THE SIASGE SYSTEM: JOINT X-L SAR BANDS FOR EMERGENCY MANAGEMENT

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1. INTRODUCTION

The SIASGE System (Italy-Argentine Satellite System for the management of the emergencies) is an initiative of the Italian Space Agency (ASI) in collaboration with the Argentinean Space Agency (CONAE), aimed at an operational integration of the two argentine satellites of SAOCOM constellation, with onboard an L-band SAR, with the 4 satellites of COSMO-SkyMed constellation operating at X-band. The initiative include the development of combined X+L bands products and SW tools in support to EO applications, the management of the logistic aspects of the integrated constellation as well as a joint Fellowships programme for technical cooperation and human resources development. The synergy between the two constellations will improve the observation potentials of the system both from the point of view of the revisit time and of the multi-frequency integration. This amount of information provides new opportunity in terms of emergency management and, in general, for detection of targets on the Earth surface. The project puts together large competences and long-lasting experiences of various scientific research groups coordinated by a company (Advanced Computer Systems A.C.S. S.p.A. www.acsys.it) expert in software e advanced systems for EO.

2. METODOLOGY

In the framework of the SIASGE project and of the previously discussed initiatives, ASI has funded a study project for definition, development, demonstration and promotion of X and X+L products, basic tools and prototypal software systems supporting applications in the field of Agriculture, National Security and Land Planning. Taking in to account the potential objectives, the system characteristics and the team expertise, a group of products was selected along with the methodology for obtaining them. An appraisal phase, which includes a review of the state of the art literature and takes into account the consortium expertise, led to a preliminary set of products. A subset has been then selected by a ranking analysis considering as topic elements: market opportunities, technical feasibility, development resources requirements, and cultural, operational, legal and temporal feasibility.

Concerning the Agriculture field, the Microwave Remote Sensing Group of the Institute of Applied Physics of the National Research Council in Florence (CNR-IFAC http://www.ifac.cnr.it) demonstrated SAR data at L and X bands can be used for producing classification maps of agricultural areas and estimating soil and vegetation parameters (such as soil moisture and plant biomass), by using inversion algorithms based on statisitc or semi-empirical models. [1,2]. ARESYS srl (http://www.aresys.it) introduced another very important and innovative application in the vegetation field using SAR data. It is the characterization of the three dimensional (3D) structure of forested areas through multi-baseline and multi-polarimetric SAR surveys exploiting SAR tomography [3].

The analysis of the applicative products using SAR data in X and L band for national security is focused on the following types of techniques: detection and velocity of moving targets, change detection technique, informal settlement mapping and land use and land cover maps.

The moving targets detection and velocity estimation by means of radar systems are addressed in literature as Ground Moving Target Indication (GMTI). GMTI is a very difficult problem due to the difficulty of separating the signal returned from a moving target from the stationary background (clutter). Focusing on three main topics, namely: Ship detection [4], Ship Velocity [5] and Traffic Monitoring [6]; different approaches are proposed by A.C.S. taking into account the characteristics of SIASGE constellation. Change detection techniques try to detect and locate areas which have changed between two or more observations of the same scene. These changes can be of different types, origins, temporal length and involves various kinds of applications: a) Land use monitoring, which corresponds to the characterization of the evolution of the vegetation, or its seasonal changes; b) natural resources

management, which corresponds mainly to the characterisation of the evolution of the urban areas, the evolution of the deforestation, etc.; c) damage mapping, which corresponds to the location of damages caused by natural or industrial disasters. A Model-based data analysis and a supervised classification approach are proposed by ACS for this topic [7]. Human settlements observation has nowadays assumed a prominent role in many application fields, especially land mapping and support in relief operations. Remote sensing technology is the best and very often the unique solution for efficiently - in terms of time and costs - mapping human settlement presence and extent. An innovative method, (L.I.S.A), relying on Local Indicators of Spatial Associations and Gray Level Co-occurence Matrix for Land Cover Mapping [8] is proposed by the Remote Sensing Group at the University of Pavia UNIPV (http://tlclab.unipv.it). It is sensor and polarimetric independent and can be applied on images acquired by different sensors and with different resolutions, providing good results with any kind of acquisition and incidence angle. This is especially important when disaster intervention issues are considered, where there is little time to fetch the optimal image for the specific algorithm. The use of multiparameter SAR data from the SIASGE system, in conjunction with high resolution optical images, offers a relatively new opportunity to map the land cover and detect its changes [9]. This approach is proposed by the Department of Electronic Engineering of the "La Sapienza" University of Rome UNIRM (http://www.die.uniroma1.it).

In the Land planning field of application, UNIPV proposed the following products: Change detection in urban areas, exploiting a very flexible and comparatively method which needs a particular tuning on the SIASGE data [10], and Raid Mapping [11], by a method capable of contemporarily exploiting geometric and radiometric characteristics of the image and to detect and outline more than one type of geometric feature. A goal of great interest in an increasing number of applications related to the understanding and management of urbanized areas is related to a product defined as Urban Areas interferometric characterization [12] proposed by ACS. It promises the reconstruction of the building sets and of other typical large-scale settlement structures exploiting the broad availability of high resolution optical and of metric interferometric Synthetic Aperture Radar (SAR). The availability of PSInSAR™ data at regional scale provides essential data for hazard and risk assessment and land use planning. The capability of detecting surface displacements over large areas supports a sustainable form of land use as well as monitoring its implementation. The Urban area subsidence analysis is a product which exploits the PSInSAR™ technology [13] proposed by Tele-Rilevamento Europa TRE (http://www.treuropa.com).

3. CONCLUSION

The aim of the project is the definition of a system oriented to the applications for risk and emergency management using the synergy between the two constellations SAOCOM and COSMO SkyMed constituting the SIASGE Joint X-L SAR band system. A particular attention was paid to generating products devoted to a pre-applicative level (the so-called High Level products), in some test areas. A series of potential products (and generation methods), giving important hints regarding their strong and weak points, have been identified and are ready for development and demonstration phase.

4. REFERENCES

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