



Current Status of Hyperspectral Imager Suite (HISUI)



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What is HISUI? A Successor of Terra ASTER and ALOS AVNIR-2



- **HISUI** is a spaceborne instrument suite which consists of hyperspectral and multispectral imagers.
- **HISUI** is being developed by Japanese Ministry of Economy, Trade, and Industry (METI) as its third spaceborne optical imager mission.
 - 1) OPS onboard JERS-1 satellite (1992 – 1998)
 - 2) ASTER onboard NASA's Terra satellite (1999 -)
- **HISUI** will be launched by H-IIA rocket in 2015 or later as one of mission instruments onboard JAXA's ALOS-3 satellite
 - 1) ALOS (2006 -) : Optical imagers (PRISM and AVNIR-2) and L-band SAR
 - 2) ALOS-2 (2013 -) : L-band SAR



Targets / Objectives of HISUI Mission

- 1) Global energy and resource related applications
 - Oil, gas, metal, ...
 - Observations for environmental assessments which are indispensable to resource developments
- 2) Other applications such as environmental monitoring, agriculture, and forestry
- 3) Promotion of domestic space and space utilization industry through wider applications of HISUI data



"What's new" since 2010 HypsIRI Workshop

- Great East Japan Earthquake
- Instrument PDR was completed.
- Progress of operation and mission planning study
- See HISUI posters behind you
 - 1) Ogawa et al. "planning for Japanese future hyperspectral and multispectral sensor: HISUI"
 - 2) Kamei et al. "Long term cal/val plan for Hyperspectral Imager Suite (HISUI)"



Great East Japan Earthquake

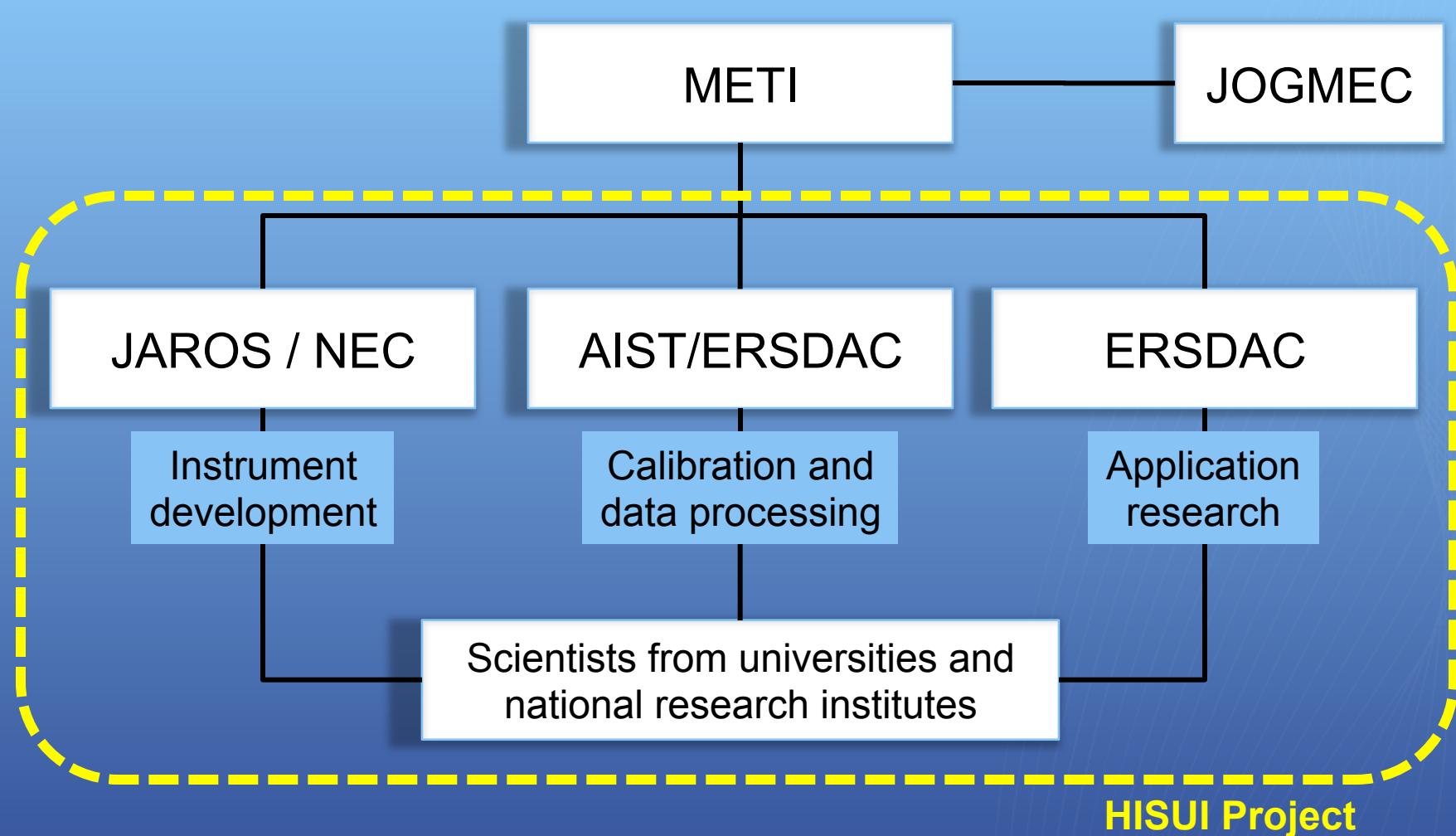
- On March 11, 2011, Great East Japan Earthquake occurred.
 - See Tonooka's poster behind you!
- The restoration from the earthquake and succeeding nuclear powerplant troubles requires tremendous amount of money.
- Japanese government is now reprioritizing the national investments on science and technology. As for space missions, the draft reprioritizing plan was issued on August 8th and being discussed.

The priorities of earth observation satellites (draft):

- High priority missions = ASNARO 1/2, ALOS-2, GCOM-W,
GPM DPR, EarthCARE CPR,,,,
- Medium priority mission = ALOS-3
- Low priority mission = GCOM-C
- HISUI's priority is currently (a little bit) higher than ALOS-3 itself.

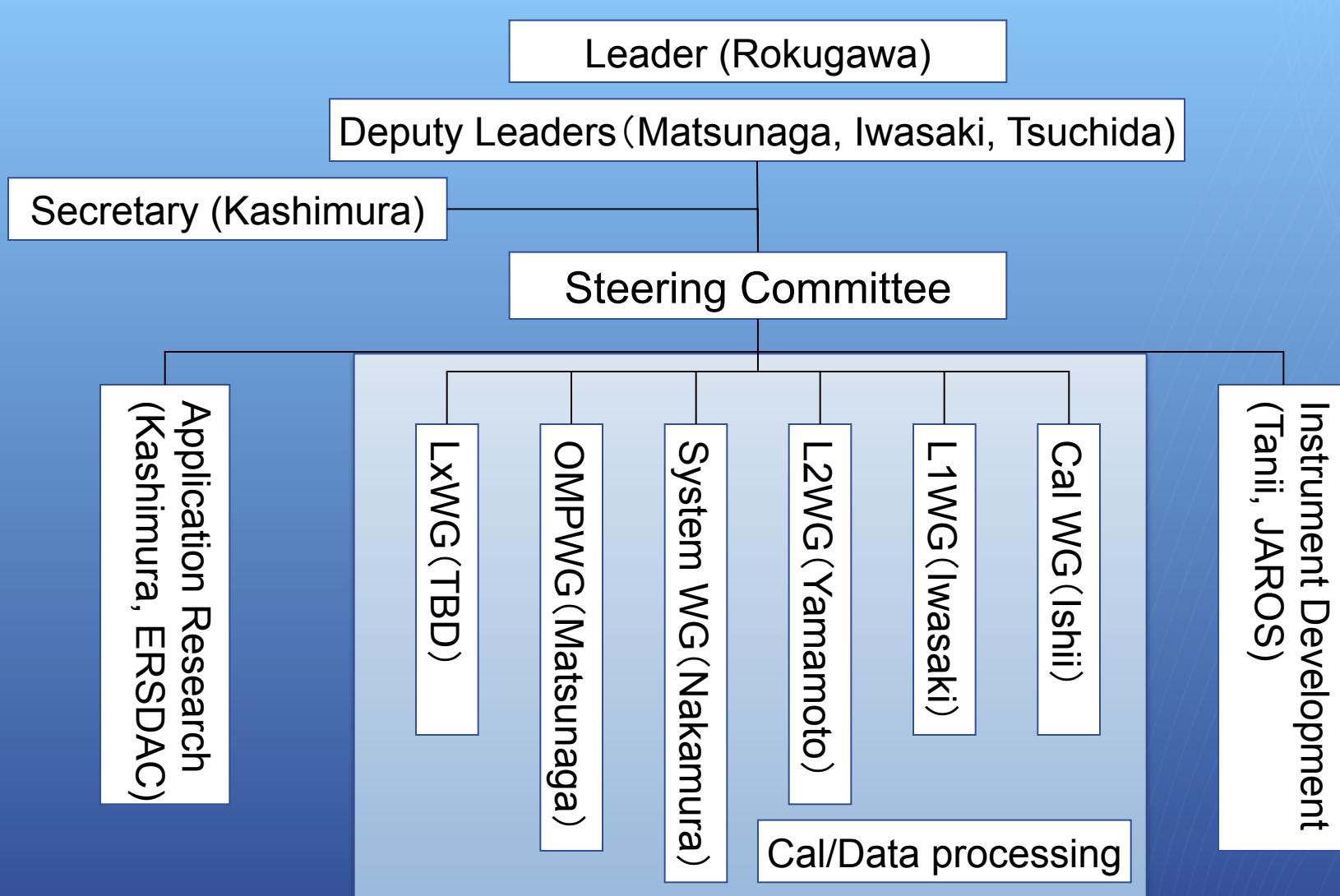


HISUI Project Structure



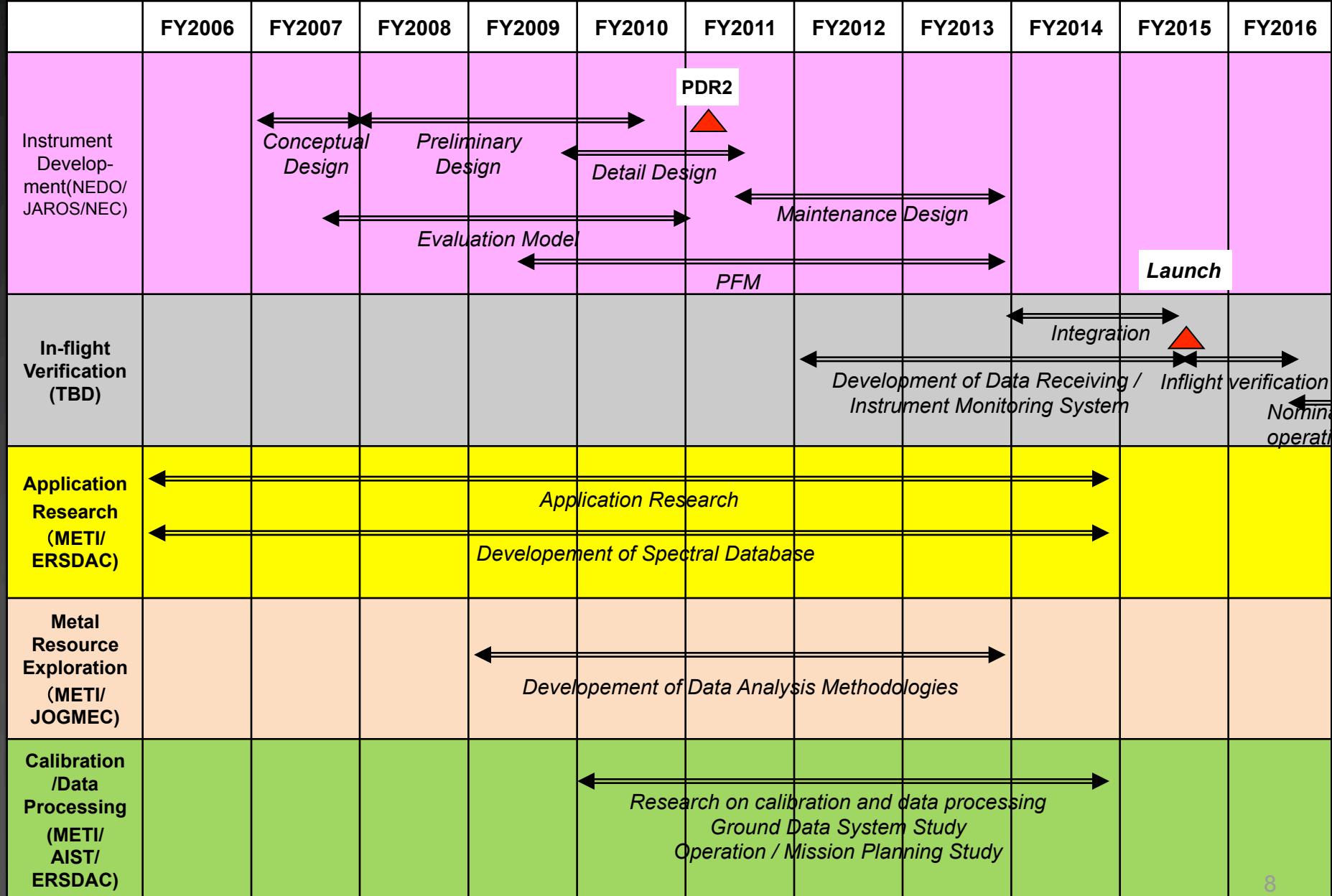


HISUI Project Team and Working Groups





Timeline of HISUI Project



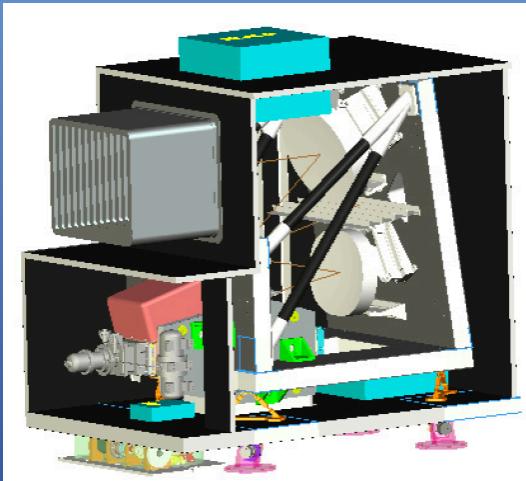


JAXA's ALOS-3 and HISUI

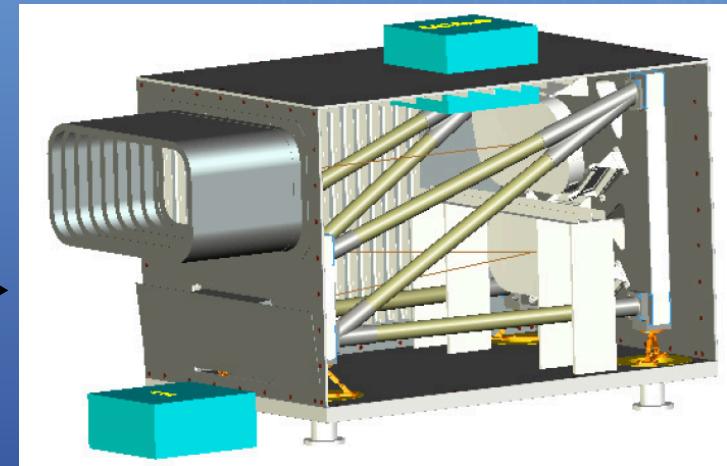


JAXA's ALOS-3

HISUI



Hyperspectral Imager



Multispectral Imager



HISUI Requirements: Hyperspectral Imager

Parameter	Requirement
Spatial Resolution and Swath Width	30 m and 30 km
Spectral	Bands
	185 (VNIR:57 SWIR:128)
	Range 0.4 - 2.5 μm VNIR:0.4-0.97 μm SWIR:0.9-2.5 μm
Signal to Noise Ratio (30% albedo)	Resolution 10 nm (VNIR), 12.5 nm (SWIR)
	≥ 450 @620 nm ≥ 300 @2100 nm
MTF	≥ 0.2
Dynamic Range	≥ 10 bits (current design=12bit)
Data Compression	Lossless (70%)
Pointing Capability	≈ ±3 ° (±30 km)



HISUI Requirements: Multispectral Imager

Parameter	Requirement
Spatial Resolution and Swath Width	5 m and 90 km
Number of Bands and Spectral Coverage	4 and 0.45 – 0.90 µm
Signal to Noise Ratio (30% albedo) and MTF	≥ 200 and ≥ 0.3
Dynamic Range	≥ 8 bits (current design = 12bits)
Data Compression	Lossless (70%)



Specification of JAXA's ALOS-3 and Panchromatic Stereo Camera

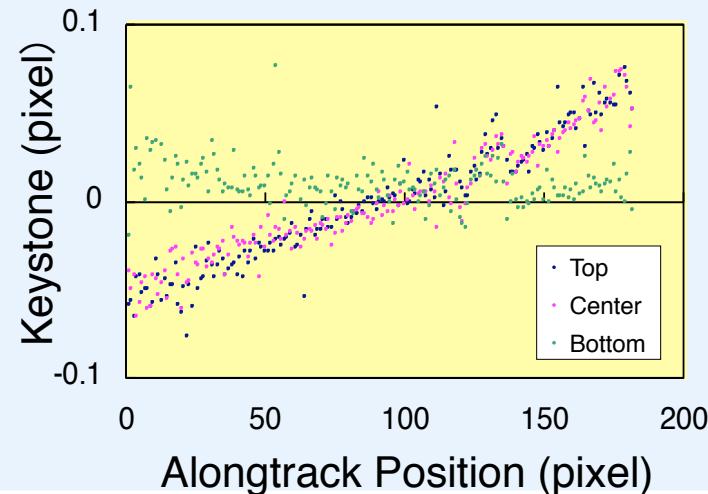
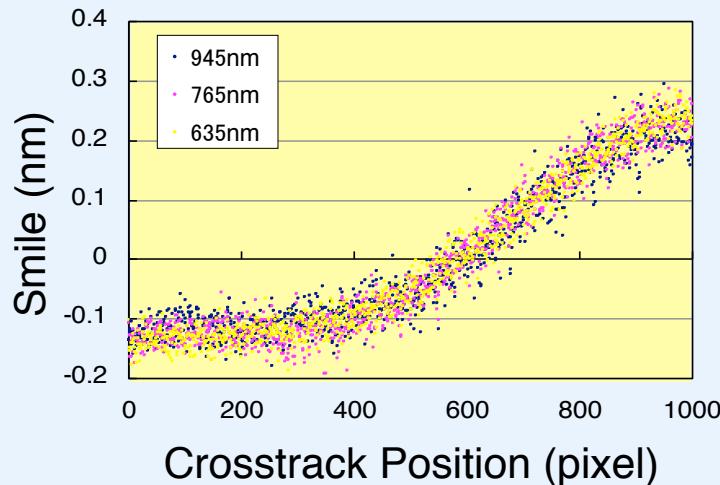
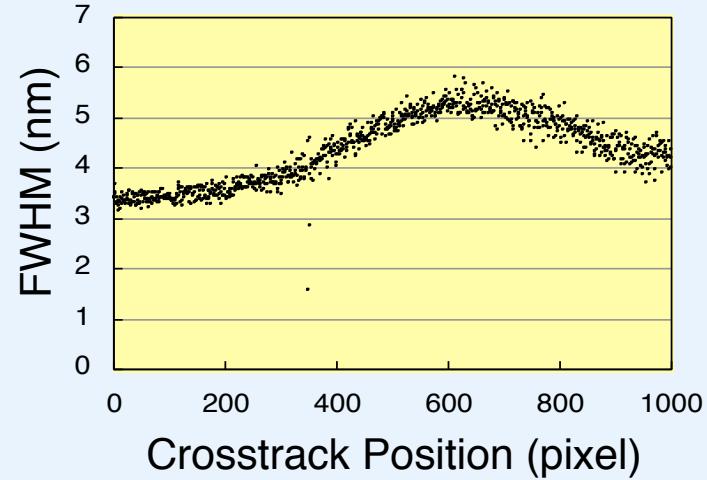
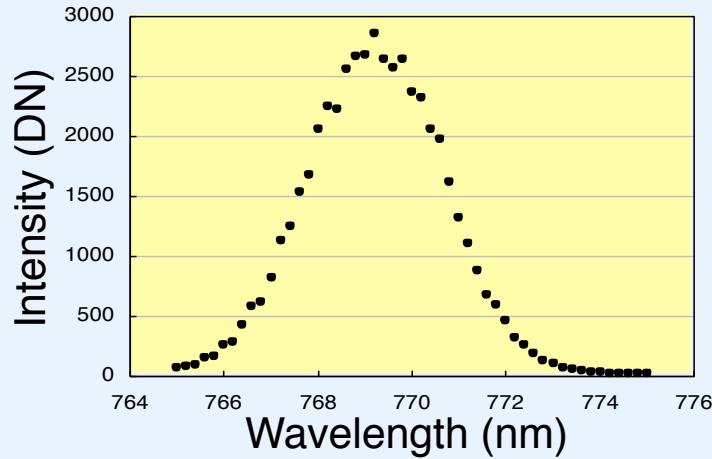
Orbit Type and Altitude	Sun Synchronous, ≈ 618 km
Local Time At Descending Node	10:30 (TBD)
Orbits per Day	15 orbits/day (TBD)
Repeat Cycle and Interval between Orbits	60 days and 45 km(TBD)
Launch Vehicle	H II-A
Downlink Capability	800 Mbps (TBD)
Onboard Storage	> 200 GB (TBD)

Parameters of JAXA's Panchromatic Stereo Camera	Requirement
Spatial Resolution and Swath Width	0.8 m(nadir) and 50 km
Data Compression	Lossy (22%)



Instrument Development

Characterization of VNIR Spectrometer Engineering Model





HISUI and ALOS-3 Data Amount and Downlink

	Data Rate (70% Comp.)	Maximum Observation Time per Orbit	Maximum Data Amount per Orbit	Maximum Data Amount per Day
HISUI - Hyper	0.4 Gbps	15 min.	46 Gbyte	690 Gbyte
HISUI - Multi	1 Gbps	15 min.	110 Gbyte	1600 Gbyte

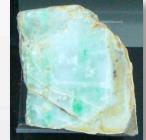
	Downlink Speed	Downlink Time per Day	Data Amount per Day
Ground Station	800 Mbps	20 min.	120 Gbyte
Relay Satellite	800 Mbps	220 min.	1320 Gbyte

- HISUI will share ALOS-3's downlink capability with JAXA's panchromatic camera.
- Allocation of ALOS-3 downlink capability to HISUI is a critical issue.



HISUI Operation / Mission Planning Study

Simulation of HISUI Hyperspectral Observation



● Hyperspectral observation baseline

- Periodical calibration data acquisition (once in a week)
- Observation of priority areas in earliest opportunity
 - ≈ 24 % of whole land surface and shallow sea
- Periodical nighttime SWIR observation of volcanoes
 - ≈ 100 high priority and ≈ 900 low priority volcanoes from ASTER STAR database.
- Global land mapping using remaining resources

● Major constraints

- Operation time = 15 minutes/orbit
- Downlink = Six cases (50, 100, 150, 200, 250, and 300 GByte/day)
- Cross track pointing frequency => In this study, only for to fill gaps between orbits.

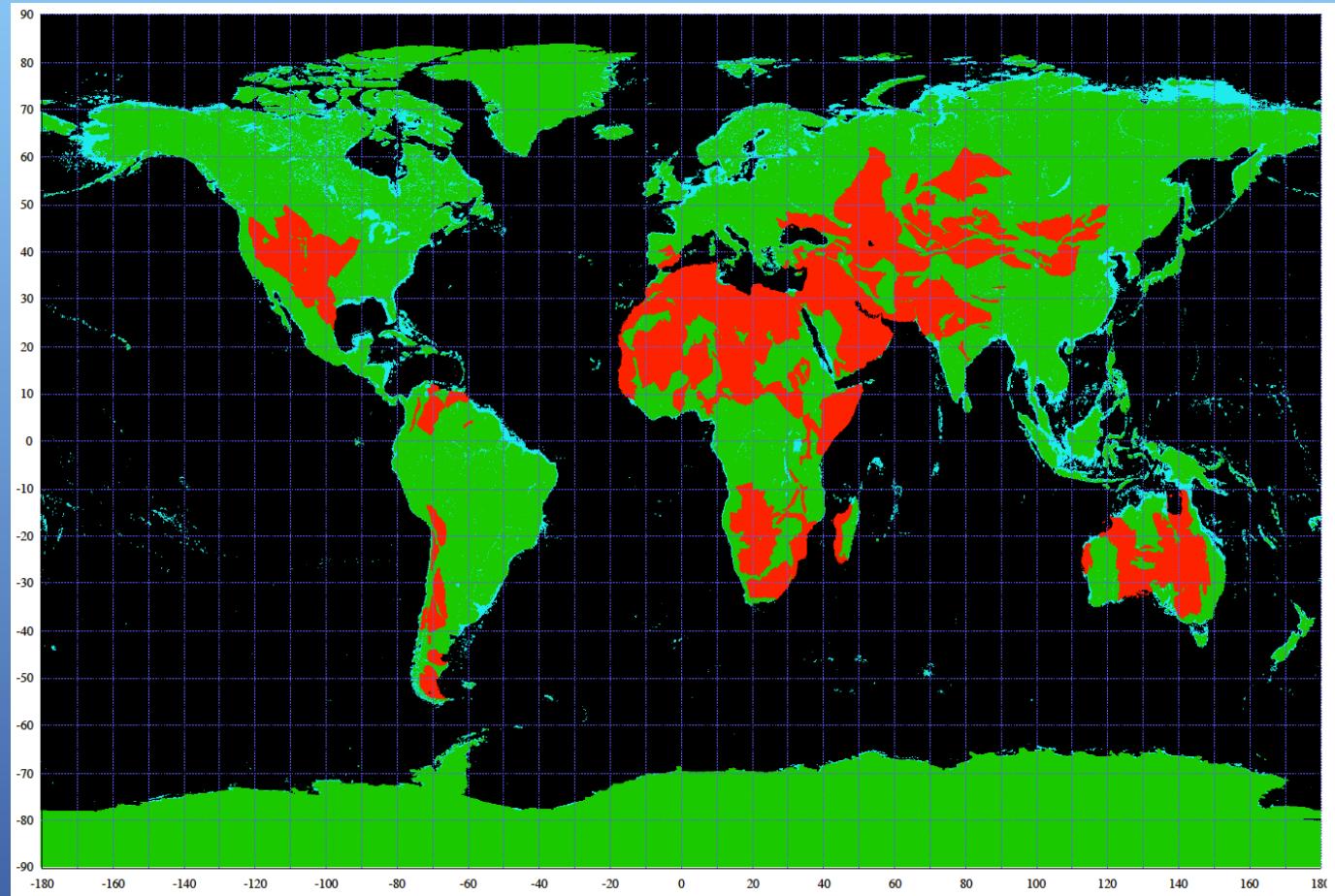
● Other constraints and conditions

- Five observation segments in one orbit
- Avoid sunglint for shallow sea observation
- Simulation period = one year starting from Autumnal Equinox
- Mid- and high latitude zones are observed only in summer.



HISUI Operation / Mission Planning Study

Tentative Global Priority Map

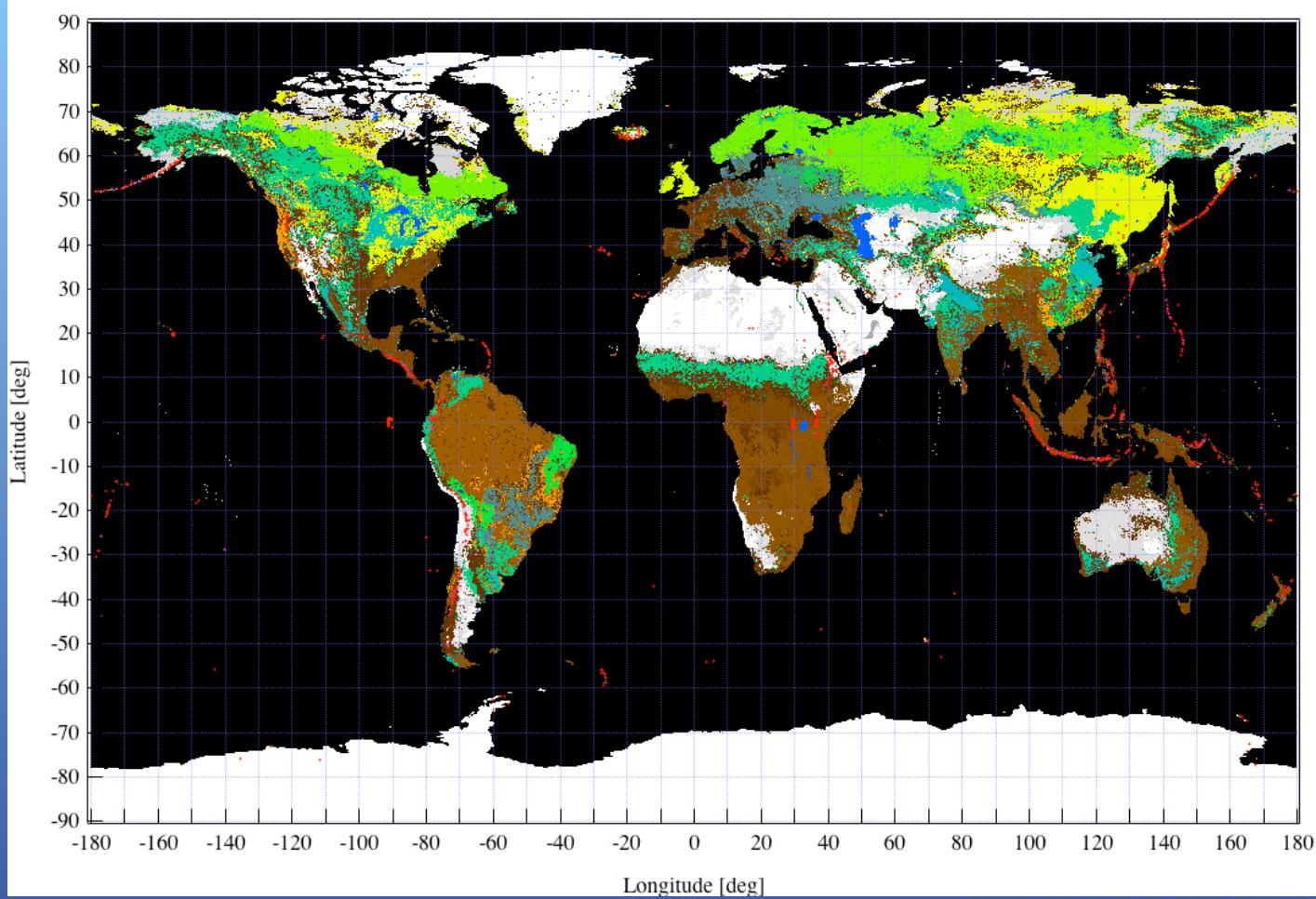


Red : Priority areas, Green : Other land areas, Light blue : Shallow sea



HISUI Operation / Mission Planning Study

Global Land Cover Type and Volcanoes



Red points : Volcanoes from ASTER STAR database

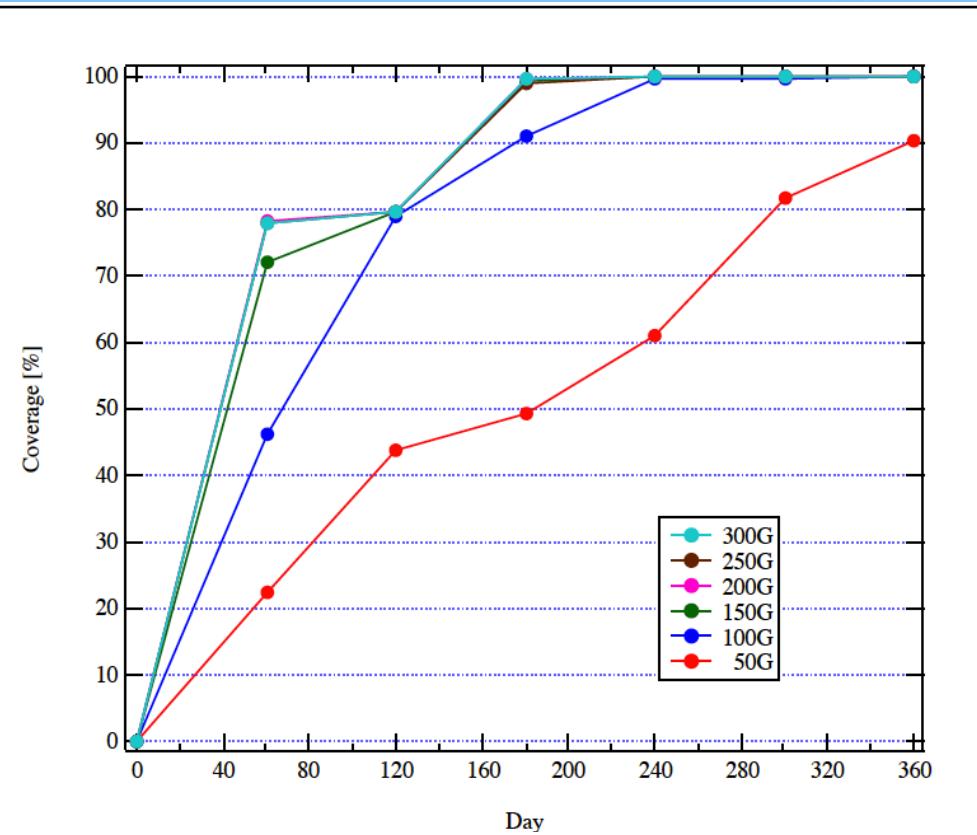


HISUI Operation / Mission Planning Study

Achievement of Priority Areas Mapping



Days	Achievement of priority areas mapping		
	50G	100G	200G
60	22.56	46.19	78.22
120	43.75	78.93	79.62
180	49.23	91.01	99.74
240	61.06	99.50	100.00
300	81.87	99.72	100.00
360		99.90	100.00



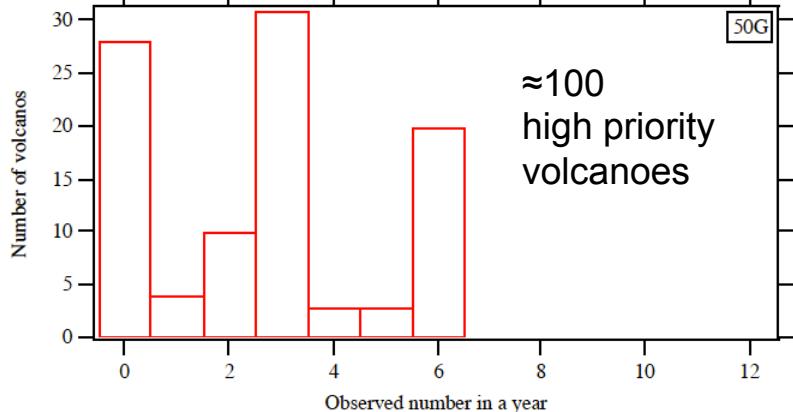
One-time observation of priority areas can be achieved within 6-8 months in case of 100 GB/day or more downlink.



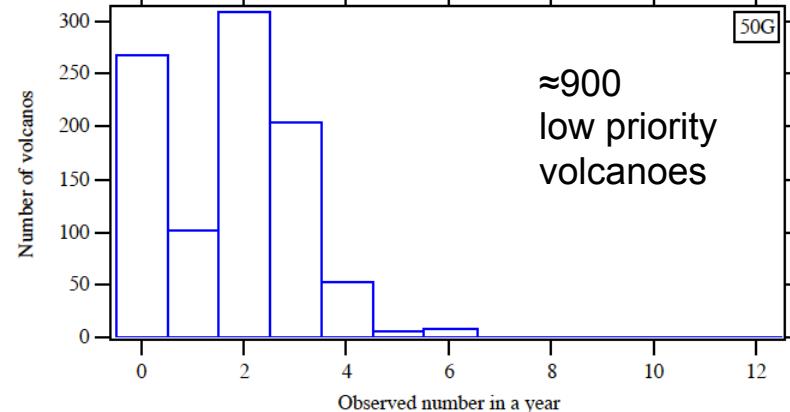
HISUI Operation / Mission Planning Study

Nighttime SWIR Volcano Monitoring

50 GB/Day

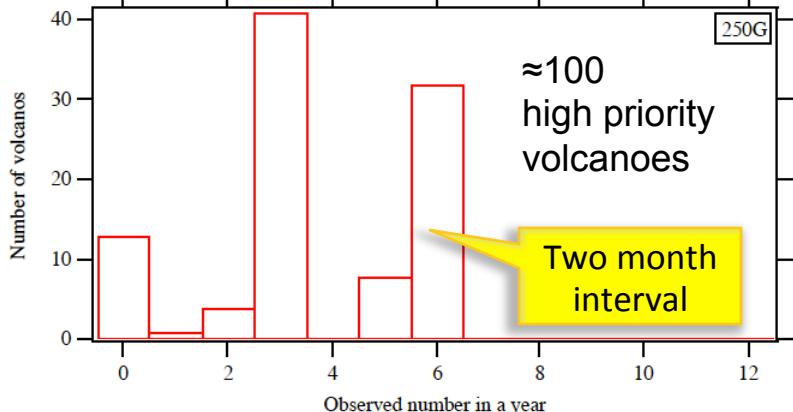


≈100
high priority
volcanoes



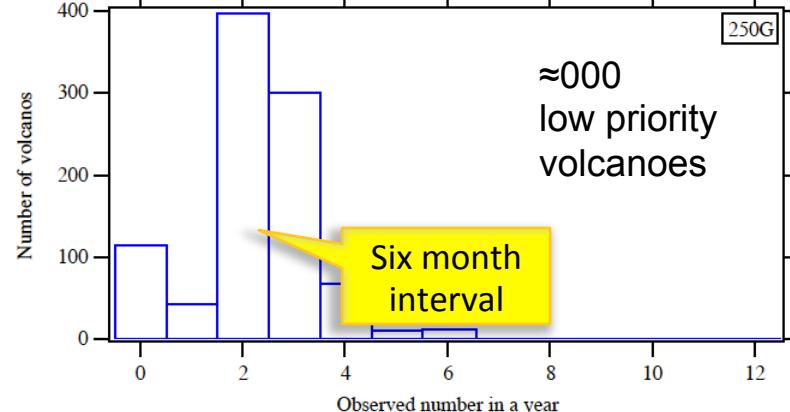
≈900
low priority
volcanoes

250 GB/Day



≈100
high priority
volcanoes

Two month
interval



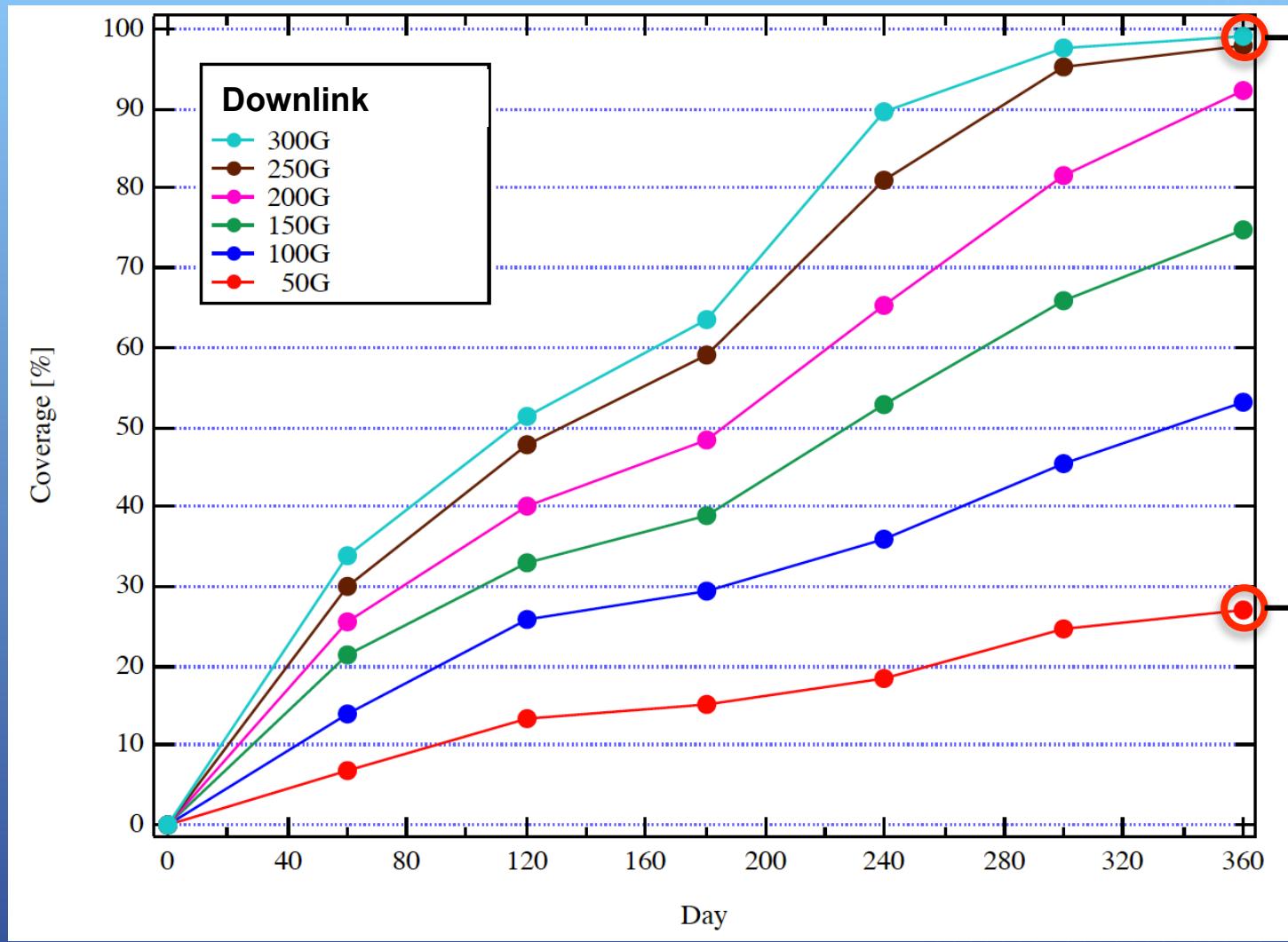
≈000
low priority
volcanoes

Six month
interval



HISUI Operation / Mission Planning Study

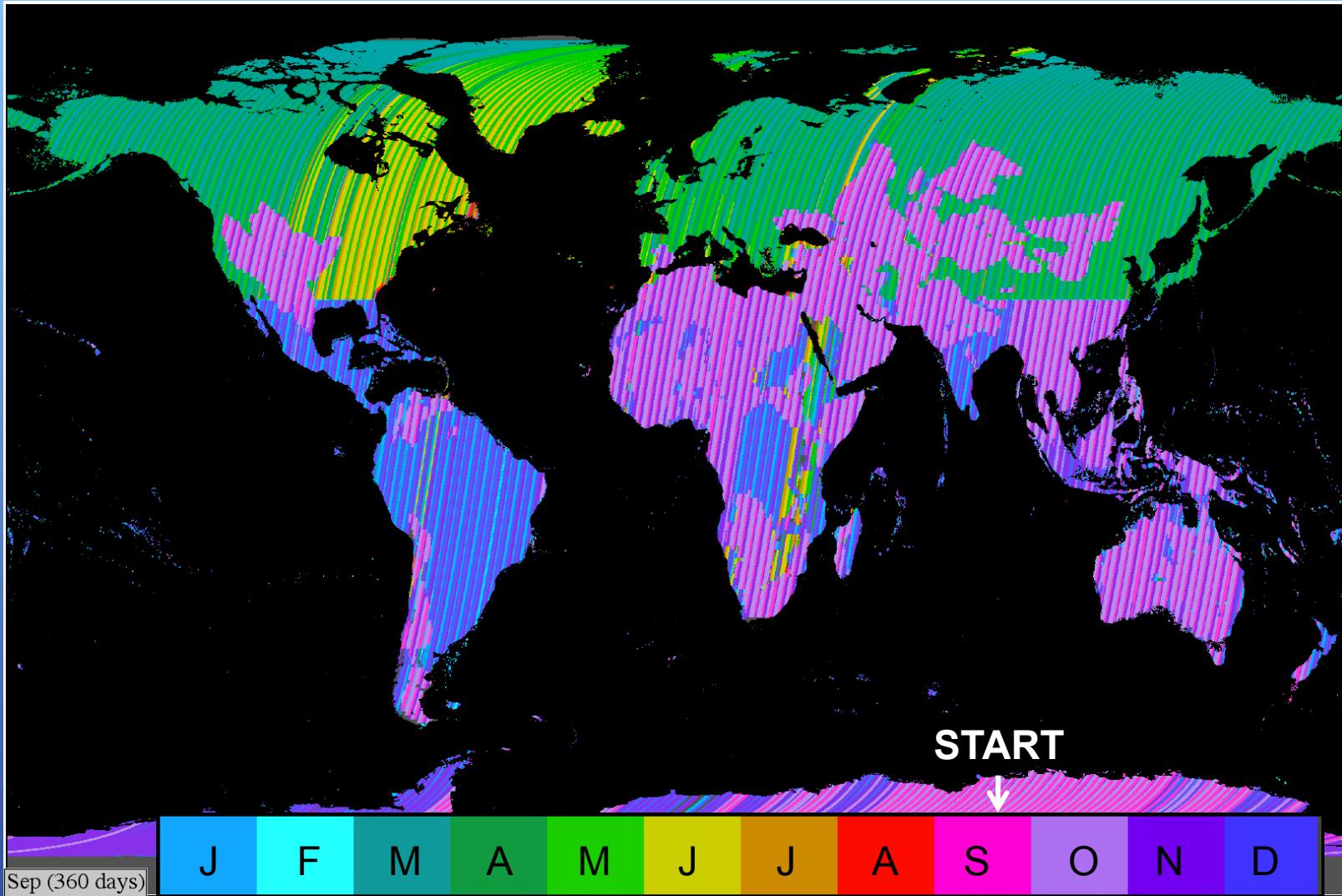
Achievement of Global Mapping





HISUI Operation / Mission Planning Study

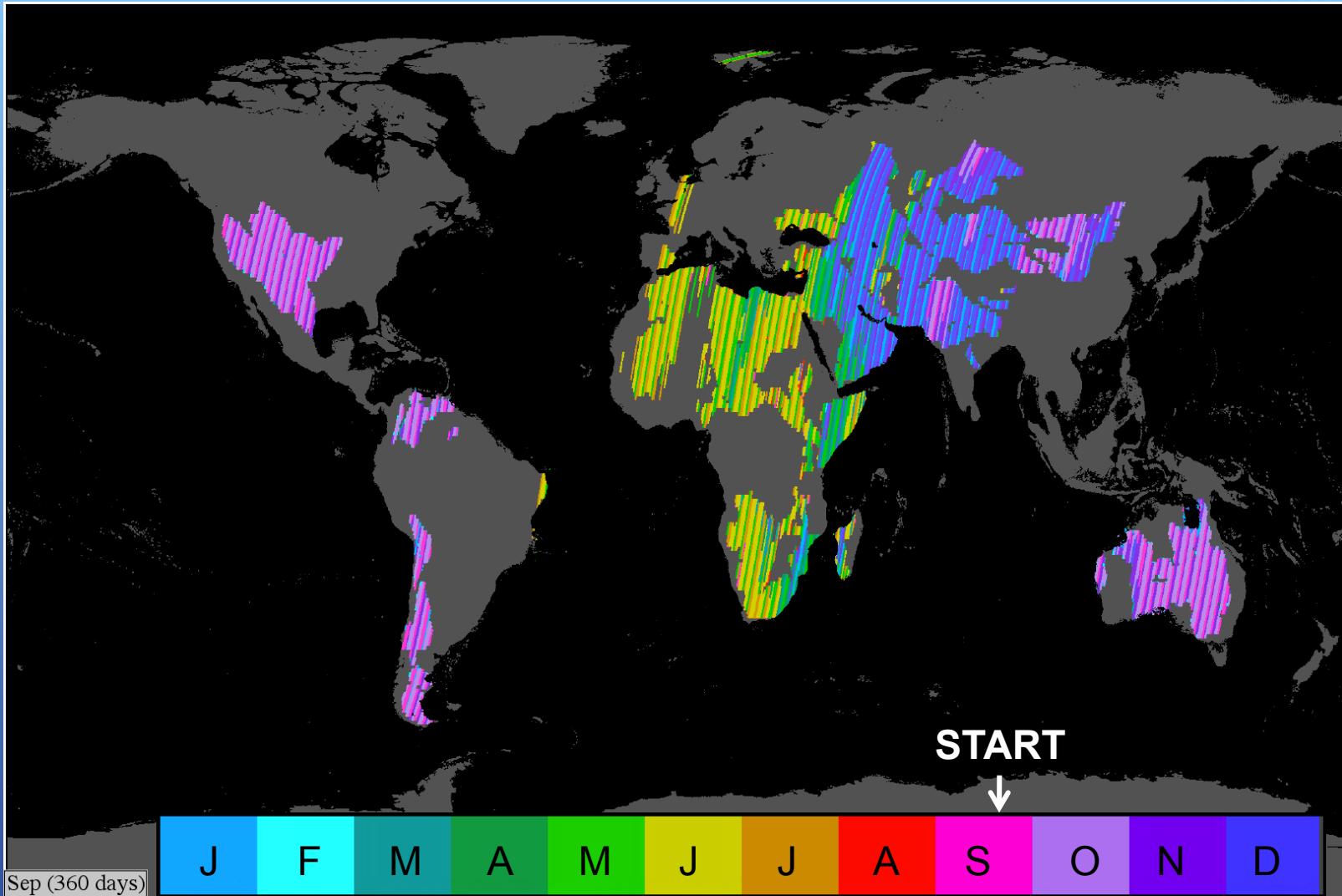
Month of Observation (300 GB/Day case, 1 year)





HISUI Operation / Mission Planning Study

Month of Observation (50 GB/Day case, 1 year)





Thank you