Multitemporal analysis of floods and tsunami effects: annotation and quantitative analysis

Daniela FAUR, Daniela ESPINOZA-MOLINA, Inge GAVAT and Mihai DATCU

This paper addresses the problem of multitemporal analysis of available TerraSAR-X data of Sendai region in order to assess flood extent and damages caused by Tohuku-oki tsunami. Over the last decade the use of Earth Observation satellites to support disaster and emergency relief has considerably grown. The 11 March 2011 earthquake northern Japan and the tsunami that followed left thousands persons dead or missing. The destructive tsunami, originated by the earthquake hit the coastline several minutes after the earthquake causing huge causalities, damages and the crisis at the Fukushima Daiichi nuclear plant. Particularly on March 12 the Japan region Sendai was partially clouded so that only the use of microwave data SAR data, able to penetrate clouds, allows a detailed and complete evaluation of the region.

Therefore, to evaluate the effects of tsunami, the analysis of remotely sensed imagery is based on s TerraSAR-X post seismic satellite time series of 3-month duration covering the area around Sendai in ascending and descending orbits in stripmap mode an on a few TerraSAR-X scenes acquired before the earthquake, between 2008 and 2011. DLR (German Aerospace Center) and Astrium GEO Information Services provided data in research purposes.

The proposed scenario considers knowledge discovery from pre and post disaster EO images by mapping the extracted data features into semantic classes and symbolic representations like “urban areas”, “agriculture”, “mountains “,“bridges”, “aquaculture”, “ high voltage pylons”, “flooded areas”, etc. In order to fully exploit high-resolution satellite images a method based on patches is proposed to extract relevant contextual information. Consequently each TerraSAR-X image is divided into non-overlapping tiles, obtaining thus sub images over which are applied feature (texture and spectral) extraction algorithms. The local features of each patch act as a compact content descriptor, such that each patch is semantically labeled to describe the main information revealed.

Further, considering the available descriptors, the next step is to cluster the data in order to find similar semantic classes. The SVM classifier implements the concept of query by example using image content. The result includes well-recognized patches sharing the same semantic label.

Following the processing chain described above it is possible to determine tsunami effects on several levels: assessment of transportation infrastructure post disaster, possible power outages due to the damaged high voltage pylons, flooded urban regions, evaluate agricultural fields, damaged crops and estimate loses, etc. The results include well-defined semantic classes, derived through semiautomatic methods thus developing an effective method of multitemporal analysis.