Monitoring spatiotemporal patterns of urbanization using satellite remote sensing data

~ A collaborative research with JAXA ~

Rajesh Bahadur THAPA
JSPS Fellow, University of Tsukuba

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Presentation outline

1. Project introduction
2. ALOS Data Characteristics
3. ALOS Applications
1. Project introduction: Goal

Purpose of this research is to conduct comprehensive analysis on spatiotemporal patterns of urbanization and its impact to environment using remote sensing approaches.
1. Project introduction: Time frame

Two years period (April 2010 ~ March 2012)

- Data acquisition: April-2010 ~ March-2011
- JAXA PIs Symposium: Nov 2010 (Tokyo), Nov 2011 (TBD)
- Final report submission: March 2012
1. Project introduction: Data

Following satellite data are available

Data:

- Marine Observation Satellite (MOS) (global)
- Japanese Earth Resources Satellite (JERS) (global)
- Advanced Earth Observing Satellite (ADEOS) (global)
- Tropical Rainfall Measuring Mission (TRMM) (global)
- ERS, LANDSAT, SPOT, RADARSAT, IRS (only around Japan)
- ALOS (Asia region, JAXA node)
1. Project introduction: ALOS Data Node
2. ALOS

General information:

- Launched: 24 Jan 2006
- Altitude: 691.65km
- Repeat cycle: 46 days
- Data types: 3
- Data availability: 2006~2010

2. ALOS: Instruments

ALOS has three remote sensing instruments:

- Panchromatic Remote-Sensing Instrument for Stereo Mapping (PRISM) for generating Digital Surface Models (DSMs).
  - Resolution: 2.5m
  - Scene coverage: 70km and 35km
  - Sensor characteristics: 1 Panchromatic band
ALOS has three remote sensing instruments:

- **Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2)** for multispectral land coverage observation.
  - Resolution: 10m
  - Scene coverage: 70km
  - **Sensor characteristics:** Color, 4 bands
    - Blue: Band 1 (0.42 - 0.50 μm)
    - Green: Band 2 (0.52 - 0.60 μm)
    - Red: Band 3 (0.61 - 0.69 μm)
    - Infra Red: Band 4 (0.76 - 0.89 μm)
2. ALOS: Instruments

ALOS has three remote sensing instruments:

- Phased Array type L-band Synthetic Aperture Radar (PALSAR) for 24-hour, all-weather land observation.
  - Resolution: 10~20m; 30m; 100m
  - Scene coverage: 70km; 30km; 250~350km
## 2. ALOS: Data products

### Common

<table>
<thead>
<tr>
<th>Level</th>
<th>Definition</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>Demodulated bit stream</td>
<td>Packetized Temporary archived</td>
</tr>
<tr>
<td>0</td>
<td>Frame synchronization and PN decoding of CADUs and R-S Error Detection and Correction of VCDUs Extracted mission telemetry, orbit, and attitude data are stored on separate files.</td>
<td>Compressed (except for PALSAR) Permanently archived Level for distribution to Data Node</td>
</tr>
</tbody>
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### PRISM

<table>
<thead>
<tr>
<th>Level</th>
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<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Uncompressed, reconstructed digital counts appended with radiometric calibration coefficients and geometric correction coefficients (appended but not applied). Individual files for forward, nadir, and backward looking data.</td>
<td></td>
</tr>
<tr>
<td>1B1</td>
<td>Radiometrically calibrated data at Sensor input</td>
<td></td>
</tr>
<tr>
<td>1B2</td>
<td>Geometrically corrected data</td>
<td>Map projection Resampling Pixel spacing</td>
</tr>
</tbody>
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## 2. ALOS: Data products

### AVNIR-2

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</tr>
<tr>
<td>1B2</td>
<td>Geometrically corrected data</td>
<td>Map projection, Resampling, Pixel spacing</td>
</tr>
<tr>
<td></td>
<td>Options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G: Systematically Geo-coded (No option: Geo-referenced)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: Correction with coarse DEM</td>
<td></td>
</tr>
</tbody>
</table>

### PALSAR

<table>
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<th>Level</th>
<th>Definition</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Reconstructed, unprocessed signal data appended with radiometric and geometric correction coefficients (appended but not applied). In Polarimetric Mode, polarimetric data is separated.</td>
<td>Beam modes: Full resolution mode, Low data rate mode, Polarimetric mode SLC: Single Look Complex Used for interferometry</td>
</tr>
<tr>
<td>1.1</td>
<td>Range and azimuth compressed complex data on slant range. Full resolution</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Multi-look processed image projected to map coordinates.</td>
<td>Map projection, Resampling, Pixel spacing</td>
</tr>
<tr>
<td></td>
<td>Options</td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
3. ALOS Applications: Vegetation monitoring in Tsukuba
3. ALOS Applications: Land use detection in Tsukuba

Source: Thapa and Murayama 2009
3. ALOS Applications: Walkability

Source: http://giswin.geo.tsukuba.ac.jp/sis/walkability/index.htm
3. ALOS Applications: Eco-friendly walk score calculator