



PROJECT DESCRIPTION

BACKGROUND

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



OBJECTIVES & SUB-THEMES

The general objectives of the CP4O project 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.

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

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

Project Approach

1. INITIAL WORK

Scientific Requirements

The first activity, led by Starlab, has engaged with the wider user community to consolidate the preliminary scientific requirements for the four themes under investigation, and produced a list of scientific and operational requirements: **The Requirements Baseline.**

State of the Art Review

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

3. IMPACT ASSESSMENT

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

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

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

4. FUTURE EXPLOITATION – SCIENTIFIC ROAD MAP

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

2. PRODUCT DEVELOPMENT & VALIDATION

The heart of the Cryosat Plus for Oceans project is the development and validation of algorithms and processing schemes for new ocean products, based on Cryosat-2 data. This activity, led by the UK National Oceanography Centre, will involve the creation of 7 new experimental altimeter data sets, and further data sets with new geophysical corrections, as follows (the lead partners are identified).

New Experimental Altimeter Data Sets

1. LRM for Open Ocean (TUDelft)
2. SAR for Open Ocean (Starlab, CLS)
3. SAR for Sea Floor Mapping (DTU Space)
4. SAR for Coastal Ocean (NOC)
5. SAR for Polar Ocean (DTU Space)
6. RDSAR for Open Ocean (Starlab, CLS)
7. SARIn for Coastal Ocean (isardSAT)

These experimental data sets will cover specific regions and time periods, The output of this activity will be **Algorithm Theoretical Basis Documents** and **Product Validation Reports** for each processing scheme. These should be available in early autumn 2013.

Improved Geophysical Corrections:

1. Wet troposphere correction (U Porto)
2. Ionospheric correction (Noveltis)
3. Regional tidal correction (Noveltis)
4. Other corrections (TUDelft)

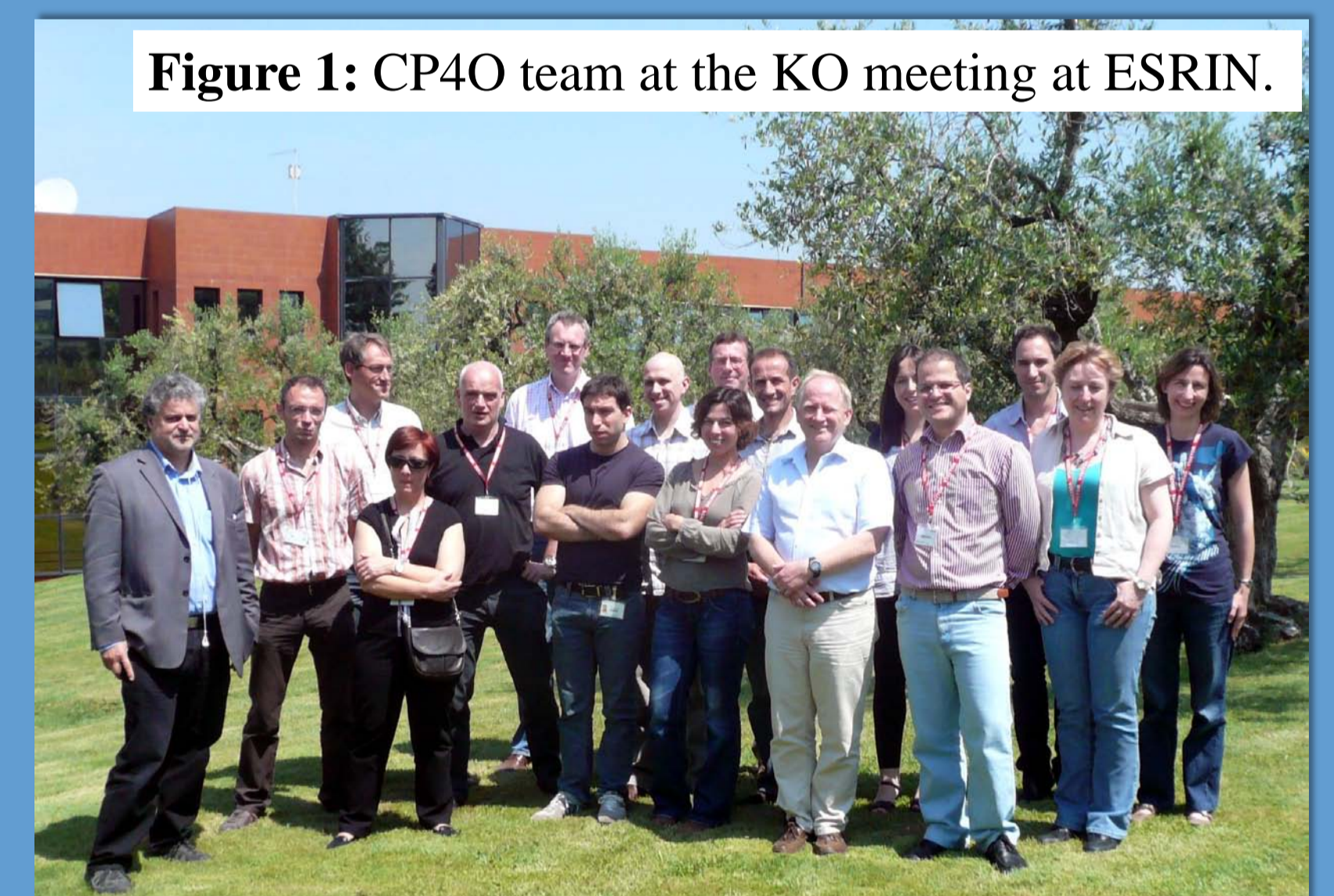


Figure 1: CP4O team at the KO meeting at ESRIN.

Final Words

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

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

The ultimate aim is to maximise the exploitation of Cryosat-2 data in oceanographic applications, and to build a sound scientific foundation for future satellite missions carrying SAR mode altimeters, starting with Sentinel-3 in 2014.

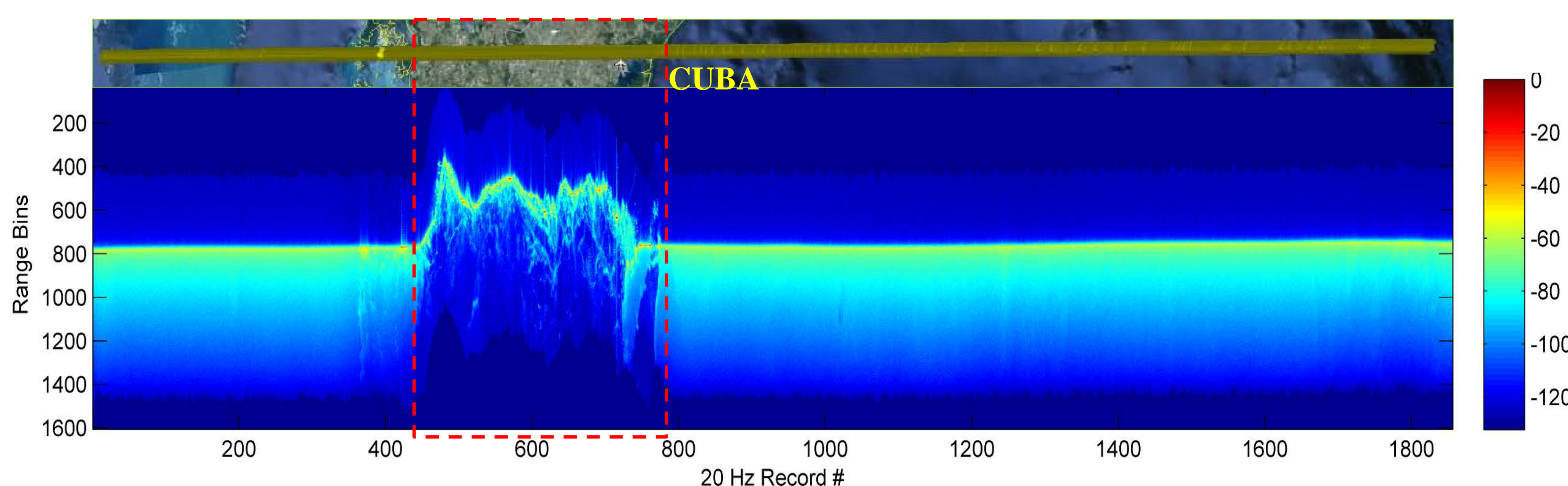


Figure 2: Stacked SARin radar echoes on a pass over Cuba. The SARin polygon over Cuba was requested by the CP4O team.