

A new semiautomated detection mapping of flood extent from TerraSAR-X satellite image using rule-based classification and taguchi optimization techniques

ABSTRACT

Floods are among the most destructive natural disasters worldwide. In flood disaster management programs, flood mapping is an initial step. This research proposes an efficient methodology to recognize and map flooded areas by using TerraSAR-X imagery. First, a TerraSAR-X satellite image was captured during a flood event in Kuala Terengganu, Malaysia, to map the inundated areas. Multispectral Landsat imagery was then used to detect water bodies prior to the flooding. In synthetic aperture radar (SAR) imagery, the water bodies and flood locations appear in black; thus, both objects were classified as one. To overcome this drawback, the class of the water bodies was extracted from the Landsat image and then subtracted from that extracted from the TerraSAR-X image. The remaining water bodies represented the flooded locations. Object-oriented classification and Taguchi method were implemented for both images. The Landsat images were categorized into three classes, namely, urban, vegetation, and water bodies. By contrast, only water bodies were extracted from the TerraSAR-X image. The classification results were then evaluated using a confusion matrix. To examine the efficiency of the proposed method, iterative self-organizing data analysis technique (ISODATA) classification method was applied on TerraSAR-X after employing the segmentation process during object-oriented-rule-based method, and the results were compared. The overall accuracy values of the classified maps derived from TerraSAR-X using the rule-based method and Landsat imagery were 86.18 and 93.04, respectively. Consequently, the flooded locations were recognized and mapped by subtracting the two classes of water bodies from these images. The acquired overall accuracy for TerraSAR-X using ISODATA was considerably low at only 57.98. The current research combined the methods and the optimization technique used as an innovative flood detection application. The successful production of a reliable and accurate flood inventory map confirmed the efficiency of the methodology. Therefore, the proposed method can assist researchers and planners in implementing and expediting flood inventory mapping.

Keyword: Flood detection; GIS; Landsat; Remote sensing; Rule-based classification; Taguchi; TerraSAR-X

