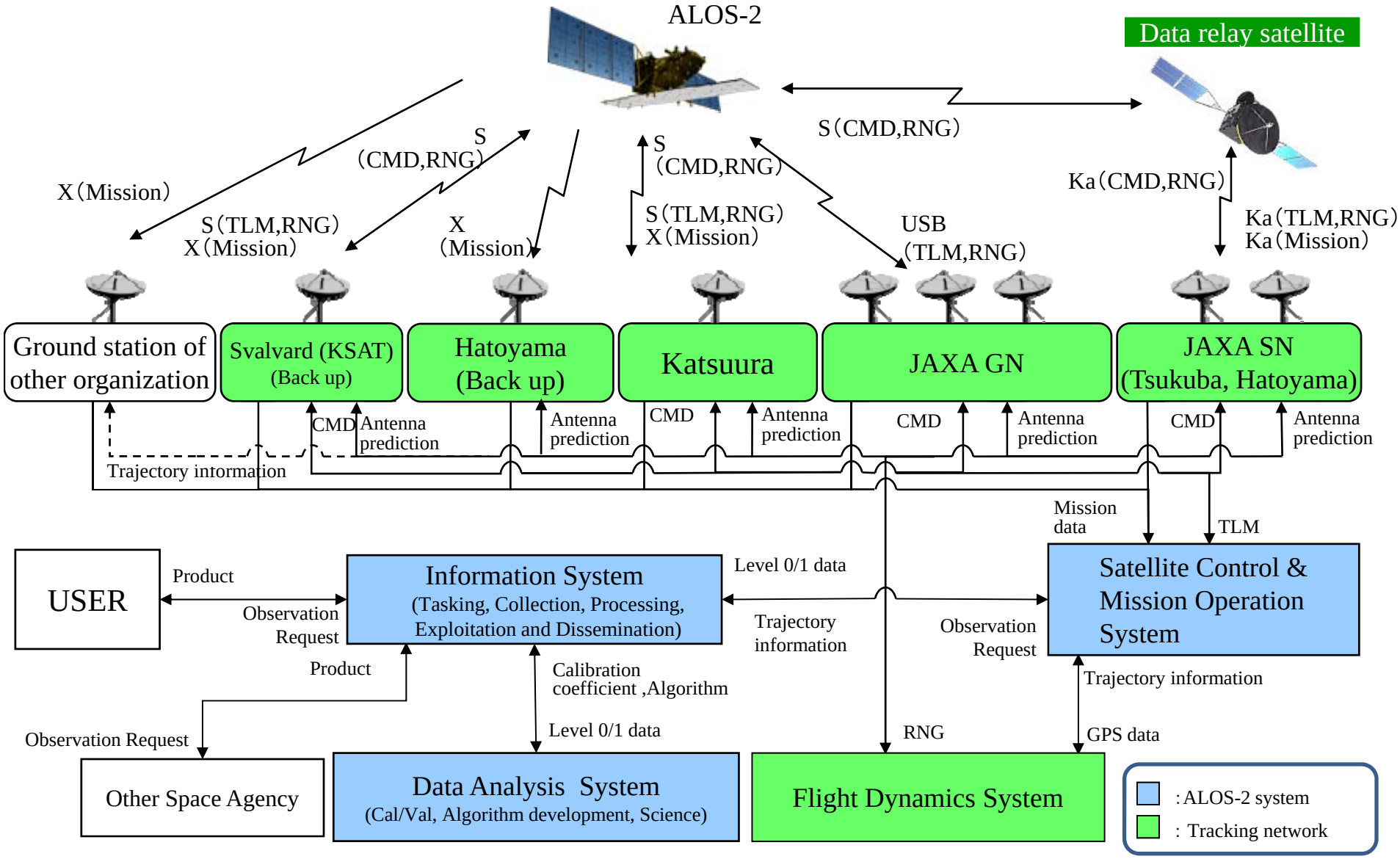


Specification

L-band SAR (PALSAR-2)	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1×3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: ≦+/-500m
Life time	5 years (target: 7 years)
Launch	JFY2013, H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (Data Relay)

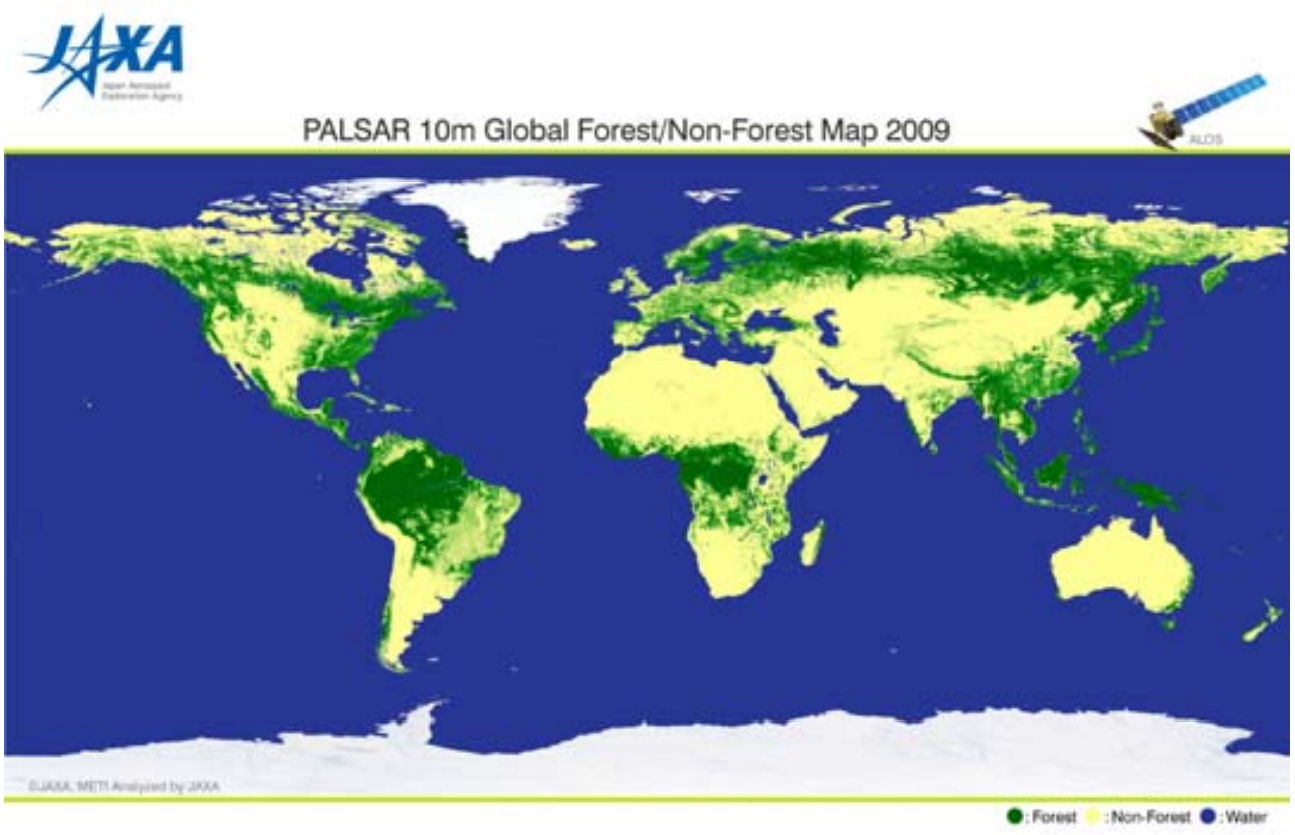
Experimental	Compact InfraRed Camera (CIRC) SPace based Automatic Identification System Experiment(SPAISE2)

ALOS-2 Ground System



Global Observation by ALOS series

From experiences of the ALOS operation, a systematic observation strategy to achieve consistent data acquisitions in time and space was crucial



Basic Observation Scenario(BOS)

Systematic Observation strategies (Basic Observation Scenarios) have been developed and implemented by JAXA for 20 years:

- JERS-1 SAR (1995-1998: **Pan-tropical, Pan-boreal**)
- ALOS PALSAR (2006-2011: **Global**)
- ALOS-2 PALSAR-2 (Under development.: **Global**)

Basic Observation Scenario (BOS)

The observation strategy of PALSAR-2 aims to provide spatially and temporally consistent, multi-seasonal global coverage, on a repetitive basis during the life-time of the ALOS-2 satellite.

Acquisition Concepts

- ✓Spatial and temporal consistency over continental scales at fine resolution
- ✓Adequate revisit frequency (including InSAR)
- ✓Accurate timing
- ✓Consistent sensor configuration
- ✓Long-term continuity

Goal

- ✓Comprehensive and homogeneous global archive of PALSAR-2 data

Japan and global BOS

Japan BOS

- To meet requirements from a large number of domestic organisations and user groups
- Covering all Japan land and sea territory

Global BOS

- Global observations over all land areas
  - ✓ *at least* **semi-annual** (dual-season)
  - ✓ *at least* **dual-polarisation**
- Higher temporal repeat frequency for specific applications (e.g. crustal monitoring; volcanoes; agriculture; wetlands; deforestation hotspot regions)

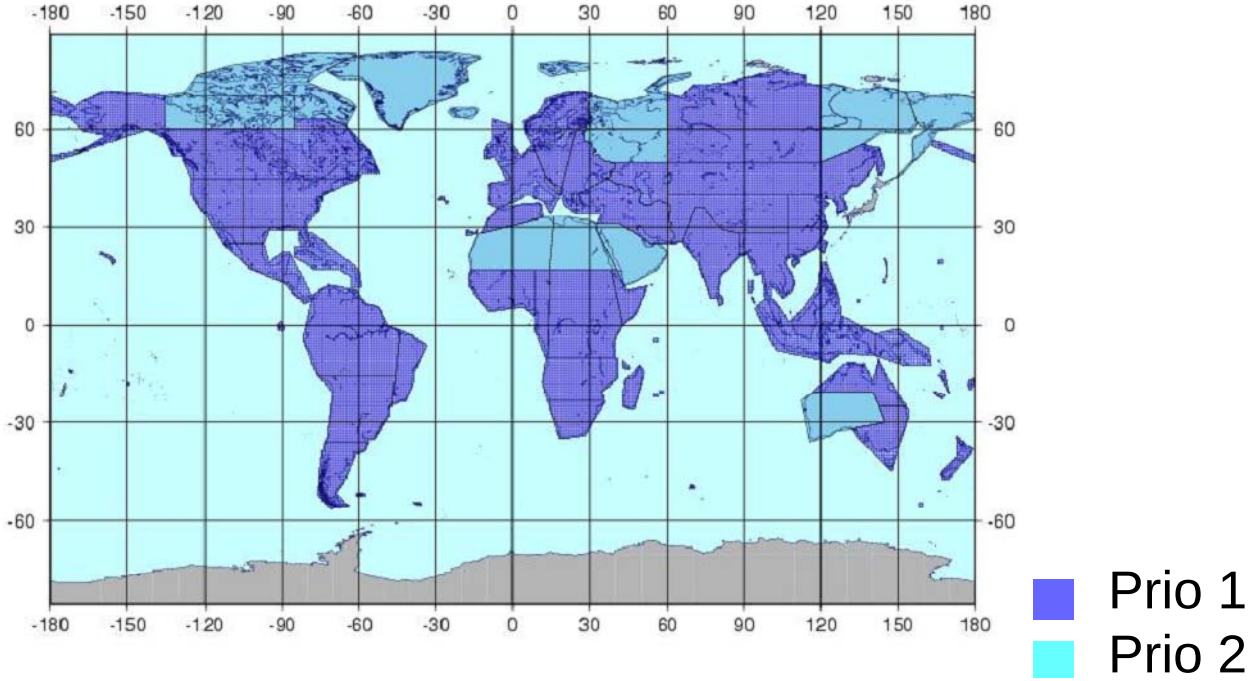
Basic Observation Scenario (Global)

Global land areas – baseline mapping

Temporal repeat: 2 cov/year

GSD: 10 m (off-nadir 28.2° -36.2°)

Mode: Stripmap Dual-pol (HH+HV/28MHz)



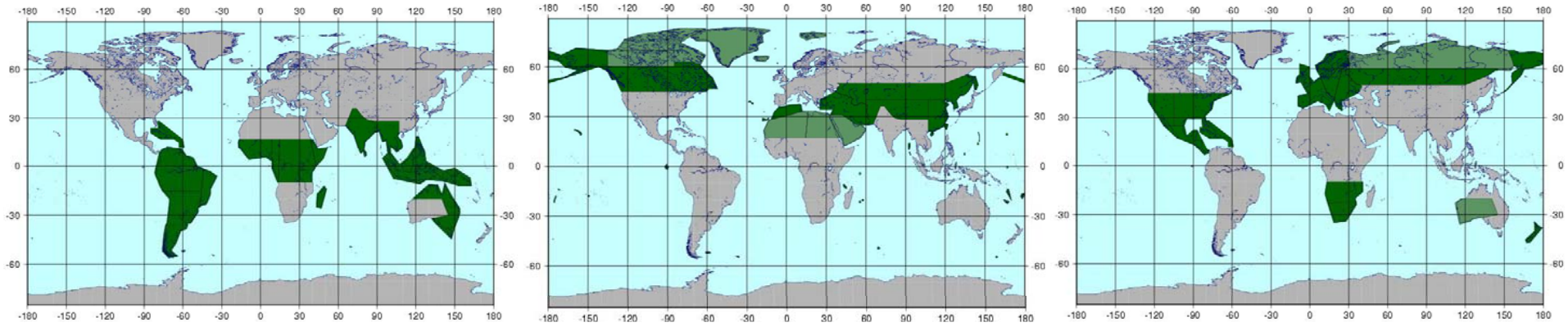
Basic Observation Scenario (Global)

Global land areas – VHR baseline mapping

Temporal repeat: 1 cov/ 3 years

GSD: 3 m (off-nadir 29.1°-38.2°)

Mode: Stripmap Single-pol（HH/84MHz）



1st year　　2nd year　　3rd year

Prio 1
Prio 2

* 3 m mode requires 3 years for global coverage

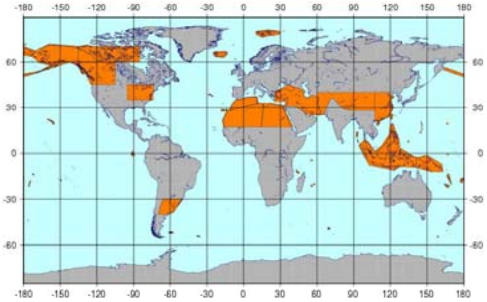
Basic Observation Scenario (Global)

Global land areas – Quad-polarimetric baseline

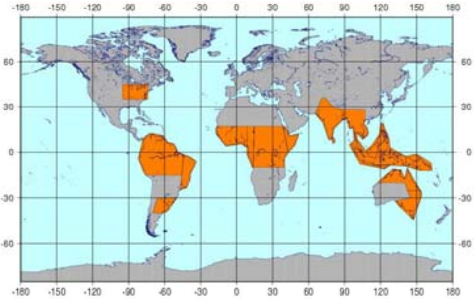
Temporal repeat: 1 cov/ 5 years

GSD: 6 m (off-nadir 25.0°-34.9°)

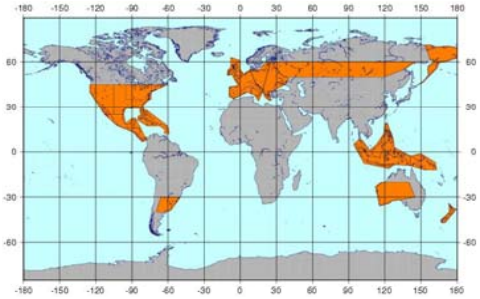
Mode: Stripmap Quad-pol (HH+HV+VV+VH/42MHz)



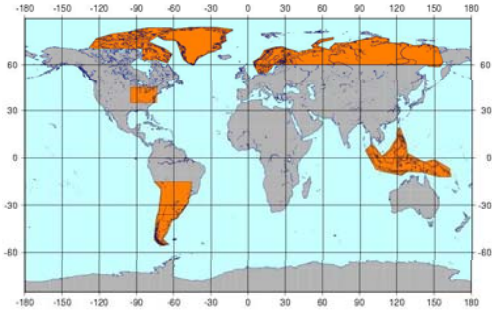
1st year



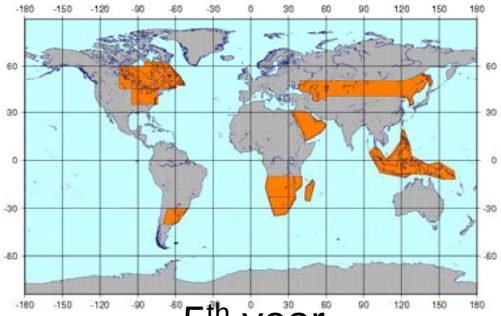
2nd year



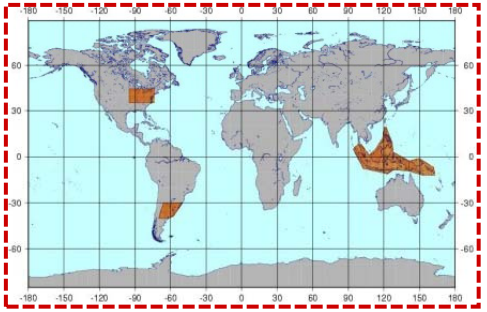
3rd year



4th year



5th year



Areas observed every year

* 6 m QP mode requires 5 years for global coverage

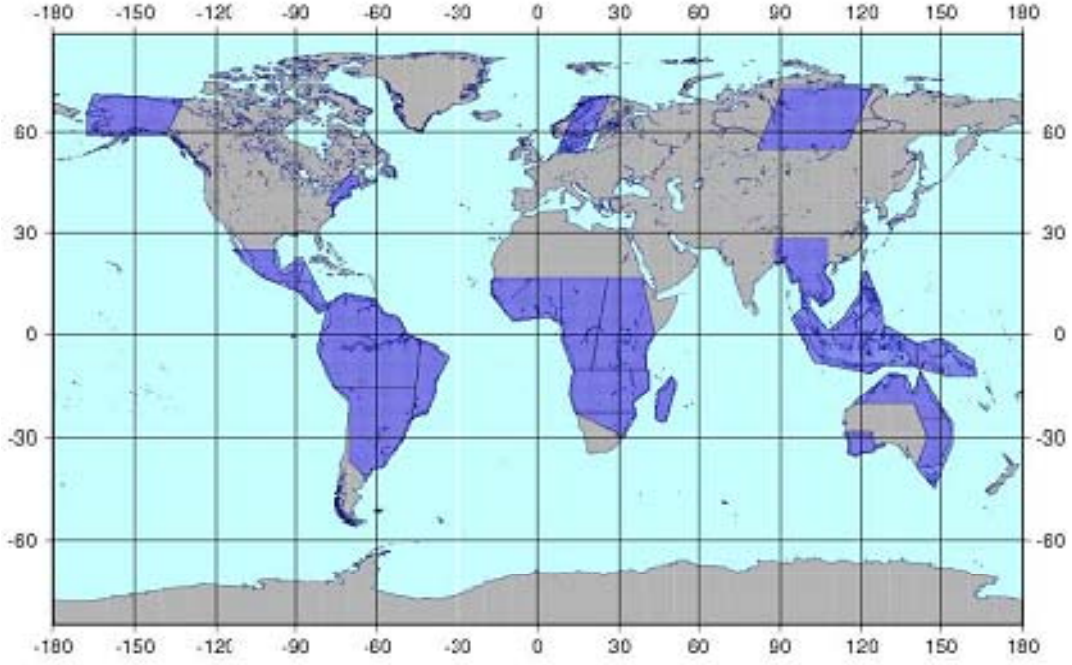
Basic Observation Scenario (Global)

Forest monitoring

Temporal repeat: 2-6 cov/year (tropics 6 cov)

GSD: 10 m (off-nadir 28.2˚ -36.2˚)

Mode: Stripmap Dual-pol (HH+HV/28MHz)



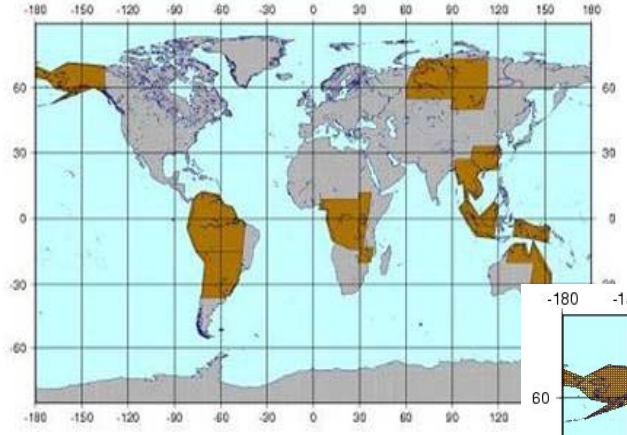
Basic Observation Scenario (Global)

Wetlands & Rapid deforestation monitoring

Temporal repeat: 9 cov/year

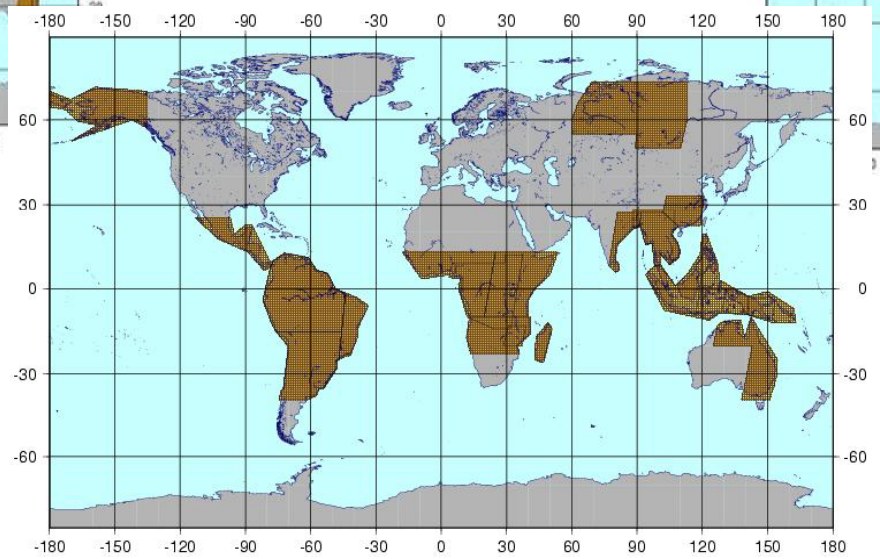
GSD: 100 m (off-nadir 26.2˚ -41.8˚)

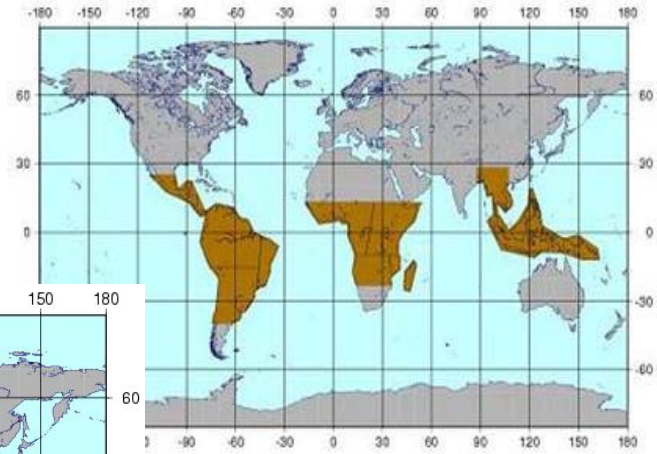
Mode: ScanSAR 350km Dual-pol (HH+HV/14MHz)



Wetlands

observed at the same time





Rapid deforestation monitoring

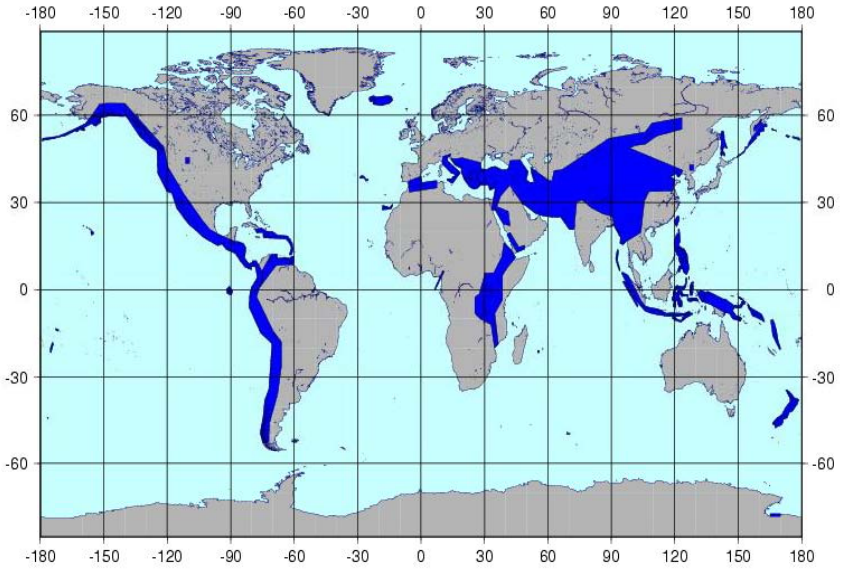
Basic Observation Scenario (Global)

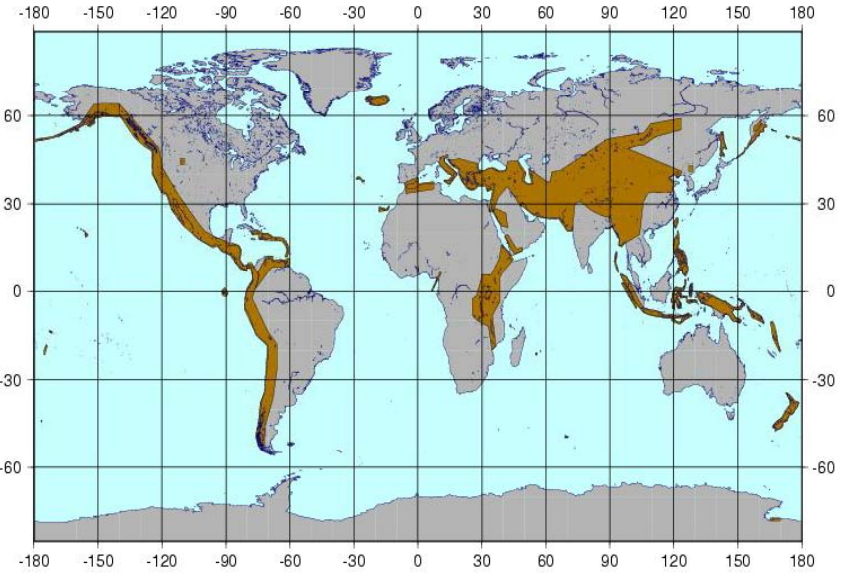
Crustal Deformation

Temporal repeat: 2-6 cov/year & 9 cov/year

GSD: 10 m (off-nadir 28.2° – 36.2°)
& 100 m (off-nadir 26.2° – 41.8°)

Mode: Stripmap Dual-pol (HH+HV/28MHz)
& ScanSAR 350km (HH+HV/14MHz)





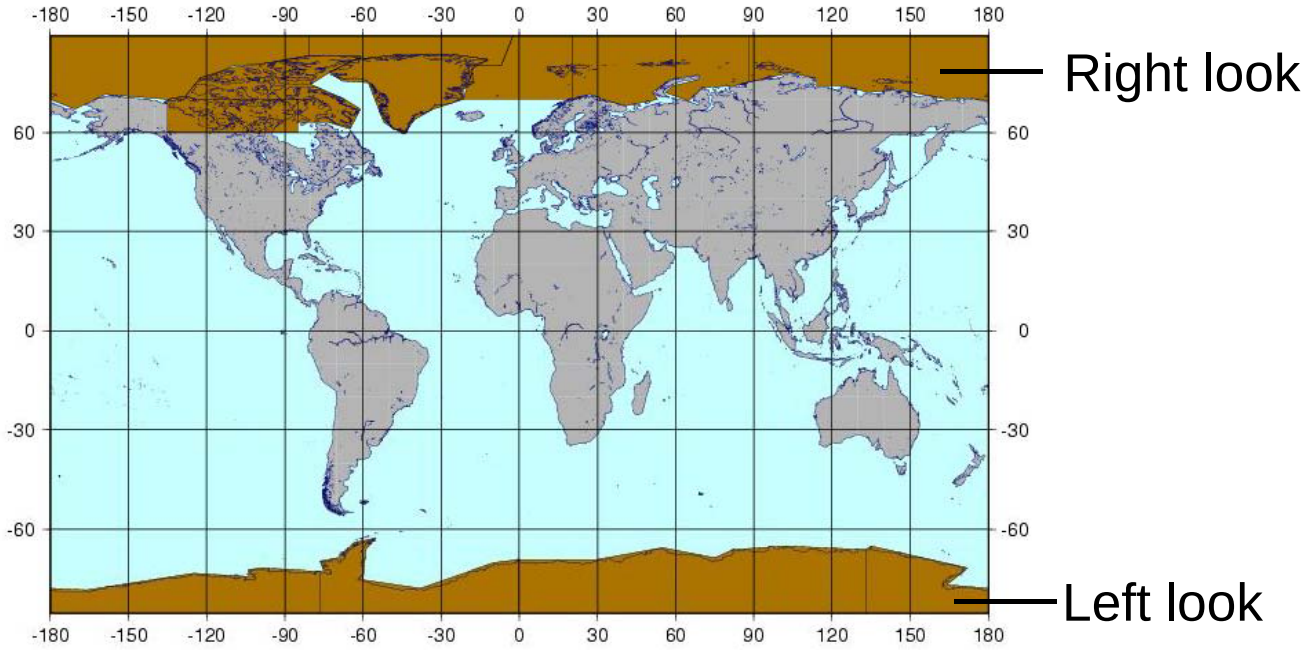
Basic Observation Scenario (Global)

Polar Ice

Temporal repeat: 3 cov/year

GSD: 100 m (off-nadir 26.2° – 41.8°)

Mode: ScanSAR 350km (HH+HV/14MHz)



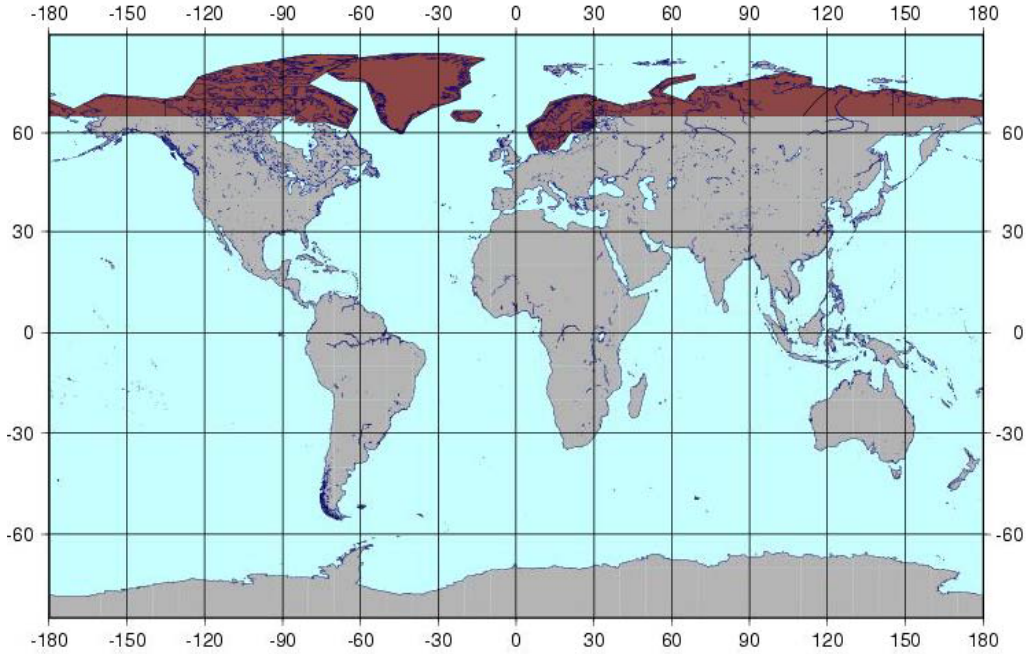
Super Sites (Boreal and sub-Arctic)

Boreal and sub-Arctic

Temporal repeat: 3 cov/year

GSD: 100 m (offnadir 34.9° -51.5°)

Mode: ScanSAR 490km (HH+HV/14MHz)



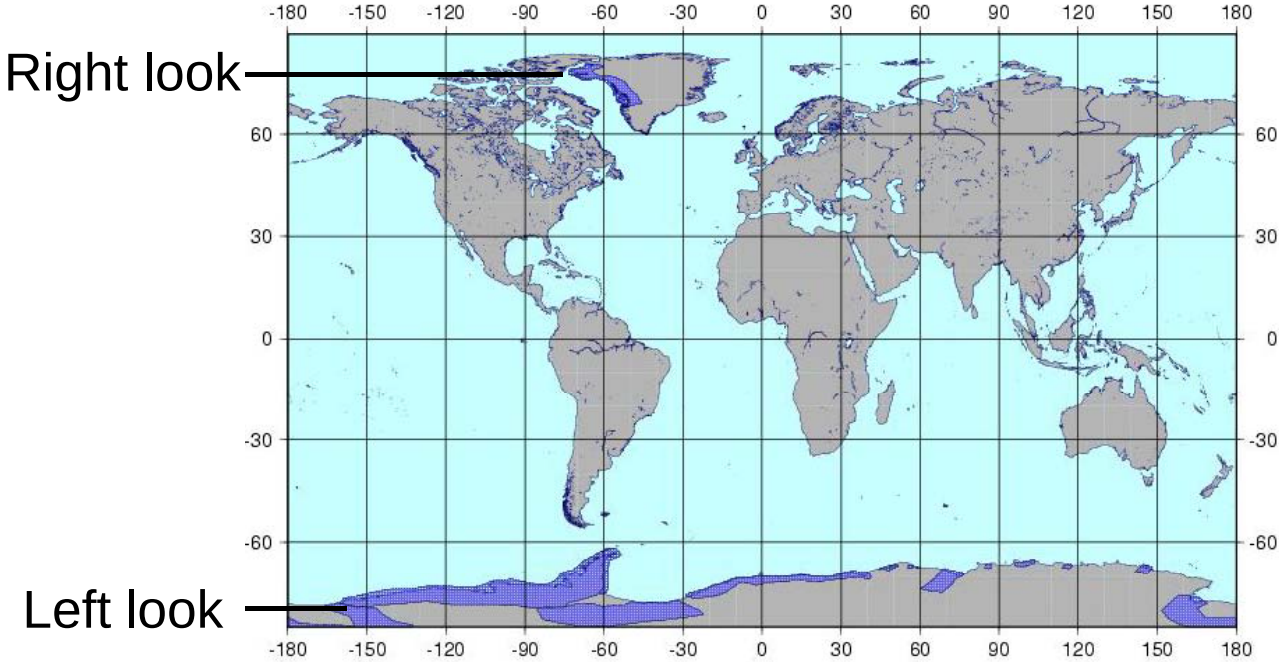
Super Sites (Glacier movement)

Polar Ice

Temporal repeat: 3 cov/year

GSD: 10 m (off-nadir 32.5°)

Mode: Stripmap Dual-pol (HH/28MHz)



Basic Observation Scenario (Global)

- Descending acquisitions (noon, ~12:00)
  - To observe globally with Stripmap (3m) mode once per three years
  - To observe Wetland and Forest with ScanSAR 350km mode
  - To observe Deformation and Forest with two successive cycles for InSAR applications

  (Super Sites)
  - *To observe Boreal and sub-Arctic with ScanSAR 490km mode*
  - *To observe Antarctica Glaciers with Stripmap (10m) mode*

- Ascending acquisitions (midnight, ~24:00)
  - To observe globally with Stripmap (10m) mode twice per year
  - To observe polar regions with ScanSAR mode more than twice per year to cover summer/winter seasons. Antarctica will be observed in Left-looking mode to cover higher latitudes.
  - To observe globally with Stripmap (6m Quad pol) mode once per five years
  - To observe special focus areas with Stripmap (6m Quad pol) mode every year

  (Super Sites)
  - *To observe Greenland Glaciers with Stripmap (10m) mode*

Basic Observation Scenario (Global)

Observation pattern for annual acquisitions *

Season	N:Winter/S:Summer				N:Spring/S:Autum						N:Summer/S:Winter							N:Autum/S:Spring								
Week of year	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50	51-52
Desc	D+W+F		Arctic	D+W+F	14-day InSAR		D+W+F	14-day InSAR		D+W+F	14-day InSAR		D+W+F	Arctic	D+W+F	Glacier Antarctica		D+W+F	Glac. Antarc	Arctic	D+W+F	Global (1/3)		D+W+F	Global (1/3)	
	WB 350km		WB490	WB 350km	DP(5) 10m	DP(5) 10m	WB 350km	DP(6) 10m	DP(6) 10m	WB 350km	DP(7) 10m	DP(7) 10m	WB 350km	WB490	WB 350km	DP(6)L	DP(6)L	WB 350km	DP(6)L	WB490	WB 350km	SP(6) 3m	SP(7) 3m	WB 350km	SP(8) 3m	SP(9) 3m
Asc	North Pole	World 1			Glacier Greenland		Global (1/5)						World 2			South Pole	N + S Pole	World 1					World 2			N + S Pole
	WB350	DP(7) 10m	DP(6) 10m	DP(5) 10m	DP(6)	DP(6)	QP(6) 6m	QP(5) 6m	QP(4) 6m	QP(3) 6m	QP(7) 6m		DP(7) 10m	DP(5) 10m	DP(6) 10m	WB350L	WB350 WB350L	DP(7) 10m	DP(5) 10m	DP(6) 10m			DP(7) 10m	DP(5) 10m	DP(6) 10m	WB350 WB350L

DP 10m — 10m(HH+HV)28MHz Right

SP 3m — 3m(HH)84MHz Right

QP 6m — 6m(HH+HV+VH+VV)42MHz Right

(*) *Beam No.

Super sites (TBD)

WB 350km — ScanSAR350km(HH+HV)14MHz Right

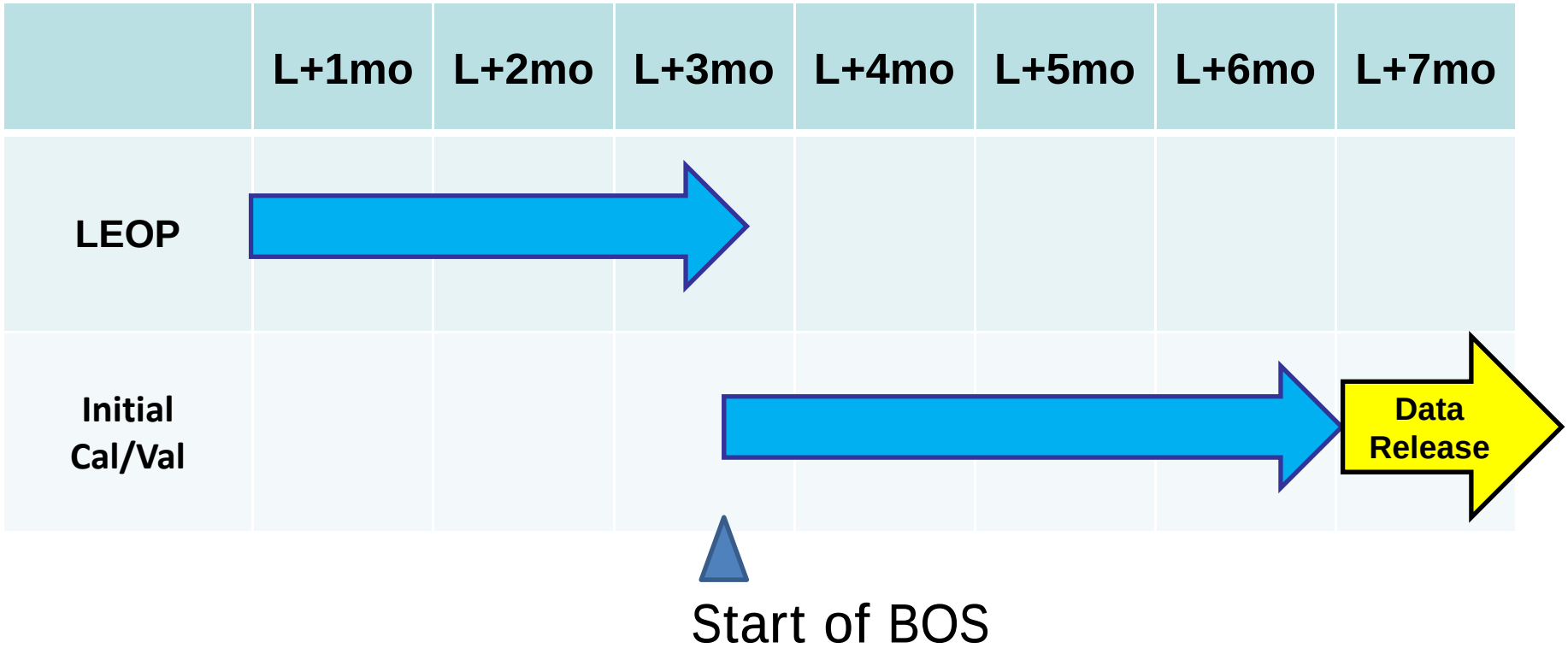
WB 350km — ScanSAR350km(HH+HV)14MHz Left

WB 490km — ScanSAR490km(HH+HV)14MHz Right

DP 10m — 10m(HH+HV)28MHz Left

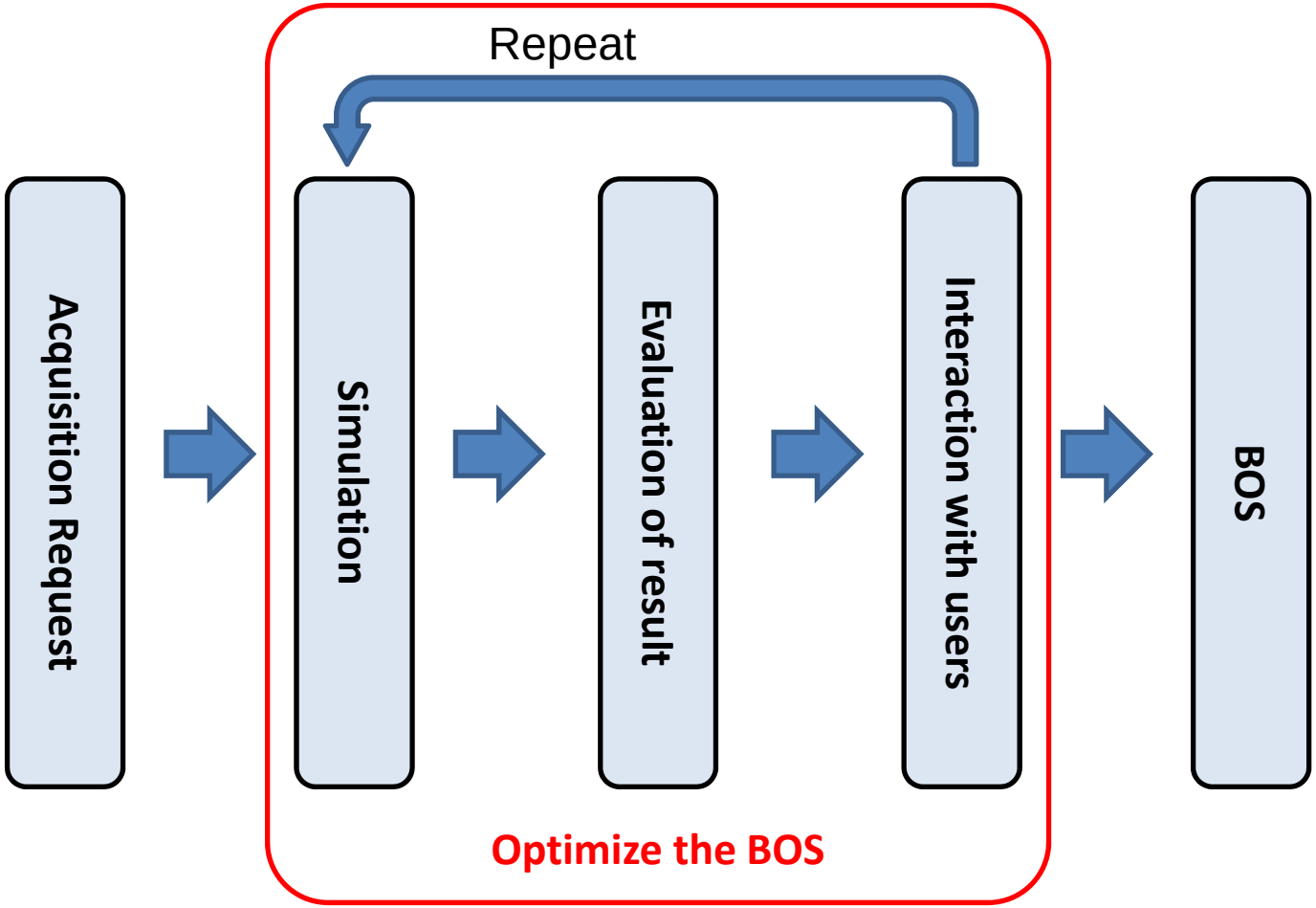
* 3m SP and 6m QP modes require 3 and 5 years for global coverage

Commissioning Schedule



Acquisition Simulation

Repetitive simulation to optimize the Basic Observation Scenario (BOS)
- Success rate of each request
- Resource analysis (acquisition, downlink)



Simulation Result Global (1/3)

Fig.1
- ☐Descending
- ☐Stripmap 10m
- ☐HH+HV 28MHz
- ☐offnadir 28.2-36.2
  - ▪2-years

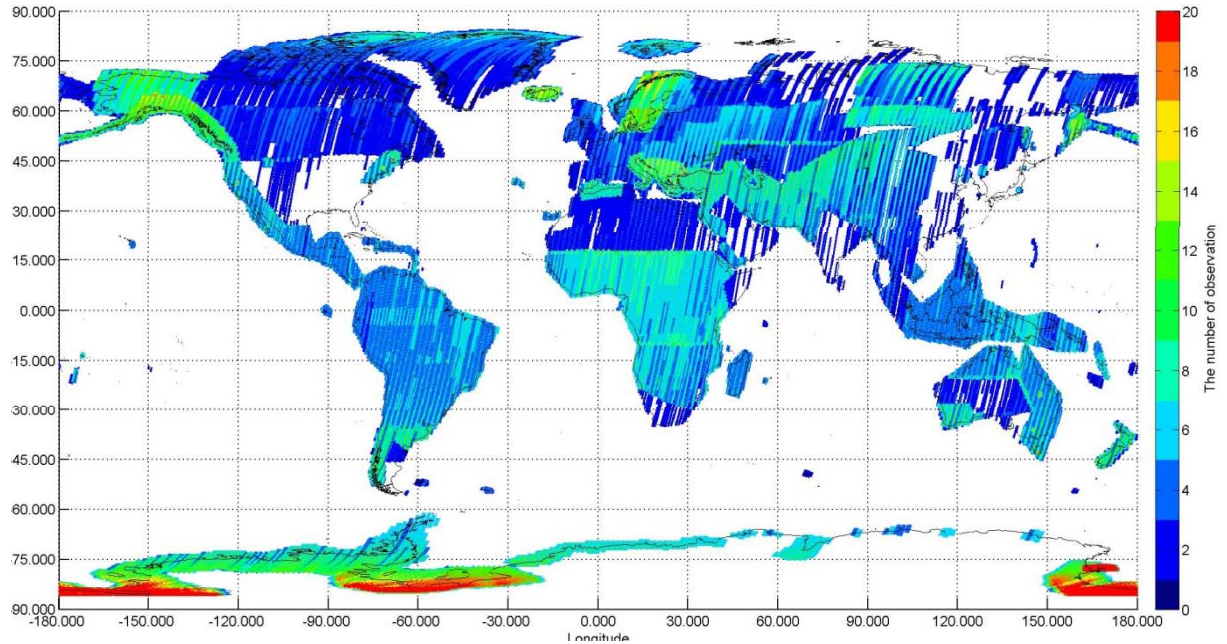
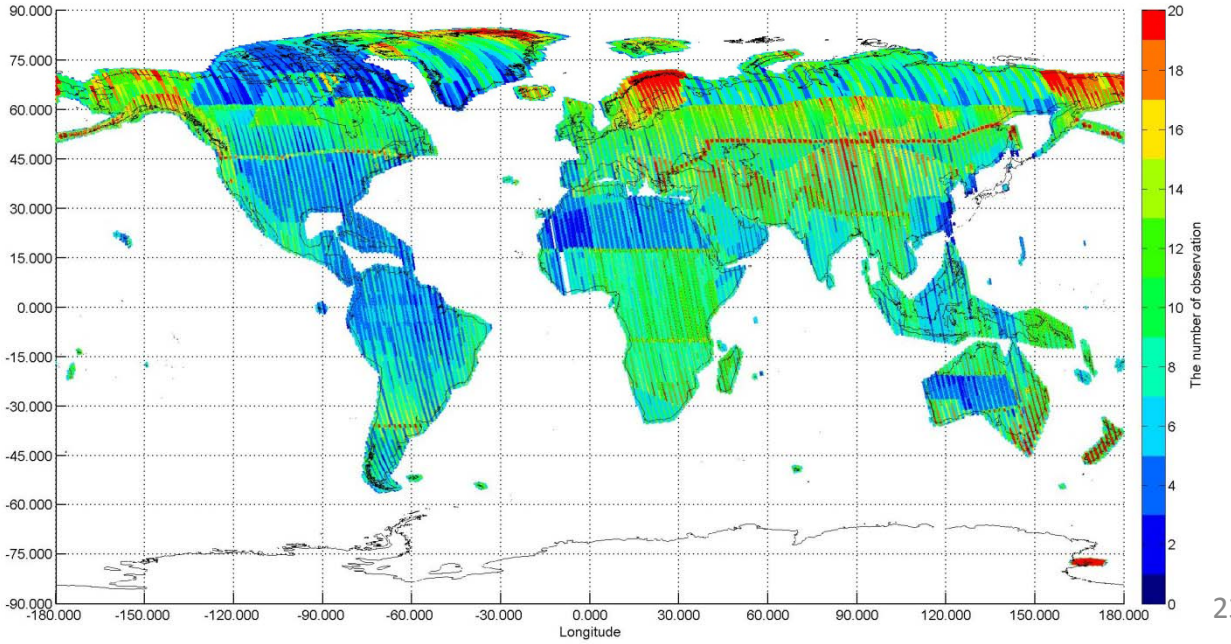


Fig.2
- ☐Ascending
- ☐Stripmap 10m
- ☐HH+HV 28MHz
- ☐offnadir 28.2-36.2
  - ▪2-years



Simulation Result Global (2/3)

Fig.3
- ☐Descending
- ☐Stripmap 3m
- ☐HH 84MHz
- ☐offnadir 29.1-38.2
  - ・2-years

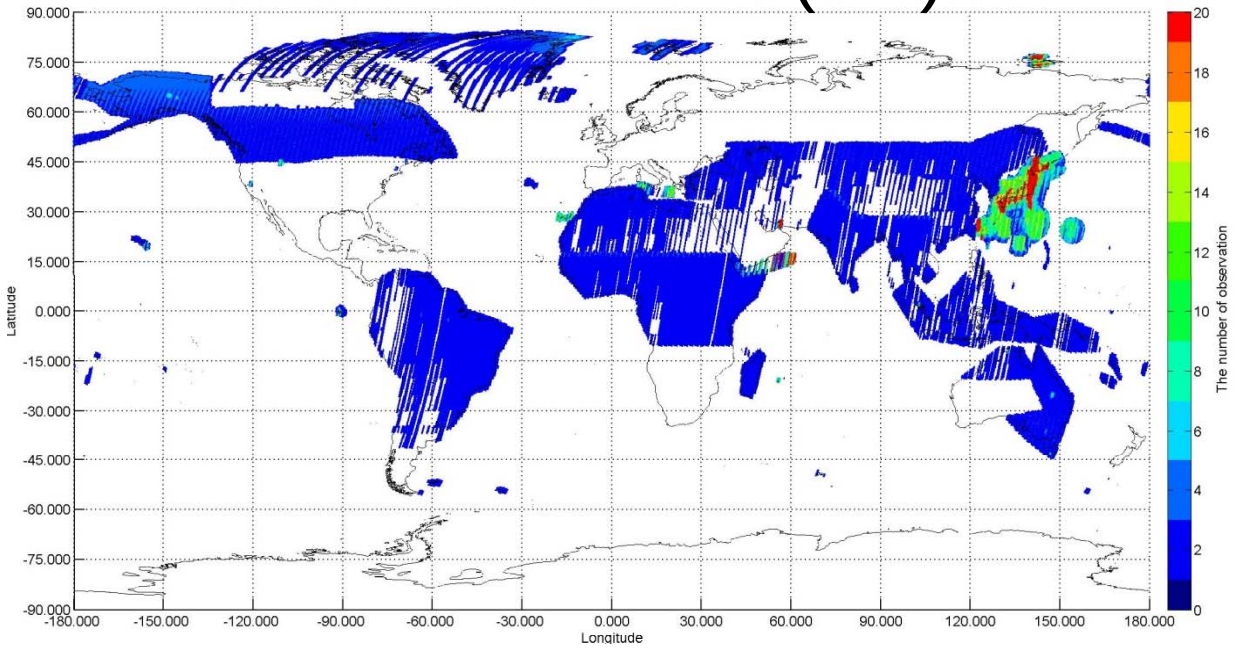
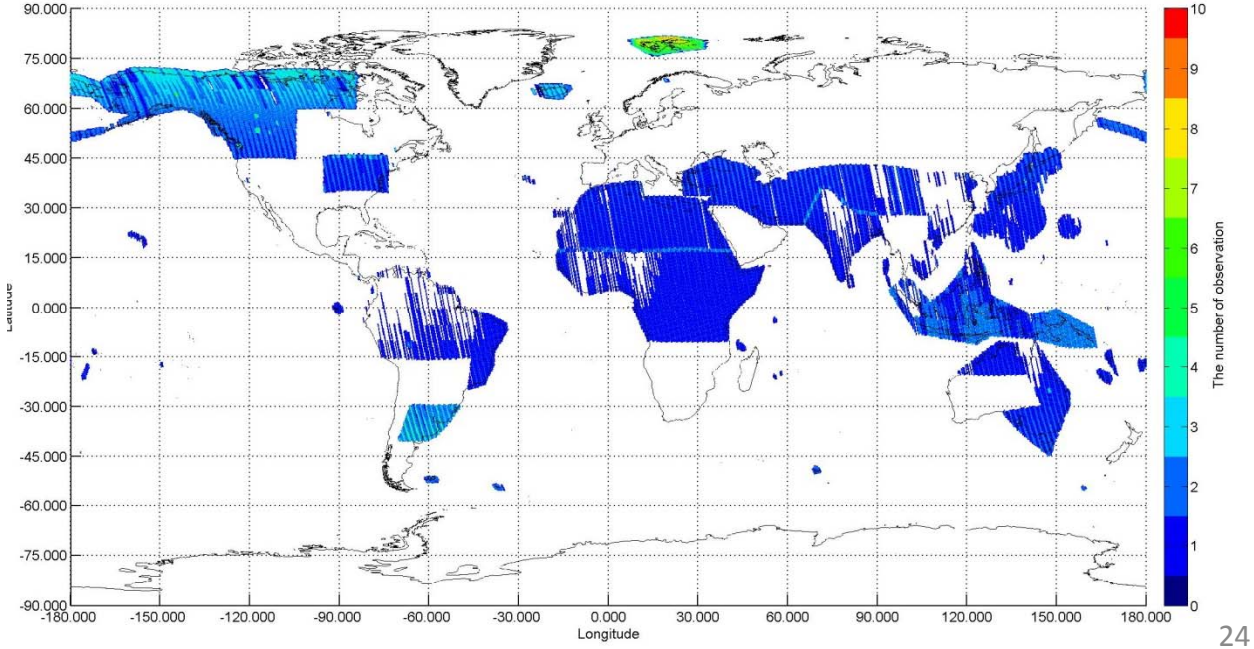


Fig.4
- ☐Ascending
- ☐FP 6m
- ☐HH+HV+VH+VV 42MHz
- ☐offnadir 25.0-34.9
  - ・2-years



Simulation Result Global (3/3)

Fig.5
- ☐Descending
- ☐ScanSAR350km
- ☐HH+HV 14MHz
- ☐offnadir 26.2-41.8
  - ・2-years

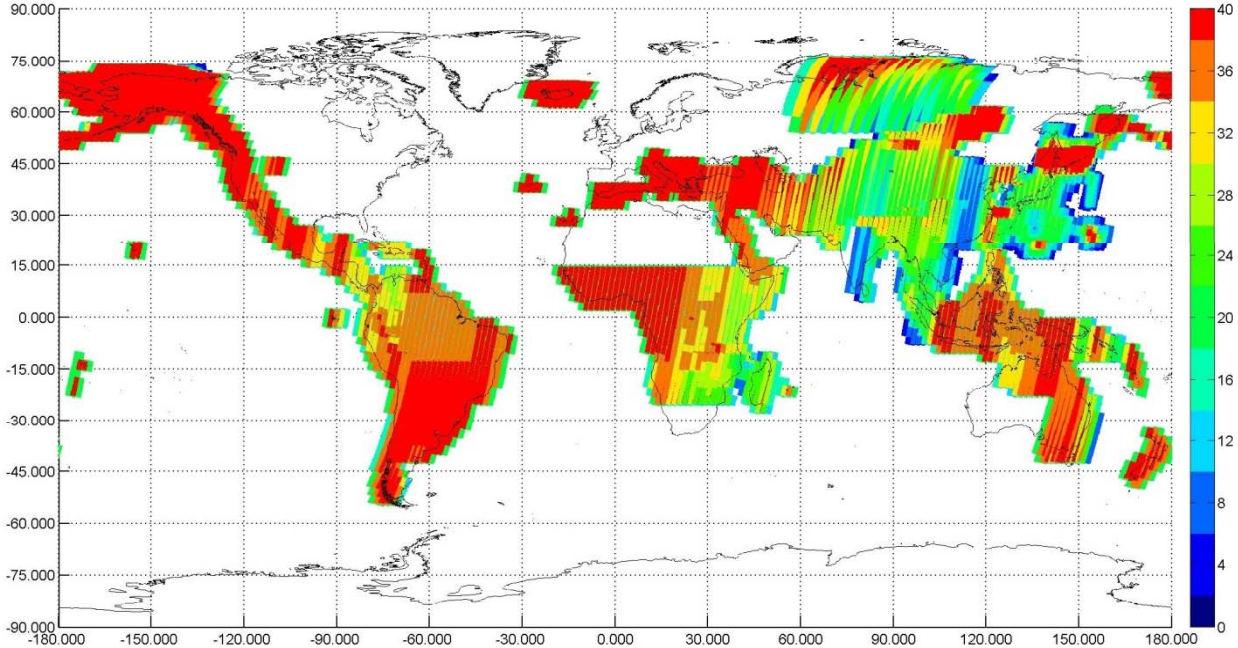
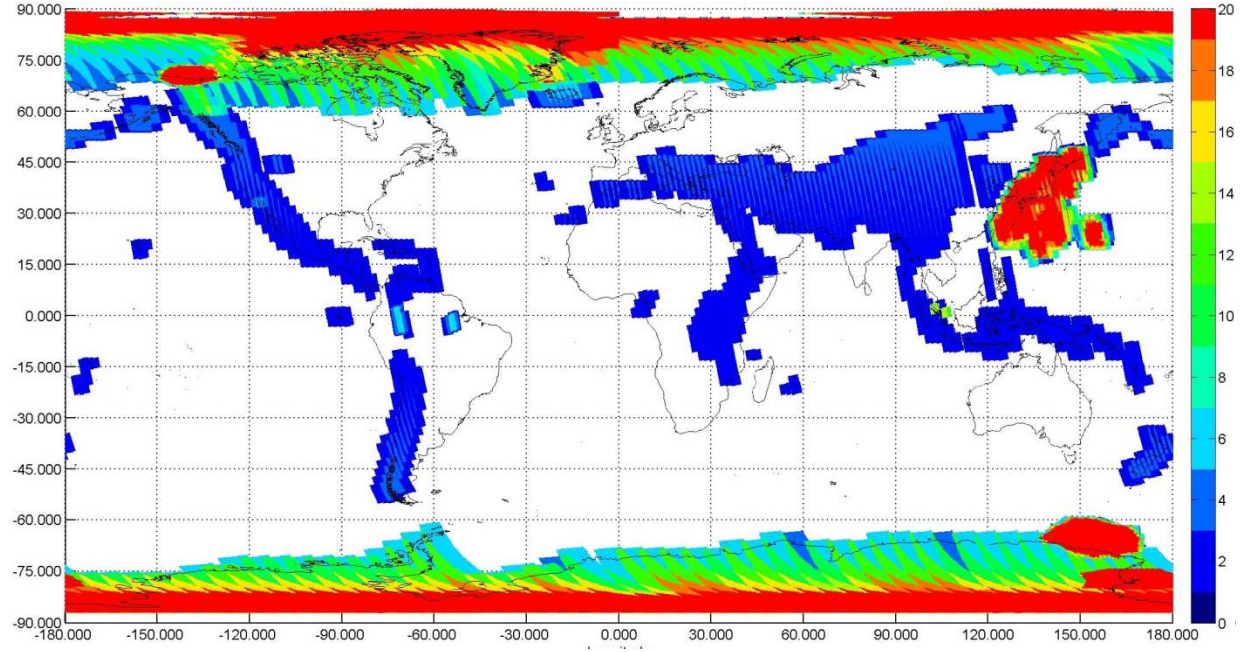


Fig.6
- ☐Ascending
- ☐ScanSAR350km
- ☐HH+HV 14MHz
- ☐offnadir 26.2-41.8
  - ・2-years



Simulation Result Japan (1/3)

Fig.7
- ☐Descending
- ☐Stripmap 3m
- ☐HH 84MHz
- ☐offnadir 29.1-38.2
  - ・2-years

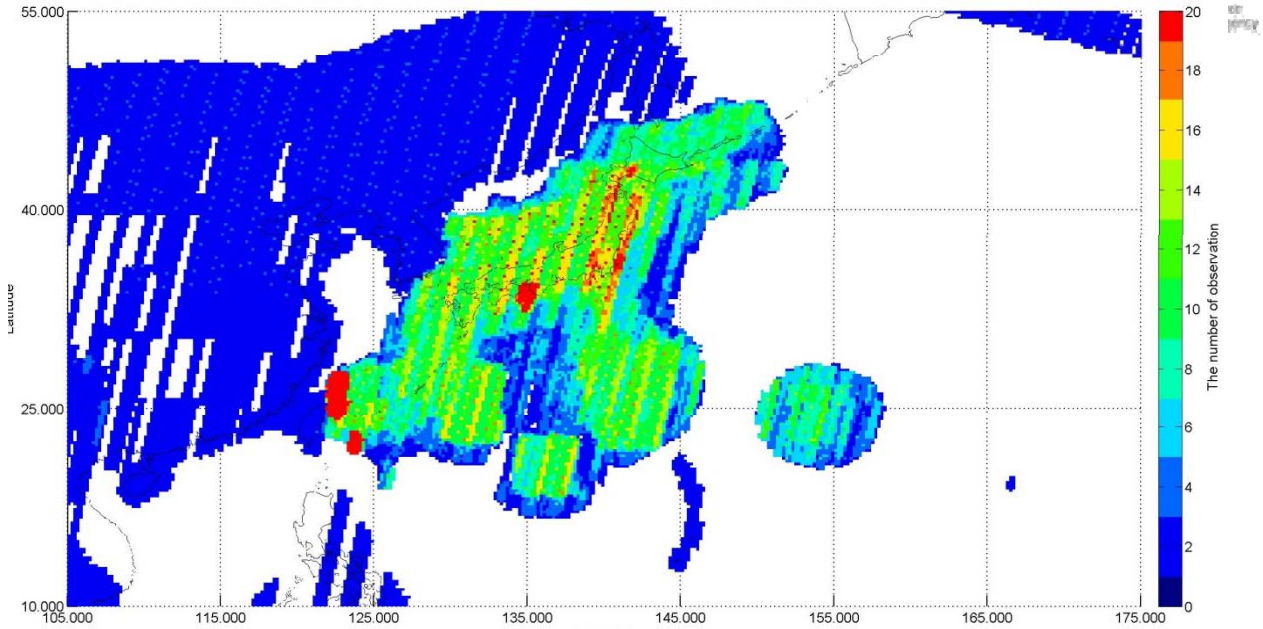
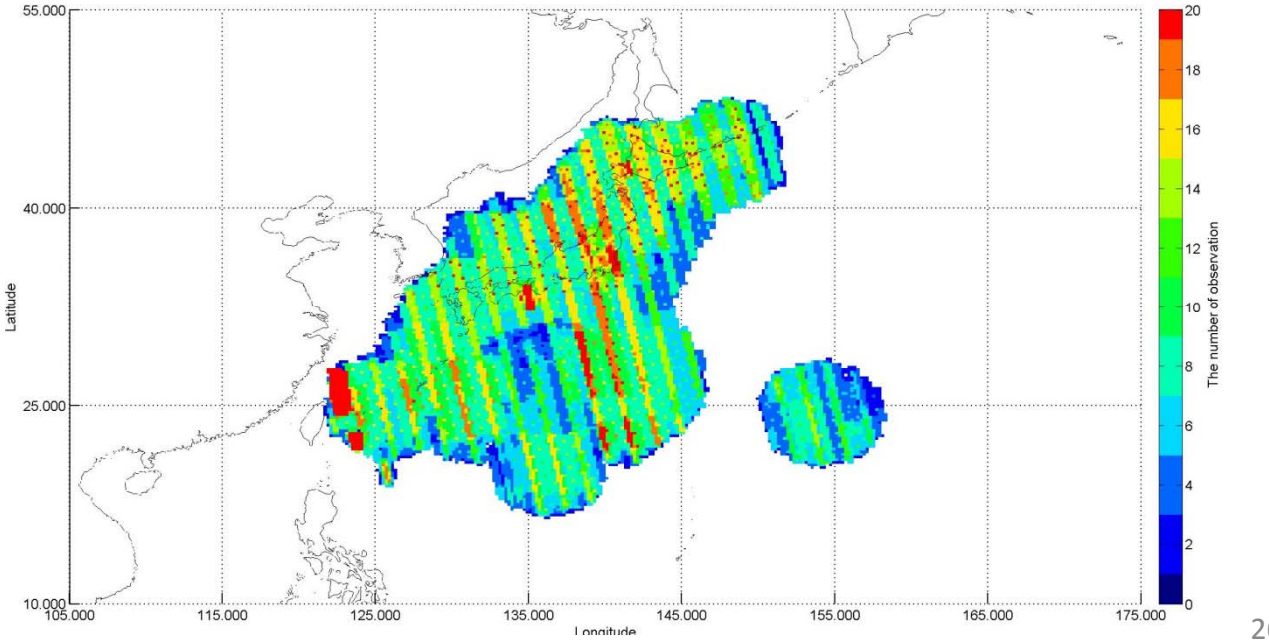


Fig.8
- ☐Ascending
- ☐Stripmap 3m
- ☐HH 84MHz
- ☐offnadir 29.1-38.2
  - ・2-years



Simulation Result Japan (2/3)

Fig.9
- ☐Descending
- ☐ScanSAR350km
- ☐HH+HV 28MHz
- ☐offnadir 26.2-41.8
  - ・2-years

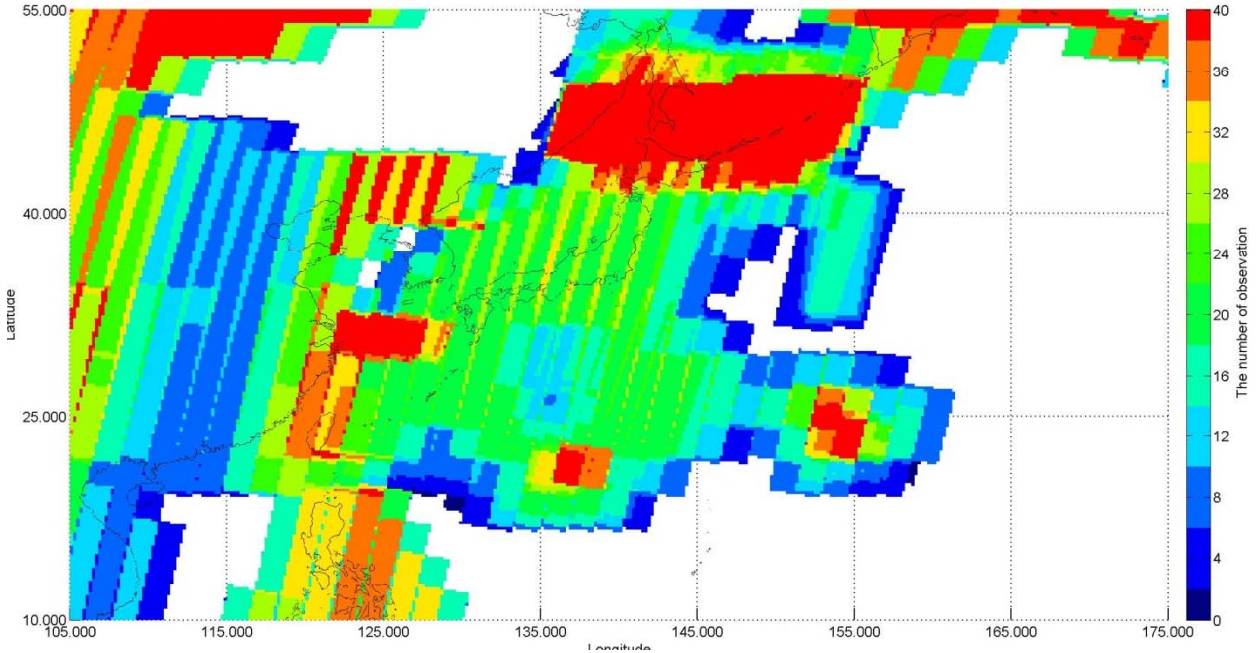
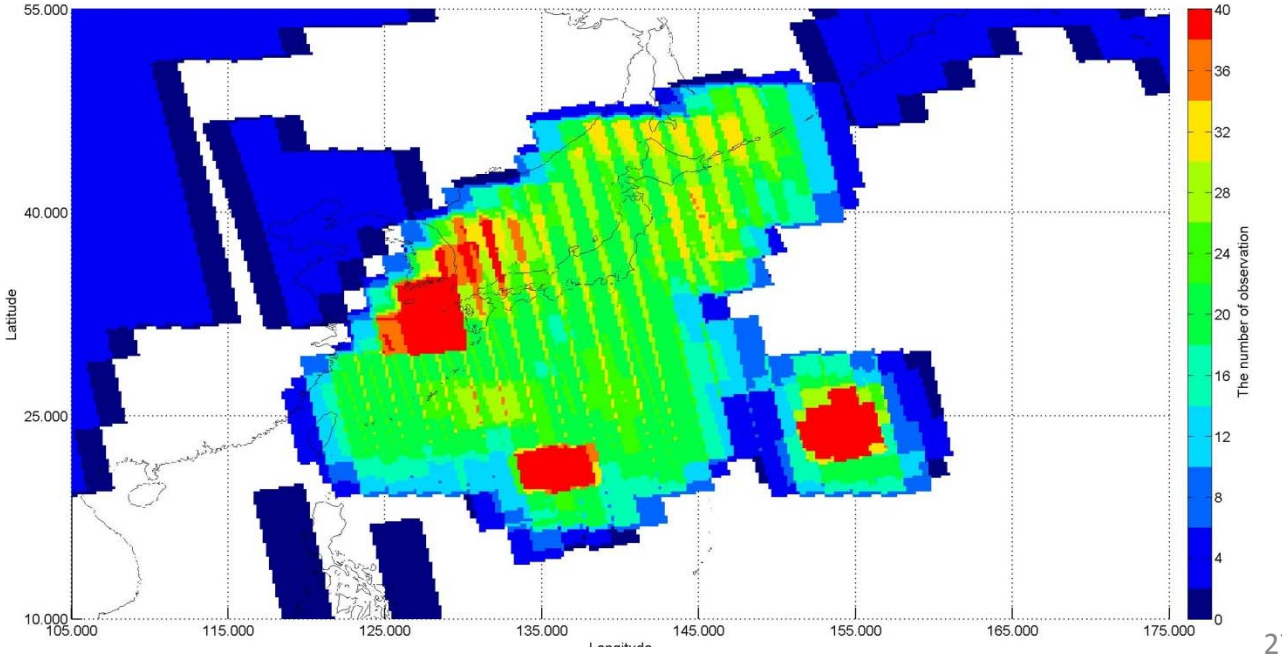
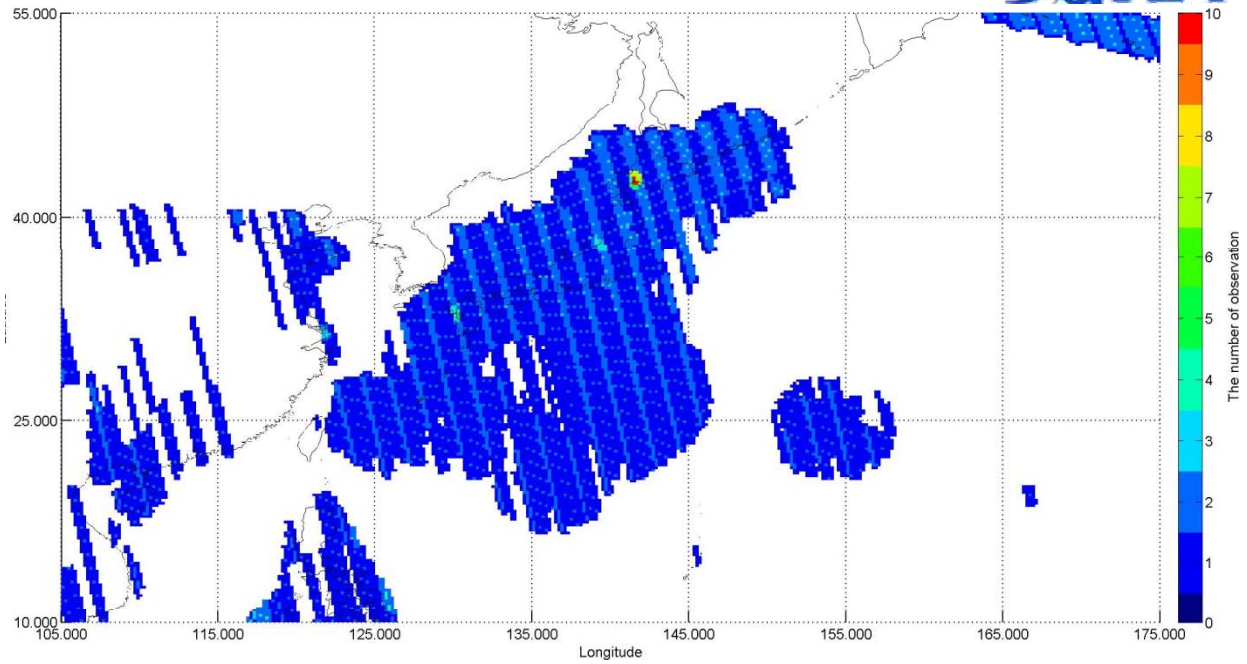


Fig.10
- ☐Ascending
- ☐ScanSAR350km
- ☐HH+HV 28MHz
- ☐offnadir 26.2-41.8
  - ・2-years



Simulation Result Japan (3/3)

Fig.11
- ☐Ascending
- ☐FP 6m
- ☐HH+HV+VH+VV 42MHz
- ☐offnadir 25.0-34.9
  - ・1-year (second year)



Conclusion

- Basic Observation Scenario (BOS) is crucial to achieve consistent data acquisitions in time and space
- BOS has been studied by repetitive simulation and discussion with user groups