

# **Space Technology in Vietnam and Space Technology Institute**

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**SPACE TECHNOLOGY INSTITUTE**

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# Brief History

- Space technology was imported into Vietnam since late 1970 years, starting with two remote sensing capacity building projects sponsored by UNDP/FAO.
- In 1978 the former Vietnam Space Research Committee was established and became a member of the Intercosmos.
- Vietnamese cosmonaut Pham Tuan used to be first Asian citizen who present in space, when he joined a space mission on July 23, 1980 together with Russian cosmonaut V. Gorbatko on Soyuz-37 spacecraft. The spacecraft afterward docked with Salut-6 space station, the crew staid there for 7 days.
- The former Space Research committee ceased activity in 1993 after the end of the Intercosmos programme.



# Strategy for Space Technology Research and Application

- Vietnam national strategy for space technology research and application first time appeared on June 14, 2006, when our Prime Minister signed to approve it for the period until 2020.
- The strategy defines the targets, primary tasks and implementation solutions for space technology development and application in Vietnam.



# Targets (until 2010)

- To set up the policy and law frame, organizational structure for coordinating space technology activities; strengthen the system of research and educational organizations in space technology field.
- To build the primary space technology infrastructure including: receiving station, image processing center, satellite-based positioning ground network; launch and operate the first communication and small earth observation satellite; build and operate the corresponding satellite control station.
- To set up and carry out a national scientific research program on space science and technology.

# Targets (until 2020)

- Master the technology to build the ground station, small earth observation satellite, and launching rocket.
- Improve the infrastructure. Prepare to launch the second communication satellite. Build and launch some more small earth observing satellites. Complete the satellite-based positioning ground station network.
- Expand the application of space technology in various fields. Expand and commercialize the space technology products.



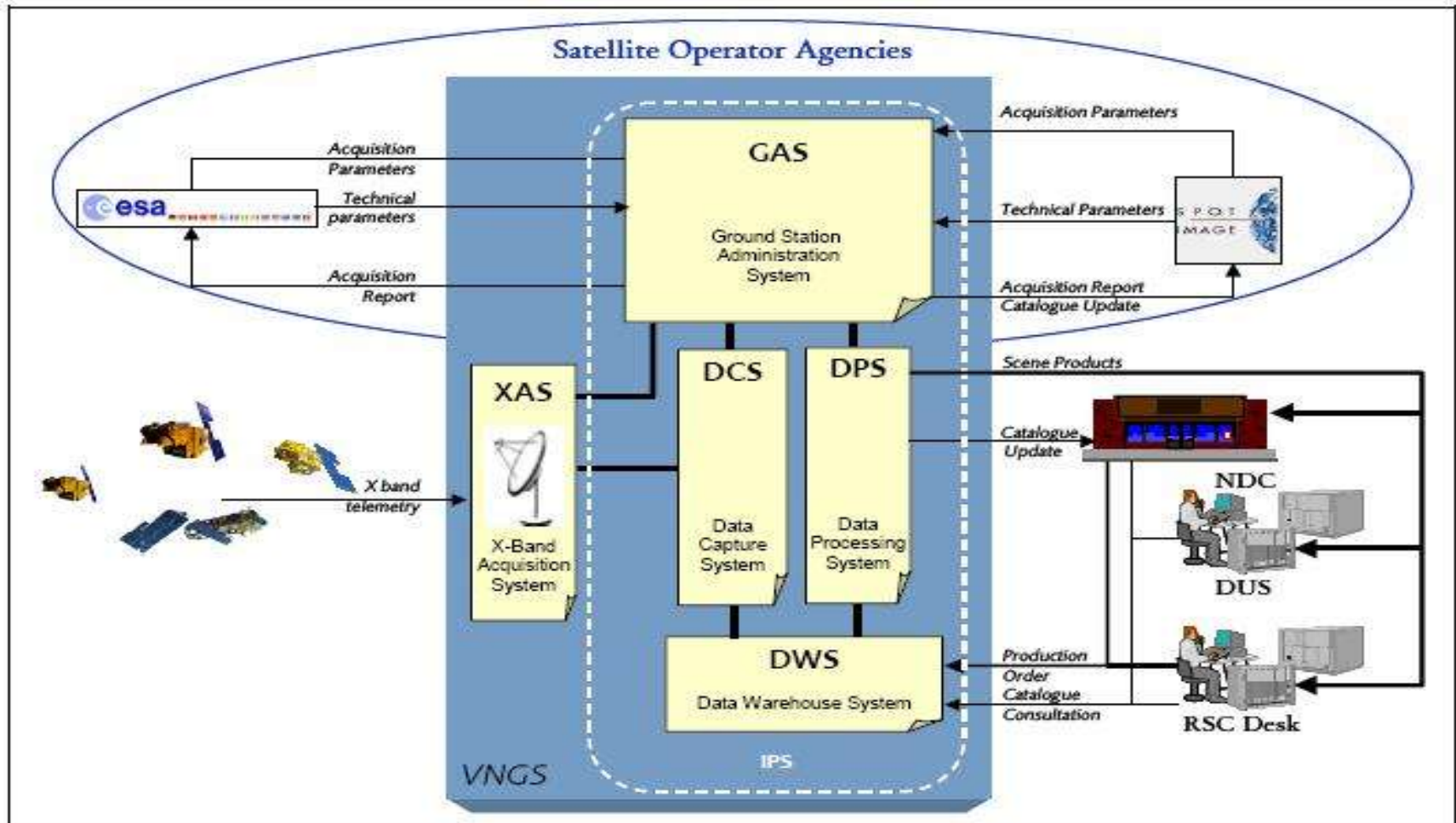
# Strategy implementing activities

- Dec. 2005: kick-off of the project on establishment of the Environment, Natural Resources Monitoring System (ENRMS) with following objectives:
  - To build a ground receiving station (VNGS);
  - To establish the National remote sensing Data Centre (NDC);
  - To strengthen the Data Use System (DUS);
- Nov. 20, 2006: the Prime Minister signed a directive to establish the Space Technology Institute to act as the national central space technology research institute as well as the permanent office of the National Space Committee.

# Strategy implementing activities

- January 2008: kick-off of the national scientific research program on space science and technology.
- April 18, 2008: Launched the first Vietnamese communication satellite VINASAT-1.
- Sep. 21, 2010: establishment of Vietnam Space Committee.
- Sep. 16, 2011: establishment of Vietnam National Satellite Centre and kick-off of the Vietnam Space Centre project.
- May 16, 2012: Launched the second Vietnamese communication satellite VINASAT-2.
- May 07, 2013: Launched the first Vietnamese earth observation satellite VNREDSat – 1.

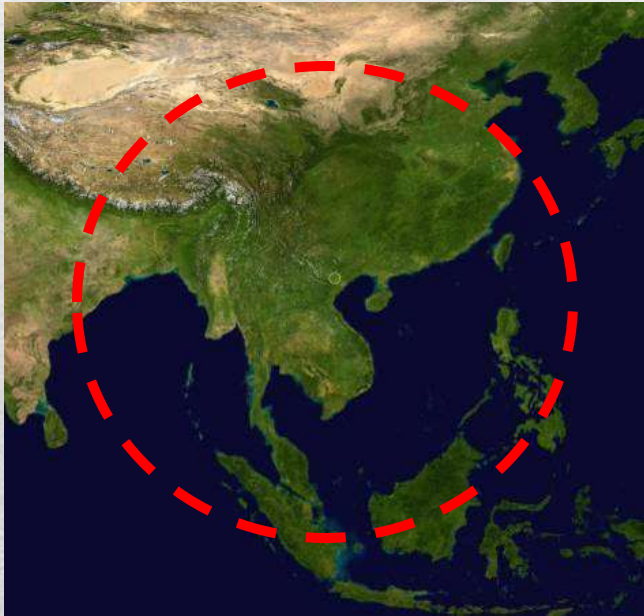
# Environment, Natural Resources Monitoring System (ENRMS)





# Ground Receiving Station

- 5.4m diameter parabolic antenna;
- Data capture system;
- Data processing system;
- Data warehouse system;
- Ground station administration system.



- Operated by MONRE
- Start to operate in November 2007;
- Designed to receive telemetry from SPOT and Envisat satellites, upgraded to receive VNREDSat-1 data.

# National Remote Sensing Data Centre (NDC)

The role of NDC is to produce higher level products, create and manage a nationwide common use remote sensing database. It is linked with VNGS through the internal local area network and with DUS through wide area network and can online accept the request from users, co-operate with VNGS to meet the user's requirement





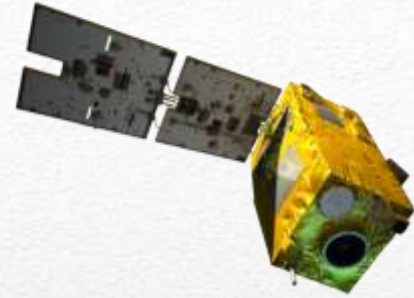
# Communication satellites VINASAT-1/2

- Designed and built by Lockheed Martin Space Systems.
- Launch: April 19, 2008/ May 16, 2012
- Orbit: Geostationary at  $132^{\circ}/131^{\circ}.8$  east longitude.
- Transponders:  
12 KU, 8 Extended C/24 KU-band.
- Mass: 2.800/3.000 kg.
- Lifetime: least 15 years.



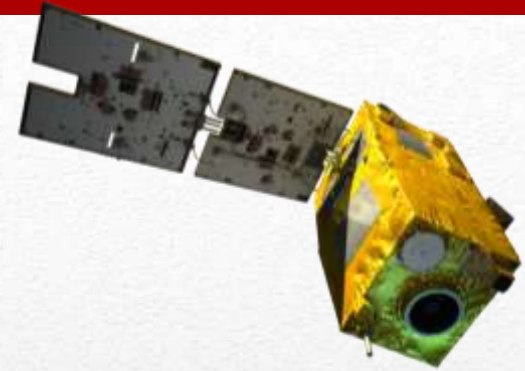


# VNREDSat – 1 Project



1. Design, manufacture and launch of VNREDSat-1 Earth Observation Satellite.
2. Building the Satellite Ground Control Station.
3. Upgrading the Existing Receiving Station to receive VNREDSat – 1 images.
4. Construction of a satellite image calibration site.
5. Setting up a Communication links between Ground stations.
6. Training and transfer to Vietnam the Small Satellite Technology

# VNREDSat-1



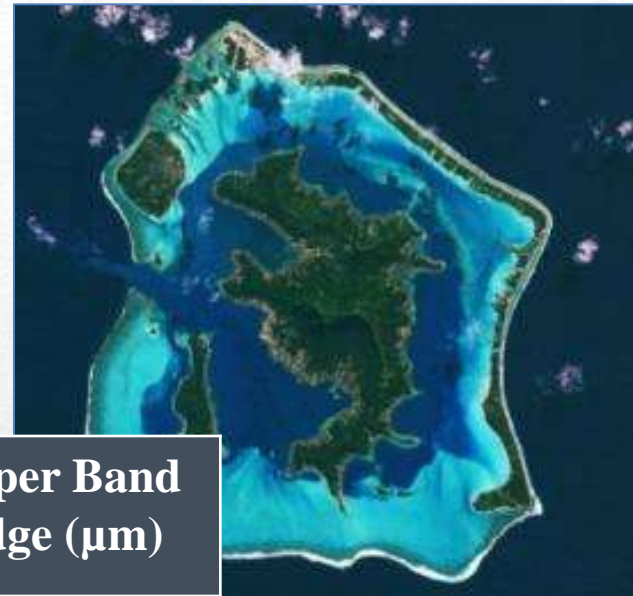
- Mission: Earth observation in PAN and 4 spectral bands
- Spatial resolution: **2.5m** (PAN) and **10m** (MS)
- Orbit: **SSO, 680 km** altitude
- Descending local time : **10:30 AM**
- Revisit time: **3 days**
- Platform dimension: **600 mm x 570 mm x 500 mm**
- Total mass: **~130kg**
- Life-time: **5 years (guaranteed)**
- Launch: May 7, 2013

# VNREDSat-1 satellite overview





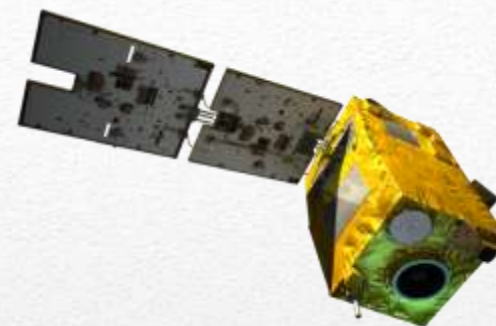
# Spectral bands



Band	Name	Lower Band Edge ( $\mu\text{m}$ )	Upper Band Edge ( $\mu\text{m}$ )
Panchromatic	PAN	$0.45\pm 0.02$	$0.75\pm 0.02$
Blue	B1	$0.45\pm 0.02$	$0.52\pm 0.02$
Green	B2	$0.53\pm 0.02$	$0.59\pm 0.02$
Red	B3	$0.625\pm 0.02$	$0.695\pm 0.02$
Near Infrared	B4	$0.76\pm 0.02$	$0.89\pm 0.02$

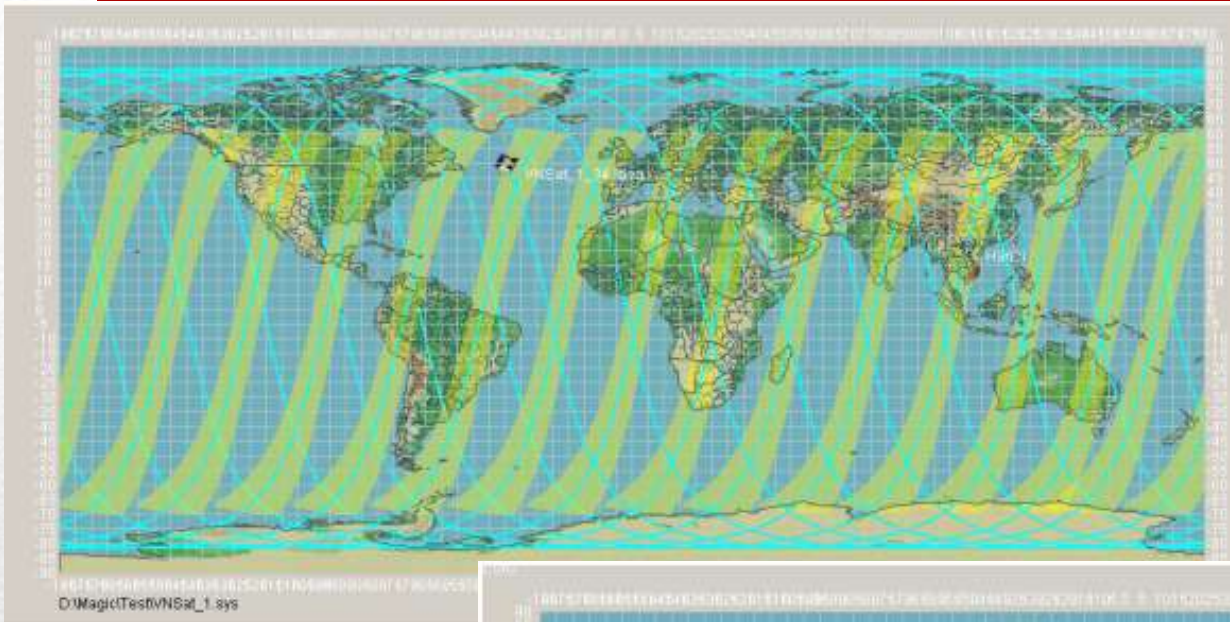


# Imaging capability



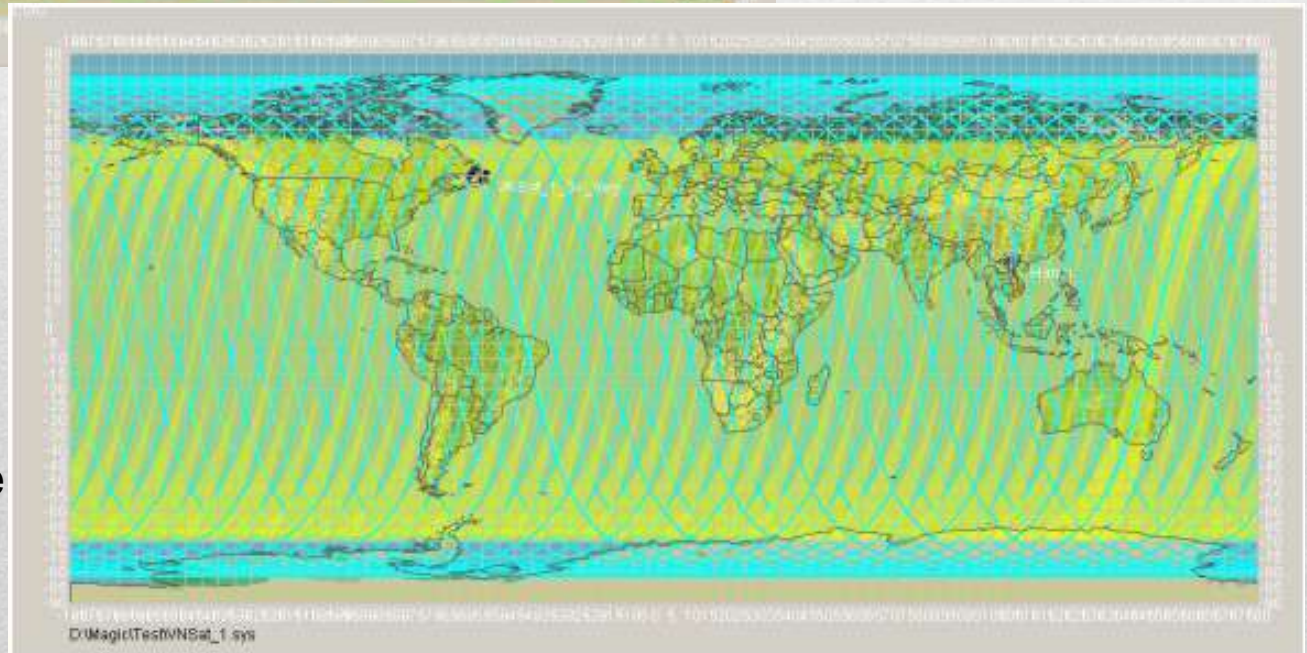
- Spatial resolution: **2.5m** (PAN) and **10m** (MS)
- Imaging modes: single shot, scanning, stereo
- Swath: **17.5 km**
- Strip length: **823 km** (PAN + MS)
- Number of acquired images per day: **100 scenes**
- Max. acquisition inclined angle: +/- 35 degrees





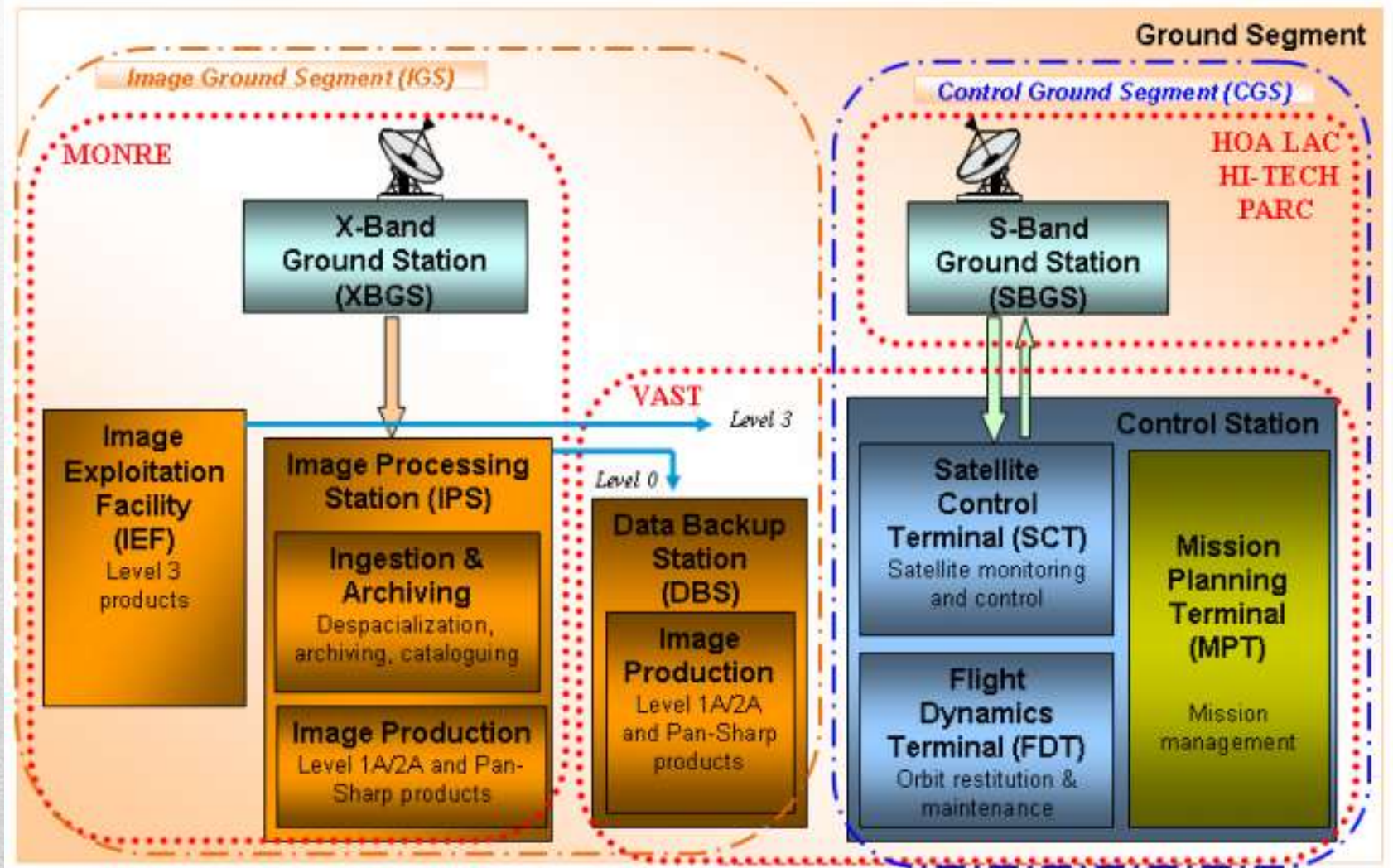
VNREDSat-1 access corridors over 1 day

VNREDSat-1 access corridors over 3 day:  
Whole world coverage





# VNREDSat-1 Ground segment architecture



# S-band Station (Hoa Lac Hi-tech Park)





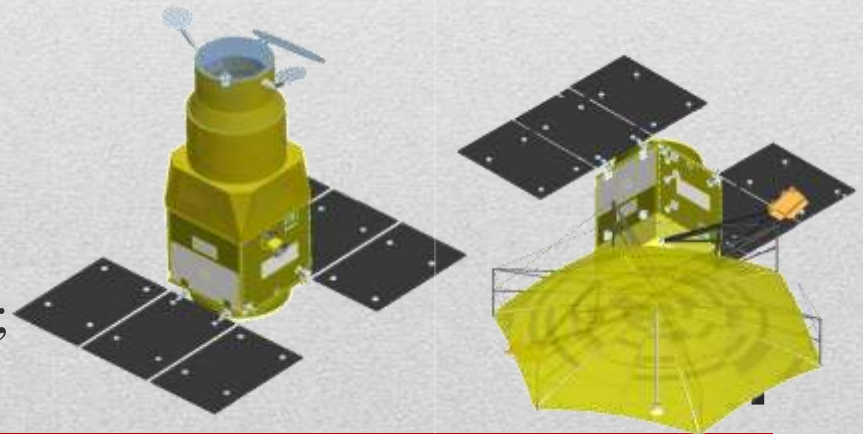
# VIETNAM SPACE CENTRE PROJECT

- Total investment: 54.4 billions ¥
- ODA: 46.595 billions ¥
- Government investment: 1774 billions VND
- Investor: VAST
- Implementing Agency: VNSC
- Project duration: 2012-2020



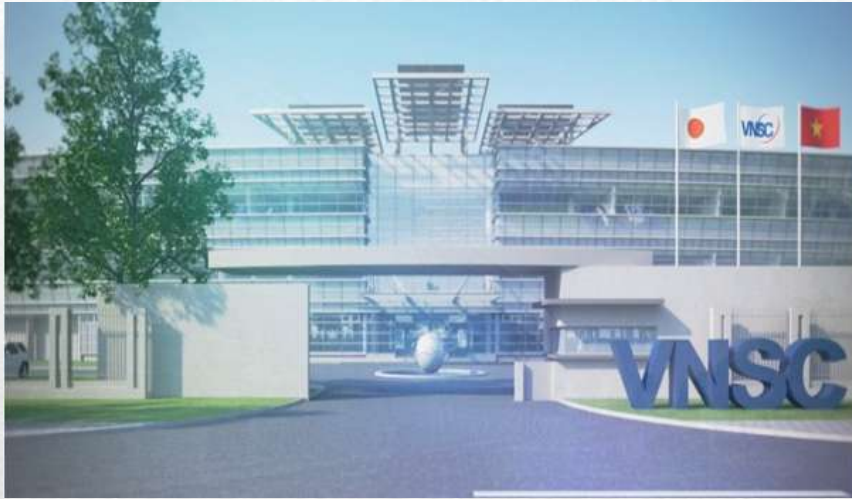
# Vietnam Space Centre Project

- Building Space infrastructure:
  - Space Centre in Hoa Lac High-Tech part;
  - Space capacity building and technology transfer Centre in Hanoi;
  - Astronomic station in Nha Trang;
  - Space Technology Application Centre in HoChiMinh city.
- Building and launch 2 radar earth observing satellites (first one produced in Japan, second one assembled and tested in Vietnam)
- Capacity development:
  - Overall management of Vietnam Space Centre;
  - Satellite production and operation;
  - Satellite data utilization.





# Space Centre in Hoa Lac



Administration and Satellite control and Application Centre



Research and Development Centre



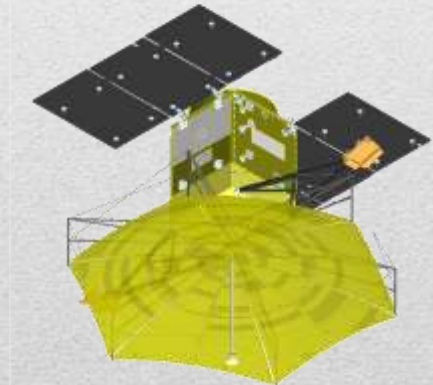
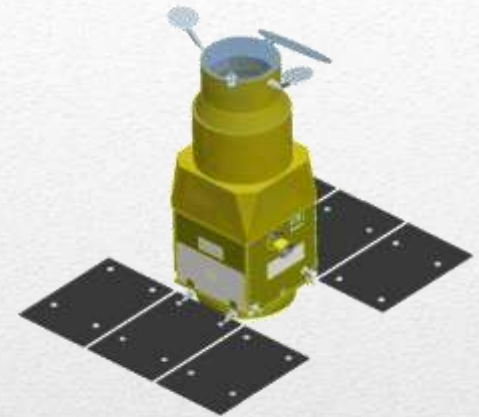
Training Centre



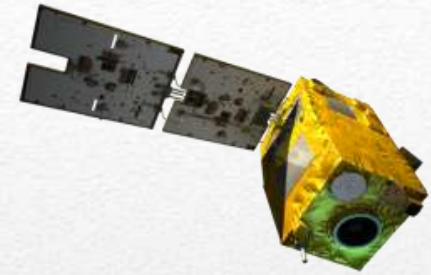
Satellite assemble, Integration and Test Centre

# Earth Observing satellite

- Launch time: 2017 and 2020
- Satellite Mass: < 500kg
- Size: 1.5m x 1.5m x 3m (H)
- Orbit: 500km, SSO
- Mission Sensor: SAR (X band)
- Resolution: 1 to 10m
- Mode: Spot, Strip
- Data Storage: 96 Gbytes
- Telemetry and Command: S Band
- Data transmission: X Band







# Space Technology Institute

# Space Technology Institute



Space Technology Institute was established on Nov. 20, 2006 by decision number 1549/QĐ-TTg of the Prime Minister to act as the central governmental research institute on space technology.



# STI Functions



Space Technology Institute has a mandate to conduct the fundamental researches and develop the applications of space science and technology including following tasks:

- Conduct the researches on space science and technologies to master the small satellite technology in order to be able to design and build small satellites; Apply space science and technology in various fields; provide value-added services in the space technology field.
- Develop the infrastructures for research and application of space technology: the laboratories and experimental facilities on space technology, earth observation satellite, ground stations etc.

# STI Functions

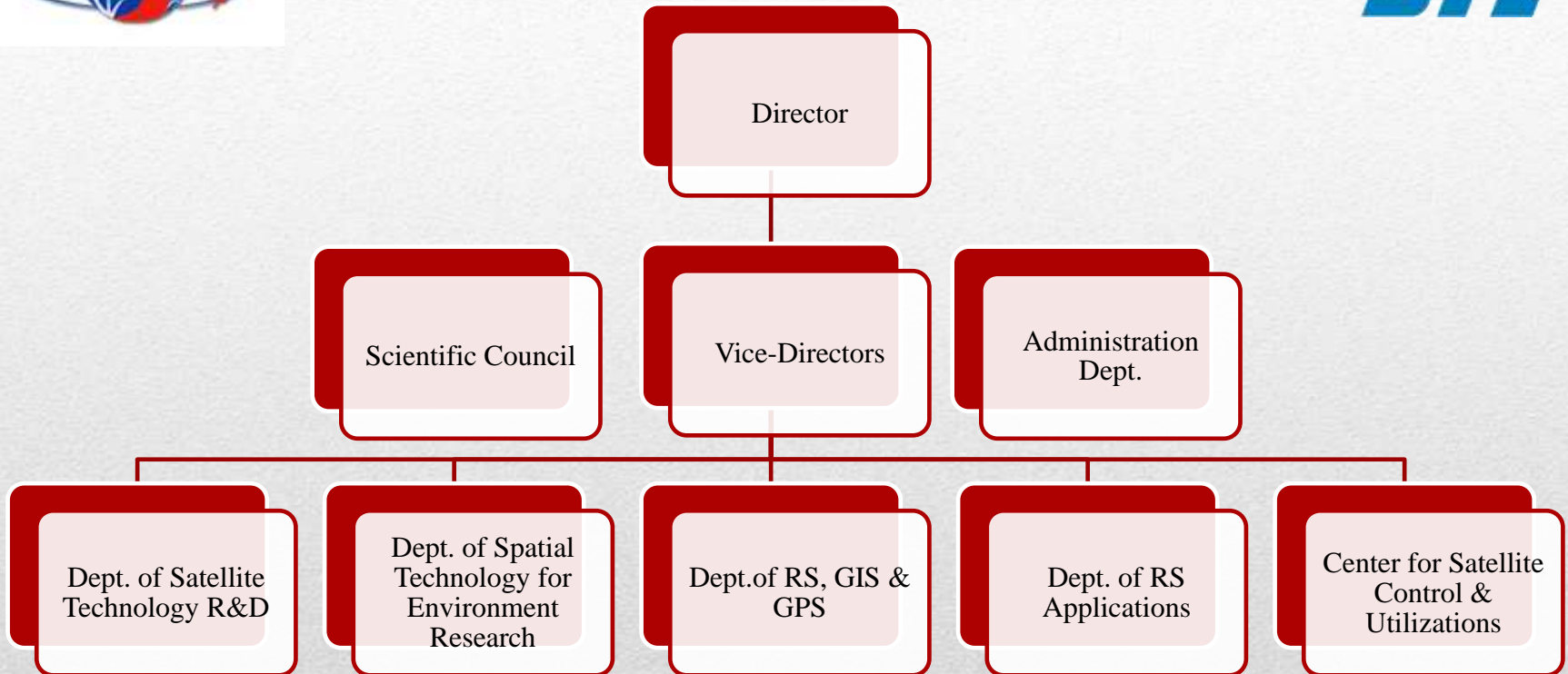


- Consultation with the governmental management agencies on the policy for development and application of space technology, legal questions on free space exploration; act as a permanent technical office to assist the Vietnam Committee for Space Research and Application; Provide the information on the application and development of the space technology for management purpose and to meet the requirement of the industries and utilities.
- Provide post-graduate training, deliver lectures in universities and propagate the knowledge on space technology.
- International cooperation on space science and technology.





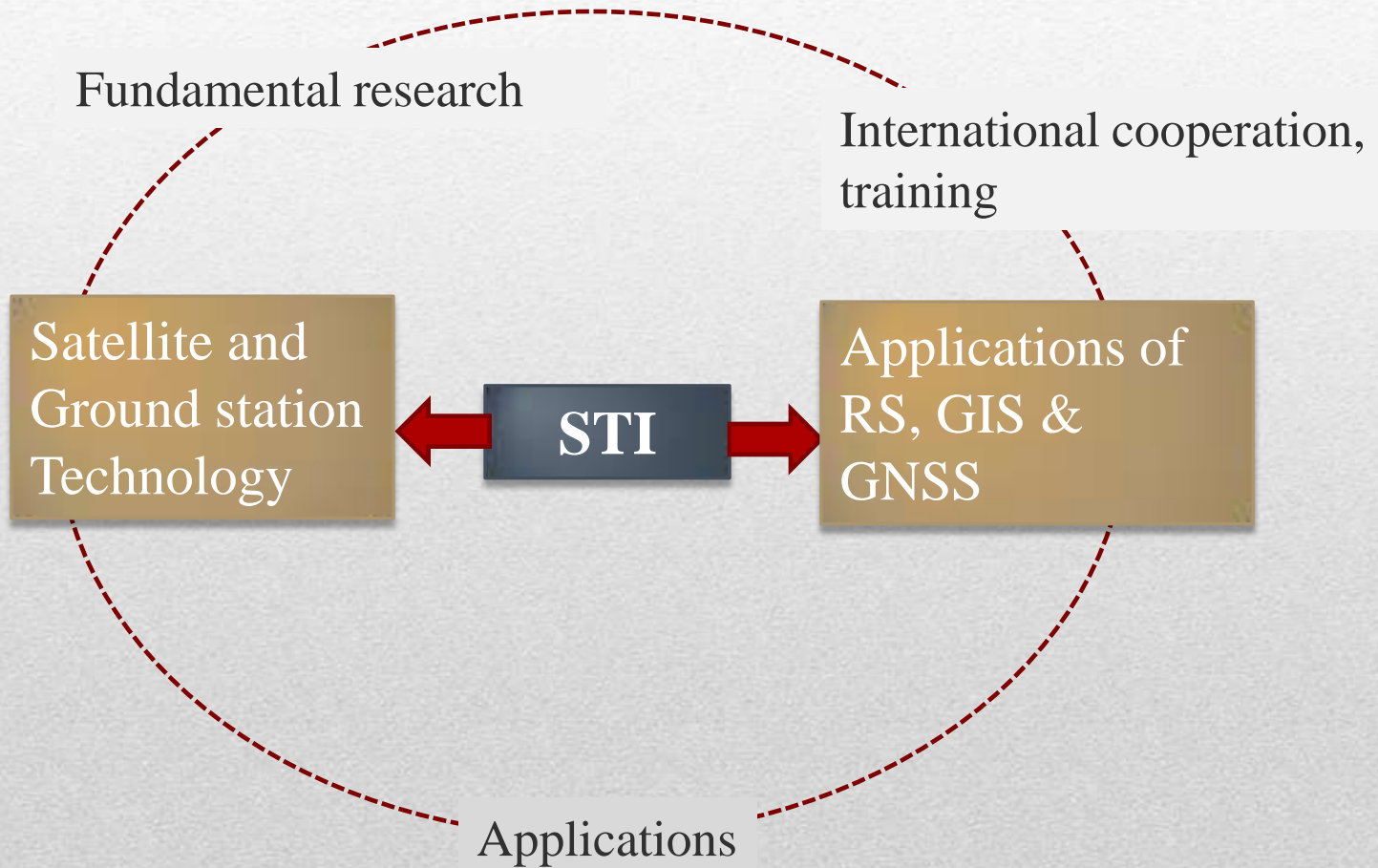
# STI Organization



Until 7/2015, STI has 60 staffs, in which 6 PhD; 6 Doctoral fellows; 25 MSc; 28 engineers & Bachelor.

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# STI – Functions





# Receive small satellite technology

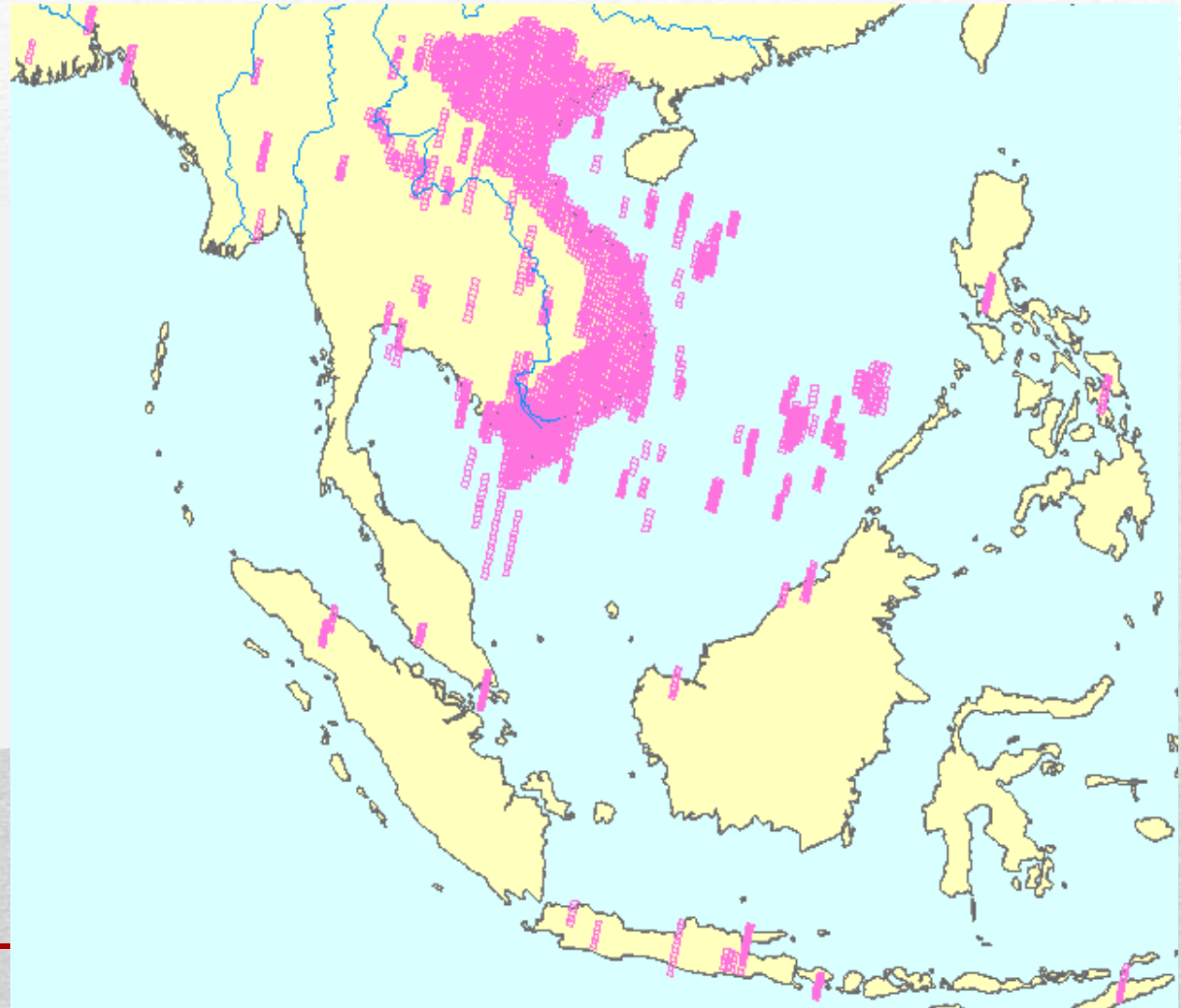


18 of STI's engineers studied to manufacture and operate the VNREDSat-1  
At Astrium EADS, Toulouse, France (8/2011-12/2012)

# Image acquisition planning and Control of VNREDSat-1

Accounting to 30/6/2015, VNREDSat-1 has captured and downlinked:

- **In total: 30439 scenes** (15236 MS and 15203 PAN)





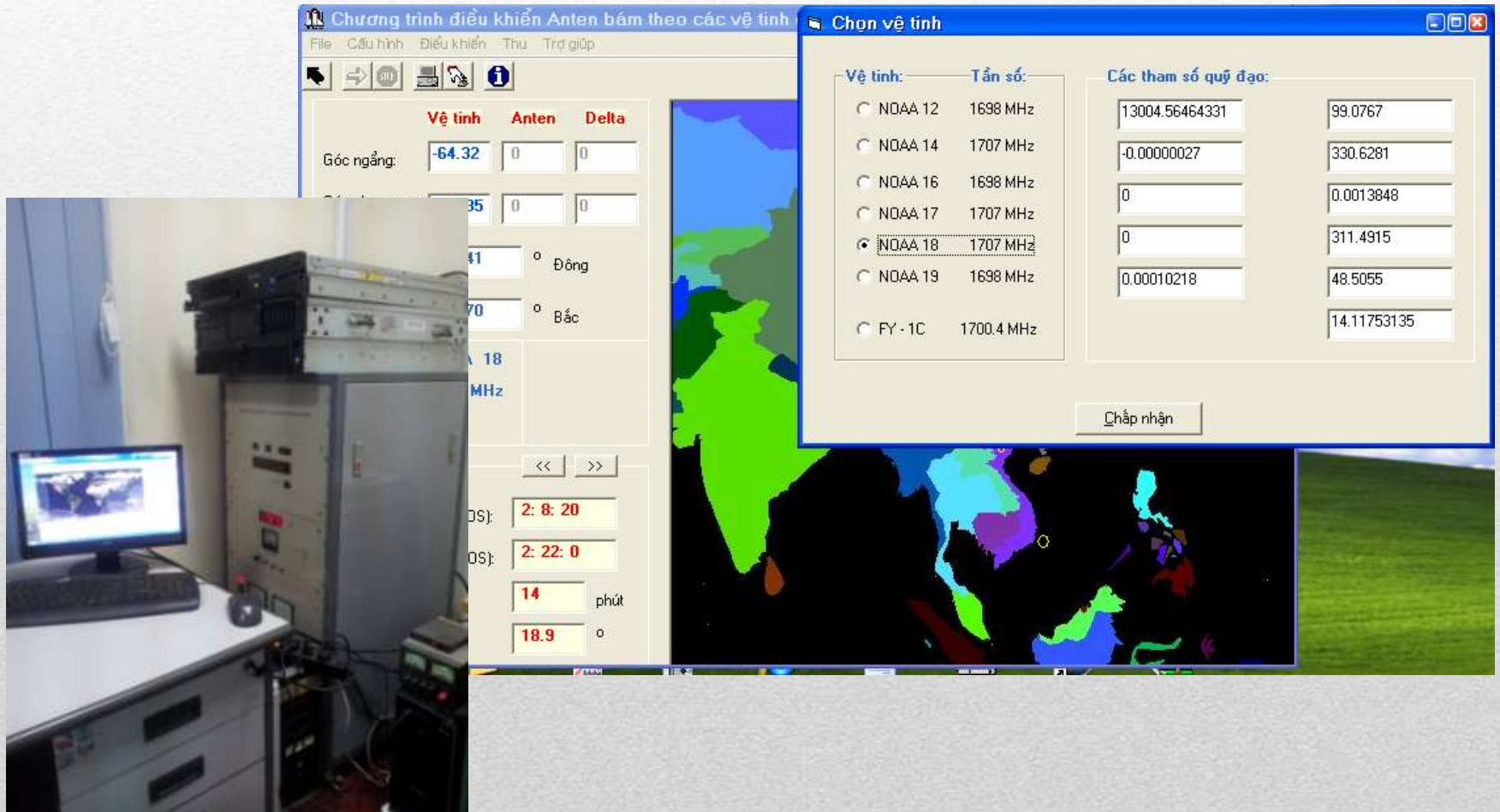
# Image acquisition planning and Control of VNREDSat-1

VNREDSat-1 satellite has captured and downlinked:

- In Vietnam: **16335 scenes** (8143 MS and 8192 PAN)



# Design and manufacture of receiving station for meteorological satellites



The image displays a photograph of a receiving station for meteorological satellites, overlaid with a software interface. The software interface consists of two windows:

- Chương trình điều khiển Anten bám theo các vệ tinh**: This window shows a table for antenna control. The table has columns for 'Vệ tinh' (Satellite), 'Anten' (Antenna), and 'Delta'. The 'Góc ngắm:' (Viewing angle) is set to -64.32. Below the table, there are buttons for '<<' and '>>', and several numerical input fields with units: '2: 8: 20', '2: 22: 0', '14 phút', and '18.9 °'.
- Chọn vệ tinh**: This window allows selecting a satellite. It lists satellites and their frequencies:

Vệ tinh:	Tần số:
<input type="radio"/> NOAA 12	1698 MHz
<input type="radio"/> NOAA 14	1707 MHz
<input type="radio"/> NOAA 16	1698 MHz
<input type="radio"/> NOAA 17	1707 MHz
<input checked="" type="radio"/> NOAA 18	1707 MHz
<input type="radio"/> NOAA 19	1698 MHz
<input type="radio"/> FY-1C	1700.4 MHz

Below the list, there are input fields for 'Các tham số quỹ đạo:' (Orbit parameters):

13004.56464331	99.0767
-0.00000027	330.6281
0	0.0013848
0	311.4915
0.00010218	48.5055
	14.11753135

A 'Chấp nhận' (Accept) button is located at the bottom of the 'Chọn vệ tinh' window. The background of the software interface shows a map of the world with a satellite's path overlaid.



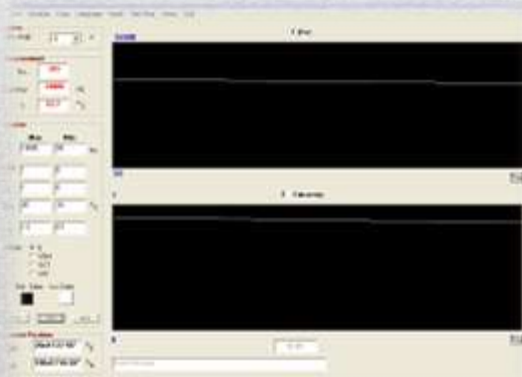
# Design and manufacture spectrometers for use on ground, in airplane and UAV



# Design and manufacture of microwave radiometers



Ảnh 16. Xổ lý số liệu sau khi đo của chuyên gia Việt Nam - Dzung Anh  
Phòng Thí nghiệm STAC, Viện Vaf Tg, Trung tâm KHVN & CNQG (10/2001)





# Development of software for image processing and management



The image displays the ENVI 4.7 software interface. The main window shows a satellite image of Vietnam with a search tool and a results panel. The 'Classification' menu is open, listing options like Supervised, Unsupervised, and Object-based Classification. A dialog box titled 'Object-based Classification' is open on the right, showing a list of ROIs to use, a method selection dropdown (currently set to Maximum Likelihood), and output options.

**ENVI 4.7**

File SARscape Basic Tools Classification Transform Filter Spectral M

- Supervised
- Unsupervised
- Fast Scanning Segmentation
- Object-based Classification
- Decision Tree
- Object Based
- Endmember Collection

Spectral Map Vector Topographic Radar MODIS Window Help

Register MODIS Temperature Data  
Mosaicking  
Convert Map Projection  
Subset Image via ROIs

Cloud Removal  
Spectral Aggregation  
Temporal Aggregation

MODIS Specific Indexes

Linear Spectral Unmixing

Normalized Difference Vegetation Index  
Normalized Difference Soil Index  
Normalized Difference Water Index  
Land Surface Water Index

Difference Vegetation Index  
Ratio Vegetation Index  
Enhanced Vegetation Index

Salinity Index  
Anomaly Vegetation Index  
Temperature Vegetation Dryness Index  
Vegetation Condition Index

**CƠ SỞ DỮ LIỆU TRẠM THU ẢNH NOAA**

Tìm kiếm dữ liệu

Loại ảnh  
Mức số tỷ  
Ngày chụp

Kết quả tìm kiếm

20/05/2013 20/05/2013

2013 - Phòng Công nghệ Viễn thám, GIS và GPS, Viện Công nghệ Vệ Tru, Viện Hàn lâm Khoa học và Công nghệ Việt Nam - Cầu Giấy - Hà Nội

**Object-based Classification**

Select ROIs to use

- [1] mặt nước 1
- [2] mặt nước 2
- [3] đất o đò thi
- [4] đất NN 1
- [5] Đất NN 2
- [6] bãi bồi

Number of items selected: 0

Method

Maximum Likelihood

Parallelepiped  
Minimum Distance  
Maximum Likelihood  
Spectral Angle Mapper  
Spectral Information Divergence  
Mahalanobis  
Binary Encoding

Data\_S

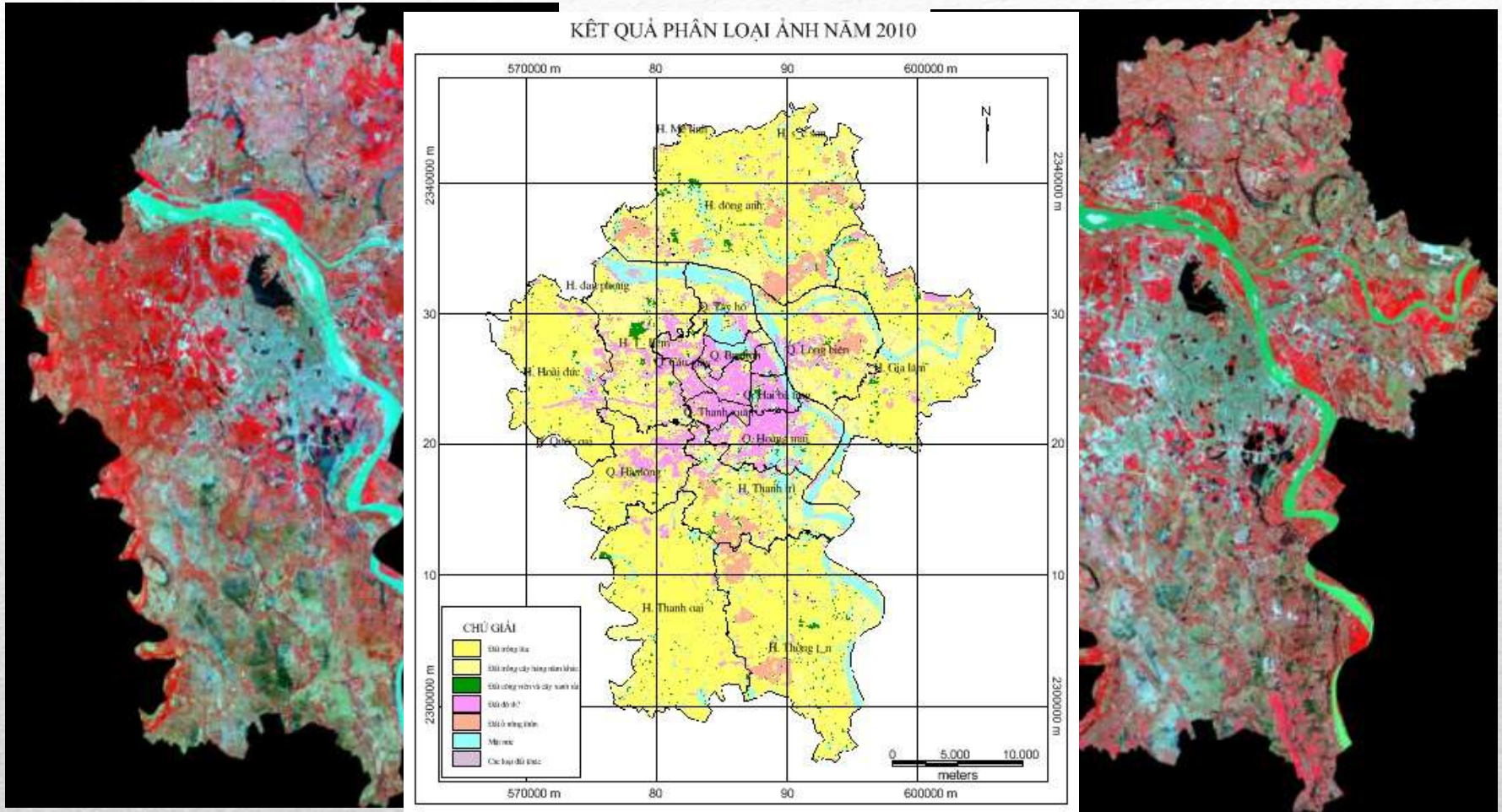
Thresh

Std Mul

Output Result to  File  Memory

Output Classification file:

# Applications



Land use mapping and land use change detection

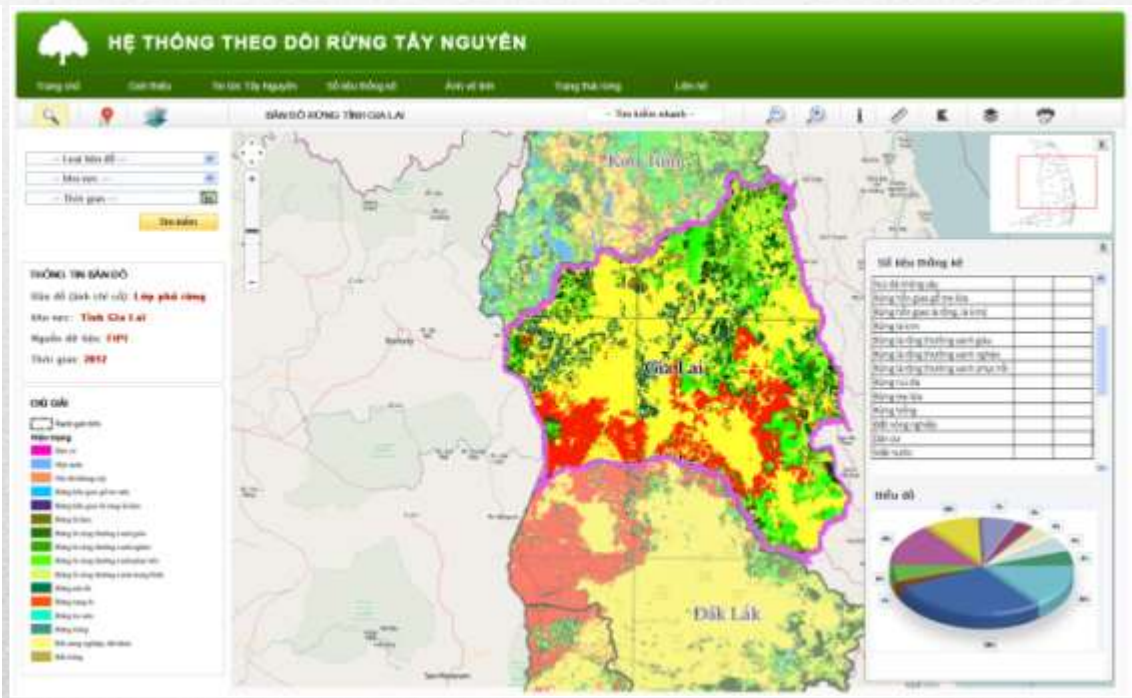




# Applications



Forest management.



Forest information system of Central Highland



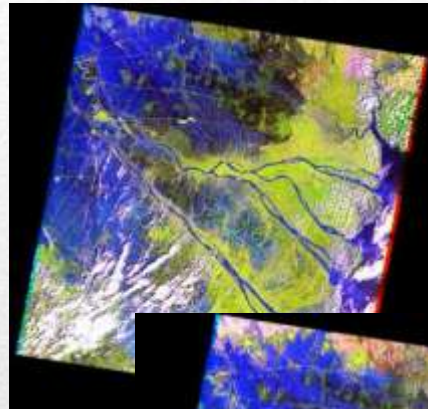
# Applications

## Forest fire detection

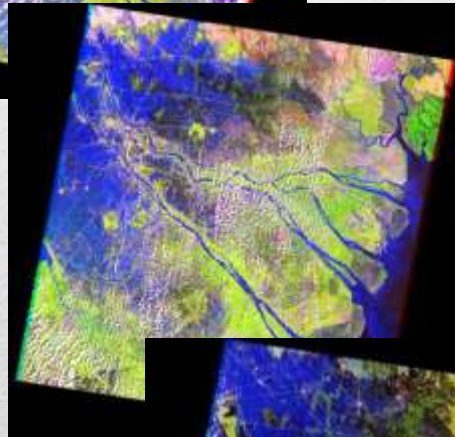
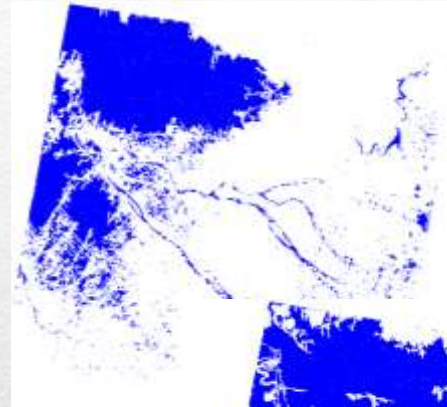




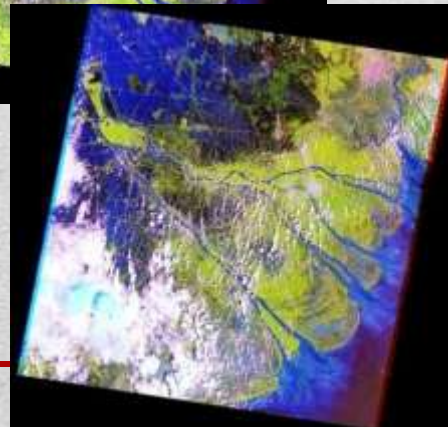
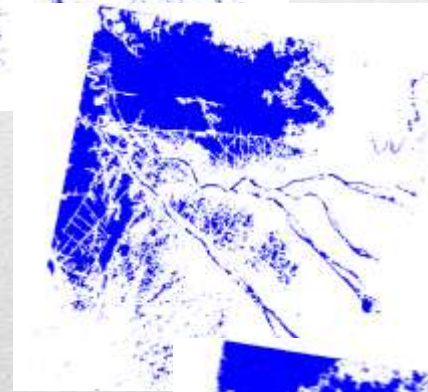
# Applications



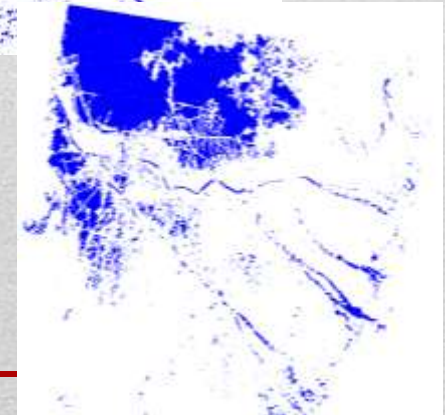
2000



2001



2003



Flood Monitoring

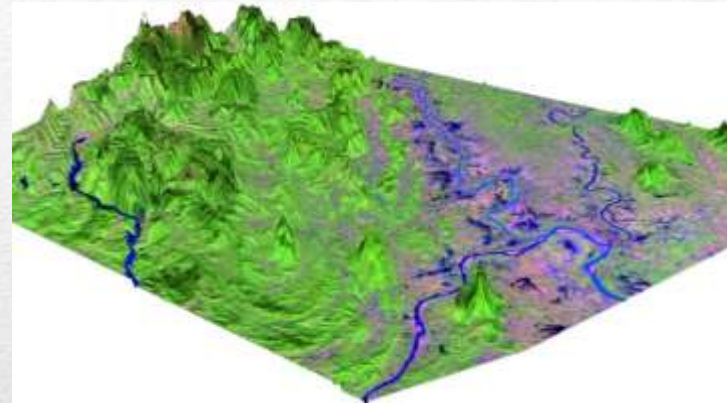
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# Applications



Drought monitoring.



 Green space

 Drought

# Applications

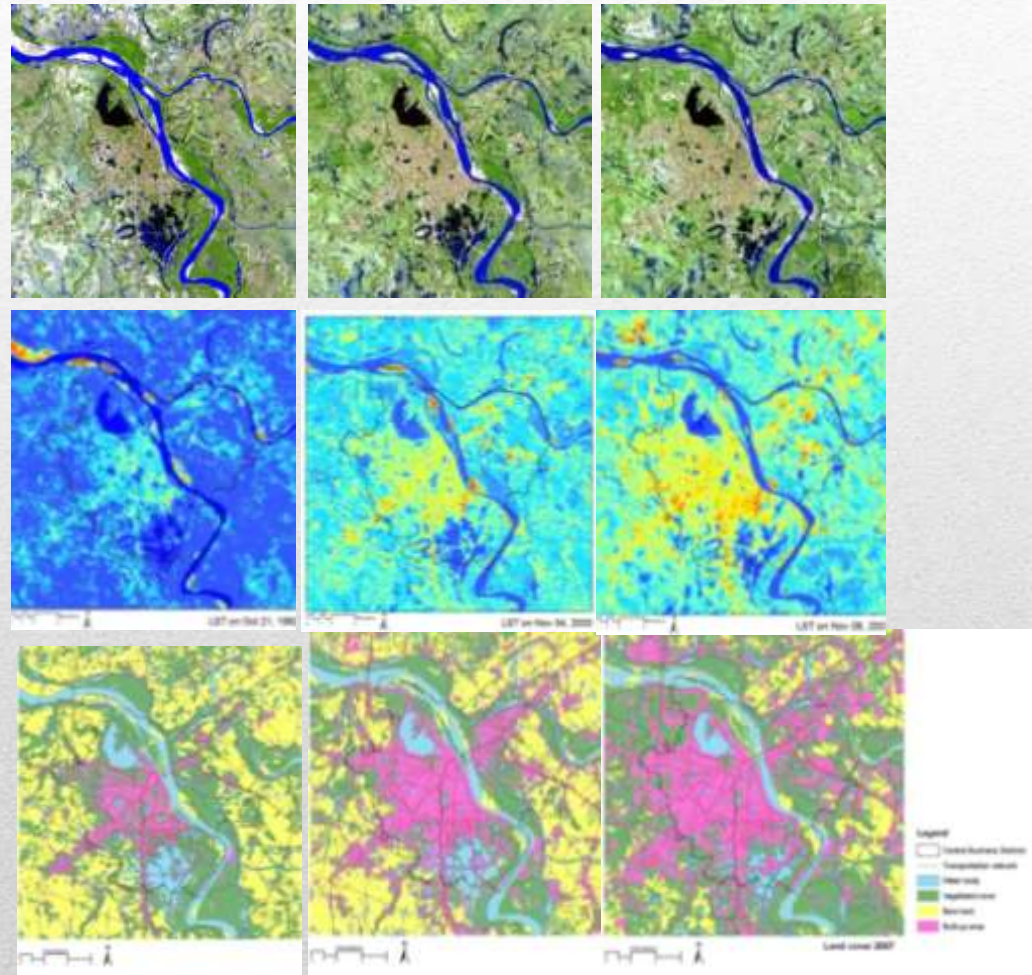


Monitoring the subsidence of the construction using GPS

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# Applications



Urban heat  
island  
monitoring

# Ongoing Projects



- Development of the methodology and software for hyperspectral image processing and analysis;
- Application of the VNREDSat – 1 images and GIS for monitoring and forecast the coffee production in Tay Nguyen plateau;
- Application of radar images from multiple satellites for rice monitoring in Thai Binh province;
- Application of VNREDSat – 1 imagery for forest inventory in Can Gio district;
- Application of remote sensing for estimation of forest biomass, its ability of CO<sub>2</sub> absorption and carbon reservation;



# THANK YOU!

