Geophysical Research Abstracts
Vol. 19, EGU2017-10082, 2017
EGU General Assembly 2017

Active and Passive Remote Sensing Data Time Series for Flood Detection and Surface Water Mapping

Filsa Bioresita (1,2), Anne Puissant (1), André Stumpf (3), and Jean-Philippe Malet ()

(1) Laboratoire Image, Ville, Environnement, UMR 7362, CNRS / Université de Strasbourg, Strasbourg, France, (2) Sepuluh Nopember Institute of Technology, Indonesia, (3) Institut de Physique du Globe de Strasbourg UMR 7516, CNRS / Université de Strasbourg, Strasbourg, France

As a consequence of environmental changes surface waters are undergoing changes in time and space. A better knowledge of the spatial and temporal distribution of surface waters resources becomes essential to support sustainable policies and development activities. Especially because surface waters, are not only a vital sweet water resource, but can also pose hazards to human settlements and infrastructures through flooding. Floods are a highly frequent disaster in the world and can caused huge material losses. Detecting and mapping their spatial distribution is fundamental to ascertain damages and for relief efforts.

Spaceborne Synthetic Aperture Radar (SAR) is an effective way to monitor surface waters bodies over large areas since it provides excellent temporal coverage and, all-weather day-and-night imaging capabilities. However, emergent vegetation, trees, wind or flow turbulence can increase radar back-scatter returns and pose problems for the delineation of inundated areas. In such areas, passive remote sensing data can be used to identify vegetated areas and support the interpretation of SAR data. The availability of new Earth Observation products, for example Sentinel-1 (active) and Sentinel-2 (passive) imageries, with both high spatial and temporal resolution, have the potential to facilitate flood detection and monitoring of surface waters changes which are very dynamic in space and time.

In this context, the research consists of two parts. In the first part, the objective is to propose generic and reproducible methodologies for the analysis of Sentinel-1 time series data for floods detection and surface waters mapping. The processing chain comprises a series of pre-processing steps and the statistical modeling of the pixel value distribution to produce probabilistic maps for the presence of surface waters. Images pre-processing for all Sentinel-1 images comprise the reduction SAR effect like orbit errors, speckle noise, and geometric effects. A modified Split Based Approach (MSBA) is used in order to focus on surface water areas automatically and facilitate the estimation of class models for water and non-water areas. A Finite Mixture Model is employed as the underlying statistical model to produce probabilistic maps. Subsequently, bilateral filtering is applied to take into account spatial neighborhood relationships in the generation of final map. The elimination of shadows effect is performed in a post-processing step.

The processing chain is tested on three case studies. The first case is a flood event in central Ireland, the second case is located in Yorkshire county / Great Britain, and the third test case covers a recent flood event in northern Italy. The tests showed that the modified SBA step and the Finite Mixture Models can be applied for the automatic surface water detection in a variety of test cases. An evaluation again Copernicus products derived from very-high resolution imagery was performed, and showed a high overall accuracy and F-measure of the obtained maps. This evaluation also showed that the use of probability maps and bilateral filtering improved the accuracy of classification results significantly.

Based on this quantitative evaluation, it is concluded that the processing chain can be applied for flood mapping from Sentinel-1 data. To estimate robust statistical distributions the method requires sufficient surface waters areas in the observed zone and sufficient contrast between surface waters and other land use classes. Ongoing research addresses the fusion of Sentinel-1 and passive remote sensing data (e.g. Sentinel-2) in order to reduce the current shortcomings in the developed processing chain. In this work, fusion is performed at the feature level to better account for the difference image properties of SAR and optical sensors. Further, the processing chain is currently being optimized in terms of calculation time for a further integration as a flood mapping service on the A2S (Alsace Aval Sentinel) high-performance computing infrastructure of University of Strasbourg.