Global Change Observation Mission
1st Research Announcement

AMSR2 on GCOM-W1
Algorithm, Validation, and Application

Issued: January 18, 2008
Proposal Due: April 14, 2008

Earth Observation Research Center
Japan Aerospace Exploration Agency

JAXA
Japan Aerospace Exploration Agency

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1. Introduction

As the first step in a series of the Global Change Observation Mission (GCOM) research announcements (RAs), the Japan Aerospace Exploration Agency (JAXA) announces the opportunity to conduct research activities directly related to retrieval algorithms for geophysical products, product validation, and data application of GCOM-W1, which is scheduled for launch in early 2012 as the first generation of GCOM-W (Water) series. This RA covers a three-year research period beginning in early Japanese Fiscal Year (JFY) 2008.

GCOM seeks to establish and demonstrate a global, long-term satellite observing system to measure essential geophysical parameters for understanding the global climate change and water cycle mechanism, and eventually contribute to improving future climate projection through a collaborative framework with climate model institutions. Demonstrating capabilities of operational applications through providing continuous data to operational agencies is another important purpose. 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 two satellite types and three consecutive generations with a one-year overlap, resulting in over a 13-year observation period. The two satellites are GCOM-W and GCOM-C (Climate). 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 for contributing to the understanding of the carbon cycle and radiation budget.

The AMSR2 instrument 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 AMSR aboard ADEOS-II and AMSR for the EOS (AMSR-E) that is currently in orbit gathering continuous data.

Through this announcement, JAXA is soliciting proposals contributing to the following areas (detailed technical information will be given in the next section).

- Algorithm Development

  Develop or improve retrieval algorithms to produce AMSR2 standard products. The GCOM project has set the success criteria using accuracies of standard products. Therefore, algorithm development and improvement are expected to meet the criteria to make the GCOM mission successful.

- Validation

  Prepare validation sites and/or methodologies for AMSR2 product validation. Effective validation activities collaborating with other science projects are expected.

- Application Research

  Perform research on monitoring environmental changes and improving future prediction and research leading to social benefits including practical applications such as monitoring of wind and flood disasters using AMSR-E and other data. Development of new research products of AMSR2 based on new ideas and needs is also solicited.

JAXA plans to select 10 to 20 proposals under this RA. The principal investigator (PI) of each selected proposal will become a member of the AMSR2 science team (name is provisional). The science team leader will be participating in the GCOM general board that will be the unique forum to discuss GCOM overall objectives and mission requirements. JAXA members from the Earth Observation Research Center (EORC) will work closely with the AMSR2 science team, particularly for testing and integrating retrieval algorithms.

For this RA, JAXA will give budget allocation priority to the areas of standard algorithm development to meet the product accuracy requirements. Although it will depend on the budget situation, JAXA plans to spend 50 to 75 million yen per year during the three-year RA period. JAXA may also select non-funded PIs for research not highly relevant to GCOM objectives. All categories of domestic and foreign organizations with nonprofit and peaceful purposes may apply under this RA. However, funding may differ for each research category and applicant. Funding by JAXA is basically restricted to domestic PIs, although some exceptions may be made for research necessary to realize the 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 2008. Descriptions of the GCOM mission, satellite and sensor systems, and definition of the products will be found in Appendix C.

2. Technical descriptions

2.1. Purposes of RA

To meet the mission objectives of GCOM-W1, which are to understand global environment variation and to improve its forecast accuracy, this RA invites research themes from both domestics and overseas. Research fields include research necessary to generate global, long-term, highly accurate and stable products utilizing and enhancing past achievements of ADEOS-II/AMSR, Aqua/AMSR-E and others, as well as research demonstrating climate variation and water cycle variation using those products.

2.2. Research areas

Research themes will be sought in the following three research areas based on the GCOM-W1 mission.

- Algorithm Development
- Validation
- Application Research

Since the research period of this RA covers the pre-launch phase, this RA will emphasize the field of "Algorithm Development." Details for each field are presented below.

(1) Algorithm Development

This research area encompasses research and development of geophysical retrieval algorithms and improvement of previously developed AMSR/AMSR-E algorithms. In addition, JAXA and PIs will jointly evaluate the algorithms and install these in JAXA computer systems. As described in chapter 5, this research theme is generally supported through a "Commissioned Research Agreement."

Table 1 lists geophysical parameters to be produced as standard products of the GCOM-W1 mission; their accuracies are defined as mission success criteria. Those accuracies were defined in consultation with users based on the performance of ADEOS-II/AMSR and Aqua/AMSR-E products. The "Data release" accuracy denotes minimum accuracy for the first data release, the "Standard" accuracy is defined as 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.

Algorithms accepted in this research area will produce standard products that meet requirements in Table 1 in the operational phase of the GCOM-W1 mission. Algorithms to produce geophysical products other than those listed in Table 1 will be considered research products and will be included in theme 3 "Application Research."

To meet the GCOM objectives, retrieval algorithms will require global applicability, robustness, long-term stability, and low cross talk. Algorithms that can be extended and applied for 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.

Table 1. GCOM-W1 Products

Product	Area	Resolution	Accuracy [1]			Range
			Data release	Standard	Goal	
Integrated water vapor	Global, over ocean	15km	± 3.5kg/m^2	± 3.5kg/m^2	± 2.0kg/m^2	0-70kg/m^2
Integrated cloud liquid water	Global, over ocean	15km	± 0.10kg/m^2	± 0.05kg/m^2	± 0.02kg/m^2	0-1.0kg/m^2
Precipitation	Global, except cold latitudes	15km	Ocean ± 50% Land ± 120%	Ocean ±50% Land ± 120%	Ocean ±20% Land ± 80%	0-20mm/h
Sea-surface temperature	Global, over ocean	50km	± 0.5°C	± 0.5°C	±0.2°C	-2 to 35°C
Sea-surface wind speed	Global, over ocean	15km	± 1.5m/s	± 1.0m/s	± 1.0m/s	0-30m/s
Sea-ice concentration	Polar region, over ocean	15km	± 10%	± 10%	± 5%	0-100%
Snow depth	Land	30km	± 20cm	± 20cm	± 10cm	0-100cm
Soil moisture	Land	50km	± 10%	± 10%	± 5%	0-40%

A) Integrated water vapor

The current algorithm for AMSR-E estimates vertically accumulated water vapor over global oceans, except sea ice and precipitating areas. Key points for algorithm development include the following.

- Use of analysis and forecast fields such as air temperature and sea surface winds derived from high-resolution numerical weather prediction models as prior information.
- Improvements of retrieval accuracy in thick and/or precipitating clouds.

B) Integrated cloud liquid water

The current algorithm for AMSR-E estimates vertically accumulated cloud liquid water over global oceans, except sea ice and precipitating areas. Key points for algorithm development include the following.

- Effective use of ancillary information on air temperature and sea surface wind speed with improved accuracy and increased frequency; retrieval considering vertical profiles of air temperature and water vapor.
- Comparison and algorithm improvement using active remote-sensing information including cloud lidar and radar.

C) Precipitation

The current algorithm for AMSR-E estimates surface precipitation over the entire globe. However, retrieval accuracy in high latitudes remains an issue. The precipitation algorithm for AMSR2 should be generalized and applicable to similar sensors considering use in the Global Precipitation Measurement (GPM) mission. Key points for algorithm development will include the following.

- Improvement of radiative transfer models considering non-spherical ice crystals.

1 Accuracy is defined as the root-mean-square error at an instantaneous value unless otherwise stated.

- Improvement of land-precipitation retrieval over various surface types such as snow areas.
- Retrieval of solid precipitation in high-latitude areas.
- Use of ancillary data including objective analysis data.

D) Sea surface temperature

The current algorithm for AMSR-E estimates sea surface temperature over the ocean except sea ice and heavy precipitation areas. Key points for algorithm development will include the following.

- Precise surface emissivity modeling considering environment conditions such as the temperature difference between the sea surface and atmosphere.
- Precise correction of wind direction effects.

E) Sea surface wind speed

The current algorithm for AMSR-E estimates sea-surface wind speed over the entire ocean, except sea ice and precipitating areas. Key points for algorithm development will include the following.

- Precise surface-emissivity modeling considering environment conditions such as temperature difference between the sea surface and atmosphere.
- Precise correction of wind direction effects.

F) Sea ice concentration

The current algorithm for AMSR-E estimates the sea ice concentration over the polar region and over oceans. Key points for algorithm development will include;

- Reduction of pseudo sea-ice areas near coastlines due to the radiometer's antenna sidelobes.
- Reduction of atmospheric effects (e.g., water vapor) particularly in lower latitude areas including the Sea of Okhotsk.
- Improvement of retrieval accuracy in marginal regions and over thin-ice areas.

G) Snow depth

The current algorithm for AMSR-E estimates snow depth over land, except ice sheets and thick forest regions. Key points for algorithm development will include the following.

- Consideration of underlying soil conditions.
- Separation of snow cover and no-snow areas in dry, cold regions.
- Seamless retrieval through all seasons from dry to melting conditions.
- Consideration of vegetation effects, particularly for snow over canopy.

H) Soil moisture

The current algorithm for AMSR-E estimates soil moisture over land including dry and cold areas, except ice sheets and thick forest regions. Key points for algorithm development will include the following.

- Development of a flexible algorithm considering vegetation types, soil texture, and surface roughness.

- Seamless and consistent retrieval of soil moisture starting from the snow-melting process.
- Estimation of soil ice content in cold regions (monitoring of the tundra region).

(2) Validation

Research themes related to the following validation activities will be adopted in this RA: research to prepare test sites and validation methods before GCOM-W1 launch, and research that will be effectively implemented by collaborating with other research programs. Research themes on implementing detailed validation after GCOM-W1 launch will be included in the second RA and later. As described in chapter 5, this research theme will generally be implemented through a "Collaborative Research Agreement."

(3) Application Research

Research themes related to the following application studies will be adopted in this RA: research that will use long-term satellite data, particularly AMSR-E data, to clarify global environmental changes and to improve its prediction accuracy, which are goals of GCOM, and research that will contribute to satisfying societal needs, such as development of operational usage of GCOM-W1 data for monitoring weather and water-related hazards. Research products based on new concepts or needs and combination with other satellites or sensors will also be adopted. Examples of research and combined products include the following.

- Cloud liquid water over ice and land.
- Precipitation over cold latitudes.
- Sea ice thickness.
- All-weather sea surface wind speed.
- Hydrological assimilation products over land.

As described in chapter 5, this research theme is generally implemented through a "Collaborative Research Agreement."

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-W1 mission's goals and to find new possibilities for utilizing GCOM-W1 data. Proposals should clearly describe plans for GCOM-W1 data usage.

3. Instructions for responding to this RA

3.1. Qualifications

If a proposal is for peaceful purposes and has non-commercial objectives, researchers belonging to all categories of domestic and foreign organizations including educational institutions, government offices, public companies, private enterprises and the 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. There are several types of associated terms and conditions of research agreements based on the category of research, funding, and domestic or overseas. Detailed information on contract matters are described in Section 5.

3.3. Research period

The total research period of this RA will be three years from JFY 2008. However, the performance will be evaluated based on an interim report at the end of each Japanese fiscal year in order to verify and decide whether the research is to be continued the next year. The 1st RA research period will be followed by the 2nd and 3rd RA activities depending on the condition of the GCOM project. Also, after government approval, JAXA may issue the RA for GCOM-C1 and interdisciplinary research using the entire GCOM dataset.

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 the "Algorithm Development" category, within JAXA's budget limitation. Proposals related to the "Validation" and "Application Research" may be funded depending on the importance and relevancy to the GCOM mission.

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

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

(2) Data sets

Data sets necessary for conducting research and owned by JAXA will basically be provided free of charge within the limitation of distribution capability. Available data sets, including AMSR and AMSR-E data, are listed in Appendix B. Provision of data sets that JAXA is not authorized to disclose will be discussed separately. The following policy shall be observed by participants for using satellite, in-situ, and other data sets provided through this RA.

A) Data sets shall be used only for research purposes that are proposed and selected under this RA.

B) Data sets shall not be disclosed to a third party or parties.

3.5. Obligations

PIs have different obligations depending on the funding status.

(1) Funded PIs shall submit to JAXA an interim report on the results at the end of each JFY and a final report at the end of the three-year 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 expense for participating in the workshop within funds provided by this RA.
(2) Non-funded PIs shall also submit an interim report and a final report. However, such reports can be substituted with papers published during the term. Participation in the workshop is highly recommended but not mandatory. Support of travel expense will depend on JAXA's budget.

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) The 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 immediately notify JAXA.

3.9. Cancellation and postponement

JAXA reserves the right to cancel this RA upon notice delivered by JAXA. In addition, JAXA assumes no liability for canceling this RA or for postponing this RA schedule.

3.10. Important dates

January 18, 2008 1st Research Announcement issued

April 14, 2008 Proposal Due Date

May 2008 Notification of Selection Results

3.11. Proposal submission and contact point

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

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

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

Mr. Hiroshi Sasaki (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:

Mr. Hiroshi Sasaki (GCOM RA Office)
Earth Observation Research Center
Tel: +81-29-868-2729
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 or patents from other institutions.
   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 format via E-mail.**
(2) Forms for cover sheet, work plan, and resource requirements can be found in Appendices A and B. No mandatory formats are applied to other parts of the proposal except the following.
   A) The page or paper size should be A4 or Letter size.
   B) The page number must appear at the middle of the bottom of each page, and the name of the applicant must appear in the upper right corner.
   C) Proposals should be word processing documents in either English or Japanese, with a font size not smaller than 12 points.
(3) Proposals should be brief and to the point, concentrating on substantive materials. The main body of the proposals should not exceed 20 pages in length. 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 the relevant category to which the proposal belongs.
   D) Information of applicants
      - Identifying information of PI.
        State the name, job title, organization, address, E-mail address, and telephone and facsimile numbers of the PI.
      - Identifying information of 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.
   E) Budget
      Provide a three-year budget broken down by year and the three-year total amount in Japanese Yen (from JFY 2008 through 2010).
   F) Endorsement
      Signature of a responsible official or authorized representative of the proposing organization, or any other person authorized to legally bind the 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 in length. 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) 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.

(6) 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 CIs in the research. State each CI's role in the proposed research.

(7) Resource requirements
Resource requirements should be described in the form indicated in Appendix B. Information of required resources will be considered during the selection process. After deciding the total amount of funding for each PI, JAXA will send more detailed forms for resource requirements to selected PIs for the final adjustment of funding. Before beginning the second and third years, 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, associated terms and conditions of research agreement, and an application form for making an agreement. Please note that JAXA will make an agreement with the organization to which the PI belongs, not to the PI or CI. The organization should submit the application form with the final research plan and final budget summary (only for funded organizations) that are agreed with JAXA according to the guidelines within the submission due date. The submission of the application form will be regarded as definite intention of making an agreement with JAXA, and the agreement will be effective upon issuance of confirmation sheet by JAXA.
(2) If JAXA determines that an extension of a research project is justified by the interim report at the end of the JFY, the research agreement will be extended for one year, within a limit of March 31, 2011. The organization will submit an application for extension to JAXA. However, funded organizations should submit the continuing agreement application form to JAXA at the beginning of the JFY.
(3) The organizations shall comply with terms and conditions defined in the research agreement.

5.2. Research agreement summary

(1) Type of research agreement
There are six types of associated terms and conditions of research agreements based on the applicable category of research, funding/non funding and domestic/overseas, and they are divided into the following two types.

A) Commissioned Research Agreement (Funding)

In principle, the "Commissioned Research Agreement" will be applied to research in the "Algorithm Development" category. The organization shall conduct the research according to the Statement of Work provided by JAXA. In this case, any result obtained through the execution of the research and also specified as a deliverable will belong to JAXA. However, the organization may retain the right to use the results for its own research purposes.

JAXA will provide necessary funds to the organization to conduct the research as described in the Statement of Work, and supply the Earth Observation Satellite Data to the organization. The organization shall submit an interim report and a final report to JAXA, participate in the workshops to report research progress. If this agreement is canceled or terminated, the organization shall refund to JAXA any unexpended funds which have already been paid by JAXA.

Commissioned Research Agreement is not applicable for Non-funding organizations.

B) Collaborative Research Agreement (Funding/Non-funding)

In principle, the "Collaborative Research Agreement" will be applied to research in "Validation" and "Application Research" categories. In this case, results obtained through the execution of the research will belong to each contributing party. JAXA will retain the right to use all results including results belonging to the organization for its own research purposes, without prior consent of the organization. There are two types of agreement (domestic/overseas) for JAXA funded and non-funded projects.

Difference between funding agreement and non-funding agreement

-Collaborative Research Agreement (Funding):
JAXA provides part of the research fund and the Earth Observation Satellite Data for the organization necessary for the implementation of the research. The organization shall submit an interim report and a final report to JAXA, participate in the workshops to report research progress. If this agreement is canceled or terminated, the organization shall refund to JAXA any unexpended funds which have already been paid by JAXA.

-Collaborative Research Agreement (Non-Funding):
JAXA provides the Earth Observation Satellite Data for the organization necessary for implementation of the research. 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, but not mandatory.

(2) Publication of results

Results derived from research activities will generally be published. A PI who wishes to release his or her research results to a third party shall

- Provide JAXA with a copy of the publication before release,
- State in the publication that he or she obtained the results through participating in this RA research,
- 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 Cover Sheet
JAXA GCOM Research Announcement

Proposal No.	_____ (Leave Blank for JAXA Use)
Title	
Research category (circle one)	Algorithm Validation Application

Principal Investigator

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

Co - Investigator

Name	Institution	Telephone	E-mail

Budget (thousand yen)

JFY2008	JFY2009	JFY2010	TOTAL

(Leave Blank for JAXA Use)

Authorizing Official: _____ _____
(Name and Title) (Institution)

Research Schedule

JFY	2008												2009												2010											
Month	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Milestone																																				
Activities																																				

APPENDIX B
RESOURCE REQUIREMENTS

BUDGET SUMMARY

1. Personnel Expenses

Outside EORC (unit: thousand yen)

	2008	2009	2010	TOTAL

2. Computers / Peripheral Equipment

2.1 EORC Lease Workstation

☐ Workstation

2.2 Peripherals / Software

(unit: thousand yen)

Peripherals / Software	2008	2009	2010	TOTAL

3. Subcontracts

(unit: thousand yen)

ITEM	2008	2009	2010	TOTAL

4. Expendable Materials and Supplies

ITEM (unit)	2008	2009	2010	TOTAL

5. Travel Expenses

(unit: days / times or days / travelers)

Departure Point – Destination	2008	2009	2010

6. Observation Equipment

(unit: thousand yen)

ITEM	2008	2009	2010	Total

7. Satellite Data

(unit: thousand yen)

Name of Satellite / Sensors	Distributor	Purpose	Cost			
			2008	2009	2010	TOTAL

8. Other Data

(unit: thousand yen)

Name of Datasets	Distributor	Purpose	Cost			
			2008	2009	2010	TOTAL

9. Others

(unit: thousand yen)

ITEM	2008	2009	2010	TOTAL

TOTAL				

BUDGET SUMMARY (***EXAMPLE***)

1. Personnel Expenses

Outside EORC (unit: thousand yen)

	2007	2008	2009	TOTAL
Part-time job for DSD data analysis	*320 (40x8)*	*320 (40x8)*	*160 (20x8)*	*800 (100x8)*

2. Computers / Peripheral Equipment

2.1 EORC Lease Workstation

☑ Workstation

2.2 Peripherals / Software

(unit: thousand yen)

Peripherals / Software	2007	2008	2009	TOTAL
CD-RW Drive	50			50

3. Subcontracts

(unit: thousand yen)

ITEMS	2007	2008	2009	TOTAL
Software development for DSD data analysis	*300*	*1,500*	*600*	*2,400*

4. Expendable Materials and Supplies

ITEMS (unit)	2007	2008	2009	TOTAL
8mm tape (112m)	*60*	*50*	*50*	*160*
CD-R	*100*	*100*	*120*	*320*
MO (640MB)	*10*	*15*	*10*	*35*
A4 Paper (package of 500 sheets)	*2*	*2*	*1*	*5*

5. Travel Expenses

(unit: days / times or days / travelers)

Departure Point – Destination	2007	2008	2009
Tokyo - Washington, D.C.	*7/2*	*7/1*	
Tokyo - Paris		*5/1*	*8/1*
Tokyo - Paris			*6/1*
Tokyo - Osaka	*3/1*		

6. Observation Equipment

(unit: thousand yen)

ITEMS	2007	2008	2009	Total
Micro Rain Radar	*1,500*			*1,500*

7. Satellite Data

(unit: thousand yen)

Name of Satellite / Sensor	Distributor	Purpose	Cost			
			2007	2008	2009	TOTAL

8. Other Data

(unit: thousand yen)

Name of Dataset	Distributor	Purpose	Cost			
			2007	2008	2009	TOTAL

9. Others

ITEM	2007	2008	2009	TOTAL

TOTAL	*2,342*	*1,987*	*941*	*5,270*

JAXA DATA REQUIREMENTS

1. JAXA-Archived Satellite Datasets

(ADEOS, JERS-1, ERS, MOS, SPOT, LANDSAT, TRMM, Aqua, ADEOS-II, ALOS)

Name of Satellite / Sensor	Quantity (scenes)	Purpose

B.1 Instructions for budget summary

Provide a budget summary by cost element (Personnel Expenses, Computers/Peripheral equipment, Subcontracts, Expendable Materials and Supplies, 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) Subcontracts
Provide the cost of subcontracts to outside companies or organizations here.
(4) Expendable materials and supplies
Enter the quantity of each item, following the example.
(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 includes AMSR and AMSR-E data and other satellite data 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)
- SPOT (only around Japan, available until JFY2001)
- 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) (TBD scenes from JAXA archives)

Data availability can be checked on JAXA's Earth Observation Satellite Data Distribution Service (linked from EORC website, http://www.eorc.jaxa.jp/en/about/distribution/index.html).

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

water cycle mechanisms.

B) 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.

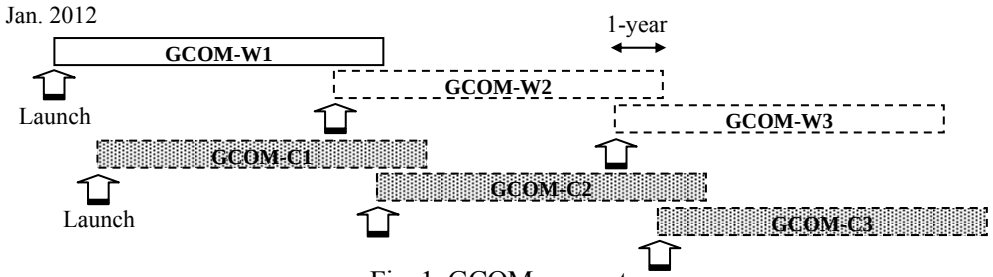

Fig. 1. GCOM concept

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.

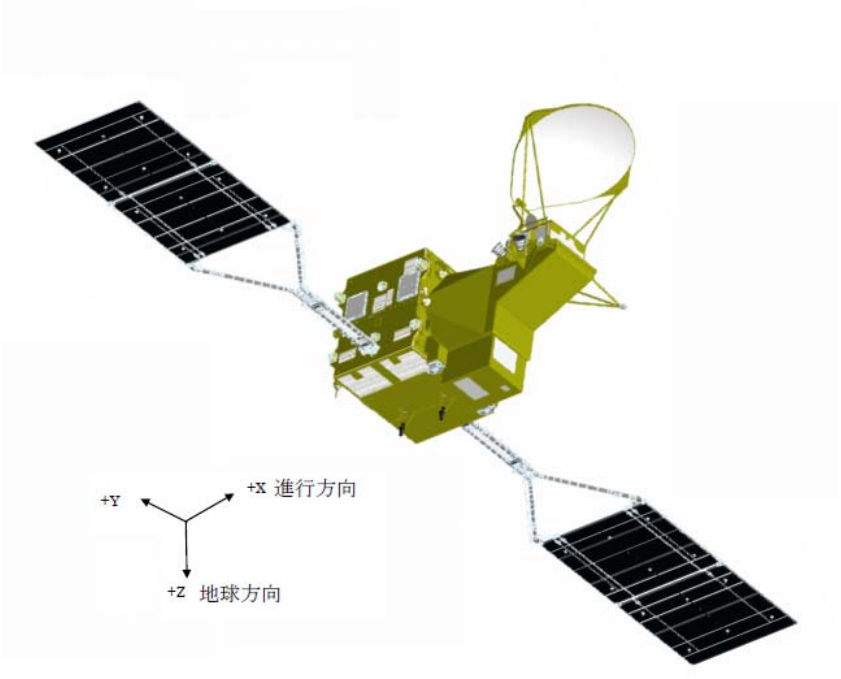

Fig. 2. Overview of GCOM-W1 satellite

TABLE 1
MAJOR CHARACTERISTICS OF GCOM-W1 SATELLITE

Instrument	Advanced Microwave Scanning Radiometer-2 (AMSR2)
Orbit	Sun-synchronous orbit Altitude: 699.6km (over the equator)
Size	5.1m (X) * 17.5m (Y) * 3.4m (Z)
Mass	1880kg
Power	Over 4050W
Launch	JFY2001 (beginning of CY2012)
Design Life	5 years
Status	Preliminary design started in JFY2007

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.

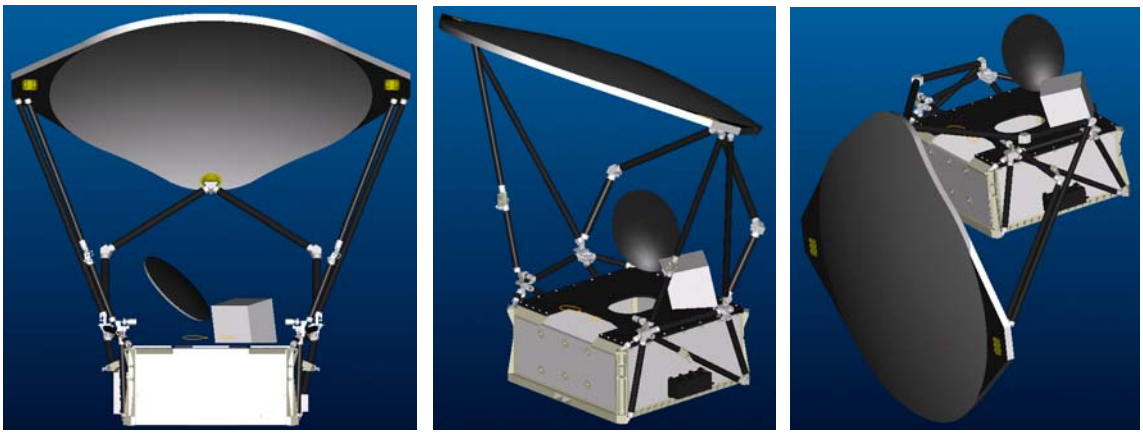

Fig. 3. Sensor unit of AMSR2 instrument in deployed (left and center) and stowed (right) conditions.

TABLE 2
FREQUENCY CHANNELS AND RESOLUTIONS OF AMSR2 INSTRUMENT

Center frequency [GHz]	Bandwidth [MHz]	Polarization	Beam width [deg.] (Ground resolution [km])	Sampling interval [km]
6.925 / 7.3	350	V and H	1.8 / 1.7 (35 x 62) / (34 x 58)	10
10.65	100		1.2 (24 x 42)	
18.7	200		0.65 (14 x 22)	
23.8	400		0.75 (15 x 26)	
36.5	1000		0.35 (7 x 12)	
89.0	3000		0.15 (3 x 5)	5

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.

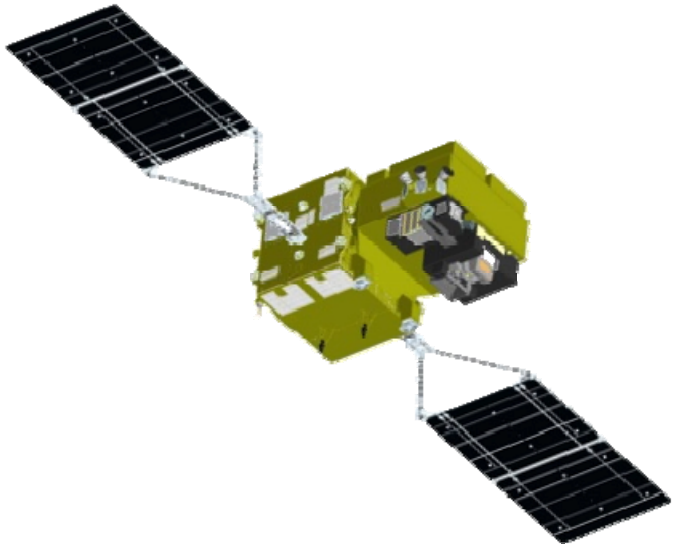

Fig. 4. Overview of GCOM-C1 satellite

TABLE 3
MAJOR CHARACTERISTICS OF GCOM-C1 SATELLITE

Instrument	Second-generation Global Imager (SGLI)
Orbit	Sun-synchronous orbit Altitude: 800km (over the equator)
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z)
Mass	1950kg
Power	Over 4250W
Launch	JFY2012 (TBD)
Design Life	5 years
Status	Research phase

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.

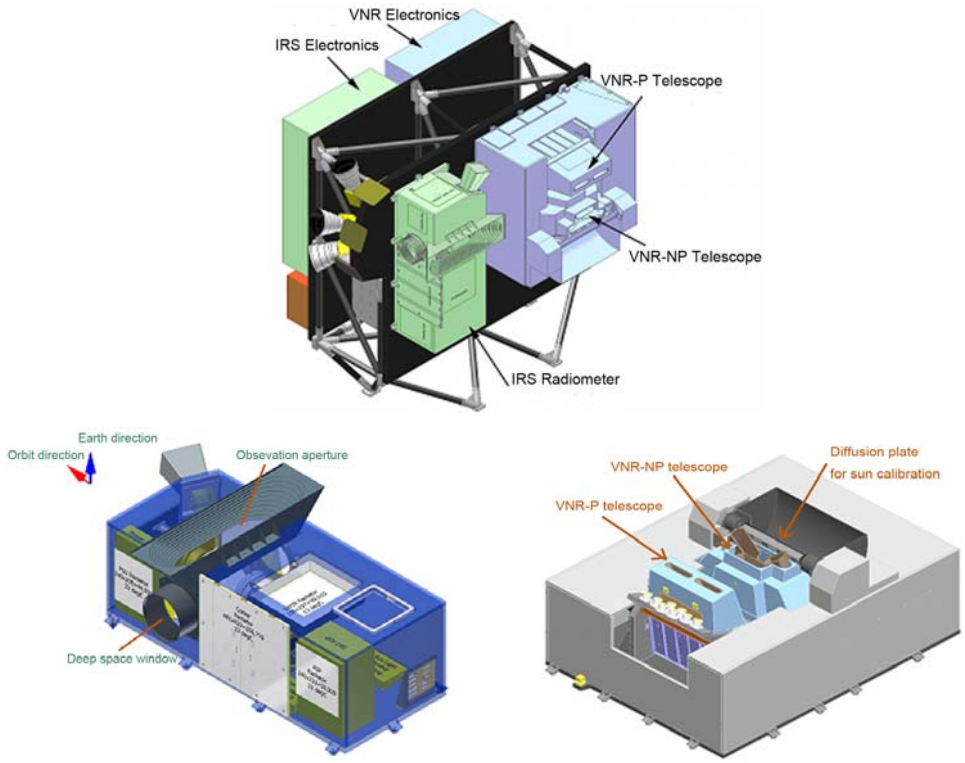

Fig. 5. Overview of SGLI radiometer layout (upper), IRS instrument (lower-left), and VNR radiometers (lower-right).

TABLE 4

SGLI MAJOR PERFORMANCE REQUIREMENTS

Item	Requirement	
Spectral Bands	VNR-NP VNR-P IRS SWI IRS TIR	11CH 380-865nm 2CH 670, 865nm / 0, 60, 120deg Polarization 4CH 1.05-2.21μm 2CH 10.8, 12.0μm
Scan Angle	VNR-NP VNR-P IRS SWI/TIR	70deg (Push-broom scanning) 55deg (Push-broom scanning) 80deg (45deg rotation mirror scanning)
Instantaneous field of view (IFOV) at nadir	VNR-NP VNR-P IRS SWI IRS TIR	1000m (VN9CH), 250m 1000m 250m (SW3CH), 1000m SW1,2,4CH) 500m
Quantization	12 bit	
Absolute Calibration Accuracy	VNR : ≤3% IRS : ≤5% TIR : ≤0.5K	
Life Time	5 Years	

TABLE 5
SGLI OBSERVATION REQUIREMENT DETAILS

	CH	Λ	Δλ	IFOV	SNR	L (for SNR)
		nm: VNR, IRS SWI μm: IRS TIR		m	SNR: VNR, IRS SWI NEΔT(K): IRS TIR	$W/m^2/sr/\mu m$
VNR-NP	VN1	380	10	250	250	60
	VN2	412	10	250	400	75
	VN3	443	10	250	300	64
	VN4	490	10	250	400	53
	VN5	530	20	250	250	41
	VN6	565	20	250	400	33
	VN7	670	10	250	400	23
	VN8	670	20	250	250	25
	VN9	763	8	1000	400	40
	VN10	865	20	250	400	8
	VN11	865	20	250	200	30
VNR-P	P1	670	20	1000	250	25
	P2	865	20	1000	250	30
IRS SWI	SW1	1050	20	1000	500	57
	SW2	1380	20	1000	150	8
	SW3	1630(TBD)	200	250	57	3
	SW4	2210	50	1000	211	1.9
IRS TIR	T1	10.8	0.7	500	0.2	300 (K)
	T2	12.0	0.7	500	0.2	300 (K)

4. Products

Geophysical products made available by GCOM-C1 and GCOM-W1 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-C1

	GCOM-C Geophysical Products	Resolution
Land	Precise Geometrically Corrected Image	250m
	Atmospherically Corrected Land Surface Reflectance	250m
	Vegetation Index including NDVI and EVI	250m
	Vegetation Roughness Index including BSI_P and BSI_V	1km
	Shadow Index	1km
	Land Surface Temperature	500m
	Fraction of Absorbed Photosynthetically Active Radiation	250m
	Leaf Area Index	250m
	Above-Ground Biomass	1km
	Land Net Primary Production	1km
	Plant Water Stress trend Index	500m
	Fire Detection Index	500m
	Land Cover Type	250m
	Land surface Albedo	1km
Atmosphere	Cloud Flag including Cloud Classification and Phase	1km
	Classified Cloud Fraction	Scene: 1km Global: 0.1deg
	Cloud Top Temperature and Height	
	Water Cloud Optical Thickness and Effective Radius	
	Ice Cloud Optical Thickness	
	Water Cloud Geometrical Thickness	
	Aerosol over Ocean by Visible and Near Infrared	
	Aerosol over Land by Near Ultra Violet	
	Aerosol over Land by Polarization	
	Long-Wave Radiation Flux	
	Short-Wave Radiation Flux	
Ocean	Normalized Water Leaving Radiance	Coast: 250m Open ocean: 1km Global: 4~9km
	Atmospheric Correction Parameters	
	Ocean Photosynthetically Available Radiation	
	Euphotic Zone Depth	
	Chlorophyll-A Concentration	
	Suspended Solid Concentration	
	Absorption Coefficient of Colored Dissolved Organic Matter	
	Inherent Optical Properties	
	Sea Surface Temperature	Coast: 500m Other: ditto
	Ocean Net Primary Production	Coast: 500m Other: ditto
	Phytoplankton Function Type	Coast: 250m Other: ditto
	Red Tide	
	Multi Sensor Merged Ocean Color Parameters	Coast: 250m Open ocean: 1km
	Multi Sensor Merged Sea Surface Temperature	Coast: 500m Open ocean: 1km

TABLE 6 (continued)
GEOPHYSICAL PRODUCTS OF GCOM-C

	GCOM-C Geophysical Products	Resolution
Cryosphere	Snow and Ice Covered Area	Scene: 250m Global: 1km
	Okhotsk Sea-Ice Distribution	250m
	Snow and Ice Classification	1km
	Snow Covered Area in Forest and Mountain	250m
	Snow and Ice Surface Temperature	Scene: 500m, Global: 1km
	Snow Grain Size of Shallow Layer	Scene: 250m, Global: 1km
	Snow Grain Size of Subsurface Layer	1km
	Snow Grain Size of Top Layer	Scene: 250m, Global: 1km
	Snow and Ice Albedo	1km
	Snow Impurity	Scene: 250m, Global: 1km
	Ice Sheet Surface Roughness	1km
	Ice Sheet Boundary Monitoring	250m

TABLE 7
GEOPHYSICAL PRODUCTS OF GCOM-W1

GCOM-W Geophysical Products	Region	Resolution
Integrated Water Vapor	Global Ocean	15km
Integrated Cloud Liquid Water	Global Ocean	15km
Precipitation	Global except Cold Latitudes	15km
Sea Surface Temperature	Global Ocean	50km
Sea Surface Wind Speed	Global Ocean	15km
Sea Ice Concentration	High-Latitude Ocean	15km
Snow depth	Land	30km
Soil Moisture Content	Land	50km