PROGRESS IN COASTAL ALTIMETRY: OUTCOMES OF THE COASTALT PROJECT

Paolo Cipollini(1), Peter Challenor(1), Henrique Coelho(2), Joana Fernandes(3), Scott Gleason(1), Jesus Gomez-Enri(4), Christine Gommenginger(1), Cristina Martin-Puig(5), Graham Quartly(1), Helen Snaith(1), Stefano Vignudelli(6), Philip Woodworth(7), Salvatore Dinardo(8), Jérôme Benveniste(9)

(1) Ocean Observing and Climate, National Oceanography Centre, Southampton, U.K. (cipo@noc.soton.ac.uk), (2) Hidromod, Lisbon, Portugal, (3) Faculdade de Ciências, Universidade do Porto, Portugal, (4) Universidad de Cádiz, Spain, (5) Starlab Barcelona S.L., Barcelona, Spain, (6) Istituto di Biofisica, Consiglio Nazionale delle Ricerche, Pisa, Italy, (7) Proudman Oceanographic Laboratory, Liverpool, U.K., (8) Serco/ESRIN, Frascati, Italy, (9) European Space Agency/ESRIN, Frascati, Italy

1. INTRODUCTION

Eighteen years after the launch of ERS-1 and TOPEX/POSEIDON, great progress has been achieved in all the components of radar altimetry bringing its accuracy over the open ocean to the centimeter level [1]. Now the interest of several researchers around the world is turning to the coastal zone, a key region for the impact of changing oceans on society. In the coastal ocean the radar altimeter and radiometer measurements are degraded by land contamination, the global ocean tide models do not properly account for local tidal effects and other geophysical corrections are affected by local effects such as the inverted barometer and the sea state bias. These processing and data correction issues have so far resulted in systematic flagging and rejection of the data. However there is growing consensus that information on sea level and significant wave height can be recovered in the coastal strip with customized processing, as shown by a few studies (see for instance [2], [3], [4]. This is beneficial in a number of applications, to the point that it can be argued that Coastal Altimetry has a legitimate role to play in many coastal observing systems [5]. The last three years have seen the start and growth of a lively community of researchers who hold regular international workshops on this novel topic, and at the same time the major space agencies have started to support the new field through projects such as COASTALT (funded by ESA, the European Space Agency), PISTACH (funded by CNES, the Centre National d'Etudes Spatiales in France) and some initiatives jointly funded by CNES and the U.S. National Aeronautics and Space Administration (NASA) within the OST-ST (Ocean Surface Topography Science Team) framework. In this abstract we focus on the ESA-funded COASTALT Project concerning the development of Coastal Altimetry techniques and their application to the Envisat RA-2 altimeter, and we review the achievements of the project, with some specific examples of the work done.

2. COASTALT: A SUMMARY AND SOME EXAMPLES

During its Phase 1 (2008-2009) COASTALT has carried out several activities. First it has surveyed the potential user base and identified the requirements for coastal altimetry product composition, posting rate and format. Then the project has reviewed the whole spectrum of corrections which need to be applied to the altimetric datum, highlighted the specific problems of some of those corrections in the Coastal Zone, identified possible solutions and issued the relevant recommendations on which corrections should be applied or investigated further. A particular and completely original contribution by COASTALT has been the research on and development of the GNSS-derived tropospheric path delay correction, which answers the pressing need for a more accurate wet tropospheric correction in the coastal zone, where the microwave radiometer-derived correction becomes inaccurate [6].

The core of the project is the design and full implementation of a prototype software processor for the Envisat RA-2 SGDRs (Sensor Geophysical Data Records) in the coastal zone, which generates an experimental Coastal GDR (CGDR) product conducive to further research and development in the topic, and also constitutes a first step towards the applications of coastal altimetry. The processor includes a baseline processor that can be run on every pass, plus a User-defined Coastal Geophysical Correction (UCGC) module that allows users to add their own corrections for research and application purposes. A block schematic of the COASTALT baseline processor, illustrating the various processes and the data flow, is in figure 1.

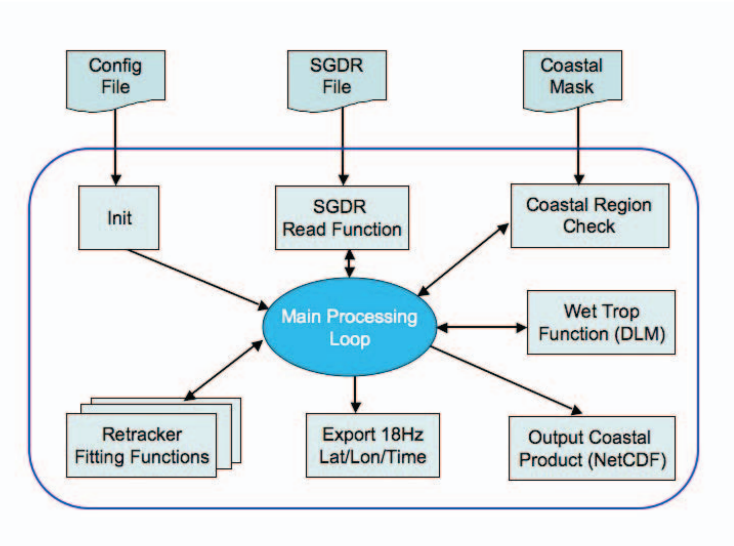

Figure 1: Process and data flow in the COASTALT Baseline processor

Some specific work dealt with the analysis of echo returns in the coastal zone, and the attempt to model the signal due to specular reflection from calm waters that sometimes prevent successful retracking of the waveforms. Figure 2 shows in its top panel a series of EnviSat waveforms on overpassing an island (Pianosa) in the NW Mediterranean Sea. Two apparent features are the reduction of power in the waveforms when aproaching and overflying the island, due to the lower scattering from land, and the bright hyperbolic feature: the latter comes from a patch of very calm water in a small gulf situated on the northern side of the island, that generates a strong quasi-specular return migrating across waveforms in a hyperbola. The presence of this feature makes the retracking of waveforms problematic. The lower panel in figure 2 is a simulated series of waveforms from an idealized model of the specific ocean/land configuration [7]. Future work will focus on using this kind of modelling to remove the contamination and therefore improve the successful retrieval of height, wave and wind parameters from specialized coastal retrackers.

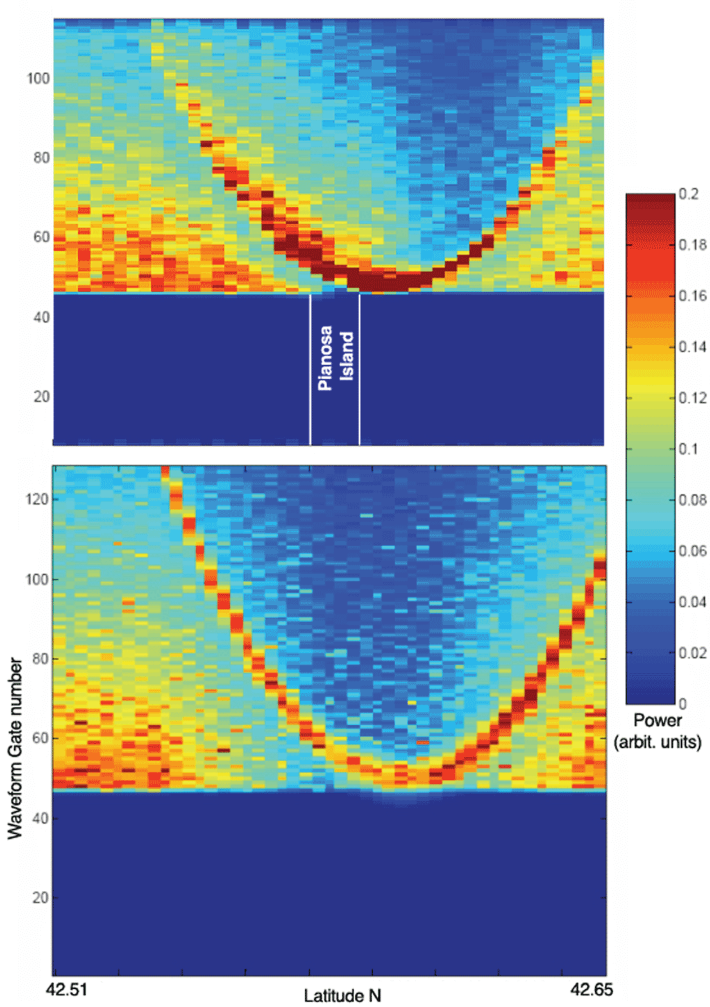

Figure 2: real (upper panel) vs simulated (lower panel) Envisat RA-2 waveforms during overflight of Pianosa Island, western Mediterranean. Redrawn from [7]

In a related task, innovative retracking techniques based on Bayesian statistics have been investigated; these will be described in some detail in the talk. We expect them to pave the way to the next generation of retrackers, and they will be prototyped in future versions of the COASTALT processor.

In parallel to the development of the processor the project has carried out a full product definition and produced the relevant documentation including a user handbook. COASTALT has also investigated the use of the new CGDRs in training and outreach activities via the BRAT (Basic Radar Altimetry Toolbox) software, issuing a series of guideline recommendations.

We will conclude our presentation discussing how to continue the COASTALT work in view of the lessons learned so far, in order to further improve coastal altimetry and promote the full uptake of reprocessed coastal altimetry products by the user community

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