PREPARING LEVELS 3 AND 4 FOR THE SMOS MISSION

Jerôme Gourrion[1,2], Baptiste Mourre[1,2], Joaquim Ballabrera[1,2], Alfredo Aretxabaleta[1,2], and Antonio Turiel[1,2]
(1) Departament Oceanografia Física, ICM-CSIC, Barcelona, Spain
(2) SMOS-Barcelona Expert Centre, Barcelona, Spain

The Soil Moisture and Ocean Salinity mission (SMOS) from the European Space agency, scheduled for launch in 2009, will initiate the era of satellite salinity observations. Because of the numerous geophysical contamination sources and the instrument complexity, the salinity products will have a low signal-to-noise ratio at Level 2. Averaging data in space and time is expected to allow a reduction of the observational error down to mission requirements (0.1 psu) at Level 3 (global maps with regular distribution). Geostatistical methods such as Optimal Interpolation are being implemented at Level 3 to operate this noise reduction. The methodologies require auxiliary information about SSS statistics that, under Gaussian assumption, consist in the mean field and the covariance of the departures from it. The present study is a contribution to the definition of the best estimates for mean field and covariances to be used in the near-future SMOS Level 3 products. At Level 4, the spatial-temporal structure of the salinity errors is investigated in a numerical ocean model to prepare for the assimilation of this new stream of observations.

This work is part of the effort conducted at the SMOS Barcelona Expert Centre (http://www.smos-bec.icm.csic.es) aiming at contributing to the ground segment of the SMOS mission.

POST - PROCESSING METHODS FOR OCEAN MONITORING FROM SAR IMAGERY

Marivi Tello, Carlos López-Martínez, Jordi J. Mallorqui, Paco López-Dekker
Remote Sensing Laboratory Signal Theory and Communications Department
Universitat Politècnica de Catalunya (UPC)C/Jordi Girona, 1-3, 08034 Barcelona, Spain
marivi.tello@tsc.upc.edu

Abstract – A number of experiments all over the world have proven that satellite borne SAR images constitute a valuable tool to monitor oceanic environment, preventing it from overexploitation or pollution matters and it can also help to evaluate the full implications of natural or man made hazards. In fact, thanks to their capability to cover large areas, in all weather conditions, during the day as well as during the night, spaceborne Synthetic Aperture Radar (SAR) techniques constitute an extremely promising alternative to traditional surveillance methods. Nevertheless, in order to assure further usability of SAR images, specific data mining tools are still to be developed to provide an efficient automatic interpretation of SAR data. In the last years, our group has been studying, analyzing and validating several dedicated methods for different marine applications: namely, ship detection, extraction of the coastline and detection and rough classification of pollutants in the sea surface.

Keywords – SAR, Wavelet Transform, ship detection, oil spill detection, coastline extraction

I. INTRODUCTION

Synthetic Aperture Radar (SAR) technology has proven to be useful in numerous civilian applications. Nevertheless, in the last years the progress in technological aspects is faster than the evolution of processing and post-processing techniques for the exploitation of SAR data. In fact, SAR images are often analyzed manually even if an operational and intensive exploitation of SAR images is not viable with completely supervised means. Automatic techniques able to produce rapid, reproducible and reliable results are to be provided instead. These techniques should be designed to work with no operator intervention and they should avoid specific tuning to a particular image. These requirements are especially difficult to satisfy with SAR imagery through automatic tools with no high level knowledge.

II. MULTISCALE FRAMEWORK FOR MARINE APPLICATIONS IN SAR DATA

In the last two years, our group has studied, analyzed and validated several dedicated and automatic processing methods for different marine applications in SAR imagery: namely, ship detection [1], extraction and monitoring of temporal evolution of the coastline [2] and detection and rough classification of pollutants on the sea surface [2]. All of these methods rely in a multiscale time (or space) - frequency framework which it has been shown to be well suited for this purpose. In fact, the use of time - frequency tools allow the evaluation of statistical parameters of the imaged scene, while preserving spatial information. Furthermore, the time – frequency trade off can be adjusted thanks to the multiscale capability of this method, providing a sense of context, extremely helpful to understand the observed scene, with no a priori information about it.

The main originality of the methods designed is that they propose the analysis of the image directly in the wavelet transformed domain, which leads to several advantages. More specifically, on the one hand, ship detection and coastline extraction are based on a combination of wavelet coefficients. On the other hand, detection of oil spills is carried out by estimating the Lipschitz exponent by means of the wavelet transform.

Even if usually treated separately, the oceanic applications concerned (vessel monitoring, coastline extraction and spill detection) are very closely related to each other. For example, any algorithm for automatic ship detection requires a previous land mask step which is usually performed with maps available from other sources. This is a problematic and time consuming operation which could be rendered easier by applying a method for automatic coastline extraction sufficiently robust. Moreover, the constitutive peakiness of SAR images can be reduced with a slight evolution of the technique used for ship detection and this increases substantially the performance of the algorithms used for coastline extraction or for the analysis of textures involved in oil spill detection. Besides, the discrimination of large elongated patterns can drastically reduce false alarms when the objective is to perform ship detection. It can also be used to locate oil spills in the sea surface. Additionally, the automatic detection of oil slicks aims at revealing responsibilities and it is then deeply associated to ship detection. Hence, previous examples suggest that the most efficient exploitation of oceanic SAR images implies a simultaneous use for different but complementary applications.

The objective of this presentation is to separately describe the algorithms specifically designed for marine applications with SAR data and to suggest the benefits of using a global tool incorporating these algorithms, enhancing both global and individual results whereas saving computing cost.

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