National Institute for Environmental Studies (NIES)
A newsletter on the Greenhouse gases Observing SATellite "IBUKI" (GOSAT) project from Satellite Observation Center
http://www.gosat.nies.go.jp/

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CONTENTS

REPORT

Looking back over the last year

Tsuneo Matsunaga, Director of Satellite Observation Center, CGER, NIES

The former issue was published in January 2017, almost a year ago. In this report, I would therefore like to review major events related to GOSAT series which took place in the past year (FY 2017).

GOSAT was operated steadily throughout the last year. In June, the annual field campaign for vicarious calibration was conducted again in USA, and two press releases were issued: one regarding the version update and the extended data period of GOSAT Level 4 Product (carbon dioxide), and one reporting whole atmosphere mean methane concentration derived by GOSAT. In addition, the new version of FTS SWIR Level 2 Product (V02.72) was released in December. Having made some improvements including the resolution of minimum reflectance data used for CAI (Cloud and Aerosol Imager) Level 2 Cloud-flag Product, which is one of the input data for FTS SWIR Level 2 Product, we could increase the amount of data by more than 20% compared to the previous version.

As for GOSAT-2, in preparation for the launch scheduled for this fiscal year, we vigorously carried out series of designing, development and testing through the year. Fourier Transform Spectrometer-2 (FTS-2), the most important equipment onboard GOSAT-2, had been developed at the factory of Harris Corporation in USA. In January, the pre-shipment review was completed and the FTS-2 finally arrived at the JAXA's Tsukuba Space Center in February. The installation of the equipment onto GOSAT-2 spacecraft is now underway.

At NIES, we further developed GOSAT-2 Data Processing System (G2DPS) for higher-level data processing and procured necessary computer systems. The primary algorithms used to produce Level 2 products and CAI Level 1B products were delivered from each provider and the algorithms are now being installed to the G2DPS for the operational processing.

Further, aiming to validate GOSAT-2 data, we started operating ground-based observation sites with the support from Ministry of the Environment, Japan (MOE); such sites include the new TCCON site in the Philippines, the Kiryu site in Shiga Japan for measuring forest solar induced chlorophyll fluorescence (SIF), and the Tokyo Skytree site for atmospheric observation and sampling. The observational data being obtained at these sites are expected to be utilized to improve reliability of GOSAT-2 data products.

Last year, there was another important progress in creating international cooperation frameworks for GOSAT series. In July, NIES and the Finnish Environment Institute (Suomen ympäristökeskus: SYKE) have signed the Minutes of Cooperation (MoC) to promote research cooperation between the two institutes. Along with this agreement, we will start preparation works for in-situ observations including SIF measurement at forest sites in Finland from this year. In light of circumstances in Europe where many projects for satellite-based observations of greenhouse gases (GHGs) are in progress, NIES and the Japan Aerospace Exploration Agency (JAXA) concluded the agreements concerning cooperation in remote sensing of GHGs in December with European Space Agency (ESA), Centre National D'Etudes Spatiales (CNES) in France, and German Aerospace Center (Deuteches Zentrum für Luft und Raumfahrt, abbreviated DLR) respectively. In particular, with ESA, we will start comparison of methane concentration data derived by GOSAT series with those derived by TROPOMI (TROPOspheric Monitoring Instrument) on board Sentinel-5p satellite, launched last autumn.

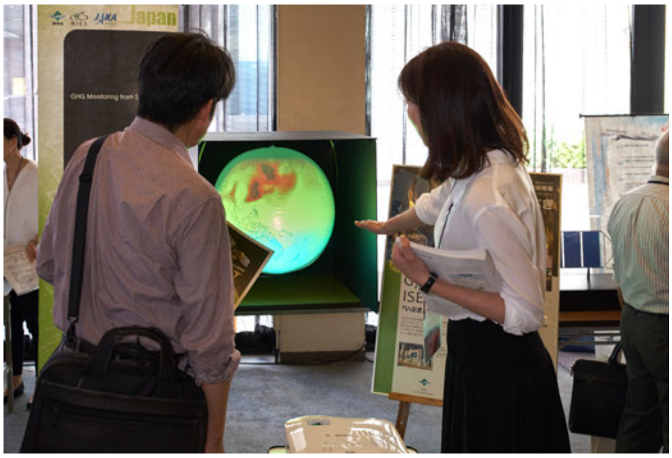
GOSAT-2 will finally be launched in this fiscal year. As GOSAT has also been in good condition at this point, we will end up starting simultaneous operation of GOSAT and GOSAT-2. Today, aiming to increase the frequency of satellite based-GHGs observations, developments of satellite constellations, a group of satellites operated together for the maximum observation coverage, has been in discussion in many countries. GOSAT and GOSAT-2 will be the first satellite constellation for GHGs observation.

We appreciate your continued interest in the progress of GOSAT and GOSAT-2.

Cover story: Satellite Observation Center's public relations activities in photos

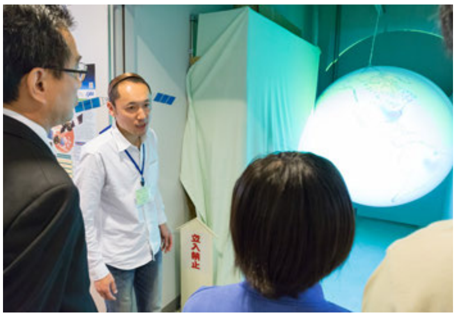
Public Symposium

June 16, 2017 (Ootsu, Shiga, Japan)
At NIES Public Symposium 2017 in Shiga
Taizo Mikazuki, Governor of Shiga Prefecture, is receiving explanation on research outcomes of GOSAT project. The governor showed a great interest in GOSAT saying, "In Shiga, we have a mountain called Ibuki, same as GOSAT's nickname. So, we feel a sense of closeness."

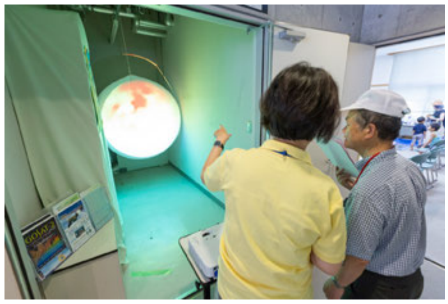


June 23, 2017 (Hamamatsu-cho, Tokyo, Japan)
At NIES Public Symposium 2017 in Tokyo
Dagik Earth, three-dimensional digital globe, 60cm in diameter

NIES Spring and Summer Open House



April 22, 2017 (Tsukuba, Ibaraki, Japan)
Hibiki Noda and Makoto Saito, senior researchers of NIES are giving presentations at the spring open house. This time, new activities were introduced such as a joint exhibition with JAXA and NIES (photo in lower left) and a virtual tour in the GOSAT-2 computer center using a VR (virtual reality) headset (photo in lower right).



July 22, 2017 (Tsukuba, Ibaraki, Japan)
Dagik Earth exhibition at the summer open house

Exhibition

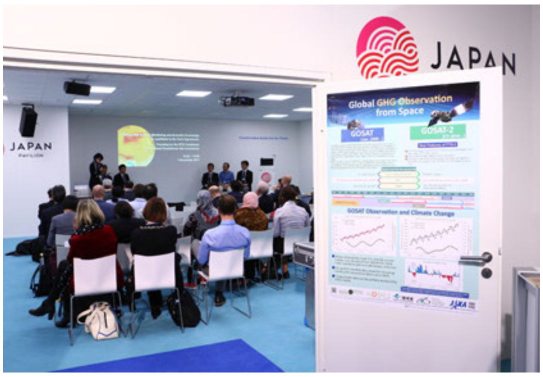
June 3 – 26, 2017 (Minato-ku, Tokyo, Japan)
A mini-sized Dagik Earth was displayed at the Minato branch office of the Tokyo Chamber of Commerce and Industry for the period of three weeks. An event for VR experience was also held.

Eco-life Fair

June 3-4, 2017 (Yoyogi, Tokyo, Japan)
At the collaboration booth of JAXA, MOE and NIES. Pictured right is State Minister of the Environment, Yoshihiro Seki, putting a stamp on the stamp rally sheet.

UNFCCC COP23

November 11-17, 2017 (Bonn, Germany)
As last year, our project members participated in the United Nations Framework Convention on Climate Change (UNFCCC) COP23 (23rd Conference of Parties) and gave presentations on GOSAT's research outcomes at meeting places including Japan Pavilion organized by Japanese government.



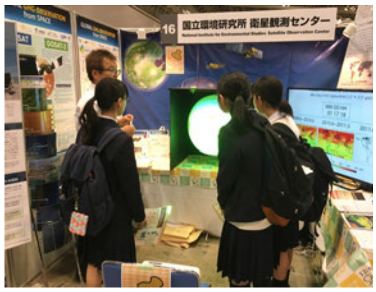
(Source: Photo from GEO's twitter)

GEO14

October 23 - 26, 2017 (Washington, D.C., USA)
Also this year, our members attended the 14th annual meeting of GEO (Group on Earth Observations), an intergovernmental organization, and gave presentations. Pictured left is Tsuneo Matsunaga, the director of NIES's Satellite Observation Center, and the center is Koichi Wakata, JAXA astronaut.

School visit (outreach activity)

November 24, 2017 (Tsukuba, Ibaraki, Japan)
With the cooperation of JAXA, we visited an elementary school in Tsukuba to give lectures to students in the fourth grade.



JpGU (Japan Geoscience Union) - AGU (American Geophysical Union) Joint Meeting 2017

May 20 - 25, 2017 (Makuhari Messe, Chiba, Japan)
We opened the exhibition booth. Many future researchers like high school students visited our booth and listened to our explanation attentively. Appeared next to our booth is NASA's.

Report on the 9th GOSAT RA PI Meeting

The 9th GOSAT RA PI meeting (the 9th PI meeting) was held at Finnish Meteorological Institute (FMI) in Helsinki on June 9, 2017, Finland with a total of 48 attendees including 34 Principle Investigators (PIs) and Co-Investigators (Co-Is), and project members from MOE, JAXA and NIES.

GOSAT Research Announcement (RA) related presentations were given either at this closed meeting or at the 13th International Workshop on Greenhouse Gas Measurement from Space (IWGGMS-13), an open meeting held from June 6 through June 8, at each PI or Co-I's own request. At IWGGMS-13, there were 25 poster presentations: 6 on validation, 5 on algorithms, 9 on inverse modelling, 3 on application and 2 on Solar Induced Chlorophyll Fluorescence (SIF).

At the 9th PI meeting, we had three sessions after the plenary: (1) Validation, (2) Algorithms/Validation/Application and (3) Inverse Modelling.

The plenary session started with welcome speeches by T. Matsunaga (NIES) and H. Suto (JAXA), and the opening remarks by H. Shimoda, a visiting professor of Tokai Univ. (the chair of the GOSAT RA Selection and Evaluation Committee), followed by presentations on current status of GOSAT project by Suto (JAXA), current status of GOSAT data products by A. Kamei (NIES) and validation results of TANSO-FTS SWIR (Thermal And Near-infrared Sensor for carbon Observation – Fourier Transform Spectrometer Short Wavelength Infrared) by O. Uchino (NIES).

The Validation session had five presentations. The first presented was N. M. Deutscher (Univ. of Wollongong) on the evaluation result of measurement accuracy of XH_2O and XHDO acquired from Total Carbon Column Observing Network (TCCON), which TCCON data are being utilized in validation of TANSO-FTS SWIR XH_2O products. P. Wennberg from California Institute of Technology reported next on the three topics: cooperative relationship between GOSAT and OCO-2; current GOSAT ACOS products; response of the carbon cycle to the 2015-2016 El Niño. The next presentation given by X. Zhang (China Meteorological Administration) was on the status of GHGs observation in China. Zhang introduced several observation sites in China such as Dunhuang, a special field campaign site in the Gobi Desert for calibration and validation, and sites where observations are conducted based on the TCCON protocol. Zhang also explained that the data acquired at these sites were used to validate GOSAT retrievals derived by retrieval algorithms developed in China and reported the validation result. The next was R. Kivi (FMI) who summarized observation activities at Sodankylä, a TCCON site in Finland; such activities include in-situ tower observation and in-situ AirCore observation of vertical profiles. At the end of this session, Y. Shibata (Tokyo Metropolitan Univ.) reported on the upgraded ground-based Differential Absorption Lider for CO_2 (CO_2-DIAL), of which measurement accuracy was improved by adding a wavelength for temperature measurement in addition to the two wavelengths used for the conventional CO_2-DIAL.

Algorithm/Validation/Application session had three presentations. Presented first was C. Camy-Payret from Institut Pierre Simon Laplace (IPSL) who reported the evaluation result of different versions of TANSO-FTS L1B based on the comparison of XCO_2, surface temperature and maximum optical path length difference of each version calculated from thermal infrared (TIR) spectra of TANSO-FTS observed over the Arctic Ocean in summer. J. Mao (Univ. of Maryland) presented the evaluation results of their model outcomes comparing with vertical profiles measured by in-situ sensors during ASCENDS (Active Sensing of CO_2 Emissions over Nights, Days & Seasons) airborne campaign and addressed points to be improved. N. Eguchi (Kyushu Univ.) reported the result comparing the secular variations of CO_2 and CH_4 at upper troposphere and lower stratosphere retrieved from GOSAT TANSO-FTS TIR spectra with those of airborne data and model outputs.

Inverse Modeling session had two presentations. S. Houweling from Netherlands Institute for Space Research (SRON) reported on inter-comparison of CO_2 inversion analyses using GOSAT data and introduced their ongoing project in which results of different inversion models derived from same input data are compared. T. Aalto (FMI) reported on the results comparing the CH_4 inversion with independent in-situ measurements and GOSAT data. Aalto also explained the GOSAT data assimilation results.

The 9th GOSAT meeting was ended with the closing address by K. Isono (MOE).

Participants of the 9th GOSAT RA PI meeting (June 9th, 2017 at FMI)

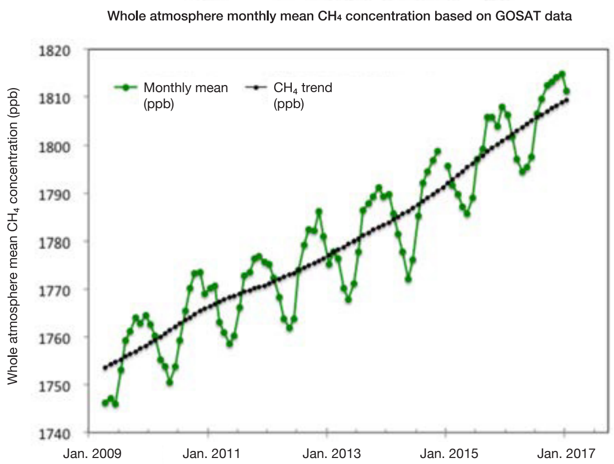
Major project outcomes in 2017

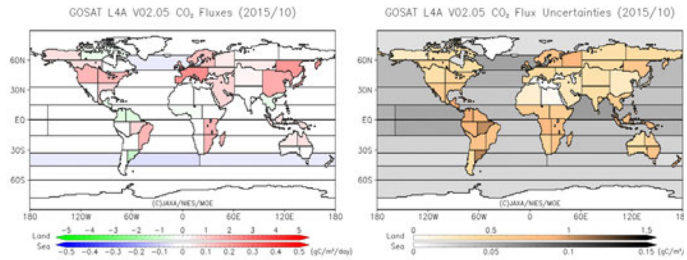
Press Release

Public release of whole-atmosphere monthly mean methane concentration based on GOSAT observations

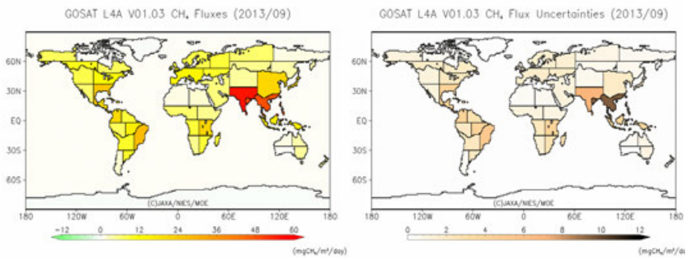
The GOSAT project released the whole-atmosphere monthly mean concentration data of methane (CH_4) calculated using GOSAT data that reflects CH_4 levels in all layers of atmosphere. The monthly mean CH_4 concentration was confirmed to have risen every year with the seasonal fluctuation characterized by a maximum in late autumn to winter and a minimum in early-to mid-summer, and to reach the record of 1815 ppb in January 2017. As for the trend line of the whole-atmosphere CH_4 mean (average seasonal cycle removed), the increase rate became higher around 2015, and it reached the record high of 1809 ppb in February 2017. The GOSAT observation elucidate for the first time the global trend of CH_4 concentration. In regard to this result, we issued a press release on June 2, 2017.

http://www.gosat.nies.go.jp/newpdf/GOSAT_pressrelease20170602_jp.pdf (in Japanese)





Latest L4A product (CO_2)：October, 2015



L4A product (CH_4)：September, 2013

Release of new products

1. Update of the L4A Product (CO_2/CH_4)

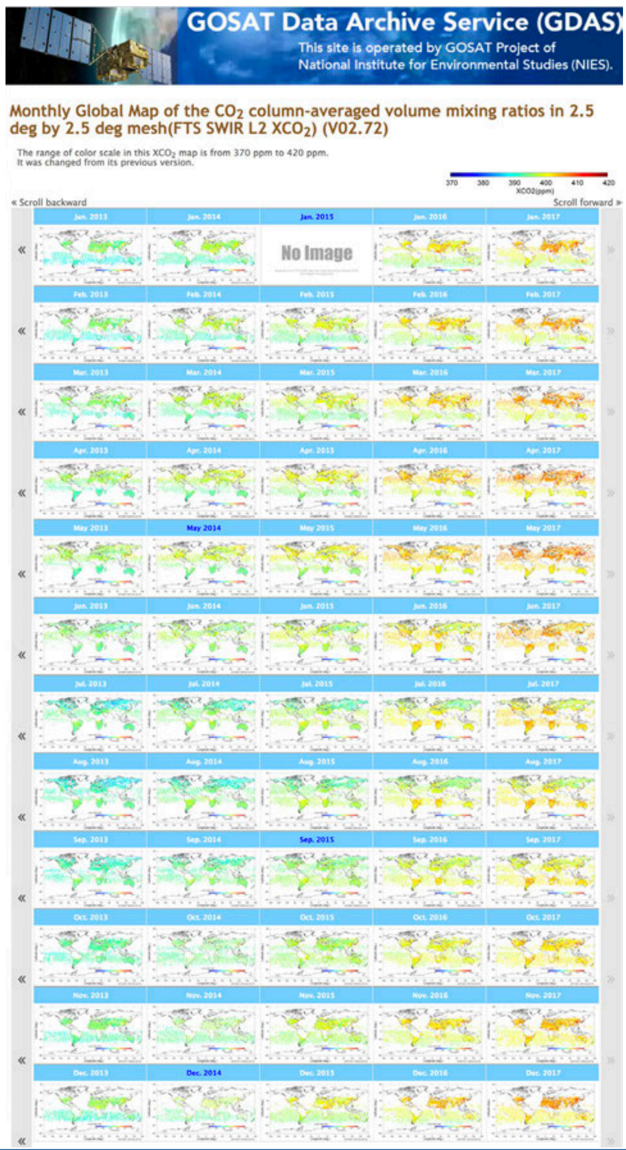
Level 4A global CO_2 flux product was updated with additional two-year of data and released for the observation period from June 2009 to October 2015. Among the GOSAT data products, this dataset can be seen as one of the most important research outcomes. As for the product of CH_4, a similar update has been scheduled and will be completed by the beginning of FY2018. L4A global flux is monthly averaged flux estimates for separate regions on the globe (64 regions for CO_2 and 43 for CH_4) based on GOSAT TANSO-FTS SWIR Level 2 (L2) column-averaged gas mixing ratio data and ground-based observational data with reference to meteorological data (e.g. wind speed and direction).

https://data2.gosat.nies.go.jp/gallery/L4A/fluxmap/fluxmap.html

2. Update of the FTS SWIR L2 (CO_2/CH_4) Product

The latest GOSAT FTS SWIR L2 products have been released in a global map format and can be seen from the GOSAT Data Archive Service (GDAS) site. With revisions of the algorithm, the amount of data for the latest SWIR L2 products (V02.72) have increased about 20% from the previous version.

https://data2.gosat.nies.go.jp/index_en.html

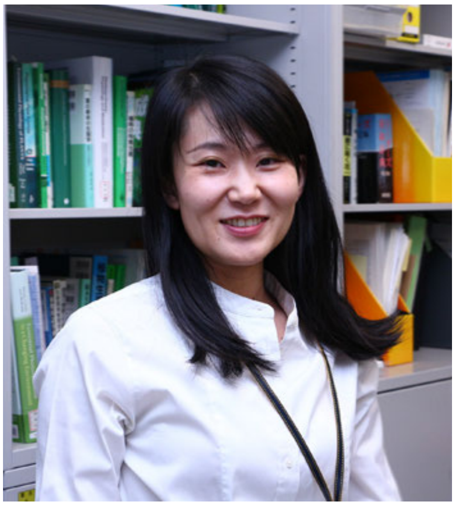


GOSAT column averaged CO_2 (January 2013 - December 2017) (acquired from GDAS website)

CO_2/CH_4 column-averaged by **FTS SWIR L2** (SWIR：Short Wave Infrared Red)
https://data2.gosat.nies.go.jp/gallery/fts_l2_swir_co2_gallery_en.html
https://data2.gosat.nies.go.jp/gallery/fts_l2_swir_ch4_gallery_en.html

GOSAT PEOPLE

Introducing Young Project Members



Hibiki Noda, Senior Researcher
Satellite Observation Center
Center for Global Environmental Research
National Institute for Environmental Studies

Question (hereafter Q): At first, I would like to ask you about your research background and role in the GOSAT project.
Noda (hereafter N): I specialize in plant ecophysiology and vegetation remote-sensing. Plant ecophysiology bridges ecosystem function and plant physiological characteristics such as photosynthesis and respiration by plants. When I was in Ph.D. course, I studied the photosynthesis and respiration traits of Japanese primrose, *Primula sieboldii*, which is an endangered species with cute pink-flowers (Photo 1) in the Conservation Ecology Laboratory.

Originally, I was studying plant ecology, and I was not related to satellite and remote-sensing techniques at all when I was a student. After I got my Ph.D., I worked for 21st century COE program "Satellite Ecology for Basin Ecosystem Studies" at Gifu University as a post-doc. The Satellite Ecology project tried to link remote-sensing techniques with ecological studies. I expanded my study to a research which connects my specialty, photosynthesis with whole-ecosystem carbon cycle through remote-sensing studies. After the three-year post-doc, I moved to University of Tsukuba and developed algorithms for vegetation products of GCOM-C1 (Global Change Observation Mission – Climate, nicknamed "Shikisai") satellite, which was launched in 2017.

<Photo 1: Primroses in Hidaka, Hokkaido>

After that, I continued to study an ecosystem model under Dr. Ito at NIES and then became a researcher at the GOSAT project.

Q: Have you been interested in satellites since your childhood?
N: Actually not. My main interest is still plants. I understand that satellites are very powerful as tools.

Q: GOSAT has been in the extended operation phase and GOSAT-2 is scheduled to be launched in FY 2018. In addition, the discussion of GOSAT-3 design was already started. Please tell me about your dream for the future of the GOSAT series.

N: Satellite projects require long time from planning to launching satellites. On the other hand, satellite lifetimes are not so long. The GOSAT lifetime is designed for five years. GOSAT is demanded for environmental policy, so its continuing observation is very important. We always need to act with an eye towards the future.

Recently it has been shown that GOSAT can be used to detect Solar Induced Chlorophyll Fluorescence (SIF) and a lot of ecologists have been interested in it and the use of GOSAT data can be widely spread in various study fields. However, there is still a large gap between the satellite remote-sensing and plant ecology because the interdisciplinary research has not been fulfilled yet. I hope that we cooperate with each other and use the satellite data, which is a powerful tool for environmental studies.

Q: So, can we expect that GOSAT has a wonderful function to connect various researchers from different fields?

N: Yes, we can do large-scale research through interdisciplinary collaborations. The importance and function of plants and vegetation would be easy to understand for people who are not researchers. So, I hope that SIF research serves as a starting point to attract people to environmental issues and the roles of the satellites.

Q: Could you explain "Solar Induced Chlorophyll Fluorescence (SIF)" observed from GOSAT? What's the difference from vegetation monitoring using general satellites?
N: In the photosynthesis process, chlorophyll, a pigment in mesophylls absorbs light energy and converts it to chemical energy to assimilate carbon dioxide. Often chlorophyll absorbs too much light and the extra energy damages cells. To avoid the damage, chlorophyll spends the extra energy by emitting heat and weak light, so-called "chlorophyll fluorescence." Since chlorophyll fluorescence is weak radiation in red and near-infrared regions, it is invisible for human eye in normal situations, such as under solar radiation. By using dark lines in solar spectra (Fraunhofer lines) observed at Band 1 of the TANSO Fourier Transform Spectrometer (FTS) onboard GOSAT, we can detect SIF, i.e., the chlorophyll fluorescence under solar light. In fact, SIF was an obstacle for the primary purpose of GOSAT. However, in 2011, NASA researchers revealed that SIF can be retrieved from the GOSAT data and it could be a good index for photosynthesis activities. Those studies made plant ecologists excited, "Photosynthesis activities can be monitored from space!" I was also one of them, "I want to use these data!" Finally, I joined the GOSAT project.

In general, vegetation indices such as NDVI (Normalized Difference Vegetation Index) and EVI (Enhanced Vegetation Index) are used for remote-sensing of vegetation structure and/or function. Roughly speaking, such indices strongly related to the quantity of leaves above ground.

Although NDVI and EVI are useful, they saturate if the quantity of leaves increases to an extent (Figure 1). In other words, both ordinal temperate-forest in Japan and dense tropical rain forest could show the same values. In addition, NDVI and EVI don't indicate photosynthesis activities. SIF is better than NDVI as a photosynthesis activity index. This band on GOSAT-2 will be slightly improved and SIF will be newly released as its L2 product.

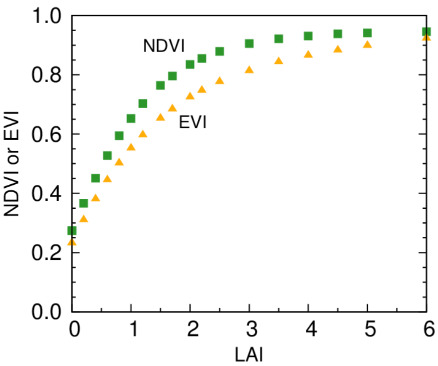


Figure 1. Relationships between LAI (Leaf Area Index) estimated from a radiative transfer model, SAIL (Scattering by Arbitrarily Inclined Leaves; Verhoef 1984) and NDVI or EVI. Although both NDVI and EVI increase as leaves quantity increases, they saturate at a certain value.

Q: In the GOSAT project, many members are trying to make efforts with their expert knowledge. What do you think about how experienced members are making use of their experience and how young members are playing active roles in the project?

N: Each member has his/her own specialties. Each member is working hard using each technical knowledge. We respect the specialty each other. Dr. Matsunaga provides precise instructions to us and we are judging by ourselves based on our own experience to proceed with the project.

Q: Do you have any advice for women who chose research as their job?

N: I think, when we face something difficult, we shouldn't excuse the fact we are women. This is also true for male researchers. Sometimes I feel that some people give up easily using the fact that we cannot change with effort (being a man or a woman) as an excuse. For instance, even some high school teachers assume that female students are not good at mathematics and physics.

Q: Finally, could you give some messages to our readers?

N: Even though we thought that SIF was a noise at first, its study has been developing. Like that, bringing new perspectives into existing things could expand to a new research. I hope that we always have wide and open viewpoints and break out of stereotypes. Also, we would like to continue to be an open research group.

(Interviewer: Katsunori Hirokane, NIES GOSAT Project)

Number of GOSAT RA proposals and published peer-reviewed papers

Table 1

Selected RA proposals per research field

Field of Research	Selected RA Themes
Calibration	4
Algorithm	22
Validation	30
Carbon Balance Estimation/Atmospheric Transport Models	17
Data Application	51
Data App./Validation	2
Carbon Balance Estimation/Atmospheric Transport Models & Data App.	1
Total	127

Table 2

Selected RA proposals per country

Country	Selected RA Themes
Japan	36
USA	22
Germany	10
China	7
Canada	5
France	5
Netherlands	5
UK	5
Russia	4
Finland	4
Others	24
Total	127

Fig. 2

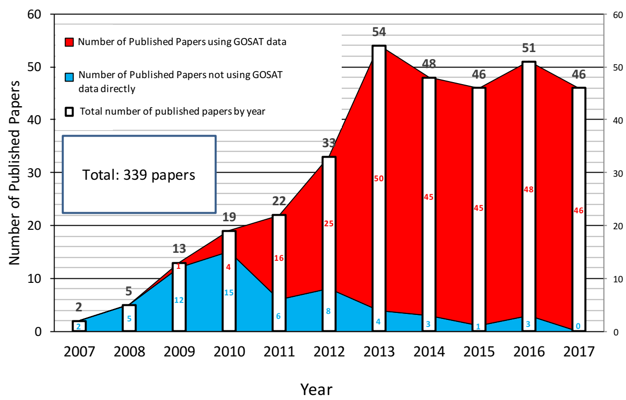


Table 3

Number of Published Papers

	Blue	Red	Total
2007	2	0	2
2008	5	0	5
2009	12	1	13
2010	15	4	19
2011	6	16	22
2012	8	25	33
2013	4	50	54
2014	3	45	48
2015	1	45	46
2016	3	48	51
2017	0	46	46
	59	280	339

The number of selected GOSAT RA proposals is shown in the left two tables above (per research field and per country of research organization). The total number is 127 proposals in 25 countries.

As shown in Fig. 2 and Table 3, the number of peer-reviewed published papers related to GOSAT increased rapidly until 2013, later remained unchanged at around 50 papers per year, and still keep going.

PUBLISHED PAPERS List of papers published in 2016 and 2017

N.B.: Sort by year of publication

Journal: Spectroscopy and Spectral Analysis (36(1), 186-190, 2016)
Title: Errors analysis and correction in atmospheric methane retrieval based on Greenhouse Gases Observing Satellite data
Authors: Bu, T. T., Wang, X. H., Ye, H. H., Jiang, X. H.

Journal: J. Geophys. Res.-Atmos. (121(23), 14084-14101, 2016)
Title: Simultaneous retrieval of aerosol optical thickness and chlorophyll concentration from multiwavelength measurement over East China Sea
Authors: Shi, C., Nakajima, T., Hashimoto, M.

Journal: Atmos. Meas. Tech. (9(12), 5975-5996, 2016)
Title: Thermal infrared laser heterodyne spectroradiometry for solar occultation atmospheric CO_2 measurements
Authors: Hoffmann, A., Macleod, N. A., Huebner, M., Weidmann, D.

Journal: Remote Sens. (8(12), 994, 2016)
Title: Retrieving XCO_2 from GOSAT FTS over East Asia using simultaneous aerosol information from CAI
Authors: Kim, W., Kim, J., Jung, Y., Boesch, H., Lee, H., Lee, S., Goo, T.-Y., Jeoing, U., Kim, M., Cho, C.-H., Ou, M.-L.

Journal: Remote Sens. (8(12), 998, 2016)
Title: A modified aerosol free vegetation index algorithm for aerosol optical depth retrieval using GOSAT TANSO-CAI data
Authors: Zhong, G., Wang, X., Tani, H., Guo, M., Chittenden, A. R., Yin, S., Sun, Z., Matsumura, S.

Journal: Atmospheric Environment (147, 344-354, 2016)
Title: Seasonal variation of the O_3-CO correlation derived from remote sensing measurements over western Japan
Authors: Ohyama, H., Kawakami, S., Uchino, O., Sakai, T., Morino, I., Nagai, T., Shiomi, K., Sakashita, M., Akaho, T., Okumura, H., Arai, K.

Journal: Atmos. Chem. Phys. (16(22), 14371-14396, 2016)
Title: Satellite observations of atmospheric methane and their value for quantifying methane emissions
Authors: Jacob, D. J., Turner, A. J., Maasakkers, J. D., Sheng, J., Sun, K., Liu, X., Chance, K., Aben, I., McKeever, J., Frankenberg, C.

Journal: J. Geophys. Res.-Atmos. (121(21), 13066-13087, 2016)
Title: Comparison between the Local Ensemble Transform Kalman Filter (LETKF) and 4D-Var in atmospheric CO_2 flux inversion with the Goddard Earth Observing System-Chem model and the observation impact diagnostics from the LETKF
Authors: Liu, J., Bowman, K. W., Lee, M.

Journal: J. Geophys. Res.-Atmos. (121(21), 13129-13157, 2016)
Title: An advanced retrieval algorithm for greenhouse gases using polarization information measured by GOSAT TANSO-FTS SWIR I: Simulation study
Authors: Kikuchi, N., Yoshida, Y., Uchino, O., Morino, I., Yokota, T.

Journal: Sci. China Earth Sci. (59(11), 2252-2259, 2016)
Title: XCO_2 satellite retrieval experiments in short-wave and infrared spectra with SCIATRAN model for Sahara Desert
Authors: Li, Y.-F., Zhang, C.-M., Dai, H.-S., Zhang, X.-Y., Zhang, P.

Journal: Environ. Res. Lett. (11(10), 105001, 2016)
Title: Inter-annual variability of summertime CO_2 exchange in Northern Eurasia inferred from GOSAT XCO_2
Authors: Ishizawa, M., Mabuchi, K., Shirai, T., Inoue, M., Morino, I., Uchino, O., Yoshida, Y., Belikov, D., Maksyutov, S.

Journal: J. Geophys. Res.-Atmos. (121(18), 11006-11020, 2016)
Title: CH_4 concentrations over the Amazon from GOSAT consistent with in situ vertical profile data
Authors: Webb, A. J., Bösch, H., Parker, R. J., Gatti, L. V., Gloor, E., Palmer, P. I., Basso, L. S., Chipperfield, M. P., Correia, C. S. C., Domingues, L. G., Feng, L., Gonzi, S., Miller, J. B., Warneke, T., Wilson, C.

Journal: Atmos. Meas. Tech. (9(9), 4633-4654, 2016)
Title: Potential of a geostationary geoCARB mission to estimate surface emissions of CO_2, CH_4 and CO in a polluted urban environment: case study Shanghai
Auhtors: O'Brien, D. M., Polonsky, I. N., Utembe, S. R., Rayner, P. J.

Journal: Atmosphere (7(9), 109, 2016)
Title: Intercomparison of carbon dioxide products retrieved from GOSAT short-wavelength infrared spectra for three years (2010-2012)
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Title: What controls the seasonal cycle of columnar methane observed by GOSAT over different regions in India?
Authors: Chandra, N., Hayashida, S., Saeki, T., and Patra, P. K.

Journal: Remote Sens. (9(11), 1167, 2017)
Title: Comparison of retrieved L2 products from four successive versions of L1B spectra in the thermal infrared band of TANSO-FTS over the Arctic Ocean
Authors: Payan, S., Camy-Peyret, C., Bureau, J.

Journal: Remote Sens. (9(11), 1158, 2017)
Title: The cross-calibration of spectral radiances and cross-validation of CO_2 estimates from GOSAT and OCO-2
Authors: Kataoka, F., Crisp, D., Taylor, T. E., O'Dell, C. W., Kuze, A., Shiomi, K., Suto, H., Bruegge, C., Schwandner, F. M., Rosenberg, R., Chapsky, L., and Lee, R. A. M.

Journal: Atmos. Meas. Tech. (10(11), 4135-4164, 2017)
Title: Global height-resolved methane retrievals from the Infrared Atmospheric Sounding Interferometer (IASI) on MetOp
Authors: Siddans, R., Knappett, D., Kerridge, B., Waterfall, A., Hurley, J., Latter, B., Boesch, H., Parker, R.

Journal: Science of the Total Environment (601-602, 1575-1590, 2017)
Title: A comparison of satellite observations with the XCO_2 surface obtained by fusing TCCON measurements and GEOS-Chem model outputs
Authors: Zhang, L. L., Yue, T. X., Wilson, J. P., Zhao, N., Zhao, Y. P., Du, Z. P., Liu, Y.

Journal: Environmental Monitoring and Assessment (189(12), 627, 2017)
Title: Spatial and temporal distribution of carbon dioxide gas using GOSAT data over Iran
Authors: Falahatkar, S., Mousavi, S. M., Farajzadeh, M.

Journal: Remote Sens. (9(12), 1228, 2017)
Title: TCCON Philippines: First measurement results, satellite data and model comparisons in Southeast Asia
Authors: Velazco, V. A., Morino, I., Uchino, O., Hori, A., Kiel, M., Bukosa, B., Deutscher, N. M., Sakai, T., Nagai, T., Bagtasa, G., Izumi, T., Yoshida, Y., and Griffith, D. W. T.

Journal: Remote Sensing of Environment (201, 109-124, 2017)
Title: Constraining a terrestrial biosphere model with remotely sensed atmospheric carbon dioxide
Authors: Kaminski, T., Scholze, M., Vossbeck, M., Knorr, W., Buchwitz, M., Reuter, M.

Journal: Remote Sensing of Environment (201, 276-295, 2017)
Title: Global satellite observations of column-averaged carbon dioxide and methane: The GHG-CCI XCO_2 and XCH_4 CRDP3 data set
Authors: Buchwitz, M., Reuter, M., Schneising, O., Hewson, W., Detmers, R. G., Boesch, H., Hasekamp, O. P., Aben, I., Bovensmann, H., Burrows, J. P., Butz, A., Chevallier, F., Dils, B., Frankenberg, C., Heymann, J., Lichtenberg, G., De Mazière, M., Notholt, J., Parker, R., Warneke, T., Zehner, C., Griffith, D. W, T., Deutscher, N. M., Kuze, A., Suto, H., Wunch, D.

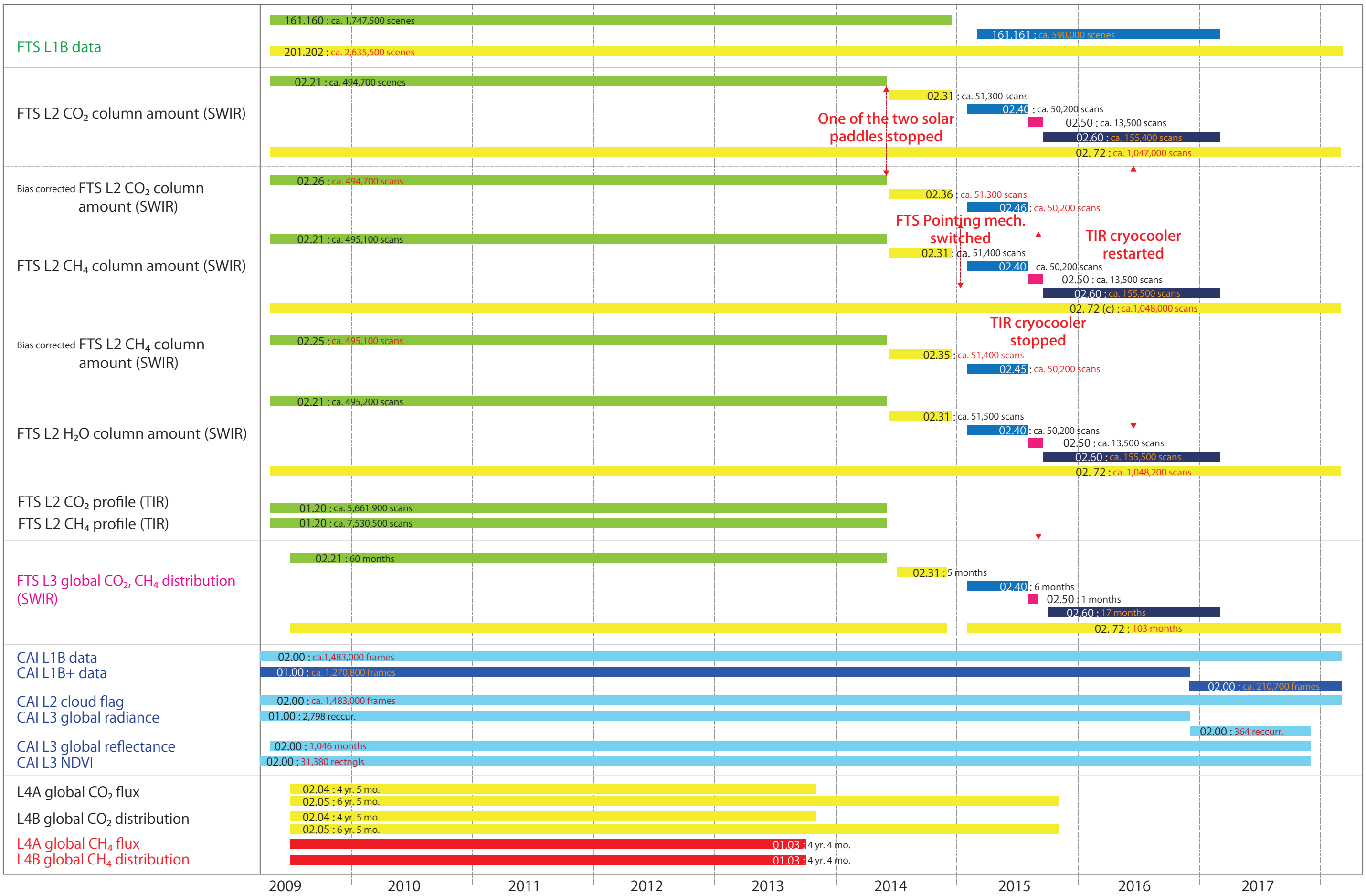
N.B.: Results of the survey conducted by 'Web of Science'. Papers published in Japanese scientific journals are not included.

DATA PRODUCTS UPDATE

As of March 16, 2018

Data Processing and Release Status

Fumie Kawazoe, Specialist,
NIES GOSAT Project



Described below are data processed and released during one year from January 2017.

FTS SWIR L2 $CO_2/CH_4/H_2O$ column amount products were upgraded to V02.72. The new version products until February 28, 2018 have been released. Their bias-corrected results using ground-based observation data are provided as Bias-corrected FTS SWIR L2 CO_2/CH_4 column amount products. FTS SWIR L3 CO_2/CH_4 products were also upgraded to V02.72.

Other latest processed and released are: reprocessed V02.00 for CAI L1B, L2 cloud flag, L3 global reflectance, and NDVI products for the whole observation period; CAI L1B+ and L3 global radiance in V01.00 until November 2016 and in V02.00 after December 2016.

As for L4 products, new versions for L4A global CO_2 flux and L4B global CO_2 distribution until October 2015 have been released. L4A global CH_4 flux and L4B global CH_4 distribution until September 2013 are provided and will be upgraded this spring.

Please refer to the release notes on GDAS for their details. The number of GDAS registered users is 685 as of March 16, 2018. (The user accounts which were not logged in during the past two years were frozen.)

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