NIES GOSAT PROJECT NEWSLETTER

ISSUE #5
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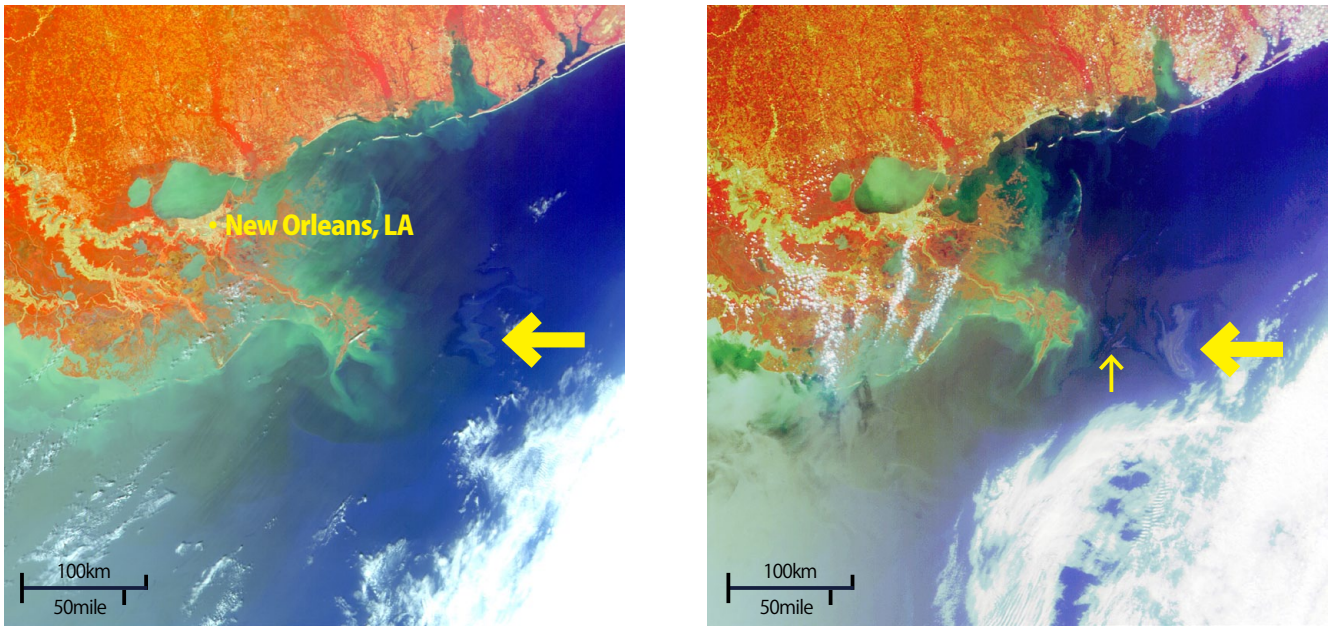
Independent Administrative Institution
National Institute for Environmental Studies (NIES)
A newsletter on the Greenhouse gases Observing SATellite (GOSAT, "IBUKI") project from the NIES GOSAT Project Office.
http://www.gosat.nies.go.jp/



(left) An image captured on April 25, 2010, by Cloud and Aerosol Imager (CAI) on board "IBUKI" over the Gulf of Mexico off the shore of Louisiana, USA. (Blue = Band 1, Green = Band 2, Red = Band 3). (right) Another CAI image captured on May 4, 2010. White parts such as seen in the bottom right in both images indicate clouds.

IMAGES OF THE MONTH

GULF OF MEXICO — OIL SPILL OFF OF LOUISIANA COAST, USA

— Tsuneo Matsunaga
Chief, Office for Global Environmental Database,
Center for Global Environmental Research (CGER), NIES

The coastal area of the Gulf of Mexico in the Southern United States is known for its abundant oil and natural gas deposits. A great amount of crude oil is produced in the undersea oil fields, and developments of new oil fields are also still being carried out.

At one drilling platform owned by a private enterprise for such oil field development, 80km off the coast of Louisiana, USA, there was an explosion in the night of April 20, 2010. Not only the accident left numbers of people injured and missing, it also unleashed a major spill of crude oil. There is a possibility of the leaking crude oil to reach the marshlands by the coast and cause a considerable impact on the local ecosystem.

Cloud and Aerosol Imager (CAI) onboard "IBUKI" captures images of the Earth continuously, covering the whole globe every three days. The oil floating in the offshore Louisiana is visible in the images captured after April 25, 2010. The left image is a CAI image captured on April 25. An enhancement process to the image reveals the oil slick spreading over about an 80km square. The right image is a CAI image captured on May 4, 2010. In addition to the large oil slick, spreading oil can be seen (indicated by a smaller yellow arrow) close to the mouth of Mississippi River (the Mississippi Delta).

As of May 25, 2010, even with the measures such as spraying dispersants and installing blowout preventers, the leak of oil and its spread towards the Louisiana coast still seem to be continuing.

GOSAT NEWS

REPORT: WMO-BIPM WORKSHOP

— Tatsuya Yokota, NIES GOSAT Project Leader
Chief, Satellite Remote Sensing Research Section,
Leader, Core Research Project 2, Climate Change Research Program, CGER, NIES

From March 30, to April 1, 2010, World Meteorological Organization (WMO) and Bureau International des Poids et Mesures (BIPM) hosted "WMO-BIPM Workshop on Measurement Challenges for Global Observation Systems for Climate Change Monitoring – Traceability[1], Stability and Uncertainty" at the WMO headquarters in Geneva, Switzerland.

This workshop was held with the following objectives :

1) Identify key measurement issues in climate science, Numerical Weather Prediction model (NWP) and Earth observation where there is a requirement for improved underpinning metrology.

2) Foster closer links and develop dialogue between the metrology and the Earth observation systems communities.

3) Drive agenda setting and road mapping within National Metrology Institutes (NMIs) and ensure that measurement science is developed to meet the needs of climate science, NWP and Earth observation community needs

4) Inform the Earth observation systems community about the capabilities and plans of the NMIs.

On the first day after the plenary session in the morning, the attendees separated into two rooms, and the reports were made in eight different sessions. The eight sessions are as follows:

A. Climate trends from satellite sounding data
B1. Stable time series for key GHGs and other trace species
B2. Remote sensing of atmospheric composition and traceability issues in spectroscopic data
C. Radiation and Earth energy balance
D. Earth surface (land and water) temperature
F. Microwave imaginary data in climate and NWP
G. Surface properties: albedo, land cover and ocean colour
H. Ocean salinity

At the B2 session during discussion (Photo : Tatsuya Yokota)

At the B2 session during discussion (Photo : Tatsuya Yokota)

Among them, in contrast to the preexisting B1 session that themes around ground-based observation, B2 is a session newly established in the beginning of this year to examine the traceability and stability of satellite data.

From GOSAT Project, Yokota from NIES gave a presentation in the B2 session and joined the discussion to formulate a report. In B2, other satellite observation projects such as SCIAMACHY[2] and OCO[3](ACOS)[4] made presentations. I believe that from now on there will be more discussion at the international level on the accuracy and traceability of satellite observation data.

The workshop program and content of each presentation can be found at:

http://www.bipm.org/en/events/wmo-bipm_workshop/

1 Traceability: an ability to trace (to demonstate a linkage of) a measurement or an instrument to national or international standards with known accuracy, which facilitates a comparison between the results created with multiple instruments.

2 SCIAMACHY is a passive remote sensing spectrometer observing backscattered, reflected, transmitted or emitted radiation from the atmosphere and Earth's surface. The instrument flies on board European Space Agency's ENVISAT satellite, which was launched on March 1, 2002.

3 The Orbiting Carbon Observatory (OCO) was a NASA Earth System Science Pathfinder Project (ESSP) mission designed to make precise, time-dependent global measurements of atmospheric carbon dioxide (CO_2) from an Earth orbiting satellite. On February 24, 2009, OCO failed to reach orbit.

4 ACOS is a group formed around the OCO Science Team, including the research members from NASA's JPL, Caltech, and Colorado State University. Using "IBUKI"'s data, ACOS team has collaborated with the GOSAT project to develop and enhance the CO_2 retrieval algorithm for both GOSAT and OCO-2 projects.

GOSAT INTERVIEW

A Series: "IBUKI"'s PI Interviews

GOSAT Project hosted the Second Annual Research Announcement Principal Investigator Meeting (RA PI Meeting) in Kyoto from January 28 to January 29, 2010. At this meeting, 133 people including the PIs of selected RAs and the related researchers from 18 countries around the world gathered and had intensive discussions.

For this issue we introduce one of the PIs from the first RA, Michael Buchwitz of Institute of Environmental Physics (IUP) of the University of Bremen. (Interviewer: NIES GOSAT Project Yokota Tatsuya. Kyoto, Japan. January 29, 2010.)

No.4

DR. MICHAEL BUCHWITZ

Researcher,
Institute of Environmental Physics of the University of Bremen, Germany

Yokota: Thank you for coming here. Today, I'd like to ask you about your birthplace, your studies in the universities, and your involvement in the measurement of greenhouse gases.

Buchwitz: Since I was a child I wanted to study art, painting, but it was not so easy to find a place at a university to do that. Directly after high school I decided to do civil service instead of military service (in Germany one has the choice). During that time, I was working as an ambulance paramedic. This was so interesting that I applied for a job on the rescue helicopter in Bremen where I worked for about five years. My interest in technology grew during that time because I was exposed to using medical equipment. I was also fascinated by the workings of the human body so that overall my interest in engineering and natural science grew. At some point, I decided to study physics also because I thought, "I probably cannot continue jumping over fences or streams and the like with all the medical equipment when I am forty or fifty years old, so maybe I should do something else." I was already quite old then, 27, when I started to study physics. In fact, during high school, I was not really interested in mathematics and physics. This interest came rather late while working as a paramedic.

After finishing my studies, I started to work at the Institute of Environmental Physics of the University of Bremen in Germany on two satellite projects. One was related to the Global Ozone Monitoring Experiment (GOME)[1] instrument, whose main purpose has been to measure ozone (O_3), and the other is SCIAMACHY that was launched after GOME.

Yokota: This was in the university student days or after post doc?

Buchwitz: No, I did not even have a PhD at that time. I was hired directly as a full time engineer responsible for the specification of SCIAMACHY. Typically, a PhD student in Germany only gets a 50 percent (part-time) position, which of course also means 50 percent of a full-time salary. However, I already had a family and three children and therefore was looking for a full time position, which I found at the University of Bremen. After the specification of SCIAMACHY was finished I moved on to doing more science. I worked on developing a radiative transfer model - mainly for the analysis of GOME data - and also on retrieval algorithms for GOME and SCIAMACHY.

Yokota: So, your field is pure physics?

Buchwitz: I studied pure physics and moved into environmental physics later on. For GOME data, I was mainly working on the radiative transfer aspects because shortly after the launch of GOME, it was recognized that more work on radiative transfer was needed especially to get the O_3 total columns right. I was working on the part of the algorithm which is called Airmass Factor correction. It is done with radiative transfer modeling. I improved the radiative transfer model and this was also used for the operational processing of GOME's total O_3 and also nitrogen dioxide (NO_2) data. This was my first contribution to the GOME retrieval algorithms.

Yokota: Were you born in Germany?

Buchwitz: Yes, I was born in Germany, and I was even born in Bremen. So, I am one of the few people working at the University of Bremen who were also born in Bremen. This is rare, but I managed to do that.

Yokota: Ok. As for your current task, you presented CarbonSat, so you have some plans in the Europe group.

Buchwitz: Yes, we are also thinking about the future. We now have good SCIAMACHY data sets since 2002, and we hope that SCIAMACHY will still work for a few more years, but the mission will come to an end at some point. So we are concerned about how the time series of carbon dioxide (CO_2) and methane (CH_4) measurements from space started by SCIAMACHY will

1 GOME is a nadir-scanning ultraviolet and visible spectrometer for global monitoring of atmospheric O_3. It was launched in 1995 on-board European Space Agency's ERS-2 satellite which just marked its fifteenth anniversary in orbit in April 2010.

be continued. Of course, GOSAT is a very important first step for this continuation, and we are really looking forward to the GOSAT data covering several years, but then - what will happen after SCIAMACHY and GOSAT? Would there be a GOSAT 2? Would there be another OCO? Would there be a European contribution? At present, we see a high risk of an observational gap after GOSAT. GOSAT is an important step in the right direction. Nevertheless, we are thinking of what can be done in the future to even further improve the information which can be obtained on greenhouse gases from satellite observations. At present, we already have some very good ideas on how this can be achieved - and we would like to implement these ideas in a new satellite mission called Carbon Monitoring Satellite - CarbonSat.

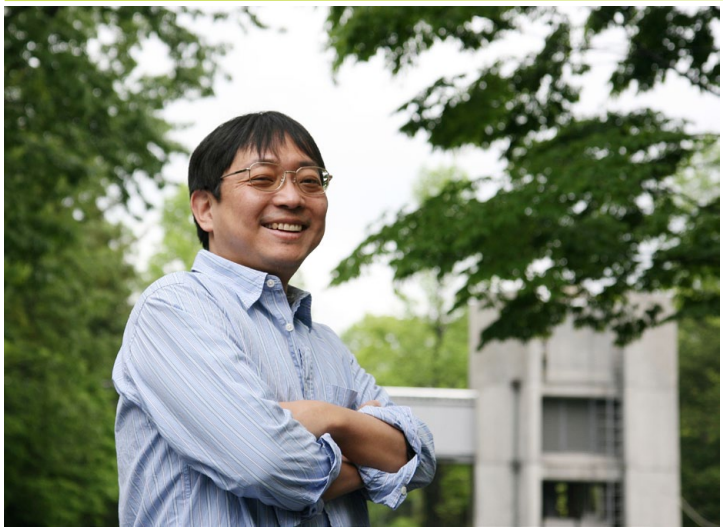
Yokota: What is your impression about the present GOSAT data?
Buchwitz: First of all, I am really impressed that the GOSAT team managed to keep its very demanding schedule proposed some years ago. When I heard just a few years ago about the plan to launch GOSAT at the end of 2008 or beginning of 2009, I thought that such an ambitious project cannot be done in such a short time period. However, the GOSAT team achieved this. There must have been a very big effort in Japan to keep to that very tight schedule. On top of that there was a successful launch. It was great. I know that many people are working with the GOSAT data for various applications. There is a largely growing community interested in the GOSAT data. For example, there are more than 100 people here in Kyoto participating at the RA PI meeting.

Also, I am sure that a lot of progress can still be made in improving the accuracy of the data products. I know from my own experience how difficult it is to do that, and I did not expect that everything would be perfect from day one after launch. A lot of good news has been presented here (at the RA PI Meeting), but also issues have been identified which will result in further improvements of the algorithms. I am sure that in one or two years, the data quality will be much higher than it is now, that the user community will grow and grow, and that more and more applications can be addressed with the GOSAT data.

Yokota: As for the GOSAT project, you and other researchers' results support us to get things done and to keep schedule of data delivery.
Buchwitz: I think we can learn a lot from GOSAT. For example, by analyzing the high spectral resolution GOSAT data, we can also learn how to improve the SCIAMACHY data products. The final goal is to get the highest possible product quality for both sensors.
Yokota: Do you expect that the higher spectral resolution will give much additional information?
Buchwitz: Yes, definitely. There is more information in the GOSAT data than in the SCIAMACHY data due to the higher spectral resolution. There are other advantages also, such as the smaller pixel size. We can also learn from that to improve future satellite missions such as CarbonSat.

Yokota: Do you have some suggestions or comments on our project? Or expectation?
Buchwitz: Yes, I have one suggestion concerning the algorithm development for CH_4 and CO_2 retrievals. For SCIAMACHY, we initially thought that we could develop one algorithm that can retrieve both gases. But in fact, our experience tells us that the retrieval of each gas is a different problem. So the current method that we use for SCIAMACHY CH_4 retrieval is different from the one used for CO_2 retrieval. For example, for CH_4 retrieval, we have a powerful method to get rid of errors caused by clouds and aerosols which cannot be applied to CO_2 retrieval under all circumstances.

My recommendation would be to also think about this for GOSAT. Using the SCIAMACHY method for GOSAT would lead to a larger number of useful CH_4 measurements because the current strict filtering for clouds and aerosols can be significantly relaxed.



GOSAT PEOPLE

People of "IBUKI"
Validation Research

by ISAMU MORINO

Senior Researcher, Satellite Remote Sensing Research Section, CGER, NIES

My Role at GOSAT Project.
"Validation is an indispensable task for a GOSAT data product to be used for scientific purposes."

For NIES GOSAT Project, I am in charge of validation of data products retrieved from "IBUKI"'s observation both as an operational project and a research. Validation is an indispensable task for a GOSAT data product to be used for scientific purposes. It is necessary to evaluate errors in the data retrieved from "IBUKI"'s observation such as concentrations of greenhouse gases using the data collected by ground-based and airborne observations that are more accurate than "IBUKI"'s observation. This process is called validation. Figure 1. is a schematic diagram explaining the validation by observation. Observations using a ground-based high-resolution Fourier Transform Spectrometer and an airborne sensor (already featured in GOSAT PROJECT NEWSLETTER ISSUE #3, #4) are considered very effective for validation. Some of the causes of errors in "IBUKI" data are thin clouds (cirrus clouds) and aerosol such as dust in the atmosphere. This is because these clouds and aerosol have an effect on the light that is observed. In other words, the retrieval of greenhouse gases is biased when the clouds and aerosol exist in the atmosphere. For this reason, it is necessary to obtain information on clouds and aerosol. We conduct observations using equipment called LIDAR to record and analyze the scattering of an emitted pulse laser light as well as an instrument called Skyradiometer to measure the intensity of solar aureole and direct solar radiation spectrum. Currently, we are working on intensive validation at certain points where the data are available for validation purposes, and it has been found that the GOSAT data products have a negative bias. It is expected that new GOSAT data products will be improved (closer to the validation data) after some measures are taken.

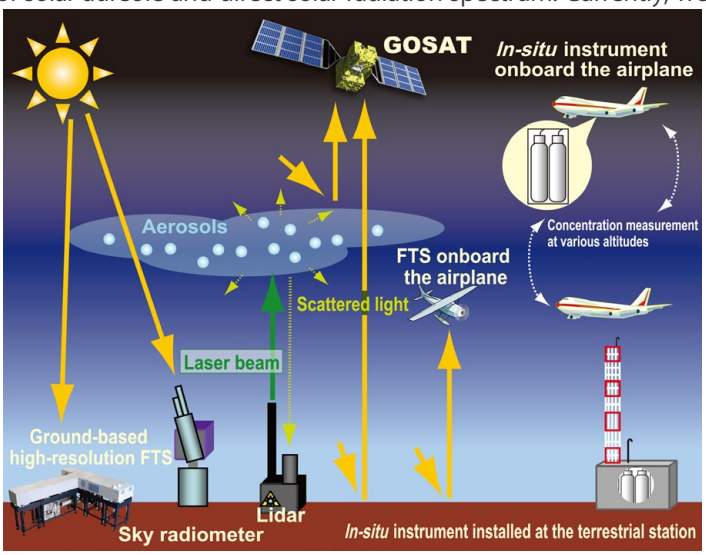


Figure 1. GOSAT schematic diagram of validation by observation. (from NIES GOSAT Project pamphlet)

The validation team.

There are operational aspect and research aspect to the validation of GOSAT data products. To put it in an extreme way, with research you may spend as much time as possible to get satisfactory results, but within an operation project you have to get results in a limited duration of time. This is why the validation team is established as a part of GOSAT Project Office. As of May 2010, the validation team led by Manager Osamu Uchino consists of a dedicated staff member, Morino, NIES Postdoctoral Fellows Yuki Miyamoto and Tomoaki Tanaka, Specialist Nobuyuki Kikuchi, and Validation Team Assistant Staff Chieko Hirobe. When the validation team has a special favor regarding GOSAT data processing, we work with GOSAT Project Office, and when we have to investigate into the algorithm to retrieve the GOSAT data products, we cooperate with the algorithm team. Since the data are acquired through domestic and overseas institutions, validation is made possible not only by teamwork of the validation team and NIES, but also with supports of many other people around the world.

On how I became involved in GOSAT Project.
An "astronomy boy" with a dream.

I became involved in GOSAT Project even though I had never imagined that I would work for NIES nor I would be involved with "IBUKI." I was born near Lake Biwa rich with beauty of nature. I remember spending weekends going out fishing in the lake and marshlands close by. I was also an "astronomy boy." I would observe meteor streams with numbers of shooting stars, sunspots, solar and lunar eclipses etc, and I had a dream to study astronomy in university. At that time, one had to be a really good student in order to major in astronomy in Japanese universities, but I did not like the so-called "studying for exams," so I eventually majored in physics. However, this did not mean physics was an easy study. I failed in many fields such as particle physics and quantum statistics. So, I was in a big trouble when I had to pick my research field. I decided to research on high-resolution laser spectroscopy based on quantum mechanics because I thought, "I understand this more or less."

Photo 1. The 45m radio telescope and a radio telescope as one of the radio interferometers (six 10m parabolic antenna) at Nobeyama Radio Observatory (NRO). (Photo: Courtesy of NRO)

Nonetheless, the lab I belonged to turned out to be working very closely with radio astronomy, which brought up the dream to study astronomy that I used to have. So, during my master's and doctoral courses, I studied at the Nobeyama Radio Observatory (NRO) of National Astronomical Observatory of Japan (NAOJ) under the National Institute of Natural Sciences (NINS). They have a radio telescope that is still one of world's largest telescopes in millimeter wavelength (Photo 1). The observatory was acknowledged worldwide for discovering many kinds of molecules whose interstellar existence had not been confirmed before. My goal was to do astronomy observations using this equipment, but the fact is, I was working on a repetition of lab works to produce and observe the spectrum of the short-lived molecules that are expected to exist in the interstellar space. Unfortunately, I was not blessed with a chance to discover new interstellar molecules, but I was able to earn a doctoral degree studying the spectroscopy that is critical in the interstellar chemistry. Meanwhile, I was able to study high-resolution molecular spectroscopy based on physics and to master the instrument and methods for analysis.

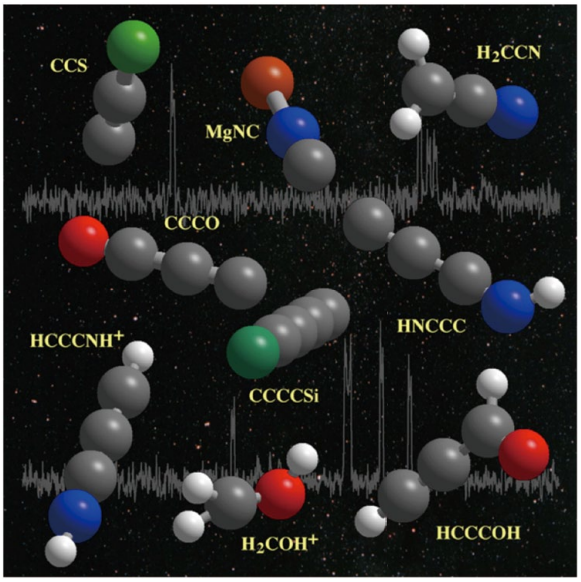


Figure 2. Interstellar molecules that have been discovered for the first time in the world by the 45m radio telescope at NRO. These are the unstable radicals and ions that cannot exit in the pressure of the atmosphere. (Image: Courtesy of NRO)

"My basis of research, high-resolution molecular spectroscopy is…"

After that, I gained eight years of experience as a post-doc fellow at three different places. First, my research was on high-resolution molecular spectroscopy that is important in the physical chemistry, and then I moved on to time-resolved spectroscopy and photochemical reactions in solutions, and then next to working on precise measurement of the spectral line shapes in a laboratory, which is the basis of the atmospheric remote sensing. During my last post-doc fellowship, I worked on obtaining the accurate data such as position, intensity and spectral line widths of absorption lines of gas molecules in laboratories. These data are necessary in the retrieval process of greenhouse gas concentrations from the absorption spectra in the atmosphere as in "IBUKI" project. Around the same time, there was a job posting at NIES about a researcher who has a basic knowledge on such matters. I was hired "by luck" and started a research work on atmospheric spectroscopy and became involved in GOSAT Project. My basis of research, high-resoultion molecular spectroscopy involves complicated yet minor research themes, and it is also a field that has already been established in a sense, so it is often said that there is no space for a big progress. However, I think this field is at the foundation of research methods in many different fields, so it is possible to take advantage of this to start a new research quite at ease. For this reason, I think I was able to pick a right field as a foundation of research. I would like to continue making efforts to expand my foundational research so that I can make more contribution to GOSAT.

GOSAT PROJECT IN THE MEDIA

"IBUKI" was featured in NHK's "Close-up Gendai."

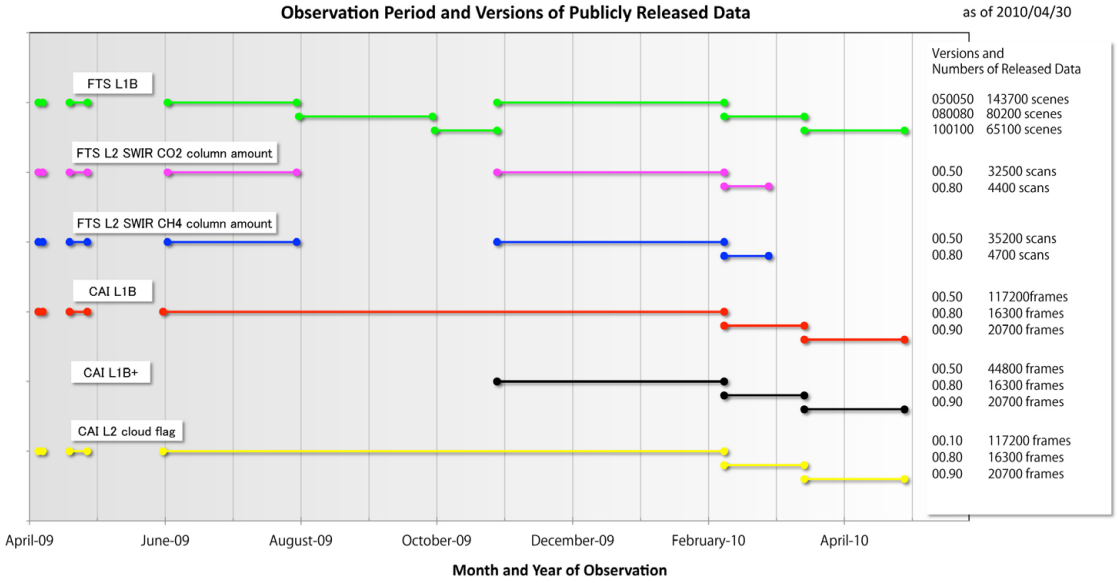
Image Source : Video on NHK Close Up Gendai Website

On April 14, 2010, "IBUKI" was featured in Japan Broadcasting Corporation (NHK)'s informational program titled "Close-up Gendai." In the program, "IBUKI"'s research activities were approached from multiple angles to show the scientific and social contexts of the research. Accorging to the researchers who use the data such as concentrations of greenhouse gases retrieved from "IBUKI"'s observation, the data are starting to be used to spot the natural disasters that produce greenhouse gases, and also to develop a system to detect gas leaks of pipelines that span continents. During the show, Professor Akimasa Sumi, a commentator from the University of Tokyo noted, "Acquiring such a large number of data globally in only one year can be stated as an achievement." On the day of airing, the members of NIES GOSAT Project gathered in a conference room to view the program.

DATA PRODUCTS UPDATE

Data Processing Status Update from GOSAT Project Office

— Fumie Kawazoe Specialist, NIES GOSAT Project Office



Here we report an update on the data processing status for the month of April 2010. Continued from March 2010, FTS L1B data products are processed as V100100, and CAI L1B, L1B+, and L2 cloud flag products are processed as V00.90 and all of these are available to the public. As reported in the April issue, it was found that the volcanic plume spreading from Iceland to Europe could be seen in the images of CAI L1B, L1B+ data products acquired after April 15, 2010.(Details on Iceland images on GOSAT Project Website : http://www.gosat.nies.go.jp/eng/related/201004.htm)

On the past data, the reprocessing of FTS L1B, CAI L1B, and L2 cloud flag data products from October 2009 is finally finished, and the consecutive data from June 2009 to April 2010 are offered to the public. There are multiple versions available for each data product. Please make sure to confirm the version numbers when you download the items.

We are currently verifying the FTS L2 SWIR CO_2 and CH_4 column amounts data acquired after March 2010, and planning to make them public as soon as the verification is finished. The number of the registered general users reached 767 as of May 10, 2010.

CALENDAR

2010/05/31-06/07
Presentation at the Network for the Detection of Atmospheric Composition Change Infrared Working Group (NDACC IRWG) • Total Carbon Column Observation Network (TCCON) Meeting held in Wollongong, Australia.

2010/06/14-15
Presentation at the 32nd Review of Atmospheric Transmission Models Meeting held in Lexington, Massachusetts, USA.

2010/06/16-18
Presentation at the11th Biennial HITRAN Conference held at Harvard-Smithsonian Center for Astrophysics, Cambridge, USA.

ANNOUNCEMENT

GOSAT PROJECT NEWSLETTER is accepting submissions from our readers.
We appreciate your opinion pieces;
"I want to read articles on ..."
"I'd like to know what ... means."
"... was really interesting. ...could have been better if ..." etc.

We also appreciate contributions from people involved in GOSAT Project;
"I'd love people to know about ..."
"My research is on ..., and I am passionate about it!" etc.
Please feel free to contact : gosat_newsletter@nies.go.jp.
Thank you for supporting our newsletter.

-Yuki Tanaka, editor

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