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 # 20 AUGUST 2011

CONTENTS

ACTIVITIES

Report : Data Acquisition over the Ocean Using High Resolution FTS aboard Research Vessels for Validation of "IBUKI"

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Japan Aerospace Exploration Agency (JAXA)

The atmospheric column averaged mixing ratios of greenhouse gases (carbon dioxide and methane) were measured for validation purpose over the ocean in a series of experiments using a high resolution Fourier Transform Spectrometer (FTS) installed on ships as "IBUKI" passed over the vicinity.

Photo 1. The FTS stored inside a container. The ocean is right outside the window! On "KAIREI."

It is an indispensable task to validate "IBUKI"'s retrieved data with a set of highly accurate data acquired by an independent observation method. Currently, the data available for "IBUKI"'s validation are those of observation sites with ground-based high resolution FTSs (ground-based FTSs) and those from limited locations such as some airports and surrounding areas observed using the Continuous CO_2 Measurement Equipment installed on commercial airliners, and it is necessary to supplement the missing validation data over the ocean.

For this reason, as one of "cooperative activities between the ocean and space," Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Japan Aerospace Exploration Agency (JAXA) conducted a joint study on the technology of over-the-ocean observation using a FTS installed on research vessels. The High Resolution Fourier Transform Infrared Spectrometer (FTS, Bruker 125 HR) owned by JAXA was installed on research vessels owned by JAMSTEC.

We conducted the experiments in the three cruises set by JAMSTEC: the Research Vessel "KAIYO" cruise (KY10-11, August 4 - 13, 2010), the Deep Sea Research Vessel "KAIREI" cruise (KR10-E02, September 10 - October 5, 2010), and the Oceanographic Research Vessel "MIRAI" cruise (MR 11-03, April 14 - May 5, 2011). The image 1 shows the tracks of the three cruises. The first experiment was in Sagami Bay, an inland bay where the waves are

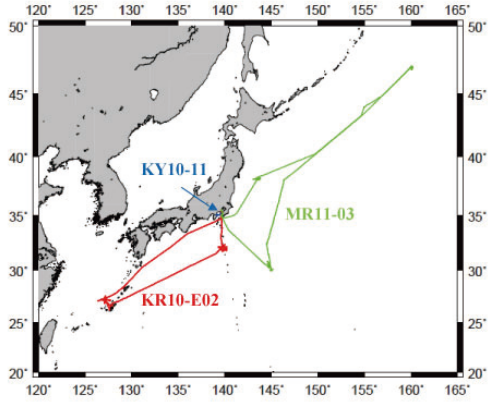


Image 1. The tracks of cruises for the high resolution FTS observation. The Research Vessel "KAIYO" cruise (KY10-11, August 4 - 13, 2010), the Deep Sea Research Vessel "KAIREI" cruise (KR10--E02, September 10 - October 5, 2010), and the Oceanographic Research Vessel "MIRAI" cruise (MR 11-03, April 14 - May 5, 2011).

not large, on "KAIYO," a catamaran whose stability is less affected by waves. Then it was followed by the experiment using "KAIREI" off of Hachijo Island and Izena Island, and then the experiment using "MIRAI" in the western part of North Pacific Ocean. We conducted experiments in such a way that the conditions such as weather and wave height gradually became more difficult.

The FTS was stored in a recycled 12 foot cargo container (previous page photo 1) installed on the deck of vessels (photo 2). The Solar Tracker (Bruker, A547N) positioned on top of the container took in solar radiation as the light source. The Solar Tracker features the fourth quadrant photoelectric detector that enables the motors to move at the azimuth and elevation angles to take in the solar radiation at maximum. It adjusts to the pitching and rolling at as fast as 2 deg/sec (Bruker Spec) to track the sun. For this instrument, we built a case made of a high transmission glass as a protection from the seawater splash (photo 3).

Both or one of us, Shuji Kawakami (SK) and Hirofumi Ohyama of JAXA, participated in each cruise to make measurements. On "KAIYO," we were able to make measurements under the low wave condition of Sagami Bay, which helped us confirm the operation systems of the Solar Tracker and FTS (Photo 4). On "KAIREI," the good weather helped us collect data not only on the days of "IBUKI"'s overpass, but on total of 22 days out of 26 days of the cruise. Since "KAIYO" sailed in the open sea, there were occasions when the ship rocked wildly (photo 5). It was learned that the accuracy of measurement was decreased when the rocking was especially wild, since the solar tracking was incomplete. During the "MIRAI" cruise, the weather stayed bad, and the waves were more than 6 m high on some days. I (SK) could do nothing because of seasickness. There was also a trouble with the observational instrument and the chance of observation was mostly limited. The fun part of life at sea was the meals with plenty of meat and fish (photo 6). I thought we would gain weight if we ate the whole food served at every meal, but in fact, a few people told me I looked I lost weight (worn-out) when we came back from the sea. To think about it now, each day was a difficult experience.

Based on the outcome of this experiment, we hope to continue making more validation opportunities for the ocean data for "IBUKI."

Photo 2. The yellow circles indicate where the container was mounted on "KAIYO," "KAIREI," and "MIRAI."

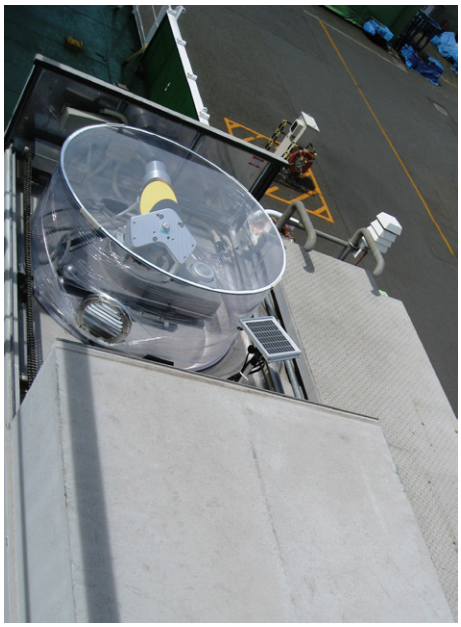


Photo 3. The Solar Tracker and a protective case. On "KAIREI."

Photo 4. Hirofumi Ohyama confirming the operation system of the Solar Tracker on top of the container on "KAIYO."

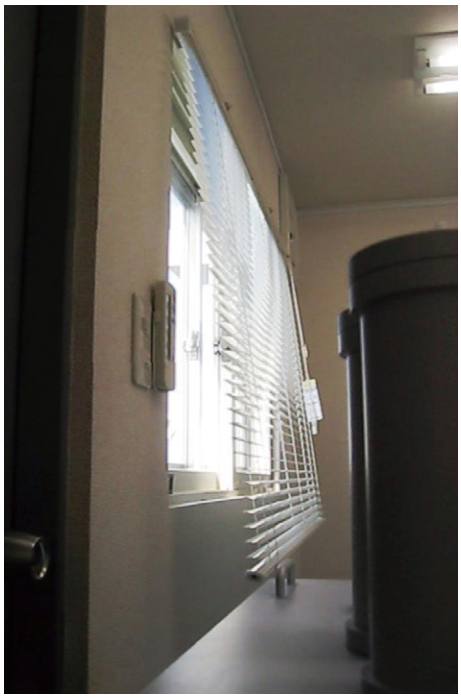


Photo 5. The ship is rocking wildly. The window blind looks tilted, but it is actually the container, or the ship that is tilted from rocking.

Photo 6. One dinner on "KAIREI." I ate it all! Yum-Yum.

<Acknowledgement> The KR10-E02 was a cruise by Japan Oil, Gas and Metals National Corporation. The experiment was made possible with the support from the vessel staff for each cruise, and the system was built with the support from Bruker Optics, Astro Optical, and Houwa Container Shop.

NEWS

Optical Adjustment for Ground-based High Resolution FTS at NIES

- Isamu Morino, Senior Researcher, Center for Global Environemtal Research, National Institute for Environmental Studies

The Great East Japan Earthquake of March 11, 2011 forced observational instruments at the National Institute for Environmental Studies (NIES) to stop their nominal operation. We are currently working on their restoration.

One of such instruments is the ground-based high resolution Fourier Transform Spectrometer (FTS, Bruker IFS 125 HR) that observes the solar radiation that has been affected by the absorption of the greenhouse gases in Earth's atmosphere, installed at the Climate Change Research Hall at NIES. This is the Tsukuba observation site for the global network of observation using the FTSs, the Total Column Carbon Observing Network (TCCON, https://tccon-wiki.caltech.edu/). The column-averaged mixing ratios of greenhouse gases collected in TCCON are used for validation of satellite data including "IBUKI" and for other carbon cycle studies.

Tsukuba city experienced tremors of seismic intensity level '6 Lower (difficult to remain standing)' during the earthquake. The optical system of the FTS at NIES went out of order because of this powerful shake and the FTS stopped functioning. One month later, the instrument was given an expedient adjustment by the local engineers from the Bruker Optics in Japan and it managed to start running. However, the perfomance could not be brought to the level that complies with the TCCON Data Protocol, and the observation is being done only as a test run of the instrument.

In order for the instrument to achieve the level of performance that meets the TCCON Data Protocol, more advanced adjustment was necessary. For this reason, Mr. Gregor Surawicz from the headquarters of Bruker Optics in Germany visited NIES from June 20 to 22, 2011, to make an adjustment to FTS in exact detail. In the top photograph is Mr. Surawicz working on FTS. The instrument now performs at the level required by the TCCON Data Protocol. Furthermore, other technical issues that were pointed out in TCCON were also worked over, and these issues were successfully minimized so as not to interfere with the accuracy of measurement. Next, we will need to fix issues with our sun tracker and the dome that is covering it. It is expected that the nominal observation as the TCCON Tsukuba site will restart as soon as such restoration works are finished.

Mr. Gregor Surawicz working on the ground-based high resolution Fourier Transform Spectrometer. Smiling for the camera as he gets fine results after making an adjustment.

Due to the powerful shake of the Great East Japan Earthquake on March 11, 2011, the ground-based high resolution FTS and the optical bench that holds FTS hit each other and paint was scratched off. It is structured that the spring between the FTS and rack should absorb shocks, but the shock seems to have been more powerful than expected.

NEWS

Report: NIES Summer Open House

- Yuki Tanaka, Specialist, NIES GOSAT Project Office

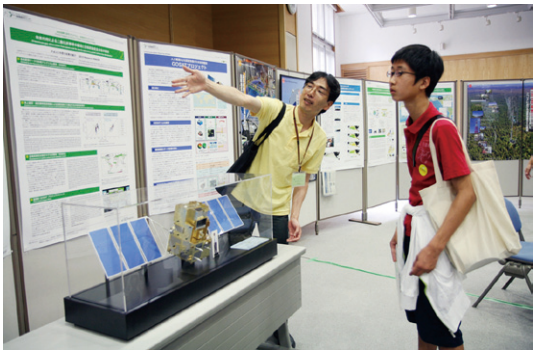
The "NIES Summer Open House" was held on July 23, 2011 at the National Institute for Environmental Studies (NIES). At this annual event, NIES opens some of the main research facilities to the public and researchers share outcomes of their work with the visitors. This year the temperature was relatively low for this time of the season, and it helped attract as many as 3,811 visitors, which outnumbered the visitors last year.

The NIES GOSAT Project belongs to the Center for Global Environmental Research (CGER). Some of the research promoted by CGER includes carbon balance monitoring, greenhouse gas measurement using vessels and commercial airliners.

The NIES GOSAT Project ran a booth alongside these research projects to introduce the workings and outcomes of greenhouse gas measurements from the space with "IBUKI" satellite. The monthly global CO_2 and CH_4 distributions (FTS Level 3 data products) were displayed on the spherical display to show how the distribution varied as the season changed. This year we had a few tablet PCs ready so that the visitors can view "IBUKI" data at hand. "IBUKI"'s Fourier Transform Spectrometer and Cloud and Aerosol Imager have accumulated data on various aspects of earth's environment for over two years. On the tablet PCs, we mounted not only the global distribution maps of greenhouses gases, but also the maps of soon-to-be-released vegetation index (CAI Level 3 data products) that shows the distribution and activity of vegetation, and also the images composed from the "IBUKI" data. I believe that people could look at how "IBUKI" sees the earth at their own pace.

NIES normally hosts another open house event in spring, but this year it was canceled due to the earthquake. The "NIES Summer Open House" was a great opportunity to introduce "IBUKI" to more people and show the progress of project after such a long time.

The visitors look at the images of "IBUKI" data on tablet PCs.

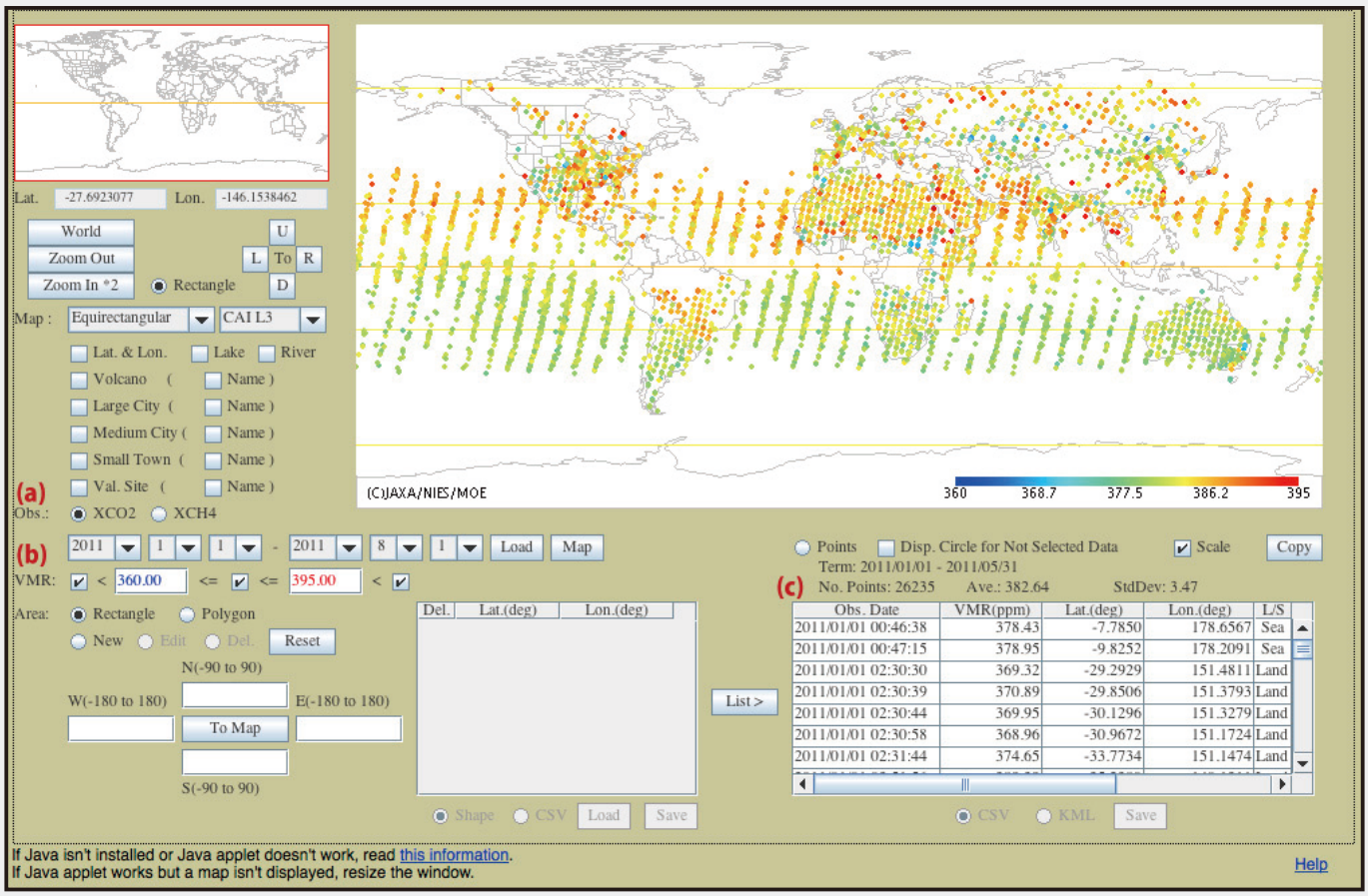


NIES GOSAT Project Office Specialist Nobuyuki Kikuchi (left) attends to a visitor at the booth.

AHA! OF THE MONTH

A Series: How to Use GUIG Tool "SWIR L2 Global Distribution Map" - 1 -

- Kenji Hayashi, NIES GOSAT Project Office



A screenshot of the Tool after searching for XCO_2 for the term, January 1, 2011 to August 1, 2011.
(Displayed data are the latest version that is available up to May 31, 2011.)

In this series of articles, I will take you step by step through the process of using the "SWIR L2 Global Distribution Map" tool on the GOSAT User Interface Gateway (GUIG). With the "SWIR L2 Global Distribution Map" tool (hereafter referred to as the Tool), one can display the values of carbon dioxide and methane concentration (SWIR Level 2 column-averaged mixing ratios; XCO_2, XCH_4) on a map, and visually understand their distribution. The displayed data can be downloaded and each user can utilize them for their own purposes. The user registration is required, and a guest user cannot use the Tool. Please follow "For Registration: here" on the User authentication page, and then on to "General registration."

After logging in, click on "SWIR L2 Global Distribution Map" and the Tool will open in a new window. The main functions of the Tool are as follows.

1) Search/display concentration data: you can search and display the latest version of SWIR Level 2 column-averaged mixing ratios of the points that were observed by "IBUKI."

2) Save displayed data: you can download the displayed data as text format or KML file format (for Google Earth).

3) Display CAI data as background: you can display CAI Level 3 satellite images (global radiance distribution (3days' worth data), or global reflectance distribution (a month's worth data)) as a background of the map. The CAI images are from the same observation periods as the displayed SWIR Level 2 data.

This month, I would like to demonstrate the functions of the Tool regarding the first half of 1) search/display concentration data. The latter part of 1) and 2), 3) will be demonstrated in the coming months. For more detailed instructions on how to use the Tool, please also refer to the "Help" in the right bottom of the Tool page.

1) Search/display concentration data

As the Tool is opened in a new window, first go to "Obs:" section (a) in the left middle and select either XCO_2 or XCH_4, and set the start and end date, then click on "Load" button. It will display colored dots that indicate the values of column-averaged mixing ratios of the selected gas during the selected time period. By setting the minimum and maximum values of "VMR" section (b), you can change the range of concentration values to view. (Image: A screenshot of the Tool after searching for XCO_2 for the term, January 1, 2011 to August 1, 2011) The search result is displayed on the list in the right bottom, and the displayed term, number of points, average value and standard deviation of the column-averaged mixing ratios are also noted on top of the list. This displayed term is shorter than the searched time period, because the latest publicly available data are up to May 31, 2011 (as of August 19, 2011). As the SWIR Level 2 data products are released, it will be reflected in the Tool.

For the next issue, I am going to demonstrate how to search and display the data for specific areas.

NEWS

"GOSAT/IBUKI Data Users Handbook" is Available Online

- Hiroshi Watanabe, NIES GOSAT Project Office Manager

The GOSAT Project is a joint effort of the Japan Aerospace Exploration Agency (JAXA), National Institute for Environmental Studies (NIES) and Ministry of the Environment, Japan (MOE). Now it has been almost two and a half years since the launch of "IBUKI," and many of the scheduled data products have been released to the public. In order to improve convenience of the data for users, we published "GOSAT/IBUKI Data Users Handbook" online.

The handbook includes the summary of data products, their retrieval algorithms, workings of the satellite, and information on the on-board sensors and ground system.

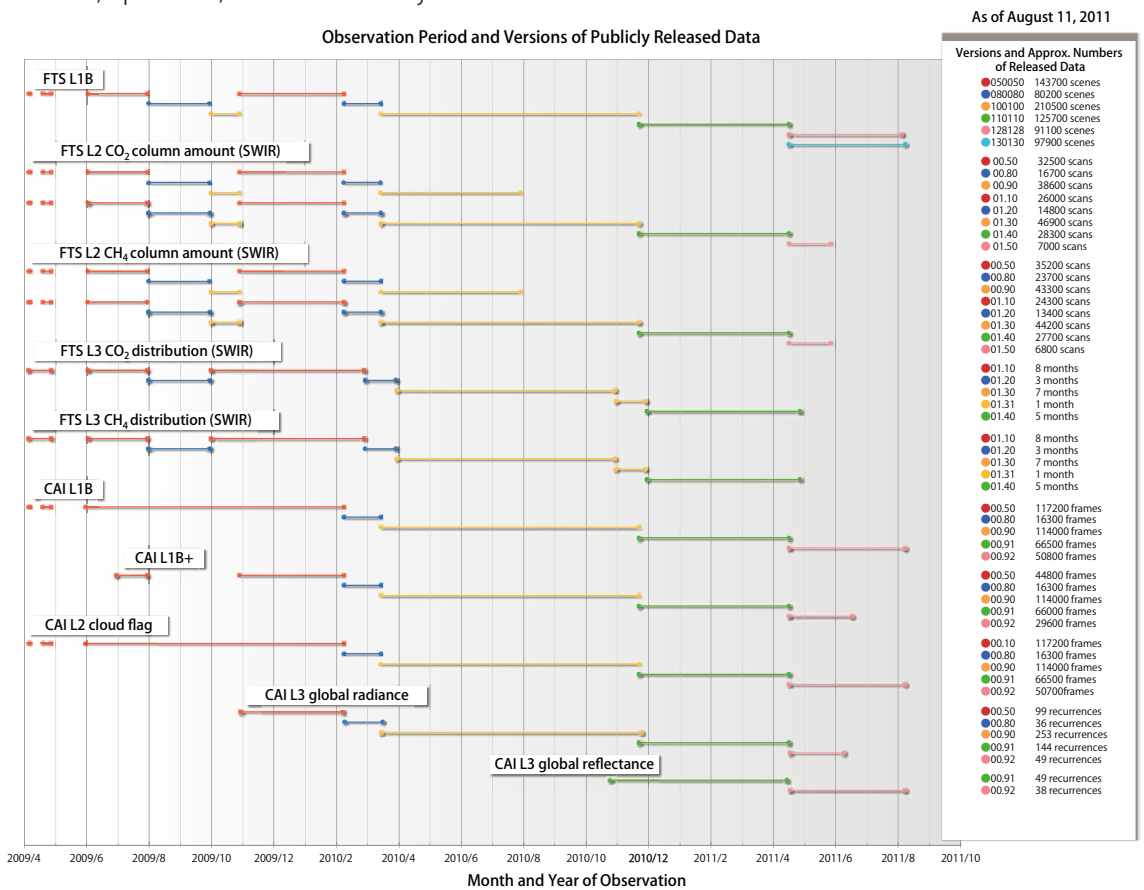
The handbook integrates the information provided in fragments on the GOSAT website. It consists of eight chapters and appendixes, and also features some of the basic information that is released for the first time.

This handbook can be downloaded from the "Data Users Handbook" link on the left bottom of the GOSAT User Interface Gateway (GUIG) top page. <http://data.gosat.nies.go.jp/> The English version is also available on the English page of GUIG.

DATA PRODUCTS UPDATE

DATA PROCESSING STATUS UPDATE FROM GOSAT PROJECT OFFICE

- Fumie Kawazoe, Specialist, NIES GOSAT Project Office



Here we report an update on data processing status for late July and early August.

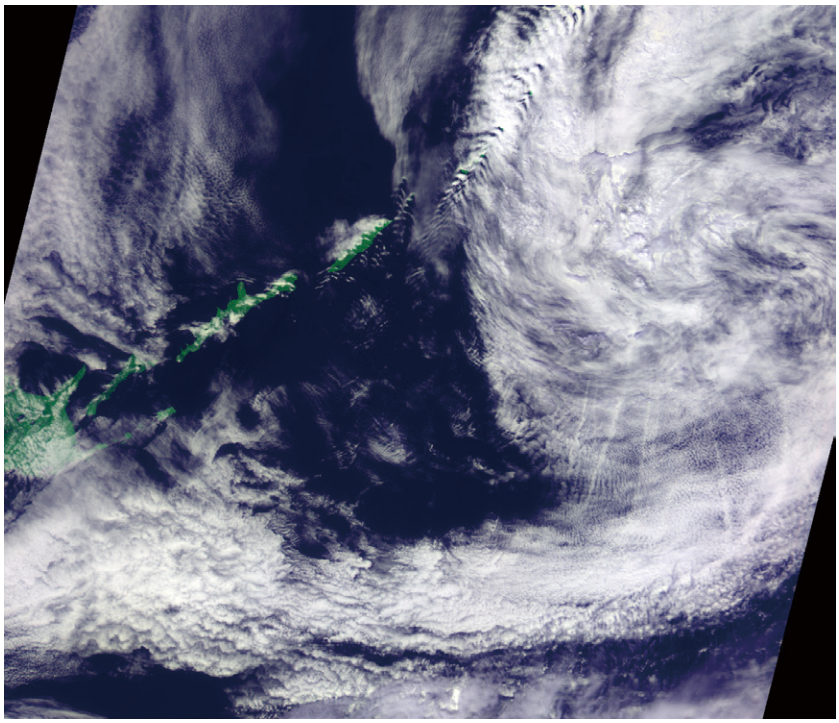
Continued from last month, we are processing and releasing the V128.128 and V130.130 of the FTS L1B data product, V00.92 of the CAI L1B, L1B+, L2 cloud flag, L3 global radiance distribution and L3 global reflectance distribution data products, V01.50 for FTS L2 CO_2/CH_4 column amounts (SWIR). We released the FTS L2 CO_2/CH_4 column amounts for the month of May and FTS L3 global CO_2/CH_4 distribution for the month of April. The FTS L2 CO_2/CH_4 column amounts are produced from the V128.128 of FTS L1B data products.

The number of registered users is 1093 as of August 11, 2011.

IMAGES OF THE MONTH

Ship Tracks Emerge in Clouds

- Nobuyuki Kikuchi, Specialist, NIES GOSAT Project Office



A number of streaks are visible in the clouds over the Pacific Ocean off the coast of Kurile Islands. The imaging sensor installed on "IBUKI," the Cloud and Aerosol Imager (CAI) captured this image on July 20, 2011. These streaks that stand out bright in the clouds are the tracks of ships. The aerosols including the exhausts from ships change the character of clouds, and the reflectance rate of these clouds become higher than that of surrounding clouds.

A seed for cloud develops as a particle of aerosol serving as a cloud nucleus attracts water vapor. A large amount of aerosols included in the ships' exhausts become cloud nucleus, and thus creates a large number of cloud droplets. However, when this occurs, the size of cloud droplets become small because the amount of water vapor that is available remains the same. Small cloud droplets have a contradictive nature; they are less likely to reflect the solar radiation. However, the number of them outweighs the size and the reflectance becomes high.

This phenomenon of aerosols causing higher reflectance of clouds is occurred in metropolitan areas with air pollution. Since the sunlight is reflected and less light (heat) reaches the ground, it is considered to have a mitigation effect against global warming.

PUBLISHED PAPERS

Field of Research: data processing algorithm
Name of Journal: Journal of Geophysical Research (Volume 116, D14304, 9PP)
Title: Detection of optical path in spectroscopic space-based observations of greenhouse gases: Application to GOSAT data processing
Authors: S. Oshchepkov, A. Bril, S. Maksyutov, and T. Yokota

ANNOUNCEMENT

NIES GOSAT PROJECT NEWSLETTER welcomes letters from our readers.
We appreciate your opinions,
"I want to read articles on ...," "... was really interesting." etc.
We also appreciate opinions or contributions from people involved in the GOSAT Project.
Please feel free to contact : gosat_newsletter@nies.go.jp.
Thank you for supporting the newsletter.

CALENDAR

2011/09/08-09
Partipation at the 29th Laser Sensing Symposium (LSS 29) held in Nanao, Japan.
2011/09/19-22
Partipation at the SPIE Remote Sensing 2011 held in Prague, Czech Republic.
2011/10/04 - 05
Participation at CAE POWER 2011 held in Tokyo, Japan.

NIES GOSAT PROJECT NEWSLETTER **ISSUE #20 AUGUST 2011**

Issued On : 2011.09.05
Revised On : 2011.11.29

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
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