"Space as a driver for socio-economic sustainable development"

UN/UAE-HLF: 6 – 9 Nov 2017, Dubai, UAE

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Realizing SPACE 2030 Through Multi-Lateral Cooperation

Prof. Dr. Li Xinjun

November 15, 2017

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20 years preparation

10 years practice

1988
China, Pakistan and Thailand came up with the idea of Multi-lateral Cooperation in the Asia-Pacific Region

1992
MoU on Asia-Asia-Pacific Multi-Lateral Cooperation in Space Technologies & Applications (AP-MCSTA)

2001
AP-MCSTA Secretariat established in China

2005
APSCO Convention signed by 9 States

2008
APSCO established

2008-2012
Initiation of APSCO cooperation activities

2013-2017
Standardization of APSCO Cooperation activities
Institutionalization of APSCO

2018

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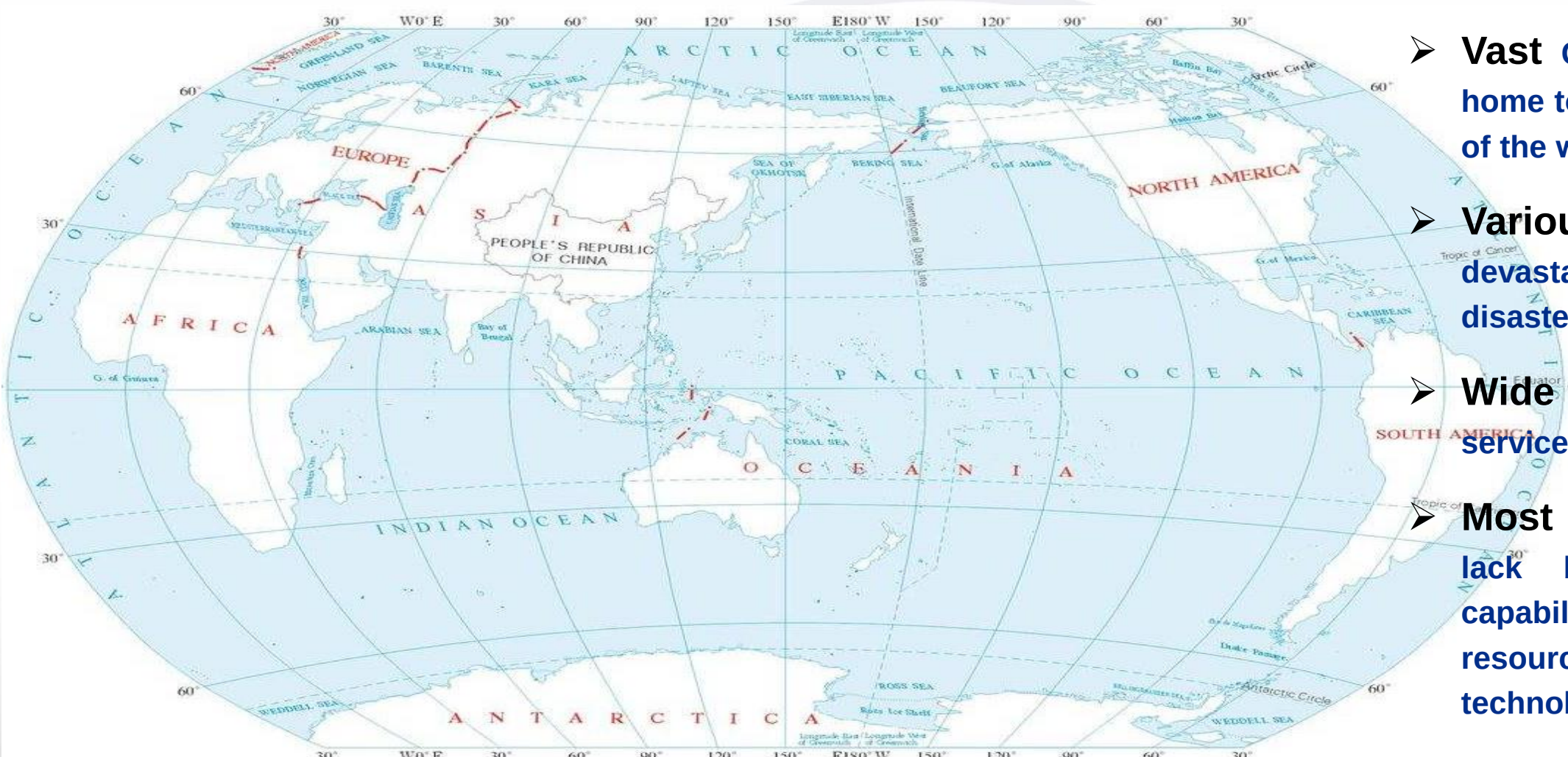
Multi-Lateral Cooperation in the Asia-Pacific Region



- **Vast** Geographical area, home to 4.1 billion or 2/3rd of the world's population
- **Various** kinds of devastating natural disasters
- **Wide** range of satellite services demands
- **Most** of the Countries lack budget, technical capabilities and human resource in space technology

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SPACE2030

- Inclusive global SPACE2030 agenda for exploration, innovation and inspiration that calls for strengthened cooperation and governance of outer space activities along **4 thematic pillars:**
  - **Space economy** - development of space-derived economic benefits;
  - **Space society** - evolution of society and societal benefits stemming from space-related activities;
  - **Space accessibility**- communities using and benefiting from space technology and applications;
  - **Space diplomacy** - partnerships & strengthening international cooperation in space activities

UN CHARTER

UN COPUOS Treaties, Principles, Guidelines on Outer space

GGE Report

Sendai Framework for Disaster Risk Reduction 2015-2030

MDGs-2015

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UNISPACE+50

Thematic Priorities

- Global partnership in space exploration and innovation
- Legal regime of outer space and global space governance: current and future perspectives
- Enhanced information exchange on space objects and events
- International framework for space weather services
- Strengthened space cooperation for global health
- International cooperation towards low-emission and resilient societies
- Capacity-building for the twenty-first century

2015 Beijing Declaration

- On the theme of "the Belt and Road Initiative for facilitating space capabilities building of the Asia Pacific countries". APSCO held its Development Strategy Forum in Beijing on October 27, 2015

- Adopted '2015 Beijing Declaration' with five action points
  - ①Space Capacity Building
  - ②Sharing Service Capability
  - ③Quick Response Capability
  - ④Industry Driving Capability
  - ⑤Information inter-connection

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Dubai Declaration

Adopted at the 1st HLF: "Space as a driver for socio-economic sustainable development", Dubai, UAE (24 Nov 2016)

- Develop space policies and regulatory frameworks at the national level
- Demonstrate societal benefits of space
- Global governance of outer space activities
- Regulatory certainty at the national level
- unified efforts of the space sector
- Capacity-building
- access to space-derived data,
- increased compatibility, standardization and integration of space systems
- involvement of youth and its capacity-building
- Broadening access to space
- safety, security and sustainability of outer space activities
- Exploration and innovation coordination mechanism like the International Committee on GNSS
- compatibility, standardization and integration of space systems
- Dialogue b/w govts, int'l organizations industry, private sector, academia and civil society
- partnerships, international cooperation for an innovative, open space economy
- safety, security and sustainability of outer space activities

CONTRIBUTION FROM APSCO

A family for its Members to sharing their Resources

Member State
Associate Member
Observer State
Signatory State

Knowledge
Technology
Space Infrastructure
Finance & Manpower
Geography

3G: Diversity in Geography

- In-orbit satellites of Member States and more Ground Stations in Member States
- Exploit advantage of geography for astronomical observation and launch corridor
- International Symposia and Workshops in different Member States within the region
- Regional cooperation for building resilience to disasters in the Asia-Pacific region
- Building Resilience contributes to achieving 11 out of 17 goals of SDGs
- Applications of Space Technology and Geographic Information Systems for Disaster Risk Reduction and Sustainable Development
- Space Cooperative Networks--wider geographical coverage, more efficiency

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Geography Network

- **Cooperation focus on establish 6 Networks:**

① **Education and Training Centre Network**

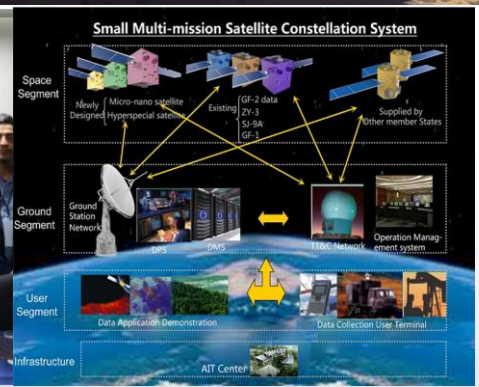
② **Data Sharing Service Platform Network**

③ **APSCO Ground-Based Space Object Observation Network (APOSOS)**

④ **Disaster Monitoring Network**

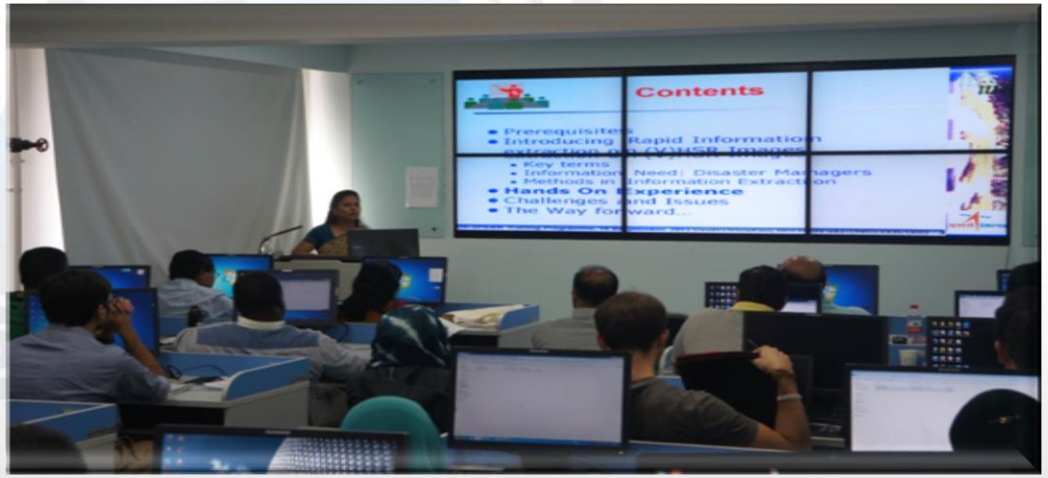
⑤ **Science Technology and Application Network**

⑥ **Space Segment Network and Inter-Connection of Ground Systems (SMMS)**

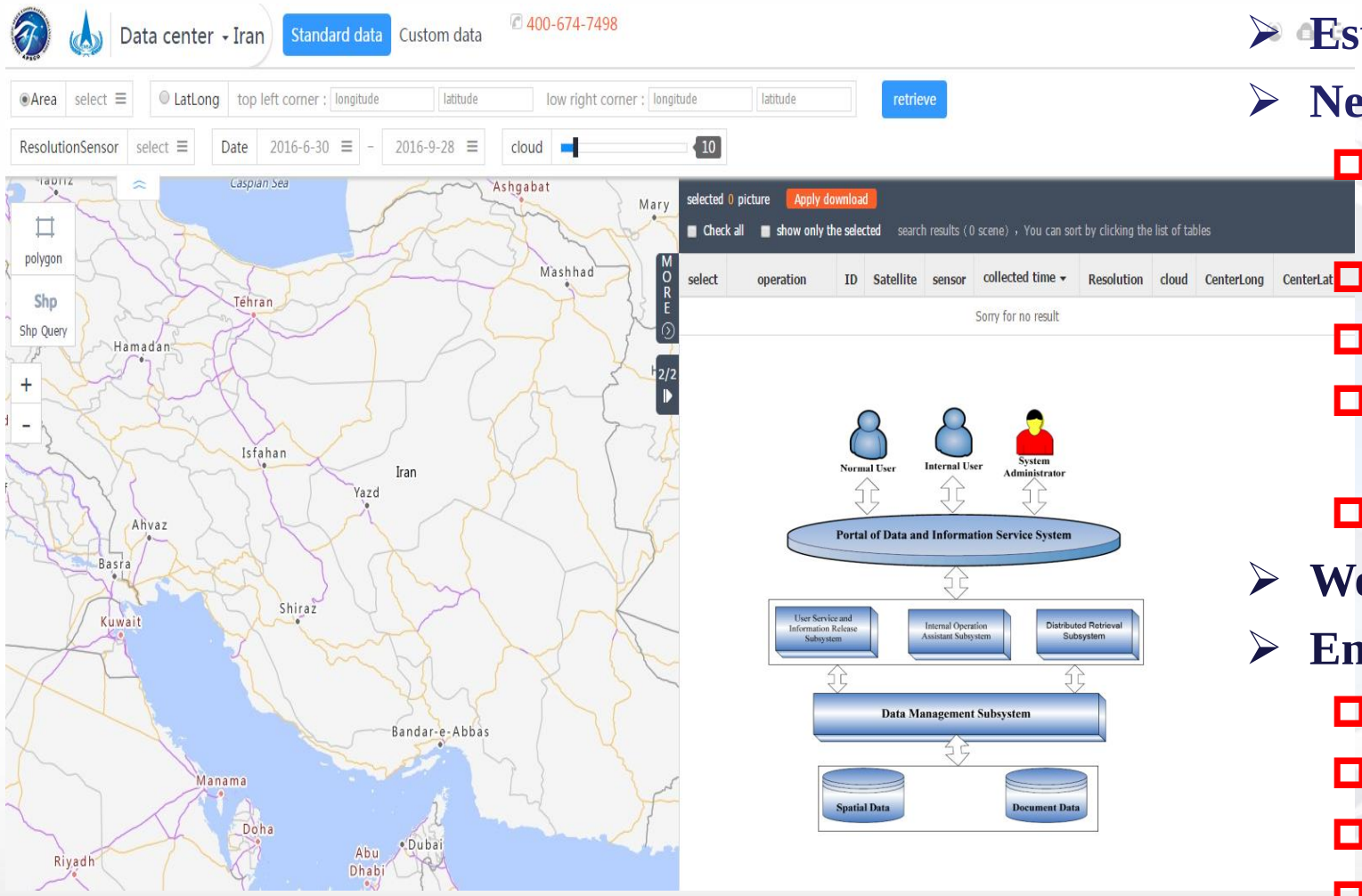


@ Education and Training Network

- **A Network for frequent Exchange of Knowledge among MS**



②Data Sharing Service Platform (DSSP)



- **Established in 2012， Update in 2016**
- **Network for sharing satellite data**
  - Data provided by 9 Earth-observation satellites from China
  - More than 223,000 satellite images
  - More than 20 million km² coverage area
  - 1000 scenes/year to each MS of different resolution level
  - 35 Authorized Users
- **World wide open in near future**
- **Enhanced Database**
  - Meteorological satellite data
  - Space and ground-based measurement data
  - Knowledge management database
  - APSCO Center of Excellent

② Data Sharing Service Platform (DSSP)

Platform Functions

The main function of this service is to retrieve and query satellite images according to the requests from customers, which can query archive satellite data and judge the available satellite data in the future.

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② Data Sharing Service Platform (DSSP)

Applied images DSSP I 2015.1-2016.4 & DSSP II 2016.9- Application was not as good as expected

		Bangladesh	Iran	Mongolia	Pakistan	Peru	Thailand	Turkey	Indonesia
GF-1	PMS	141	602	5177	2155	88	149	63	1039
	WFV	116	381	1033	822	12	108	27	653
HJ-1A	HIS	3988	7832	41477	13872	0	8920	29	9807
	CCD1	2045	1775	10457	4026	110	3149	110	3907
	CCD2	1734	2647	10041	4430	185	2974	185	3692
Hj-1B	IRS	1904	1451	10339	3281	22	3663	92	2832
	CCD1	1932	1639	11020	3017	89	3296	81	4023
	CCD2	1569	2067	10533	3471	128	3108	169	3748
DSSP I Source	223432	**13429**	**18394**	**100077**	**35074**	**634**	**25367**	**756**	**29701**
Applied I	5171	**45**	**24**	**0**	**123**	**2607**	**2343**	**29**	**0**
DSSP II Source	109691	**3320**	**24188**	**44683**	**24549**	**2225**	**7482**	**3314**	**0**
Applied II	589	**224**	**4**	**113**	**56**	**58**	**109**	**25**	**0**
Total applied	5760	**269**	**28**	**113**	**179**	**2665**	**2452**	**54**	

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② Data Sharing Service Platform (DSSP)

Training: 7 On Site Trainings on “Remote Sensing Application and DSSP”

Trainees: 320

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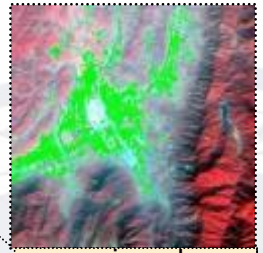
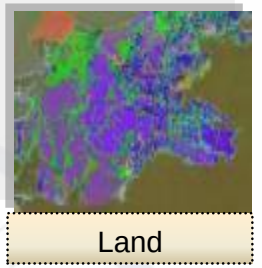
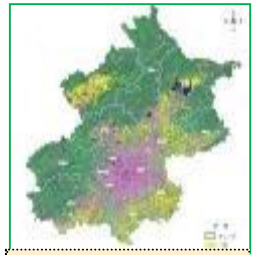
Users from different Fields

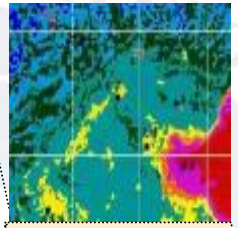

Public safety

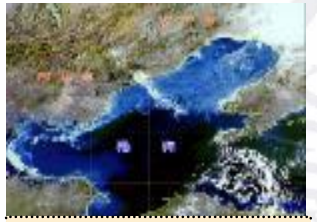

planning

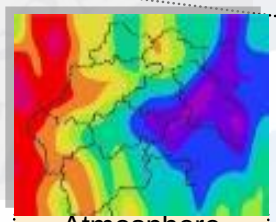

mineral resources


Land


Agriculture


Ocean


Disaster mitigation

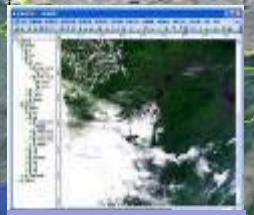

Atmosphere monitor


Forestry


Water conservancy

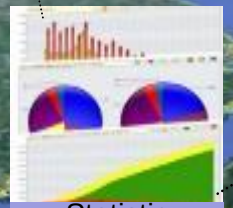
The platform could provide customized products such as DEM, DOM, and thematic products such as Land-use & Land-change, and other value-added services according to member countries' demands.


Power


Basic process


Change detection


Simulator


Statistic analysis


Trend prediction

② Data Sharing Service Platform (DSSP)

Application situation 3 months after the on site trainings

		Bangladesh	Iran	Mongolia	Pakistan	Peru	Thailand	Turkey	
Storage Source	109691	3320	24188	44683	24549	2225	7482	3314	
Released	705	205	41	113	23	42	249	32	
Order	303	90	17	52	12	31	84	17	

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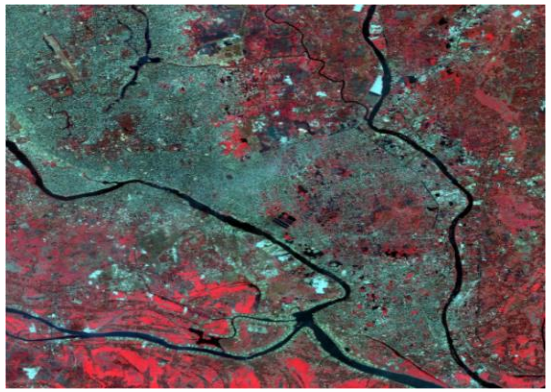
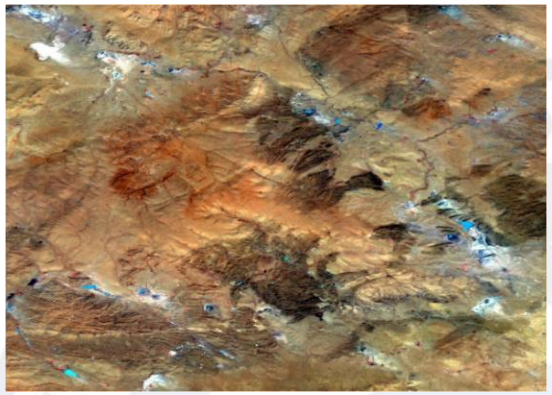
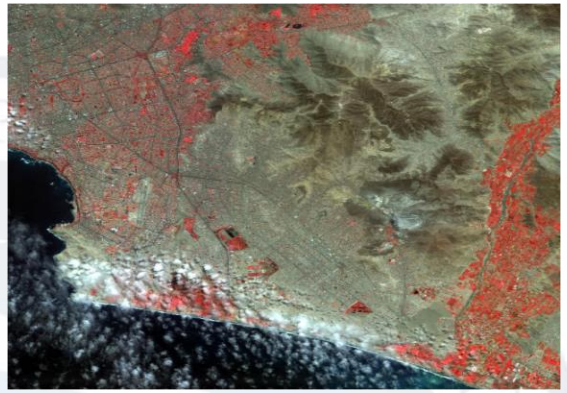
Disaster Management Framework & Response Mechanism



Land use monitoring Dhaka, Bangladesh, 2016



Water coverage and snow coverage, Mongolia, 2016-2017

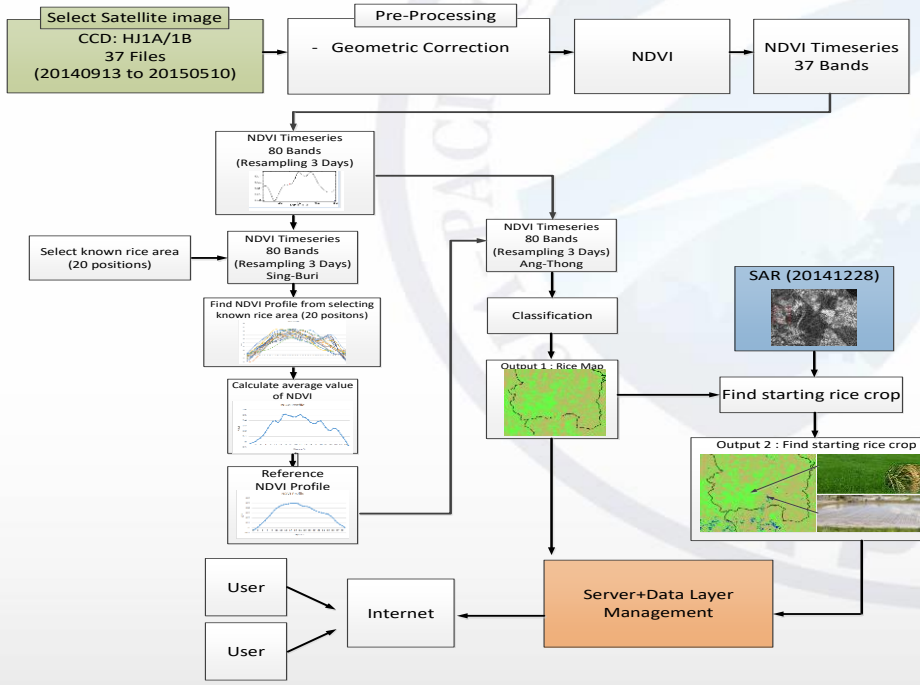


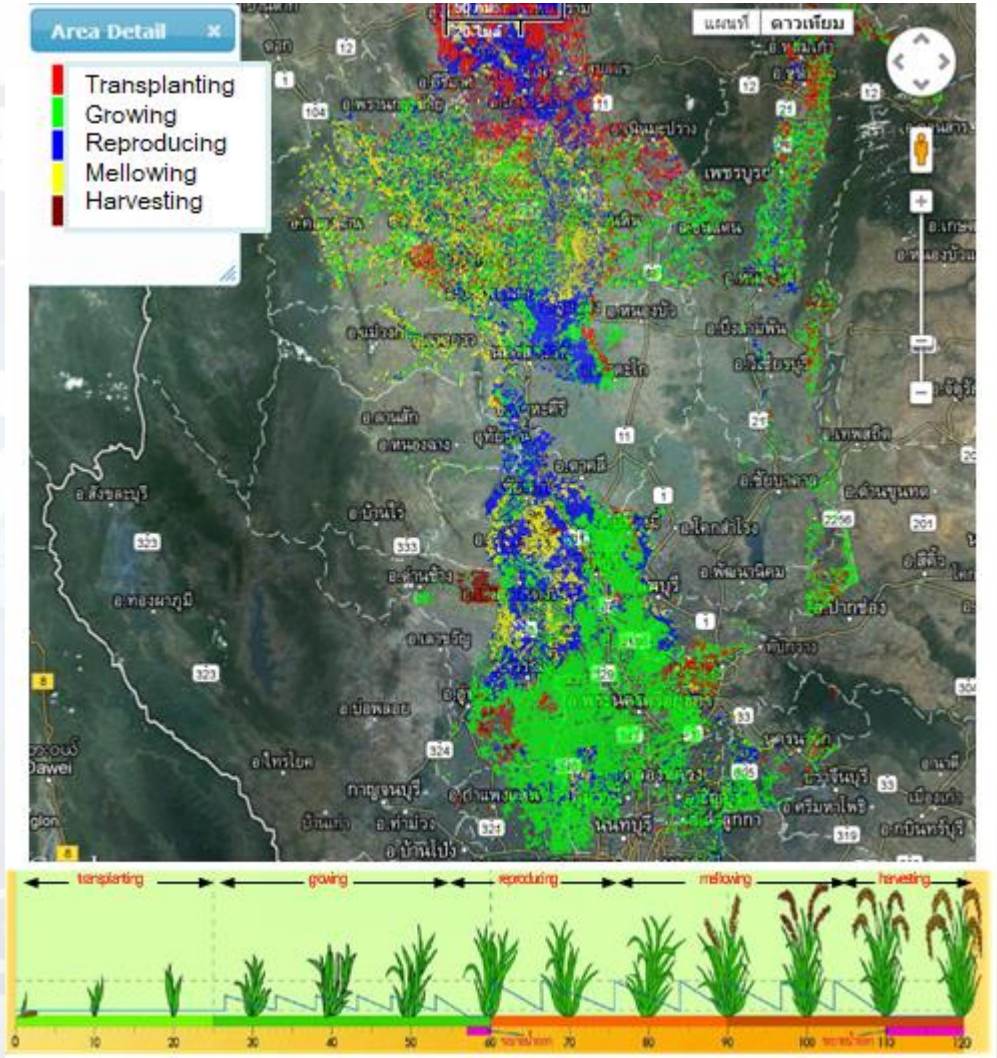
Flood affected area monitoring May 2017, Lima, Peru.

Earthquake monitoring Jan 2017, Mexico.

DSSP Pilot Project 1:
Estimation of Rice Field using Multiple Satellite Sensors

- Successfully conducted by Chulabhorn Satellite Receiving Station, Kasetsart University, Thailand
- Combined sensors from HJ1A/1B and SAR satellites
- The rice field estimation has been substantially improved with >80% reliability
- The algorithm and project outcomes have been shared among APSCO Member states





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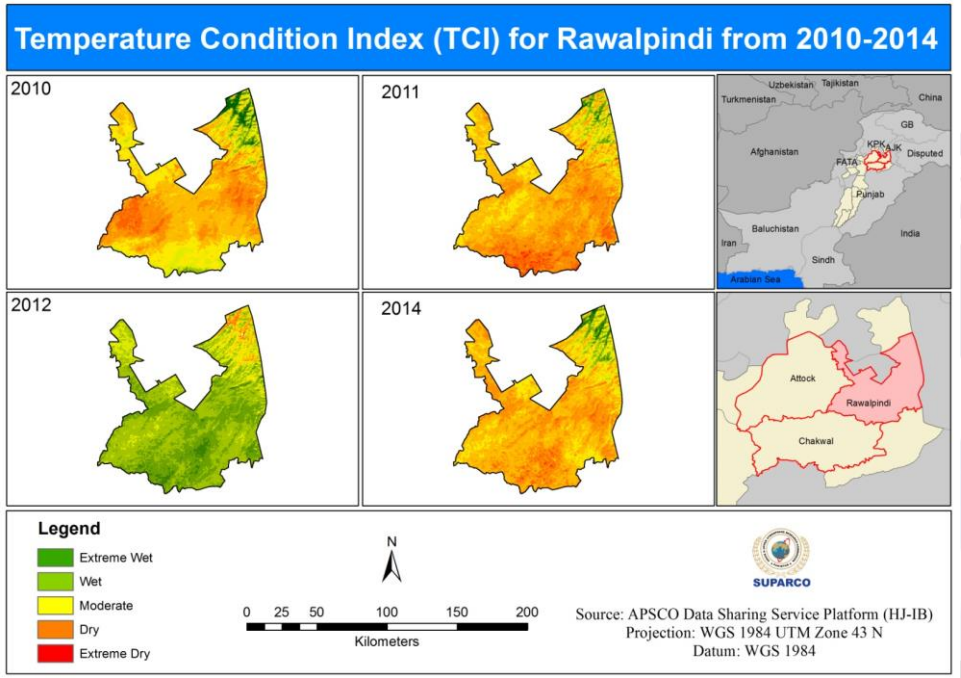
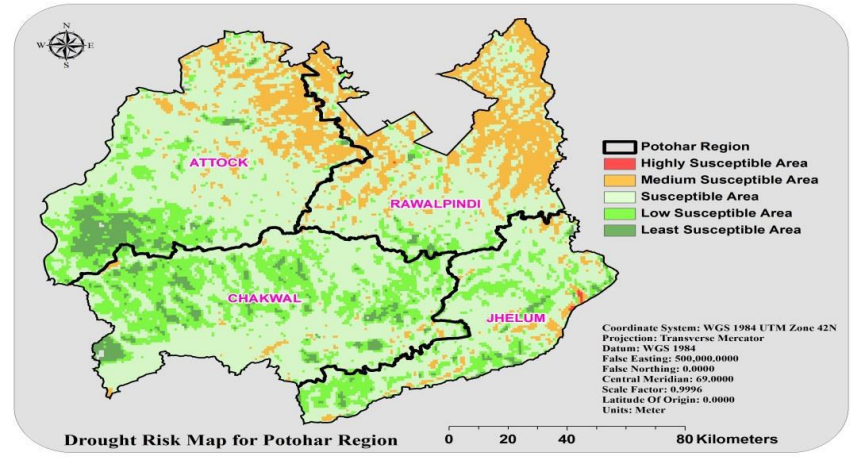
DSSP Pilot Project 2:
Remote Sensing Techniques for Drought Study



- Successfully conducted by SUPARCO, Pakistan
- Combined sensors from HJ1A/1B and AQUA satellite
- Time-series of different indices, such as NDVI, VCI, TCI were studied
- Monitoring and mapping of satellite based drought indices is reliable and would play an important role in predicting drought conditions
- The algorithm and project outcomes have been shared among APSCO Member states for applications in their own countries



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③ Asia-Pacific Ground-Based Optical Space Objects Observation System (APOSOS)

- **Three observation nodes were deployed**
  - 150mm diameter telescope
  - 2015, Deployment of Pakistan and Peruvian observation nodes,
  - 2016, Deployment of Iranian telescope
- **APOSOS Data Processing and Service Center in Beijing, China**
- **Observations**
  - 2015, 33 observation nights, 138 objects, 475 tracks
  - 2016, 22 observation nights, 121 objects, 410 tracks
- **Joint observation in China**
  - Facilities belongs to different organizations conduct joint observation campaign
  - Conduct emergency response based on the joint network

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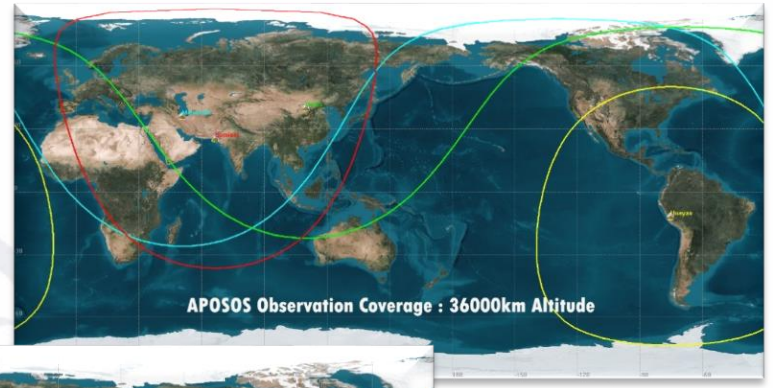
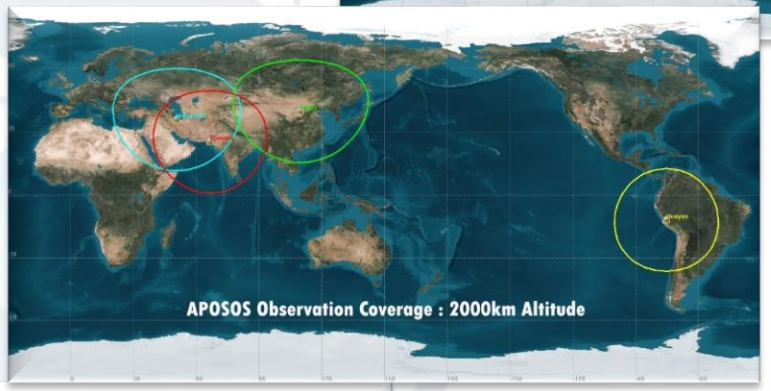
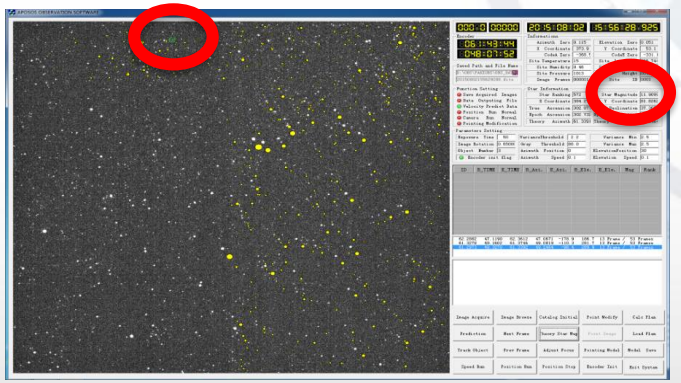
③ Asia-Pacific Ground-Based Optical Space Objects Observation System (APOSOS)

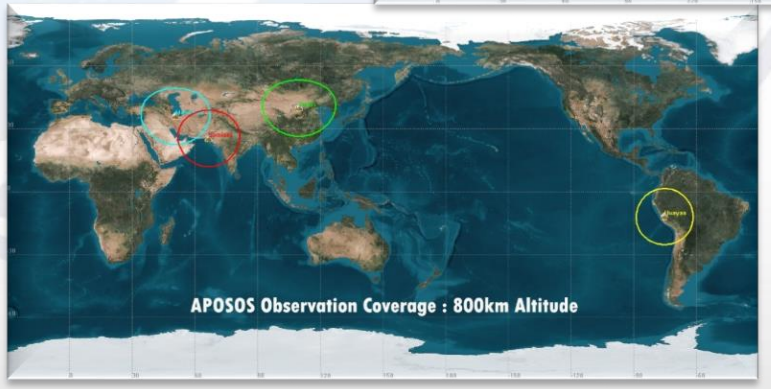
Benefits and Achievements

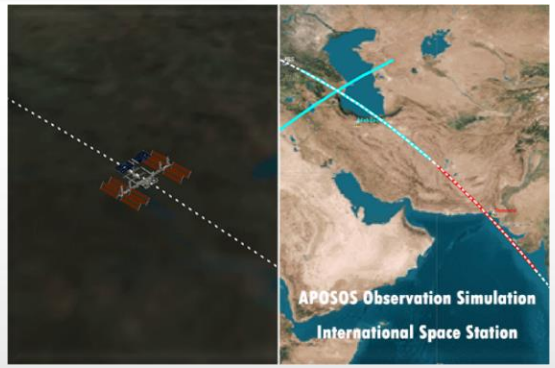
- Space object detecting, tracking and identifying - more than *206 objects are currently identified*
- Satellite Orbit determination and cataloging - *more than 90% of LEO satellites of APSCO MS can be fully tracked (40 satellites: 10 from China and 30 from other MS)*
- Early Warning Service to protect space assets of MS from space debris conjunction
- Space objects re-entry prediction











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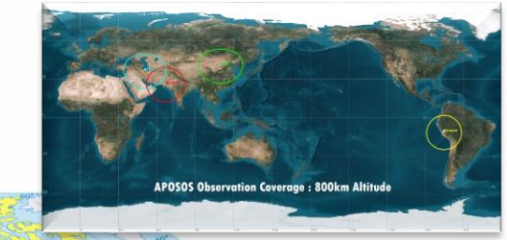
Future of APOSOS

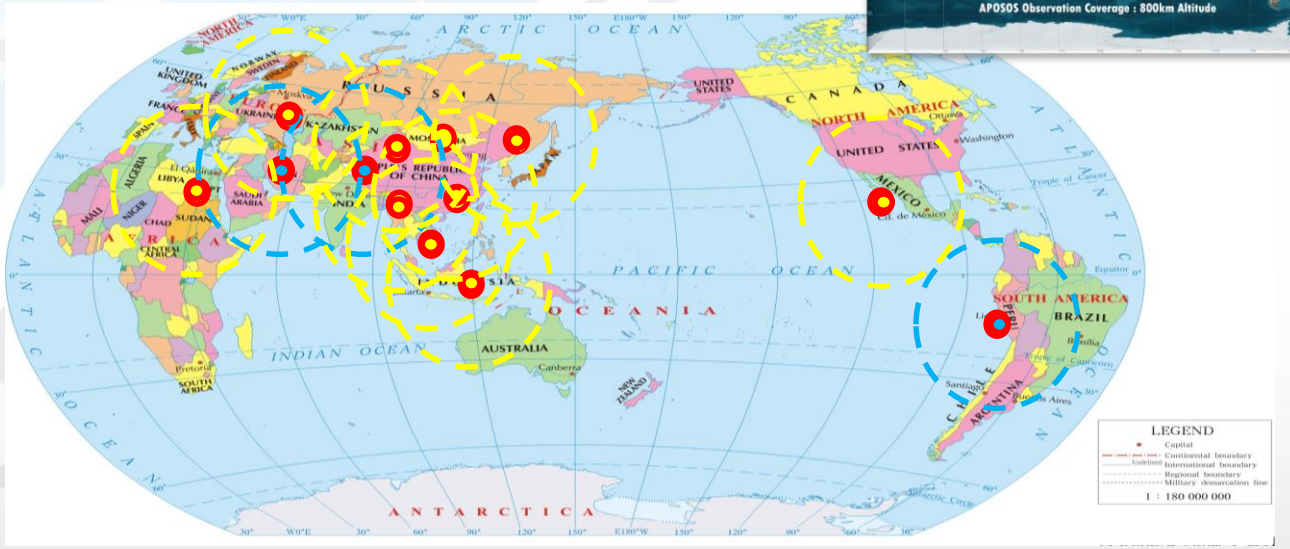
➢ Objectives

- To establish a data application service network for data sharing, space hazard prevention and response for APSCO members
- To improve the observation network for more efficient survey and tracking
- To build a technical training and communication network for students and researchers from APSCO members
- To form a science popularization network for people from APSCO members

➢ Network design

- Formed by telescopes with medium aperture, 30cm to 80cm class
- Deployed in each member state of APSCO
- Each site has supporting facilities observation scheduling, data exchange, technical training and communication and science popularization





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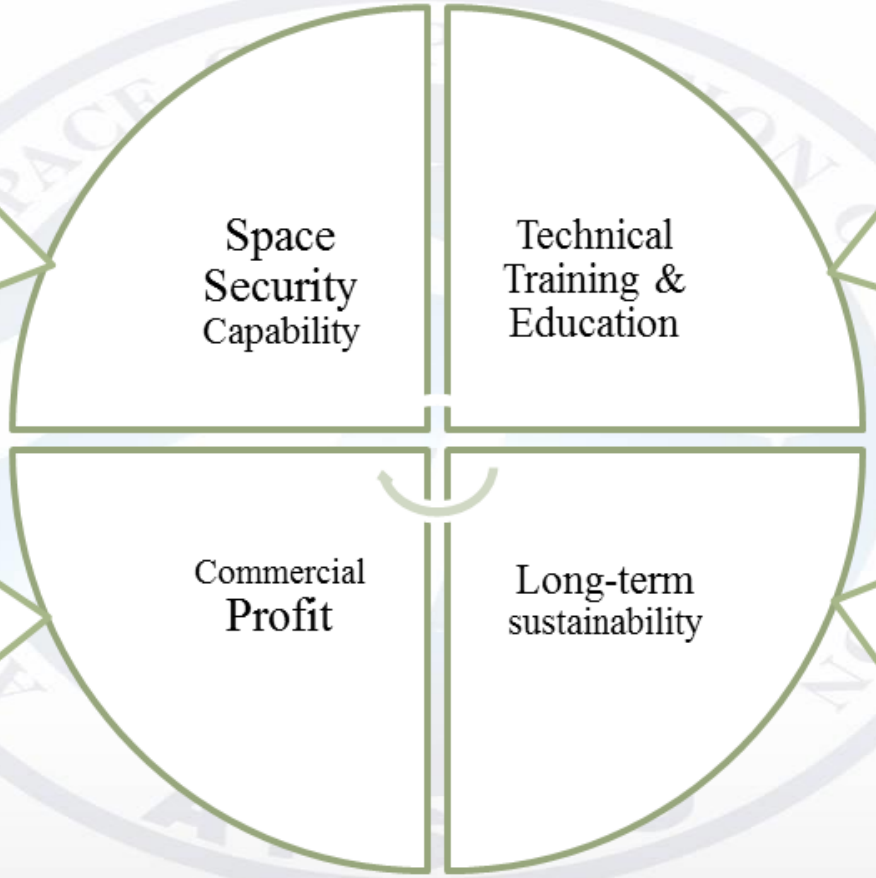
Expected Performance

- ✓ Space debris conjunction and reentry risk assessment
- ✓ Maneuvering strategy analysis to avoid collision
- ✓ NEO hazard warning and response



- ✓ Form a technical team from APSCO members
- ✓ Upgrade space security knowledge level of people from APSCO members

- ✓ Commercial satellite conjunction assessment
- ✓ Commercial satellite end-of-life deorbiting support
- ✓ Commercial maneuvering support

- ✓ Support long-term sustainability of outer space activities
- ✓ Facilitate the global data sharing and transparency in the area of space security

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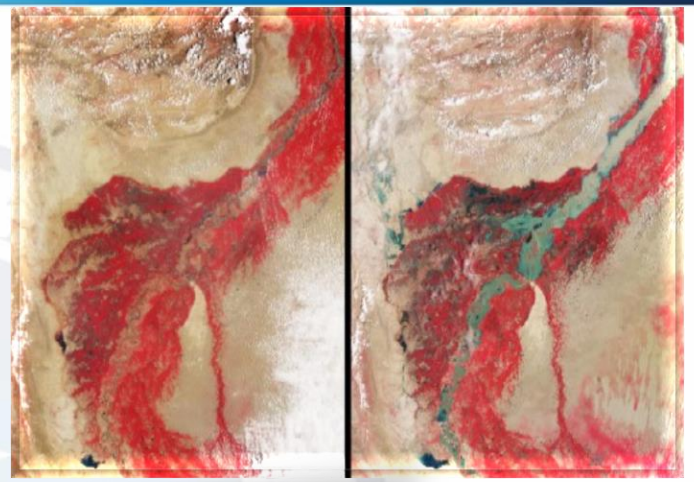
④ Disaster Monitoring Network

- Determining Precursor Ionospheric Signatures of **Earthquakes** by Ground-Based Ionospheric Sounding
- Compatible **GNSS Terminals** for **Emergency** Management and **Disaster Rescue**
- **Framework** for Researches on Application of Space Technology for **Disaster Monitoring** in the APSCO Member States
- International **CHARTER** similar **mechanism** & Seek to become a member of **CHARTER**



Earthquake Signatures Project

- **Benefits and Achievements**
  - **The Ground-Based Ionospheric Monitoring and Information Sharing Platform (GIMISP) has been established**
  - **The web portal equipped with ground-based Ionospheric monitoring data processing and analysis**
  - **The platform is equipped with tools for seismo-ionospheric coupling mechanism investigation**
  - **Real-time joint observation and analysis among APSCO Member State through GIMISP**

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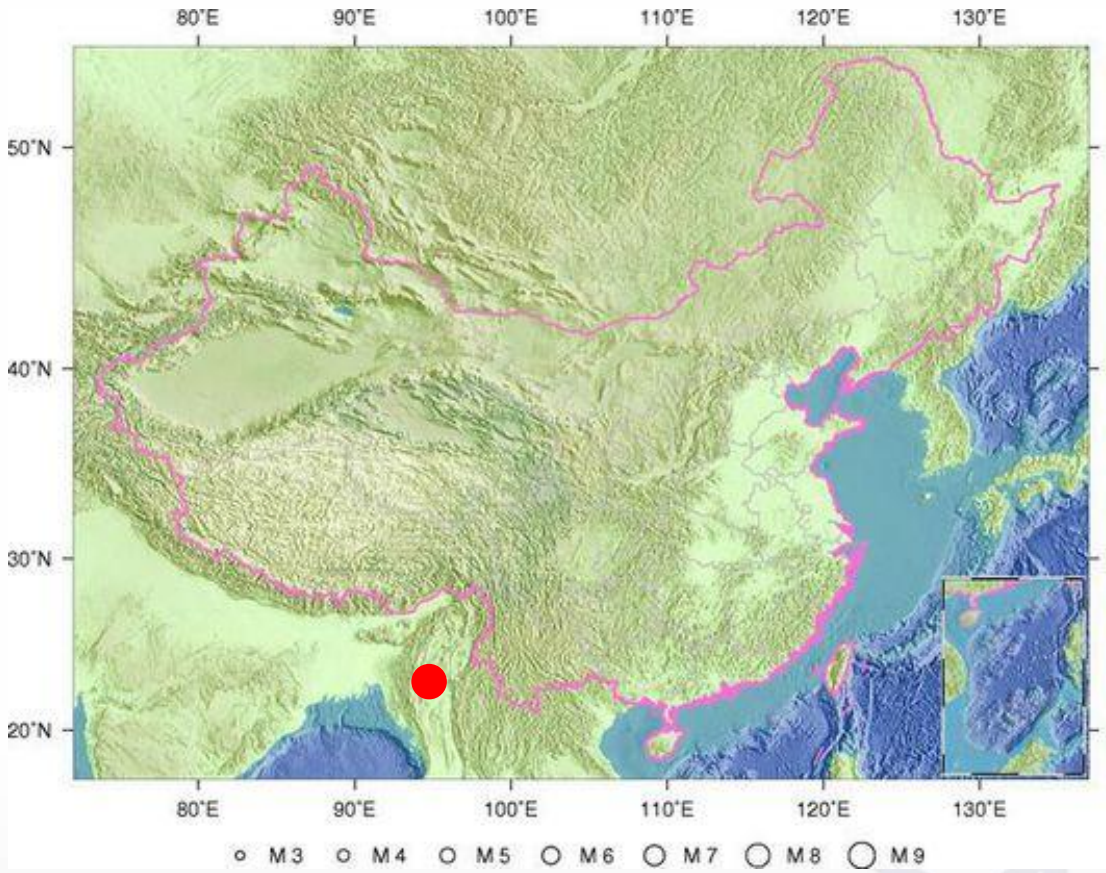
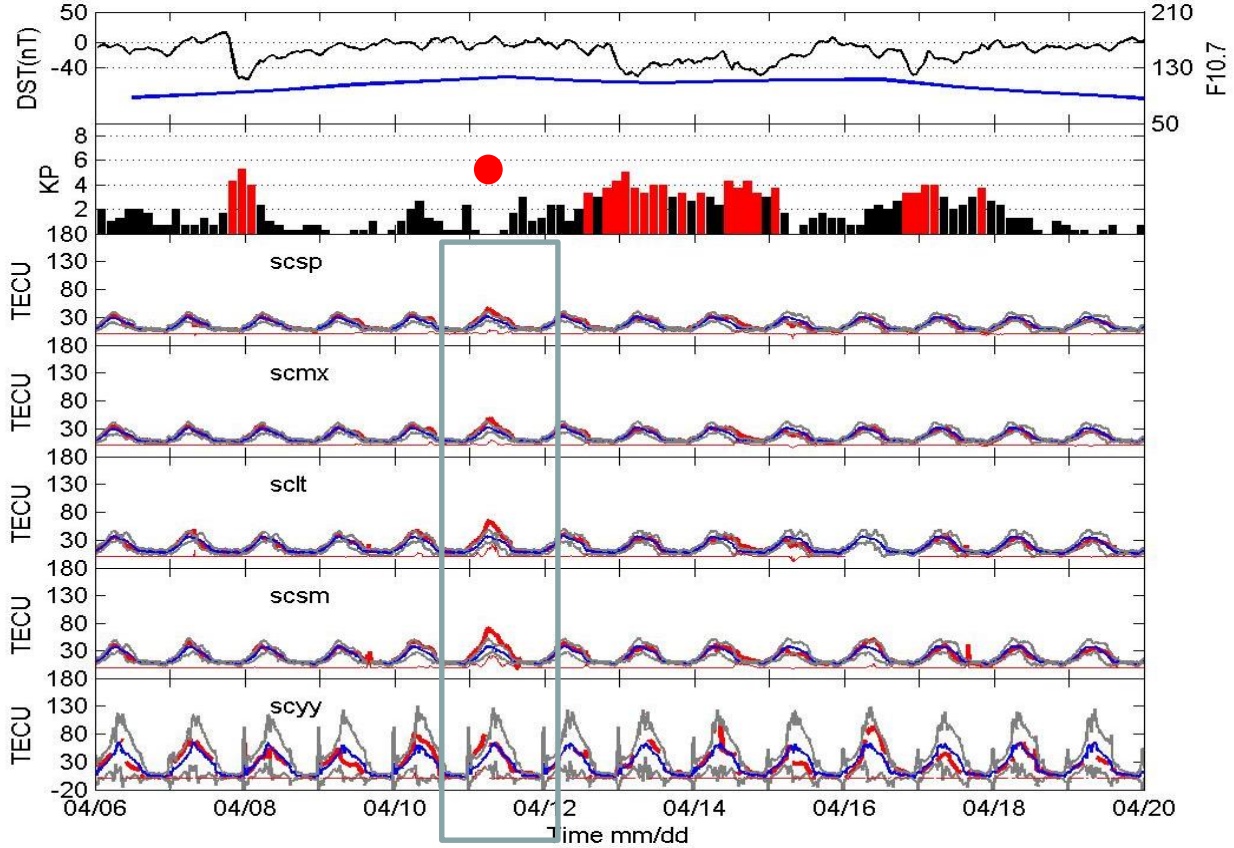
Earthquake monitoring





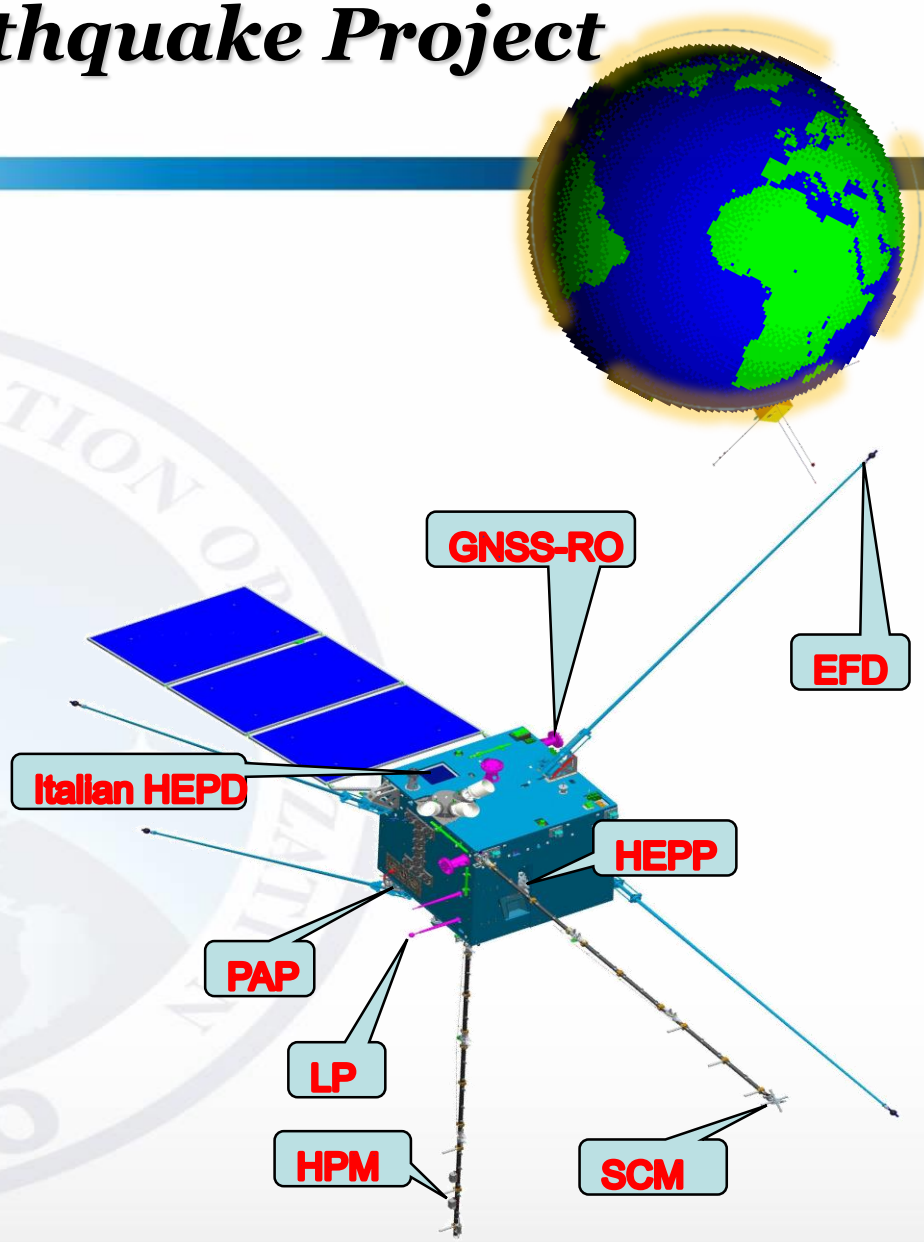
On April 13, 2016, there occurred an large earthquake in Burma, located at 23.14° N, 94.87° E. , with magnitude of 7.2.

Future of Earthquake Project

Source data

- Ionosphere oblique
- Ionosphere vertical
- VLF
- Geomagnetic
- GPS TEC
- Magnetic index

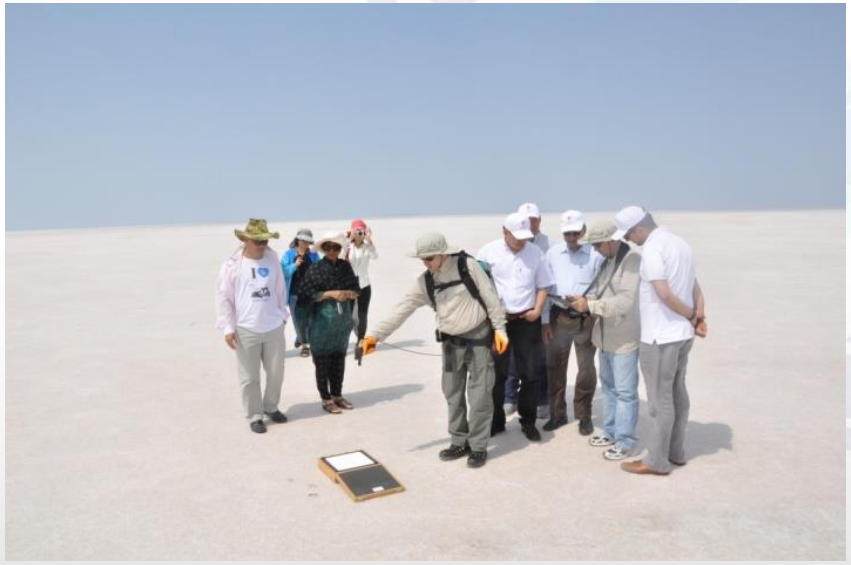
Physical parameters
Magnetic field
Electric field
TEC and content profile
Ion density/temperature
Electron density/temperature
Proton flux，Electron flux，Pitch Angle
infrared remote sensing

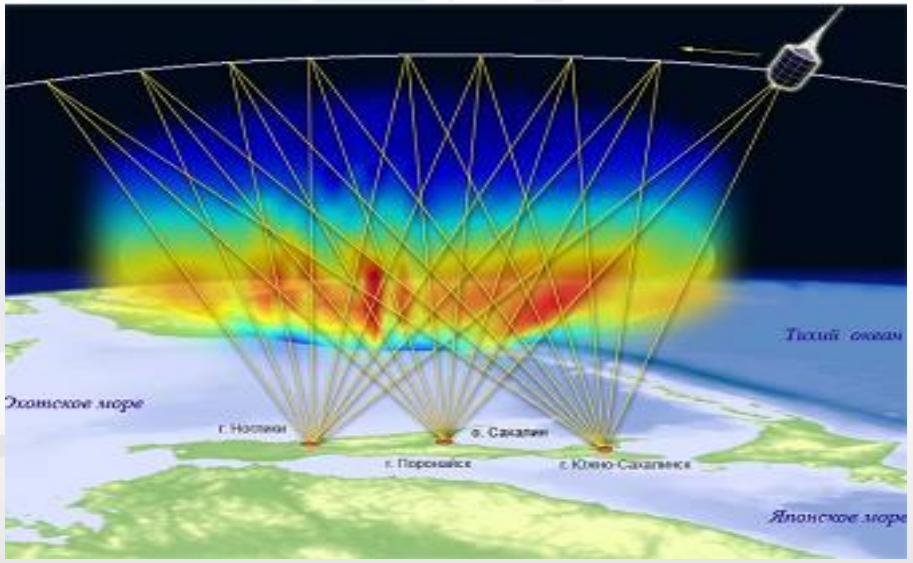


CSES data will be added into GIMISP

China Seismo-Electromagnetic Satellite To be launched in Feb, 2018

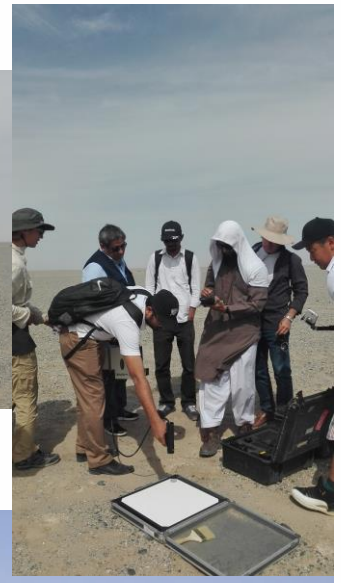
- **Radiometric Calibration** for Satellite Sensors Network
- **Ka**-Band **Rain Attenuation** Modeling
- **Ionosphere Modeling** through Study of Radio Wave Propagation and Solar Activity
- COMSAT-Based **Tele-Medicine** Network

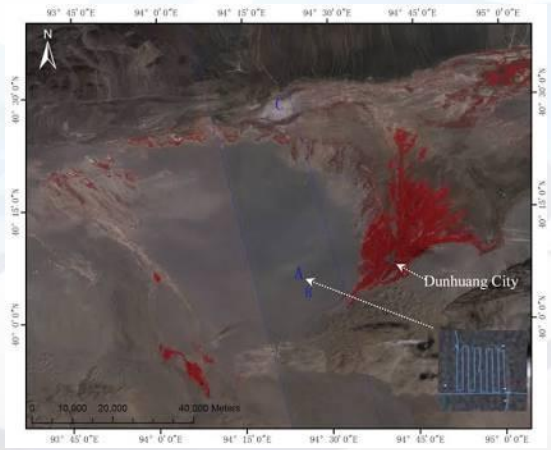




Radiometric Calibration Project

- **Benefits and Achievements**
  - The project was successfully kicked off in August, 2017
  - Technologies and knowhow have been transferred through both in-class training and field campaign activities
  - The APSCO Satellite Sensors Calibration Center of Excellent has been established, where data, techniques and best practices can be shared among MS
  - New potential calibration site in APSCO MS is under investigation

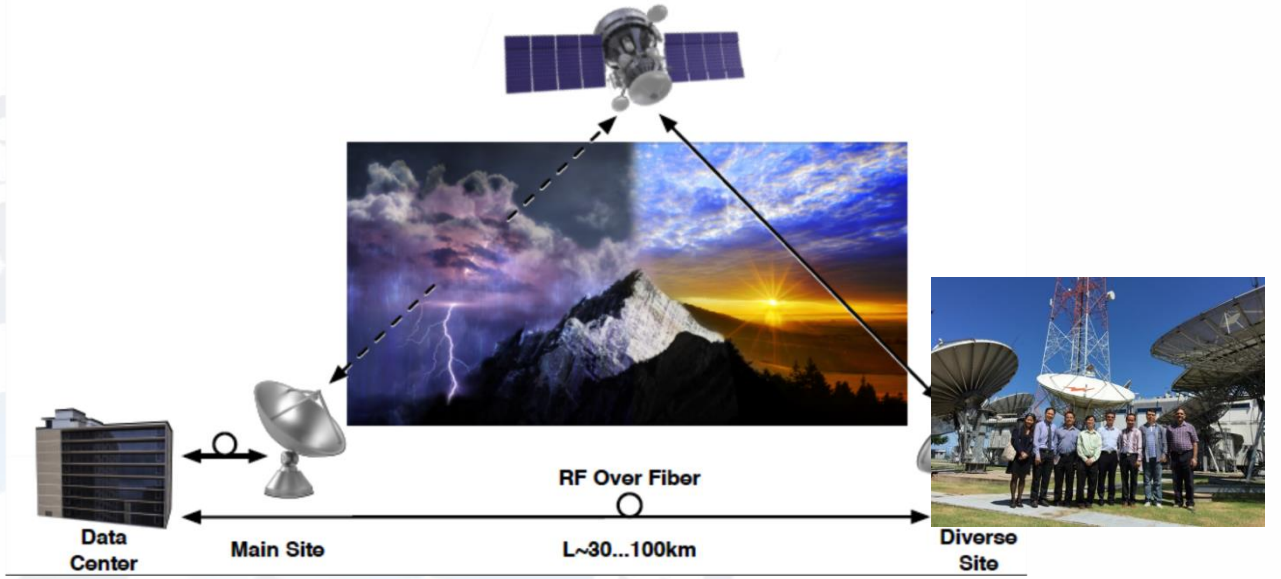


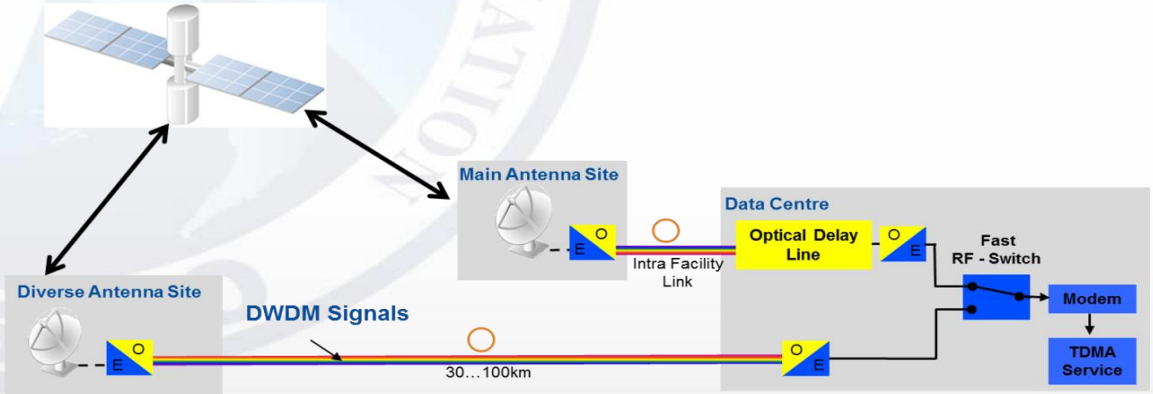


Ka-Band Rain Attenuation Modeling Project

➢ Objectives

- **Focusing on signal attenuation for Ka-band communication satellite**
- **To establish a database from collected Ka-band beacon signals and related meteorological data**
- **To develop a rain attenuation model that links the rain process and its atmospheric effects**
- **To develop practical site-switching algorithm for site diversity for continuity and reliability of communication link**

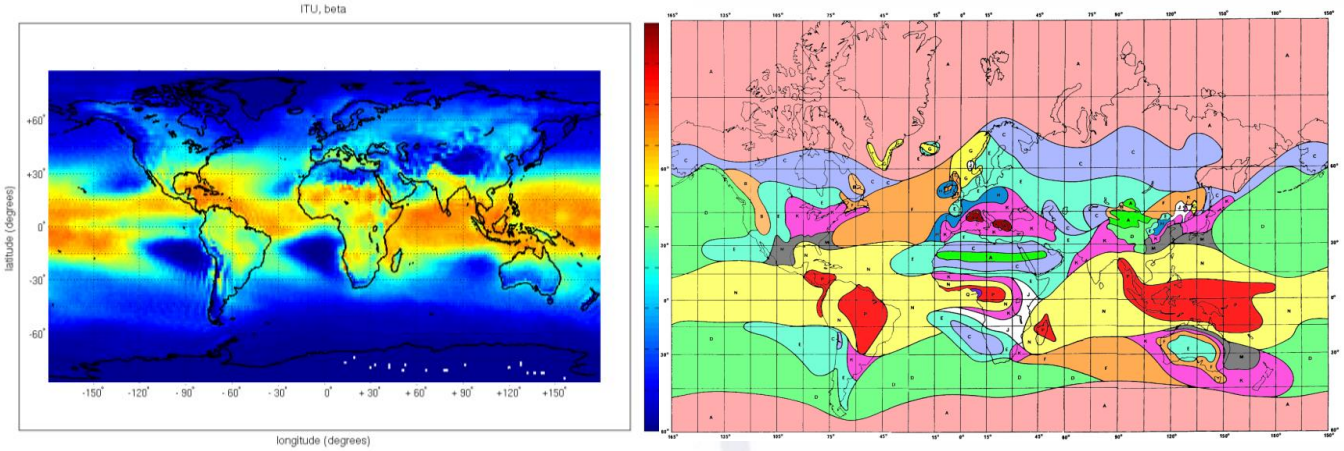




Ka-Band Rain Attenuation Modeling Project

➢ Benefits and Achievements

- A Regional Ka-Band Rain Attenuation Model has been developed
  - The proposed Model presented at the IAC2017, Australia
  - The methodology for Effective Rain Rate Conversion to be published in ITU Journals
  - The proposed Model will be addressed to ITU Working Group for possibly adoption
- A Site-Switching Algorithm for site diversity has been developed
- The Model and Algorithm have been shared among APSCO Member States for practical applications in their countries

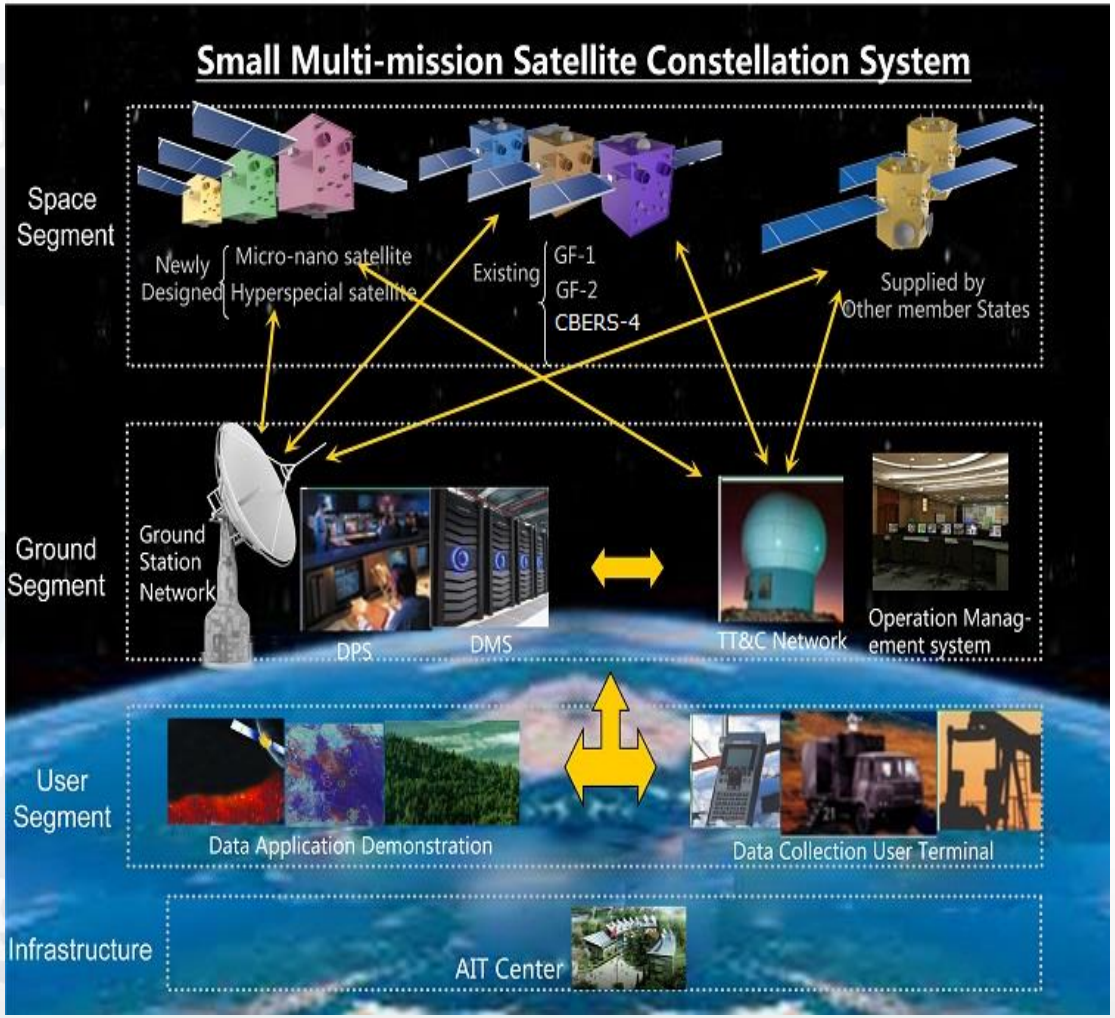


APSCO Joint SMMS Constellation

- **The Space Segment**

  3+8+X

  - 3 operating satellites provided by China, GF-1,GF-2 and CBERS-4
  - 2 newly developed satellites, 1 Hyperspectral + 1 High-Resolution
  - 6 nano/micro satellites for quick response communication
  - participating satellites from MS
- **Asia-Pacific Ground Station Network**
  - Existing network GS in China
  - Compatible upgraded stations in MS
- **Shared AIT Facilities**



APSCO Joint SMMS Constellation

- Data application service will be carried out on the basis of existing in-orbit satellites
- Scheme design for small multi-mission satellite constellation will be carried out to define task division and expenditure allocation

- Development of hyperspectral small satellite, high resolution micro satellite, micro-nano satellites, ground system and application system will be carried out in phases

- Complete the constellation
- Operate the system
- Start business promotion

APSCO Joint SMMS Constellation

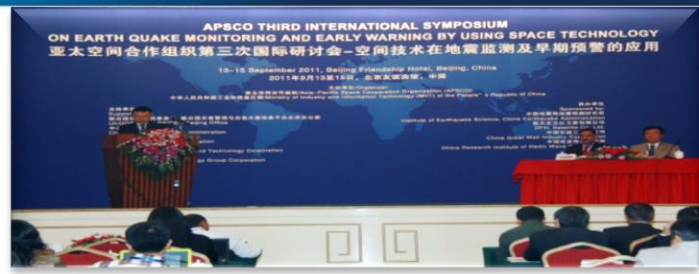
- **Benefits of APSCO Joint SMMS Constellation Program**
  - To improve Space Capacity Building
  - To improve Sharing Service Capability
  - To improve the Quick Response Capability
  - To improve the Industry Driving Capability
  - To improve Information Inter-Connection

APSCO
ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

2 International Exchange Platforms

APSCO International Symposium

1. Space Cooperation for the Asia-Pacific Region **(July 2009, Thailand)**
2. Food Security and Monitoring of Agriculture trough Satellite Technology **(September 2010, Pakistan)**
3. Earthquake monitoring and early warning by using space technology and its applications **(September 2011, Beijing)**
4. Communication satellite Technology and Applications **(November 2012, Indonesia)**
5. Satellite Remote Sensing (RS) and Geographic Information System (GIS) Development in the Asia-Pacific Region **(October 2013, Turkey)**
6. Global Navigation Satellite System (GNSS) Technology and Applications **(November 2014, Bangladesh)**
7. Telemedicine in Asia-Pacific Region **(November 2015, China)**
8. Space Technology and Applications **(October 2016, Peru)**



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ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

2 International Exchange Platforms

② Space Law and Policy Forum

	Space Law Workshops organized with UNOOSA	APSCO Space Law and Policy Forum
1	Role of International Space Law in the Development and Strengthening of International and Regional Cooperation in the Peaceful Exploration and Use of Outer Space (November, 2009, Iran)	APSCO Space Law and Policy Forum (June, 2012, Beijing, China)
2	Activities of States in Outer Space in Light of New Developments: Meeting International Responsibilities and Establishing National Legal and Policy Frameworks (November, 2010, Thailand)	APSCO Space Law and Policy Forum (June, 2013, Beijing, China)
3	The Role of National Space Legislation in Strengthening the Rule of Law (November, 2014, China)	APSCO Space Law and Policy Forum (September, 2015, Beijing, China)
4	4th Space Law & Policy Workshop will be held in 2019	APSCO Space Law and Policy Forum (10-12 Jul 2017, Harbin, China)

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ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

CONTRIBUTION FROM APSCO

A family for its Members to sharing their Resources

3G: Diversity in Generation

⑪ Degree Education

- 39 Doctors and 153 Masters

② Short-term Training

- 35 trainings
- More than 1000 trainees
- On-line Training
- On-site Training

③ New Generation Cultivating

- Space Science School,
- CanSat Competition
- Space Innovation Contest

④ Hands-on training

- Student Small Satellite (SSS)
- Space Education Curricula Development

APSCO
ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

- 39 Doctors and 153 Masters
- 35 (100) students/year
- Full Scholarship from China

Country	MASTA	DOCSTA
Bangladesh	17 students	4 students
Indonesia	11 students	---
Iran	13 students	13 students
Laos	1 students	---
Mongolia	32 students	4 students
Pakistan	23 students	5 students
Peru	20 students	2 students
Sri Lanka	1 students	---
Thailand	28 students	10 students
Turkey	7 students	1 student
Total	153 students	39 students

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- Space Science School
- CanSat Competition
- Space Innovation Contest

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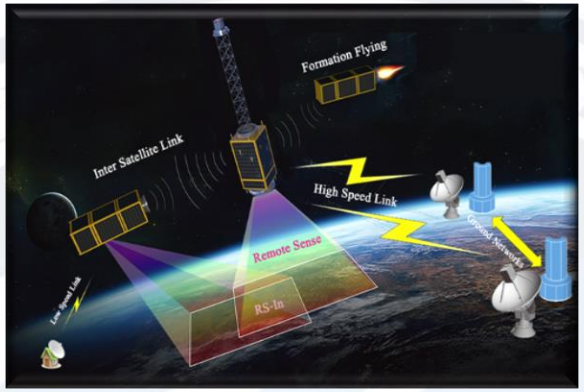
- Student Small Satellite
  - Kicked off in Dec. 2016
  - 1 micro 40kg+ 2 CubeSats 3U
  - University cooperation



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ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

CONTRIBUTION FROM APSCO

A family for its Members to sharing their Resources

3G: Diversity in Gender

- About 1/4th of all trainees in the Short Training Courses in APSCO are Females
- APSCO is Equal Opportunity Organization – Secretariat has a staff, comprising 12 Male employees and 13 Female employees
- Equal opportunity in all international events
- APSCO Member States have a fair representation of females in their Space Agencies

Conclusions

- APSCO, has a **successful model for capacity-building** along the 'Four Space2030 Thematic Pillars':
  - People (Space Society)
  - Space Infrastructure (Space Accessibility)
  - Industry (Space Economy)
  - Policy (Space Diplomacy)
- APSCO, within its ambit, contributes to global governance of space activities and ensures that the **benefits of space are available to future generations**

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Conclusions

- APSCO platform **promotes cooperation** among Member States in space science, technology and related applications; provides them with assistance in R&D, applications and training; strives to improvs their space capabilities; and **contributes to economic and social development** for common prosperity of the Asia-Pacific region
- APSCO is **ready to take additional responsibilities in collaboration with UNOOSA** and other international bodies, to bring together governments, international organizations, industry, the private sector, academia and civil society, in Asia-Pacific region, to connect the four pillars of UNISPACE+50 and Space2030

APSCO

ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

Resources Sharing

Capacity Building

Space Environment Protecting

New Generation Cultivating

Invitation

2008–2018

Tenth anniversary of the establishment

APSCO

ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

Active Involvement in international space affairs

Peaceful use of outer space

Sharing knowledge and experiences

Collaborative gains with its Member States

Open worldwide to international space communities

Thank You!