

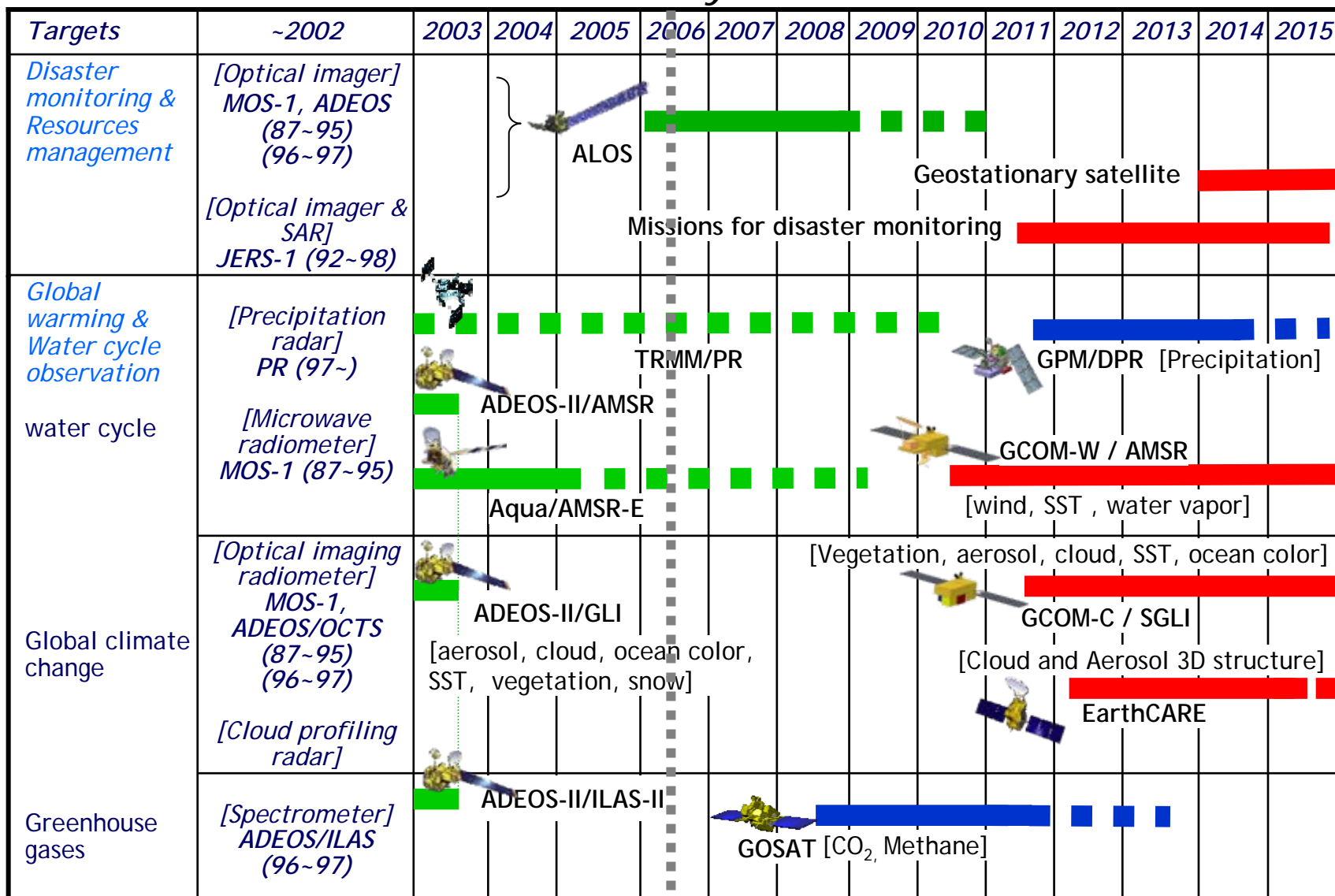
***- Agency Report -
Japan Aerospace Exploration Agency (JAXA)***

***Keiji Imaoka
Earth Observation Research Center (EORC), JAXA***

***25th CEOS WGCV Meeting
Budapest, Hungary
May 9, 2006***

JAXA Earth Observation Mission Plan

- Today -



■ Status of CAL/VAL activities in JAXA

– Missions in post-operation phase

- **TRMM/PR**
 - **CAL:** Keep monitoring instrument calibration stability.
 - **VAL:** Rainfall comparison with microwave radiometers.
- **Aqua/AMSR-E, ADEOS-II/AMSR (~ 2003/10)**
 - **CAL:** Keep updating calibration procedure, monitoring long-term stability over homogeneous regions.
 - **VAL:** Keep updating retrieval algorithms, conducting in-situ observations (e.g., soil moisture over Mongolia).
- **ADEOS-II/GLI (~ 2003/10)**
 - Almost ends, but still updating some products.

– Missions in CAL/VAL phase

- **ALOS/PALSAR, PRISM, and AVNIR**
 - Currently working hard in the initial CAL/VAL phase (initial C/O phase completed).

– Missions in R/D phase

- **GOSAT, GPM, GCOM, Earth-Care**
 - Preparation and documentation of CAL/VAL plan.

Status of TRMM observation

Sensor Operation

- **TRMM has continuously been operated more than 8 years since the launch at Nov. 1997. There is no degradation of PR sensor and trouble in house keeping statistics.**

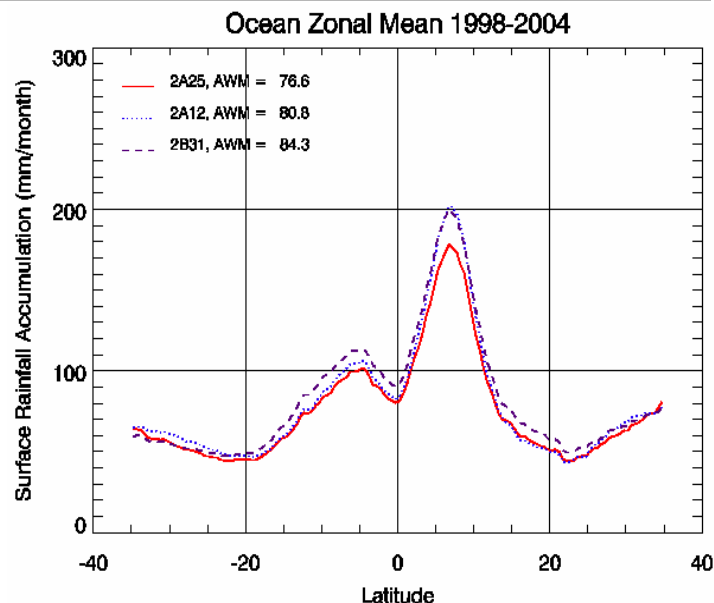


- **NASA officially approved the extension of TRMM science operations through fiscal year 2009.**

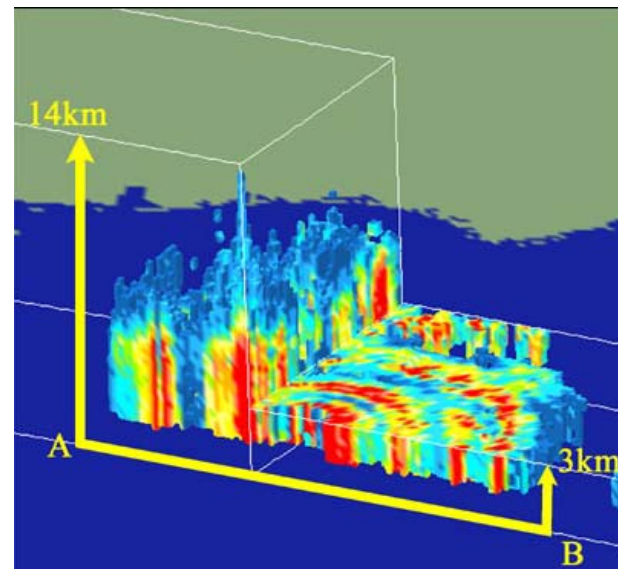
Standard Process and Reprocess of TRMM Products

- **Products Reprocessing by Ver. 6 algorithms for 76 months was finished. Global rainfall over ocean increased about 20% comparing Ver. 5 products. Difference of global rainfall between PR and TMI decreased less than 8%.**
- **Standard process for current observation is steadily continuing.**
- **TRMM PR observed detailed 3-D structure of Tropical cyclones (e.g. Hurricane Katrina).**
- **TRMM products are used for numerical prediction and operational data assimilation by JMA.**

Hurricane Katrina
03 UTC 28 Aug. 2005



Zonal mean of rainfall retrieved by PR and TMI



GPM Status

GPM/DPR development status

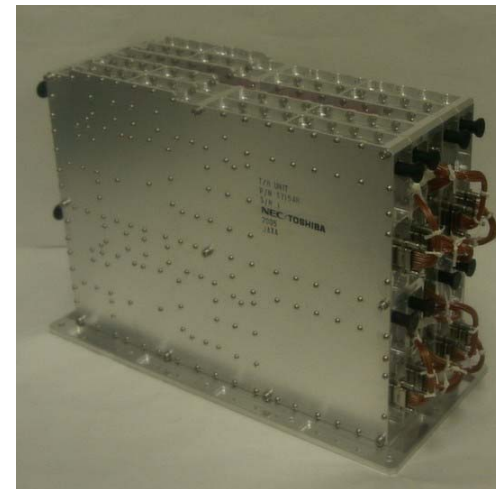
- DPR (Dual-frequency Precipitation Radar) is currently being developed by JAXA and NiCT. The conceptual design work has almost completed.
- JAXA constructed and examined the KuPR (14GHz) T/R Unit (Bread Board Model: BBM). Preliminary design and EM activity started
- NiCT has almost completed to fabricate and is currently examining the KaPR (35GHz) T/R Unit (Engineering Model: EM).

DRR #1 on Dec.12, 2005

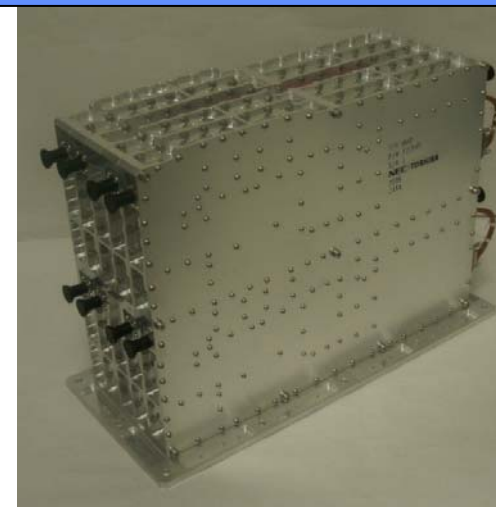
- Successfully completed, and it was approved to start preliminary design and EM activity in JAXA

The issue for launch delay of GPM-core satellite

- 2.5 years delay was announced again in President's NASA FY 2007 budget issue. JAXA continues to request that NASA will study acceleration of GPM.



T/R Unit BBM of KuPR



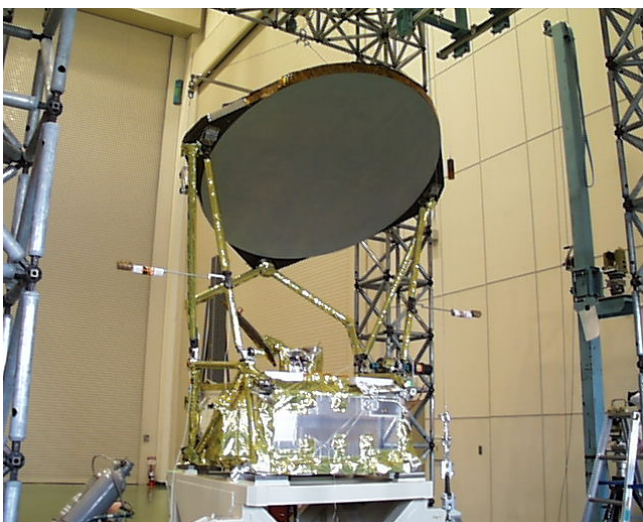
Aqua/AMSR-E mission and status

■ Mission outline

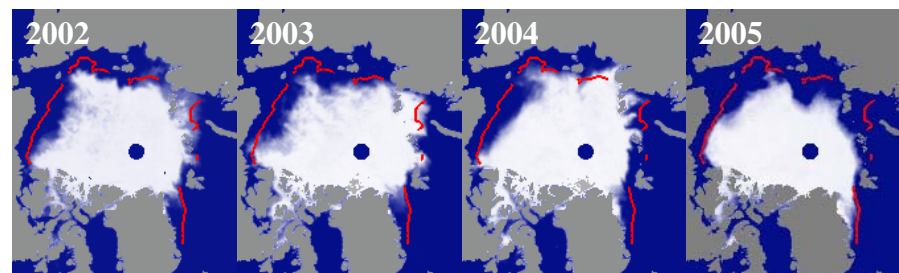
- Continuous stable observation over 4-year after the launch on May 4, 2002 onboard NASA's EOS Aqua satellite.

■ Instrument characteristics

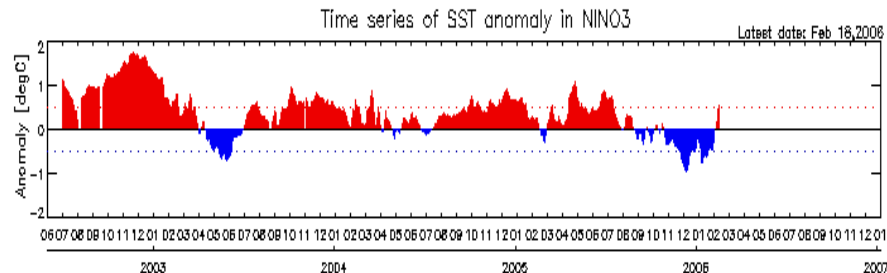
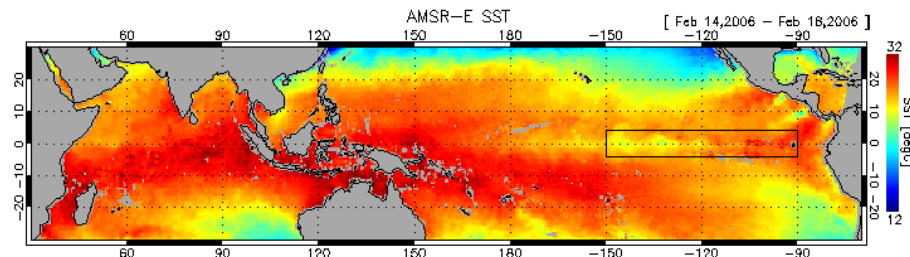
- Multi-frequency microwave radiometer with dual polarization capability (developed by JAXA).
- High-spatial resolution compared to existing instruments by large size antenna.
- C-band (6.9GHz) channels for estimating SST and soil moisture.
- Afternoon (1:30 pm) equatorial crossing time that is currently unique for microwave radiometers.



Pre-launch AMSR-E photo in Tsukuba Space Center



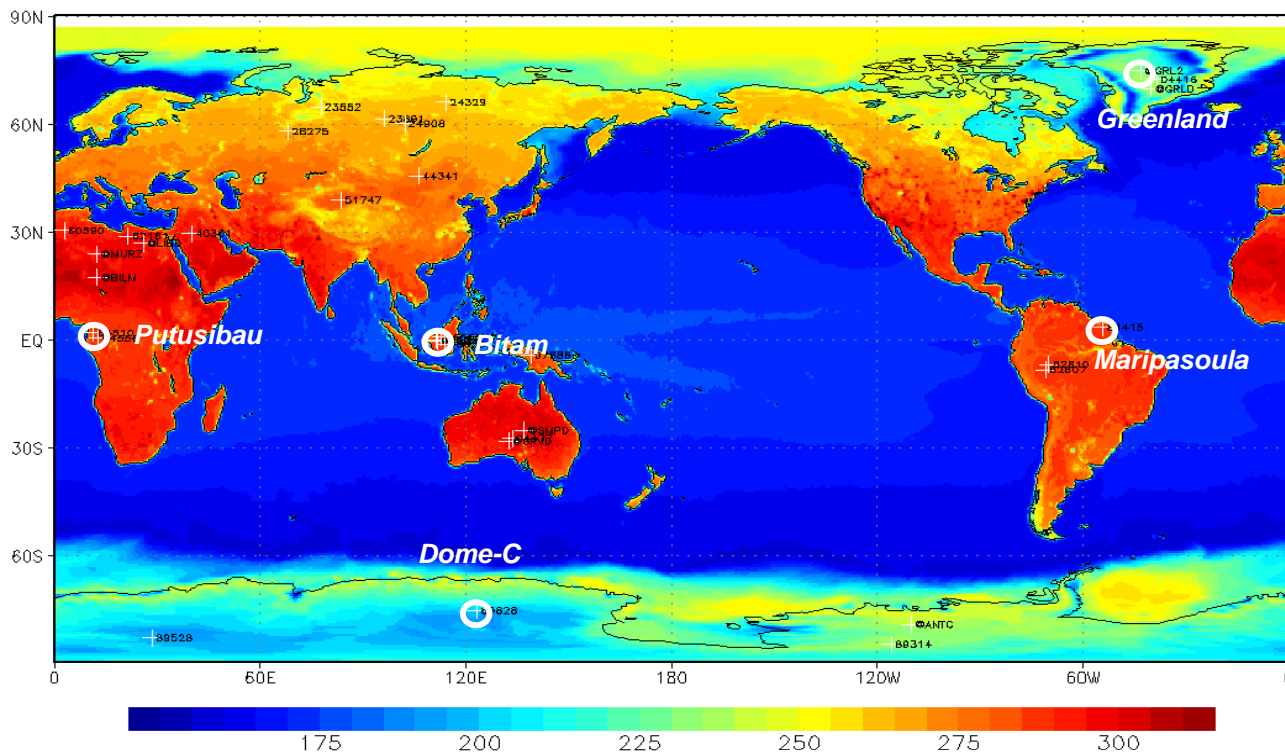
Yearly variation of sea ice distribution (September) in the Arctic observed by AMSR-E. Red line indicates averaged sea ice extent in the month during 1988 and 2000 (produced by the National Snow and Ice Data Center).



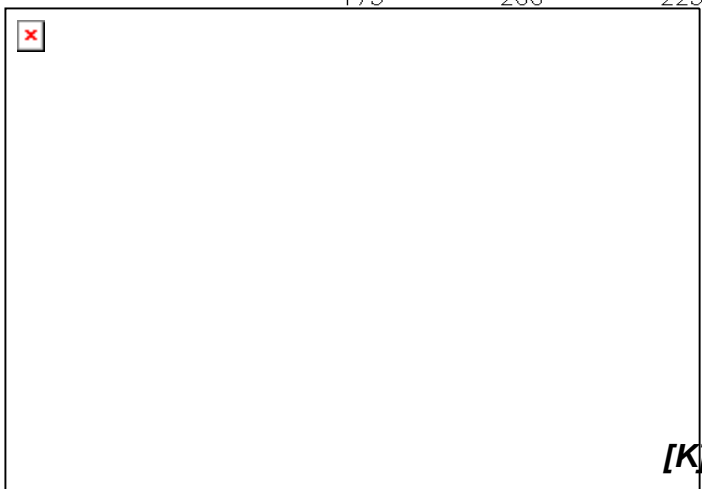
Example of El-Nino monitoring by AMSR-E. Upper: AMSR-E sea surface temperature (SST) distribution. Lower: Time series of SST anomaly (AMSR-E minus climate SST) in the area surrounded by black borders of upper figure.

TB monitoring site over land

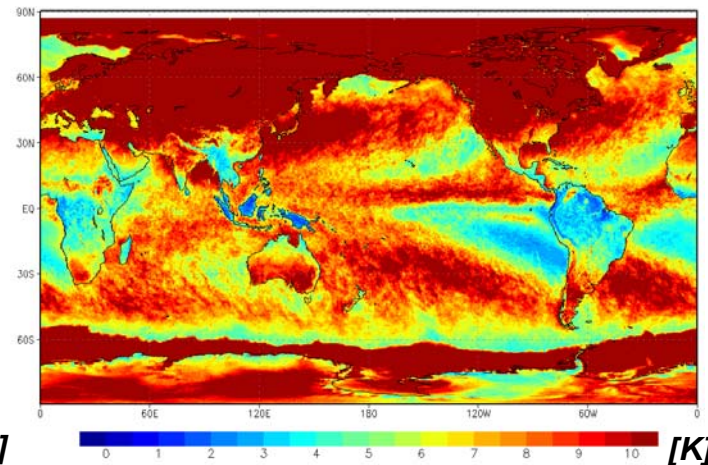
TB 06V AVG 2003



6V Tb STD
in 2003

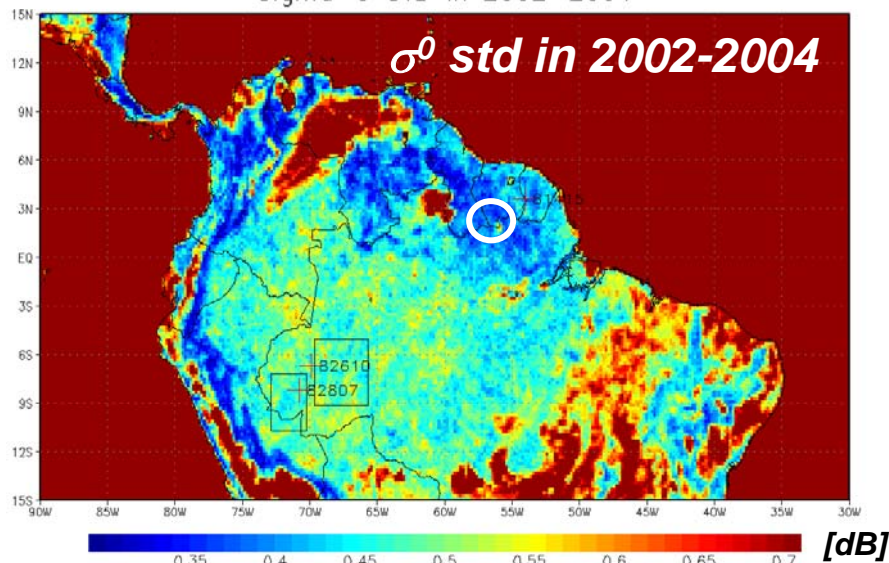


36V Tb STD
in 2003

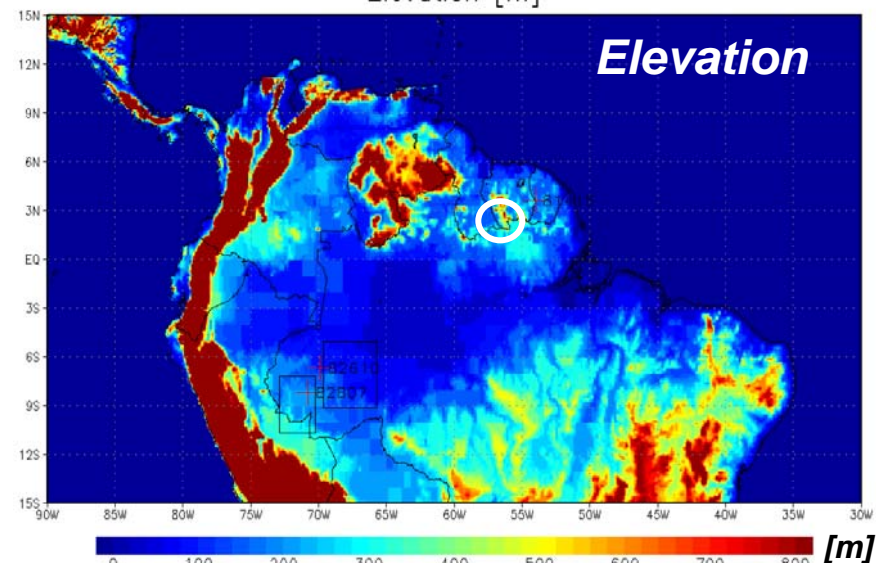


Forest sites

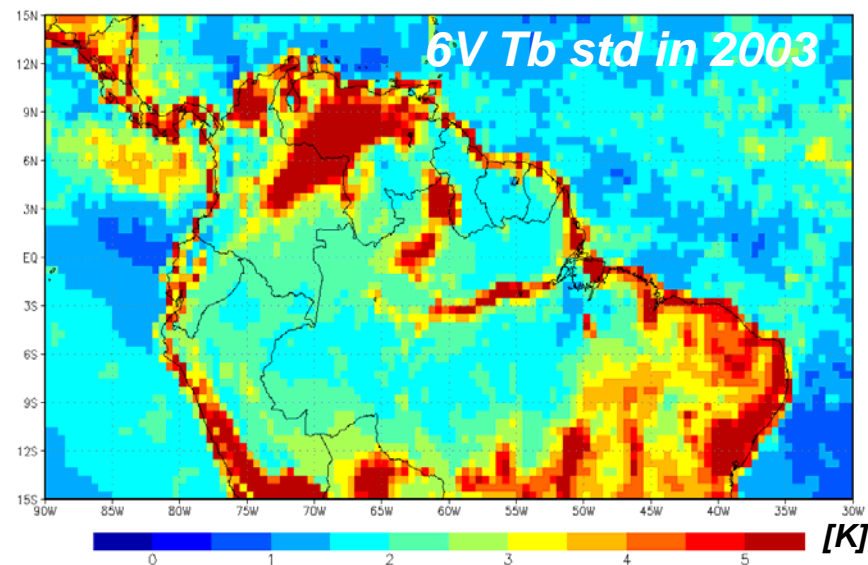
Sigma-0 STD in 2002-2004



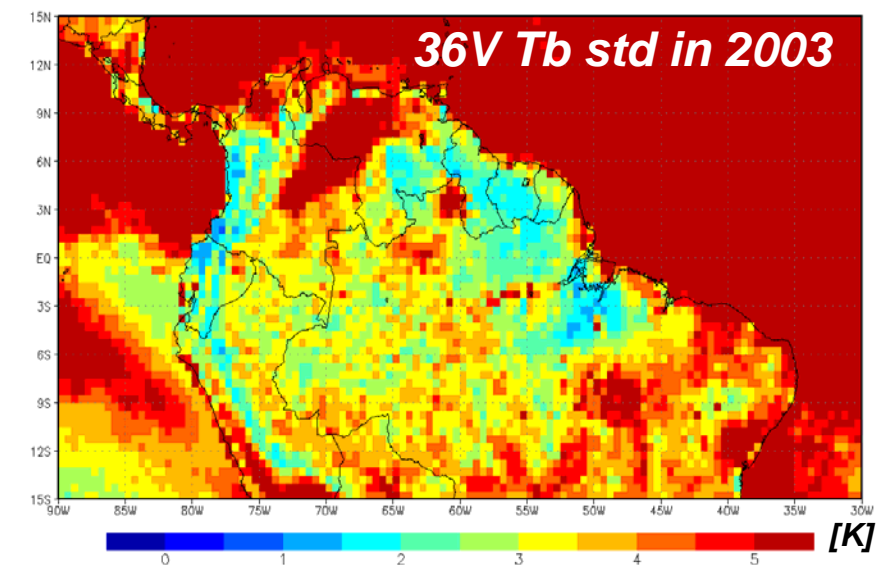
Elevation [m]



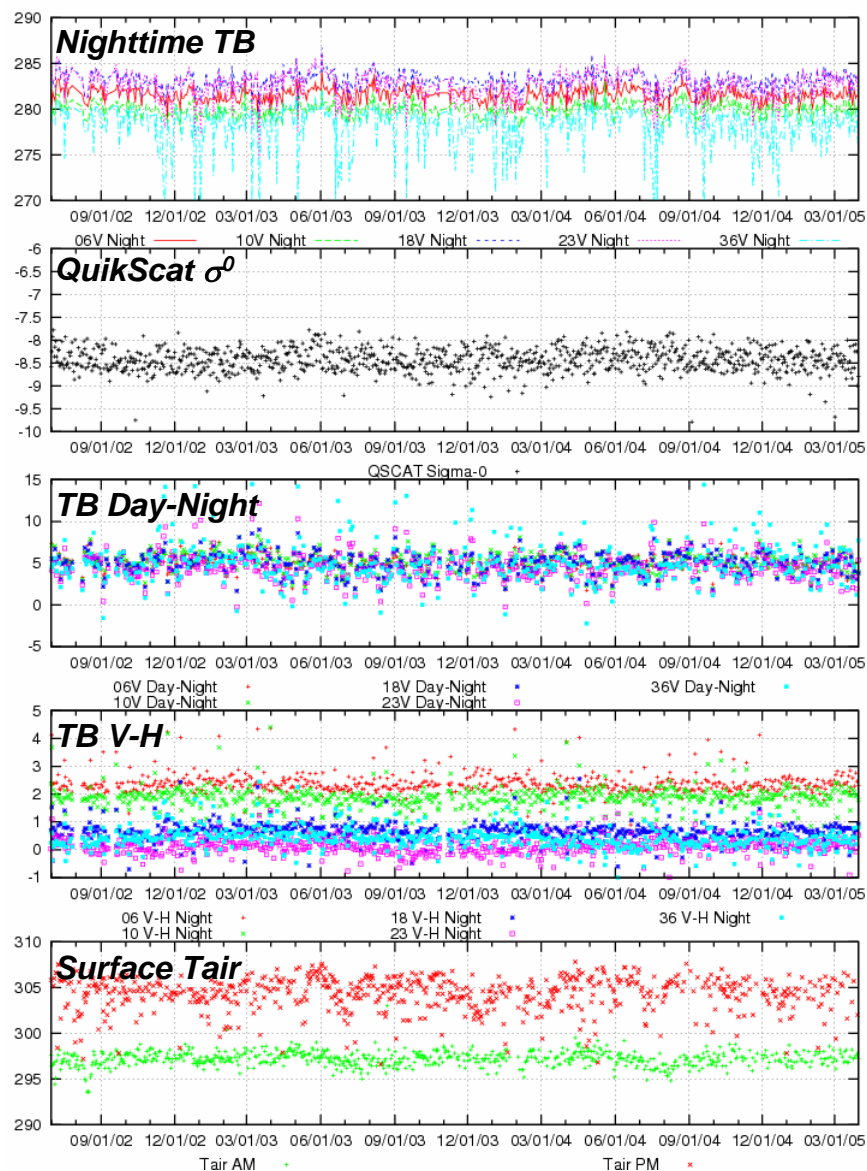
6V Tb std in 2003



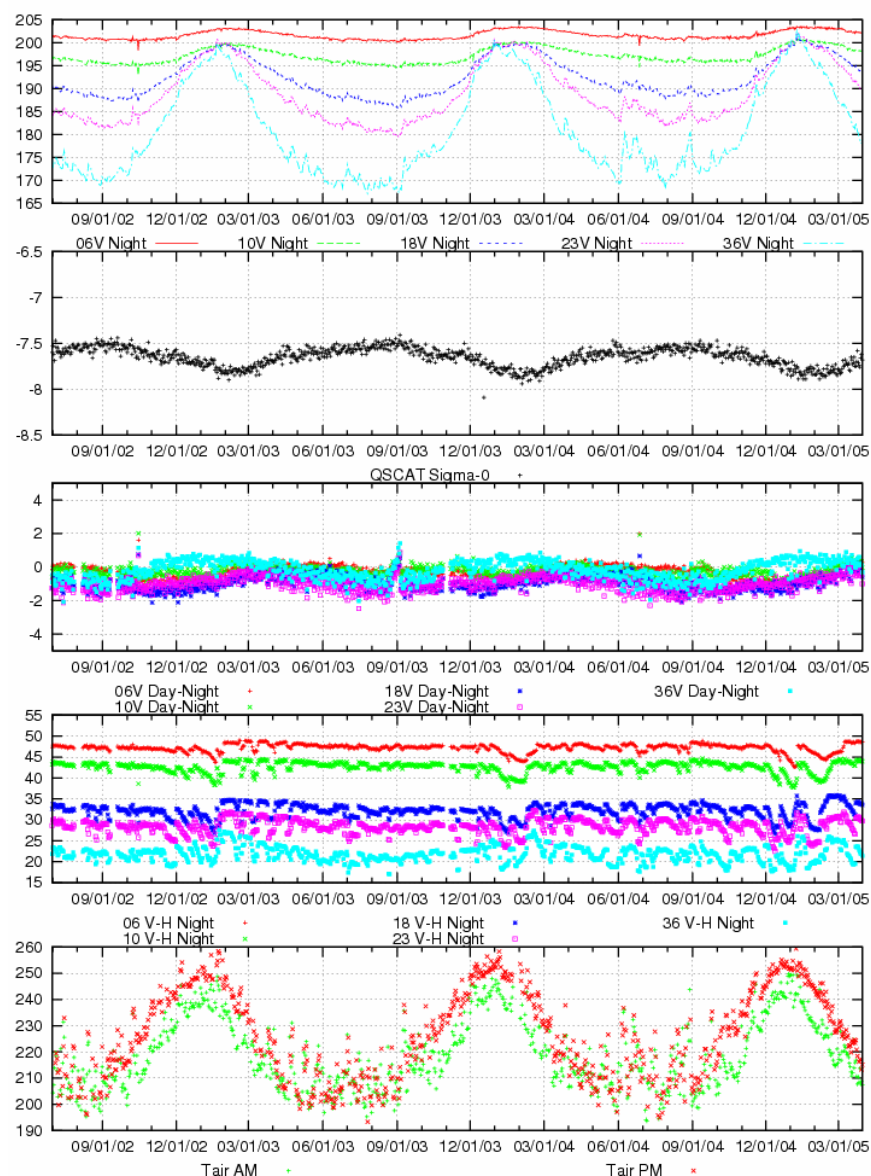
36V Tb std in 2003



Time series



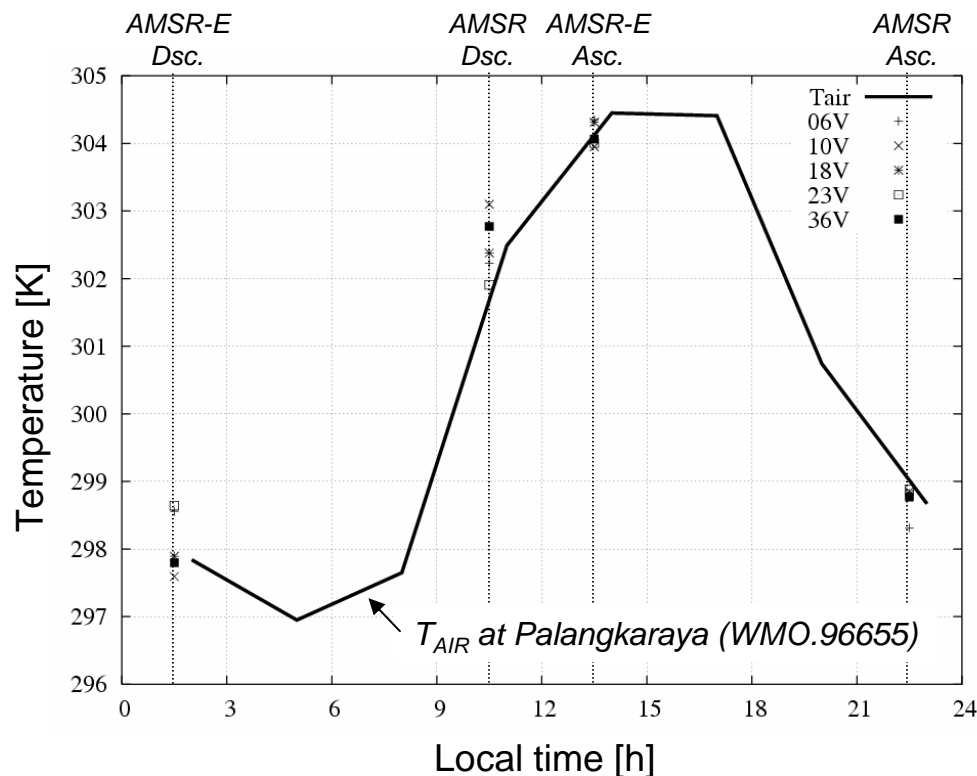
Forest: Putusibau (WMO-96565)



Ice sheet: Dome C (WMO-89828)

TB stability and diurnal validity

Site	6.925GHz V-pol			36.5GHz V-pol		
	02-03	03-04	04-05	02-03	03-04	04-05
Putusibau	284.2	284.3	284.3	280.9	280.9	280.6
Maripasoula	285.6	285.7	285.6	283.7	283.5	283.6
Bitam	284.3	284.5	284.4	281.4	281.5	281.4
Dome C	201.6	201.7	201.9	-	-	-
Greenland	233.1	233.1	233.2	-	-	-



- Left table shows yearly average of nighttime Tb over selected regions (upper 3 are tropical forest and lower 2 are over ice sheet). Definition of “year” was from Jul. to Mar. due to incomplete data coverage period at the time of comparison. For dense forested sites, tabulated values were “ $T_n = T_b / T_{air} * 300$ ” to eliminate air temperature changes.
- Right figure shows diurnal variation of AMSR and AMSR-E Tb (arbitrary factors applied to each channel for ease of comparison) and surface air temperature measurements over tropical forest area averaged for the entire AMSR data period.

Inter-sensor comparison of PMRs

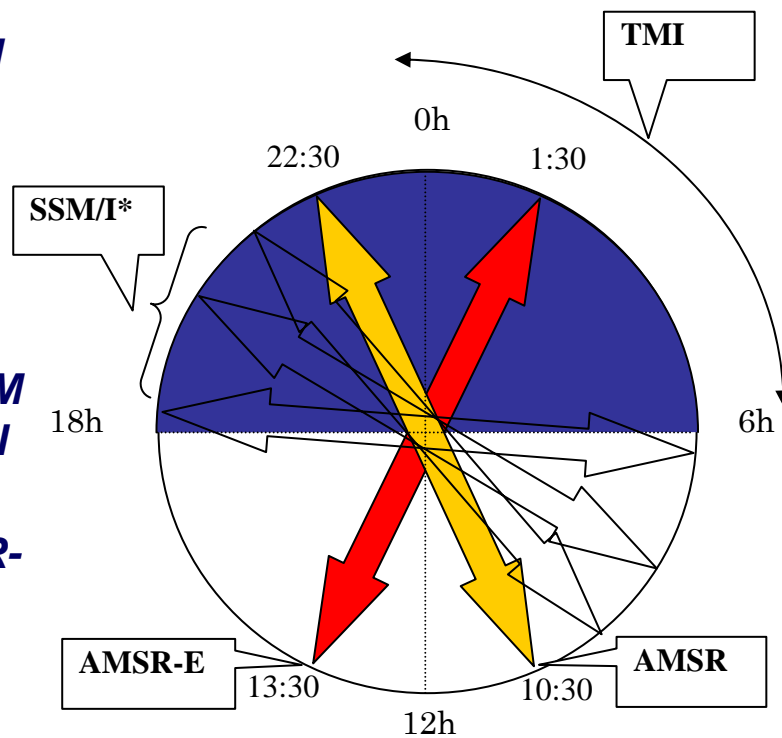
■ TMI instantaneous comparison over land

- Confirmation of warm Tb values needs comparison over land areas. Instantaneous comparison is needed due to significant diurnal changes of Tb over land.
- TMI, onboard non-sun-synchronous TRMM satellite, provides round-robin tests for all microwave radiometer in polar orbit.
- Results from comparison of AMSR, AMSR-E, SSM/I with TMI were used to correct warm-end offset.

■ Comparison of averaged oceanic Tb

- AMSR, AMSR-E, and SSM/I x 3

■ Quick check with Windsat Tb





* 3 SSM/Is are in operation (SSM/IS is also in orbit, but the data are not available to the public).



Global Change Observation Mission

- The Global Change Observation Mission (**GCOM**) is a follow-on mission of the ADEOS-2 and AMSR-E on EOS Aqua. The targets are:

- Establish and demonstrate the **global and long-term Earth observing system** (contribute to GEOSS),
- Contribute to improving **climate change prediction** in concert with climate model research institutions,
- Contribute to operational users,
- Promote comprehensive data use in conjunction with other satellite data including EarthCARE, GPM, and GOSAT, and
- Investigate potential data analysis methodology.

GCOM-W & -C characteristics (TBD)		
	GCOM-W	GCOM-C
Design		
Orbit (TBD)	<ul style="list-style-type: none">■ Sun-synchronous■ Altitude: 699.6km■ Inclination: 98.19deg■ Ascending local time: 13:30	<ul style="list-style-type: none">■ Sun-synchronous■ Altitude: 798km■ Inclination: 99.36deg■ Descending local time: 10:30
Instruments	■ AMSR2 Microwave imager	■ SGLI Near-UV ~ TIR imager
Launch Date	JFY 2010	JFY 2011
Mission Life	5 years (x3 satellites; total 13 years)	
Launch Vehicle	H-IIA	

- GCOM consists of **GCOM-W** and **GCOM-C** satellite series.
- Each of them consists of 3 generations with 1-year overlap (13-years total).
- GCOM activity is in “research” phase (not yet approved).

ALOS “Daichi”

(Advanced Land Observing Satellite)

Data Relay Antenna (DRC)

[Data rate: 240Mbps]

Star Tracker

GPS Antenna

PALSAR

8.9m

2.9m

PRISM

AVNIR-2

Solar Array Paddle

22m

Velocity

Nadir

Mission objectives:

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

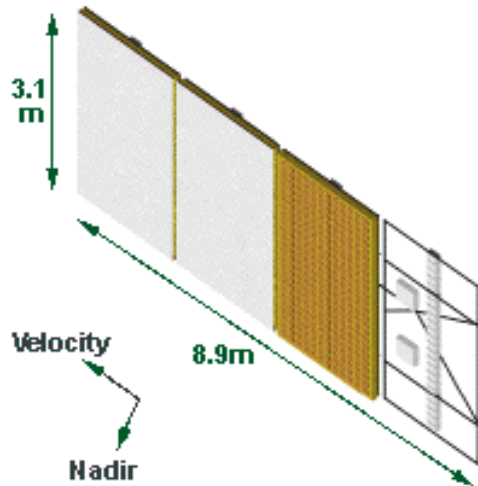
PRISM : Panchromatic Remote-sensing Instrument for Stereo Mapping

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

PALSAR: Phased Array type L-band Synthetic Aperture Radar

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.

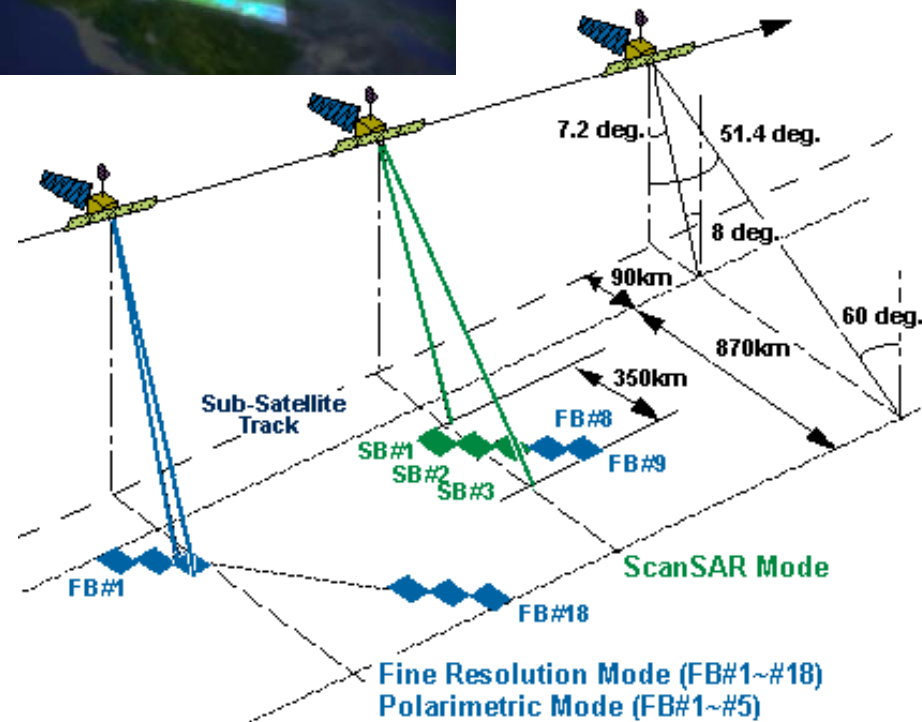
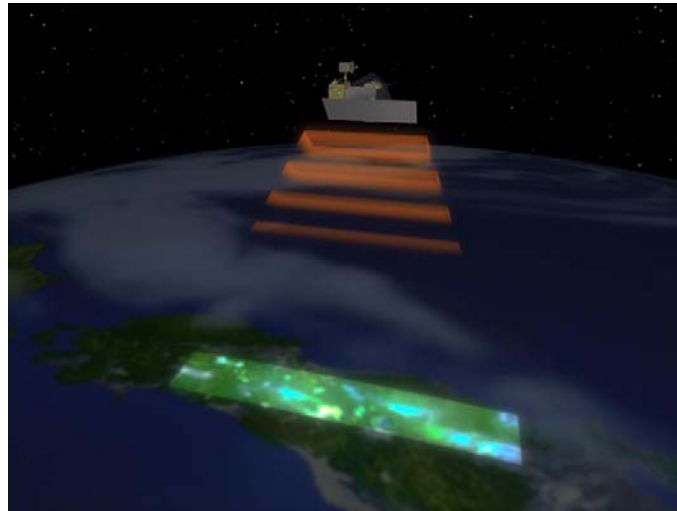
HH or VV / 100m / 250-350km

Polarimetric Mode

8.0-30.0 deg.

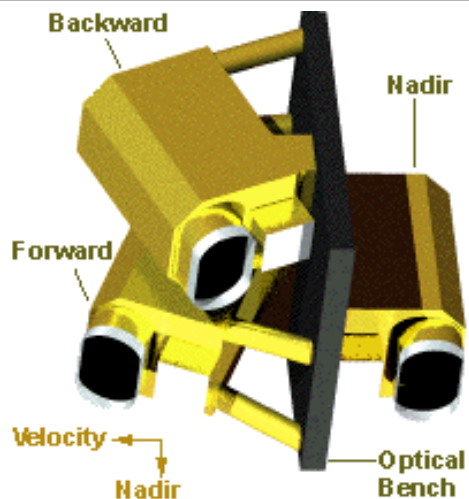
HH + HV + VH + VV

24.1-88.6m / 20-60km



PRISM

Panchromatic Remote-sensing Instrument for Stereo Mapping



$0.52\text{--}0.77\ \mu\text{m}$

Number of Optics : 3, AT $\pm 23.8^\circ$
(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

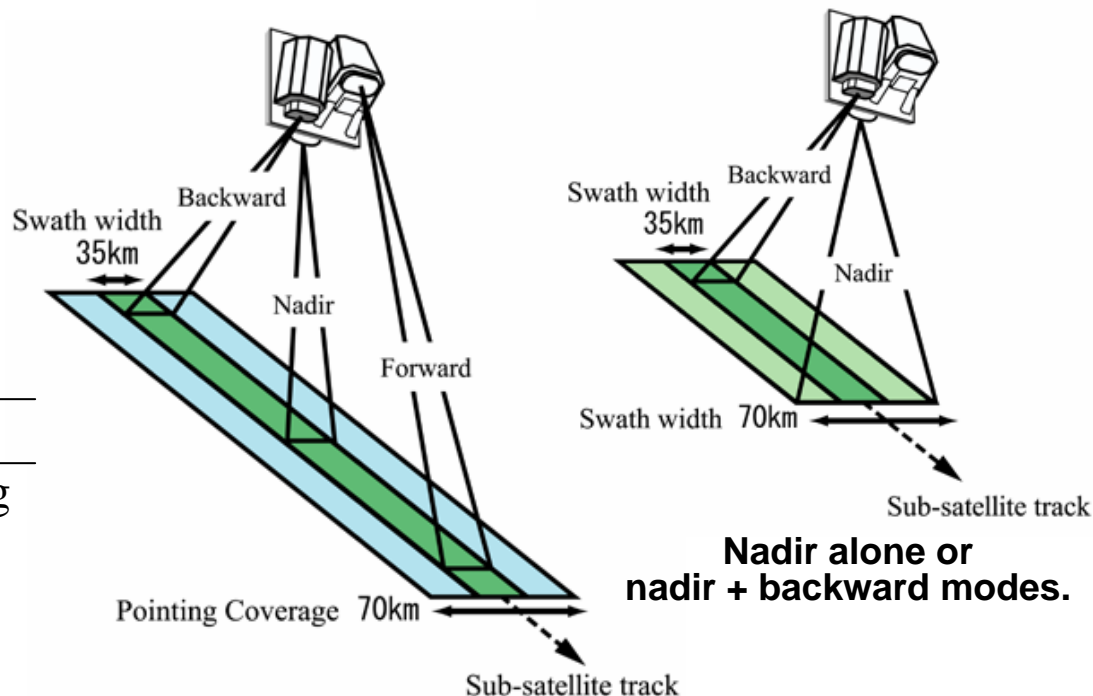
Pointing angle : $\pm 1.5^\circ$

S/N : >70 , MTF : >0.20

Scanning method : Push broom

Quantization : 8 bits

Data compression: JPEG extension

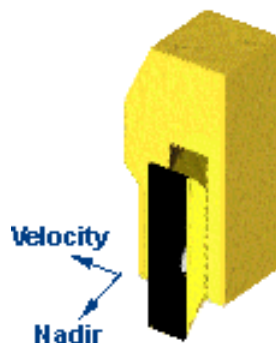


Observing geometry of triplet mode.

- ❖ *Two observation ($\pm 1.20^\circ$ pointing angle) per orbit are necessary for observing whole coverage by triplet mode except in high latitude areas.*

AVNIR-2

Advanced Visible and Near Infrared Radiometer type 2



Band 1 : 0.42-0.50 μ m

Band 2 : 0.52-0.60 μ m

Band 3 : 0.61-0.69 μ m

Band 4 : 0.76-0.89 μ m

Field of view : 5.8 deg.

Swath width : 70km at Nadir

Instantaneous FOV : 14.28 μ rad

Spatial resolution : 10m at Nadir

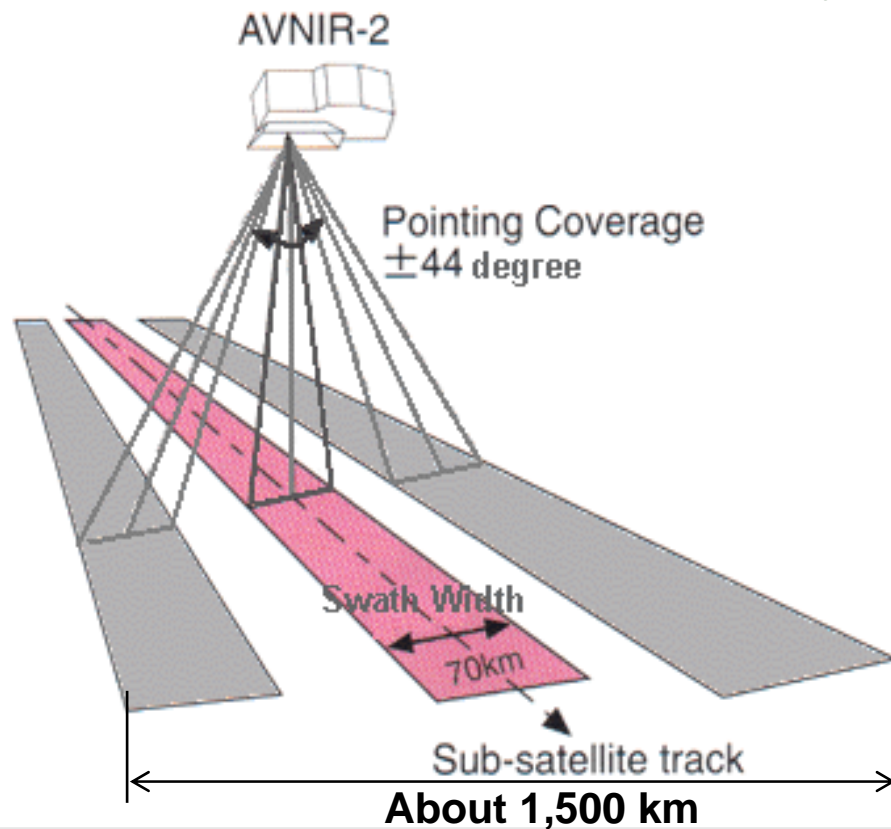
Number of detectors : 7000 /band

Pointing angle : +/- 44 deg.

S/N : >200, MTF : >0.25 (1-3), >0.20 (4)

Scanning method : Push broom

Quantization : 8 bits

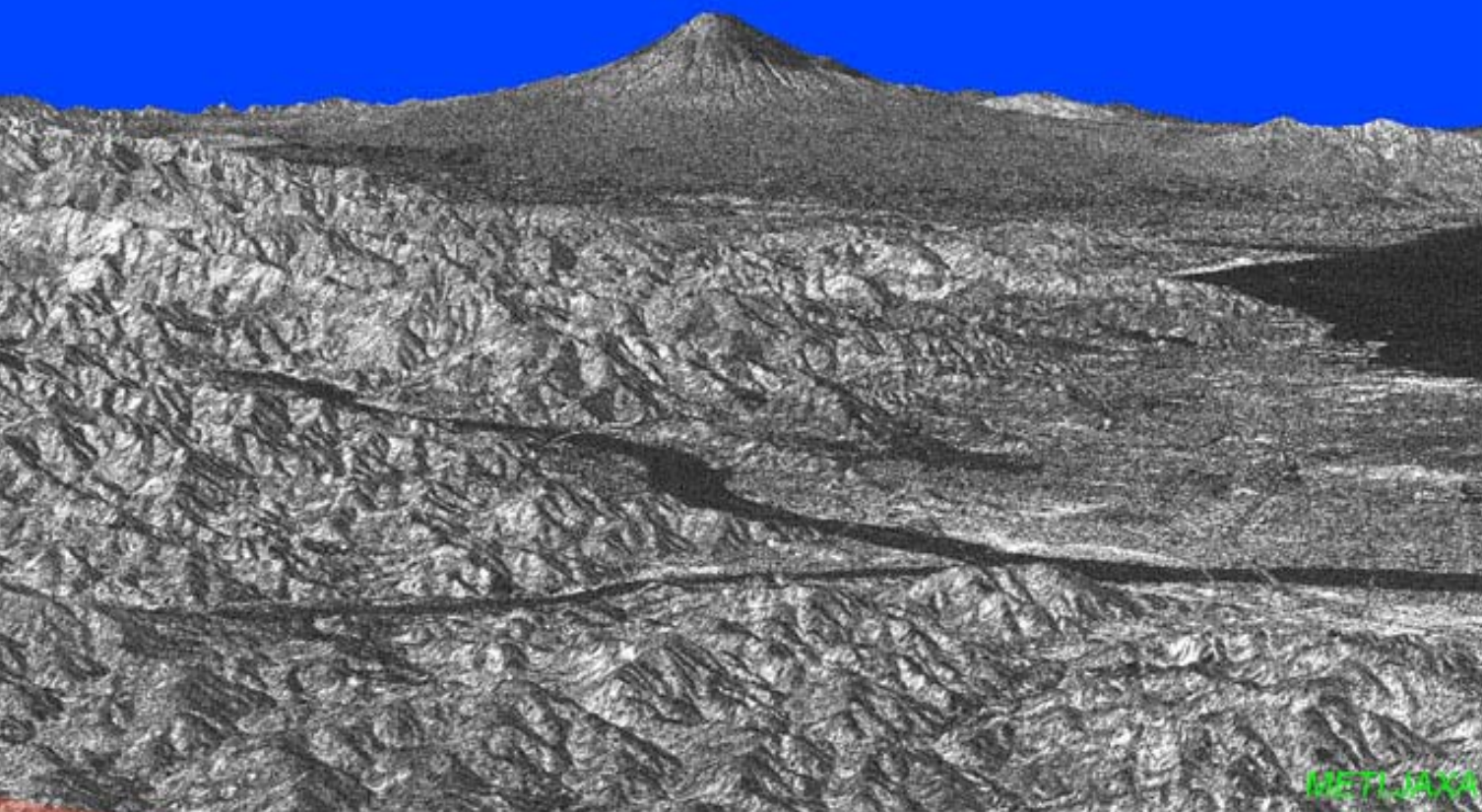


- ❖ *Improvements in AVNIR-2 from AVNIR*
- ✓ *Resolution : 10m < 16m*
- ✓ *Pointing angle : +/-44 deg < +/-40 deg*
- ✓ *Calibration system : lamp 2 < lamp 1, Solar*

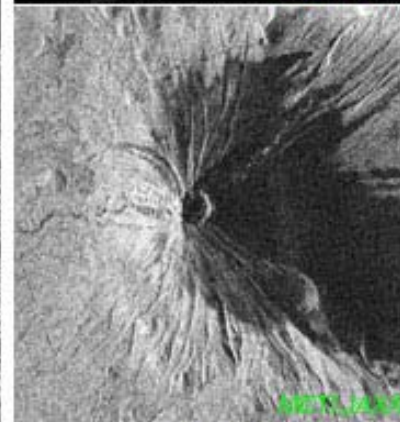
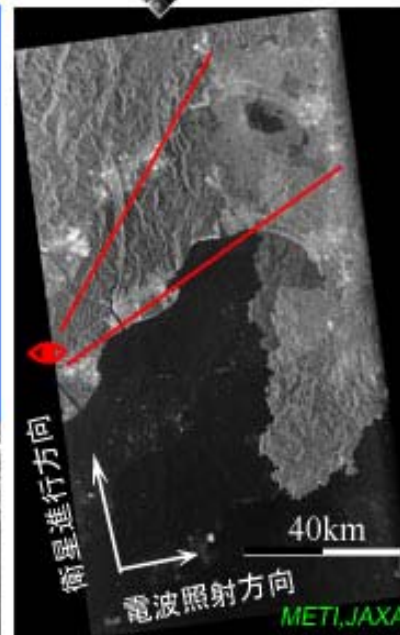


PALSARが観測した夜間の富士山

PALSAR Night View of Mt. Fuji



METI, JAXA



METI, JAXA

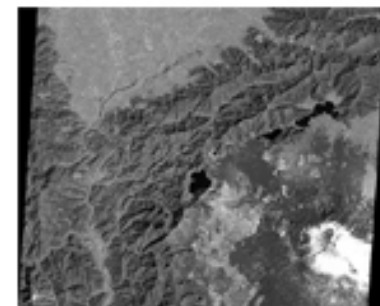
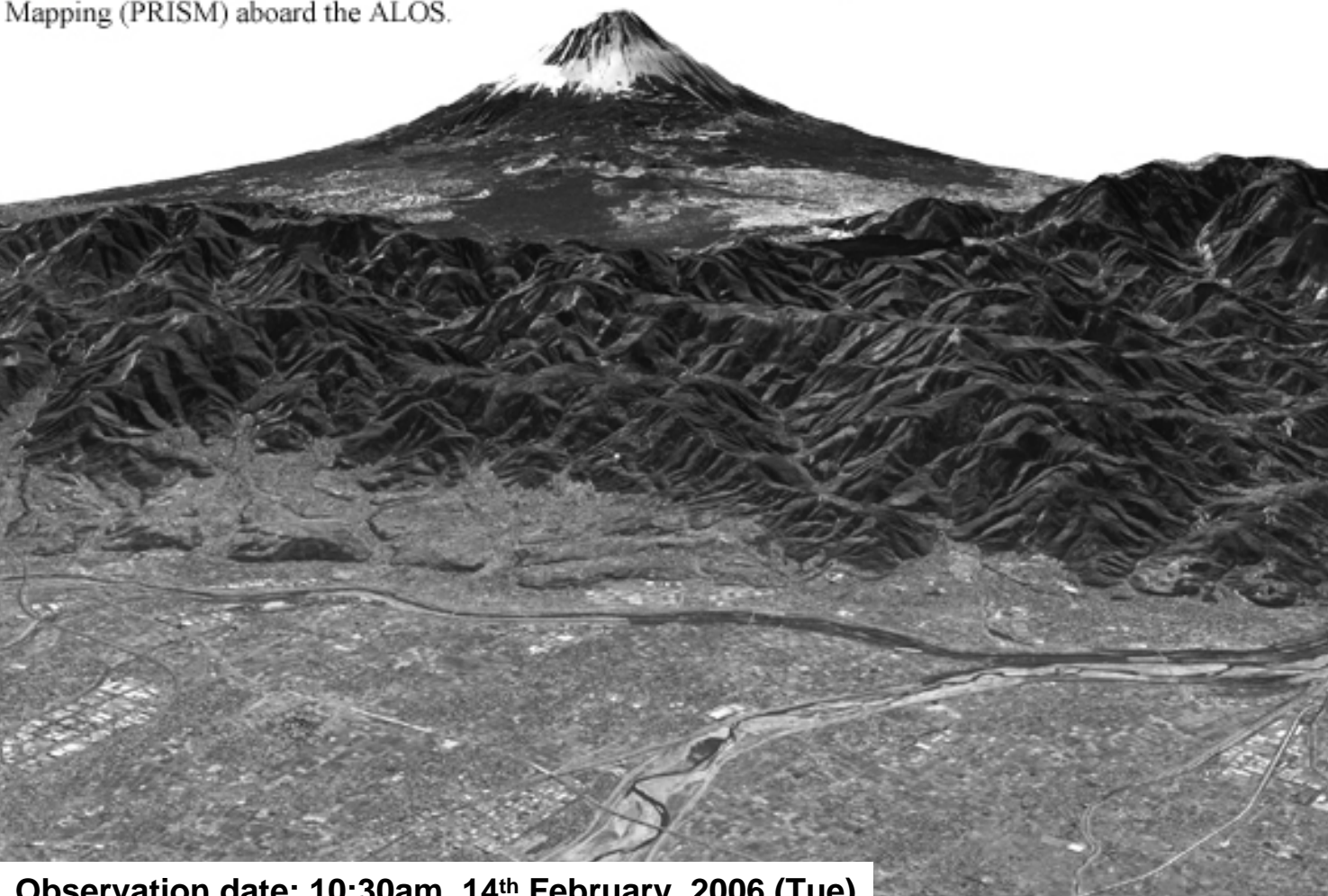
富士山

PALSARが観測した富士山の鳥瞰図

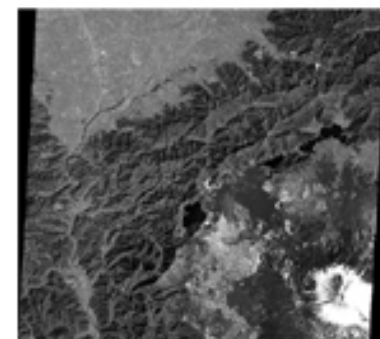
観測日 : 2006年2月15日22時16分

陸域観測技術衛星「だいち」(ALOS)パナクロマチック立体視センサ(PRISM)が観測した富士山

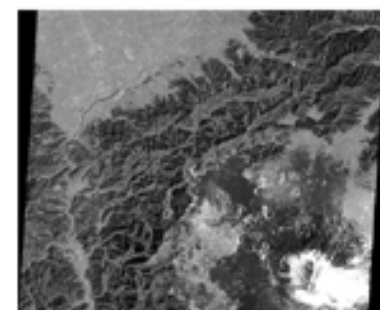
View of Mt. Fuji, Japan observed by the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) aboard the ALOS.



後方視画像

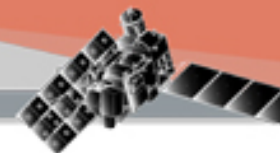


直下視画像



前方視画像

Observation date: 10:30am, 14th February, 2006 (Tue)
Data down/link to EOC: 11:00pm, 14th February, 2006



観測技術衛星「だいち」(ALOS)パナクロマチック立体視センサ
(PRISM)が観測した静岡県清水港

View of Shimizu Port, Japan observed by the Panchromatic Remote-sensing
Instrument for Stereo Mapping (PRISM) aboard the ALOS.



Observation date: 10:30am, 14th February, 2006 (Tue)
Data dawn/link to EOC: 11:00pm, 14th February, 2006



ALOS

Advanced Land Observing Satellite



AVNIR-2



陸域観測技術衛星「だいち」(ALOS)高性能可視近赤外放射計2型(AVNIR-2)が観測した種子島
View of Tanegashima Island, Kagoshima Pref., Japan observed by the Advanced Visible and Near Infrared Radiometer type 2
(AVNIR-2) aboard ALOS



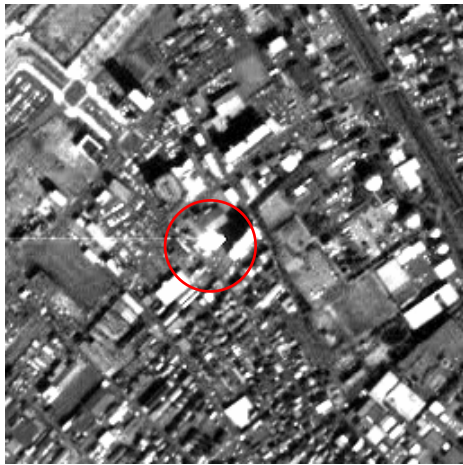
- ①大型ロケット発射場
- ②種子島灯台
- ③総合指令棟
- ④竹崎展望台

2006年2月17日観測 ©JAXA

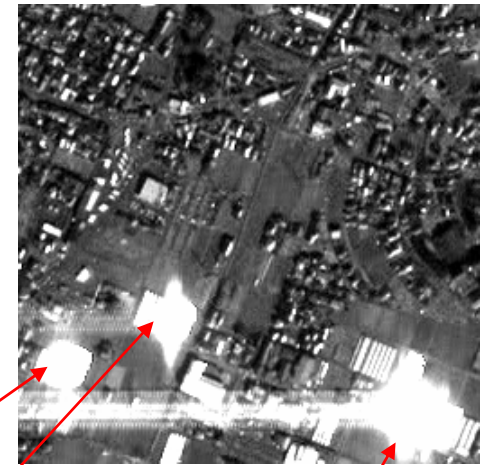


Observation and D/L: 10:50am, 17th February, 2006 (Fri)

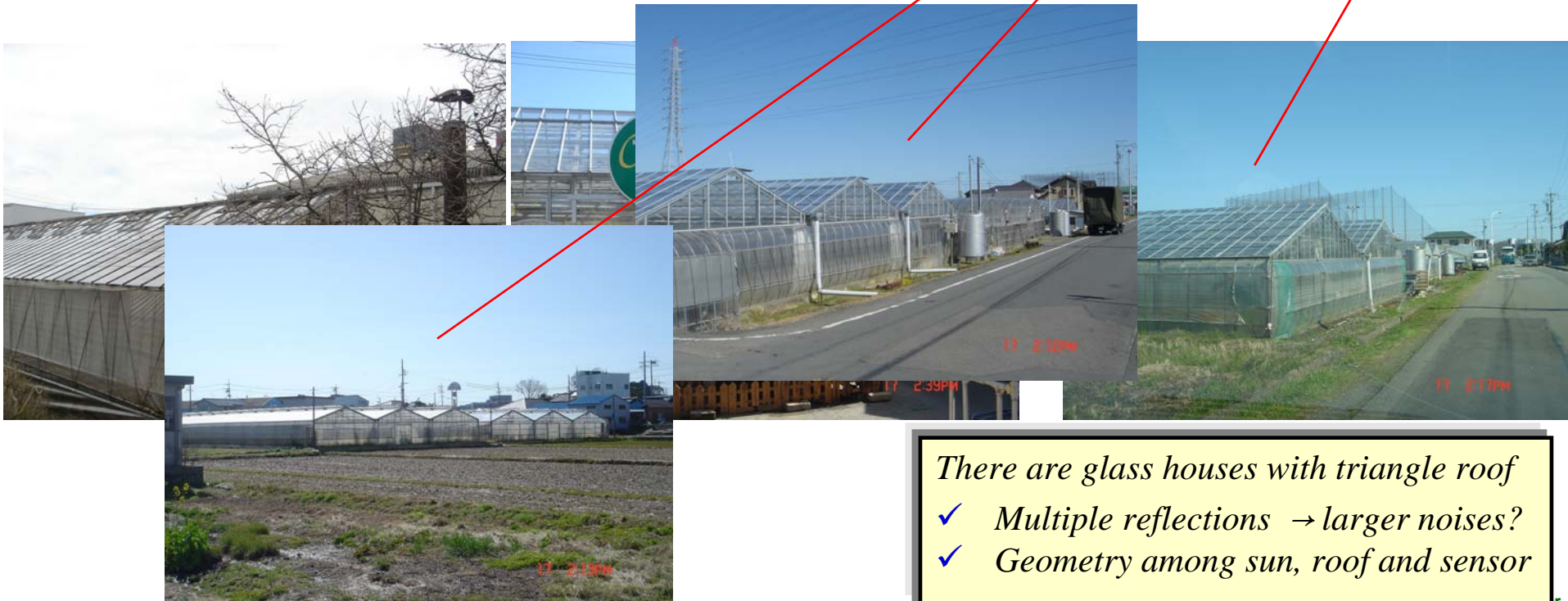
Evaluation of 1st Acquired PRISM: Bright Noise



Enlarged image of nadir-looking.



Forward image.



There are glass houses with triangle roof

- ✓ *Multiple reflections → larger noises?*
- ✓ *Geometry among sun, roof and sensor*

Proposed JAXA Earth Environmental Monitoring System

