

HIST: A New Platform of Space Technology for Natural & Cultural Heritage

GUO Huadong

Center for Earth Observation and Digital Earth of the Chinese Academy of Sciences &
International Centre on Space Technologies for Natural and Cultural Heritage under the Auspices
of UNESCO, China



Background

The International Center on Space Technologies for Natural and Cultural Heritage (HIST), a category-II center under the auspices of UNESCO, was proposed to UNESCO by the Chinese Academy of Sciences in May 2007. The proposal was approved by the 35th General Conference of UNESCO in October 2009, and ratified by the State Council of China in April 2011. On 24 July, 2011, the launching ceremony of HIST was held in Beijing. This is the first UNESCO center applying space technologies to the monitoring and conservation of world natural and cultural heritage sites. The center is hosted by and built on the premises of the Center for Earth Observation and Digital Earth (CEODE) of the Chinese Academy of Sciences.



United Nations
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International Centre on Space Technologies for
Natural and Cultural Heritage
under the auspices of UNESCO

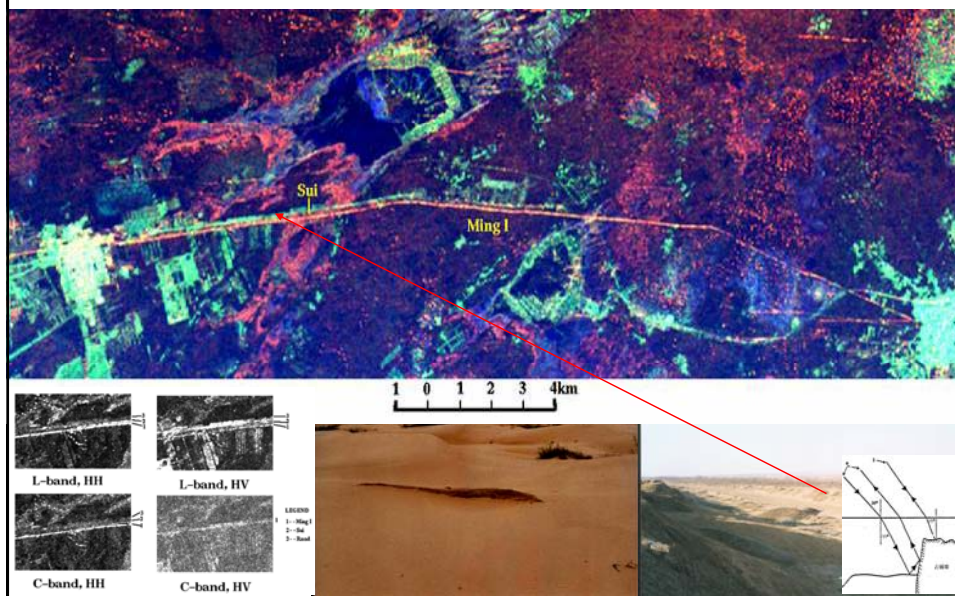
HIST: A New Platform of Space Technology for Natural & Cultural Heritage

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ICRSA4

Oct. 24, 2012 Beijing

Detection of Great Wall segments of Ming and Sui dynasties Using Multifrequency, Multipolarization Radar



OUTLINE

- **Role of Space Technology for Heritage**
- **Birth of HIST: Ten Years Experiences**
- **Status and Activities of HIST**
- **Atlas of Remote Sensing for World Heritage**
- **Perspective**

Role of Space Technology for Heritage

- Heritage is our legacy from the past, what we live with today, and what we pass on to future generations. Our cultural and natural heritages are both irreplaceable sources of life and inspiration.
- World Heritage sites belong to all the peoples of the world, irrespective of the territory on which they are located.

Challenges

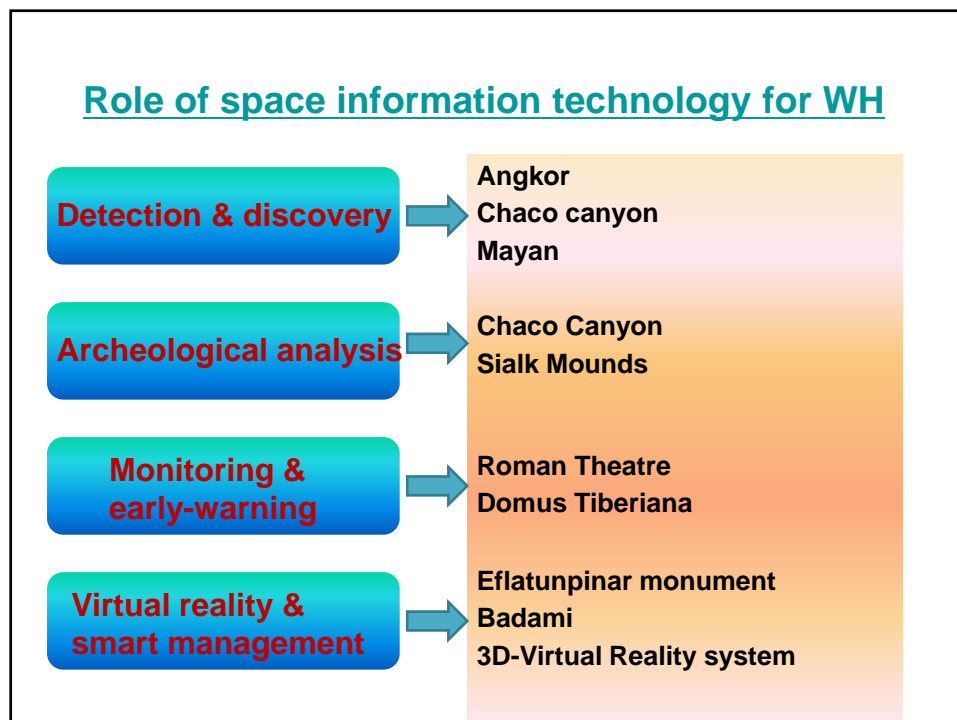
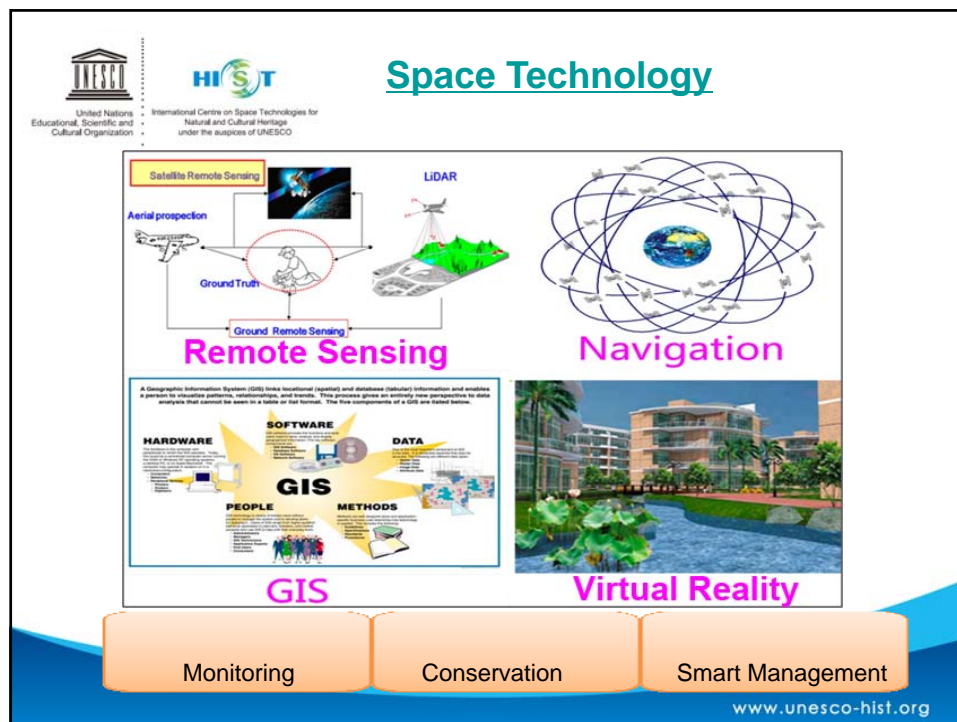
Earthquake
Landslides
Flood
Forest fire
Global change
.....

Resource over-exploitation
Deforestation
Land encroachment
Hydroelectric project
Pollution
Urbanization
Uncontrolled tourism
.....

Natural
influence

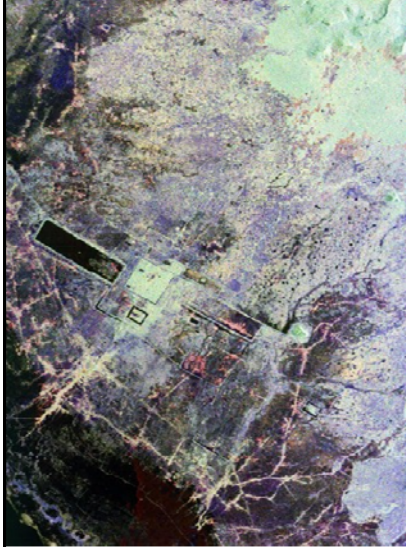
Human
induced

What should we do?



Detection & Discovery

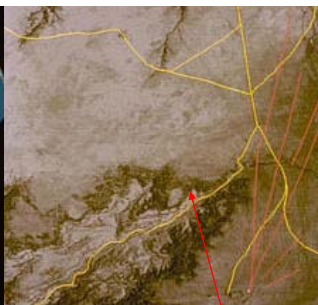
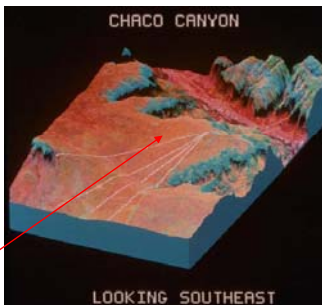
Re-estimation of the residential area and the drainage system around Angkor in Cambodia



SIR-C/X-SAR in 1994



The prehistoric road (900AD) detection in Chaco canyon, Mexico, USA



Remote Sensing Imagery

Present road



Convergence of four prehistoric road photo derived from field investigation



Prehistoric road gain

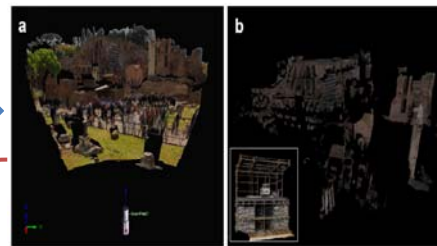
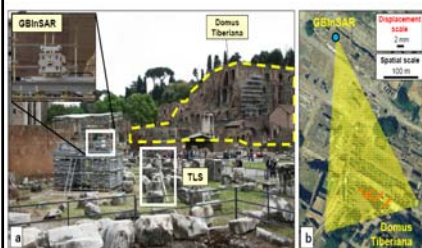
Convergence of four prehistoric roads as seen by the naked eye.

Ancient Maya architecture hidden deep in the rain forest of Guatemala

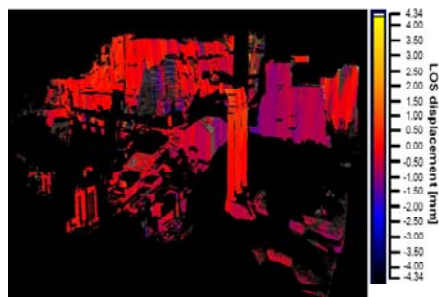


<http://www.pbs.org/wgbh/nova/ancient/maya.html>

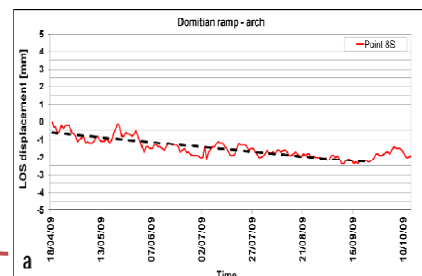
Integrating GBInSAR and laser-based remote sensing for monitoring structural deformation of Domus Tiberiana



Structure scanning

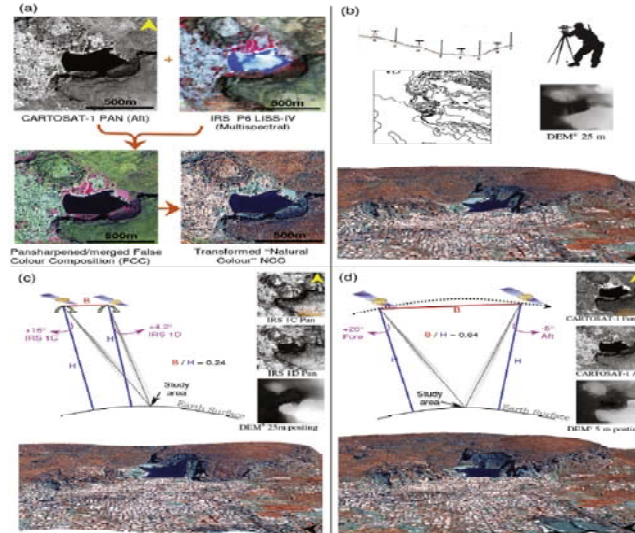


D. Tapete et al., 2012

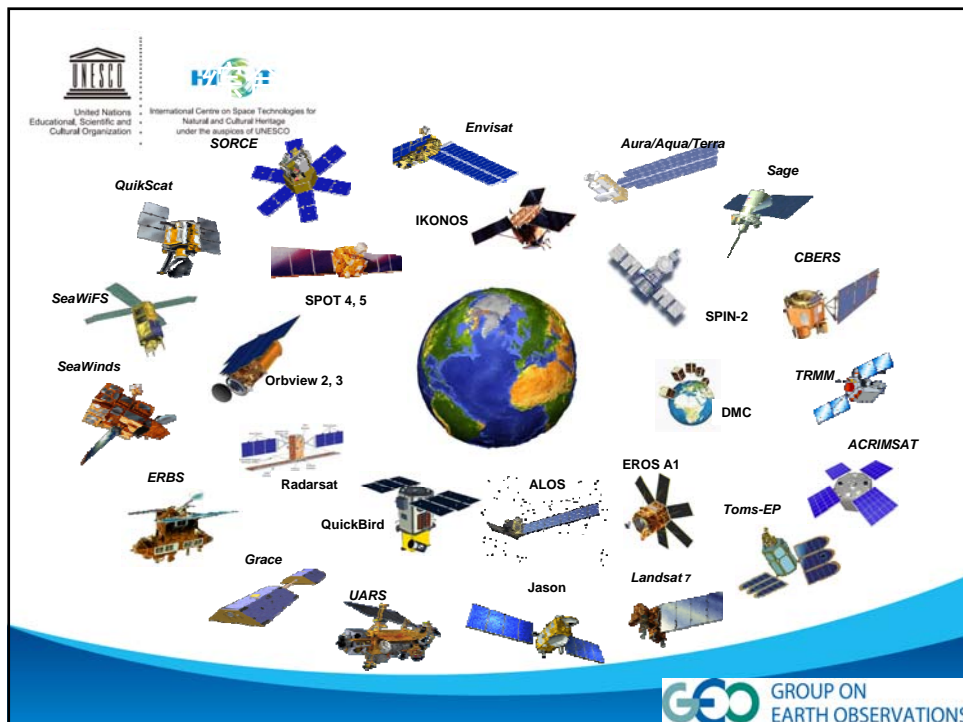


GBInSAR deformation monitoring

Earth observation for generating 3D perspective views of the archaeological site of Badami in India



M.B. Rajani, et al., 2009



☐ Meteorological Satellite	
Polar Orbit FY-1 A, B, C, D	4
Geo-stationary FY-2A, 2B, 2C	3
☐ Marine Satellite HY-1	1
☐ Resource Satellite (CBERS, ZY, Beijing, Tsinghua)	7
☐ Environmental and Disaster Monitoring Satellite	2
☐ Communication Satellite	7
☐ Navigation Satellite Beidou -1	8
☐ Return Land Satellites	17
☐ Scientific experiment Satellites	15
☐ Spacecraft SZ -1, 2, 3, 4, 5, 6,7	7

EO Satellite Series in China

Satellite Type	Satellite	Payload	Spectral ranges	Spatial resolution (m)	Swath width (km)	Revisit rate (d)	Launch time
Resource Series	CBERS-1-01	CCD/WFI	VIS/NIR	20/258	120/890	26/5	14.10.1999/21.10.2003
	/02	Infrared Scanner	VIS/SWIR/TIR	78/156	120	26	
	CBERS-1-01	CCD/WFI	VIS/NIR	20/258	113/890	26/5	29.10.2007
	/02B	High-Resolution Camera	VIS	2.36	27	104	
	ZY-3-01	CCD	VIS/NIR	6/2.1	52/51	59/5	09.01.2012
Environment Series	HJ1-1A	Forward/Back-looking Camera	VIS	3.5	52	59/5	06.09.2008
	HJ1-1A	CCD Hyperspectral Imager	VIS/NIR	30/100	700/50	4	
	HJ1-1B	CCD	VIS/NIR	30	700	4	
	HJ1-1B	Infrared Multispectral Camera	IR	150/300	720	4	
Meteorological Series	HJ1-1C	Synthetic Aperture Radar	-	5 (single look) * 20 (4 looks)	40-strip mode/100-scan mode	4	-
	FY-1A/B	MVISR	VIS/NIR/TIR	1100/4000	2860	-	06.09.1988/03.09.1990
	FY-1C/D	MVISR	VIS/IR	1100/4000	3100	12	10.05.1999/15.05.2002
		HEPD	-	-	-	-	
	FY-2A/B/C	VISSR	VIS/IR	1250/5000/5760	-	30/25.5	10.06.1997/25.06.2000/
		IRAS/VISSR/MERSI	VIS/IR	17km/1100/250-1000	2800	5.5	
	FY-3A/B	MWTS	EHF/U-band	15km/50-75km	2700	-	27.05.2008/04.11.2010
		MWRI	X/Ku/Ka/W-band	15-85km	1400	-	
		ERM/SIM	UV/VIS/IR	-	-	-	
		SBUS/TOU	UV	200km/50km	-	-	
		Space Environment Monitor	-	-	-	-	
Ocean-Series	HY-1A/B	COCTS/CZI	VIS/IR/NIR	1100/250	1600/3000/500	3/1/7	15.05.2002/11.04.2007
		Radar Altimeter	C/Ku-band	-	-	14	
	HY-2	Microwave Scatterometer	Ku-band	-	1350/1700	1	16.08.2011
		SMR/CMR	C/X/Ka-band	-	1600	1	

Note: VIS: Visible; SWIR: Short-wave Infrared; IR: Infrared; NIR: Near Infrared; TIR: Thermal Infrared; EHF: Extremely High Frequency; UV: Ultraviolet; WFI: Wide Field of View Imager; IRMSI: Infrared Multispectral Scanner; MVISR: Multichannel Visible and IR Scanning Radiometer; HEPD: High Energy Particle Detector; VISSR: Visible and Infrared Spin Scan Radiometer; IRAS: Infrared Atmospheric Sounder; MERSI: Medium Resolution Spectral Imager; MWTS: Microwave Temperature Sounder; ERM: Earth Radiation Measurement; SIM: Solar Irradiance Monitor; SBUS: Solar Backscattering UV Sounder; TOU: Total Ozone Unit; COCTS: Chinese Ocean Color and Temperature Scanner; CZI: Coastal Zone Imager; SMR: Scanning Microwave Radiometer; CMR: Calibrated Microwave Radiometer.



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Birth of HIST: Ten Years Experiences

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Launching Ceremony of HIST

On 24 July, 2011, the Launching Ceremony of HIST was successfully held in Beijing.

This is the first UNESCO center applying space technologies to the monitoring and conservation of natural and cultural heritage sites.



Ms. Gretchen Kalonji,
Assistant Director General of
UNESCO for Natural Sciences
gives an address



Ding Zhongli, CAS Academician
and Vice-President of CAS, gives
an address



CAS Academician Xu
Guanhua, gives an address



Guo Huadong, Director
General of CEODE and
Director of HIST, addresses
www.unesco-hist.org



...This international Centre, established in collaboration with UNESCO's Natural Sciences Sector will bring to UNESCO all the expertise and know-how of CEODE with the aim of strengthening inter-sectorial cooperation.

...The international Centre that we are opening today is one step more to strengthen the scientific and technical assistance that UNESCO can provide to its Member States

(Ms. Gretchen Kalonji, ADG for Natural Sciences of UNESCO)

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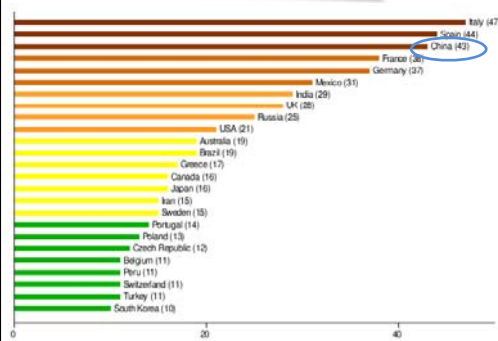
- International Background**
 In 2001, UNESCO and the European Space Agency co-launched the *Open Initiative on Space Technologies to Monitor Natural and Cultural Heritage of UNESCO Sites*. This initiative was intended to support UNESCO's heritage conservation by sharing space technologies with developing countries.
- Domestic Background**
 Chinese Academy of Sciences, Ministry of Education, and State Administration of Cultural Heritage founded a joint Laboratory of Remote Sensing Archaeology In 2001.

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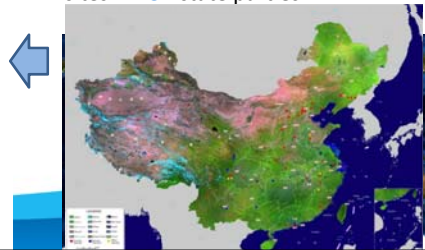


UNESCO World Heritage

The Convention Concerning the Protection of the World Cultural and Natural Heritage was adopted by the General Conference at its 17th session in 1972.



China has 43 world heritage sites to date: 30 cultural, 9 natural, and 4 mixed sites in 159 state parties



- ◆ In 2001, Established the *Joint Laboratory of Remote Sensing for Archaeology (JLRSA)* affiliated to the Chinese Academy of Sciences, Ministry of Education, and State Administration of Cultural Heritage, and 10 provincial stations under the JLRSA.
- ◆ In 2002, *First China's Workshop on Remote Sensing for Archaeology* was held in Beijing, China.
- ◆ In 2003, *the 216 Xiangshan Science Forum* with theme "Understanding cultural heritage from space" took place in Beijing.



Launching Ceremony of JLRSA



Group Photo of the 1st National Conference
on Remote Sensing in Archaeology



216 Xiangshan Science Forum

Initiate and Host ICRSA1 By JLRSA in Beijing In 2004

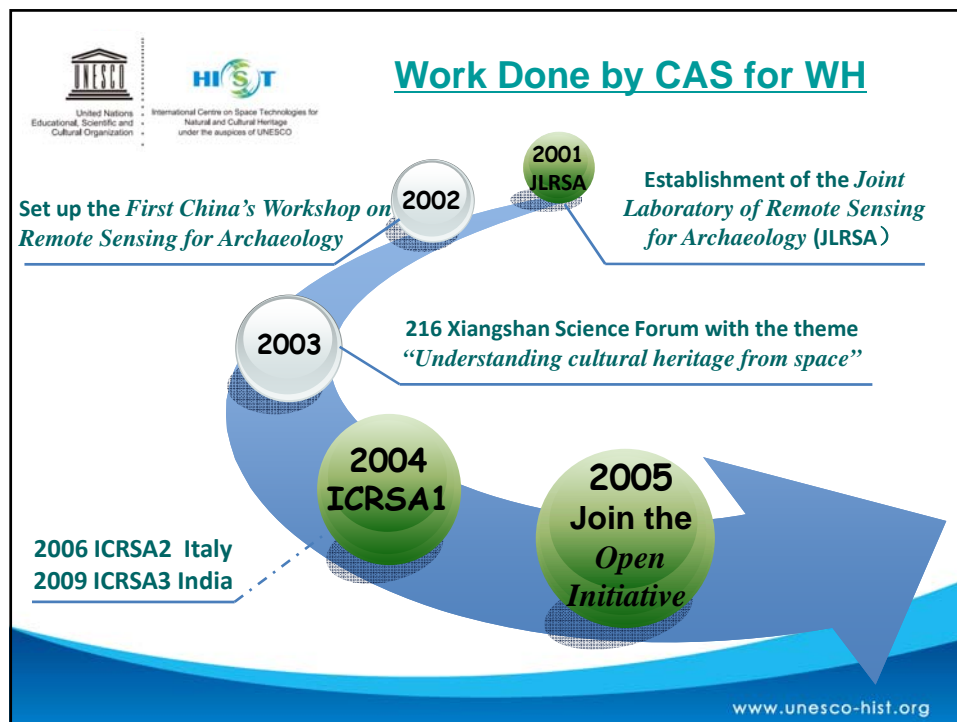
In 2004, First International Conference on Remote Sensing for Archaeology was held in Beijing, China. Meanwhile, the international workgroup of Remote Sensing archaeology experts was set up.



Join the *Open Initiative* in 2005

In 2005, the Chinese Academy of Sciences signed with UNESCO as a partner of the **“ESA-UNESCO Open Initiative on the use of space technologies to support World Heritage”**, which owns over **60** space partners located in **33** countries.





The 2nd International Conference on Remote Sensing in Archaeology (ICRSA2) was held in Rome, Italy On 4-7 December 2006.

The screenshot shows the UNESCO website with the headline "From Space to Place: 2nd Int'l Conf. on Remote Sensing in Archaeology". It includes details about the conference's focus on the study and conservation of archaeological and ancient landscapes through integrated technologies and virtual reality.

FROM SPACE TO PLACE

2nd INTERNATIONAL CONFERENCE ON REMOTE SENSING ARCHAEOLOGY

Title: From Space to Place: International Conference on Remote Sensing in Archaeology
Place: Rome, CNR headquarters, piazza Aldo Moro
Date: 4-7 December 2006
Deadline: abstracts before 10th April 2006
Download: Programme Program

Organizers
CNR IITABC - Virtual Heritage Lab, Institute for Technologies Applied to Cultural Heritage, Rome
UNIVERSITY OF SIENA - Department of Medieval Archaeology, Laboratory of Landscapes Archaeology and Remote Sensing (LAP&T)

Topics
Remote sensing, archaeology, landscape, environment, ecosystem, image processing, virtual reality, 3D visualization, conservation, geophysics, photogrammetry, open source and Web-GIS.

In October 2004, the International Conference on Remote Sensing Archaeology was organized by the Chinese Academy of Sciences in Beijing and hosted by the Joint Laboratory of Remote Sensing Archaeology (JLRSA). In that context an international treaty of experts was created in order to promote multidisciplinary activities of remote sensing archaeology in the entire world.

We announce hereby that in 2006, the conference will be organized in Rome at the National Research Council (main building) with particular attention to the study and the conservation of archaeological and ancient landscapes through integrated technologies and virtual reality: 4-7 December, 2006.

2007 – Proposal

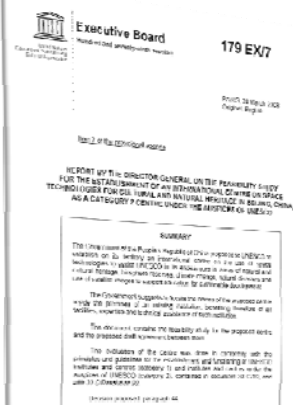
In May, 2007, **Lu Yongxiang**, the Former President of CAS, **proposed to Koichiro Matsuura**, the Former Director-General of UNESCO, to establish in China a category 2 centre under the auspices of UNESCO and received a positive reply.



Several months later, a **feasibility study** was undertaken by a group of UNESCO programme specialists led by **Mario Hernandez**.

2008 – Feasibility Study Report Examined

In April, 2008, the feasibility study report by the Director-General for the establishment of HIST went through the examination of **179th session of UNESCO Executive Board**.



2009 – Approval of the Establishment by UNESCO

In October, 2009, the report on establishing HIST was approved by **the 35th General Conference of UNESCO**.



2011: Ratified by Chinese Government

In April, 2011, the establishment of HIST was officially ratified by **the State Council of China**.

Ministry of Foreign Affairs of China

Chinese National Commission
for UNESCO

Ministry of Housing and
Urban-Rural Development of China

State Administration of
Cultural Heritage of China



HIST

State Council of China



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2011: Sign the Agreement



On 27 May, 2011, Irina Bokova, Director-General of UNESCO, signed an agreement establishing HIST on behalf of UNESCO.

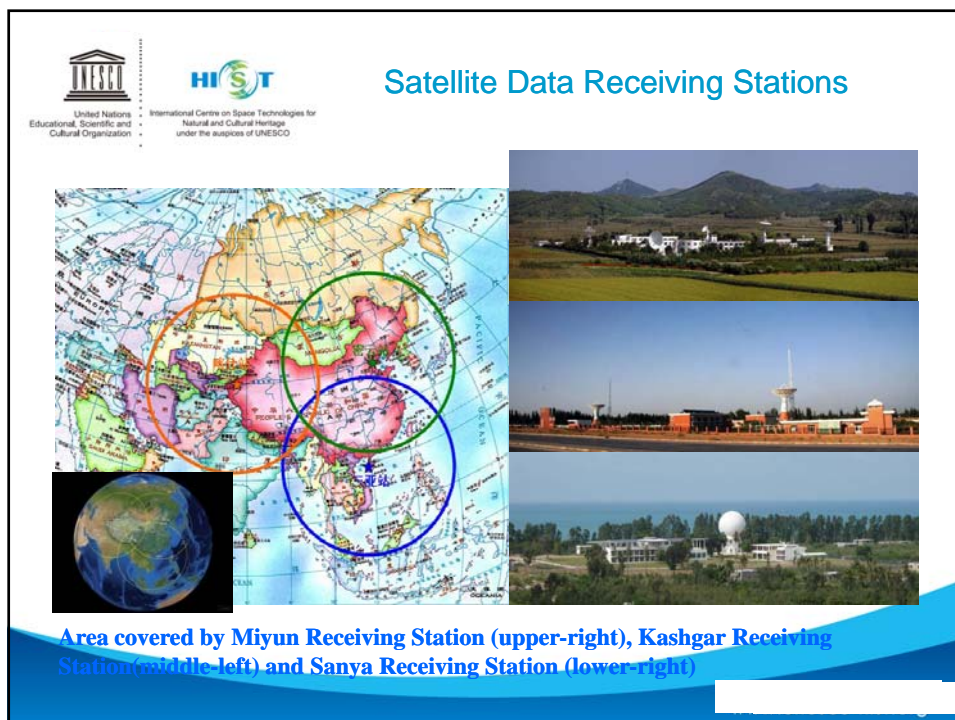
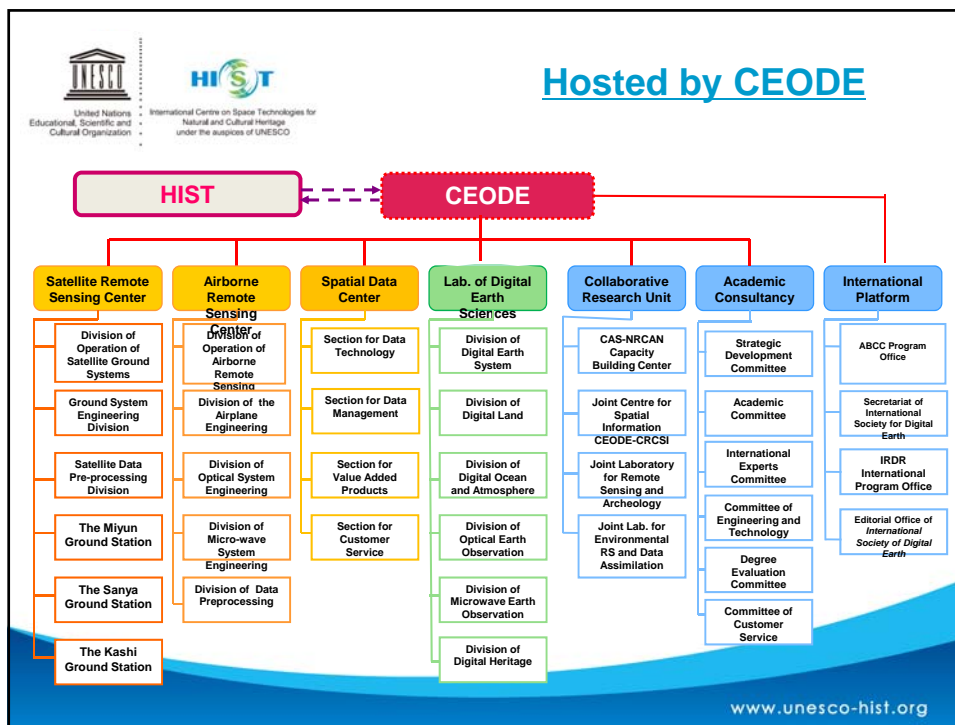
On 2 June, Bai Chunli, President of the Chinese Academy of Sciences (CAS), also signed the agreement on behalf of the Chinese Government.

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Host by CEODE, CAS

CEODE is one of the world's best earth observation institutions. Staffed by 600 researchers, it possesses large scientific facilities, including two remote sensing airplanes and three satellite ground stations, able to receive satellite remote sensing data that geographically cover 70% of Asia.





EO Data Acquisition & Archiving



Over 2.50 million scenes of satellite data have been acquired and preserved at CEODE since 1986, providing a precious database for the earth observation .

Satellite Data Received by CEODE: past and present

Satellite	Country	Period	Reception Station
LANDSAT-5	USA	1986-	Miyun, Kashgar
JERS-1 SAR	Japan	1993-1998	Miyun
ERS-1	ESA	1993-2000	Miyun
ERS-2	ESA	1996-2011	Miyun
SPOT-1	France	1998-2002	Miyun
SPOT-2	France	1998-2009	Miyun, Kashgar
RADARSAT-1	Canada	1999-	Miyun
SPOT-4	France	2000-	Miyun, Kashgar
LANDSAT-7	USA	2000-2004	Miyun
SPOT-5	France	2002-	Miyun
ENVISAT	ESA	2003-2012	Miyun
RESOURCESAT-1	India	2005-	Miyun, Kashgar
RADARSAT-2	Canada	2008-	Miyun, Kashgar, Sanya
THEOS	Thailand	2011-	Miyun, Kashgar, Sanya
CBERS-01	China	1999-2003	Miyun
CBERS-02	China	2003-2008	Miyun
CBERS-02B	China	2007-2010	Miyun
HJ-1A	China	2008-	Miyun, Kashgar, Sanya
HJ-1B	China	2008-	Miyun, Kashgar, Sanya
ZY-02C	China	2011-	Miyun, Kashgar, Sanya
ZY-3	China	2012-	Miyun, Kashgar, Sanya

WV

Airborne Remote Sensing System

Two Remote Sensing Aircrafts

- Round-the-clock flying capability;
- Equipped with various airborne remote sensors, and can be used to test newly-developed advanced sensors;
- Provides high-resolution satellite data.



Max Altitude	13,000 m
Max Range	3,300 km
Max Speed	746 km/h

Two new Remote Sensing Aircrafts

- Equipped with 10 state-of-the-art remote sensors: visible, infrared, and microwave remote sensors and a high-performance data processing system.



ARJ21 Airplane
To be purchased



Airborne atmospheric
laser radar



Digital CCD camera



Airborne whiskbroom
imaging spectrometer
(0.45um-12.5um)



Airborne 3-D light
detection and ranging



Airborne X-band
interferometry SAR



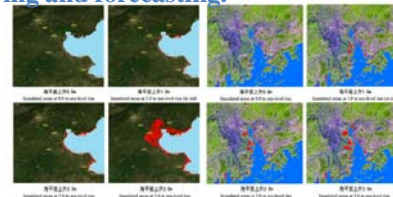
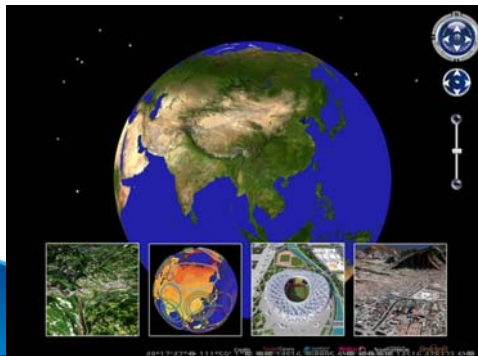
Airborne pushbroom
imaging spectrometer
(0.45um-2.5um)

Key Lab of Digital Earth Sciences, CAS

◆ **Focus on remote sensing application and digital earth, to support:**

The national economic and social development, environmental protection, resource exploitation, disaster mitigation.

A digital earth prototype system was developed and is used to support the global change study and disaster monitoring and forecasting.



环渤海海平面上升模拟 Sea-level rise simulation in the Bohai Sea region

珠三角海平面上升模拟 Sea-level rise simulation in the Pearl River Delta

- Cutting-edge EO Technologies
- Spatial Earth Information Sciences
- Digital Earth Platform
- Global Change

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Status and Activities of HIST

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General Objective

- **Bring the benefit of space technologies to UNESCO Member States**
 - Management, conservation, presentation, documentation and sustainability, as applied to monitoring natural and cultural heritage sites with space technology
- **Reinforce the current capacity of Member States to:**
 - Make use of all data derived from satellite images
 - Sustainable development education
 - Make climate change assessments
- **Results → Educational material**
 - Use research results to support the United Nations Decade of Education for Sustainable Development.

Purpose

- HIST is a non-profit organization established to apply earth observation technologies in the research, training and education in such fields as natural and cultural heritage, climate change, natural disasters and biosphere reserves.
- It focuses mainly on carrying out demonstrative work in terms of the monitoring, evaluation and documentation of World Heritage sites, global change, natural disaster and biosphere reserves, and using space technologies to support education on sustainable development, improving capacity building among developing countries in terms of space technologies, and promoting knowledge sharing and information exchange.

Main Research Interests

- Building databases of Remote Sensing Images and Environments on Natural and Cultural Heritage Sites
- Dynamic monitoring with space technologies for typical heritage sites
- Study the influence of global change and natural disasters on heritage sites
- Situational simulation and reconstruction of large-scale heritage sites

Tasks

- Assisting developing countries with earth observation technologies to improve their capacity for the conservation, management and sustainable development of World Heritage.
- Using space technologies to help developing countries' policy makers gain a better understanding...
- Holding international seminars and training sessions, in an effort to promote the application of space technologies



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Capacity Building

- *Team building:* Build an well-structured international research and management team.
- *Data acquisition and sharing:* Establish an effective international data sharing mechanism based on the satellite and airborne remote sensing data of CAS to step up heritage database building.
- *Technical support:* Conduct research on World Heritage conservation and sustainable development by means of remote sensing image and environment database building
- *Domestic and international cooperation:* strengthen collaboration with the World Heritage Centre, related international space agencies, UNESCO Member States and other international organizations

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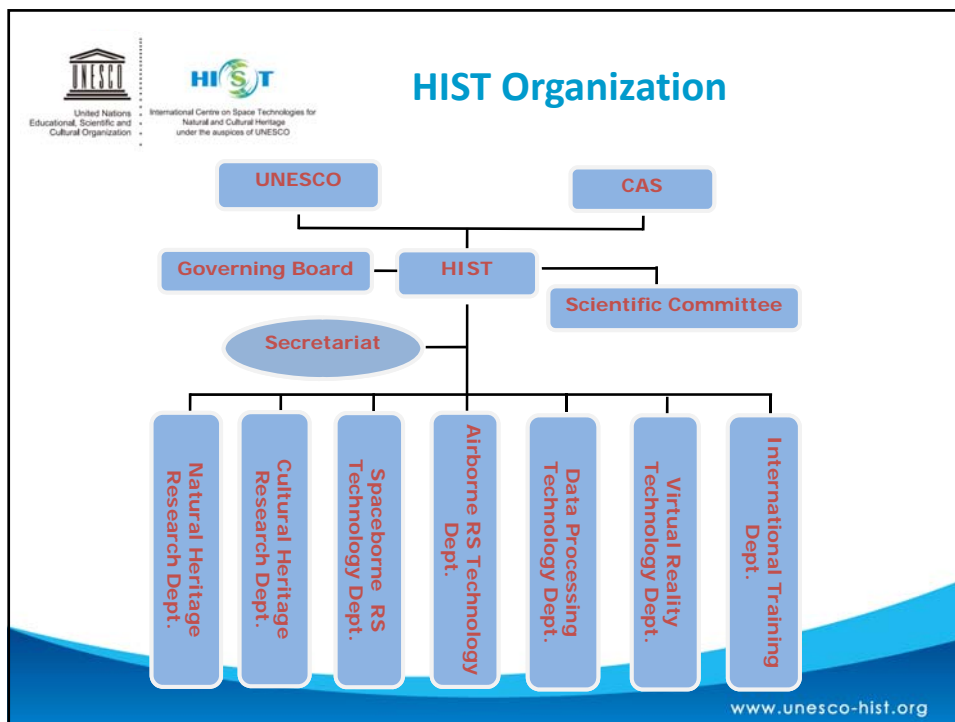


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Training Programs

HIST will provide training in the application of space technologies for the natural and cultural heritage located in Asia Pacific, Africa and Latin America, once a year, to enhance capacity building of developing countries in terms of applying space technologies to the conservation of World Heritage.

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Governing Board

On 24 July 2011, first the HIST Governing Board convened in Beijing.

On 22 October 2012, the second HIST Governing Board held in Beijing.

The block contains two photographs. The left photo shows a group of people seated around a large conference table during a meeting. The right photo shows a group of people standing and sitting in front of a large screen displaying a globe and the Chinese text '创新驱动 创造未来' (Innovation-driven, creating the future).

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Science Committee

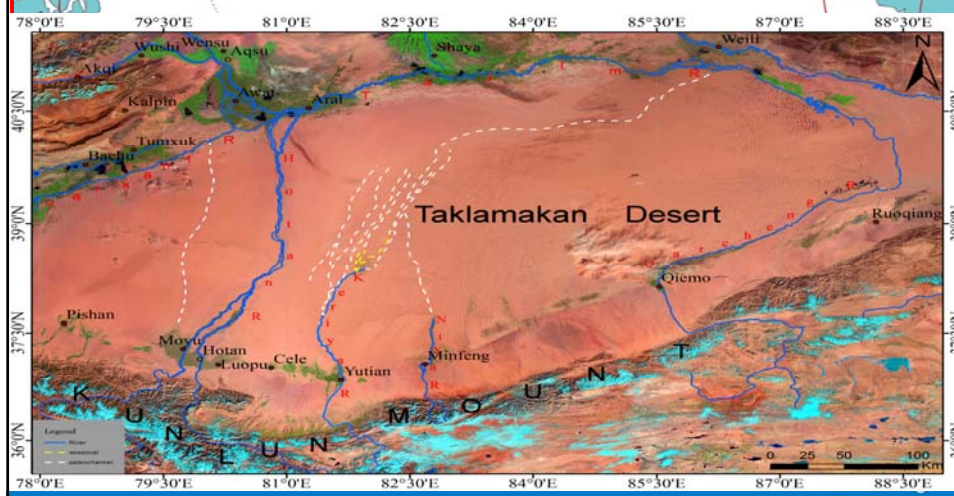
During the first session of the Science Committee (China), convened on **20 June, 2011**, experts discussed and offered advice on HIST's strategic planning and research orientation.

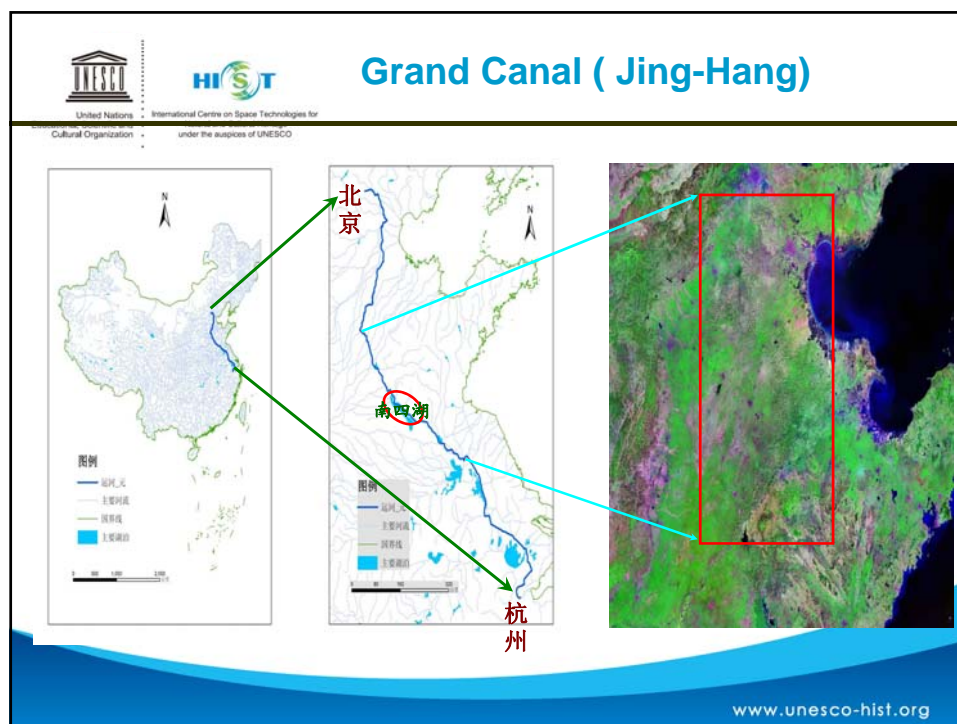



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Remote Sensing for Silk Road


The preliminary result of Silk Road: Paleochannels of Keriya River by multi resource data (SIR-C, TM, SRTM, old map etc)








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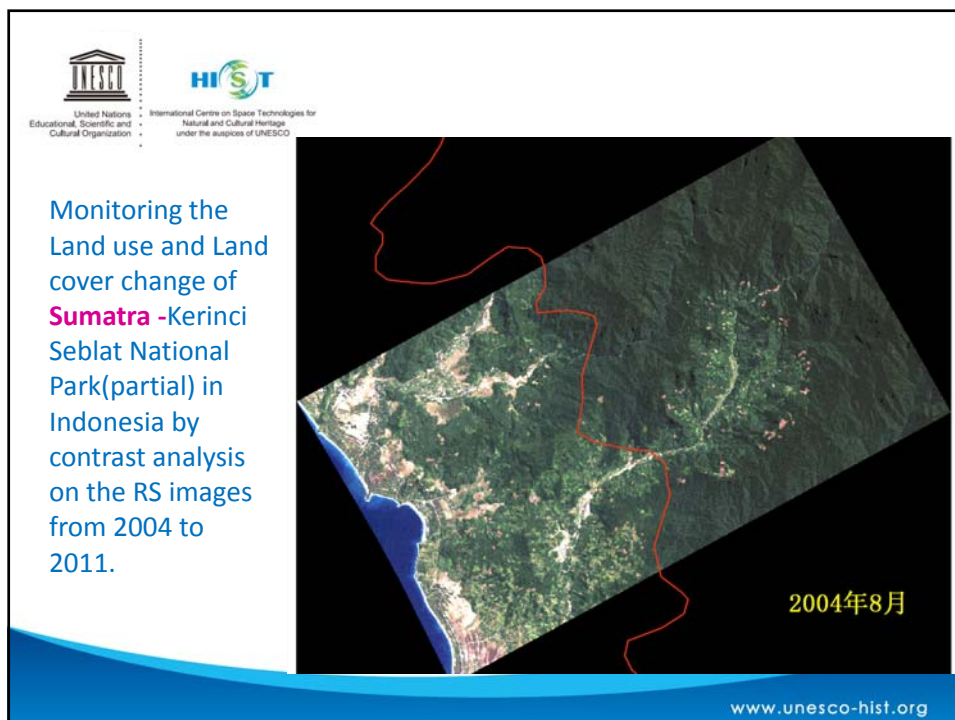
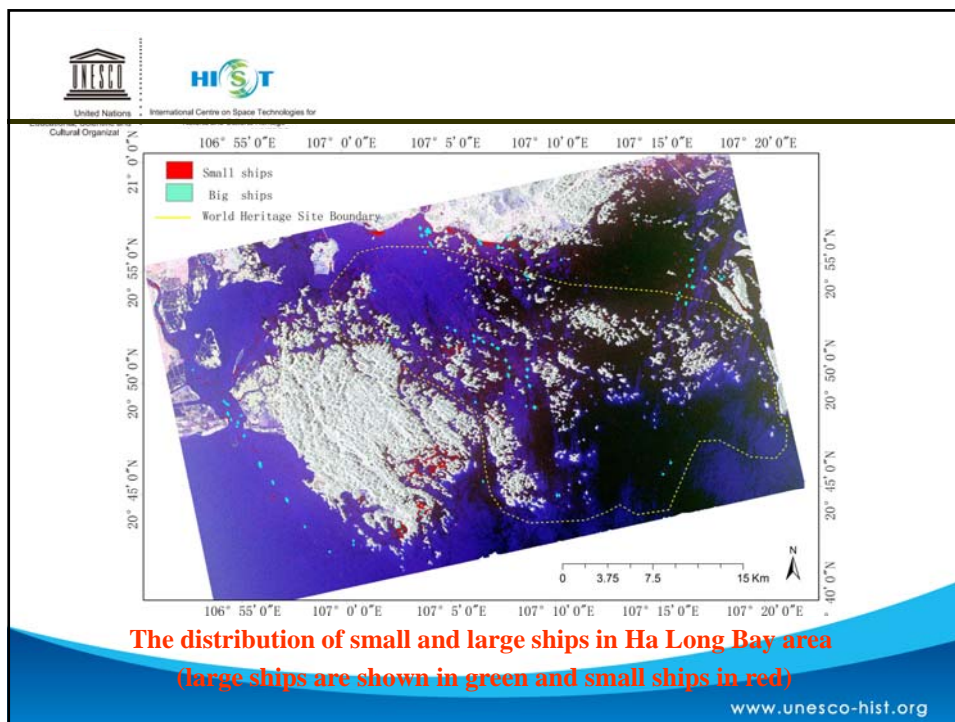
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Annex 1: List of candidate natural World Heritage Sites for remote sensing monitoring work

Note: The sites that IUCN considers could be priorities for a pilot project are highlighted in blue

Natural World Heritage Site	Country	Conservation issue to monitor via remote sensing	Habitat type
1 Mount Nimba Strict Nature Reserve	Ivory Coast/ Guinea	Mining impacts in and around the site.	Tropical forest
2 Kahuzi-Biega National Park	Democratic Republic of the Congo	Deforestation and agricultural encroachment, particularly in the corridor linking the two sections of the site.	Tropical forest
3 Selous Game Reserve	Tanzania	Encroachment in the elephant migration corridor linking the property to the Niassa Game Reserve.	Woodland/ savannah
4 Tropical Rainforest Heritage of Sumatra	Indonesia	Ongoing deforestation and agricultural encroachment.	Tropical forest
5 Galapagos Islands	Ecuador	Tourism and urban infrastructure.	Island
6 Los Katios	Colombia	Illegal logging	Tropical forest
7 Rio Platano	Honduras	Illegal logging and agricultural encroachment.	Tropical forest
8 Belize Barrier Reef	Belize	Development pressure from tourism	Coastal
9 Ha Long Bay	Vietnam	Development pressures	Coastal
10 Monarch Butterfly Reserve	Mexico	Illegal logging and encroachment	Forest
Possible World Heritage 'success stories' that could be illustrated through presentation of time sequence remote sensing images			
11 Djoudi National Bird Sanctuary	Senegal	Wetland restoration	Wetland
12 Ichkeul National Park	Tunisia	Wetland restoration	Wetland



Training Workshop

- The 1st International Workshop on Space Technologies for World is held in Beijing in 09-28 October, 2012.



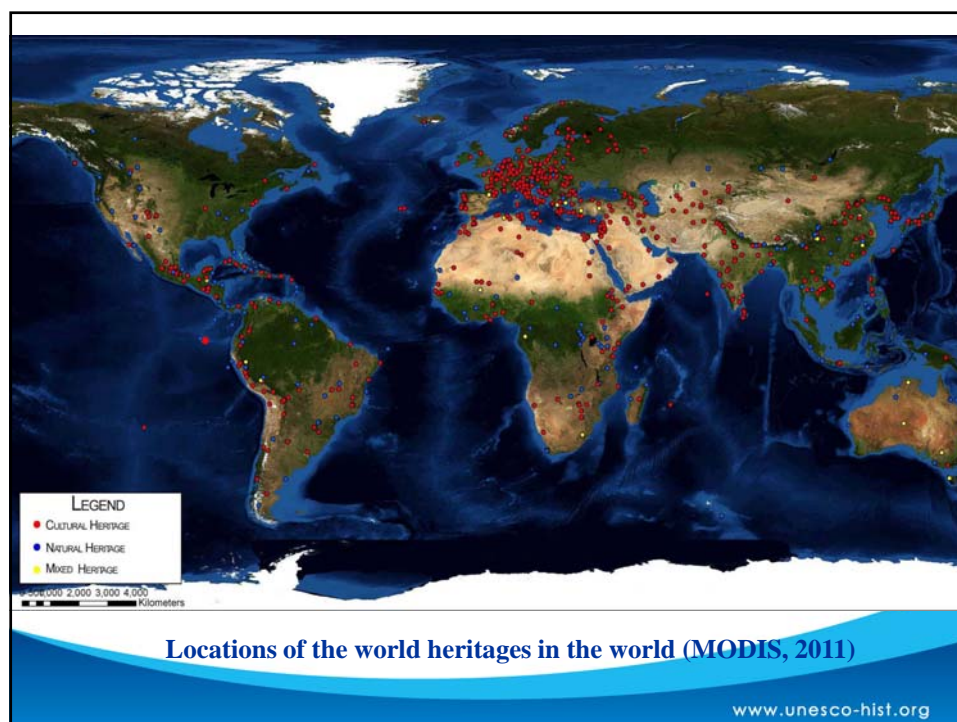
- The 4th EABRN-UNESCO Training Workshop on “Remote Sensing and GIS for Biosphere Reserve Management” was held in Beijing in 11-22 April, 2011.

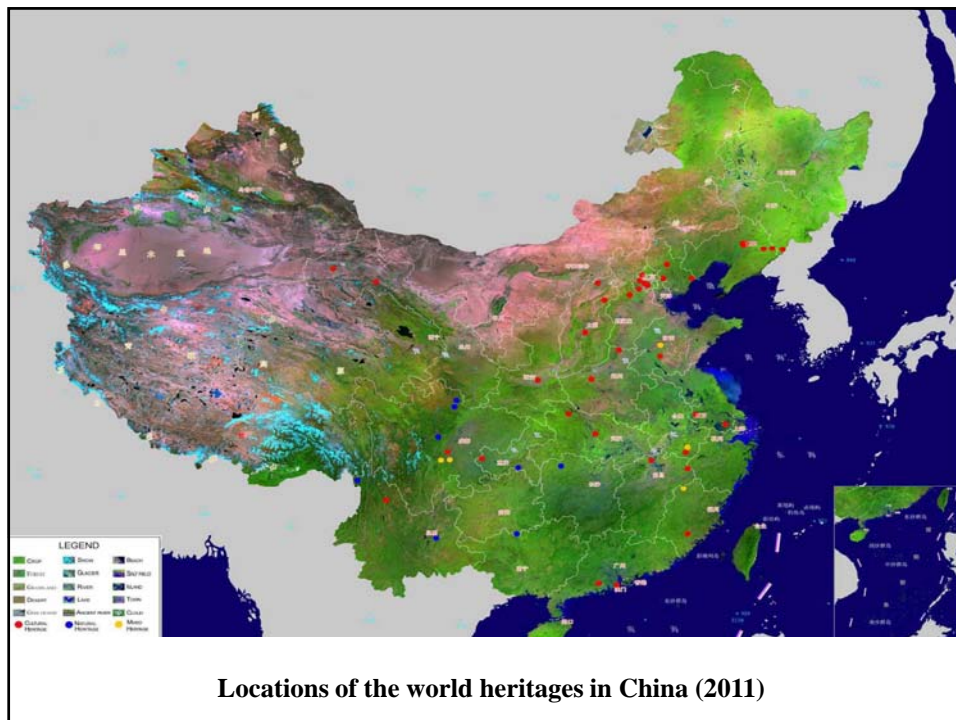


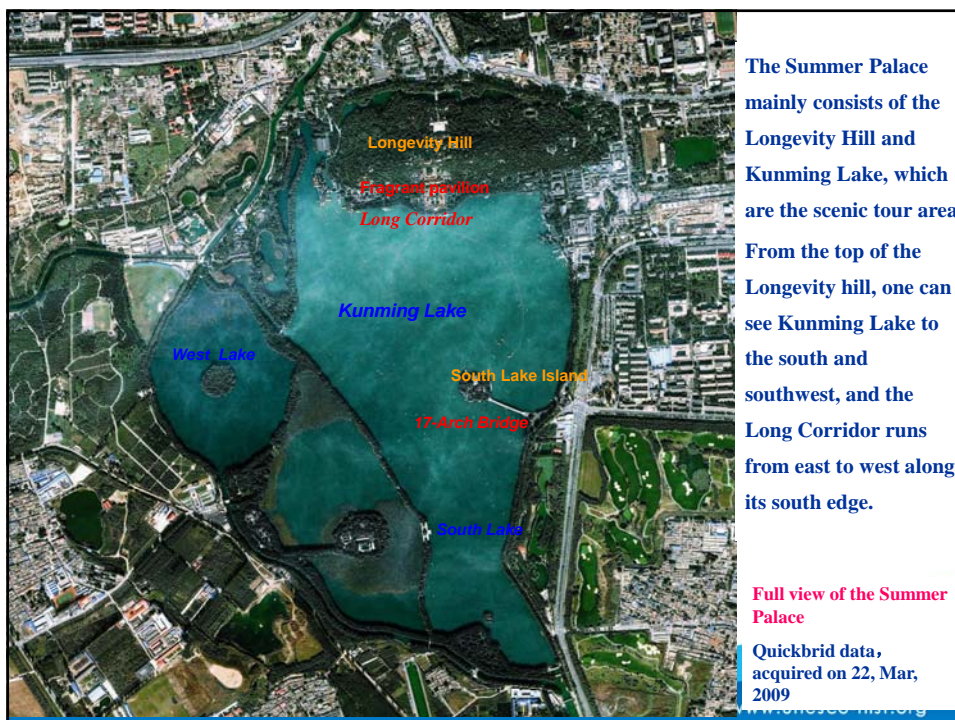
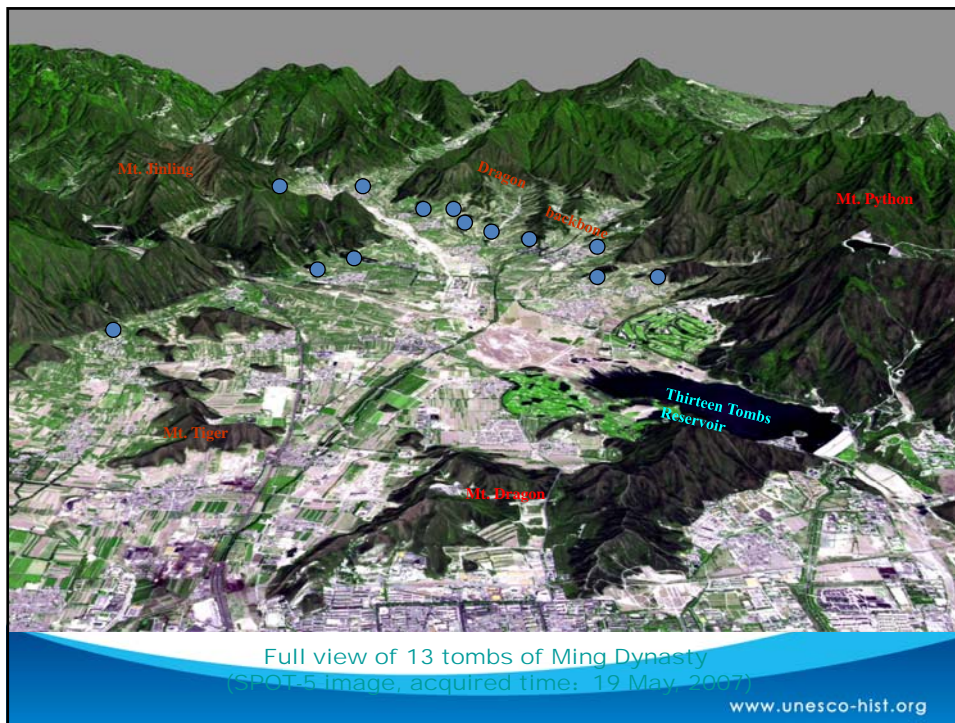
- The 3rd EABRN-UNESCO Training Workshop took place in Beijing in 2009.

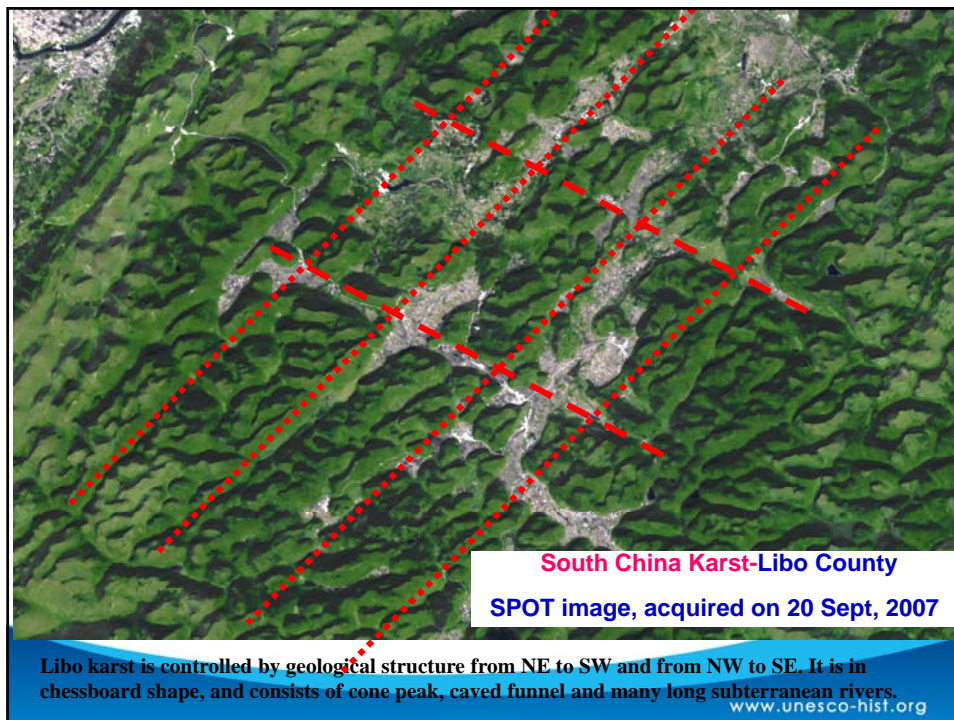


**Atlas of Remote Sensing for
World Heritage**







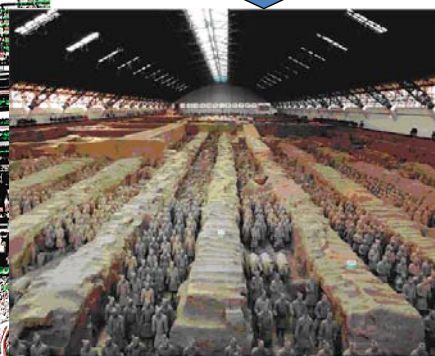


Cultural heritage

Airborne imagery of Qin Terracotta warriors and horses in 1985



Pit 1 In the shape of a rectangle holds infantry and war chariots.



Qin Terracotta Warriors and Horses, Pit 1

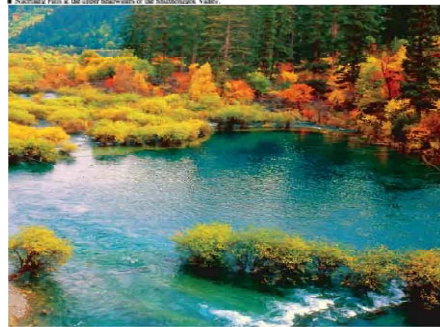
SPOT 5 image of Jiuzhaigou Valley



SPOT 5 image acquired on July
31, 2004



■ **Nacirliya Falls** is the upper headwaters of the Shattiriyon Valley

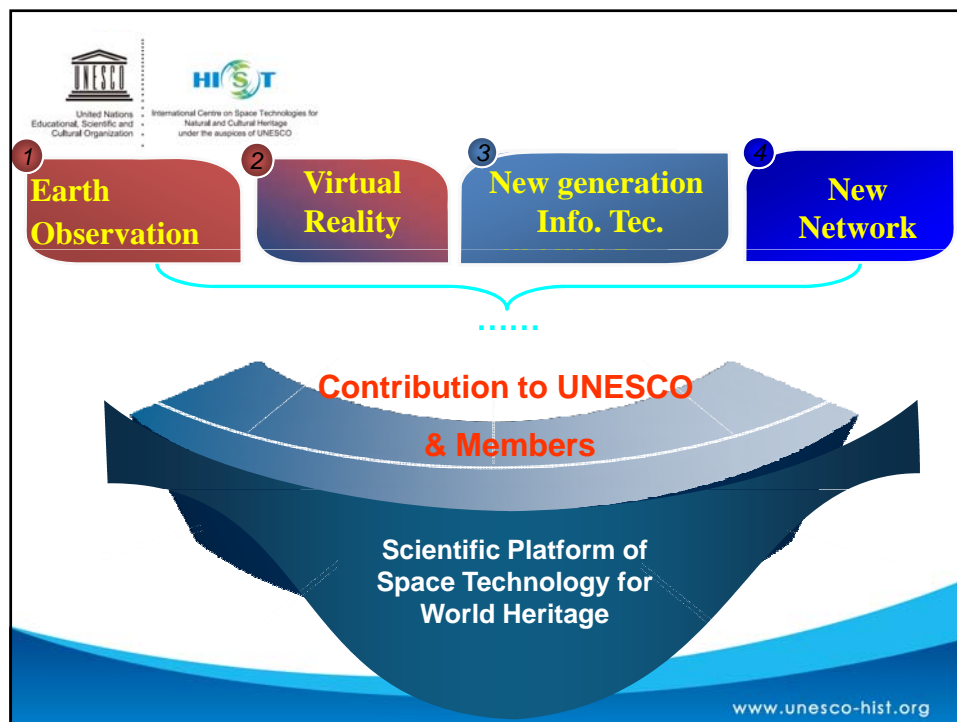
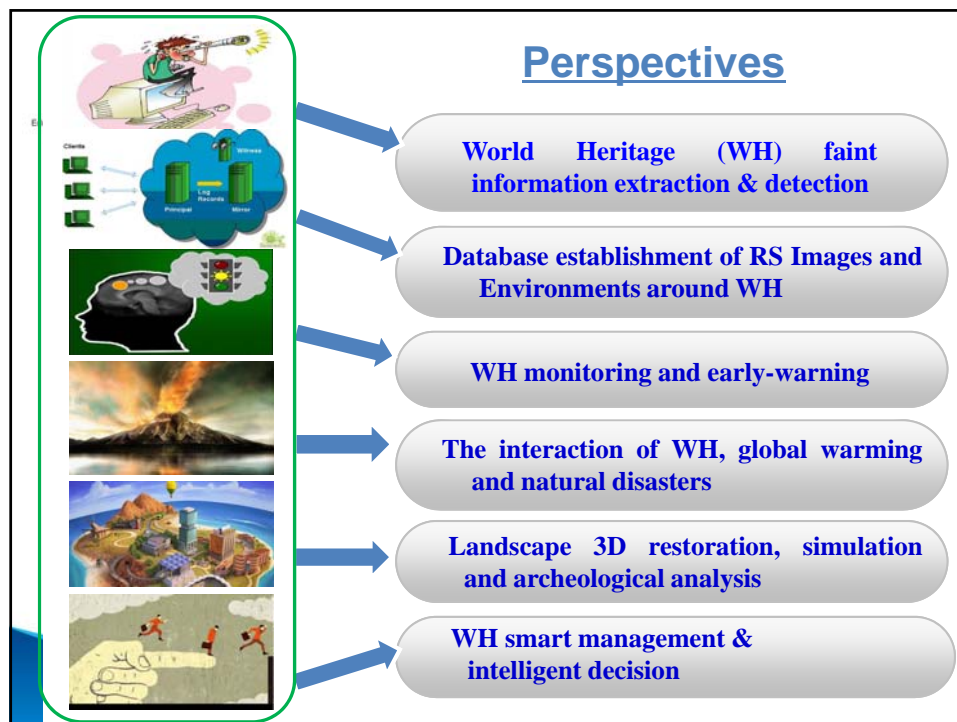


■ One of the 19 lakes in the Shuzheng Lakes Region



International Centre on Space Technologies for
Natural and Cultural Heritage
under the auspices of UNESCO

Perspective





Thank you !

www.unesco-hist.org