

M. Scagliola<sup>(1)</sup>, M. Fornari<sup>(2)</sup>, N. Tagliani<sup>(1)</sup>, A. Di Giacinto<sup>(1)</sup>, T. Parrinello<sup>(3)</sup>  
 (1)Aresys srl, Milan, Italy (2)ESA-ESTEC, Noordwijk, The Netherlands (3)ESA-SRIN, Frascati Italy

→ **CRYOSAT Mission in a nutshell**



**Primary mission goals**  
 Determination of regional and basin-scale *trends* in perennial Arctic sea ice thickness and mass

**Launched:** 8th April 2010 as the third Explorer mission

**Orbit:** Polar, non sun-synchronous. Inclination: 92°. Mean altitude: 717 km with 369 days repeat cycle.

**Main payload: SIRAL** – innovative instrument able to operate as a conventional altimeter or as a high-resolution synthetic aperture radar.

- SIRAL is capable of operating in three main measurements modes
- ❑ **Low Resolution Mode (LRM):** similar to the operation of conventional pulsedwidth-limited altimeters.
  - ❑ **Synthetic Aperture Radar (SAR) mode:** the along-track resolution of the altimeter is enhanced by exploiting the Doppler properties of the echoes so that a larger number of independent measurements are available over a given area in order to increase the accuracy of the estimated elevation.
  - ❑ **SAR-Interferometric (SARIn) mode:** the combination of SAR and interferometry makes it possible to accurately determine the arrival direction of the echoes both along and across the satellite track. This directivity is required to derive the height of the surface from the range measurements of the radar where the surface slopes is high.

The BaselineB for the products was released into operations the 1<sup>st</sup> of February 2012 and it is currently in use.

**The BaselineC for the products is expected to be released into operation for the end of 2014.**

- Several improvements are foreseen for the CryoSat Level1b SAR/SARIn products in BaselineC:
- ❑ Datation bias compensation
  - ❑ Range bias compensation
  - ❑ The waveform length will be doubled with respect to Baseline-C
  - ❑ Surface Sample Stack weighting to improve the Signal-to-Clutter-Noise-Ratio

All CryoSat L1b & L2 products are **freely** available through ESA's dissemination server <ftp://science-pds.cryosat.esa.int>  
 For more information on how to get CryoSat data visit <http://earth.esa.int/cryosat>

→ **Bias compensation**

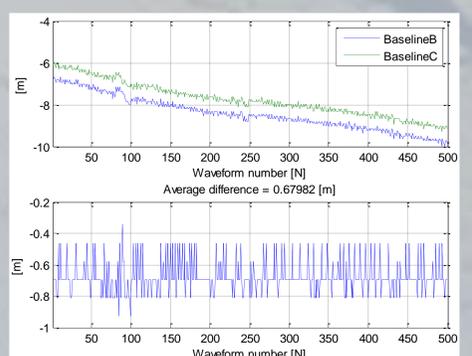
The following known biases affecting CryoSat Level1b products in Baseline-B will be compensated in Baseline-C for SAR/SARIn products

Bias	Value	Description
Datation	-0.5195 ms	The datation bias is here intended as the offset that affects the timestamp referred to each Level1b waveform.
Range	0.6730 m	The range bias is here intended as the offset that affects the one-way range measurement in each Level1b waveform.
Roll	0.1062 deg	The mispointing angle bias is here intended as the offset that affects the angle between the antenna pointing, i.e. the direction of the actual antenna beam, and the nadir direction.
Pitch	0.0550 deg	

**Range bias**

The retracked distance on Level1b waveforms over ocean, with no geo-corrections applied, has been compared for BaselineB and BaselineC.

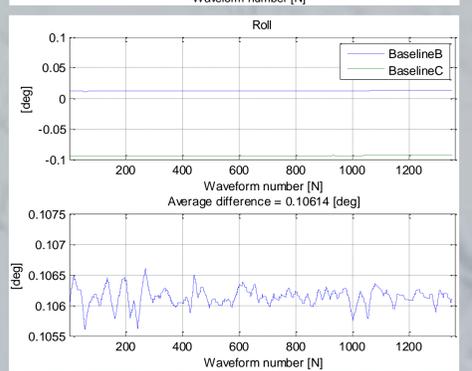
The BaselineC range is shorter of about 0.68 cm.



**Attitude angles**

The roll angle annotated in two corresponding Level1b products, BaselineB and BaselineC respectively, has been compared.

The roll angle from BaselineC product is lower of about 0.1061 deg.



In BaselineC products, the attitude information is derived on ground from the same Star Tracker that is selected on board as the best available at a given time stamp.

→ **Modified Level1b format**

BaselineC Level1b products will be distributed in an updated product format:

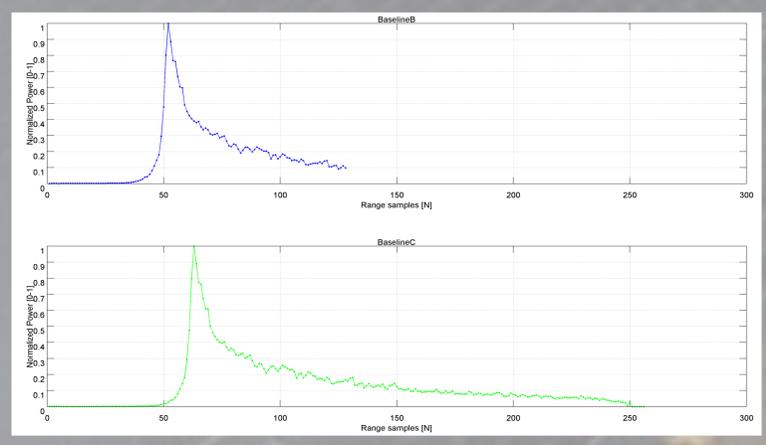
- ❑ The attitude information will be made available in Level1b products with the same frequency of the 20Hz waveforms

Field	Description	Units
<b>Time and Orbit Group (structure repeated 20 times per record)</b>		
14	Star Tracker Identification	-
15	Antenna Bench Roll Angle	10 <sup>-1</sup> mdeg
16	Antenna Bench Pitch Angle	10 <sup>-1</sup> mdeg
17	Antenna Bench Yaw Angle	10 <sup>-1</sup> mdeg

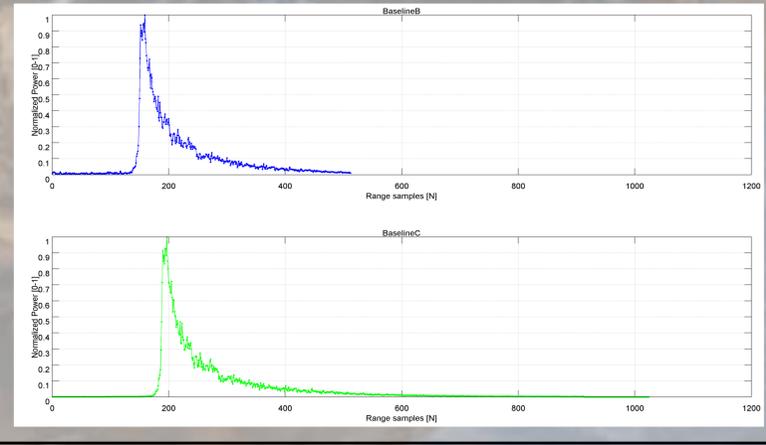
- ❑ The number of samples, and correspondingly the range window, for the 20Hz waveforms will be doubled keeping unchanged the range bin sampling (~0.23 m)

Baseline	SAR	SARIn
BaselineB	128 samples (range window of ~30 m)	512 samples (range window of ~120 m)
BaselineC	256 samples (range window of ~60 m)	1024 samples (range window of ~240 m)

**SAR waveform over ocean for BaselineB and BaselineC**

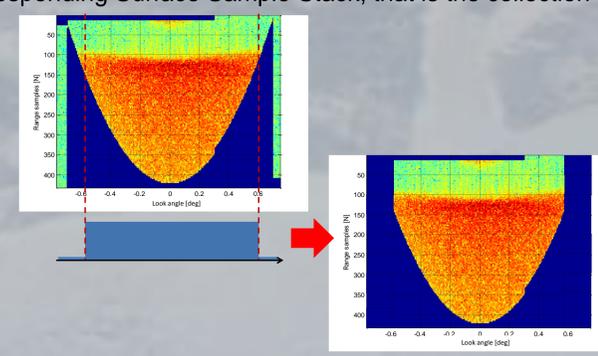


**SARIn waveform over ocean for BaselineB and BaselineC**

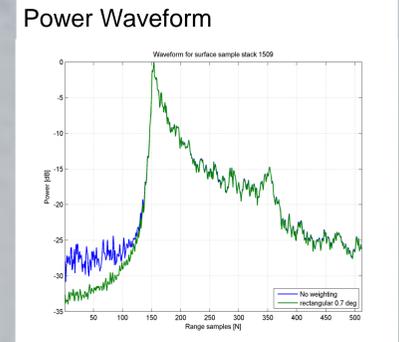
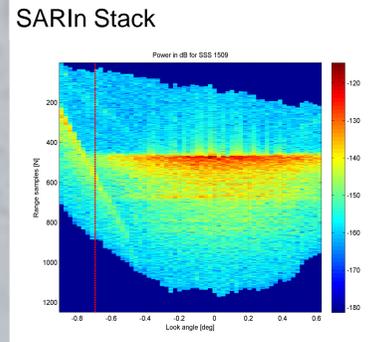


→ **Surface sample stack weighting**

For each surface sample, i.e. a point on Earth surface, a 20Hz Level1b waveform is computed by multilooking of the corresponding Surface Sample Stack, that is the collection of all the single-look waveforms that are referred to the surface sample. In BaselineC, a weighting is applied as function of the look angle (the angle with respect to the nadir direction) to cut away the single look echoes originated by furthest bursts.



- ❑ **Improvement on the Signal-to-Clutter-Noise-Ratio (SCNR)**



In the example above, the single look echoes most affected by the ambiguity are filtered out so that the SCNR is improved.