

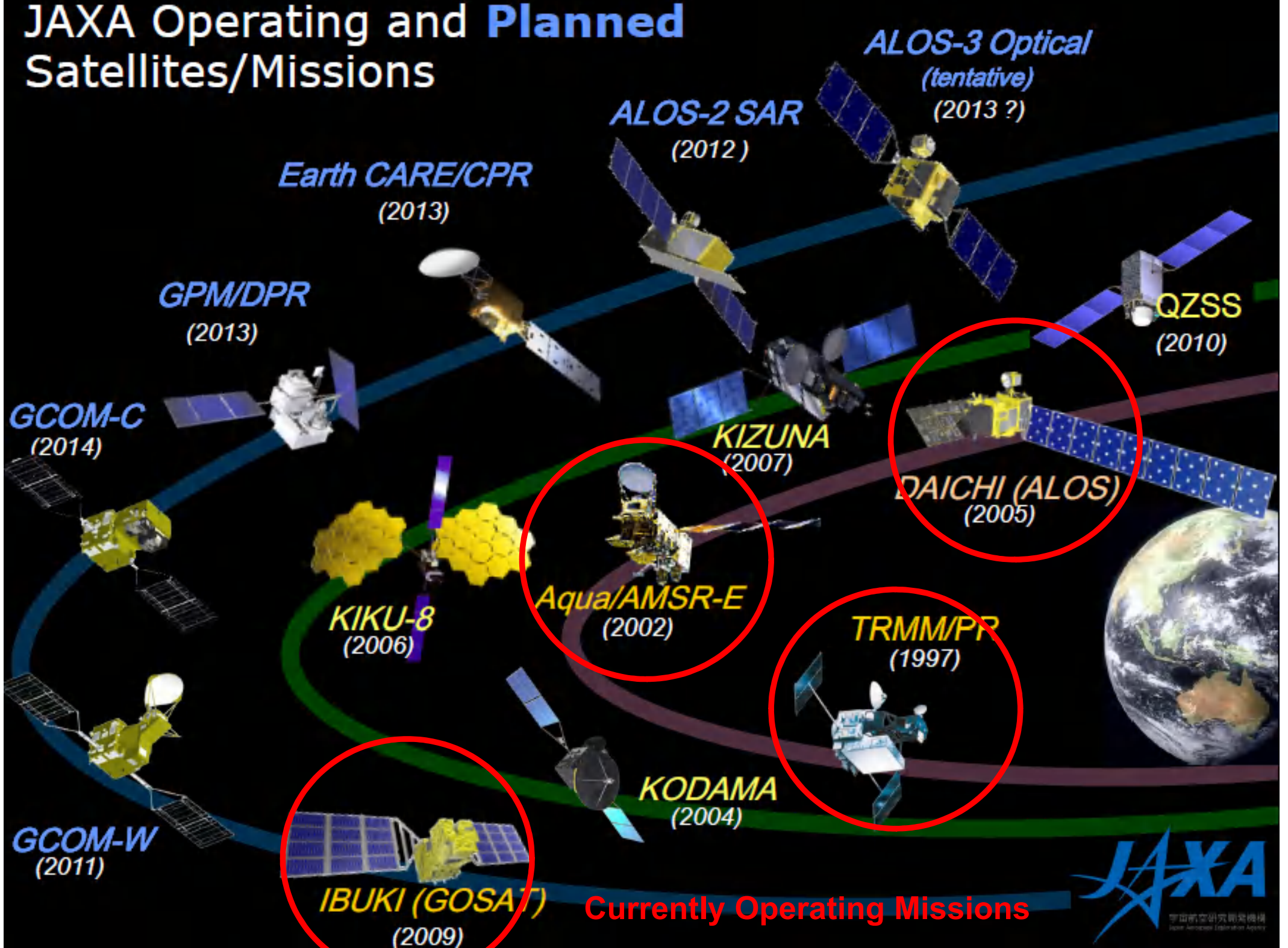
Satellite Observations

- JAXA EO Data for Water Cycle Observation -

Keiji Imaoka (with help from EORC colleagues)
Earth Observation Research Center
Japan Aerospace Exploration Agency

The 7th AWCI ICG Meeting
October 6, 2010
Tokyo, Japan

JAXA Operating and Planned Satellites/Missions



Currently Operating Missions

Advanced Microwave Scanning Radiometer for EOS (AMSR-E)



■ Mission status

- Continuous observation over 8-years after the launch on May 4, 2002 onboard NASA's EOS Aqua satellite.
- Stable brightness temperature records, except the loss of 89GHz-A data from November 2004.



■ Instrument characteristics

- Multi-frequency microwave radiometer, which is capable of observing various parameters related to water (developed by JAXA).
- High-spatial resolution compared to existing instruments by large size antenna.
- C-band (6.9GHz) channels for estimating SST and soil moisture.
- Afternoon (1:30 pm) equatorial crossing time that is currently unique for microwave radiometers.



Pre-launch AMSR-E in Tsukuba Space Center

Tropical Rainfall Measuring Mission (TRMM)

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

- Major achievement in Japan
 - Demonstration of high quality and high reliability of a satellite onboard precipitation radar
 - Improvement of MWR precipitation retrieval by PR 3D observation
 - Pioneering precipitation system climatology by PR observation
 - Operational use in NWP etc.
 - New products including all-weather SST, global soil moisture

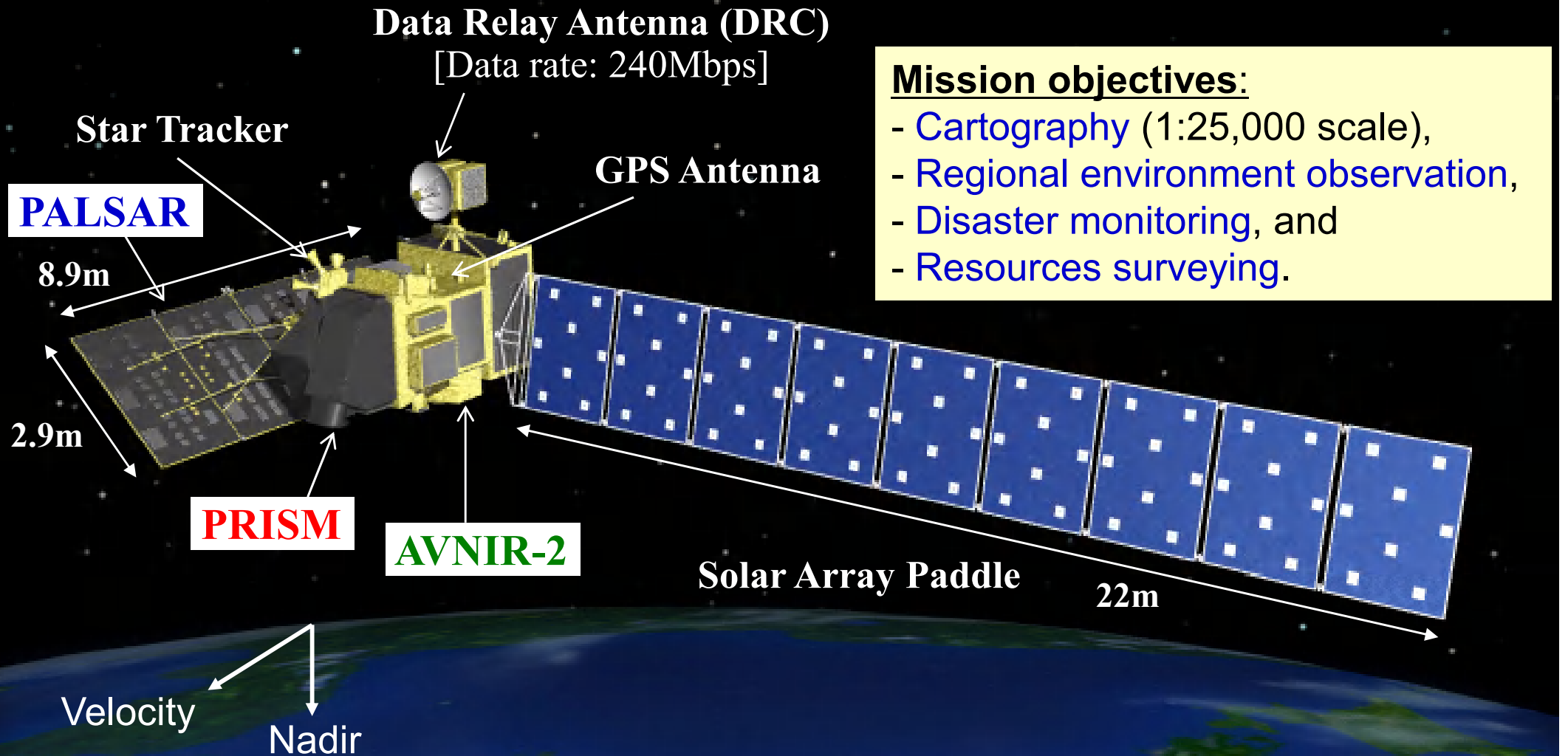


Launch	28 Nov. 1997 (JST)
Altitude	About 350km (since 2001, boosted to 402km to extend mission operation)
Inc. angle	About 35 degree, non-sun-synchronous orbit
Design life	3-year and 2month (still operating)
Instruments	Precipitation Radar (PR) TRMM Microwave Imager (TMI) Visible Infrared Scanner (VIRS)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

ALOS "Daichi"

(Advanced Land Observing Satellite)

Jan. 24, 2006: Launch by H-IIA #8 from TNSC



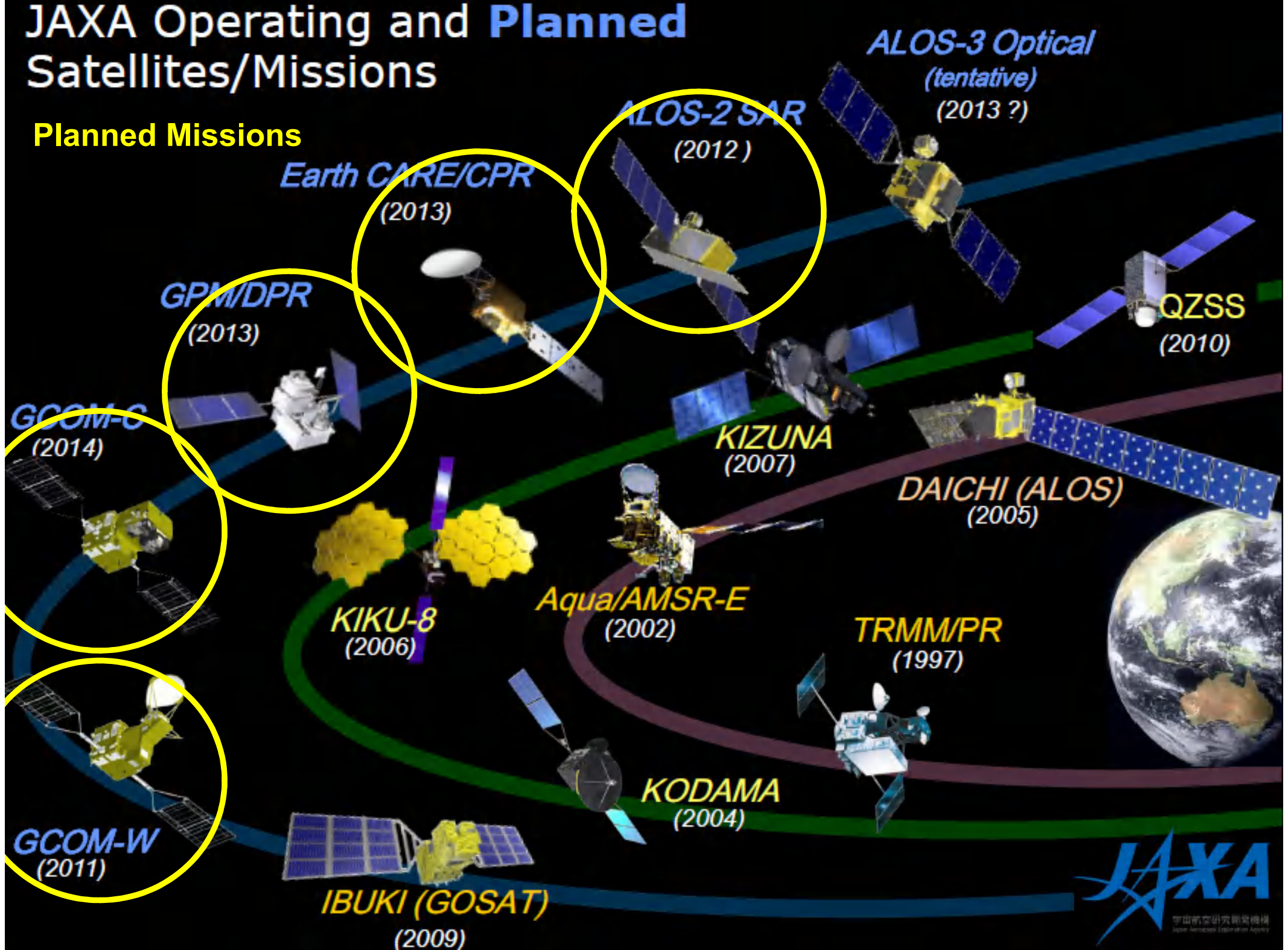
Mission objectives:

- Cartography (1:25,000 scale),
- Regional environment observation,
- Disaster monitoring, and
- Resources surveying.

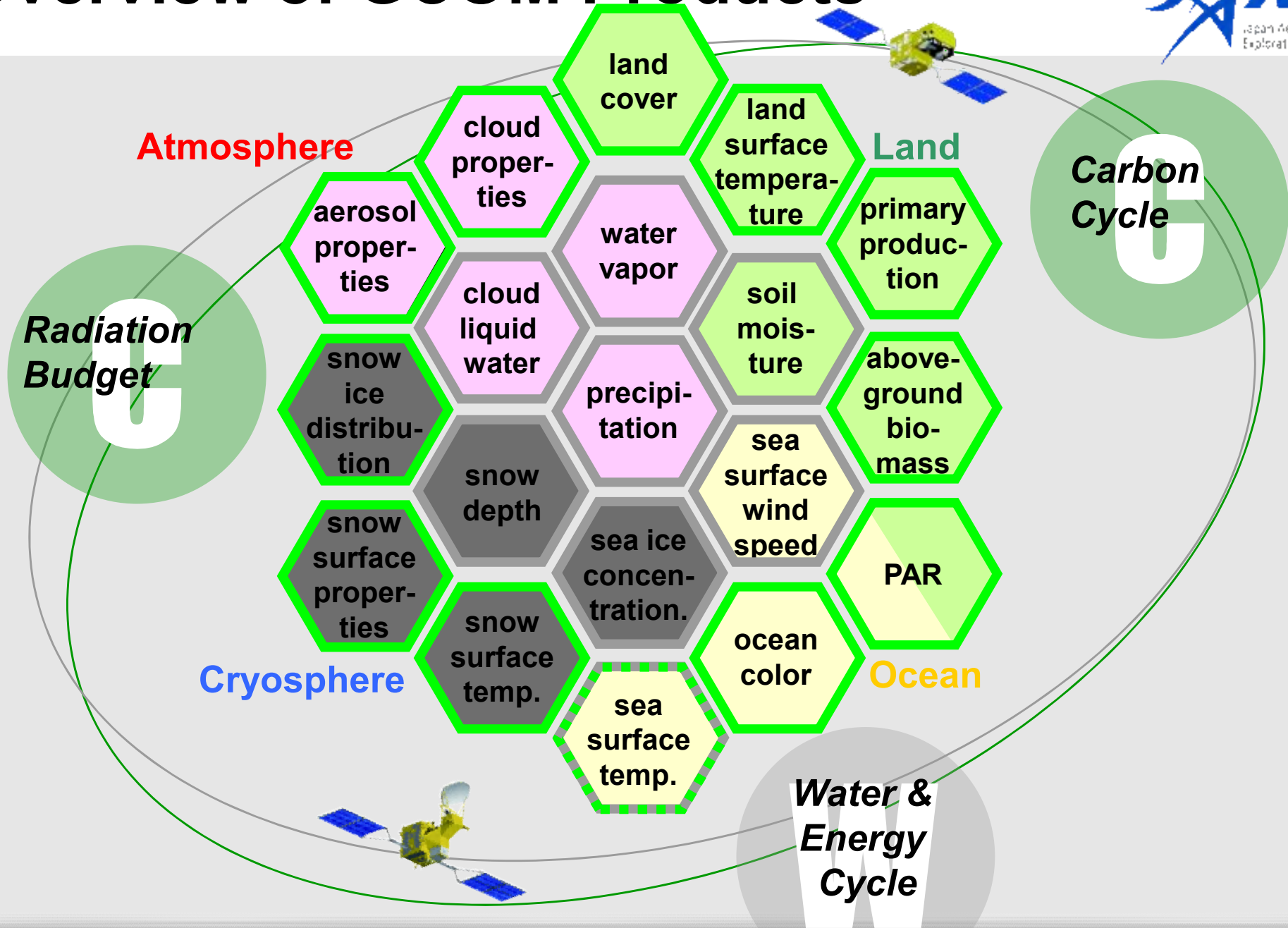
PRISM : Panchromatic Remote-sensing Instrument for Stereo Mapping
AVNIR-2: Advanced Visible and Near Infrared Radiometer type 2
PALSAR: Phased Array type L-band Synthetic Aperture Radar

JAXA Operating and Planned Satellites/Missions

Planned Missions



Overview of GCOM Products



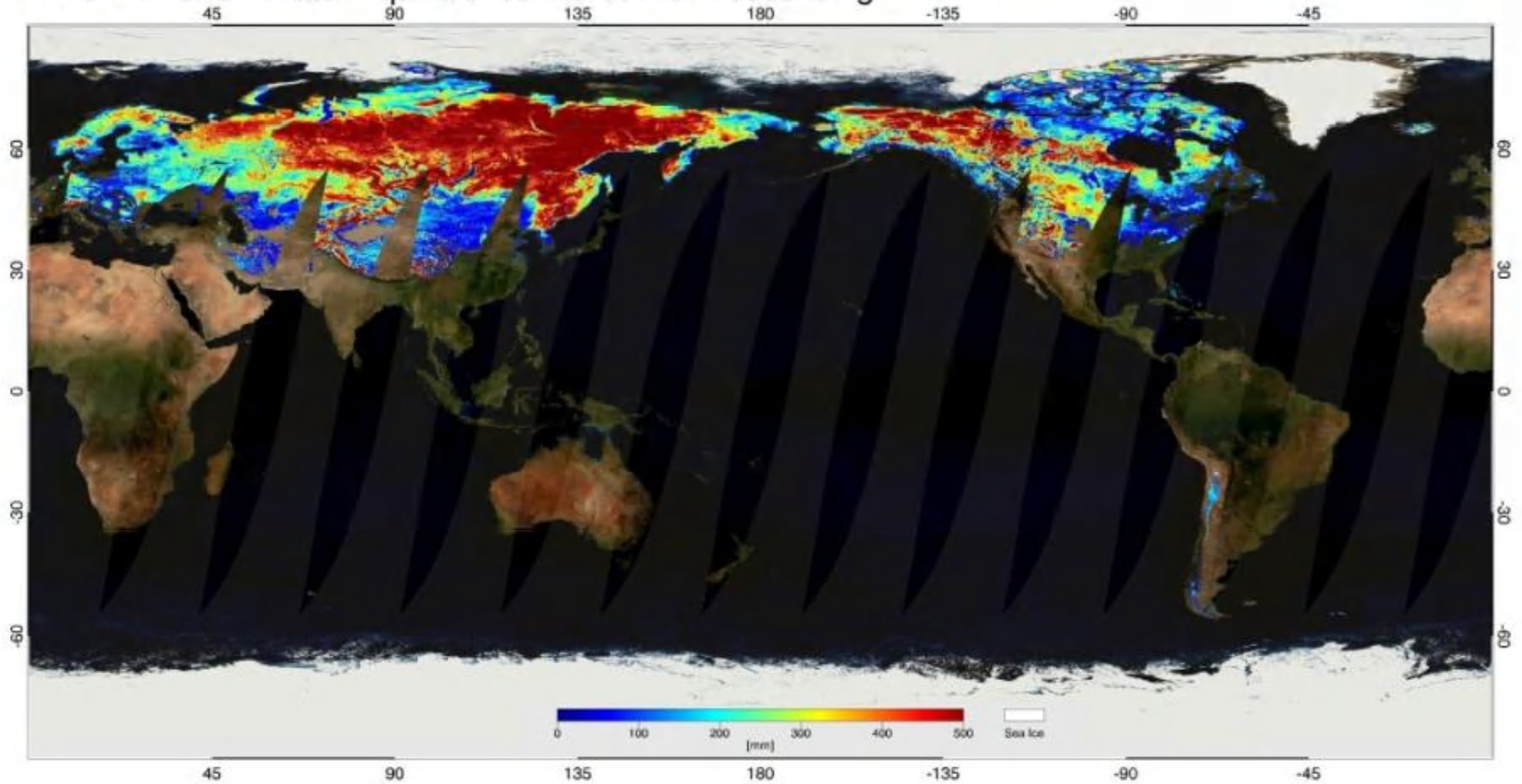
JAXA Satellite Product Categories



- **Standard Product**
 - Core and proven products for achieving the mission goals.
 - Scheduled and operational processing.
- **Near Real-time Product**
 - Near real-time distribution to operational users to meet their needs.
 - Some optimization and/or simplification to meet timeliness.
- **Subset Product**
 - Sub-set of specific region or area, produced from standard products.
- **Research Product**
 - Product that uses research algorithm and is produced mainly for research objectives. Products are not produced operationally.
- **Websites, Browse Images**
 - Various projects websites, including browse images, satellite information, observation topics.

AMSR-E Product Examples

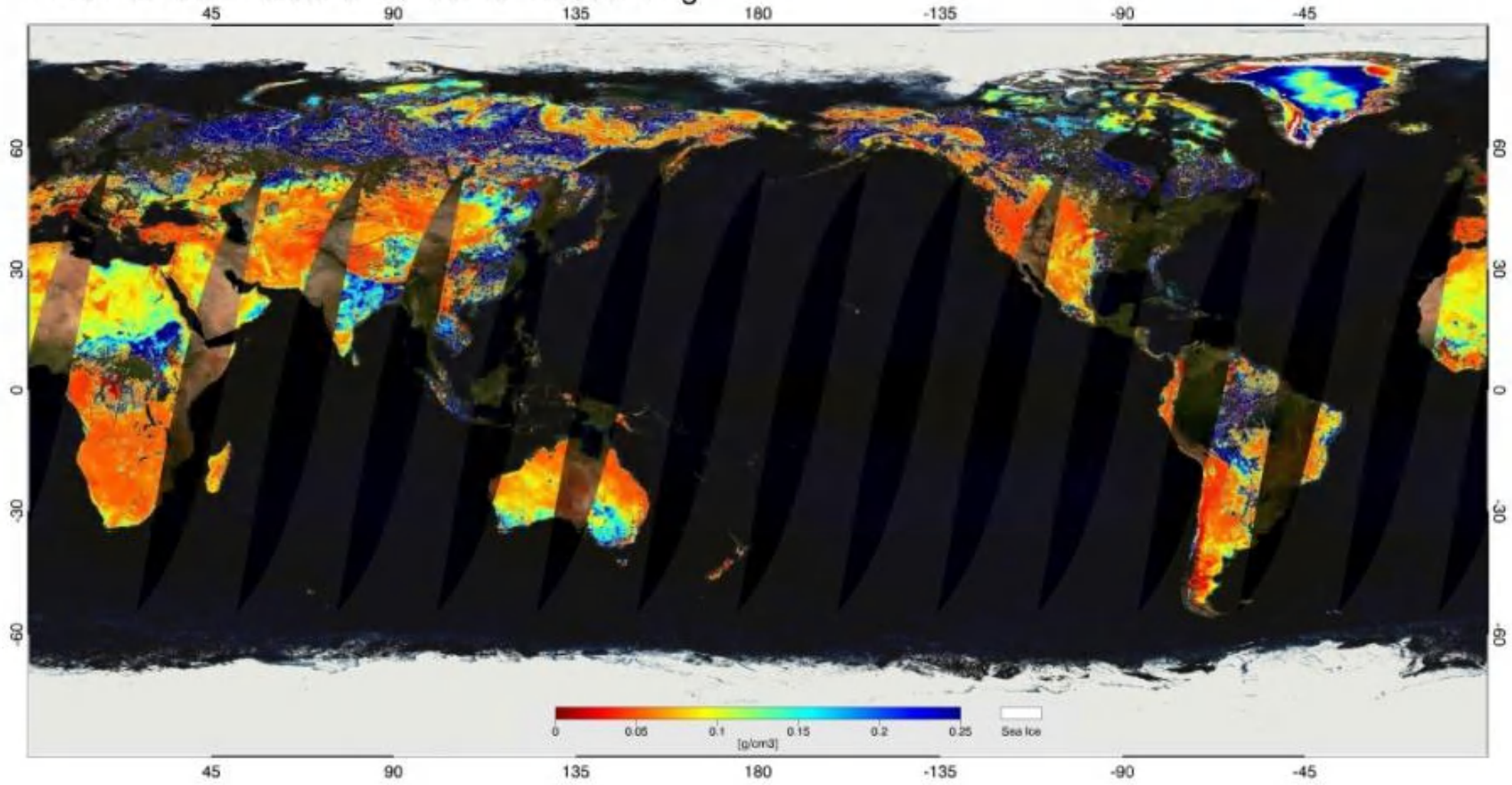
AMSR-E Snow Water Equivalence 20100215 Descending



Snow Depth

AMSR-E Product Examples

AMSR-E Soil Moisture 20100715 Descending



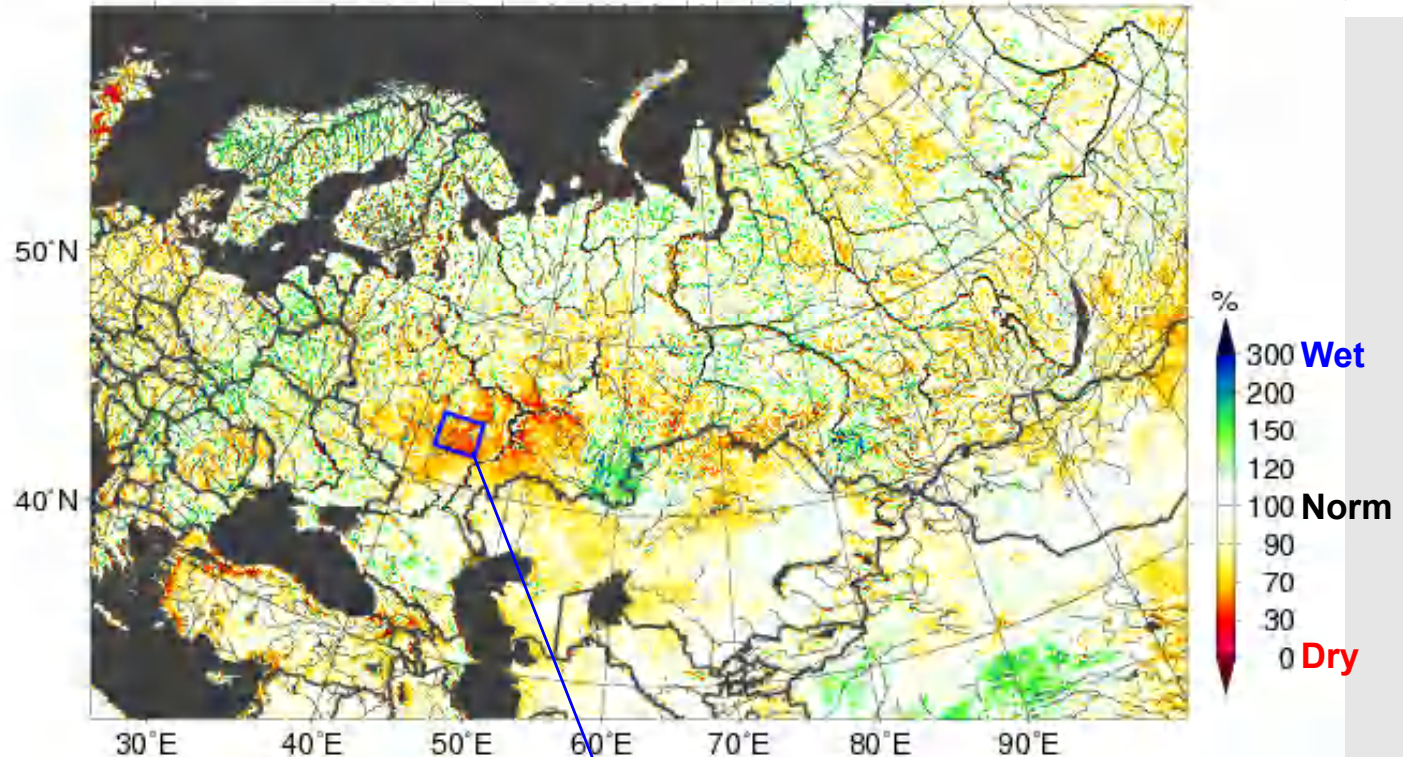
Soil Moisture Content

Example of AMSR-E Monitoring

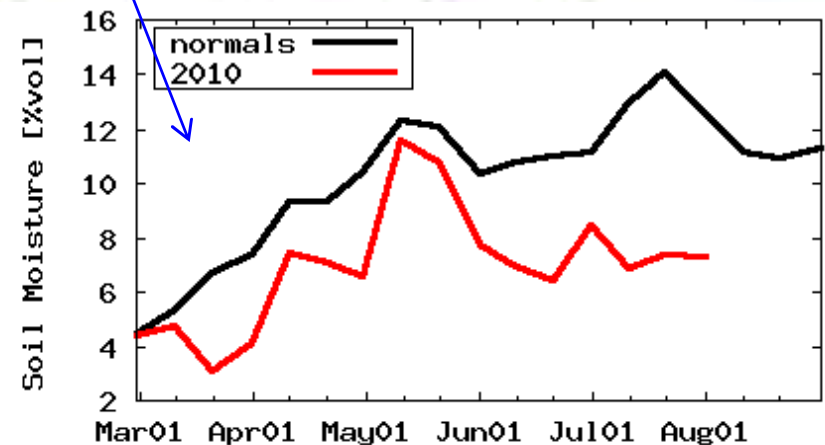


AQUA/AMSR-E SM ratios Jul., 2010 DES (Monthly)

AMSR-E is continuously observing the Earth after the launch on May 4, 2002 onboard EOS Aqua satellite.



- ❑ Serious crop damages have been reported due to catastrophic drought over western part of Russia in 2010.
- ❑ AMSR-E soil moisture is well capturing this phenomena and indicates that the drought already began from April-May period.



[Monthly changes of soil moisture \(March-August\)](#)

Black: Nominal trend (2002-2009 average)

Red : Trend in 2010

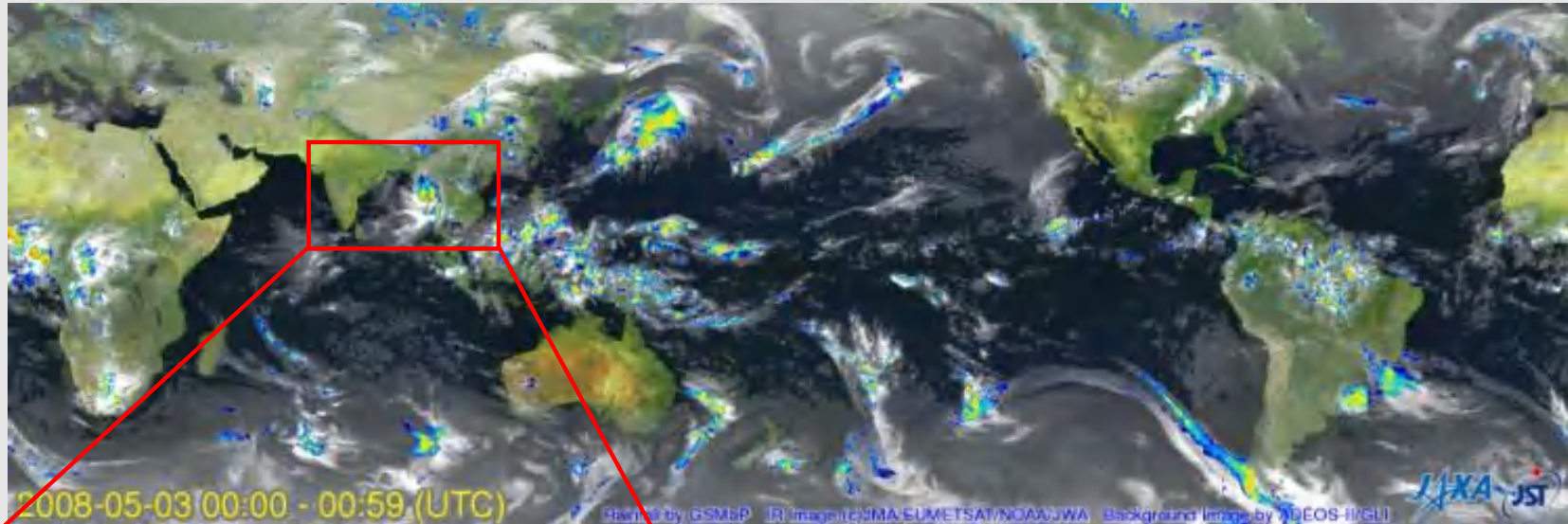
Global Rainfall Map in Near Real Time

- Displaying global rainfall map merging TRMM, AMSR-E and other satellite information
- Available 4-hr after observation
- Browse images, 24-hr animation, displaying by Google Earth
- 0.1-degree lat/lon grid, hourly products
- Data are also available via password protected ftp site
- Based on JST/CREST GSMaP algorithm



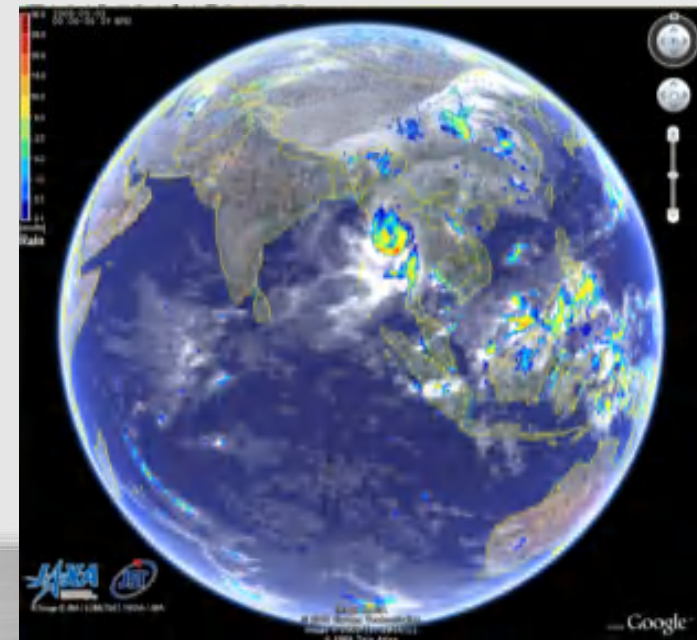
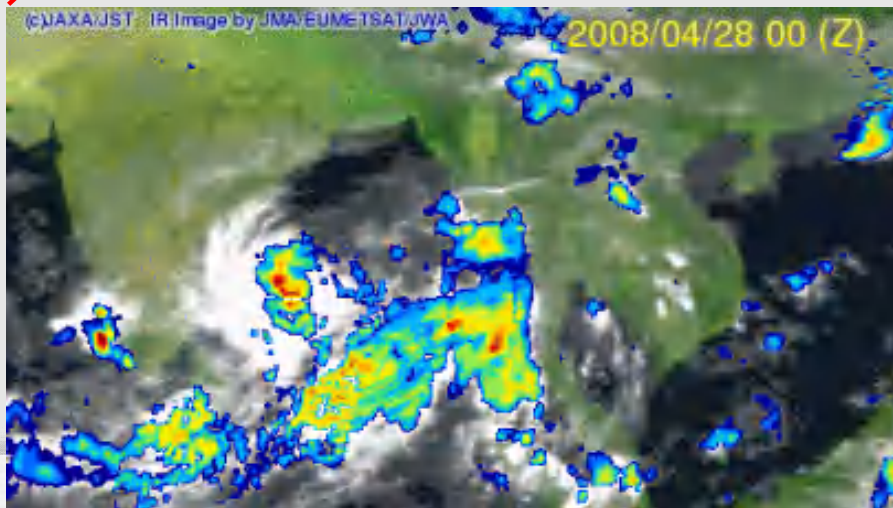
<http://sharaku.eorc.jaxa.jp/GSMaP/>

GSMaP_NRT observed cyclone attack in Myanmar (May 2008)



00Z
May 3,
2008

April 28~May 3

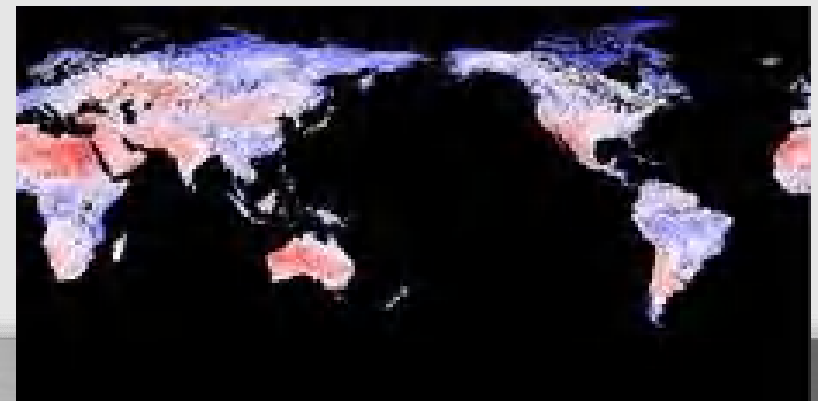
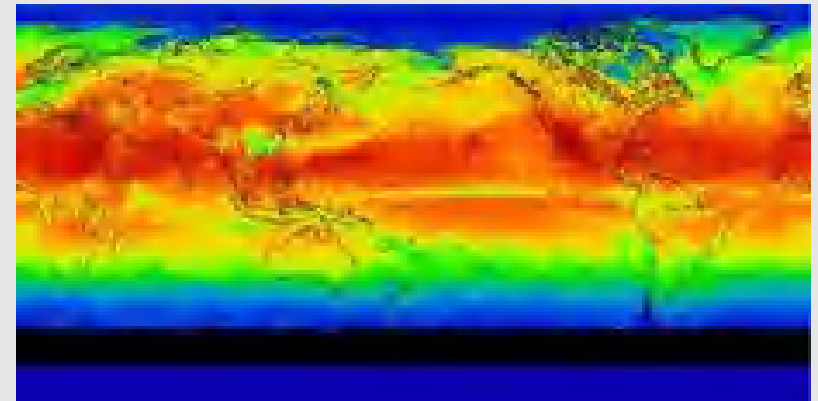
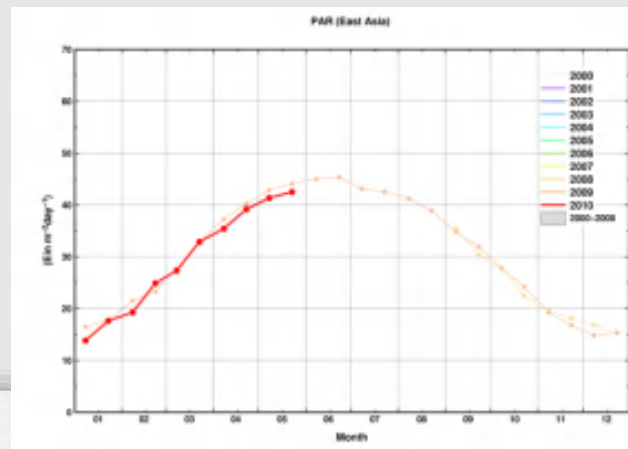


JASMES

JAXA Satellite Monitoring for Environmental Study

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

- Environmental monitoring by MODIS-derived geophysical parameters, as a preparatory activity for GCOM-C/SGLI project.
- Currently available parameters are RGB Images, Photosynthetically Active Radiation (PAR), Snow Cover Extent, Water Stress Trend, Wild Fire, Cloud Cover Rate.
- Images, binary data, and trend curves for monthly/twice-a-month statistics over globe and around Japan.



How to get JAXA's EO data

- EORC Homepage: <http://www.eorc.jaxa.jp/>



Data Distribution Service
[Standard Product]



Research Project Sites
[Research Product]

A screenshot of the EORC homepage with several annotations. The page includes a search bar, a 'Hi, we are EORC!' message, a 'NEWS' section, and various data distribution links. Annotations include:

- An orange circle around the 'Earth Observation Satellite Data Distribution Service' link.
- A green circle around the 'Global Rainfall Map in Near Real Time by JAXA/EORC' link.
- A green circle around the 'JASMES' link.
- A green box around the 'Research Project' section, which lists links for GPM, Daichi (ALOS), TRMM, JERS-1 (Fuyou), GCOM, Midori II (ADEOS-II), Midori (ADEOS), Arctic, Ibuki (GOSAT), and AMSR-E.

Top page of Data Distribution Service



EOC/EOIS: Earth Observation Information System

The screenshot displays the JAXA Earth Observation Data and Information System (EOIS) interface. At the top, there's a navigation bar with 'HOME', 'Images & Data', 'Work on EORC', 'about Earth Observation', 'FAQ', 'Link', and 'Site Map'. Below this, the 'Earth Observation Research Center EORC' logo is visible, along with a search bar and a breadcrumb trail: 'HOME > Work on EORC > Activities of EORC > Data Distribution Service'. The main heading is 'Data Distribution Service'. A paragraph explains that JAXA has been receiving and recording data from earth observation satellites at ground stations, including Earth Observation Center. These data have been processed with various corrections, such as geometric and radiometric corrections, and provided to users.

The 'Search and Order System' section states: 'The following is the available product list provided by EORC. Click on "Search & Order" to order product data.' Below this is a table with columns: Satellite, Search & Order, Product list, and Related Information.

Satellite	Search & Order	Product list	Related Information
ALOS	Search & Order	AVNIR-2 Media	[Related information]
TRMM	Search & Order	PR Media	[Related information]
Aqua	Search & Order	AMSR-E Media	[Related information]
ADEOS-II	Search & Order	AMSR Media	[Related information]
ADEOS	Search & Order	AVNIR Media	[Related information]
JERS-1	Search & Order	SAR/AMR/MSAR Media	[Related information]

An orange arrow points from the 'Search & Order' button for ALOS to a callout box that says: 'EOIS (Earth Observation Interface System)'. Another callout box, shaped like a speech bubble, says: 'All users can download JAXA's Earth Observation data (except for ALOS and GOSAT) after user registration.'

There is a category of users.

CEOP Satellite Data Gateway

<http://www.ceop.net/>



■ Three Scales

- 250km rectangular covering each Reference Sites,
- Monsoon Regional
- Global Area

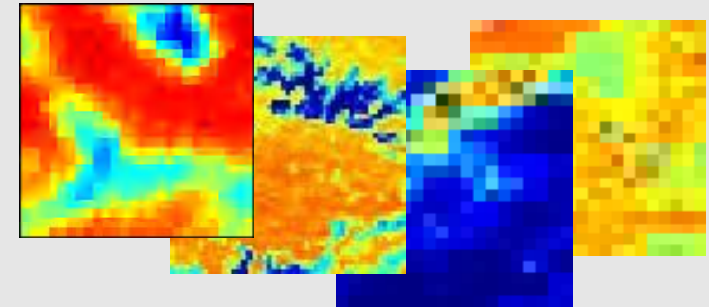
■ Product Levels

- **Level-1b:** Radiance product with full resolution at reference sites.
- **Level-2:** Geophysical product at the same resolution at reference sites and monsoon regions.
- **Level-3:** Statistical geophysical product in space and/or time at reference sites, monsoon regions and global. (example: Monthly mean rain rate at reference sites, etc.)

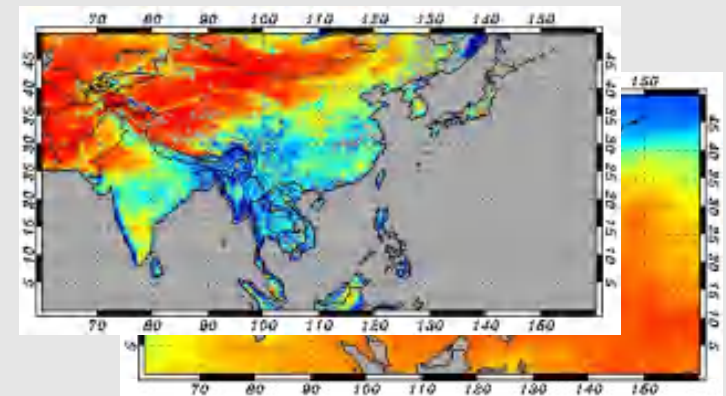
■ Metadata

- Consist of an image element and a metadata part element that is compliant with the ISO-19115 metadata standard.

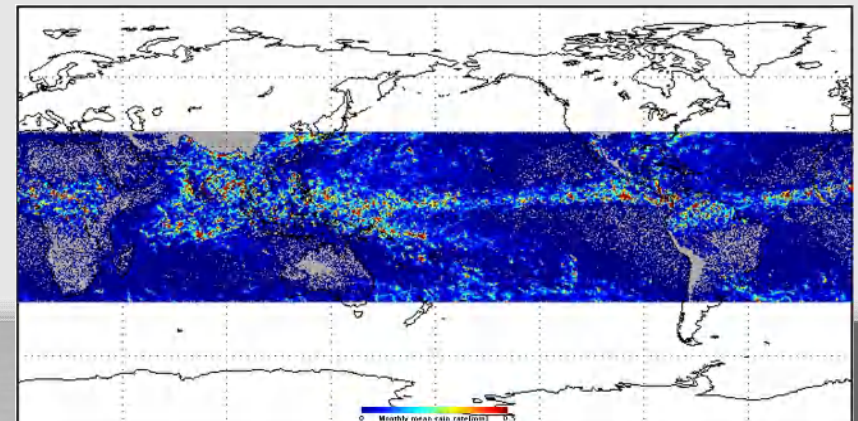
Reference Sites



Monsoon Regional



Global Area



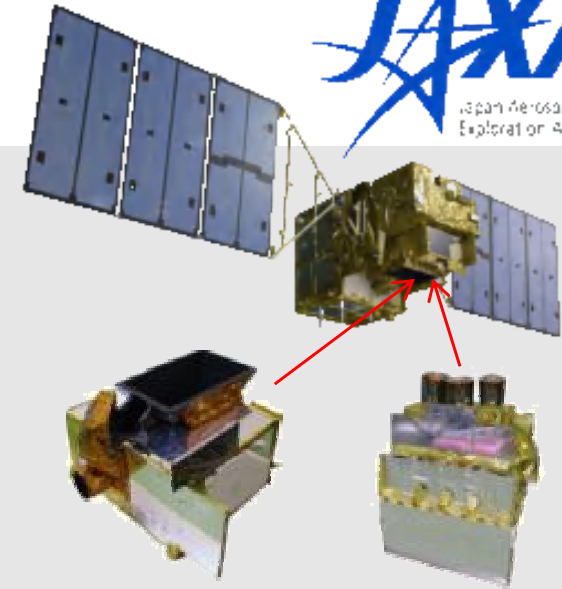
Summary of JAXA EO Products



- Standard Product
 - <http://www.eorc.jaxa.jp/about/distribution/index.html>
All products, except ALOS and GOSAT, can be used by registration.
- Research Product (not limited to below), Browse Images
 - AMSR-E
<http://sharaku.eorc.jaxa.jp/AMSR/index.html>
<http://sharaku.eorc.jaxa.jp/cgi-bin/amsr/pmips/quicklooks.cgi> (testing)
 - GSMaP
http://sharaku.eorc.jaxa.jp/GSMaP/index_j.htm
 - JASMES
<http://kuroshio.eorc.jaxa.jp/JASMES/index.html>
- CEOP Satellite Data Gateway
 - <http://www.ceop.net/>

Backup Slides

Greenhouse gases Observing SATellite (GOSAT)



FTS

CAI

Mission Objectives

- GOSAT observes high resolution spectra for monitoring CO₂ and CH₄ from space.
- GOSAT is a Japanese joint project of Japan Aerospace Exploration Agency (JAXA), National Institute of Environmental Studies (NIES) and Ministry of Environment (MOE).

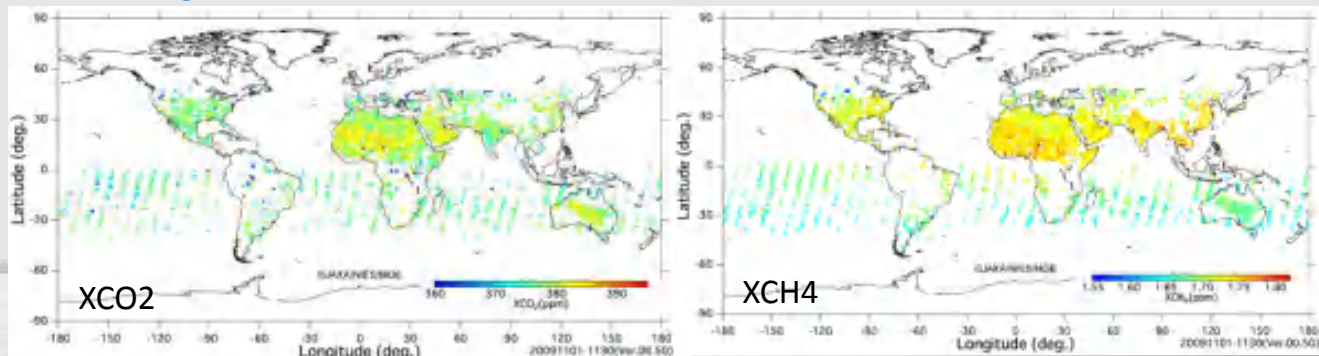
Mission Target

- To observe CO₂ and CH₄ column density
 - at 100-1000km spatial scale (with scanning mechanical)
 - with relative accuracy of 1% for CO₂(4ppmv in 3 months average; target 1ppmV) and 2% for CH₄.
 - during the Kyoto Protocol's first commitment period (2008 to 2012).
- To reduce sub-continental scale CO₂ annual flux estimation errors by half
 - 0.54GtC/yr→0.27GtC/yr

Mission Status

- Jan 23, 2009 Launch by H2-A rocket
- Feb 09 First lights of FTS SWIR spectra and CAI image
- Mar 12 First light of FTS TIR spectra
- Apr 10 Complete Check-out phase and Start Cal/Val phase
- Jul 27 Complete Cal/Val phase and Start Normal observation operation
- Oct 30 FTS L1B data release (Calibrated spectral radiance)
- Nov 19 CAI L1B data release (Calibrated radiance)
- Nov 25 CAI L1B+ data release (Calibrated radiance with map re-sampling)
- Feb 16, 2010 FTS and CAI L2 data release (Column-averaged mixing ratio of CO₂ and CH₄, CAI cloud flag)

GOSAT Characteristics		
Launch	Jan 23, 2009 (by H2A-15 rocket)	
Orbit	Sun synchronous orbit 3 days revisit Local time 13:00 +/- 15min (12:47 Mar 17)	
Mission Life	5 years	
Mission Instruments	Thermal And Near infrared Spectrometer for carbon Observation (TANSO)	
	Fourier Transform Spectrometer (FTS)	Cloud and Aerosol Imager (CAI)
Swath	790km (Nominal: 5 points cross track)	750-1000km
Resolution	10.5km	0.5-1.5km
Spectral Coverage	B1: 0.75-0.78 um B2: 1.56-1.72 um B3: 1.92-2.08 um B4: 5.5-14.3 um B1-3 polarization bands	B1: 0.38 um B2: 0.67 um B3: 0.87 um B4: 1.62 um
Spectral Resolution	0.2 cm ⁻¹	20nm



Soil Moisture and Precipitation

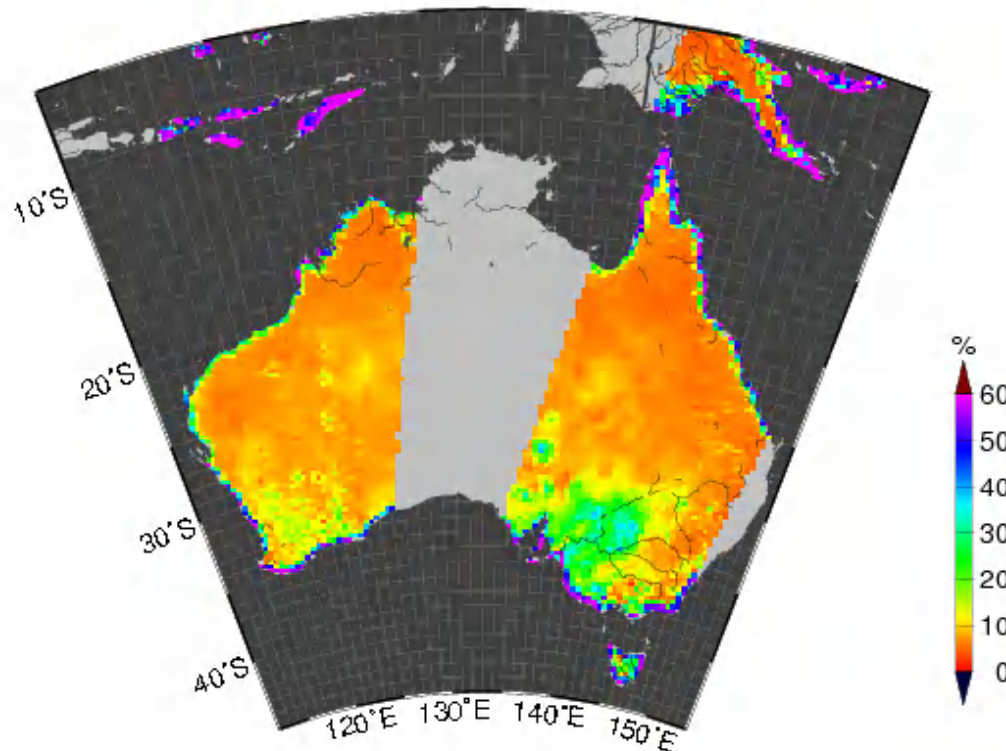
AMSR-E Soil Moisture

- L2, Descending
- Volumetric SoilMoisture [%]

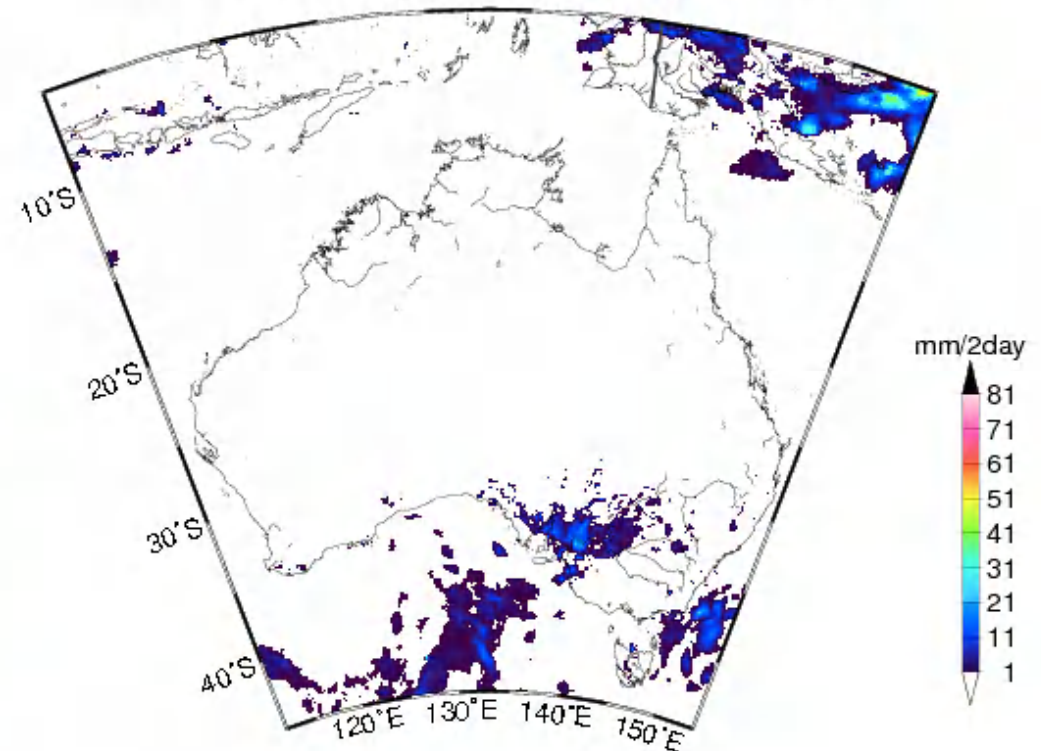
Precipitation :

- Total amount of precipitation for 48 hours before AMSR-E observation.
- Data source: GSMaP MVK hourly (JST-CREST/GSMaP)

AQUA/AMSR-E SM May. 23, 2003 DES

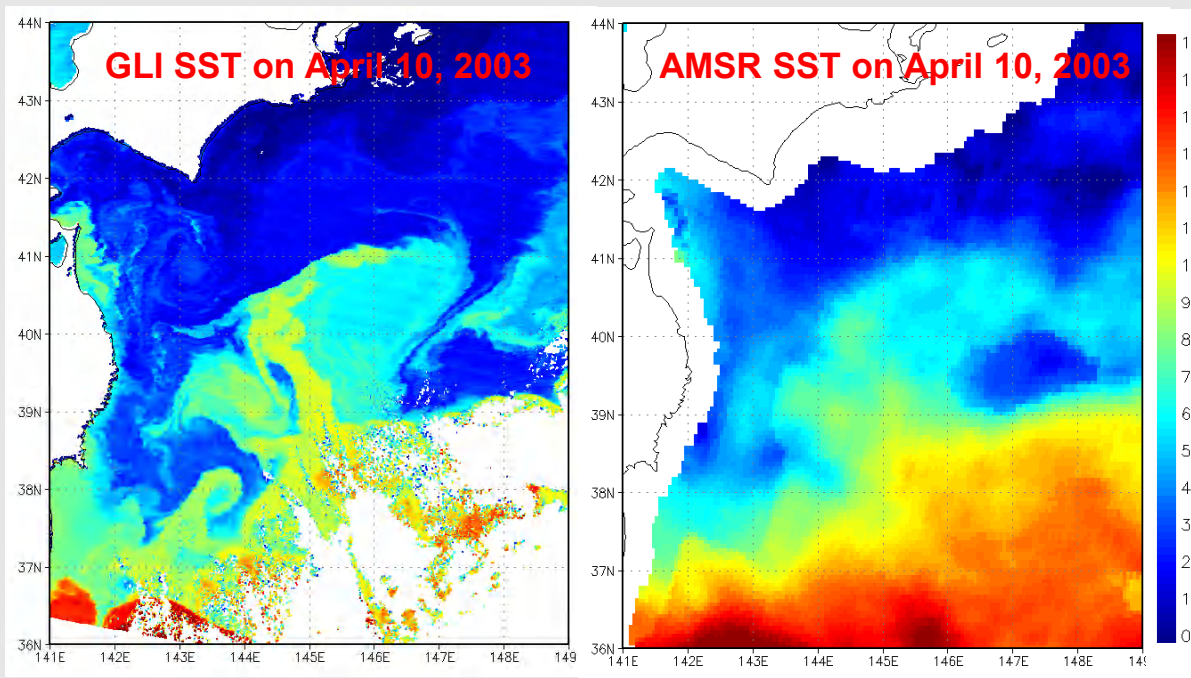


GSMaP MVK 2Days Precipitation May. 23 2003



Microwave and IR SST Combination

- C-band (6.9GHz) is indispensable frequency for retrieving SST and soil moisture. Microwave measurement can provide cloud-through frequent SST mapping.
- Microwave and IR observations complement each other in terms of spatial resolution and error sources. Importance and needs of Merged SST from microwave and IR are increasing.



SST images around east coast of Japan on April 10, 2003, observed by GLI (left) and AMSR (right). Difference of spatial resolution and cloud effect are clearly seen in the figures.

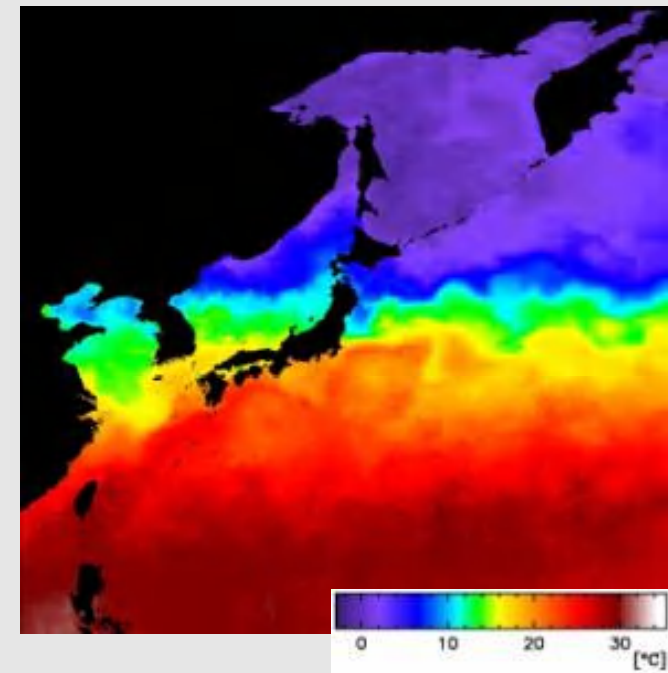
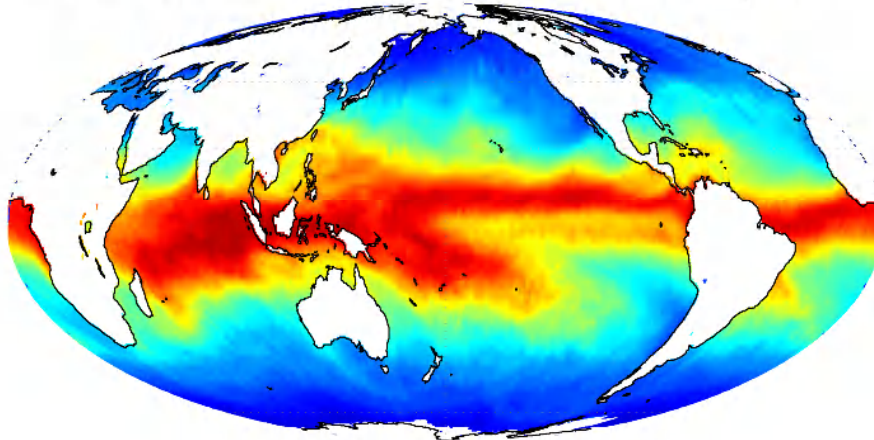


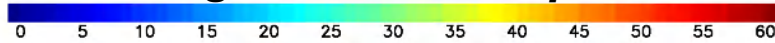
Image of the New Generation Sea Surface Temperature (NGSST) for Open Ocean on May 10, 2005. Provided by NGSST development group led by Professor Kawamura of Tohoku University.

AMSR Product Examples (monthly)

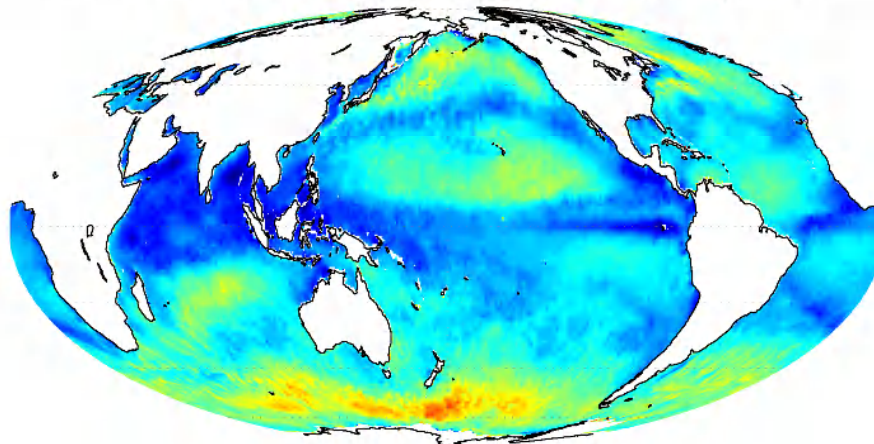
AMSR 200304 Monthly TPW (kg/m²) Takeuchi Algorithm



Integrated water vapor



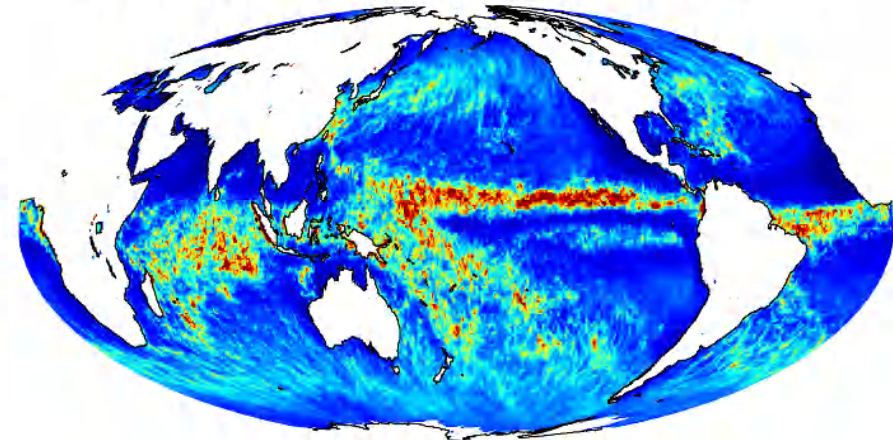
AMSR 200304 Monthly SSW (m/s) Shibata Algorithm



Sea surface wind speed



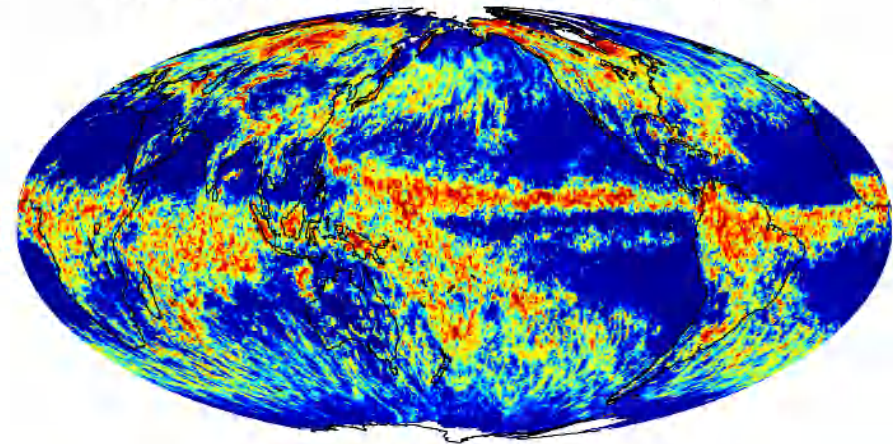
AMSR 200304 Monthly CLW (kg/m²) Wentz Algorithm



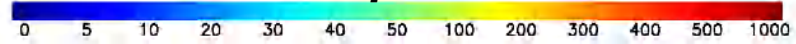
Integrated cloud liquid water



AMSR 200304 Monthly Precip. (mm) Liu Algorithm

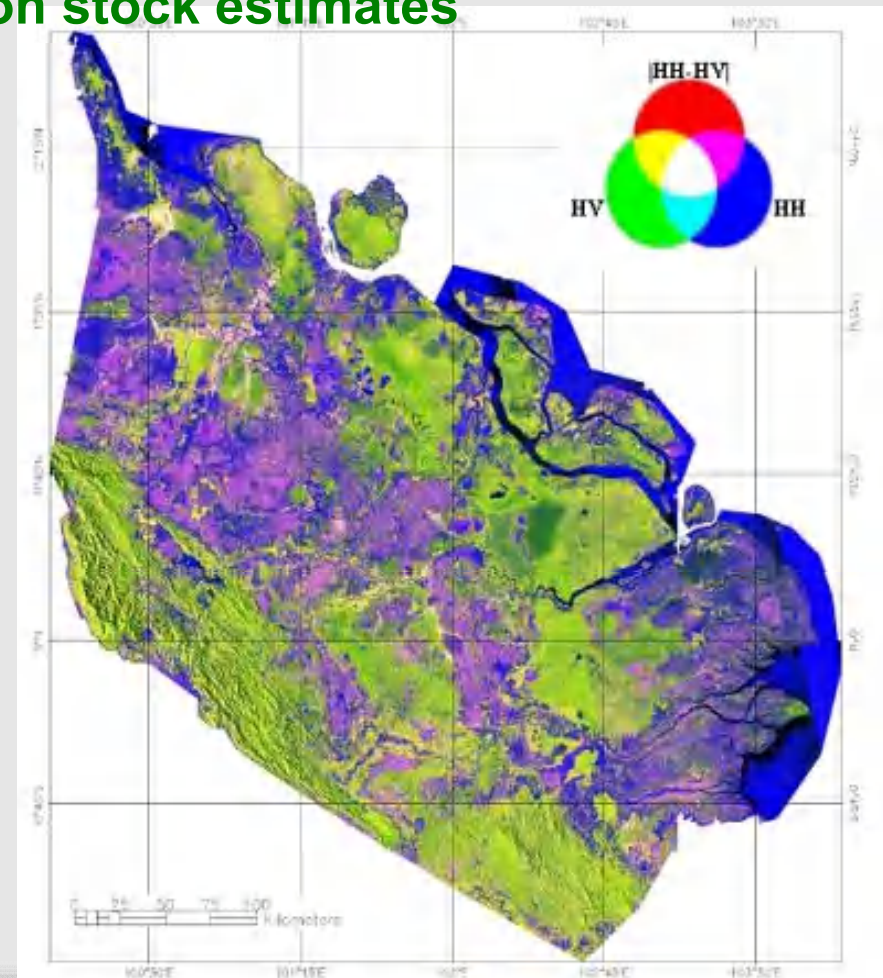


Precipitation



- **Development of Semi-Automated Systems for detection of forest and land cover change based on PALSAR mosaic data**

è **Possible applications for carbon stock estimates**



50m orthorectified PALSAR mosaic in 2007

Top page of Data Distribution Service



EOC/EOIS: Earth Observation Information System

Japan Aerospace Exploration Agency (JAXA) has been receiving and recording data from various observation satellites at ground stations, including Earth Observation Satellites (EOS) and Earth Observation Satellites (EOS) with various corrections, such as AVNIR-2, AVNIR-1, AVNIR-1R, AVNIR-1S, AVNIR-1L, AVNIR-1M, AVNIR-1N, AVNIR-1O, AVNIR-1P, AVNIR-1Q, AVNIR-1R, AVNIR-1S, AVNIR-1T, AVNIR-1U, AVNIR-1V, AVNIR-1W, AVNIR-1X, AVNIR-1Y, AVNIR-1Z, AVNIR-1AA, AVNIR-1AB, AVNIR-1AC, AVNIR-1AD, AVNIR-1AE, AVNIR-1AF, AVNIR-1AG, AVNIR-1AH, AVNIR-1AI, AVNIR-1AJ, AVNIR-1AK, AVNIR-1AL, AVNIR-1AM, AVNIR-1AN, AVNIR-1AO, AVNIR-1AP, AVNIR-1AQ, AVNIR-1AR, AVNIR-1AS, AVNIR-1AT, AVNIR-1AU, AVNIR-1AV, AVNIR-1AW, AVNIR-1AX, AVNIR-1AY, AVNIR-1AZ, AVNIR-1BA, AVNIR-1BB, AVNIR-1BC, AVNIR-1BD, AVNIR-1BE, AVNIR-1BF, AVNIR-1BG, AVNIR-1BH, AVNIR-1BI, AVNIR-1BJ, AVNIR-1BK, AVNIR-1BL, AVNIR-1BM, AVNIR-1BN, AVNIR-1BO, AVNIR-1BP, AVNIR-1BQ, AVNIR-1BR, AVNIR-1BS, AVNIR-1BT, AVNIR-1BU, AVNIR-1BV, AVNIR-1BW, AVNIR-1BX, 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AVNIR-1WY, AVNIR-1WZ, AVNIR-1XA, AVNIR-1XB, AVNIR-1XC, AVNIR-1XD, AVNIR-1XE, AVNIR-1XF, AVNIR-1XG, AVNIR-1XH, AVNIR-1XI, AVNIR-1XJ, AVNIR-1XK, AVNIR-1XL, AVNIR-1XM, AVNIR-1XN, AVNIR-1XO, AVNIR-1XP, AVNIR-1XQ, AVNIR-1XR, AVNIR-1XS, AVNIR-1XT, AVNIR-1XU, AVNIR-1XV, AVNIR-1XW, AVNIR-1XX, AVNIR-1XY, AVNIR-1XZ, AVNIR-1YA, AVNIR-1YB, AVNIR-1YC, AVNIR-1YD, AVNIR-1YE, AVNIR-1YF, AVNIR-1YG, AVNIR-1YH, AVNIR-1YI, AVNIR-1YJ, AVNIR-1YK, AVNIR-1YL, AVNIR-1YM, AVNIR-1YN, AVNIR-1YO, AVNIR-1YP, AVNIR-1YQ, AVNIR-1YR, AVNIR-1YS, AVNIR-1YT, AVNIR-1YU, AVNIR-1YV, AVNIR-1YW, AVNIR-1YX, AVNIR-1YY, AVNIR-1YZ, AVNIR-1ZA, AVNIR-1ZB, AVNIR-1ZC, AVNIR-1ZD, AVNIR-1ZE, AVNIR-1ZF, AVNIR-1ZG, AVNIR-1ZH, AVNIR-1ZI, AVNIR-1ZJ, AVNIR-1ZK, AVNIR-1ZL, AVNIR-1ZM, AVNIR-1ZN, AVNIR-1ZO, AVNIR-1ZP, AVNIR-1ZQ, AVNIR-1ZR, AVNIR-1ZS, AVNIR-1ZT, AVNIR-1ZU, AVNIR-1ZV, AVNIR-1ZW, AVNIR-1ZX, AVNIR-1ZY, AVNIR-1ZZ

AUIG (ALOS User Interface Gateway)

観測日	観測時間	観測場所	災害種別	センサ
2018/05/21	0121:09頃	ポーランド中部	洪水	PALSAR(FBG)
2018/05/21	0118:04頃	ポーランド中部	洪水	AWNIR-2
2018/05/10	0117:18頃	スリランカ、コロンボ周辺	洪水	PALSAR(FBG)
2018/05/15	0105:59頃	バキスタン、アイナバッド村等	洪水/ダム決壊警戒	AWNIR-2
2018/05/11	0117:34頃	タジキスタン、クムヤブ地区	洪水	PALSAR(FBG)

For General Users, JAXA will provide only disaster monitoring images.

There is a category of users.