Space-based Earth Observation Applications for Resilient Cities

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JAXA Activities

Space Transportation
Human Space Activities
Satellite Programs
Lunar & Planetary Exploration Programs
Aeronautics
Space Science

Priorities of JAXA Earth Observations

GOAL: Earth observation system based upon advanced space technologies becomes a part of social infrastructure and provide solutions to issues

Disaster prevention / disaster preparedness
Climate Change (Mitigation and Adaptation)

New frontier / innovation

Disaster
Climate Change
**JAXA努力定义卫星在主要国际协议中的角色**

- Sendai Framework for DRR (March 2015)
- 2030 Agenda for SD (Sep 2015)
- COP21 Paris Agreement (Dec 2015)

**JAXA的活动对可持续发展目标**

**愿景**

1. 提供使用空间技术的解决方案
2. 提供决策理由（定义卫星在SDG指标框架中的角色）

**合作**

通过**EO社区**

- 地球观测组（GEO）
- 地球观测卫星委员会（CEOS）

与**非空间社区**的合作

- JICA, JST
- WB, ADB
- UNSC, WGGI
- NSO
Features of Satellite Earth Observations

A number of common characteristics are driving satellite-based Earth observation demand in support of global governance and derivation of Indicator information:

- **Scale**
- **Long time series and continuity**
- **Consistency and comparability**
- **Diversity of measurements**
- **Complementarity with in-situ observations and traditional statistical methods**
- **Free and open data is on the increase**
Examples of EO data applications for Cities

- Air quality monitoring
- Precipitation monitoring
- Disaster damage assessment
- Land use and environment monitoring
• JAXA EORC applied the aerosol algorithm developed for JAXA LEO missions (GCOM-C, EarthCARE, GOSAT–2) to Himawari–8
• Wild fire in Borneo Island (Indonesia), atmospheric pollutant from Chinese continent and hot spot over Southeast Asia

**Air Quality Monitoring of Mega Cities in Africa**

**TANSO-FTS** targets 10km area with its agile pointing system and measure not only CO$_2$ and CH$_4$ emission amount but also aerosol thickness and its height using the high resolution spectra.

**TANSO-CAI** UV (380) nm imager can distinguish aerosol from cloud.

Mega Cities in Africa are by GOSAT

WHO working group on air quality remote sensing is interested in making data base over mega cities where ground data is limited.

TANSO-FTS has been targeting Addis Ababa and Accra since Feb. 2016
Global Satellite Mapping of Precipitation (GSMaP)

GSMaP (Global) observed Hurricane Patricia and Olaf, and Typhoon Champi: 20-24 Oct. 2015, hourly animation

- Global rainfall map merging GPM Core Observatory, polar orbiting microwave radiometer/sounders, and geostationary infrared radiometers.

JAXA Global Rainfall Watch (4-hr delay): http://sharaku.eorc.jaxa.jp/GSMaP
JAXA Realtime Rainfall Watch (Himawari-area): http://sharaku.eorc.jaxa.jp/GSMaP_NOW

Disaster Damage Assessment in Tacloban city

Base maps
(Layers of houses, infrastructure, roads, etc.)

GIS Analysis

Damaged infrastructure by visual check of satellite imagery

1. Number of damaged infrastructure
2. Damaged infrastructure maps
Land Deformation: 2015 Nepal Earthquake

- The deformation area extended more than 100 km from north to south.
- The land around the central Kathmandu moved toward the satellite about 1 meter.
- Several local displacements detected around Kathmandu.

Interferogram obtained by ALOS-2 PALSAR-2 data and In situ photo

1. Wide observation mode (350 km swath, Apr. 5/May 3)
2. High resolution mode (70 km swath, Feb. 21/May 2) - Map data © OpenStreetMap Contributors
3. Photo taken on May 1. Courtesy of the investigation team of the Japan Society of Civil Engineers, Japanese Geotechnical Society, and Japan Association of Earthquake Engineering.

Infrastructure Monitoring

Application:
Infra monitoring about airport runway, dam, levee, etc. (Cross-ministerial strategic innovation promotion program (SIP) in Japan) to provide irregularity (subsidence).

Technology:
Detect elevation irregularity using Interferometric synthetic aperture radar of L-band SAR (InSAR)

JAXA’s Contribution:
Can provide InSAR data, InSAR technology skill / advice to check irregularity using L-SAR.

Runway check was already validated at some airport located with related organization. And, dam and levee are also applied and verified now in Japan.
High Resolution Land-Use and Land-Cover Map

- Input data: 1,800 scenes of ortho-rectified and atmospheric corrected AVNIR-2
- Vegetation phenology (seasonal change)
- Machine learning with Kernel Density Estimation (KDE)
- 30m spatial resolution
- PALSAR mosaic, MODIS, DEM are used as ancillary data
- Overall accuracy in Japan: 85.0%

Summary

- SDGs provide guidance for planning and monitoring city development.
- Space-based Earth observation has great potentials to contribute to implementation of various SDG Indicators for cities and solving its issues.
- JAXA would like to work with stake holders for city planning and monitoring, including the custodian agencies and NSO, to define the role of space technology.