JAXA's Inputs Addressing the Recommendations from GEOSS Water Strategy Report

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Recommendations of GEOSS Water Strategy Report (WSR)

- A.1.–A.8. Enhancing User Engagement
- B.1.–B.3. Expanding data acquisition (General)
- C.1.–C.10. Advancing satellite data acquisition
- D.1.–D.10. Strengthening in-situ data acquisition
- E.1.–E.16. Encouraging and conducting research and product development
- F.1.–F.7. Facilitating data sharing and common standards
- G.1.–G.4. Expanding capacity development

C.1.

The feasibility of developing a Water-Train satellite constellation should be assessed. This suite of satellites would be modelled after the A-Train, providing a space segment of an observation system that would capture all fluxes and stores of the water cycle using a diverse suite of platforms and instruments. This system would operate as a Virtual Water Cycle Constellation.

Questions on C.1.

Detailed requirements from users are necessary.

Is the proposed constellation an A-Train type constellation or a virtual constellation?

-> If an A-Train type;

- Does it aim nearly simultaneous observations by various sensors on various satellites?
- What are the merits and scientific purposes of the nearly simultaneous observations?
- What will be the outcome for societal benefits from the constellation?

C.2.

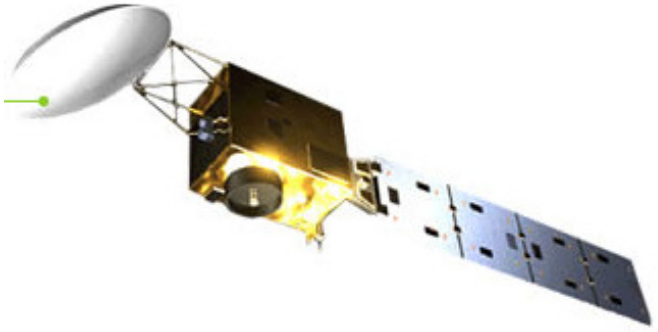
Satellite missions such as those in the A-Train and the planned EarthCARE and GCOM-W2 missions and field experiments should be closely coordinated to measure cloud properties, with the goal of providing data for the study of precipitation processes and energy budgets. Furthermore, these satellite measurements should be transitioned into operations and sustained in the long term.

C.3.

Advanced satellite technologies, such as hyperspectral infrared and millimetre/sub-millimetre and microwave radiometres, should be promoted to improve horizontal and vertical resolutions of key measurements to observe clouds, water vapour, and aerosols. As well, multi-frequency radars should be sustained and Doppler capabilities should be introduced to observe the cloud precipitation particle continuum and provide vertical velocities for critical cloud-process studies.

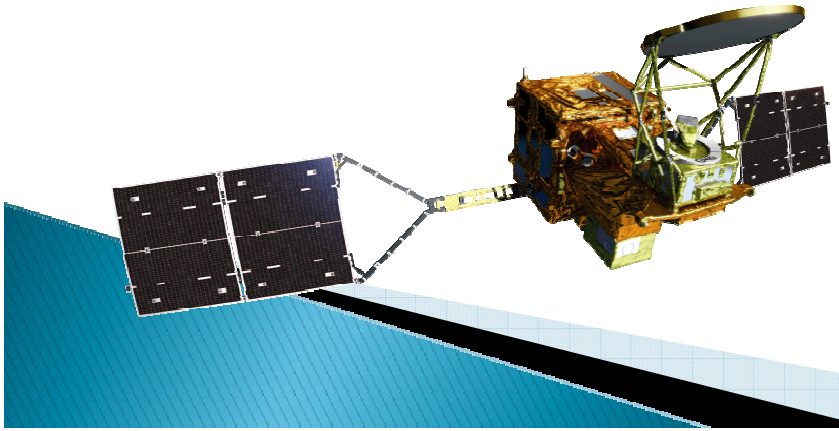
Inputs for C.2. and C.3.

- EarthCARE（Earth Clouds, Aerosols and Radiation Explorer） equipped with world's first satellite-borne millimeter-wave Doppler radar.



- Approved
- Launch scheduled in 2015 or after

- A follow-on mission of GCOM-W equipped with a new AMSR-2-class microwave radiometer



- Considered
- Needs continuous users' voice and support

C.4.

The coverage and quality of satellite observations should be improved to a constellation providing three-hourly (or more frequent) revisit times over the entire globe by a combination of GMI/AMSR2-class multi-channel conically scanning microwave imagers and ATMS-class multi-channel cross-track microwave sounders. These instruments are identified because they provide input data for a wide range of applications.

C.5.

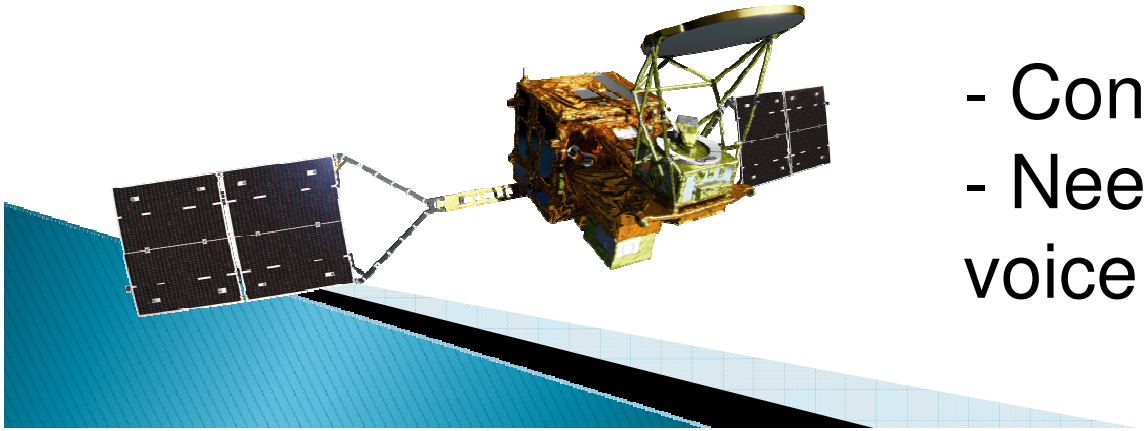
Space-borne precipitation radar should be made operational and next-generation precipitation radar with advanced technology should be developed. The success of the TRMM precipitation radar has demonstrated that space-borne radar observations are among the most valuable multi-purpose observations of precipitation. Although the GPM Dual-frequency Precipitation Radar is expected to extend this result, a long-term plan is needed for using these radars operationally and a long-term commitment is needed by GEO members to ensure a continuity in the supply of these instruments.

Inputs for C.4. and C.5.

- The CEOS Precipitation Constellation

- Discussing a follow-on mission of the GPM.
- JAXA supports this activity as a co-lead.

- A follow-on mission of GCOM-W equipped with a new AMSR-2-class microwave radiometer



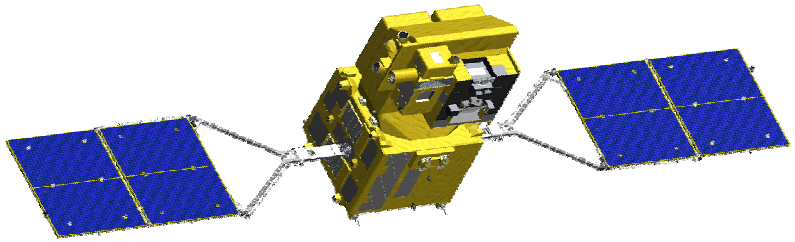
- Considered
- Needs continuous users' voice and support

C.6.

A commitment by CEOS, GEO, and their members to provide requisite thermal band imaging sensors on satellites is needed. Routine Land Surface Temperature (LST) observations at high spatial/low temporal (e.g., LANDSAT), moderate spatial/temporal (e.g., MODIS), and low spatial/ high temporal (e.g., GOES, Meteosat, and other geostationary platforms) are essential in order to improve ET estimation from the field to the continental and, ultimately, to the global scale. Responsible agencies need to process and make available LST datasets from GEO satellites so that these products can be used to map ET in near-real time. More frequent revisit times (four-day) along with higher resolutions (finer than 100 metres) through multiple LANDSAT-type satellites are needed to compensate for data loss from clouds and water management requirements.

Inputs for C.6

- GCOM-C equipped with a second-generation global imager



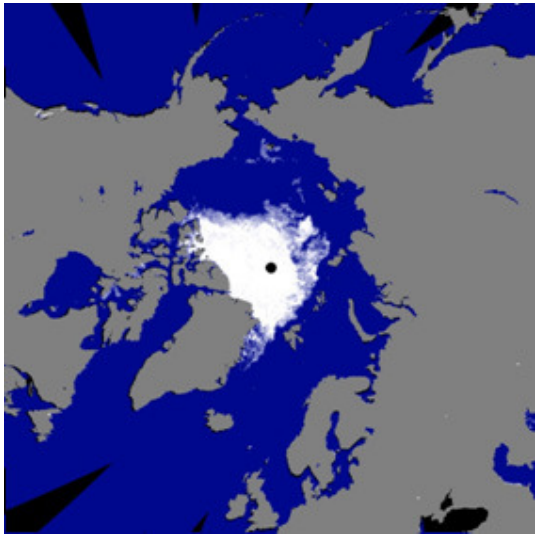
- Approved
- Launch scheduled in 2016 or after
- Observation of land surface temp. at moderate spatial/temporal

C.8.

Plans for a mission optimized to measure cold season processes and variables from space drawing on experience with algorithms for cold season microwave measurements and cold season field projects should be developed.

Inputs for C.8.

- GCOM-W is currently observing cold regions.



Arctic Sea Ice (Aug. 2012)

- GPM/DPR is also on orbit, and JAXA plans to develop a method to distinguish between rainfall and snowfall using observation data of DPR.
- These new challenges will provide new requirements for future missions.

Thank you for your attention.

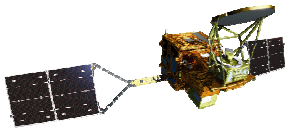
Backup Slides

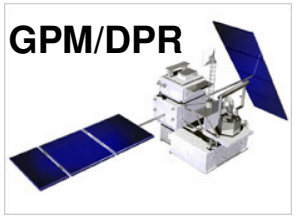
JAXA Satellite Programs

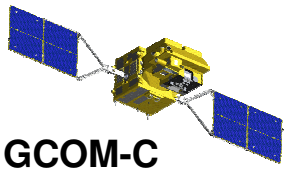
Late 1990s | 2000s | 2003 (JAXA established)

Earth Observation

Climate Change/Water



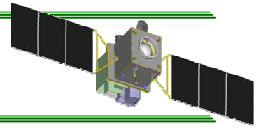




Global Warming

Land Use

Disaster Monitoring



ALOS 3

Communications

COMETS | DRTS | WINDS

Technology Development

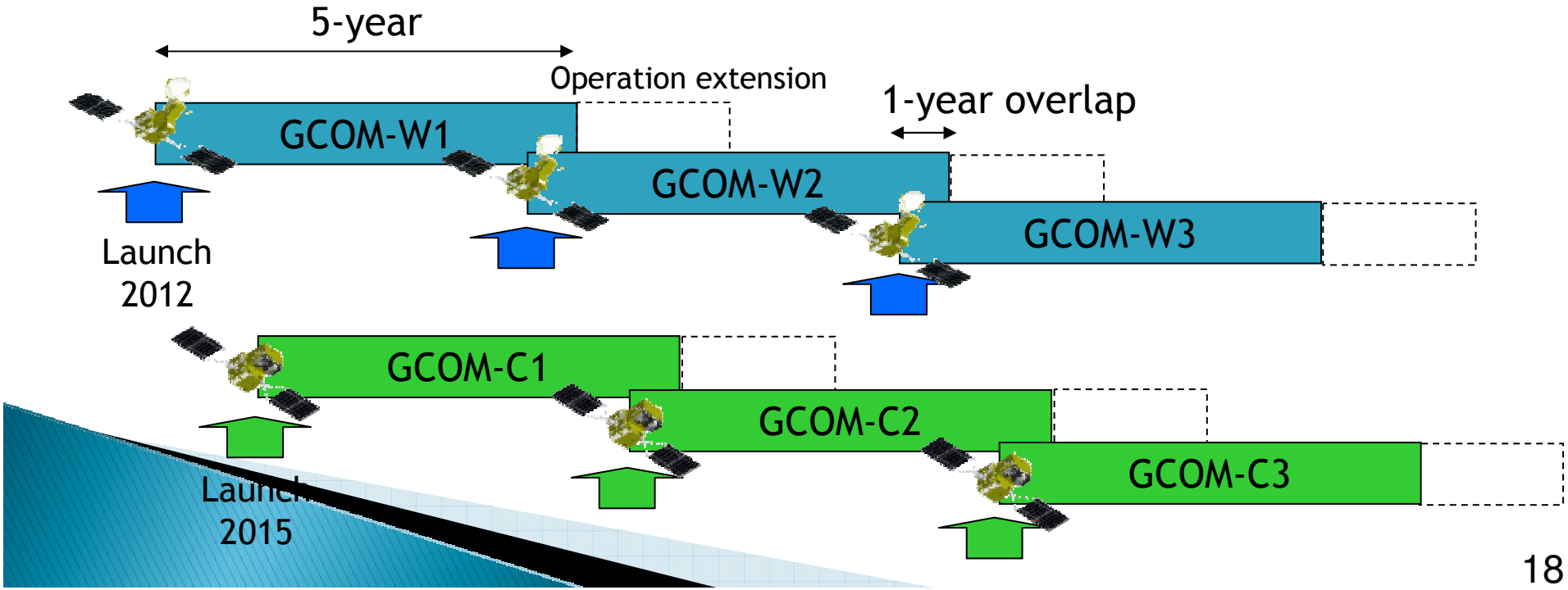
Positioning

QZSS

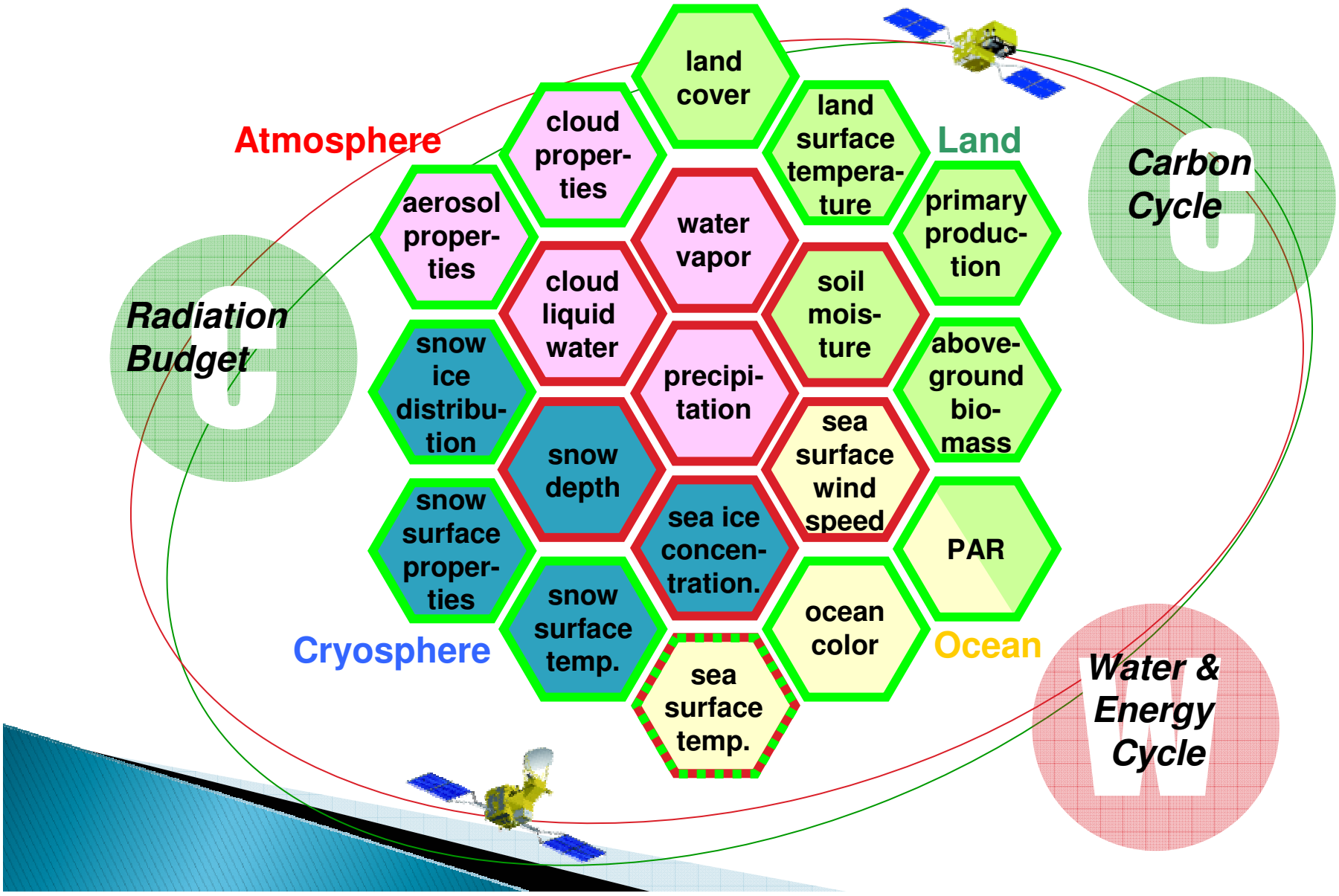
ETS-Ⅵ | ETS-Ⅶ | OICETS | ETS-Ⅷ

Global Change Observation Mission
- GCOM -

- Demonstrate long-term global observation of various geophysical parameters for understanding climate variability and water cycle.
- Two medium-sized satellites with three generations to ensure 10-15 years stable data records.



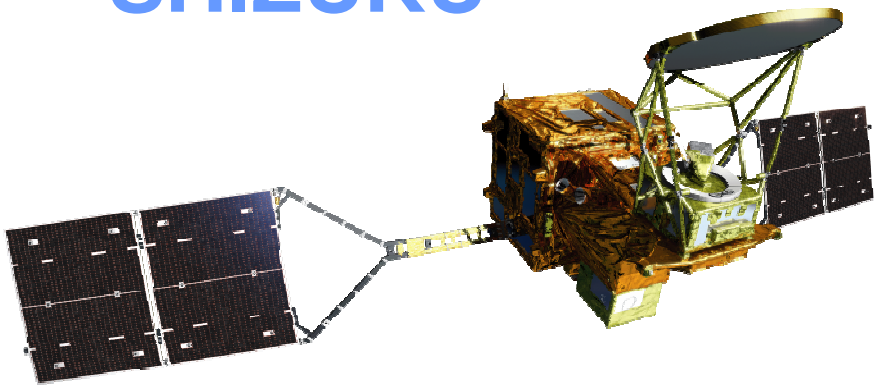
Overview of GCOM Products

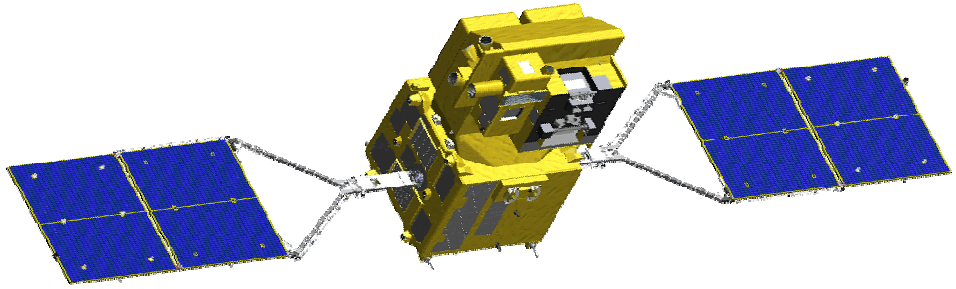


GCOM 1st Generation Satellites

- 2 types of medium-sized satellites and 3 generations: 10-15 years observation

"SHIZUKU"





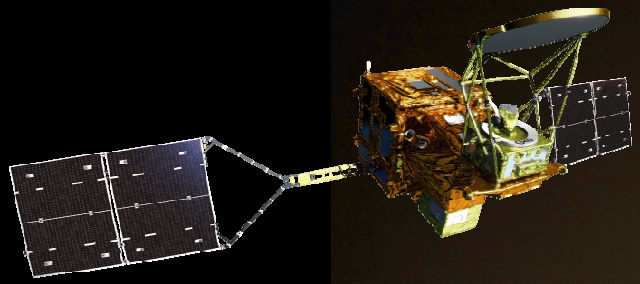
GCOM-W1 (Water)

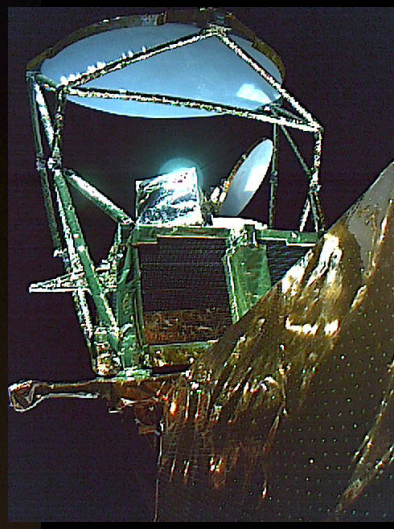
Instrument	Advanced Microwave Scanning Radiometer-2
Orbit	Sun Synchronous orbit Altitude : 699.6km (on Equator) Inclination: 98.2 degrees Local sun time: 13:30+/-15 min
Size	5.1 m (X) * 17.5 m (Y) * 3.4 m (Z) (on-orbit)
Mass	1991 kg
Power gen.	More than 3880 W (EOL)
Launch	May 18, 2012
Design Life	5-years

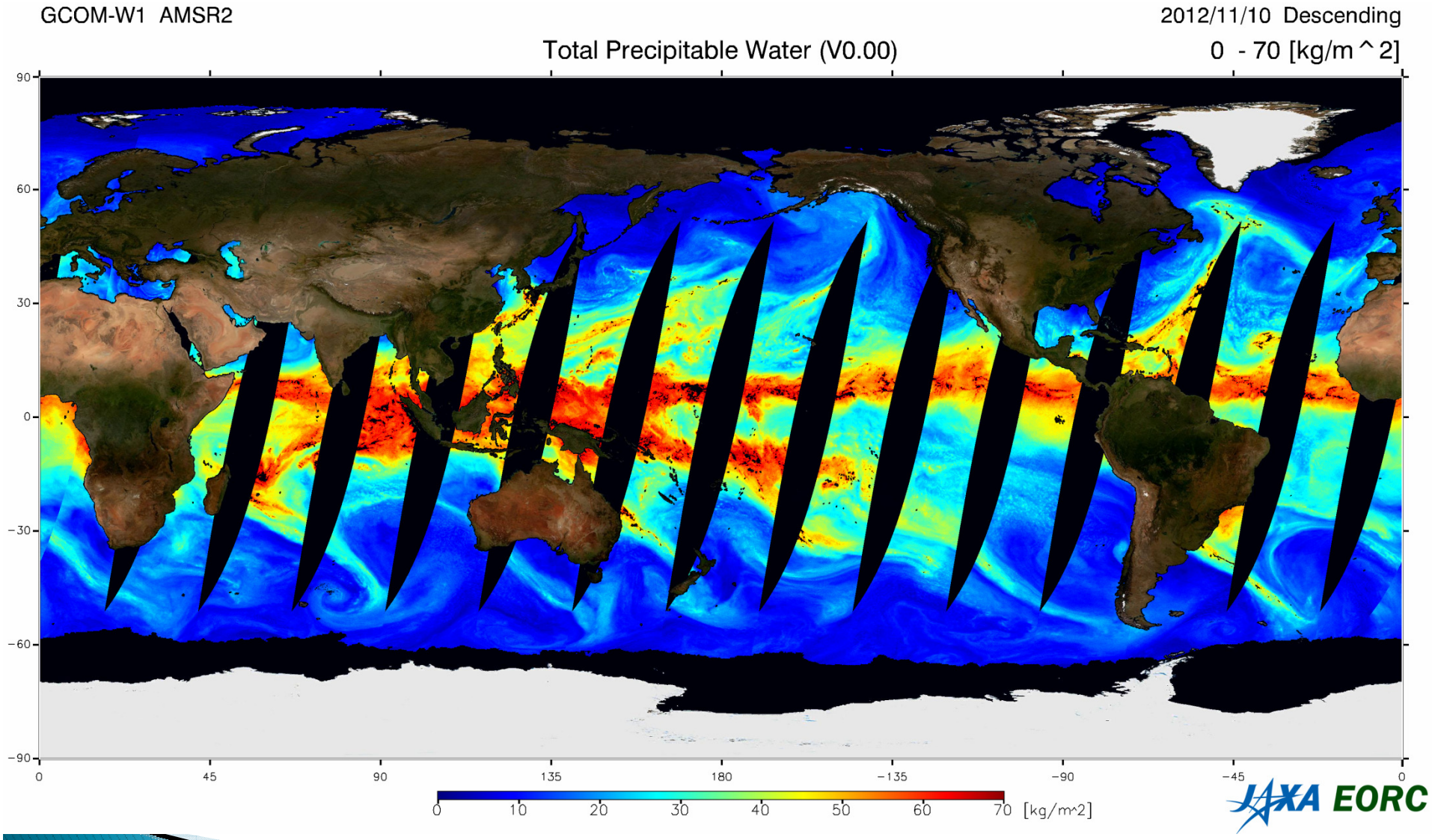
GCOM-C1 (Climate)

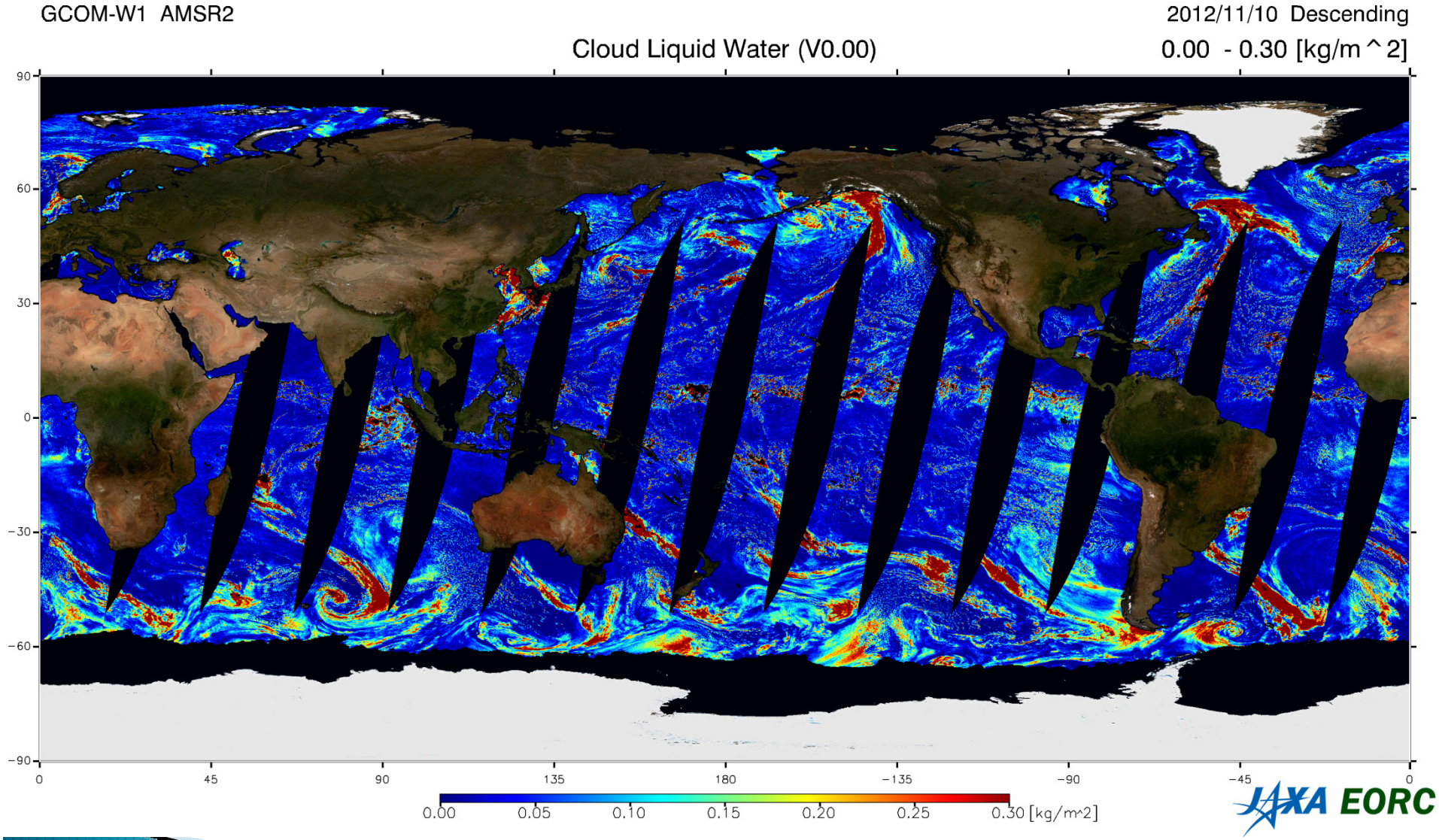
Instrument	Second-generation Global Imager
Orbit	Sun Synchronous orbit Altitude : 798 km (on Equator) Inclination: 98.6 deg. Local sun time: 10:30+/- 15min
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z) (on orbit)
Mass	2093kg
Power gen.	More than 4000W (EOL)
Launch	JFY 2015 (TBD)
Design Life	5-years

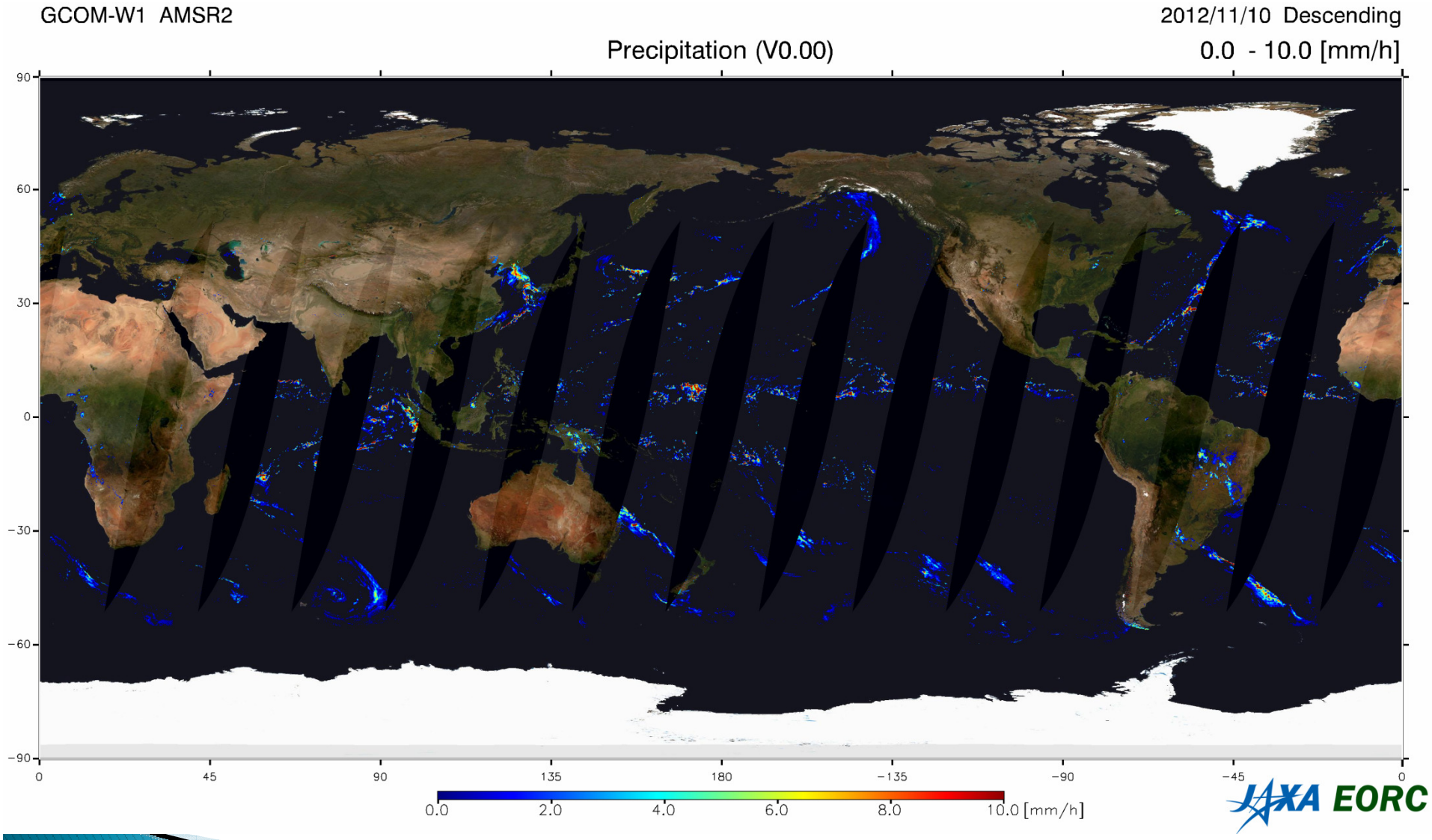
GCOM-W1 "SHIZUKU" was successfully launched on May 18, 2012 (JST).



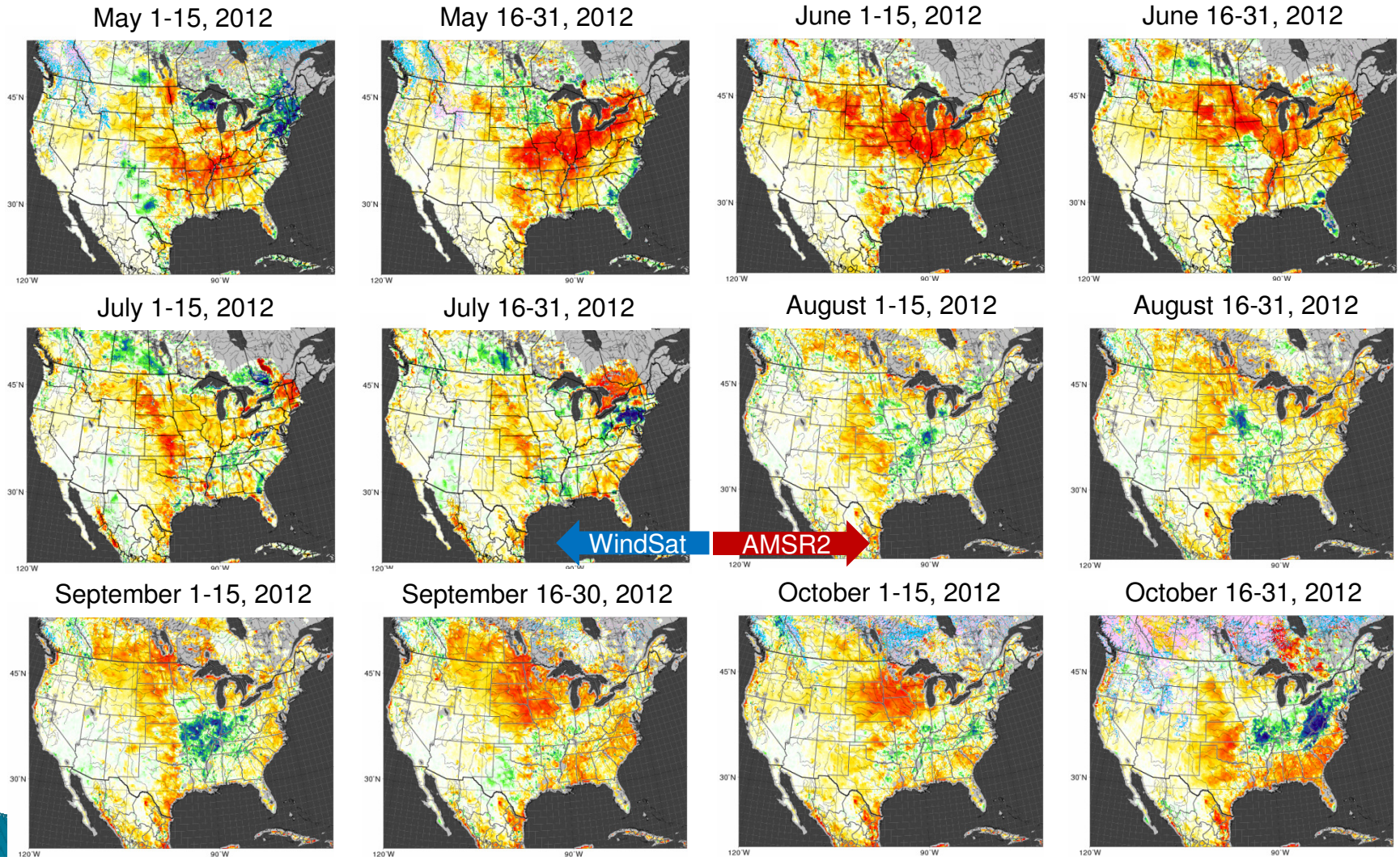



GCOM-W1 AMSR2
2012/11/10 Descending
Total Precipitable Water (V0.00)
0 - 70 [kg/m ^ 2]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0
10
20
30
40
50
60
70 [kg/m^2]
JAXA EORC

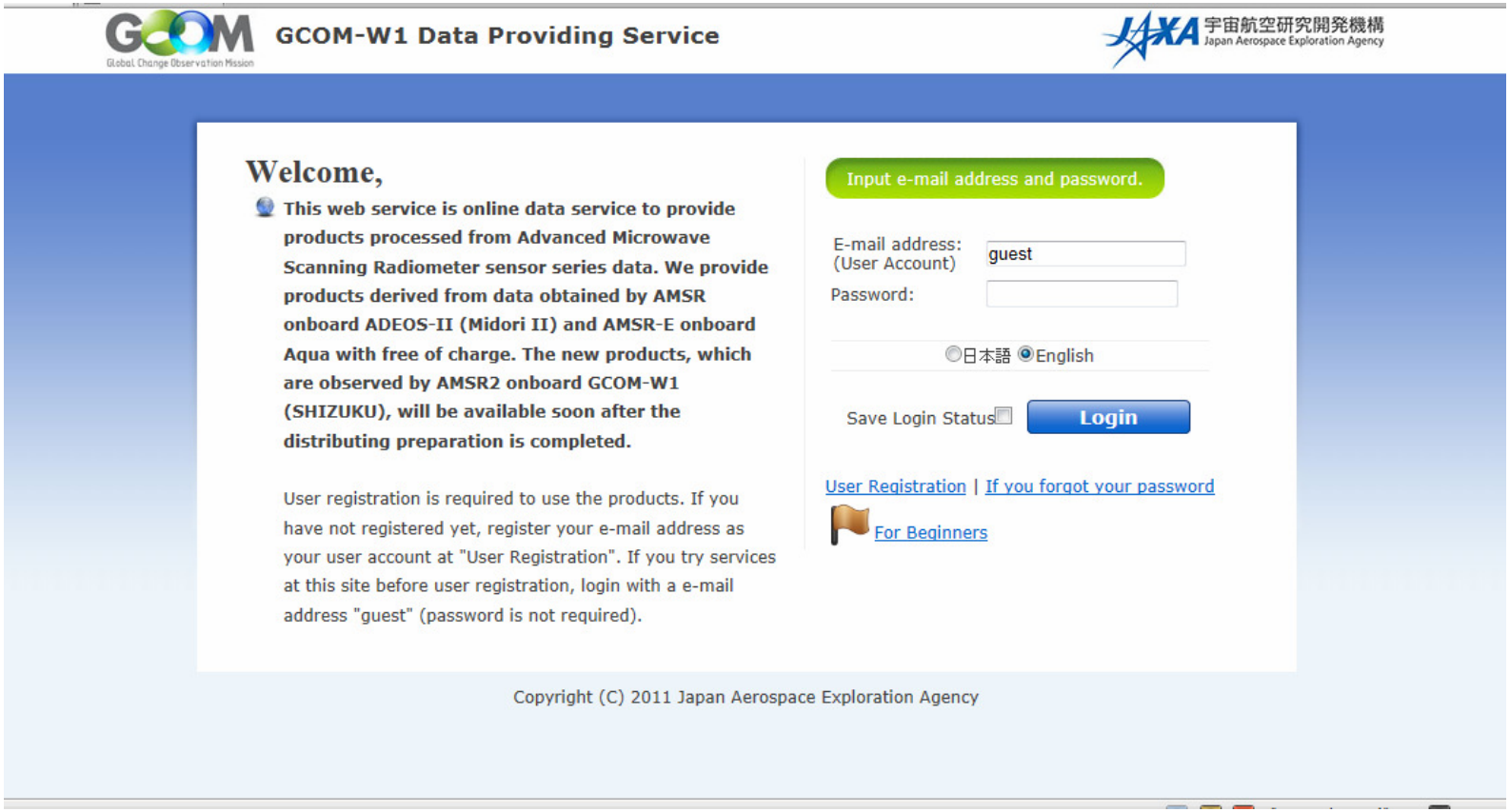

GCOM-W1 AMSR2
2012/11/10 Descending
Cloud Liquid Water (V0.00)
0.00 - 0.30 [kg/m ^ 2]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30 [kg/m^2]
JAXA EORC


GCOM-W1 AMSR2
2012/11/10 Descending
Precipitation (V0.00)
0.0 - 10.0 [mm/h]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0.0
2.0
4.0
6.0
8.0
10.0 [mm/h]
JAXA EORC

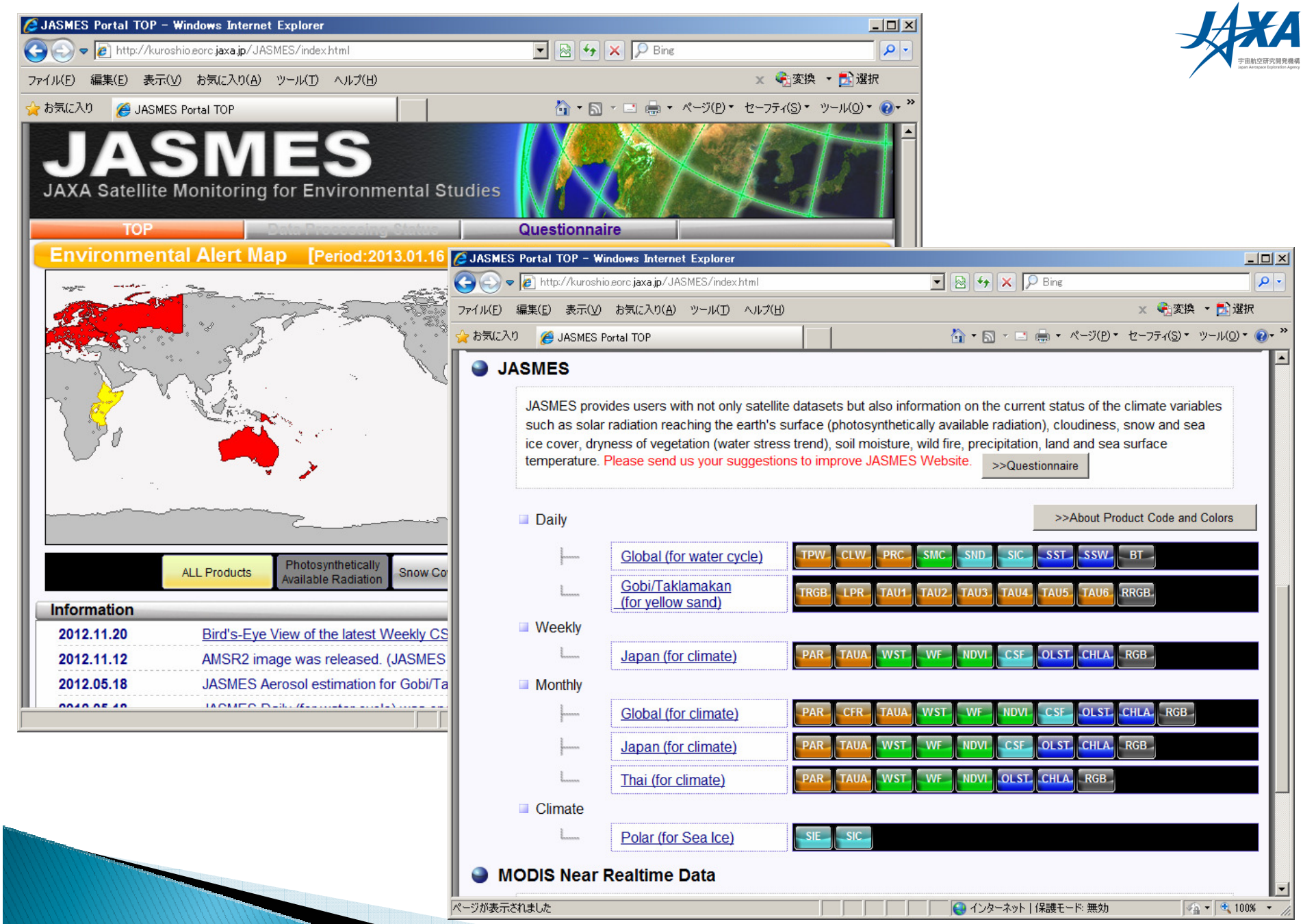
Soil Moisture Anomaly over North America



GCOM-W1 Data Providing Service

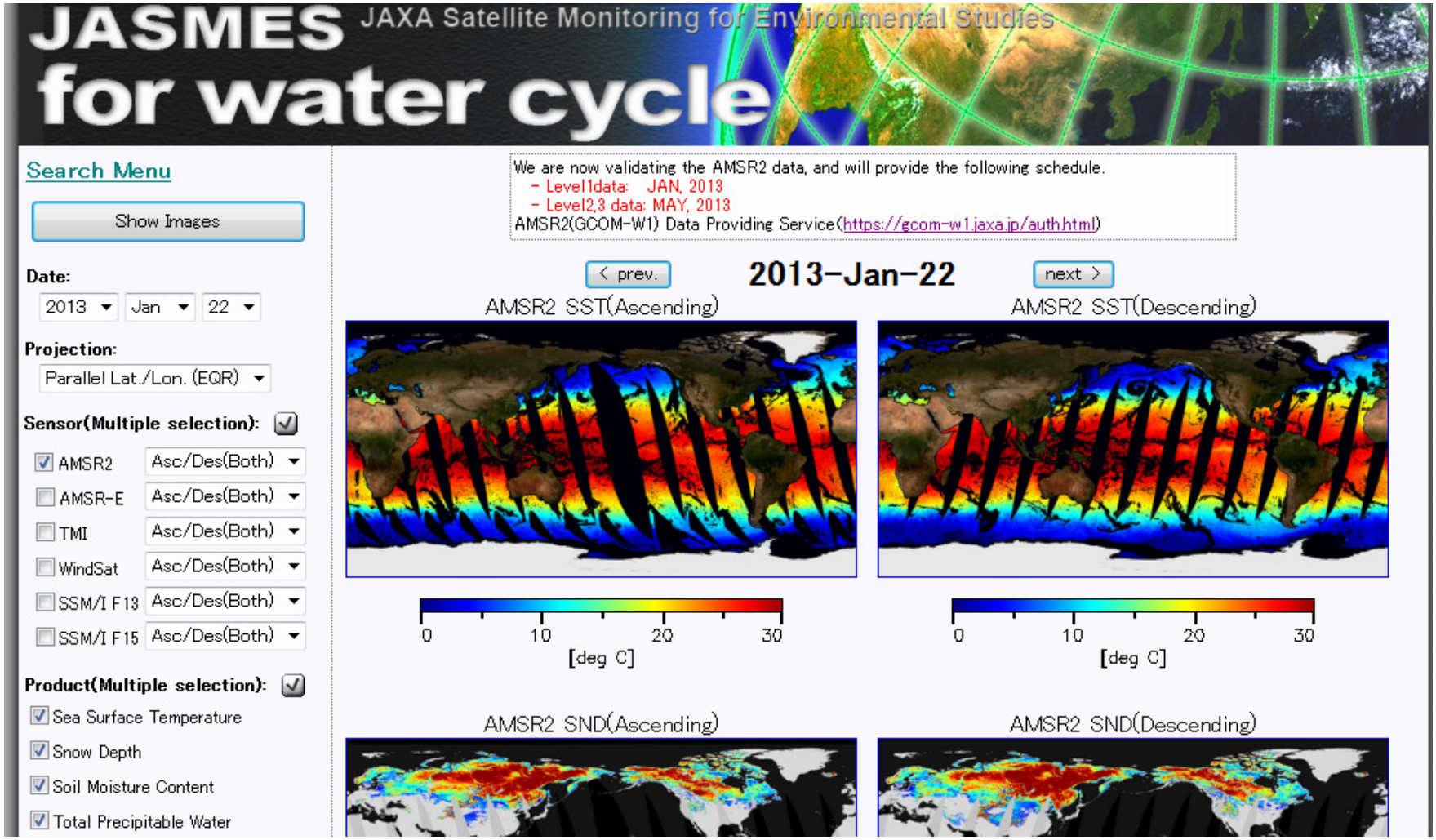


- **https://gcom-w1.jaxa.jp/**
- Standard products of AMSR2, AMSR-E, and AMSR
- AMSR2 brightness temperatures are already available to the public.
- AMSR2 geophysical parameters will be released in May 2013.



http://kuroshio.eorc.jaxa.jp/JASMES/index.html

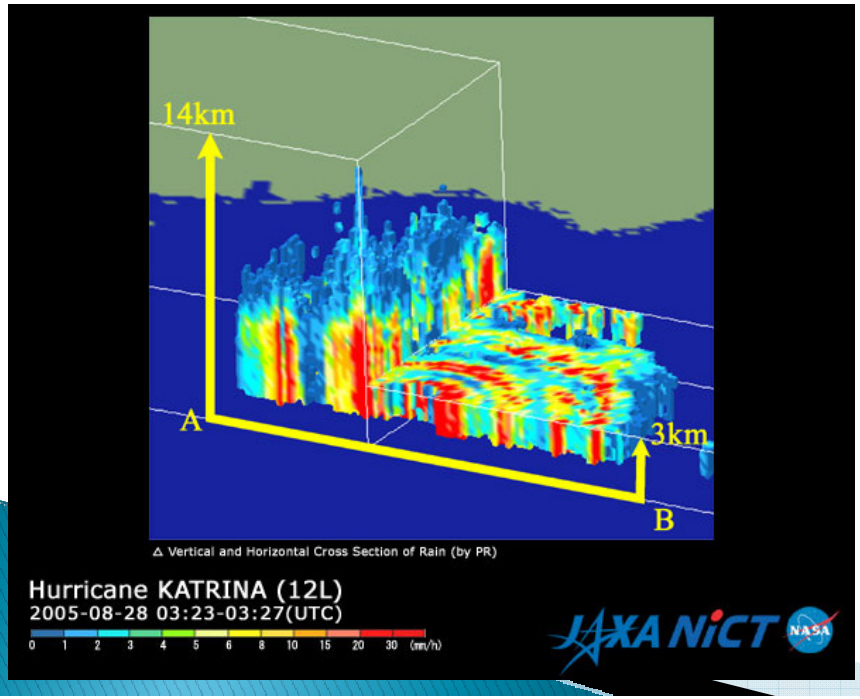
JASMES Daily

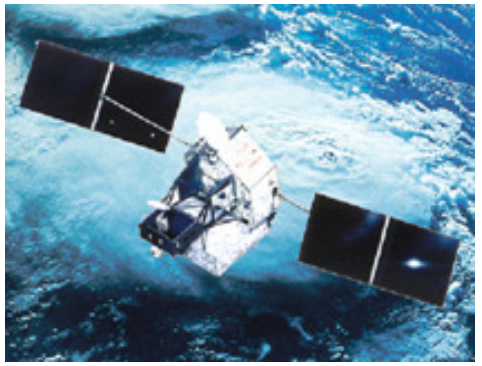


http://suzaku.eorc.jaxa.jp/GCOM_W/JASMES_daily/

Tropical Rainfall Measuring Mission
- TRMM -

- Focused on rainfall observation. First instantaneous rainfall observation by three different sensors (PR, TMI, VIRS). PR, active sensor, can observe 3D structure of rainfall.
- Targeting tropical and subtropical region, and chose non-sun-synchronous orbit (inc. angle 35 degree) to observe diurnal variation.





US-Japan joint mission

Japan: PR, launch

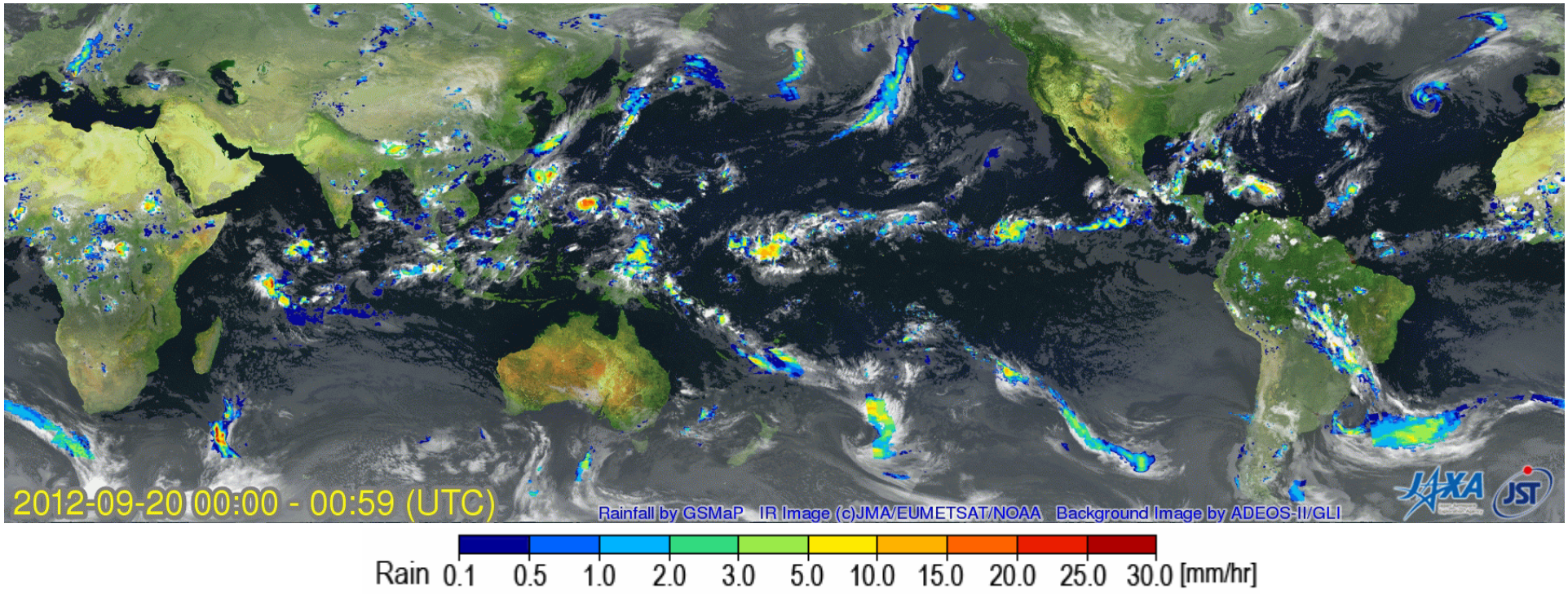
US: satellite, TMI, VIRS, CERES, LIS, operation

Launch	28 Nov. 1997 (JST)
Altitude	About 350km (since 2001, boosted to 402km to extend mission operation)
Inc. angle	About 35 degree, non-sun-synchronous orbit
Design life	3-year and 2 month (still operating)
Instruments	Precipitation Radar (PR) TRMM Microwave Imager (TMI) Visible Infrared Scanner (VIRS) Lightning Imaging Sensor (LIS) CERES (not in operation)

JAXA/EORC Global Rainfall Watch

http://sharaku.eorc.jaxa.jp/GSMaP/

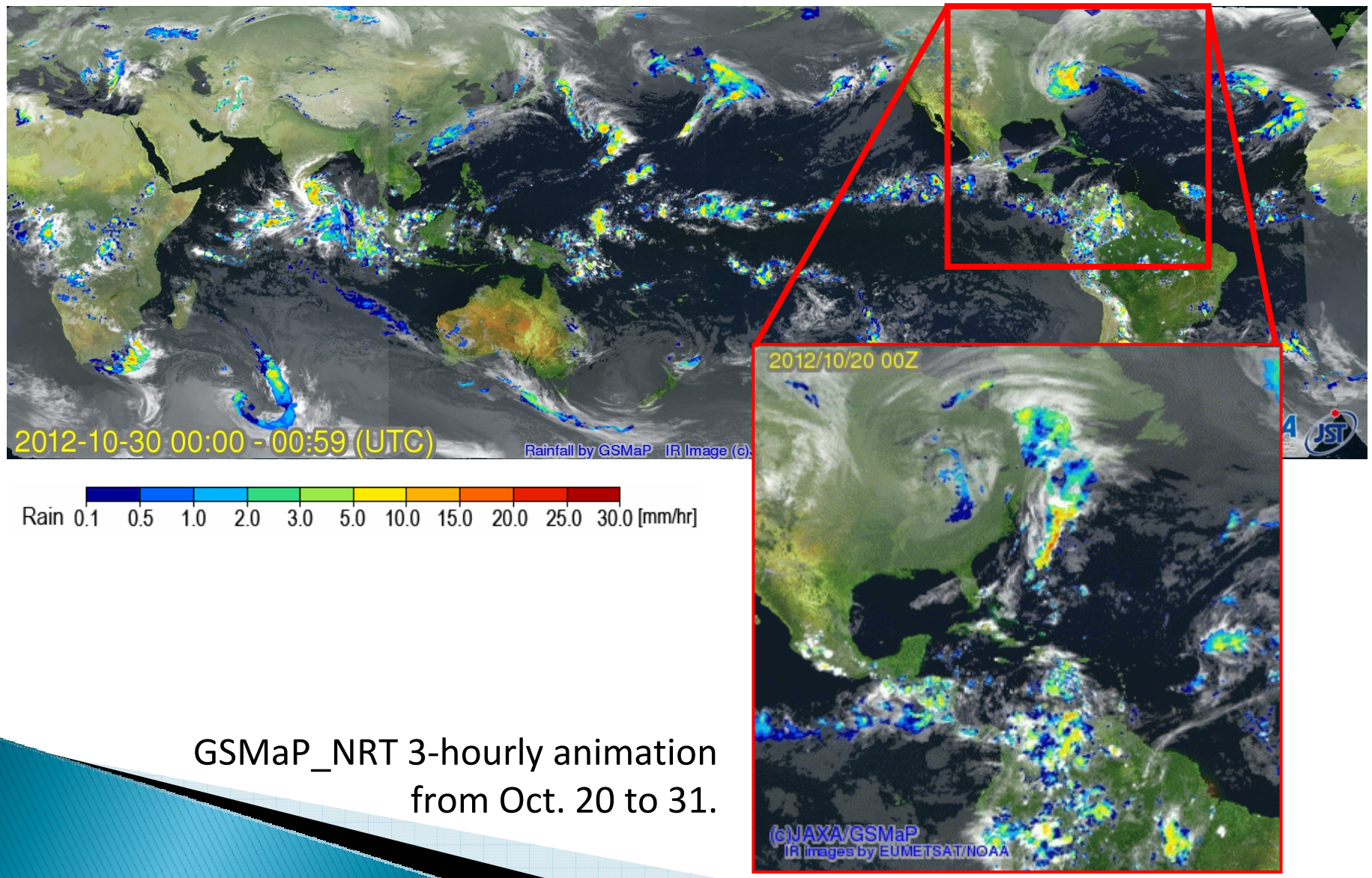
3-hourly animation of Typhoon 17 and global rainfall observed by GSMaP_NRT from 20 Sep. to 1 Oct., 2012.



JAXA/EORC Global Rainfall Watch web site releases GSMaP_NRT products by merging TRMM and a number of passive microwave radiometers with geo-stationary IR information.
Providing hourly and 0.1-degree grid data 4-hour after observation.

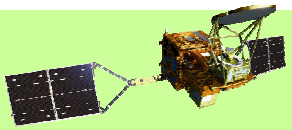
- browse images, Google Earth KMZ files, 24-hour animations
- binary data for research purposes
- reanalysis version (GSMaP_MVK) from Mar. 2000 to Nov. 2010 is also available

Hurricane Sandy in Oct. 2012

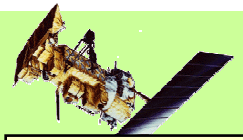


GSMaP_NRT 3-hourly animation
from Oct. 20 to 31.

Global Satellite Mapping of Precipitation (GSMaP)



GCOM-W1 will join soon

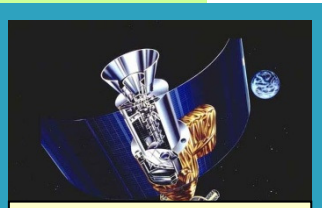


TRMM
TMI

Aqua
AMSR-E

DMSP
SSM/I, SSMIS

NOAA
AMSU-A/B
&MHS



Geostationary
Satellites/IR

GSMaP
Microwave Radiometer (MWR)
Algorithm

GSMaP_MVK
algorithm

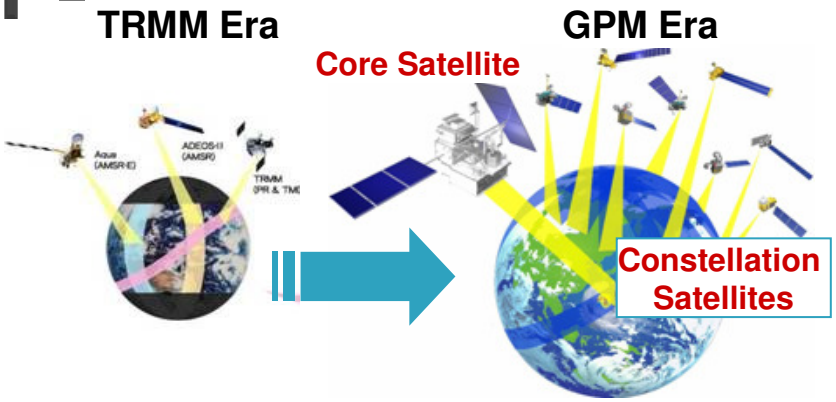
Products of Each Microwave
Radiometer Data

GSMaP Product

(IR-MWR Merged product)
0.1-deg. grid, hourly

Global Precipitation Measurement
- GPM -

- GPM: An international satellite mission to be launched by JAXA and NASA in 2014 for precipitation measurements worldwide



Core Satellite (JAXA, NASA)

Dual-frequency precipitation radar (DPR)

GPM Microwave Imager (GMI)

- **Precipitation with high precision**
- **Discrimination between rain and snow**
- **Adjustment of data from constellation satellites (The core satellite will fly in non-sun-synchronous orbit.)**

(launch in early 2014)

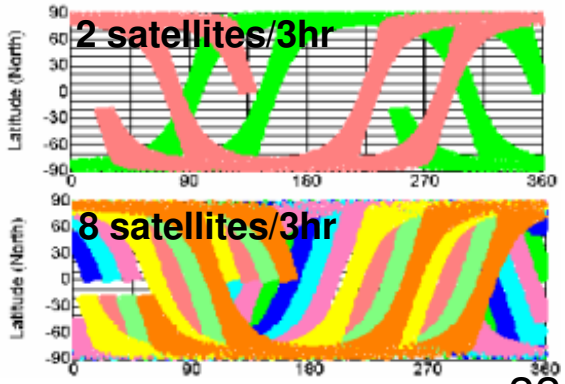
Constellation Satellites (International Partners)

Microwave radiometers

Microwave sounders

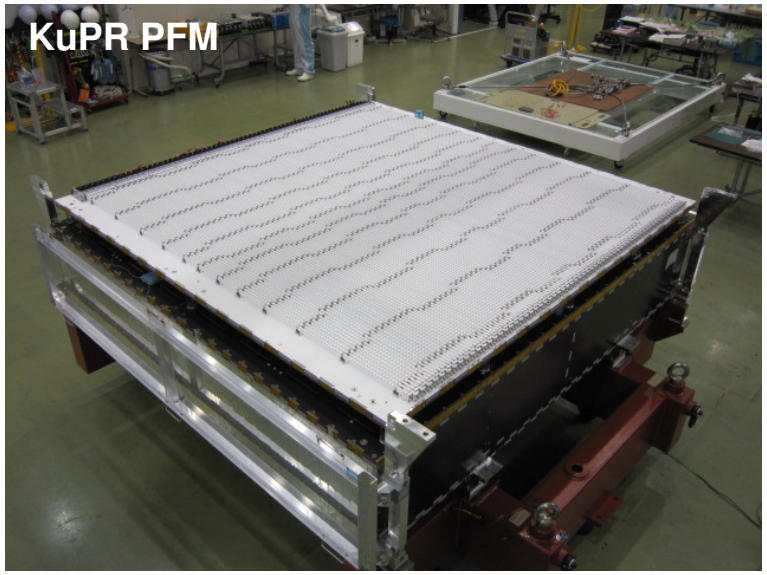
- **Global precipitation every 3 hours**

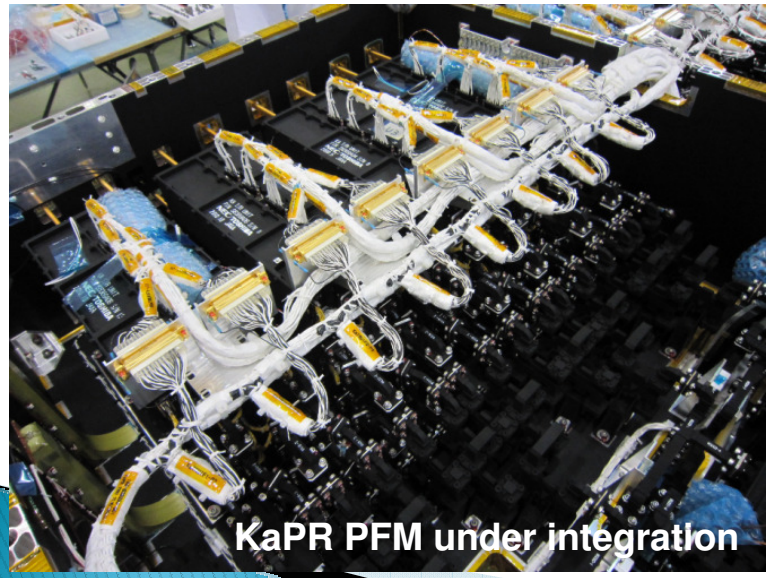
(launch around 2014)



- Improve the accuracy of both long-term and short-term weather forecasts
- Improve water resource management in river control and irrigation systems for agriculture

Preparation in Progress





Satellite Photo Credit: NASA