JAXA’s Ocean Environment Monitoring Activities and Himawari Monitor

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Yasumasa Miyazawa (JAMSTEC)
**Research Themes & Missions**

JAXA has launched thematic research activities that cover multiple missions.

<table>
<thead>
<tr>
<th>Research theme</th>
<th>ALOS2</th>
<th>GPM TRMM</th>
<th>Earth CARE</th>
<th>GCOM W&amp;C</th>
<th>GOSAT</th>
<th>Collaborating agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ocean Environment Monitoring</strong></td>
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<td></td>
<td><strong>JAMSTEC, NIPR, MRI</strong></td>
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<td><strong>Water Cycle &amp; Resource Management</strong></td>
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<td><strong>Univ. Tokyo, ICHARM</strong></td>
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<td><strong>Air Pollutant Monitoring</strong></td>
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<td>☺ ☺</td>
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<td>☺ ☺</td>
<td><strong>MRI, NIES, Kyushu Univ., JMA</strong></td>
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<td><strong>Infrastructure Displacement Monitoring</strong></td>
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<td><strong>IDI, etc.</strong></td>
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<tr>
<td><strong>Climate System &amp; Radiative Process</strong></td>
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<td>☺ ☺</td>
<td>☺ ☺ ☺</td>
<td></td>
<td>☺ ☺</td>
<td><strong>Univ. Tokyo</strong></td>
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<td><strong>Ecosystems</strong></td>
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<td></td>
<td>☺ ☺</td>
<td><strong>Tsukuba Univ., NIES, Hokkaido Univ. JAMSTEC</strong></td>
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<td><strong>Agriculture</strong></td>
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<td></td>
<td>☺ ☺</td>
<td><strong>NIAES, Univ. Tokyo</strong></td>
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<tr>
<td><strong>Public Health</strong></td>
<td>☺ ☺</td>
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<td></td>
<td>☺ ☺</td>
<td><strong>NCGM, Nagasaki Univ., Univ. Tokyo</strong></td>
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</tbody>
</table>
GMI Sea ice concentration (SIC) algorithm was developed based on that for AMSR2 except using 36-GHz V as weather filter instead of 6-GHz V.

DPR Sea ice concentration was produced by comparing noise power of KuPR and AMSR2 SIC. Finer resolution SIC maps (5 km) can be obtained although the coverage is limited.

DPR SIC has been included to DPR standard product V04 released in March 2016.

(DPR sea ice concentration: Motooka et al., in preparation)
Development of DPR Sea Ice Product

- GPM DPR L1B/L2 product
- GCOM-W AMSR2 L2 SIC product

Method:
1. Mean value of the DPR data points matching the following conditions:
   - Distance: < 5 km from AMSR-2 points
   - Observation time: < +/- 30 minutes
   - Number of points: > 3 points
   - Region: Southern hemisphere, Okhotsk sea, etc.

2. Mean/deviation of the derived samples were calculated for each SIC/incidence-angle class.

Result:
Noise power shows linear relationships with SIC:
- SIC estimated by a regression model, RMSE = 2.65%, bias = 0.03% (Aug. 4)

Motooka et al. (2014)
All-weather Sea Surface Wind Speed

- Use 6-GHz/10-GHz channels to avoid influence of rainfall (Shibata, 2006), corresponding to wind speed at best track released by JMA and NHC.
- Algorithm is applied to AMSR2, AMSR-E and Windsat.
- AMSR2 all-weather SSW Released to public in October 2015 at http://suzaku.eorc.jaxa.jp/GCOM_W/research/terms.html
- Used in JMA’s operational typhoon analysis.

AMSR2 Standard SSW

AMSR2 All-weather SSW

1 July, 2015 (Desc)
Validation by Dropsonde

- Compared with NOAA GPS dropsonde wind speed with distance within 10km and time difference within 90 minute
  - Removed data at EYE_EYEWALL, less than 50km from best track
- Validation result for all-wind range
  - Bias 0.20 m/s
  - RMSE 5.87 m/s
- Validation result of strong wind range (more than 17m/s)
  - Bias -1.51 m/s
  - RMSE 4.18 m/s
- Negative bias will be improved in future version

GPS-dropsonde data are provided courtesy of the NOAA/AOML/Hurricane Research Division in Miami, FL (USA).
10GHz Sea Surface Temperature

- 10GHz SST has advantage that it has finer (30km) resolution compared to that of standard 6GHz SST (60km).
- Disadvantage is poor sensitivity to low temperature range, less than 10 degC. SST less than 9 degC is set as missing.
- 10GHz observed SST is included in the AMSR2 SST V2 product in addition to standard SST, in order to provide complementary information to users, since March 2015.
- Same algorithm was applied to GPM-Core/GMI and product was released to public in April 2015.
- GMI & Windsat SSTs in NetCDF are available at JAXA GHRSSST server http://suzaku.eorc.jaxa.jp/GHRSSST/index.html

Validation with iQuam buoy

<table>
<thead>
<tr>
<th>Product</th>
<th>RMSE</th>
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<tbody>
<tr>
<td>AMSR2 6GHz SST</td>
<td>0.58°C</td>
</tr>
<tr>
<td>AMSR2 10GHz SST</td>
<td>0.61°C</td>
</tr>
<tr>
<td>GMI 10GHz SST</td>
<td>0.63°C</td>
</tr>
</tbody>
</table>
JAXA Himawari Monitor

- To seek synergies between Himawari-8 and JAXA’s Earth Observation Missions by applying same algorithm to produce consistent dataset
- Opened the webpage on 31st August, 2015
- Registration: 300 people (as of 17th May, 2016)
- Brose images of Himawari-8 RGB and geophysical parameters on the Webpage
- Disseminates Himawari Standard data and JAXA produced geophysical data via FTP
  - SST, Ocean Color, PAR, SWR
  - Aerosol Properties
- Data can be downloaded with simple user registration

http://www.eorc.jaxa.jp/ptree
Himawari-8 Ocean Products

- Developed based on the GCOM-C/SGLI algorithms
- Himawari Ocean Products
  - NetCDF-CF format
  - Sea Surface Temperature (2km res., 10-min/1-hr ave.)
  - Night-time SST (2km res., 1-hr ave.)
  - Ocean Color (Chlorophyll-a) (5km (full-disk)/1km (near Japan) res., 1-hr ave.)
  - Short Wave Radiation & Photosynthetically Available Radiation (PAR) (5km (full-disk)/1km (near Japan) res., 10-min/1-hr ave.)

<table>
<thead>
<tr>
<th>Year/month</th>
<th>RMSE</th>
<th>Bias</th>
<th>STD</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015/06</td>
<td>0.58</td>
<td>-0.16</td>
<td>0.55</td>
<td>143,714</td>
</tr>
<tr>
<td>2015/07</td>
<td>0.59</td>
<td>-0.14</td>
<td>0.57</td>
<td>150,020</td>
</tr>
<tr>
<td>2015/08</td>
<td>0.56</td>
<td>-0.15</td>
<td>0.54</td>
<td>148,107</td>
</tr>
<tr>
<td>2015/09</td>
<td>0.59</td>
<td>-0.15</td>
<td>0.57</td>
<td>189,148</td>
</tr>
</tbody>
</table>

SST Validation by NOAA iQuam buoy (Kurihara et al., 2016)
Development of SST Data Assimilation System with JAMSTEC

- JAMSTEC currently operates ocean forecast model over the south of Japan, called JCOPE2 (Japan Coastal Ocean Predictability Experiment 2), with 1/12 deg. grid, and has switched its data assimilation system input since the end of February 2016.

- We are also developing Himawari SST data assimilation system onto JAMSTEC’s future regional ocean forecast model “KFSJ” (Emsemble Kalman-Filter for South of Japan) with 1/36 deg. grid.

![Daily MODIS SST](image1)

![Daily Himawari SST](image2)
In some cases, Kuroshio flow shows worse expression with Himawari SST assimilation. Under investigation. (JAXA/JAMSTEC)
Comparison with Current Model

Comparison with KFSJ (1/36 deg.) and JCOPE2 (1/12 deg.)

KFSJ shows Kuroshio front better than JCOPE2. Positive bias of MODIS affects to JCOPE2 --> Switched to use Himawari SST in JCOPE2.

(JAXA/JAMSTEC)
Summary

JAXA recently started cross-cutting research activities among multiple satellite missions including non-JAXA missions, such as Himawari-8.

- “Ocean Environment Monitoring” is one of the research theme.

PMW ocean products are produced based on AMSR2 algorithms.
- AMSR-E, Windsat, GMI & DPR sea ice concentration
- GMI & Windsat SST, new AMSR2 10-GHz SST
- New AMSR2 & Windsat all-weather sea surface wind speed

VIS/NIR/IR ocean products are produced based on SGLI algorithms
- Himawari-8 SST, Ocean color, SWR & PAR
- Aqua/Terra MODIS & NPP/VIIRS SST are underway

JAXA and JAMSTEC is developing ocean forecast system with Himawari SST data assimilation into 1/36 degree resolution regional ocean model, Ensemble Kalman-Filter for South o Japan (KFSJ).
- Early results shows good demonstration of Kuroshio front in the model forecast. Further investigation will be needed in some bad demonstration cases.
- Start working with local experimental fishery stations to evaluate Himawari SST and model forecasts in their operational sea state analysis.