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Title : **[Envisat Altimetry Data Set Version 2.1] Level 1B and Level 2 processing upgrades**

Abstract : Information to be distributed to the user community regarding the processing upgrades performed on the ESA Altimetry NRT and OFL processing chains, respectively implemented in the RA2/MWR IPF and CMA processors

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	DATE	DCI No	REASON
1.0	26 January 2010	N/A	First delivery
1.1	2 February		Updated with more references
1.2	2 March 2011		Updated Envisat Altimetry Data Set Version 2.0 to 2.1 in title and added information on new IPF versions 6.03 and 6.04

1. INTRODUCTION

1.1 Purpose and Scope

This document contains information to be distributed to the user community concerning the operational implementation of the RA2/MWR PF version 6.02L04 (and following versions) and CMA version 9.3 and reports on the ground processing evolutions used to process ENVISAT Altimetry Data Set 2.1 (See chapter 2)

The Envisat Altimety products [Envisat Altimetry Data Set Version 2.1] issued from this new version of the ground processing are complaint with the RA2/MWR product specification Vol. 14 issue 4C available from the ESA URL http://earth.esa.int/pub/ESA_DOC/ENVISAT/Vol14_Ra2mwr_4C.pdf

Further details are provided in the Product Handbook (v1.3), available at http://envisat.esa.int/pub/ESA_DOC/ENVISAT/RA2-MWR/PH_light_1rev3_ESA.pdf

The most significant changes were implemented in IPF 6.02L04. After this release two further updated versions of the Level 1b processor were delivered: IPF 6.03 (to take into account ENVISAT orbit evolution) and IPF 6.04 (which corrected a bug in the USO correction implemented in IPF 6.02L04).

2. LEVEL 1B

2.1 IPF 6.02L04

2.1.1 New S-Band Waveform Reconstruction algorithm on RA-2 Level 1b data

RA-2 sensor corrected anomaly: An undesired behaviour of the S-band waveforms was encountered after launch and during the ENVISAT Commissioning phase: the waveforms are accumulated by the digital units of the RA-2 instrument with a random occurrence. The anomaly stops only when the RA-2 is set to stand-by. The new algorithm subtracts the accumulated waveforms, sample by sample, except for the first data block, when the previous sample is not available in the product.

Software evolution: This function implements the reconstruction of the S-band waveform when an anomalous behaviour is found with the evaluation of the S-band waveform anomaly flag.

For each S-band waveform, the waveform corresponding to previous data shall be subtracted, sample per sample.

ADF modification: RA2_CON_AX: new parameter (S-Band_Threshold_Evaluation, Field #43) added in the AUX file.

L1b product impact: The content of the S-band waveform field (Field #18 in Main MDSR) will be modified in those cases where the S-band flag is TRUE (Field #14 Measurement Confidence Flag -bit 1 S-band anomaly flag).

Reference document: A. Martini, P. Femenias, G. Alberti, M.P. Milagro-Perez, RA-2 S-Band Anomaly: Detection and Waveform Reconstruction. “15 Years of Progress in Radar Altimetry” Symposium, Venice (Italy) 13-18 March 2006.

2.1.2 New USO Correction algorithm on RA-2 Level 1b data

RA-2 sensor corrected anomaly: For an unknown reason a change of behaviour of the Ultra Stable Oscillator (USO) clock frequency occurred randomly in the period 1st February 2006 – 23rd January 2008 . When the anomaly occurs, the USO period increases rapidly during several hours lasting from several days to several months. This change of frequency has a direct impact on the altimetric range measurement in both Ku and S bands. Translated into range, the anomaly consists in an oscillating signal with an orbital period and amplitude of 30cm around a 5.6m mean bias. Since January 2008 the USO period bias and orbital variations disappeared, coming back to the nominal behaviour. The reason remains unexplained as well.

Software evolution: The method proposed for the USO anomaly correction is the one currently used to correct by the long term USO drift. The difference lies in the choice of the step value: for the USO long term drift is set to 86400 s (equivalent to 1 day), while the adequate value in order to see the orbital fluctuations in the USO period was 100 s. The choice of a step of 100 s is a good compromise between a good restitution of the short wave length, and a low noise level.

With IPF 6.02L04, the USO clock period correction will be computed inside the RA2 processing and the information is included in the product. Therefore, the user shall not apply anymore the external correction to the RA2 products and the generation of the external USO clock period correction files will be stopped.

ADF modification:

RA2_CON_AX: 3 new parameters added to the AUX file:

Field #40: step,

Field #41: Smooth_factor, and

Field #42: USO_correction_switch.

L1b product modification: 4 new parameters added to the product:

Field #24: Rx_dist_c,

Field #25: Rx_dist_f,

Field #66: USO_clock_smooth,

Field #67: USO_correction_quality_flag.

Reference document: Y. Faugère, A. Ollivier, O. Z. Zanifé, R. Scharroo, A. Martini, M..Roca, P. Femenias, An operational Correction for the RA-2 Side A USO Anomaly: Method and Performances Assessment. *ENVISAT Symposyum, Montreaux (Switzerland) 23-27 April 2007*

2.1.3 Other changes on Level 1b ADFs

Ground processing tuning:

RA2_CON_AX: updated the following parameters:

Field #8: Zero padding factor for PTR evaluation,

Fields #11,12,13, and 14: Minimum and Maximum value of length of the stack used for averaging the in-flight time delay calibration factor for Ku and S Band,

Fields #15 and 16: maximum time lag in SP multiples between two Ku/S PTR measurements.

MWR_SLT_AX: Updated the following parameters*:*

Fields #2 and 3: Transmission coefficients of the reflector for 23.8 and 36.5 GHz

Fields #21 and 22: Efficiency factor for satellite contribution on the secondary lobes for 23.8 and 36.5 GHz

MWR_CHD_AX: deactivated 36.5 GHz drift correction

RA2_CHD_AX: updated parameter:

Field #40: Factor for PTR width computation

2.2 IPF 6.03

The only change in IPF 6.03 is the use of the ESA CFI libraries, enabling the processor to be able to handle the new ENVISAT satellite orbit (~17km lower that the previous one, starting from 24th October 2010, cycle 95)

2.3 IPF 6.04

IPF 6.04 fixes a bug in the USO correction that was identified during Cal/Val activities in F-PAC. Anomalous jumps occurred in the USO correction computation, which impacted the range (being the USO correction already implemented in the processor). This anomalous behaviour has been identified and corrected.

3. LEVEL 2

3.1 CMA 9.3

3.1.1 Update of the Rain Flag algorithm

Algorithm updates description:

In the algorithm the coefficients and look-up tables have been updated, in order to set the value of the flag.

ADF modification: updated parameter:

RA2_SOI_AX: Field #11 Node 34: Rain Flag coefficient

L2 product impact: updated parameter:

Field #147: Altimeter Rain Flag

Reference document: Tran N., J. Tournadre and P. Féménias, "Validation of Envisat rain detection and rain rate estimates by comparing with TRMM data", IEEE GRS letters, doi:10.1109/LGRS.2008. 2002043, 5 (4), 658-662, 2008.

3.1.2 Inclusion of a Sea-Ice Flag algorithm

Algorithm Description:

The new Sea-Ice algorithm includes a 2-state sea ice flag (ice-free ocean and sea-ice) and 4 values indicating the membership of the pixel to each class (ice-free ocean, first-year ice, multi-year ice and wet ice). They are provided as percentages between 0 and 100 in the product.

ADF modification:

RA2_SOI_AX: Fields #72-82: New parameters for Sea-Ice Flag algorithm

L2 product impact: New fields added to the product

Field #149: Sea-Ice flag;

Fields #150-154: Membership of the pixel for each of the 4 classes.

Reference document: Tran N., F. Girard-Ardhuin, R. Ezraty, H. Feng, and P. Femenias, "Defining a sea ice flag for Envisat altimetry mission", IEEE GRS letters, doi:10.1109/LGRS.2008. 2005275, 6 (1), 77-81, 2009.

3.1.3 Other changes on Level 2 ADFs

Other changes will include only ADF updates.

Updated wind tables

ADF modification: updated parameters **to be in line with ECMWF model (added 10 more values)**

RA2_SOI_AX: Field #3: Tabulated values of RA-2 windspeed

Reference document: Abdalla, S., "A wind retrieval algorithm for satellite radar altimeters", ECMWF Technical Memorandum, 2006.

Evolution from FES2002 to FES2004: new Ocean Tide and Tidal Loading

ADF modification:

RA2_TLD_AX: Update of the tidal wave frequencies

RA2_OT2_AX: Update of the tidal wave frequencies

RA2_SOI_AX: Node A33 Field #16: Frequency of the solution 2 tidal wave number 1 to 29

L2 product impact: updated parameters:

Filed #102: Total geocentric ocean tide height (solution 2)

Field #104: Tidal loading height (solution 2)

Sea State Bias: updated tables

ADF modification:

The Sea-State bias table has been recomputed (Labroue, 2007) accounting for the impact of the new orbit and the new geophysical corrections (MOG2D, GOT00 ocean tide correction with the S2 component corrected once only). The new SSB correction is shifted in average by +2.0 cm in comparison

Reference document: Labroue, S., 2007 : RA2 ocean and MWR measurement long term monitoring, 2007 report for WP3, Task 2 - SSB estimation for RA2 altimeter. Contract 17293/03/I-OL. CLS-DOS-NT-07-198, 53pp.CLS Ramonville St. Agne.

