
Independent Administrative Institution
National Institute for Environmental Studies (NIES)
A newsletter on the Greenhouse gases Observing SATellite (GOSAT, "IBUKI" ) project from the NIES GOSAT Project Office.
**http://www.gosat.nies.go.jp/**

ISSUE # 27
APRIL 2013

# CONTENTS



Group photo of participants in front of Tokyo Metropolitan Art Museum

REPORT

## GOSAT Workshop 2013

Akihiko Kuze, Associate Senior Engineer, Satellite Applications and Promotion Center (SAPC), JAXA

GOSAT Workshop 2013 was held at Tokyo Metropolitan Art Museum from March 5 to 7, 2013 with 96 participants gathering from around the world (photo above). We were blessed to be allowed to use the brand-new auditorium (just reopened), because "GOSAT Spectrum is an Art."

This time, we concentrated on three topics required for the determination of GOSAT-2 sensor specification: (1) flux estimate and assimilation by modeling, (2) error sources for $CO_2$ retrieval, (3) new targets (CO and $NO_2$), each of which was presented at first by those who were deeply involved and then discussed by all participants for one hour.

We shared the message through 3 days' discussion: "GOSAT should establish the status of flying TCCON (Total Carbon Column Observing Network)", because the existing 10 or more greenhouse gases observation plans are not competing each other but collaborating to prove the effectiveness of satellite observation, especially in the case of GOSAT family, which are equipped with Fourier Transform Spectrometer to ensure, in principle, high

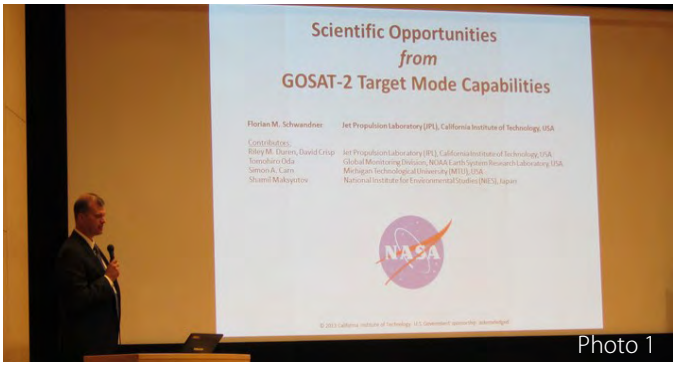


Photo 1

spectral resolution with wide spectral range for $CO_2$ and other components, enabling themselves to be standards for other satellites' observation. Target observation by GOSAT is effective for modeling, and improved single-point accuracy of $CO_2$ mole fraction can go directly to more accurate flux estimate; for which purpose, hardware improvement such as linearity of FTS Band 1 ($O_2$ A band) and enhancement of the pointing function and state-of-the-art data processing will be required, e.g., retrieval at low reflectance area, handling of multiple scattering at high reflectance area, consideration of ground bidirectional reflectance distribution function (BRDF), etc..


Photo 2

As for additional CO observation planned by GOSAT-2, experienced fellow from MOPITT*1 proposed to standardize the satellite-based CO observation data. Easier-to-use data sure help expand the GOSAT community including university people and atmospheric researchers. 10 years ago when GOSAT Project started, it seemed reckless to many people to observe $CO_2$ from space on the basis of experience of satellite-based stratospheric ozone ($O_3$) observation, because $CO_2$ is less variable than stratospheric $O_3$. However, it really is successful as the community steadily grown during 4 years' GOSAT operation proves, which can be recognized in earnest discussion (photo 2) and wide smiles (photo 3) here.


Photo 3

It is also made clear that we have plenty of issues yet to be solved with present GOSAT such as more effective pointing to get more cloud-free data over Amazon and Southeast Asia, combined use of SWIR and TIR data for retrieval analysis, multi-angle observation to reduce aerosol-associated error, etc. The workshop reminded us of those issues found in 4 years' operation, both in hardware and data processing, to be dealt with one by one, which leads to the next.

*1 Measurements Of Pollution In The Troposphere (MOPITT) is a TIR sensor mounted on Terra (refer *2 on page 5) to monitor pollution patterns and its effect in the lower atmosphere of the Earth.

## REPORT

# EGU2013 (European Geosciences Union General Assembly 2013)

Tatsuya Yokota, Project Leader, GOSAT Project, NIES

EGU General Assembly held in Vienna every April was on April 7 to 12 this year at the Austria Center (photo 1). This is a very huge place for presentation by researchers, mainly from European countries, and attracting more people year after year: 11,167 participants from 95 countries, 228 from Japan. According to a Chinese friend of mine, China is making a strong effort to this field, sending a total of 240 researchers and students, greater number ever, related to meteorology and climate model. This year, a new presentation style named PICO (Presenting Interactive COntent) was introduced in addition to the traditional oral and poster presentation. PICO uses the Internet for the initial brief presentation materials, from which the audience selects presentation numbers to add their own related materials, animations, and PDF files as their questions or comments, creating elaborative hyper discussion. It looks like discussion papers posted on the WEB. The discussion place is open to participants during the Assembly period to deepen discussions, accelerate researches, and shorten the time to share the research results. There were 452 PICOs against 4,684 oral / 8,207 poster presentations.

The main session related to GOSAT *IBUKI* (AS3.13 Remote-Sensing of Atmospheric Carbon Dioxide and Methane) had oral from 10 to 11, and poster on 10 evening. GOSAT members from Japan, Yokota, Maksyutov, and Takagi from NIES, and Ohyama (as proxy for Nakajima and Suto) from JAXA made presentations at this session. Other sessions which included GOSAT were AS3.12 Satellite observations of tropospheric composition and pollution, analyses with models and applications, BG2.6 Earth observation for monitoring the global energy, water and carbon cycles over land, BG2.11 Greenhouse gas fluxes in managed ecosystems and regions, etc.

Photo1

**GOSAT PEOPLE** A Series: Supporting GOSAT Project (3)

Photo 1 (Jun. 2009)

TANSO Team in NEC, who are now in relief after months of desperate work, with successful launch and world's first ever data offering.

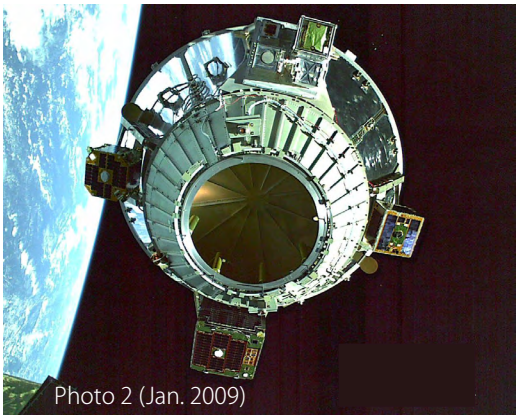


Photo 2 (Jan. 2009)

A MEISEI Electric camera caught the moment of the birth of IBUKI. Photo shows leaving H-IIA rocket.

# Big Stagehands having given birth to GOSAT *IBUKI*

Hiroshi Suto, Engineer, Earth Observation Research Center, JAXA

### 4 year-old *IBUKI*

4 years have passed since the launch of *IBUKI* on January 23, 2013. *IBUKI*'s housekeeping data were sometimes abnormal just after the birth, making daily emergency calls for staffs, regardless of holidays or nights. Now it's all in the past. *IBUKI* is observing silently 365 days a year and offering valuable data for us, which makes us forget the past birth pangs. Let me tell you just a little bit about the birth story of *IBUKI*.

### *IBUKI*'s eye

That is the sensor to measure atmospheric mole fractions of $CO_2$ and $CH_4$ from space. *IBUKI* measures the scattered solar light absorbed by earth atmosphere to identify the amount of $CO_2$ and $CH_4$ existing on the path the light came through. As you know, the eye is called TANSO named after the acronym of Thermal And Near infrared Sensor for carbon Observation. *IBUKI* challenged the world's first ever high resolution observation from space with short wavelength infrared light (1.56 - 2.08 μm) including information of mole fractions near earth's surface, which is important because the information reflects prominently the influence of human activities. NEC TANSO Team was the contractor to make the sensor (photo 1), who worked day and night for design, manufacture, and test. I can clearly remember their hard work in year-end and New Year holidays of 2007 – 2008. Literally they worked ceaselessly on the test when you were enjoying a long vacation. One day TANSO was confronted with an accident which might have made TANSO into Tanso (Carbon in Japanese). There was a fire on another floor and it could affect the manufacturing process of TANSO, however, fortunately the fire was a small one and on a different floor, TANSO and its test equipment were saved undamaged.

This is how TANSO was given birth to with the effort and hard work of people involved, and maybe with a bit of good luck. Now we can get data with just one click on the Internet, free of charge, but we should not forget extraordinary effort of many people behind the scene.

### *IBUKI*'s body

That is the satellite looking at the Earth from space. Its design life is 5 years. It may sound very short compared to cars with 10 or more years of design life, however, the stress a satellite receives going around the Earth is beyond our imagination. *IBUKI* goes through higher temperature than the baking heat of desert and lower temperature than the coldest polar zone in only 100 minutes' circuit, whose harsh physical circumstances may cause various troubles. A car can be repaired when broken but a satellite, never, once it's launched. That's why "how to make it live a long time" is the most important thing. The answer is redundancy and adoption of matured technologies. Engineers like trying new technologies, however, that should be controlled to ensure reliability as the most important value in *IBUKI* making. And also the sensor needs to be kept healthy to continue observation by avoiding degradation factors, one of which is the dirt and dust from the satellite itself. The satellite is manufactured in a clean room to control the dirt and dust where there is no such visible thing. On the other hand, workers have much dirt and dust on themselves and spit scatters in their conversation, which necessitate them to wear special clothes and medical masks. They assembled and tested *IBUKI* steadily and tidily under those various constraints.

In addition to normal set of tests to confirm function and performance executed in common with many satellite developments, *IBUKI* underwent many other tests: for example, "how does the real sunlight look like to IBUKI," which was readily accepted by Mitsubishi Electric GOSAT Team (photo 3), though not included in the initial test plan, "if you think it's necessary," and it was executed by sheer force of numbers on a very tight schedule. They could have rejected the test in the hard situation but they didn't, and helped us find even subtle "tendencies" of TANSO.

### The moment of the birth of *IBUKI*

We were really cliff-hanged at the moment. A camera made by

MEISEI Electric caught the moment of IBUKI jumping into the space just separated from H-IIA rocket. Leaving H-IIA rocket (photo 2), deploying and rotating of solar battery paddles, and the Earth seen from *IBUKI* – these steps of *IBUKI*'s activation were recorded and sent to us. We were excited with those images to know "*IBUKI* is standing up!" though its heartbeat was not heard yet. Eight cameras are attached to *IBUKI* to take photos of major part of itself, and one of which is set in TANSO enabling to look at the same place and take its photo as TANSO views (that means the camera helps to correct TANSO's viewing direction). Today compact digital cameras flood the market and no one will find anything special in mounting one on a satellite. Nothing special? Really? Well, imagine how difficult it is to make a camera which can take clear photos anywhere, be it ever hot or cold in space.

**Many thanks to *IBUKI***

*IBUKI* has successfully continued its observation since launched on January 23, 2009 and started distribution of $CO_2$ and $CH_4$ mole fraction data to the world since February 18, 2010. The observation result was compared with other ground or airplane based observation to find there was no large discrepancy among those data, which validated the quality of observation by *IBUKI*. *IBUKI* data is used by many researchers around the world. That is the greatest pleasure for us, the birth parents, to know the data is used by so many people and help generate new findings. Brilliant it may seem, the world of satellite development is nothing but patience: patience to find and use matured technologies to add new values, from which *IBUKI* was born. There are many things left to be done to accomplish its mission. Please keep your eyes on ever-growing *IBUKI.* Sometimes it may catch cold. But don't worry. We are also a team of family doctors and always ready to cure *IBUKI* for its lasting mission.


Mitsubishi Electric GOSAT Team and JAXA people now in relief in front of completed IBUKI

## ANNOUNCEMENT

### 6th Research Proposals (RA) now being invited


## PUBLISHED PAPERS

**Field of Research:** data processing algorithm, validation
**Name of Journal:** Journal of Geophysical Research (Volume 118, pages 1493–1512, 2013)
**Title:** Effects of atmospheric light scattering on spectroscopic observations of greenhouse gases from space. Part 2: Algorithm intercomparison in the GOSAT data processing for $CO_2$ retrievals over TCCON sites
**Authors:** S. Oshchepkov, A. Bril, T. Yokota, P. O. Wennberg, N. M. Deutscher, D. Wunch, G. C. Toon, Y. Yoshida, C. W. O'Dell, D. Crisp, C. E. Miller, C. Frankenberg, A. Butz, I. Aben, S. Guerlet, O. Hasekamp, H. Boesch, A. Cogan, R. Parker, D. Griffith, R. Macatangay, J. Notholt, R. Sussmann, M. Rettinger, V. Sherlock, J. Robinson, E. Kyrö, P. Heikkinen, D. G. Feist, I. Morino, N. Kadygrov, D. Belikov, S. Maksyutov, T. Matsunaga, O. Uchino, H. Watanabe

**Field of Research:** data processing algorithm, validation
**Name of Journal:** Atmospheric Measurement Techniques (Volume 6, pages 599–612, 2013)
**Title:** HDO/$H_2O$ ratio retrievals from GOSAT
**Authors:** H. Boesch, N. M. Deutscher, T. Warneke, K. Byckling, A. J. Cogan, D. W. T. Griffith, J. Notholt, R. J. Parker, Z. Wang

**Field of Research:** carbon balance estimation, atmospheric transport models
**Name of Journal:** Scientific Online Letters on the Atmosphere (Volume 9, pages 45–50, 2013)
**Title:** Inverse modeling of $CO_2$ fluxes using GOSAT data and multi-year ground-based observations
**Authors:** T. Saeki, S. Maksyutov, M. Saito, V. Valsala, T. Oda, R. J. Andres, D. Belikov, P. Tans, E. Dlugokencky, Y. Yoshida, I. Morino, O. Uchino, T. Yokota

## GREETINGS

# Greetings from GOSAT Project Office

Greetings

Hiroshi Watanabe

I left my office this March. I was GOSAT Project Office Manager for 6 years and 7 months since I took the post in September 2006. These years saw the launch of GOSAT on January 23, 2009, release of various high-level products, and other big events on GOSAT, which I look back now with happy feeling. I regret leaving now a little when GOSAT is still operated well and new outcomes are coming, however, "to everything there is a season under heaven," and I made up my mind at this Japan's fiscal year end.

I had worked as Project Manager of the ground system for ASTER*1, the sensor mounted on Terra*2 launched by NASA*3, until I was involved in GOSAT Project. As ASTER observed the ground surface, atmospheric absorption had been something to be corrected, and then, to my embarrassment, that became the target of observation, which I gradually accustomed to and now I thank as a valuable experience. I was a bit close with some NASA researchers in both projects and some of whom left me indelible memory of deep NASA, for example, when I found Dr. Abrams, ASTER's science team leader, and Dr. Crisp of ACOS*4 team which GOSAT collaborated with, lived next door to each other in JPL*5.

GOSAT Project helped me know not only many RA researchers but wide variety of general users through GOSAT data, which is also a good experience for me.

I have not decided my next way to go yet, but it would be nice if I can contribute something in the field of remote sensing. I really appreciate your support over the years and I ask you the same support for Mr. Masataka Ajiro and ever prosperous GOSAT Project.

Thank you.

*1 *2 Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is a high resolution optical sensor with 14 channels from visible light to thermal infrared bands developed in a joint project by NASA*3, METI, and ERSDAC, which was launched in 1999 mounted on the satellite Terra.

*3 National Aeronautics and Space Administration

*4 Atmospheric $CO_2$ Observations from Space (ACOS) team is a group organized around OCO (Orbiting Carbon Observatory) science team involving researchers of JPL*5, Caltech, and Colorado State University.

*5 Jet Propulsion Laboratory is a federally funded research and development center and operated by Caltech for NASA.

*6 Marine Observation Satellite-1 (1987~1995) is Japan's first marine observation satellite, as a link in a global satellite observation system for more effective natural resource utilization and for environmental protection.

*7 Advanced Land Observing Satellite (2006~2011) has been developed to contribute to the fields of mapping, precise regional land coverage observation, disaster monitoring, and resource surveying.

Ex-manager, Dr. Watanabe (left) and Manager, Mr. Ajiro (right)

Greetings

Masataka Ajiro

I was assigned to take over the position of the Project Office Manager on April 1st in succession to Dr. Watanabe. I am glad to be able to return to the space development field for the first time in 7 years.

Since last September, I have worked as a sub-manager and as a proxy last December, but there is much left to be covered in the passionate relationship with GOSAT users established by the ex-manager, on which I will do my best considering and responding to users' voices for the better later-stage operation GOSAT has now entered breaking longevity record.

I had been involved for more than 25 years in data processing and equipment development of ground systems for earth observing satellites from MOS-1*6 to ALOS*7 before I joined Microsoft as a manager to sell aerial digital cameras or support on-line business such as map services for consumers (Virtual Earth/ Bing Maps).

I will do my best utilizing my experience in Microsoft on customer creed, corporate social responsibility, customer loyalty assessment, and business development methods to help researchers and other users in GOSAT community achieve results in science field by delivering products and services.

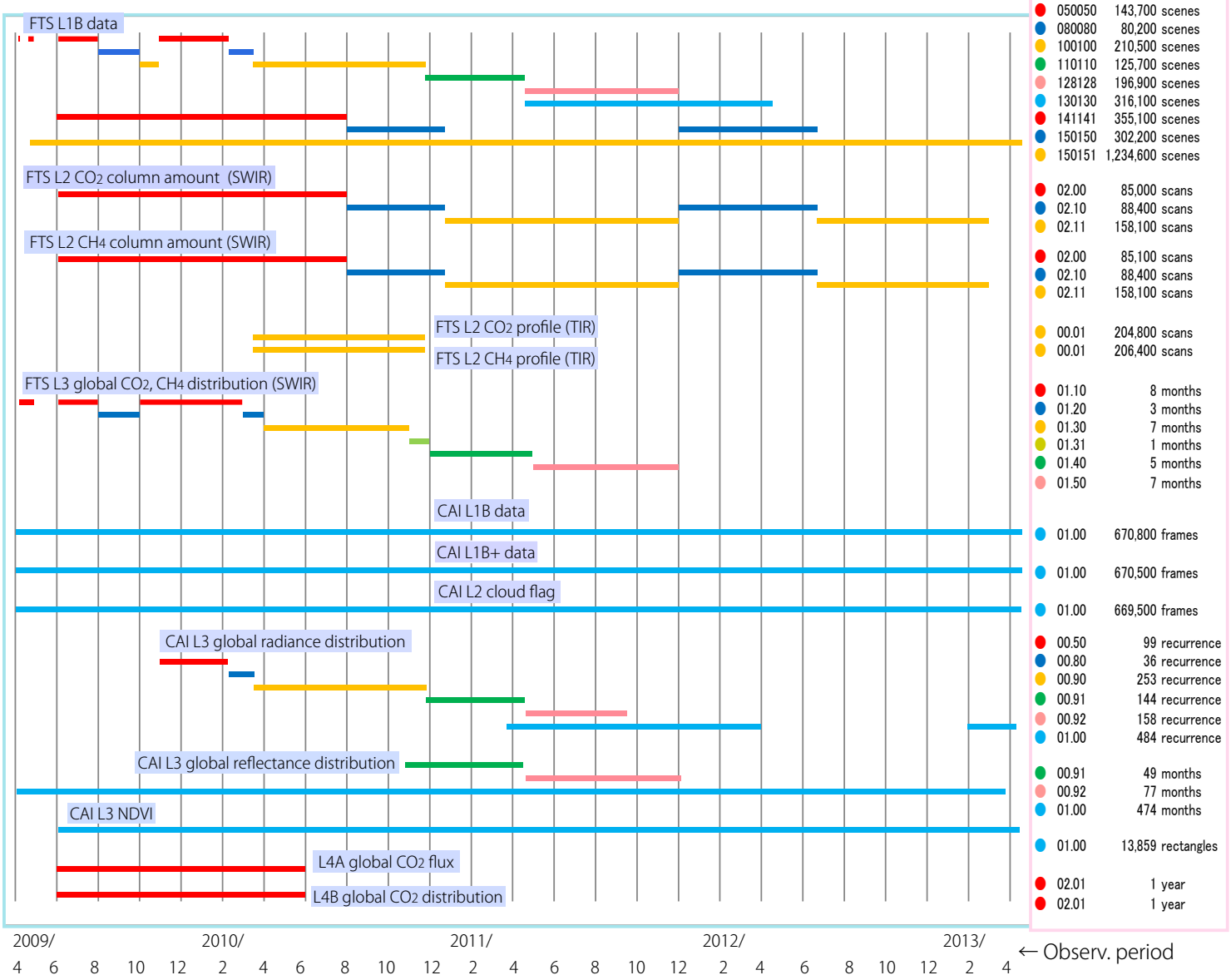
Thank you.

DATA PRODUCTS UPDATE

# Data Processing Status Update from GOSAT Project Office

Fumie Kawazoe, Specialist, NIES GOSAT Project Office

Observation Period and Versions of Publicly Released Data As of April 19, 2013




The chart above is as of April 19, 2013. The latest processed and released on are: FTS L1B in V150.151; CAI L1B/L1B+/L2 cloud flag/ L3 global reflectance distribution/NDVI in V01.00; FTS L2 $CO_2/CH_4$ column amount (SWIR) in V02.11. We have released to general public the new V01.00 of CAI L3 global radiance distribution on April 9. CAI L1B+ has been completed its reprocessing in V01.00.

FTS L1B will be upgraded to V160.160 in May, which will also bring the change of minor version as V02.20 in FTS L2 $CO_2/CH_4$ column amount (SWIR). Please refer to coming GUIG pages "ATBD, Product Format Descriptions, Product Description, Results of Validation" for more detail.

The number of registered users is 1423 as of April 19, 2013.

**NIES GOSAT PROJECT NEWSLETTER** ISSUE #27 APRIL 2013 Issued on : 2013/5/13

edited and published by : NIES GOSAT Project Office

email : gosat_newsletter@nies.go.jp
website : http://www.gosat.nies.go.jp/eng/newsletter/top.htm
address : 16-2 Onogawa, Tsukuba-City, Ibaraki,
305-8506 Japan
GOSAT Project Office
Center for Global Environmental Research
National Institute for Environmental Studies

You can download this newsletter here:
URL : http://www.gosat.nies.go.jp/eng/newsletter/top.htm

If you would like to receive an email notification when each issue is published, please send us an email with your name, email address, and preferred language (English or Japanese) at:
gosat_newsletter@nies.go.jp