EarthCARE Products

JAXA standard products currently being created is shown below.

Processing Level	Product Identifier	Available Latest Product Version	Product Release Date
L1b	CPR_NOM	vCb	2025/3/13
L2a	CPR_ECO	vBa	2025/3/17
	CPR_CLP	vBb	2025/4/23
	ATL_CLA	vBa	2025/3/17
	MSI_CLP	vBa	2025/3/17
L2b	AC__CLP	vBb	2025/4/23
	ACM_CLP	TBD	L+18M
	ALL_RAD	TBD	L+18M

ESA standard products currently being created is shown below.

Processing Level	Product Identifier	Available Latest Product Version	Product Release Date
L1b	ATL_NOM	vAe	2025/3/11
	MSI_NOM	vAf	2025/1/27
	BBR_NOM	vAd	2025/1/14
L1c	MSI_RGR	vAf	2025/1/27
L2a	ATL_FM_	vAd	2025/3/17
	ATL_AER	vAe	2025/3/17
	ATL_ICE	vAe	2025/3/17
	ATL_TC_	vAe	2025/3/17
	ATL_EBD	vAe	2025/3/17
	ATL_CTH	vAe	2025/3/17
	ATL_ALD	vAe	2025/3/17
	MSI_CM_	vAc	2025/3/17
	MSI_COP	vAd	2025/3/17
	MSI_AOT	vAc	2025/3/17
	CPR_FMR	vAc	2025/3/17
	CPR_CD_	vAc	2025/3/17
	CPR_TC_	vAc	2025/3/17
	CPR_CLD	vAb	2025/3/17
L2b	AM__MO_	vAc	2025/3/17
	AM__CTH	vAc	2025/3/17
	AM__ACD	vAc	2025/3/17
	AC__TC_	vAc	2025/3/17
	BM__RAD	vAb	2025/3/17
	BMA_FLX	TBD	L+18M
	ACM_CAP	TBD	L+18M
	ACM_COM	TBD	L+18M
	ACM_RT_	TBD	L+18M
	ALL_3D_	TBD	L+18M
	ALL_DF_	TBD	L+18M

SEC-2024057 Rev.A
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Revision A: 13 March 2025

Release notes for the EarthCARE/CPR Level-1b Product

All users of the EarthCARE/CPR Level 1b data should keep in mind the following descriptions related to the EarthCARE/CPR L1b product in Version vCa.

<Change History>

--- Current Version Information ---

Product Version (baseline): vCb (operation from 13th March 2025 for forward processing, reprocessing of old data is out of scope for this version.) A

ProcessorVersion	:2.1
ExecutableVersion	:2.1
FormatVersion	:0.14

The following are the modified points from vCa.

--- Changes in vCb from vCa ---

1. Modification of the radiometric levels

By reflecting the results of further external calibrations, the radiometric values (radar reflectivity, received echo power, etc.) increased about 1.6 dB compared with vCa, and the modified values in vCb are more consistent with Cloudsat data. A

2. Modification of the "rayHeaderRangeBinSize"

The values of the "rayHeaderRangeBinSize" included in Geo/ScienceData is correctly modified values as 99.93082m in vCb because this values in vCa was expressed as an ideal nominal values of 100.0m.

3. Modification of the "degradedQualityFlag"

The "degradedQualityFlag" is an boolean flag to assess the overall product quality identifying the presence of significant errors within the product. The definition of the quality flags 0 and

1 was reversed in vCb (0: No degraded product, 1: Degraded product.)

<Caveats for the EarthCARE/CPR Level-1b product>

CPR Level-1b (CPR_NOM_1B) Product has the following known issues and limitations;

--- Known product quality limitations and points of note ---

1. Mirror Image

The “Mirror image” is a phenomenon in which an upside-down cloud pattern appears in a vertical symmetrical form to the direct echo from the target, due to backscattering from the target via reflection from the surface. When the returning timing of the signals of the mirror image to the EarthCARE/CPR overlaps to the receiving timing of the next pulse, the mirror image often appears upper-side of the actual cloud (direct echo from the cloud) as below figures.

EarthCARE/CPR adopts a higher PRF than CloudSat, so the mirror image appears at a lower altitude than that of the CloudSat. The mirror image affects not only echo data but also doppler data.

The mirror image will be indicated by flag in the CPR L2 product (CPR_ECO_2A).

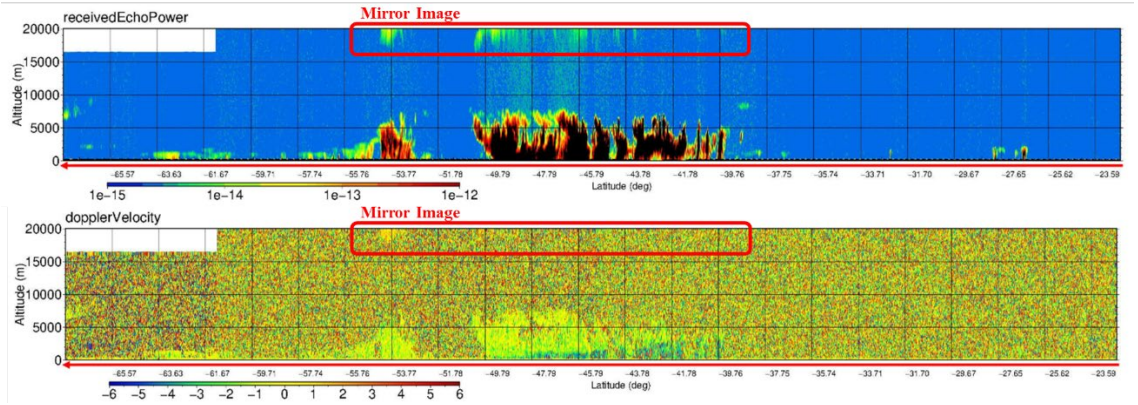


Figure 1-1:An example of the mirror images on the frame:03071F observed on 12 December 2024
(uppler image: receivedEchoPower, lower image: doppler velocity)

2. Radar reflectivity and received echo power [Improved in vCb]

The released EarthCARE/CPR L1b product reflects the results of calibrations during the commissioning phase. In vCa, the calibration factor was considered with assessment results for only CPR transmitter chain and it was confirmed that the echo power level of vCa was about 2dB lower than that of the CloudSat/CPR data. The calibration factor was updated in vCb by considering assessment results for both the CPR transmitter chain and receiver chain.

A

This update increased the echo power level by 1.6dB from vCa, resulting in a value even closer to that of the CloudSat/CPR.

A

3. Doppler velocity anomalies due to the Gap of orbit data

When orbit data has gap, its interpolation is not performed correctly, and an error of the doppler velocity appear like a rainbow pattern as the following figures. If the GPS orbit data gap is found after L1b data processing, the L1b data will be re-generated within a week using restituted orbit file. This is a very rare case, but please keep it in mind when you download data just after observation. By checking the following metadata items, you can see if data was regenerated using Reconstituted Orbit File;

- HeaderData/VariableProductHeader/SpecificProductHeader/orbitFileFlag
  0:PDGS Reconstructed Orbit File
  1:FOS Reconstituted Orbit File
  2:FOS Predicted Orbit File
- HeaderData/VariableProductHeader/MainProductHeader/processingStartTime
- HeaderData/VariableProductHeader/MainProductHeader/processingStopTime

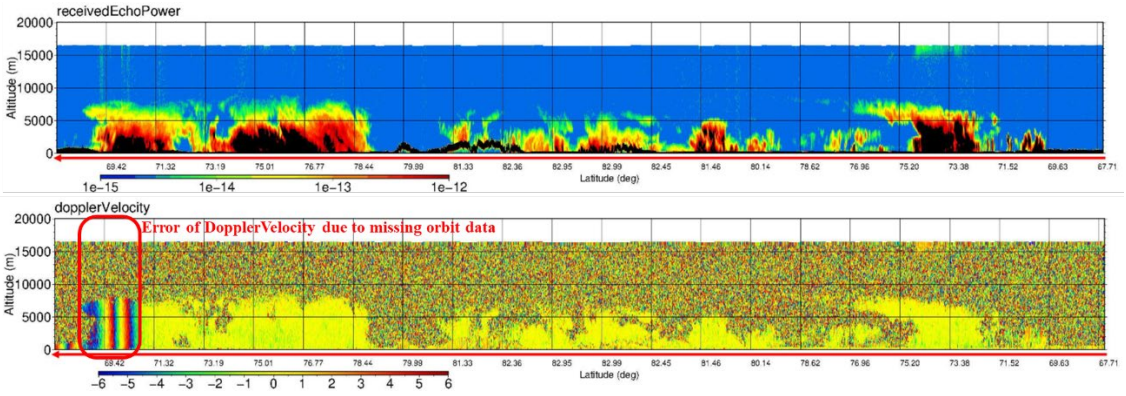


Figure 3-1:An example of Error of doppler velocity due to the partly missing of the orbit data missing
(upper image: receivedEchoPower, lower image: doppler velocity)

4. Anomalies observed over specific areas

JAXA found some echo/doppler anomalies that are not clouds in a specific area at the same relative orbit pass*. Here, two examples of the anomaly are shown. The mechanism by which the anomaly occurs is still under investigation. And it is possible that other similar anomalies may be occurring in other areas. The cause of this anomaly is likely to be a second trip (mirror image of reflectance form the earth's surface), and JAXA and NICT are continuing to investigate.

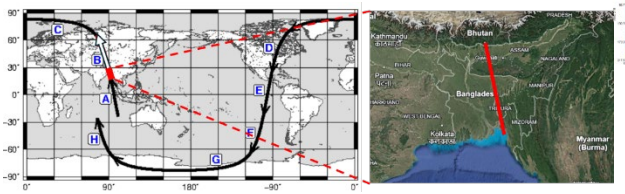
A

* The first ascending node crossing at 0.6 degree longitude, equivalent to the relative orbit 1, after reaching the reference orbit acquisition occurred as of absolute orbit 2087 on 10th October 2024. And there are 389 passes in one recurrence period. Therefore, the relationship between absolute orbit number (AbsOrbNo) and relative orbit number (RelOrbNo) after achieving the reference orbit can be addressed as below.

$$\text{RelOrbNo} = (\text{AbsOrbNo} - 2086) \bmod 389$$

(a) Frame-B of the relative orbit pass no.=028 (around Bangladesh region)

Non-cloud patterns appear in the echo & doppler data at the same height near land surface around Bangladesh area on the frame B of the relative orbit pass no.=028 (Absolute pass no. =2503B, 2892B, 3281B).



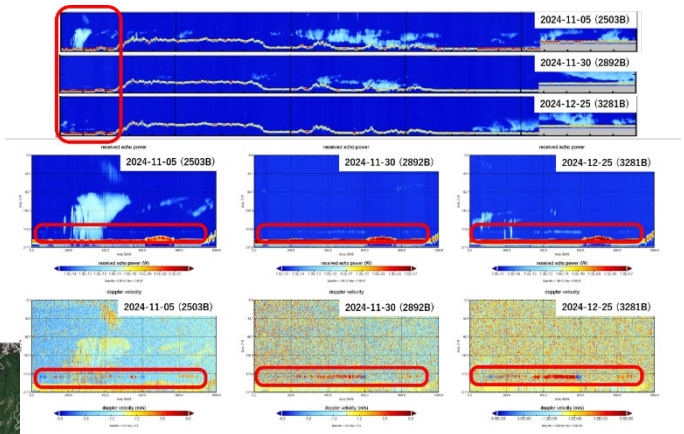
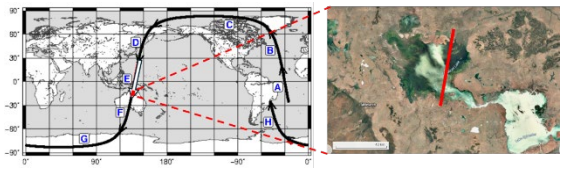


Figure 4-1:example of anomalies over Bangladesh

(b) Frame-E of the relative orbit pass no=049 (around the Tarrabool Lake in Australia) (Absolute pass no. =2524E, 2913E, 3302E).



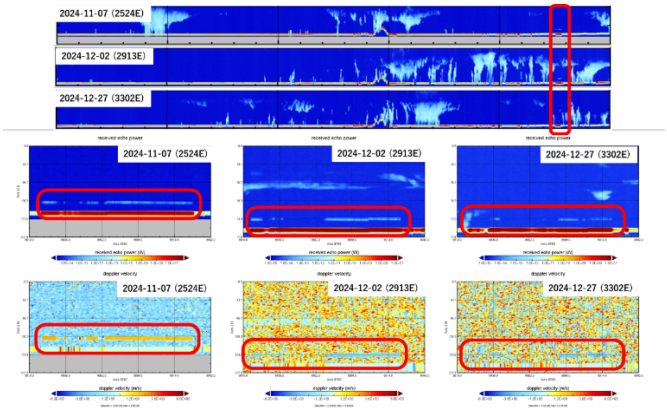


Figure 4-2: examples of anomaly over Tarrabool Lake

5. Antenna pointing correction is not implemented.

The CPR L1b processor will employ a method to compensate for antenna distortion due to thermal distortion of the Main Reflector (MREF) to improve antenna pointing accuracy, but this is not yet implemented in the current version.

6. Disturbance in the received power correction term.

In the current L1b software, the term of received echo power (ΔG) which is based on Y-factor method is adopted. It has been confirmed that the disturbance of the value of the ΔG occurs at a certain satellite altitude. The amount of this disturbance is at most about 0.5dB. Currently JAXA is preparing the update of the PRF table to remove this disturbance, and it will be reflected in the next L1b software update with CPR onboard parameter update.

Note that what is updated is only the part related to the timing of acquiring the noise source data for calibration, and it does not affect the PRF value itself at the time of observation.

7. Error of TxRxStatusflag just after the internal calibration.

The data of the internal calibration is not included in the L1b product. During the internal calibration, the CPR stops RF transmission, which may cause the HPT transmission stability to decrease immediately after restarting RF transmission when CPR is just back to the nominal observation mode. For this reason, the TxRxStatus flag is set in the L1b product for a few seconds after returning from internal calibration. However, a problem has been confirmed in which this flag is not set for just one second immediately after internal calibration.

<Major event history related to EarthCARE/CPR observation>

The CPR off-nominal operations such as on-board parameter updates and some operation that would affect data quality are listed below and Table-1 until 09 January 2025.
Observation data loss may occur during planned operation, such as CPR Calibration Operations, Silent State Operation Over Radio Astronomy Sites (RAS), Satellite maneuvers, GS outage etc. Please refer the followings;

- CPR L1b Data Missing List (CPR Operation Status):
  https://www.eorc.jaxa.jp/EARTHCARE/data/operational_status_e.html
- RAS overpasses:
  https://ec-pdgs-monitor.eo.esa.int/flyover/passes/
- Overview of CPR Calibration Plan :
  https://www.eorc.jaxa.jp/EARTHCARE/data/calibration_e.html

--- IQ offset change history ---

(1)SPU-A IQ offset change history

As the result of internal calibration of SPU-A, IQ offset values and the reference temperature have been updated as necessary. A history of the IQ offset changes of SPU-B is as below.

1) **26-29 July 2024　IQ offset values and reference temperatures were updated**
   The updated IQ offset values failed to meet the criteria. Therefore, the doppler velocities for low echo level around -19dBz may not be accurate until the next IQ offset update on 01 August.

2) **01 August 2024　IQ offset values and reference temperatures were updated**
   The updated IQ offset values could pass the criteria at the confirmation on 02 August. However, it could not pass the criteria at the confirmation on 02 September. Therefore, the accuracy of the doppler velocity for low echo level near -19dBz were gradually getting wrong since 02 August to 05 September.

3) **08 October 2024　IQ offset values and reference temperatures were updated**
   The updated IQ offset values could pass the criteria at the confirmation just after update on the same date. However, it could not pass the criteria at the confirmation on 01 November. Therefore, the accuracy of the doppler velocity for low echo level near -19dBz were gradually getting wrong since 08 October to 01 November.

4) **14 November 2024　IQ offset values and reference temperatures were updated**
The updated IQ offset values could pass the criteria at the confirmation on 24 November. and it was valid until SPU was changed to SPU-B on 26 November.

(2)SPU-B IQ offset change history

JAXA confirmed that IQ offset values set before lunch could pass the criteria at the confirmation in orbit. However, in order to further improve accuracy of the doppler velocity, JAXA determined to update the IQ offset values. A history of the IQ offset changes of SPU-B is as below.

1) **04 December 2024　IQ offset values and reference temperatures were updated**
JAXA confirmed that the doppler pattern like a rainbow on the very low echo region (lower than -19dBz) was removed after IQ offset value update.

--- PRF table update history ---

(1)SPU-A PRF table update history

1) **12:49(UTC) 23 October 2024: PRF table for external calibration was updated**
The range of the observation height of the external calibration mode was changed from "-2km ~ 18km" to "-3km ~ 17km" (1km shifted lower).

(2)SPU-B PRF table update history

1) **12:05(UTC) 04 December 2024: PRF table for external calibration was updated**
This update was done during the startup process of SPU-B switching from SPU-A. The range of the observation height of the external calibration mode was changed from "-2km ~ 18km" to "-3km ~ 17km" (1km shifted lower).

--- Other on-board update history affected to the performance　---

There are no other major on-board updates for both SPU-A and SPU-B

Table-1　Major events of EarthCARE/CPR (until 9 March 2025)

Event	UTC(From)	To	Duration		Obs. Data		SPU	Orbit/ Frame	Note
			Days	Time	Yes	No			
CPR First Turn-on	**2024-06-07T13:02:00**	-				✓	**B**	**—**	
Observation with B8 configuration	**2024-06-12T12:02:24**	**2024-07-16T11:44:28**	**33d**	**23h42m04s**	✓		**B**	**00226A-00386A**	**Start of CPR Obaservation.**
Observation with Initial IQ offset values	**2024-06-12T12:02:24**	**2024-07-16T11:44:28**	**33d**	**23h42m04s**	✓		**B**	**00226A-00386A**	**Initial IQ offset values were passed the criteria.**
Mode Transition Test	2024-06-13T09:51:58	2024-06-14T12:00:02	1d	02h08m04s		✓	B	00241H-00258G	For initial Checkout. Intenal Calibration is included.
Sub-mode Fix (Middle)	2024-06-14T12:00:03	2024-06-14T16:37:32	0d	04h37m29s	✓		B	00258G-00261G	For initial Checkout.
Sub-mode Fix (HIGH)	2024-06-14T16:37:33	2024-06-14T21:15:01	0d	04h37m28s	✓		B	00261G-00264G	For initial Checkout.
Sub-mode Fix (LOW)	2024-06-14T21:15:02	2024-06-17T12:45:26	2d	15h30m24s	✓		B	00264G-00305G	For initial Checkout. Long Silent State (10min.) is included.
Rx_ATT Change Operation	2024-06-17T13:57:57	2024-06-18T17:43:19	1d	03h45m22s	✓		B	00306F-00324E	For initial Checkout.
Mode Transition Test	2024-06-19T10:54:32	2024-06-19T13:27:08	0d	02h32m36s		✓	B	00335F-00337C	For initial Checkout. Intenal Calibration is included.
Contingency Mode Test1	2024-06-20T12:34:02	2024-06-20T14:19:57	0d	01h45m55s	(✓)	(✓)	B	00351F-00353D	For initial Checkout. Partly observed in CONT(Obs.) & CONT(Ext.).
Contingency Mode Test2	2024-06-20T15:41:02	2024-06-20T15:43:18	0d	00h02m16s	(✓)	(✓)	B	00354C	For initial Checkout. Partly observed in CONT(Obs.) & CONT(Ext.).
Observation Interruption	**2024-06-22T16:41:07**	**2024-07-16T11:44:28**	**23d**	**19h03m21s**		✓	**B**	**00386A-00755F**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
Preparation of SPU Swithing to SPU-A	**2024-07-16T11:44:29**	**2024-07-17T14:58:02**	**1d**	**03h13m33s**		✓	-	**00755F-00773C**	
Observation with A8 configuration	**2024-07-17T14:58:03**	**2024-11-25T13:33:19**	**130d**	**22h35m16s**	✓		**A**	**00773C-02801E**	
Observation with Initial IQ offset values	**2024-07-17T14:58:03**	**2024-07-29T10:29:13**	**11d**	**19h31m10s**	✓		**A**	**00773 - 00956H**	**Before IQ offset adjustment (Doppler accuracy is not good)**
Observation Interruption	**2024-07-22T01:06:26**	**2024-07-24T13:49:41**	**2d**	**12h43m15s**		✓	**A**	**00842A-00881D**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**

Observation with 1st Updated IQ offset values	**2024-07-29T10:29:15**	**2024-08-01T15:22:03**	**3d**	**04h52m48s**	✓		**A**	**00956H-00959H**	
Sub-mode Fix (Middle)	2024-07-29T10:29:15	2024-07-29T15:06:43	0d	04h37m28s	✓		A	00956H-00959H	For initial Checkout.
Sub-mode Fix (HIGH)	2024-07-29T15:06:44	2024-07-29T19:44:14	0d	04h37m30s	✓		A	00959H-00962H	For initial Checkout.
Sub-mode Fix (LOW)	2024-07-29T19:44:15	2024-07-30T07:59:32	0d	12h15m17s	✓		A	00962H-00970F	For initial Checkout.
Rx_ATT Change Operation	2024-07-30T07:59:33	2024-07-31T11:54:20	1d	03h54m47s	✓		A	00970G-00988H	For initial Checkout.
Contingency Mode Test	2024-07-31T13:39:18	2024-07-31T15:27:04	0d	01h47m46s	(✓)	(✓)	A	00990A-00991C	For initial Checkout. Partly observed in CONT(Obs.) & CONT(Ext.).
Observation with 2nd Updated IQ offset values	**2024-08-01T15:22:04**	**2024-10-08T13:59:05**	67d	22h37m01s		✓	**A**	**01006G-02063F**	
Observation Interruption	**2024-08-28T16:18:11**	**2024-08-30T07:43:38**	**1d**	**15h25m27s**		✓	**A**	**01425C-01453C**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
Observation Interruption	**2024-09-02T09:58:52**	**2024-09-03T12:51:28**	**1d**	**02h52m36s**		✓	**A**	**01500H-01518D**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
Rx_ATT Change Operation	2024-09-06T06:30:03	2024-09-06T20:25:50	0d	13h55m47s	✓		A	01560H-01569H	For initial Checkout.
Rx_ATT Change Operation	2024-09-06T23:30:50	2024-09-07T13:29:56	0d	13h59m06s	✓		A	01571H-01581A	For initial Checkout.
Observation Interruption	**2024-09-21T09:24:14**	**2024-09-23T10:04:34**	**2d**	**00h40m20s**		✓	**A**	**01796B-01827G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
Observation Interruption	**2024-09-21T09:24:14**	**2024-09-23T10:04:34**	**2d**	**00h40m20s**		✓	**A**	**01796B-01827G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
IQ Offset re-adjustment Operation	2024-10-08T12:24:25	2024-10-08T12:26:45	0d	00h02m20s		✓	A	02062F	For IQ offset values update
IQ Offset re-adjustment Operation	2024-10-08T13:56:54	2024-10-08T13:59:05	0d	00h02m11s		✓	A	02063F	For Reference Temperature Update
Observation with 3rd Updated IQ offset values	**2024-10-08T13:59:05**	**2024-11-14T14:24:53**	**37d**	**00h25m48s**	✓		**A**	**02063F-02639F**	
Observation Interruption	**2024-10-11T12:58:56**	**2024-10-14T14:26:35**	**3d**	**01h27m39s**		✓	**A**	**02109D-02157D**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**
Observation Interruption	**2024-10-17T12:50:19**	**2024-10-18T14:04:42**	**1d**	**01h14m23s**		✓	**A**	**02203A-02219D**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**

Update of the PRF table for External Calibration	2024-10-23T12:38:14	2024-10-23T12:49:37	0d	00h11m23s		✓	A	02296C	for SPU-A	
Observation Interruption	**2024-10-26T18:20:46**	**2024-10-28T10:40:23**	**1d**	**16h19m37s**		✓	**A**	**02346F-02372G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
HPT auto restarst during observation	2024-10-28T13:05:35	2024-10-28T13:07:39	0d	00h02m04s	✓*		A	02374C-02374D	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	
Sub-mode Fix (Low)	2024-11-05T21:00:01	2024-11-09T00:00:02	3d	03h00m01s	✓		A	02503H-02552E		
Sub-mode Fix (Middle)	2024-11-09T00:00:03	2024-11-12T11:50:48	3d	11h50m45s	✓		A	02552E-02606H		
Observation with 4th Updated IQ offset values	**2024-11-14T14:24:54**	**2024-11-26T12:45:40**	**11d**	**22h20m46s**	✓		**A**	**02639F-2810C**		
Zerro Doppler obaservation	2024-11-15T10:38:12	2024-11-16T11:06:32	1d	00h28m20s	✓		A	02652G-02668F		A
Preparation of SPU Swiching to SPU-B	**2024-11-25T13:33:20**	**2024-11-26T12:45:40**	**0d**	**23h12m20s**		✓	**-**	**02810C-02825D**	**Including update of the PRF table for External calibration (SPU-B)**	
Observation with B8 configuration	**2024-11-26T12:45:41**	**Continue**	-	-	✓		**B**	**Continue**	**Observation Sub-mode: MIX in usual**	
Observation with Initial IQ offset values	**2024-11-26T12:45:41**	**2024-12-04T12:05:58**	**7d**	**23h20m17s**	✓		**B**	**02825D-02949D**	**Initial IQ offset were passed the criteria (Quality of the Doppler is good.)**	
Observation Interruption	**2024-11-27T12:08:09**	**2024-11-28T10:07:24**	**0d**	**21h59m15s**		✓	**B**	**02840E-02854G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
Observation Interruption	**2024-11-28T10:15:13**	**2024-11-29T09:17:12**	**0d**	**23h01m59s**		✓	**B**	**02854H-02869G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
HPT auto restart during observation	2024-11-29T09:20:22	2024-11-29T09:22:28	0d	00h02m06s	✓*		B	02869G	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	
Observation with 1st Updated IQ offset values	**2024-12-04T12:05:59**	**Continue**	-	-	✓		**B**	**Continue**	**Quality of the doppler is even better than before IQ offset update.**	

		Stop the observation for satellite Manoeuvre (Regular weekly work)	2024-12-10T17:48:21	2024-12-10T18:45:21	0d	00h57m00s		✓	B	03046E-03047A	CPR is in Internal Calibration Mode during the Satellite Manoeuvre	
		Observation Interruption	**2024-12-14T08:11:10**	**2024-12-19T12:55:23**	**5d**	**04h44m13s**		✓	**B**	**03102E-03183C**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
		Observation Interruption	**2024-12-21T23:27:14**	**2024-12-23T10:04:29**	**1d**	**10h37m15s**		✓	**B**	**03221C-03243H**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
		HPT auto restart during observation	2024-12-24T11:35:46	2024-12-24T11:41:59	0d	00h06m13s	✓*		B	03260C -03260D	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	
		Observation Interruption	**2024-12-28T03:51:40**	**2024-12-30T10:12:07**	**2d**	**06h20m27s**		✓	**B**	**03317E-03352G**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
		HPT auto restart during observation	2024-12-30T10:14:48	2024-12-30T10:16:54	0d	00h02m06s	✓*		B	03352G	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	
		Observation Interruption	**2025-01-01T22:20:31**	**2025-01-02T14:39:15**	**0d**	**16h18m44s**		✓	**B**	**03391G-03402C**	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	
		HPT auto restart during observation	2025-01-02T14:43:37	2025-01-02T14:45:42	0d	00h02m05s	✓*		B	03402D	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	
		HPT auto restart during observation	2025-01-13T10:37:15	2025-01-13T10:43:29	0d	00h06m14s	✓*		B	03570H	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	A
		Rx_ATT Change Operation (17.5[dB])	2025-01-19T19:40:01	2025-01-19T19:45:21	0d	00h05m20s	✓	(✓)	B	03670A-03670B	Observation was implemented with high Rx_ATT setting (17.5[dB]). This time range includes the durations of the IDLE mode for changing the RxATT setting to 17.5[dB] before	A

	Observation Interruption	2025-01-20T18:39:13	2025-01-22T15:52:39	1d	21h13m26s		✓	**B**	03685A-03714C	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	A
	HPT auto restart during observation	2025-01-22T16:02:37	2025-01-22T16:04:43	0d	00h02m06s	✓*		B	03714D	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	A
	HPT auto restart during observation	2025-03-05T12:43:52	2025-03-05T12:45:56	0d	00h02m04s	✓*		B	04365G	HPT-B auto restart is occurred (Operation based on design, not anomaly. *Observation was continued but RF is OFF in this period.	A
	Observation Interruption	2025-03-06T21:36:44	2025-03-07T14:52:26	0d	17h15m42s		✓	**B**	04387B-04398C	**HPT-B OFF is occurred and CPR transits to Standby-refuse mode.**	A
	～Cotinue the observation	2025-03-07T14:52:27	-								A

✓*: The observation data was obtained but RF was OFF during in this period.

(✓): The observation data was obtained during part of this period.

Mar 17, 2025

Release Notes for EarthCARE JAXA Level-2 Products

CPR Level 2 Echo Product Algorithm – vBa (v1.0)

PI: Hiroaki Horie, NICT

Summary

This document describes the EarthCARE JAXA CPR Level 2 Echo Product (CPR L2 ECO).

The version of the CPR L2 ECO Product provided in this document is v 1.0.

Changes from previous version

Radar Reflectivity Product

- The algorithm is not changed but value is lower because L1b CPR product is corrected for this version.
- The mirror echo flag is implemented to "mirror_echo_flag_1km/10km". If it is not zero, the echo contaminates either mirror echo or multiple scattering echo.
- The clutter flag is implemented to "integrated_radar_reflectivity_flag_1km/10km". If it is greater than 0x100 (=256), the echo contaminates clutter echo.
- When RF signal is off, the values are set to Fill value.

Doppler Velocity Product

- The clutter flag is implemented to "doppler_velocity_quality_flag_1km/10km". If it is greater than 0x100 (=256), the echo contaminates clutter echo.
- Bias correction products are implemented as temporary products because antenna miss pointing due to thermal distortion is not corrected, currently. Until correction is implemented in L1b product, the products by bias

correction using surface velocity are added temporary. These variable names are added the word "_bias_corr" at the tail of original variables names.
- When RF signal is off, the values are set to Fill value.

Surface Product

- Clutter echo product is not implemented and sets Fill value because it is not significant compared CloudSat. Instead of this, the clutter flag is implemented to "integrated_radar_reflectivity_flag_1km/ 10km". If it is greater than 0x100 (=256), the echo contaminates clutter echo.
- PIA estimation is implemented.

Spectrum Width Product

- no change

Quality Flag

- "L2_quality_flag_1km/10km" are introduced. If it is not zero, either warning or error is occurred in this algorithm and the variables should not be used. It is independent to other flags, currently.

New Issues

- The calibration factor of the L1b input data for this product has been updated as of March 13, 2025 (frame 4483C) from baseline vCa to vCb, where radar reflectivity and received echo power increased by 1.6 dB. Data prior to 4483B uses L1b (vCa) as input, while data from 4483C onwards uses L1b (vCb) as input. Please note that there is no continuity in the data across March 13 2025.

Known Issues

- The second trip echo between satellite and surface occurs rarely around 2000m in height, where NRCS is saturated.

April 23, 2025

Release Notes for EarthCARE JAXA Level-2 Products

CPR Level2 Cloud Product Algorithm – vBb (v1.1)

PI: Kyushu University

Summary

This is the CPR cloud algorithm described in Okamoto et al. (2024) and Sato et al. (2025) that provides cloud-related microphysical parameters.

- Hajime Okamoto, Kaori Sato, Tomoaki Nishizawa, Yoshitaka Jin, Shota Ogawa, Hiroshi Ishimoto, Yuichiro Hagihara, EIji Oikawa, Maki Kikuchi, Masaki Satoh, and Wooosub Roh, Cloud masks and cloud type classification using EarthCARE CPR and ATLID, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2024-103, 2024
- Kaori Sato, Hajime Okamoto, Tomoaki Nishizawa, Yoshitaka Jin, Takashi Y. Nakajima, Minrui Wang, Masaki Satoh, Woosub Roh, Hiroshi Ishimoto, and Rei Kudo, JAXA Level 2 cloud and precipitation microphysics retrievals based on EarthCARE radar, lidar, and imager: the CPR_CLP, AC_CLP, and ACM_CLP products, Atmos. Meas. Tech., 18, 1325–1338, https://doi.org/10.5194/amt-18-1325-2025, 2025

Changes from previous version (vBa/v1.0) to this version (vBb/v1.1)

The vBa cloud mask detected more clouds than actual cloud existence near the ground surface due to the contamination of surface clutter. The algorithm has been updated to vBb and cloud detection near the ground surface has been improved.

New Issues

No new issues.

Known Issues

The following variables are consistent with scientific knowledge, but have not yet been fully evaluated and should be used with caution.

- Air Vertical Velocity
  (cloud_air_velocity_10km, cloud_air_velocity_1km)
- Sedimentation Velocity
  (cloud_terminal_velocity1_1km, cloud_terminal_velocity1_10km, cloud_terminal_velocity2_1km, cloud_terminal_velocity2_1km)

The calibration factor of the L1b input data for this product have been updated as of March 13, 2025 (frame 4483C) from baseline vCa to vCb, where radar reflectivity and received echo power increased by 1.6 dB. Data prior to 4483B uses L1b (vCa) as input, while data from 4483C onwards uses L1b (vCb) as input. Please note that there is no continuity in the data across March 13 2025.

March 17, 2025

Release Notes for EarthCARE JAXA Level-2 Products

ATL_CLA – vBa (v1.0)

PI: National Institute for Environmental Studies (NIES)

Summary

In the revision from version 0.6 (v0.6) to version 1.0 (v1.0), most of the algorithms for estimating each product were modified. In particular, the algorithms for L1 data preprocessing and feature mask retrieval were significantly revised. Issues remain for several products, but studies are underway to improve them.

Changes from previous version (v0.6) to this version (v1.0)

L1 data preprocessing

To improve the quality of L1 data, noise reduction processing using wavelet analysis is performed in the vertical direction before retrieving L2 products. In this smoothing process, contamination of the reflected signal from the ground and sea surface to the atmospheric signal occurs, resulting in misidentification by feature mask and misestimation of cloud and aerosol optical properties. In order to reduce this contamination, the application range of wavelet analysis is limited to the atmosphere above 500 m altitude.

Feature mask product

The continuity test developed by Kyushu University, which was implemented for cloud layer identification to reduce mis-identifications due to signal noise, was extended to aerosol and clear-sky layer identification.

Cloud optical property

In order to account for the effects of multiple scattering by clouds, η-factor was implemented. v0.6 had η=0.8, but was changed to η=0.6 to reflect the initial analysis results using EarthCARE measured data. This results in an upward adjustment of the cloud extinction coefficient in v1.0 compared to that in v0.6.

Target mask product

The continuity test developed by Kyushu University was implemented for cloud and aerosol type classification to reduce mis-identifications due to signal noise.

PBL height product

Due to the difficulty of ensuring sufficient signal-to-noise ratio of L1, it was decided not to perform PBLH retrieval for the 1 km resolution data..

New Issues

Nothing in particular.

Known Issues

Feature mask product

- Aerosol and clear-sky detection results were still scattered in space mainly due to signal noise. Measures to reduce signal noise are still needed.
- Some misidentifications between cloud and aerosol are still found. Improvements to thresholds and conditions for discriminating clouds and aerosols will be investigated in the future.
- Some misidentifications of cloud layers are still found near the surface. Improvements to thresholds for surface detection and signal smoothing methods are being considered.

Target mask product

- Aerosol type classification results are still scattered in space mainly due to signal noise. Measures to reduce signal noise are still needed.

March 17, 2025

Release Notes for EarthCARE JAXA Level-2 Products

MSI Cloud Product Algorithm– vBa (v1.0)

PI: Takashi Y. Nakajima

Summary
This document describes the EarthCARE JAXA MSI Level 2 Cloud Characteristics Product (MSI L2 Cloud Characteristics Product).
The version of the MSI L2 Cloud Characteristics Product provided in this document is v0.6.

About the cloud characteristics Product Algorithm

The cloud characteristics product algorithm contains cloud flag detection algorithms (CLAUDIA) and cloud properties product (CAPCOM) algorithm. When focusing on a pixel in the MSI, if the pixel is identified as water cloud or ice cloud by CLAUDIA, then cloud characterization analysis is performed by CAPCOM.

The MSI L2 cloud properties product contains the following physical quantities: cloud optical thickness, cloud particle effective radius (unit: μm), cloud top height (unit: m), cloud top temperature (unit: K), and cloud top pressure (unit: hPa). Cloud particle effective radius data contains results from both band 3 and band 4. The file format is HDF5. The MSI L2 cloud characteristics product uses MSI level 1C data and ECMWF AUX-3MH data as input.
-
The principle by which the cloud optical thickness and cloud particle effective radius are obtained is as follows. First, the imaginary part of the complex refractive index of a water droplet in Band 1 (0.670 μm) of the MSI is very small, about 10^{-8}, so that even if multiple scattering by cloud particles occurs, it is hardly absorbed. Therefore, light that incident into the cloud layer is repeatedly scattered by cloud grains, and finally light scattered from the cloud top in the direction of the satellite is observed. As cloud optical thickness increases, more light is scattered upward from the cloud tops, and more light observed by MSI Band 1. As the cloud optical thickness increases to about 70, the probability of upward scattering as a result of multiple scattering reaches an upper limit and the observed radiance does not change any more.

On the other hand, MSI Band 3 (1.6 μm) and Band 4 (2.1 μm) is used to estimate the effective radius of cloud particles. The imaginary part of the complex refractive index of water droplets at this near-infrared wavelength is ~ 10^{-5}, three orders of magnitude larger than that of visible light. Therefore, NIR light that enters the cloud layer is absorbed as it is repeatedly scattered by cloud particles. The larger the cloud particle size, the stronger the absorption, and the weaker the light observed by satellite onboard sensors. As the particle size increases, the absorption in the cloud layer gradually saturates, so there is an upper limit to the effective radius of cloud particles that can absorb near-infrared light.

The cloud properties to be estimated are the cloud optical thickness τ_c (at a light wavelength of 0.5 μm) and the cloud particle effective radius r_e. τ_c is a dimensionless quantity indicating the cloud thickness relative to light. Assuming the radius of the cloud particle, the size distribution of the cloud particle dispersion system as $n(r)$, and the dissipation efficiency factor as Q_{ext}, τ_c

between geometric locations z = 0 and z can be expressed as follows (Nakajima and Nakajima 1995, Kawamoto et al. 2001),

$$\tau_c = \int_0^z \int_0^\infty \pi r^2 Q_{ext} n(r) dr dz \quad (1)$$

r_e takes the weighted average of the cross-sectional area of the particles, which could be defined as:

$$r_e \equiv \frac{\int_0^\infty \pi r^3 n(r) dr}{\int_0^\infty \pi r^2 n(r) dr} \quad (2)$$

For oceanic stratocumulus clouds, *n(r)* is often log-normally distributed as follows:

$$n(r) = \frac{N}{\sqrt{2\pi}\sigma} \exp\left[-\frac{(\ln r - \ln r_0)^2}{2\sigma^2} \right] \quad (3)$$

(Nakajima et al. 1991) observed that the typical value of σ is 0.35. Note that r_0 in Eq. (3) is the mode radius of the lognormal distribution.

Estimation of physical quantities from satellite observations is performed by comparing the observed radiance from satellite onboard sensors with the simulated radiance using a radiative transfer code (Nakajima and Tanaka, 1988). In this estimation method, a database (Look Up Table, LUT) is prepared by calculating τ, r, by iterative calculations using Newton's iteration method and so on.

Changes from previous version to this version

In ECTK structure definition file, the upper limit of cloud optical thickness and cloud effective radius was revised to 150 and 100μm, respectively. This is to match the retrieval of ice cloud pixels.
For pixels with extremely high cloud optical thickness (>150), or those with extremely low cloud top temperature (lower than the minimum value of the temperature in ancillary data), the cloud top temperature will be outputted as 150, and the cloud top temperature will be outputted as the same value with brightness temperature from L1c data. The output data for these pixels were fill value or NaN in previous versions.

Usage

See "README" file for details.

Validation for L2 data release

The validation for L2 data release was performed for liquid water cloud optical thickness and cloud flag (clear confidence level), and was found to satisfy the release criteria as follows.

- Cloud flag: error within +/- 15% at sea surface and within +/-20% at land surface
- Liquid water cloud optical thickness: within +/- 10%

New Issues

A tendency for L1 radiance value to be excessive has been reported, which possibly affects the accuracy of L2 products. L1 calibration is underway by ESA and expected to be improved later.

Known Issues

For pixels with cloud optical thickness <150 and cloud top temperature < minimum temperature in ancillary data, CAPCOM 1 channel method failed to retrieve cloud optical thickness, therefore the cloud optical thickness is determined by linear search method from the cloud top downward.

Additional Notes

The data quality flag is output as binary integer type with a length of 3 bits, which contains seven patterns for each pixel (000 = No data, 001 = Night, 010 = Clear, 011 = Unsatisfied condition, 100 =Retrieval failed, 101 = Successful with low confidence, 110 = Successful with high confidence). For all pixels in that CAPCOM uses 2 channels method (usually for center regions of hurricane, typhoon, or thick cumulonimbus cloud), data quality is fixed as 101 = Successful with low confidence.

The cloud flag bit field contains algorithm execution flag, clear confidence level, day/night flag, land/water flag, snow/ice probability flag, sunglint flag, heavy aerosol flag, cirrus probability flag, cloud inhomogeneity flag, cloud phase flag, and snow screening flag. However, because EarthCARE/MSI does not have 530nm wavelength band which is required to calculate the normalized difference snow index (NDSI), the snow/ice probability flag here can not recognize snow/ice correctly. To distinguish clouds from snow/ice areas, EarthCARE/MSI still needs additional data from other sensors.

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April 23, 2025

Release Notes for EarthCARE JAXA Level-2 Products

CPR-ATLID Cloud Product Algorithm– vBb (v1.1)

PI: Kyushu University

Summary

This is the CPR-ATLID synergy cloud algorithm described in Okamoto et al. (2024) and Sato et al. (2025) that provides cloud-related microphysical parameters.

- Hajime Okamoto, Kaori Sato, Tomoaki Nishizawa, Yoshitaka Jin, Shota Ogawa, Hiroshi Ishimoto, Yuichiro Hagihara, EIji Oikawa, Maki Kikuchi, Masaki Satoh, and Wooosub Roh, Cloud masks and cloud type classification using EarthCARE CPR and ATLID, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2024-103, 2024
- Kaori Sato, Hajime Okamoto, Tomoaki Nishizawa, Yoshitaka Jin, Takashi Y. Nakajima, Minrui Wang, Masaki Satoh, Woosub Roh, Hiroshi Ishimoto, and Rei Kudo, JAXA Level 2 cloud and precipitation microphysics retrievals based on EarthCARE radar, lidar, and imager: the CPR_CLP, AC_CLP, and ACM_CLP products, Atmos. Meas. Tech., 18, 1325–1338, https://doi.org/10.5194/amt-18-1325-2025, 2025

Changes from previous version (vBa/v1.0) to this version (vBb/v1.1)

The vBa cloud mask detected more clouds than actual cloud existence near the ground surface due to the contamination of surface clutter. The algorithm has been updated to vBb and cloud detection near the ground surface has been improved.

New Issues

No new issues.

Known Issues

The following variables are consistent with scientific knowledge, but have not yet been fully evaluated and should be used with caution.

- Air Vertical Velocity
  (cloud_air_velocity_10km, cloud_air_velocity_1km)
- Sedimentation Velocity
  (cloud_terminal_velocity1_1km, cloud_terminal_velocity1_10km, cloud_terminal_velocity2_1km, cloud_terminal_velocity2_1km)