

United Nations/United Arab Emirates High Level Forum
“Space as a driver for socio-economic sustainable development”

20 – 24 November 2016
Dubai, United Arab Emirates

Breakout session 1 – Space Economy

***Space medicine
and satellite technology for
socioeconomic contribution***

**Chiaki Mukai, M.D., Ph.D
Japan Aerospace Exploration Agency (JAXA)**

Topics

1. Space medicine : Contribution to the people on earth

- Space Environment and its Health Risks
- Applications of Space Medicine on Earth
- Contribution to society with increase of aged population

2. Satellite technology : Contribution to public health and human life

- Satellite data for health issues
- JAXA Satellite Program
- Some results/examples
- Japan's Commitment and contribution to SDGs

Space Environment and its Health Risks

International Space Station (450 km above the earth)

Environment:

1. Microgravity

- Balance disorders
- Cardiovascular deconditioning
- Decrease of bone mineralization
- Muscle-disuse atrophy

2. Closed, confined, multi-cultural environment

- Mental stress
- Depression
- Reduction in group dynamics

3. Cosmic radiation

- Cancer risk
- Reduction of immune response



“ War of the Worlds ” by H.G.Wells

Space environment affects health

Some symptoms are similar to the ones of aging manifestations

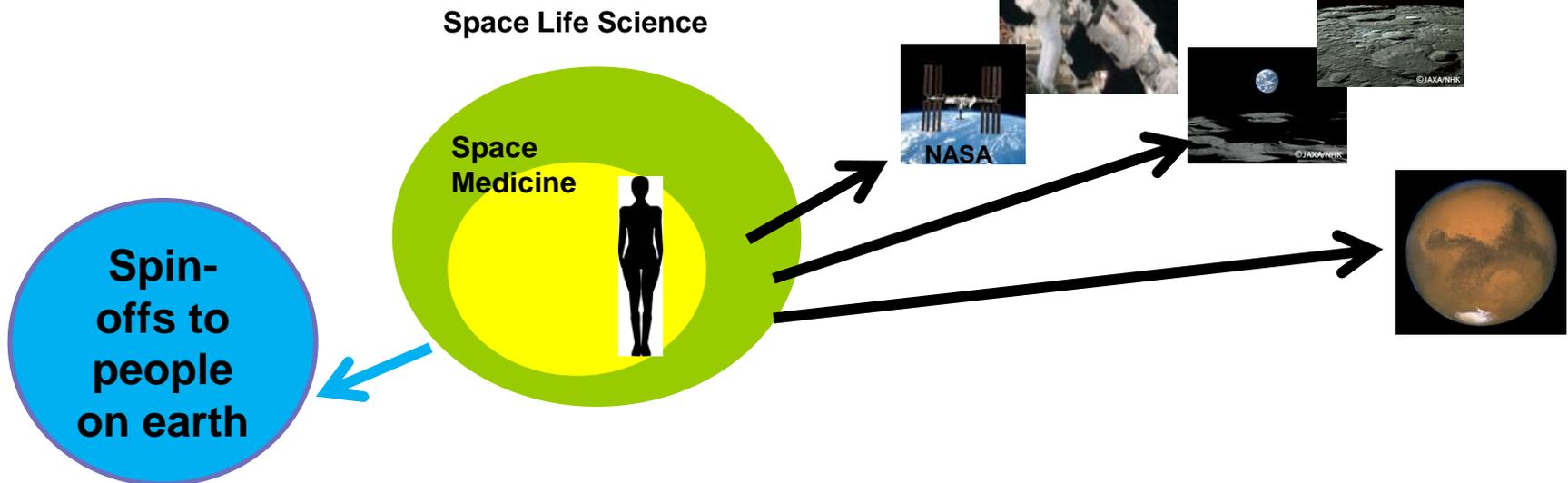
Space medicine is for ensuring the health of people living and working in space

Space solutions will contribute to creating a better society

Aerospace medicine (www.asma.org)

Aerospace medicine concerns the determination and maintenance of the health, safety, and performance of persons involved in air and space travel.

Space medicine and space life science enable human space exploration



Spin-offs from space

Exploration

Applications of Space Medicine on Earth

Preventive medicine in space

Physiological Countermeasure

- Bone Loss
- Exercise method



Long-term bed rest verification

Physiological Support

- Behavior and performance
- Stress management



Long-term isolation experiment

Telemedicine in orbit

- HDTV
- Portable Medical device



High-definition Camera

Development of Japanese Space Food

- Fortified foods



Japanese Space Food

Health Care of Astronauts

- Health care
- Sleep work cycle



Health Care from the Earth

Application to life on Earth

Practice of Health and Preventive Medicine

- Health care for elderly people
- Preventive medicine

Countermeasures for Mental Health

- Stress management
- Sleep

Enhancement of Medical Care

- Emergency medicine
- Disaster Management

Food Safety

- food for disaster
- Biodegradable containers
- Nutritional management

Occupational Medicine providing health care to workers in a variety of sectors e.g. nurses,

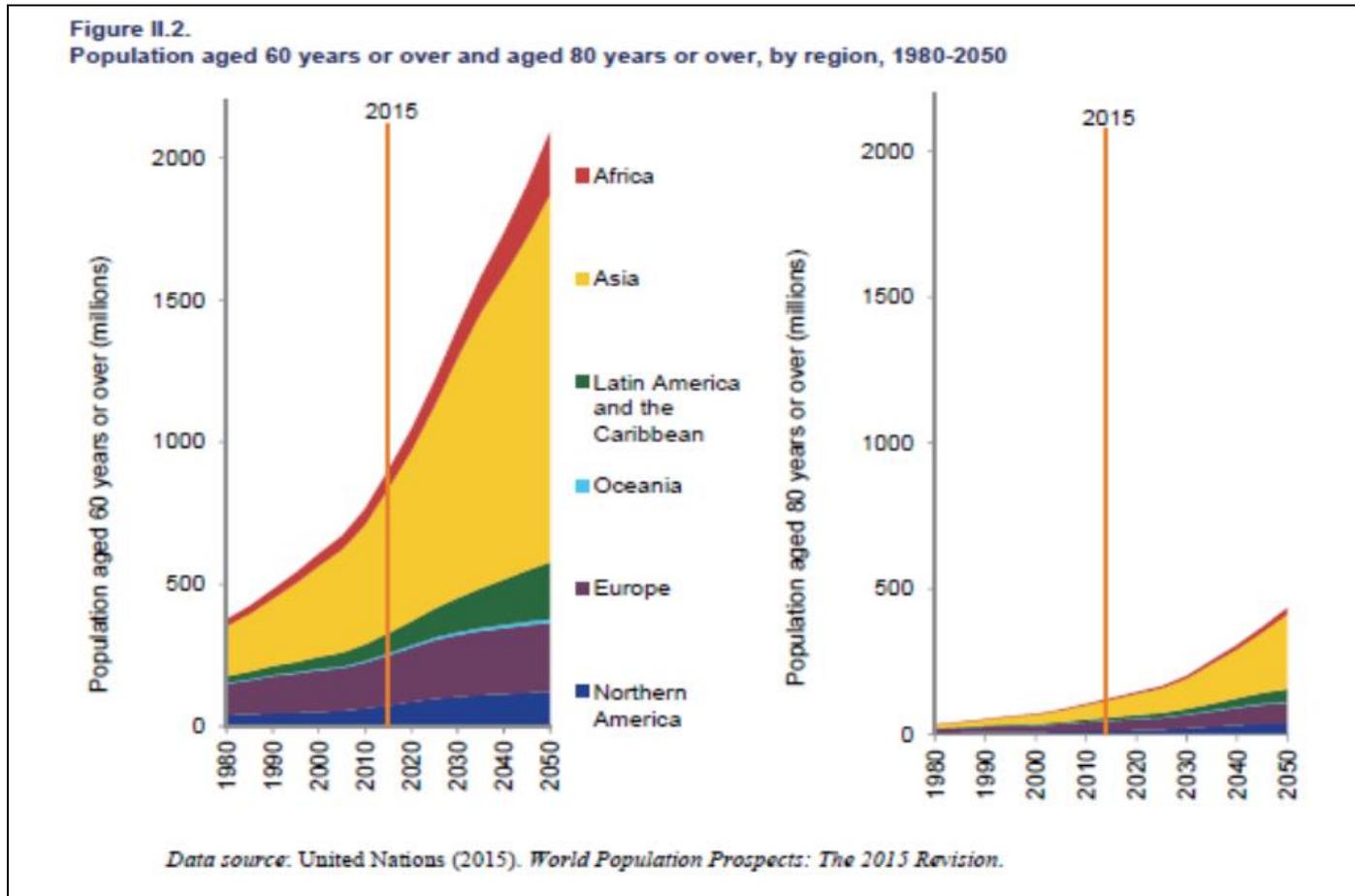
Example of Spin-offs by Human Space Flight Technology

• Diagnostic Devices
➤ Thermometer

• Small Medical instruments
➤ Telemetry system
➤ Cardiac pacemaker

• Others
➤ HACCP
➤ Air/water purification/ recycle system

Increasing aging society can be helped by space medicine as a preventive medicine



World Population Aging 2015

Department of Economic and Social Affairs Population Division

ST/ESA/SER.A/390

United Nations • New York, 2015

Topics

1. Space medicine : Contribution to the people on earth
 - Space Environment and its Health Risks
 - Applications of Space Medicine on Earth
 - Contribution to society with increase of aged population

2. Satellite technology : **Contribution to public health and human life**
 - **Satellite data for health issues**
 - **JAXA Satellite Program**
 - **Some results/examples**
 - **Japan's Commitment and contribution to SDGs**

Concept: Satellite Technology for public health

Environmental information helps health care at public-level

Space Medicine

Health Care at Individual-Level

- for Astronauts
- for people on earth

Satellite Technology

1. Communication
2. Earth observation
 1. Monitor
 2. Assessment
 3. Prediction, Prevention

Benefits from space for Public Health

Health Care at Public-level

- Contribution of space technology
 - ◆ Earth observation
 - ◆ Human health
 - ◆ Education



Satellite data for health issues

Air quality and aerosol mapping

Air pollution
(PM, Ozone, NO_x,
SO_x, etc.)

Aerosol
Asian dust (Kosa)

Green House Gas
(GHG)

Vector's habitat/transmission route characterization and mapping

Land surface
Temperature

Precipitation

NDVI
(Normalized Difference
Vegetation Index)

Sea surface
Temperature
Ocean color

LULCC, DEM

Geographic Information System (GIS as base map)

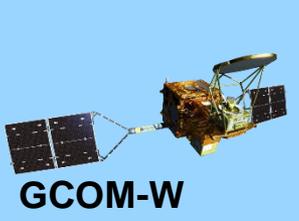
JAXA Satellite Programs

Late 1990s

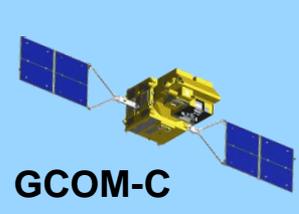
2000s

2003 (JAXA established)

Earth Observation



Climate Change/Water



precipitation, aerosols, solar insolation,
surface temperature, soil moisture,
ocean color

Global Warming

GOSAT-2

Land Use

Disaster Monitoring



land use classification, DEM ...

Communications

COMETS

DRTS

WINDS

Technology Development

Positioning

QZSS

ETS-VI ETS-VII

OICETS ETS-VIII

ALOS-2



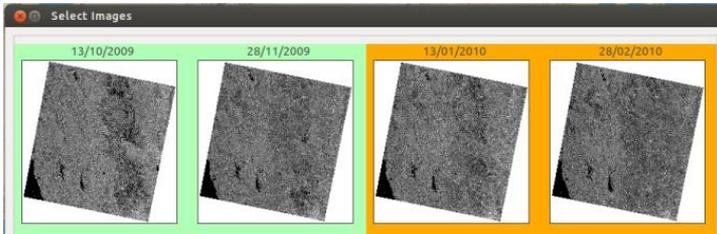
Application	Disaster, Land, Agriculture, Natural Resources, Sea Ice & Maritime Safety
L-band SAR (PALSAR-2)	Strip map: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1 × 3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: \leq +/- 500m
Life time	5 years (target: 7 years)
Launch	JFY2013, H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (Data Relay)
Experimental Instrument	Compact InfraRed Camera (CIRC) Space-based Automatic Identification System Experiment 2 (SPAISE2)

GOAL 2: Zero Hunger –satellite application for agriculture

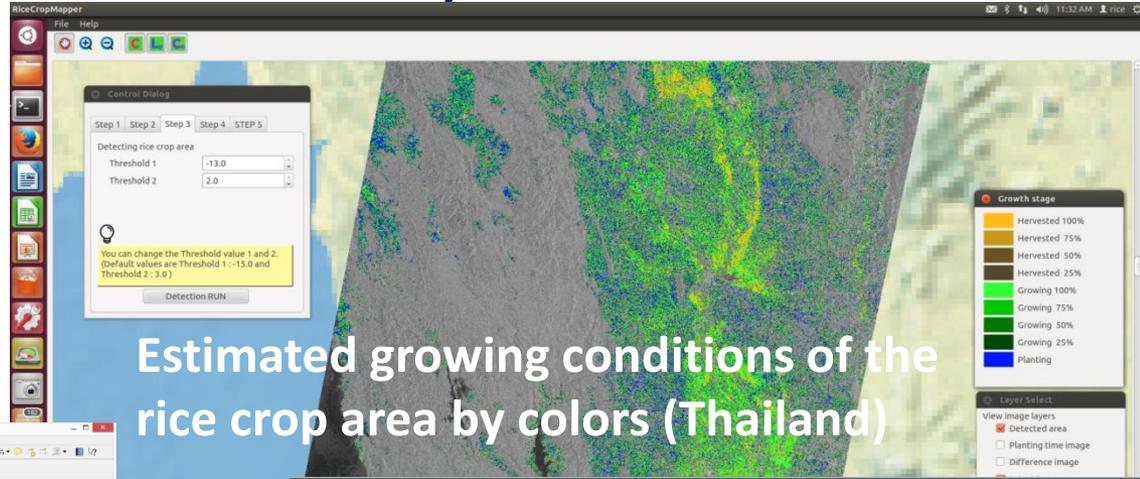
Applied Countries

- ☐ Philippines
- ☐ Vietnam
- ☐ Thailand
- ☐ Lao PDR

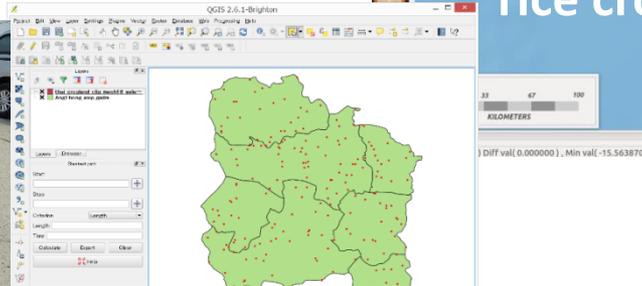
Improved quality (80 % accuracy) and timeliness of rice crop area and production estimates and forecasts (quarterly within one month)



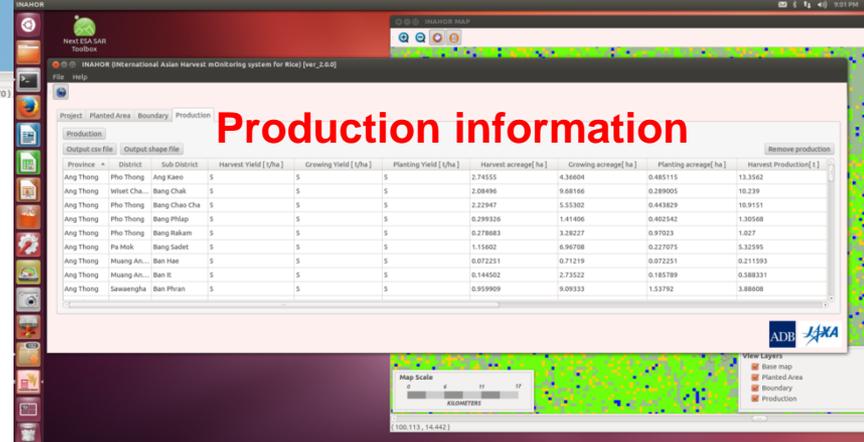
Rice area and growth estimation using ALOS-2



Estimated growing conditions of the rice crop area by colors (Thailand)



Field survey to tune up and validate result



Production information

JAXA-ADB Agreement opened a way for application of space technologies to development in Asia Pacific region.



宇宙航空研究開発機構



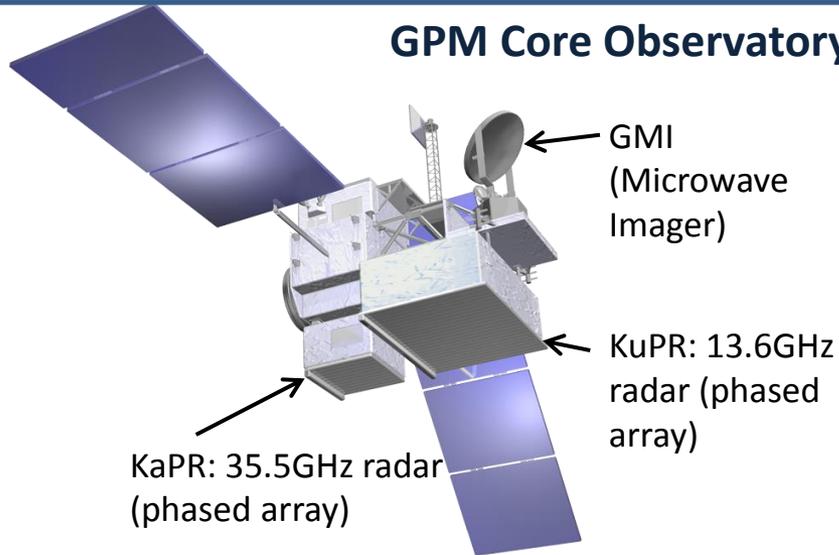
Asian Development Bank

FIGHTING POVERTY IN ASIA AND THE PACIFIC

Goal 6: Clean Water and Sanitation

- Global Precipitation Measurement Mission (GPM) -

GPM Core Observatory



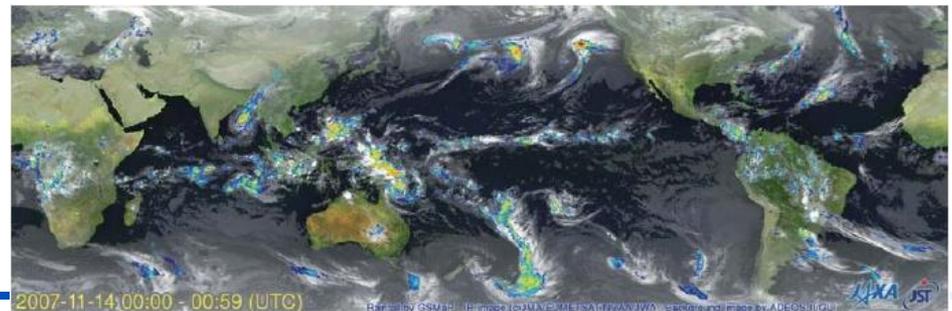
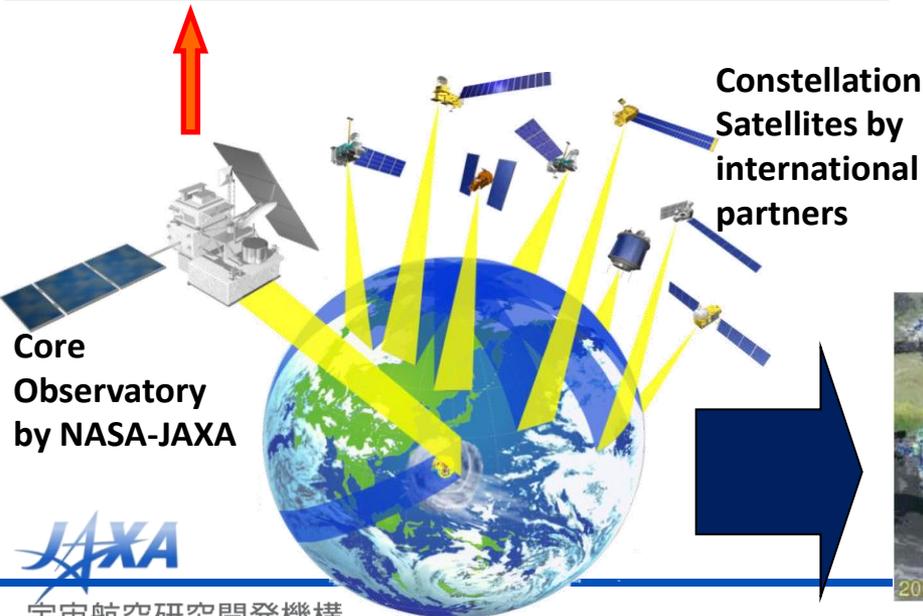
- GPM is an international mission consisting of the GPM Core Observatory and Constellation Satellites for high accurate and frequent global precipitation observation.

- Core Observatory: developed under NASA and JAXA equal partnership.
- Constellation satellites: provided by international partners (includes GCOM-W).

■ Dual-frequency Precipitation Radar (DPR)

- developed by JAXA and NICT
- DPR is composed of two radars: KuPR & KaPR

- GPM Core Observatory was successfully launched **on 28 Feb. 2014 (JST)**.



Goal 6: Clean Water and Sanitation

- Advanced Microwave Scanning Radiometer (AMSR) -

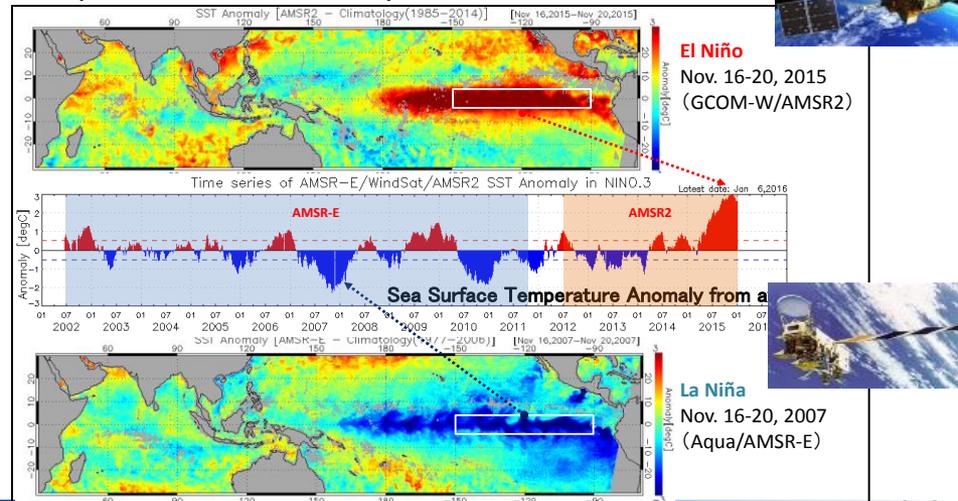
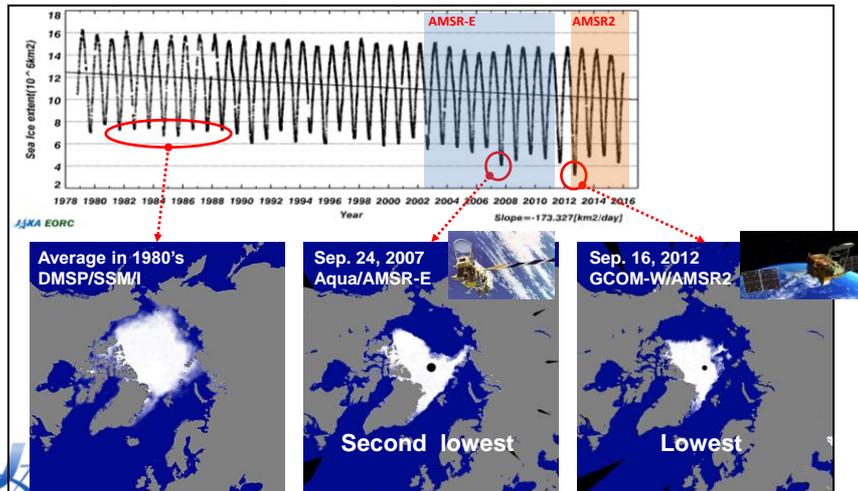
AMSR-E on Aqua (NASA satellite)
2002.6 – 2011.10

AMSR2 on GCOM-W
2012.7 – Current



Arctic Sea Ice Extent
(JAXA' contribution since 2002)

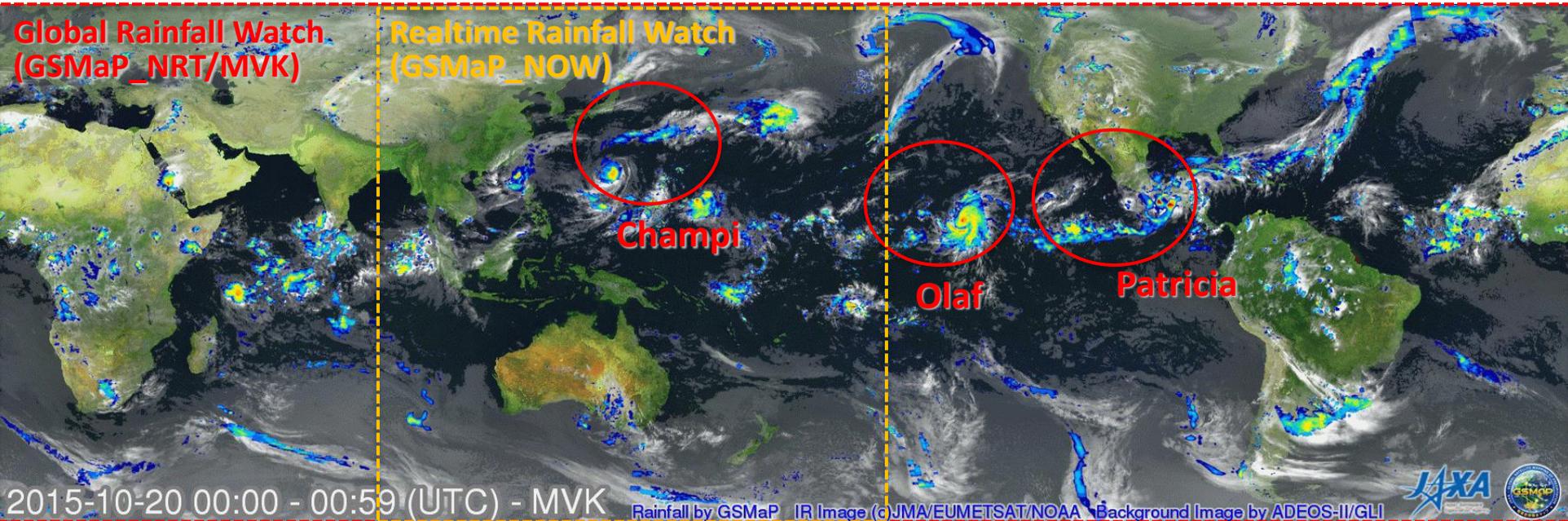
El Niño & La Niña Phenomena
(2002 - current)



Goal 6: Clean Water and Sanitation -GSMaP-

We have started to provide GSMaP_NOW over the area of Himawari-8!

- It provides precipitation data in an hour after observation
- We improved the data latency from GSMaP's 4 hours to “quasi-real-time”



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

- For climate phenomena that changes rapidly, frequent observations are very much needed.
- Global precipitation map integrating the data from GPM core observatory, microwave radiometers/sounders, and infrared radiometers of geostationary satellites

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

Goal 13: Climate Action



- Greenhouse Gases Monitoring -



GOSAT the Greenhouse gases Observing SATellite

- Monitoring global distribution of Greenhouse Gases from space
- Observing Carbon dioxide and Methane at 100-1000km spatial scale with relative accuracy of 1% (4ppm) for CO₂ and 2% (34ppb) for CH₄
- Joint project with NIES and MOE
- Launch: 23 January, 2009 by H2A launch vehicle (Lifetime: 5 years)

*NIES: National Institute for Environmental Studies

*MOE: Ministry of the Environment

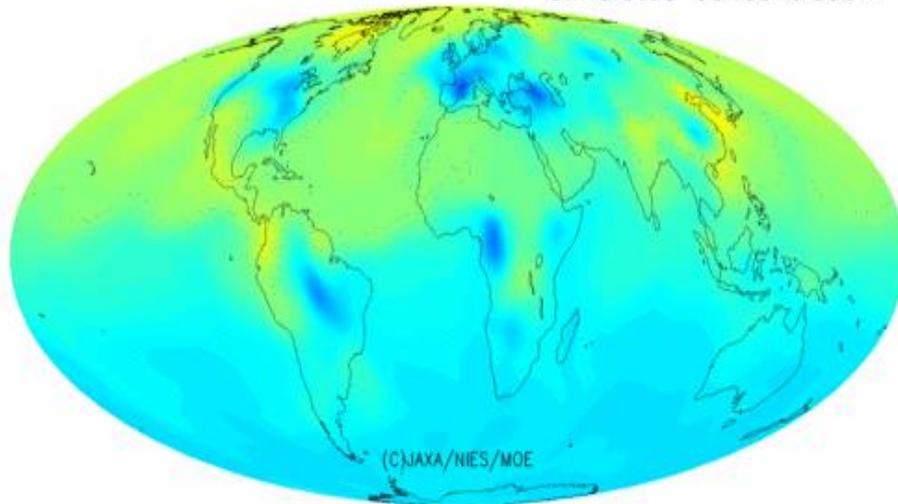
Goal 13: Climate Action

- Greenhouse Gases Monitoring -

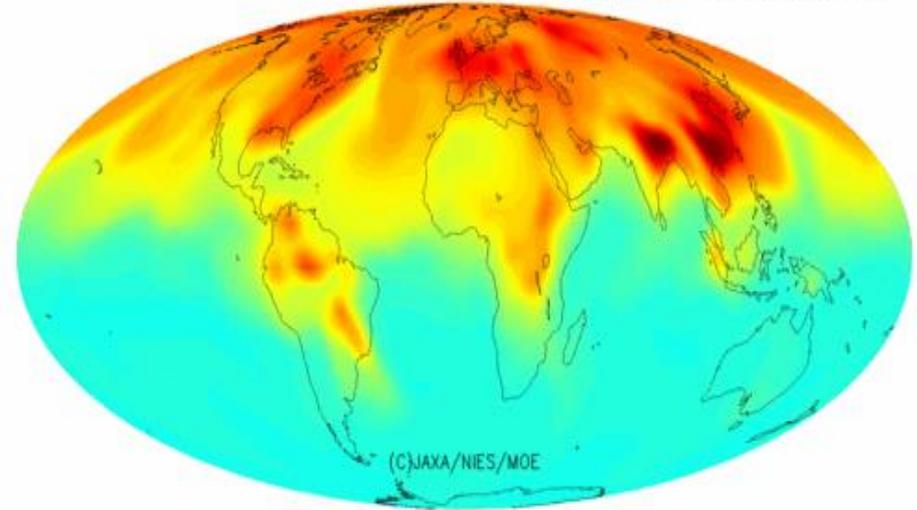
Daily average CO₂ concentration

(June 2009 - May 2011,
at 800 km altitude)

GOSAT L4B V02.02 CO₂ (2009/06/01) ETA:925
Simulated Concentration



GOSAT L4B V01.01 CH₄ (2009/06/01) ETA:925
Simulated Concentration



Daily average CH₄ concentration

(June 2009 - May 2011,
at 800 km altitude)

(c) MOE/NIES/JAXA

Goal 13: Climate Action

- Greenhouse Gases Monitoring -

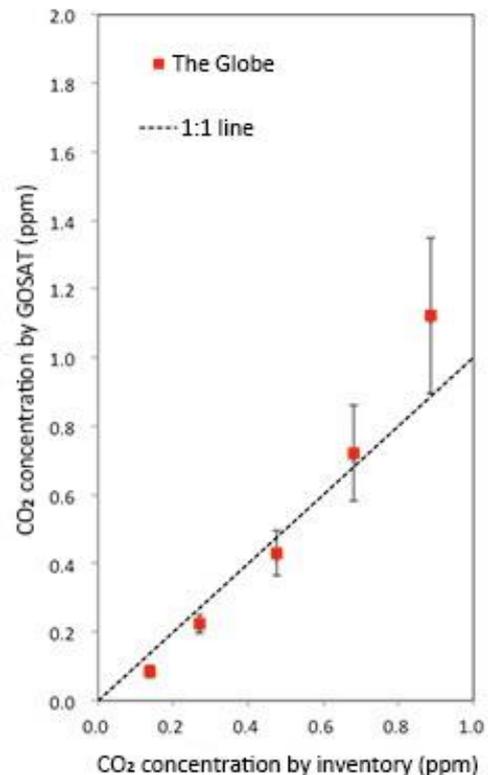


GOSAT

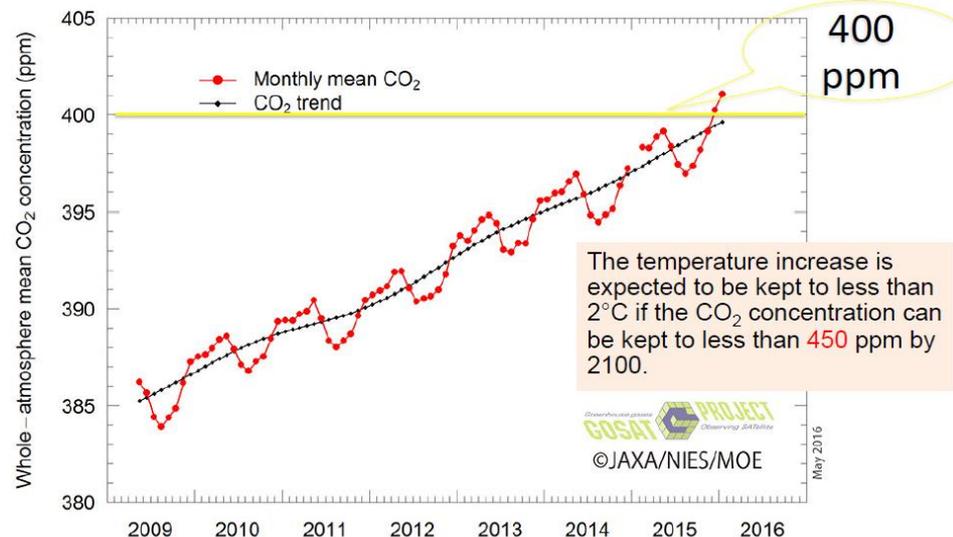


GOSAT-2

2018 (planned to launch)



Comparison of CO₂ concentration observed by GOSAT and inventory data in Japan: **showing a 1:1 correlation**



Trend of atmospheric mean CO₂ Concentration observed by GOSAT

GOAL 15: Life on Earth – Forest Preservation –



JJ-Fast
WEB page

25m resolution
Global Forest / Non-Forest Map

JICA-JAXA Forest Early Warning System in the Tropics

Rainforest Monitoring Map | Topics | Partnership | Forest Governance Improvement Initiative | About JICA & JAXA

From Partners

2016.8.25 "The JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)" will be demonstrated at the TICAD VI side event.

2016.8.22 New field reports and pictures from participated countries arrive.

2016.8.19 "The JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)" newly opened!

2015.12.16 A press release on "the JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)" was released at the JICA's website.

Copyright © Japan International Cooperation Agency

- Update data on forest logging every 1.5 months.
- Data access from mobile devices.

This system has been made available with cooperation with JICA



JAXA's Contribution to SDGs

- ◆ Provide Satellite Data as indicators to monitor progress of the efforts for SDGs. (National/Global)
- ◆ Provide Satellite Data for the use for application to promote SDGs.
- ◆ Cooperate with other research institutes and international development aid organizations.
- ◆ Conduct research and development as well as demonstration to develop new infrastructure in Asia.

Space for Humanity

**Space solutions will contribute to creating
a better society
by “Bringing the benefits of space to earth”**

**UNISPACE+50 will unite diverse
stakeholders to achieve SDGs**

