Plinius Conference Abstracts
Vol. 13, Plinius13-51, 2011
13th Plinius Conference on Mediterranean Storms

Monitoring Mediterranean floods using COSMO-SkyMed: experiences gained in the OPERA project

L. Pulvirenti (1), N. Pierdicca (1), M. Chini (2), and L. Guerriero (3)

(1) Dept. Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Italy, (2) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy, (3) Dept. Computer Science, Systems and Production, Tor Vergata University of Rome, Italy

The potentiality of spaceborne Synthetic Aperture Radar (SAR) systems for flood mapping was demonstrated by several past investigations. The synoptic view and the capability to operate in almost all-weather conditions and during both day and night are the key features that make the SAR images useful for monitoring inundation events. In addition, the latest generation of very high resolution SAR satellites allows a fairly accurate delineation of the flood extent. In particular, the COSMO-SkyMed (COnstellation of small Satellites for Mediterranean basin Observation) mission offers a unique opportunity to obtain radar images characterized by a high spatial resolution and by a short revisit time, so that it is presently possible to produce near real-time accurate flood maps that enable emergency responders to react to and manage fast-moving events, and to direct the resources to the highest-priority areas.

Italian Space Agency (ASI) is presently funding some projects aiming at assessing the utility of Earth Observation techniques into an operational flood management system. In the framework of one of these projects, named OPERA, ASI made available some COSMO-SkyMed (CSK) images of recent flood events. A number of these events occurred in the Mediterranean area, in particular in Italy and in Albania. This study presents the major outcomes of the experiences we made, within the framework of the OPERA project, using the X band radar images provided by CSK for flood mapping.

Most of the literature algorithms for flood mapping from SAR data use a threshold applied on an image temporarily close to the event, to separate flooded and non-flooded regions. The threshold is determined either by performing a visual interpretation of the image or in an automatic way. Heuristic segmentation techniques are also employed. Our approach is based on the considerations of the physics of the radar return from flooded areas, since, an analysis accounting for the various electromagnetic mechanisms that determine the radar return in the presence of a water surface may improve the accuracy of flood mapping. Indeed, in the presence of an inundation, not only specular reflection, characteristic of flooded bare terrains, but also double bounce backscattering, typical of agricultural/forested areas, may take place. While a specular surface is characterized by low radar return, so that flooded bare terrains, as well as vegetated areas completely covered by water appear dark in a SAR image, the intensity of double bounce backscattering involving stems or trunks is generally increased by the underlying water.

To carry out an accurate inundation map, the variations of the radar return caused by the presence of water surfaces have to be identified. For this purpose, it is useful to analyze not only a SAR observation of the event, but also an image of the monitored area under dry conditions, i.e. preceding the flood, or following it with a sufficiently large temporal interval.

The results obtained through our approach, particularly when dealing with agricultural and forested flooded areas will be stresses in our presentation. The importance of having available also ancillary data such as a digital elevation model and a land cover map will be also underlined. Finally, the possibility to monitor also the temporal evolution of a flood, thanks to the short revisit time of CSK data, will be presented making reference to one case study we analyzed throughout our activity.

This work has been supported by the Italian Space Agency (ASI) under contract No. I/048/07/0.