JAXA Earth Observation Program and Contribution to Paris Agreement

The Coordination Group for Meteorological Satellites
CGMS-45 Plenary
15 June 2017

Akiko Suzuki
Associate Senior Chief Officer of Satellite Applications
JAXA Activities

Space Transportation

Human Space Activities

Satellite Program

Aviation Program

Space Science

Lunar & Planetary Exploration Program
Current Situation

❖ Global Issues:
   • Tackle common challenges; “Sustainable Development Goals (SDGs)”, “Sendai Disaster Prevention Framework” and “Paris Agreement”

❖ Japanese Government Policies in Science & Technology:
   1. Sustainable growth and self-sustaining regional development
   2. Ensure safety and security for our nation and its citizens and a high-quality, prosperous way of life
      • Disaster Risk Management Using Satellite Data and Applications: ALOS-2
   3. Respond to global challenges and contribute to global development
      • Contribution to understanding of Climate Change Using Satellite and Applications: GOSAT, GCOM-W, GCOM-C, GPM and EarthCARE
      • Contribution to Paris Agreement
   4. Sustainable creation of intellectual property
JAXA’s Current Earth Observation Satellites

Greenhouse gases Observing SATellite (GOSAT)
- Launched in 2009
- Observes CO2 and Methane (CH4) globally once every 3 days

Global Change Observation Mission - Water (GCOM-W)
- Launched in 2012
- Observes Wind, SST, Water Vapor, Precipitation for understanding of water cycle
- Used for weather forecasting

Advanced Land Observing Satellite-2 (ALOS-2)
- Launched in 2014
- Capable of observing day and night, and in all weather conditions
- Contributes to disaster risk management and forest monitoring

Dual-frequency Precipitation Radar (DPR) onboard GPM Core Observatory
- Launched in 2014
- Measures three-dimensional rainfall structure and intensity for better understanding of global precipitation

Courtesy of NASA
GOSAT Scientific Outcomes (1/3)

◆ Acquires **56,000 data of GHG concentration on the entire surface of the earth once every 3 days**

◆ Monitored that the whole-atmospheric CO2 mean exceeded 400ppm in December 2015

◆ Understood trends of 8-year GHG concentrations of **100 sites of large cities and major emission sources** all over the world

◆ Anthropogenic CO2 concentrations in global mega-cities estimated from GOSAT data well agreed with those estimated from emission inventories

◆ Found that the monthly-averaged CH4 concentration marked a record high of **1815ppb** in January 2017
Trends of 8-year GHG Concentrations of 100 sites of Large Cities & Major Emission Sources


Long term GOSAT TANSO-FTS CO₂ (ACOS B73)

XCO₂ (ppm)

2010/1 2011/1 2012/1 2013/1 2014/1 2015/1 2016/1 2017/1

CO₂ long term trend
ACOS B7.3 is the level 2 product version released in Jan. 2017. The same algorithm as OCO-2 V7.
OCO-2 V8 will be released summer 2017.

Long Beach
Pasadena
Los Angeles
CH4 Emissions Estimated from Each Category of Emission Sources

- July 2010

https://mirador.gsfc.nasa.gov/
GOSAT-2

- Launch: JFY2018
- Gases: CO2, CH4 and CO
- Accuracy: 0.5 ppm (CO2) and 5 ppb (CH4) at 500-km mesh over earth’s surface
- Nominal Operation Period: 5 years
- Mass: Approx. 2,000Kg
- Launch Vehicle: H-IIA

◆ Continuous Observation of CO2 & CH4 by GOSAT/GOSAT-2 for Long Period
◆ More Accurate Estimation of CO2 Emissions by Measuring CO
Contribution to Paris Agreement by Satellite GHG Observation Data

Satellite-based GHG Data

- Provide highly accurate and quality-controlled data set through cross-calibration and validation
- Support accuracy of national GHG inventory reporting

[Image Credit]
OCO-2: NASA; Sentinel-5P: ESA/ATG medialab; MetOp: ESA/Eumetsat; MicroCarb: © CNES/Illustration Oliver Sattler 2015; TanSat: TanSat collaboration; FLEX: ESA/ATG medialab
Monitoring of Global Precipitation on Real-time & Contribution to Disaster Risk Management

◆ Integrated data: GPM core observatory, microwave radiometers/sounders and infrared radiometers of geostationary satellites

GSMaP observing hurricane Patricia and Olaf and Typhoon Champi: 2015/10/20 ~ 2015/10/24 (hourly animation)

JAXA Global Rainfall Watch (4-hr delay): http://sharaku.eorc.jaxa.jp/GSMaP
JAXA Realtime Rainfall Watch (Himawari-area): http://sharaku.eorc.jaxa.jp/GSMaP_NOW
Nominal Operation Period of GCOM-W was successfully completed in May 2017.

GCOM-W’s condition is extremely well. Extended Operation was determined.

GCOM-C will be launched in latter half of JFY 2017.

GCOM-C & W will contribute to understanding of Climate Change.

Study on the capability of AMSR2’s successor sensor onboard GOSAT-3 was stipulated in “the Roadmap for the Basic Plan on Space Policy” which has been effective since April 2017, and JAXA has started its study.
GCOM-C

◆ Launch in latter half of JFY 2017
◆ Observes **Radiation Budget and Carbon Cycle**

GCOM-C Satellite PFM @ JAXA Tsukuba Space Center
### Essential Climate Variables Covered by GCOM-C & W

#### Atmospheric

<table>
<thead>
<tr>
<th>Surface</th>
<th>Upper-air</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air temperature</td>
<td>Temperature</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>Wind speed &amp; direction</td>
<td>Wind speed &amp; direction</td>
<td>Methane</td>
</tr>
<tr>
<td>Water vapour</td>
<td>Water vapour</td>
<td>&amp; other long-lived GHGs *</td>
</tr>
<tr>
<td>Pressure</td>
<td>Cloud properties</td>
<td>Ozone &amp; Aerosol</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Earth radiation budget (including solar irradiance)</td>
<td>supported by their precursors **</td>
</tr>
</tbody>
</table>

* including N2O, CFCs, HCFCs, SF6, PFCs
** in particular NO2, SO2, HCHO, CO

#### Terrestrial

<table>
<thead>
<tr>
<th>Surface</th>
<th>Sub-surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>River discharge</td>
<td>Temperature</td>
</tr>
<tr>
<td>Water use</td>
<td>Sea-surface temperature</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Sea-surface salinity</td>
</tr>
</tbody>
</table>

#### Lakes

- Snow cover
- Glaciers and ice caps
- Ice sheets
- Permafrost

#### Oceanic

<table>
<thead>
<tr>
<th>Surface</th>
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<tbody>
<tr>
<td>Sea-surface temperature</td>
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</tr>
<tr>
<td>Sea-surface salinity</td>
<td>Salinity</td>
</tr>
<tr>
<td>Sea level</td>
<td>Current</td>
</tr>
<tr>
<td>Sea state</td>
<td>Nutrients</td>
</tr>
<tr>
<td>Sea state</td>
<td>Surface ice</td>
</tr>
<tr>
<td>Sea state</td>
<td>Ocean colour</td>
</tr>
<tr>
<td>Sea state</td>
<td>Ocean current</td>
</tr>
<tr>
<td>Sea state</td>
<td>Ocean state</td>
</tr>
<tr>
<td>Sea state</td>
<td>Ocean acidity</td>
</tr>
<tr>
<td>Sea state</td>
<td>Phytoplankton</td>
</tr>
<tr>
<td>Sea state</td>
<td>CO2 partial pressure</td>
</tr>
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</tr>
<tr>
<td>Sea state</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Sea state</td>
<td>Tracers</td>
</tr>
</tbody>
</table>

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**Total Essential Climate Variables (ECVs)**

(ECVs largely dependent on satellite observations identified by CEOS and GCOS are shown in **bold**.)

<table>
<thead>
<tr>
<th>ECVs covered by GCOM-W and GCOM-C</th>
<th>21</th>
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**Supported by their precursors:**

- NO2, SO2, HCHO, CO
Thank you for your attention.