Prevention of Illegal Deforestation in Amazon Forest using ALOS/ PALSAR

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About ALOS
Key parameter of the Satellite

- Weight 4 metric tons
- Designed Life: 3~5 years (Launch 2006.1.21)
- Orbit Sunsync: $H=691.65\text{km}$, $Inc=98.16\text{deg}$,
  Recursion=46days, sub cycle=2days
- Total turn/recursion=671
- Sensors:
  - PRI SM : Optical
  - AVNIR 2: Optical
  - PALSAR: Radar
## PALSAR

### PALSAR Characteristic

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fine</th>
<th>ScanSAR</th>
<th>Polarimetric (Experimental mode)*1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Frequency</td>
<td>1270 MHz (L-band)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chirp Bandwidth</td>
<td>28MHz</td>
<td>14MHz</td>
<td>14MHz, 28MHz</td>
</tr>
<tr>
<td></td>
<td>HH or VV</td>
<td>HH+HV or VV+HV</td>
<td>HH or VV</td>
</tr>
<tr>
<td></td>
<td>HH+HV+VH+VV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarization</td>
<td>HH or VV</td>
<td>HH or VV</td>
<td>HH+HV+VH+VV</td>
</tr>
<tr>
<td>Incident angle</td>
<td>8 to 60deg.</td>
<td>8 to 60deg.</td>
<td>18 to 43deg.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8 to 30deg.</td>
</tr>
<tr>
<td>Range Resolution</td>
<td>7 to 44m</td>
<td>14 to 88m</td>
<td>100m (multi look)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24 to 89m</td>
</tr>
<tr>
<td>Observation Swath</td>
<td>40 to 70km</td>
<td>40 to 70km</td>
<td>250 to 350km</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 to 65km</td>
</tr>
<tr>
<td>Bit Length</td>
<td>5 bits</td>
<td>5 bits</td>
<td>5 bits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 or 5 bits</td>
</tr>
<tr>
<td>Data rate</td>
<td>240Mbps</td>
<td>240Mbps</td>
<td>120Mbps, 240Mbps</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>240Mbps</td>
</tr>
<tr>
<td>NE sigma zero *2</td>
<td>&lt;-23dB (Swath Width 70km)</td>
<td>&lt;-25dB (Swath Width 60km)</td>
<td>&lt;-29dB</td>
</tr>
<tr>
<td>S/A *2, *3</td>
<td>&gt;16dB (Swath Width 70km)</td>
<td>&gt;21dB (Swath Width 60km)</td>
<td>&gt;19dB</td>
</tr>
<tr>
<td>Radiometric accuracy</td>
<td>scene: 1dB / orbit: 1.5 dB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Amazon Project
The Project for utilization of ALOS images to support the protection of the Brazilian Amazon Forest and combat against illegal deforestation.
Project

• Name: Projeto Contribuição à Proteção da Floresta da Amazônia e Combate ao Desmatamento Ilegal com a Utilização de Imagens do Satélite Japonês ALOS
• Sponsor: JICA (Agência de Cooperação Internacional do Japão)
• Counter Part: IBAMA* and DPF**
• Duration: June 2009-June 2012
• Purpose: Transfer technology to detect deforestation in Amazon Forest using Japanese Radar Satellite ALOS

*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
**Departamento de Polícia Federal
Background

• From 2004, INPE* is detecting deforestation in Amazon using optical satellite images.
• Weakness of the system is lack of information in rainy season by cloud cover over the area.
• Satellite SAR is useful to solve the problem but due to poor experience to handle SAR data, it was not used effectively.
• IBAMA and DPF requested JICA to transfer SAR data handling technology and the project started.

*INPE: Instituto Nacional de Pesquisas Espaciais
Our Activities

• Develop image handling tools to use ALOS data and handbooks for deforestation detection
• Develop data base to handle satellite images and related information
• Develop WebGIS system to utilize deforestation information timely and effectively
• Conduct training for SAR data handling and WebGIS system design both in Brazil and in Japan
Direct Effect of SAR

Cloud cover

Cloud free

Optical

LANDSAT 19/08/2005

CBERS 2 22/06/2006

RADAR

RADAR R99B 07/04/2006
Process for law enforcement against illegal deforestation

- Detect new deforestation
- IBAMA situation room
- Joint troop with federal police and military for regional deforestation exposure
- Site check
- Law enforcement, Fine / confiscation
- Localização dos pontos por GPS
Developed Software

Customized software development for specific purposes in the project.
Multi temporal ScanSAR composite
Site survey to verify analysis
Discovery of log transfer
Training programs

• Basic course: SAR basics and GIS basics

• Advanced course: Interferometry, phase unwrap, change detection, optical image handling, WebGIS technology

• Education for future trainers
Forensic reports Support
Detection of Deforestation Using ALOS
Detection of new deforestation
Some results

Year 2010: Detection 1007 polygons, verified 140 polygons

Year 2011: Detection 176 polygons, verified 11 polygons,
(satellite stopped in April 2011)
According to the report by INPE 2011, deforestation in Legal Amazon area was significantly reduced for recent 3 years. Deterrent power by project activities along with Brazilian advertise for ALOS through mass media contribute to the results.
In April 2011, ALOS stopped its operation. After this, no new data in rainy season are supplied to IBAMA. We are now waiting for ALOS 2 launch.
Expectation to ALOS2
# ALOS-2 satellite

## ALOS-2 in-orbit configuration

![Satellite Diagram](image)

- **Data relay antenna**
- **L-band SAR antenna**
- **X-band downlink antenna**
- **Solar Arrays**

## Specification

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| **Observation mode**   | Strip map: 3 to 10m res., 50 to 70 km swath  
|                        | ScanSAR: 100m res., 350km swath  
|                        | Spotlight: 1×3m res., 25km swath  |
| **Orbit**              | Sun-synchronous orbit  
|                        | Altitude: 628km  
|                        | Local sun time: 12:00 +/- 15min  
|                        | Revisit: 14days  
|                        | Orbit control: ≦ +/-500m  |
| **Life time**          | 5 years (target: 7 years)  |
| **Launch**             | JFY2013, H-IIA launch vehicle  |
| **Downlink**           | X-band: 800Mbps (16QAM)  
|                        | 400/200Mbps (QPSK)  
|                        | Ka-band: 278Mbps (QPSK)  |

**Experimental**  
Compact InfraRed Camera (CIRC)

Launch is expected in this year (Autumn 2013 ?)