CRYOSAT-2

Level 2 product evolutions and quality improvements in Baseline C

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Date	Issue	Page	Change
22/01/2014	1	1-17	Minor edits and Table added in section 5
26/01/2014	2	9-17	Addition of closed Anomaly Reference on ARTS and updated table for L2 ARs
27/01/2014	3	1	Addition of signatures

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1 INTRODUCTION

1.1 Scope

This document is a high-level overview of recent evolutions in the CryoSat data processing associated to the upcoming Baseline C.

The Baseline C changes concern both the Level 1b and Level 2 products (RD-01). However, the impacts of Level 1b changes on the resulting Level 2 products are out of the scope of this document. This document is targeted to the CryoSat users interested in scientific applications based on the exploitation of the Level 2 products. The main objective of this technical note is thus to briefly describe the effects of the Instrument Processing Facility (IPF2) evolutions on the Level2 products from Baseline B to Baseline C, both in terms of formats and contents. A complementary document dealing with the whole Level 1b SAR/SARin changes is also made available to the users (RD-02).

The IPF2 upgrades are expected to have significant and positive impacts on the scientific exploitation of the CryoSat mission over land ice, Sea ice and - in a less extend - over the Ocean. The combined effect of the IPF1 and IPF2 improvements would indeed allow generating L2 products at higher quality than the previous release associated to Baseline B.

Within the next months, the quality control and validation teams will provide substantial evaluation associated to this new release. Feedback and suggestions from the QWG and the scientific user community are also encouraged.

1.2 Applicable Documents

AD-01 Products Specification Format - Instrument Processing Facility L1b, C2-RS-ACS-GS-5106 issue 6.2, 13th October 2014

AD-02 Products Specification Format - Instrument Processing Facility L2, CS-RS-ACS-GS-5123, issue 4.2, 14th October 2014

AD-03 Instrument Processing Facilities IPF Processors I/O Description, CS-TN-ACS-GS-5124, issue 4.2, 17th October 2014

AD-04 Level 2 Processor ICD, CS-ID-ACS-GS-0117, Issue: 4.3, 16 October 2014

AD-05 CryoSat2: L2 Design Summary Document, CS-DD-MSL-GS-2002, Issue: 7.1, 27 November 2014.

1.3 Reference documents

RD-01 CryoSat Data Quality Summary Status, CS-TN-ESA-GS-808, Version 8, January 2015

RD-02 Quality improvements in SAR/SARin BaselineC Level1b products, CS-TN-ARS-GS-5154 issue 1.2, 16th October 2014

RD-03 Wingham, D. J., Phalippou, L., Mavrocordatos, C., & Wallis, D. (2004). The mean echo and echo cross product from a beamforming interferometric altimeter and their application to elevation measurement. *Geoscience and Remote Sensing, IEEE Transactions on*, *42*(10), 2305-2323.

RD-04 CryoSat2 IPF2 Test Report, C2-TR-MSL-C-0004, issue 2.2, 18th December 2014

1.4 Acronyms

ADC	Analogue-to-Digital Converter
CFI	Customer Furnished Item
DAD	Dynamic Auxilairy Data
FDM	Fast Delivery Mode
FOS	Flight Operation System
CAL1	L1B Calibration Type-1 File
DORIS	Doppler Orbit and Radio-positioning Integrated by Satellite
IDEAS+	Instrument Data Quality Evaluation and Analysis Service.
IPF	Instrument Processing Facility
IPFDB	Instrument Processing Facility Database
L1B/L2	Level 1B and Level 2
LRM	Low Resolution Mode
MDSR	Measurement Data Set Record
MSSL	Mullard Space Science Laboratory
NRT	Near Real Time
PDGS	Payload Data Ground Segment
RD	Reference Document
SIRAL	Synthetic Interferometric Rader Altimeter
SAR	Synthetic Aperture Radar mode
SIN	Synthetic Interferometric mode
SICC1B	Level 1 CAL1 SIN Complex Data
SSB	Sea State Bias
SSH	Sea Surface Height
SWH	Significant Wave Height

2 CONTEXT

2.1 Mission Context

With the effects of a fast-changing climate becoming apparent, particularly in the Polar Regions, it is increasingly important to understand exactly how Earth's ice fields are responding. Diminishing ice cover is frequently cited as an early casualty of global warming and since ice, in turn, plays an important role regulating climate and sea level, the consequences of change are far-reaching. To understand fully how climate change is affecting these remote but sensitive regions, there remains an urgent need to determine exactly how the thickness of the ice, both on land and floating in the sea, is changing (RD-03).

In this respect, the ESA's Earth Explorer CryoSat-2 spacecraft (CS) was launched on 8 April 2010. The primary mission objectives are the determination of the regional and basin-scale trends in perennial Arctic sea ice thickness and the contributions to global sea-level of the Antarctic and Greenland ice sheets. The secondary mission objectives are the observation of the seasonal cycle and variability of Arctic and Antarctic sea ice mass and thickness in addition to the variation in thickness of the world's ice caps and glaciers. By addressing this challenge, the data delivered by CryoSat can be used to complete the picture and lead to a better understanding of the role ice plays in the Earth system.

To do this, the quality of the CryoSat products have to meet the highest performance, through constant improvement of the Instrument Processing Facilities, based on a number of external and internal inputs from the scientific community and validation campaigns.

The ground segment is continuously evolving in order to satisfy growth within the science community, which has increased by 170% since launch. Prior to Baseline C, two major product Baselines (A and B) have been already released to users since the launch of the mission and the first data reprocessing campaign was completed in December 2013.

2.2 Main outputs from the IPF2

The primary output quantities from all of the IPF2 are L2 products containing:

- Geophysically corrected ice sheet elevations, measurement locations and associated parameters
- Geophysically corrected sea-ice elevations and associated parameters
- Sea-ice freeboard and associated parameters
- Ice-free ocean elevations and associated parameters
- Associated auxiliary and geophysical correction data

In the first step of L2 processing, the L2 products are separated by modes and defined over the same time window of the input L1B (main outputs of the IPF2).

In the second step of the processing, a global L2 product is generated from the L2 mode dependent products collected over an entire orbit. This compact Geophysical Data Record (GDR) is designed to minimize the data volume distributed to users. Another L2 data set dedicated to few specialists is also made available. This dataset, called the L2 Intermediate Product, contains many more parameters and flags. This is also an input to the second pass of the L2 SAR processing chain where, in Baseline C, the sea-surface height anomaly is interpolated to the location of all measurements identified as sea ice, to allow the computation of the so-called freeboard.

2.3 Baseline A to Baseline B

The change from Baseline A to Baseline B (January 2012) was primarily motivated by the need to improve the performance of CryoSat-2 over sea ice. The transition to Baseline B processing (*Release B = IPF1 version K1.0 and IPF2 version J1.2*) for the Cryosat-2 products available on the data dissemination ftp server became effective for products from February 2012. The main differences between Baseline A and Baseline B is the use of finer gate spacing in Baseline B resulting in a truncation of the trailing edge of the waveform. A tuned Level 2 SAR discriminator and retracker thresholds have also been implemented and several configuration parameters have been improved. The Fast Delivery Marine (FDM) product is then produced in Near Real Time (NRT) with an average latency of 2-3 days, both for L1B and L2.

The FDM product has been improved in April 2013 with an upgraded processor (*IPF1 version K2.0 and IPF2 version K1.*0). The main evolutions concern the tuned FDM retracker threshold and the backscatter coefficient calculated from an improved algorithm developed by the NOAA. Moreover the GIM ionospheric correction and meteorological forecast DAD are now used in NRT. Several FDM configuration parameters are also improved to generate FDM L2 data with a quality comparable to other ocean-oriented altimetric missions. At time this document is written, evolution on the SWH and WS computation for FDM data are planed (***CRYO-IDE-115*** on ARTS, refer to section 5).

Baseline B processor have been used in the first CryoSat Reprocessing Campaign to reprocess all offline science data (LRM, SAR and SARIn) back to the start of the mission (July 2010). This data is available on the dissemination ftp server.

2.4 Introduction to Baseline C

Baseline C is a major upgrade to the CryoSat IPFs. The new ground processors are expected to be operational from 01 April 2015 and will be used to reprocess CryoSat data during the mission's second global Reprocessing Campaign. Baseline C introduces major evolutions to the processors with respect to the current Baseline B and mark the release of Freeboard data within the L2 SAR products. The following sections of this document are non-exhaustive but summarize the main changes, expected improvements and issues that been resolved with the new Baseline C processors.

3 L2 PRODUCT FORMAT AND CONTENT CHANGES

Even if the interpretation of the data depends on the instrument mode (LRM SAR or SARin), the L2 format itself is however mode independent.

This section aim at providing a high level overview of the main modifications associated to Baseline C in terms of product format and content. We illustrate this with the L2 mode dependent product. The interested reader may refer to (AD-02, AD-03) for the L2i and GDR[1] products format specification. For the Reference Data Set Descriptions (DSDs), all the reference DSDs of the source L1B file are included, in order to provide a Level-2 product which contains all the references to the files that were used along the IPF1 / IPF2 processing chain to generate the product. In Baseline C, some new DSDs have been introduced and others have been updated.

In the Tables below the new available parameters in the Product Format for the Level2 product with respect to the Baseline B have been highlighted. Table 1 shows that the following fields have been added in the L2 MDS layout (only the new fields are shown):

- Antenna Bench Roll Angle - corresponding to the MDSR Time Stamp.
- Antenna Bench Pitch Angle – corresponding to the MDSR Time Stamp.
- Antenna Bench Yaw Angle – corresponding to the MDSR Time Stamp .

ID	Descriptor	Unit	Type	Size	Tot. Size
Time and Orbit group					
6	Spacecraft Roll Angle	10-7 degrees	sl	4 bytes	4 bytes
7	Spacecraft Pitch Angle	10-7 degrees	sl	4 bytes	4 bytes
8	Spacecraft Yaw Angle	10-7 degrees	sl	4 bytes	4 bytes

TABLE 1- Baseline C Level2 product format: Time and Orbit Group

Table-2 below summarises the retrackers used in Baseline C. Particular attention should be paid to the respectively new and updated UCL Land-Ice (LIRT) and OCOG retrackers

Retracker ID	Mode LRM	Mode SAR	Mode SARin
1	Ocean CFI model fit	Laxon/Ridout sea-ice model fit	Wingham/Wallis model fit
2	UCL land-ice	TBD	TBD
3	OCOG	TBD	TBD

TABLE 2- Retracker used in baseline C function of the mode

[1] *With Baseline B, the file description field in SIR_GDR_2A product header files is set to: "L2 Consolidated Product in the first year of the Mission"; which is changed to "L2 Consolidated Product"with Baseline C (CRYO-IDE-195). Moreover, multiple versions of SIR_GDR_2A products are being generated and disseminated via the PDS science server (CRYO-IDE-149). Preliminary investigations have suggested that this may be due to GDR products being generated with an incomplete number of constituent L2 products, and then being re-generated when additional L2 products are processed. It is important for users to note that whilst this problem is being solved, they should use only the most recently generated version of each GDR product (with the highest version number).*

Table 3 summarizes the main modifications in Baseline C in regards to fields that have been added and ones that have been updated (by adding new or improved parameters) in the L2 Measurement Data Set Record (MDS) layout:

Measurements group - Repeated 20 times					
30	Corrections status flags	-	ul	4	4
38	Height of surface w.r.t. reference ellipsoid (retracker 2)	Mm	Sl	4	4
39	Height of surface w.r.t. reference ellipsoid (retracker 3)	Mm	Sl	4	4
40	Backscatter (sigma-zero) (retracker1)	dB/100	Ss	2	2
41	Backscatter (sigma-zero) (retracker2)	dB/100	Ss	2	2
42	Backscatter (sigma-zero) (retracker3)	dB/100	Ss	2	2
43	Freeboard	Mm	Ss	2	2
44	Interpolated Sea Surface Height Anomaly	mm	ss	2	2
45	Number of interpolated records for SSHA	-	ss	2	2
46	SSHA Interpolation Quality	mm	ss	2	2
51	Correction Application Flag	-	Ul	4	4
52	Retracker 1 Quality Value	-	Ul	4	4
53	Retracker 2 Quality Value	-	Ul	4	4
54	Retracker 3 Quality Value	-	Ul	4	4

TABLE- 3 Baseline C Level2 product format: Measurement group

- Field: 30: Corrections status flag used to show validity of 1Hz corrections. This flag indicates the validity of 1Hz parameters. In baseline C, new corrections have been used to derive the surface height (fields 37, 38, 39) in the L2 products, and thus this status flag has been updated.
- Field 38: Height of surface. The height of the surface at the measurement point w.r.t. the reference ellipsoid. Computed by retracker 2. In Baseline C, it corresponds to the new UCL retracker opetrating in LRM over land -ice.
- Field 39: Height of surface. The height of the surface at the measurement point w.r.t. the reference ellipsoid. Computed by retracker 3. Which has been tuned in Baseline C.
- Field 40: The fully corrected backscatter including instrument gain correction and bias. Computed by the improved retracker 1.
- Field 41: The fully corrected backscatter including instrument gain correction and bias. Computed by the new retracker 2 .
- Field 42: The fully corrected backscatter including instrument gain correction and bias.

Computed by the improved retracker 3.

- Field 43: The Freeboard over the sea ice which is now computed in Baseline C. In the previous Baseline this was be set to '-9999' for all records. In baseline C, the freeboard will be computed and the field will be filled in the L2 product. Note that Freeboard can be a small negative value when there is sufficient snow-loading on thin ice. Set to 0 in SARin and LRM modes.
- Field 44: The Interpolated Sea Surface Height Anomaly which is now computed in Baseline C. The ocean height anomaly, computed by comparing the interpolated ocean height from the SAR processing with the MSS from the model.
- Field 45: Number of interpolated records for SSHA is the number of records that were used to create the fit to calculate the SSHA.
- Field 46: SSHA Interpolation Quality is the root mean square (RMS) of the residuals of the SSHA fit.
- Field 51: Measurement Quality Flags indicating the quality of the 20Hz measurement parameters which has been updeted with respect to new parameters added in Baseline C
- Field 52: Correction Application Flags indicating which corrections were applied in the computation of the height values in this record. The intent is to allow the user to remove applied corrections and substitute their own.
- Field 53: Retracker Quality Values – chi^2 value from fit of waveform amplitude.

The format of the new products has been independently checked by MSSL and IDEAS+. Successful ingestion of the Baseline C format L2 products in QC tools indicate correct implementation of the new product format, which corresponded to the expected product structure from (AD-03).

4 MAIN EXPECTED IMPROVMENTS WITH THE BASELINE C

Throughout this section, the IPF2 upgrade quality improvements having a direct impact on the quality of the L2 products are described, mainly based on information extracted from (AD-05) and (RD-04). For sake of completeness the complete list of changes and IPF issues, which have been resolved in Baseline C with respect to Baseline B, have been reported in a tabular form in Section 5.

4.1 Refinement of the OGOG and CFI land-ice retrackers (LRM)

The waveform retracker is defined as one algorithm for determining the range, i.e. the distance between the satellite and the remotely-sensed surface. Until baseline B, two LRM retrackers where operating: the OCOG and the CFI. The OCOG is a variant of that used for ENVISAT. OCOG is not as accurate as some new models, and provides nor quality estimation and neither information about derivable parameters. The CFI is delivered as a binary library, no details of the functional fit performed by the retracker are given, making difficult potential evolutions and tuning. Given the weaknesses observe with the Baseline B retracker in LRM, it has been decided to refine the existing retracker (OGOG and CFI).

Previous analysis performed by MSSL, from CS Baseline B data has shown that height failure rate was too high for LRM over land and land ice. Some data rejections are expected and were roughly estimated to be around 40 % for LRM echoes over land (without ice) and only 10% over ice sheets. However, the observed rejections were higher: approximately 78 % over land and 17 % over ice sheets with the TDS generated with the previous IPF2 version for November 2011. It was suspected that the error thresholds might be too tights over non-ocean areas compared with what expected.

During the testing of Baseline C (RD-04) it was observed that the retracking point for the OCOG retracker was sometimes much closer to the start of the range window than the point determined by the model fitting retrackers. The reason for this was traced to the OCOG retracker snagging on aliased or noise power at the very front of the range window. Windowing the OCOG retracker to use a configurable sub-window of the echo have resolved this issue. Moreover, this new filtering step has also enabled to improve the CFI retracker performance with fewer of the results being flagged as bad. The diagnostic information in the L2i product clearly shows the effect of the change. If the first bin tested is already above the retrack power, then the record is flagged as bad and the retrack point is output as zero offset (bin 64). With Baseline C, the numbers of records in this state and of records retracker to a very early bin are greatly reduced.

Corresponding closed Anomaly Reference on ARTS: CRYO-IDE-117 (see Section 5)

4.2 New retracker for land ice (LRM)

A new land-ice retracker in LRM have been also developed, implemented and tested. Its performance appears to be better than OCOG and similar to the CFI. All of the details of the model will be documented and exposed as externally configurable parameters, allowing future improvement in the quality of the land ice elevation retrieval

The purpose of the newly implemented Land-Ice ReTracker (LIRT) is to propose an alternative to the existing retracker CFI with an algorithm that can be tuned and further developed to increase performance. The design goal for the initial implementation was to match or exceed the performance of the CFI retracker. The LIRT follows the typical method for a retracker that fits a

Brown model to the waveform. All of the details of the model are documented and are exposed as externally configurable parameters. This allows the tuning of the retracker for the target surface. The model implemented by the retracker is simple, and makes no account for surface penetration or multiple returns over topography. Over the Antarctica interior land ice the absolute height residual derived from the LIRT retracker show expected results (Fig.1)

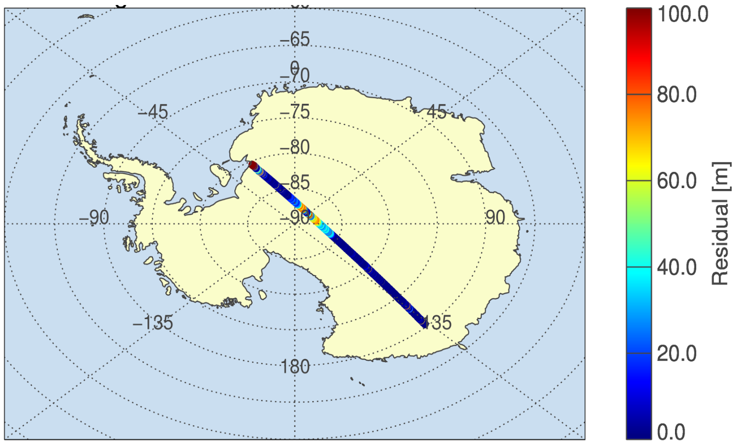

Figure 1 (*courtesy D. Brockley, MSSL*): Height residual along a single CS track over Antactica interior land ice (Nov2010 Baseline C TDS, 20101114T213830)

When compared to the CFI retracker, fewer records should be flagged as bad. Preliminary results from the new LIRT appear to have higher residuals in some locations, but the CFI retracker produced an error-flagged result in these areas. Over the flat regions of East Antarctica, statistics performed by MSSL on the Baseline C November TDS[2] show an improvement over the CFI retracker with a reduced standard deviation (stdev) indicating that the new results follow the surface of the DEM more closely. Over land ice, the CFI retracker gives mean -0.29m and stdev 7.79m whereas the LIRT retracker gives mean -0.11m and stdev 3.15m (associated distribution on Fig2)

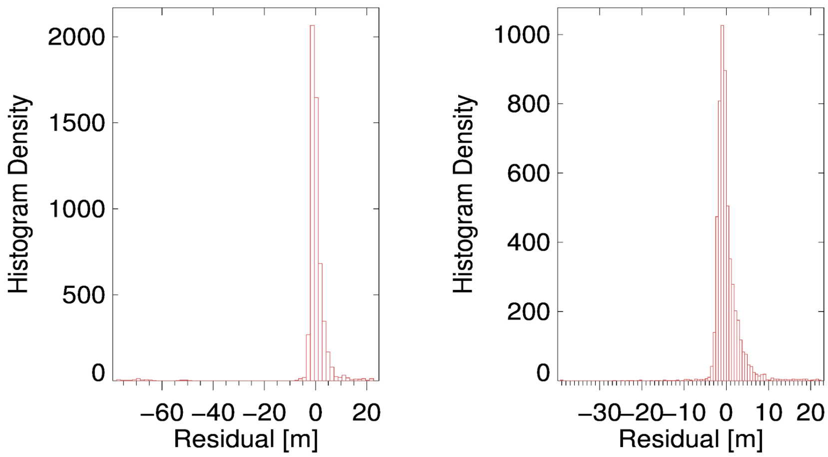

Figure 2 (*courtesy D. Brockley, MSSL*): (left) Histogram of CFI (left) and (right) LIRT height residual over Antarctica land ice (Nov2010 Baseline C TDS)

Corresponding closed Anomaly Reference on ARTS: CRYO-IDE-117 (see Section 5)

[2] This TDS contains data processed with the new Baseline-C IPFs. The Test Data Set covers a one-week period (08-14 November 2010) over the whole globe

4.3 New retracker and freeboard activation (SAR)

Until Baseline C the sea-ice freeboard – i.e. the height of the ice surface above the sea level - was set to a default value of '-9999' for all records in order to prevent users from mistakenly using un-commissioned data. The freeboard computation requires very accurate range measurements over open water and the ice surface. Thanks to the experience gained on the interpretation of the SAR echoes, a code change has been performed after commissioning. With Baseline C, the freeboard is now computed and the field filled with a valid value in the L2 (*field .43*)

For this, a new retracker was implemented in the SAR processing chain for use with returns from open-ocean and sea-ice flows (diffuse echoes). The retracker for sea-ice leads (specular echoes) is unchanged. First analysis performed by MSSL on the derived freeboard from November 2013 and from the 1 week Baseline C TDS and seem indicate that Baseline C is coherent, meeting the design goal of '*the best freeboard results possible within the available time limits*'.

Below is a simple, unfiltered plot of freeboard from a month (November 2013) of Cryosat L2 data output and from a different processing chain executed at CPOM (Fig 3). Although the raw dataset is noisy (unsmoothed signals), the expected geographical distribution of thickness is seen and seems coherent. Comparison against the (unpublished) reference dataset supplied by CPOM shows a general good agreement. Significant differences are however observed at the edges of the sea-ice and in a areas where the IPF2 chain does not produce data (previously in SARin mode)

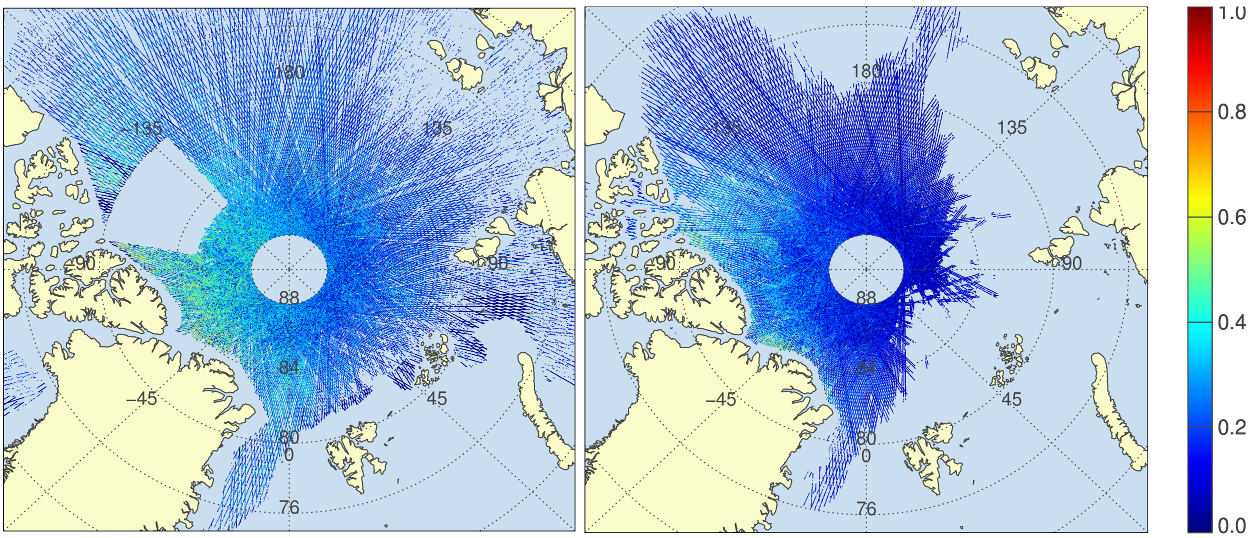

Figure 3 (*courtesy D. Brockley, MSSL*): (left) Freeboard (in m) derived from pseudo Baseline C IPF2 (processed from non official L1b as input) and (right) from CPOM processing for the November 2013 period

The following figure also shows an unfiltered plot of freeboard from the 1week TDS of November 2011 with freeboard histogram and geographical distribution in agreement with what expected. Further validation should be however performed in the frame of the QWG.

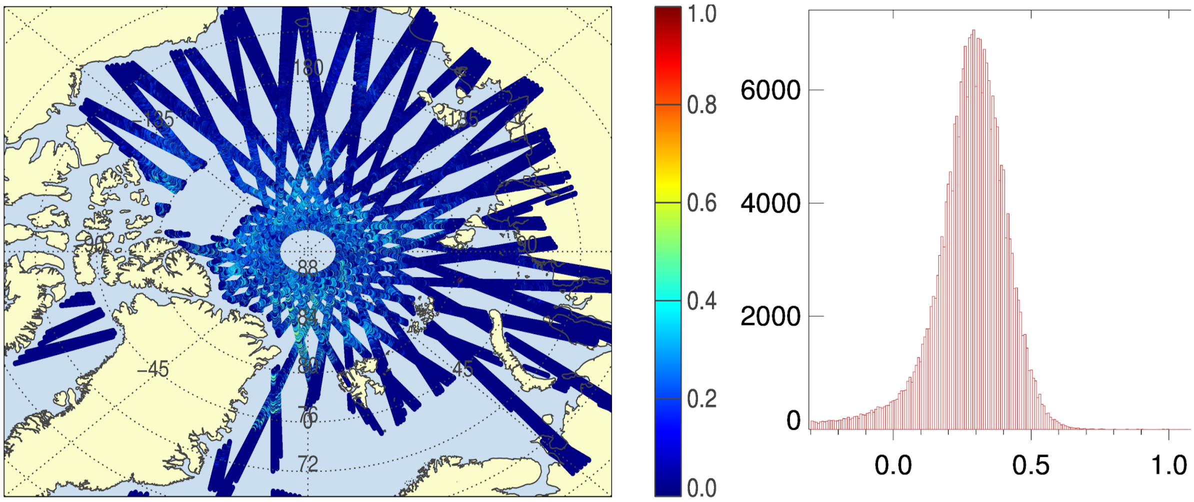

Figure 4 (*courtesy D. Brockley, MSSL*): (left) Freeboard (in m) derived from Baseline C 1 week TDS and (right) corresponding density histogram (abscise in m)

It should be noted that a certain number of negative freeboard measurements are expected (Fig4) due to measurement noise, or snow loading, therefore these are not flagged as bad — they are valid, useful measurements. A bias in freeboard is also to be expected until the relative bias between the diffuse and specular retrackers has been characterised and corrected.

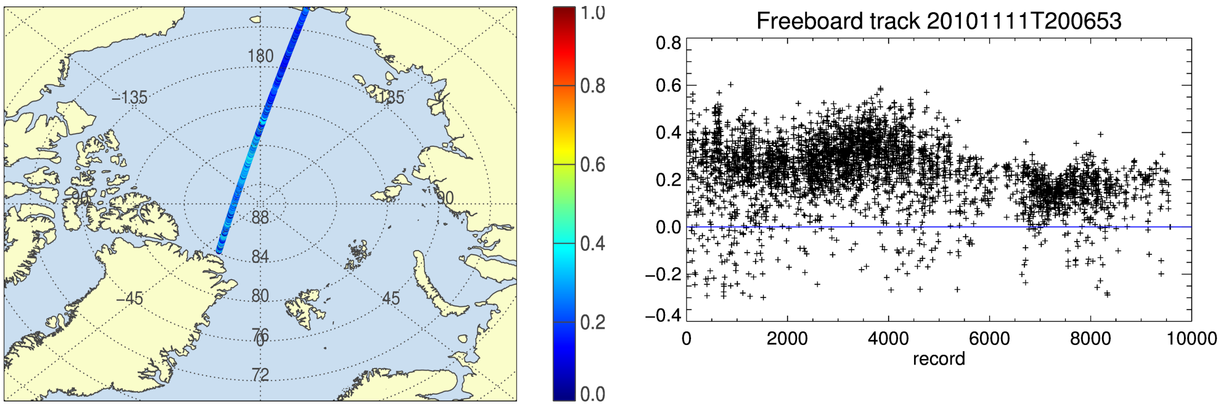

Figure 5 (*courtesy D. Brockley, MSSL*): (left) alongtrack freeboard and (right) associated profile (m)

Corresponding closed Anomaly Reference on ARTS: CRYO-IDE-172 (see Section 5)

4.4 New Arctic MSS (SAR)

In order to improve the IPF2 SAR processing, a new Arctic mean sea surface has been created, by combining existing models to provide full coverage over the region of interest of CryoSat. The UCL13 MSS is a merge of the CLS2011 model with CryoSat Arctic data and is interpolated via the Geo CFI library. This MSS is specifically used in the SAR processing in order to compute the interpolated sea height Anomaly (*field 44*) The new MSS is listed in the DSD of the SAR products as:
> CS_OPER_AUX_MSSURF_00000000T000000_99999999T999999_0007

Corresponding closed Anomaly Reference on ARTS: CRYO-IDE-172 (see Section 5)

4.5 New Antarctica and Greendland DEM (SARin)

New DEM have been implemented in order to improve SARin results by fixing issues on the SIN x-track angle error and on the IPF2 SIN ambiguity flag. In this respect, QWG#5 recommended the upgrade of the DEM for Antarctica and Greenland. This new DEM has been delivered by CPOM Leeds University and evaluated by MSSL within the framework of the Baseline C evolution. Thanks to the new DEM more retracked waveforms are flagged as valid, and visual inspection of the associated waveforms shows them to be clean, reasonable waveform shapes. Also, according to preliminary tests performed by MSSL, a number of the points that are now being retracked, but then still failing the ambiguity test, seem to correctly follow the topography (Fig.6).

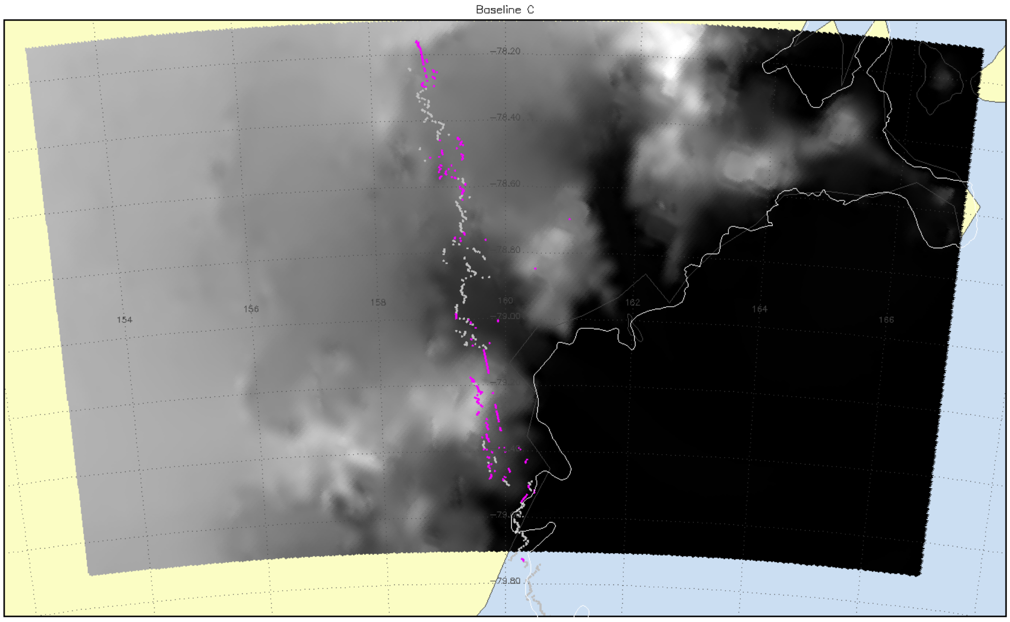

Figure 6: Example of Baseline C SARin retracker behaviour wrt the DEM. The purple points are flagged 'ambiguous' and grey are valid. Purple points that are at nadir have not been passed to the retracker, due to failing threshold checks.

The new DEM is listed in the DSD of the SARIn products as:

> CS_OPER_AUX_DEMMSL_00000000T000000_99999999T999999_0007

Corresponding closed Anomaly References on ARTS: CRYO-IDE-115, CRYO-IDE-135 and CRYO-IDE-174 (see Section 5)

5 LIST OF ALL THE L2 CHANGES WITH BASELINE C

Listed below are all IPF issues, related to CryoSat L2 products, which have now been resolved with Baseline C.

For full details in regards to these issues, please refer to the CryoSat Data Quality Status Summary [RD-01] provided at the following link:

https://earth.esa.int/web/guest/missions/cryosat/product-status

Anomaly Ref.	**Title**
CRYO-IDE-115	Wrong IPF2 SARIn Ambiguity Flag
CRYO-IDE-117	IPF2 Failure Rate for Surface Height flag too high for LRM over land ice
CRYO-IDE-135	SIN L2 across-track angle error flag
CRYO-IDE-149	IPF2: Multiple SIR_GDR_2A versions
CRYO-IDE-172	Activation of SAR-B chain with new MSS
CRYO-IDE-174	New DEM for Greenland and Antarctica
CRYO-IDE-195	GDR Header "File Description" field corrected
CRYO-IDE-202	Wrong flagging strategy at L1B and L2I

For completeness, all IPF issues, related to CryoSat L1B products, which have been resolved with Baseline C, are provided below. Some of these will also improve the resulting L2 product.

Anomaly Ref.	**Title**
CRYO-IDE-43	LRM time-tag bias
CRYO-IDE-53	FDM time-tag bias
CRYO-IDE-75	Pitch sign mismatch and attitude biases
CRYO-IDE-85	Wrong SAR window delay computation
CRYO-IDE-111	UT1 Field in Product Header to be filled
CRYO-IDE-112	Gain Ingestion from AutoCal products
CRYO-IDE-127	IPF1 SIN beam and baseline vectors set to nominal values
CRYO-IDE-141	Wrong code for bursts in IPF1 SAR 1 Hz
CRYO-IDE-142	Blurring of IPF1 SAR & SIN 1Hz waveforms with high orbit height rate

CRYO-IDE-143	Wrong sign of CAL1 correction
CRYO-IDE-167	Datation bias in SAR and SIN modes
CRYO-IDE-170	Integrated power in L1B product
CRYO-IDE-171	LRM one range gate shift
CRYO-IDE-173	LRM 1-FAI shift
CRYO-IDE-176	Range error due to CoM reference
CRYO-IDE-177	Range error due to IPFDB parameters
CRYO-IDE-179	Intraburst power decay not fully calibrate
CRYO-IDE-186	Power normalisation for the azimuth window
CRYO-IDE-187	H0 computation for LRM
CRYO-IDE-191	ADC calibration application in IPF1 SIN
CRYO-IDE-194	Bad cut in slant range correction
CRYO-IDE-199	Negative window delay in first 1Hz record
CRYO-IDE-203	1Hz Corrections Time and Location Computation
CRYO-IDE-204	IPF1 SAR/SIN power scaling
CRYO-IDE-205	Spike correction in CAL2SIN products
CRYO-IDE-206	Problems of rounding values in IPF1
CRYO-IDE-210	Perform IPF1 multilook without zeroes introduced by contributing beam alignment
CRYO-IDE-211	Beam Behaviour Parameters do not take account of oversampling factor
CRYO-IDE-213	Strategy when an insufficient number of samples are available for processing the last 1Hz waveform Beam Behaviour Parameters do not take account of oversampling factor
CRYO-IDE-214	Window delay is not referred to the central sample of the waveforms
CRYO-IDE-151	SAR/SIN power calibration error in IPF1 SP
CRYO-IDE-155	Intraburst alignment for IPF1 SAR&SIN 20-Hz waveforms
CRYO-IDE-161	Invalid DAC Values Over Ocean