Global Change Observation Mission: 
Third Research Announcement

GCOM-W1 Research
*Algorithm development, validation, and application research*

Multi-Sensor Research
*Algorithm development and application research*

Issued: January 21, 2011
Proposal Due: March 25, 2011

Earth Observation Research Center
Japan Aerospace Exploration Agency
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1. Introduction

1.1 About the Third Research Announcement

In this third Global Change Observation Mission (GCOM) research announcement (RA), the Japan Aerospace Exploration Agency (JAXA) is announcing the opportunity to conduct algorithm development, validation, and application research for the first satellite of the GCOM-W (Water) series, GCOM-W1, as well as multi-sensor research mainly using data from GCOM-W1. The target launch years are Japanese fiscal years (JFY) 2011 and 2014 for GCOM-W1 and the first satellite of the GCOM-C (Climate) series (GCOM-C1), respectively. This RA covers 3-year research period beginning in early JFY 2011.

1.2 Global Change Observation Mission (GCOM)

GCOM seeks to establish and demonstrate a global, long-term satellite observing system to measure essential geophysical parameters for understanding global climate change and the water cycle mechanism, and eventually contribute to improving future climate projections through a collaborative framework with climate model institutions. Demonstrating capabilities of operational applications through the provision of continuous data to operational agencies is another important objective. GCOM will take over the Advanced Earth Observing Satellite-II (ADEOS-II) mission and transition into long-term monitoring of the Earth. To achieve global, comprehensive, long-term, and homogeneous observation, GCOM will consist of three consecutive generations of two satellite types with a 1-year overlap, resulting in a 13-year observation period. The two satellites are GCOM-W and GCOM-C. The GCOM-W1 satellite will carry the Advanced Microwave Scanning Radiometer-2 (AMSR2) to contribute to understanding the water and energy cycle. The GCOM-C1 satellite will be equipped with the Second-generation Global Imager (SGLI) to observe the Earth’s atmosphere and surface, contributing to the understanding of the carbon cycle and radiation budget.

The AMSR2 instrument on board GCOM-W1 is a multi-frequency, dual-polarized, passive microwave radiometer for observing water-related geophysical parameters. AMSR2 is being designed and manufactured based on the experience of the AMSR aboard ADEOS-II and the AMSR for EOS (AMSR-E), which is currently in orbit gathering continuous data. Based on the experiences of the Global Imager (GLI) on board ADEOS-II, the SGLI on GCOM-C1 will have special features, including wide spectral coverage from 380 nm to 12 um, a high spatial resolution of 250m, a field of view exceeding 1000km, two-direction simultaneous observation, and polarization observation. The GCOM-C1 mission aims to contribute to improving our knowledge and prediction of the global carbon cycle and radiation budget through high-accuracy observation of global vegetation, ocean color, temperature, cloud, aerosol, and polar regions through SGLI observations. Details of the GCOM sensor and satellite specification are presented in APPENDIX C.

1.3 Targets of GCOM and its success criteria

The objectives, targets, and success criteria of GCOM are summarized in Tables 1 and 2. This RA solicits research proposals that will lead the mission to success by meeting the success criteria and accomplishing these targets with JAXA.
<table>
<thead>
<tr>
<th>GCOM Objectives</th>
<th>GCOM-C1 Targets</th>
<th>GCOM-W1 Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build a long-term observation system that can observe effective physical parameters (e.g., sea surface temperature, soil moisture, and so on.) continuously for 10 to 15 years to solve the mechanism of global climate change and water cycle, and establish its usability.</td>
<td>Produce and distribute satellite-observed radiance, nine land, eight atmosphere, seven ocean, and four cryosphere products as standard products</td>
<td>Produce and distribute satellite-observed brightness temperatures (Tbs), two land, three atmosphere, two ocean, and one cryosphere products as standard products.</td>
</tr>
<tr>
<td>Improve the prediction accuracy of long-term climate change by improving the process research on the climate-change mechanism and numerical models, and provide information service in support of national policy decisions through cooperation with user organizations that have climate models.</td>
<td>Process and provide satellite data to the Data Integration and Analysis System established by the University of Tokyo, JAMSTEC, and JAXA.</td>
<td>Process and provide satellite data to the Data Integration and Analysis System established by the University of Tokyo, JAMSTEC, and JAXA.</td>
</tr>
<tr>
<td>Establish an Earth-observation satellite system to obtain important physical parameters to assess the global environment and seek integrative use with other observation systems.</td>
<td>Improve the accuracy of climate change prediction by assimilating data and improving model parameters with the cooperation of application research organizations. Through the above activities, confirm the quality of GCOM data and demonstrate its ability to contribute to predicting long-term climate change. Contribute to predicting the global environment response to climate change by observing snow surface temperature, snow grain size, ocean chlorophyll-a concentration, and so on.</td>
<td>Improve short-term prediction accuracy by assimilating data, such as Tbs and water vapor, with the cooperation of application research organizations. Through the above activities, confirm the quality of GCOM data and demonstrate its ability to contribute to predicting long-term climate change. Contribute to predicting the global environment response to climate change by observing sea ice concentration, snow cover, sea surface temperature, and so on.</td>
</tr>
<tr>
<td>Contribute directly to operational fields, such as predicting intense weather that may bring disasters by distributing data to operational organizations that provide weather forecasts, fishery information service, sea-route information control, etc.</td>
<td>Improve fishery management by providing data to the Japan Fisheries Information Service Center within the required time frame.</td>
<td>Improve accuracy of weather forecast including typhoons, and fishery management by providing data to the Japan Meteorological Agency and the Japan Fisheries Information Service Center within the required time frame.</td>
</tr>
<tr>
<td>Develop new products for effectively clarifying climate change and the water cycle mechanism, which is difficult to do with current analysis technology</td>
<td>Produce five land, three atmosphere, seven ocean, and eight cryosphere research products by cooperating with research and application organizations.</td>
<td>Produce new research products by cooperating with research and application organizations.</td>
</tr>
<tr>
<td>Table 2 GCOM Success Criteria</td>
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<tr>
<td><strong>GCOM-W1</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Success level</strong></td>
<td>Minimum success</td>
<td>Full success</td>
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<tr>
<td>---</td>
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</tr>
<tr>
<td><strong>Assessment condition</strong></td>
<td>Complete calibration and validation phase and start data distribution about 1 year after launch. Achieve release threshold accuracy*2.</td>
<td>Achieve standard accuracies within 5 years after launch.</td>
</tr>
<tr>
<td><strong>Standard product</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Set release threshold/standard/target accuracies)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Research product</strong></td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>(Set only target accuracy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Real-time availability</strong></td>
<td>From the time of achieving the release threshold accuracy until 4 years after launch*3, maintain ability to distribute the data within the required time.</td>
<td>From the time of achieving the release threshold accuracy until 5 years after launch, maintain ability to distribute the data within the required time.</td>
</tr>
<tr>
<td><strong>Continuity</strong></td>
<td>From the time of achieving the release threshold accuracy until 4 years after launch*3, maintain ability to observe and distribute products.</td>
<td>From the time of achieving the release threshold accuracy until 5 years after launch, maintain ability to observe and distribute products.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th><strong>GCOM-C1</strong></th>
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<tr>
<td><strong>Success level</strong></td>
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<td><strong>Assessment condition</strong></td>
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<td><strong>Real-time availability</strong></td>
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<tr>
<td><strong>Continuity</strong></td>
</tr>
</tbody>
</table>

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*1 Standard products are defined as products that are especially important for achieving the mission goal, sufficiently confirm the application reality from ADEOS-II results etc., and are suitable for operational data distribution. Research products are defined as products still in the research phase of development and application, or are unsuitable for operational data distribution.

*2 Release threshold accuracy: Minimum accuracy for release as available for climate research.

*3 Set the period until the GCOM-W2 launch.

*4 This means to obtain observation data continuously during the planned Earth-observation operation period.
1.4 Overview of this RA

JAXA plans to select 30 to 40 proposals under this RA. The principal investigator (PI) of each selected proposal will become a member of the GCOM-W1 science team or GCOM-C1 science team depending on the contents of the proposal. The PIs will conduct their research, such as algorithm development and application study, with the cooperation of members of the Earth Observation Research Center (EORC), and must attend and present their status at PI workshops held once a year. The science team leaders will participate in the GCOM Advisory Committee to feed back the science team activities to the GCOM overall objectives and mission requirements.

Selected PIs will be able to receive prioritized distribution of GCOM data and related information during the calibration and validation phase, as well as to use JAXA owned Earth observation satellite data and in-situ measurement data free of charge. In this RA, JAXA will give budget allocation priority to the areas of GCOM-W1 algorithm development and validation, to meet the release threshold accuracy of GCOM-W1 standard products and to accomplish the minimum success criteria within a year of its launch. Although it will depend on the budget situation, JAXA plans to spend 80 million yen each year in total of this RA period. JAXA may also select non-funded PIs for pure application research and research not highly relevant to GCOM mission success criteria. All categories of domestic and foreign organizations with nonprofit and peaceful purposes, except students, may apply under this RA. However, funding may differ for each research category and applicant. Funding by JAXA is restricted to domestic PIs, although some exceptions may be made for research necessary to realize GCOM mission success. Proposals will be selected based on a peer-review process and discussions in science/project evaluation boards. JAXA plans to announce the selection results in May 2011.
2. Technical descriptions

2.1 Purposes of this RA

To meet the mission objectives of GCOM, which are to understand global environment variation and to improve its prediction accuracy, this RA seeks to utilize the research results of the first RA for GCOM-W1 and related AMSR-E studies, and to conduct effective research necessary to generate global, long-term, and highly accurate and stable GCOM products, as well as to demonstrate global change research using those products by inviting research themes with new knowledge and science from both domestic and overseas scientists.

2.2 Research areas

JAXA seeks proposals in the following research areas:

- GCOM-W1 research: algorithm development, validation, and application research
- Multi-sensor research: multi-sensor algorithm development and application research

As noted in the previous section, JAXA will give budget priority to the areas of GCOM-W1 algorithm development and validation, since the research period of this RA will include the GCOM-W1 launch and the first data release. Details are listed below.

2.2.1 GCOM-W1 research

2.2.1.1 Algorithm development

JAXA seeks proposals for developing standard and research algorithms to produce GCOM-W1 products. As described in Chapter 5, research themes in standard algorithm development will be implemented under the “Commissioned Research Agreement (Funded),” and research themes in research algorithm development under the “Collaborative Research Agreement (Funded/Non-funded),” in principle.

(1) Standard algorithm development

In this category, JAXA seeks proposals on implementation and improvement of the standard algorithms, which will be used for processing GCOM-W1 standard products after launch. In principle, to utilize the existing results of the first RA directly, proposals from applicants whose algorithms were selected as the standard algorithm after launch through the first RA research activity will continue to be selected. Selected PIs and JAXA will work together in evaluating, implementing, and validating the algorithms, as well as in preparing the algorithm theoretical basis document (ATBD) and validation plans.

The GCOM-W1 standard products and their expected accuracies, which are defined in the mission success criteria, are listed in Table 6 of APPENDIX C. These accuracies were defined in consultation with data users based on the experience and performance of the AMSR and AMSR-E products. The “data release threshold” accuracy denotes the minimum accuracy for the first data release, the “standard” accuracy is defined as the valuable and standard accuracy, and the “goal” accuracy includes many challenges in improving algorithm performance and/or calibration accuracy and is to be achieved on a research basis. The standard algorithms are required to produce standard products that meet the accuracy requirements in Table 6 of APPENDIX C; particularly, those that meet the release threshold accuracy during this RA research period to accomplish the minimum success. Therefore, concrete methods and expectancy of validation must be clearly documented. To meet the GCOM objectives, retrieval algorithms will require global applicability, robustness, and long-term...
stability. Algorithms that can be extended and applied to similar microwave radiometers and historical data records are preferable for integrated retrieval. Computationally efficient, fast-processing algorithms are important for the operational applications of the products.

(2) Research algorithm development

Research algorithms will include a new algorithm to produce standard products with further improved accuracy, and ones to produce research products. The former ones have the potential to be selected as standard algorithms at the time of product revision through the inter-comparison study with other algorithms. Therefore, the research needs to be carried out with the goal accuracy in mind. Other preferable characteristics are the same as those of standard algorithms. Regarding the latter ones, once after the proposed products are selected as research products, those research products will have the potential to be candidates of new standard products. Current candidates of research products are listed below. Research products are not limited to those listed below if new research products of great significance are proposed.

- **Ocean**
  Retrieve all-weather sea surface wind speed under severe weather such as typhoons, by utilizing the AMSR2 lower frequency channels at 7- and 10-GHz frequency bands.

- **Land**
  Produce spatially and temporally homogeneous products by assimilating AMSR2 information into land-hydrology models. Also produce cloud-through land parameters such as land surface temperature, vegetation water content, and vegetation indices by utilizing the characteristics of microwave radiometry.

- **Atmosphere**
  Detection and retrieval of solid precipitation in a cold zone remain an issue using information from the AMSR2 frequency range. Further improvements are necessary in cold zones to complement the current standard products, of which accuracy is defined in tropical to temperate zones.

- **Cryosphere**
  In addition to sea ice extent and concentration, thin sea ice information is valuable from the viewpoint of the heat and energy exchange between ocean and atmosphere as well as ocean circulation. Identify thin ice areas, and further estimate sea ice thickness from the AMSR2 brightness temperatures. Sea ice motion provides information valuable to understanding the mechanism of sea ice advance and retreat, and to the navigation of vessels. Perform accurate sea ice motion retrieval regardless of seasons and sensor characteristics.

2.2.1.2 Validation

JAXA seeks proposals contributing to the validation of standard and research products and to the acquisition of basic datasets, which are necessary to improve algorithms. It is also expected to feed back the validation results to improve AMSR2 calibration. Regarding the field campaign and experiments, obtaining both effective validation results and scientific outputs by collaborating with other research programs is expected. Particularly, in-situ measurements and validation studies of geophysical parameters, for which obtaining the global and operational validation dataset is difficult, are highly desired as indicated below.
- **Land**
  Test sites to obtain validation data such as soil moisture and meteorological measurements will be established and maintained in the Mongolian plateau (semi-arid area), north-east Thailand (humid area), and the Murray-Darling basin in Australia (humid to arid area). JAXA seeks proposals which will actively participate in these validation efforts.

- **Atmosphere**
  JAXA seeks proposals to validate precipitation product by utilizing operational observation data such as ground-based rain radars. For the validation of cloud liquid water, cooperation with other research projects which can provide us validation data, and the research on quantitative validation by comparing with other satellite observations are expected.

- **Cryosphere**
  In addition to ongoing in-situ measurements of snow depth at Yakutsk site in Russia, cooperation with research projects, in which snow pit observations are being conducted under a variety of snow condition, is expected. For sea ice validation, cooperation with research projects operating research vessels in various sea areas, as well as validation using high spatial resolution satellite images, are expected.

To apply for improving the algorithms, obtained in-situ data and knowledge need to be provided to JAXA. Furthermore, JAXA intends to open these in-situ data to the public, after consulting with the PIs about their disclosure level and release timing. Proposals including both algorithm development and validation can be submitted to the category of algorithm development.

As described in Chapter 5, the research themes in this category will be implemented under the “Collaborative Research Agreement (Funded/Non-funded),” in principle.

### 2.2.1.3 Application research

JAXA seeks research themes aiming to understand global environment changes and improve prediction accuracy using AMSR2 and existing datasets, such as the Special Sensor Microwave/Imager (SSM/I) and the AMSR-E, as well as research themes that contribute to satisfying societal needs, such as monitoring severe weather and water-related hazards, ocean environment monitoring, and agricultural applications. Research themes based on new concepts or needs, and new research and products resulting from the fusion of numerical models are preferable.

As described in Chapter 5, the research themes in this category will be implemented under the “Collaborative Research Agreement (Non-funded),” in principle.

### 2.2.2 Multi-sensor research

JAXA seeks multi-sensor research proposals, particularly those mainly using data from GCOM-W1. They include multi-sensor algorithm development to create new products and application research utilizing variety of sensor information. Examples of expected multi-sensor combinations are listed below, but are not limited to them:
- **GCOM-W1 and GCOM-C1**
  Multi-sensor research is highly expected for GCOM-W1 and GCOM-C1, since the contribution of GCOM to climate and water cycle change research is done through comprehensive utilization of both datasets. In research directly combining both datasets, some models or objective analysis methods may be used to consider the differences of satellite orbits and observing local times.

- **GCOM-W1 and A-Train constellation**
  To continue obtaining the AMSR-E type data and to produce further scientific results from AMSR2 through multi-sensor research using other satellites and sensors, GCOM-W1 will participate in the A-Train constellation, which is being led mainly by the National Aeronautics and Space Administration (NASA) and the Centre National d’Etudes Spatiales (CNES). Therefore, multi-sensor proposals to fully utilize the AMSR2 data are expected. Participating A-Train platforms, which fly contiguously in formation, enable the synchronized observation of various observing instruments. Various combinations and science are expected, such as research on clouds and precipitation systems and their interaction with aerosols using cloud radar/lidar, visible and infrared radiometers, infrared and microwave sounders. This also includes research on merged sea surface temperatures and atmosphere-ocean interaction using visible and infrared radiometer and infrared sounders, as well as the improvement of land and cryospheric products using high-resolution visible and infrared observations. Observation data of the A-Train satellites are available from respective development and operating agencies.

- **GCOM-W1 and JAXA Earth environmental observing satellites**
  Some of JAXA’s Earth environmental observing satellites including the Tropical Rainfall Measuring Mission (TRMM), the Greenhouse gases Observing SATellite (GOSAT), the Global Precipitation Measurement (GPM), and the Earth Clouds, Aerosols and Radiation Explorer (EarthCARE), have the potential to overlap in the observation period with GCOM-W1. JAXA seeks multi-sensor proposals to fully utilize the GCOM-W1 observations and effectively combine them with those JAXA missions. GCOM-W1 will also undertake a role as a constellation satellite of GPM mission.

In principle, the research themes in this category will be implemented under the “Collaborative Research Agreement (Funded/Non-funded)” for multi-sensor algorithm development, and the “Collaborative Research Agreement (Non-funded)” for multi-sensor application research, as described in Chapter 5.

All applicants should keep in mind that JAXA is not a general funding body for the scientific community. This RA seeks to accomplish the GCOM mission goals and to find new possibilities for utilizing GCOM data. Proposals should clearly describe plans for GCOM data usage.
3. Instructions for responding to this RA

3.1 Qualifications

If the proposal is for peaceful purposes and has non-commercial objectives, researchers from all categories, except students, of domestic and foreign organizations, including educational institutions, government offices, public companies, private enterprises, and other groups can apply for this RA.

3.2 Research agreement conclusion

After the proposals are selected, a research agreement should be made between JAXA and the organization to which the PI belongs, using associated terms and conditions to be prepared by JAXA. In principle, the associated terms and conditions of research agreements attached in APPENDIX D will be used. However, JAXA may coordinate with a PI to use a standard contract document depending on the contents of the proposal and its research phase. All applicants should read Chapter 5 carefully, which describes detailed information on contract matters and the associated terms and conditions of the research agreement in APPENDIX D.

3.3 Research period

The total research period of this RA will be 3 years from JFY 2011. However, performance will be evaluated based on an interim report at the end of each JFY to verify and decide whether the research is to be continued the following year.

3.4 Resources

(1) Funding

JAXA will reserve funds to support selected proposals. The basic policy for funding is as follows:

A) Based on the purpose of this RA, funding will be mainly available for GCOM-W1 algorithm development and validation, within JAXA’s budget limitation. Proposals submitted to other areas may be funded if they provide a substantial contribution to the GCOM mission.

B) JAXA funding is basically restricted to domestic PIs, although some exceptions may be made for research that is necessary to the success of the GCOM mission.

C) JAXA funding is restricted to the direct cost of research (“Direct Cost”) and does not cover any overhead costs, indirect costs, general costs, or whatsoever (“Overhead Cost”) of the organization to which an applicant belongs. However, if this is impossible or requires special procedures, an applicant may fill in the provided remarks column of the Resource Requirement (APPENDIX B) as such.

D) If funding is not available for an applicant, the applicant may be selected as a non-funded PI upon consultation with JAXA.

(2) Earth observation satellite data by JAXA

Earth observation satellite data necessary for conducting research and owned by JAXA will be provided free of charge within the limitations of the distribution capability of JAXA. Available data are listed in APPENDIX B. Those who receive Earth observation satellite data shall comply with the terms and conditions described in the chapter titled “Providing of Earth Observation Satellite Data by JAXA” in the research agreement.
3.5 Obligations

PIs have different obligations depending on their funding status.

(1) **Funded** PIs shall submit to JAXA a yearly report on the results at the end of each JFY and a final report at the end of the entire research period. Furthermore, funded PIs are required to participate in the workshop organized by JAXA once a year and present a status report. PIs must cover necessary travel expenses to participate in the workshop within the funds provided by this RA.

(2) **Non-funded** PIs shall also submit a yearly report and a final report. However, such reports can be substituted with papers published during the term. Participation in the workshop is highly recommended. Support of travel expenses will be decided by JAXA on a case-by-case basis depending on the research content, results, and its progress.

3.6 Selection

Selection of proposals will be based on a peer-review process and discussions in science/project evaluation boards. JAXA selection officials make the final decisions. The principal elements considered in evaluating a proposal are its relevance to the objectives, intrinsic merit, and cost. Evaluation of its intrinsic merit includes consideration of the following equally important factors:

(1) Overall scientific and technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal

(2) Proposer’s capabilities, related experience, facilities, techniques, or unique combinations of these that are integral factors for achieving the proposal objectives

(3) Qualifications, capabilities, and experience of the proposed PI and CI

(4) Overall standing among similar proposals and/or evaluation against the state-of-the-art

3.7 Late proposals

Proposals or modifications received after the date specified in this RA may be considered if the selecting official deems them to offer JAXA a significant scientific and/or technical advantage or cost reduction.

3.8 Withdrawal of proposal

Proposals may be withdrawn by the applicant at any time. To withdraw a proposal, the applicant should notify JAXA immediately.

3.9 Cancellation and postponement

JAXA reserves the right to cancel or postpone this RA for reasons of JAXA’s own. In addition, JAXA assumes no liability for canceling this RA or for postponing this RA schedule.
3.10 Important dates

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>January 21, 2011</td>
<td>Third Research Announcement Issued</td>
</tr>
<tr>
<td>March 25, 2011</td>
<td><strong>Proposal Due Date</strong></td>
</tr>
<tr>
<td>May 2011</td>
<td>Notification of Selection Results</td>
</tr>
</tbody>
</table>

3.11 Proposal submission and contact point

Proposals with complete sets of attachments, such as reprints of papers, should be converted to **PDF (Portable Document Format) and sent via E-mail** to the GCOM RA Office. The maximum file size acceptable by E-mail is **10 MB**.

GCOM RA Office E-mail address: GCOM_RA@jaxa.jp

In case of difficulty sending via E-mail, five copies each of the proposal and the complete set of attachments should be sent via postal mail to:

GCOM RA Office
Earth Observation Research Center (EORC)
Tsukuba Space Center
Japan Aerospace Exploration Agency
2-1-1 Sengen, Tsukuba, Ibaraki, 305-8505, Japan

The point of contact is:

GCOM RA Office
Earth Observation Research Center
Tel: +81-50-3362-6529
Fax: +81-29-868-2961
E-mail address: GCOM_RA@jaxa.jp
4. Instructions for proposal contents

4.1. General

(1) Proposals received in response to this RA will be used only for evaluation purposes.

(2) The following types of proposals are not acceptable:

A) Proposals that include restrictions from other institutions or have the potential to infringe on third-party rights

B) Proposals that are restricted when distributed or published

(3) Proposals will not be returned to applicants.

4.2. Format

(1) It is highly recommended that applicants send their proposals and complete sets of all attachments, such as reprints of papers, in PDF via E-mail.

(2) Forms for the cover sheet, work plan, effort allocation, and resource requirements can be found in APPENDIX A and APPENDIX B. Only the following formatting is mandatory in other parts of the proposal:

A) The page or paper size should be A4 or letter size.

B) The page number must appear at bottom center of each page, and the name of the applicant must appear in the upper right corner.

C) Proposals should be word-processed documents in either English or Japanese, with a font size no smaller than 12 points.

(3) Proposals should be brief and to the point, concentrating on substantive material. The main body of the proposal should not exceed 20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments must accompany each copy of a proposal when submitting via postal mail.

4.3 Proposal contents

(1) Cover sheet

A) Research title

State your research title precisely and clearly. The title should be brief, reflecting an especially valid project intelligible to a science-literate reader and suitable for use in the public process.

B) Research category

Choose a relevant category to which the proposal belongs.

C) Information of applicants

- Identifying information of the PI

  State the name, job title, organization, address, E-mail address, and telephone and facsimile numbers of the PI.

- Identifying information of the Co-investigator

  State the name, organization, telephone number, and E-mail address of each Co-investigator (CI).

  One research team should consist of only one PI, or one PI and several CIs.

D) Budget

Provide a budget broken down by year and the total amount in Japanese yen.

E) Endorsement

Provide a signature of a responsible official or authorized representative of the proposing organization.
(2) Abstract
Include a concise, one-page abstract describing the objective, significance, method of approach, and anticipated results.

(3) Description of proposal
This is the main body of the proposal and should not exceed 20 pages. This main body shall be a detailed statement of the work to be undertaken, including its objectives and significance, relation to the present state of knowledge, and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experiment methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the RA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(4) Work plan (Research schedule)
The research schedule should be outlined in the form indicated in APPENDIX A.

(5) Effort allocation
Provide effort allocation for currently proposed and/or ongoing research funding including those of other JAXA satellite projects. Include the name of research funding, period, research title, role, budget, and difference from the present proposal in the form in APPENDIX A. The effort allocation should be provided with a percentage of time allocation (%) necessary for implementing each research activity (assuming the entire yearly working time as 100%) for the research period of this RA.

(6) Management approach
For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(7) Personnel
A) Biographical information, experience, papers in related fields
A short biographical sketch, a list of publications, experiences related to this RA, and professional qualifications of the PI should be included. Also provide similar biographical information on each CI.
B) Role of CI
The PI is responsible for supervising the work and the CIs in the research. State each CI’s role in the proposed research.

(8) Resource requirements
Resource requirements should be described in the form indicated in APPENDIX B. Information regarding required resources will be considered during the selection process. After deciding the total amount of funding for each PI, JAXA will send detailed forms for resource requirements to selected PIs for the final adjustment of funding. Before the beginning of each subsequent year, JAXA will send the same forms for resource requirements again. Instructions for the budget summary and data request are also included in APPENDIX B.
5. Description of research agreement

5.1 Contractual procedure

(1) After selecting the proposal and the PI, JAXA will send the PI guidelines and an application
form for making an agreement. Please note that JAXA will make an agreement with the
organization to which the PI belongs (“the Organization”), not to the PI or CI.

(2) A research agreement will be made using associated terms and conditions, such as those in
APPENDIX D. The Organization should submit the application form with the necessary
documents according to the guidelines by the submission due date. Submission of the
application form will be regarded as definite intention of making an agreement with JAXA
in accordance with the terms and conditions as stipulated in APPENDIX D, and the
agreement will be effective upon issuance of the confirmation sheet by JAXA.

(3) If JAXA determines that extension of a research project is qualified by the interim report at
the end of the JFY, the research agreement will be extended for 1 year, and up to March 31,
2014. Funded organizations should submit the continuing agreement application form to
JAXA at the beginning of every JFY.

(4) Organizations shall comply with the terms and conditions defined in the research
agreement.

(5) JAXA may coordinate to make an agreement with the Organization using JAXA’s standard
contract document if JAXA thinks it appropriate in consideration of the research content
and phase.

5.2 Research agreement summary

There are two types of research agreements based on the applicable category of research: a
Commissioned Research Agreement and a Collaborative Research Agreement. There are also
two types of Collaborative Research Agreement: funded by JAXA and not funded.

(1) Commissioned Research Agreement (Funded)

- In principle, the Commissioned Research Agreement will be applied to research in the
“GCOM-W1 algorithm development (standard algorithm)” category. The Organization shall
conduct the research according to the Statement of Work provided by JAXA.

- JAXA will provide the necessary funds and Earth observation satellite data to the Organization to
conduct the research as described in the Statement of Work.

- JAXA will own the research results required to be delivered by the Statement of Work
(Deliverable Research Results).

- JAXA will retain royalty-free rights to use research results other than the Deliverable Research
Results only for its own research and development purposes.

- In the event JAXA provides prior written consent, the Organization may use the Deliverable
Research Results for its own research and development purposes.

- If the Agreement is terminated, the Organization will refund to JAXA any unexpended research
funds that have already been paid by JAXA.

- JAXA will adjust the amount of the research funds based on a fiscal financial statement at the end
of a year-on-year contract.
(2) Collaborative Research Agreement (Funded/Non-funded)
- In principle, the Collaborative Research Agreement will be applied to research in a category “other than” GCOM-W1 algorithm development (standard algorithm).
- JAXA will provide the necessary funds (for funded cases) and Earth observation satellite data to the Organization to conduct the research.
- In principle, the research results will be jointly owned by the parties.
- JAXA will retain the right to use all results including results belonging to the Organization (if any), and the Organization will retain the right to use jointly-owned research results only for its own research and development purposes, without prior consent by the other party.

The difference between a funded agreement and non-funded agreement:

- Collaborative Research Agreement (Funded)
  JAXA provides part of the research funds and the Earth observation satellite data. JAXA adjusts the amount of the research funds based on a fiscal financial statement at the end of a year-on-year contract. The Organization shall submit an interim report and a final report to JAXA, and shall participate in the workshops to report research progress. If this agreement is canceled or terminated, the Organization shall refund to JAXA any unexpended funds that have already been paid by JAXA.

- Collaborative Research Agreement (Non-funded)
  JAXA provides the Earth observation satellite data. The Organization shall submit an interim report and a final report to JAXA. However, such reports can be substituted with papers published during the research term. Participation in the workshops is highly recommended.

(3) Publication of results
A PI who wishes to release his or her research results derived from these research activities to a third party shall

- Provide JAXA with a copy of the publication before release and obtain JAXA’s consent,
- State in the publication that the results are obtained in this RA research, and
- Grant JAXA an irrevocable and royalty-free right to use the provided publications, unless an academic society responsible for its publication requires the PI to transfer the copyright to it.
APPENDIX A
PROPOSAL COVER SHEET AND SCHEDULE
Proposal No.  
(Leave Blank for JAXA Use)  

Title  

Research category (check one)  
GCOM-W1: □ Algorithm (Standard) □ Algorithm (Research) □ Validation □ Application  
Multi-Sensor: □ Algorithm □ Application  

Principal Investigator  
Name  
Job Title  
Department  
Institution  
Address  
Country  
E-mail  
Telephone  
Facsimile  

Co-Investigator  
Name  
Institution  
Telephone  
E-mail  

Budget (yen in thousands) (Direct Cost only)  

<table>
<thead>
<tr>
<th>JFY2011</th>
<th>JFY2012</th>
<th>JFY2013</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Leave Blank for JAXA Use)  

Authorizing Official:  
(Name and Title)  
(Institution)
### Research Schedule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>JFY</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
<td>4-6</td>
<td>7-9</td>
<td>10-12</td>
<td>1-3</td>
</tr>
<tr>
<td>Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Application for Research Funding, the Current State of Funding and Effort

<table>
<thead>
<tr>
<th>Funding System e.g., JAXA, JSPS etc.</th>
<th>Research Title (PI name)</th>
<th>Role e.g., PI or CI</th>
<th>Budget (throughout the period) (thousands of yen)</th>
<th>Effort (%)</th>
<th>Differences in Research and Reasons for Additional Application for This Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCOM 3rd RA (JFY2011-13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2) Research Funding to Be Provided

(3) Other activities

<table>
<thead>
<tr>
<th>Total</th>
<th>(Total of the effort in (1), (2) and (3) above)</th>
<th>100 (%)</th>
</tr>
</thead>
</table>

A-4
**BUDGET SUMMARY**

Direct Cost only

1. Personnel Expenses

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

2. Purchases

2.1 Computers / Peripheral Equipment

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

2.2 Software

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

2.3 Expendable Materials and Supplies

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

3. Subcontracts

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>
4. **Travel Expenses** (unit: days / times or days / travelers)

<table>
<thead>
<tr>
<th>Departure Point – Destination</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
</table>

5. **Observation Equipment** (unit: yen in thousands)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

6. **Satellite Data** (unit: yen in thousands)

<table>
<thead>
<tr>
<th>Name of Satellite / Sensors</th>
<th>Distributor</th>
<th>Purpose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2011</td>
</tr>
</tbody>
</table>

7. **Other Data** (unit: yen in thousands)

<table>
<thead>
<tr>
<th>Name of Data Sets</th>
<th>Distributor</th>
<th>Purpose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2011</td>
</tr>
</tbody>
</table>

8. **Others** (unit: yen in thousands)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

**TOTAL** (unit: yen in thousands) (Except “4. Travel Expenses”)

* Remarks “Overhead Cost” (q.v. 3.4(1)C) of this RA *

Please check either of the following boxes:

- □ Unnecessary
- □ Deductible with special procedures (e.g. submission of certain application form from JAXA)
- □ Indispensable (Reason(s): )
# BUDGET SUMMARY (EXAMPLE)

## 1. Personnel Expenses

<table>
<thead>
<tr>
<th>Personnel Expenses</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Part-time job for DSD data analysis</em></td>
<td>320 (40x8)</td>
<td>320 (40x8)</td>
<td>160 (20x8)</td>
<td>800 (100*8)</td>
</tr>
</tbody>
</table>

## 2. Purchases

### 2.1 Computers / Peripheral Equipment

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

### 2.2 Software

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

### 2.3 Expendable Materials and Supplies

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

### 3. Subcontracts

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>
### 4. Travel Expenses (unit: days / times or days / travelers)

<table>
<thead>
<tr>
<th>Departure Point – Destination</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo - Washington, D.C.</td>
<td>7/2</td>
<td>7/1</td>
<td></td>
</tr>
<tr>
<td>Tokyo - Paris</td>
<td>5/1</td>
<td></td>
<td>8/1</td>
</tr>
<tr>
<td>Tokyo - Paris</td>
<td></td>
<td></td>
<td>6/1</td>
</tr>
<tr>
<td>Tokyo - Osaka</td>
<td>3/1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 5. Observation Equipment (unit: yen in thousands)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro Rain Radar</td>
<td>1,500</td>
<td></td>
<td></td>
<td>1,500</td>
</tr>
</tbody>
</table>

### 6. Satellite Data (unit: yen in thousands)

<table>
<thead>
<tr>
<th>Name of Satellite / Sensors</th>
<th>Distributor</th>
<th>Purpose</th>
<th>Cost</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

### 7. Other Data (unit: yen in thousands)

<table>
<thead>
<tr>
<th>Name of Data Sets</th>
<th>Distributor</th>
<th>Purpose</th>
<th>Cost</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

### 8. Others (unit: yen in thousands)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
</table>

**TOTAL (unit: yen in thousands)**

(Except “4.Travel Expenses”)

|                  | 2,342 | 1,987 | 941  | 5,270 |

B-5
1. JAXA-Archived Satellite Datasets
   (ADEOS, JERS-1, ERS, MOS, LANDSAT, TRMM, Aqua, ADEOS-II, ALOS)

<table>
<thead>
<tr>
<th>Name of Satellite / Sensor</th>
<th>Quantity (scenes)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B.1 Instructions for budget summary

Provide a budget summary by cost element (Personnel Expenses, Computers/Peripheral equipment, Software, Expendable Materials and Supplies, Subcontracts, Travel Expenses, Observation Equipment, Satellite Data, Other Data, and Others), sorted by Japanese fiscal year as in the example attached to this form. An annual summary budget should also appear on the last line.

(1) Personnel expenses
Enter expenses for part-time workers here as the total cost calculated by multiplying the unit cost per day by the number of days. For part-time workers, use your own cost estimates.

(2) Computers/peripheral equipment/software
Enter the lease and rental cost of computers and/or peripheral equipment. Note that JAXA has the right to change specifications of all equipment. Also enter the cost of software here.

(3) Expendable materials and supplies
Enter the quantity of each item, following the example.

(4) Subcontracts
Provide the cost of subcontracts to outside companies or organizations here.

(5) Travel expenses
Describe the proposed domestic and/or international travel including information on destination and number of days/number of times (or travelers).

(6) Observation equipment
Enter costs of observation equipment including installation cost.

(7) Satellite data
Investigators requesting satellite data other than JAXA-owned or archived data (listed in the next section) should provide cost information here.

(8) Other data
Enter costs for data other than satellite data.

(9) Others
Enter costs for publication and others here.

B.2 Instructions for data requirements

JAXA-owned satellite data are listed below. JAXA will provide requested data judged necessary for the proposed research, subject to availability of data processing.

- Marine Observation Satellite (MOS) (only around Japan)
- LANDSAT (only around Japan)
- European Remote-sensing Satellite (ERS)-1, 2 (only around Japan; for Japanese researchers only; available until JFY2002)
- Japanese Earth Resources Satellite (JERS)-1 (global)
- Tropical Rainfall Measuring Mission (TRMM)
- Advanced Earth Observing Satellite (ADEOS)
- Advanced Microwave Scanning Radiometer for EOS (AMSR-E) aboard EOS-Aqua satellite
- Advanced Earth Observing Satellite-II (ADEOS-II)
- Advanced Land Observing Satellite (ALOS) (10 scenes from JAXA archives)

APPENDIX C
OVERVIEW OF THE GLOBAL CHANGE OBSERVATION MISSION (GCOM)
1. Introduction

Comprehensive observation, understanding, assessment, and prediction of global climate change are common and important issues for all mankind. This is also identified as one of the important socio-economic benefits by the 10-year implementation plan for Earth Observation that was adopted by the Third Earth Observation Summit to achieve the Global Earth Observation System of Systems (GEOSS). International efforts to comprehensively monitor the Earth by integrating various satellites, in-situ measurements, and models are gaining importance. As a contribution to this activity, the Japan Aerospace Exploration Agency (JAXA) plans to develop the Global Change Observation Mission (GCOM). GCOM will take over the mission of the Advanced Earth Observing Satellite-II (ADEOS-II) and develop into long-term monitoring of the Earth.

As mentioned in the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), warming of the climate system is unequivocal as is now evident from observations of increases in global average air and ocean temperatures and widespread melting of snow and ice. However, climate change signals are generally small and modulated by natural variability, and are not necessarily uniform over the Earth. Therefore, the observing system of the climate variability should be stable, and should cover a long term over the entire Earth.

To satisfy these needs, GCOM consists of two medium-size, polar-orbiting satellite series and multiple generations (e.g., three generations) with one-year overlaps between consecutive generations for inter-calibration. The two satellite series are GCOM-W (Water) and GCOM-C (Climate). Two instruments were selected to cover a wide range of geophysical parameters: the Advanced Microwave Scanning Radiometer-2 (AMSR2) on GCOM-W and the Second-generation Global Imager (SGLI) on GCOM-C. The AMSR2 instrument will perform observations related to the global water and energy cycle, while the SGLI will conduct surface and atmospheric measurements related to the carbon cycle and radiation budget. This chapter presents an overview of the mission objectives, observing systems, and data products of GCOM.

2. Mission Objectives

The major objectives of GCOM can be summarized as follows.

- Establish and demonstrate a global, long-term Earth-observing system for understanding climate variability and the water-energy cycle.
- Enhance the capability of climate prediction and provide information to policy makers through process studies and model improvements in concert with climate model research institutions.
- Construct a comprehensive data system integrating GCOM products, other satellite data, and in-situ measurements.
- Contribute to operational users including weather forecasting, fishery, and maritime agencies by providing near-real-time data.
- Investigate and develop advanced products valuable for understanding of climate change and water cycle studies.

Detailed explanations of the objectives are as follows.

(1) Understanding global environment changes
   A) Establish and demonstrate a global, long-term Earth-observing system that is able to observe valuable geophysical parameters for understanding global climate variability and
Contribute to improving climate prediction models by providing accurate values of model parameters.

C) Clarify sinks and sources of greenhouse gases.

D) Contribute to validating and improving climate prediction models by forming a collaborative framework with climate model institutions and providing long-term geophysical datasets to them.

E) Detect trends of global environment changes (e.g., global warming, vegetation changes, desertification, variation of atmospheric constituents, wide area air pollution, and depletion of ozone layers) from long-term variability of geophysical parameters by extracting short-term (three- to six-year) natural variability.

F) Advance process studies of Earth environmental changes using observation data.

G) Estimate radiative forcing, energy and carbon fluxes, and albedo by combining satellite geophysical parameters, ground in-situ measurements, and models.

H) Advance the understanding of the Earth’s system through the activities above.

I) Contribute to an international environmental strategy utilizing the results above.

(2) Direct contribution to improving people’s lives

A) Improvement of weather forecast accuracy (particularly typhoon track prediction, localized severe rain, etc.).

B) Improvement of forecast accuracy for unusual weather and climate.

C) Improvement of water-route and maritime information.

D) Provision of fishery information.

E) Efficient coastal monitoring.

F) Improved yield prediction of agricultural products.

G) Monitoring and forecasting air pollution including yellow dust.

H) Observation of volcanic smoke and prediction of the extent of the impact.

I) Detection of forest fires.

3. Observing Systems

3.1. Overall concept

As mentioned in the previous section, the entire GCOM will consist of two satellite series spanning three generations. However, a budget will be approved for each satellite. Currently, only the GCOM-W1 satellite has been approved for actual development as the first satellite in the GCOM series. Both GCOM-W1 and GCOM-C1 satellites will be medium-size platforms that are smaller than the ADEOS-II satellite. This is to reduce the risk associated with large platforms having valuable and multiple observing instruments. Also, since the ADEOS-II problem was related to the solar paddle, a dual solar-paddle design was adopted for both satellites. To assure data continuity and consistent calibration, follow-on satellites will be launched so as to overlap the preceding satellite by one year. The concept is summarized in Fig. 1.

Japanese Fiscal Year 2011

Launch

GCOM-W1

Launch

GCOM-C1

GCOM-C2

GCOM-W2

GCOM-W3

1-year

Fig. 1. GCOM concept
3.2. **GCOM-W1 and AMSR2 instrument**

Figure 2 presents an overview of the GCOM-W1 satellite; its major characteristics are listed in Table 1. GCOM-W1 will carry AMSR2 as the sole onboard mission instrument. The satellite will orbit at an altitude of about 700km and will have an ascending node local time of 1330, to maintain consistency with Aqua/AMSR-E observations.

![Fig. 2. Overview of GCOM-W1 satellite](image)

**TABLE 1**

**MAJOR CHARACTERISTICS OF GCOM-W1 SATELLITE**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Advanced Microwave Scanning Radiometer-2 (AMSR2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>Sun-synchronous orbit</td>
</tr>
<tr>
<td></td>
<td>Altitude: 700km (over the equator)</td>
</tr>
<tr>
<td>Size</td>
<td>5.1m (X) * 17.5m (Y) * 3.4m (Z) (on-orbit)</td>
</tr>
<tr>
<td>Mass</td>
<td>1991kg</td>
</tr>
<tr>
<td>Power</td>
<td>More than 3880W (EOL)</td>
</tr>
<tr>
<td>Launch</td>
<td>JFY2001 by H-IIA Rocket</td>
</tr>
<tr>
<td>Design Life</td>
<td>5 years</td>
</tr>
<tr>
<td>Status</td>
<td>Phase-D</td>
</tr>
</tbody>
</table>

Figure 1 presents an overview of the AMSR2 instrument in two different conditions. Also, basic characteristics including center frequency, bandwidth, polarization, instantaneous field of view (FOV), and sampling interval are indicated in Table 2. The basic concept is almost identical to that of AMSR-E: a conical scanning system with a large offset parabolic antenna, feed horn cluster to realize multi-frequency observation, external calibration with two temperature standards, and total-power radiometer systems. The 2.0m diameter antenna, which is larger than that of AMSR-E, provides better spatial resolution at the same orbit altitude of around 700km. The antenna will be developed based on the experience gained from the 2.0m diameter antenna for ADEOS-II AMSR except the deployment mechanism. For the C-band receiver, we adopted additional 7.3GHz channels for possible mitigation of radio-frequency interference. An incidence angle of 55 degrees (over the equator) was selected to maintain consistency with AMSR-E. The swath width of 1450km and the selected satellite orbit will provide almost complete coverage of the entire Earth’s surface.
within two days independently for ascending and descending observations.

Fig. 3. Sensor unit of AMSR2 instrument in deployed (left) and stowed (right) conditions.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>MAJOR CHARACTERISTICS OF AMSR2 INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Performance and characteristics</td>
</tr>
<tr>
<td>Center Frequency (GHz)</td>
<td>6.925/7.3</td>
</tr>
<tr>
<td>Bandwidth (MHz)</td>
<td>350</td>
</tr>
<tr>
<td>Polarization</td>
<td>Vertical and Horizontal polarization</td>
</tr>
<tr>
<td>NEAT (K)</td>
<td>&lt; 0.34/0.43</td>
</tr>
<tr>
<td>Dynamic range (K)</td>
<td>2.7 to 340</td>
</tr>
<tr>
<td>Nominal incidence angle (deg.)</td>
<td>55.0</td>
</tr>
<tr>
<td>Beam width (deg.)</td>
<td>1.8</td>
</tr>
<tr>
<td>IFOV (km) Cross-track x along-track</td>
<td>35x62</td>
</tr>
<tr>
<td>Approximate sampling interval (km)</td>
<td>10</td>
</tr>
<tr>
<td>Swath width (km)</td>
<td>&gt; 1450</td>
</tr>
<tr>
<td>Digital quantization (bits)</td>
<td>12</td>
</tr>
<tr>
<td>Scan rate (rpm)</td>
<td>40</td>
</tr>
</tbody>
</table>

3.3. **GCOM-C1 and SGLI instrument**

Figure 4 gives an overview of the GCOM-C1 satellite; its major characteristics are listed in Table 3. GCOM-C1 will carry SGLI as the sole mission onboard instrument. The satellite will orbit at an altitude of about 800km; the descending node local time will be 1030, to maintain a wide observation swath and reduce cloud interference over land.
Fig. 4. Overview of GCOM-C1 satellite

TABLE 3
MAJOR CHARACTERISTICS OF GCOM-C1 SATELLITE

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Second-generation Global Imager (SGLI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>Sun-synchronous orbit</td>
</tr>
<tr>
<td></td>
<td>Altitude: 798km (over the equator)</td>
</tr>
<tr>
<td>Size</td>
<td>4.6m (X) * 16.3m (Y) * 2.8m (Z) (on orbit)</td>
</tr>
<tr>
<td>Mass</td>
<td>2093kg</td>
</tr>
<tr>
<td>Power</td>
<td>More than 4000W (EOL)</td>
</tr>
<tr>
<td>Launch</td>
<td>JFY2014 by H-IIA Rocket</td>
</tr>
<tr>
<td>Design Life</td>
<td>5 years</td>
</tr>
<tr>
<td>Status</td>
<td>Phase-C</td>
</tr>
</tbody>
</table>

The SGLI instrument has two major new features: 250m spatial resolution for most of the visible channels and polarization/multidirectional observation capabilities. The 250m resolution will provide enhanced observation capability over land and coastal areas where the influences of human activity are most obvious. The polarization and multidirectional observations will enable us to retrieve aerosol information over land. Precise observation of global aerosol distribution is a key for improving climate prediction models.

SGLI consists of two major components: the Infrared Scanner (IRS) and the Visible and Near-infrared Radiometer (VNR). An overview of the SGLI instrument is shown in Fig. 5 for the entire radiometer layout, IRS, and VNR components. Also, requirements for sensor performance are listed in Tables 4 and 5. VNR can be further divided into two components: VNR-Non Polarized (VNR-NP) and VNR-Polarized (VNR-P). VNR-NP and VNR-P are the 11-channel multi-band radiometer and the polarimeter with three polarization angles (0, 60, and 120 degrees). VNR-P has a tilting function to meet the scatter angle requirement from aerosol observation. The IRS is an infrared radiometer covering wavelengths from 1µm to 12µm. It consists of short infrared (SWI; 1.05 to 2.21µm) and thermal infrared (TIR 10.8 and 12.0µm) sensors. It employs a scanning mirror system with a 45-degree tilted flat mirror rotating continuously to realize an 80-degree observation swath and calibration measurement in every scan.

Through intensive discussions and optimizing studies, the number of SGLI channels was decreased from the 36 channels of GLI aboard ADEOS-II to 19 channels, while the number of SGLI standard products will increase compared to those of GLI.
TABLE 4
SGLI MAJOR PERFORMANCE REQUIREMENTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
</table>
| Spectral Bands                      | VNR-NP : 11CH 380-865nm  
VNR-P : 2CH 673.5, 868.5nm / 0, 60, 120deg Polarization  
IRS SWI : 4CH 1.05-2.21µm  
IRS TIR : 2CH 10.8, 12.0µm |
| Scan Angle                          | VNR-NP : 70deg (Push broom scanning)  
VNR-P : 55deg (Push broom scanning)  
IRS SWI/TIR : 80deg (45deg rotation mirror scanning) |
| Swath width                         | 1150km for VNR-NP/P  
1400km for IRS SWI/TIR |
| Instantaneous field of view (IFOV) at nadir | VNR-NP : 1000m(VN9CH), 250m  
VNR-P : 1000m  
IRS SWI : 250m(SW3CH), 1000m(SW1,2,4CH)  
IRS TIR : 500m |
| Observing direction                 | ±45 degrees in along track direction for VNR-P  
Nadir for VNR-NP, IRS SWI, and IRS TIR |
| Quantization                        | 12bit |
| Absolute Calibration Accuracy       | VNR : ≤3%  
IRS : ≤5%  
TIR : ≤0.5K |
| Lifetime                            | 5 Years |
### TABLE 5
**SGLI OBSERVATION REQUIREMENT DETAILS**

<table>
<thead>
<tr>
<th>CH</th>
<th>λ (nm: VNR, IRS SWI)</th>
<th>Δ(μm: IRS TIR)</th>
<th>IFOV (m)</th>
<th>SNR SNR: VNR, IRS SWI NEΔT(K): IRS TIR</th>
<th>L (for SNR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNR-NP</td>
<td>VN1</td>
<td>380</td>
<td>10</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>VN2</td>
<td>412</td>
<td>10</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>VN3</td>
<td>443</td>
<td>10</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>VN4</td>
<td>490</td>
<td>10</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>VN5</td>
<td>530</td>
<td>20</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>VN6</td>
<td>565</td>
<td>20</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>VN7</td>
<td>673.5</td>
<td>20</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>VN8</td>
<td>673.5</td>
<td>20</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>VN9</td>
<td>763</td>
<td>12</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>VN10</td>
<td>868.5</td>
<td>20</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>VN11</td>
<td>868.5</td>
<td>20</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td>VNR-P</td>
<td>P1</td>
<td>673.5</td>
<td>20</td>
<td>1000</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>P2</td>
<td>868.5</td>
<td>20</td>
<td>1000</td>
<td>250</td>
</tr>
<tr>
<td>IRS SWI</td>
<td>SW1</td>
<td>1050</td>
<td>20</td>
<td>1000</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>SW2</td>
<td>1380</td>
<td>20</td>
<td>1000</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>SW3</td>
<td>1630</td>
<td>200</td>
<td>250</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>SW4</td>
<td>2210</td>
<td>50</td>
<td>1000</td>
<td>211</td>
</tr>
<tr>
<td>IRS TIR</td>
<td>T1</td>
<td>10.8</td>
<td>0.74</td>
<td>500</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>12.0</td>
<td>0.74</td>
<td>500</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### 4. Products

Geophysical products made available by GCOM-W1 and GCOM-C1 are listed in Tables 6 and 7. There are two categories of data products: standard product and research product. A “standard” product is defined as a product with proven accuracy that is to be operationally processed and distributed. In contrast, a “research” product is a prototype for a standard product and is processed on a research basis. Both tables indicate standard products with shading.
# TABLE 6
GEOPHYSICAL PRODUCTS OF GCOM-W1

<table>
<thead>
<tr>
<th>Product</th>
<th>Areas</th>
<th>Grid (km)</th>
<th>Accuracy 1</th>
<th>Data release threshold</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated water vapor</td>
<td>Global, over ocean</td>
<td>15</td>
<td>±3.5 kg/m²</td>
<td>±3.5 kg/m²</td>
<td>0-70 kg/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±2.0 kg/m²</td>
<td>±2.0 kg/m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vertically integrated (columnar) water vapor amount. Except sea ice and precipitating areas.</td>
</tr>
<tr>
<td>Integrated cloud liquid water</td>
<td>Global, over ocean</td>
<td>15</td>
<td>±0.10 kg/m²</td>
<td>±0.05 kg/m²</td>
<td>0-1.0 kg/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±0.02 kg/m²</td>
<td>±0.02 kg/m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vertically integrated (columnar) cloud liquid water. Except sea ice and precipitating areas.</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Global, except cold latitudes</td>
<td>15</td>
<td>±50 %</td>
<td>±50 %</td>
<td>0-20 mm/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±120 %</td>
<td>±120 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surface precipitation rate. Accuracy is defined as relative error (ratio of root-mean-square error to average precipitation rate) in 50km grid average.</td>
</tr>
<tr>
<td>Sea surface temperature</td>
<td>Global, over ocean</td>
<td>50</td>
<td>±0.5 °C</td>
<td>±0.5 °C</td>
<td>-2-35 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±0.2 °C</td>
<td>±0.2 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Except sea ice and precipitating areas. Goal accuracy is defined as monthly mean bias error in 10 degrees latitudes.</td>
</tr>
<tr>
<td>Sea surface wind speed</td>
<td>Global, over ocean</td>
<td>15</td>
<td>±1.5 m/s</td>
<td>±1.0 m/s</td>
<td>0-30 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±1.0 m/s</td>
<td>±1.0 m/s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Except sea ice and precipitating areas.</td>
</tr>
<tr>
<td>Sea ice concentration</td>
<td>Polar region, over ocean</td>
<td>15</td>
<td>±10 %</td>
<td>±10 %</td>
<td>0-100 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±5 %</td>
<td>±5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Accuracy is expressed in absolute value of sea ice concentration (%) .</td>
</tr>
<tr>
<td>Snow depth</td>
<td>Land</td>
<td>30</td>
<td>±20 cm</td>
<td>±20 cm</td>
<td>0-100 cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±10 cm</td>
<td>±10 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Except ice sheets and dense forest areas. Accuracy is expressed in snow depth and defined as mean absolute error of instantaneous observations.</td>
</tr>
<tr>
<td>Soil moisture</td>
<td>Land</td>
<td>50</td>
<td>±10 %</td>
<td>±10 %</td>
<td>0-40 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±5 %</td>
<td>±5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Volumetric water content over global land areas including arid and cold regions, except areas covered by vegetation with 2kg/m² water equivalent. Accuracy is defined as mean absolute error of instantaneous observations.</td>
</tr>
</tbody>
</table>

1 Accuracy is defined as root-mean-square error of instantaneous values unless otherwise stated. Assumed validation methodologies are not explained here.
<table>
<thead>
<tr>
<th>Area</th>
<th>Group</th>
<th>Product</th>
<th>Category</th>
<th>GLI heritage*1</th>
<th>Day/night</th>
<th>Production unit</th>
<th>Grid size</th>
<th>Release threshold*2</th>
<th>Standard accuracy*2</th>
<th>Target accuracy*2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiance</td>
<td>A(non-Pol)</td>
<td>TOA radiance (including system geometric correction)</td>
<td>Standard</td>
<td>A</td>
<td>Both*</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
</tr>
<tr>
<td></td>
<td>B(Pol)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A(non-Pol)</td>
<td>TIR and land 2.2 μm: both, Other VNR, SWI: daytime (+special operation)</td>
<td>Standard</td>
<td>A</td>
<td>Both*</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
</tr>
<tr>
<td></td>
<td>B(Pol)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface reflectance</td>
<td>Standard</td>
<td>Precise geometric correction</td>
<td>A Both</td>
<td></td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Atmospheric corrected reflectance (incl. cloud detection)</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td>Vegetation and carbon cycle</td>
<td>Standard</td>
<td>Vegetation index</td>
<td>A Daytime</td>
<td></td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Leaf area index</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Above-ground biomass</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shadow index</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surface temperature</td>
<td>Standard</td>
<td>B Both</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land net primary production</td>
<td>Research</td>
<td>C Daytime</td>
<td>Global</td>
<td>500m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water stress trend</td>
<td>Research</td>
<td>C N/A</td>
<td>Scene, Global</td>
<td>500m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fire detection index</td>
<td>Research</td>
<td>B Both</td>
<td>Scene</td>
<td>500m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land cover type</td>
<td>Research</td>
<td>B Daytime</td>
<td>Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land surface albedo</td>
<td>Research</td>
<td>B N/A</td>
<td>Scene, Global</td>
<td>250m</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td>Cloud</td>
<td>Standard</td>
<td>Cloud flag/Classification</td>
<td>A Both</td>
<td></td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Classified cloud fraction</td>
<td>Standard</td>
<td>A Both</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cloud top temp/height</td>
<td>Standard</td>
<td>A Both</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water cloud OT/effective radius</td>
<td>Standard</td>
<td>B Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice cloud optical thickness</td>
<td>Standard</td>
<td>B Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Water cloud geometrical thickness</td>
<td>Research</td>
<td>C Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<tr>
<td>Atmosphere</td>
<td></td>
<td>Aerosol over the ocean</td>
<td>Standard</td>
<td>A Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<td></td>
<td></td>
<td>Land aerosol by near UV</td>
<td>Standard</td>
<td>B Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<td></td>
<td>Aerosol by Polarization</td>
<td>Standard</td>
<td>B Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<td></td>
<td></td>
<td>Radiation budget</td>
<td>Research</td>
<td>C Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<td>Short-wave radiation flux</td>
<td>Research</td>
<td>B Daytime</td>
<td>Scene, Global</td>
<td>1km (scene), 1.1deg (global)</td>
<td>0.1 (&lt;443nm), 0.2 (&gt;443nm) (scene) *7</td>
<td>0.15 (scene)</td>
<td>0.15 (scene)</td>
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<tr>
<td>Area/Group</td>
<td>Product</td>
<td>Category</td>
<td>GLI heritage*1</td>
<td>Day/night</td>
<td>Production unit</td>
<td>Grid size</td>
<td>Release threshold*2</td>
<td>Standard accuracy*2</td>
<td>Target accuracy*2</td>
<td></td>
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<tr>
<td>Ocean</td>
<td>Normalized water-leaving</td>
<td>Standard</td>
<td>B</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>60% (443~565nm)</td>
<td>50% (&lt;600nm)</td>
<td>30% (&lt;600nm)</td>
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<td>radiance (incl. cloud detection)</td>
<td></td>
<td></td>
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<td>0.5W/m²/str/um (&gt;600nm)</td>
<td>50% (&lt;600nm)</td>
<td>30% (&lt;600nm)</td>
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<td>A</td>
<td></td>
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<td>80% (AOT@865nm)</td>
<td>50% (AOT@865nm)</td>
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<td>Standard</td>
<td>A</td>
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<td>Ocean</td>
<td>Photosynthetically available</td>
<td>Standard</td>
<td>A</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>Global: 4-9km</td>
<td>-60 to +150% (offshore)</td>
<td>-35 to +50% (offshore), -50 to +100% (coast)</td>
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<tr>
<td></td>
<td>radiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Coast: 250m Offshore: 1km</td>
<td>-60 to +150% (offshore)</td>
<td>-50 to +100%</td>
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<td>Ocean</td>
<td>Euphotic zone depth</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
<td>30%</td>
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<td></td>
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<tr>
<td>In-water</td>
<td>Chlorophyll-a concentration</td>
<td>Standard</td>
<td>A</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
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<td>Temperature</td>
<td>Sea-surface temperature</td>
<td>Standard</td>
<td>A</td>
<td>Both</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>Coast: 500m Others: Same as above</td>
<td>0.8K (daytime)</td>
<td>0.8K (day &amp; night time)</td>
<td>0.6K (day and night time)</td>
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<td>Application</td>
<td>Ocean net primary productivity</td>
<td>Research</td>
<td>C</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
<td>70% (monthly)</td>
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<td>Phytoplankton functional type</td>
<td>Research</td>
<td>C</td>
<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
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<td>Red tide</td>
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<td>Research</td>
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<td>Daytime</td>
<td>Scene, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
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<td>multi sensor merged ocean color</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Area, Global (1, 8 days, month)</td>
<td>Coast: 250m Offshore: 1km</td>
<td>N/A</td>
<td></td>
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<td></td>
<td>multi sensor merged SST</td>
<td>Research</td>
<td>A</td>
<td>Both</td>
<td>Area, Global (1, 8 days, month)</td>
<td>N/A</td>
<td>N/A</td>
<td>0.8K (day &amp; night time)</td>
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<td>Arctic</td>
<td>Snow and ice covered area</td>
<td>Standard</td>
<td>A</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>250m (scene), 1km (global)</td>
<td>10% (vicarious val with other sat. data)</td>
<td>7% (vicarious val with other sat. data)</td>
<td></td>
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<td></td>
<td>(incl. cloud detection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5K (vicarious val with other sat. data and climatology)</td>
<td>2K</td>
<td></td>
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<td></td>
<td>Okhotsk sea-ice distribution</td>
<td>Standard</td>
<td>A</td>
<td>Daytime</td>
<td>Area (1day)</td>
<td>250m</td>
<td>10%</td>
<td>5%</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>N/A</td>
<td>N/A</td>
<td>3%</td>
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<tr>
<td></td>
<td>Snow and ice classification</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Global (16 days, month)</td>
<td>1km</td>
<td>N/A</td>
<td>10%</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td></td>
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<td></td>
<td>Snow covered area in forests and</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Area (1, 8 days)</td>
<td>250m</td>
<td>N/A</td>
<td>30%</td>
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<td>Snow and ice surface</td>
<td>Temperature</td>
<td>Standard</td>
<td>A</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>500m (scene), 1km (global)</td>
<td>100% (vicarious val. with climatology between temp-size)</td>
<td>50%</td>
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<td>N/A</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Snow grain size of shallow layer</td>
<td>Standard</td>
<td>B</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>250m (scene), 1km (global)</td>
<td>N/A</td>
<td></td>
<td></td>
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<tr>
<td>Snow grain size of subsurface layer</td>
<td></td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow grain size of top layer</td>
<td></td>
<td>Research</td>
<td>C</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>N/A</td>
<td></td>
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<tr>
<td>Snow and ice albedo</td>
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<td>B</td>
<td>Daytime</td>
<td>Global (1, 16 days, month)</td>
<td>1km</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Area</td>
<td>Group</td>
<td>Product</td>
<td>Category</td>
<td>GLI heritage*1</td>
<td>Day/night</td>
<td>Production unit</td>
<td>Grid size</td>
<td>Release threshold*2</td>
<td>Standard accuracy*2</td>
<td>Target accuracy*2</td>
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<tr>
<td>Cryosphere</td>
<td>Surface properties</td>
<td>Snow impurity</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Scene, Global (1, 16 days, month)</td>
<td>250m (scene), 1km (global)</td>
<td>N/A</td>
<td>N/A</td>
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<td>Ice sheet surface roughness</td>
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<td>C</td>
<td>Daytime</td>
<td>Area (Season)</td>
<td>1km</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.05 *15</td>
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<td>Boundary</td>
<td>Ice sheet boundary monitoring</td>
<td>Research</td>
<td>B</td>
<td>Daytime</td>
<td>Area (Season)</td>
<td>250m</td>
<td>N/A</td>
<td>N/A</td>
<td>&lt;500m</td>
</tr>
</tbody>
</table>

Common notes:
*1. Heritage levels from ADEOS-II/GLI study are shown by A-C; A: high heritage, B: Remaining issues, C: new or many issues remaining to be resolved
*2. The “release threshold” is minimum levels for the first data release at one year from launch. The "standard" and "research" accuracies correspond to full and extra success criteria of the mission. Accuracies are basically shown by RMSE.

Radiance data notes:
*3. Absolute error is defined as offset + noise; relative error is defined as relative errors among channels, FOV, and so on. Release threshold of radiance is defined as estimated errors from vicarious, onboard solar diffuser, and onboard blackbody calibration because of lack of long-term moon samples

Atmosphere notes:
*4. Vicarious val. on sea-surface temperature and comparison with objective analysis data
*5. Inter comparison with airplane remote sensing on water clouds of middle optical thickness
*6. Release threshold is defined by vicarious val. with other satellite data (e.g., global monthly statistics in the mid-low latitudes)
*7. Comparison with cloud liquid water by in-situ microwave radiometer
*8. Comparison with optical thickness by sky-radiometer (the difference can be large due to time-space inconsistence and large error of the ground measurements)
*9. Comparison with in-situ observation on monthly 0.1-degree
*10. Estimated by experience of aerosol products by GLI and POLDER

Land data notes:
*11. Defined with land reflectance~0.2, solar zenith<30deg, and flat surface. Release threshold is defined with AOT@500nm<0.25
*12. Night time 250m product can be produced by special observation requests of 1.6μm channel
*13. Evaluate in semi-arid regions (steppe climate, etc.)
*14. Fires >1000K occupying >1/1000 on 1km pixel at night (using 2.2μm of 1 km and thermal infrared channels)

Cryosphere notes:
*15. Defined as height/width of the surface structures
APPENDIX D
ASSOCIATED TERMS AND CONDITIONS
OF RESEARCH AGREEMENTS
(FOR THE GCOM RESEARCH ANNOUNCEMENT)

COMMISIONED RESEARCH AGREEMENT FOR THE GLOBAL CHANGE OBSERVATION MISSION BETWEEN THE JAPAN AEROSPACE EXPLORATION AGENCY AND THE RESEARCH ORGANIZATION (D-2 ~ D-18)

COLLABORATIVE RESEARCH AGREEMENT (FUNDED) FOR THE GLOBAL CHANGE OBSERVATION MISSION BETWEEN THE JAPAN AEROSPACE EXPLORATION AGENCY AND THE RESEARCH ORGANIZATION (D-19 ~ D-34)

COLLABORATIVE RESEARCH AGREEMENT (NON-FUNDED) FOR THE GLOBAL CHANGE OBSERVATION MISSION BETWEEN THE JAPAN AEROSPACE EXPLORATION AGENCY AND THE RESEARCH ORGANIZATION (D-35 ~ D-48)
COMMISSIONED RESEARCH AGREEMENT
FOR THE
GLOBAL CHANGE OBSERVATION MISSION
BETWEEN THE
JAPAN AEROSPACE EXPLORATION AGENCY (JAXA)
AND
THE RESEARCH ORGANIZATION
(FOR THE RESEARCH ANNOUNCEMENT

JAPAN AEROSPACE EXPLORATION AGENCY
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COMMISSIONED RESEARCH AGREEMENT

This agreement ("Agreement") is entered into between the Japan Aerospace Exploration Agency, established under the provision of the Law Concerning the Japan Aerospace Exploration Agency on October 1, 2003, represented by its President and having its principal office at 7-44-1 Higashimachi, Jindaiji, Chofu-shi, Tokyo, Japan ("JAXA") and a research organization ("Research Organization") that submitted an application form for the below described research activities to JAXA, hereinafter collectively referred to as "the Parties."

WITNESSETH

WHEREAS, the Global Change Observation Mission ("GCOM") aims to construct, use, and verify systems that enable continuous global-scale observations of effective geophysical parameters for clarifying global climate change and water circulation mechanisms;

WHEREAS, JAXA issued the Research Announcement ("RA") to engage in research activities directly related to retrieval algorithms for geophysical products, product validation, and data application of GCOM, and the Research Organization applied pursuant to such RA;

WHEREAS, JAXA accepted the Research Organization's proposal that was in response to the RA, delivered the confirmation sheet and JAXA further desires to utilize such proposal in JAXA's project; and

WHEREAS, JAXA desires to commission the Research Organization to engage in the above research activities.

NOW, THEREFORE, in consideration of the mutual agreements hereinafter set forth, and for other good and reasonable consideration, the receipt and adequacy of which are hereby acknowledged, the Parties hereby agree as follows:

Article 1. Definitions

The following capitalized terms shall have the following meanings:

"Annual Evaluation" means JAXA's annual review, which is scheduled by JAXA at the end of each
Japanese fiscal year, of the Research Results (as defined below) from the PI.

"Application Form" means the application form for the Research Projects (as defined below) submitted by the Research Organization.

"Co-Investigator" ("CI") means a person who supports the PI (as defined below) in performing the Research Projects (as defined below) with approval by JAXA.

"Commissioned Research Plan" means the plan described in Attachment A of the Application Form.

"Confirmation Sheet" means the confirmation sheet or the acceptance form prescribed by JAXA with regard to the Application Form.

"Earth Observation Satellite Data" means data sets obtained from satellites which are retained by JAXA at the time of execution of this Agreement. The available data sets (including names of satellites, sensors, observation period that can be offered, and observation areas) are listed in Attachment A of this Agreement.

"Industrial Property Rights" means all domestic and foreign patents, utility models and industrial designs.

"Principal Investigator" ("PI") means the Research Organization employee who was selected to be responsible for the Research Projects, and who is named in the "Commissioned Research Plan" (as defined below).

"Potential Industrial Property Rights" means all domestic and foreign application rights for patents, utility models, or industrial designs.

"Program/Data Copyrights" means all domestic and foreign copyrights related to computer programs, software and databases.

"Research Funding" means the total amount of funds payable to the Research Organization by JAXA under Article 8 of this Agreement.

"Research Projects" has the meaning given to it in Article 2, Paragraph 2.
"Research Results" means the technical results and scientific knowledge derived from the implementation of the Research Projects pursuant to this Agreement, including all inventions, ideas, designs, literary works, algorithms, and technological developments, such as programs, that can execute the algorithm(s).

Article 2. Purpose and Scope of Research Projects
1. Under the terms and conditions of this Agreement, JAXA hereby commissions the Research Organization and the Research Organization hereby accepts the commission to engage in the research activities as set forth in the RA and/or the statement of work issued by JAXA ("Statement of Work"), and/or the Commissioned Research Plan and/or otherwise under this Agreement.
2. The Research Organization's research activities ("Research Projects") shall be carried out in accordance with (i) the Statement of Work, and (ii) the Commissioned Research Plan.

Article 3. Effective Term
1. The Agreement shall become effective as of the date of the issuance of the Confirmation Sheet prescribed by JAXA and shall continue in effect until the end of each Japanese Fiscal Year ("Agreement Term").
2. The Research Organization may renew the Agreement annually under the same terms and conditions provided that JAXA approves an extension of the research period in the Annual Evaluation; provided, however, that the Parties mutually agree upon the amount to be paid by JAXA for such extended period; further provided, however, the Research Organization shall submit a renewal Application Form to JAXA and JAXA shall issue a new Confirmation Sheet; further provided, however, that the Agreement Term shall not extend beyond March 31, 2011.
3. Termination of this Agreement shall not affect a Party’s continuing obligation under Paragraph 2 and 3 of Article 9, Article 13, Article 14, Article 15, Article 16, Article 27, Article 28 and Article 29.

Article 4. Researchers
1. In the event that the PI dies, retires from the Research Organization, takes a leave absent from work, or come to be no longer engaged in the Research Projects, the Research Organization shall immediately notify to JAXA as such and JAXA may at its sole discretion terminate this Agreement; provided however, if the RO designates a researcher who belongs to the Research Organization as the PI’s successor and JAXA approves the succession, the Parties may amend this Agreement, with the succeeding researcher being a new PI. The terms and conditions of the amendment to this Agreement shall be determined upon mutual consultation and consent.
2. In the event that the Research Organization intends to select or add CIs, the Research Organization
shall first obtain the consent of JAXA for such personnel. The Research Organization shall submit to JAXA the list of such candidates of CIs and consult with JAXA in order to obtain JAXA's consent.

3. The Research Organization shall supervise the PI's and CI's engaging in the Research Projects and shall ensure all PI's and/or CI's engaging in the Research Projects in accordance with the terms and conditions of the Agreement. For the avoidance of doubt, with regard to this Agreement, the PIs and CIs shall not be deemed to be a third party.

**Article 5. JAXA's Performance for Research Projects**

JAXA shall make reasonable efforts to perform the following tasks related to the Research Projects:

a) Deliver the Earth Observation Satellite Data to the PI;

b) Provide satellite operation data, ground validation data and meteorological data; and

c) Hold workshops and meetings to evaluate the Research Results and the Progress Reports (as defined below) and to promote information exchange among PIs and JAXA.

**Article 6. The Research Organization's General Responsibilities for Research Projects**

1. The Research Organization shall conduct and complete the Research Projects in accordance with the Commissioned Research Plan and the Statement of Work. The progress and results of the Research Projects by the Research Organization shall be subject to the review of JAXA.

2. For the purpose of ensuring the Research Organization's performance of the above obligations, the Research Organization shall perform certain actions including, but not limited to:

a) Participate in necessary workshops and meetings for the Research Projects and report upon request from JAXA;

b) Deliver periodically to JAXA the Research Results and the reports ("Progress Reports") in the form specified by JAXA, and in all instances, at least one (1) month before the Annual Evaluation;

c) Deliver the reports as a final report ("Final Reports") by the end of the Agreement Term; and

d) Take necessary measures to ensure the PI's and/or CI's compliance with this Agreement.

**Article 7. Subcontract**

1. The Research Organization shall not subcontract the whole Research Projects to a third party. Provided, however, that the Research Organization may subcontract part of it upon prior written approval of JAXA. Should there be a case where subcontractors re-commission part of the Research Project to a third party, the company name, address and scope of business of such third party are required to be submitted to the Research Organization in writing.
2. If the Research Organization subcontracts the Research Projects to a third party at any tier, any act of such third party in connection with the subcontract shall be deemed to be an act of the Research Organization and the Research Organization shall be responsible therefor.

Article 8. Research Funding

1. The Confirmation Sheet identifies the amount of funding to be provided by JAXA to the Research Organization for the Research Projects ("Research Funding"). JAXA shall, within thirty (30) days from the date when JAXA receives an invoice duly issued by the Research Organization, make payment for the Research Funding by wire transfer. All payments stipulated in this Agreement shall include any charges, taxes or duties levied by any official authorities of the country where the Research Organization exists.

2. If JAXA fails to pay the Research Funding within the above period, JAXA shall pay to the Research Organization default interest of six (6) percent per annum on such unpaid amount for the period from the immediately succeeding day of due date for payment to the date of actual payment; provided, however, that if such nonpayment was due to an Act of God or any other reasons outside of the control of JAXA, the period for which such reasons exist shall not be counted in the number of days subject to payment of default interest.

3. The Research Organization shall submit Budget Summary as attachment of Commissioned Work Plan at the beginning of every Japanese fiscal year. The Research Organization shall report to JAXA in advance if there is a need to reallocate the budget between Expense Item Categories of Budget Summary. For the reallocation in the amount of Expense Item Categories for over 30% or 500,000 Japanese yen, in case the amount of 30% is less than 500,000 Japanese yen, and/or increase in the personnel cost, the Research Organization shall resubmit the revised Budget Summary for approval in advance.

4. Throughout the performance of the Agreement, the Research Organization shall maintain books, records, logs, documents and other evidence sufficient to record all actions taken with respect to the completion of the Research Project. The Research Organization shall agree to allow JAXA to inspect, copy, and audit such books, records, documents and other evidence at any reasonable time. The Research Organization shall keep all the accounting documents for 5 (five) years after the end of the research period.

5. If the original contract amount or the amended contract amount, if there is any amendment to the original contract amount, is 1 (one) million Japanese yen or more, the Research Organization shall submit fiscal financial statement by the end of each Japanese fiscal year. JAXA shall review the fiscal financial statement, determine the final contract amount which should be within the limit of the original or the amended contract amount, and notify the final contract amount to the Research Organization. When the amount paid by JAXA in accordance with paragraph 1 above
exceeds the final contract amount and the excess payment needs to be reimbursed, the Research Organization is required to make the reimbursement. If the Research Organization fails to pay the reimbursement, the procedure described in paragraph 2 above shall apply.

Article 9. Providing of Earth Observation Satellite Data by JAXA

1. JAXA will provide the Research Organization with the Earth Observation Satellite Data for the Research Projects free of charge subject to the following conditions:
   a) The Research Organization agrees and accepts that JAXA may not provide all the Earth Observation Satellite Data which the Research Organization may request;
   b) JAXA does not guarantee a specific quality or the timely provision of the Earth Observation Satellite Data;
   c) The Advanced Land Observing Satellite data, which is one portion of the Earth Observation Satellite Data and is to be provided to the Research Organization, shall be limited to ten scenes every fiscal year; and
   d) JAXA reserves the right to curtail or suspend Earth Observation Satellite Data supply to the Research Organization due to faults or difficulties relating in the satellites, limitations on their operations, or any other reasons.

2. With respect to the Earth Observation Satellite Data provided by JAXA, the Research Organization shall:
   a) Only use the Earth Observation Satellite Data for the singular purpose of advancing the efforts of these Research Projects;
   b) Not duplicate the Earth Observation Satellite Data except for distributing to authorized CIs the necessary data backups;
   c) Not distribute the Earth Observation Satellite Data to any third party without JAXA's prior written consent; and
   d) Return or otherwise appropriately manage the Earth Observation Satellite Data upon completion of this Agreement, according to the directives of JAXA.

3. Any rights regarding the Earth Observation Satellite Data provided by JAXA shall conform to the following:
   a) Any rights relating to the Earth Observation Satellite Data shall belong to JAXA or to an institute designated by JAXA except in the case mentioned in b) below; and
   b) If value-added products, which means highly processed products that do not retain the original pixel structure and that cannot be converted back to the primary Earth Observation Satellite Data, are developed in the course of executing the Research Projects, the ownership of such products shall be determined upon mutual agreement between the Parties, taking into consideration the degrees of contribution by JAXA and the Research Organization.
Article 10. Providing of Meteorological Data by JAXA

1. For the purpose of performing the Research Projects, JAXA will attempt to provide the Research Organization with the meteorological data provided by the Japan Meteorological Agency pursuant to the agreement between JAXA and the Japan Meteorological Agency ("Meteorological Data"). The Research Organization agrees that JAXA's provision of the Meteorological Data may be limited or otherwise affected by the fact that some rights to the Meteorological Data belong to the Japan Meteorological Agency.

2. The Research Organization shall use the provided Meteorological Data solely for the purpose of conducting Research Projects. The Research Organization may not disclose the provided Meteorological Data to any third party.

3. The Research Organization shall return or otherwise appropriately keep the Meteorological Data in accordance with the instructions of JAXA upon the termination of this Agreement.

Article 11. Disclosure of Technical Data

1. To the extent feasible, each party shall disclose all necessary technical data ("Technical Data") which does not include the Earth Observation Satellite Data and the Meteorological Data. The Parties will undertake to handle expeditiously any request for the Technical Data presented by the other party.

2. The Technical Data shall be used and/or disclosed by the receiving party only for the purpose of fulfilling the receiving party's responsibilities under this Agreement. The receiving party shall protect Technical Data from unauthorized use and/or disclosure.

3. The Technical Data shall not be disclosed, duplicated or used by persons or entities other than the receiving party, or for any other purpose, without the prior consent of the furnishing party.

4. According to directives of the furnishing party, the receiving party shall return or otherwise dispose of Technical Data provided under the Agreement upon completion of the activities under the Agreement.

Article 12. Review and Confirmation of Research Results

1. The Research Organization shall deliver the Deliverable Research Results (as defined below) before the expiration of the Agreement Term. After receiving all Deliverable Research Results, JAXA may examine the Deliverable Research Results and the performance of the Research Organization to confirm the completion of the Research Projects.

2. If JAXA reasonably determines that 1) the Deliverable Research Results are not of the required quality and/or 2) the performance of the Research Organization is inadequate, JAXA may request the Research Organization to perform remedial activities during a period specified by JAXA and
within the amounts of the Research Funding.

3. The failure to perform the remedial activities contemplated in the foregoing paragraph shall constitute a default under the Agreement; hence Article 19 of the Agreement shall apply.

**Article 13. Ownership and Usage of the Research Results**

1. All Research Results required by the Statement of Work to be delivered to JAXA ("Deliverable Research Results") shall be owned solely by JAXA unless the Research Organization has reasonably proven that rights related to the Deliverable Research Results were already owned by the Research Organization on the date of execution of this Agreement. The Research Organization may not use in any way JAXA's Deliverable Research Results unless JAXA provides the Research Organization prior written consent. In the event JAXA provides prior written consent to use JAXA's Deliverable Research Results, the Research Organization may use such Deliverable Research Results only for its own non-military (i.e., peaceful) and non-commercial purposes.

2. With regard to copyrights in the written documents related to the Deliverable Research Results including Progress Reports and Final Reports, the Research Organization shall assign such copyrights to JAXA at the time of delivering the Deliverable Research Results. Such assigned copyrights include, but not limited to, the rights to translate, transform or otherwise adapt works and to use derivative works. The Research Organization waives and shall cause its directors, officers, employees including PIs and CIs, regardless of whether such persons are employed by the Research Organization, to waive any related moral rights to the assigned copyrights in the written documents related to Deliverable Research Results including Progress Reports and Final Reports and agrees not to rescind such waivers and shall cause such directors, officers, employees including PIs and CIs to agree not to rescind such waiver.

3. The Research Results other than the Deliverable Research Results ("Non-Deliverable Research Results") shall be owned by the Research Organization. The Research Organization hereby grants and will be deemed to have granted to JAXA and JAXA's affiliates a perpetual, irrevocable, royalty-free, non-exclusive, worldwide right to use the Non-Deliverable Research Results (and derivative works thereof); provided, however, JAXA shall use such Non-Deliverable Research Results (and derivative works thereof) for its own research and development work including, but not limited to, the granting to commissioned research organizations and/or collaborating research organizations the use of such Non-Deliverable Research Results (and derivative works thereof)

4. JAXA may request the Research Organization to disclose any Research Results including the Non-Deliverable Research Results and other related materials to JAXA.

5. The Research Organization shall not disclose the Deliverable Research Results to a third party without prior written consent of JAXA.
**Article 14. Publication of Research Results**

1. If the Research Organization intends to publish the JAXA's Deliverable Research Results, the Research Organization shall provide JAXA with a written document regarding the description of the subjected JAXA's Deliverable Research Results to be published and request a written consent of JAXA. JAXA will not unreasonably withhold consent from the publishing party's request for such publication.

2. Before publishing, the Research Organization shall provide JAXA with a copy of the publication. JAXA is entitled to an irrevocable and royalty-free right to use the provided publications, unless the copyright of such publication is owned or held by an academic society.

3. The Research Organization shall state in the publication that such JAXA's Deliverable Research Results have been obtained pursuant to this Agreement and identify the owner of the rights to the Earth Observation Satellite Data and Meteorological Data used in such publication.

4. In the event that a PI or CI wishes to publish or disclose the JAXA's Deliverable Research Results, the Research Organization shall cause the PI and/or CI to act in accordance with the terms and conditions of this Article and shall cause the PI and/or CI to grant JAXA an irrevocable and royalty-free right to use the provided publications, unless the copyrights to such publication belongs to an academic society.

**Article 15. Industrial Property Rights**

1. The Research Organization shall report the existence of Potential Industrial Property Rights generated in the course of the Research Projects, if any, to JAXA without delay and take the necessary procedures to file and prosecute applications in JAXA's name, if possible, for the registration of the resulting Industrial Property Rights, at JAXA's expense and with the approval of JAXA. The Research Organization shall consult with JAXA and seek JAXA's instructions in advance regarding every material matter concerning the application for the registration of the resulting Industrial Property Rights. If the Research Organization successfully is granted such Industrial Property Rights it shall notify JAXA without delay.

2. Unless the Research Organization currently has stipulated work rules regarding the following, the Research Organization shall institute rules governing, and/or agreements with its employees which provide that any Potential Industrial Property Rights and/or Industrial Property Rights owned by and/or held by the employees shall be transferred by such employees to the Research Organization in the event the employees' inventions and Potential Industrial Property Rights and/or the Industrial Property Rights related thereto were created or otherwise arose within the scope of the Research Organization's business.

3. If the technology developed by the Research Organization in the course of the Research Projects
has Potential Industrial Property Rights, JAXA may make an application for such Potential Industrial Property Rights to be registered Industrial Property Rights in JAXA's name. In this case, the Research Organization shall submit to JAXA the materials required for the application and otherwise cooperate with JAXA in accordance with JAXA's instructions.

4. The Research Organization shall assign any Potential Industrial Property Rights and/or Industrial Property Rights contemplated in Paragraph 1 and 2 of this Article 15 to JAXA immediately after their acquisition, if acquired in the name of the Research Organization. For the avoidance of doubt, the consideration for such assignment of Potential Industrial Property Rights and/or the Industrial Property Rights is included in the Research Funding.

5. If the Research Organization requests a license to use the Industrial Property Rights assigned to JAXA under the preceding paragraph, JAXA will grant the Research Organization a nonexclusive license unless it is reasonably deemed to be inappropriate. The conditions for the approval shall be determined by mutual agreement between the Parties as necessary.

6. The Research Organization shall obtain approval of JAXA in advance if the Research Organization wishes to grant to a third party a license to use the Industrial Property Rights.

7. JAXA shall bear the total or a portion of the costs which the Research Organization paid to the Research Organization's employee who created the technology which is subject of the Potential Industrial Property Rights and/or the Industrial Property Rights and transferred such Potential Industrial Property Rights and/or Industrial Property Rights to the Research Organization in accordance with Paragraph 2 of this Article 15. The amount to be paid by JAXA shall be based upon a standard determined solely by JAXA.

Article 16. Program/Data Copyrights

1. The Research Organization shall notify JAXA without delay in the event that the Research Organization creates a program, software and/or database that may potentially constitute the Program/Data Copyrights.

2. The Research Organization shall assign to JAXA all Program/Data Copyrights required by the Statement of Work to be delivered to JAXA ("Deliverable Program/Data Copyrights") including, but not limited to, rights to translate, transform or otherwise adapt works and to use derivative works. The Research Organization waives and shall cause its directors, officers, and employees including PIs and CIs, regardless of whether such persons are employed by the Research Organization, to waive any related moral rights to the Deliverable Program/Data Copyrights and agrees not to rescind such waivers and shall cause such directors, officers, employees including PIs and CIs to agree not to rescind such waiver. For the avoidance of doubt, the consideration for such assignment of the Deliverable Program/Data Copyrights is included in the Research Funding. Provided, however, that the Research Organization may retain the Deliverable Program/Data
Copyrights, if the Research Organization has reasonably proven that it owned on the date of execution of this Agreement; further provided, however that the Research Organization may retain the portion of the Deliverable Program/Data Copyrights regarding the know-how, routine, subroutine and modules which the Research Organization has designated. In this case, JAXA shall be entitled to an irrevocable and royalty-free right to use such know-how, routine, subroutine and modules in the form as it is provided to JAXA, even if the ownership of such know-how, routine, subroutine and modules are retained by the Research Organization. Such use by JAXA shall include the right of JAXA to grant a third party the right to use the know-how, routine, subroutine and modules in the form as it is provided to JAXA without paying any royalties to the Research Organization.

3. The Research Organization shall extend the terms and conditions of this Article to its researcher who created the copyrightable item and shall prevent that researcher from executing the related Deliverable Program/Data Copyrights.

4. If the Research Organization requests of JAXA a license to use the assigned Deliverable Program/Data Copyrights, JAXA will grant the Research Organization such rights unless it is reasonably deemed to be inappropriate. The conditions for the approval shall be determined upon mutual agreement between the Parties as necessary.

5. After such Deliverable Program/Data Copyrights has been assigned to JAXA, JAXA may modify a program, software and/or database which is subject of the Deliverable Program/Data Copyrights and shall bear the risk and responsibility related to such modification.

6. The Program/Data Copyrights other than the Deliverable Program/Data Copyrights ("Non-Deliverable Program/Data Copyrights ") shall be owned by the Research Organization. The Research Organization hereby grants and will be deemed to have granted to JAXA and JAXA's affiliates a perpetual, irrevocable, royalty-free, non-exclusive, worldwide right to use the Non-Deliverable Program/Data Copyrights (and derivative works thereof) ; provided however, JAXA shall use such Non-Deliverable Program/Data Copyrights (and derivative works thereof) for its own research and development work including, but not limited to, the granting to commissioned research organizations and/or collaborating research organizations the use of programs, software and databases related to Non-Deliverable Research Results (and derivative works thereof).

Article 17. Impossibility of Performance

In the event it becomes impossible for the Research Organization to carry out all or any part of the Agreement due to reasons attributable to the Research Organization, such failure to carry out its duties shall constitute a default and JAXA may terminate all or any part of the Agreement.
Article 18. Delay of Performance
1. In the event there is a reasonable basis for which the Research Organization is unable to complete the Research Projects by the due date set forth in this Agreement, the Research Organization may make a written request to JAXA for its consideration to extend the due date.
2. If the Research Organization fails to submit the Final Reports and deliverables to JAXA by the extended due date, such failure shall constitute a default and JAXA may terminate all or any part of the Agreement.

Article 19. Termination and Refund
1. Either party may terminate the Agreement:
   a) When the other party commits a dishonest and/or inequitable act that irreparably harms the mutual trust between the Parties; provided, that breaching party fails to offer any effective and satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party;
   b) When the other party violates any of the terms and conditions of this Agreement provided that the breaching party fails to offer any effective and/or satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party;
   c) When the events stipulated in Article 22 occurs; or
   d) Upon the consent of both Parties.
2. In addition to the preceding Paragraph, JAXA may terminate the whole or a part of the Agreement at its sole direction upon the occurrence of:
   a) The events contemplated in Article 4 Paragraph 1, Article 12 Paragraph 3, Articles 17and 18 ("Agreement Termination Events"); and
   b) Any other material breach of this Agreement by the Research Organization, PI and CI.
3. Upon the termination of the Agreement, the Research Organization shall promptly deliver to JAXA all work including, but not limited to, all works in progress and all work that is completed and otherwise ready for delivery.
4. If the Agreement is terminated as set forth in the preceding paragraph, the Research Organization shall refund to JAXA any unexpended Research Funding. The Research Organization shall remit such funds within thirty (30) days from the date when the Research Organization receives an invoice issued by JAXA with regard to such funds.

Article 20. Ownership of the Rights to the Acquired Equipments
1. The Research Organization shall transfer, upon the expiration of this Agreement, all rights and ownership in the equipment acquired by the Research Organization with the Research Funding; provided, however, that JAXA may determine that any or all such rights and ownership will be
retained by the Research Organization.

2. The Research Organization shall manage the equipment acquired with the Research Funding (if any) with the care of a good manager. Such equipment shall be listed in a “List of Property” which should be submitted to JAXA at the end of each Japanese fiscal year.

**Article 21. Liquidated Damages**

If the Agreement is terminated by reasons attributable to the Research Organization, PI and/or CI including, but not limited to, the occurrence of the Agreement Termination Events, the Research Organization shall pay liquidated damages to JAXA in the amount of ten (10) percent of the portion of the remaining Research Funding in addition to any amount to be refunded under Article 19 Paragraph 4.

**Article 22. Force Majeure**

Neither party shall be liable for failure, delay or suspension to perform its part of the Agreement when such failure is due to force majeure circumstances including, but not limited to, fire, war, unavoidable accidents, government acts or policies, or legal restrictions beyond the reasonable control of either party. The Party claiming to be affected by force majeure shall promptly notify the other Party in writing on the intervention and on the cessation of such circumstance.

**Article 23. Confidentiality**

1. In this Agreement, "Confidential Information" means any information that a party discloses or presents in writing or by other media, to the other party in the course of these Research Projects, provided however, Confidential Information does not include the following:
   a) Information that is already known to the public when disclosed by the disclosing party;
   b) Information that becomes known to the public after the disclosure by the disclosing party without intentional misconduct or negligence of the receiving party;
   c) Information that the receiving party already had before the disclosure by the disclosing party;
   d) Information that the receiving party acquires from a duly authorized third party not subject to confidentiality obligations;
   e) Information that the receiving party independently develops without utilizing information obtained from the disclosing party;
   f) Information with a prior written consent of the disclosing party for the disclosure and the publication; or
   g) Information that is required to be disclosed by applicable laws, judgment or order of a competent court. In this case, the receiving party shall promptly notify the disclosing party of the necessity of disclosure.
2. The receiving party shall keep the Confidential Information secret and shall not disclose or divulge any Confidential Information to a third party without a prior written consent of the disclosing party.

3. The confidentiality obligation under this Article shall remain effective for a period of five (5) years after the termination of the Agreement. However this period of keeping confidentiality may be extended or shortened by mutual agreement.

**Article 24. Government Approvals**

Each party shall obtain such permits, licenses, and other government authorizations as are required for it to perform its responsibilities under the Agreement, and shall comply with all respective laws and regulations.

**Article 25. Language**

All communications between the Research Organization and JAXA under this Agreement shall be in English.

**Article 26. Special Agreement**

Any supplement, modification or amendment of this Agreement shall only be binding if made upon the Parties’ mutual written agreement which makes specific reference to this Agreement.

**Article 27. Dispute Resolution**

The Parties agree to put forth their best efforts to solve amicably any dispute, controversy, or difference arising out of, in connection with, or resulting from this Agreement.

**Article 28. Arbitration**

All disputes that cannot be amicably settled by the method defined in the previous Article hereof will be settled by arbitration in Tokyo in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association.

**Article 29. Governing Law**

The Agreement shall be governed and interpreted under the laws of Japan.
**Attachment A  “Earth Observation Satellite Data”**

<table>
<thead>
<tr>
<th>Name of Satellite or Sensor</th>
<th>Observation Period (YY/MM/DD)</th>
<th>Observable Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS (Advanced Land Observation Satellite)</td>
<td>2006/05/16～</td>
<td>Global</td>
</tr>
<tr>
<td>MOS (Marine Observation Satellite)</td>
<td>1987/02/23～1996/04/19</td>
<td>Around Japan, Antarctic and Southeast Asia</td>
</tr>
<tr>
<td>JERS (Japanese Earth Observation Satellite)</td>
<td>1992/09/01～1998/10/11</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS (Advanced Earth Observation Satellite)</td>
<td>1996/10/15～1997/6/29</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS-II (Advanced Earth Observation Satellite-II)</td>
<td>2003/01/18～2003/10/24</td>
<td>Global</td>
</tr>
<tr>
<td>AMSR-E (Advanced Microwave Scanning Radiometer for EOS-Aqua satellite)</td>
<td>2002/06/19～</td>
<td>Global</td>
</tr>
<tr>
<td>TRMM (Tropical Rainfall Measuring Mission)</td>
<td>1997/12/01～</td>
<td>Global</td>
</tr>
<tr>
<td>ERS (European Remote-Sensing Satellite)</td>
<td>1991/08/18～2003/03/29</td>
<td>Around Japan and Antarctic</td>
</tr>
<tr>
<td>LANDSAT* (Land Satellite)</td>
<td>1979/02/19～2002/03/31</td>
<td>Around Japan</td>
</tr>
</tbody>
</table>

* LANDSAT-5 data received by 2001/3/31 will be available in the dataset.
COLLABORATIVE RESEARCH AGREEMENT (FUNDED)
FOR THE
GLOBAL CHANGE OBSERVATION MISSION
BETWEEN THE
JAPAN AEROSPACE EXPLORATION AGENCY (JAXA)
AND
THE RESEARCH ORGANIZATION
(FOR THE RESEARCH ANNOUNCEMENT

JAPAN AEROSPACE EXPLORATION AGENCY
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COLLABORATIVE RESEARCH AGREEMENT

This agreement ("Agreement") is entered into between the Japan Aerospace Exploration Agency, established under the provision of the Law Concerning the Japan Aerospace Exploration Agency on October 1, 2003, represented by its President and having its principal office at 7-44-1 Higashimachi, Jindaiji, Choufu-shi, Tokyo, Japan ("JAXA") and a research organization ("Research Organization") that submitted an application form for the below described research activities to JAXA, hereinafter collectively referred to as "the Parties."

WITNESSETH

WHEREAS, the Global Change Observation Mission ("GCOM") aims to construct, use, and verify systems that enable continuous global-scale observations of effective geophysical parameters for clarifying global climate change and water circulation mechanisms;

WHEREAS, JAXA issued the Research Announcement ("RA") to engage in collaborative research activities directly related to retrieval algorithms for geophysical products, product validation, and data application of GCOM, and the Research Organization applied pursuant to such RA;

WHEREAS, JAXA accepted the Research Organization's proposal that was in response to the RA, delivered the confirmation sheet to the Research Organization and JAXA further desires to utilize such proposal in JAXA's project; and

WHEREAS, JAXA desires to engage in the above research activities in collaboration with the Research Organization.

NOW, THEREFORE, in consideration of the mutual agreements hereinafter set forth, and for other good and reasonable consideration, the receipt and adequacy of which are hereby acknowledged, the Parties hereby agree as follows:

Article 1. Definitions
The following capitalized terms shall have the following meanings:

"Annual Evaluation" means JAXA's annual review, which is scheduled by JAXA at the end of each
Japanese fiscal year, of the Research Results (as defined below) from the PIs.

"Application Form" means the application form for the Research Projects (as defined below) submitted by the Research Organization.

"Co-Investigator" ("CI") means a person who supports the PI (as defined below) in performing the Research Projects (as defined below) with approval by JAXA.

"Collaborative Research Plan" means the plan described in Attachment A of the Application Form.

"Confirmation Sheet" means the confirmation sheet or the acceptance form prescribed by JAXA with regard to the Application Form.

"Earth Observation Satellite Data" means data sets obtained from satellites which are retained by JAXA at the time of execution of this Agreement. The available data sets (including names of satellites, sensors, observation period that can be offered, and observation areas) are listed in Attachment A of this Agreement.

"Intellectual Property Rights" means the following:
   (i) Industrial Property Rights (as defined below);
   (ii) Potential Industrial Property Rights (as defined below); and
   (iii) Program/Data Copyrights (as defined below).

"Industrial Property Rights" means all domestic and foreign patents, utility models, and industrial designs.

"Potential Industrial Property Rights" means all domestic and foreign application rights for patents, utility models, or industrial designs.

"Principal Investigator" ("PI") means the Research Organization employee who was selected to be responsible for the Research Projects, and who is named in the Collaborative Research Plan.

"Program/Data Copyrights" means all domestic and foreign copyrights related to computer programs, software and databases.

"Research Funding" means the total amount of funds payable to the Research Organization by
JAXA under Article 7 of this Agreement.

"Research Projects" has the meaning given to it in Article 2, Paragraph 2.

"Research Results" means the technical results and scientific knowledge derived from the implementation of the Research Projects pursuant to this Agreement, including all inventions, ideas, designs, literary works, algorithms, and technological developments, such as programs, that can execute the algorithm(s).

**Article 2.  Purpose and Scope of Research Projects**

1. Under the terms and conditions of this Agreement, JAXA and the Research Organization hereby agree to work in collaboration with regard to the research activities as set forth in the RA, and/or the Collaborative Research Plan and/or otherwise under this Agreement.

2. The Parties' research activities ("Research Projects") shall be carried out in accordance with the Collaborative Research Plan.

**Article 3.  Effective Term**

1. The Agreement shall become effective as of the date of the issuance of the Confirmation Sheet prescribed by JAXA and shall continue in effect until the end of each Japanese Fiscal Year ("Agreement Term").

2. The Research Organization may renew the Agreement annually under the same terms and conditions provided that JAXA approves an extension of the research period in the Annual Evaluation; provided, however, that the Parties mutually agree upon the amount to be paid by JAXA for such extended period; further provided, however, the Research Organization shall submit a renewal Application Form to JAXA and JAXA shall issue a new Confirmation Sheet; further provided, however, that the Agreement Term shall not extend beyond March 31, 2011.

3. Termination of this Agreement shall not affect a Party’s continuing obligation under Paragraph 2 and 3 of Article 9, Article 12, Article 13, Article 14, Article 15, Article 24, Article 25 and Article 26.

**Article 4.  Researchers**

1. In the event that the PI dies, retires from the Research Organization, takes a leave absent from work, or come to be no longer engaged in the Research Projects, the Research Organization shall immediately notify to JAXA as such and JAXA may at its sole discretion terminate this Agreement; provided however, if the RO designates a researcher who belongs to the Research Organization as the PI’s successor and JAXA approves the succession, the Parties may amend this
Agreement, with the succeeding researcher being a new PI. The terms and conditions of the amendment to this Agreement shall be determined upon mutual consultation and consent.

2. In the event that the Research Organization intends to select or add CIs, the Research Organization shall first obtain the consent of JAXA for such personnel. The Research Organization shall submit to JAXA the list of such candidates of CIs and consult with JAXA in order to obtain JAXA's consent.

3. The Research Organization shall supervise the PI's and CI's engaging in the Research Projects and shall ensure all PI's and/or CI's engaging in the Research Projects in accordance with the terms and conditions of the Agreement. For the avoidance of doubt, with regard to this Agreement, the PIs and CIs shall not be deemed to be a third party.

Article 5. JAXA's Performance for Research Projects

JAXA shall make reasonable efforts to perform the following tasks related to the Research Projects:

a) Deliver the Earth Observation Satellite Data to the PI;

b) Provide satellite operation data, ground validation data and meteorological data;

c) Evaluate the Research Result and the Progress Reports (as defined below) for the Annual Evaluation and send the results to the PI; and

d) Hold workshops and meetings to evaluate the Research Results and the Progress Reports and to promote information exchange among PIs and JAXA.

Article 6. The Research Organization's General Responsibilities for Research Projects

1. The Research Organization shall conduct and complete the Research Projects in accordance with the Collaborative Research Plan.

2. For the purpose of ensuring the Research Organization's performance of the above obligations, the Research Organization shall perform certain actions including, but not limited to:

a) Participate in necessary workshops and meetings for the Research Projects and report upon request from JAXA;

b) Deliver periodically to JAXA the Research Results and the reports ("Progress Reports") in the form specified by JAXA, and in all instances, at least one (1) month before the Annual Evaluation;

c) Deliver the reports as a final report ("Final Reports") by the end of the Agreement Term; and

d) Take necessary measures to ensure the PI's and/or CI's compliance with this Agreement.

Article 7. Research Funding

1. The Confirmation Sheet identifies the amount of funding to be provided by JAXA to the Research.
Organization for the Research Projects ("Research Funding"). JAXA shall, within thirty (30) days from the date when JAXA receives an invoice duly issued by the Research Organization, make payment for the Research Funding by wire transfer. All payments stipulated in this Agreement shall include any charges, taxes or duties levied by any official authorities of the country where the Research Organization exists.

2. If JAXA fails to pay the Research Funding within the above period, JAXA shall pay to the Research Organization default interest of six (6) percent per annum on such unpaid amount for the period from the immediately succeeding day of due date for payment to the date of actual payment; provided, however, that if such nonpayment was due to an Act of God or any other reasons outside of the control of JAXA, the period for which such reasons exist shall not be counted in the number of days subject to payment of default interest.

3. The Research Organization shall submit Budget Summary as attachment of Commissioned Work Plan at the beginning of every Japanese fiscal year. The Research Organization shall report to JAXA in advance if there is a need to reallocate the budget between Expense Item Categories of Budget Summary. For the reallocation in the amount of Expense Item Categories for over 30% or 500,000 Japanese yen, in case the amount of 30% is less than 500,000 Japanese yen, or increase in the personnel cost, the Research Organization shall resubmit the revised Budget Summary for approval in advance.

4. Throughout the performance of the Agreement, the Research Organization shall maintain books, records, logs, documents and other evidence sufficient to record all actions taken with respect to the completion of the Research Project. The Research Organization shall agree to allow JAXA to inspect, copy, and audit such books, records, documents and other evidence at any reasonable time. The Research Organization shall keep all the accounting documents for 5 (five) years after the end of the research period.

5. If the original contract amount or the amended contract amount, if there is any amendment to the original contract amount, is 1 (one) million Japanese yen or more, the Research Organization shall submit fiscal financial statement by the end of each Japanese fiscal year. JAXA shall review the fiscal financial statement, determine the final contract amount which should be within the limit of the original or the amended contract amount, and notify the final contract amount to the Research Organization. When the amount paid by JAXA in accordance with paragraph 1 above exceeds the final contract amount and the excess payment needs to be reimbursed, the Research Organization is required to make the reimbursement. If the Research Organization fails to pay the reimbursement, the procedure described in paragraph 2 above shall apply.

Article 8. Subcontract
The Research Organization shall not re-commission the whole Research Projects to a third party.
Provided, however, that the Research Organization may re-commission part of it upon prior written approval of JAXA. Should there be a case where subcontractors re-commission part of the Research Projects to a third party, the company name, address and scope of business of such third party are required to be submitted to the Research Organization in writing. If the Research Organization re-commission the Research Projects to a third party at any tier, any act of such third party in connection with the subcontract shall be deemed to be an act of the Research Organization and the Research Organization shall be responsible therefore.

Article 9. Providing of Earth Observation Satellite Data by JAXA

1. JAXA will provide the Research Organization with the Earth Observation Satellite Data for the Research Projects free of charge subject to the following conditions:
   a) The Research Organization agrees and accepts that JAXA may not provide all the Earth Observation Satellite Data which the Research Organization may request;
   b) JAXA does not guarantee a specific quality or the timely provision of the Earth Observation Satellite Data;
   c) The Advance Land Observing Satellite data, which is one portion of the Earth Observation Satellite Data and is to be provided to the Research Organization, shall be limited to ten scenes every fiscal year; and
   d) JAXA reserves the right to curtail or suspend Earth Observation Satellite Data supply to the Research Organization due to faults or difficulties relating to the satellites, limitations on their operations, or any other reasons.

2. With respect to the Earth Observation Satellite Data provided by JAXA, the Research Organization shall:
   a) Only use the Earth Observation Satellite Data for the singular purpose of advancing the efforts of the Research Projects;
   b) Not duplicate the Earth Observation Satellite Data except for distributing to authorized CIs the necessary data backups;
   c) Not distribute the Earth Observation Satellite Data to any third party without JAXA's prior written consent; and
   d) Return or otherwise appropriately manage the Earth Observation Satellite Data upon completion of this Agreement, according to the directives of JAXA.

3. Any rights regarding the Earth Observation Satellite Data provided by JAXA shall conform to the following:
   a) Any rights relating to the Earth Observation Satellite Data shall belong to JAXA or to an institute designated by JAXA except in the case mentioned in b) below; and
   b) If value-added products, which mean highly processed products that do not retain the original
Article 10. Providing of Meteorological Data by JAXA

1. For the purpose of performing the Research Projects, JAXA will attempt to provide the Research Organization with the meteorological data provided by the Japan Meteorological Agency pursuant to the agreement between JAXA and the Japan Meteorological Agency ("Meteorological Data"). The Research Organization agrees that JAXA’s provision of the Meteorological Data may be limited or otherwise affected by the fact that some rights to the Meteorological Data belong to the Japan Meteorological Agency.

2. The Research Organization shall use the provided Meteorological Data solely for the purpose of conducting the Research Projects. The Research Organization may not disclose the provided Meteorological Data to any third party.

3. The Research Organization shall return or otherwise appropriately keep the Meteorological Data in accordance with the instructions of JAXA upon the termination of this Agreement.

Article 11. Disclosure of Technical Data

1. To the extent feasible, each party shall disclose all necessary technical data ("Technical Data") which does not include the Earth Observation Satellite Data and the Meteorological Data. The Parties will undertake to handle expeditiously any request for the Technical Data presented by the other party.

2. The Technical Data shall be used and/or disclosed by the receiving party only for the purpose of fulfilling the receiving party's responsibilities under this Agreement. The receiving party shall protect any such Technical Data from unauthorized use and/or disclosure.

3. The Technical Data shall not be disclosed, duplicated or used by persons or entities other than the receiving party without the prior consent of the furnishing party.

4. According to directives of the furnishing party, the receiving party shall return or otherwise dispose of Technical Data provided under the Agreement upon completion of the activities under the Agreement.

Article 12. Ownership and Usage of Research Results

1. All Research Results shall be jointly owned by the Parties ("Jointly-Owned Research Results") unless one party reasonably proves that it solely generates the Research Results solely in the course of the Research Projects. For the avoidance of doubt, only if the product is the result of the
Research Organization's sole work and sole funding shall such product be deemed to be the solely generated Research Results by the Research Organization.

2. Generally, JAXA and the Research Organization shall enter into a separate agreement and obtain the consent of the other party with regard to the usage of Jointly-Owned Research Results. However, if each party uses such Jointly-Owned Research Results peacefully (i.e., non-military purposes) and for non-commercial purposes, consent of the other party is not required. In the event that a party intends to grant a third party a license to use such Jointly-Owned Research Results, the party shall obtain the prior written consent from the other party.

3. In the event that the Research Organization solely owns some portion of the Research Results, the Research Organization hereby grants and will be deemed to have granted to JAXA an irrevocable, royalty-free, non-exclusive, worldwide right to use such Research Results (and derivative works thereof including Progress Reports and Final Reports); provided, however, JAXA shall use such Research Results (and derivative works thereof including Progress Reports and Final Reports) for its own research and development work including, but not limited to, the granting to commissioned research organizations and/or collaborating research organizations the use of such Research Results (and derivative works thereof).

4. With regard to copyrights in the Progress Reports and Final Reports, regardless of whether they relate to the Research Organization's Research Result or not, the Research Organization waives and shall cause its directors, officers, employees including PIs and CIs, regardless of whether such persons are employed by the Research Organization, to waive any related moral rights to the copyrights in the Progress Reports and Final Reports and agrees not to rescind such waivers and shall cause such directors, officers, employees including PIs and CIs to agree not to rescind such waiver.

Article 13. Publication of Research Results

1. Regardless as to whether the Research Results are owned solely or jointly, if either party intends to publish the Research Results which are owned by the other party, the publishing party shall provide the other party with a written document regarding the description of the subject Research Results to be published and request a written consent of the other party. The other party will not unreasonably withhold consent from the publishing party's request for such publication.

2. Before publishing, the publishing party shall provide the other party with a copy of the publication. Each party is entitled to an irrevocable and royalty-free right to use the provided publications, unless the copyright of such publication is owned or held by an academic society.

3. The Research Organization shall state in the publication that such Research Results have been obtained pursuant to this Agreement and identify the owner of the rights to the Earth Observation Satellite Data and Meteorological Data used in such publication.
4. In the event that a PI or CI wishes to publish or disclose the Research Results, the Research Organization shall cause the PI and/or CI to act in accordance with the terms and conditions of this Article and shall cause the PI and/or CI to grant JAXA an irrevocable and royalty-free right to use the provided publications, unless the copyright of the paper belongs to an academic society.


1. All Intellectual Property Rights generated in the course of the Research Projects shall be jointly owned by the Parties unless such rights are deemed to be Solely-Owned Intellectual Property as defined in Article 15 below. JAXA or the Research Organization shall give the other party prompt written notice of Intellectual Property Rights generated and discuss the ownership of such generated Intellectual Property Rights, as well as whether it is necessary to submit an application for registration of such Intellectual Property Rights.

2. JAXA and the Research Organization shall enter into a separate joint ownership agreement ("Joint Ownership Agreement") unless they decide not to make an application for the registration of the resulting Intellectual Property Rights. The Joint Ownership Agreement shall provide the allocation of Intellectual Property Rights related to, or the allocation of an interest in, such joint innovation or work.

3. After entering into the Joint Ownership Agreement, JAXA and the Research Organization shall take the necessary procedures to secure the joint ownership of the Intellectual Property Rights.

4. JAXA and/or Research Organization shall take any necessary procedures for any Industrial Property Rights owned by and/or held by each employees to be transferred by such employee to JAXA or the Research Organization in the event the employees' inventions and the Industrial Property Rights related thereto were created or otherwise arose within the scope of the Research Organization's business.

5. If a party alters or improves the Jointly-Owned Intellectual Property within one (1) year from the completion of this Agreement, the party shall provide a written notice to the other party describing the alterations or improvements.

6. A party may grant to any third party a license to use the Jointly-Owned Intellectual Property Rights, provided, however that the relevant party shall obtain the written prior consent of the other party, and determine the licensing terms after discussion with the other party. In this case, the relevant party shall collect the usage fee from such third party as set forth in the separate usage agreement. The usage fee to be collected from the third party shall be distributed between JAXA and Research Organization pro rata in proportion to their respective interests in those rights.

7. JAXA and the Research Organization may transfer their respective interests to the Jointly-Owned Intellectual Property Rights only to their respective designees after discussion between JAXA and the Research Organization pursuant to a separate transfer agreement. In this event, the relevant
party shall cause its designee to succeed to all of its rights and obligations with respect to those Intellectual Property Rights.

8. If JAXA or the Research Organization disclaims its interests in the Jointly-Owned Intellectual Property Rights, the relevant party shall give the other party prior notice thereof and transfer its interests to the other party, only if the other party wishes to acquire it.

9. Any expenses, costs and charges required for the application procedure and protection of the Jointly-Owned Intellectual Property Rights shall be borne by JAXA and Research Organization pro rata in proportion to their respective interests.

**Article 15. Solely-Owned Intellectual Property Rights**

1. If a party solely generates Potential Intellectual Property Rights in the course of the Research Projects ("Solely-Owned Intellectual Property Rights") the party shall notify such fact to the other party without delay. In this case, the party may take steps to apply for the registration of the resulting Intellectual Property Rights as solely-owned ones at its own expense, provided that it shall obtain prior confirmation of the other party. For the avoidance of doubt, only if Potential Intellectual Property Rights are generated or created by the Research Organization's sole work and sole funding shall such Potential Intellectual Property Rights be deemed to be solely generated or created by the Research Organization.

2. In the event of an emergence of Solely-Owned Intellectual Property Rights, the Research Organization and/or the PI shall grant JAXA an irrevocable, royalty-free and non-exclusive right to use such Intellectual Property Rights for JAXA's own research and development.

**Article 16. Termination and Refund**

1. Either party may terminate the Agreement:
   a) When the other party commits a dishonest and/or inequitable act that irreparably harms the mutual trust between the Parties; provided, that breaching party fails to offer any effective and satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party;
   b) When the other party violates any of the terms and conditions of this Agreement provided that the breaching party fails to offer any effective and/or satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party; or
   c) Upon the consent of both Parties.

2. Upon the termination of the Agreement, the Research Organization shall promptly deliver to JAXA all work including, but not limited to, all works in progress and all work that is completed and otherwise ready for delivery.

3. If the Agreement is terminated as set forth in the preceding paragraph, the Research Organization
shall refund to JAXA any unexpended Research Funding. The Research Organization shall remit such funds within thirty (30) days from the date when the Research Organization receives an invoice issued by JAXA with regard to such funds.

**Article 17. Ownership of the Rights to the Acquired Equipments**

1. The Research Organization shall transfer, upon the expiration of this Agreement, all rights and ownership in the equipment acquired by the Research Organization with the Research Funding; provided, however, that JAXA and the Research Organization may determine through mutual agreement that any or all such rights and ownership will be retained by the Research Organization.

2. The Research Organization shall manage the equipment acquired with the Research Funding (if any) with the care of a good manager. Such equipment shall be listed in a “List of Property” which should be submitted to JAXA at the end of each Japanese fiscal year.

**Article 18. Limitations on Liabilities**

JAXA and the Research Organization agree to waive any claim against the other with respect to damage of any kind, or any loss of its own property or property of its related entities arising out of activities under this Agreement (“Damages”), except such Damages which arise through gross negligence or willful misconduct and except Intellectual Property Rights.

**Article 19. Confidentiality**

1. In this Agreement, "Confidential Information" means any information that a party discloses or presents in writing or in by other media, to the other party in the course of these Research Projects, provided however, Confidential Information does not include the following:
   a) Information that is already known to the public when disclosed by the disclosing party;
   b) Information that becomes known to the public after the disclosure by the disclosing party without intentional misconduct or negligence of the receiving party;
   c) Information that the receiving party already had before the disclosure by the disclosing party;
   d) Information that the receiving party acquires from a dully authorized third party not subject to confidentiality obligations;
   e) Information that the receiving party independently develops without utilizing information obtained from the disclosing party;
   f) Information with a prior written consent of the disclosing party for the disclosure and the publication; or
   g) Information that is required to be disclosed by applicable laws, judgment or order of a competent court. In this case, the receiving party shall promptly notify the disclosing party of
the necessity of disclosure.

2. The receiving party shall keep the Confidential Information secret, and shall not disclose or divulge any Confidential Information to a third party without prior written consent of the disclosing party.

3. The confidentiality obligation under this Article shall remain effective for a period of five (5) years after the termination of the Agreement. However this period of keeping confidentiality may be extended or shortened by mutual agreement.

Article 20. Designation of Know-How

1. After mutual agreement by the Parties, JAXA and the Research Organization shall promptly designate as know-how the Research Results which are appropriately to be treated as know-how ("Know-How").

2. After designating the Know-How, such Know-How should be kept in confidence in principle, for five (5) years commencing on the day immediately following the date of the completion of this Agreement; provided, however, that JAXA and the Research Organization may extend or shorten that period upon mutual agreement.

Article 21. Government Approvals

Each party shall obtain such permits, licenses, and other government authorizations as are required for it to perform its responsibilities under the Agreement, and shall comply with all respective laws and regulations.

Article 22. Language

All communications between the Research Organization and JAXA under this Agreement shall be in English.

Article 23. Special Agreement

Any supplement, modification or amendment of this Agreement shall only be binding if made upon the Parties' mutual written agreement which makes specific reference to this Agreement.

Article 24. Dispute Resolution

The Parties agree to put forth their best efforts to solve amicably any dispute, controversy, or difference arising out of, in connection with, or resulting from this Agreement.

Article 25. Arbitration

All disputes that cannot be amicably settled by the method defined in the previous Article hereof
will be settled in Tokyo by non-binding arbitration.

**Article 26. Governing Law**

The Agreement shall be governed and interpreted under the laws of Japan.
## Attachment A  “Earth Observation Satellite Data”

<table>
<thead>
<tr>
<th>Name of Satellite or Sensor</th>
<th>Observation Period (YY/MM/DD)</th>
<th>Observable Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS (Advanced Land Observation Satellite)</td>
<td>2006/05/16～</td>
<td>Global</td>
</tr>
<tr>
<td>MOS (Marine Observation Satellite)</td>
<td>1987/02/23～1996/04/19</td>
<td>Around Japan, Antarctic and Southeast Asia</td>
</tr>
<tr>
<td>JERS (Japanese Earth Observation Satellite)</td>
<td>1992/09/01～1998/10/11</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS (Advanced Earth Observation Satellite)</td>
<td>1996/10/15～1997/6/29</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS-II (Advanced Earth Observation Satellite-II)</td>
<td>2003/01/18～2003/10/24</td>
<td>Global</td>
</tr>
<tr>
<td>AMSR-E (Advanced Microwave Scanning Radiometer for EOS-Aqua satellite)</td>
<td>2002/06/19～</td>
<td>Global</td>
</tr>
<tr>
<td>TRMM (Tropical Rainfall Measuring Mission)</td>
<td>1997/12/01～</td>
<td>Global</td>
</tr>
<tr>
<td>ERS (European Remote-Sensing Satellite)</td>
<td>1991/08/18～2003/03/29</td>
<td>Around Japan and Antarctic</td>
</tr>
<tr>
<td>LANDSAT* (Land Satellite)</td>
<td>1979/02/19～2002/03/31</td>
<td>Around Japan</td>
</tr>
</tbody>
</table>

* LANDSAT-5 data received by 2001/3/31 will be available in the dataset.
COLLABORATIVE RESEARCH AGREEMENT (NON-FUNDED)
FOR THE
GLOBAL CHANGE OBSERVATION MISSION
BETWEEN THE
JAPAN AEROSPACE EXPLORATION AGENCY (JAXA)
AND
THE RESEARCH ORGANIZATION
(FOR THE RESEARCH ANNOUNCEMENT)

JAPAN AEROSPACE EXPLORATION AGENCY
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COLLABORATIVE RESEARCH AGREEMENT

This agreement ("Agreement") is entered into between the Japan Aerospace Exploration Agency, established under the provision of the Law Concerning the Japan Aerospace Exploration Agency on October 1, 2003, represented by its President and having its principal office at 7-44-1 Higashimachi, Jindaiji, Choufu-shi, Tokyo, Japan ("JAXA") and a research organization ("Research Organization") that submitted an application form for the below described research activities to JAXA, hereinafter collectively referred to as "the Parties."

WITNESSETH

WHEREAS, the Global Change Observation Mission ("GCOM") aims to construct, use, and verify systems that enable continuous global-scale observations of effective geophysical parameters for clarifying global climate change and water circulation mechanisms;

WHEREAS, JAXA issued the Research Announcement ("RA") to engage in collaborative research activities directly related to retrieval algorithms for geophysical products, product validation, and data application of GCOM, and the Research Organization applied pursuant to such RA;

WHEREAS, JAXA accepted the Research Organization's proposal that was in response to the RA, delivered the confirmation sheet to the Research Organization and JAXA further desires to utilize such proposal in JAXA's project; and

WHEREAS, JAXA desires to engage in the above research activities in collaboration with the Research Organization.

NOW, THEREFORE, in consideration of the mutual agreements hereinafter set forth, and for other good and reasonable consideration, the receipt and adequacy of which are hereby acknowledged, the Parties hereby agree as follows:

Article 1. Definitions

The following capitalized terms shall have the following meanings:

"Annual Evaluation" means JAXA's annual review, which is scheduled by JAXA at the end of each
Japanese fiscal year, of the Research Results (as defined below) from the PIs.

"Application Form" means the application form for the Research Projects (as defined below) submitted by the Research Organization.

"Co-Investigator" ("CI") means a person who supports the PI (as defined below) in performing the Research Projects (as defined below) with approval by JAXA.

"Collaborative Research Plan" means the plan described in Attachment A of the Application Form.

"Confirmation Sheet" means the confirmation sheet or the acceptance form prescribed by JAXA with regard to the Application Form.

"Earth Observation Satellite Data" means data sets obtained from satellites which are retained by JAXA at the time of execution of this Agreement. The available data sets (including names of satellites, sensors, observation period that can be offered, and observation areas) are listed in Attachment A of this Agreement.

"Intellectual Property Rights" means the following:
   (i) Industrial Property Rights (as defined below);
   (ii) Potential Industrial Property Rights (as defined below); and
   (iii) Program/Data Copyrights (as defined below).

"Industrial Property Rights" means all domestic and foreign patents, utility models, and industrial designs.

"Potential Industrial Property Rights" means all domestic and foreign application rights for patents, utility models, or industrial designs.

"Principal Investigator" ("PI") means the Research Organization employee who was selected to be responsible for the Research Projects, and who is named in the Collaborative Research Plan.

"Program/Data Copyrights" means all domestic and foreign copyrights related to computer programs, software and databases.

"Research Projects" has the meaning given to it in Article 2, Paragraph 2.
"Research Results" means the technical results and scientific knowledge derived from the implementation of the Research Projects pursuant to this Agreement, including all inventions, ideas, designs, literary works, algorithms, and technological developments, such as programs, that can execute the algorithm(s).

**Article 2. Purpose and Scope of Research Projects**

1. Under the terms and conditions of this Agreement, JAXA and the Research Organization hereby agree to work in collaboration with regard to the research activities as set forth in the RA, and/or the Collaborative Research Plan and/or otherwise under this Agreement.

2. The Parties' research activities ("Research Projects") shall be carried out in accordance with the Collaborative Research Plan.

**Article 3. Effective Term**

1. The Agreement shall become effective as of the date of the issuance of the Confirmation Sheet prescribed by JAXA and shall continue in effect until the end of each Japanese Fiscal Year ("Agreement Term").

2. The Research Organization may renew the Agreement annually under the same terms and conditions provided that JAXA approves an extension of the research period in the Annual Evaluation; provided, however, the Research Organization shall submit a renewal Application Form to JAXA and JAXA shall issue a new Confirmation Sheet; further provided, however, that the Agreement Term shall not extend beyond March 31, 2011.

3. Termination of this Agreement shall not affect a Party's continuing obligation under Paragraph 2 and 3 of Article 8, Article 11, Article 12, Article 13, Article 14, Article 22, Article 23 and Article 24.

**Article 4. Researchers**

1. In the event that the PI dies, retires from the Research Organization, takes a leave absent from work, or come to be no longer engaged in the Research Projects, the Research Organization shall immediately notify to JAXA as such and JAXA may at its sole discretion terminate this Agreement; provided however, if the RO designates a researcher who belongs to the Research Organization as the PI's successor and JAXA approves the succession, the Parties may amend this Agreement, with the succeeding researcher being a new PI. The terms and conditions of the amendment to this Agreement shall be determined upon mutual consultation and consent.

2. In the event that the Research Organization intends to select or add CIs, the Research Organization
shall first obtain the consent of JAXA for such personnel. The Research Organization shall submit to JAXA the list of such candidates of CIs and consult with JAXA in order to obtain JAXA's consent.

3. The Research Organization shall supervise the PI's and CI's engaging in the Research Projects and shall ensure all PI's and/or CI's engaging in the Research Projects in accordance with the terms and conditions of the Agreement. For the avoidance of doubt, with regard to this Agreement, the PIs and CIs shall not be deemed to be a third party.

Article 5. JAXA's Performance for Research Projects
JAXA shall make reasonable efforts to perform the following tasks related to the Research Projects:
   a) Deliver the Earth Observation Satellite Data to the PI;
   b) Provide satellite operation data, ground validation data and meteorological data;
   c) Evaluate the Research Result and the Progress Reports (as defined below) for the Annual Evaluation and send the results to the PI; and
   d) Hold workshops and meetings to evaluate the Research Results and the Progress Reports and to promote information exchange among PIs and JAXA.

Article 6. The Research Organization's General Responsibilities for Research Projects
1. The Research Organization shall conduct and complete the Research Projects in accordance with the Collaborative Research Plan.
2. For the purpose of ensuring the Research Organization's performance of the above obligations, the Research Organization shall perform certain actions including, but not limited to:
   a) Participate in necessary workshops and meetings for the Research Projects and report upon request from JAXA;
   b) Deliver periodically to JAXA the Research Results and the reports ("Progress Reports") in the form specified by JAXA, and in all instances, at least one (1) month before the Annual Evaluation;
   c) Deliver the reports as a final report ("Final Reports") by the end of the Agreement Term; and
   d) Take necessary measures to ensure the PI's and/or CI's compliance with this Agreement.

Article 7. Research Funding
There will be no exchange of funds under this agreement. Each party shall bear necessary costs to fulfill its own responsibilities under this agreement.

Article 8. Providing of Earth Observation Satellite Data by JAXA
1. JAXA will provide the Research Organization with the Earth Observation Satellite Data for the
Research Projects free of charge subject to the following conditions:

a) The Research Organization agrees and accepts that JAXA may not provide all the Earth Observation Satellite Data which the Research Organization may request;
b) JAXA does not guarantee a specific quality or the timely provision of the Earth Observation Satellite Data;
c) The Advance Land Observing Satellite data, which is one portion of the Earth Observation Satellite Data and is to be provided to the Research Organization, shall be limited to ten scenes every fiscal year; and
d) JAXA reserves the right to curtail or suspend Earth Observation Satellite Data supply to the Research Organization due to faults or difficulties relating to the satellites, limitations on their operations, or any other reasons.

2. With respect to the Earth Observation Satellite Data provided by JAXA, the Research Organization shall:

a) Only use the Earth Observation Satellite Data for the singular purpose of advancing the efforts of the Research Projects;
b) Not duplicate the Earth Observation Satellite Data except for distributing to authorized CIs the necessary data backups;
c) Not distribute the Earth Observation Satellite Data to any third party without JAXA's prior written consent; and
d) Return or otherwise appropriately manage the Earth Observation Satellite Data upon completion of this Agreement, according to the directives of JAXA.

3. Any rights regarding the Earth Observation Satellite Data provided by JAXA shall conform to the following:

a) Any rights relating to the Earth Observation Satellite Data shall belong to JAXA or to an institute designated by JAXA except in the case mentioned in b) below; and
b) If value-added products, which mean highly processed products that do not retain the original pixel structure and that cannot be converted back to the primary Earth Observation Satellite Data, are developed in the course of executing the Research Projects, the ownership of such products shall be determined upon mutual agreement between the Parties, taking into consideration the degrees of contribution by JAXA and the Research Organization.

**Article 9. Providing of Meteorological Data by JAXA**

1. For the purpose of performing the Research Projects, JAXA will attempt to provide the Research Organization with the meteorological data provided by the Japan Meteorological Agency pursuant to the agreement between JAXA and the Japan Meteorological Agency ("Meteorological Data"). The Research Organization agrees that JAXA's provision of the Meteorological Data may be
limited or otherwise affected by the fact that some rights to the Meteorological Data belong to the Japan Meteorological Agency.

2. The Research Organization shall use the provided Meteorological Data solely for the purpose of conducting the Research Projects. The Research Organization may not disclose the provided Meteorological Data to any third party.

3. The Research Organization shall return or otherwise appropriately keep the Meteorological Data in accordance with the instructions of JAXA upon the termination of this Agreement.

Article 10. Disclosure of Technical Data

1. To the extent feasible, each party shall disclose all necessary technical data ("Technical Data") which does not include the Earth Observation Satellite Data and the Meteorological Data. The Parties will undertake to handle expeditiously any request for the Technical Data presented by the other party.

2. The Technical Data shall be used and/or disclosed by the receiving party only for the purpose of fulfilling the receiving party's responsibilities under this Agreement. The receiving party shall protect any such Technical Data from unauthorized use and/or disclosure.

3. The Technical Data shall not be disclosed, duplicated or used by persons or entities other than the receiving party without the prior consent of the furnishing party.

4. According to directives of the furnishing party, the receiving party shall return or otherwise dispose of Technical Data provided under the Agreement upon completion of the activities under the Agreement.

Article 11. Ownership and Usage of Research Results

1. All Research Results shall be jointly owned by the Parties ("Jointly-Owned Research Results") unless one party reasonably proves that it solely generates the Research Results solely in the course of the Research Projects. For the avoidance of doubt, only if the product is the result of the Research Organization's sole work and sole funding shall such product be deemed to be the solely generated Research Results by the Research Organization.

2. Generally, JAXA and the Research Organization shall enter into a separate agreement and obtain the consent of the other party with regard to the usage of Jointly-Owned Research Results. However, if each party uses such Jointly-Owned Research Results peacefully (i.e., non-militaristic purposes) and for non-commercial purposes, consent of the other party is not required. In the event that a party intends to grant a third party a license to use such Jointly-Owned Research Results, the party shall obtain the prior written consent from the other party.

3. In the event that the Research Organization solely owns some portion of the Research Results, the Research Organization hereby grants and will be deemed to have granted to JAXA an irrevocable,
royalty-free, non-exclusive, worldwide right to use such Research Results (and derivative works thereof including Progress Reports and Final Reports); provided, however, JAXA shall use such Research Results (and derivative works thereof including Progress Reports and Final Reports) for its own research and development work including, but not limited to, the granting to commissioned research organizations and/or collaborating research organizations the use of such Research Results (and derivative works thereof).

4. With regard to copyrights in the Progress Reports and Final Reports, regardless of whether they relate to the Research Organization's Research Result or not, the Research Organization waives and shall cause its directors, officers, employees including PIs and CIs, regardless of whether such persons are employed by the Research Organization, to waive any related moral rights to the copyrights in the Progress Reports and Final Reports and agrees not to rescind such waivers and shall cause such directors, officers, employees including PIs and CIs to agree not to rescind such waiver.

Article 12. Publication of Research Results

1. Regardless as to whether the Research Results are owned solely or jointly, if either party intends to publish the Research Results which are owned by the other party, the publishing party shall provide the other party with a written document regarding the description of the subjected Research Results to be published and request a written consent of the other party. The other party will not unreasonably withhold consent from the publishing party's request for such publication.

2. Before publishing, the publishing party shall provide the other party with a copy of the publication. Each party is entitled to an irrevocable and royalty-free right to use the provided publications, unless the copyright of such publication is owned or held by an academic society.

3. The Research Organization shall state in the publication that such Research Results have been obtained pursuant to this Agreement and identify the owner of the rights to the Earth Observation Satellite Data and Meteorological Data used in such publication.

4. In the event that a PI or CI wishes to publish or disclose the Research Results, the Research Organization shall cause the PI and/or CI to act in accordance with the terms and conditions of this Article and shall cause the PI and/or CI to grant JAXA an irrevocable and royalty-free right to use the provided publications, unless the copyright of the paper belongs to an academic society.


1. All Intellectual Property Rights generated in the course of the Research Projects shall be jointly owned by the Parties unless such rights are deemed to be Solely-Owned Intellectual Property as defined in Article 14 below. JAXA or the Research Organization shall give the other party prompt written notice of Intellectual Property Rights generated and discuss the ownership of such
generated Intellectual Property Rights, as well as whether it is necessary to submit an application for registration of such Intellectual Property Rights.

2. JAXA and the Research Organization shall enter into a separate joint ownership agreement ("Joint Ownership Agreement") unless they decide not to make an application for the registration of the resulting Intellectual Property Rights. The Joint Ownership Agreement shall provide the allocation of Intellectual Property Rights related to, or the allocation of an interest in, such joint innovation or work.

3. After entering into the Joint Ownership Agreement, JAXA and the Research Organization shall take the necessary procedures to secure the joint ownership of the Intellectual Property Rights.

4. JAXA and/or Research Organization shall take any necessary procedures for any Industrial Property Rights owned by and/or held by each employees to be transferred by such employee to JAXA or the Research Organization in the event the employees' inventions and the Industrial Property Rights related thereto were created or otherwise arose within the scope of the Research Organization's business.

5. If a party alters or improves the Jointly-Owned Intellectual Property within one (1) year from the completion of this Agreement, the party shall provide a written notice to the other party describing the alterations or improvements.

6. A party may grant to any third party a license to use the Jointly-Owned Intellectual Property Rights, provided, however that the relevant party shall obtain the written prior consent of the other party, and determine the licensing terms after discussion with the other party. In this case, the relevant party shall collect the usage fee from such third party as set forth in the separate usage agreement. The usage fee to be collected from the third party shall be distributed between JAXA and Research Organization pro rata in proportion to their respective interests in those rights.

7. JAXA and the Research Organization may transfer their respective interests to the Jointly-Owned Intellectual Property Rights only to their respective designees after discussion between JAXA and the Research Organization pursuant to a separate transfer agreement. In this event, the relevant party shall cause its designee to succeed to all of its rights and obligations with respect to those Intellectual Property Rights.

8. If JAXA or the Research Organization disclaims its interests in the Jointly-Owned Intellectual Property Rights, the relevant party shall give the other party prior notice thereof and transfer its interests to the other party, only if the other party wishes to acquire it.

9. Any expenses, costs and charges required for the application procedure and protection of the Jointly-Owned Intellectual Property Rights shall be borne by JAXA and Research Organization pro rata in proportion to their respective interests.

1. If a party solely generates Potential Intellectual Property Rights in the course of the Research Projects ("Solely-Owned Intellectual Property Rights") the party shall notify such fact to the other party without delay. In this case, the party may take steps to apply for the registration of the resulting Intellectual Property Rights as solely-owned ones at its own expense, provided that it shall obtain prior confirmation of the other party. For the avoidance of doubt, only if Potential Intellectual Property Rights are generated or created by the Research Organization's sole work and sole funding shall such Potential Intellectual Property Rights be deemed to be solely generated or created by the Research Organization.

2. In the event of an emergence of Solely-Owned Intellectual Property Rights, the Research Organization and/or the PI shall grant JAXA an irrevocable, royalty-free and non-exclusive right to use such Intellectual Property Rights for JAXA's own research and development.

Article 15. Termination

1. Either party may terminate the Agreement:

   a) When the other party commits a dishonest and/or inequitable act that irreparably harms the mutual trust between the Parties; provided, that breaching party fails to offer any effective and satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party;

   b) When the other party violates any of the terms and conditions of this Agreement provided that the breaching party fails to offer any effective and/or satisfactory remedial measures within seven (7) days after receiving demands for corrective action from the harmed party; or

   c) Upon the consent of both Parties.

2. Upon the termination of the Agreement, the Research Organization shall promptly deliver to JAXA all work including, but not limited to, all works in progress and all work that is completed and otherwise ready for delivery.

Article 16. Limitations on Liabilities

JAXA and the Research Organization agree to waive any claim against the other with respect to damage of any kind, or any loss of its own property or property of its related entities arising out of activities under this Agreement ("Damages"), except such Damages which arise through gross negligence or willful misconduct and except intellectual property rights.

Article 17. Confidentiality

1. In this Agreement, "Confidential Information" means any information that a party discloses or presents in writing or in by other media, to the other party in the course of these Research Projects,
provided however, Confidential Information does not include the following:

a) Information that is already known to the public when disclosed by the disclosing party;

b) Information that becomes known to the public after the disclosure by the disclosing party without intentional misconduct or negligence of the receiving party;

c) Information that the receiving party already had before the disclosure by the disclosing party;

d) Information that the receiving party acquires from a dully authorized third party not subject to confidentiality obligations;

e) Information that the receiving party independently develops without utilizing information obtained from the disclosing party;

f) Information with a prior written consent of the disclosing party for the disclosure and the publication; or

g) Information that is required to be disclosed by applicable laws, judgment or order of a competent court. In this case, the receiving party shall promptly notify the disclosing party of the necessity of disclosure.

2. The receiving party shall keep the Confidential Information secret, and shall not disclose or divulge any Confidential Information to a third party without prior written consent of the disclosing party.

3. The confidentiality obligation under this Article shall remain effective for a period of five (5) years after the termination of the Agreement. However this period of keeping confidentiality may be extended or shortened by mutual agreement.

**Article 18. Designation of Know-How**

1. After mutual agreement by the Parties, JAXA and the Research Organization shall promptly designate as know-how the Research Results which are appropriately to be treated as know-how ("Know-How").

2. After designating the Know-How, such Know-How should be kept in confidence in principle, for five (5) years commencing on the day immediately following the date of the completion of this Agreement; provided, however, that JAXA and the Research Organization may extend or shorten that period upon mutual agreement.

**Article 19. Government Approvals**

Each party shall obtain such permits, licenses, and other government authorizations as are required for it to perform its responsibilities under the Agreement, and shall comply with all respective laws and regulations.
Article 20. Language
All communications between the Research Organization and JAXA under this Agreement shall be in English.

Article 21. Special Agreement
Any supplement, modification or amendment of this Agreement shall only be binding if made upon the Parties' mutual written agreement which makes specific reference to this Agreement.

Article 22. Dispute Resolution
The Parties agree to put forth their best efforts to solve amicably any dispute, controversy, or difference arising out of, in connection with, or resulting from this Agreement.

Article 23. Arbitration
All disputes that cannot be amicably settled by the method defined in the previous Article hereof will be settled by arbitration in Tokyo in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association.

Article 24. Governing Law
The Agreement shall be governed and interpreted under the laws of Japan.
## Attachment A  “Earth Observation Satellite Data”

<table>
<thead>
<tr>
<th>Name of Satellite or Sensor</th>
<th>Observation Period (YY/MM/DD)</th>
<th>Observable Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS (Advanced Land Observation Satellite)</td>
<td>2006/05/16～</td>
<td>Global</td>
</tr>
<tr>
<td>MOS (Marine Observation Satellite)</td>
<td>1987/02/23～1996/04/19</td>
<td>Around Japan, Antarctic and Southeast Asia</td>
</tr>
<tr>
<td>JERS (Japanese Earth Observation Satellite)</td>
<td>1992/09/01～1998/10/11</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS (Advanced Earth Observation Satellite)</td>
<td>1996/10/15～1997/6/29</td>
<td>Global</td>
</tr>
<tr>
<td>ADEOS-II (Advanced Earth Observation Satellite-II)</td>
<td>2003/01/18～2003/10/24</td>
<td>Global</td>
</tr>
<tr>
<td>AMSR-E (Advanced Microwave Scanning Radiometer for EOS-Aqua satellite)</td>
<td>2002/06/19～</td>
<td>Global</td>
</tr>
<tr>
<td>TRMM (Tropical Rainfall Measuring Mission)</td>
<td>1997/12/01～</td>
<td>Global</td>
</tr>
<tr>
<td>ERS (European Remote-Sensing Satellite)</td>
<td>1991/08/18～2003/03/29</td>
<td>Around Japan and Antarctic</td>
</tr>
<tr>
<td>LANDSAT * (Land Satellite)</td>
<td>1979/02/19～2002/03/31</td>
<td>Around Japan</td>
</tr>
</tbody>
</table>

* LANDSAT-5 data received by 2001/3/31 will be available in the dataset.