Current Status of the ALOS-2 Operation and PALSAR-2 Calibration Activities

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CEOS SAR CALVAL WS 2016
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**ALOS-2: Advanced Land Observing Satellite**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch date</td>
<td>May 24, 2014</td>
</tr>
<tr>
<td>Mass</td>
<td>2.1 tons</td>
</tr>
<tr>
<td>Lifetime</td>
<td>5 years (goal: 7 years)</td>
</tr>
<tr>
<td>Orbit</td>
<td>Sun-synchronous&lt;br&gt;628 km altitude&lt;br&gt;14 days revisit</td>
</tr>
<tr>
<td>LSDN</td>
<td>12:00 +/- 15 min</td>
</tr>
<tr>
<td>Mission data transmission</td>
<td>Direct: 800 Mbps&lt;br&gt;Data relay: 278 Mbps</td>
</tr>
<tr>
<td>Data recorder</td>
<td>128 GB</td>
</tr>
</tbody>
</table>
ALOS-2: Advanced Land Observing Satellite-2

Mission Objectives

Disaster monitoring
- Earthquake
- Volcano
- Flooding

Ocean

Environment and land management
- Forest and wetland
- Ice

Agriculture & natural resources
History of Japanese L-band SAR Satellites

**JERS-1 SAR**  
1992～1998

- Transmit power: ~1.5 kW
- Resolution: 18 m
- Swath width: 75 km
- Polarization: Single
- Obs. direction: Right

**ALOS PALSAR**  
2006～2011

- Transmit power: ~2 kW
- Resolution: 10 m / 100 m
- Swath width: 70 km / 350 km
- Polarization: Single, Dual, Quad
- Obs. direction: Right

**ALOS-2 PALSAR-2**  
2014～

- Transmit power: ~6.1 kW
- Resolution: 3 m / 100 m
- Swath width: 50 km / 490 km
- Polarization: Single, Dual, Quad
- Obs. direction: Right or Left
Current status of ALOS-2

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>May 24 Launch</td>
</tr>
<tr>
<td>2015</td>
<td>Initial checkout phase</td>
</tr>
<tr>
<td>2016</td>
<td>Initial cal/val phase</td>
</tr>
<tr>
<td>2017</td>
<td>Mission operation (5 years)</td>
</tr>
<tr>
<td>2018</td>
<td>Post-mission operation</td>
</tr>
<tr>
<td>2019</td>
<td>Emergency observation</td>
</tr>
<tr>
<td>2020</td>
<td>Basic observation scenario (BOS)</td>
</tr>
<tr>
<td>2021</td>
<td>Advanced optical satellite</td>
</tr>
<tr>
<td></td>
<td>Advanced SAR satellite</td>
</tr>
</tbody>
</table>

May 24:
- Launch

Jun. 19:
- First image
- Emergency observation
- Basic observation scenario (BOS)
Status of the ALOS-2 systems

- The ALOS-2 bus and sensor systems are correctly running over 2 years after the launch.
- Monitoring and prediction values of power generation by solar array paddles are in good agreement.
- A large amount of propellant is remained.

- **Power generation of solar array paddles**
- **Amount of remaining propellant**
Status of the ALOS-2 systems

- Orbit determination accuracy (relative) keeps below 10 cm
- Performance of autonomous orbit control

### Reference orbit

#### 500-m radius tube

**Satellite position**

May, 1 to 31, 2016

**RMS [cm]**

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage within 500 m radius*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 (Oct. 1~)</td>
<td>100 %</td>
</tr>
<tr>
<td>2015</td>
<td>100 %</td>
</tr>
<tr>
<td>2016 (~May 31)</td>
<td>100 %</td>
</tr>
</tbody>
</table>

* Except for debris avoidance maneuvers
Status of PALSAR-2

• The condition of PALSAR-2 is checked by the internal calibration mode.
  ✓ The functions of transmit and receive sub-systems such as phase-shifters and attenuators are checked every about 3 months.
  ✓ The transmit pulse replica, transmit power, noise level of raw signals, calibration of A/D and range offsets, and so on, are checked before and after observations.

• Currently, there are no anomalies and PALSAR-2 keeps stable performance after the launch.

Thermal condition of a TRM
(Mar. 1-May 1, 2016)
Status of PALSAR-2 standard products

- Evaluation of the PALSAR-2 standard products is regularly performed by using the images over the calibration sites (mainly Japan and Brazil) and Amazonian forests.

- The standard deviation of radiometric calibration factor is less than the system requirement (1 dB) but we are now trying to reduce the value by checking and modifying the product generation algorithms.

![Chart showing calibration factor distribution with average of -81.924 dB and standard deviation of 0.909 dB.](chart.png)
The PALSAR-2 observations are performed according to the BOS. The BOS has two separate plans for Japan and the rest of the world.

Success rate of the BOS is 70-90%. Missing observations are mainly due to insufficient downlink resources, conflict of observation requests, and internal calibration or orbit tuning operations.

Downlink data volume of PALSAR-2 is approx. 14 TB/month.

We are now considering the revision of the BOS from 4th year to improve the success rate.

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**Basic Observation Scenario (ALOS-2 BOS)**

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- Success rate of the BOS is 70-90%. Missing observations are mainly due to insufficient downlink resources, conflict of observation requests, and internal calibration or orbit tuning operations.
- Downlink data volume of PALSAR-2 is approx. 14 TB/month.
- We are now considering the revision of the BOS from 4th year to improve the success rate.

**Global BOS (3rd year)**

1 year = 26 cycles

Global 10 m resolution, HH/HV pol.

Beam F2, Ascending, Right
(Global land observation)

Beam F2, Descending, Right
(Deformation, Forest, Ice)
Data acquisition status


Global ScanSAR (350km-swath/100m-res.), HH/HV pol.

Beam W2, Ascending, Right (Polar regions)
Beam W2, Descending, Right (Deformation, Forest, Ice)
Data acquisition status


6m resolution with full-polarimetry
Beam FP6, Ascending, Right

3m resolution with HH-pol.
Beam U2, Descending, Right

50% of the global coverage

55% of the global coverage
Data acquisition status


Japan disaster basemap observations with 3 m res. HH-pol.
Emergency observations

- 254 emergency observations were performed from the launch of ALOS-2 to Aug. 4, 2016.

<table>
<thead>
<tr>
<th></th>
<th>Earthquake</th>
<th>Volcano</th>
<th>Flood, Heavy-rain, Landslide</th>
<th>Others*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Japan</strong></td>
<td>23</td>
<td>69</td>
<td>46</td>
<td>1</td>
<td>139</td>
</tr>
<tr>
<td><strong>World</strong></td>
<td>26</td>
<td>3</td>
<td>75</td>
<td>11</td>
<td>115</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>72</td>
<td>121</td>
<td>12</td>
<td>254</td>
</tr>
</tbody>
</table>

* Oil spill, Forest fire, Glacier lake, etc.

- Obtained data and analysis results were provided to disaster management organizations, International Disaster Charter, Sentinel Asia, etc.
Example of emergency observations

- On August 24 and 31, 2016, an emergency observation with PALSAR-2 was performed in response to the magnitude-6.2 earthquake in central Italy on August 24, 2016 at 1:36 (UTC).

Interferogram acquired before (September 9, 2015; UTC) and after (August 24, 2016; UTC) the earthquake.

Damage proxy map of Amatrice generated by the interferometric coherence change analysis.
Summary

• The ALOS-2 and PALSAR-2 keep good performance over 2 years after the launch.

• The PALSAR-2 standard products are regularly evaluated. The performance is almost not changed from the initial calibration phase in 2014.

• A lot of data have been obtained according to the BOS and emergency observation requests for disaster monitoring.