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National Institute for Environmental Studies (NIES)
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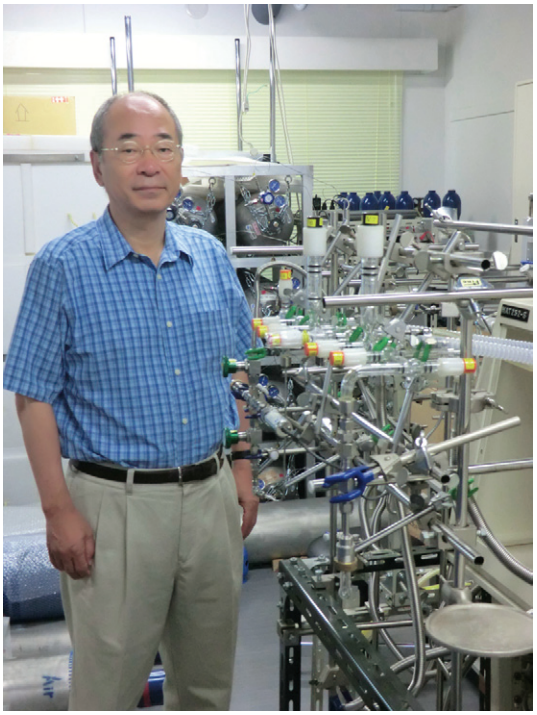
GOSAT PEOPLE

Messages from People of "IBUKI" Atmospheric Trace Gas Research



In the laboratory at Tohoku University.
Photo by Hironobu Iwabuchi (Tohoku University).

PROFESSOR TAKAKIYO NAKAZAWA

**Atmospheric Trace Gas Laboratory,
Center for Atmospheric and Oceanic Studies,
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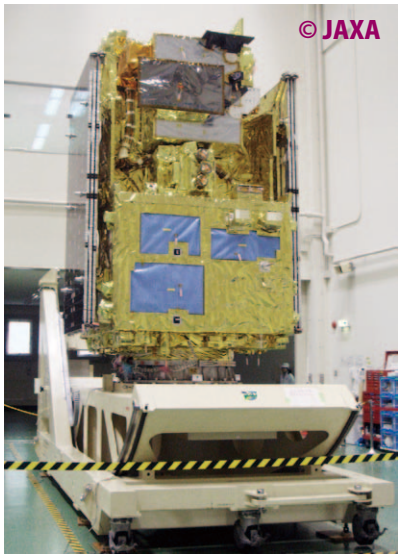
GOSAT Science Team member**

Seeing the Satellite Up Close For the First Time

In March 2008, I had an opportunity to visit "IBUKI" (GOSAT) still being assembled at the Tsukuba Space Center of Japan Aerospace Exploration Agency, with my fellow GOSAT Science Team members. "IBUKI" is a mid-sized satellite focusing solely on one mission, but seeing a working satellite in person for the first time, I was overwhelmed by its size and sophistication. There were some parts that looked roughly built, but I was explained that this was made that way so it flies in the zero gravity condition, and I remember being convinced and impressed. When the Soviet Union shocked the world by launching the satellite Sputnik for the first time in human history, I was in the fourth grade. Back then, I was just a boy living in the countryside of Shimane Prefecture in Japan. I never imagined that satellites would evolve this much or that they would be the cutting-edge technology for earth observation, or not to mention that I would be involved in the satellite observation.

Getting Involved in GOSAT Project

I studied meteorology as my graduate study at Tohoku University, and stepped into the world of scientific research. I was doing research on how the gases in the atmosphere absorb light. This is an elementary topic in meteorology, so when I got a researching position at Tohoku University after finishing my graduate studies, I wanted to work on something new and contributing to meteorology. After careful consideration, I decided to work on greenhouse gas research.



"IBUKI" being assembled at the Tsukuba Space Center of Japan Aerospace Exploration Agency photographed in November 2008. Photo by Japan Aerospace Exploration Agency

It was in 1977 when I actually took on the research. Since then, I have been doing a wide range of research targeting carbon dioxide (CO_2), methane (CH_4) and dinitrogen monoxide (N_2O): atmospheric observation using ground-based stations, regional observations using airplanes, vessels, and balloons, observation over the ocean in various parts of the world, analysis of ice core*1 acquired in Antarctica and Greenland, and also data analysis of all the acquired data. All of such research is closely related to what is

*1 **analysis of ice core :** In the ice in Antarctica and Greenland, the air from the ancient time can be found locked in. It is possible to learn about the greenhouse gas concentrations of the ancient times by analyzing the air taken out of the bubbles in such ice.

expected to achieve in the GOSAT Project, and this is why I became a member when the GOSAT Science Team was organized.

Understanding the Cycle

When the greenhouse gases are produced some place on the earth, they travel in the atmosphere, then disappear at some point in other place. This series of processes is called "cycle." In order to mitigate the controversial global warming, it is necessary to understand this cycle of greenhouse gases and to learn how much of the human-caused greenhouse gases remain in the atmosphere. There are ways to understand the greenhouse gas cycle, but the method that is considered very effective and has been attracting a lot of attention lately is to use the atmospheric transport modeling[*2] to analyze the closely measured concentrations of greenhouse gases. In fact, researchers in and out of Japan, including we, have found a lot about the cycle with this method. However, the findings are not enough to understand the complicated and extensive system of the earth.

"IBUKI" is an unprecedented approach to the measurement of CO_2 and CH_4 concentrations; it makes observation on a global scale. It is expected to lead to a great advance in understanding the greenhouse gas cycle. However, the cycle changes every moment due to the activities of the nature and human beings. In order to fully understand the whole picture, it is important to acquire data not only over the wide range of space but also over a long period of time. Hopefully, in the near future, the quality of data retrieved from "IBUKI" will be further improved, and the data will be analyzed using the high-spec atmospheric transport modeling, and then a long-term observation will be planned with a possible successor in consideration.

*2 **atmospheric transport modeling** : A computation model to calculate the process of how the greenhouse gases are transported in the atmosphere from emission until absorption. By inputting the "IBUKI" data in the atmospheric transport modeling, it is possible to estimate the net flux of emission and absorption of greenhouse gases.

ACTIVITIES

Observation for GOSAT Data Product Validation Starts in Saga, Japan

- Osamu Uchino
Validation Manager
NIES GOSAT Project Office

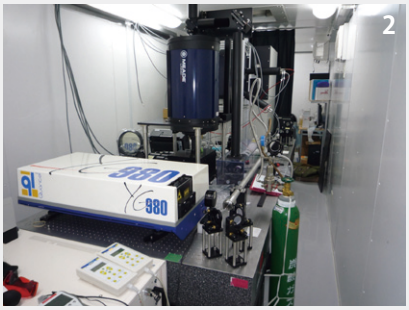


Photo 1. LIDAR (two containers on the left) and FTS (container on the right) set up right next to the Building 7 (four story building in the back) at Saga University. Photo 2. LIDAR installed inside the container. Photo 3. Two observation windows built in the roof of container (the one in the back is for tropospheric ozone LIDAR, and the one in the front is for aerosol observation). Photo 4. The sky radiometer (left) and sky camera (right) on the rooftop of the Building 7. Photo 5. JAXA's high resolution FTS installed inside the container. Photo : 1 Shuji Kawakami (JAXA) 2-5 Osamu Uchino

The National Institute for Environmental Studies (NIES) and the Japan Aerospace Exploration Agency (JAXA) have chosen Saga University as a new key site for validation of GOSAT data products. The university is located in the vast Chikushi Plains in Kyushu Island. NIES signed an agreement with Saga University for a joint research, and the mobile LIght Detection And Ranging (LIDAR) that had been used at NIES for validation of GOSAT data products was moved to the new validation point, right next to the Saga University's Faculty of Science and Engineering Building 7 (33.24 N, 130.29 E)(Photo 1). In the midst of preparation for transportation of instruments at NIES, the Great Tohoku Earthquake struck Tsukuba with the tremors of seismic intensity level '6 -.' Fortunately, it was after we finished packing more delicate instruments such as optical parts. On March 12, 2011, one day after the earthquake, the instruments were loaded on two air-suspension trucks which arrived late due to the post-disaster traffic and transported to Saga. From March 14, we started installing the container at the assigned location, then assembled LIDAR and made adjustments (Photo 2). At the same time, observation windows were built in the roof of the container (Photo 3). We tested emitting laser light into the atmosphere and receiving the backscattered light from the atmosphere through the observation window, and it was made sure that the earthquake or the long distance travel had not affected the instruments. Simultaneously, on the rooftop of the Building 7, a sky camera and a sky radiometer were installed as well (Photo 4).

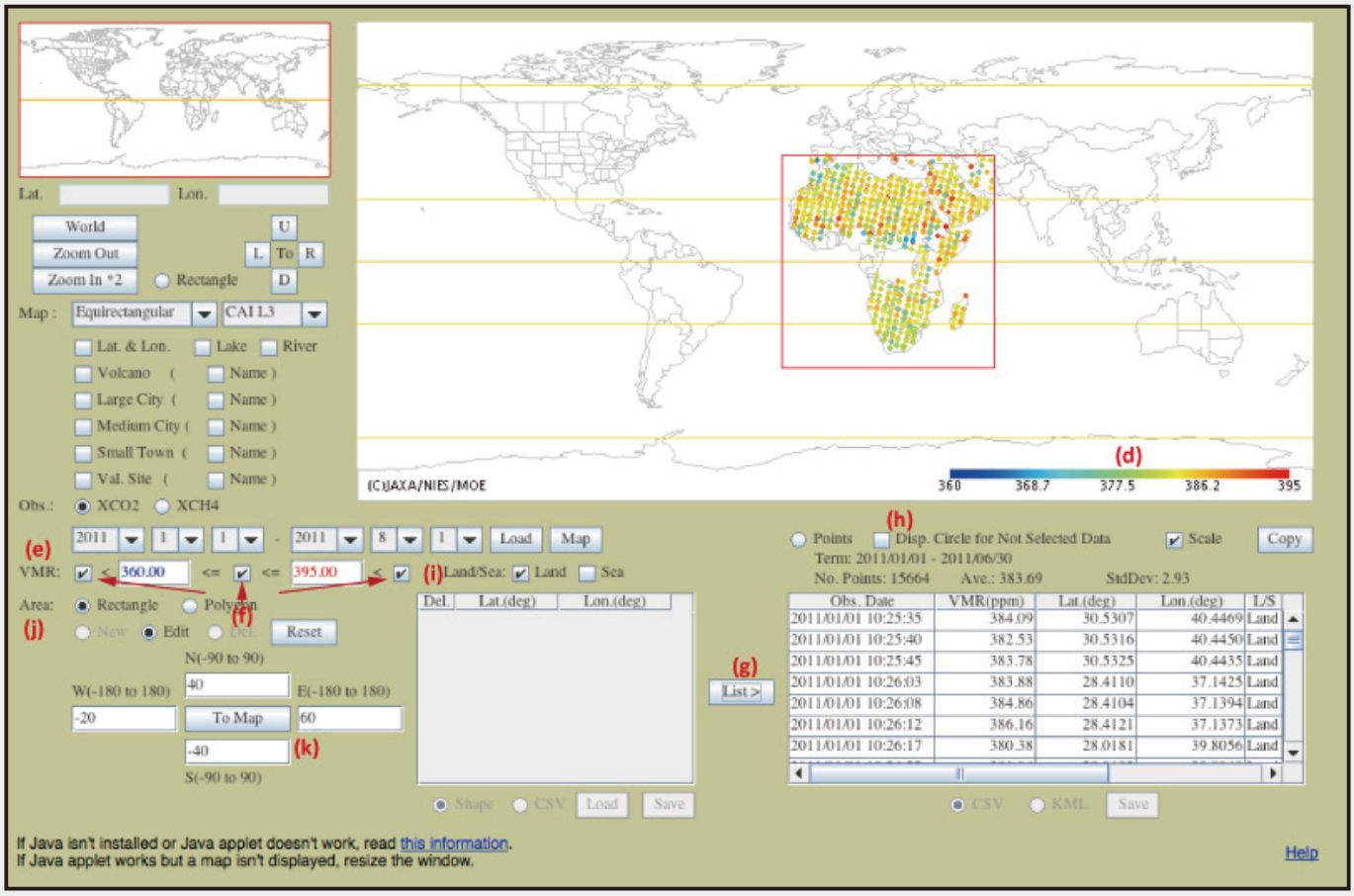
In late May, JAXA installed a high-resolution Fourier Transform Spectrometer, based on their joint research agreement with Saga University (Photo 1 and 5). This FTS had been used for observation on vessels over the ocean near Japan for GOSAT data product validation, as mentioned in the last issue of the newsletter.

The concentrations of carbon dioxide (CO_2) and methane (CH_4), vertical profiles of thin cirrus clouds and aerosols, and optical thickness of aerosols have been observed using the FTS, LIDAR, and sky radiometer, mainly on clear-sky days during "IBUKI"'s overpass. By validation, we hope to find to what extent the aerosols and thin cirrus clouds affect "IBUKI"'s CO_2 /CH_4 concentration observation in order to further improve the quality of GOSAT data products.

AHA! OF THE MONTH

A Series: How to Use GUIG Tool "SWIR L2 Global Distribution Map" - 2 -

- Kenji Hayashi, NIES GOSAT Project Office



A screenshot of the Tool after searching for XCO_2 for the term, from January 1, 2011 to August 1, 2011 and for the specified area (Rectangle: N40 - S40, W20 - E60) over the land.

In this series of articles, I will take you step by step through the process of using the "SWIR L2 Global Distribution Map" tool (hereafter referred to as the Tool) on the GOSAT User Interface Gateway (GUIG). 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 (XCO_2, XCH_4) 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 (3 day's 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 main functions of the Tool regarding the part 2 of 1) Search/display concentration data (for requirements and how to start the Tool, please refer to the last issue (August 2011)). 2) and 3) will be demonstrated in the coming issues. 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 (part 2)

In the last issue (August 2011 issue), we introduced how to search and display the concentration data products for a specific time period. It is possible to search under even narrower search conditions.

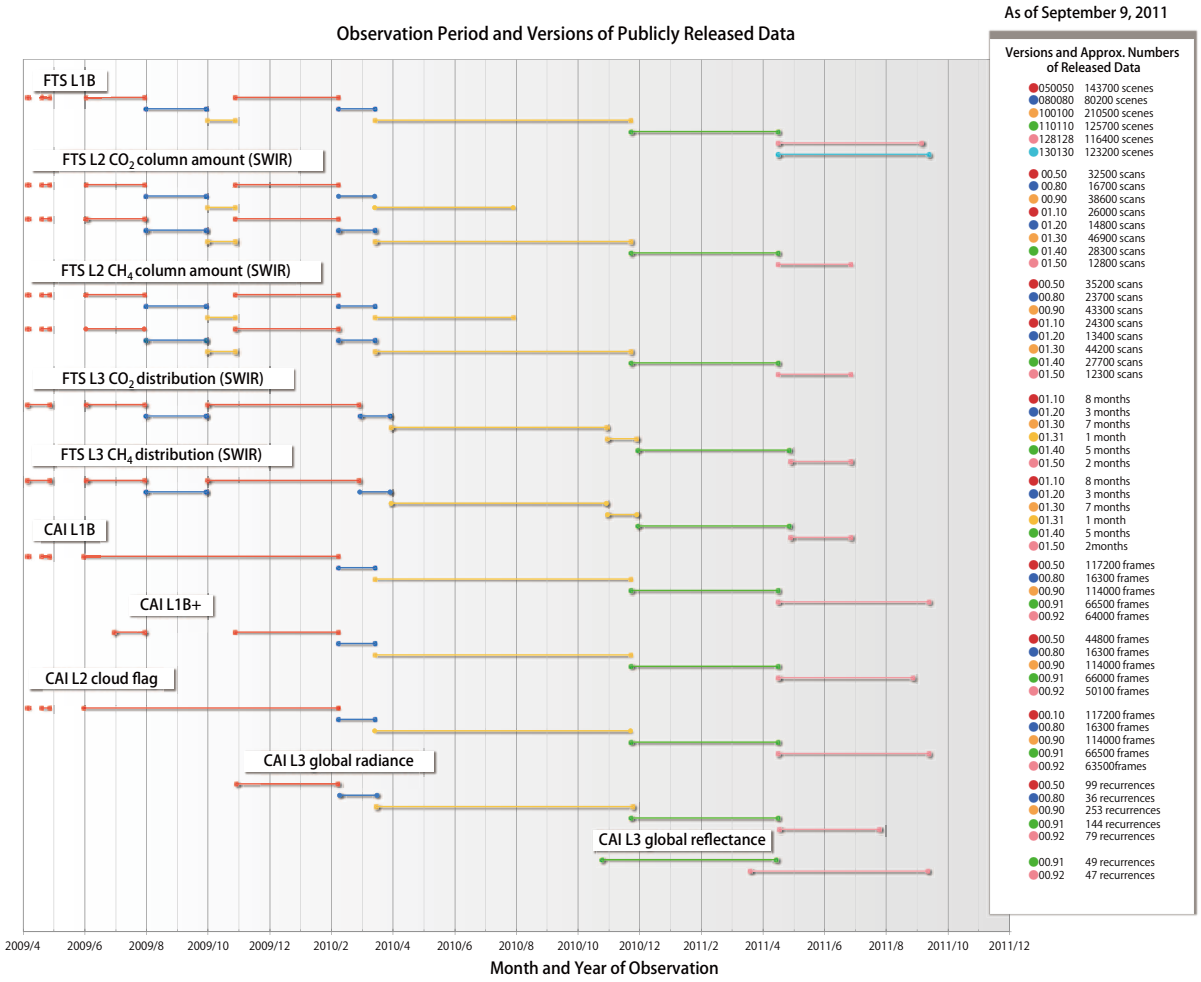
First, by setting the minimum and maximum values in the "VMR (volume mixing ratio)" section (e), the range of color bar (d) on the bottom of the map can be changed. You can also set up either to view or not to view the data of certain ranges by checking on and off in the boxes (f), and if you press the "List>" button, only the corresponding data will be displayed on the map and listed in the table in the bottom right of the page. If you check on the "Disp. Circle for Not Selected Data," box (h) you can display the data from checked-off range as empty circles instead of solid circles. Additionally, you can also choose to hide data of either "Land" or "Sea" by checking the box in the "Land/Sea" section (i) and pressing "List>" button.

You can specify the area of data to view using the "Rectangle" or "Polygon" in the "Area" section (j). With "Rectangle," you can specify an area by click-and-dragging on the map, or by entering values in latitude/longitude (k). If you click on the "List>" button in the end, only the data in the specified area will be searched and plotted on the map, and listed in the table in the bottom right of the page.

DATA PRODUCT 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 August and early September.

Continued from last month, we are processing and releasing the V128.128 and V130.130 for FTS L1B data product, V00.92 for CAI L1B, L1B+, L2 cloud flag, L3 global radiance distribution and L3 global reflectance distribution data products, and V01.50 for FTS L2 CO_2/CH_4 column amounts (SWIR). We have newly released the FTS L2 CO_2/CH_4 column amounts for the month of June, and FTS L3 global CO_2/CH_4 distribution for the month of May and June. 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 1108 as of September 9, 2011.

CALENDAR

2011/10/04 - 05
Participation at CAE POWER 2011 held at the Garden City Shinagawa in Tokyo, Japan.

2011/10/18 - 20
Participation at the 17th Atmospheric Chemistry Symposium held at Kyoto University in Uji, Japan.

2011/11/10 - 11
Participation at the 51st Autumn Conference of the Remote Sensing Society of Japan held at Hirosaki University in Hirosaki, Japan.

2011/11/16 - 18
Participation at the 2011 Autumn Meeting of the Meteorological Society of Japan held at Nagoya University in Nagoya, Japan. Hosting the special topic session "Development of atmospheric carbon dioxide measurement techniques and their data application" on November 18, 2011.

PUBLISHED PAPERS

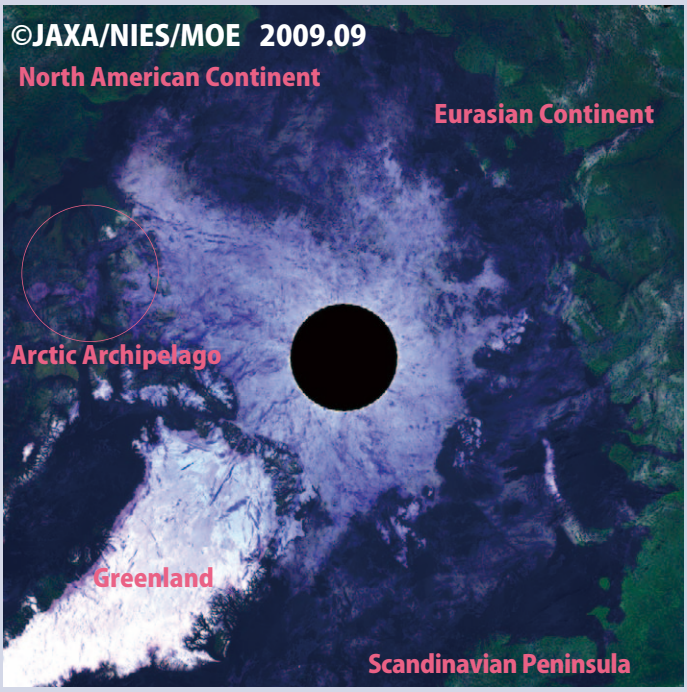
Field of Research : carbon balance estimation, atmospheric transport models
Name of Journal : Journal of Climate (Volume 24, Issue 15, 4109-4125)
Title : Evaluation of Biases in JRA-25/JCDAS Precipitation and Their Impact on the Global Terrestrial Carbon Balance
Author : M. Saito, A. Ito, and S. Maksyutov

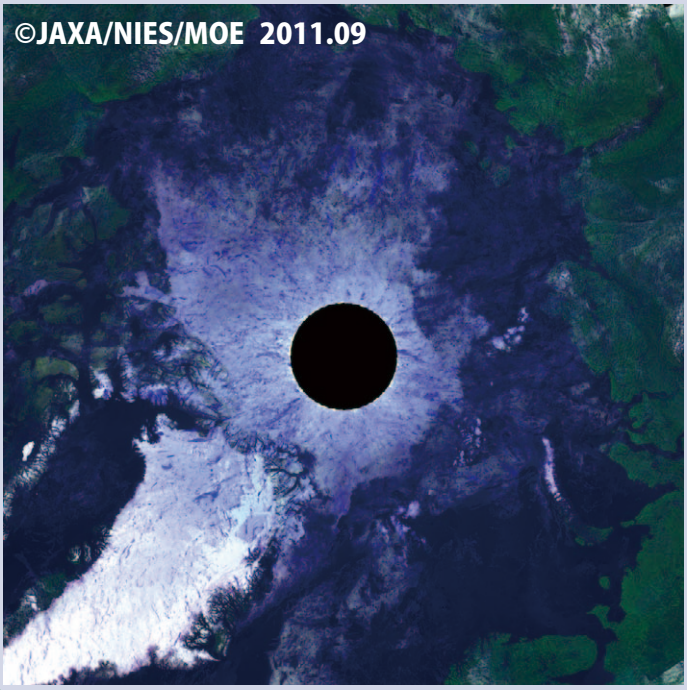
Field of Research : data application
Name of Journal: Geophysical Research Letters (Volume 38, No.14, L17706, 6 PP.)
Title: New global observations of the terrestrial carbon cycle from GOSAT: Patterns of plant fluorescence with gross primary productivity
Authors: C. Frankenberg, J. B. Fisher, J. Worden, G. Badgley, S. S. Saatchi, J.-E. Lee, G. C. Toon, A. Butz, M. Jung, A. Kuze, and T. Yokota

IMAGES OF THE MONTH

ARCTIC SEA ICE

- Nobuyuki Kikuchi, Specialist, NIES GOSAT Project Office





Three summers have passed in the northern hemisphere since "IBUKI" was launched. The three images captured by "IBUKI" show what the sea ice looked like in the Arctic Ocean in early September of the last three years. September is the time when the Arctic Sea Ice becomes the smallest of an entire year. After the autumnal equinox, the sun does not reach the Arctic Circle anymore, and thus "IBUKI" cannot capture what it looks like in the Arctic.

It's been reported that the area of sea ice covering the Arctic Ocean has declined to the second smallest on record[*1]. It might not be clearly visible in these three images that the area of sea ice is declining, however, it is obvious that the distribution of ice coverage differs depending on the year. In the Arctic Archipelago, the strait looks closed with ice in 2009, but it looks open in 2010 and 2011.

The Arctic Ocean is connected to the Atlantic Ocean between the Scandinavian Peninsula and Greenland. Due to the warm ocean current that flows in from there, the ice is melted away in the bottom right part of the image. In the top part of the image, the Arctic Ocean is connected to the Pacific Ocean by the Bering Strait between Eurasia and North America. Since this strait is narrower, the ice has not been melted away as much. There is no ice along the coast of Eurasian continent, and the only area where the Arctic sea ice touches the coast is Greenland to the Arctic Archipelago.

*1 2011 Sea Ice Minimum - NASA
http://earthobservatory.nasa.gov/IOTD/view.php?id=53108

ANNOUNCEMENT

NIES GOSAT PROJECT NEWSLETTER October issue will not be published. We are coming back in November 2011.

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