Proposals for APRSAFSat Cooperation

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National Institute of Aeronautics and Space - LAPAN

Indonesia is located between $94^0$45'E and $141^0$65'E or around 5,150 km along the length of the equator (or about 1/8th of earth circumference), and the widest breadth is between $6^0$8'N and $11^0$15'S or around 1,900 km, with more than 237 million population (July 2008 estimate). It is an archipelago positioned between the Indian and Pacific oceans, and between the Asian and Australian continents.

Equator Line

The utilization of space is significant to address solutions to present and real needs of the Indonesian people and nation.

Space applications in Indonesia:

Extensive and diverse maritime continent geography of Indonesia;

Growing need of space technology utilization and application for national development:

+ Telecommunication (first domestic satellite telecommunication system in operation in 1976);
+ Earth Observation (EO), e.g. for land and marine resources, urban and rural land use, environment, weather, climate and others;
+ Disaster management;
+ Navigation and position location;
+ Search and Rescue;
+ Health;
+ Education;
+ Others;

Utilization of space technology for development of prosperity for the people.

Existing space remote sensing utilization (1):

Character of current space Earth Observation (EO) groups:

- **+ Low spatial resolution, with high temporal and spectral resolution (NOAA AVHRR, MODIS), e.g. environment, ocean, climate applications;**
- **+ Medium spatial, spectral and temporal resolution (Landsat ETM, SPOT 4, ASTER), e.g. forestry, agriculture, coastal, geology, disaster management applications;**
- **+ High spatial resolution, ≥ 2.5 m (Ikonos, Quickbird, ALOS, SPOT 5), e.g. urban monitoring, land use, disaster management applications.**

Commonly used Landsat ETM and SPOT 4 data:

- **Medium resolution (range 10 m to 30 m) and swath width (range 60 km to 185 km);**

- **Data processing and product formats, e.g. pre-processing of SPOT 5 data:**
  - **+ Level 1A: radiometrically normalized, accuracy 50 m;**
  - **+ Level 1B: systematic corrected geo-referenced, accuracy 50 m;**
  - **+ Level 2A: geo-rectified to map projection, using GCP, accuracy 50 m;**
  - **+ Level 2B: geo-corrected to cartographic projection, using GCP, accuracy 30 m;**
  - **+ Level 3: ortho-rectified, using GCP and DEM, accuracy 15 m;**
  - **+ Radiometric resolution 8-bit for optical data (16-bit for radar data);**

- **Image evaluation and analysis (4 to 7 optical spectral bands);**

Existing space remote sensing utilization (2):

Food security application, e.g.
- **Crop yield estimation;**
- **Crop growth cycle;**
- **Fishing and aquaculture;**
- **Agriculture land use and farm estates;**
- **Estimation of planting season;**
- **Soil and agro-climate, and others.**

Land application, e.g.
- **Disaster management, e.g. land slide, volcano, tsunami, floods, forest fires;**
- **Natural resources management;**
- **Forest management and inventory;**
- **Land use and land cover monitoring;**
- **Environment monitoring, e.g. draught and environment change detection;**
- **Water catchment areas and hydrology;**
- **Geology, and others.**

Space earth observation to promote social and economic development.

Marine application, e.g.
- **Coastal marine resources;**
- **Potential fishing ground;**
- **Coastal zone and environment;**
- **Marine pollution;**
- **Maritime vehicle monitoring;**
- **River estuary environment monitoring, and others.**

Existing space remote sensing utilization (3):

Spectral band requirements (refer to Landsat ETM, i.e. medium spatial, spectral and temporal resolution) for coastal marine and land applications:

• **Blue (450-520 nm):**	**Coastal zone mapping, bathymetry and water quality;** **Monitoring of marine phytoplankton and sediment;** **Detection of atmosphere pollution and haze;**
• **Green (520-600 nm):**	**Peak reflectance of green leaves (chlorophyl);** **Vegetation species;** **Vegetation stress;**
• **Red (630-690 nm):**	**Chlorophyl absorption;** **Differentiation of vegetation species;** **Biomass content;**
• **NIR (760-900 nm):**	**Vegetation species;** **Vegetation stress;** **Biomass content;** **Soil moisture;** **Land and water boundary;**
• **Panchromatic:** **(500-900 nm)**	**Medium scale topography mapping;** **Image sharpening.**

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Natural disasters and the utilization of satellites

Detection and monitoring of disasters by satellites:

Recurring disasters:
- **Earthquake;**
- **Tsunami;**
- **Volcanic eruption;**
- **Floods and flash floods;**
- **Land slides;**
- **Draught and other climate anomalies;**
- **Forest fires.**

Disaster management:
- **Early warning;**
- **Distress information relay;**
- **Detection and assessment of disaster areas;**
- **Mitigation and relief;**
- **Rehabilitation.**

Utilization of satellites:
- **Remote sensing (medium to high spatial res.);**
- **Communication (data, voice);**
- **Navigation and position location.**

Ulee Lhee, Banda Aceh, effects of Tsunami, Ikonos data.

Temporal Resolution

Higher temporal resolution required for:
- **Change detection;**
- **Disaster management;**
- **Observation of occurring events;**
- **Overcome high cloud cover incidence.**

Obtaining higher temporal resolution of EO satellite data in Indonesia:
- **Constellation of satellites at low altitude sun synchronous orbits (LEO SSO);**
- **Constellation of satellites at low altitude quasi equatorial orbits (LEO with approx. 10^0 inclination for coverage of Indonesia);**
- **Satellite at medium altitude true equatorial orbit (MEO equatorial);**
- **Off-nadir viewing capability of EO satellite imaging sensor payloads.**

The possibility of daily temporal coverage for medium spatial resolution remote sensing data shall be an ideal condition, e.g. by use of LEO satellite constellation in combination with off-nadir EO sensor payload viewing capability.

Most suitable equator crossing time for LEO SSO is around 08:00 local time for Indonesia.

Current LAPAN activity in satellite development.

- **LAPAN-TUBSAT micro-satellite in cooperation with Technical University Berlin, Germany for acquisition of knowledge and experience in development of video earth observation satellite. It is launched as auxiliary payload on January 10, 2007 by ISRO PSLV-C7 Cartosat-2 and SRE mission at Sriharikota, India;**
- **LAPAN-A2 micro-satellite, for video earth observation, under design and development;**
- **Amateur Radio micro-satellite, for communication, in planning phase.**

LAPAN-TUBSAT on PSLV C7 for auxiliary launch, photo courtesy of ISRO.

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Current expectations from APRSAFSat Cooperation

1. <u>Joint system study on APRSAFSat (300 - 500 kg class):</u>

- **a. Participation in APRSAFSat concept study, design, integration, test and utilization of small satellite and EO instrument payload;**
- **b. Participation in human resource training on APRSAFSat multi-spectral imaging instrument payload;**
- **b. Participation in human resource training on APRSAFSat small-satellite bus structure, sub-system and component;**

2. <u>Development of Technology Experiment Satellite (50 kg class):</u>

- **a. Participation in capacity building and human resource training for project member countries on satellite planning, design, assembly, integration, test and operation;**
- **b. Opportunity on utilization of satellite development and test facility of Technology Experiment Satellite by project member countries for the development and test of their own satellite, satellite sub-systems and components;**
- **c. Auxiliary launch opportunity of satellite programs for participating countries;**

3. <u>Technical Workshop for APRSAFSat EO satellite data users and satellite developer:</u>

- **a. Exchange on satellite mission needs;**
- **b. Exchange of satellite technology and introduction of new technology;**
- **b. Participation of remote sensing data user community.**

Closing

- **Appreciation to JAXA for the proposal of APRSAFSat cooperation. Recommendations of APRSAF-14, November 21-23, 2007 in Bangalore, India;**

- **APRSAFSat cooperation contribute to Indonesian satellite development.**

- **APRSAFSat cooperation beneficial for Asia-Pacific countries.**

Thank You Very Much