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. <u>Space medicine</u> : 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. <u>Satellite technology</u> : 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



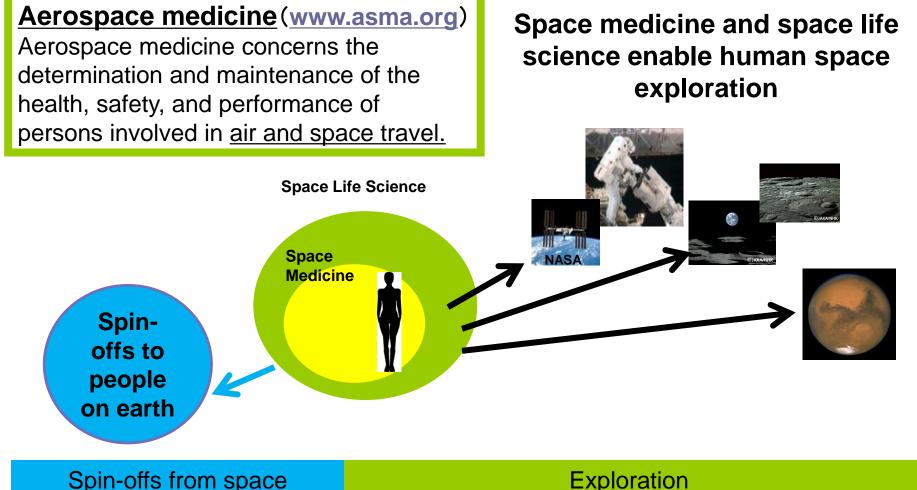


"War of the Worlds " by H.G.Wells

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



Spin-offs from space

Applications of Space Medicine on Earth

Preventive medicine in space

Physiological Countermeasure

> Bone Loss Exercise method

Physiological Support

•Behavior and performance Stress management

Telemedicine in orbit

·HDTV ·Portable Medical device

Development of Japanese Space Food

·Fortified foods

Health Care of Astronauts

·Health care

·Sleep work cycle



Long-term bed rest verification



Long-term isolation experiment



High-definition Camera



Japanese Space Food



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 Spinoffs by Human **Space Flight** Technology

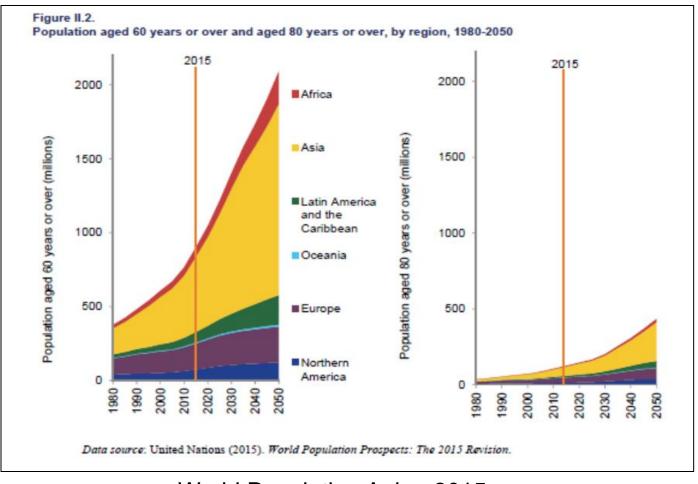
 Diagnostic Devices >Thermometer

 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. <u>Satellite technology</u> : 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

D. Contraction

Ibuki(GOSAT)

Space Medicine

Health Care at Individual-Level

- for Astronauts
- for people on earth

Satellite Technology

1.Communication

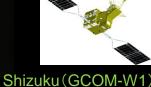
- 2.Earth observation
 - 1. Monitor
 - 2. Assessment
 - 3. Prediction, Prevention

Benefits from space for Public Health

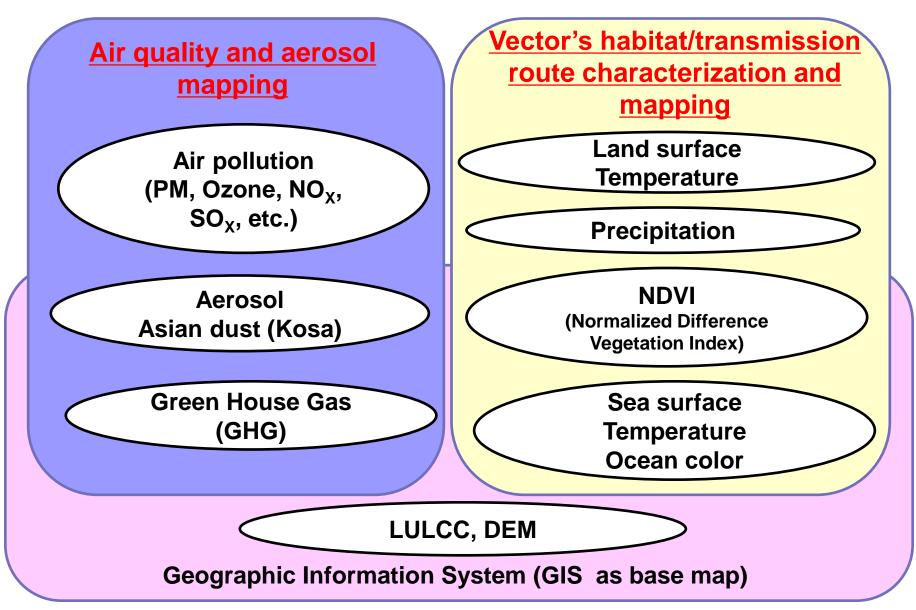
Health Care at Public-level Contribution of space technology

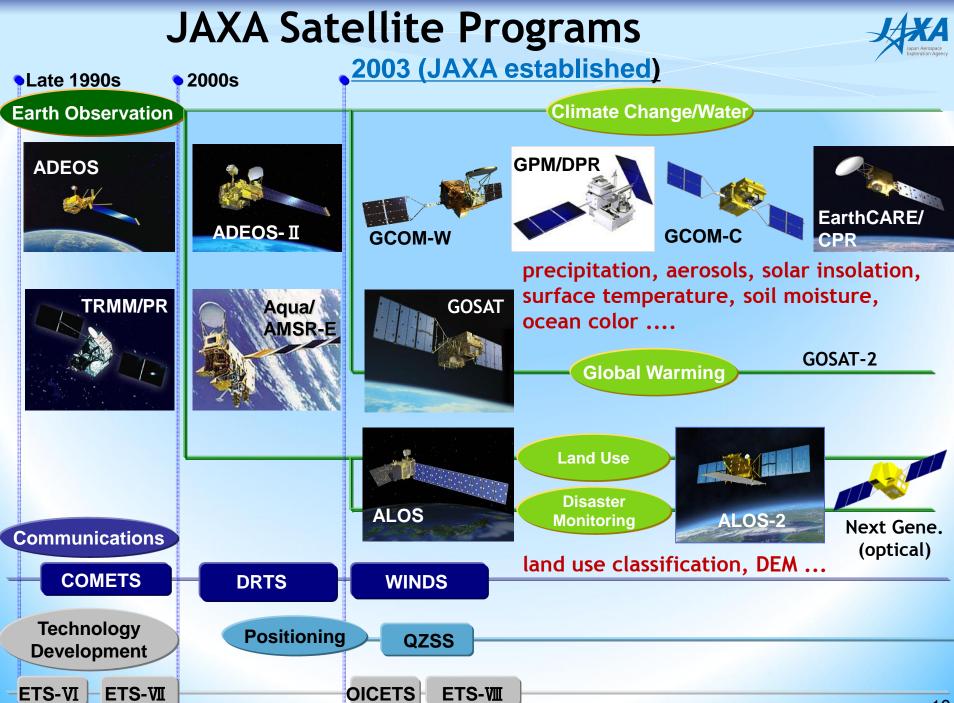
- Earth observation
 - Human health
 - Education





Satellite data for health issues







	and an an all the second se
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: $1 \times 3m$ res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628 km Local sun time : $12:00 +/- 15$ min Revisit: 14 days Orbit control: $\leq +/-500$ m
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-

(quarterly within one month)

O 🕀 🔾 🕻 🗖 🕻

ep 1 Step 2 Step 3 Step 4 STE

old 2:3.0)

Estir

rice

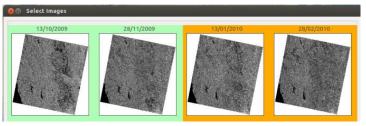
Improved quality (80 % accuracy) and timeliness of rice

crop area and production estimates and forecasts



D Vietnam

- Thailand
- 🗖 Lao PDR



Rice area and growth estimation using ALOS-2



Field survey to tune up and validate result

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

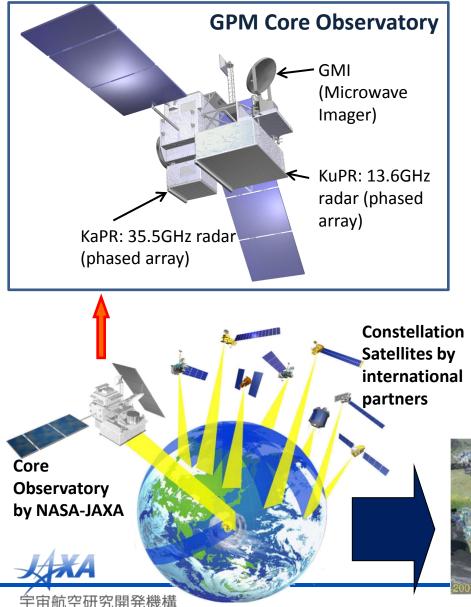
ted growing conditions of the failed growing conditions of										1	Hervested 25% Growing 100% Growing 75% Growing 50%
Cop area by colors (Thailand) Image: set of the set of th	te		-		ing	cond	litic	nsc	fth		
op area by colors (Thailand)			5	-A''	1115	Source	1111	HP		-	Planong
op area by colors (Thailand)				Ser Ser		and the second		Contraction of the second	Last I	-	aver Select
Particular		S	05		VICO	OFC		at ar	36	1000	
Particular		eu	Ee			IUD					Detected area
		8324		Sector 1		And a start		Mary and State			Planting time image
		1			A. 1. 1.			and the			Difference image
	INAHOR									-	871 ž tu eti i
		-									
	0							P			
		Next ESA SAR									
Protect Production		TOOIDOX							a data data da		a subscription of the subs
10 Participant Restord Area Boundary Production Production Consequences (%) Production Consequences (%) Restord Restord (%) 10 Product Product Mark Sold Data & Sold Restord (%) Product Mark Restord Restord (%) Restord Restord (%) 10 Product Product Mark Sold Data & Sold Restord (%) Product Mark Restord Restord (%) Restord Restord (%) Restord Restord (%) 10 Product Mark Sold Restord (%) Sold Restord (%) Sold Restord (%) Restord Restord (%) Restord Restord (%) Restord Restord (%) 10 Product Mark Sold Restord (%) Sold Restord (%) Sold Restord (%) Sold Restord (%) Restord Restord (%) Restord Restord (%) 10 Product Mark Sold Restord (%) Sold Restord (%) Sold Restord (%) Sold Restord (%) Restord Restord (%) <t< td=""><td></td><td></td><td>t (INternatio</td><td>nal Asian Harves</td><td>t mOnitoring system for R</td><td>lice) [ver_2.0.0]</td><td></td><td></td><td></td><td></td><td></td></t<>			t (INternatio	nal Asian Harves	t mOnitoring system for R	lice) [ver_2.0.0]					
A grange finde finde state and the grand of the state and the state	- P-		-								
Instantia Proclamation Instantia Instantia Restrict of the Consequence of	0)										
Instantia Proclamation Instantia Instantia Restrict of the Consequence of						_		_			
Datace strafe Description Reverse Vield (J/h) Convergived (J/h) Description Description <thdescription< th=""> Description Descrip</thdescription<>		Project Plant	td Area Bou	undary Producti	Dro	duct	ion i	nfor	mati	<u>on</u>	
Datace strafe Description Reverse Vield (J/h) Convergived (J/h) Description Description <thdescription< th=""> Description Descrip</thdescription<>		Production			FIU	uuci			IIIau		
No Thome Montome And Statue S S 2.7455. 4.4664. 0.4511.5 1.3562 Ang Thome Winter, Cal		Output csv f	le Output	shape file	_		-	-		-	Remove production
No Three Worksom Beng Chak S S 2.2849.K 9.6146.G 2.2890.K 12.39 Virable More Three More Three <t< th=""><th></th><th>Province *</th><th>District</th><th>Sub District</th><th>Harvest Yield [t/ha]</th><th>Growing Yield [t/ha]</th><th>Planting Yield [t/ha]</th><th>Harvest acreage[ha]</th><th>Growing acreage[ha]</th><th>Planting acreage[ha]</th><th>Harvest Production[t]</th></t<>		Province *	District	Sub District	Harvest Yield [t/ha]	Growing Yield [t/ha]	Planting Yield [t/ha]	Harvest acreage[ha]	Growing acreage[ha]	Planting acreage[ha]	Harvest Production[t]
Ang Thong Pile Thong Bang Okao Cha S S S22947 S5352 0.44329 9.9111 Ang Thong Thoma Bang Philage S S 229932 L14080 0.45124 L5568 Ang Thong Thoma Bang Philage S S 229932 L14080 0.45124 L5568 Ang Thong Philage Name S S 229932 L12093 L32993 L32993 Ang Thong Hamada Bang Stade S S 0.40221 0.97129 0.92121 271295 271199 0.921119 Ang Thong Hamada Banet S S 0.40221 0.71294 0.82121 111993 0.82131					5		5				
Avg Thote Photog Bvag Photog S S 0.29936 14166 0.46154 1.5058 Avg Thote Photog Bvag Photog S S 0.29936 2.5275 0.57031 12.5275 Avg Thote Photog Bvag Photog S S 0.19936 2.8277 0.57031 0.22757 Avg Thote Photog Bvad Photog S S 0.19936 0.27231 0.27237 0.21937 Avg Thote Naurag Ava Mag Mark Bart S S S 0.472231 0.27239 0.211937 Avg Thote Naurag Av Mag Mark Bart S S S 0.472231 0.27239 0.82831	I				s		5				
Ang Thong Pho Thong Bang Stakem S S 0.276643 3.38227 0.97023 Ea27 Ang Thong Pho Thong Bang Stakem S S 0.10520 0.97024 Ea27 5.3505 Ang Thong Phos Thong Bans Have S S 1.10520 0.97014 227075 S.25054 Ang Thong Huang An	1000	Ang Thong	Pho Thong	Bang Chao Cha	s	5	5				
Apy Theory Physikab Beng Sadet S S 1.15602 6.49708 6.227075 5.32935 Apy Theory Mang Anali, Ban Heat S S 6.072211 0.71219 0.227105 0.211939 Apy Theory Mang Anali, Ban Heat S S 0.407251 0.21219 0.211939		Ang Thong	Pho Thong	Bang Phlap	5	5	5	0.299326	1.41406	0.402542	1.30568
Ang Thong Huang An Ban Hee S S G872251 G72291 G72253 G211933 Ang Thong Huang An Ban R S S G14562 273522 G165789 G368331	256	Ang Thong	Pho Thong	Bang Rakam	5	5	5	0.278683	3.28227	0.97023	1.027
Ang Thong Muung An Ban R 5 5 5 0.144502 2.73522 0.185789 0.588331		Ang Thong	Pa Mok	Bang Sadet	5	5	5	1.15602	6.96708	0.227075	5.32595
		Ang Thong	Muang An	. Ban Hae	5	5	5	0.072251	0.71219	0.072251	0.211593
Ang Thong Saweengba Ban Phran S S S S 0.555909 9.09333 1.53792 3.8608	<u></u>	Ang Thong	Muang An	. Ban It	5	5	5	0.144502	2.73522	0.185789	0.588331
		Ang Thong	Sawaengha	Ban Phran	5	5	5	0.959909	9.09333	1.53792	3.88608
	Correspondence in the second)			
	0										
	1										ADB X
ADE 🚧			_				COLUMN DATE		M321 AV64	41.120	View Layers
ADB 4								100 C 100 C	1.424 N.K.	1990 - N. M.	🗧 😸 Base map
Mar and a second a									C 162 C 1		
Rup Sale							0 6				
Mag Solar Mag Solar								11 17	63 C V W	- CAR - 1	
Mag Katar Mag Katar Mag Katar Kata								11 17 ETENS	$Q \in \{0\}$	$\mathbb{C}_{2}(\mathbb{R}^{n})$	

FIGHTING POVERTY IN ASIA AND THE PACIFIC

宇宙航空研究開発機構

Goal 6: Clean Water and Sanitation

- Global Precipitation Measurement Mission (GPM) -



- 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).



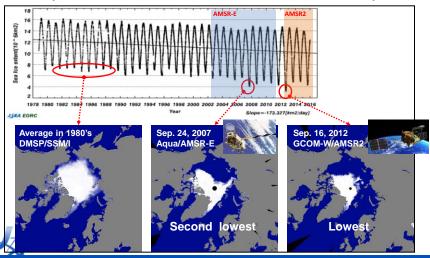
Goal 6: Clean Water and Sanitation

Advanced Microwave Scanning Radiometer (AMSR) -

AMSR-E on Aqua (NASA satellite) AMSR2 on GCOM-W 2002.6 - 2011.10



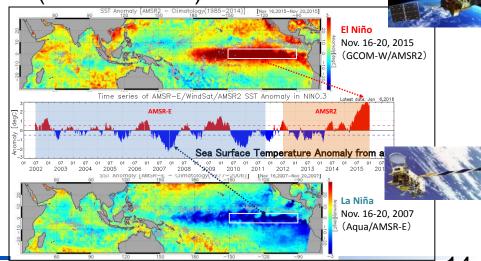
Arctic Sea Ice Extent (JAXA' contribution since 2002)



2012.7 – Current



El Niño & La Niña Phenomena (2002 - current)



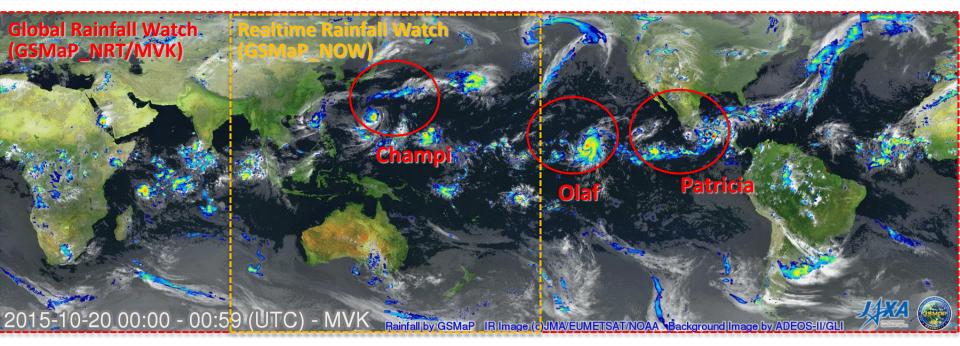
宇宙航空研究開発機構

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

т5

Goal 13: Climate Action



Greenhouse Gases Monitoring -

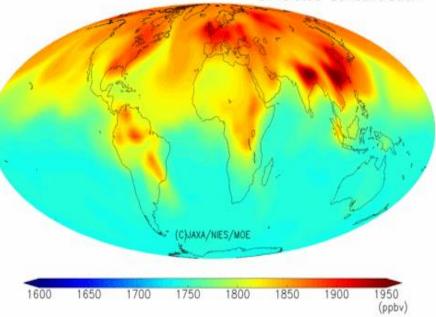
GOSAT the <u>Greenhouse gases Observing</u> <u>SATellite</u>

- 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 -

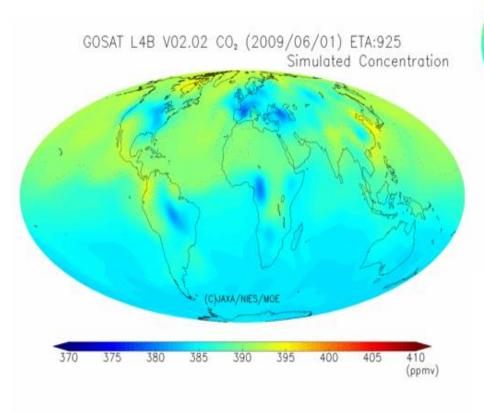
GOSAT L4B V01.01 CH. (2009/06/01) ETA:925 Simulated Concentration



Daily average <u>CH4 concentration</u> (June 2009 - May 2011, at 800 km altitude)

(c) MOE/NIES/JAXA

Daily average <u>CO2 concentration</u> (June 2009 - May 2011, at 800 km altitude)



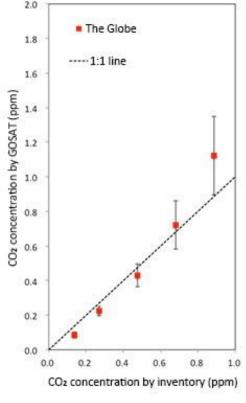
宇宙航空研究開発機構

Goal 13: Climate Action

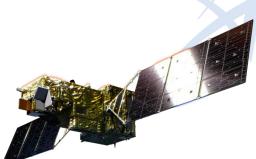
- Greenhouse Gases Monitoring -



GOSAT

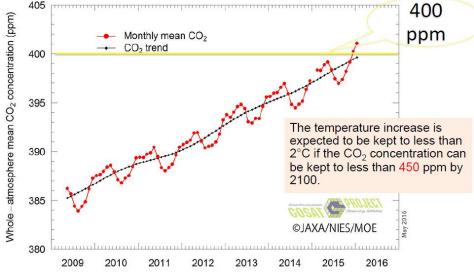






GOSAT-2 2018 (planned to launch)

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

🚻 JICA-JAXA Forest Early Warning System in the Tropics



rom Partners

rganizations, private companies, NGOs, aternational organizations etc.] arrive.

nformatio

 The JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)* w be demonstrated at the TICAD VI side event.
 New field reports and

- countries arrive.

 16.8.19 The JICA-JAXA Forest
 Reach Warries Sectors is
- the Tropics (JJ-FAST)" newly opened! 2015.12.16 A press release on "the JICA-JAXA Forest Earl Warning System in the Tropics (JJ-FAST)" was released at the JICA's

Tropics (JJ-FAST)⁺ was released at the JICA's web site. pan International Cooperation Age improvement or rorest Governance was officially released at the COP21 in

25m resolution Global Forest / Non-Forest Map

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

This system has been made available with cooperation with JICA

Japan International Cooperation Agency⁹

- pdates on Data Availa
- D16.8.24: Polygon data in Kenya are now a
- e Map Site Polygon data in Ucayali and San Martin states, Peru are ne Site Polygon SNS Terms of Use



JAXA's Contribution to SDGs

<u>Provide Satellite Data</u> as indicators <u>to monitor</u>
 progress of the efforts for SDGS. (National/Global)
 Provide Satellite Data <u>for the use for application</u>

to promote SDGs.

Cooperate with other research institutes and international development aid organizations.

◆<u>Conduct research and development</u> 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



