



A Member of **NARLabs**
National Space Organization

Latin America Geospatial Forum, Mexico City, 10-12 November, 2015

Seminar: Sensors and UAVs

FORMOSAT Satellite Programs

- Contributions & Opportunities in International Societal Benefits

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Outline

FORMOSAT-2 Mission

FORMOSAT-2 Supports in Disasters

FORMOSAT-5 Mission

Summary

FORMOSAT Programs of NSPO

 <p>1999 FORMOSAT-1</p>	 <p>2004 FORMOSAT-2</p>	 <p>2006 FORMOSAT-3</p>	 <p>2016 FORMOSAT-5</p>	 <p>2016 2019 FORMOSAT-7</p>
<p>Scientific mission for ocean color monitoring, ion distribution data, & communication experiment. Mission completed in 2004</p>	<p>Mission: Earth Observations Orbit: 891 km SSO Revisit: 1 day Resolution: 2m (PAN)/ 8m (MS) Swath: 24km Life: 5 years</p>	<p>6 Satellite Constellation Observation System for Meteorology, Ionosphere, and Climate Life: 5 years</p>	<p>Mission: Earth Observations Orbit: 720 km SSO Revisit: 2 day Resolution: 2m (PAN)/ 4m (MS) Swath: 24km Life: 5 years</p>	<p>12+1 Satellite Constellation Observation System for Meteorology, Ionosphere, and Climate Life: 5 years</p>

May 21, 2004

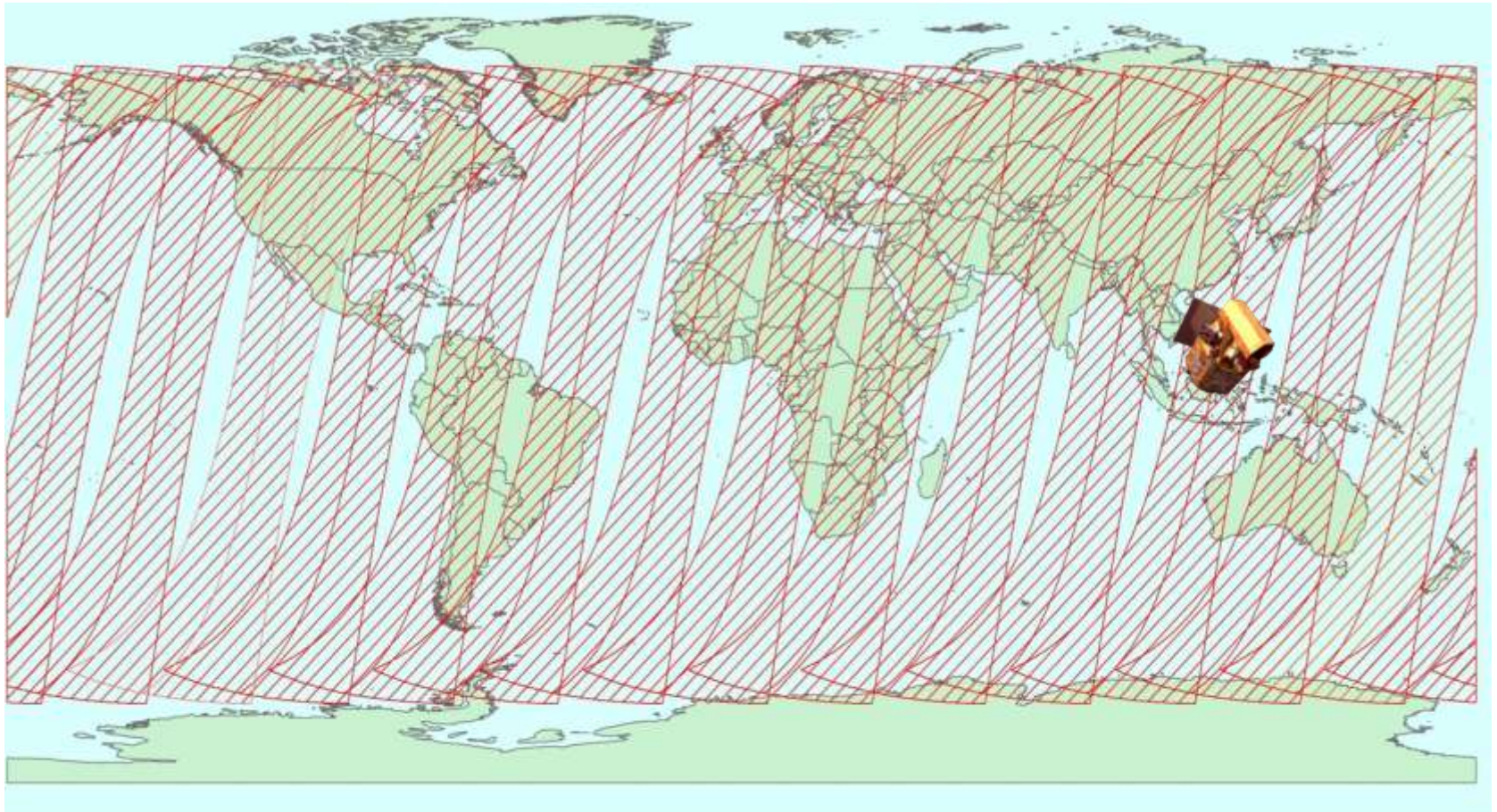
FORMOSAT-2

Successfully Launched
Vandenberg, California

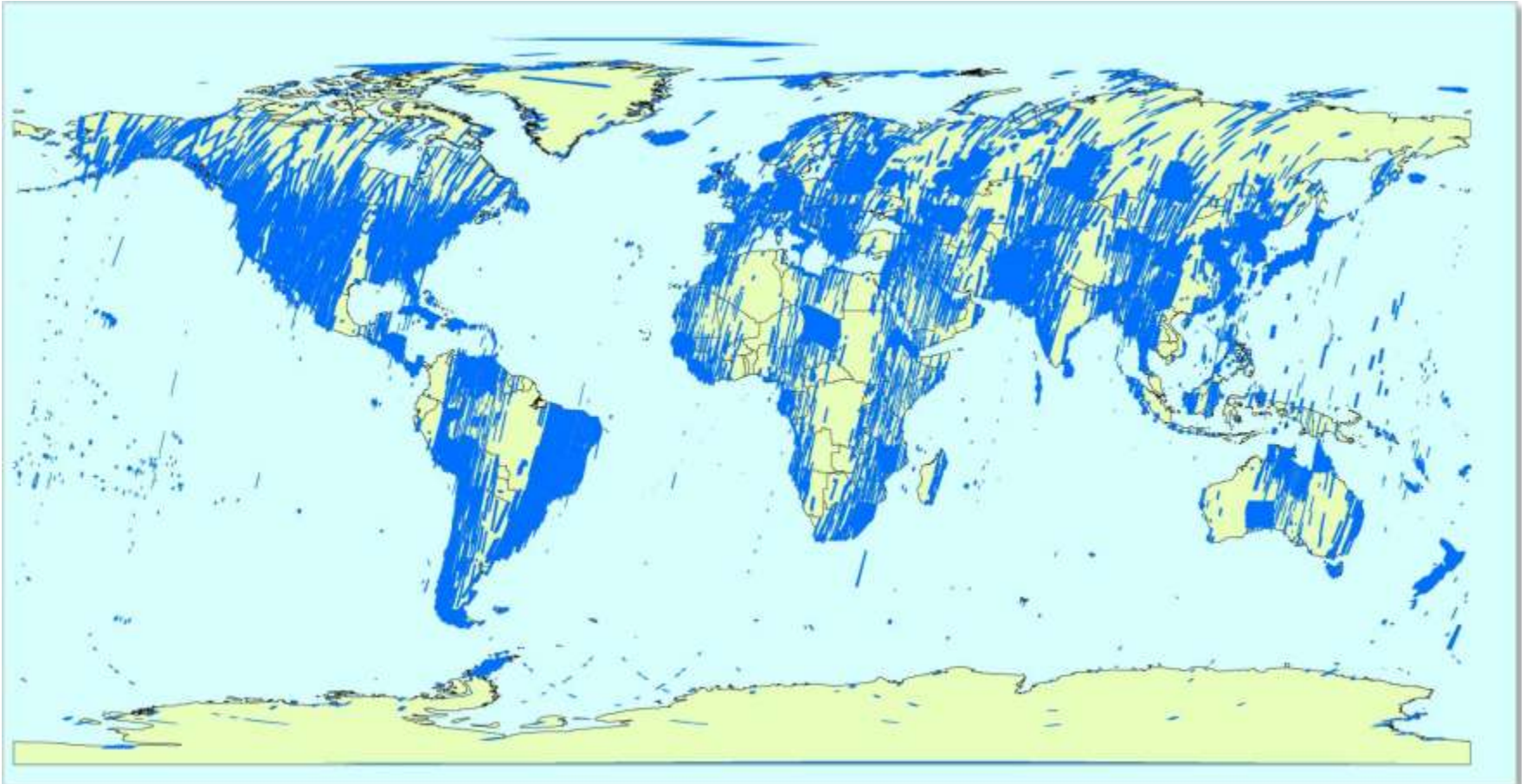


FORMOSAT-2 Mission

- Daily Revisit for 14 Strips of Worldwide Coverage with 45° Viewing Angle
- Imaging up to the Polar Areas

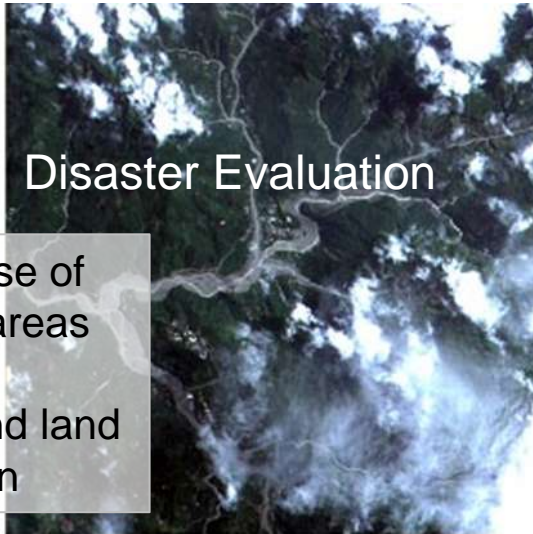


FORMOSAT-2 Footprint



- 51.2% global land area during 2004.6.2~2015.3.31
- Over $1.2 \times 10^9 \text{ km}^2$ (8 times of global land area) acquired over the past years

FORMOSAT-2 Image Applications



Disaster Evaluation

- ✓ quick response of the disaster areas
- ✓ vital disaster evaluation and land reconstruction



Environmental Monitoring

- ✓ water sources, reservoirs monitoring
- ✓ national park, ecological environment protection zone monitoring.
- ✓ industrial wastes and spoils monitoring.



Land Usage

- ✓ land development plan
- ✓ categorization of land usage
- ✓ changes of land usage



Farmland and Forest Plan

- ✓ production outputs of farmlands.
- ✓ changes in national forests,
- ✓ agricultural damage prevention.



Scientific Research and Education

Exchange images and information of earth's natural resources and environmental evaluation with allies.

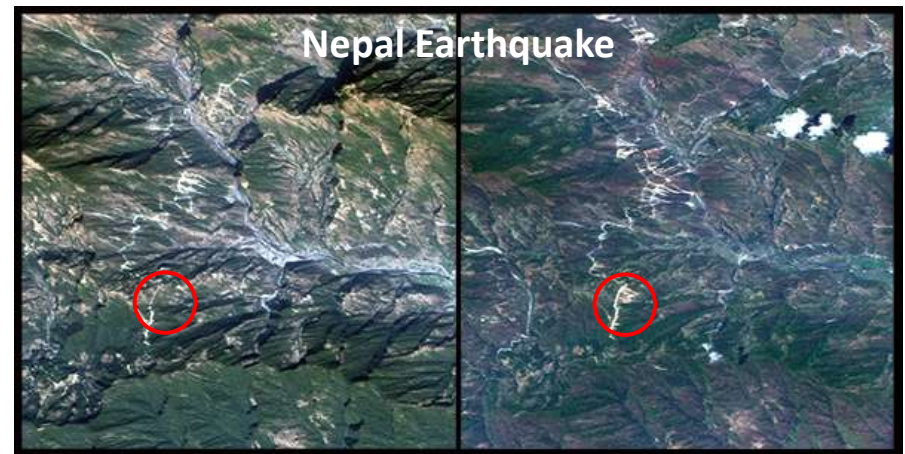


Worldwide Humanitarian Natural Disaster Relief

- FORMOSAT-2 continues to monitor after large disaster over the world to support international organizations including
 - UNITAR-UNOSAT (UN Operational Satellite Applications Programme),
 - International Charter on Space and Major Disasters,
 - UNOOSA-UNSPIDER (Space based Information for Disaster Management and Emergency Response), and
 - Sentinel Asia.



2004	Southern Asia Tsunami
2008	Wilkins Ice Shelf Corruption
2008	Sichuan Earthquake
2011	Eyjafjallajokull Volcano Shinmoedake Volcano
2011	Great East Japan Earthquake
2015	Nepal Earthquake



Before (2011/02/09)

After (2015/04/27)

Supporting UN-SPIDER since 2006



Nepal Earthquake, 2015/5

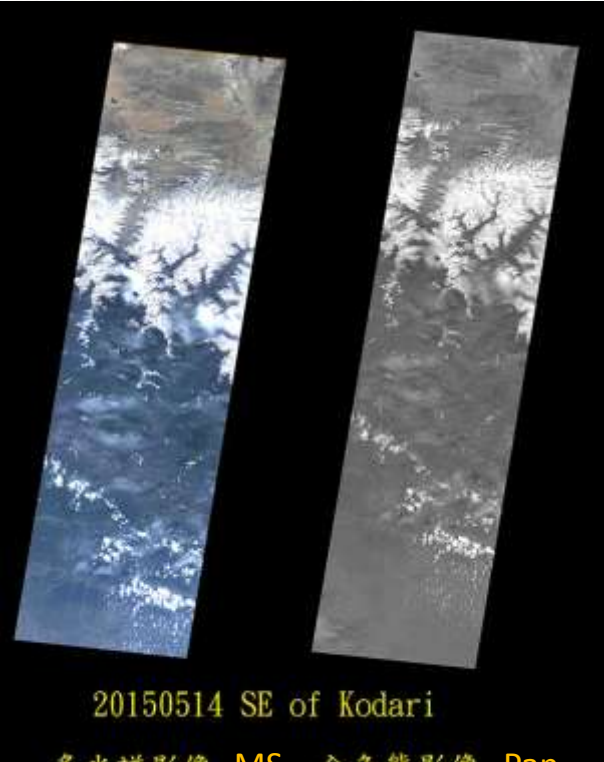
http://nepal-quake.colliis.org.tw/ FORMOSAT-2

FORMOSAT-2 Response to Nepal earthquake

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Web Map Service

No.	Image Date	Title	URL
1	2015/05/13	Nepal_20150513_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
2	2015/05/07	Nepal_20150507_Level_04 (f0020032)	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
3	2015/05/06	Nepal_20150506_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
4	2015/05/05	Nepal_20150505_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
5	2015/05/04	Nepal_20150504_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
6	2015/05/03	Nepal_20150503_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
7	2015/05/02	Nepal_20150502_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
8	2015/05/01	Nepal_20150501_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
9	2015/04/30	Nepal_20150430_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...
10	2015/04/29	Nepal_20150429_Level_04	http://140.110.20.179:8080/geoserver/Nepal/wms?service=WMS&version=1.1.0&request=GetMap&layers=nsipo:Nepal_...



20150514 SE of Kodari

多光譜影像 MS 全色態影像 Pan

Tian-Jin Blasts, 2015/8/12



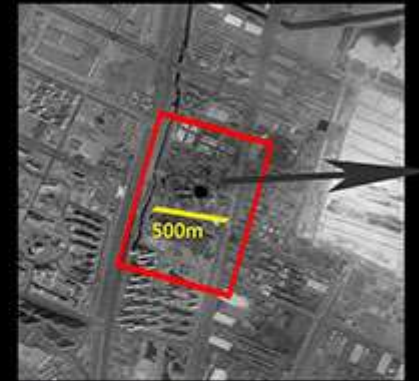
福衛二號歷史影像
2011/11/27

福衛二號災後影像
2015/8/16

福衛二號歷史影像
2011/11/27



福衛二號災後影像
2015/8/16



巨坑



FORMOSAT-2 Support to UNOSAT

FORMOSAT-2 Response to Ebola Crisis

UNOSAT
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National Space Organization

Web Map Service

In response to the ongoing Ebola outbreak, Ebola Treatment Centers (ETCs) in multiple West African countries had been established by WHO. As part of supporting efforts, the UNOSAT is coordinating in using Satellite maps to help respond to Ebola crisis. From Taiwan, the National Space Organization-NAR Labs is tasking its FORMOSAT-2 Satellite to provide imagery from space. These high resolution images will share with and support international community to better understand the status and immediate environment of locations of the ETCs:

No.	Image Date	Title	URL
1	2014/12/28	Ebola_Fusion_#0018988	http://140.110.20.179:8080/groserver/napo/wms?service=WMS&version=1.1.0&request=GetMap&layers=napo-Ebola_Fusion_#0018988&styles=&bbox=618000,0.933002,0.719998,0.958000,0&width=512&height=399&crs=EPSG:32628&format=...
2	2014/12/27	Ebola_Fusion_#0019029	http://140.110.20.179:8080/groserver/napo/wms?service=WMS&version=1.1.0&request=GetMap&layers=napo-Ebola_Fusion_#0019029&styles=&bbox=436000,0.847002,0.468998,0.871000,0&width=512&height=372&crs=EPSG:32629&format=...
3	2014/12/26	Ebola_Fusion_#0019022	http://140.110.20.179:8080/groserver/napo/wms?service=WMS&version=1.1.0&request=GetMap&layers=napo-Ebola_Fusion_#0019022&styles=&bbox=436000,0.847002,0.468998,0.871000,0&width=512&height=372&crs=EPSG:32629&format=...
6	2014/12/17	Ebola_Fusion_#0018995	http://140.110.20.179:8080/groserver/napo/wms?service=WMS&version=1.1.0&request=GetMap&layers=napo-Ebola_Fusion_#0018995&styles=&bbox=436000,0.847002,0.468998,0.871000,0&width=512&height=372&crs=EPSG:32629&format=...

These high resolution images will share with and support international community to better understand the status and immediate environment of locations of the Ebola Treatment Centers (ETCs)

FORMOSAT-2 Support to Int'l Charter

During 2004.1.1 - 2014.12.31, out of **392** Charter activations, **76** have needed and have been provided by FORMOSAT-2 images.



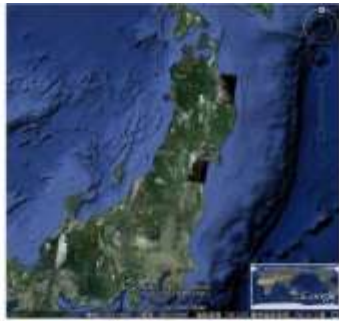
- 2011: 19 images provided to the Int'l Charter (35 activations)
- 2012: 11 images (22 activations)
- 2013: 5 images (29 activations)

Source:
AIRBUS Defence & Space

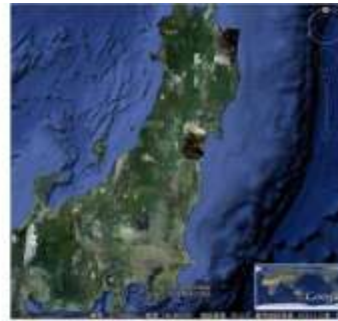
Great East Japan Earthquake



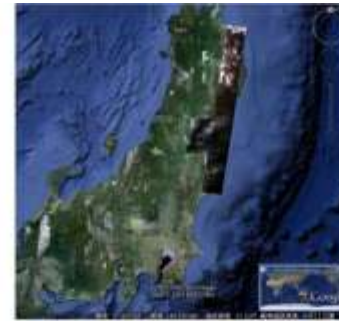
2011/03/10



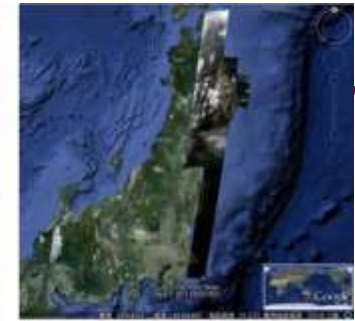
2011/03/11



2011/03/12



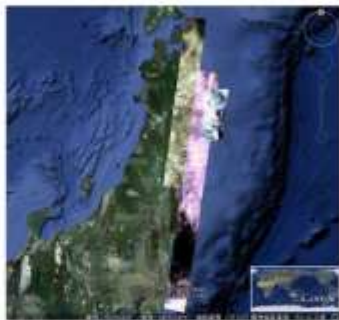
2011/03/13



2011/03/14



2011/03/15



2011/03/16



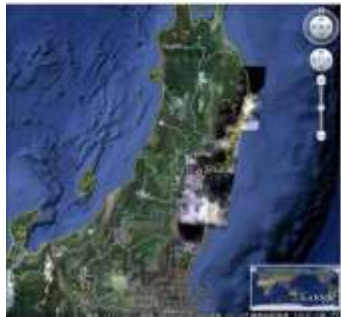
2011/03/17



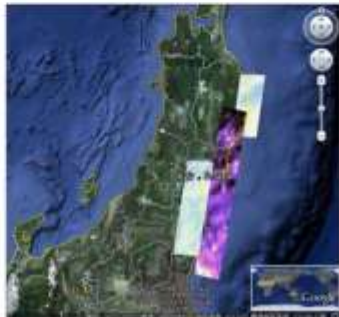
2011/03/18



2011/03/19



2011/03/20



2011/03/21



2011/03/22

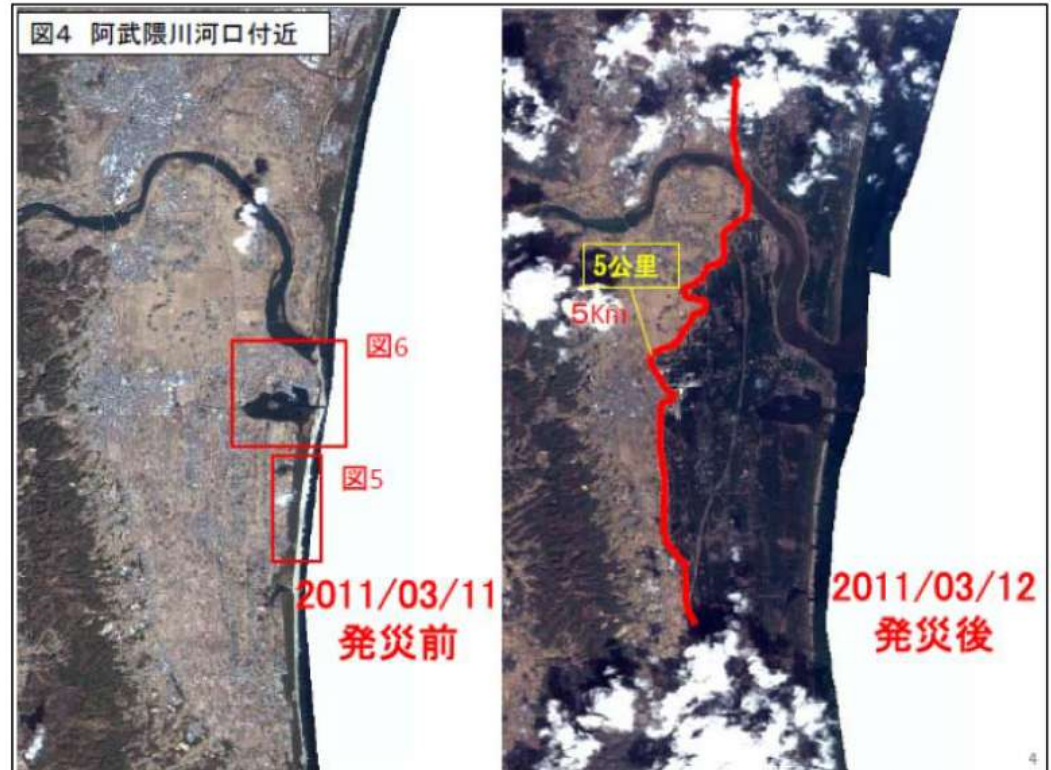
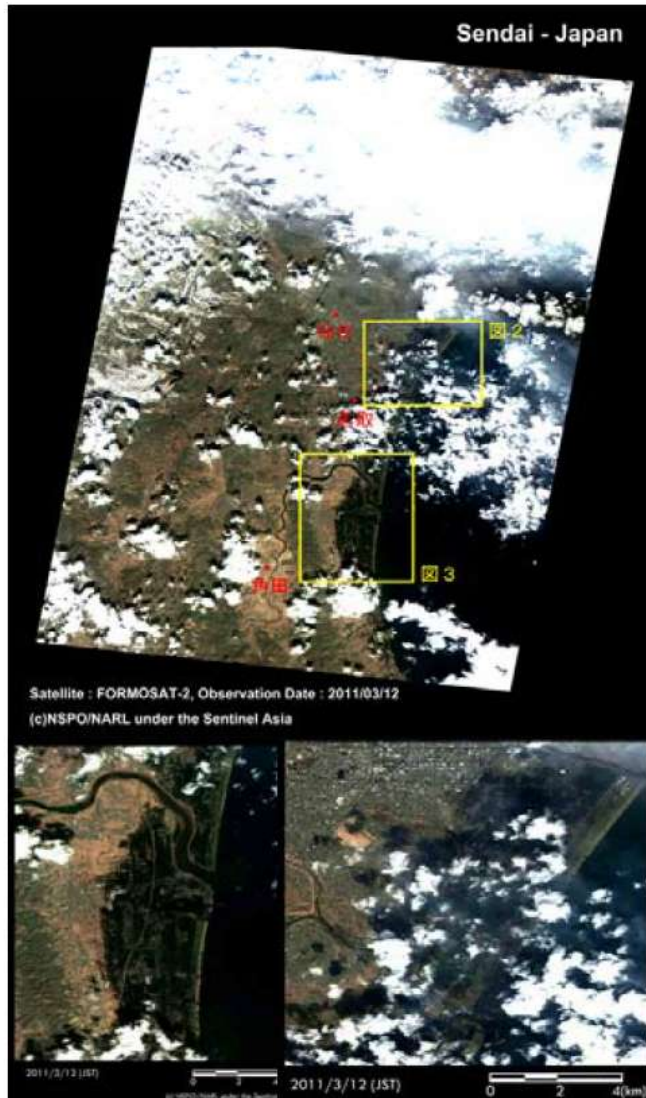


2011/03/23



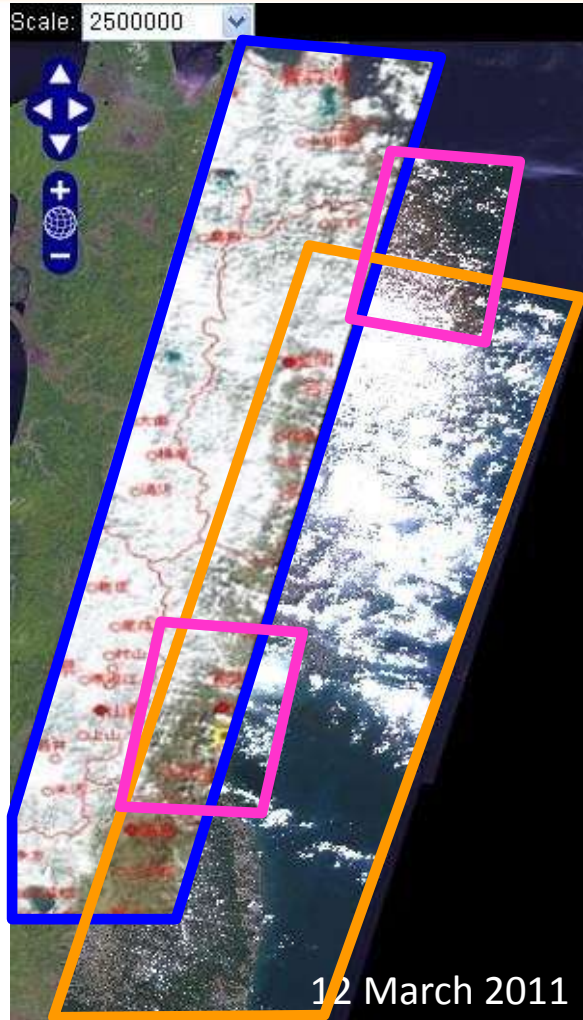
2011/03/24

Great East Japan Earthquake – 11 March, 2011



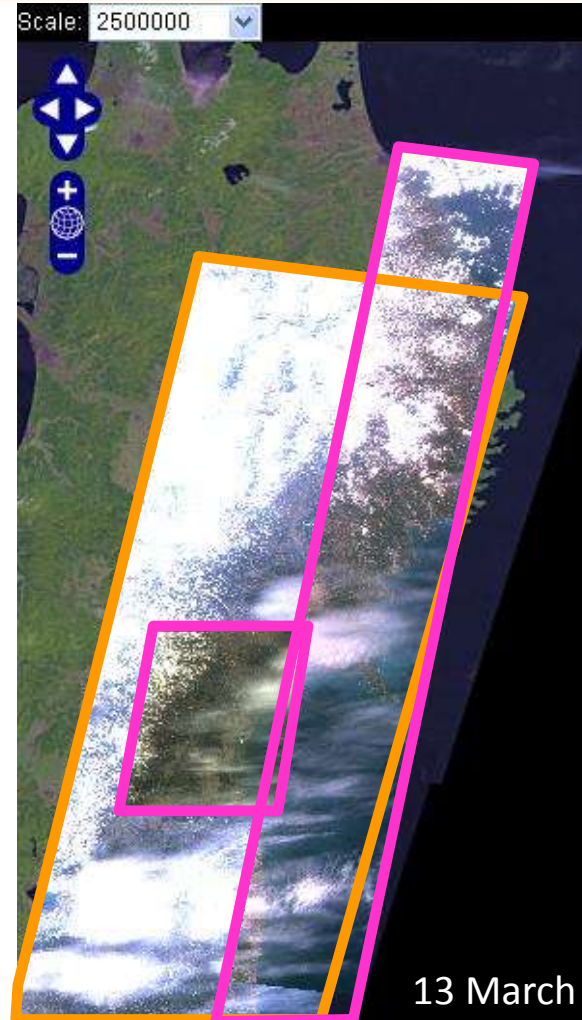
Analyzed Product by NAR Labs

Great East Japan Earthquake Observation by Sentinel Asia Constellation



12 March 2011

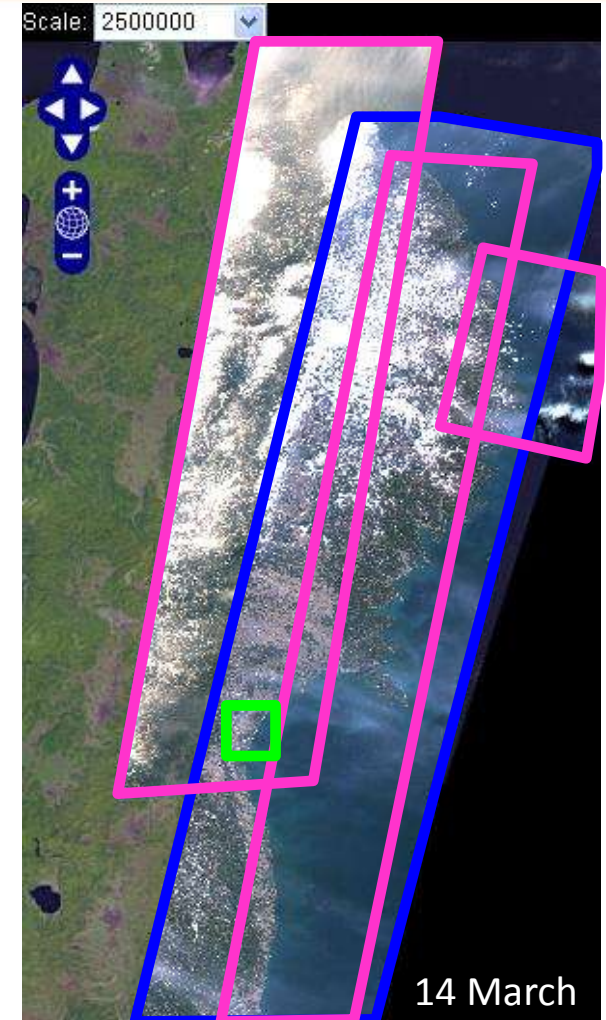
Credit: JAXA



13 March

ALOS

THEOS



14 March

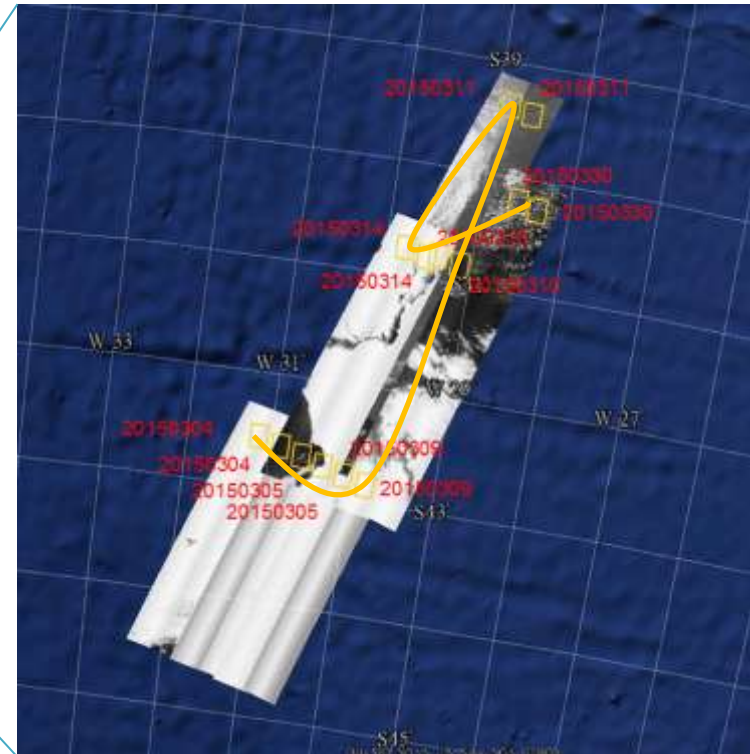
FORMOSAT-2

CARTOSAT-2

In search for Missing Vessels ...



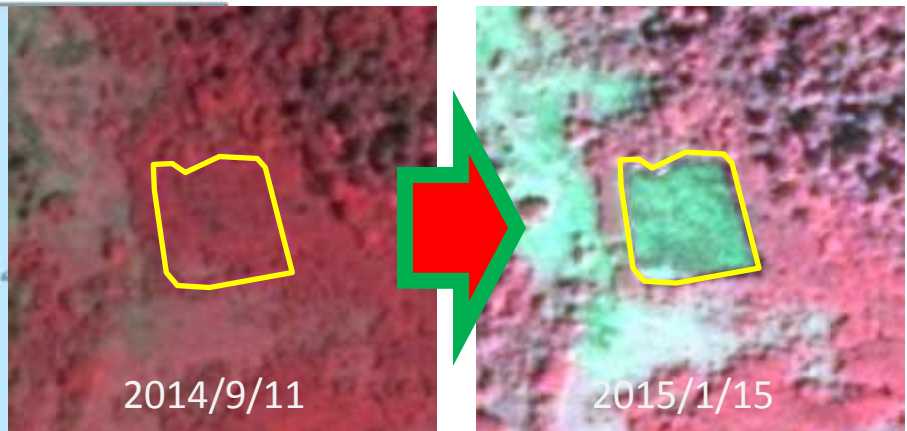
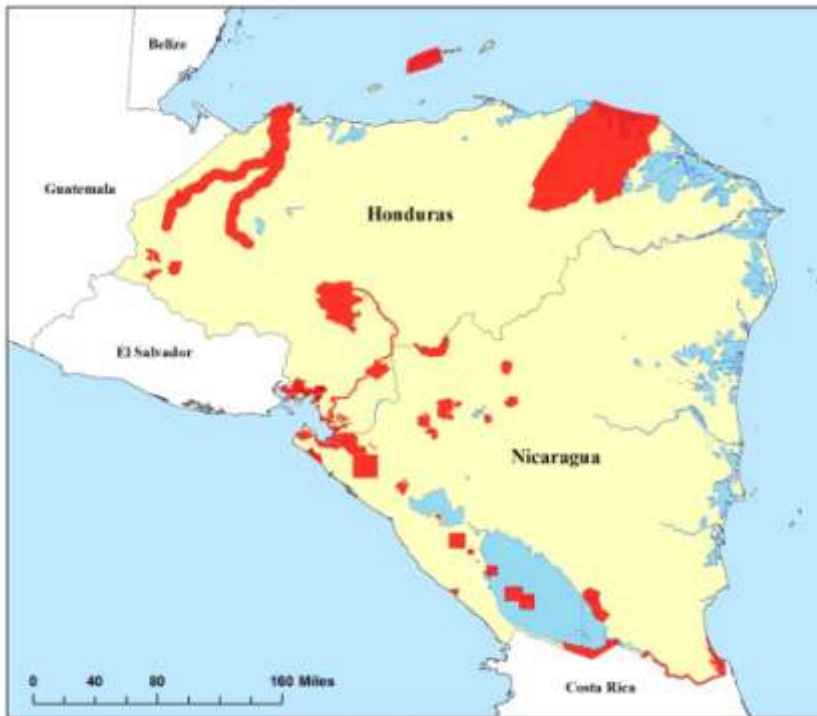
“... contact with the Taiwanese squid-fishing vessel Hsiang Fu Chun in waters southeast of Argentina had been lost at 3:00 AM on February 26, Taipei time. ... the boat had 49 crew members ...” (press release from MOFA)



Formosat-2 Applications in Latin America

- Taiwan has engaged in several cooperation projects in Latin America since 2011, including Honduras, Nicaragua and El Salvador, by applying Formosat-2 satellite imagery and GIS technique for resource management and natural disasters.

Tisey Estanzuela Natural Reserve, Nicaragua



Change in Forest Land

Area of Changed Land: 6,599 m²

Reason: Fire



Support to Forest Fire Monitoring - Nueva Segovia

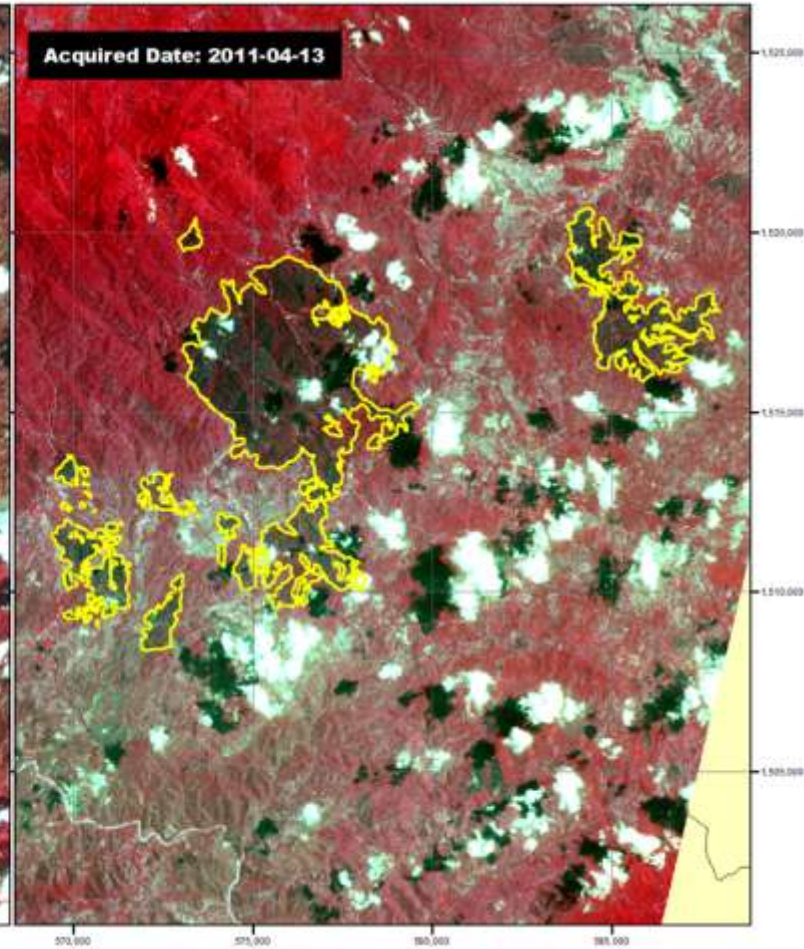
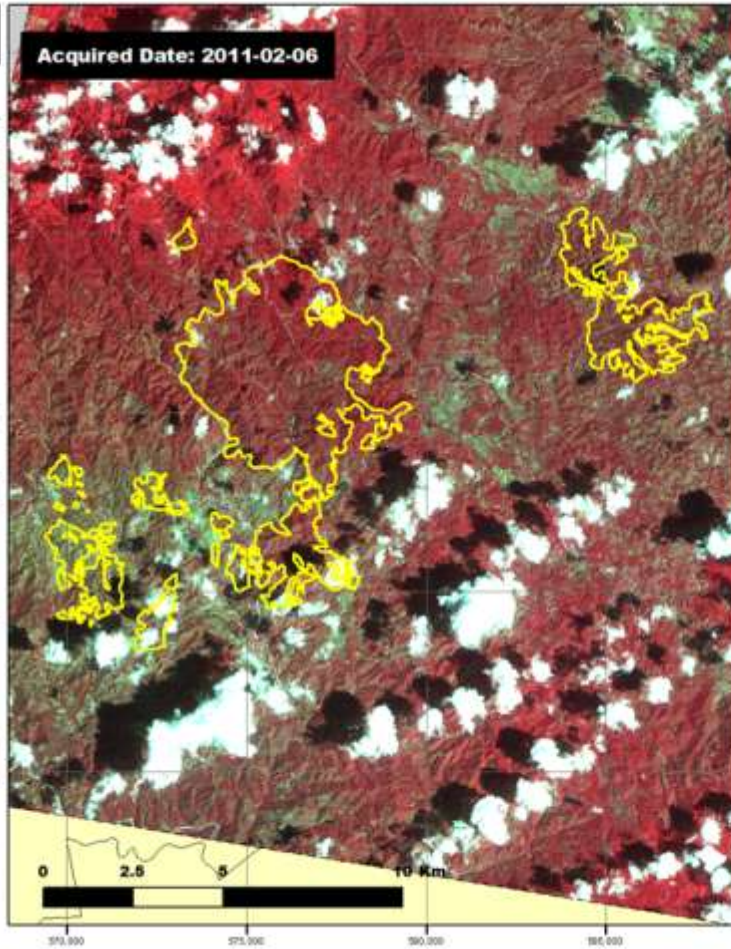
Emergency Event

DESCRIPTION

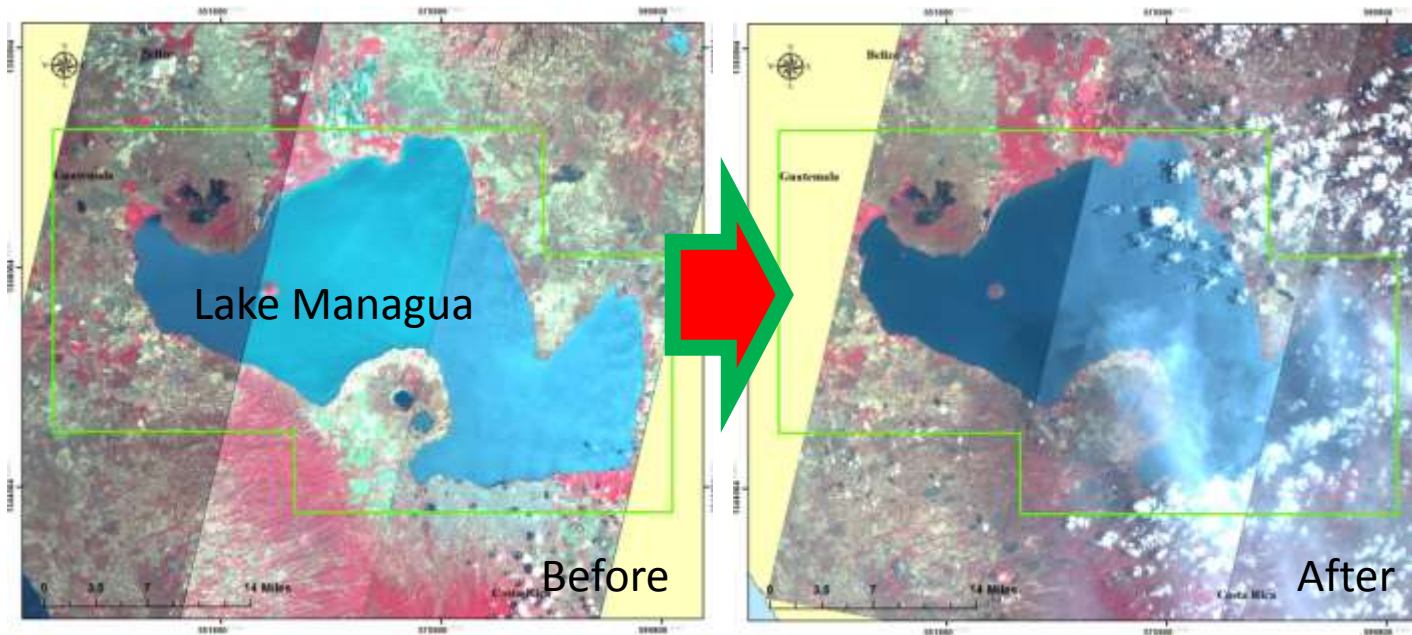
Location	Jalapa
Map Projection	UTM 16N
Background	Satellite Image
Satellite Type	FORMOSAT 2

Legend

■ Suspected Forest Fire Area



Earthquake in Nicaragua, Honduras



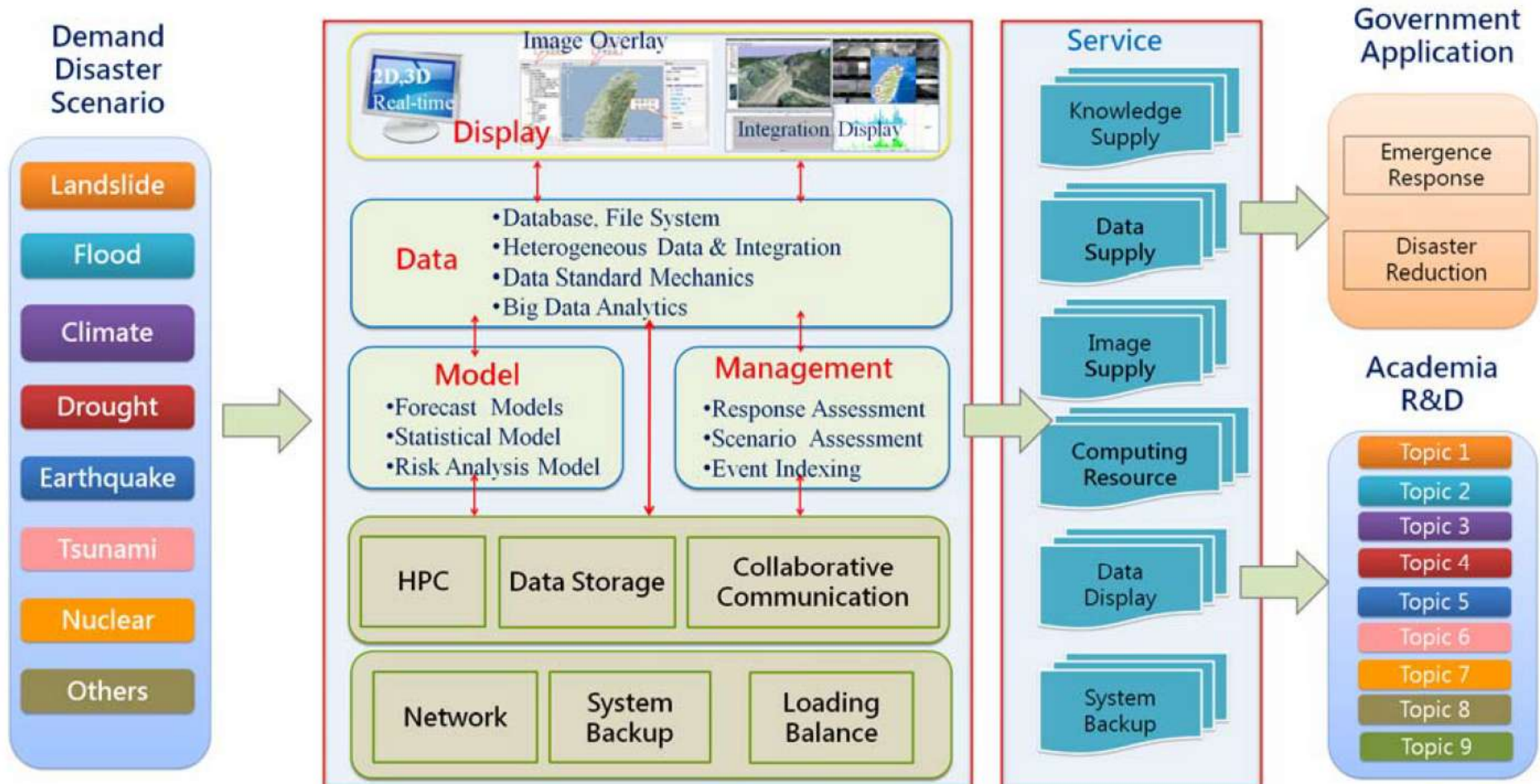
Nicaragua Earthquake
(2014/4)



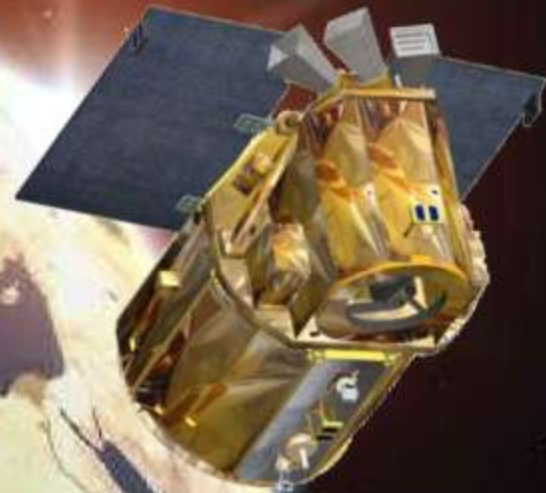
Democracy Bridge, El Progreso, Honduras
(2009/5/29)

Disaster Management Information Platform



- With the integration of spatial information, big data analytics and models, disaster information can be updated and access in near-real-time.



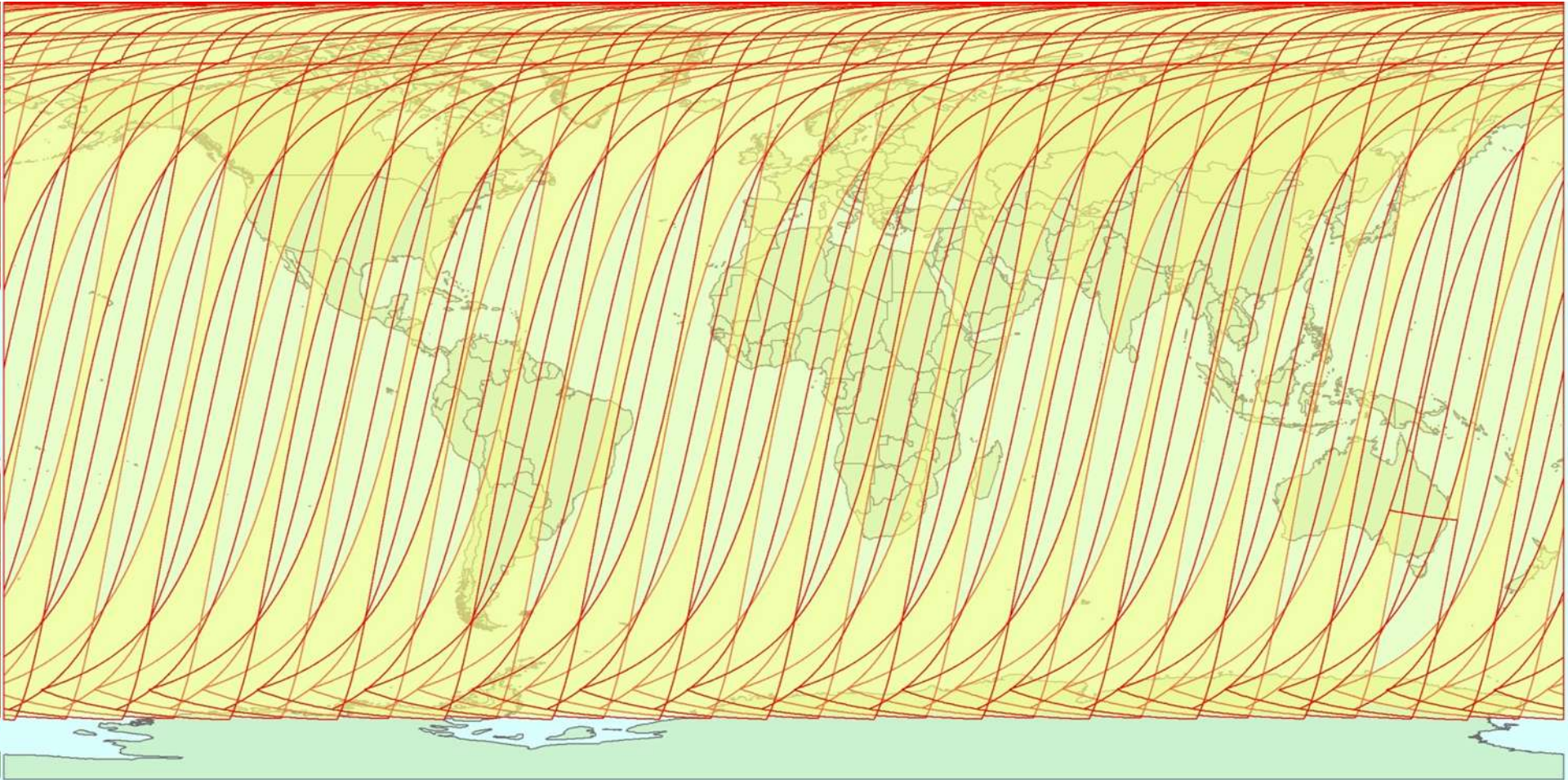
FORMOSAT-5
First Self Reliant Satellite
Developed in Taiwan



FORMOSAT Earth Observation Satellites

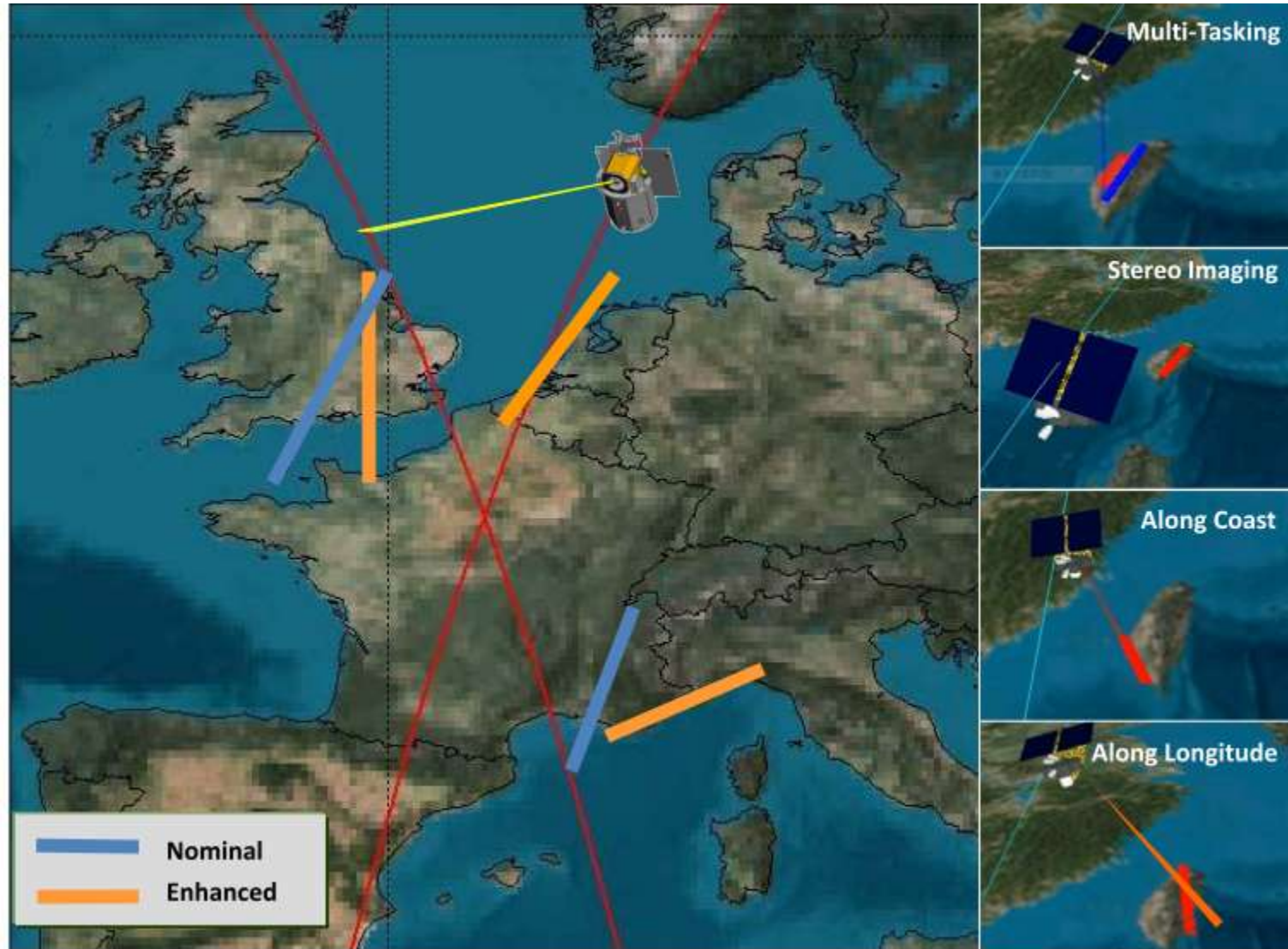
Key Parameter	 FORMOSAT-2	 FORMOSAT-5
Orbit	SSO @ 891 km/99.10°	SSO @ 720 km/98.28°
Revisit Period	1 day	2 days
Mission Life	5 years	5 years
GSD	PAN (2m)/MS (8m)	PAN (2m)/MS (4m)
Swath	24km	24km
Spectral Bands	1PAN+4MS	1PAN+4MS
RSI Image Sensor	CCD	CMOS Image Sensor
RSI Duty Cycle	8%	8%
Satellite Weight	760 kg	525 kg

FORMOSAT-5 Global Coverage



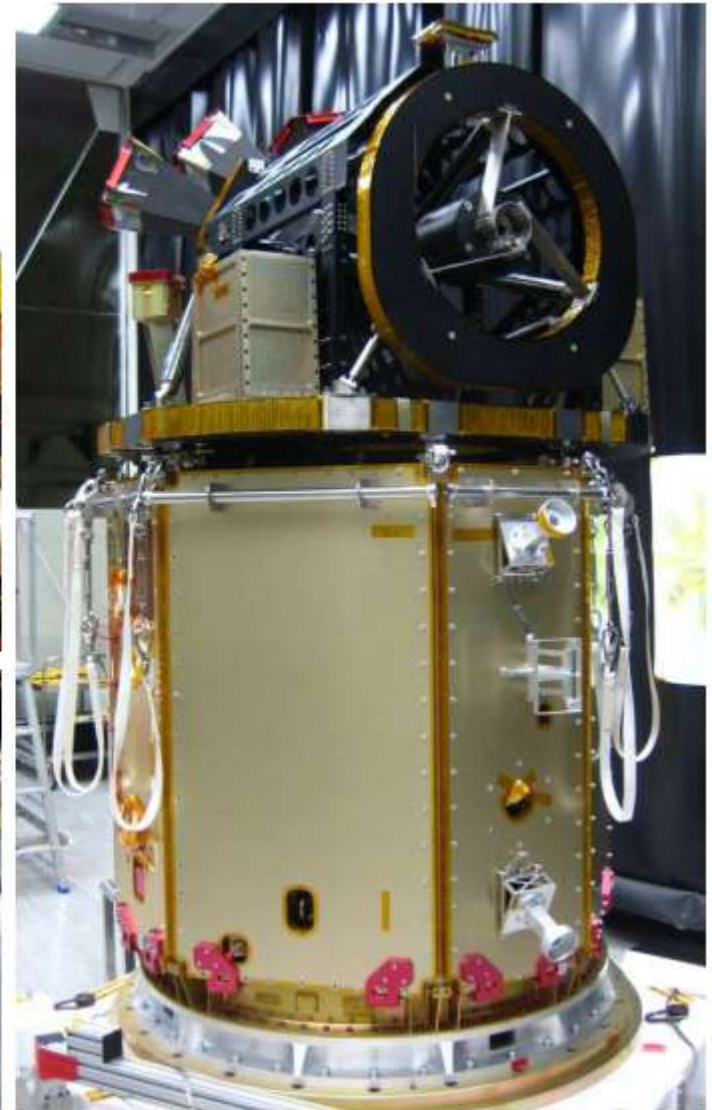
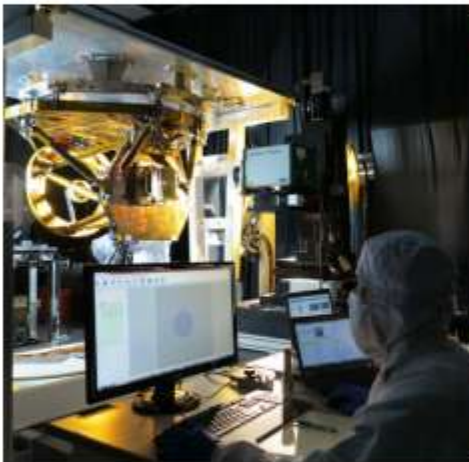
- Global coverage with 2 day revisit

Smart Agility Capability



FORMOSAT-5 Status

Entering final I&T stage,
FORMOSAT-5 is targeted to
launch in early 2016



Summary

- Taiwan's FORMOSAT-2 has been making major contributions to international societal benefits through international collaborative projects. NSPO shares imagery, exchange experiences, and conduct joint projects under cooperation framework.
- Follow-on FORMOSAT-5 is targeted to launch in 2016. NSPO is committed to continuous support to the global community.

High and Reliable Level of Commitment!





NAR Labs 國家實驗研究院

國家太空中心

NSPO

National Space Organization

The Center of Innovation and Excellence for Space Technology in Taiwan.

Meteorology

3-Hours Constellation RO Profiles Comparison between FORMOSAT-3 and FORMOSAT-7

FORMOSAT-3 Occultations-3 Hrs Coverage

FORMOSAT-7 Occultations-3 Hrs Coverage



FORMOSAT-1



FORMOSAT-2



FORMOSAT-3



FORMOSAT-5



FORMOSAT-7

Remote Sensing

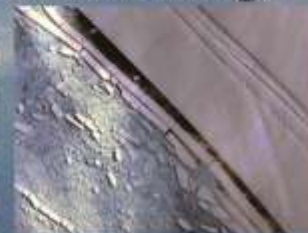
Disaster



Agriculture



Climate Change





NSPO
NATIONAL SPACE ORGANIZATION

In pursuit of global excellence !

