AMSR2/AMSR3 Updates

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## Development of AMSR Series

<table>
<thead>
<tr>
<th>Sensor</th>
<th>MOS-1/MSR</th>
<th>ADEOS-II/AMSR</th>
<th>Aqua/AMSR-E</th>
<th>GCOM-W/AMSR2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage</td>
<td>Direct receive only</td>
<td>Global</td>
<td>Global</td>
<td>Global</td>
</tr>
<tr>
<td>Swath</td>
<td>317km</td>
<td>1600km</td>
<td>1450km</td>
<td>1617km</td>
</tr>
<tr>
<td>Frequencies (GHz)</td>
<td>2 (23,31)</td>
<td>9 (6.9,10,18,23,36,50,52,89)</td>
<td>6 (6.9,10,18,23,36,89)</td>
<td>7 (6.9,7.3,10,18,23,36,89)</td>
</tr>
<tr>
<td>Polarization</td>
<td>Mixed V and H</td>
<td>V and H</td>
<td>V and H</td>
<td>V and H</td>
</tr>
<tr>
<td>Antenna Size</td>
<td>0.5m</td>
<td>2.0m</td>
<td>1.6m</td>
<td>2.0m</td>
</tr>
<tr>
<td>Spatial Res.</td>
<td>23km @31GHz</td>
<td>8x14km @36GHz</td>
<td>8x14km @36GHz</td>
<td>7x12km @36GHz</td>
</tr>
</tbody>
</table>

### Images

1987 **MOS-1**

2002 **ADEOS-II**

2002 **Aqua**

2012 **GCOM-W**

**AMSR3?**
Overview of GCOM-W and AMSR2

✓ Successor of Aqua/AMSR-E (launched in May 2002), providing continuous data for climate studies and operational applications
✓ Joining A-train constellation (same as Aqua) and also GPM constellation
✓ Carrying AMSR2, a multi-polarization and multi-frequency microwave imager
✓ Observing various water-related ECVs at high spatial resolution
✓ Improving on-board calibration target has resulted reduction of annual TB variation due to calibration and improvement of TB stability
✓ Achieved designed mission life (5-year) on May 18, 2017, and continues observation
✓ Enough fuels to keep current orbit for more than 15 years

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Advanced Microwave Scanning Radiometer 2 (AMSR2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>~700 km</td>
</tr>
<tr>
<td>Orbital inclination</td>
<td>98.2 deg</td>
</tr>
<tr>
<td>Local sun time at Ascending node</td>
<td>13:30</td>
</tr>
<tr>
<td>Launch vehicle</td>
<td>H-IIA</td>
</tr>
<tr>
<td>Launch</td>
<td>May 18, 2012</td>
</tr>
<tr>
<td>Designed lifetime</td>
<td>5 years</td>
</tr>
</tbody>
</table>
GCOM-W Operation Status

GCOM-W satellite and AMSR2 instruments are in healthy conditions.
• No major problem in data acquisition and processing
• Data Loss events (except annual inclination adjust maneuvers):
  – Jul. 17, 18, 23, 2012: Calibration activity (half orbit each day)
  – May 10 - 14, 2013 : SEU-induced AMSR2 observation halt #1
  – Dec. 4, 2015: SEU-induced data recorder halt #1 (20 hours)
  – Apr. 15, 2016: SEU-induced AMSR2 observation halt #2 (20 hours)
  – Aug. 3, 2016: Retrograde maneuver (half orbit)
  – Feb. 22, 2017: Retrograde maneuver (half orbit)
  – Jul. 12, 2017: Retrograde maneuver (half orbit)
  – Sep. 27, 2017: SEU-induced data recorder halt #2 (20 hours)
  – Nov. 25, 2017: SEU-induced AMSR2 observation halt #3 (14 hours)
  – Mar. 14, 2018: Retrograde maneuver (half orbit)
  – Dec. 16, 2018: SEU-induced data recorder halt #3 (10 hours)
• Enough fuels to keep current orbit
• Initial indication of aging and degradation of mechanical bearings lubricants of AMSR2
AMSR2/AMSR-E Product Status

• AMSR2
  – Level 1 & 3 (brightness temperature): Ver. 2.2 (Aug. 2016)
  – Level 2 & 3 (geophysical parameters): Ver.2 (Mar. 2015)
    • Total precipitable water, integrated cloud liquid water, precipitation, snow depth
  – Level 2 & 3 (geophysical parameters): Ver.3 (Mar. 2017)
    • SST, sea surface wind speed, sea ice concentration, soil moisture content
  – Level 2 & 3 (research):
    • 10-GHz SST (included in standard SST): Ver.3 (Mar. 2017)
    • All-weather sea surface wind speed: Ver.3 (Jan. 2018)
    • Land surface temperature: Ver.1 (Feb. 2018)
    • Thin ice detection, Total precipitable water over land: Ver. 1 (end of Jan. 2019)

• AMSR-E (in AMSR2 format and algorithms)
  – Level 2 & 3 (geophysical parameters): Ver.8 in early JFY2019
AMSR-E L1 Product Ver. 4

• **L1 Reprocessing Policy**
  – Brightness temperature (TB) between AMSR-E and AMSR2 is not adjusted
  – **Swath width** of AMSR-E (1450km, 196 pixels for low-freq. Ch. / 392 for high-freq. Ch.) is extended to **be equivalent to that of AMSR2** (1620km, 243 pixels for low-freq. Ch. / 486 for high-freq. Ch.)
  – **AMSR-E L1R (resampling) product**, which is highly requested by users, are newly developed

• **Improvements in L1B Algorithm**
  – Bias correction of TB is applied to scan edges to extend swath width
  – Improved method to calculate hot load temperature correction by using two orbit paths to resolve gaps between Ascending and Descending orbit products
  – Improved geometric parameters

• **AMSR-E L1 products (ver.4)** has been released to public through the G-Portal since April 2018.
  – https://www.gportal.jaxa.jp/gp/
AMSR-E L1 Ver.4: Extend Swath Width

Satellite flight direction

Swath width 1450km (193 pix for low-freq. / 392 for high-freq.)

Swath width 1620km (243 for low-freq. / 486 for high-freq.)
AMSR-E L1 Ver.4: Hot Load Correction

- Parameters to correct hot load temperature are calculated using half orbit data previously, but gaps are found at boundary of A/D products.
- In new version, two orbits path data (1 orbit before and after) are used for calculation and gaps are resolved.

![Graph comparing previous and new methods for hot load temperature correction]

- **Previous method**: Descending and Ascending for 1 orbit.
- **New method**: Descending and Ascending for 2 orbits (1 orbit before and after).
Status of AMSR2 follow-on mission

• “Development of the AMSR2’s successor sensor (Launch on the GOSAT-3 satellite)” is mentioned on The Roadmap for the Basic Plan on Space Policy revised December, 2018.
  – AMSR2 follow-on instrument will share satellite bus with greenhouse-gas observation instrument developed by Ministry of Environment for a follow-on mission of Greenhouse-gas Observation Satellite 2 (GOSAT-2).

• JAXA proceeds with internal process to launch development project.
  – Mission Definition Review (MDR) and project readiness reviews were completed in Jun. 2018.
  – GOSAT-3 pre-project team takes charge of Project Preparation Phase (Phase-A) activities from Sep. 1, 2019.
  – System Requirement Review (SRR) was completed in Jan. 2019.
AMSR2 follow-on specification

- Specification of the AMSR2 follow-on instrument
  - Almost equivalent to AMSR2
  - A few high frequency channels (166 GHz and 183 GHz) is considered for approval.
- Orbit will be 666 km altitude (same as GOSAT-1) and 13:30 LT in Ascending node (same as GCOM-W)
  - Finer FOV (5% less), narrower swath width (1535km)
- Targets of the follow-on mission
  - To produce long-term continuous data record
  - To enhance operational utilization of near-real time data
    - weather forecast including hurricane analysis
    - fishery in coastal area
    - navigational assistance on arctic shipping route
    - New geophysical parameter products
- New standard products for the mission above
  - solid precipitation, water vapor over land, high-resolution sea surface temperature, all-weather sea surface wind speed and high-resolution sea ice concentration
Summary

• JAXA’s GCOM-W mission is now flying more than 6-years without any serious problem. Satellite and sensor (AMSR2) is in healthy condition.
  – AMSR2 products are distributed to public via internet. Transfer to G-Portal (https://www.gportal.jaxa.jp/gp/) has completed in June 2018
  – 8 standard geophysical parameters and 3 research products are now available, and 2 research products are close to release
• AMSR-E reprocessing products applying AMSR2 format and algorithms are in preparation, expecting contribution to CDRs
  – L1B and L1R (resampling: new) products are already available at G-Portal
  – L2 products are now validated and show accuracy equivalent to AMSR2
• AMSR2 follow-on sensor (AMSR3) and TANSO-2 successor sensor will be joint mission and JAXA has initiated pre-project team phase Sep. 1, 2018.
  – Orbit is defined to keep AMSR2 LT observation (13:30 ATAN), but altitude is lower than GCOM-W (699km -> 666km: same as GOSAT orbit)
  – Sensor specification of AMSR3 will be equivalent to AMSR2 except additional 166/183 GHz channels for solid precipitation retrievals and water vapor analysis in NWP