



Geo-Informatics and Space Technology Development Agency (Public Organization)



**GISTDA**

# **THEOS: A New Era in Space Missions of THAILAND**

## **COPUOS : 09-20 February 2008**

### **UN, AUSTRIA**

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# TOPICs Summary

- ❖ THEOS Background
- ❖ THEOS Architecture & Characteristics
- ❖ THEOS Operations and Products
- ❖ THEOS MISSIONS
  - National Level
  - International Level



# THEOS Background 1/2

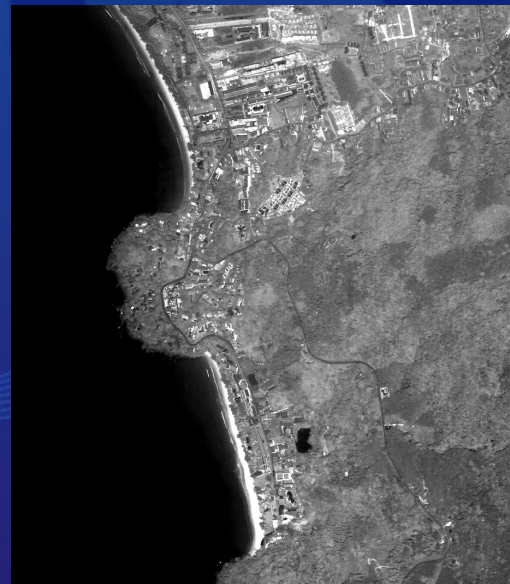
- ❖ After several years of using satellite remote sensing from foreign system, Thailand decided to develop of its own satellite.
- ❖ Thailand Earth Observation System (THEOS) program is developed by GISTDA with EADS as a prime contractor.
- ❖ The THEOS satellite manufacturing begun in 2005 and completed in 2007





## THEOS Background 2/2

- ❖ The successful launch was on 1<sup>st</sup> October 2008, by Dnepr Rocket from Yasni, Russia
- ❖ The 1<sup>st</sup> Image was acquired over Thailand, Phuket on 3<sup>rd</sup> Oct. 08.
- ❖ IOT period was 17<sup>th</sup> October – 7<sup>th</sup> December 2008,



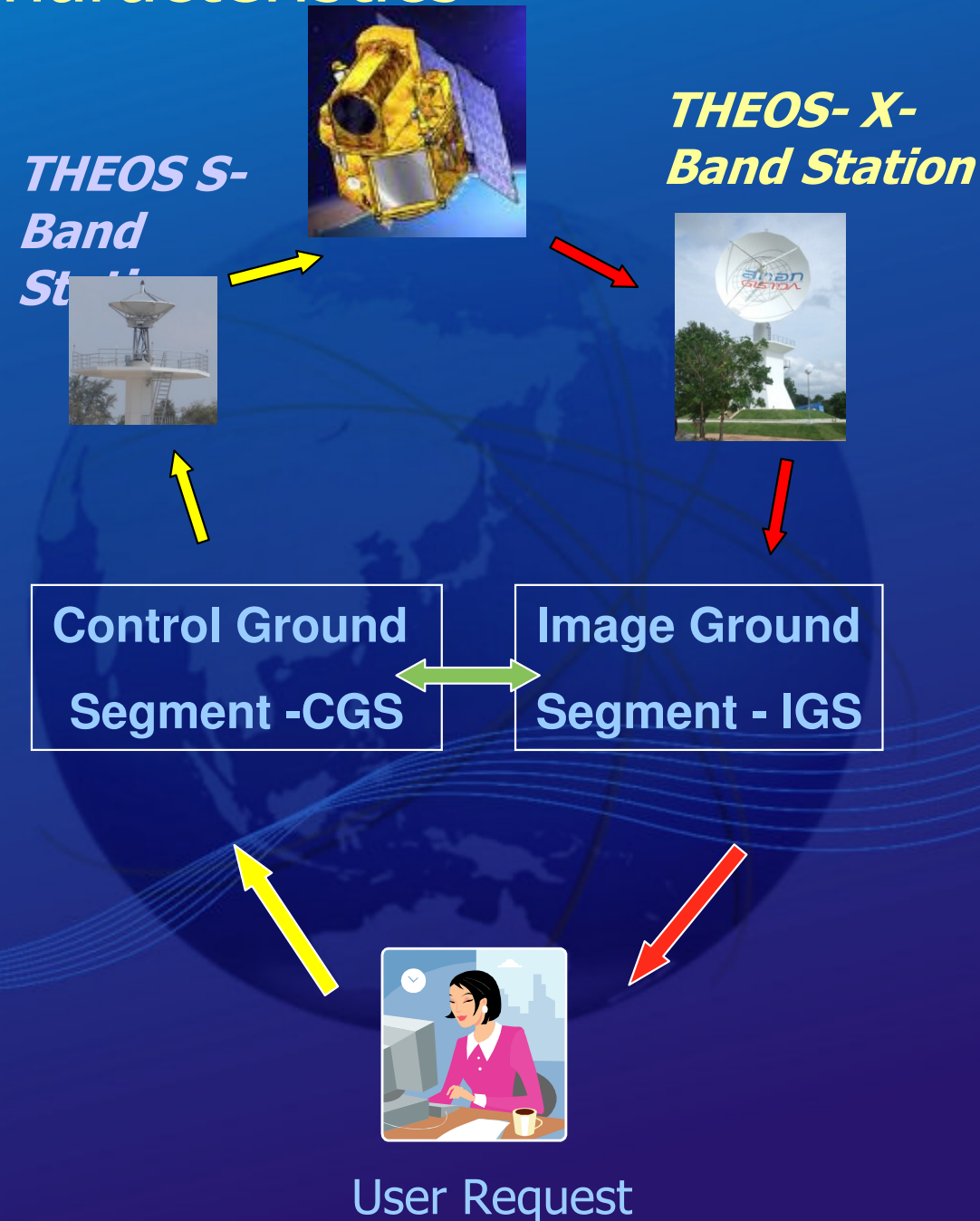




# THEOS Architecture & Characteristics

❖ THEOS is a stand-alone earth observation system comprise of :

- THEOS Satellite (Space Segment)
  - Payload (imaging)
  - Bus (services function)
- Ground Facilities (Ground Segment)
  - Control Ground Segment (CGS)
  - Image Ground Segment (IGS)





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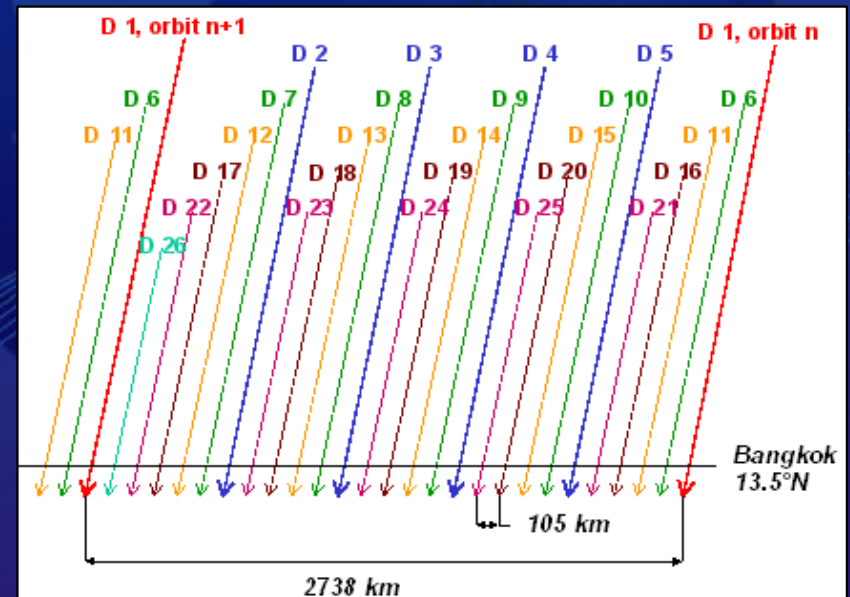
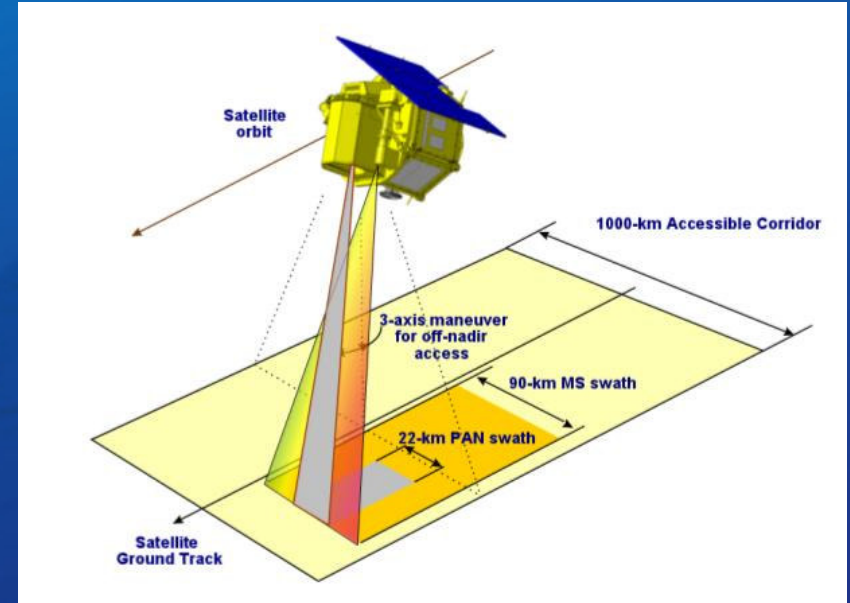
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# THEOS Satellite



# THEOS Performance

Orbit Type	Circular SSO low earth orbit
Attitude	822 km
Number of Orbits per Day	14+5/26 orbits per day
Local Equator Crossing Time	10:00 am (descending)
Orbit Period	101 minutes
Orbit Inclination	98.7
Orbit Cycle	26 days (369 orbits)
Distance Between Passes (at Equator)	108 km (Between 2 closest passes) 2800 km (Between 2 consecutive passes)
Coverage Area	Radius more than 2000 km from Ground Station







# THEOS Satellite : Payload

## THEOS Optical Payload :

- PAN Telescope
- MS Camera
- Instrument Processing Unit (IPU)

	PAN	MS
<b>Resolution (m)/ Imaging swath (km)</b>	<b>2/22</b>	<b>15/90</b>
<b>Spectral ranges (um)</b>	0.45 – 0.90	B1 (Blue): 0.45-0.52 B2 (Green): 0.53-0.60 B3 (Red): 0.62-0.69 B4 (NIR): 0.77-0.90
<b>Signal to Noise Ratio</b>	<b>&gt; 140</b>	<b>&gt;200</b>
<b>Imaging dynamics</b>	<b>8 bits among 12 bits</b>	
<b>Absolute localization accuracy</b>	<b>~ 190 m</b>	
<b>Off-nadir viewing</b>	<b>± 50° (roll and pitch)</b>	



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# THEOS Ground Segment



# THEOS Ground Segment

## ❖ Control Ground Segment –CGS

### ❖ S Band Station

- Satellite to Ground IF for TM/TC

### ❖ SCC : Satellite Control Center

- Satellite Commanding
- Satellite Monitoring

### ❖ FDS : Flights Dynamics System

- Orbit management
- Orbit manoeuvres computation

### ❖ MPC : Mission Planning Center

- Imaging Request Deposit
- Mission Planning





# THEOS Ground Segment

## ❖ Image Ground Segment - IGS

### ■ **X-Band Station**

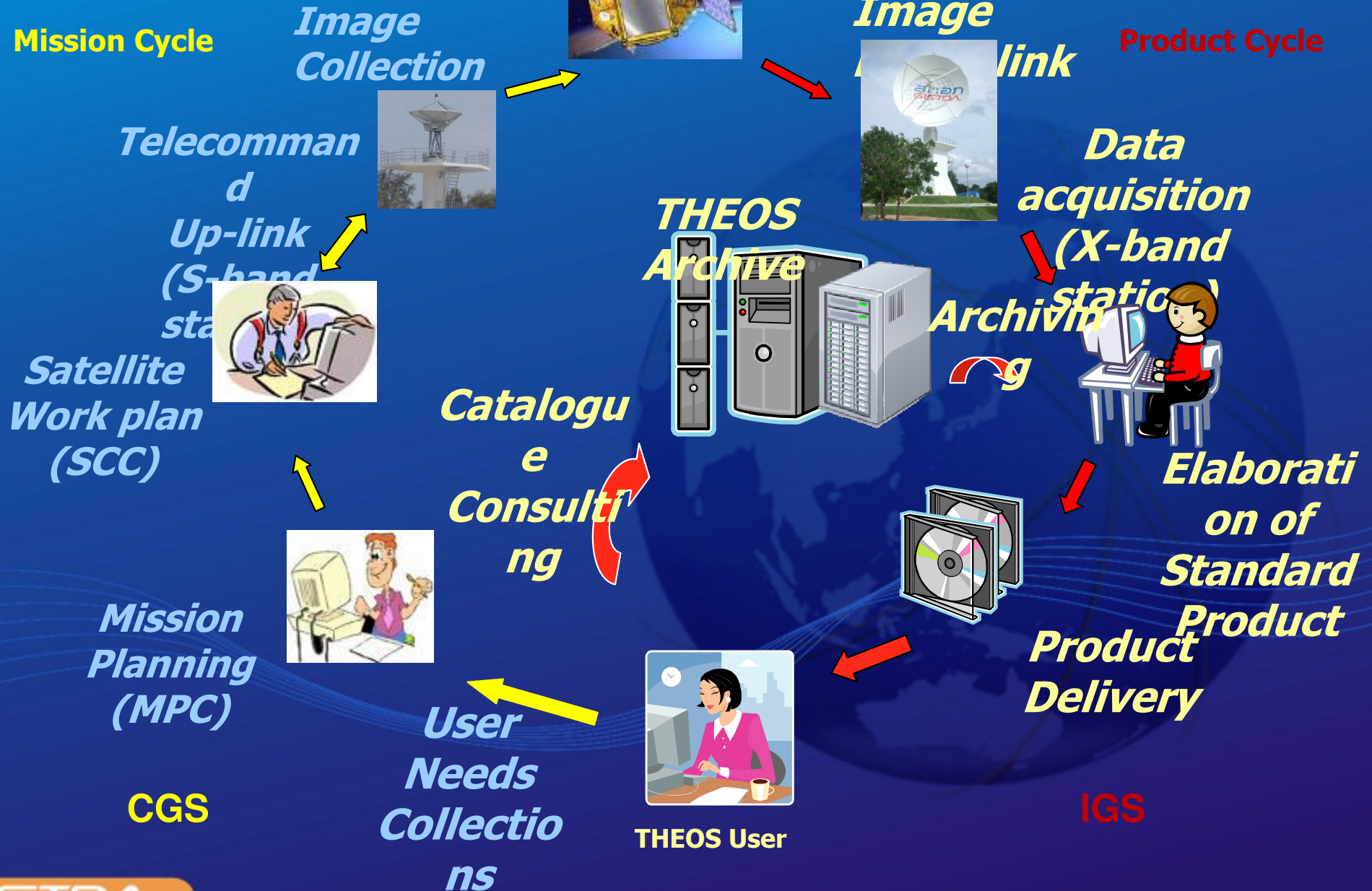
- Control Antenna and Satellite to Ground IF THEOS Telemetry data

### ■ **Data Processing Facilities - DPF**

- Acquire and process Theos telemetry
- Generate Gerald files
- Generate Catalogue
- Produce Standard products



# THEOS Operations





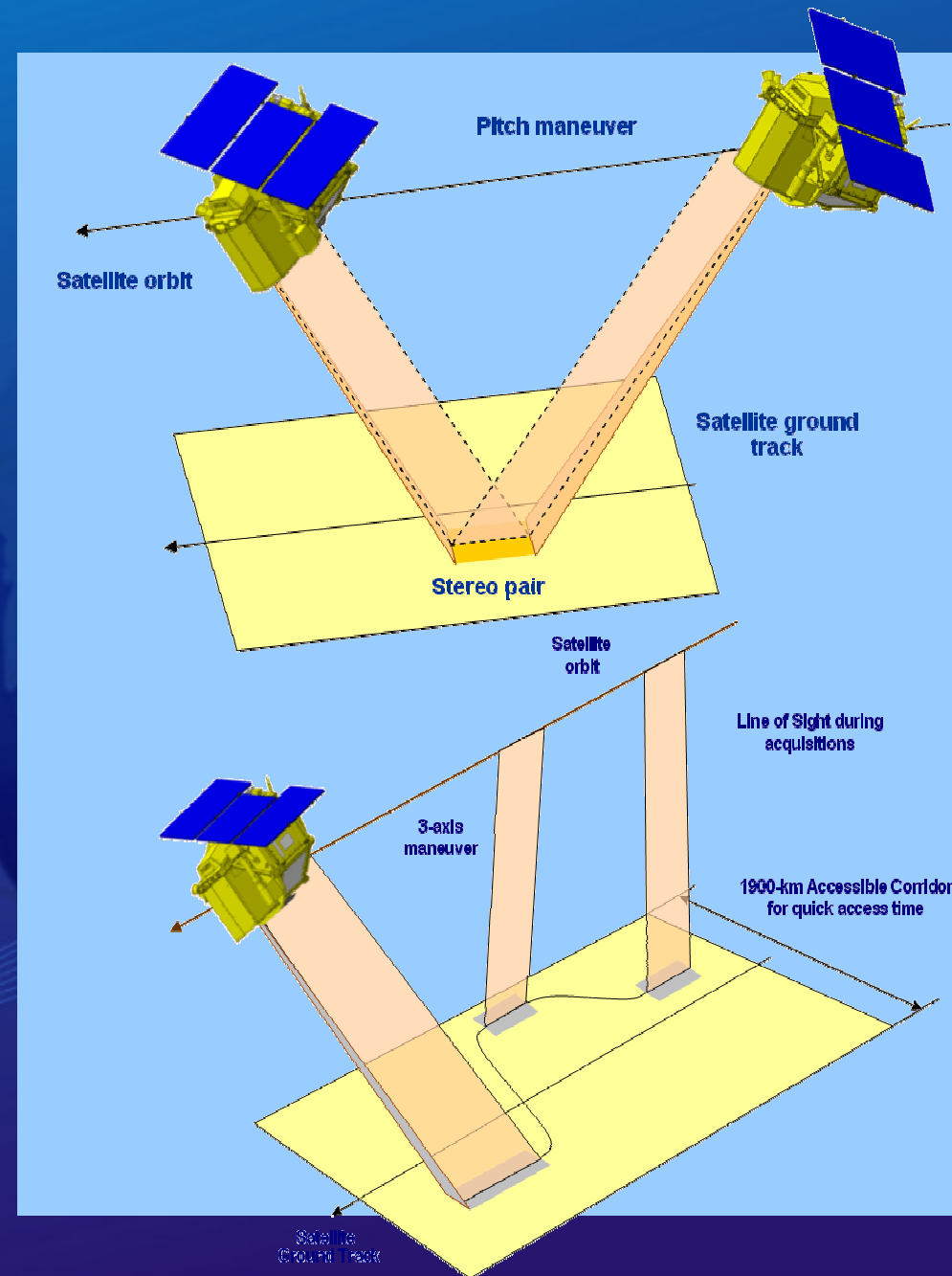
# Acquisition Capabilities

## ❖ Imaging Mode

- Multi targets mode
- Covering or Strip imaging mode

## ❖ Repeat Viewing Capabilities

## ❖ Stereoscopic Capabilities







# THEOS Products

## ❖ Standard Products

- Level 1A : Radiometric Corrected
- Level 2A : Radiometric , Systematic and Geometric Corrected
- Pan Sharpening : Fusion image color with 2m resolution, 2A image

**Products**

**Radiometric  
Correction**

**Geometric  
Systematic  
Correction**

**Systematic  
Correction &  
Map  
Projection**

**1A**

**2A**

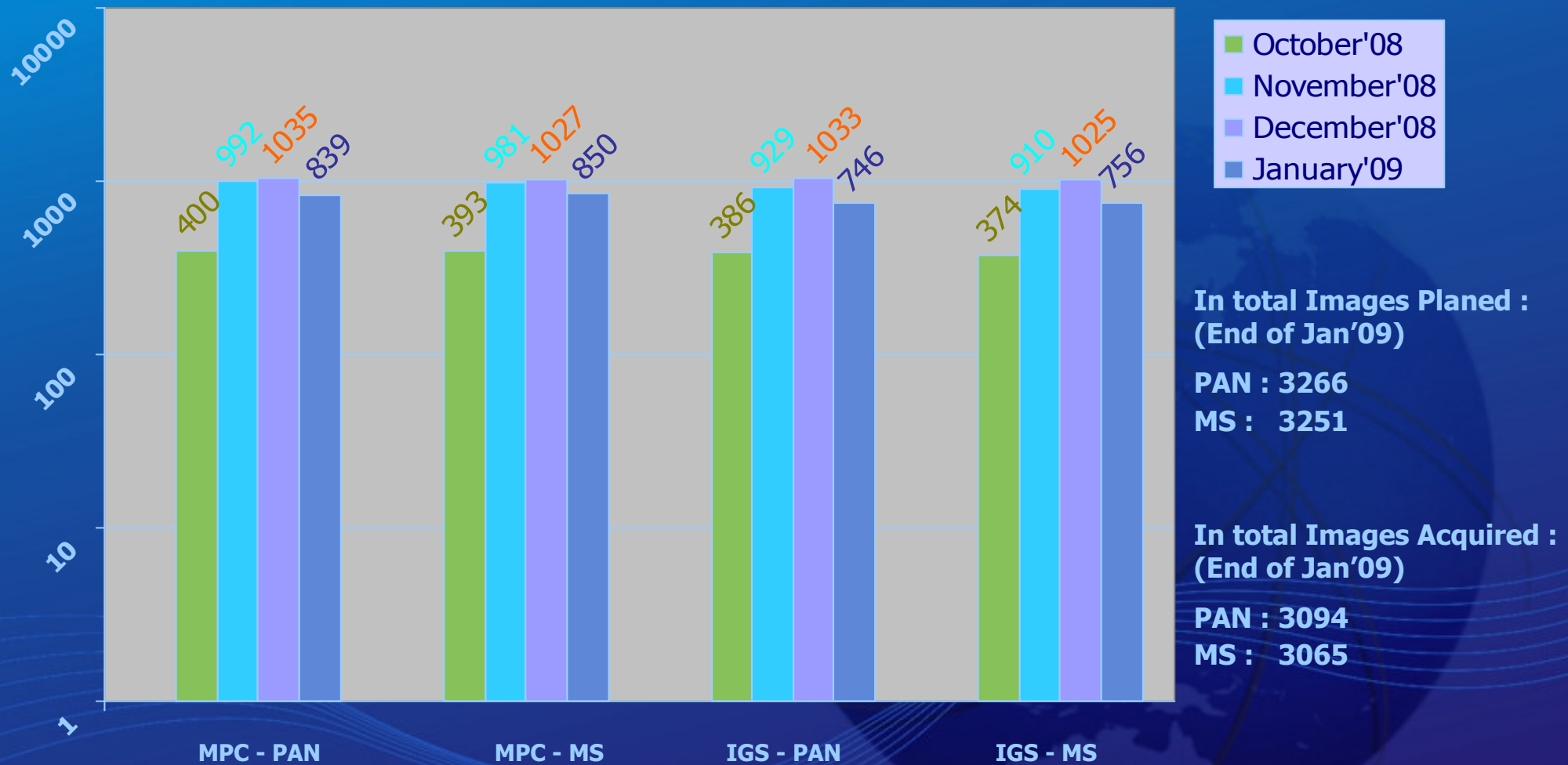


# THEOS Products - Application

- ❖ PAN images : 2 m resolution with 22 km swath width
  - Use for urban and town planning
  - Cartography and Mapping
  - Land use
  
- ❖ MS Images : 15 m resolution with 90 km swath width
  - Agricultural, Forestry, environmental monitoring
  - Application requires large area coverage with short revisit time

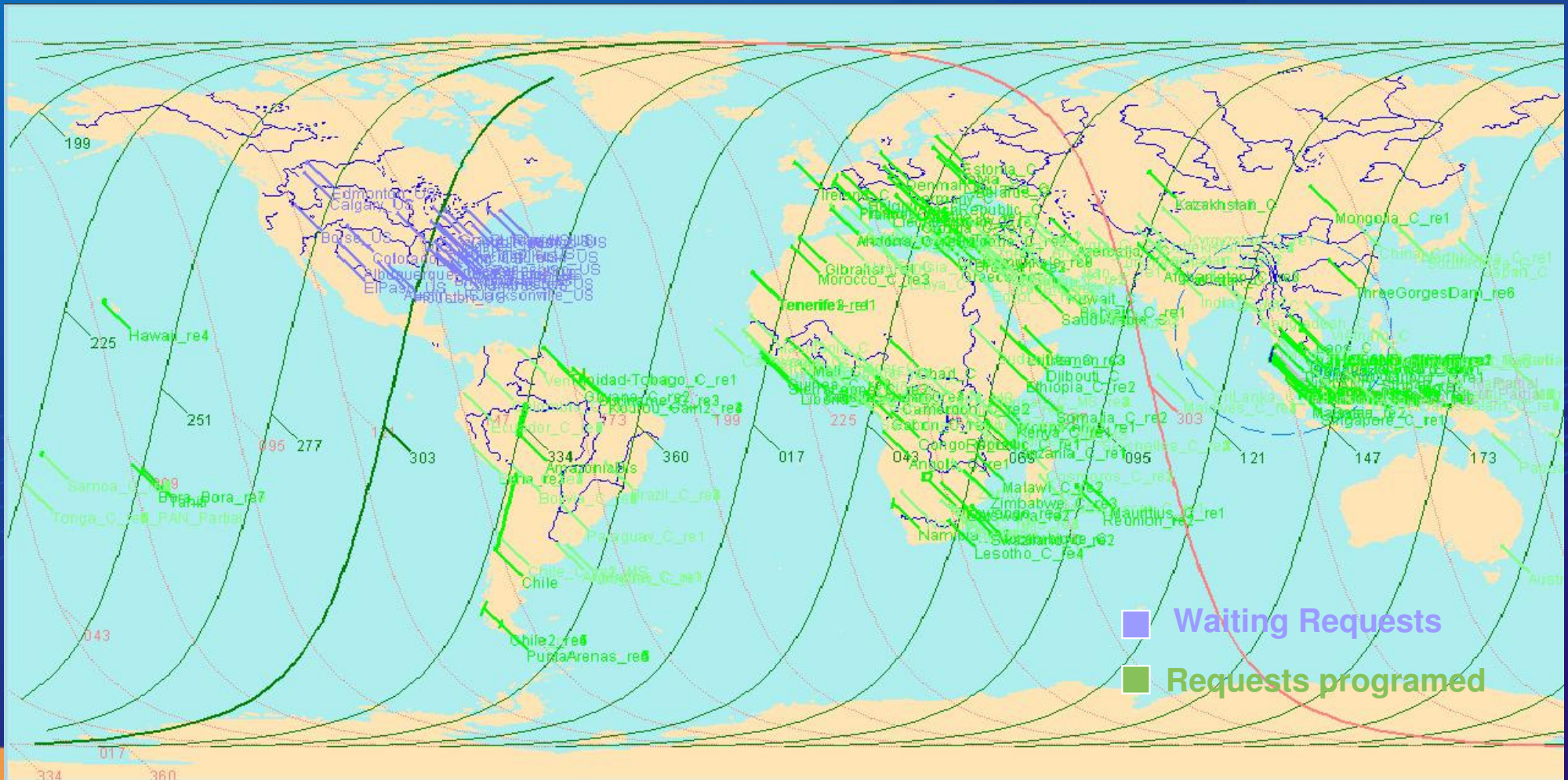


# THEOS Acquisition Performance : Oct 08 -Jan 09





- ❖ 70% of Request Orders in MPC DB since December'08
- ❖ High Latitude – not yet acquired





# THEOS MISSIONS 1/2

## ❖ National THEOS Missions

- Government sectors : planning and monitoring national resources, disaster management, agriculture, water management, mapping etc.
- Private sectors : applications to promote the use of THEOS images
- Academic Research : local universities and research institutes





# THEOS MISSIONS 2/2

## ❖ International THEOS Missions

- THEOS Ground receiving Station at Kiruna, SCC
- THEOS Global Online
- THEOS international Distributors and Resellers
- Cooperation in Disaster Management
- Academic Research



# THEOS GLOBAL ONLINE

Other THEOS IGS

Communication

Communication

Image Acquisition

Central  
THEOS  
Archive

Elaboration  
of  
standard  
Image  
products

Mission  
Planning  
(MPC)



Completed Acq-Order

ACQ-Order

Completed  
ARC-Order

Image  
Production  
in ARC-  
Order  
ACQ-  
Order



Communication

THEOS Global Online

Billing

ACQ-Order

ARC-Order

Catalogue  
Consulting

Product  
Delivery

Management

Management

User needs  
New  
Image  
Acquisition



User needs  
Archived  
Image



## Conclusion

- ❖ Thailand has changed its status from an imagery user to be an imagery provider
- ❖ The new role will be very challenging and promising future in utilizing Theos imagery application for the country and international users
- ❖ More cooperation in useful resources exploitation, disaster management and academic research



# THEOS MS Images





# Pyramid Cairo \_2A











# TEXAS\_2A







# La Crou\_ 2A







# Kagoshima\_2A







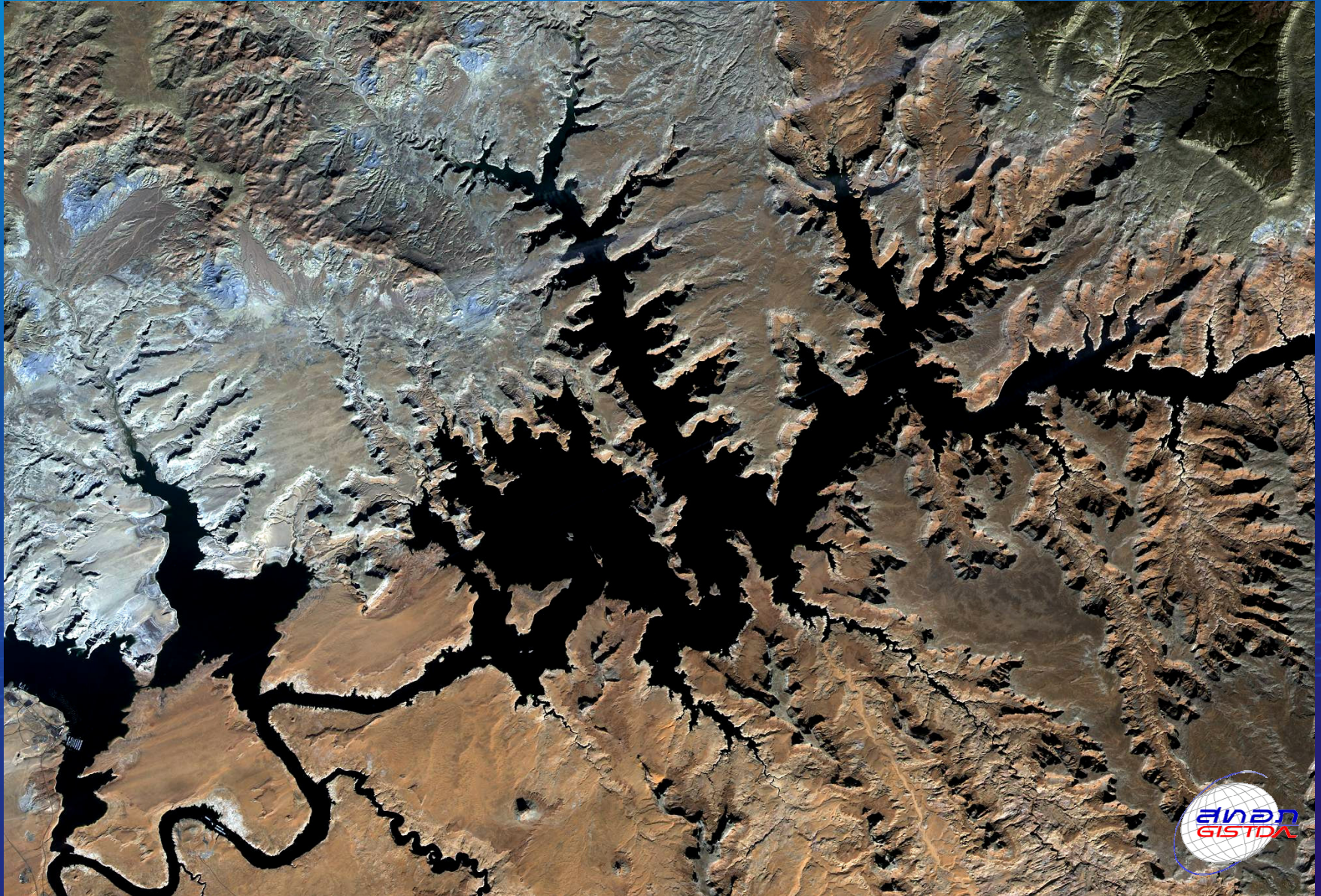
# Halong Bay\_ 2A







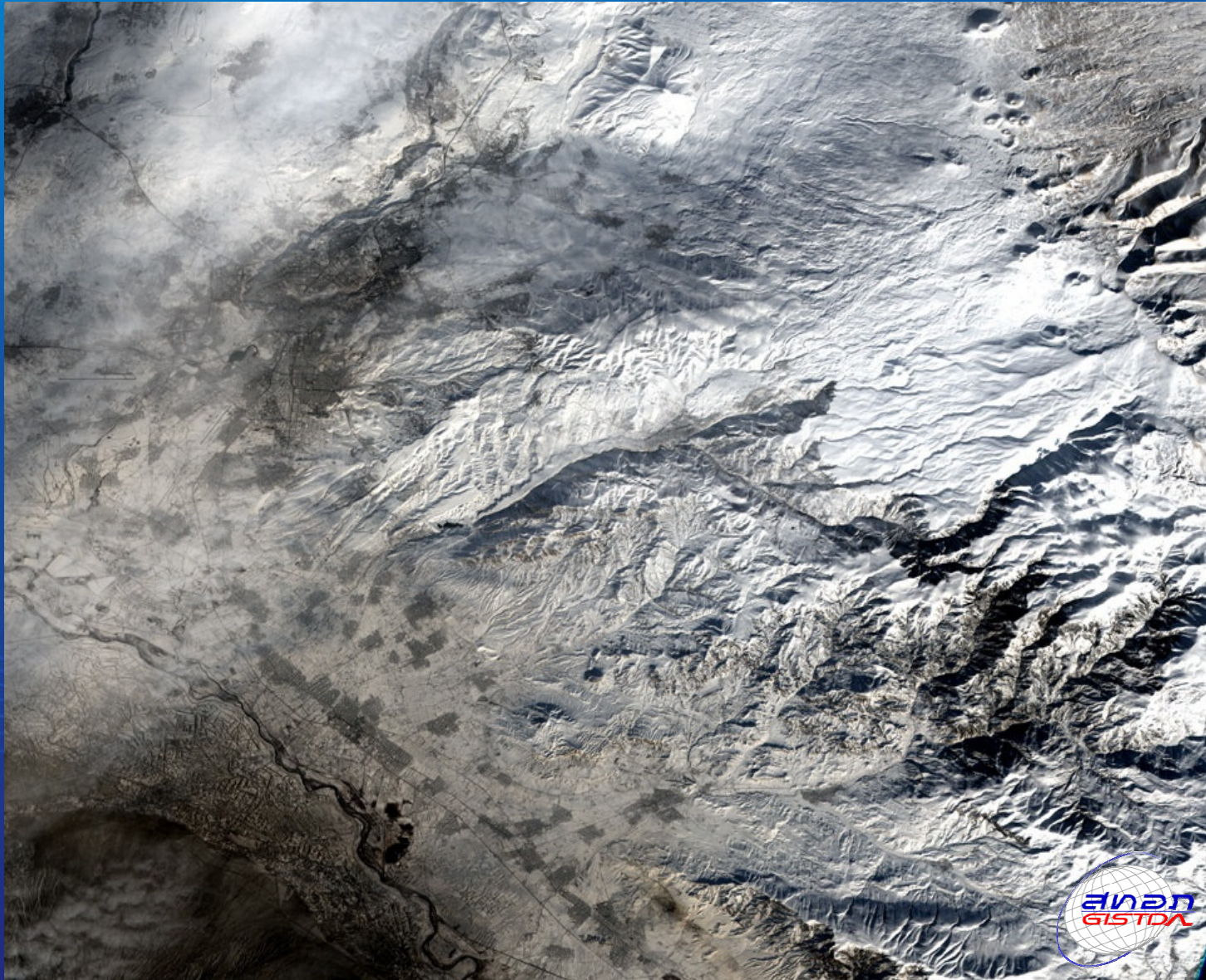
# Lake Powell, USA,







# Botswana \_1A



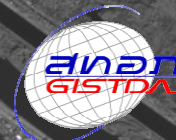
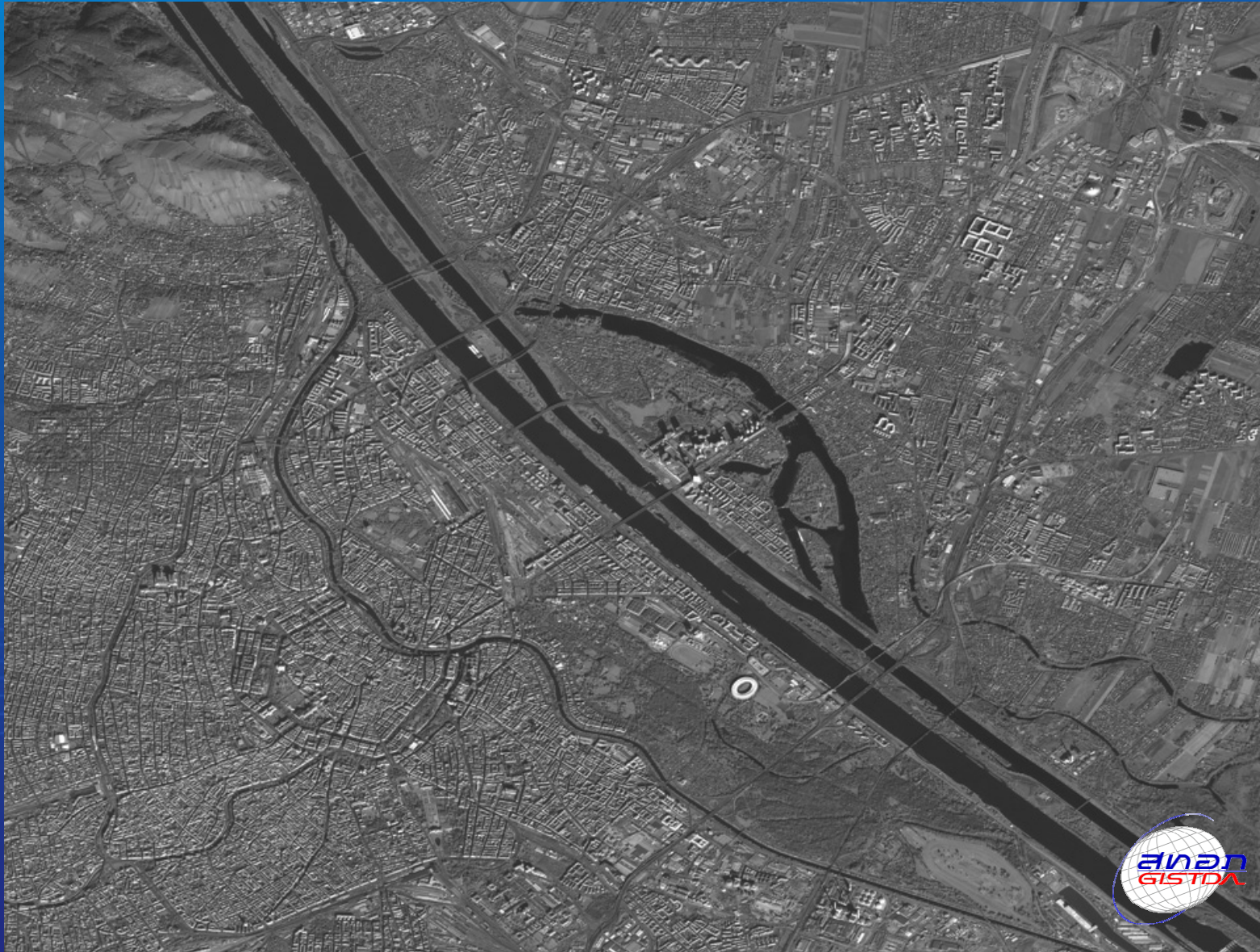


# THEOS PAN Images





# Vienna\_2A





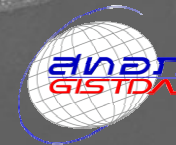


# UN International Center, Vienna

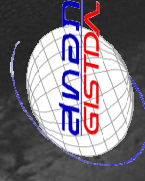




# Argentina\_2A : Buenos Aires









# Bangkok \_2A







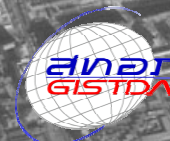
# Bangkok :2A







# Olympic Stadium Beijing \_1A







# Forbidden Palace \_1A : Beijing, CHINA







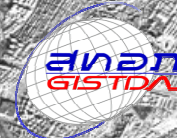
# Melbourne \_1A







# Istanbul \_2A







# THEOS Pan Sharpening Images



# Dubai \_PS







# Dubai \_PS







# Dubai \_PS







# Pyramid Cairo \_PS







# Spain \_PS







**Thank you  
for  
your kind Attention  
Sawasdee**