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Flood damage assessment performed based on Support Vector Machines combined with Landsat TM imagery and GIS

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Floods are a water-related natural disaster affecting and often threatening different aspects of human life, such as property damage, economic degradation, and in some instances even loss of precious human lives. Being able to provide accurately and cost-effectively assessment of damage from floods is essential to both scientists and policy makers in many aspects ranging from mitigating to assessing damage extent as well as in rehabilitation of affected areas. Remote Sensing often combined with Geographical Information Systems (GIS) has generally shown a very promising potential in performing rapidly and cost-effectively flooding damage assessment, particularly so in remote, otherwise inaccessible locations.

The progress in remote sensing during the last twenty years or so has resulted to the development of a large number of image processing techniques suitable for use with a range of remote sensing data in performing flooding damage assessment. Supervised image classification is regarded as one of the most widely used approaches employed for this purpose. Yet, the use of recently developed image classification algorithms such as of machine learning-based Support Vector Machines (SVMs) classifier has not been adequately investigated for this purpose.

The objective of our work had been to quantitatively evaluate the ability of SVMs combined with Landsat TM multispectral imagery in performing a damage assessment of a flood occurred in a Mediterranean region. A further objective has been to examine if the inclusion of additional spectral information apart from the original TM bands in SVMs can improve flooded area extraction accuracy. As a case study is used the case of a river Evros flooding of 2010 located in the north of Greece, in which TM imagery before and shortly after the flooding was available. Assessment of the flooded area is performed in a GIS environment on the basis of classification accuracy assessment metrics as well as comparisons versus a vector layer of flooded area obtained from the local authorities based on image photo-interpretation. Damage assessment from the flood is performed on the basis of land use/cover information derived from the GlobeCover2009 dataset freely-distributed from the European Space Agency.

Results from our study indicated the ability of SVMs in extracting the flooded area as well as in performing a flooding damage assessment. The use of additional spectral information layers in SVMs showed an improvement in the flooded area extraction from the surrounding environment, in comparison to when only the original spectral bands of the sensor were used. All in all, our proposed SVMs scheme proved quite capable in performing flooding damage assessment in the complex and highly fragmented case of our Mediterranean study site.

Keywords: flooded area mapping, flood damage assessment, remote sensing, Geographical Information Systems, Support Vector Machines, Landsat TM, Evros river, Greece.