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REPORT

CryoSat-2 Baseline-D Evolutions

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1 INTRODUCTION

1.1 Scope of the document

This document provides a high-level overview of the recent evolutions in the CryoSat-2 Baseline-D data processing chain. This document also provides details of known anomalies which have been tracked and solved.

1.2 Acronyms and Abbreviations

ADF	Auxiliary Data File
AR	Anomaly Report
CAL	Calibration
COP	CryoSat Ocean Processor
CONFORM	CryOsat Netcdf FORmat
DEM	Digital Elevation Model
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
DSD	Data Set Descriptors
EE	Earth Explorer
ESA	European Space Agency
FBR	Full Bit Rate
FDM	Fast Delivery Marine
GOP	Geophysical Ocean Product
IDEAS	Instrument Data quality Evaluation and Analysis Service
IOP	Intermediate Ocean Product
IPF	Instrument Processing Facility
Lo/L1B/L2	Level 0/Level 1B/Level 2
LRM	Low Resolution Mode
NetCDF	Network Common Data Form
NOP	NRT Ocean Product
NRT	Near Real Time
P2P	Pole-to-Pole
PCONF	Parameter Configuration File
PDS	Payload Data System



PLRM	Pseudo LRM
PSAR	Pseudo SAR
RMS	Root Mean Square
SAR	Synthetic Aperture Radar
SARIn	SAR Interferometric
SID	SARIn Degraded
SIRAL	SAR Interferometric Radar Altimeter
SPR	Software Problem Report
SW	Software
XREF	Reference DSDs



2 LIST OF Cryosat-2 BASELINE-D EVOLUTIONS

2.1 L1 Processor Evolutions

ID	Description	Status	Note
1	Issue in L1b time increment	Fixed	It was noticed in some products that, after that a jump in L1b time occurs, time increments slowly and oscillates; this has an effect on latitude, longitude, altitude and also window delay. The issue is due to the fact that, when an empty surface sample stack is found, the surface sample buffer in jMultilook.c is not shifted. The buffer has been shifted when an empty surface sample stack is processed and the memory occupied by the corresponding structure freed.
2	Reprocessing Task 'IPF1_SRNP' finished with exit code 128 but expected 0	Fixed	Processing failures have been encountered during the last last reprocessing campaign due to the unexpected management of an unsuccessful retrieving of the attitude information. Unexpected management of the error has been fixed.
3	Memory issues in Specialized SAR/SARIn IPF1	Fixed	An issue was encountered whereby after the Surface Sample Stack weighting is applied, there are surface samples with no associated contributing beams, resulting in invalid memory issues. When all the contributing beams of a surface sample are discarded, the buffer shall be shifted and the memory released.
4	Error in writing function of CAL2 Flag in MCD	Fixed	If the CAL2SIN1 file, CAL2SIN2 file or CCAL1 file is not provided as input to the L1B processor, the corrections for both CAL2 and CCAL1 are taken from the IPFDB. In this case, the MCD flag for CAL2 and CCAL1 should be set to 1 indicating that the calibration correction has been taken from IPFDB.
5	Unknown failure in Rep. Campaign	Fixed	Some processing failures were encountered with L1B SARIn products during the last reprocessing campaign. The failures were due to a memory issue and the resolution to this issue involves cleaning of the extended part of the reallocated memory performed since the reallocation instructions does not perform this operation by default.
6	Time anomaly in last SS in L1b product	Fixed	The last computed Surface Sample was, in some cases, placed at ~ 0.7 s instead of ~ 0.05 s. The formula to compute the time difference to be added to the previous burst to get the timestamp of the next extrapolated one has been corrected.



7	Duplicated datation in time_avg_01_ku and time_20_ku variable	Fixed	The last 1Hz sample was being computed even if the relative 20hz record is not complete. The issue has been fixed by avoiding the computation of the last 1Hz record when the relative 20Hz one is not complete
8	SARin power scale issue	Fixed	In SARin product there was a bug in the computation of the power waveform and an unexpected scaling factor 2 was applied. The computation of the SARin power waveform in the specialized SARin IPF1 has been fixed.
9	CAL4 not applied to the first 19 bursts in SARin Level1 processing	Fixed	An issue with Freeboard artifacts occurring at the boundaries of the SARin patch when Off-Nadir Range Correction (ONC) information is used from SARin data was noted. This is due to the CAL4 phase difference not being applied in the first 19 bursts (i.e. the first 2.5 seconds of each SARin L1B product). The fix is based on a change in the ingestion algorithm in order to find the first CAL4 and apply the CAL4 correction to the first 19 bursts.
10	interburst alignment	Fixed	Bug fixed in SAR/SARin IPF1 in the processing function to align the pulses in each burst for the altitude rate.
11	Discrepancy in L1B and L2 Filename Validity Times	Fixed	During the last reprocessing it has been noted that L1B products generated have a slightly different start/stop validity in the filename to the corresponding L2 product. Between FBR and L1B validity there is a slight difference, which causes the discrepancy. In IPF1 PostProcessor the validity name for the product was wrongly shared between FBR and L1B. This (wrong) assumption led to the discrepancy observed. IPF1 PostPprocessor has now been updated to handle real datation from their relevant intermediate product
12	Datation outside processing window due to out of range Offset counter	Fixed	Processing failures were noted in the last reprocessing campaign. The issue was associated to the CoM correction introduced for Baseline-C. To avoid failure, the SW will be modified using 0 CoM values in case of default state vector values. Documentation updated accordingly.
13	FBR LRM Product remove from Inventory List	Fixed	The LRM FBR products will no longer be archived in the PDS, it will remain avasialble only for 3-days. This is because there are no users for this product and the product is not input into other processors. First Solution: LRM Task Table shall be modified to suppress the FBR product from the inventory List: Destination field for FBR shall be updated with value "PROC" instead of "DB".



			<p>Second Solution: An alternative solution has been evaluated and implemented, which aims at configure the generation of the FBR product: the advantage from this solution is to save time during processing execution. In this case, when configured the LRM FBR skip, the post processor will not process/generate at all the LRM FBR product, saving processing time.</p>
14	Unexpected Values for AGC ch 1	Fixed	<p>Some unexpected values have been flagged in the AGC gain annotated in L1b products. The proposed solution for the issue is to use the 4 char spare bytes available in the intermediate FBR LRM to store the information relevant to the gain variation and use it, in specialised LRM processing, to compute the AGC corrected removing its contribute</p>
15	Inconsistency between L1b 1Hz waveform and L2 1Hz height	Fixed	<p>The algorithm to generate the 1Hz average waveforms was improved in order to increase their accuracy.</p>
16	Pitch estimation from CryoSat data in L1b Product (Baseline D)	Fixed	<p>A new beam behaviour parameter, that gives an estimate of the mispointing pitch angle starting from the surface sample stack data, has been added to the L1b product.</p>
17	Decommissioning of FDM production	Fixed	<p>FDM products will be operationally replaced by the NOP products</p>
18	Spike correction in CAL2SIN products	Fixed	<p>Spike correction in CAL2 Processor has been improved to decrease the number of invalidated CAL2 SARin products.</p>
19	Improved information on surface characteristics	Fixed	<p>New GEO Correction CFI library integrated (V4.4)</p>
20	SAR/SARin Stack Peakiness parameters for new sea-ice discrimination	Fixed	<p>New beam behaviour parameters that give an estimate of peakiness of the Range Integrated Power on the surface sample stack, has been added. This will be useful for sea-ice discrimination.</p>
21	Switch to NetCDF Format	Fixed	<p>NetCDF format implemented</p>

2.2 L2 Processor Evolutions

ID	Description	Status	Note
1	Window Delay not referred to central sample of the waveforms	Fixed	The change in range window size could not be fully accounted for in Baseline C SARin mode without impacting the peakiness value. The shift in the 0 range offset bin number was therefore accounted for by applying a height bias to ocean and ice surfaces. However, the IPF did not have the capability to apply a bias to land or enclosed sea (not intended to be seen in SARin mode during the original design), and these height measurements were biased by ~60m in the Baseline C products. This is corrected in Baseline D.
2	SAR Sea ICE Concentration	Fixed	The annotation of the scale factor in the CDL has been corrected, and the netCDF L2 output products now contain the correct scale factors
3	Investigation about the increased number of bad-flagged points in inland water areas	Fixed	The increase in the number of bad-flagged points over inland water corresponded to the Baseline-C introduction of the new diffuse-waveform retracker designed for sea-ice surfaces. All locations in regions of low sea-ice concentration (everywhere away from the poles) are passed to this retracker. The retracker has been altered to reject fewer points with steep leading edges, and also does not perform filtering steps designed for sea-ice surfaces when not in regions of high sea-ice concentration.
4	FDM not using DORIS navigator orbit	Fixed	FDM orbit data processing preferably uses the DORIS Navigator Orbit (DOR_NAV). However, when this is not available the FOS Predicted Orbit (MPL_ORBPRES) is used instead. However, the usage of the FOS Predicted Orbit causes FDM outliers. FDM orbit data processing preferably uses the DORIS Navigator Orbit (DOR_NAV). However, when this is not available the FOS Predicted Orbit (MPL_ORBPRES) is used instead. However, the usage of the FOS Predicted Orbit causes FDM outliers. This issue currently affects ~6% of FDM products and has been closed following an update of the FDM Task Tables.
5	Define and optimise strategy for L2 NRT SAR Production	Fixed	The fix is implemented replacing the query "LatestValCover" with "LatestValidityClosest": this choice makes it possible to keep the file as mandatory and, at the same time, makes sure that the latest ADF is used even though it doesn't cover the processing window.
6	Incorrect usage of NRT L2 products in the GDR chain	Fixed	The solution to the issue in order to avoid the usage of the NRT L2 product in GDR, is to modify the Task Table settings by selecting the operational modes required for the processing modes we need (the Mode "ALWAYS" has to be replaced with that referring to the desired Mode, which is "REPROCESSING" and/or "SYSTEMATIC").



7	IPF2 preprocessor issue affecting SIRAL B processing	Fixed	Incorrect reading of the L1B SIRAL ID discovered. It affects the SIRAL Identifier reading operation from L1b only. Fixed in Baseline-D
8	Error Computing Cartesian state vector	Fixed	The Orbit files validity close to the processing window margins makes out of borders the computation of the cartesian state vectors. To solve the issue, the orbit file better covering the processing window shall be used. Margins defined inside Task tables allow to implement this approach.
9	Non-monotonically increase of time stamp at Mode transitions.	Fixed	Linked to L1b evolutions #6 and fixed
10	Freeboard computation in SARIn sea-ice area	Fixed	Freeboard provided for SARIN L2 product. Previously only available in SAR mode areas.
11	New improved Slope Correction/DEM for LRM	Fixed	New slope models were created using the same methodology as implemented in Baseline-C but using a more up-to-date set of input DEMs for Antarctica and Greenland, and output at a slightly higher resolution.
12	USO frequency correction on window delay	Fixed	The USO correction applied at L1 is listed in the L1b product as a correction to window delay with units of time. The L2 code has been updated to take this correction, convert it to a correction to range, and to list it in the output L2 product.
13	Tune/improve of the existing Baseline-C retracker over sea-ice (Arctic + Antarctic) and Land ice	Fixed	Improvements have been made to the SAR/SARin mode diffuse waveform retracker used for sea-ice processing. These improvements reduce the number of 'snags' where the retracker tracks to off-nadir returns. Over land-ice surfaces, no improvements to the retracking were identified, but the results will be improved via the updated slope modes.
14	Peakiness of Stack in BBP & SAR sea-ice new discrimination	Fixed	The discrimination scheme that classifies returns into ocean, sea-ice, lead, or unknown has been updated to use a new input parameter: stack peakiness. The thresholds for the other parameters used (sea-ice concentration, peakiness, stack standard-deviation) have been updated.
15	Unavailability of Star Tracker L0 products relevant to the \"star tracker in use\"	Fixed	In its current implementation, the \"Baseline C\" star tracker Processor uses data of the star tracker next in the priority list if the Star Tracker data of the \"Star Tracker in use\" are not available. As this behaviour doesn't assure the \"best quality\" of the STR_ATTREF product, an analysis was performed to monitor the occurrence of this anomaly (i.e. unavailability of Star Tracker L0 products relevant to the \"star tracker in use\") and the star tracker processor behaviour has been adapted for Baseline D.
16	Uncorrected range and altitude to be included in L2/L2i/GDR	Fixed	New parameters added: range_1_20_ku, range_2_20_ku and range_3_20_ku. These contain a retracked range without any geophysical corrections applied, so that the user may apply their own.
17	Link between 1Hz and 20 Hz measurements	Fixed	New set of variables allowing to link the 1Hz and 20 Hz measurement in both L1b and L2 ice products by means of incremental indexes.



18	Switch to NetCDF Format	Fixed	NetCDF format implemented
19	Improved information on surface characteristics	Fixed	New GEO Correction CFI library integrated (V4.4)
20	Geophysical corrections in L2 product	Fixed	All geophysical corrections are now present in the L2 product for all records, rather than setting them to zero if they were not applied.
21	Lead retracking correction	Fixed	A minor issue where the retracker for sea-ice lead records could exit without performing the requested number of iterations has been corrected.
22	Revert change to product status flagging	Fixed	An update to the recipe for setting the calibration bit in flag_prod_status_20_ku caused the bit to be set for all records. The update was incorrect and the change was reverted.
23	Correction of bias in sigma zero	Fixed	A bugfix at L1b caused a 3dB change in sigma zero at L2. The calibration bias applied at L2 was updated to maintain the calibration.

2.3 STR Processor Evolutions

ID	Description	Status	Note
1	Sporadic failure in the STR processor	Fixed	BaselineC version of the STR processor code expects the stamp ID of the STR can assume one of the following values only: 1, 2 or 3. As a result the STR processor fails if a different character is read (i.e. in case of a platform anomaly when the STR ID will be 0). The STR processor has therefore been updated to manage STR_ID = 0
2	STR File Format Change	Fixed	Additional information to the STR_ATTREF product added.
3	STR Process with aux file for varying mispointing angle biases	Fixed	Interface modification to STR Processor to apply mispointing angle biases that can vary as function of the mission lifetime

2.4 CAL2 Processor Evolutions

ID	Description	Status	Note
1	USO frequency correction on window delay	Fixed	<p>The USO Frequency Correction is not applied in FBR but annotated only as [s] It is applied and annotated as [s] in L1B At L2 it is automatically applied and annotated (annotation as [m]) An On/Off configurable variable has now been introduced, handled through pconf, to enable/disable the correction on window delay</p> <p>New beam behaviour parameters that give an estimate of peakiness of the Range Integrated Power on the surface sample stack, has been added. This will be useful for sea-ice discrimination.</p>