The Status of NIES GOSAT-2 Project and NIES Satellite Observation Center

T. Matsunaga, S. Maksyutov, I. Morino, Y. Yoshida, M. Saito , H. Noda, Y. Terao, T. Nishizawa, H. Mukai, N. Saigusa, and T. Machida

GOSAT-2 Instrument and Product Related Posters

JAXA	GOSAT-2 Specifications
Poster 6	Makiko Hashimoto, et al. (JAXA, Japan) Aerosol retrieval algorithm and aerosol properties retrieved from GOSAT/TANSO-CAI
Poster 8	Yu Someya, et al. (AORI/U. Tokyo, Japan) The CO2 slicing algorithm for the TIR cloud/aerosol products of TANSO-FTS2/GOSAT-2
Poster 9	Yu Oishi, et al. (Tokai U., Japan) Primary verification of new cloud discrimination algorithm used with GOSAT TANSO-CAI in Borneo Island
Poster 30	Isamu Morino, et al. (NIES, japan) Towards TCCON in the Philippines: The importance of monitoring atmospheric carbon in tropical Southeast Asia
Poster 42	Yosuke Niwa, et al. (MRI, Japan) A 4D-Var inversion system based on the icosahedral grid model (NICAM-TM 4D-Var)
Poster 54	Yukio Yoshida, et al. (NIES, Japan) Plan of the GOSAT-2 FTS SWIR products and its preliminary sensitivity study
Poster 55	Ronald Glumb, et al. (Harris Space & Intell. Sys., USA) An Update on the TANSO-FTS-2 Instrument for GOSAT-2

CAI-2 L2 Aerosol

FTS-2 TIR L2

CAI-2 L2 Cloud

Validation

L4A

FTS-2 SWIR L2

FTS-2 Instrument

Major Milestones of NIES GOSAT-2 Project in FY2015 and FY2016

FY2015

- Preliminary and critical designs of G2DPS (GOSAT-2 Data Processing System)
- Testing of a new FTS (125HR) in NIES Tsukuba Campus
- Completion of Two GOSAT-2 buildings for offices and computers
- Installation of GOSAT RCF2 (GOSAT-2 Research Computation Facility)

FY2016

- (April) Establishment of Satellite Observation Center at NIES
- (June – July) CDR of G2DPS
- (December) Shipment of FTS to the new TCCON site in Phillipines.
- Procurements of computers for G2DPS

Role Sharing in the GOSAT and GOSAT-2 Project

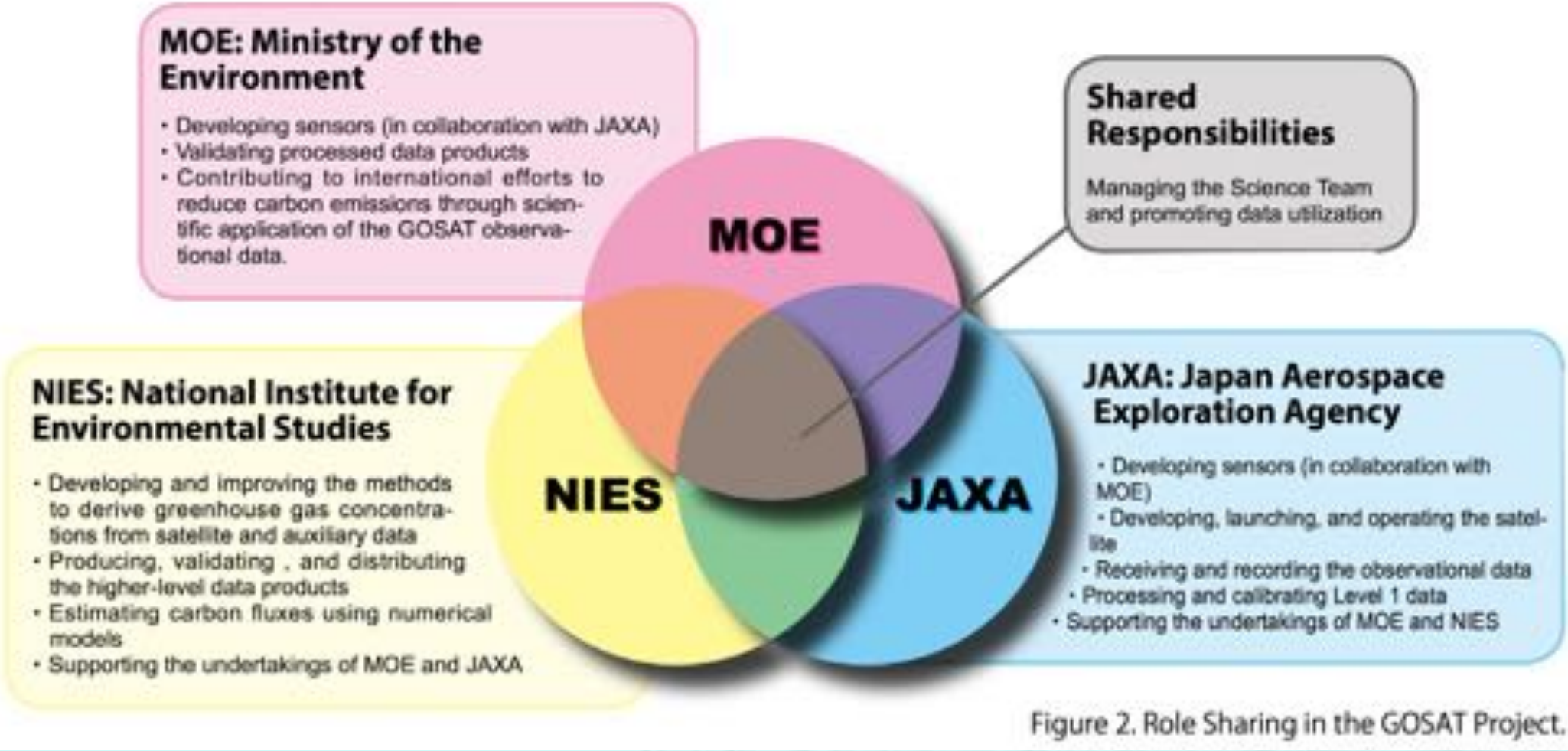
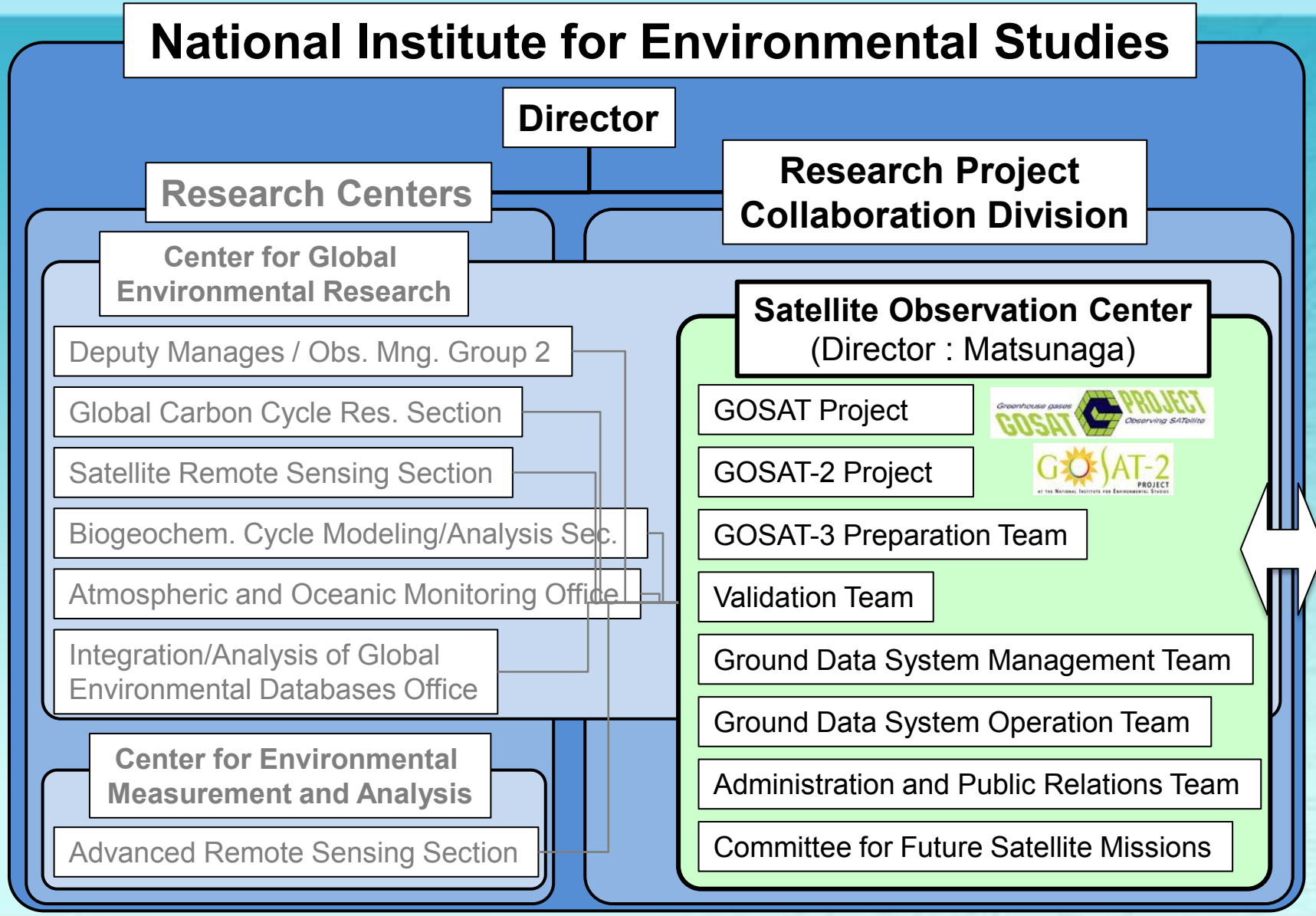


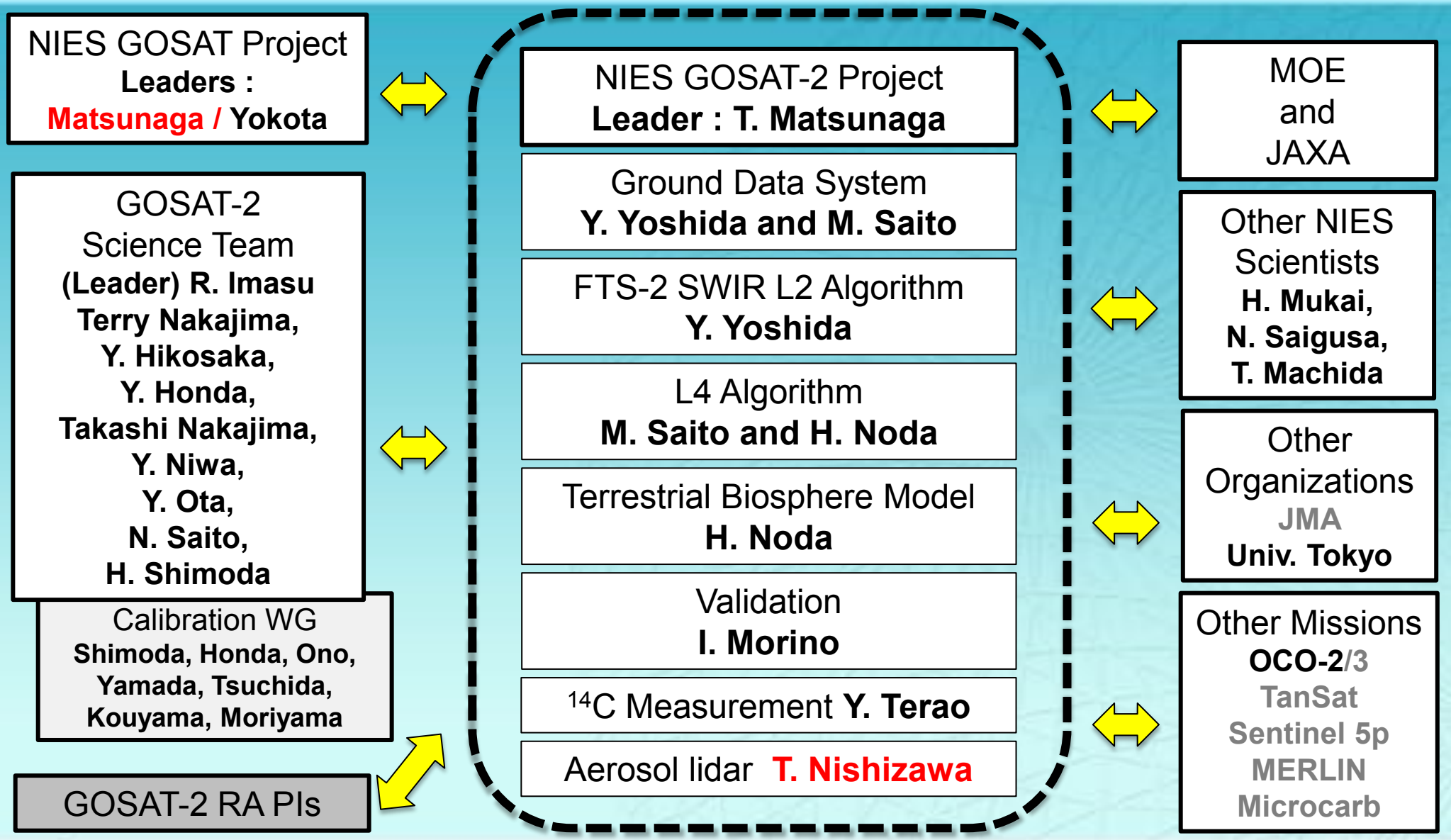
Figure 2. Role Sharing in the GOSAT Project.

In GOSAT-2 Project, “Satellite development, launch, and operation “ are added to MOE’s role.

NIES Organizational Structure (April 2016)



Organizational Structure of NIES GOSAT-2 Project (as of April 2016)



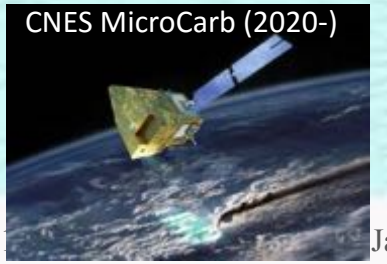
Timeline of Planned Total Column CO2 Observing Satellites as of June, 2016

(Calender year)

Mission	Period	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
ESA ENVISAT SCIAMACHY	2002/3 - 2012/4																									
Japan GOSAT	2009/1 + 5 years																									
NASA OCO-2	2014/7 + 2 years																									
China TanSat	End of 2016 + 3 years																									
Japan GOSAT-2	2018/1 + 5 years																									
NASA OCO-3	late 2018 + 3 years																									
CNES MicroCarb	2020 + 3 years																									
Japan GOSAT-3	2022-																									

Green Designed life time
Yellow Extended operation
Pink End of mission

We are here.



GOSAT-2 Project Long-term Schedule

FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
	OCO-2 launch		Tansat launch	GOSAT-2 launch	[Public Release] L1B CAI-2 L2 Cloud SWIR L2 OCO-3 launch	[Public Release] TIR L2 CAI-2 L2 Aerosol	[Public Release] L4 CO2 Microcarb launch	[Public Release] SWIR L2(new version) L4 CH4	End of GOSAT-2 Nominal operation GOSAT-3 launch
Spacecraft and Instruments									
RFP	System PDR	System CDR		System PQR					
GOSAT-2 Data Processing System (G2DPS) and computing facilities									
Requirement survey	Preliminary design	Critical design	Manufacturing	Testing	Nominal operation	Nominal operation	Nominal operation	Nominal operation	Nominal operation
	Design of GOSAT-2 buildings	Completion of GOSAT-2 buildings Installation of GOSAT RCF2	G2DPS computer installation				G2DPS computer renewal		
Validation and other experiments									
	Procurement of a new FTS (125HR)	Modification of airborne FTS	Relocation of FTS to Phillipines			Validation of 2018 data	Validation of 2019 data	Validation of 2020 data	Validation of 2021 data

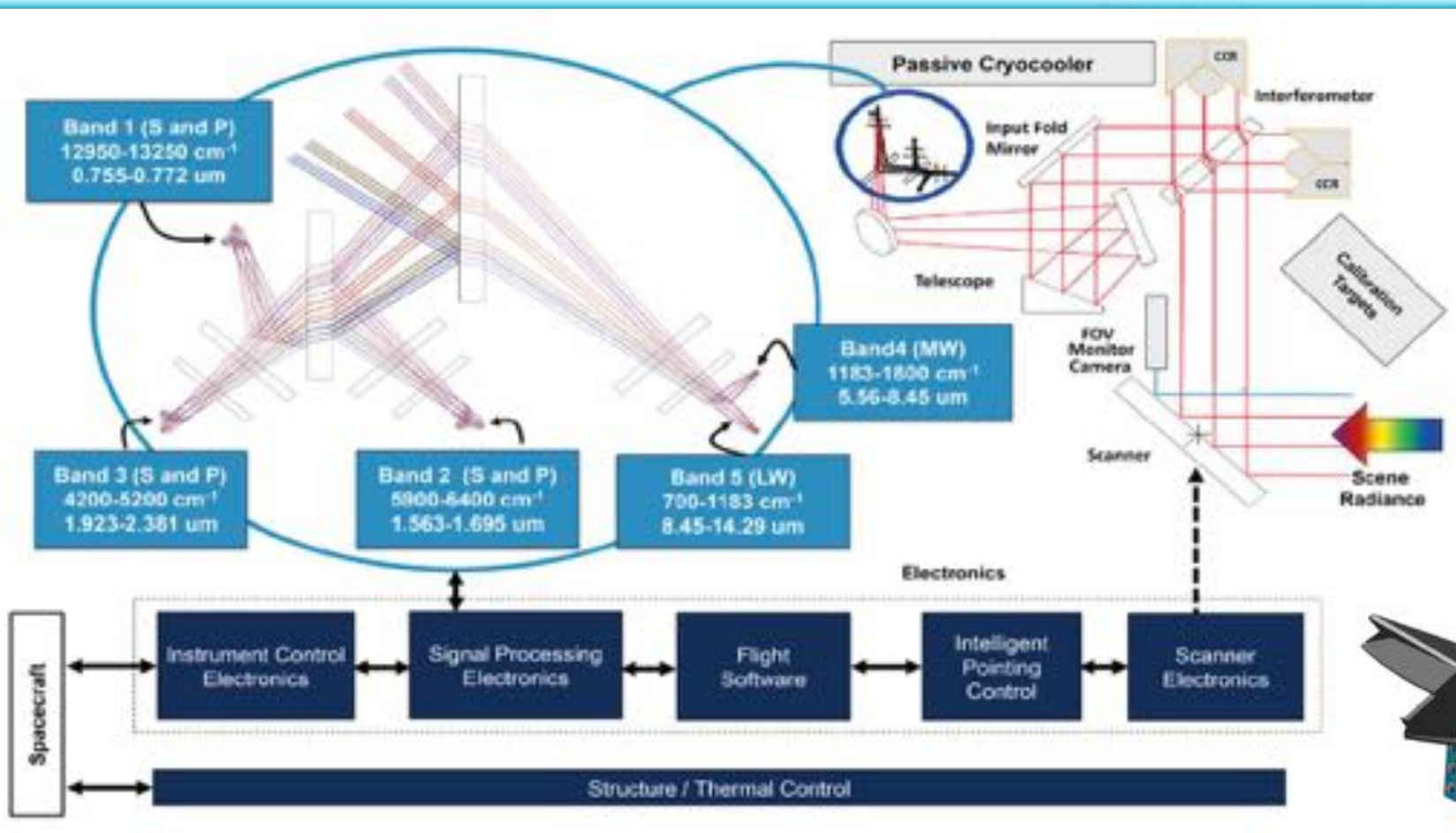
Quick Overview of GOSAT and GOSAT-2

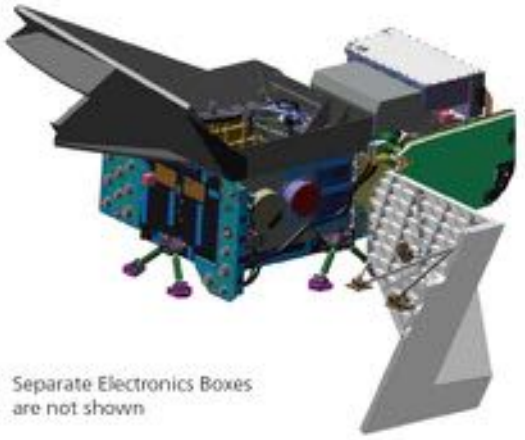
	GOSAT Specifications	GOSAT-2 Requirements
Launch year and life time	Jan. 2009, 5 years	FY2017, 5 years
Satellite (Dimension, mass, power)	3.7 x 1.8 x 2.0 m, 1750kg, 3.8KW (EOL)	5.3 x 2.0 x 2.8 m, <2000kg, 5.0KW
Orbit (Type, altitude, repeat cycle, equator crossing time)	Sun synchronous, 666 km, 3 days, 13:00	Sun synchronous, 613 km, 6 days, 13:00±15 min
Target gases	CO_2, CH_4, O_2, O_3, H_2O	CO_2, CH_4, O_2, O_3, H_2O, CO
Fourier Transform Spectrometer (FTS and FTS-2)	Band 1 : 0.76 – 0.78 μm Band 2 : 1.56 – 1.72 μm Band 3 : 1.92 – 2.08 μm Band 4 : 5.6 – 14.3 μm IFOV = 10.5 kmϕ Pointing = ±20° (AT), ±35° (CT) Polarimetry = Band 1, 2, 3	Band 1 : 0.75 – 0.77 μm Band 2 : 1.56 – 1.69 μm Band 3 : 1.92 – 2.33 μm Band 4 : 5.5 – 8.4 μm Band 5 : 8.4 – 14.3 μm IFOV = 9.7 kmϕ Pointing = ±40° (AT), ±35° (CT) Polarimetry = Band 1, 2, 3
Cloud and Aerosol Imager (CAI and CAI-2)	Nadir B1 = 380 nm B2 = 674 nm B3 = 870 nm B4 = 1600 nm B1-B3 = 500 m / 1000 km, B4 = 1500 m / 750 km	B1-5: forward (+20°), B6-10:backward(-20°) B1 = 343 nm B6 = 380 nm B2 = 443 nm B7 = 550 nm B3 = 674 nm B8 = 674 nm B4 = 869 nm B9 = 869 nm B5 = 1630 nm B10= 1630 nm B1-B4, B6-B9= 460 m / 920 km B5, B10 = 920 m / 920 km
Other new features of GOSAT-2 FTS-2	Intelligent pointing using FTS-2 FOV camera, fully programmable (target mode) observation, and improved SNR.	

GOSAT-2's New Capabilities / Major Improvements

- ✓ FTS-2 SWIR L2 carbon monoxide
- ✓ FTS-2 SWIR L2 chlorophyll fluorescence (Noda et al. [ACG10-P07])
- ✓ Improved FTS-2 signal to noise ratio
  "reduces the retrieval random error (precision) about 15% for XCO_2 and 35% for XCH_4 than those of GOSAT." (Yoshida et al., JpGU Meeting, 2016)
- ✓ Extended FTS-2 AT pointing angle limit => More ocean sunglint data
- ✓ FTS-2 Intelligent pointing => More cloud-free FTS data
- ✓ FTS-2 Fully programmable operation => More "target-mode" data
- ✓ CAI-2 Multiple UV bands => Better land aerosol estimation
- ✓ CAI-2 forward / backward looking system => More non-glint ocean data

GOSAT-2 FTS-2 Optical Layout



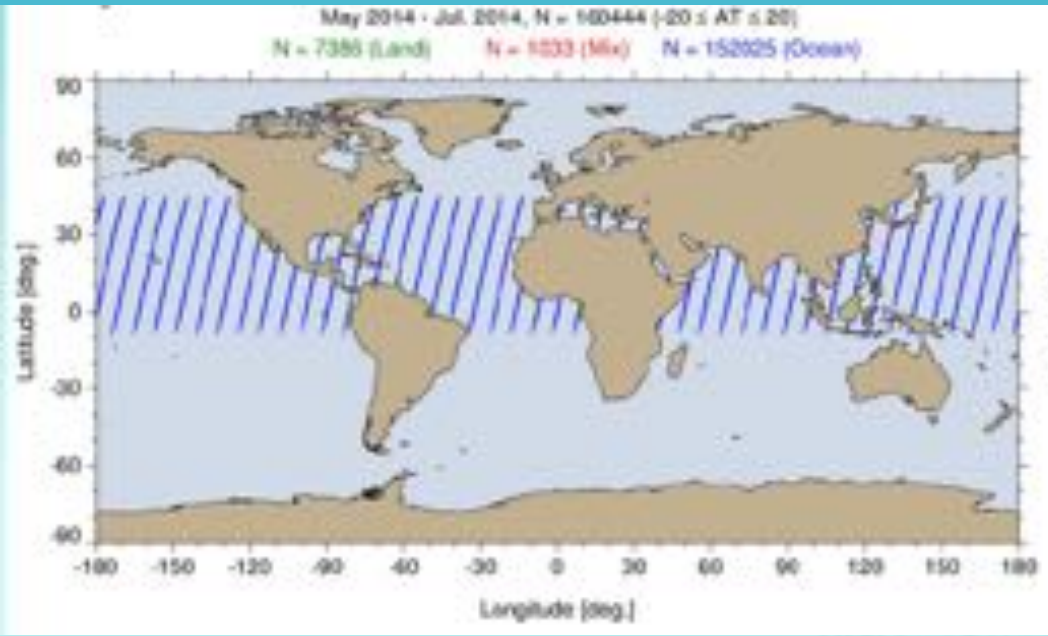


FTS-2 is designed based on not GOSAT FTS but CrIS(Cross-track Infrared Sounder) onboard NASA's Suomi NPP.

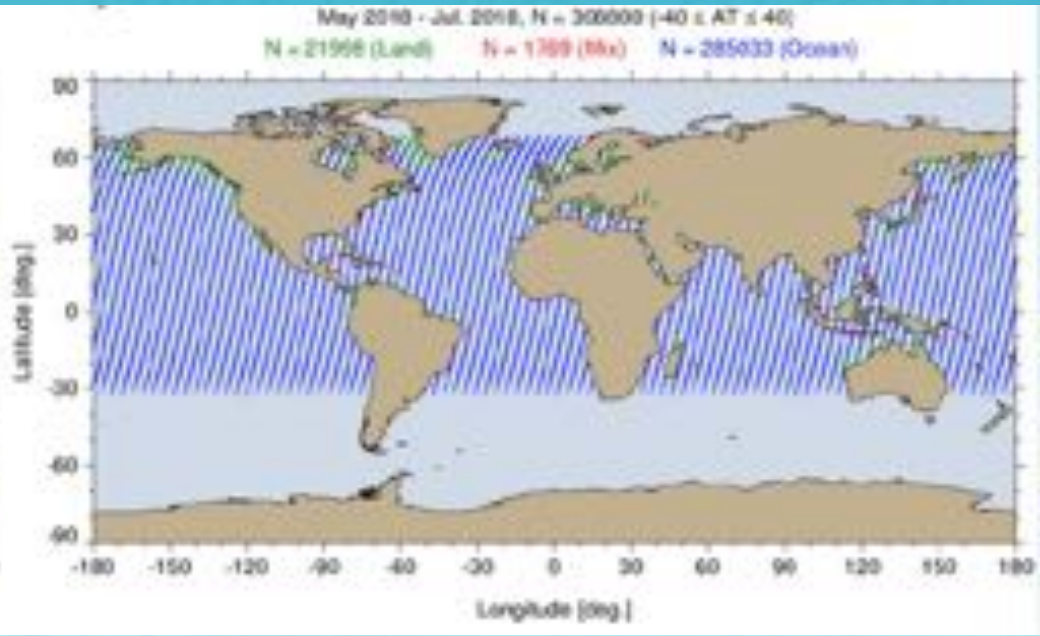
Glumb et al. IWGGMS-11, 2015

Simulated FTS Sunglint Observation in May-July

GOSAT



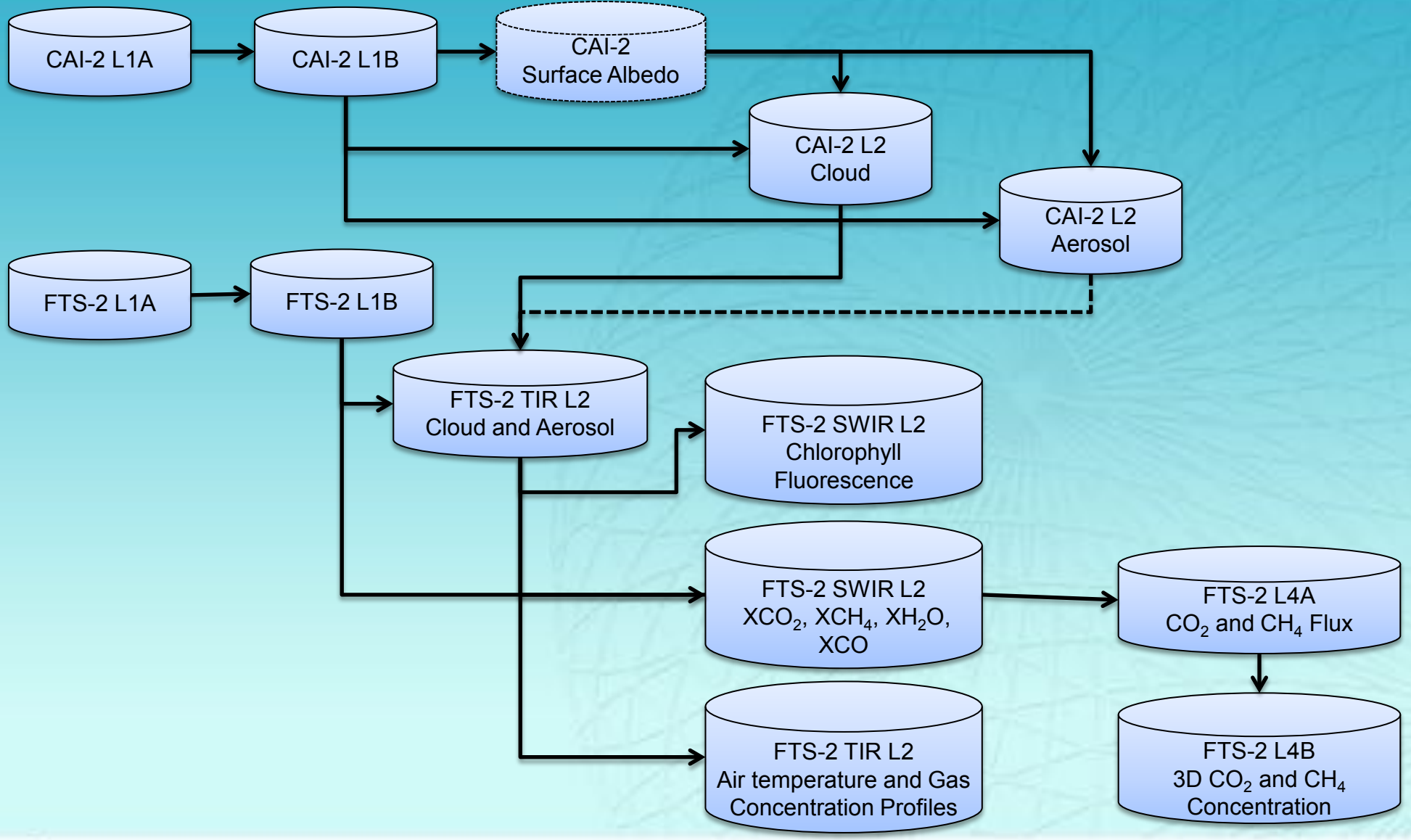
GOSAT-2



- ✓ The apparent increase of the number of sunglint paths is simply due to the difference of orbit repeat cycles between GOSAT (3 days) and GOSAT-2 (6 days).
- ✓ GOSAT-2 can cover the wider latitude zone than GOSAT.
- ✓ The FTS sunglint data will double in number.

Kamei et al. (2015)

GOSAT-2 Data Processing Flow



GOSAT-2 Product List (At-launch version)

Product Name	Algorithm	Processing
TANSO-CAI-2 L1A Product	JAXA	JAXA
TANSO-CAI-2 L1B Product	JAXA	NIES
TANSO-CAI-2 L2 Cloud Discrimination Product	Tokai Univ.	NIES
TANSO-CAI-2 L2 Aerosol Properties Product	JAXA	NIES
TANSO-FTS-2 L1A Product	JAXA	JAXA
TANSO-FTS-2 L1B Product	JAXA	JAXA
TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence/Proxy Method Product	NIES	NIES
TANSO-FTS-2 SWIR L2 Column Averaged Gas Concentration Product	NIES	NIES
TANSO-FTS-2 TIR L2 Cloud and Aerosol Properties Product	Univ. Tokyo	NIES
TANSO-FTS-2 TIR L2 Air Temperature and Gas Concentration Product	Chiba Univ.	NIES
TANSO-FTS-2 L4A Product (CO_2 and CH_4)	NIES	NIES
TANSO-FTS-2 L4B Product (CO_2 and CH_4)	NIES	NIES

Thank you for your attention

matsunag@nies.go.jp