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| Code | CP4O-PMP-01 | Edition | 3.0 | Date | 04/12/12 |
| Client | European Space Agency | Final User | | - | |

**ESA Support to Science Element (STSE)**

**Cryosat+: Ocean Theme**

**CP4O – Cryosat Plus 4 Oceans**

**ESA AO/1-6827/11/I-NB**

**Project Management Plan *Version 3.1***

|  |  |  |  |
| --- | --- | --- | --- |
|  | Name | Signature | Date |
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| --- | --- | --- | --- | --- |
| SUMMARY OF MODIFICATIONS | | | | |
| Ed. | Date | Chapter | Modification | Author/s |
| 1.0 |  |  | Document Issue 1 | SatOC |
| 1.1 | 20/06/12 | Various | First update following project Kick Off | SatOC |
| 1.2 | 10/07/12 | Various | Updates on Scheduling | SatOC |
| 1.3 | 14/08/12 |  | Revision of Starlab personnel, update to timetable for WP1000, Expert Group contribution and details for first Progress meeting. | SatOC |
| 2.0 | 17/08/2012 | Annex I | Adaptation to changes in Starlab’s team | STARLAB |
| 2.1 | 16/11/2012 | Various | Updates to work package descriptions, updates to reflect progress on deliverables | SatOC |
| 3.0 | 04/12/2012 | Various | Updates to work package descriptions (detail in WP4000 and WP5000) updates to reflect progress on deliverables | SatOC |
| 3.1 | 05/02/2013 | Various | Changes to Starlab and isardSAT personnel | SatOC, STARLAB and isardSAT |

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# Introduction

## Purpose of the Document

This is the initial version of the Project Management Plan (PMP) for CP4O.

The PMP will be an internal document provided to consortium members.

* It forms the implementation plan and provides information on project timing, outline work package descriptions, deliverable lists and due dates, and preliminary timings and arrangements for project meetings.
* It is proposed to provide controlled updates of this document only after discussion with the project team, and approval from ESA.

## Project Background

### Introduction

This proposal is submitted in response to the Cryosat+ AO 6827 under the ESA Support To Science Element Programme, addressing Theme 1 “Innovative Ocean applications”.

The ESA Cryosat-2 mission is the first space mission to carry a radar altimeter that can operate in Synthetic Aperture Radar (SAR) mode. Although the prime objective of the Cryosat-2 mission is dedicated to monitoring land and marine ice, the SAR mode capability of the Cryosat-2 SIRAL altimeter also presents the opportunity of demonstrating significant potential benefits of SAR altimetry for ocean applications, based on expected performance enhancements which include improved range precision and finer along track spatial resolution.

### Project Objectives

The general objectives of this “Cryosat Plus for Oceans” (CP4O) proposal are:

* to build a sound scientific basis for new scientific and operational applications of Cryosat-2 data over the open ocean, polar ocean, coastal seas and for sea-floor mapping.
* to generate and evaluate new methods and products that will enable the full exploitation of the capabilities of the Cryosat-2 SIRAL altimeter, and extend their application beyond the initial mission objectives.
* to ensure that the scientific return of the Cryosat-2 mission is maximised.

In addition there are specific objectives under each of the sub-themes as follows:

***Open Ocean Altimetry***

The application and evaluation of Cryosat-2 Low Rate Mode (LRM) data in the following applications:

* Generation of Mean Sea Surface and Mean Dynamic Topography (through the use of the GOCE geoid model) and subsequent analysis of mesoscale and large scale ocean features (e.g. boundary currents, eddy kinetic energy)
* Assessment of ocean wind speeds and wave heights, and their contribution to existing operational and research applications.
* The improvements to Cryosat-2 data offered by application of specifically modelled ionospheric and wet troposphere models to provide accurate estimates of radar path delay

The application and evaluation of Cryosat-2 SAR Mode data:

* Ability to detect short spatial scale open ocean features.
* The improvement of CryoSat-2 Oceanographic products through the application of new SAR retracking schemes.
* The application of the RDSAR technique to convert SAR Full Bit Rate data to LRM data and so to study the best method for ensuring continuity in Sentinel-3 ocean products from the coastal zone to the open ocean.

***Polar Ocean Altimetry:***

To develop and evaluate processing schemes applicable to sea-ice affected regions, so that Cryosat-2 SAR Mode data can be used to study large scale polar ocean signals and so make a significant new contribution to in the following important applications:

* Generation of Mean Sea Surface and Mean Dynamic Topography and subsequent analysis of key polar ocean circulation features
* Improvements of polar tide models
* Investigations into the coupling between wind forcing and polar current patterns.
* Support investigations into critical Climate Change issues in the polar oceans such as ice-melting effects on circulation and sea-level rise

***Coastal Zone Altimetry:***

The exploitation of Cryosat-2 SAR Mode data in the Coastal Ocean to demonstrate their finer spatial resolution, improved retrieval accuracy and lower sensitivity to land contamination, and so deliver high-quality altimeter measurements closer to the shore, to improve the estimation of coastal sea level changes, the detection of coastal features (coastal current jets, coastal wave set up, coastal tides) and the characterisation of inshore wave conditions.

The demonstration of the potential of Cryosat-2 SARIn mode data to help discriminate and mitigate land contamination signals from off-nadir land targets (e.g. steep cliffs) in SAR and LRM waveforms over coastal regions.

***Sea-Floor Altimetry:***

The potential offered by the higher resolution and improved Signal to Noise Ratio of Cryosat-2 SAR Mode data to resolve short-wavelength sea surface signals caused by sea-floor topography elements and to map uncharted sea- mounts/trenches.

### Project Overview

The first Work Package (WP1000), led by Starlab, is the Scientific Requirements Consolidation – the aim of this activity is to consolidate the preliminary scientific requirements for the four sub-themes under analysis in this proposal (open ocean, high-resolution coastal zone, high-resolution polar ocean and high-resolution sea floor).

This activity is followed by the Preliminary Analysis of the State of the Art (WP2000), led by TU Delft, which will provide a comprehensive review of the state-of-the-art, relevant current initiatives, algorithms, models and EO-based products and datasets that are relevant in the context of the Cryosat+ ocean theme.

The first review point occurs after the end of WP2000, which will review the outputs of WP1000 and WP2000, discuss and revise as necessary the initial plan for subsequent activities. It is understood that this review will have the support of an external independent panel.

Following the review WP3000 (led by isardSAT) will commence the collection of the data sets needed for all subsequent activities. In parallel WP4000 (Product Development and Validation) will start, led by NOC. This work package is perhaps the most critical work package in which methods and algorithms needed to derive Cryosat-2 products fit for scientific exploitation analysis will be analysed, developed and validated. For each of the four sub-themes (open ocean, coastal zone, polar ocean, sea floor), a Data Set of prototype Cryosat-2 products will be produced and used to validate and refine the methods and algorithms.

The potential impact of the algorithms and demonstration data products produced in WP4000 will be assessed in WP5000 (led by CLS), using the “round robin” methodology successfully deployed in the ESA Sea Level Climate Change Impacts project. Finally the results of the Impact Assessment will be reviewed against the User Requirements Baseline generated early in the project and 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 operation activities to optimise the application of data flowing from the Sentinel-3 series of satellites.

Two work packages last for the entire duration of the project: WP7000 (Outreach, Promotion and Publication), which is regarded as an important aspect of the project by ESA, which has emphasised the importance of sharing the scientific findings of this work, and WP8000 (Project Management). Both these work packages are led by SatOC

## Applicable documents

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **CODE** | **TITLE** | **Issue** |
| LI | AO6827-li00pe | Letter of Invitation to Tender | 02/09/2011 |
| SOW | EOEP-STSE-EOPS-SW-11-0001 | Statement of Work | 2 – 09/08/2011 |
| TC | Appendix III to ESRIN/AO/1-6827/11/I-NB | Special Tender Condition | 05/09/2011 |
| CC | Appendix II to ESRIN/AO/1-6827/11/I-NB | Draft Contract | 05/09/2011 |

Table 1.1. Applicable Documents

## Reference documents

|  |  |  |
| --- | --- | --- |
| **REF.** | **CODE** | **TITLE** |
| [RD01] | CP4O TP | CP4O Technical Proposal |
| [RD02] | CP4O MP | CP4O Management Proposal |
|  |  |  |
|  |  |  |

Table 1.2. Reference documents

## Abbreviations and acronyms

This section lists the abbreviation and acronyms used in this document.

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning** |
| AGU | American Geophysical Union |
| AMSR-E | Advanced Microwave Scanning Radiometer – Earth Observing System |
| AMSU | Advanced Microwave Sounding Unit |
| ATBD | Algorithm Theoretical Baseline Documents |
| CCI | Climate Change Initiative |
| CCN | Contract Change Notice |
| CLS | Collecte Localisation Satellites |
| CNES | Centre Nationale d’Etudes Spatiales |
| CNR | Consiglio Nazionale delle Ricerche, Italy |
| CO | Coastal Ocean |
| COASTALT | ESA Project on Coastal Altimetry |
| COSPAR | Committee on Space Research |
| CP4O | Cryosat Plus for Oceans |
| CPP | Cryosat Processing Prototype (CNES Processor for Cryosat) |
| CRYMPS | Cryosat Mission Performance Simulator |
| Cryosat | ESA altimeter satellite for polar ice investigations |
| CRYOVEX | Cryosat Validation Experiment |
| C2 | Cryosat-2 |
| DAC | Dynamic Atmospheric Correction |
| DComb | Data Combination |
| DTU Space | National Space Institute, Technical University of Denmark |
| DNSC | Danish National Space Centre (former name of DTU Space) |
| DVP | Development and Validation Plan |
| EGU | European Geophysical Union |
| ECMWF | European Centre for Medium Range Weather Forecasting |
| ECV | Essential Climate Variables |
| EO | Earth Observation |
| ERS-1, ERS-2 | ESA remote sensing satellites |
| ESA | European Space Agency |
| eSurge | ESA project: Satellite data for the Storm Surge Community |
| FBR | Full Bit Rate |
| Geosat | US altimeter satellite |
| Globwave | ESA Project to produce and disseminate satellite wave data |
| GM | Geodetic Mission |

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning (continued)** |
| GMES | Global Monitoring for Environment and Security |
| GNSS | Global Navigation Satellite Systems |
| GOCE | Gravity field and steady-state Ocean Circulation, ESA gravity mission |
| HERACLES | ESA project to develop merged Envisat and Cryosat products |
| IAR | Impact Assessment Report |
| ICESAT | NASA Ice, Cloud and land Elevation Satellite |
| ISO | International Organisation for Standardisation |
| Jason-1, Jason-2 | Radar Altimeter Satellites |
| LRM | Low Rate Mode |
| LSE | Least Squares Estimation |
| MDT | Mean Dynamic Topography |
| MLE | Maximum Likelihood Estimation |
| MOE | Medium Orbit Ephemeris |
| MSS | Mean Sea Surface |
| MWR | MicroWave Radiometer |
| MyOCean | GMES project to provide operational ocean products |
| NASA | National Aeronautics and Space Administration |
| NOAA | National Oceanic and Atmospheric Administration |
| NOC | National Oceanography Centre |
| OA | Objective Analysis |
| OCOG | Offset Centre of Gravity |
| OO | Open Ocean |
| OSTST | Ocean Surface Topography Science Team |
| PI | Principal Investigator |
| PISTACH | CNES supported project to develop Coastal Altimetry Products |
| PAR | Preliminary Analysis Report |
| POE | Precise Orbit Ephemeris |
| PO | Polar Ocean |
| PPP | Precise Point Positioning |
| PVR | Product Validation Report |
| PTR | Point Target Response |
| RADS | Radar Altimeter Data System maintained by TU Delft. |
| RDSAR | Reduced resolution SAR mode data to pseudo LRM |
| REAPER | ESA Project to Reprocess ERS-1 and ERS-2 data |
| SAMOSA | SAR altimetry Mode Studies and Applications |
| SAR | Synthetic Aperture Radar |
| SARIN | SAR interferometric mode |
| SARM | SAR Mode |

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning (continued** |
| SatOC | Satellite Oceanographic Consultants |
| SFM | Sea Floor Mapping |
| Sigma0 | Radar Backscatter at nadir |
| SLA | Sea Level Anomaly |
| SSB | Sea State Bias |
| SSH | Sea Surface Height |
| SSMI | Special Sensor Microwave / Imager |
| STSE | Support to Science Element |
| SVD | Single Value Decomposition |
| SWH | Significant Wave Height |
| TCWV | Total Column Water Vapour |
| TMI | TRMM Microwave Imager |
| TOPEX | French / US Radar Altimeter Satellite |
| TRMM | Tropical Rainfall Measuring Mission |
| TUD | Technical University of Delft |
| UCL | University College, London |
| USO | Ultra Stable Oscillator |
| WP | Work Package |
| WTC | Wet Troposphere Correction |
| ZTD | Zenith Total Delays |

## 

## Document overview

The document is structured in 4 main parts:

1. Introduction
2. Project Milestones and Deliverables.

Details of project scheduling, key dates including milestones, deliverables, meetings programme and proposed milestone payment plan

1. Project Team Organisation and Key Personnel

Details partner’s responsibilities, reporting structure, and key personnel involved.

1. Work Package Breakdown

Provides summary details of tasks within each work package, dependencies, input requirements, deliverables (internal and external)

# Project Milestones and Deliverables

## Project Timing

* Project Administrative Kick-Off 18 May 2012
* Project Technical Kick-Off 30 May 2012
* Project duration: 24 months
* Project Ends, 18 May 2014

### Work Package Overview: Timing and Organisation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Work Package** | **Led by** | **Starts** | **Ends** |
| WP1000 | Scientific Requirements Consolidation | Starlab | 30/05/12 | 31/11/12 |
| WP2000 | Preliminary Analysis of the State of the Art | TU Delft | 31/08/12 | 14/02/13 |
| WP3000 | Data Set Collection | isardSAT | 30/11/12 | 18/03/13 |
| WP4000 | Product Development and Validation | NOC | 30/11/12 | 18/11/13 |
| WP5000 | Impact Assessment | CLS | 18/05/13 | 18/01/14 |
| WP6000 | Scientific Roadmap | SatOC | 18/01/14 | 18/04/14 |
| WP7000 | Outreach, promotion and publication | SatOC | 18/05/12 | 18/04/14 |
| WP8000 | Project Management | SatOC | 18/05/12 | 18/04/14 |

## Project GANNT Chart



Milestones

There are six major milestones:

**M1** 18 May 2012 Project Kick-Off

Acceptance of Project Management Plan (D8.1)

Project FTP Site

Finalisation of contracts.

**M2** 22 November 2012 Progress Meeting 1

Acceptance of Deliverables *D1.1[[1]](#footnote-2)* D 2.1, D2.2

**M3** 18 May 2013 Mid Term Review / Progress Meeting 2

Presentation of results / findings to date

Acceptance of Deliverables *D3.1[[2]](#footnote-3), D3.2*, D7.2, D4.1 (draft), D4.2 (draft)

Revised Project Management Plan

**M4** 18 September 2013 Progress Meeting 3

Acceptance of Deliverables D4.1, D4.2, D4.3, D4.4

**M5** 18 January 2014 Progress Meeting 4

Acceptance of Deliverables D5.1

**M6** 18 May 2014 Final Presentation

Acceptance of remaining deliverables

Acceptance of final project management report

**Closure of Project**

## Deliverable Items

| **Deliverable** | **Title** | **Due date** | **Responsible** |
| --- | --- | --- | --- |
| D8.1 | Project Management Plan | 30 May 2012 | SatOC |
| D8.2 | Project FTP site | 30 May 2012 | SatOC |
| D8.3 | Monthly reports, progress meeting minutes and presentations | As required | SatOC |
| D7.1 | Project Web Site | 30 Aug 2012 | SatOC |
| *D1.1* | RB – Requirements Baseline (draft) | 30 Aug 2012 | STARLAB |
| D1.1 | RB – Requirements Baseline (final) | 30 Oct 2012 | STARLAB |
| D2.1 | PAR - Preliminary Analysis Report | 14 Feb 2013 | TU Delft |
| D2.2 | DVP -Development and Validation Plan | 14 Feb 2013 | TU Delft |
| D3.1 | DS -Data Set | 18 Mar 2013 | isardSAT |
| D3.2 | DSUM – Data Set User Manual | 18 Mar 2013 | isardSAT |
| D7.2 | Project Brochure | 18 May 2013 | SatOC |
| D4.1 | ATBD- Algorithm Theoretical Basis Document – Draft version\*  Final version\* | 18 May 2013  18 Nov 2013 | STARLAB |
| D4.2 | PVR -Product Validation Report – Draft version  Final version | 18 May 2013  18 Nov 2013 | NOC |
| D4.3 | VDS -Validation Data Set (Round-robin dataset) | 18 Nov 2013 | NOC |
| D4.4 | DSUM+ -Updated Data Set User Manual | 18 Nov 2013 | isardSAT |
| D5.1 | IAR - Impact Assessment Report | 18 Jan 2014 | CLS |
| D6.1 | SR - Scientific Roadmap | 18 May 2014 | SatOC |
| D7.3 | Final Presentation Slides | 18 May 2014 | SatOC |
| D7.4 | Final Results Project Brochure | 18 May 2014 | SatOC |
| D8.4 | Final Technical Report | 18 May 2014 | SatOC |

\* In the case of D4.1 we expect a requirement to have an *internal* project version which contains full details of processing schemes, and an *external* version – which will, where necessary to protect IPR, contain an overview description of processing schemes. This latter version will be the official project deliverable and can be publically distributed. If partners request the same approach for other deliverables the request will be reviewed by ESA and the Project Manager.

Three paper copies of all deliverable documents will be delivered to ESRIN in hardback ring binders or equivalent binding solution. Review copies will be sent (emailed or ftp’d) to ESRIN in advance of delivery of hardcopies.

In addition to hard copy, deliverable documents will be provided to ESRIN as word and pdf documents.

## Proposed Meeting Schedule

| **Meeting** | **Place** | **Time** | **Attendees** | **Purpose** |
| --- | --- | --- | --- | --- |
| Kick-off | ESRIN | 30/05/12 | All except NOVELTIS and  isardSAT | Kick-Off, Acceptance of project management plan |
| Progress 1 | ESRIN | 22/11/12 | All except isardSAT and Noveltis | Review of Task 1 and Task 2. Agree Approach for remaining tasks  Revise Project Plan as necessary |
| Progress 2 and mid-term review | ESRIN | 18/05/13 | All except Noveltis | Review progress in Tasks 3 and 4.  Revise programme as necessary |
| Progress 3 | TU Delft or Noveltis | 18/09/13 | To be confirmed, dependent on venue | Review of Tasks 3 and 4. Plan for tasks 5 and 6 |
| Progress 4 | Provisionally DTU Space (Copenhagen) | 18/01/14 | To be confirmed, dependent on venue | Review of Task 5. Plan Task 6 and outreach material |
| Final Review | ESRIN | 18/05/14 | All | Project completion |

## Milestone Payment Plan

To be confirmed on receipt of ESA contract

| **Payment** | **Date** | **Value (EUR)** | **%** |
| --- | --- | --- | --- |
| Payment 1 (Contract Signature) | June 2012 | 60,000 | 20 |
| Payment 2 (Deliverables D1.1, D2.1, D2.2) | February 2013 | 60,000 | 20 |
| Payment 3 (Deliverables D3.1, D3.2) | May 2013 | 60,000 | 20 |
| Payment 4 (Deliverables D4.1, D4.2, D4.3, D4.4) | November 2013 | 60,000 | 20 |
| Payment 5 (Final Review) | May 2014 | 60,000 | 20 |
| **TOTAL** |  | **300,000** | **100** |

# Project Team Organisation and Key Personnel

## Organisation

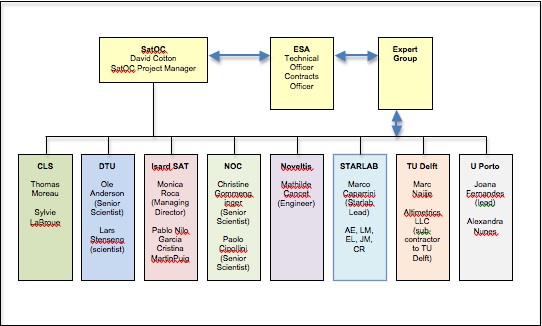


Figure 3‑1 CP4O Partner Structure

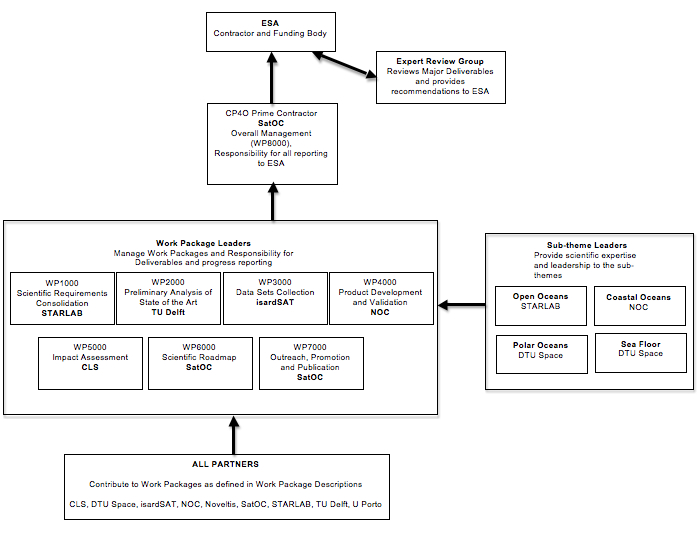


Figure 3‑2 CP4O Reporting Strucuture

## Project Team Organisation and Key Personnel

| **Name** | **Company** | **Position** | **Role** |
| --- | --- | --- | --- |
| Dr David Cotton | SatOC | Managing Director | Overall project management. SatOC technical management  WP6000 manager, WP7000 manager, WP8000 manager |
| Dr Ellis Ash | SatOC | Consultant | Management support: WP3000, WP7000, WP8000 |
| Ole B. Andersen | DTU Space | Senior Scientist | DTU project manager: WP1000, WP2000, WP5000, WP6000, WP7000 |
| Lars Stenseng | DTU Space | Scientist | WP1000, WP2000, WP3000, WP4000, WP5000, WP6000, WP7000 |
| Mònica Roca | isardSAT | Managing Director and Altimeter Expert | isardSAT lead, WP2000, WP3000 manager, WP4000, WP6000, WP7000 |
| Pablo Nilo Garcia | isardSAT | Research Altimeter Engineer | WP2000, WP3000, WP4000, WP6000, WP7000 |
| Cristina Martin-Puig | isardSAT | Research Scientist | WP6000 |
| Christine Gommenginger | NOC | Senior research scientist | NOC lead & technical input: WP1000, WP2000, WP3000, WP4000 manager, WP5000, WP6000, WP7000 |
| Paolo Cipollini | NOC | Senior research scientist | Technical input |
| Helen Snaith | BODC | Data scientist | Product development & documentation |
| Chris Banks | NOC | Research scientist | Technical input |
| Mathilde Cancet | NOVELTIS | Engineer | Ocean Tide correction: WP2000, WP3000, WP4000, WP6000, WP7000 |
| François Crespon | NOVELTIS | Expert Engineer | Ionospheric correction: WP2000, WP3000, WP4000, WP6000 |
| Marco Caparrini | STARLAB | Space Engineering Director, | Starlab’s Project Manager |
| Alejandro Egido | STARLAB | Researcher | Technical team member, WP 2000, WP3000, WP4000, WP5000, WP6000 |
| Jose Marquez | STARLAB | Researcher | Technical team member WP2000, WP4000 |
| Elizabeth Gil-Roldán Little | STARLAB | Consultant | Team member, WP1000 |
| Chris Ray | STARLAB | Researcher | Technical team member: WP2000, WP3000, WP4000, WP6000, WP7000 |
| Marc Naeije | TUDelft | Assist. Professor | WP2000 manager, WP3000, WP4000, WP6000, WP7000 |
| Ernst Schrama | TUDelft | Assoc. Professor | scientist |
| Pieter Visser | TUDelft | Assoc. Professor | scientist |
| Remko Scharroo | Altimetrics LLC, contracted by TUDelft | CEO and NOAA Jason-2 measurement systems engineer | consultant and RADS support: WP4000 |
| Joana Fernandes | U.Porto | Lecturer / Researcher | Research: WP2000, WP3000, WP4000, WP5000, WP6000, WP7000 |
| Clara Lázaro | U.Porto | Lecturer / Researcher | Research: WP2000, WP4000, WP7000 |
| Alexandra Nunes | U.Porto | Lecturer (IPP-ISEP) / Researcher | Research: WP2000, WP4000, WP7000 |
| Sylvie Labroue | CLS | Engineer (calval) | scientist, sensor processing, retracking bench test: WP1000, WP2000, WP3000, WP4000, WP5000 manager, WP6000, WP7000 |
| Thomas Moreau | CLS | Engineer, instruments and physical measurements | WP1000, WP2000, WP3000, WP4000, WP5000, WP6000, WP7000 |

# Work Package Breakdown

Work packages to be updated as necessary to include higher level of detail

## List of Work Packages

| **Work package** | **Title** |
| --- | --- |
| **WP1000** | **Scientific Requirements Consolidation** |
| **WP2000** | **Preliminary Analysis of the State-of-the-Art** |
| **WP3000** | **Data Set Collection** |
| **WP4000** | **Product Development and Validation** |
| **WP5000** | **Impact Assessment** |
| **WP6000** | **Scientific Roadmap** |
| **WP7000** | **Outreach, Promotion and Publication** |
| **WP8000** | **Project Management** |

## Work structure

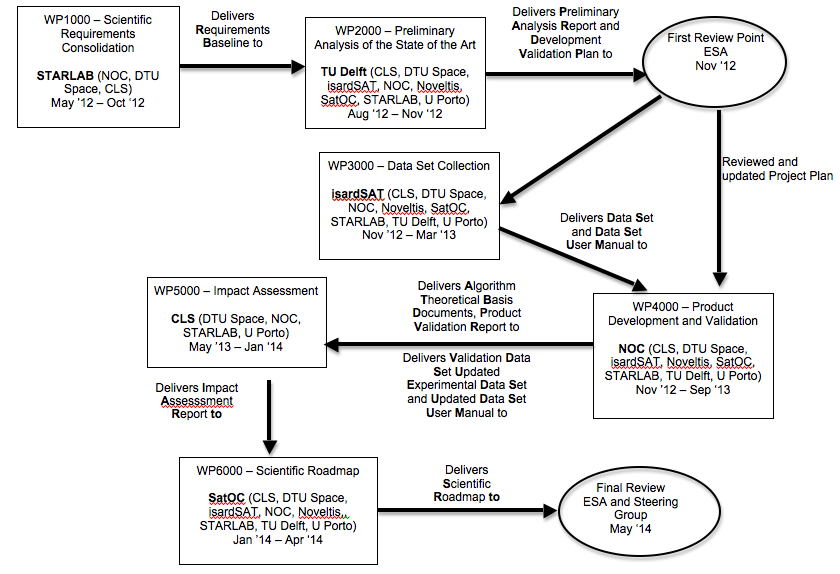


Figure 4‑1: **Work Programme Structure and linkages. NB changes in dates are not reflected in this figure.**

## Work Package Descriptions

**WP1000 – SCIENTIFIC REQUIREMENT CONSOLIDATION**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **WP**: 1000 | **Start**: 30 May 2012 | | | **End**: 31 October 2012 | | |
| **Title**: Scientific Requirement Consolidation | | | | **WP Leader**: Starlab | | |
| **Contributing Partners:** Sub-theme leaders:NOC, DTU-Space, CLS | | | | | | |
| **Objectives**  Derive a consolidated the preliminary scientific requirements for the four sub-themes under analysis in this proposal. These include: open ocean, high-resolution coastal zone, high-resolution polar ocean and high-resolution sea floor. | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * 1. Users consultation   2. Limitations and drawbacks analysis   3. Scientific and operational requirements definition   4. Generate draft report by 31 August 2012, identifying questions to be asked of community at September altimeter meetings (OSTST, Venice meeting, COASTalt   5. Generate final version of report by 31st October 2012 | | | | | STARLAB  STARLAB, NOC, DTU-Space, CLS | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project | None | | | |
| * ESA work statement | | ESA | . | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D1.1 RB - Requirements Baseline | | | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

**WP2000 – Preliminary Analysis of the State of the Art**

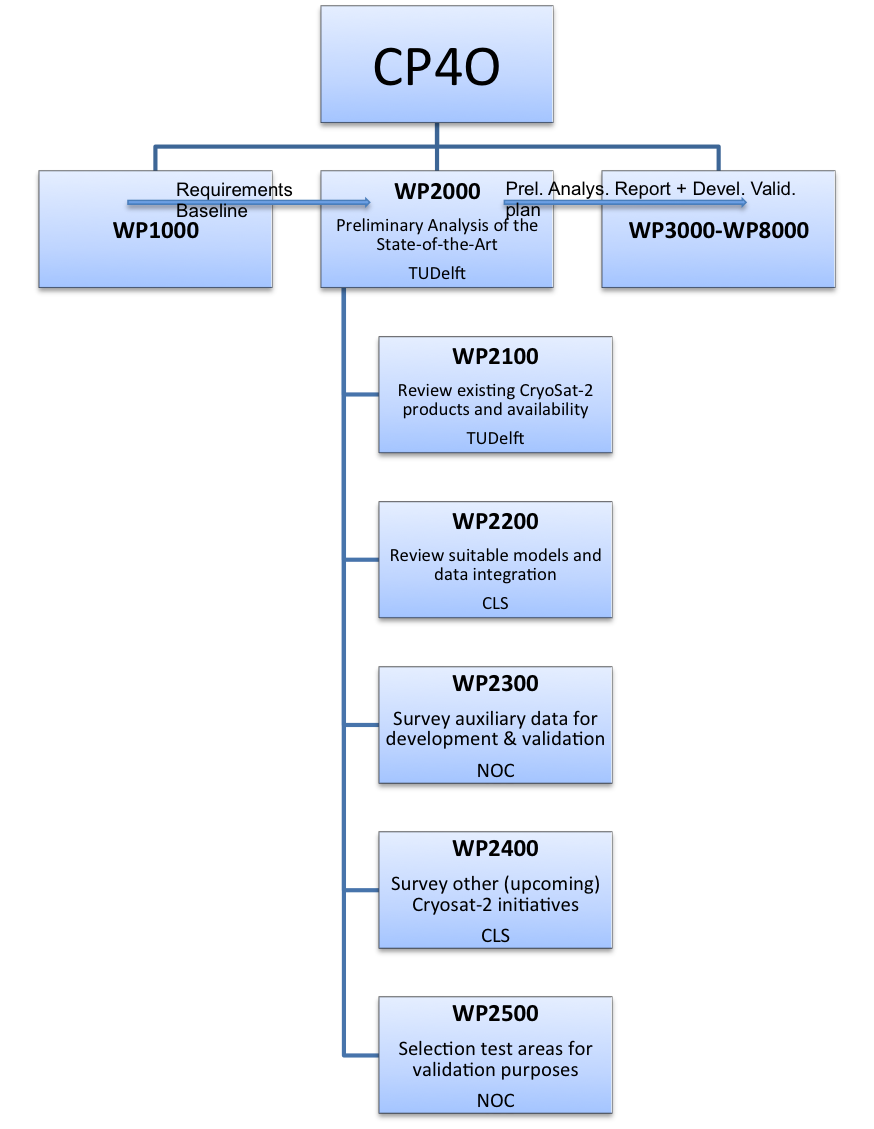


Figure 4‑2: Work breakdown for WP2000

**WP2000 – Preliminary Analysis of the State of the Art**

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| **WP**: 2000 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Preliminary Analysis of the State of the Art | | | | **WP Leader**: TUDelft | | |
| **Contributing Partners:** NOC, CLS, DTU-Space, STARLAB, isardSAT, Noveltis, U Porto, SatOC, and TUDelft (contributions on specific themes related to their respective expertise). Advising role for Altimetrics. | | | | | | |
| **Objectives**  Perform a comprehensive review of CryoSat state-of-the-art, relevant current initiatives, algorithms, models and EO-based products and datasets to be documented in the Preliminary Analysis Report (PAR) and the Development Validation Plan (DVP). | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Manage 5 work packages within WP2000: WP2100, WP2200, WP2300, WP2400, and WP2500 2. Preparing PAR with contributions from all WP2000 partners 3. Preparing DVP with contributions from all WP2000 partners | | | | | TUDelft  TUDelft+All  TUDelft+All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * D 2.1 Preliminary Analysis Report * D 2.2 Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by entire team before delivery to ESA. | | | | | | |

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| **WP**: 2100 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Review existing Cryosat-2 products and availability | | | | **WP Leader**: TUDelft | | |
| **Contributing Partners:** NOC, DTU-Space, isardSAT, Noveltis, UPorto, TUDelft | | | | | | |
| **Objectives**  Detailed review, assessment and cross-comparison of existing products, datasets, methods, models and algorithms, plus related range of validity limitations, drawbacks and challenges. | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Review Cryosat-2 LRM products over the Ocean, among which L1B, L2, FDM, RADS, CNES RDSAR and LRM CPP products 2. Review CryoSat-2 SAR products over water: L1B and L2 3. Review CryoSat-2 SAR products at high latitude and over sea ice: L1B & L2 4. Review CryoSat-2 SARIn products over water 5. Review CryoSat-2 altimeter corrections over open, coastal and polar ocean, which include orbits, ionosphere, wet troposphere, tides, SSB and DAC | | | | | TUDelft  NOC  DTU  isardSAT  UPorto, Noveltis, TUDelft | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * Contributions to Preliminary Analysis Report * Contributions to Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by entire team before delivery to ESA. | | | | | | |

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| **WP**: 2200 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Review suitable models and data integration | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** NOC, DTU, CLS, Starlab, isardSAT, TUDelft, Noveltis, UPorto | | | | | | |
| **Objectives**  Detailed analysis of the suitable models and data integration approaches plus their related limitations, drawbacks and challenges. | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Review SAR re-tracking over open ocean, over coastal ocean and for sea-floor mapping: e.g. SAMOSA2 and SAMOSA3 re-tracking algorithms, numerical SAR waveform models 2. Review SAR re-tracking over open ocean 3. Review SAR re-tracking over sea ice: e.g. threshold, leading edge, double ramp, beta and OCOG re-tracker for polar regions with occasional very specular echoes from sea ice and sea ice leads 4. Review RDSAR methodologies: SAR FBR processing to pseudo-LRM 5. Review SARIn processing/re-tracking 6. Review improved/dedicated corrections for  * LRM over open ocean: e.g. SSB * SAR over coastal ocean: e.g. GNSS-derived wet tropo * SAR over coastal ocean: regional tidal models, ionosphere correction models and DAC corrections * SAR over polar ocean: better ionosphere * SAR over polar ocean: improved tides  1. Review sigma0 retrieval in LRM and SAR mode: identification of needed algorithms and auxiliary data sources 2. Review data integration methods: optimized methods to integrate data from multiple satellite altimeters targeted to develop higher resolution products | | | | | NOC, DTU  CLS  DTU  Starlab, CLS  isardSAT  TUDelft  UPorto, CLS  Noveltis, CLS  Noveltis  DTU  TUDelft, NOC  DTU, TUDelft | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * Contributions to Preliminary Analysis Report * Contributions to Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |
| **WP**: 2300 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Survey auxiliary data for development and validation | | | | **WP Leader**: NOC | | |
| **Contributing Partners:** NOC, DTU-Space, Noveltis, SatOC, TUDelft | | | | | | |
| **Objectives**  Survey of all accessible associated data sets (space, airborne and in situ) which could be of use in helping adequate development and validation activities, investigating problems such as the lack of sufficient data sets and identification of practical solutions | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Survey of satellite altimeters over the oceans through RADS 2. Survey of satellite data over polar regions: like SAR, ICESAT and Envisat 3. Survey of airborne data, particularly CRYOVEX 4. Survey of *in situ* data: tide gauges, wave measurements, including wave period and direction, data sets available through Globwave. | | | | | TUDelft  DTU  DTU  Noveltis, NOC | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * Contributions to Preliminary Analysis Report * Contributions to Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

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| **WP**: 2400 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Survey other (upcoming) Cryosat-2 initiatives | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** NOC, isardSAT, TUDelft, CLS, SatOC | | | | | | |
| **Objectives**  Survey of relevant current and upcoming CryoSat-2 initiatives and projects | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Survey of RADS 2. Survey of eSurge 3. Survey of REAPER 4. … SAMOSA 5. … COASTALT 6. … PISTACH 7. … CNES CPP SAR re-tracking preparation for Sentinel-3: experiments with CryoSat-2 8. … CCI sea level ECV | | | | | TUDelft  NOC  CLS, isardSAT, TUDelft  SatOC  NOC  CLS  CLS  CLS | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * Contributions to Preliminary Analysis Report * Contributions to Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

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| **WP**: 2500 | **Start**: 31 August 2012 | | | **End**: Feb 2013 | | |
| **Title**: Selecting test areas for validation purposes | | | | **WP Leader**: NOC | | |
| **Contributing Partners:** NOC, DTU-Space, isardSAT, Noveltis, SatOC, Starlab, TUDelft | | | | | | |
| **Objectives**  Analysis and identification of the best candidate test areas to be used for the development and validation activities, including a complete analysis and description of the available data over those test areas | | | | | | |
| **Activities** | | | | | **Responsible** | |
| 1. Selection of open ocean LRM areas: global comparison with other altimeters 2. Selection of open ocean SAR areas: sites with in situ data, especially directional wave buoy data, if possible collocated with tide gauges 3. Selection of open ocean SAR areas for sea floor mapping: sites with high-resolution marine gravity information 4. Selection of coastal ocean SAR areas: sites with wet trop, iono and regional tidal corrections and in situ data, especially directional wave buoy data, preferably collocated with tide gauges e.g. English Channel, Gulf of Lion, Gulf of Cadiz, German Bight, and North Western Mediterranean Sea (Tuscany/Corsica) 5. Selection of coastal ocean SARin areas 6. Selection of polar ocean SAR areas: SSH validation data in the Arctic region, tide gauges and mean sea surfaces | | | | | TUDelft  Starlab, NOC  DTU  NOC, Noveltis,  isardSAT  DTU | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Proposal | | Project |  | | | |
| * ESA work statement * Requirements Baseline | | ESA  Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Associated validation datasets * Selected test areas | | Project (WP3000) | * Contributions to Preliminary Analysis Report * Contributions to Development and Validation Plan | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

**WP3000 – DATA SET COLLECTION**

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| **WP**: 3000 | **Start**: 30 November 2012 | | | **End**: 18 March 2013 | | |
| **Title**: Data Set Collection | | | | **WP Leader**: isardSAT | | |
| **Contributing Partners:** TU Delft, NOC, DTU-Space, STARLAB, Noveltis, SatOC, U Porto, CLS | | | | | | |
| **Objectives**  A database of suitable EO based products, in-situ data and relevant ancillary information shall be collected over the areas of interest in order to perform the required work. The database shall be made accessible on a project webpage and described in detail in a user manual | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * 1. Confirm and finalise requirements for CRYOSAT-2 data, order & obtain data   2. Confirm and finalise requirements for auxiliary data needed to produce the Cryosat-2 derived products, order and obtain data   3. Confirm and finalise requirements for validation data, order and obtain data   4. Generate Data Set User Manual and metadata   5. Cross-compare CLS SAR model and SAMOSA SAR model using sample waveforms from both models, with values in the parameter table agreed *a-priori*, and for different sea state conditions.   6. Publish Experimental Data Set on project web page | | | | | isardSAT + All  isardSAT + All  isardSAT + All  isardSAT  Starlab and CLS  SatOC | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Data Set requirements | | Project | Availability of Cryosat-2 reprocessed data in time.  Availability of auxiliary and validation data sets, which can be made freely and publically available as required by ESA | | | |
|  | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| * Experimental Data Set | | WP4000 | * D3.1 Experimental Data Set * D3.2 Experimental Data Set User Manual | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

**WP4000 – PRODUCT DEVELOPMENT AND VALIDATION**

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| **WP**: 4000 | **Start**: 1 Dec 2012 | | | **End**: 30 Nov 2013 | | |
| **Title**: Product Development and Validation | | | | **WP Leader**: NOC | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**   * Analyse, develop and validate the methods and algorithms needed to derive CryoSat-2 products fit for scientific exploitation in the Open Ocean, Coastal Ocean, Sea Floor Mapping and Polar Ocean sub-themes. * Validate the methods and algorithms against independent data sources and report the error analysis and cross-comparisons in the Product Validation Report (PVR). * Document the selected methods and algorithms for each sub-theme in the form of Algorithm Theoretical Basis Documents (ATBDs). * Produce Cryosat-2 products for the Experimental Data Set needed in WP5000 for the public round-robin exercise. | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * Coordinate activities in WP4100, WP4200, WP4300 and WP4400 | | | | | NOC | |
| * Coordinate preparation and delivery of Product Validation Report(s) with input from all WP4000 partners | | | | | NOC + All | |
| * Coordinate delivery of Algorithm Theoretical Basis Document(s) with input from all WP4000 partners | | | | | NOC + All | |
| * Coordinate delivery of Validation Data Set and Updated Data Set User Manual | | | | | NOC + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Cryosat-2 FBR data * Cryosat-2 L1B and L2 data * Cryosat-2 Auxiliary data * Experimental Data Set (WP3000) * Experimental Data Set User Manual (WP3000) | | Project | Availability of Cryosat-2 data  Availability of Auxiliary data  Availability of independent validation data sets, which can be made freely and publically available as required by ESA | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Output and corrections for Experimental Data Set | | Internal | * D4.2 Product Validation Report (one per sub-theme or one single document, to be agreed between the Agency & team) * D4.1 Algorithm Theoretical Basis Document(s) (one per sub-theme or one single document, to be agreed between the Agency & team) * D 4.3 Validation Data Set * D 4.4 Updated Data Set User Manual | | | ESA  ESA  ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. * Draft ATBD and PVR to be reviewed by Steering Group | | | | | | |

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| **WP**: 4100 | **Start**: 1 Dec 2012 | | | **End**: 30 Apr 2013  November 2013 for task 3 | | |
| **Title**: Experimental validation exercise | | | | **WP Leader**: NOC | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**   * Analyse, develop and validate methods and algorithms through a detailed experimental validation exercise for different implementation choices and different sites and conditions to produce improved CryoSat-2 products fit for scientific exploitation | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * For each of the following, perform a detailed experimental validation exercise to develop and validate methods and algorithms:  1. LRM for Open Ocean: select and validate methods and algorithms through global comparison with other altimeters (MLE3, MLE4) | | | | | TUDelft | |
| 1. SAR for Open Ocean: select and validate methods and algorithms through comparisons of the SAMOSA retracker and the CNES/CLS numerical retracker for the same SAR data in North-East Atlantic, with validation against other altimeters and (for SWH) available in situ and model data | | | | | Starlab, CLS, NOC, SATOC | |
| 1. SAR for Sea Floor Mapping: select and validate methods and algorithms in SAR regions with available high-resolution marine gravity information | | | | | DTU Space | |
| 1. SAR for Coastal Ocean: select and validate methods and algorithms through comparisons against other altimeters and in situ data along South Coast of UK | | | | | NOC | |
| 1. SAR for Polar Ocean: select and validate methods and algorithms through comparison against validation data in the Arctic region from tide gauges and mean sea surfaces | | | | | DTU Space | |
| 1. RDSAR for Open Ocean: select and validate methods and algorithms through comparisons of the SAMOSA RDSAR and the CNES/CLS SAR Reduction algorithms for available FBR data, with validation against SAR retracked data and (for SWH) available in situ and model data. | | | | | Starlab, CLS, SATOC | |
| 1. SARIn for Coastal Ocean: scientific study of the capability of Cryosat-2 SARIn to assist the mitigation of land contamination echoes in LRM and SAR data in the coastal zone. | | | | | isardSAT | |
| 1. Improved Geophysical Corrections: development and validation of methods and algorithms for improved wet tropospheric correction for the whole Cryosat-2 mission | | | | | UPorto | |
| 1. Improved Geophysical Corrections: development and validation of improved ionospheric correction over the Mediterannean Sea and the European continental shelf (Lat [+30, +70], Lon [-15, +40] deg) | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: development and validation of improved regional tidal correction for coastal ocean over the North East Atlantic | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: development and validation of other improved geophysical corrections for Cryosat-2 e.g. DAC | | | | | TUDelft | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Cryosat-2 FBR data * Cryosat-2 L1B and L2 data * Cryosat-2 Auxiliary data * Experimental Data Set (WP3000) * Experimental Data Set User Manual (WP3000) | | Project | Availability of Cryosat-2 data  Availability of Auxiliary data  Availability of independent validation data sets, which can be made freely and publically available as required by ESA | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Results of validation experiments | | WP4200 |  | | |  |
| **Quality Control**   * Outputs to be reviewed by entire team before delivery to ESA | | | | | | |

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| **WP:** 4200 | **Start:** 1 May 2013 | | | **End:** 30 June 2013  November 2013 for task 3 | | |
| **Title**: Error analysis and Product Validation Report | | | | **WP Leader**: Starlab | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**   * Validate the methods and algorithms against independent data sources and report the error analysis and cross-comparisons in the Product Validation Report (PVR). | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * For each of the following, perform the error analysis and cross-comparisons and document in the Product Validation Report(s):  1. LRM for Open Ocean | | | | | TUDelft | |
| 1. SAR for Open Ocean | | | | | Starlab, CLS, NOC, SATOC | |
| 1. SAR for Sea Floor Mapping | | | | | DTU Space | |
| 1. SAR for Coastal Ocean | | | | | NOC | |
| 1. SAR for Polar Ocean | | | | | DTU Space | |
| 1. RDSAR for Open Ocean | | | | | Starlab, CLS, SATOC | |
| 1. SARIn for Coastal Ocean | | | | | isardSAT | |
| 1. Improved Geophysical Corrections: wet tropospheric correction (full mission) | | | | | UPorto | |
| 1. Improved Geophysical Corrections: ionospheric correction (Mediterrannean Sea and the European continental shelf) | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: regional tidal correction (North East Atlantic) | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: other geophysical corrections e.g. DAC | | | | | TUDelft | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| Results of validation experiments | | WP4100 |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D4.2 Product Validation Report (one per sub-theme or one single document, to be agreed between the Agency & team) | | | ESA |
| **Quality Control**   * Outputs to be reviewed by entire team before delivery to ESA * Draft PVR to be reviewed by Steering Group | | | | | | |
| **WP**: 4300 | **Start**: 1 July 2013 | | | **End**: 31 August 2013  November 2013 for task 3 | | |
| **Title**: Final algorithm selection and Algorithm Theoretical Basis Document(s) | | | | **WP Leader**: TUDelft | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**   * Create detailed description of the final methods and algorithms into Algorithm Theoretical Basis Documents (ATBD), including a scientific analysis of the results driving specific development choices and trade-offs | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * For each of the following, select the final methods and algorithms and document in the form of Algorithm Theoretical Basis Documents (ATBD), including a scientific analysis of the results driving specific development choices and trade-offs:  1. LRM for Open Ocean | | | | | TUDelft | |
| 1. SAR for Open Ocean | | | | | Starlab, CLS, NOC, SATOC | |
| 1. SAR for Sea Floor Mapping | | | | | DTU Space | |
| 1. SAR for Coastal Ocean | | | | | NOC | |
| 1. SAR for Polar Ocean | | | | | DTU Space | |
| 1. RDSAR for Open Ocean | | | | | Starlab, CLS, SATOC | |
| 1. SARIn for Coastal Ocean | | | | | isardSAT | |
| 1. Improved Geophysical Corrections: wet tropospheric correction (full mission) | | | | | UPorto | |
| 1. Improved Geophysical Corrections: ionospheric correction (Mediterannean Sea and the European continental shelf) | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: regional tidal correction (North East Atlantic) | | | | | Noveltis | |
| 1. Improved Geophysical Corrections: other geophysical corrections e.g. DAC | | | | | TUDelft | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| D4.2 Product Validation Report(s) | | WP4200 |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D4.1 Algorithm Theoretical Basis Document(s) (one per sub-theme or one single document, to be agreed between the Agency & team) | | | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. * Draft ATBD to be reviewed by Steering Group | | | | | | |

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| **WP**: 4400 | **Start**: 1 July 2013 | | | **End**: 30 September 2013  November 2013 for task 3 | | |
| **Title**: Production and Documentation of Cryosat-2 Validation Dataset | | | | **WP Leader**: DTU Space | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**   * Produce Cryosat-2 products for the Validation Data Set needed in WP5000 for the public round-robin exercise. * Produce Validation Data Set User Manual (isardSAT, SATOC). | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * For each of the following, produce Cryosat-2 products for the Validation Data Set needed in WP5000 for the public round-robin exercise.  1. LRM for Open Ocean: global via RADS | | | | | TUDelft | |
| 1. SAR for Open Ocean | | | | | Starlab, CLS | |
| 1. SAR for Sea Floor Mapping: subset of experimental data used in WP4100 | | | | | DTU Space | |
| 1. SAR for Coastal Ocean, including where available, improved wet troposphere, ionospheric and regional tidal corrections, for Gulf of Cadiz, North-West Mediterranean & German Bight | | | | | NOC, U Porto, Noveltis | |
| 1. SAR for Polar Ocean: subset of experimental data used in WP4100 | | | | | DTU Space | |
| 1. RDSAR for Open Ocean | | | | | CLS, TUDelft | |
| * Produce Validation Data Set User Manual | | | | | isardSAT, SATOC | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Cryosat-2 FBR data * Cryosat-2 L1B and L2 data * Cryosat-2 Auxiliary data * Experimental Data Set (WP3000) * Experimental Data Set User Manual (WP3000) | | Project |  | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D 4.3 Validation Data Set * D 4.4 Updated Data Set User Manual | | | ESA  ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

**WP5000 – IMpact Assessment**

D2.1 PAR

D2.2 DVP

CP4O

WP2000

Preliminary Analysis of the state of the Art

WP5000

Impact Assessment

WP6000

Scientific Roadmap

WP5100

Development of Assessment tools and inter-comparison framework

WP5200

Comparison with State of the Art and other altimeter missions

WP5300

Evaluation of Scientific Innovations

WP5400

Overall Assessment

WP5500

Open Ocean Impact Assessment

WP5600

Coastal Ocean Impact Assessment

WP5700

Polar Ocean Impact Assessment

WP5800

Sea Floor Impact Assessment

WP5900

Compile Impact Assessment Report

D5.1 IAR

WP4000

Product Development and Validation

WP3000

Data Set Collection

D3.1 DS

D3.2 DSUM

D4.1 PVR

D4.2 ATBD

D4.3 VDS

D4.4 DSUM

Figure 4‑3 Work breakdown for WP5000

**WP5000 – IMpact Assessment**

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| **WP**: 5000 | **Start**: 1 October 2012 | **End**: 18 January 2014 | |
| **Title**: Impact Assessment | | **WP Leader**: CLS | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC + U Porto for wet tropo | | | |
| **Objectives**  To interpret, analyse and quantify the impact and benefits of the CRYOSAT-2 data in the context of the considered sub-Themes | | | |
| **Tasks** | | | **Responsible** |
| * 1. Development of assessment tools and inter-comparison framework   2. Comparison with the state of the art and with other altimeter missions   3. Evaluation of scientific innovations   4. Overall assessment   5. Open Ocean Impact Assessment   6. Coastal Ocean Impact Assessment   7. Polar Ocean Impact Assessment   8. Sea Floor Altimetry Impact Assessment   9. Compile findings into a combined Impact Assessment Report | | | CLS + All  STARLAB + round-robin participants  NOC + round-robin participants  DTU Space  + round-robin participants  DTU Space  + round-robin participants  CLS |

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| **Inputs** | **From** | **Critical Dependencies** | |
| * Experimental Data Set (WP3000 and WP4000) * Experimental Data Set User Manual (WP3000 and WP4000) * Product Validation Report (WP4000) * ATBDs (WP4000) | Project | The task depends on the availability of sufficient amount of reprocessed data to allow robust statistical analyses and efficient assessment of the impact of the new products | |
| **Internal Deliverables** | **To** | **External Deliverables** | **To** |
|  |  | * D5.1 Impact Assessment Report | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | |

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| **WP**: 5100 | **Start**: 1 October 2012 | | | **End**: 18 December 2012 | | |
| **Title**: Development of assessment tools and inter-comparison framework | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC +….. | | | | | | |
| **Objectives**  To …… | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.1.1 Description of the recommended zones and recommended period (19/10/12)  5.1.2 Production of draft document describing methodology for assessment and metrics. (19/10/12)  5.1.3 Iterations between WP2000 and WP500 regarding the sensitivity of the retracking algorithm in order to add the relevant metrics in WP5000  5.1.4 Update of document describing methodology for assessment and metrics. (18/12/2012) | | | | | CLS + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| Drafts of Preliminary Analysis Report and Development and Validation Plan | | WP2000 |  | | | |
| **Internal Deliverables**  5.1.1 Data zones and period 19/10/12  5.1.2 Draft Methodology 19/10/12  5.1.1 Revised methodology 18/12/12 | | **To**  WP5000  WP5000  WP5000 | **External Deliverables** | | | **To** |
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| **Quality Control**  Review by WP5100 participants | | | | | | |

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| **WP**: 5200 | **Start**: TBD | | | **End**: TBD | | |
| **Title**: Comparison with the state of the art and with other altimeter missions | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC +….. | | | | | | |
| **Objectives**  To …… | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.2.1 | | | | | CLS + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
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| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
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| **Quality Control** | | | | | | |

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| **WP:** 5300 | **Start:** TBD | | | **End:** TBD | | |
| **Title**: Evaluation of Scientific Innovation | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC +….. | | | | | | |
| **Objectives**  To …… | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.3.1 | | | | | CLS + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
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| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
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| **Quality Control** | | | | | | |

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| **WP:** 5400 | **Start:** TBD | | | **End:** 18 May 2013 | | |
| **Title**: Overall Assessment | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC +….. | | | | | | |
| **Objectives**  To …… | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.4.1 | | | | | CLS + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
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| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
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| **Quality Control** | | | | | | |

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| **WP:** 5500 | **Start:** 18 May 2013 | | | **End:** 18 December 2013 | | |
| **Title**: Impact and Benefit Analysis for Open Ocean | | | | **WP Leader**: STARLAB | | |
| **Contributing Partners:** STARLAB + Round Robin participants | | | | | | |
| **Objectives**  To interpret, analyse and quantify the impact and benefits of the CRYOSAT-2 data in the context of the Open Ocean sub-theme | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.5.1 Compare results with existing and current state of the art results quantifying the improvement of the development methods and models  5.5.2 Analyse the errors/uncertainties.  5.5.3 Investigate the potential of the derived product to enhance the current knowledge state-of-the-art.  5.5.4 Determine the benefit and impact of CRYOSAT-2 on the specific test areas | | | | | STARLAB + Round Robin participants | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Experimental Data Set (WP3000 and WP4000) * Experimental Data Set User Manual (WP3000 and WP4000) * Product Validation Report (WP4000) * ATBDs (WP4000) | | Project | The task depends on the availability of sufficient amount of reprocessed data to allow robust statistical analyses and efficient assessment of the impact of the new products | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Open Ocean Report on Benefits and Impacts | | WP5900 |  | | |  |
| **Quality Control**  Review by WP5500 participants | | | | | | |

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| **WP:** 5600 | **Start:** 18 May 2013 | | | **End:** 18 December 2013 | | |
| **Title**: Impact and Benefit Analysis for Coastal Ocean | | | | **WP Leader**: NOC | | |
| **Contributing Partners:** NOC + Round Robin participants | | | | | | |
| **Objectives**  To interpret, analyse and quantify the impact and benefits of the CRYOSAT-2 data in the context of the Coastal Ocean Sub-Theme | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.5.1 Compare results with existing and current state of the art results quantifying the improvement of the development methods and models  5.5.2 Analyse the errors/uncertainties.  5.5.3 Investigate the potential of the derived product to enhance the current knowledge state-of-the-art.  5.5.4 Determine the benefit and impact of CRYOSAT-2 on the specific test areas | | | | | NOC + Round Robin participants | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Experimental Data Set (WP3000 and WP4000) * Experimental Data Set User Manual (WP3000 and WP4000) * Product Validation Report (WP4000) * ATBDs (WP4000) | | Project | The task depends on the availability of sufficient amount of reprocessed data to allow robust statistical analyses and efficient assessment of the impact of the new products | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Coastal Ocean Report on Benefits and Impacts | | WP5900 |  | | |  |
| **Quality Control**  Review by WP5600 participants | | | | | | |

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| **WP:** 5700 | **Start:** 18 May 2013 | | | **End:** 18 December 2013 | | |
| **Title**: Impact and Benefit Analysis for Polar Ocean | | | | **WP Leader**: DTU Space | | |
| **Contributing Partners:** DTU Space + Round Robin participants | | | | | | |
| **Objectives**  To interpret, analyse and quantify the impact and benefits of the CRYOSAT-2 data in the context of the Polar Ocean Sub-Theme | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.5.1 Compare results with existing and current state of the art results quantifying the improvement of the development methods and models  5.5.2 Analyse the errors/uncertainties.  5.5.3 Investigate the potential of the derived product to enhance the current knowledge state-of-the-art.  5.5.4 Determine the benefit and impact of CRYOSAT-2 on the specific test areas | | | | | DTU Space + Round Robin participants | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Experimental Data Set (WP3000 and WP4000) * Experimental Data Set User Manual (WP3000 and WP4000) * Product Validation Report (WP4000) * ATBDs (WP4000) | | Project | The task depends on the availability of sufficient amount of reprocessed data to allow robust statistical analyses and efficient assessment of the impact of the new products | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Polar Ocean Report on Benefits and Impacts | | WP5900 |  | | |  |
| **Quality Control**  Review by WP5700 participants | | | | | | |

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| **WP:** 5800 | **Start:** 18 May 2013 | | | **End:** 18 December 2013 | | |
| **Title**: Impact and Benefit Analysis for Sea Floor Altimetry | | | | **WP Leader**: DTU Space | | |
| **Contributing Partners:** DTU Space + Round Robin participants | | | | | | |
| **Objectives**  To interpret, analyse and quantify the impact and benefits of the CRYOSAT-2 data in the context of the Sea Floor Altimetry Sub-Theme | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| 5.5.1 Compare results with existing and current state of the art results quantifying the improvement of the development methods and models  5.5.2 Analyse the errors/uncertainties.  5.5.3 Investigate the potential of the derived product to enhance the current knowledge state-of-the-art.  5.5.4 Determine the benefit and impact of CRYOSAT-2 on the specific test areas | | | | | DTU Space + Round Robin participants | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Experimental Data Set (WP3000 and WP4000) * Experimental Data Set User Manual (WP3000 and WP4000) * Product Validation Report (WP4000) * ATBDs (WP4000) | | Project | The task depends on the availability of sufficient amount of reprocessed data to allow robust statistical analyses and efficient assessment of the impact of the new products | | | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
| Sea Floor Altimetry Report on Benefits and Impacts | | WP5900 |  | | |  |
| **Quality Control**  Review by WP5800 participants | | | | | | |

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| **WP**: 5900 | **Start**: 18 December 2013 | | | **End**: 18 January 2014 | | |
| **Title**: Compilation of Combined Impact Assessment Report | | | | **WP Leader**: CLS | | |
| **Contributing Partners:** Sub theme leaders DTU-Space, STARLAB, NOC + U Porto for wet tropo | | | | | | |
| **Objectives**  To compile the final, combined report on the impact and benefits of the CRYOSAT-2 data in the context of the considered sub-Themes | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * + 1. Compile findings into a combined Impact Assessment Report | | | | | CLS | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| Sub-theme reports from WP5500, 5600, 5700, 5800 | | Project |  | | | |
|  | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D5.1 Impact Assessment Report | | | ESA |
| **Quality Control**   * IAR to be reviewed by all WP5000 partners and SatOC before delivery to ESA. | | | | | | |

**WP6000 – SciENTIFIC ROADMAP**

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| --- | --- | --- | --- | --- | --- | --- |
| **WP**: 6000 | **Start**: 18 Jan 2014 | | | **End**: 18 April 2014 | | |
| **Title**: Scientific Roadmap | | | | **WP Leader**: SatOC | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**  Define a Scientific Roadmap for fostering future developments aimed at transferring the outcomes of the project into future scientific and operational activities with a data flow sustained by the Sentinel-3 series of satellites | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * 1. Provide a critical analysis of all the feedbacks from scientists and institutions that have accessed the validation datasets;   2. Identify potential strategies for integrating the development methods and models into existing large scientific initiatives and operational institutions;   3. Define a scientific development strategy improving the development methods and products;   4. Define a potential plan for fostering a transition from research to operational activities;   5. Identify scientific priority areas to be addressed in future projects in support of the CRYOSAT-2 data exploitation | | | | |  | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Impact Assessment Report | | Project |  | | | |
|  | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D 6.1 Scientific Roadmap | | | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. * Draft SR to be reviewed by Expert Group | | | | | | |

**WP7000 – OUtreach, PROMOTION AND PUBLICATION**

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| **WP**: 7000 | **Start**: 18 May 2012 | | | **End**: 18 May 2014 | | |
| **Title**: Outreach, Promotion and Publication | | | | **WP Leader**: SatOC | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**  Promote the projects results within the relevant scientific and operational communities;  Promote the resulting products, methods and datasets to the user community;  Represent the project at scientific conferences and other international forums through scientific presentations and exhibitions.  Submit one or more papers to an international peer-reviewed journal, publishing the results of the project. | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * 1. Establish Outreach, Promotion and Publication Plan   2. Establish Project Website   3. Participate in conferences and international forums   4. Submit papers to peer reviewed journals   5. Generate Final Products: Presentation Slideshow targeted at DOSTAG / PB-EO level, Project Brochure, Final Results Brochure | | | | | SatOC  SatOC  All  All  SatOC + All | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * All project results, datasets and deliverables | | Project |  | | | |
|  | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * D 7.1 Project Web Site * D 7.3 Final Presentation Slideshow * D 7.2 Project Brochure * D 7.4 Final Results Brochure | | | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

**WP8000 – Project Management**

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| --- | --- | --- | --- | --- | --- | --- |
| **WP**: 8000 | **Start**: 18 May 2012 | | | **End**: 18 May 2014 | | |
| **Title**: Project Management | | | | **WP Leader**: SatOC | | |
| **Contributing Partners:** ALL | | | | | | |
| **Objectives**  The main objective of Project Management is to help technical staff manage their work in accordance with accepted methods of project control and monitoring.  The Project Manager will oversee the whole project and each company within the team will provide their own Team Leader to provide responsibility for their technical delivery.  Each Team Leader is accountable for their company’s project element, and is required to provide timely performance information to management. | | | | | | |
| **Tasks** | | | | | **Responsible** | |
| * 1. Generate Project Plan, update as necessary throughout the project   2. Monitor progress against project plan   3. Monitor risks and take pro-active actions to minimise impact on project   4. Provide the point of liaison with ESA Scientific Officer   5. Organise and manage meetings as specified | | | | | SatOC | |
| **Inputs** | | **From** | **Critical Dependencies** | | | |
| * Technical Proposal * Financial, Management and Administrative Proposal | | Proposal |  | | | |
|  | |
| **Internal Deliverables** | | **To** | **External Deliverables** | | | **To** |
|  | |  | * Project Plan, updated as necessary * Monthly Progress updates * Quarterly Progress Reports * Progress Meeting Presentations and Minutes * D 8.4 Final Technical Report | | | ESA |
| **Quality Control**   * Outputs to be reviewed by team before delivery to ESA. | | | | | | |

## Risk Factors and Mitigation Strategies

Below we list specific risk factors that could impact on the management of the project, and the mitigation strategies that are proposed, in the form of the risk register below, which will be updated as the project progresses:

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| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **WP** | **Risk** | **Impact** | **Mitigation** | **Owner** | **Status** |
| 1 | WP3000 - general | Because of reprocessing timetable for Cryosat mission data, required Cryosat data sets cannot be made available in time for beginning of WP4000 (November 2012 | Critical on WP4000 and 5000 | Acquire updated schedule for the reprocessing campaign and revise the schedule / plans accordingly. | SatOC, isardSAt | Live |
| 2 | WP3000 - general | It may not be possible to provide open aspects to some of the validation in situ / model data sets. | Not critical on WP4000 and 5000 | List the data sets used, and to provide a link to the data owners | SatOC, isardSAt | Potential |
| 3 | WP4000 - general | Delay to WP4000, due to need to reschedule as a consequence of Risk 1 | Delay to Project WP4000 and later | Investigate if a work around solution can be developed, based on an understanding of the changes made to the new Cryosat-2 processing chain. All contributors to this work package will be asked to review the potential impact on their plans, once a firm timetable for the availability reprocessed Cryosat-2 data is available | SatOC | Potential |
| 4 | WP4000 -general | Uncertainties around the development of new products, could delay progress | Delay to Project WP4000 and later | only select mature approaches, and have already had considerable development time | SatOC | Potential |
| 5 | WP4000 - Sea floor altimetry | Lack of SAR mode coverage in regions suitable for sea floor mapping. There is little SAR mode data in the Pacific Ocean, where 95% of all sea mounds are supposed to be located. A limited test region has been identified but the water depth (roughly 5 km) makes this very challenging. | Potentially critical to sea floor altimetry sub-theme.  May not be possible to map small scale bathymetry | An optional additional activity has been proposed, which would require a change to the mode mask and a collection of SAR mode data for a suitable period before processing. | ESA, DTU Space | Potential |
| 5 | WP4000 - Polar altimetry | Spikiness of SAR waveforms in polar oceans – results in difficulty in re-tracking | Potentially critical to polar altimetry sub-theme. | Problem recognized by ESA, who plan to upgrade the operational Cryosat-2 L1B SAR processor to produce SAR waveforms with finer gate resolution | ESA, DTU Space | Potential |
| 6 | WP5000 | The round robin validation concept requies a relatively large volume of data to support statistically valid results. |  | Once the true volume of data to be made available is known it may be necessary to modify the proposed approach | CLS, ESA, SatOC | Potential |
|  |  |  |  |  |  |  |

In addition to the above specific identified risks, progress will be monitored weekly against the Project Management plan to check for delays or difficulties, and all partners will be required to notify the Project Manager of any circumstances or conditions which may lead to delay. Recovery actions will be agreed, involving ESA if any changes to the Project Management plan are required.

# Annex A CP4O Work Package Listing – Personnel Contributions

**WP1000 - Scientific Requirements Consolidation**

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| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 1000 | Scientific Requirement Consolidation | **STARLAB** | MPC, EGR | WP Manager |
| 1.1 | Users Consultation | **STARLAB** | MPC, EGR |  |
| 1.2 | Limitations and Drawbacks Analysis | **STARLAB** | MPC |  |
| 1.3 | Scientific and operational requirements definition | **NOC** | CG |  |
| DTU | **LS**, OA |  |
| CLS | TM, SL |  |

**WP2000 - Preliminary Analysis of the State of the Art**

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| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 2000 | Preliminary Analysis of the State of the Art | **TU Delft** | MN | WP Manager |
| 2.1 | Detailed Review of existing products…. | **TU Delft** | MN | Review C-2 LRM over the ocean, and alt corrections |
| DTU Space | **LS**, OA | Review C-2 SAR polar / ice products |
| isardSAT | PG | Review C-2 SARin over water |
| NOC | CG | Review C-2 SAR L1B, L2 over ocean |
| Noveltis | MC, FC | Regional tides, ionospheric correction |
| U Porto | JF, AN | Review of existing wet tropo |
| 2.2 | Detailed analysis of the suitable models…. | TU Delft | MN | LRM corrections, data integration methods, sigma0 |
| DTU Space | **LS**, OA | Sea ice, polar ocean |
| STARLAB | AE, JM,  CR | RDSAR |
| isardSAT | **MR**, PG | SARin |
| NOC | CG | SAR retracking, sigma0 |
| Noveltis | MC, FC | Regional tides, ionospheric correction |
| U Porto | JF, AN | Review of existing wet tropo |
| **CLS** | TM, SL | SAR retracking |
| 2.3 | Survey of all accessible associated data sets…. | TU Delft | MN | RADS |
| DTU Space | **LS**, OA | Polar and airborne data |
| **NOC** | CG | Wave buoys |
| Noveltis | MC, FC | Regional tides, ionospheric correction |
| U Porto | JF | Review of existing tropospheric path delay data sets |
| 2.4 | Survey of relevant current and upcoming initiatives…. | TU Delft | MN | REAPER, RADS |
| isardSAT | **MR**, PG | REAPER |
| NOC | CG | SAMOSA, Coastalt, eSurge |
| **CLS** | TM, SL | CNES CPP, CCI, Pistach,… |
| 2.5 | Analysis and identification of the best candidate test areas …. | TU Delft | MN | LRM over ocean - global |
| DTU Space | **LS**, OA | SAR for sea floor mapping, polar |
| STARLAB | AE, MPC,  CR | SAR over ocean, in situ collocations |
| isardSAT | **MR**, PG | Coastal SARin |
| **NOC** | CG | SAR over ocean, in situ collocations, coastal |
| Noveltis | MC, FC | Coastal SAR, iono, and tidal corrections |
| U Porto | JF, CL | Issues related with the wet tropo. |

**WP3000 - Data Set Collection**

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| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 3000 | Data Set Collection | **isardSAT** | **PG**/ MR | WP Manager |
| 3.1 | Confirm and finalise requirements for CRYOSAT-2 data, order and obtain data | TU Delft | MN |  |
| DTU Space | LS |  |
| STARLAB | AE, CR |  |
| **isardSAT** | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF | Issues related with the wet tropo. |
| CLS | TM, SL |  |
| 3.2 | Confirm and finalise requirements for auxiliary data needed to produce the Cryosat-2 derived products, order and obtain data | TU Delft | MN |  |
| DTU Space | LS |  |
| STARLAB | AE, CR |  |
| **isardSAT** | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF | Issues related with the wet tropo. |
| CLS | TM, SL |  |
| 3.3 | Confirm and finalise requirements for validation data, order and obtain data | TU Delft | MN |  |
| DTU Space | LS |  |
| STARLAB | AE, CR |  |
| **isardSAT** | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF | Issues related with the wet tropo. |
| CLS | TM, SL |  |
| 3.4 | Generate Data Set User Manual and metadata | **isardSAT** | **PG**/ MR |  |
| 3.5 | Publish Experimental Data Set on project web page | **SatOC** | EA |  |

**WP4000 - Product Development and Validation**

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| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 4000 | Product Development and Validation | **NOC** | CG | WP Manager |
| 4.1 | Analyse, develop and validate metohds and algorithms | TU Delft | MN/RS | LRM for Open Ocean; Improved Geophysical Corrections |
| DTU Space | LS | SAR for Open Ocean, Sea Floor Mapping and Coastal Ocean; SAR for Polar Ocean |
| STARLAB | AE, JM,  CR, | SAR for Open Ocean, Sea Floor Mapping and Coastal Ocean; RDSAR for Open Ocean |
| isardSAT | **PG**/ MR | SARIN for Coastal Ocean |
| **NOC** | CG | SAR for Open Ocean, Sea Floor Mapping and Coastal Ocean; |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF / CL / AN | Improved Geophysical Corrections(wet tropo) |
| 4.2 | Perform Error Analysis and Cross Comparisons – report in PVR | TU Delft | MN/RS |  |
| DTU Space | LS |  |
| STARLAB | AE, JM,  CR, |  |
| isardSAT | **MR**/PG |  |
| **NOC** | CG |  |
| Noveltis | MC / FC | Regional tides, ionospheric correction |
| U Porto | JF / CL | Wet tropo error analysis |
| CLS | TM, SL |  |
| 4.3 | Create Detailed Description in ATBD, plus scientific analysis | TU Delft | MN/RS |  |
| DTU Space | LS |  |
| STARLAB | AE, JM,  CR, |  |
| isardSAT | **PG**/ MR |  |
| **NOC** | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF / AN / CL | Wet tropo algorithm description |
| CLS | TM, SL |  |
| 4.4 | Generate output, corrections and documentation for C2 prototype products in Experimental Data Set | TU Delft | MN/RS |  |
| DTU Space | LS |  |
| STARLAB | LM, JM,  CR |  |
| isardSAT | **PG**/ MR |  |
| **NOC** | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF / CL | Computation of wet tropo. |
| CLS | TM, SL |  |
| 4.4 | Experimental Data Set User Manual | isardSAT | **PG**/ MR |  |

**WP5000 - Impact Assessment**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 5000 | Impact Assessment | CLS | PT, TM | WP Manager |
| 5.1 | Development of Assessment Tools and inter-comparison Framework | DTU Space | LS |  |
| STARLAB | LM |  |
| NOC | CG |  |
| U Porto | JF | Contribution to wet tropo validation |
| **CLS** | TM, SL |  |
| 5.2 | Comparison with State of the art and other altimeter missions | DTU Space | LS |  |
| STARLAB | AE |  |
| NOC | CG |  |
| U Porto | JF | Contribution to wet tropo validation |
| **CLS** | TM, SL |  |
| 5.3 | Evaluation of scientific innovations | DTU Space | LS |  |
| STARLAB | AE |  |
| NOC | CG |  |
| U Porto | JF | Contribution to wet tropo validation |
| **CLS** | TM, SL |  |
| 5.4 | Overall Assessment | DTU Space | LS |  |
| STARLAB | AE |  |
| NOC | CG |  |
| U Porto | JF |  |
| **CLS** | TM, SL |  |
| 5.5 | Open Ocean:  Comparison, Errors, potential to enhance state of the art, benefit and impact | **STARLAB** | AE |  |
| NOC | CG |  |
| U Porto | JF | Contribution to wet tropo validation |
| CLS | PT, TM |  |
| 5.6 | CoastalOcean:  Comparison, Errors, potential to enhance state of the art, benefit and impact | STARLAB | AE |  |
| **NOC** | CG |  |
| U Porto | JF | Contribution to wet tropo validation |
| CLS | TM, SL |  |
| 5.7 | Polar Ocean:  Comparison, Errors, potential to enhance state of the art, benefit and impact | **DTU Space** | OA |  |
| STARLAB | AE |  |
| U Porto | JF | Contribution to wet tropo validation |
| CLS | PT, TM |  |
| 5.8 | Sea Floor Altimetry:  Comparison, Errors, potential to enhance state of the art, benefit and impact | **DTU Space** | OA |  |
| CLS | TM, SL |  |
| 5.9 | Impact Assessment Report | **CLS** | TM, SL |  |

**WP6000 - Scientific Road Map**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 6000 | Define a Scientific Roadmap | **SatOC** | DC | WP Manager |
| 6.1 | Provide Critical Analysis of Feedbacnk from Validation | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | LM, CR |  |
| isardSAT | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF |  |
| CLS | TM, SL |  |
| 6.2 | Strategies for Integrating Development Methods into Scientific Institutes and Operations | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE, CR |  |
| isardSAT | **PG**/ MR/ CMP |  |
| NOC | CG |  |
| Noveltis | MC / FC | Regional tides, ionospheric correction |
| U Porto | JF |  |
| CLS | TM, SL |  |
| 6.3 | Define Scientific Development Strategy | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE, CR |  |
| isardSAT | MR/CMP |  |
| NOC | CG |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF |  |
| CLS | TM, SL |  |
| 6.4 | Plan for fostering transition to operations | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE, CR |  |
| isardSAT | **PG**/ MR/CMP |  |
| NOC |  |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF |  |
| CLS | TM, SL |  |
| 6.5 | Identify Scientific Priority Areas for future C-2 Exploitation Projects | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE, CR |  |
| isardSAT | **PG**/ MR/CMP |  |
| NOC |  |  |
| Noveltis | MC /FC | Regional tides, ionospheric correction |
| U Porto | JF |  |
| CLS | TM, SL |  |

**WP7000 - Outreach, Promotion and Publication**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 7000 | Outreach, Promotion and Publication | **SatOC** | DC | WP Manager |
| 7.1 | Esablish Outreach, Promotion and Publication Plan | **SatOC** | DC |  |
| 7.2 | Establish Project Website | **SatOC** | EA |  |
| 7.3 | Participate in Conferences and International Forums | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE, CR |  |
| isardSAT | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC | Regional tides, ionospheric correction |
| U Porto | JF / AN / CL |  |
| CLS | TM, SL |  |
| 7.4 | Submit Papers to Peer Reviewed Journals | **SatOC** | DC |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | CR, JM |  |
| isardSAT | **PG**/ MR |  |
| NOC |  |  |
| Noveltis | MC / FC | Regional tides, ionospheric correction (contribution) |
| U Porto | JF / AN / CL |  |
| CLS | TM, SL |  |
| 7.5 | Generate Final Product: Slideshow, Brochures | **SatOC** | **DC**/EA |  |
| TU Delft | MN |  |
| DTU Space | **OA**/LS |  |
| STARLAB | AE |  |
| isardSAT | **PG**/ MR |  |
| NOC | CG |  |
| Noveltis | MC | Regional tides, ionospheric correction |
| U Porto | JF / AN / CL |  |
| CLS | TM, SL |  |

**WP8000 - Project Management**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WP / Subtask** | **Title** | **Partner** | **Personnel** | **Contribution** |
| 8000 | Project Management | **SatOC** | DC | WP Manager |
| 8.1 | Generate and update Project Plan | **SatOC** | DC |  |
| 8.2 | Monitor Progress | **SatOC** | DC/EA |  |
| 8.3 | Monitor and Manage Risk | **SatOC** | DC/ EA |  |
| 8.4 | Liaison with ESA | **SatOC** | DC |  |
| 8.5 | Organise and Manage Meetings | **SatOC** | DC/ EA |  |

**SatOC**

DC – David Cotton

EA – Ellis Ash

**DTU**

OA – Ole Andersen

LS – Lars Stenseng

**Noveltis**

MC- Mathilde Cancet

FC – Francois Crespon

**Starlab**

MPC – Maria Paola Clarizia

MC – Marco Caparrini

AE – Alejandro Egido

LM – Laura Moreno

EL – Elizabeth Gil-Roldán Little

JM – Jose Marquez

CR – Chris Ray

**isardSAT**PG – Pablo Nilo Garcia

MR – Monica Roca

**U Porto**

JF – Joana Fernandes

AN – Alexandra Nunes

CL – Clara Lazaro

**TU Delft**

MN – Marc Naeije

RS – Remko Scharoo (Altimetrics LLC)

**CLS**

PT – Pierre Thibaut

TM – Thomas Moreau

SL – Syvlie LaBroue

# ANNEX B – Preliminary Tables of Content of key deliverables

**D1.1 Requirements Baseline (RB)**

Executive Summary

1. Introduction
2. User Consultation
   1. The CryoSat + community
      1. Review and identification of potential community members for the user consultation
   2. Methodology to Infer the User Consultation
      1. Review of methods to be used to contact users for the consolidation of scientific requirements
      2. Description of dossier to circulate to the users for inputs
3. Limitations and drawbacks analysis
   1. Characterization of the limitations and drawbacks of existing products to be applied to CryoSat-2 for the achievement of the user needs.
4. Scientific and operational requirements
   1. Definition of requirements as well as identification of technical scientific constrains for methods and models to be developed.
5. Conclusions
6. References

**D2.1 Preliminary analysis report (PAR)**

Executive Summary

1. Introduction

2. Current status of CryoSat-2 products, methods, models and algorithms

* Review, assessment and cross-comparison
* Range of validity limitations, drawbacks and challenges

3. Suitable models and data integration methods

* Analysis
* Limitations, drawbacks and challenges

4. Auxiliary data sets

* Survey
* Application in development and validation activities
* Identification of shortcomings and solutions

5. Auxiliary initiatives and projects

* Recently finished
* Current
* Near future

6. Candidate test areas

* Identification and analysis
* Analysis and description of available data

7. Risk analysis

* availability of data
* availability of methods, models, and algorithms
* availability of development resources
* risk mitigation

8. Selection for Development and Validation Plan

* CryoSat+ key ocean products
* Key test areas

References

**D2.2 Development and Validation Plan (DVP)**

Summary

1. Introduction

* Purpose, scope and goals
* Documents and definitions

2. Activity objectives

* Open ocean altimetry (low and high resolution)
* High resolution Polar ocean altimetry
* High resolution Coastal zone altimetry
* High resolution sea floor altimetry
* Summary of key products to be developed and validated

3. Development, validation and assessment

* Organization and schedule
* Stakeholders, resources and responsibilities
* Tools, techniques, and methodologies
* Bottlenecks and shortcomings

4. DV Lifecycle

* Management
* DV Phases (from requirements to implementation)

5. Administration

* Reporting
* Control procedures
* Standards, practices, and conventions

6. Plan approvals

List of figures

List of tables

References

**D4.1 Algorithm Theoretical Baseline Document**

(one ATBD per sub-theme or one single document, to be agreed between the Agency & team)

1. **INTRODUCTION**
2. **OVERVIEW**
3. **ALGORITHM DESCRIPTION**
   1. Theoretical Description
      1. *Physics Of The Problem*
      2. *Mathematical Description Of The Algorithms*
   2. Development Choices And Trade-Offs
      1. *Scientific Results*
      2. *Error Analysis*
4. **ASSUMPTIONS, CONSTRAINTS, AND LIMITATIONS**
   1. Practical Considerations
      1. *Input Data*
      2. *Ancillary Information*
      3. *Output*
   2. Programming Considerations
   3. Quality Control
   4. Exception Handling
5. **REFERENCES**
6. **SYMBOLS**
7. **LIST OF ACRONYMS**

**D4.2 Product Validation Report**

(one PVR per sub-theme or one single document, to be agreed between the Agency & team)

1. Introduction
2. Overview
3. Description Of Cryosat-2 Products
4. Description Of Experimental Datasets
   1. Cryosat-2 Data
   2. Independent Data Sources
5. Validation Activities
   1. Validation Results
   2. Experimental Error Analysis
6. References
7. List Of Acronyms

**D5.1 Impact assessment report**

1. Introduction
2. General Approach
3. Tools, Protocols And Methodology Description
4. Inputs From Wp4000 And Product Validation Report
5. Inputs From The International Community
6. Performance Of Innovative Cryosat-2 Algorithms
7. Comparison To Other Missions
8. Impact Assessment According To Domain Areas And Applicatons
   1. Open Ocean
   2. Coastal Areas
   3. Polar Regions
   4. Sea Floor
9. References
10. List Of Acronyms

**D6.1 Scientific Roadmap**

1. Introduction

2. Summary And Critical Analysis Of Validation Results

3. Integrating CP4O Developments Into Large-Scale Initiatives

4. Scientific Development Strategy For Improving Cp4o Methods And Products

5. Fostering Transition To Operational Activities

6. Scientific Priority Areas

# ANNEX C – List of Background IPR and Inventions

The CP4O partners have asked that the following items be indicated as background IPR that will be bought to the project:

**NOVELTIS**

SPECTRE dataset: SPECTRE is a database of the Total Electronic Content Maps over Europe. It was developed through NOVELTIS own funds and the French Ministry of Research. A specific ionospheric correction under CRYOSAT-2 ground tracks will be computed from SPECTRE and will be made freely available to the project for dissemination. The primary SPECTRE dataset shall not be delivered.

COMAPI tidal Atlas over the North-East Atlantic: COMAPI was developed mostly in the framework of a CNES contract. NOVELTIS has verified that CNES agrees that NOVELTIS compute from COMAPI a specific ocean tide correction for CRYOSAT-2 (sea-surface elevation under CRYOSAT-2 tracks). The ocean tide correction for CRYOSAT-2 will be made openly available to the project for dissemination. The primary COMAPI tidal atlas (tidal harmonic constituents) shall not be delivered.

**CLS**

Some of the performance and assessment tools used in the frame of this study (WP5000) are shared propriety of CLS and CNES.

The SAR and RDSAR processing algorithms for which CLS will deliver documentation (ATBDs) in the frame of WP4000 of the current study are shared property of CLS and CNES. This should be managed by coordination between ESA and CNES.

**STARLAB**

**STARLAB SAR MODE RETRACKER**

Starlab has developed and validated its own implementation of SAMOSA2/3 models as presented by Martin-Puig et al at OSTST´11, 18th to 21st October, San Diego, CA. This module was resulting from work undertaken with internal investment. The Agency and Starlab will benefit of this module (delivered as executable) for the activities envisioned under WP4000 and WP5000. No charges have been included for licensing nor royalties: the Agency will be granted with a free licence of use.

In addition we wish to notify that the following inventions, as listed in the statement of invention and inventory for the SAMOSA project, will be made available.

**STATEMENT OF INVENTION AND INVENTORY**

Contract Number***:* 20698/07/I-LG**

Contract Subject: **Development of SAR Altimetry Mode Studies and Applications over Ocean, Coastal Zones and Inland Water**

1. INVENTIONS

[OPTION 2. INVENTION]

In accordance with the provisions of the above Contract, ***Satellite Oceanographic Consultants Ltd*** hereby certifies for itself and on behalf of its consortium/subcontractors that the following inventions have been made in the course of or resulting from work undertaken for the purpose of this contract:

**Starlab Theoretical Model for SAR altimeter mode processed echoes over ocean surfaces**

**Starlab** (Authors: C.Martin-Puig, G.Ruffini) has derived a novel theoretical model for Synthetic Aperture Radar (SAR) altimeter (a.k.a delay/Doppler radar altimeter) echoes over ocean surfaces, in the same spirit set by conventional altimeters. This work was part of WP4 –WP5 of the SAMOSA project (ESA contract 20698/07/I-LG). The model, a.k.a SAMOSA1, is needed for the efficient/optimal retracking of the individual delay - Doppler (DD) waveforms.

**Further development of SAR altimetry waveform model**

**Starlab** (Authors: Ray, C., Ruffini, G.) have improved SAMOSA1 as requested by the Agency, the model is described in issue 1.4 released on 31th August 2011 for the CCN to ESRIN contract 20698/07/I-LG SAMOSA Deliverable No. D8.

**RDSAR Software Documentation (including Methodology description)**

**STARLAB** (Authors: Martin-Puig, C., Marquez, J) developed the method to generate reduced SAR mode (RDSAR) pseudo-LRM sequences from SAR mode Full Bit Rate (FBR) data. This is well documented in Issue 1.1 released on 8th October 2011 for the CCN to ESRIN contract 20698/07/I-LG SAMOSA Deliverable No. D4. (being published)

**NOC Method and prototype software to generate open ocean and coastal zone surface scenarios for CRYMPS**

NOC (Authors: P. Cipollini) developed methods to generate explicit 2D surfaces with realistic ocean waves over the open ocean and the coastal zone for ingestion in the Cryosat Mission Simulator (CRYMPS). This capability was developed with ESA funding in SAMOSA. The capability may be used in WP4000 to test methods and algorithms against simulated SAR waveforms in the open ocean and the coastal zone. The method and software were developed within the ESA SAMOSA project.

**NOC Method and prototype software Retracker for SAR Altimeter waveforms over the ocean**

NOC (Authors: C. Gommenginger, M. Srokosz) developed prototype software to retrack simulated and measured SAR altimeter waveforms from the Cryosat Mission Simulator and Cryosat-2 using the SAM1, SAM2 and SAM3 analytical SAR waveform models. The NOC SAR retracker includes the ability to perform multi-looking and to use fixed or platform-derived satellite attitude and motion measurements. This capability was developed with ESA funding under SAMOSA and NERC funding under National Capability. The capability forms a critical component of the work to be performed in WP4000.

**NOC Mathematical formulation to resolve numerical instability for low significant wave height in SAMOSA1 theoretical model for SAR waveforms**

NOC (Authors: M. Srokosz, C. Gommenginger) developed an alternative mathematical formulation to compute the SAMOSA1 theoretical model for large gates and low significant wave height values. The new formulation avoids numerical instability issues introduced by the use of Bessel functions in SAMOSA1.

**NOC Mathematical formulation to simplify the SAMOSA2 theoretical model and produce a fully analytical SAMOSA3 model for SAR waveforms**

NOC (Authors: M. Srokosz, C. Gommenginger) developed alternative mathematical formulations to compute the F0 and F1 terms of the SAMOSA2 theoretical model for SAR waveforms. The new formulations of F0 and F1 are exact analytical solutions, which make it possible to obtain the fully analytical theoretical model for SAR waveforms, known as SAMOSA3.

**NOC prototype software for automatic selection of Cryosat-2 SAR products featuring valid 20 Hz SAR waveforms.**

NOC developed a suite of prototype software that allows automatic selection of Cryosat-2 SAR products featuring valid 20Hz SAR waveforms within a particular region and particular time period, to produce track segments of L1B 20Hz waveforms ready for SAR retracking. This capability was developed with ESA funding under SAMOSA and NERC funding under National Capability. The capability forms a critical component of the work to be performed in WP4000 and WP5000.

**NOC Methods and prototype software to retrack and process ENVISAT S-GDR products to generate Coastal-GDR products in the coastal zone for ENVISAT**

NOC (Authors: P. Cipollini, C. Gommenginger, H. Snaith) developed prototype software to retrack and process Envisat SGDR products in the coastal zone. The software is able to compute coastal geophysical corrections, to retrack 18Hz ENVISAT waveforms with different retrackers and to produce Coastal-GDR (CGDR) products in NetCDF. This capability was developed with ESA funding under the COASTALT project. It will form the basis of the CP4O software processor to be developed in WP4000 to retrack Cryosat-2 SAR and pseudo-LRM waveforms and produce Cryosat-2 CGDR products in netCDF for the coastal zone.

The Agency’s rights on such inventions shall be in accordance with the ESA General Conditions Part II provisions as amended by the above contract.

1. Deliverables that are italicised are due in advance of the milestone [↑](#footnote-ref-2)
2. Deliverables that are italicised are due in advance of the milestone [↑](#footnote-ref-3)