Thermal And Near infrared Sensor for carbon Observation (TANSO)
onboard
the Greenhouse gases Observing SATellite (GOSAT)

Research Announcement

August 2015

Japan Aerospace Exploration Agency (JAXA)
National Institute for Environment Studies (NIES)
Ministry of the Environment (MOE)

Japan

GOSAT/TANSO Research Announcement

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Appendices

*Please note that Appendices A, B, and C have not revised since the first research announcement was made. Consequently, some descriptions differ from current conditions; such as, a version-up of the processing algorithm has not explained in Appendix B. Updates are provided at the GOSAT User Interface Gateway, a website for GOSAT data distribution (GUIG).

1. Introduction

The Fourth Assessment Report issued by the Intergovernmental Panel on Climate Change (IPCC) in 2007 states that most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic Green House Gas (GHG) concentrations. The drastic increase in the concentration of GHGs, particularly carbon dioxide (CO_2), caused directly and indirectly by human activities, is attributed to the fact that the emission of CO_2 into the atmosphere in the process of the mass consumption of fossil fuel, deforestation, etc., significantly surpasses the absorption by the land ecosystem and the oceans. Thus, it is imperative to balance the emission due to human activities and the absorption by the nature, in order to stabilize the climate for the future. In the meantime, however, we, humans, have not grasped, to a sufficient level, the mechanisms of the absorption by land ecosystem and ocean, and the climatological feedback in the carbon cycle involving atmosphere, land ecosystem and ocean. This lack of understanding comprises a substantial part of the uncertainty in predicting future climate change.

The clarification of these problems involves not only an ascertainment of the spatial and temporal variations in the CO_2 emission from human activities but also a calculation of the spatial distribution and temporal variation of CO_2 and also methane (CH_4), which is the second largest contributor to global warming after CO_2, and the spatial distribution and temporal variation of the source and sink in land ecosystem and oceans, based on earth observation, and ultimately an attainment of adequate scientific knowledge on the underlying mechanisms. These efforts to observe GHG concentrations and to analyze the causes of their variations at some locations are, though still limited, in progress. On top of these attempts, it is vital to observe the distributions of CO_2, CH_4, and other GHG concentrations, which fluctuate both spatially and temporally, on the global scale, using satellite platforms, in a continuous and systematic manner, and to elucidate the current issues, with a goal to elevate the reliability of prediction of future climate change and climate system models effective for assessing the consequences of climate change.

Under such circumstances, the GOSAT (Greenhouse gases Observing SATellite) Project was initiated and has been promoted jointly by the Japan Aerospace Exploration Agency (JAXA), the National Institute for Environmental Studies (NIES) and the Ministry of the Environment (MOE) (hereinafter referred to as the "Three Parties" collectively). One of the missions of the Project is to increase the accuracy of the flux (source and sink) estimation of the GHGs on the sub-continental basis (a few thousand kilometers square), thereby to contribute to environmental administration efforts such as ascertainment of fluxes per region and evaluation of the carbon balance in forests. The Project will further contribute, through research on applications of the data acquired by GOSAT, to an accumulation of scientific knowledge regarding the global distribution of GHG concentrations and its temporal variations as well as the global carbon cycle mechanism and its impact on climate change, which will assist the prediction of climate change and evaluation of consequences therefrom. At the same time, the Project aims to maintain and further evolve conventional earth-observing technologies to develop new methodologies to measure GHGs and enable engineering development necessary for future earth-observing satellites.

To achieve these goals, JAXA takes charge of developing and launching the satellite with the sensors on board, calibrating and operating the sensors, acquiring observation data, and processing the

acquired data to Level 1 (spectral) products, whereas NIES undertakes the examination of requirements for the sensor specifications, development and operation of the higher-level product processing system, development of the data processing algorithms, generation of Level 2 (GHG concentrations), Level 3 & 4 (global distribution of GHG concentrations, and distribution of carbon source/sink based on them, etc) products, validation of data quality, and storage and provision of the generated data products. Furthermore, the MOE supplements the development of the sensors and bears the responsibility for utilization of the GOSAT data in its environmental administration through the acquisition of validation data and scientific use of mission data. The Three Parties have been and will continue to be vigorously carrying forward the research and development necessary for fulfilling these tasks with the help and advice from the GOSAT Science Team, which was established and is administered by the Three Parties.

The Research Announcement to be made herein (hereinafter referred to as the "RA") solicits proposals for research on the data processing algorithms, calibration, validation, carbon balance estimation/atmospheric transport models, and scientific use with respect to the GOSAT data from the public, on top of the basic research and development topics to be performed by the Three Parties, with an aim to make the outcomes of the Project more effective. All research teams responding to this RA whose proposals are selected by the Three Parties based on the results of evaluation by the RA Selection and Evaluation Committee (hereinafter referred to as the "Committee") will be granted a priority in data distribution, the right to make observation requests (within a predetermined scope), accommodation in obtaining other related data, and so forth. Incidentally, the Committee will consist of the members selected and requested by the Three Parties from among Japanese and non-Japanese experts and specialists.

The succeeding chapters in this document describe the contents of the GOSAT Project in detail, including items ranging from the equipment onboard the satellite, overview of data processing algorithms, calibration and validation plans to data utilization plans. Applicants to this RA are encouraged to read the contents of this document carefully and make active efforts to write research proposals.

2. Definitions of the GOSAT/TANSO Research Announcement (RA)

2.1 GOSAT Project

GOSAT carries an observing instrument called Thermal And Near-infrared Sensor for carbon Observation (TANSO). The GOSAT/TANSO is composed of two sensors called Fourier Transform Spectrometer (FTS), which measures greenhouse gases (GHGs), and Cloud and Aerosol Imager (CAI), which collects information on cloud and aerosol.

The primary purpose of GOSAT is to measure the global distribution of GHG concentrations and its temporal variation and to increase the accuracy of the flux estimation of GHGs on the sub-continental scale, thereby contributing to the sustention and development of systemized observation in accordance with the Kyoto Protocol, while at the same time facilitating the environmental administration efforts, including ascertainment of the flux per region and evaluation of the carbon balance in forests during the first period (2008-2012) as specified by the Protocol. In the meantime, the Project is intended to develop GHGs-measurement technologies and other technologies necessary for future earth-observing satellites, by standing on and further evolving the existing earth-observing technologies.

2.2 Purpose

The purpose of the RA is to open to public an opportunity for researching on the data processing algorithms, calibration, validation, carbon balance estimation/atmospheric transport models, and scientific use of the GOSAT data, in addition to the basic research and development topics to be performed by the Three Parties, with a goal to make more use of the outcomes from the Project. The research topics selected by the Committee and adopted by the Three Parties will be subject to preferential data distribution, the right to make observation requests (of reasonable amount), and accommodations in obtaining other related data, etc.

The implementation of the RA is expected to bring about additional researches by other parties than JAXA and NIES, which will supplement the research to be conducted in accordance with the calibration and validation plans of the Project, facilitation of studies on the processing algorithms, carbon balance estimation/atmospheric transport models, and utilization of the GOSAT/TANSO data, objective evaluation of the research concerning the effectiveness and usefulness of the data, expansion of opportunities for researchers and scientists inside and outside Japan to access the GOSAT data, and so on.

2.3 Scope

The GOSAT/TANSO RA is open to all countries across the world, not limited to Japan. All individual researchers, educational organizations, research institutes, and governmental bodies who are willing to use the GOSAT data for non-profit and peaceful purposes are entitled to participate in the RA. In this manner, private companies are also qualified for submitting research proposals as long as their themes are for non-profit and peaceful purposes.

Investigators involved in carrying out the research themes selected in the RA are called "RA

Investigators" for the purpose of the RA. A team of RA Investigators working on a research theme will elect one principal investigator (hereinafter referred to as "PI") who will represent the team. The PI will act as the contact person with the Three Parties in carrying out the research on the selected theme, such as communication, data transfer, submission of necessary documents, etc. In principle the research organization (hereinafter referred to as "RO") to which the PI belongs shall also be responsible for signing the joint research contract with the Three Parties, as provided in Appendix E hereto, when selected for the RA. The signer may be the PI himself/herself only in case if the PI does not belong to any organization.

Incidentally, the research teams selected for the RA may be requested to conclude a separate contract in order to strengthen the cooperative relationship between the team and the Three Parties.

2.4 Basic Policies

The GOSAT/TANSO RA will be conducted based on the following policies:

1) The Three Parties will establish a committee to select the research proposals and to follow their results. This committee will be referred to as "the Committee" hereinafter. Research proposals submitted in response to the RA will be evaluated by the Committee, and they will be selected by the Three Parties based on the evaluation results by the Committee. The Committee shall be responsible for not only evaluating the submitted proposals but also, as shown in Chapter 8.2.1 hereof, evaluating the progress and adequacy of the adopted researches.

2) The research period shall be the operational period of GOSAT/TANSO plus the operational period of its ground system — five years after the launch, in principle (until January 22, 2014) —. Any long-term research to be conducted, which goes beyond one year, will be subject to interim reporting to the Three Parties, basically once a year.

3) The GOSAT/TANSO RA took place in April to August 2008 for the first time, in April to August 2009 for the second time, and in August 2010 to February 2011 for the third time. Taking into account the success of the past RAs, applicants are invited to submit their research proposals anytime from August 2012 aiming to improve convenience of the candidates and to give opportunities to become new GOSAT RA Investigators.

4) PI of a research team may make multiple research proposals on different themes during the mission period. (In other words, a single person may submit proposals on more than one research themes to be carried out under this RA scheme.)

5) The PI may submit observational requests to the extent determined by the Committee per research theme.

6) The PI may request for distribution of GOSAT data free of charge to the extent designated by the Committee per research theme.

7) Applications for the GOSAT/TANSO RA and research plans shall be submitted via the Websites run by the RA Office or by e-mail, in principle; those documents sent by conventional mail or other means may also be accepted according to the situation.

8) Research themes to be conducted under the RA scheme were selected in August 2008 for the first RA, in July and August 2009 for the second RA, and in January 2011 for the third RA. From the RA starting from August 2012, the selection will be administered at each time the Committee meeting is held semiannually in principle.

9) Proposal titles and names of PIs and their ROs will be disclosed on the websites run by the NIES GOSAT Project office when their research themes are selected for the RA.

10) Outcomes of the GOSAT/TANSO RA must, in general, be disclosed to the public in the form of papers published on academic journals and other media and at the same time be reported at the research result reporting meetings held by the Three Parties.

11) The Three Parties do not provide any financial assistance to PIs, in principle, under the RA scheme.

12) RO (or PI in case he/she does not belong to any organization) must conclude the joint research contract, as provided in Appendix E, with the Three Parties prior to the start of research activities on the selected research theme.

2.5 Implementing Organization of the GOSAT/TANSO RA

The Three Parties have set up an office in charge of the RA within the NIES GOSAT Project office, for firm and efficient implementation of the GOSAT/TANSO RA. The RA Office carries out the following tasks in accordance with the basic policies set forth by the Three Parties.

1) Prepares the RA procedures and release them to the world.

2) Carries out administrative works as the secretariat of the Committee.

3) Accepts proposals submitted in response to the RA and requests the Committee for due evaluation for selecting research themes.

4) Notifies the selection results to all PIs who submitted research proposals and assists those selected PIs in signing the joint research contract (see Appendix E) necessary for carrying out the research.

5) Receives the outputs of the research from the PIs by the deadline designated in the contract and distributes them among the Three Parties.

6) Assists in organizing the research result report meetings to be held by the Three Parties.

7) Notifies the completion of the joint research agreement to the RO (or the PI in case if he/she does not belong to any organization) in writing when the Committee confirms and accepts the Final Report of Research Result submitted by the PI in accordance with section 8.2.2 of this Research Announcement.

See Chapter 14 hereof for the contact information of the RA Office.

3. Outline of GOSAT and TANSO Sensors

3.1 Outline of GOSAT

An outline of GOSAT is provided in Chapter A.1 of Appendix A hereto.

3.2 Outline of GOSAT/TANSO-FTS

GOSAT/TANSO-FTS is one of the two sensors onboard GOSAT and is a Fourier interferometer which observes GHGs such as CO_2 and CH_4. An outline of TANSO-FTS is provided in Chapter A.2 of Appendix A hereto.

3.3 Outline of GOSAT/TANSO-CAI

GOSAT/TANSO-CAI is one of the two sensors onboard GOSAT and is an imager which collects cloud and aerosol information. An outline of TANSO-CAI is provided in Chapter A.3 of Appendix A hereto.

4. GOSAT/TANSO Data Policies

Each PI is entitled to obtain the GOSAT data necessary for his/her respective research activities (up to a limited number) without any cost, from the Three Parties on the condition that he or she agrees to the following provisions:

1) The use of the data for any purpose in opposition to peaceful use is prohibited.
2) The use of the data for any other purpose than his/her research purpose is prohibited.
3) Redistribution of the data to any third party is prohibited.
4) The data obtained can only be distributed among the PI and RA Investigators.
5) Any publication of the outcomes obtained in consequence of the use of the data must be accompanied by an indication of the data source.
6) The use of the data under the mechanisms of the Kyoto Protocol, namely the Joint Implementation (Article 6 thereof), Clean Development Mechanism (Article 12 thereof), and the International Emission Trading (Article 17 thereof), without consent of the Three Parties is prohibited, provided that any use for such a purpose may be allowed if the PI obtains an approval of and concludes a contract with the Three Parties in advance.

The data to be distributed will be subject to the operational status of the satellite and the physical restrictions of the sensors. The invisible areas by FTS and CAI are explained in Chapters A.2 and A.3 of Appendix A hereto, respectively.

The Three Parties shall not be liable for any missing data, degradation of data quality, delay in data delivery, or any other situation in which the data cannot be provided, as a result of problems that occurs to the spacecraft or the ground facilities.

The ownership of the original data acquired with GOSAT/TANSO belongs to the Three Parties. The "original data" here means the products provided by JAXA or NIES and should be distinguished from the data obtained by RA Investigators as an outcome from their research activities.

RA Investigators are entitled to access the GOSAT data prior to the release of the data to the public. They are also entitled to use the data planned to be acquired in accordance with the Basic Observation Plan of the TANSO sensor attached hereto as Appendix C.

Although the RA Investigators and the Three Parties shall confer with respect to the content of new observation requests after the selection, the RA Investigators drawing up research plans in response to the RA should carefully examine the "Operation Policies of GOSAT and Basic Observation Plan of the TANSO Sensor", as provided in Appendix C, and plan acquisition and distribution requests for the GOSAT data, with due consideration given to the constraints of each sensor in its observation (more concretely, invisible areas, observation mode switching, etc.)

RA Investigators are entitled to access the following data products:

1) L1 and L2 Standard products (See Table 1)
The "standard" products mean the calibrated Level 1B products, and all Level 2 or higher level products generated from the validated L1B products and are released to general users. There are four

calibration stages for L1 and four validation stages for L2 products, and they are explained in Table 2 and 3, respectively. All L1 and L2 products are released to general users at the "Confirmed" stage.

2) L2 Research products (See Table 1 as well as Table 6 described in Chapter 8)
The "research" products are the data products intended to be used in the research fields of calibration, validation, data processing algorithms, data application, and other scientific researches. Their validation stage goes up until (V) "Validated" and no further. They are available to RA Investigators, to an extent necessary for their respective researches, at suitable timing. However, it should be noted that because the research products are basically not the subjects for the validation activity, the research products at the "Validated" stage are the comparable quality to the "Preliminarily checked" stage with feedback from RA* Investigators as supplementary explanation.

3) L3 Products (See Table 1)
L3 products are the global-scale products calculated from L1 and L2 products. L3 products are not "validated", but they are released to RA Investigators prior to the public for preliminary evaluation.

4) L4 Products (See Table 1)
L4 Products consist of L4A (global CO_2 flux) and L4B (global CO_2 distribution) data products as the standard products and L4A (global CH_4 flux) and L4B (global CH_4 distribution) data products as the research products. As for the standard products, at first, they are disclosed to the RA Investigators in the research field of "carbon balance estimation, atmospheric transport models" explained in section 12.1, in order to obtain the investigators' feedback and reflect them on the products' release notes and other documents. Then, prior to their release to the public, the products are distributed to all other RA Investigators for a purpose of quality confirmation.

5) JAXA's satellite data other than the GOSAT data
Those selected PIs who are willing to use the satellite data owned by JAXA, other than the GOSAT data, may so request to JAXA. When the request is made to JAXA, it shall also be informed to the RA office.

Table 1　List of GOSAT/TANSO data products (as of 30 March 2015)

Processing Level	Sensor / Band	Product Name	Category	Unit	Format
L1A	FTS	FTS L1A　data	Internal (*1)	FTS scene	HDF5
L1A	CAI	CAI L1A　data	Internal (*1)	CAI scene	HDF5
L1B	FTS	FTS L1B　data	Standard	FTS scene	HDF5
L1B	CAI	CAI L1B data	Standard	CAI flame	HDF5
L1B+	CAI	CAI L1B+ data (*2)	Standard	CAI flame	HDF5
L2	FTS SWIR	L2 CO_2 column amount (SWIR)	Standard	Scan	HDF5
L2	FTS SWIR	L2 CH_4 column amount (SWIR)	Standard	Scan	HDF5
L2	FTS SWIR	L2 H_2O column amount (SWIR)	Standard	Scan	HDF5
L2	FTS TIR	L2 CO_2 profile (TIR)	Standard	Scan	HDF5
L2	FTS TIR	L2 CH_4 profile (TIR)	Standard	Scan	HDF5
L2	FTS TIR	L2 H_2O column amount (TIR)	Research	Scan	HDF5
L2	CAI	L2 cloud flag	Standard	CAI flame	HDF5
L2	CAI	L2 cloud property	Research	CAI flame	HDF5
L2	CAI	L2 aerosol property	Research	CAI flame	HDF5
L3	FTS SWIR	L3 global CO_2 distribution (SWIR)	Standard	Global・monthly	HDF5
L3	FTS SWIR	L3 global CH_4 distribution (SWIR)	Standard	Global・monthly	HDF5
L3	CAI	L3 global radiance distribution	Standard	Global	HDF5
L3	CAI	L3 global reflectance distribution	Standard	Global	HDF5
L3	CAI	L3 NDVI	Standard	Rectangle (30° x 60° (lat. x lon.))	HDF5
L4A	-	L4A global CO_2 flux (*2)	Standard	Global (64 regions & 1 degree mesh)・annually	Text or Net CDF
L4A	-	L4A global CH_4 flux (*2)	Research	Global (43 regions & 1 degree mesh)・annually	Text or Net CDF
L4B	—	L4B global CO_2 distribution (*2)	Standard	Global 2.5 degree mesh・monthly	Net CDF
L4B	—	L4B global CH_4 distribution (*2)	Standard	Global 2.5 degree mesh・monthly	Net CDF

(*1) Internal products are available only to the investigators and organizations working with the GOSAT Project in the field of calibration.

(*2) Browse images are also attached with these products at release.

Products colored yellow are those having been released to the public; products colored green are those having been distributed only to RA Investigators; and products colored blue are those having been stopped distributing to the public temporarily. (as of 30 March 2015)

Table 2 Definitions of the calibration stages for L1 standard products

Calibration Stage	Definition
Unchecked (U)	Data products generated by simply processing the observation data.
Preliminarily checked (P)	Data products visually checked and judged as reliable.
Calibrated (Ca)	Preliminarily checked data products having been verified by the initial sensor calibration activity.
Confirmed (C)	Calibrated data products which have been used by a limited community of users for a certain period of time and for which no problem has been reported by the users.

Table 3 Definitions of the validation stages for L2 standard products

Validation Stage	Definition
Unchecked (U)	Products generated by simply processing the observation data.
Preliminarily validated (P)	Products visually checked and judged as reliable.
Validated (V)	Preliminarily validated products which were compared with other observation data having higher-accuracy (e.g., ground-based observation) and judged as sufficiently accurate accordingly.
Confirmed (C)	Validated products which have been used by a limited community of users for a certain period of time and for which no problem has been reported by the users.

These validation stages apply when major changes in the processing algorithms are implemented and version of the product is changed.

Table 4 Definitions of the evaluation stages for L3 standard products

Evaluation Stage	Definition
Unchecked (U)	Products generated by simply processing L1 or L2 products.
Evaluated (E)	Products generated by processing L1 or L2 products and visually checked and judged as reliable.
Confirmed (C)	Evaluated products which have been used by a limited community of users for a certain period of time and for which no problem has been reported by the users, and for which their comments are reflected on documents like product release notes.

Table 5 Definitions of the check stages for L4 standard products

Validation Stage	Definition
Unchecked (U)	Products simply generated based on the carbon balance analysis using both L2 products and the data of the ground-based observation stations.
Preliminarily checked (P)	The above unchecked products which have been visually checked and judged as reliable.
Checked (Ch)	Preliminarily checked products which have been checked by the expert users for a certain period of time and for which no problem has been reported by the users, and for which their comments are reflected on documents like product release notes, if any.
Confirmed (C)	Checked products which have been used by a limited community of users for a certain period of time and for which no problem has been reported by the users, and for which their comments are reflected on documents like product release notes, if any.

5. Data Distribution of GOSAT/TANSO Products and Standards for their Use

5.1 List of Products

Table 1 shown in Chapter 4 outlines the GOSAT/TANSO products, by product type, for which RA Investigators can submit data distribution requests.

5.2 Data Format and Distribution Media

1) Data format
Of the GOSAT data, L1 to L3 products will be provided in the following format, which is commonly used for distributing earth-observing sensor data.
- HDF 5 (Hierarchical Data Format 5)

Higher-level data (L4 products) will be provided in the following format, considering that it is used by TRANSCOM.
- NetCDF
- Text

2) Distribution media
The GOSAT data will be distributed online via the Internet, in general.

6. Funding

The Three Parties do not provide any kind of financial assistance to PIs, in principle.

7. Qualifications

As long as the research proposals are designed for peaceful and non-profit purposes, any research institute, educational organization, governmental body, private company or individual researcher who belongs or does not belong to any sort of organization, in any country, can apply for the RA, regardless of nationality, group or individual.

8. Rights and Obligations of the Principal Investigator (PI)

As explained in Chapter 2.3 above, the PI (one person) shall be responsible for communicating with the Three Parties when applying for the RA and also researching on the research theme, if adopted. Furthermore, as described in 12) of Chapter 2.4 above, the RO to which the PI belongs shall conclude the joint research contracts, attached hereto as Appendix E, with the Three Parties, with respect to the implementation of the research on the theme selected in the RA. The signer may be the PI himself/herself only in case the PI does not belong to any organization.

8.1 Rights

The PI shall be entitled to the following rights:
1) Submitting observation requests necessary for the implementation of the research on the selected theme.
2) Requesting a delivery of standard products without any cost, before the release to the public. (This applies when major changes in the processing algorithms are implemented and version of the product is changed.)
3) Requesting a delivery of research products without any cost. However, note that the number of such requests will be determined in consideration of the conformity to the research purpose.
4) Requesting a "forced" processing of FTS L2 data and a distribution of its results if the L2 data are not generated by any reasons. The "forced" means the processing condition applying neither filtering nor screening to the data in its processing. For making such request, browse images including the targeted observation point shall be visually confirmed beforehand so that there is no cloud over the point. The request will be accepted only in case if those data are necessary for the progress of the adopted RA research.
5) In addition to the FTS L2 data products (column abundances of CO_2, CH_4, and H_2O (SWIR)), PIs can obtain additional information so-called "sub-datasets" of these products.
6) Accessing the NIES "large-volume data distribution system" server to download the GOSAT data collectively. This privilege, however, is only granted to those PIs whose specific applications for its use are approved.
7) Requesting a delivery of the FTS L2 data products which are applied less strict criteria of screening than usual to the public.
8) PIs are entitled to participate in the "PI Meeting" being held by the Three Parties.

Note: PIs' rights over the products which will be distributed after the release of this document will be announced via appropriate means such as the NIES GOSAT Project webpage or e-mail.

In addition, Table 6, 7, 8 and 9 below summarize the timing of product distribution by user categories which mainly consist of two categories; RA users and general users. As far as the RA users, those RA Investigators who study on calibration, validation, or data processing algorithm are grouped as RA* users, while those who study on carbon balance estimation and atmospheric transport models or data application are grouped as RA+ users. Further, those particularly specializing in the field of carbon balance estimation and atmospheric transport models are categorized as RA-Mo users.

Table 6　L1 data distribution conditions for standard/research products

User Category	Standard product	Research product (*1)
RA* Investigator	To be distributed from the P (preliminarily checked) stage	-
RA+ Investigator	To be distributed from the Ca (calibrated) stage	-
General user	To be released at the C (confirmed) stage	-

Table 7　L2 data distribution conditions for standard/research products

User Category	Standard product	Research product (*1)
RA* Investigator	To be distributed from the P (preliminarily checked) stage	To be distributed from the P (preliminarily checked) stage
RA+ Investigator	To be distributed from the V (validated) stage	To be distributed from the V (validated nominally) stage (*2)
General user	To be released at the C (confirmed) stage	Not available

Table 8　L3 data distribution conditions for standard/research products

User Category	Standard product	Research product (*1)
RA Investigator	To be distributed from the E (evaluated) stage	To be distributed from the E (evaluated) stage
General user	To be released at the C (confirmed) stage	Not available

Table 9　L4 data distribution conditions for standard/research products

User Category	Standard product	Research product (*1)
RA-Mo Investigator	To be distributed from the P (preliminarily checked) stage	To be distributed from the P (preliminarily checked) stage
RA Investigator other than RA-Mo	To be distributed from the Ch (checked) stage	To be distributed from the Ch (checked) stage
General user	To be released at the C (confirmed) stage	Not available

(*1) The research products are made available to RA Investigators, to an extent necessary for their respective researches, at suitable timing. The Three Parties do not guarantee their product quality. At this moment, invention of the L1 research product is not planned (See Table 1).

(*2) Because the research products are not the subjects for the validation activity, as far as L2 research products are concerned, the V (validated) stage shall be stated as the V (validated nominally) (See Chapter 4, 2. L2 research products).

8.2 Obligations

8.2.1 Interim reporting

PI shall report the progress of his/her RA research, once a year in principle, in the way designated by the Three Parties, such as submitting the report in writing or presenting the report at GOSAT-related workshops, symposiums, interim report meetings, and conferences to be held by the Three Parties. The Three Parties shall evaluate the interim research result report and the progress report in the Interim Evaluation based on the results of deliberation by the Committee and notify the evaluation results to the RO (or the PI if the PI does not belong to any organization) in accordance with Article 2 of the General Contractual Conditions for the Joint Research on the GOSAT data.

Moreover, if the Committee deems the research purpose or data application of the RA Investigators as deviant from the initial research plan or in breach of the joint research contract, as a result of the examination of the progress reported, the Three Parties may terminate the said agreement.

8.2.2 Final reporting and termination of the contract

When the research period scheduled and stated in the research proposal comes to the end, all PIs are required to submit the Final Report of Research Result to the Three Parties in accordance with the instructions provided in the contract. Timing of the submission is generally within one year from the last interim research result report. When the RA Office receives the Final Report of Research Result from the PI and the Committee confirms and accepts the report, the RO will be informed (or the PI if the PI does not belong to any organization) about the completion of the joint research agreement in writing. The report shall be prepared in English.

9. Preparation and Submission of Research Proposals

9.1 Notes to the preparation of research proposals

The documents to be submitted in response to the RA must be prepared in accordance with the following procedures. Those proposals that are prepared in disregard of these conditions may be excluded from the succeeding evaluation process. In addition, none of the submitted documents will be returned to the proposers for any reason whatsoever.

- Prepare a research proposal in accordance with the procedure for submission defined in this Chapter and the "Contents of Research Proposals and Application Forms" provided as Appendix D hereto. The application forms in Appendix D will be selected and used as necessary, except Forms 1a, 1b and 2 that are mandatory for all applicants.
- Submit your research proposal in the PDF format, in the way that it is ready for printing in A4 or letter size, together with necessary references, such as relevant theses, via e-mail to the GOSAT/TANSO RA Office's e-mail address (gosat-prj1@nies.go.jp). Note that the size of the submission e-mail should not exceed 10 MB, including the main text. Should your proposal exceed this limit, prepare six copies of the proposal documents as well as the references, record the proposal in the PDF format on an electric medium, such as CD-R, and send the whole package to the RA Office by conventional mail.
- Letters on the documents should all be typed in 10- to 12-point size.
- Indicate the page number at the bottom center and the name of applicant in the upper right corner on each page of the documents.

9.2 Language

The research proposal and accompanying reference documents must all be prepared in either English or Japanese. Those who are native speakers of Japanese shall prepare and submit Forms 1a and 1b of Appendix D, which are cover sheets of the proposal, in both English and Japanese.

9.3 Volume

The research proposal must be compiled in the most simplified way, focusing on the minimally necessary contents. The total volume of the proposal, excluding appendices, must be 20 pages or less. See Appendix D for further specific rules.

9.4 Contents to be included in research proposals and the preparation procedure

See Appendix D

9.5 Submission of research proposals

As mentioned in Chapter 9.1 above, the applicants for the RA should submit the proposal and other necessary documents basically via e-mail. However, in a case that the applicant is unable to use e-mail, insert all documents necessary for the application in an envelope, and send it to the following address by conventional mail.

GOSAT RA Office

Center for Global Environmental Research (CGER)

National Institute for Environmental Studies (NIES)

16-2 Onogawa, Tsukuba-shi, Ibaraki

305-8506 Japan

TEL: 81-29-850-2966 (Japanese)

TEL: 81-29-850-2035 (English)

FAX: 81-29-850-2219

E-mail: gosat-prj1@nies.go.jp

10. Selection of Research Proposals

10.1 Evaluation and Selection Procedure

The research proposals submitted in response to the RA will be evaluated by the Committee. The Three Parties will make a final decision on the selection of research themes, based on the evaluation results of the Committee. The applicants may be requested to modify or rectify the contents of the proposed research plan, in the course of the selection by the Committee, with a view to enriching the expected scientific results from the proposed research. In addition, the Committee may solicit advice of the GOSAT Science Team in the process of evaluation. All applicants will be notified of the selection results by the scheduled date announced; the schedule of the fourth RA is given in Chapter 13.4 of this document while the schedules for the following RAs will be publicized via the NIES GOSAT Project website in an appropriate timing.

10.2 Evaluation Criteria

The submitted research proposals will be examined and selected based on the following evaluation criteria.

1) The contents of the proposed research conform to the purpose of the RA.
2) The methods and approaches adopted in the proposed research are appropriate and the underlying concept is original and/or innovative.
3) The RA Investigators are qualified in terms of research capability, experience, facility/equipment, and skills necessary for accomplishing the purpose of the proposed research.
4) The proposed research is consistent and relevant with the purpose of the GOSAT Project.
5) The purpose of the proposed research can be accomplished within the research period.

10.3 Post-selection Procedure

The RO of the selected PI shall sign the joint research contract with the Three Parties, in principle, based on the "General Contractual Conditions for the Joint Research on the GOSAT data", attached as Appendix E hereto. The RO and the PI shall observe all the clauses, in connection with the performance of the research, as stipulated in the General Contractual Conditions.

The RA Office shall carry out the administrative work necessary for concluding such a contract, in line with the intentions of the Three Parties.

11. Cancellation and Postponement of RA

The Three Parties reserve the right to cancel the RA and joint research projects based on the RA by notifying in writing, and shall not be liable for any delay in the RA schedule or cancellation of the RA program itself or to those who did not receive any notice regarding such delay or cancellation.

12. Expected Research Topics

The Three Parties have been and will be continually promoting the GOSAT Project by playing the respective roles in the research and development deemed as necessary for achieving its purpose with the advice and help from the GOSAT Science Team. The specific research and development activities within the Project include; the calibration of the GOSAT/TANSO equipment, validation of higher-level products (observation and analysis for validation), development and improvement of the data processing algorithms, development of atmospheric transport models and land ecosystem models, generation of source inventories, and development of carbon flux estimation models, etc. Also, the analysis methods for such basic phenomena that have influence on evaluation of the characteristics and quality of data such as temporal variation of concentrations and carbon balance distributions are studied. Furthermore, with the GOSAT Project, research on advanced application of the GOSAT/TANSO data, for example, detection of CH_4 leakage from natural gas pipelines or local forest fires, and so forth, is conducted. More details are provided in the succeeding section.

Through the implementation of the RA, the GOSAT Project expects to benefit from the RA research outcomes for developing higher level data products. At the same time, the Project wants to see the research field of data application being further facilitated, and the data acquired by the GOSAT will contribute to resolve the global-warming issues through the effective utilization. Therefore, the GOSAT Project is open and willing to accept new research proposals from all parts of the world.

In this Chapter hereunder is provided a summary of research topics to be or to have been carried out in the GOSAT Project. It is anticipated that a large number of research themes, that will supplement the research topics of the GOSAT Project, that will utilize the applicant's own validation data, or that are based on very original and unprecedented perspectives, will be proposed.

12.1 Research Topics conducted or targeted by the GOSAT Project

1) Calibration
   The calibration-related research topics conducted or targeted by the GOSAT Project include calibration (including wavelength calibration) when interferogram is transformed into spectra, calibration in relation to correction of the variation of the observation sensors' field of view, instrument function calibration, radiance calibration, etc. as for TANSO-FTS, and radiometric calibration, geometric correction, calibration of the sensor sensitivity, etc. as for TANSO-CAI.

2) Data processing algorithms
   The processing algorithm-related research topics conducted or targeted by the Project include development of fast data processing algorithms, sunglint observation data processing methods, processing algorithms using polarized data, and algorithms to extract parameters from thermal-infrared data, evaluation of spectral parameters of gaseous molecules and sunlight spectra, combined use of short wavelength infrared and thermal infrared data, etc.

3) Carbon flux estimation, atmospheric transport models
   The model-development-related research topics conducted or targeted by the Project include development and refining of source inventory databases, refining of atmospheric transport and land ecosystem models, etc., development of carbon flux estimation models with high temporal/spatial resolution, etc.

4) Validation

*Before the launch

The research topics targeted by the GOSAT Project included validation by ground-based high-resolution and by small-sized FTSs with airborne in-situ instruments, evaluation of sunglint observation algorithms using airborne or ground-based FTSs, development of validation methods based on data taken by LIDAR, sky radiometers or other equipment for validating aerosol, etc.

*After the launch

The research topics conducted or targeted by the GOSAT Project include acquisition and analytical validation of data taken at validation sites on land and on ocean (including island and cape), analytical validation of data taken by instruments on board private aircraft, comparison with data taken by other satellites or computed by models, etc., for the purpose of validating the quality of data on the CO_2 and CH_4 column abundances, as well as validating the quality of data on vertical distributions of CO_2 and CH_4 concentrations to be derived from the thermal-infrared data. Validation of CAI data products is also included.

5) Data application

FTS: The research topics conducted or targeted by the Project include analysis of basic phenomena that have influence on evaluation of the characteristics and quality of data such as temporal/spatial variation of concentration distributions and carbon balance distributions, possible advanced applications, such as detection of CH_4 leak from pipelines, local high-volume exhaust due to forest fires and detection of the fluorescence from vegetation, possibility of observing atmospheric trace components, such as N_2O, CFC, etc., and so on.

CAI: Generation and utilization of the global vegetation index map based on the CAI data, and others.

12.2 Expected Research Topics to be proposed in the RA

1) Calibration
2) Data processing algorithm
3) Carbon balance estimation, atmospheric transport models
4) Validation
5) Data application

13. Schedule

13.1 1st Announcement

Release of RA	April 7, 2008
Deadline for submission of proposals	July 7, 2008
Notification of the selection results	August 29, 2008
Sign up of the agreement	August 30, 2008 and later
PI meeting/workshop	November 5-7, 2008
Launch of GOSAT	January 23, 2009
Submission of interim reports	December 28, 2009

13.2 2nd Announcement

Release of RA	April 7, 2009
Deadline for submission of proposals	June 1, 2009 for RA* users
	June 23, 2009 for RA+ users
Notification of the selection result	July 31, 2009 for RA* users
	August 28, 2009 for RA+ users
Sign up of the agreement	August 3, 2009 or later for RA* users
	August 31, 2009 or later for RA+ users
2nd PI meeting/workshop	January 28-29, 2010
Submission of interim reports	September 30, 2010

13.3 3rd Announcement

Release of RA	August 20, 2010
Deadline for submission of proposals	October 29, 2010
Notification of the selection result	January 31, 2011
Sign up of the agreement	February 1, 2011 and later
3rd PI meeting/workshop	May 19-20, 2011
Submission of interim reports	March 1, 2012

13.4 4th Announcement (Current Announcement)
(Memos bracketed are the principle for RAs following the 4th RA)

Release of RA	August 31, 2012

[See * for the 5th and following RAs.]

Period for proposal acceptance	August 31, 2012 ~ October 26, 2012*

[More than 50 days shall be secured for this period in principle.]

Evaluation Period	August 31 ~ November 11, 2012

[Evaluation is, in principle, completed within the period between the release of RA and until two weeks after proposal submission due.

Date of the selection board	November 16, 2012

[After the evaluation, the selection board is held in the RA committee meeting.]

Notification of the selection result	November 30, 2012

[Notification is made in a prompt manner.]

Sign up of the agreement	December 3, 2012 and later

[The Three Parties and the RO of the PI whose research proposal was accepted shall execute the contract. If the PI does not belong to any organization, the PI shall execute the contract instead.]

 Submission of interim reports   December 28, 2013

[In principle, the first interim report shall be submitted within one year after the acceptance of the proposal.]

* Applications and research proposals are always invited - even after October 26, 2012. Schedules for the fifth RA and all of following RAs will be posted on the NIES GOSAT Project website in an appropriate timing.

   In case no proposal is submitted or no proposal is selected during the above period, the Three Parties will continue to invite research proposals under the ongoing RA instead of making a new announcement. For example, if no research proposal is submitted in response to the fourth RA, the Three Parties will carry the selection board over to the next RA committee meeting and continue to invite research proposals under the fourth RA. The schedule revised by adjustment will be publicized via the NIES GOSAT Project website or other appropriate means.

14. Contact Information

GOSAT RA Office
Center for Global Environmental Research (CGER)
National Institute for Environmental Studies (NIES)
16-2 Onogawa, Tsukuba-shi, Ibaraki
305-8506 Japan

TEL: 81-29-850-2966 (Japanese)
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