Nov. 9, 2015
PEOIC Seminar

National Satellite Earth Observation: Status and Policy issues

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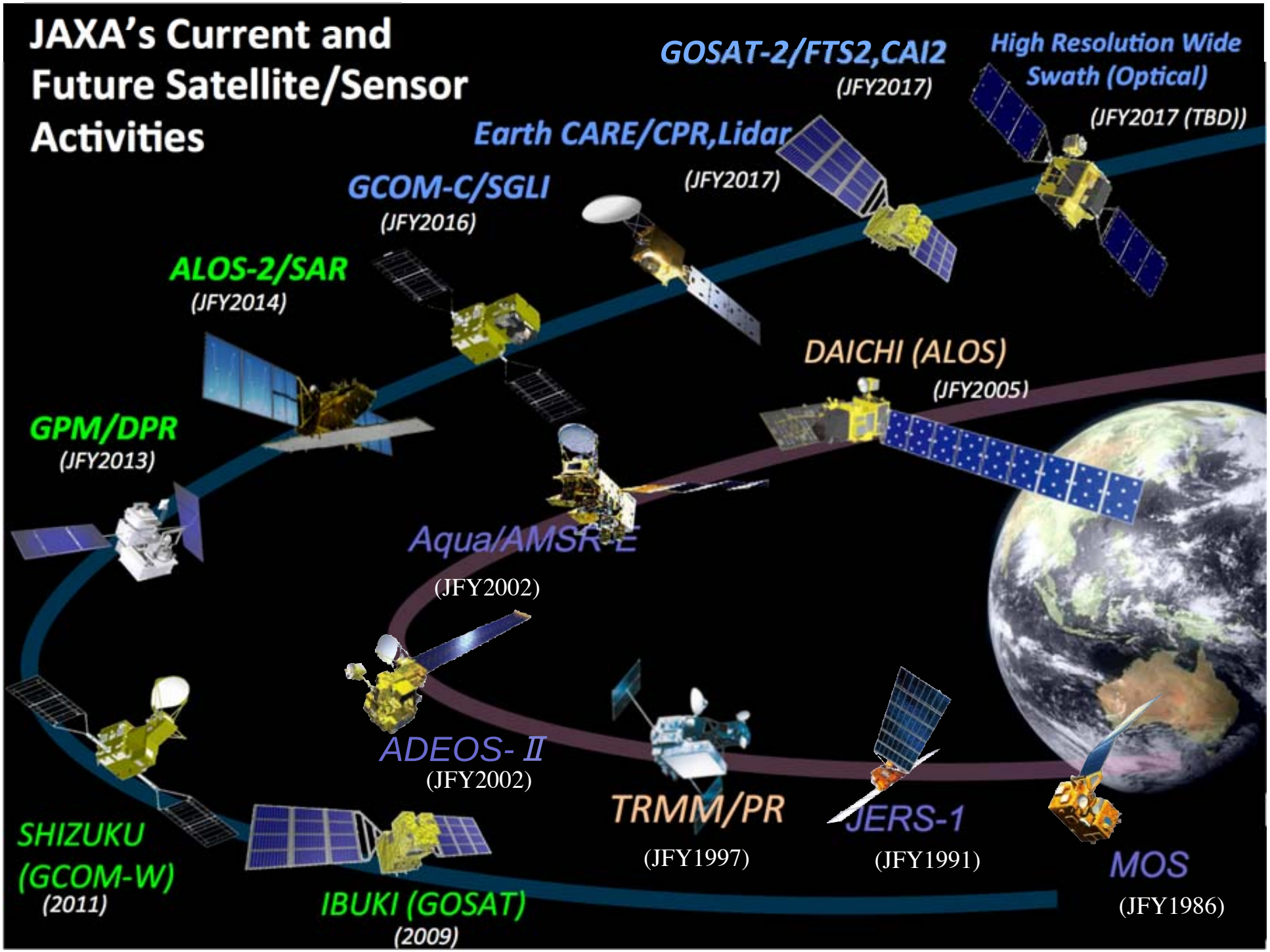
Policy related EO issues

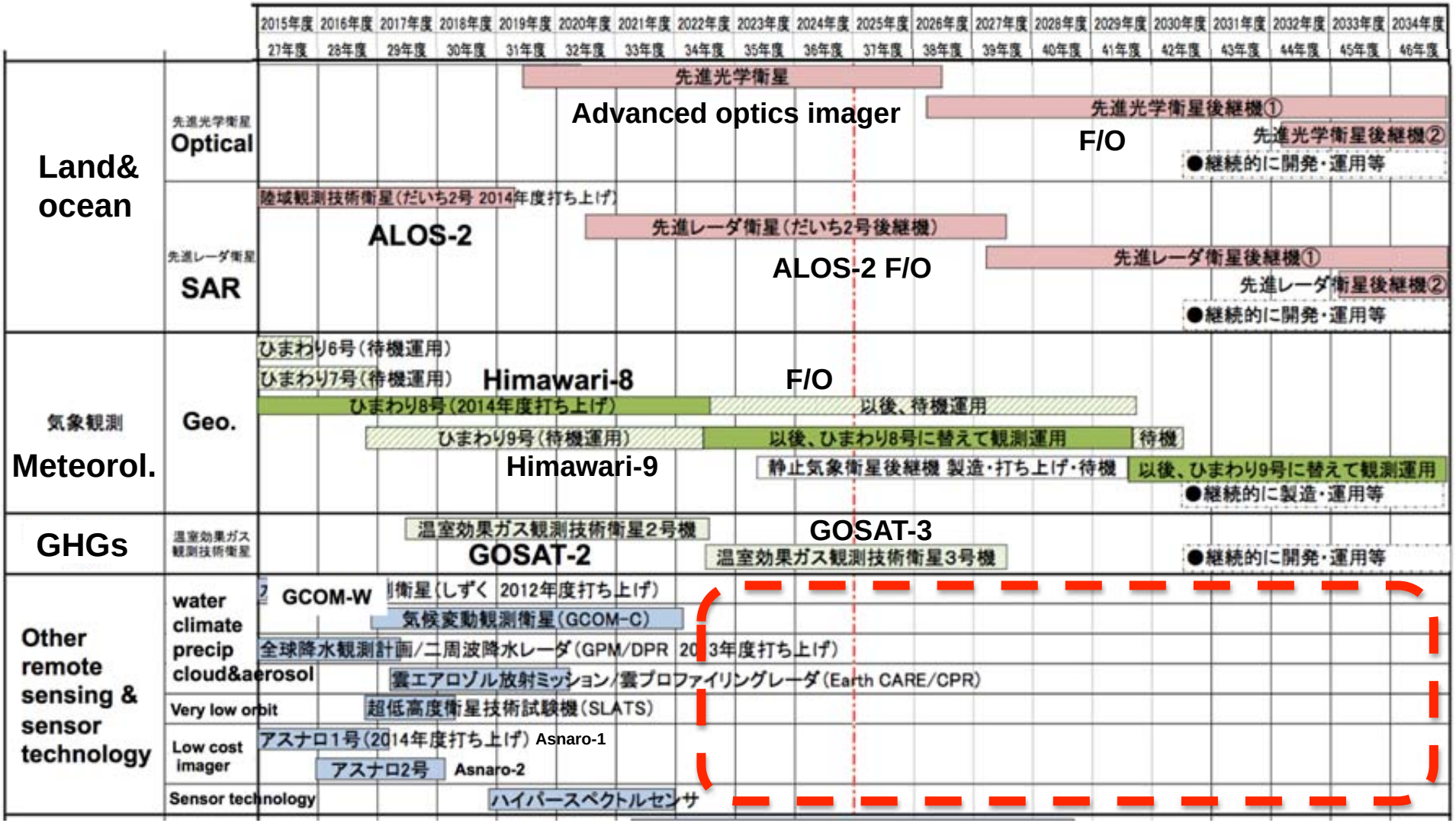
1. for EO satellite programming

2. for the remote sensing results


JAXA's Current and Future Satellite/Sensor Activities
GOSAT-2/FTS2,CAI2
(JFY2017)
High Resolution Wide Swath (Optical)
(JFY2017 (TBD))
Earth CARE/CPR,Lidar
(JFY2017)
GCOM-C/SGLI
(JFY2016)
ALOS-2/SAR
(JFY2014)
DAICHI (ALOS)
(JFY2005)
GPM/DPR
(JFY2013)
Aqua/AMSR-E
(JFY2002)
ADEOS-Ⅱ
(JFY2002)
TRMM/PR
(JFY1997)
JERS-1
(JFY1991)
MOS
(JFY1986)
SHIZUKU (GCOM-W)
(2011)
IBUKI (GOSAT)
(2009)

New Basic Plan on Space Policy & its work plan(Jan. '15)

- Governance by the Cabinet Office from MEXT
- No plan for other remote sensing satellites after 2020
- Sustainable development; longer satellite lifetime



New Space basic plan (Jan 2015)

- Space committee: Space Security; Space civilian use; Space industry, science and technology infrastructure (Space legislation; Space science and exploration Subcommittee; JAXA)
- Government promotion: Positioning; Remote sensing; Communication&broadcasting; Space science; Manned; Space solar power; Space transportation
- Development of Quasi-Zenith Satellite System
- No EO subcommttee

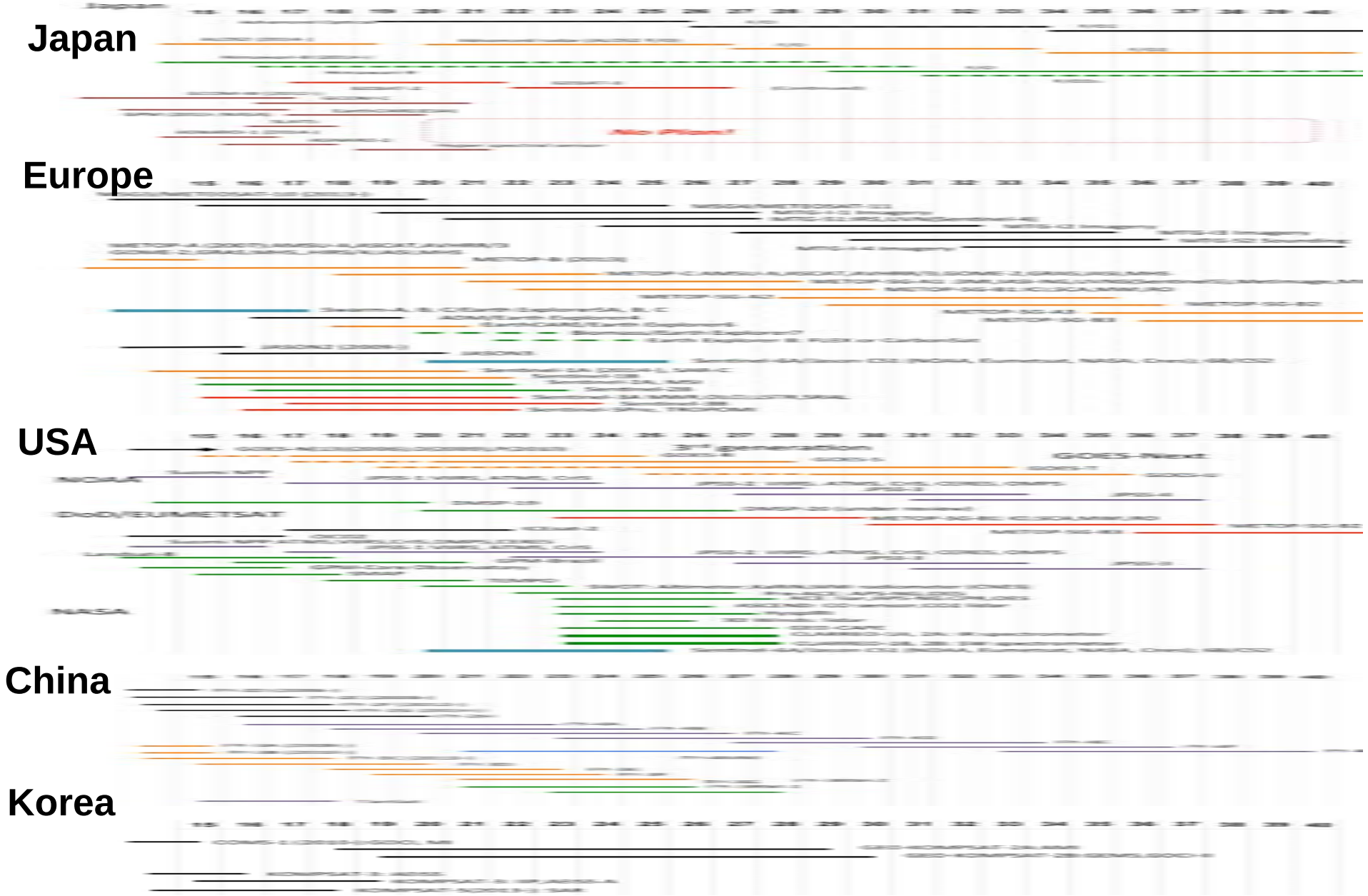
EO: High scientific contributions

	#articles	Citation except for self-citation	h-index	Articles in 2014	Citations in 2014
TRMM	2,224	27,974	85	232	262
AMSR	821	9,514	52	119	110
ALOS	787	5,033	34	169	174
GOSAT	191	1,262	25	42	50
GCOM	24	272	5	5	1
GPM	597	6,779	40	56	76
LANDSAT	9,828	139,670	147	1,021	993
MODIS	9,434	98,128	144	1,533	1,561

Web of Science（収録対象1993年以降）　2015年5月15日調べ。

h指数(h-index)　：　トピックや著者等の論文の被引用に関する指標。少なくともx回以上引用された論文がx本。

Need sustainable system
International coordination (GEO, CEOS, WIGOS)



Policy issues for EO satellite programming

- Programming in the 2020-2040 horizon in Europe, US, China and others; International coordination and planning; Role of GEO, WIGOS, CEOS important
- Japan: Programming by the Space Basic Plan
  - Governance: MEXT to Space committee
    - Low evaluation of EO science
    - Multi-ministry planning, difficult
    - No planning after 2020 of "other remote sensing" category: GCOM series; AMSR,DPR,CPR etc
    - We need EO subcommittee; Bottom−up discussion started
- Technology transfer/Businesses vs R&D/Capacity building
    - JMA Himawari: Omnibus Foreign Trade and Competitiveness Act article 301 (Super-301) vs WTO Panel report
    - Europe: role of ESA in the Sentinel program; 2 Geo from China

Cross-cutting Researches@EORC

5th, 6th Science&Tecnol. Basic Plans

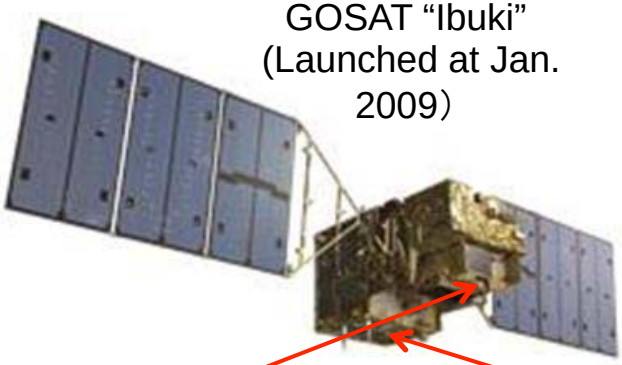
data → analysis, modeling, (JSS2 Super comp. etc) → Applictions tooles ⇔ Frameworks Policies

Info. Platform on earth environent observation & prediction technology (MIC,MEXT,MLIT,MOE)

Field \ Satellite		ALOS 2	GPM TRMM	Earth CARE	GCOM	GOSAT	Himawari -8	Related Organization
Disaster Prevention		○						
Ocean monitor	Fishing boat	○						
	Environment		○		○		○	NiPR・MRI・JAMSTEC
Water cycle/Water resource management			○		○		○	UT PWRI
Atmosphere environment				○	○	○	○	MRI・NIES・ Kyushu Univ.・JMA
Infrastructure monitor		○						IDI・Others
Climate system/Radiative process			○	○	○	○	○	Univ. Tokyo
Ecosystem		○	○		○	○	○	Tsukuba Univ.・NIES・ Hokkaido Univ.・JAMSTEC
Agriculture		○	○		○		○	NIAES・UT
Public health		○	○		○		○	NCGM・Nagasaki Univ.・UT

CH4 Evaluation by GOSAT data

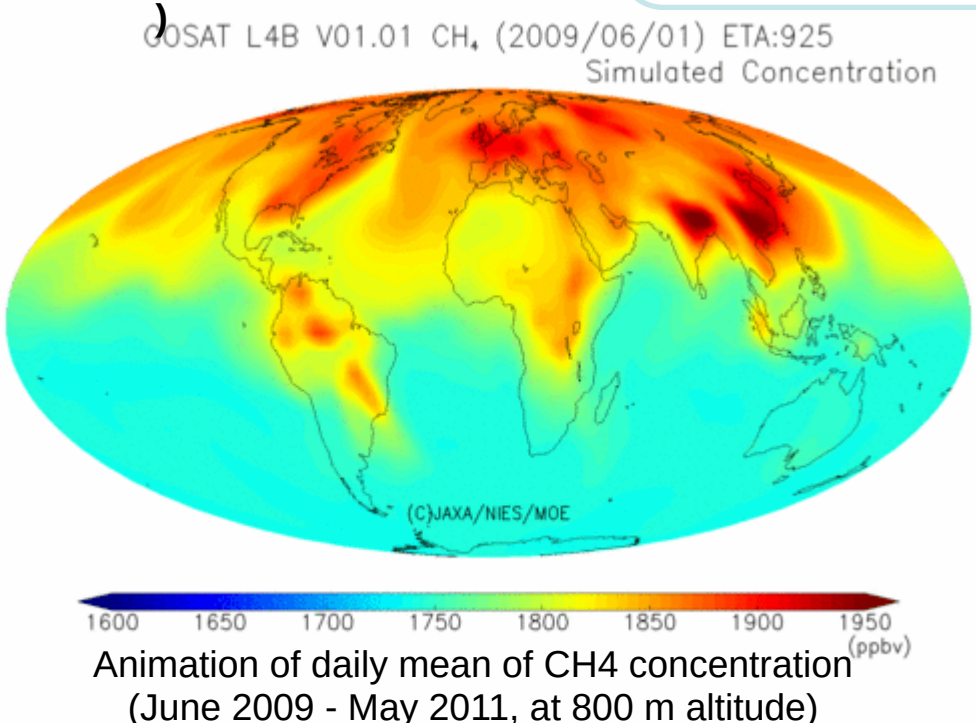
GOSAT “Ibuki” (Launched at Jan. 2009)



FTS (Fourier Transform Spectrometer)

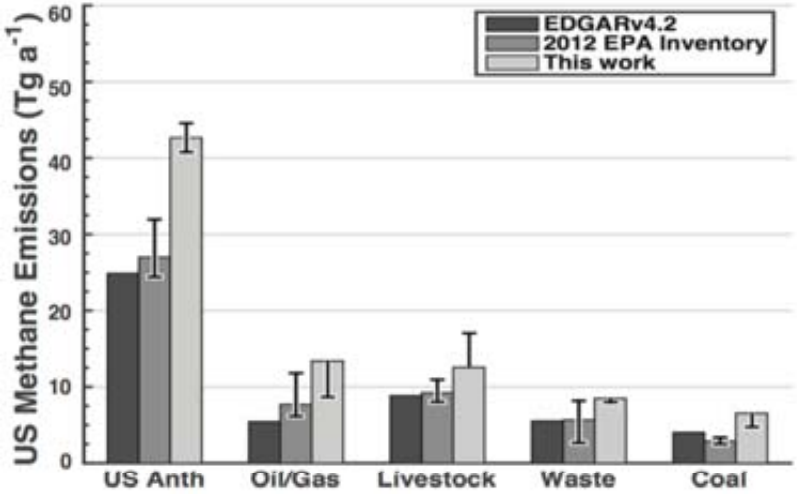
CAI (Cloud and Aerosol Imager)

- **Measure global distribution of GHGs, and understand how their emission is reduced.**
- **The only operation satellite for monitoring CO_2 and methane from space**



Animation of daily mean of CH4 concentration (June 2009 - May 2011, at 800 m altitude)

North America

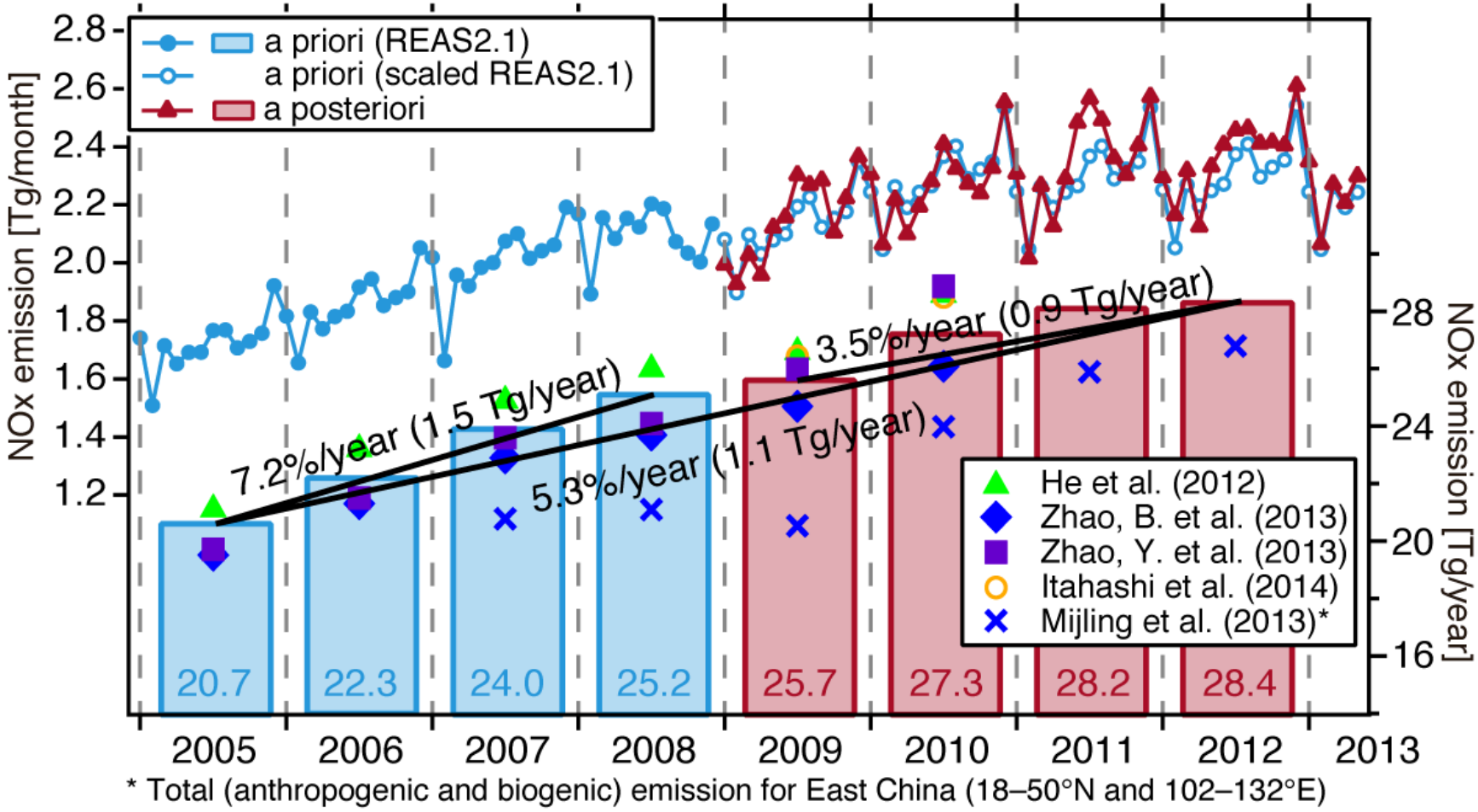


GOSAT CH_4 observation data showed that the existing EPA Inventory is underestimated (Turner/Harvard University) (ACP'15)

- **GOSAT-derived methane emissions are a factor of 1.5 and 1.7 larger than US EPA and EDGARv4.2**

MOEJ-S12/T1: Annual variation of Chinese emissions

- **Decrease in the emission increasing rate after 2009**
- **Introduction of satellite inversion loop to control measures**



T1: T. Ohara@NIES

Yumimoto et al. (JSAE, in print)

Does SLCP (BC,CH4,O3 etc) reduction works?

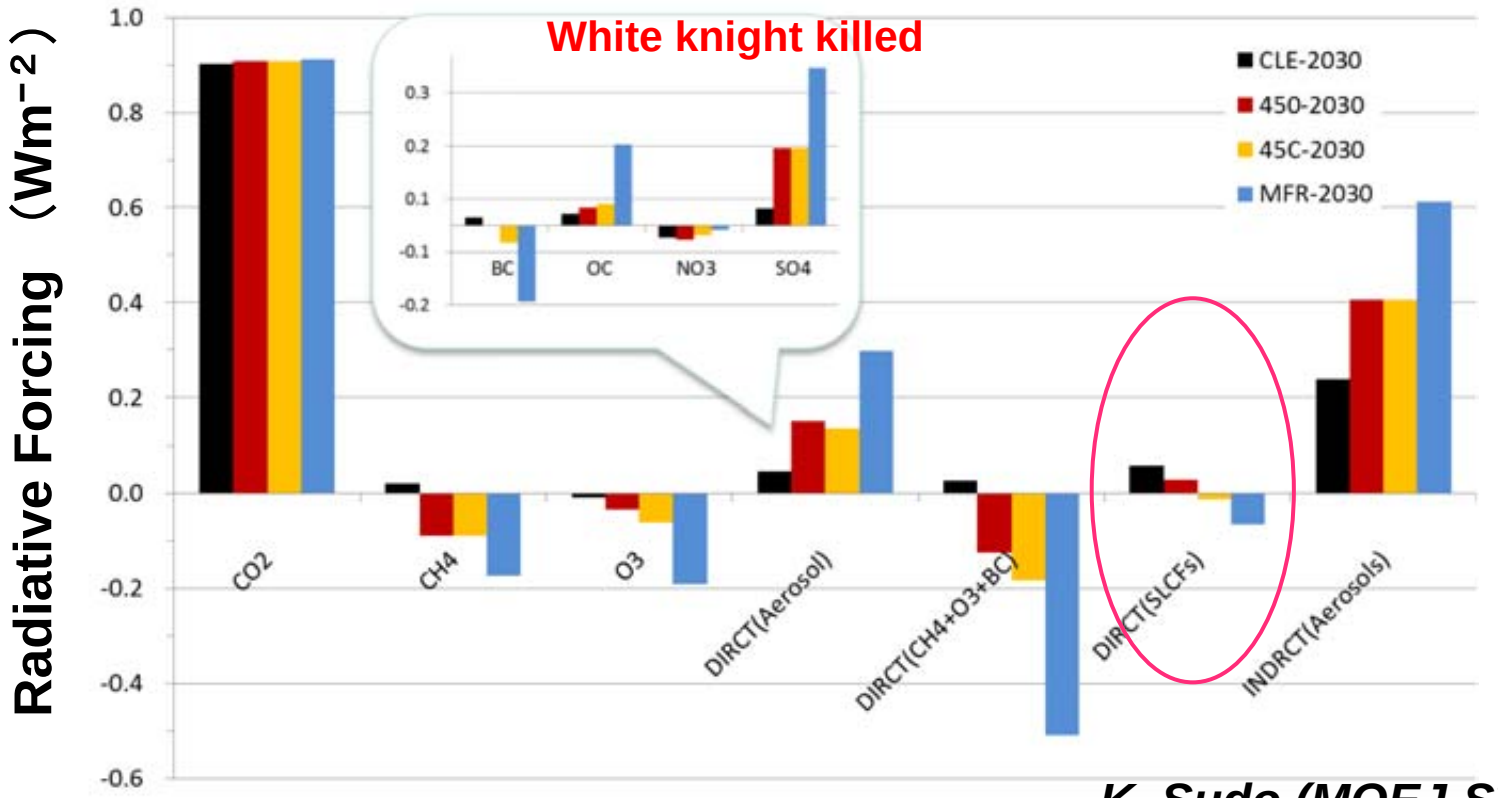
- **Climate and Clean Air Coalition**

IIASA emission scenario 2030:

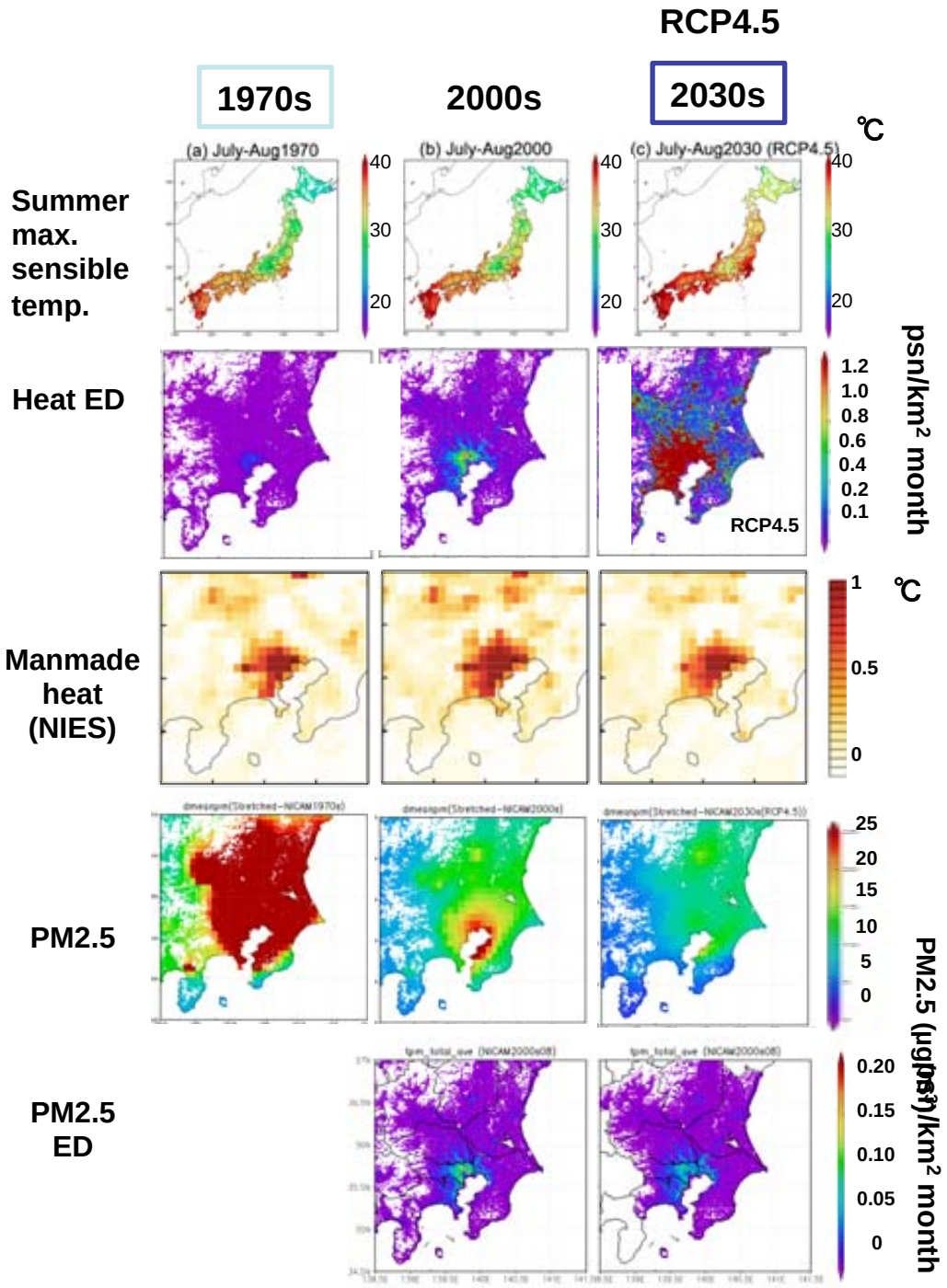
1. **CLE: Present action**
2. **450: Medium**
3. **450C: Enhanced Asian reduction**
4. **MFR: Maximum feasible reduction**

Need to monitor single scattering albedo of aerosols

CO2 450ppm
2005 to 2030



K. Sudo (MOEJ-S7 report)



Tokyo, August from 2000s to 2030s

Tem (°C)	29.7	31.0
O3 (μg/m³)	51.8	40.8
PM2.5 (μg/m³)	16.9	7.0

Excess death (persons/month)
(ratio to non-accident dth., %)

Temp	128.2 (2.6)	347.2 (3.4)
O3	113.8 (2.0)	165.8 (1.6)
PM:	59.6 (0.9)	43.2 (0.4)

PM-related mortality rate (psn/ Million inhabitants), acute only

Tokyo	60	43

Prematured death by PM

OECD	190	210
Chine	400	600
India	120	400

> 1.4 millions/world

Future:

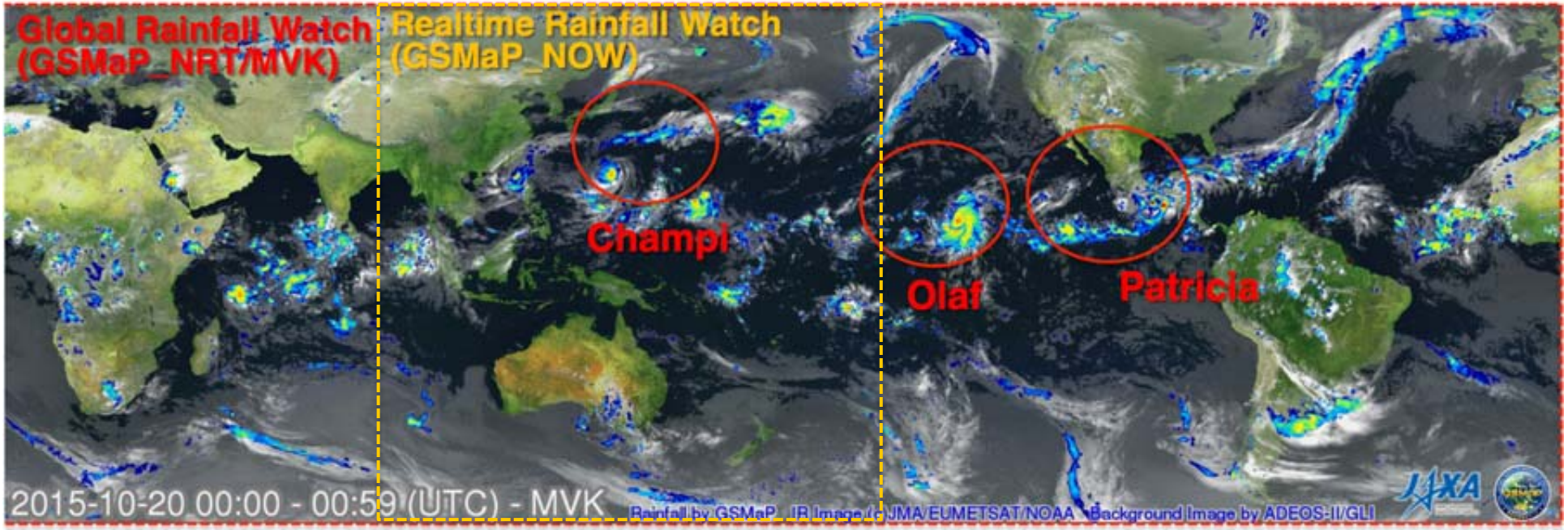
Scenario dep., Aged society

MEXT/RECCA/SALSA

JAXA's Contribution to Forecasting

"GSMaP_NOW" over "Himawari-8" area start just now!

Global Satellite Mapping of Precipitation (GSMaP)



GSMaP (Global) observed Hurricane Patricia and Olaf, and Typhoon Champi: 20-24 Oct. 2015, hourly animation

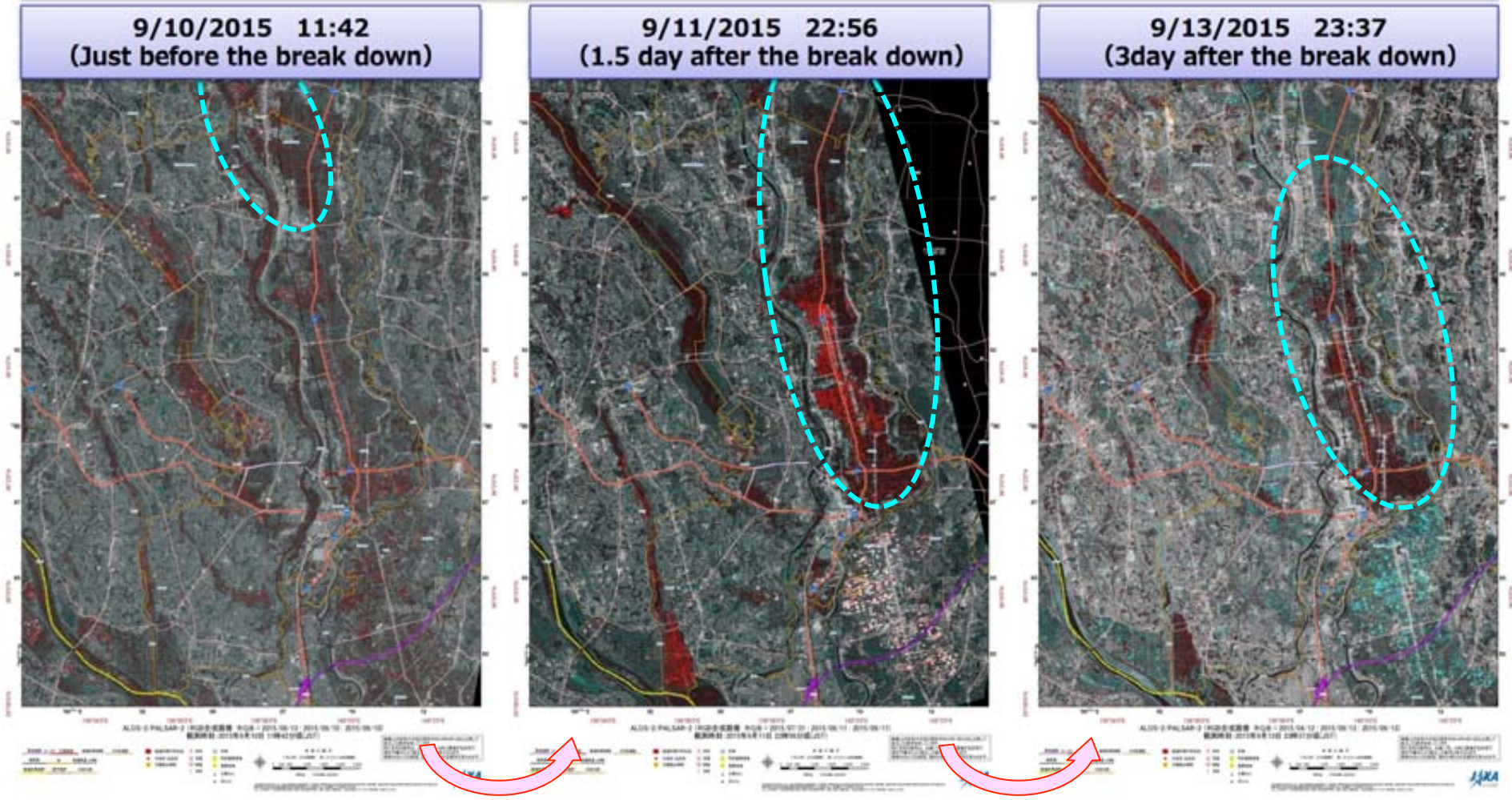
- **Rapidly changing precipitation phenomena need frequent observations.**
- **Global rainfall map merging GPM Core Observatory, polar orbiting microwave radiometer/sounders, and geostationary infrared radiometers.**

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

Flood caused by KANTO/TOHOKU heavy rain in Joso-city, Ibaraki-Pref. in September 2015.)

Flooded area detection by ALOS-2

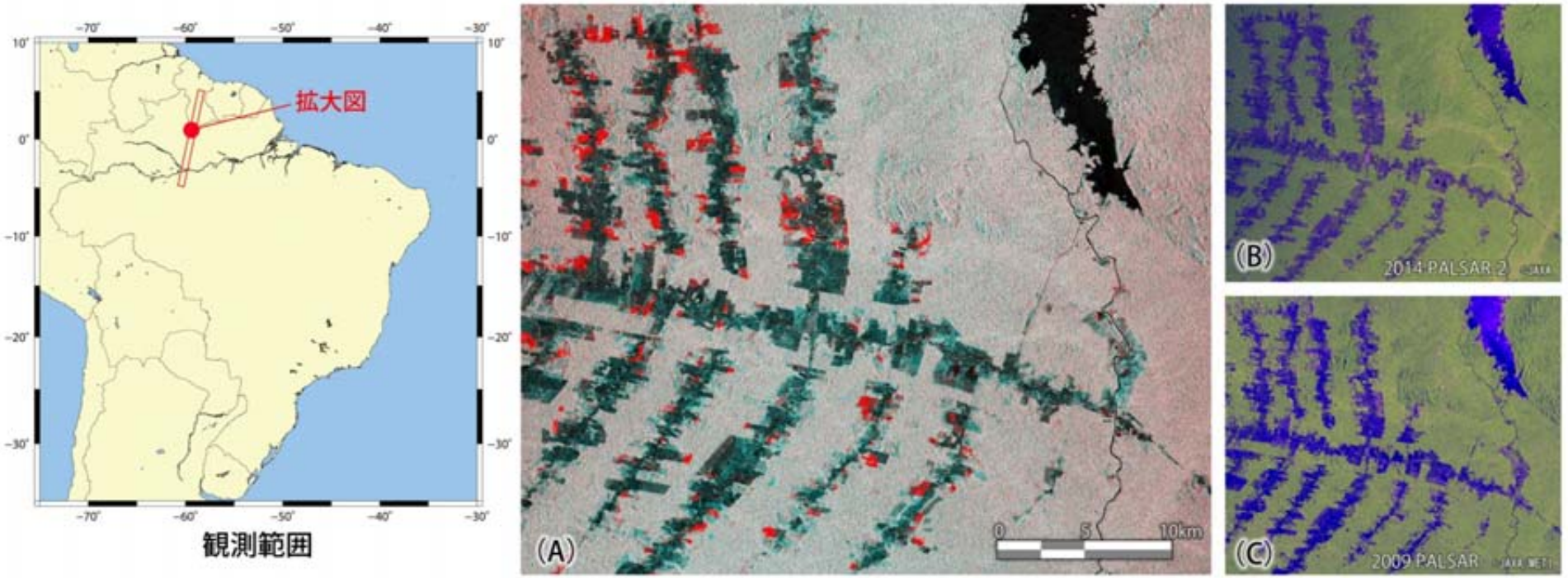
Grasp the flooded area, and Assist decision making for the dispatch request of drain pump vehicles



Flooded area expanding

Flooded area reducing but moving to south direction

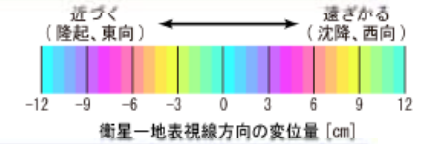
Deforestation in Amazon captured by PALSAR-2

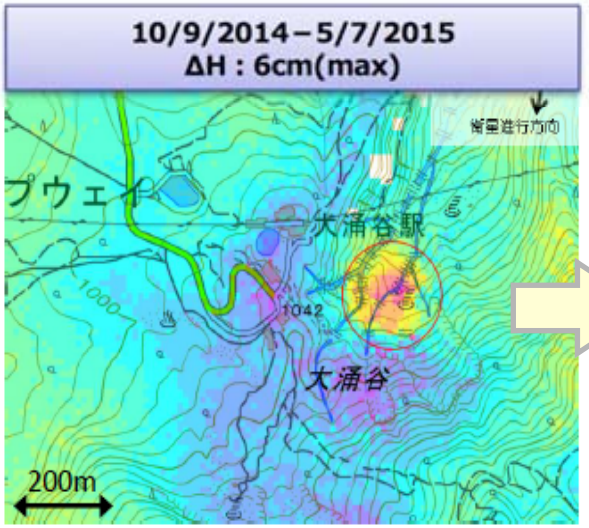


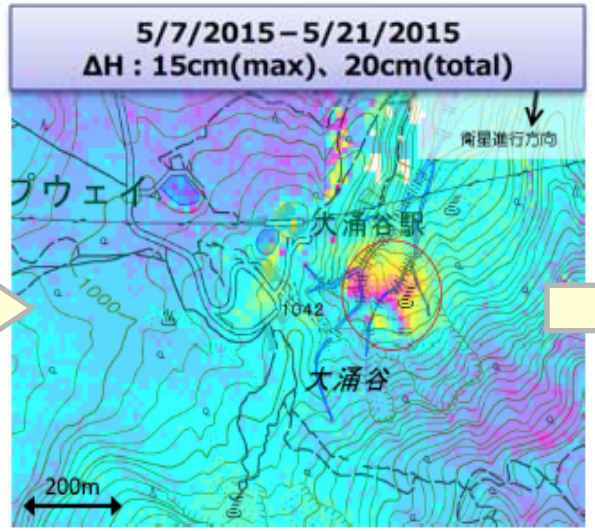
- Image (A) was compiled by combining image (B) acquired by the PALSAR-2 on June 21, 2014, and the other (C) shot by PALSAR (aboard the DAICHI) in 2009 and adding colors. (Sky-blue indicates non-forest areas, gray represents forests, red is deforested areas over five years.) The total deforested space reaches 25.0 km^2 within the area shown in this image.
- Observations by the PALSAR-2, which are suitable for measuring forestry with L-band radio waves, will enable global-scale forest monitoring. Therefore, the DAICHI-2 is expected to significantly contribute to the estimation of biomass of forests, which is deeply related to climate change and forestry control.

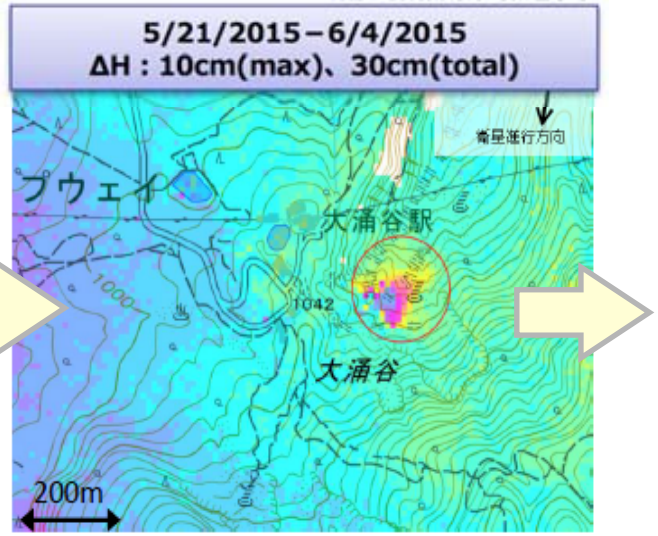
Monitoring the diastrophism around HAKONE area caused by volcanic activity

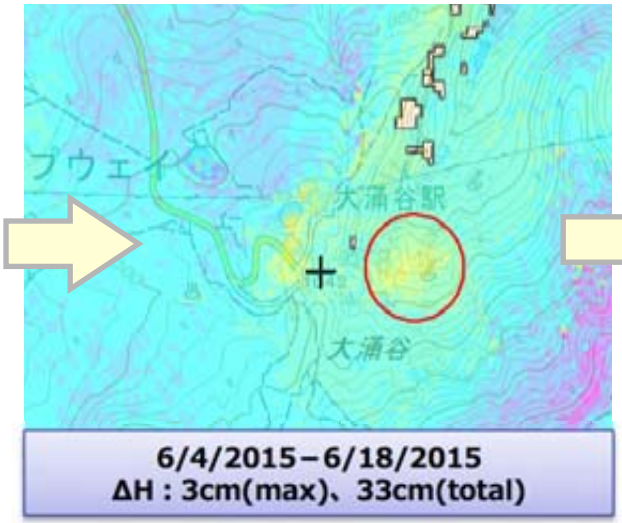
Monitoring the diastrophism by ALOS-2

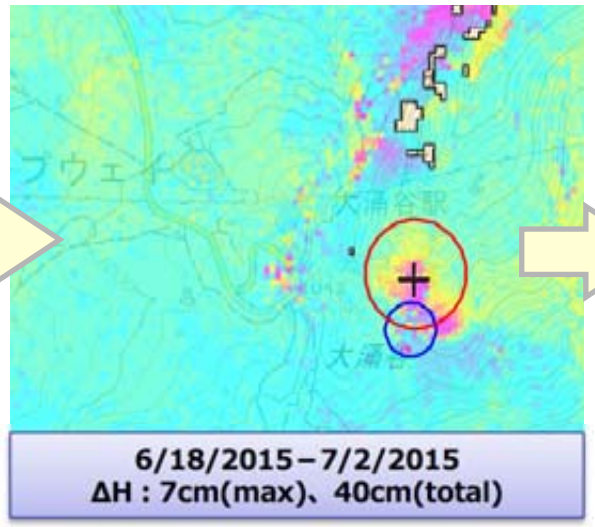












In-SAR data were used for setting and opening the no entry area by HAKONE town government

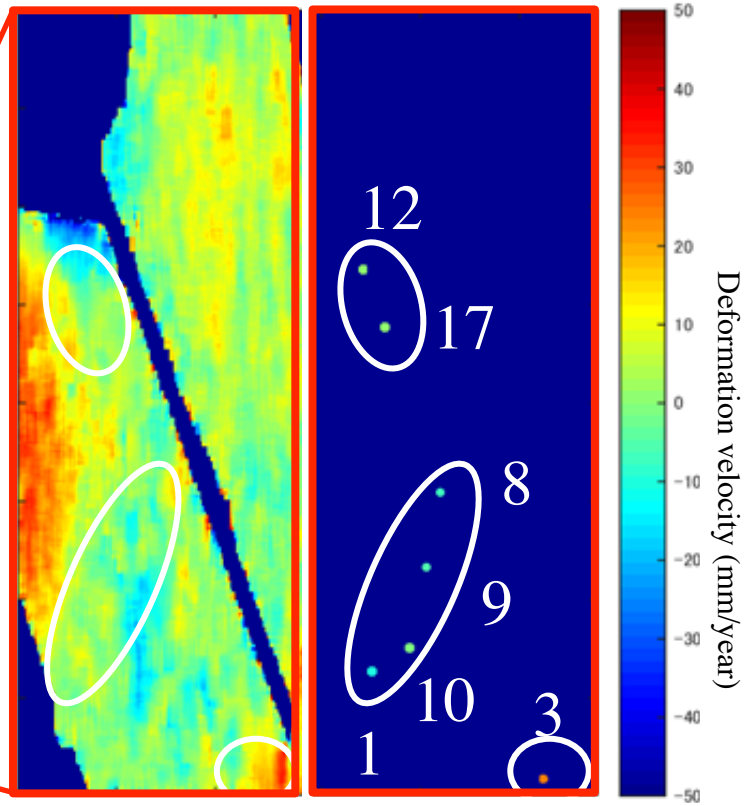
Images provided by GSI

Monitoring subsidence of a reclaimed land

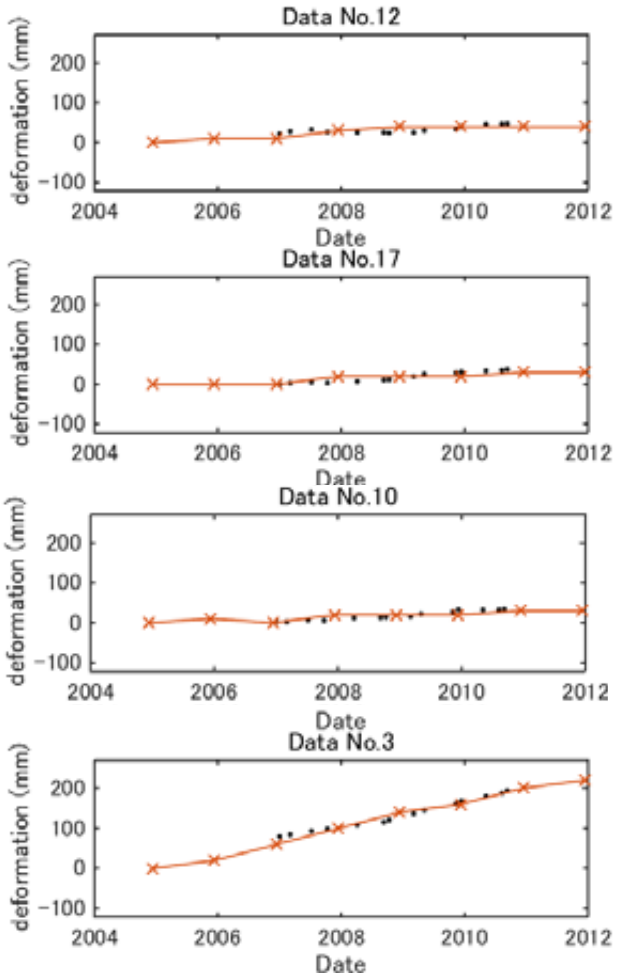
- Time series interferometry quantitatively visualizes deformation that reveals subsidence area over the monitored infrastructures.
- The results shows good agreement between interferometry and ground measurement data. Verified to be 11.5mm (RMSE).

Input data
Sensor: ALOS/PALSAR
Date: 10/2006 ~ 10/2010
Orbit: Descending
polarimetry: HH
Scenes: 13

Optical image ©Google



Measured with ALOS Measured on the ground



Time-series subsidence is shown;
Orange : Measured on the ground with GPS and leveling
Brack : Measured with ALOS

Data fusion : Contributions in the era of Future Earth

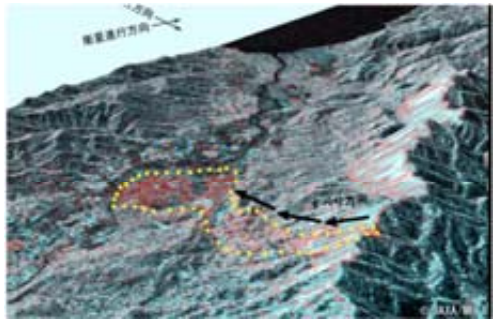
Climate & Environmental change

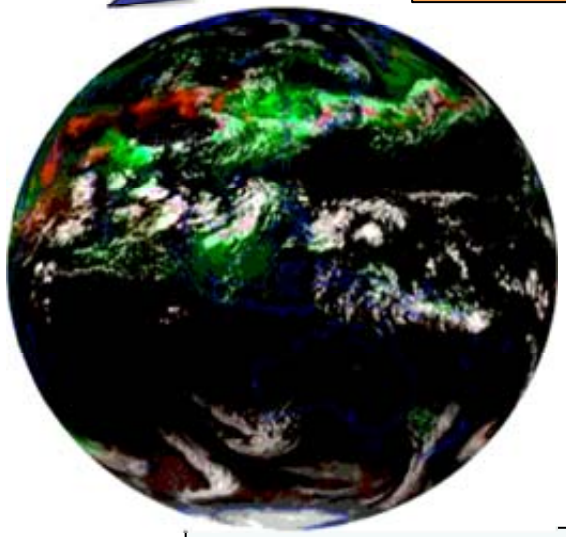
Earth Observation

Modeling

Surface monitoring
Infra. maintenance

Disaster prevention





Fine (green), coarse (red) aerosols

Health impact reduction

Adaption

Mitigation

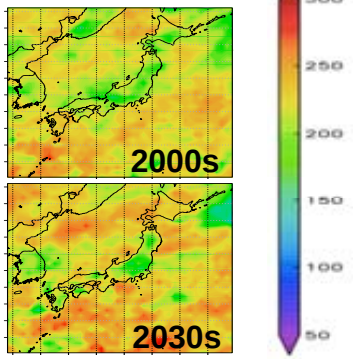
New sciences

Reduction of LLGHGs

Solar energy application

Adaptation in Asia

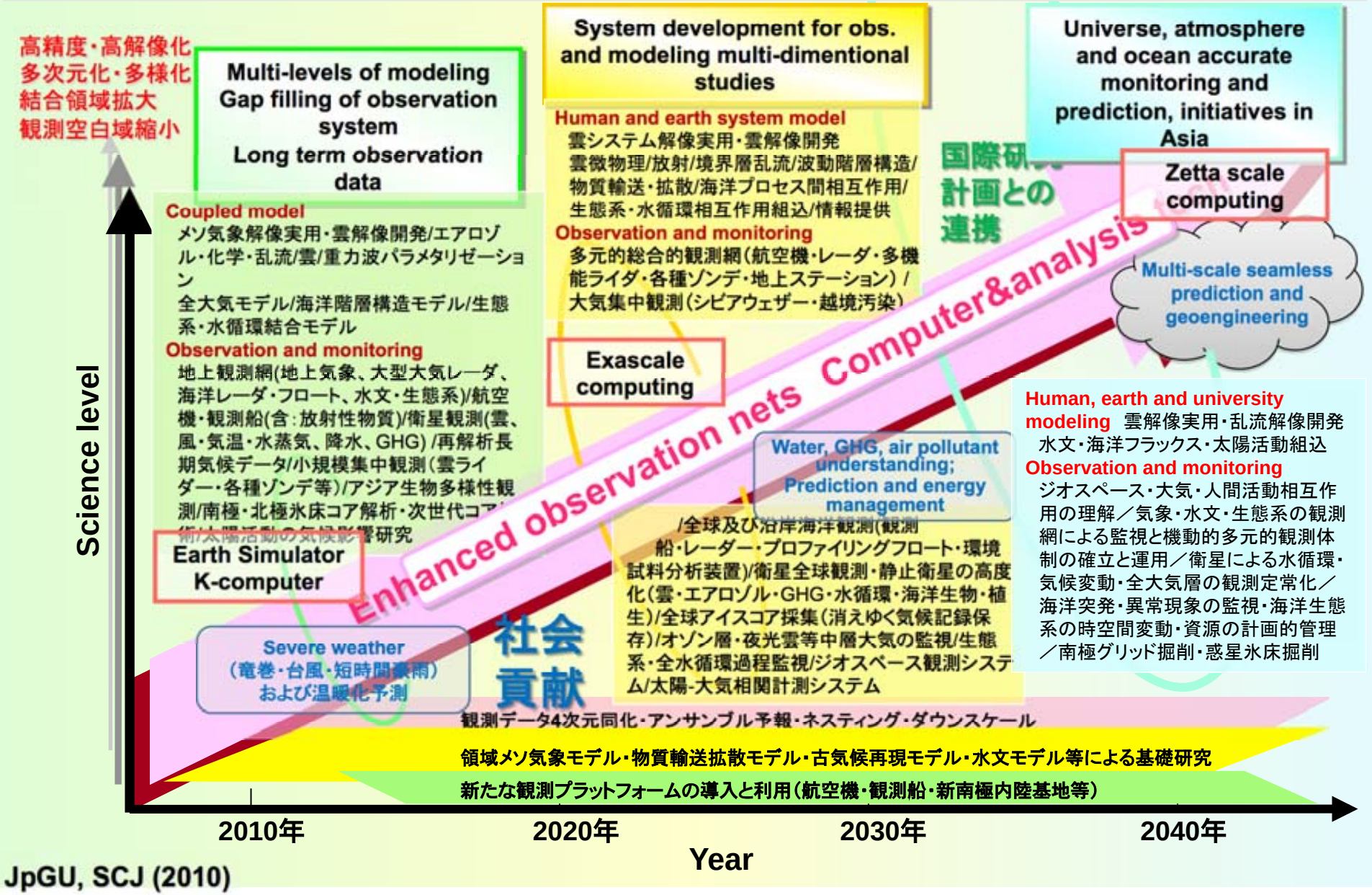
Solar energy



Earth Simulator @JAMSTEC; High Performance Computing Infra. (HPCI): K-Computer (10pF) @ RIKEN

Road map 2050 SCJ: Atmospher&hydrosphere sciences

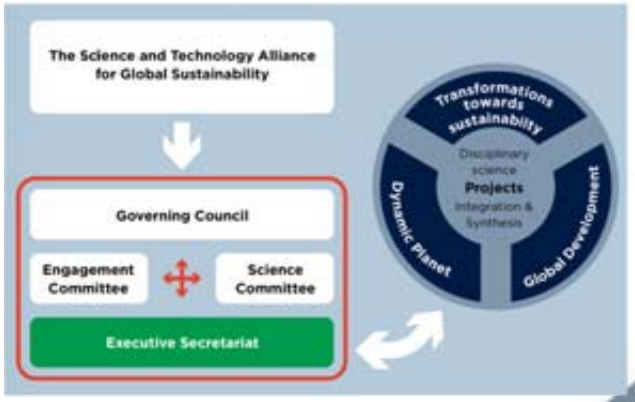
Basic process understanding, climate prediction, and monitoring

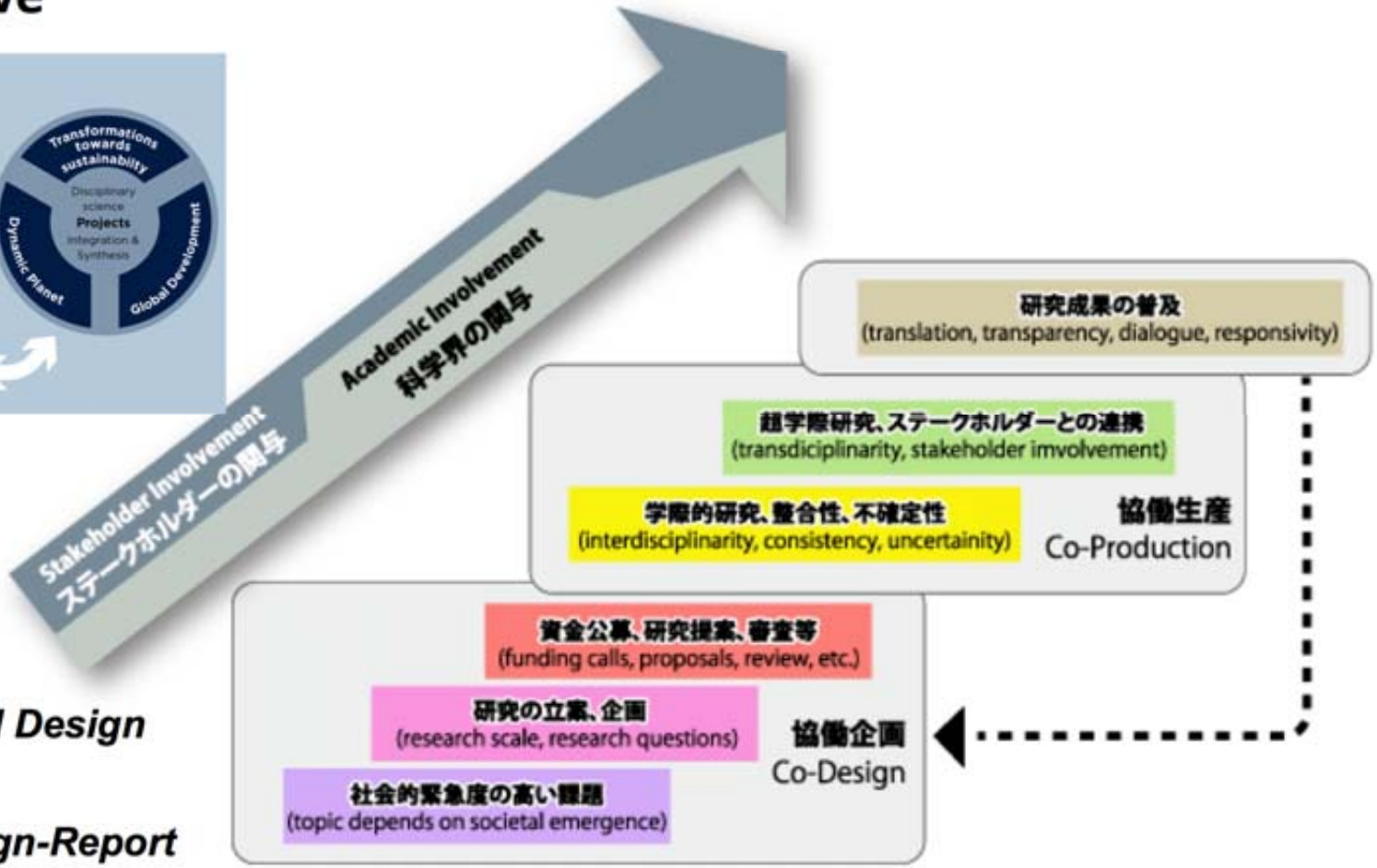


JpGU, SCJ (2010)

ISCU Future Earth Strategy

- 2013: Recorganization of IGBP,DIVER-SITAS,IHDP
- UN: MDG, SDG
- cf. IPCC: policy-relevant & yet policy-neutral, never policy-prescriptive





Future Earth Initial Design Document

Future-Earth-Design-Report

Policy issues in EO problems

- LLHGs & SLCP
  - Carbon monitoring and attribution: GOSAT/GOSAT2
  - Forest, REDD+: ALOS/ALOS2, SAR and optical imaer F/O
  - Cobenefit issues of climate and public health, CCAC etc: Emission: Inversion loop in the policy discussion
  - Geoengineering; Inadvertent side effects
- Water and disaster
  - Meteorological Service Act: NRT data, forecasting error
  - Flood, volcanic erruption: Monitoring data: Early warming vs Harmful rumor
  - Combined observation of satellite remote sensing and ground-based sysem: Largely different in each country
- Infrastructure
  - Monitoring and validation: Collaboration with local government & business sector
- Data archive: GFCS, Copernicus CCI; traceability, data policy, Data error
- Increased role of sciences: Neutrality of sciences