Earth Cloud, Aerosol and Radiation Explorer:

1st RESEARCH ANNOUNCEMENT
（Algorithm Development）

Issued: November 1, 2011

Proposals Due: January 4, 2012

Earth Observation Research Center
Japan Aerospace Exploration Agency

Contents

1. Introduction

1.1. About the First Research Announcement (Algorithm Development)

In this the first Earth Cloud, Aerosol and Radiation Explorer (EarthCARE) Science research announcement (RA) for algorithm development, the Japan Aerospace Exploration Agency (JAXA) is soliciting research proposals that can contribute to the development of algorithms for JAXA EarthCARE standard and research products. Based on the mission requirements, the success criteria outlined in Table 1 were devised by the JAXA EarthCARE/Cloud Profiling Radar (CPR) project. For the mission to be considered successful, the algorithms developed are required to satisfy these criteria. Detailed technical descriptions of the algorithms are given in Section 2.

The EarthCARE mission is scheduled to launch in JFY 2015. This RA covers the 3-year research period beginning in JFY 2012. Another RA that relates to the EarthCARE ground validation is slated to be announced in JFY 2012, and to commence in JFY 2013 for 2 years. EarthCARE is a Japanese–European joint mission. As with JAXA, the European Space Agency (ESA) will also plan to make a Research Announcement on the production of Level 2 products in the frame of its activities.

1.2. EarthCARE Objectives and Mission Success Criteria

The objectives of the EarthCARE mission are to evaluate the radiative forcing of clouds and aerosols (two of the biggest uncertainties in understanding and predicting climate change), and to observe the interactions between clouds and aerosols. EarthCARE defines the success criteria so as to clarify the baselines for mission accomplishment. In addition, EarthCARE has identified a list of products to be used along with their accuracy criteria (Table 2). This RA invites research to achieve these targets through collaboration with JAXA. Detailed technical descriptions of the corresponding research topics are given in Section 2.

Table 1. JAXA EarthCARE/CPR Project Success Criteria

Minimum Success (Decision : at the end of Commissioning and Cal/Val Phase evaluation : at 6 months from launch)	Full Success (Decision : at the end of planned operation evaluation : at 3 years from launch)	Extra Success (Decision : at the end of planned operation evaluation: at 3 years from launch)
• Complete Commissioning and Cal/Val Phase and publish an image data of the observed vertical cloud profile*	• Accomplish with the standard accuracy requirement of CPR-only standard product and produce a dataset which covers over 90% of nominal operation for more than 2 years** • Capable to release more than one research product of CPR • Accomplish with the standard accuracy requirement of a synergy product	• Accomplish with the target accuracy requirement of a CPR standard product , OR • Accomplish with the target accuracy requirement of a synergy product***, OR • Capable to use with data of other satellites, with good integrity

* In Commissioning and Cal/Val Phase, the confirmation of the CPR flight hardware and the ground processing are conducted. Uncorrected absolute value (i.e. relative value) of consecutive Level1 (quicklook) data that last more than one orbit is defined as an image to be published for the minimum success.

** The requirements of the satellite attitude accuracies are to be accomplished for Doppler products.

*** On the premise that the performance requirements of ESA sensors are satisfied for synergy products.

Table 2. JAXA EarthCARE/CPR Products List

(Near Real Time (NRT) products are under discussion with ESA)

Standard L1b, L2a, and L2b Products

Sensor(s)	Processing Level	Product Name	Primary Parameters	Resolution		Release Accuracy	Standard Accuracy	Target Accuracy	Total Volume (/orbit)
				Horizontal	Vertical				
CPR	L1b	CPR one-sensor Received Echo Power Products and Doppler Product	Received Echo Power	0.5km	0.1km	< 4.7dB	< 2.7dB	-	340MB
			Radar Reflective Factor			< 4.7dB	< 2.7dB	< 2.7dB	
			Surface Radar Cross Section		-	-	-	-	
			Doppler Velocity		0.1km	-	< 1m/s (Doppler Vel.)	< 0.2m/s (Doppler Vel.)	
			Covariance of Pulse Pair						
			Spectrum Width						
CPR	L2a	CPR one-sensor Echo Product	Integrated Radar Reflective Factor/Integrated Doppler Velocity/Gas Correction Factor	① 1km *② 10km*	① 0.1km *② 0.5km*	-	< 1m/s (Integrated Doppler Vel.)	< 0.2m/s (Integrated Doppler Vel.)	300MB
CPR	L2a	CPR one-sensor Cloud Products	Cloud Mask	① 1km *② 10km*	① 0.1km *② 0.5km*	±30%	±10%	±5%	550MB
			Cloud Particle Type			±100%	±50%	±20%	
			Radar Reflective Factor with attenuation correction	*1km*	*0.1km*	< 7.6dB	< 5.7dB	< 4.5dB	
			Reff./LWC/IWC			-	±100% (LWC)	±50% (LWC)	
			Optical Thickness		-	-	±100%	±50%	
MSI	L2a	MSI one-sensor Cloud Poducts	Cloud Flag/Cloud Phase	*0.5km*	-	±15% Ocean ±20% Land	±15%	±10%	630MB
			Optical Thickness of Liquid Cloud			±10%	±100% (converting to LWP)	±50% (converting to LWP)	
			Reff. of Liquid Cloud			±30%			
			Cloud Top Temp./Pressure/Altitude			±1K (CTT)	±3K (CTT)	±1.5K (CTT)	
ATLID	L2a	ATLID one-sensor Cloud Poducts	Feature Mask	0.2km/1km *10km*	*0.1km*	±100%	±40%	±10%	1200MB
			Target Mask	1km *10km*		±100%	±40%	±10%	
			Aerosol Extinction Coeff./Backscat. Coeff./Lidar Ratio/Dep. Ratio	*10km*		±60%/±90%, ±150%/±150%	±40%/±70%, ±110%/±130%	±20%/±50%, ±70%/±100%	
			Cloud Extinction Coeff./Backscat. Coeff./Lidar Ratio/Dep. Ratio	1km *10km*		±50%/±90%, ±140%/±150%	±30%/±70%, ±100%/±130%	±15%/±50%, ±65%/±100%	
			Planetary Boundary Layer Height			±500m	±300m	±100m	
CPR + ATLID	L2b	CPR-ATLID synergy Cloud Poducts	Cloud Mask	① 1km *② 10km*	① 0.1km *② 0.5km*	-	root mean square of errors of one-sensor products	-	520MB
			Cloud Particle Type					±2μm(Liquid)/ ±20%/±30%	
			Reff./LWC/IWC			-			
			Optical Thickness	1km	-	-		-	
CPR + ATLID + MSI	L2b	CPR-ATLID-MSI synergy Cloud Poducts	Cloud Mask	① 1km *② 10km*	① 0.1km *② 0.5km*	-	root mean square of errors of one-sensor products	-	550MB
			Cloud Particle Type					±2μm(Liquid)/ ±20%/±30%	
			Reff./LWC/IWC			-			
			Optical Thickness/LWP/IWP		-	-		-	
CPR+ ATLID+ MSI+BBR	L2b	Four-sensors Synergy Radiative Products	SW/LW Radiative Flux	*10km*	-	-	±25W/m2	±10W/m2	6MB
			SW/LW Radiative Heating Rate		0.5km	-	-	-	

NRT Product

CPR	L1b	CPR one-sensor NRT Product	Received Echo Power/Radar Reflect./Normalized Surface Radar	0.5km	0.1km	-	-	-	340MB

① and ② in the resolution row specifies the combination of horizontal and vertical resolultion. JAXA will produce both ①- and ②-pair resolution products.
The accuracies are defined using the "product resolution" in red italic numbers.
The accuracies of CPR L1b are defined by 10km integration.
Those accuracies except for CPR are assumed under the condition that sensors developed by ESA functioned as expected.
The accuracies of ATLID are based on the information before the change of specifications.
The length of a scene is defined as the length of an orbit divided equally (default : 1scene = 1 orbit)

CPR-ATLID-MSI Synergy Cloud Products and Four Sensors Synergy Radiative Product is the final goal of the EarthCARE mission.
Therefore, they are defined as the standard products, although they will be released one year after the start of MOP.
NRT and Statistics (L2c) will be adjusted appropreately by taking user's needs into account.

Research L2a and L2b Products

Sensor(s)	処理レベル	Product Name	Primary Parameters	Resolution		Total Volume (/orbit)
				Horiziontal	Vertical	
CPR	L2a	CPR one-sensor Doppler Products	Doppler Velocity/Multiple Scattering Effect	1km / 10km	0.1km / 0.5km	870MB
		CPR one-sensor Rain & Snow Products	LWC*/IWC*/ Rain Rate/Snow Rate			
		CPR one-sensor Vertical Velocity Products	Vertical air motion/ Sedimentation Velocity			
MSI	L2a	MSI one-sensor Ice Cloud Products	Ice Optical Thickness/Effetive Radius of Ice/Ice Cloud Top Temperature/Pressure/Altitude	0.5km	-	500MB
		MSI one-sensor Aerosol Products	Aerosol Optical Thickness (Ocean/Land)/ Angst. Exp.			
ATLID	L2a	ATLID one-sensor Aerosol Extinction Products	Aerosol Extinction Coefficient (Water Soluble/Dust/SS/BC)	1km / 10km	0.1km	400MB
BBR	L2a	BBR one-sensor Radiative Flux Products	Radiative Flux at TOA/BOA	10 km	-	1MB
CPR + ATLID	L2b	CPR-ATLID synergy Particle Mass Ratio Products	Mass Ratio (2D_Ice/IWC)	1km / 10km	-	720MB
		CPR-ATLID synergy Rain & Snow Products	LWC*/IWC*/ Rain Rate/Snow Rate		0.1km / 0.5km	
		CPR-ATLID synergy Vertical Velocity Products	Vertical air motion/ Sedimentation Velocity			
ATLID + MSI	L2b	CPR-MSI synergy Aerosol Components Products	Aerosol Extinction Coefficient (Water Soluble/Dust/SS/BC)	10km	0.1km	600MB
CPR + ATLID + MSI	L2b	CPR-ATLID-MSI Synergy Cloud Products	Cloud Mask/Cloud Particle Type/Effective Radius (Liquid/Ice)/LWC (with Doppler)/IWC(with Doppler)	1km / 10km	0.1km / 0.5km	1240MB
			Optical Thick./LWP(with Doppler)/IWP(with Doppler)	1km / 10km	-	
		CPR-ATLID-MSI Synergy Rain & Snow Products	LWC*/IWC*/ Rain Rate/Snow Rate	1km / 10km	0.1km / 0.5km	
		CPR-ATLID-MSI Synergy Vertical Velocity Products	Vertical air motion/ Sedimentation Velocity			
		CPR-ATLID-MSI Synergy Ice Cloud Products	Effective Radius (Ice)/Optical Thickness	0.5km	-	

The length of a scene is defined as the length of an orbit divided equally (default : 1scene = 1 orbit)

* in the table : includes with and without Doppler

1.3. This RA and EarthCARE Algorithm Development and Validation Phases

This RA covers the 3-year research period from JFY 2012 to JFY 2014, which corresponds to the pre-launch algorithm development phase for algorithm development activities, as can be seen in the schedule shown in Figure 2. Since this RA period will end before the launch of EarthCARE, the emphasis of this RA is primarily on the development of standard and research algorithms. Following this RA, that is, 1 year before the launch of EarthCARE, we plan to recommence research more geared toward algorithm improvement and product validation. This research will go on for 4 years (JFY 2015–JFY 2018), during which time the EarthCARE satellite will be launched.

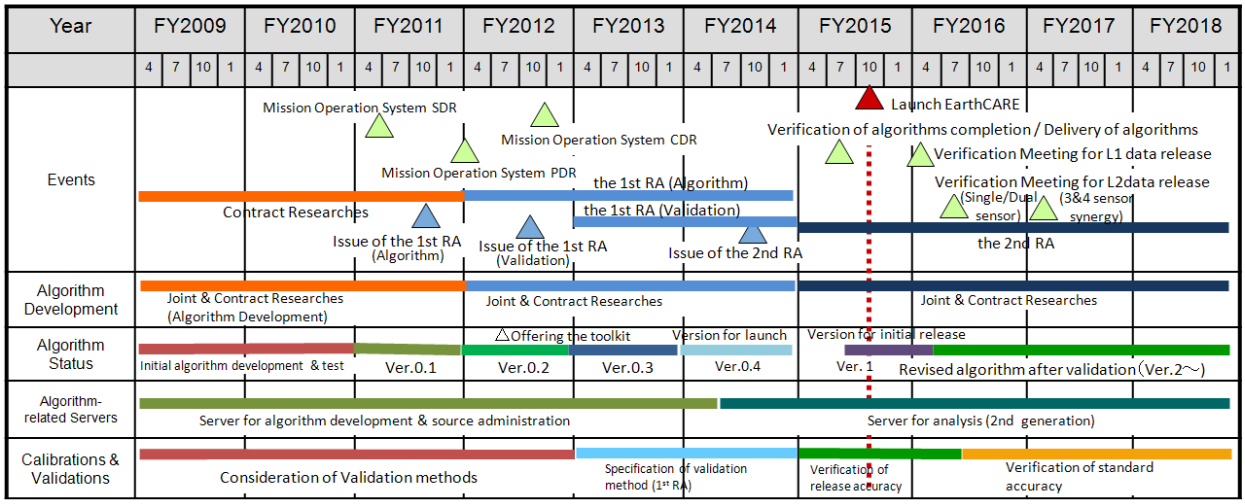

Figure 2. Schedule for the RA and EarthCARE Algorithm Development and Validation Phases

1.4. Role of the PI and the RA Policy

For this RA, JAXA will accept approximately 5 algorithm development-related research proposals. The principal investigators (PIs) for the selected 5 research topics in this RA will belong to the Japanese EarthCARE science team and conduct the algorithm development activities in collaboration with the JAXA Earth Observation Research Center (EORC). The selected PIs will be expected to join in meetings organized by JAXA and corresponding research groups, as well as attend and give accomplishment briefings at related workshops that will be held approximately once every year. In addition, PIs are required to participate and cooperate in the Japanese–European joint algorithm development activity, called the Joint Algorithm Development Endeavor (JADE). The leader of the EarthCARE science team will join the Japanese EarthCARE Mission Advisory Group, which discusses EarthCARE objectives and mission requirements, and this person will play the integral role of applying the new knowledge acquired to the mission requirement in accordance with the progress of the research activities.

In order to fulfill the accuracy requirement of the Japanese EarthCARE product, JAXA is planning to distribute the budget with a special focus on algorithm development in this RA. Although dependent on the budget status, JAXA is planning to allocate approximately 35,000,000 yen per year, which is the total of all the research proposals, during the 3-year RA period. As long as they are for nonprofit and peaceful purposes, all categories of Japanese domestic organizations may apply to this RA, which is intended to advance the EarthCARE data application technique in Japan. However, funding may differ for each research category and applicant. The selection of the proposals will be conducted through a peer-review process and discussions in science/project evaluation boards. The official announcement of the selection result is scheduled for February 2012.

2. Technical Description

2.1. Purpose of this RA

To meet the objective of the EarthCARE mission—which is to evaluate the radiative forcing of clouds and aerosols (these two elements being two of the biggest uncertainties in predicting climate change)—this RA is intended to attract researchers who can efficiently develop retrieval algorithms that will result in global, highly accurate, and stable JAXA EarthCARE products. The researches selected in this RA will work in collaboration and sharing with the JAXA/EORC/EarthCARE group.

2.2. Research Areas

Based on the EarthCARE objectives, JAXA is currently soliciting algorithm development proposals. In particular, because this RA period corresponds to the pre-launch period of the EarthCARE satellite, the RA requires researches that directly develop standard and research products. The details of these are outlined below.

2.2.1 Algorithm Development

This RA seeks to develop JAXA EarthCARE standard and research algorithms based on research themes (1)–(9) below. JAXA and the PIs will jointly evaluate the algorithms and install them on JAXA computer systems. In addition, each PI is expected to hand over the algorithms developed after installing and conducting operational checks on JAXA computer systems. If a failure occurs at any time during installation, the PI will be required to support the troubleshooting process and upgrade the algorithm. During the 3-year period of this RA, those PIs that develop standard product algorithms are expected to submit their algorithms three times, as explained below, for the assessment of the JAXA Mission Operation System. Submission of the research product algorithm is not required, but is recommended. On the other hand, the research algorithms related to CPR must be submitted in the third submission, due to its commitment to the success criteria. Those proposals that involve several research products will be considered to have satisfied this requirement if more than one algorithm for CPR-related research products is submitted.

(A) First submission—March 2013

For the production of the ground system and internal testing, the selected PIs will submit the following programs:

- Skeleton programs that can confirm the inputs and outputs
- Programs that are self-operated
- Programs that have already incorporated the toolkits delivered by JAXA
- Programs that have been checked, can be operated under the algorithm development environment, and that are confirmed to work in the JAXA computer system

(B) Second submission—March 2014

The PI will submit substantially complete programs that fulfill the required processing time (20 min per orbit) for assessment in the Mission Operation System.

(C) Third submission—March 2015

The PI will submit the final version of the program before the launch. The bugs from the previous version should be fixed.

(1) CPR One-Sensor Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE CPR Level 2 standard and research products shown in Table 2. The Level 2 CPR-only algorithm must have the following functions:

(i) Standard echo product

- A function that uses the CPR Level 1b profile to calculate integrated radar reflectivity factor and integrated Doppler velocity
- A function that retrieves the gas correction factor using water vapor in the atmosphere.

(ii) Standard cloud product

- A function that calculates the radar reflectivity factor with attenuation correction
- A function that detects clouds
- A function that estimates the phase and shape of cloud particles
- A function that retrieves cloud microphysics (liquid/ice water content, effective radius of liquid/ice cloud, optical thickness).

(iii) Research product

- A function that computes Doppler velocity while taking into consideration the multiple scattering effect
- A function that estimates rain/snow water content (where it is desirable to do the estimation both with and without using Doppler velocity information)
- A function that retrieves rain/snow rate
- A function that computes vertical air motion and sedimentation velocity.

(2) ATLID One-Sensor Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE Atmospheric LIDar (ATLID) Level 2 standard and research products shown in Table 2. The Level 2 ATLID-only algorithm must have the following functions:

(i) Standard product

- A function that detects aerosols and clouds
- A function that retrieves cloud phase and aerosol type (black carbon, dust, sea salt, etc.)
- A function that computes backscattering coefficient, depolarization ratio, lidar ratio, and extinction coefficient in cloud/aerosol regions
- A function that estimates planetary boundary layer height.

(ii) Research product

- A function that computes aerosol extinction with respect to its type (black carbon, dust, sea salt, etc.).

(3) MSI One-Sensor Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE Multi-Spectral Imager (MSI) Level 2 standard and research products shown in Table 2. The Level 2 MSI-only algorithm MSI must have the following functions:

(i) Standard product

- A function that detects clouds
- A function that retrieves cloud phase
- A function that retrieves the optical thickness of water clouds
- A function that retrieves the effective radius of water clouds (where it is desirable to retrieve using 1.6 μm and 2.1 μm bands)
- A function that computes the altitude, temperature, and pressure at the top of clouds.

(ii) Research product

- A function that retrieves the optical thickness of ice clouds
- A function that retrieves the effective radius of ice clouds (where it is desirable to retrieve using 1.6 μm and 2.1 μm bands)
- A function that calculates the altitude, temperature, and pressure at the top of ice clouds
- A function that computes the optical thickness of aerosols
- A function that computes the angstrom parameter of aerosols.

(4) BBR One-Sensor Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE BroadBand Radiometer (BBR) Level 2 research products shown in Table 2. The Level 2 BBR-only algorithm must have the following functions:

(i) Research product

- A function that computes top of atmosphere (TOA) and bottom of atmosphere (BOA) radiative flux.

(5) CPR/ATLID Synergy Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE CPR/ATLID Synergy Level 2 standard and research products shown in Table 2. The Level 2 algorithm to be used synergistically by CPR and ATLID must have the following

functions:

(i) Standard product

- A function that detects clouds
- A function that estimates the phase and shape of cloud particles
- A function that retrieves cloud microphysics (liquid/ice water content, effective radius of liquid/ice cloud, optical thickness).

(ii) Research product

- A function that computes the volume ratio of ice crystal plane within the liquid water content (where it is desirable to estimate both with and without using Doppler velocity information)
- A function that estimates rain/snow water content (where it is desirable to estimate both with and without using Doppler velocity information)
- A function that retrieves rain/snow rate
- A function that computes vertical air motion and sedimentation velocity.

(6) ATLID/MSI Synergy Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE ATLID/MSI Synergy Level 2 research products shown in Table 2. The Level 2 algorithm to be used synergistically by ATLID and MSI must have the following functions:

(i) Research product

- A function that computes the aerosol extinction with respect to its type (black carbon, dust, sea salt, etc.)
- A function that computes the size information (mode radius, etc.) of aerosols.

(7) CPR/ATLID/MSI Synergy Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE CPR/ATLID/MSI Synergy Level 2 standard and research products shown in Table 2. The Level 2 algorithm to be used synergistically by CPR, ATLID, and MSI must have the following functions:

(i) Standard product

- A function that detects clouds
- A function that estimates the phase and shape of cloud particles
- A function that retrieves cloud microphysics (liquid/ice water content, effective radius of liquid/ice cloud, optical thickness).

(ii) Research product

- A function that detects clouds, using Doppler velocity information
- A function that estimates the phase and shape of cloud particles, using Doppler velocity information
- A function that retrieves cloud microphysics (liquid/ice water content, effective radius of liquid/ice cloud, optical thickness), using Doppler velocity information
- A function that estimates rain/snow water content (where it is desirable to estimate both with and without using Doppler velocity information)
- A function that retrieves rain/snow rate
- A function that computes the vertical air motion and sedimentation velocity
- A function that estimates the effective radius and optical thickness of ice clouds using thermal channel.

(8) Four-Sensor Synergy Algorithm

This theme encompasses research to develop algorithms that produce the EarthCARE Four-sensor Synergy Level 2 standard and research products shown in Table 2. The Level 2 algorithm to be used synergistically by CRP, ATLID, MSI, and BBR must have the following functions:

(i) Standard product

- A function that computes shortwave and longwave radiation
- A function that computes the heating ratio of shortwave and longwave.

(9) EarthCARE Data Simulator

In order to assist with Level-2 algorithm development, as well as to promote the application of EarthCARE observation data, JAXA requires the development of an EarthCARE data simulator that can compute EarthCARE sensor data from the atmospheric data of numerical weather/climate models. Therefore, JAXA seeks research themes associated with the EarthCARE data simulator.

With regard to the development of this simulator, candidates need to take into account the following:

- The simulator should be able to conduct forward computations for each sensor on the EarthCARE satellite, and should also be based on the Satellite Data Simulator Unit (SDSU) (Masunaga et al., 2010, *BAMS*).
- The simulator should be applicable to the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) (Satoh et al., 2008, *J.Comp. Physics*). More preferably, it should also to be applicable to the atmospheric general circulation models and global aerosol transport models.

3. Instructions for Responding to this RA

3.1. Qualifications

So long as the proposal is for peaceful purposes and has noncommercial objectives, researchers from all categories of Japanese domestic organizations, including educational institutions, government ministries, public companies, private enterprises, and other groups, may apply to this RA.

3.2. Research Agreement Conclusion

After the proposals are selected, a research agreement will be drawn up between JAXA and the respective organization to which the PI belongs under relevant terms and conditions to be prepared by JAXA. All applicants should carefully read Section 5, which gives detailed information on contract matters; Appendix D contains associated terms and conditions of the research agreement.

3.3. Research Period

The total research period of this RA will be 3 years, commencing JFY 2012. However, performance will be evaluated based on an interim report at the end of each JFY in order 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 within JAXA's budget limitation.

B) JAXA funding is restricted to domestic PIs.

C) JAXA funding is restricted to the direct cost of research ("Direct Cost") and does not bear 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 prescribed 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 distribution capability of JAXA. Available data are listed in APPENDIX .B. Those who receive Earth observation satellite data shall comply with terms and conditions described in the chapter titled "Providing of Earth Oservation Satellite Data by JAXA" in the research agreement.

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 3-year research period. The submission of programs of the algorithms will followed to the statement in Section 2.2.1. Funded PIs are also required to participate in the accomplishment debriefing meeting organized by JAXA once a year and present Research Progress and Research Progress. PIs must cover necessary travel expenses for participating in this meeting using 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. The submission of programs of the algorithms will followed to the statement in Section 2.2.1. PIs shall also report research progress ("Research Progress") either in presentation at the workshops and meetings which JAXA holds or in writing at least one (1) month before the Annual Evaluation. 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 of Proposals

Selection of proposals will be carried out on the basis of a peer-review process and discussions in science/project evaluation boards. The final decisions will be made by JAXA selection officials. The principal elements to be considered in evaluating a proposal are its relevance to the objectives, intrinsic merit, and cost. Evaluation of 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) The 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; and

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

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 Proposals

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 due to the cancellation of this RA or the postponement of the RA schedule.

3.10. Important Dates

November 1, 2011	RA issued
January 4, 2011	**Due Date for Proposals**
February 2012	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 and sent via e-mail** to the EarthCARE RA Office. The maximum file size acceptable by E-mail is 10 MB.

E-mail address of EarthCARE RA Office: EarthCARE_CNT@jaxa.jp

In case of difficulty sending via e-mail, five copies of both the proposal and the complete set of attachments should be sent via postal mail to this address:

Mr. Kenichi Komachi (EarthCARE 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. Kenichi Komachi (EarthCARE RA Office)
Earth Observation Research Center
Tel: +81-50-3362-4433
Fax: +81-29-868-2961
E-mail: EarthCARE_CNT@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, 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 for the following:
   A) The page or paper size should be A4.
   B) The page number must appear at the bottom of each page, centered, and the name of the applicant must appear in the top, right-hand corner.
   C) Proposals should be word-processing documents in English, with font size no smaller than 12 points.
(3) Proposals should be brief and to the point, concentrating on substantive materials. The main body of each proposal should not exceed 20 pages. Necessary detailed information, such as reprints, should be included as attachments. The complete set of attachments must accompany each copy of a proposal when submitting via e-mail.

4.3. Proposal Contents

(1) Cover Sheet

A) Research Title

State your research title clearly and precisely. 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.

C) Applicant Information

- Personal information relating to the PI:
  State the name, job title, organization, address, e-mail address, and telephone and facsimile numbers.
- Personal information relating to the co-investigator (CI):
  State the name, organization, telephone number, and e-mail address of each CI. One research team should consist of only one PI, or one PI and several CIs.

D) Budget

Provide a 3-year budget broken down by year and the 3-year total amount in Japanese Yen (from JFY 2012 through to JFY 2014).

E) Endorsement

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 it should not exceed 20 pages. It should contain 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 a 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 prohibited.

(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. Similar biographical information on each CI should also be provided.

B) Role of the CI
   The PI is responsible for supervising the work and the 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 related to 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 final adjustment of funding. Before beginning the second and third years, JAXA will re-send the same forms for resource requirements. 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 Research Organization"), not with the PI or CI.
(2) A research agreement will be made in accordance with 'associated terms and conditions' attached herein as Appendix D. The Research Organization shall submit the application form with necessary documents 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 in full consent to all of the terms and conditions stipulated in Appendix D, and the agreement will be effective upon issuance of the confirmation sheet by JAXA.
(3) In the case of funded PIs, the Research Agreement is on a single-year basis. If JAXA determines that an extension of a research project is justified by the Annual Evaluation at the end of the Japanese Fiscal Year (JFY), the research agreement will be extended for 1 year, but no later than March 31, 2015. Funded organizations should submit the continuing agreement application form to JAXA at the beginning of every JFY.
(4) In the case of non-funded PIs, the Research Agreement is three-year basis. If JAXA determines that an extension of a research project is not justified by the Annual Evaluation at the end of the Japanese Fiscal Year (JFY), the research agreement will be dissolved.
(5) The Research Organization shall comply with the terms and conditions defined in the research agreement.

5.2. Research Agreement Summary

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

(1) Commissioned Research Agreement (Funded)

- In principle, the Commissioned Research Agreement will be applied to research that develop "standard algorithms". The Research Organization shall conduct the research according to the Statement of Work provided by JAXA.
- JAXA will provide to the Research Organization the funds and the data sets necessary to conduct the research as described in the Statement of Work.
- JAXA will own research results that the Research Organization shall deliver to JAXA in accordance with the Statement of Work (Deliverable Research Results). The Research Organization shall assign to JAXA all Program/Data Copyrights obtained under this Agreement including, but not limited to, rights to translate, transform or otherwise adapt works and to use derivative works.
- JAXA will retain royalty-free rights to use all of the results derived from these research activities other than Deliverable Research Results only for its own research and development purposes.
- In the event JAXA provides prior written consent, the Research Organization may use Deliverable Research Results for its own research and development purposes.

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

(2) Collaborative Research Agreement (Funded/Non-funded)

- In principle, the Collaborative Research Agreement will be applied to research that only develop "research algorithms".
- JAXA will provide to the Research Organization funds the finds (for funded cases) and the data sets necessary to conduct the research.
- In principle, the research results will be jointly owned by the parties: the share of which shall be determined in proportion to the contribution of the parties.
- JAXA will retain the right to use all results including results belonging to the Research Organization (if any), and the Research Organization will retain the right to use jointly-owned research results, only for each party's own research and development purposes, without prior consent of the other.

The difference between funded agreement and non-funded agreements:

- Collaborative Research Agreement (Funded)
  JAXA provides part of the research funds and the data sets. The Research Organization shall submit an interim report and a final report to JAXA, and shall participate in the workshops to report research progress. The submission of programs of the algorithm will followed to the statement in Section 2.2.1. If this agreement is canceled or terminated, the Research Organization shall refund to JAXA any unexpended funds that have already been paid by JAXA.
- Collaborative Research Agreement (Non-funded)
  JAXA provides only the data sets. The Research 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. The submission of programs of the algorithm will followed to the statement in Section 2.2.1 is recommended. PIs shall also report research progress ("Research Progress") either in presentation at the workshops and meetings which JAXA holds or in writing at least one (1) month before the Annual Evaluation.

(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,
- Obtain the written consent of JAXA in advance
- State in the publication that he or she obtained the results through participating in this RA research and identify the owner of the rights to the Earth Observation Satellite Data and Meteorological Data used in such publication, 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 Cover Sheet
JAXA EarthCARE Research Announcement

Proposal No.	_____ (Leave Blank for JAXA Use)									
Title										
Research category (tick all)	Class	CPR	ATLID	MSI	BBR	CPR/ ATLID	ATLID/ MSI	CPR/ATLID/ MSI	4-sensor-synergy	EarthCARE simulator
	Algorithm (Standard)	☐	☐	☐	-	☐	-	☐	☐	☐
	Algorithm (Research)	☐	☐	☐	☐	☐	☐	☐	-	-

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)

JFY2012	JFY2013	JFY2014	TOTAL

(Leave Blank for JAXA Use)

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

Research Schedule

JFY	2010				2011				2012			
Month	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3
Milestone												
Activities												

APPENDIX B
RESOURCE REQUIREMENTS

BUDGET SUMMARY

Direct Cost only

1. Personnel Expenses **(unit: yen in thousands)**

	2012	2013	2014	Total

2. Purchases

2.1 Computers / Peripheral Equipment **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

2.2 Software **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

2.3 Expendable Materials and Supplies **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

3. Subcontracts **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

4. Travel Expenses **(unit: days / times or days / travelers)**

Departure Point – Destination	2012	2013	2014

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

ITEM	2012	2013	2014	Total

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

Name of Satellite / Sensors	Distributor	Purpose	Cost			
			2012	2013	2014	Total

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

Name of Data Sets	Distributor	Purpose	Cost			
			2012	2013	2014	Total

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

ITEM	2012	2013	2014	Total

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 **(unit: yen in thousands)**

	2012	2013	2014	Total
Part-time job for DSD data analysis	*320 (40x8)*	*160 (20x8)*	*800 (100x8)*	*1280*

2. Purchases

2.1 Computers / Peripheral Equipment **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

2.2 Software **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total

2.3 Expendable Materials and Supplies **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total
8mm tape (112m)	*50*	*50*	*50*	*150*
CD-R	*100*	*120*	*120*	*340*
MO (640MB)	*15*	*10*	*10*	*35*
A4 Paper (package of 500 sheets)	*2*	*1*	*1*	*4*
CD-RW Drive	*50*			*50*

3. Subcontracts **(unit: yen in thousands)**

ITEM	2012	2013	2014	Total
Software development for DSD data analysis	*1,500*	*600*	*600*	*2,700*

4. Travel Expenses **(unit: days / times or days / travelers)**

Departure Point – Destination	2012	2013	2014
Tokyo - Washington, D.C.	*7/1*		
Tokyo - Paris	*5/1*	*8/1*	
Tokyo - Paris		*6/1*	*6/1*
Tokyo - Osaka			*3/1*

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

ITEM	2012	2013	2014	Total
Micro Rain Radar	*1,500*			*1,500*

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

Name of Satellite / Sensors	Distributor	Purpose	Cost			
			2012	2013	2014	Total

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

Name of Data Sets	Distributor	Purpose	Cost			
			2012	2013	2014	Total

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

ITEM	2012	2013	2014	Total

TOTAL (unit: yen in thousands) (Except "4.Travel Expenses")	*3,537*	*941*	*1,581*	*6,059*

JAXA DATA REQUIREMENTS

1. JAXA-Archived Satellite Data Sets
(ADEOS, JERS-1, ERS, MOS, 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, 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 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 owns satellite data as 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)
- Global Change Observation Mission 1st-Water (GCOM-W1) [TBD]

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

EARTH CLOUD, AEROSOL AND RADIATION

EXPLORER (EarthCARE) MISSION

1. Introduction

1.1 Cloud and Climate Change

Since the last report of IPCC (Third Report), the level of scientific understandings regarding the effect of aerosols and clouds, show a good progress. From the most recent report (Fourth Assessment Report; FAR), carbon dioxide is said to be the largest factor to the influence of the global warming. However, the effect of carbon dioxide to the global warming is considered to have been evaluated with a good accuracy. On the other hand, the radiative forcing of clouds and aerosols still remains as the dominant uncertainty in the prediction of the climate change in the future. It is reported that -0.5 W/m^2 for aerosol direct effect and -0.7 W/m^2 for cloud albedo effect, -1.2 W/m^2 as total aerosol, are counted for radiative forcing relating with aerosol/cloud. The figure is large enough comparing with the total anthropogenic radiative forcing; +1.6 W/m^2. We have to make a special attention to the fact that the uncertainty of the cloud albedo effect, i.e. interactions between aerosol and cloud, is very large; 2 W/m^2. This leads, without the correct understanding of the interaction between aerosol and cloud, climate change to remain uncertainties to predict future status with sufficient accuracy.

Furthermore, FAR suggests that the cloud life cycle process should be examined not just for cloud forming but also for the precipitation process or cloud termination process, which will affect global radiation budget through latent heat release and changing the radiative characteristics of the ground surface by such as snowing (IPCC, 2007).

1.2 EarthCARE mission and instruments

Japanese Aerospace Exploration Agency (JAXA), National Institute of Information and Communications Technology (NICT) and European Space Agency (ESA) are going to materialize a project named “Earth Cloud, Aerosol and Radiation Mission; EarthCARE”. EarthCARE is a challenging mission toward to solve the issues noted in the previous section. The observation scope of the EarthCARE is to observe globally such processes; the aerosol distribution, cloud forming with aerosol interaction and beginning of precipitation. To materialize such observation, four instruments were chosen, with their respective needs, to load on EarthCARE; LIDAR (light detection and ranging) and Doppler Radar for the aerosol/cloud profile observation, multi spectral imager (MSI) for aerosol/cloud lateral distribution observation and broadband radiometer (BBR) for Earth radiative flux observation. The observations by these instruments guarantee their synchronism and their uniformity in the observation region. In other word, more accurate synergy observations are preserved, by minimizing the differences in the condition of the observations between the

instruments, resulted from such as the differences in the timing of the observation. The relationship between target geophysical parameters and instruments is shown in figure 1. The final goal of the mission is to reconstruct aerosol cloud structure with their physical characteristics with the accuracy of 10 W/m2 as radiative flux at top of atmosphere (ESA,2004, Gelsthorpe et.al., 2008).

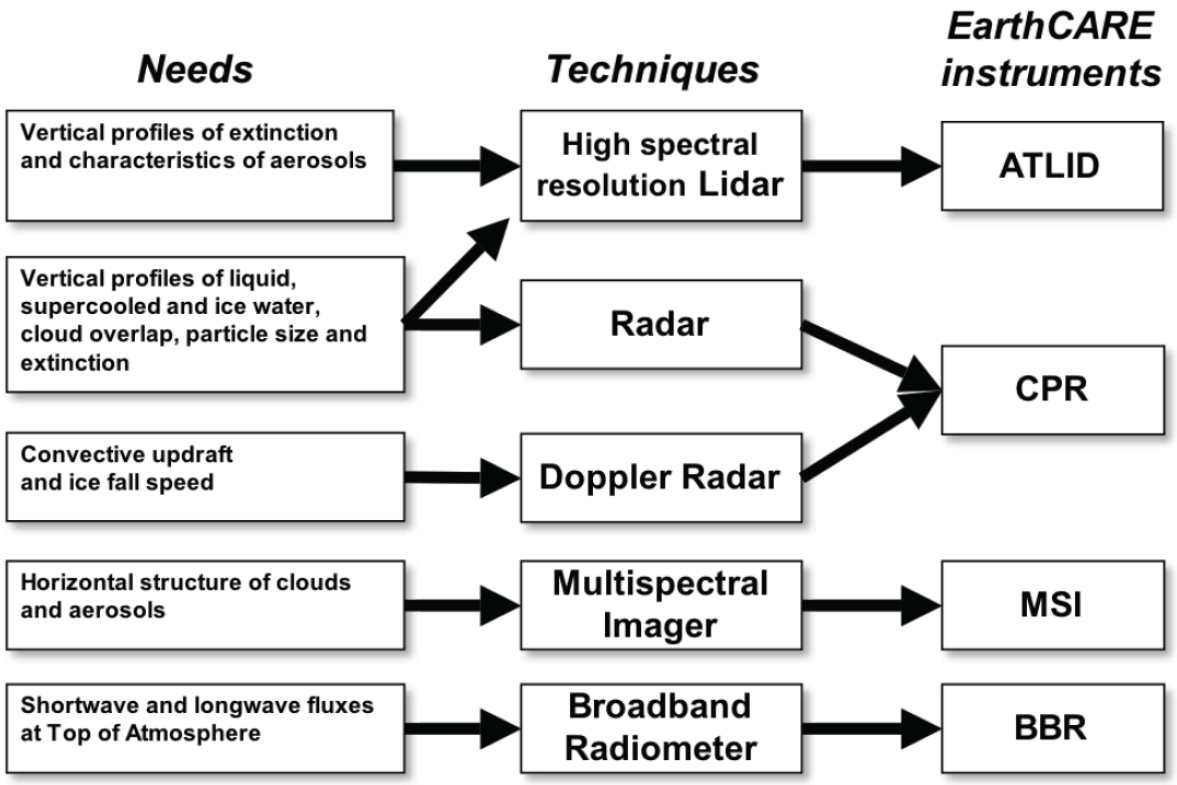

Figure 1 Relationship between target geophysical parameters and instruments

The outlook of EarthCARE satellite and CPR are shown in figure 2. A sun synchronous orbit was chosen as the observational orbit to cover all region of the Earth. Local time at equator of the orbit is 13:45 to 14:00 with consideration of cloud processes being active in the afternoon.

To get the accurate aerosol/cloud observation data, several unique points are implemented for instrumentation. The LIDAR is an Ultra Violet range single wavelength High Spectral Resolution LIDAR. The wavelength, 355 nm, has well sensitivity for the small aerosol particles that are missed by Radar, and make high transmit power possible for its eye safe character. It is possible for the LIDAR signals to be strongly attenuated when they meet dense regions composed by large particles such as clouds. High spectral resolution enables to receive Mie and Rayleigh scattering signals independently. In this way, the optical properties of aerosols can be retrieved directly, without an

assumption of lidar ratio. Through its polarization measurement, the depolarization ratio can be calculated to estimate the nonsphericity of the observed particle. Doppler W-band Radar penetrates thick cloud layers. Doppler measurement function distinguishes cumulus / convective cloud types and its particle status inside of cloud layer. Using Doppler value, we precisely know kinds of cloud particles. The detailed description of the Doppler Radar is noted in Section 2.1. The MSI has 7 channels with their central wavelengths to be 0.67, 0.865, 1.65, 2.21, 8.8, 10.8 and 12.0 μm, respectively. These channels will be used with split window method to get optical depth and effective radius of cloud and aerosols. Thermal infrared channel can be used to retrieve the cloud top height. The ground resolution of MSI is 500 m^2 and the swath width is 150 km. BBR design is a heritage of past Earth Radiation Mission, such as ERBE or CERES. BBR has two channels; one for the observing shortwave (0.25 ~ 4μm) and the other for longwave (4 ~ 50μm). Three angle radiometer will be used for flux determination considering its angular distribution. The effect of cloud forcing by the reflection of sunlight as well as by its emittence of longwave radiation are expected to be evaluated from the BBR observation. General characteristics for all four instruments are shown in Table 1.

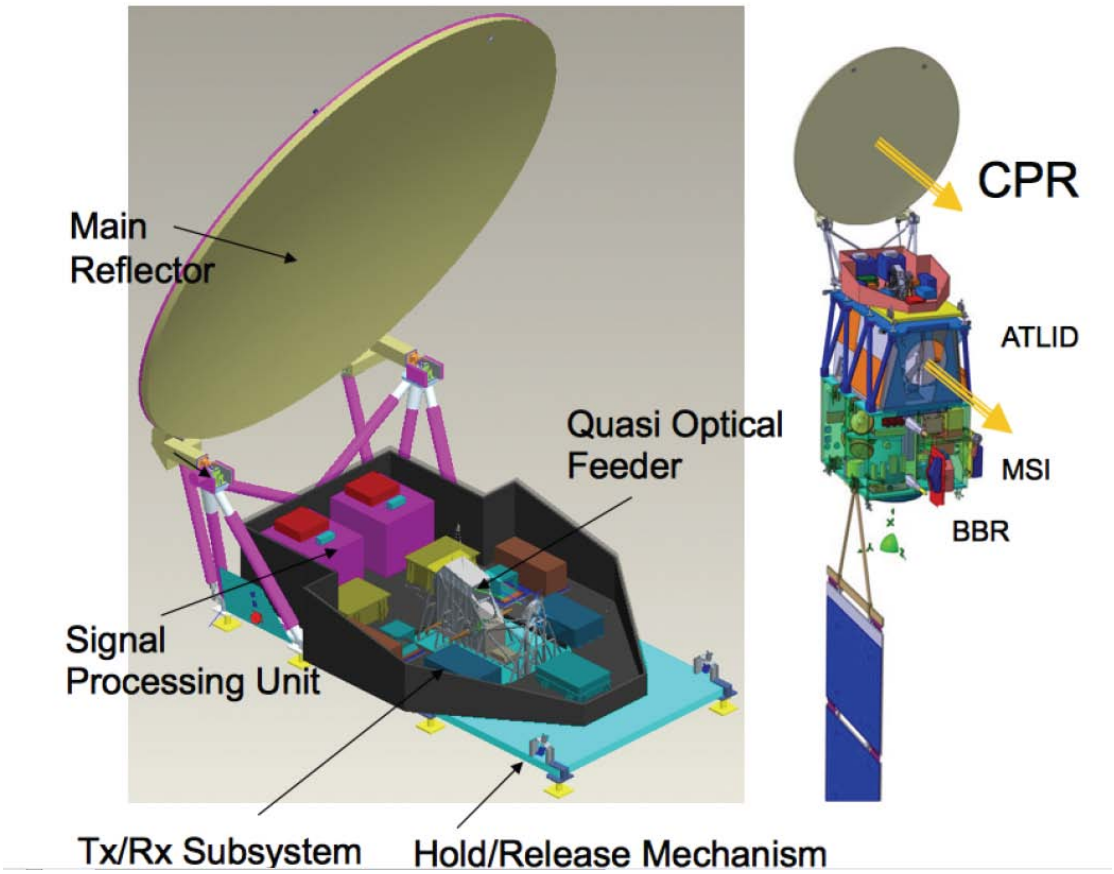

Figure 2. Outlook of CPR and EarthCARE satellite

Table 1 General characteristic of instruments

Instrument	Description
CPR	94 GHz Doppler Radar (see Table 2.)
ATLID	355 nm Hyper Spectral Resolution Lidar with three channels (Mie co-polar, Rayleigh, Mie cross-polar)
MSI	Push broom imager Resolution 500m, swath 150 km Seven channels (0.67, 0.865, 1.65, 2.21, 8.8, 10.8, 12.0 micron)
BBR	Three views radiometer Angle: Nadir, +- 55 deg Two channels; 0.2–4, 4–50 micron

2. Doppler Cloud profiling RADAR

The new space borne radar; Cloud Profiling Radar (CPR) is going to be developed in the cooperation between JAXA and NICT. From CPR observational requirements, we identified following design requirements. First point is the high sensitivity. This requirement is divided into large antenna size requirement, low noise figure of receiver requirement and high power of transmitter requirement. Second point is the Doppler capability. To materialize this function with satisfactory accuracy, large diameter of antenna with precise surface figure and high pulse repetition frequency (PRF) are required. To keep accuracy especially at boundary layer region, several other fine characteristics, such as side lobe characteristics of antenna, cross polarization characteristics and so on, are also required for CPR design.

As the result of design, we chose pulse pair scheme for Doppler measurement. In addition, the diameter of antenna was set as 2.5 m considering the limited diameter of launcher fairing. For transmitter, we employed improved Extended Interaction Klystron (EIK), of which original model is already employed for CloudSAT mission by NASA (Stephens et.al., 2002). The transmit power is 1.5 kW at end of three year mission. For PRF design, CPR has variable control capability of PRF with satellite altitude information. This is for maximizing frequency to keep good coherency between radar pulses, also good sensitivity by having much integration. Outlook of CPR is shown in Figure 2 and major specification of CPR is shown in Table 2.

However, the PRF is a factor of trade off between observational heights. Considering the natural cloud height distribution, the planned operation of CPR is to change observational height with latitude. As natural cloud height distribution, for low latitude region, the cloud height is rather high; in contrast, the polar region cloud height is rather low. The image of CPR operation is shown in Figure 3.

Table 2. General Specifications of CPR

Item	Specification
Radar Type	94 GHz Doppler Radar
Center frequency	94.05 GHz
Pulse width	3.3 micro second (equivalent to 500m vertical resolution)
Beam width	0.095 deg
Polarization	Circular
Transmit power	> 1.5 KW (Klystron spec.)
Height range	-0.5 ~ 20 km
Resolution	500 m (100 m sample); Vertical 500 m integration; Horizontal
Sensitivity*	-35 ~ +21 dBZ
Radiometric accuracy*	< 2.7 dB
Doppler range*	- 10 ~ +10 m/s
Doppler accuracy*	< 1 m/s
Pulse repetition frequency	Variable; 6100 ~ 7500 Hz
Pointing accuracy	< 0.015 degree

; at 10 km integration and 387 km orbit height

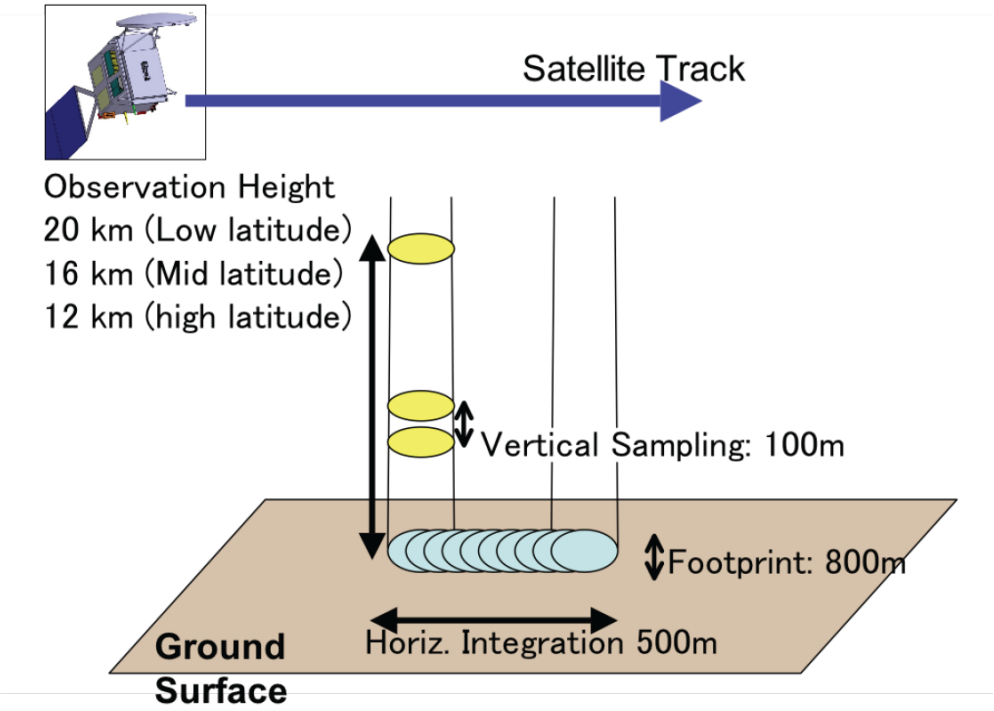

Figure 3. CPR Operation Image

3. Operation Planning

EarthCARE is planned to be launched in JFY2015. The calibrated engineering parameters (Level 1 data) and the retrieved physical parameters (Level 2 data) by all four sensors on EarthCARE will be stored and distributed from both JAXA and ESA. Data are planned to be used by research institutes and agencies in order to improve the accuracies of numerical weather/climate models. The data are also opened to researchers (after appropriate procedures), and are used in the analysis of radiation/aerosol/cloud/precipitation process.

REFERENCES

EarthCARE – Earth Clouds, Aerosols and Radiation Explore Mission Report, ESA SP-1279(1).2004, available from http://esamultimedia.esa.int/docs/SP_1279_1_EarthCARE.pdf

RV. Gelsthorpe, A. Heliere, A. Lefebvre, J. Lemanczyk, E. Mateu and K. Wallace, “EarthCARE and its payload”, *Proc. SPIE*, Vol. 7152, 2008

T. Kimura and H. Kumagai, “Japanese Cloud Profiling RADAR for EarthCARE”, *Proc. 26th ISTS*, Hamamatsu 2008

T. Kimura, H. Nakatsuka, K. Sato, Y. Sakaide , Y. Seki , K. Okada, N. Takahashi , Y. Ohno , H. Horie, “EARTHCARE MISSION WITH JAPANESE SPACE BORNE DOPPLER CLOUD RADAR; CPR”, *Proc. ISPRS Technical Commission VIII symposium*, 2010.