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

ISSUE # 23
AUGUST 2012

CONTENTS

Group photo of the 4th GOSAT RA PI Meeting held at California Institute of Technology

NEWS

Report : The 4th GOSAT RA PI Meeting

Chairperson, GOSAT RA Selection and Evaluation Committee (RA Committee)
Professor Haruhisa Shimoda of Research Institute of Science and Technology at Tokai University

The meeting was held at California Institute of Technology (Caltech) in Pasadena, CA, USA, on July 20, 21 and 22, following the 8th International Workshop on Greenhouse Gas Measurements from Space (see another report) held on 18, 19 and 20 also at Caltech. The venue was the Cahill Hameetman Auditorium (see next page). The participants were 46 including Principal Investigators (PIs) and Co-Investigators (Co-Is), and 73 in total, including the staff from National Institute for Environmental Studies (NIES), Japan Aerospace Exploration Agency (JAXA), and the guests from the National Aeronautics and Space Administration (NASA) and others.

The meeting started with the opening session at 2 p.m. on the first day, followed by sessions on calibration, validation, algorithms, modeling, application, and closing session.

The plenary started with the greeting remarks from Technical Official Atsushi Goto of Office for Global Environment Research at Ministry of the Environment, Japan, and the local host of the meeting, Professor Paul Wennberg of Caltech. They were

The Cahill Hameetman Auditorium, Caltech


Participants at the meeting

followed by reports on current status of GOSAT project: "Brief report on the GOSAT Science Team activity" (Visiting Professor Gen Inoue, the University of Tokyo), "Recent status of GOSAT operation and L1 calibration" (Shinichi Fukagawa, JAXA), "Report on SWIR L2 V02.xx algorithms" (Yukio Yoshida, NIES), "Report on validation summary of SWIR L2 V02.xx" (Isamu Morino, NIES), "Current status of aerosol retrieval" (Hideaki Takenaka, the University of Tokyo), "Data processing status and review on RA users' privileges" (Hiroshi Watanabe, NIES), "Summary of action items from the 3rd RA PI Meeting in Edinburgh" (Hiroshi Watanabe, NIES).

Three researchers gave presentations in the calibration session: "GOSAT TIR band: vicarious calibration using ground-based, airborne, and satellite infrared sensors" (Dr. Robert Knuteson, the University of Wisconsin), "Processing GOSAT spectra and images at LPMAA[*1]" (Dr. Claude Camy-Peyret, LPMAA), and "Effects of atmosphere and sun-target-sensor geometry on CAI-measured reflectance and NDVI[*2]" (Professor Masayuki Tamura, Kyoto University).

The validation session saw 13 presentations: 4 used ground-based high-resolution FTSs (mainly TCCON[*3] data); 3 were related to observation with validation instruments like CO_2 sonde, Fabry-Perot interferometer, differential absorption lidar; 2 intended to identify the large point sources like thermal power plants; 3 made comparison with other satellites' data, and 1 focused on the ground vegetation.

The algorithm session had 9 presentations reporting: influences on retrieval by cloud, aerosol, and ground reflectance; comparison of outcomes when proxy / full physics algorithms were applied to CH_4; retrieval of N_2O, O_3, CH_3OH, NH_3, HDO from thermal infrared data; the fluorescence observation from the vegetation chlorophyll (reported last year for the first time) and its global map of Gross Primary Production being under validation with the expectation of coming outcomes (Dr. Christian Frankenberg, JPL[*4]).

In the following model session, there were 7 presentations, which showed that GOSAT data greatly contributed to the improvement of regional CO_2 sources and sinks (flux) estimation by inverse modeling methods. Also comparison on flux was made among various models' outcomes, revealing comparatively good accordance with each other in regions except tropical area, where large differences were found among models.

The last was the application session with 11 presentations, mainly targeting on regional greenhouse gas trend (CO_2 and CH_4). Enhanced accuracy of column-averaged volume mixing ratio data has brought many accomplishments in application areas. As for CAI-related presentation, radiative forcing of CO_2 and soot aerosol were reported.

Thereafter discussions were held in 3 groups of SWIR, TIR, and flux estimation, summaries of which were briefly reported at the closing session: SWIR and TIR groups are respectively to compare outcomes of each retrieval using common spectrum data, and flux estimation group is to conduct comparative experiments to identify the nature of flux estimation differences, whether they are caused by the difference of column-averaged volume mixing ratio data or by algorithm itself. Also it was pointed out that spectrum data versions for column-averaged volume mixing ratio data used by each estimation group are not the same.

Below is my summing up of the PI meeting as a whole.

(1) The quality improvement of column-averaged volume mixing ratio data for CO_2 and CH_4 by NIES, ACOS[*5], etc., validated by TCCON data, has enabled authentic scientific application including inverse model analysis
(2) That said, data accuracy is waited for validation in high-reflectance areas with no TCCON sites, and also accuracy of TCCON data itself needs to be re-evaluated in high-latitude areas
(3) As for FTS TIR, no retrieval is got based on the latest spectrum data, wanting immediate retrieval and validation, and its consequential improvement of retrieval algorithm
(4) Currently, inverse models have large differences in flux estimations to apply them to policymakings or scientific researches, leaving much further improvement

*1 Laboratoire de Physique Moléculaire pour l'Atmosphère et l'Astrophysique is a joint laboratory of Université Pierre et Marie Curie (the University of Paris VI) and Centre National de la Recherche Scientifique.
*2 Normalized Difference Vegetation Index is an index representing a degree of activity of vegetation.
*3 Total Carbon Column Observing Network is a network of the ground-based high-resolution FTSs observations. Currently, its observations are carried out in more than ten locations worldwide. TCCON's column-averaged volume mixing ratios of greenhouse gases are used for validating greenhouse gases observation by satellites and other carbon cycle studies.
*4 Jet Propulsion Laboratory is a federally funded research and development center and operated by Caltech for NASA.
*5 Atmospheric CO_2 Observations from Space is formed by a number of institutions including JPL, Caltech, and Colorado State University, and is formed around the Orbiting Carbon Observatory (OCO) Science Team.

NEWS

Report : IWGGMS-8

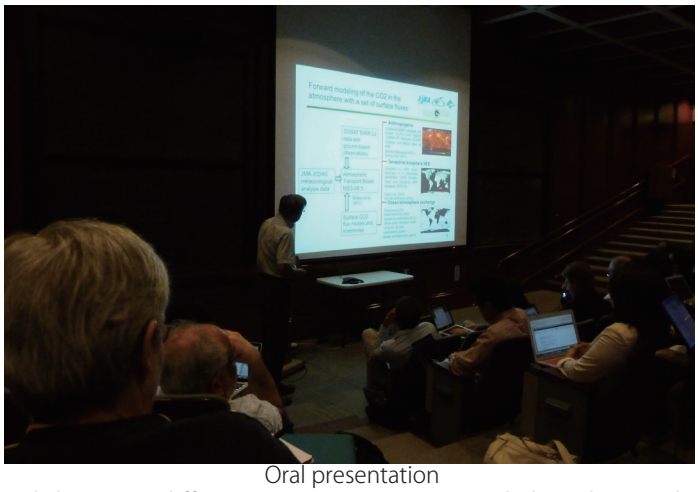
- Yukio Yoshida,
Researcher, Satellite Remote Sensing Research Section,
Center for Global Environmental Research at NIES

The Eighth International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-8) was held from Jun. 18 to 20, 2012, hosted by the Jet Propulsion Laboratory, the National Aeronautics and Space Administration (NASA/JPL) and the California Institute of Technology (Caltech). The workshop has been held almost annually since 2004 to share and discuss latest knowledge for observation of greenhouse gas from space. The venue this time, Caltech, where IWGGMS-2 (Mar. 2005) and IWGGMS-5 (Jun. 2008) were held, is a very familiar place for this workshop.

The first and second day had various presentations related to greenhouse gas observations by current satellites, validation of their results, and application studies. Third day saw introductions of future satellites' missions. A poster session was held in the second day's afternoon, creating festive scenes of participants with a couple of beers and discussions around the fountain. The workshop had approximately 100 presentations, oral and posters all together, where GOSAT data were used in many cases.

Several research groups, including NIES, are conducting retrieval analyses of column-averaged volume mixing ratios of greenhouse gases from Short Wavelength InfraRed (SWIR) spectra of GOSAT, and presentations were made on results of these analyses and intercomparisons among them. The major error source is the optical path length modification due to atmospheric light scattering,

Outdoor poster session



Oral presentation

and the major difference among SWIR retrieval algorithms is the handling of the optical path length modification (i.e., how to handle aerosol/cloud to minimize errors). Many validation studies use TCCON data, however, most of the TCCON sites are located with good observation conditions where aerosol concentration is relatively low and ground reflectance is not so high; the consequence is that SWIR retrieval results agree well around TCCON sites, whereas in other regions, not necessarily do. For this reason, an idea was extended to build new TCCON sites with much aerosol influence and high ground reflectance. The retrieval results were evaluated by other methods; e.g., focusing on CO_2 column-averaged volume mixing ratio in the southern hemisphere where its spatiotemporal fluctuation is relatively small; comparison with the simulated result by atmospheric transport model. As for the GOSAT Thermal InfraRed (TIR) spectra, not only CO_2 and CH_4, but O_3, CFCs, and NH_3 retrieval results were also presented.

There were also several presentations about the global carbon flux inverse analysis based on the GOSAT-measured column-averaged volume mixing ratio. GOSAT gave the first opportunity for global carbon flux inversions enabled with the column-averaged volume mixing ratio of CO_2. Practically it is difficult now to make comparison among carbon flux quantifications, each of which is based on different data and methodology. The range of result with a particular methodology and various data has been shown, and those by different methodology with the same data will be evaluated for further discussions.

The next IWGGMS is going to be held in Japan, details of which will be informed on this newsletter once determined.

Group photo of the IWGGMS-8

Dr. Vanessa Sherlock

INTERVIEW

A Series : "IBUKI"'s PI Interview

No.7

Dr. Vanessa Sherlock

NIWA Scientist

NIES GOSAT Project invited Dr. Vanessa Sherlock of National Institute of Water and Atmospheric Research (NIWA), New Zealand, from Jan. 23 to 27, 2012, by the Environment Research and Technology Development Fund of the Ministry of the Environment, Japan, on "Study on Precision Improvement of Greenhouse Gas Concentrations Obtained by Analysis of the "IBUKI" Observational Data", and exchanged information about and discussed the data validation methodology and the outcomes of its analysis in the Southern Hemisphere. This interview was made during her stay.

(Interviewer: H. Watanabe and I. Morino, NIES GOSAT Project)

Watanabe (hereafter W) & Morino (hereafter M): Thank you for coming to Japan and taking time for us. We know you are getting back to your work, so let's go very quickly and shortly…

Vanessa Sherlock (hereafter S): It's OK, it's my pleasure.

W: At first, I'd like to start by asking your personal history as a researcher, including your education and research work.

S: I studied at University of Canterbury in Christchurch, New Zealand and graduated with BSc in Physics and then undertook 4 year post-graduate cycle in Meteorology, Oceanography and Environment at the Université Pierre et Marie Curie (Paris IV).

W: Then your career started in France?

S: Yes, I obtained my PhD in France, for my work on the measurement of water vapour in the mid and upper troposphere using Raman lidar*1. Then I took up a research position at the United Kingdom Meteorological Office for two years, working on the development of radiative transfer codes for the direct assimilation of radiances from high resolution infrared sounders (IASI*2, AIRS*3). I returned to my home country, New Zealand, to work for NIWA in 2001. While at NIWA, I have worked on projects ranging from mesoscale*4 satellite data assimilation to the inference of nutrient availability in the upper ocean using remote sensing data. I have been involved in the TCCON*5 (Total Carbon Column Observing Network) project since 2004, and became the PI of the TCCON programme in Lauder in 2007.

W: So what do you think of GOSAT status?

S: I think in the past year JAXA and NIES have had made a significant improvements to the spectrum and column-averaged volume mixing ratio retrievals. The satellite data sets have reached maturity and can now be used to provide insights into the global carbon cycle. This is a very exciting time.

W: I would like to ask that if you have some request for the GOSAT Project, GUIG*6, or GOSAT interface. I have already heard of GUIG from you, so no need to repeat...only if you have additional request.

S: I'd like to take this opportunity to thank you for the funding you have provided which has enabled me to attend some of the RA meetings and to make this visit to Japan to further our collaboration. We have a common interest in understanding retrieval errors, and to take advantage of low inherent atmospheric variability of CO_2 and CH_4 in the Southern Hemisphere to characterize the NIES SWIR retrieval errors. The GUIG is a very efficient data order and delivery system and suggestions I have made to improve it have been promptly implemented.

W: Now we are going to consider GOSAT-2. Have you heard of that?

S: No, I hadn't, but I think it is great you are considering a follow-on mission.

W: In future, we'll have OCO-2, CarbonSat, and followed by GOSAT-2…

S: I hope the OCO-2 mission finds a launch vehicle soon.
W: We are not sure, at this moment. Do you have any request on the future GOSAT-2? Do you prefer the interferometer or the grating?
M: We have now started thinking this interferometer and also they plan to have CAI sensor similar to GOSAT. But JAXA may be thinking an imaging spectrometer for CAI Band 1…
W: It might be a similar question, but do you have any comment or recommendation for NIES and JAXA on current GOSAT project operation?
S: I think that the GOSAT project has been very successful, and I know that many researchers appreciate the fact that you have provided opportunities for meetings/discussions going from the spectrum data right through to the results of surface flux inversions. It is very valuable to bring the measurement, retrieval and inversion communities together in this way...
W: This is officially the end of questions, following is my final question as an aside… (here switched to French) I studied French in Tokyo before going to France to study at the Universite de Grenoble. How did you learn French in New Zealand?
S: I learned French in the school in New Zealand. But after I went to Paris, I learned French more at the Alliance Française.
W: There are several francophone PIs, as you know. I sometimes speak with them in French.
S: Yes, there are some. Are you thinking cooperation with CNES?
W: I don't know at this moment. But I discussed it with Camy-Peyret-san, Ricaud-san, and I think it very encouraging to have non-native francophone members like you because I'm not so good in speaking English.

Well, thank you very much and see you again at next PI meeting.
S: Thank you.

From left, Dr. Sherlock, Watanabe, Morino

*1 Raman Lidar stands for Raman Light Detection And Ranging. Lidar is an optical remote sensing technology that measures the properties of a target by illuminating the target with light, often using pulses from a laser. Raman lidar uses the scattering (Raman scattering) properties of molecules and aerosols to identify the molecule (by wavelength shift) and its number concentration (by intensity of scattering light).

*2 Infrared Atmospheric Sounding Interferometer (IASI) is an instrument unit of MetOp, a series of European meteorological satellites. IASI measures infrared radiation emitted from the surface of the Earth to derive data on humidity and temperature profiles in the troposphere and lower stratosphere, as well as some of the chemical components playing a key role for climate monitoring and atmospheric chemistry. The first model was launched on MetOp-A satellite in October 2006.

*3 Atmospheric InfraRed Sounder (AIRS) is a high spectral resolution spectrometer that measures atmospheric temperature and humidity, and land and sea surface temperature. It is installed on Aqua satellite, and launched in May 2002. The instrument is designed to support climate research and improve weather forecasting.

*4 Atmospheric phenomena are divided into scales of four stages: micro, local, meso, and global (from small to large). Mesoscale covers from 10km to some hundreds km.

*5 Please refer to *3 of page 2.

*6 GOSAT User Interface Gateway (GUIG) provides GOSAT observation data and it also provides various images, global or regional, at its gallery. http://data.gosat.nies.go.jp/

NEWS

New Version FTS SWIR Level 2 Data Product Released

Fumie Kawazoe, Specialist and Akira Yuki, Office Staff, NIES GOSAT Project Office

GOSAT Project upgraded two Level 2 standard products generated based on SWIR*1 band data obtained by the TANSO-FTS onboard "IBUKI", and released to general public on June 1, 2012. The new version Level 2 products are FTS Level 2 CO_2 column amount*2(SWIR) and FTS Level 2 CH_4 column amount (SWIR), their version being V02.xx (xx is numeric).

There are two major differences between these new products and their previous version.

(1) CO_2 column-averaged volume mixing ratios (XCO_2) became higher than the previous version (Figs.1, 2). By validating the new version, XCO_2 are found to be 0.3% lower than the validation data, compared to having been 2 – 3% lower in the case of previous version, which proves the improvement of product quality. The improvement was brought in by updating the retrieval algorithm and reference data; the details of which are described in "Algorithm Theoretical Basis Document for CO_2 and CH_4 Column Amounts Retrieval From GOSAT TANSO-FTS SWIR" (in preparation).

(2) Released data area has increased for CO_2 column amount and CH_4 column amount (Figs.1 – 4). FTS SWIR Level 2 data is verified its quality after the retrieval processing and is not released when the quality is not good. The upgrade has improved data quality, also bringing data volume increase accordingly. All verified quality items are described on "Important Notes at releasing FTS SWIR L2 Products (V02.xx)" on GOSAT User Interface Gateway (GUIG)*3.

*1 SWIR stands for Short Wavelength InfraRed.

*2 Total number of gas molecule included in a vertical column of atmosphere from the surface of the ground to upper-air

*3 GOSAT User Interface Gateway (GUIG) : http://data.gosat.nies.go.jp/ For more details, please refer to *6 of page 5.

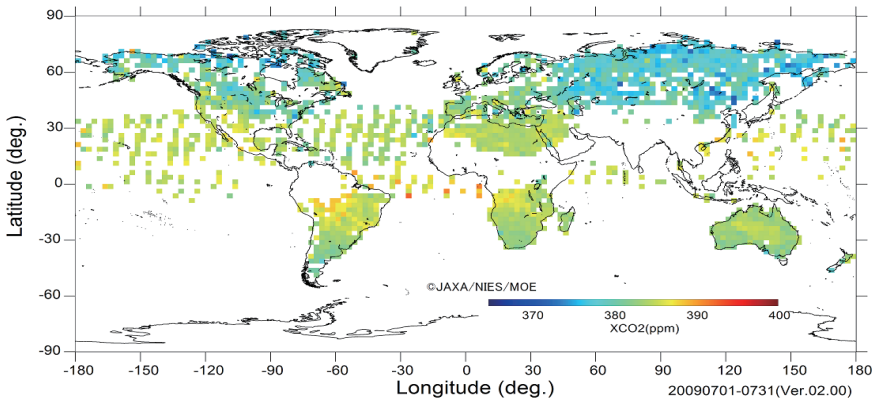


Fig. 1 Global map of the V02.00 XCO_2 in 2.5 degree mesh for the month of July, 2009

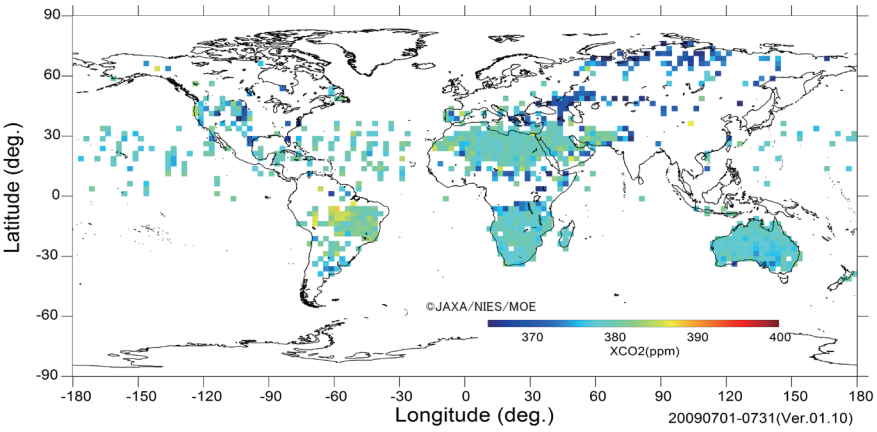


Fig. 2 Global map of the V01.10 XCO_2 in 2.5 degree mesh for the month of July, 2009

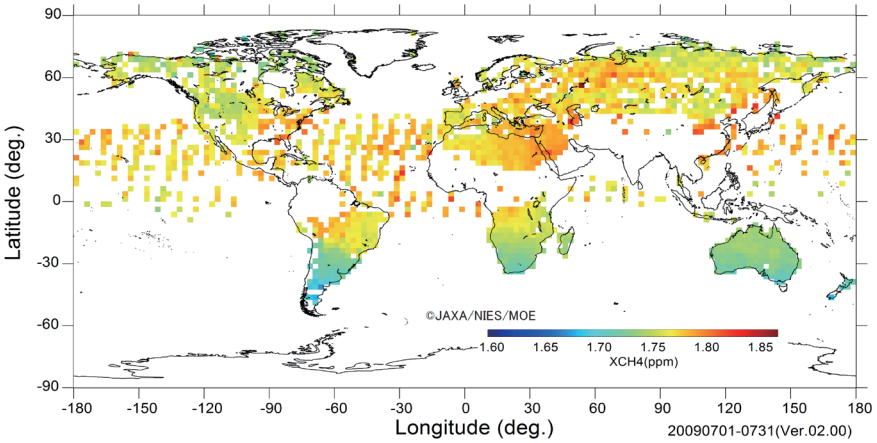


Fig. 3 Global map of the V02.00 XCH_4 in 2.5 degree mesh for the month of July, 2009

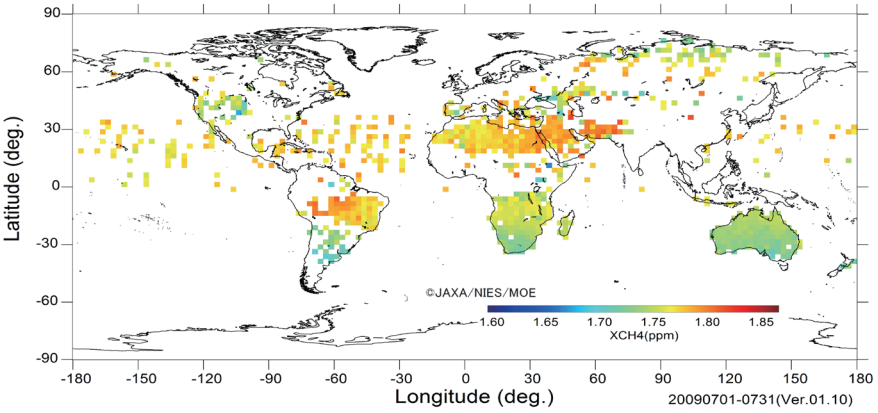
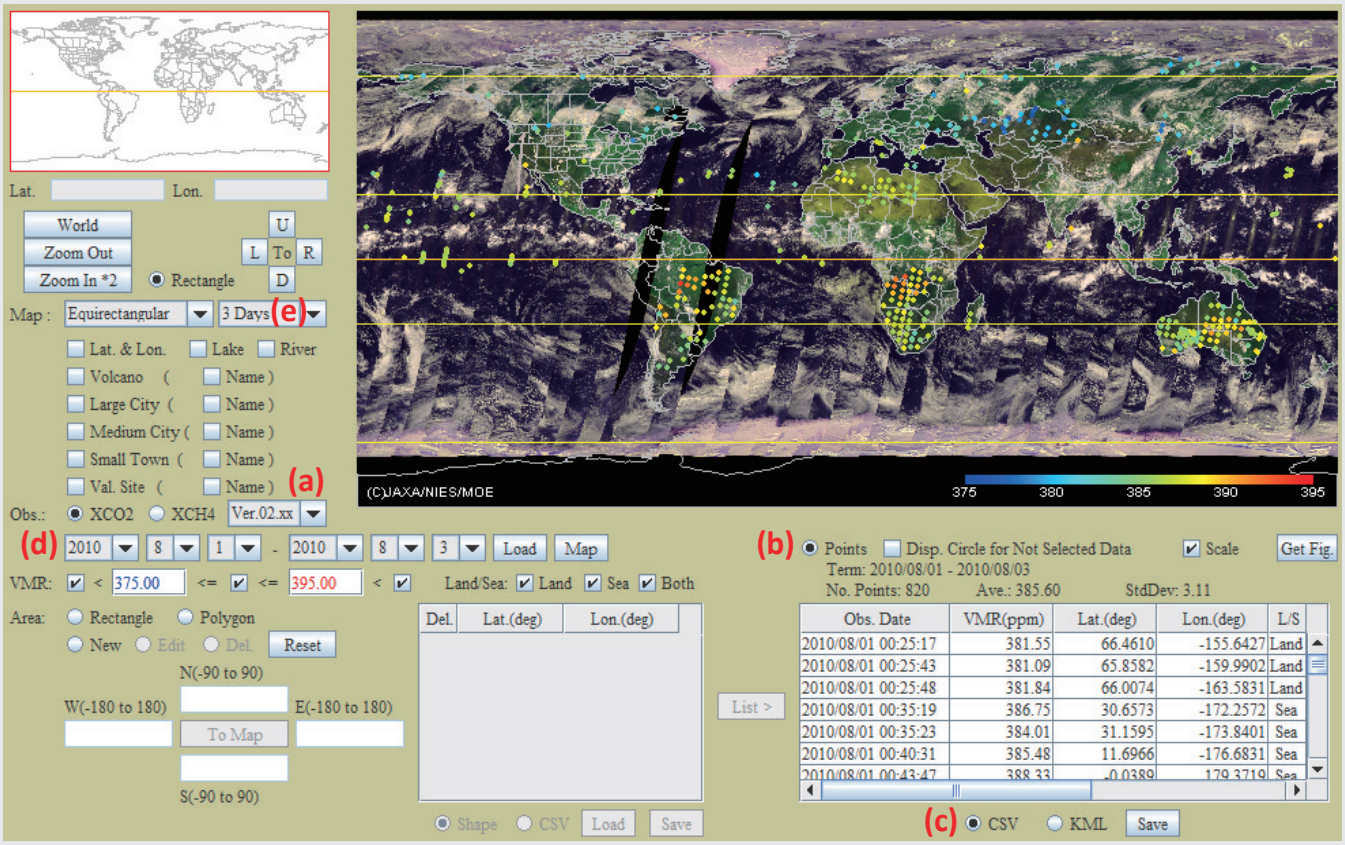


Fig. 4 Global map of the V01.10 XCH_4 in 2.5 degree mesh for the month of July, 2009

AHA! OF THE MONTH

A Series: How to Use GUIG Tool "SWIR L2 Global Distribution Map" - 4 -

- Sayaka Kanekon, Office Staff, NIES GOSAT Project Office



A screenshot of the Tool after the "3 days" CAI image underlaid to the map

In this series, we have explained in stages how to use "SWIR L2 Global Distribution Map" tool, a menu contained in GOSAT User Interface Gateway (GUIG), and this is the 4th and last time of explanation.

The main functions of the Tool are:

(1) Search/display concentration data: you can search and display SWIR Level 2 column-averaged mixing ratios (XCO_2, XCH_4) of the points observed by "IBUKI."

(2) Save displayed data: you can download data displayed at (1) as CSV file 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 days' composite) , or global reflectance distribution (30 days' composite) as a background of the map.

This time, we describe additional functions of (1), and main functions of (2) and (3) - (As for use conditions, starting of the Tool, and main functions of (1), please refer to issues of Aug., Sept., and Nov., 2011). For further details of usage, read "help" put right bottom of the top screen of the Tool.

(1) Search/display concentration data

Now choice of SWIR Level 2 data version became available; In addition to the past required items, you can specify data version of your choice at drop-down list (a). The difference between versions is explained in the article "New Version FTS SWIR Level 2 Data Product Released" on page 6 of this issue.

(2) Save displayed data

If you check "Points" (b) and click any observed point on the map, a pop-up screen comes out to show the information of the point: observed date, volume mixing ratio, latitude, longitude, Land/Sea, etc., and data on the table can be downloaded in the format selected at (c) when "save" clicked. CSV means text format, while KML is applicable on Google Earth. KML file is used to show observed points on the earth by a double-click or "file"-"open" on Google Earth (Google Earth needs to be installed beforehand).

(3) Display CAI data as background

CAI Level 3 image of the same observation period can be displayed on the map as a background to SWIR Level 2 data. Available period of CAI Level 3 image is limited for the moment, "No CAI Image" can be responded depending on the search period set at (d), that is, please note ● shown below (data will be added according to our plan). Then choose what image to show at drop-down list (e). In the case the period has multiple images to show, pop-up screen comes out to ask you which one to adopt. Finally CAI image is underlaid as a background to the plotted SWIR Level 2 data.

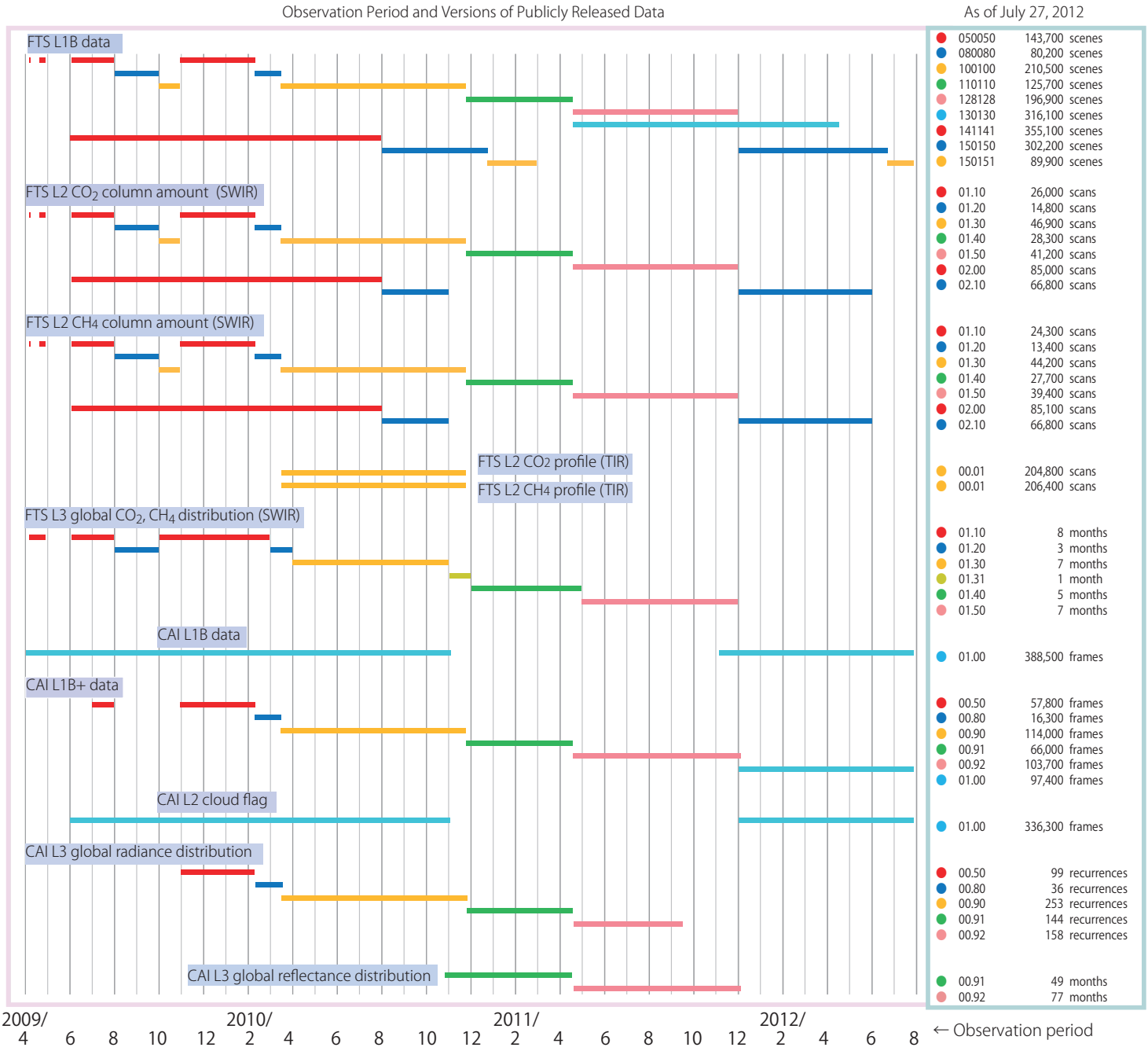
● "3Days": 3 days' composite of global radiance distribution (with could), available Apr. 20, 2009 - Aug. 9, 2010

● "Clear Sky": 30 days' composite of global minimum reflectance distribution (without cloud), available Apr. 1, 2009 - Aug. 31, 2010

DATA PRODUCTS UPDATE

DATA PROCESSING STATUS UPDATE FROM GOSAT PROJECT OFFICE

- Fumie Kawazoe, Specialist, NIES GOSAT Project Office



We had processed and released 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).

Processing of data products FTS L1B V128.128 and its corresponding V01.50 for FTS L2 CO_2/CH_4 column amounts (SWIR) were terminated. FTS L1B was upgraded from V130.130 to V150.150 on April 16, 2012, and its data since December 2011 was released on V150.150, and corresponding FTS L2 CO_2/CH_4 column amounts (SWIR), upgraded from V01.50 to V02.10, were processed and released. Also FTS L1B V141.141 and FTS L2 CO_2/CH_4 column amounts (SWIR) V02.00 were processed and released as preliminary versions mentioned above. Then, FTS L1B was upgraded to V150.151 on June 21, 2012 by changing processing parameter. Version number for FTS L2 CO_2/CH_4 column amounts (SWIR) is changed to V02.11 correspondingly. For CAIs, observation data since December 2011 are upgraded from V00.92 to V01.00. L3 products' new versions will be released as soon as they are ready. At this moment, both FTS and CAI data are under reprocessing and planned for sequential release. In using these new version products, please refer to "Important Notes at Releasing" provided on GUIG.

Also FTS L2 profiles (TIR) have been partially released since March 30, 2012. On the other hand, old V00.50 - V00.90 of FTS L2 CO_2/CH_4 column amounts (SWIR), V00.50 - V00.92 of CAI L1B, and V00.10 - V00.92 of CAI L2 cloud flag were terminated their offering.

The number of registered users is 1282 as of July 27, 2012.

ANNOUNCEMENTS

● Side event "GOSAT Seminar" held at Rio+20, Brazil

Rio+20, United Nations Conference on Sustainable Development, was held in Rio de Janeiro, Brazil, on June 2012, where JAXA, NIES, and MOE jointly had a poster session on GOSAT and GOSAT-2 at MOE booth in Japan Pavilion and also had a seminar "Greenhouse Gases Observing Satellite "GOSAT" - A clue to global climate policy development", with Mr. Nishioka as the moderator, and Deputy Director Sasaki from MOE, Executive Director Honma and Manager Nakajima from JAXA, NIES GOSAT project leader Yokota and NIES GOSAT-2 project preparation team deputy leader Matsunaga from NIES, made presentations.

Japan Pavilion

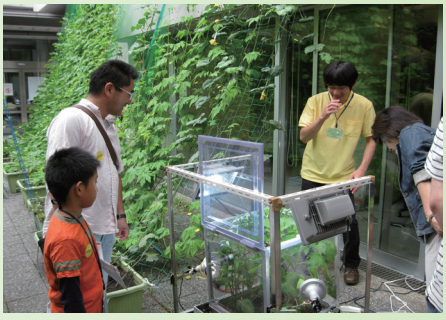
Entrance to Rio+20 main conference pavilion crowded with press waiting for dignitaries

● GOSAT Project received Environment Preservation Award 2012

GOSAT Project was awarded by the Minister of the Environment. The commendation ceremony was held in Tokyo, June 29, 2012, attended with JAXA manager Nakajima and NIES GOSAT project leader Yokota.

● NIES SUMMER OPEN HOUSE held on July 21 with more than 4,000 visitors.

NIES GOSAT Project presented its observation products on a spherical display, GOSAT model, etc.



From left, GOSAT booth, lecture on global warming, photosynthesis experiment to absorb CO_2 emitted from soil

EDITOR'S NOTE

It's our pleasure to be able to publish this newsletter and see you again after such a long leave of 8 months. Please enjoy the long-absent issue, No. 23, including the last part of GUIG tool series.

For the time being, the issuance will be bimonthly.

We appreciate readers' voices, such as "I want to read articles on ...,""... was really interesting." etc. Please feel free to contact : gosat_newsletter@nies.go.jp.

Thank you for supporting the newsletter. S. Aikawa

NIES GOSAT PROJECT NEWSLETTER ISSUE #23 AUGUST 2012

Issued On : 2012/8/10

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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