

# CryoSat Plus For Oceans: an ESA/CNES Project for CryoSat-2 Data Exploitation Over Ocean

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## PROJECT DESCRIPTION

### 1. BACKGROUND

- ESA's CryoSat-2 mission is the first one to carry a radar altimeter that can operate in SAR mode.
- Although the primary aim is land and marine ice monitoring, the SAR mode capability of the CryoSat-2 SIRAL altimeter also offers potential benefits for ocean applications;
- The "CryoSat Plus for Oceans" (CP4O) project is dedicated to the exploitation of CryoSat-2 data over the ocean.
- It is supported by the ESA under the Support to Science Element (STSE) Programme, and by CNES, and brings together an expert European consortium, led by SatOC (UK).

### 2. OBJECTIVES & SUB-THEMES

The general objectives of the CP4O project are to:

- Build a sound scientific basis for new applications of CryoSat-2 data over the open ocean, polar ocean, coastal seas and for sea-floor mapping.
- Generate & evaluate new methods & products to enable full exploitation of CryoSat-2 SIRAL altimetry, and extend applications beyond the initial mission objectives.
- To ensure that the scientific return of the CryoSat-2 mission is maximised.

The specific themes that will be addressed by the project are:

- 1) Open Ocean Altimetry;
- 2) High Resolution Coastal Zone Altimetry;
- 3) High Resolution Polar Ocean Altimetry;
- 4) High Resolution Sea-Floor Altimetry.

## Project Approach

### 1. INITIAL WORK

#### Scientific Requirements

The first activity, led by Starlab, has engaged with the wider user community to consolidate the preliminary scientific requirements, and produced a list of scientific and operational requirements:

#### State of the Art Review

The next step is an analysis of the State Of the Art including the status and quality of Cryosat-2 data, relevant algorithms and approaches for processing Low Rate Mode, SAR Mode and SARIN mode data, including producing so-called RDSAR, or Pseudo-LRM data, and waveform re-tracking. Also the status of the necessary geophysical corrections is assessed. This activity will produce a **Preliminary Analysis Report** and a **Development and Validation Plan**, which will be available in 2013. This activity is led by Delft University of Technology.

### 3. IMPACT ASSESSMENT

Based on the processing schemes and experimental data sets validated in step 2, larger data sets will be generated and more widely evaluated, to analyse and quantify the impact and benefits of the new CryoSat-2 products.

CLS will lead this activity and will apply a "round robin" methodology, successfully applied in earlier projects such as the ESA Sea Level Climate Change Impacts Project.

The output will be an **Impact Assessment Report**, available early 2014

### 4. FUTURE EXPLOITATION – SCIENTIFIC ROAD MAP

Finally, the results of the Impact Assessment will be reviewed against the User Requirements Baseline generated early in the project and used to define an agreed Scientific Roadmap to ensure fullest possible exploitation of CryoSat-2 data over the oceans, and to support the transfer the results into scientific and operational activities.

### 2. PRODUCT DEVELOPMENT & VALIDATION (a)

The heart of the CryoSat Plus for Oceans project is the development and validation of algorithms and processing schemes for new ocean products, based on CryoSat data. This activity, led by the UK National Oceanography Centre, will involve the creation of 7 new experimental altimeter data sets, and 4 data sets with new geophysical corrections, as follows (the lead partners are identified).

These experimental data sets will cover limited regions and time periods, see table. Because the version of CryoSat data currently distributed by ESA has known anomalies for ocean applications initial work will use data from alternative processing chains, including the CNES CryoSat Processing Prototype (CPP) and the NOAA processed data available on RADS.

	Initial Development and Validation	Large scale assessment
1	LRM for Open Ocean	Global (RADS & CLS)
2	RDSAR for Open Ocean	NE Atlantic
3	SAR for Open Ocean	NE Atlantic
4	SAR for Coastal Ocean	South Coast UK
5	SARin for Coastal Ocean	Cuba, Chilean Coast
6	SAR for Polar Ocean	Arctic (initially Baffin Bay)
7	SAR for Sea Floor Mapping	Pacific / North Pacific
8	Improved wet trop correction	Global, full C2 mission
9	Improved iono correction	Mediterranean Sea, European continental shelf
10	Improved regional tides	North East Atlantic (coastal)
11	Other improved corrections	Global (RADS)

The outputs of this activity will be **Algorithm Theoretical Basis Documents** and **Product Validation Reports** for each processing scheme. These should be available in early autumn 2013.

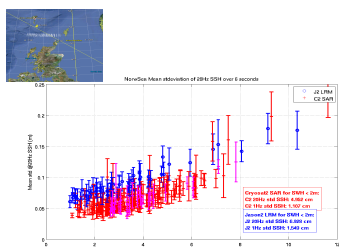
### Final Words

SAR mode altimetry offers an exciting opportunity to oceanographers, opening up a number of potential new applications, as well as significant improvements to more well established products.

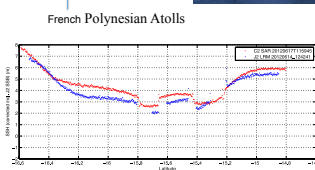
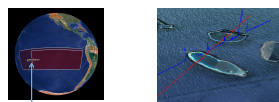
We plan to share our results with the oceanographic community as the project progresses. We are planning to hold a number of open workshops at which we will present our latest findings and invite others working this area to present their work. We also intend to establish an expert group to provide an independent evaluation of our work

The ultimate aim is to maximise the exploitation of CryoSat-2 data in oceanographic applications, and to build a sound scientific foundation for future satellite missions carrying SAR mode altimeters, starting with Sentinel-3 in the near future.

### PRODUCT DEVELOPMENT & VALIDATION (b) – Early results



Analysis confirming improved accuracy of sea surface height data from the CryoSat-2 SAR Mode. Red – CryoSat Baseline A, Pink – CryoSat Baseline B, Blue – Jason-2



CryoSat-2 SAR (red) and Jason-2 (blue) data from Iles Palliser atolls in the Pacific, confirming the ability of SAR mode to retain track.

