Space-based Activities for Disaster Emergency Response in Indonesia

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INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE (LAPAN)

Outline

- Introduction: about LAPAN
- Data Acquisition
- Space-based Early Warning System
- Space-based Emergency Response
- Challenges
- Further Improvements
Introduction: about LAPAN

- **LAPAN** is abbreviation of LembagA Penerbangan dan Antariksa Nasional (National Institute of Aeronautics and Space)

- LAPAN as Indonesian Space Agency was established on November 27, 1963 by Presidential Decree No.236 of 1963

- LAPAN role reinforced by the presence of the Law No.21 of 2013 (Indonesian Space Law).

- LAPAN has authorities on:
  1) Space science,
  2) Remote sensing,
  3) Space technology mastery,
  4) Platform Launching, and
  5) Space commercial activities
Remote Sensing Scope

- In the field of remote sensing LAPAN responsible for:
  1) RS Data acquisition,
  2) RS Data processing,
  3) RS Data storage and distribution,
  4) The use of RS data, and
  5) Dissemination of space-based information
LAPAN Ground Station

Jakarta & Rumpin (West Java)

Parepare, South Sulawesi
Data Acquisition

- **Low Resolution (≥ 30 m):**
  - Terra & Aqua
  - NPP
  - NOAA/AVHRR
  - Feng Yun
  - MTSAT/Himawari-6

- **Medium Resolution (4 – 30 m):**
  - Landsat-7
  - LDCM/Landsat-8
  - SPOT-4

- **High Resolution (≤ 4 m):**
  - SPOT-5 dan SPOT-6
Roadmap of Satellite Data Acquisition (2012-2022)

- **Low Resolution**
  - Operational and acquired
    - Terra
    - Aqua
    - NOAA-19
    - Himawari-6
    - FY-3B
  - Operational and proposed for acquisition
    - NPP
    - MetOp-B
    - Himawari-7
    - FY-3C
  - Operational planning and proposed for acquisition
    - JPSS-1
    - MetOp-C
    - Himawari-8
    - FY-3D
    - FY-3E
    - FY-3F

- **Medium Resolution**
  - Operational and acquired
    - SPOT-4
    - Landsat-7
  - Operational and proposed for acquisition
    - Landsat-8 (LDCM)
  - Operational planning and proposed for acquisition
    - Landsat-9

- **High Resolution**
  - Operational and acquired
    - SPOT-5
    - SPOT-6
  - Operational and proposed for acquisition
    - SPOT-7
  - Operational planning and proposed for acquisition
    - SPOT-8, SPOT 9

- **Radar**
  - Operational and acquired
    - SAOCOM-1A
  - Operational and proposed for acquisition
    - SAOCOM-1B
    - ACOM-2A
    - ACOM-2B
  - Operational planning and proposed for acquisition
    - ALOS-2
Roadmap of Indonesian Satellite Development

LAPAN-TUBSAT
Surveillance, transfer of technology

2007

2012

LAPAN-A2/LAPAN-ORARI
Surveillance, Ship Monitoring, Amateur Communication

2013

LAPAN-A3/LAPAN-IPB
Remote Sensing, Ship Monitoring, Amateur Communication

2015

LAPAN-B1
Remote Sensing satellite to support national food security program

t.b.d

TELE-EDUCATION SATELLITE
Tele-Education, Tele-Medicine, ICT Network, etc.
LAPAN contribution in Disaster Management

- Dealing with Disaster, LAPAN committed to provide the space-based information especially in the context of preparedness and emergency response.
- In order to support space-based disaster information, LAPAN coordinates with the Indonesian National Board for Disaster Management (BNPB) and another stakeholder agencies (both national and international).
- LAPAN has implemented several projects in the field of disaster management and emergency response such as flood, drought, fire hotspot, and climate monitoring or prediction, as well as the assessment of those disasters and emergency response for other catastrophes such as landslide, tsunami, earthquake, and volcanic eruption.
- LAPAN has been established as Regional Support Office of UNSPIDER since February 19, 2013.
Types of Disaster in Indonesia

- FLOOD
- FOREST/LAND FIRE
- DROUGHT
- EPIDEMIC
- LANDSLIDE
- TECHNOLOGY FAILURE
- EARTHQUAKE
- TSUNAMI
- VOLCANIC
- SOCIAL CONFLICT
Spaced-based Early Warning System

- Rainfall Prediction

![Maps showing rainfall prediction and anomaly estimation for December 2009 and January 2010.](image-url)
Spaced-based Early Warning System

- Cloud Cover & Rainfall Monitoring (from MTSAT)
Spaced-based Early Warning System

- **Fire Danger Rating System (FDRS)**

  - Fire weather observations:
    - Temperature, relative humidity, wind speed, rain
  - Fuel moisture codes:
    - Fine Fuel Moisture Code (FFMC)
    - Duff Moisture Code (DMC)
    - Drought Code (DC)
  - Fire behavior indices:
    - Initial Spread Index (ISI)
    - Buildup Index (BI)
    - Fire Weather Index (FWI)

Maps showing fire risk patterns across Indonesia.
Spaced-based Early Warning System

- Fire Hotspot Monitoring (from MODIS & AVHRR)
Spaced-based Emergency Response
Standard Operating Procedure

STANDAR OPERASIONAL PROSEDUR
TANGGAP DARURAT BENCANA
SIMBA CENTER / RSO-UN-SPIDER

1. PERSIAPAN
   a. Data dan Bencana
   b. Pengamanan Lahan
   c. Media Massa

2. IDENTIFIKASI BENCANA
   a. Spaced-based
   b. Bencana Sinergi
   c. Data dan Informasi

3. PROYEKSI
   a. Identifikasi Bencana
   b. Pelacakan Bencana
   c. Peta Bencana

4. RESPON
   a. Penanggulangan Bencana
   b. Pemulihan Bencana
   c. Penilaian Bencana

5. KERJASAMA
   a. Kerjasama AntarInstansi
   b. Kerjasama AntarNegara
   c. Kerjasama AntarBenua

6. KELUARAN
   a. Laporan Bencana
   b. Analisis Bencana
   c. Pelatihan Bencana
Earthquake and Tsunami

Before Tsunami,
June 23, 2004

After Tsunami,
Dec 28, 2004
Forest/Land Fire – Smoke Dispersion

Riau Province

June, 2013

Fire hotspot, June 14-23, 2013

Aqua MODIS
June 20, 2013

SPOT-6
June 18, 2013
Forest/Land Fire – Burned Area Mapping

Riau Province
June 5 – July 17, 2013

Aqua MODIS
FLOOD

Bengawan Solo River
February 1-2, 2009
Terra MODIS

KEJADIAN BANJIR
DI DAERAH ALIRAN SUNGAI (DAS) BENGAWAN SOLO
TANGGAL 1-2 FEBRUARI 2009

TUTUPAN LAHAN TAHUN 2000

TUTUPAN LAHAN TAHUN 2008

CITRA LANDSAT-7 ETM+ TAHUN 2000

CITRA MODIS TAHUN 2008

PENGAMANAN PENGENALAN DAN PENYANDIRAN JAUH
LENGKAP DENGAN PENDEKATAN DAN ALAT-ALAT NASIONAL

Sumber Data:
1. Informasi luas lahan dalam pengamatan data LANDSAT-7 ETM+ tahun 2002 dan MODIS tahun 2008
2. Data Digital Elevation Model (DEM) tahun 1995
3. Data digital drainage data tahun 1995
4. Data luas permukaan dan luas lahan tahun 2008

Penjaminan data oleh:

AKUMULASI CURAH HUJAN (04 JANUARI 04 SDA 01 FEBRUARI 2009)

CITRA DIGITAL ELEVATION MODEL - SRTM

FLOOD

Kp. Melayu Village, Jakarta City
January 18, 2013
Unmanned Aerial Vehicle

BEFORE FLOOD

QUICKBIRD IMAGERY, Date: SEPTEMBER 11, 2011

DURING FLOOD

UNMANNED AERIAL VEHICLES IMAGERY, Date: JANUARY 18, 2013

LANDFORMS
POTENTIAL FLOOD AREAS

- FLOODPLAINS (Flood Potential: High)
- CUT MEANDERS (Flood Potential: High)
- ALLUVIAL PLAINS (Flood Potential: High - Moderate)
- RIVER COURSES

AFFECTED FLOOD AREAS KAMPUNG PULO
KAMPUNG MELAYU 2007

AFFECTED AREAS

SPACEMAP OF FLOOD INUNDATION AREAS
FROM UAV (UNMANNED AERIAL VEHICLES)
ACQUISITION DATE JANUARY 18, 2013
COMPOSED WITH PREVIOUS CONDITIONS
KAMPUNG PULO - KAMPUNG MELAYU
AND SURROUNDING AREAS, JAKARTA

EXPLANATIONS:
- The flood-affected areas detected on UAV imagery are indicated by flooded roads (colored brownish).
- UAV imagery was recorded by Center for Aeronautic Technology LAPAN.
- The information of flood-affected areas year 2007 over all Jakarta region was processed by using PALSAR imagery.
- Predicted in 2013, the region will be flooded again.
- The information of landforms and flood potential areas was analyzed from UAV, Quickbird, Landsat, and SRTM.

Data Processing by:
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FLASHFLOOD
Central Maluku
July 27, 2013
Landsat-8 OLI
LANDSLIDE

Cianjur District, West Java
September, 2009
Landsat-5 TM
VOLCANO ERUPTION

Mt. Merapi, Central Java
October 26, 2010
ALOS-PALSAR

Nuee Ardente

DEM & NOAA-14, May 16, 2006
VOLCANO ERUPTION

Mt. Sinabung
September 15, 2013
Landsat
Integrated Disaster Information System in INDONESIA

InAWARE (NBoDM)

SIMBA CENTER (LAPAN)
INATEWS (BoMCG)
DMRC (AHA Center)
Geological Hazard Monitoring (MoEMR)
Flood Monitoring (MoPW)
InaGeoportal (BoGI)
SiJAMPANG (BoRT)
Forest Fire Monitoring (MoF)

ADRC SENTINEL ASIA International Charter
Challenges

- Timely availability of data.
- Lack of trained manpower.
- Difficulty in getting high resolution satellite images during emergencies.
- Discrepancies in maps and data from various organisations.
Further Improvements

- Improve hazard information systems and early warning by making effective use of InAWARE (new disaster management early warning and decision support system at Indonesia’s national disaster management agency).
- Develop best practice of using space based information in pre-disaster phase (such as information preparedness) to address hazard, risk and vulnerability mapping, specially promoting role of LAPAN, BNPB and other scientific organization, and
- Strengthen emergency response using space based information by addressing important concerns such as provision of high resolution images and microwave image to monitor hydro-meteorological disasters.

Resulted from the Discussion of Stakeholder Meeting of Spaced-Based Information for Disaster Risk Management
Jakarta, September 3rd, 2013
Cooperate with UNSPIDER
Thank You

謝謝