Utilization of Satellite for Disaster Management with a Focus on the Sentinel Asia

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Features of Earth Observation Satellite

Earth Observation Satellite
(Altitude: 200km – 1000km)
• Long revisit interval: 14~60 days
• Swath: 10-100km
• Ground Resolution: 1~10m

Geostationary Satellite
(Altitude: 36,000km)
• Appears nearly stationary in the sky
• 40 percent of the earth’s surface continuously
• Ground Resolution: 1~10km
Features of Earth Observation Satellite

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<th>Satellite</th>
<th>Swath</th>
<th>Cycle</th>
<th>Res.</th>
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<tr>
<td>LANDSAT</td>
<td>185km</td>
<td>15day</td>
<td>30m</td>
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<tr>
<td>ALOS/PRISM</td>
<td>70km</td>
<td>46day</td>
<td>2.5m</td>
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<tr>
<td>ALOS/AVNIR</td>
<td>70km</td>
<td>2-3day</td>
<td>10m</td>
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Optical Camera vs. Radar from Satellite

Optical Camera

Radar Image
Emergency Observation Flow of Sentinel Asia

Data Provider Node (DPN) in Step3

Sentinel Asia Constellation contributing to Emergency Observations

ISRO
RESOURCESAT, OCEANSAT-2 OCM, IMS-1, CARTOSAT-1&2, RISAT-1

IRS
LISS-4: 5.8m Pan, LISS-3: 2.5m Multi, AWiFS: 56m Multi

GISTDA
THEOS

JAXA
ALOS-2 & 3

ALOS
PALSAR: 10-100m, L-Band

KARI
KOMPSAT-1

NARL
PAN: 2m, MS: 8m

XSAT
EOC: 6.6m, OSMI: 1km

FORMOSAT-2

Sentinel Asia Constellation

CRISP
RESOURCESAT, OCEANSAT-2 OCM, IMS-1, CARTOSAT-1&2, RISAT-1

PALSAR: 10-100m, L-Band

EOC: 6.6m, OSMI: 1km

ATI, ADRC CRISP, CAIAG LAPAN, SD/Sri Lanka MONRE, ICIMOD Sri Lanka MoDM, CEA NCRST, BPPT, MO, etc.

Data Provider Node (DPN) in Step3

Sentinel Asia Constellation contributing to Emergency Observations

JAXA ISRO KARI GISTDA NARL

Emergency Observation Request

Disaster Occurrence

Support

Disaster Management Agencies

http://sentinel.bsc.jaxa.jp/
Utilization of Satellite

Examples of Utilization of Satellite data in each disaster phase
- Sentinel Asia and others
- from ALOS observation

Disaster Management Cycle

A large-scale flood in Nepal on August 2008

- A large-scale flood occurred by burst of dike, in Sunsari district in southeastern Nepal on **18 August 2008**.

- JAXA made emergency observation with PRISM/AVNIR-2 aboard ALOS on **22 August** and by PALSAR on **24 August** by request of ICIMOD, Survey Department and Department of Water Induced Disaster Prevention through Sentinel Asia.

- Analyzed products indicating inundation area are provided immediately to the Nepalese government.
  - ICIMOD: International Centre for Integrated Mountain Development,

- Using these data overlaid with census data such as population, houses, map of damaged area and data such as damaged area, the number of victims, the number of suffering houses were made and were utilized for rescue of victims, recovery plan, and payment of the subsidy to victims.
The heavy rain in Vietnam on 30 October 2008

- The heaviest rains since 1984, which continued for more than 72 hours from 30 October 2008, occurred in the northern and central part of Vietnam.
- JAXA made emergency observation with PALSAR aboard ALOS late at night on 5 November by request of Vietnamese Academy of Science and Technology (VAST) through Sentinel Asia on 4 November. JAXA provided analyzed products to VAST via Sentinel Asia.
- In Hanoi city located lower than a river, the dike around a river is built and the water is drained away at the time of the flooding. But a large quantity of water overflowed by rainfall more than the ability of drainage facilities by this disaster.
- VAST made map of damage situation in the suburbs of Hanoi and estimated the ability of drainage system of pumping station from a displacement and was able to consider where to be improved.
The heavy rain in Vietnam on 30 October 2008

- Heavy rains continued from 30 Oct.
- 4 Nov.: Request from VAST\(^1\)
- Late at night on 5 Nov.: Observation by Rader
- Provided analyzed products to VAST via Sentinel Asia

\(^1\): Vietnamese Academy of Science and Technology

Response Phase

Recovery Phase

Mitigation/Preparedness Phase

A large-scale flood in Sri Lanka on May 2010

- On the occasion of the record-breaking flood that occurred around Colombo in May 2010, JAXA made emergency observation with PALSAR aboard ALOS late at night on 18 May by request of Disaster Management Centre (DMC), Sri Lanka through Sentinel Asia on the same day. Observed data were provided to DMC in the morning of the next day.

- DMC made analyzed products indicating inundation area in cooperation with Survey Department of Sri Lanka.

- DMC is a central organization in Sri Lanka for disaster management, and inundation maps were presented to and was used for grasp of inundation area, detection of submerged roads, and plan of their detour.
A large-scale flood in Sri Lanka on May 2010

May 2010: flood occurred
18 May: Request from DMC*1
late at night on 18 May: Observation by Rader
19 May: provided to DMC in the morning
DMC made analyzed products indicating inundation area
organizations concerned local prefecture,
grasp of inundation area detection of submerged roads plan of their detour

Disaster Management Agencies

Response Phase
Recovery Phase
Mitigation/Preparedness Phase

Volcanic activity in Philippines from 14 December 2009

- Mayon volcano in Luzon, the Philippines, activated volcanic activity from 14 December 2009, and the lava which flowed out from the crater was confirmed on 20 December. About 47 thousands people living near Mayon volcano evacuated according to warning by Province government. JAXA made emergency observation with PRISM/AVNIR-2 aboard ALOS on 25 December 2009 by request of Philippine Institute of Volcanology and Seismology (PHIVOLCS) through Sentinel Asia, and provided observed data to PHIVOLCS.
- PHIVOLCS made lava deposit map by the eruption using these ALOS imagery and others, which was used to understand the situation and make decision by National Disaster Coordinating Council (NDCC).
- Lava flow hazard map and lahar hazard map are prepared before hand using ALOS DEM with cooperation of JAXA and PHIVOLCS, which were used by updating with new lava deposit during eruption emergencies.
Volcanic activity in Philippines from 14 December 2009

Response Phase
Recovery Phase
Mitigation/Preparedness Phase

Hazard maps were prepared with cooperation of JAXA and PHIVOLCS.
PHIVOLCS made lava deposit map by the eruption using these ALOS imagery and others. The maps were used to understand the situation and make decisions by NDCC.

1: Philippine Institute of Volcanology and Seismology
2: National Disaster Coordinating Council

20 Dec.: the lava was confirmed
25 Dec.: Observation by Camera

Disaster Management Agencies
DPN/ DAN

driftwood drifted in the Sea on August 2006

Response Phase
Recovery Phase
Mitigation/Preparedness Phase

A large quantity of driftwood drifted in the Sea of Japan side of Kyushu in the nearshore waters from July through August 2006.

27 July: Observation by Camera
Analyzed products to Japan Coast Guard (JCG).
JCG used the information as safe report to navigation ships.

This is not from Sentinel Asia
Summary

- Based on satellite’s strong points, “all-weather”, “day-and-night”, “wide coverage” and “repeat monitoring” images and information are provided to related agencies.
- In order to use satellite image during a hazard, preparedness is important
  - to make hazard map, evacuation drill with residents
- Useful information will be obtained by using satellite analysis data with census data such as population or houses
  - the number of victims, the number of suffering houses
- ALOS-2 equipped with Radar sensor will be launched this year. it will contribute to Sentinel Asia.

Thank you for attention
What is Sentinel Asia?

Sentinel Asia is:
- a voluntary initiative
- collaboration between space agencies and disaster management agencies
- applying remote sensing and Web-GIS technologies to assist disaster management in the Asia-Pacific region.

Main Activities are:
1. Emergency observation
2. Working Group (WG)
   - Wildfire
   - Flood
   - Glacial Lake Outburst Flood (GLOF)
   - Tsunami
3. Capacity building
   - human resource development
   - human network

Learn more at: http://sentinel.tksc.jaxa.jp/
Working Group Activities for Disaster Risk Reduction

- **Wildfire WG**
  - To contribute to the Asia-Pacific region with wildfire management
  - To contribution to REDD-plus
  - JST-JICA(*) project for wildfire and carbon management in a peatland in Kalimantan, Indonesia

- **Flood WG**
  - To contribute to the mitigation of flood disasters in Asia
  - Flood analysis using IFAS

- **GLOF WG** (Glacial Lake Outburst Flood)
  - Monitor and establish early warning system in the risk areas
  - Local awareness and knowledge transfer through capacity building

- **Tsunami WG**
  - Tsunami early warning system

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Concept of Sentinel Asia Step3 (2013 onwards)

- **Pre-disaster**
  - Mitigation: Community education
  - Preparedness: Hazard map, Early warning system

- **Just after disaster**
  - Response: Emergency observation

- **Post-disaster**
  - Recovery: Monitoring

**Information sharing (Web-GIS)**

**Human network**
Capacity Building, Outreach

(*) JST: Japan Science and Technology Agency
JICA: Japan International Cooperation Agency
Concept of Sentinel Asia Step3 (APRSAF-18)

(1) Successor to Step2’s activities, basically
(2) Expansion from response (in Step1 and 2) to cover mitigation/preparedness and recovery phase in the disaster management cycle
(3) Participation of various satellites:
   EO satellites, Com satellites, and Nav satellites
(4) Further collaboration for operation
(5) Further utilization and human networking through capacity building and outreach