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THE STUDY OF RIVER EXTRACTION TECHNIQUES AND METHODS USING REMOTE SENSING

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ABSTRACT
In this paper, Methods and technology of river Extraction are studied. First DEM with K means, Hill Climbing, and Thresholding. Then different technics like NDWI, pixel-based (supervised and unsupervised) classification and object-based classification. Then a new water body extraction model was developed using the advantages of the OBIA and the NDWI. The need for this kind of method comes from the fact that it is hard for pixel-based classification methods and th NDWI method to separate water from another object that has a low albedo, and since it is impossible to separate them by their spectral differences, we have decided to include the NDWI within the object-based method.

KEYWORDS: DME; NDWI; K means Clustering; Hill climbing.

I. INTRODUCTION

This Water body extraction has become a very important part of remote sensing science since water monitoring plays an important role in water resource management. Water body extraction from remotely sensed images has been a problem for over two decades. A number of indexes have been developed over the years in order to try to eliminate misleading information, such as topographic shadows, could shadows, built-up areas, snow and ice. The reason for the abovementioned misleading information comes from the difficulty in distinguishing water from other surface with a low albedo. Although the indexes have been improved over the years, there is still a need for more efforts in water body extraction to effectively maintain water resources [1]

Extraction water from satellite images has been conducted in many research areas. Starting in 1995, the first Normalized Difference Water Index (NDWI) (Gao,1995) was developed. To date, many other indexes and methods have been developed (Ding, 2009; Feysia, Meilby, Fensholt & Proud, 2014; Lacaux, Tourre, Vingolles, Ndione, & Lafaye, 2007; McFeeters, 1996; Meng, Zhu, Cao, Xsu, & Cao, 2013; Pereira-Cadenal et al., 2011; Rogers & Kearney, 2004; Xiao, Zhao & Zhu 2010; Xu, 2006; Yan, Zhang & Zhang, 2007; Yuanzheng, Zhen Guo, Kaipeng, Dan & Zhouab, 2016), however, they still face the same problems. In a recent study, a method that uses NDWI (McFeeters,1996) and land surface temperature was developed, improving the results by more than 80% [1].

In addition, pixel-based classification can be used for classifying water areas, the two pixel-based classifications are unsupervised and supervised classifications. In unsupervised classification, pixel are grouped based on the reflectance properties of the pixel and the created groups are called "clusters" The number of clusters should be identified by the user. The two main clustering algorithms are K-means and ISODATA. Supervised classification is done y selecting representative samples for each land cover class in the image, and the classification of the land cover is based on the spectral signatures defined by the user.

Object-based or object- oriented image analysis (OBIA) classification thus supports the use of multiple bands for multiresolution segmentation and classification. Although OBIA has been used for decades (Camara, Souza, Freitas, & Carrido, 1996; Flanders, Hall-Beyer, & Preverzoff, 2003; Kettig & Landgrebe, 1976; Ryherd & Woodcock, 1996; Strahler, Woodcock, & Smith, 1986) in the last few years it has beeb used frequently in different study areas, such as vegetation (Yu et al., 2006), forest cover (Heyman, Gaston, Kimerling & Compbell, 2003) and water body extraction (He, Zhang, & Hua, 2016). The publication of papers related to OBIA has drastically increased since 1995(Blaschke, 2010). As the spatial resolution of the imagery is an important factor when selecting image classification techniques (Blaschke, 2010), OBIA is superior to traditional pixel-based classification. It has been suggested that for high-resolution imagery, object-based classification should be used and for medium/low-resolution imagery, pixel-/object-based classification should be used (gisgeography, 2016). Most of the studies for object-based classification use high-resolution imagery, such as IKONOS, QuickBird (He et al., 2016), SPOT (Polychronaki & Gitas, 2012) or images from unmanned aerial vehicle (Comert, Avdan, & Avci, 2016).
Not being able to completely extract water bodies from satellite image with methods or algorithms has necessitated a solution to find links between water indexes and the rapidly growing OBIA.

II. METHODS

a. K means Clustering:

In this method of image segmentation we use K means method to divide the image into a number of clusters. But before considering all this it is important to understand how a basic K means algorithm works K-means (Macqueen, 1967) is one of the simplest unsupervised learning algorithms that solve the well known clustering problem and is used to cluster observations into groups of related observations without any prior knowledge of those relationships.[2]

The algorithm clusters observations into k groups, where k is provided as an input parameter. It then assigns each observation to clusters based upon the observation's proximity to the mean of the cluster. The cluster's mean is then recomputed and the process begins again.

b. Hill climbing algorithm:

Hill climbing is good for finding a local optimum (a good solution that lies relatively near the initial solution) but it is not guaranteed to find the best possible solution (the global optimum) out of all possible solutions (the search space).

The relative simplicity of the algorithm makes it a popular first choice amongst optimizing algorithms. It is used widely in artificial intelligence, for reaching a g oal state from a starting node. Choice of next node and starting node can be varied to give a list of related algorithms. Hill climbing can often produce a better result than other algorithms when the amount of time available to perform a search is limited, such as with real-time systems. Hill climbing technique can be mathematically represented as follows.[2]

c. Thresholding:

It is a simple and effective means for obtaining a segmentation of images in which different structures have contrasting intensities or other quantifiable features. The input to thresholding operation is typically a grayscale or color image. In the simplest implementation, the output is a binary image representing the segmentation. Black pixels correspond to background and white pixels correspond to foreground (or vice versa). In simple implementations, the segmentations is determined by a single parameter known as the intensity threshold. In a single pass, each pixel in the image is compared with this threshold. If the pixel's intensity is higher than the threshold, the pixel is set to, say, white in the output. If it is less than the threshold, it is set to black.

As mentioned before, a number of pixel-based indexes have been developed for water body extraction form satellite images, but most of them do not have the required accuracy and produce a number of errors, mostly caused by shadows and built-up areas (Kaplan & Avdan, 2016). A comparison was made between NDWI, pixel-based (unsupervised and supervised) classification and object-based classification. The NDWI method used in this paper uses the green and NIR bands (McFeeters, 1996 since it was intended to never fail at water body extraction (Kaplan & Avdan, 2016).

Watershed is a region (or area) delineated with a well-defined topographic boundary and water outlet. It is a geographic region within which hydrological conditions are such that water become concentrated within a particular location, for example, ocean, sea Lake, a river, or a reservoir, by which the watershed is drained. Within the topographic boundary or a water divide, watershed comprises a complex of soils, landforms, vegetations, landform and land uses. The terms watershed, catchment, and basins are often considered synonyms. Remote sensing, defined as the science of using an instrument for measuring a target and its properties from a remote location, without a physical connection between the measuring instrument and the target, which is to be featured. Typically, the measurements are performed through various techniques. Those techniques are electromagnetic radiation (e.g. ultra-violet, visible light, reflective, thermal infrared, microwaves, etc). The instruments records the radiation reflected or emitted by the target and its properties are then inferred from the measured signal.[4]

III. RIVER EXTRACTION TECHNIQUES

The extraction of an actual network from the contributing drainage area image can be achieved by thresholding it for a fixed threshold value. This is illustrated in Fig. 3. Rather than using fixed thresholds, adaptive, threshold values can be defined using a priori knowledge or further transformations of the input image. By doing so, the river network is defined as the downstream of all pixels whose contributing drainage area exceed their threshold value. This idea has already been used for the extraction of river networks from actual DEMs in [6].

A. Determination of Flow Directions:

The water-ways movement can be calculated by flow direction. The DEM may contain some sinks that can block the water flow. These sinks may results due to errors in interpolation and disturbance in data whole creating DEM. The grid cell values of all adjacent cells of sink and depressions are greater than that of sink which prevent the water flow in the adjacent cell. So, all sinks and depressions must be corrected by filling them before determining the flow directions so that accurate sub-basin and river network can be obtained.

The flow direction of each cell in raster DEM can be determined by finding the direction of steepest descent from each cell by calculating the distance-weighted gradient. This gradient can be determined by first subtracting the elevation value of cell from is surrounding cells and then dividing the elevation difference by distance between the center of cells. If the cell size is 1 then the elevation difference is divided by 1 if the two cells are orthogonal or by 1.414 if the cells are placed diagonally . The maximum positive gradient is considered for determining flow direction of each cell. If the gradient is less than or equal to zero then the cell will flow out of the grid.

If the gradient is same for all surrounding cells then the neighborhood should be enlarged until a steepest descent is found. In case three surrounding cells in a single row or column have same gradient then position of middle cell among those surrounding cell is chosen. If two surrounding cells have same steepest direction then one of them is taken arbitrarily.

32	64	128
16	X	1
8	4	2

In "Fig", the X cell can take these possible eight flow directions. According to this, if the flow of cell X is towards right then the value of flow direction is 1. Similarly if the flow of cell X is upwards, then the value of flow direction is 64 and so on.

B. Determination of Flow Accumulation:

Flow accumulation model cab be obtained from flow direction model by determining the amount of flow to every cell taken as cumulative sum. The calculation of flow accumulation starts from right to corner. The value will be zero in case there is no flow form one cell to another. For example, in the cell (1,1) there is no flow so its flow accumulation will be zero. But the value of cell (2,2). Similarly, by considering the flows from cell (2,1) cell (3,1) and cell (4,1) the value of cell (3,2) is 3. In the similar manner the flow accumulation values of other cells can be calculated by considering the flow directions of all adjacent cells of each cell "Fig.5" shows flow accumulation model.

C. Determination of Drainage Network:

Drainage network can be obtained from flow accumulation model. The cell with the highest flow accumulation value is taken as lower limit. The cells above this lover limit are consider as a part of drainage network.

The basic unit of the ASTER GDEM is the i10-by 10 title. Each GDEM title container accommodates two zip-compressed files, a DEM file and a quality assessment (QA) file. Then all 25 DEM files are mosaicked and the desired area Gomati basin is clipped by using DATA MANAGEMENT TOOLS available under ARCTOOL BOX ArcGIS10.1. The filling of clipped DEM voids, calculation of flow direction and flow accumulation is done by using HYDROLOGY tools available under extension SPATIAL ANALYST TOOLs. A stream threshold of 111,111 is applied to calculate dominant streams in the study area using MAP ALGEBRA.

IV CONCLUSION

The Above study may have some problems as follows:

1. The problem often caused by the pixel-based indexes leads to an error in the detection of water due to the other occlusions like the cloud shadows, ice or snow.
2. The noise that is incorporated during the image fusion process has to be eliminated for a more enhanced quality of image.

The proposed model will be extended by integrating the other machine learning models to create a hybrid or both can be compared such as SVM (support vector machine), ANN (Artificial neural network) or ML (maximum likelihood) classification. Further, the model is developed by adding filters that completely eliminates the noise and that are more adaptive and robust in nature. The pre-processing of the data obtained from the GSI helps to evaluate and investigate the data more accurately and efficiently in predicting the water resources and determining the quality of the water.

V. REFERENCES

1) Gordana Kaplan and Ugur Avdan. Object-based water extraction model using Sentine-2 satellite imagery. European Journal of Remote Sensing, 2017, Vol-50, No.1, 1297540.
2) Ms. Venu Shah, Ms. Archana Choudhary and Prof. Kavita Tewari. River extraction from satellite image. DCSI International Journal of Computer Science Issues, Vol-8, Issue 4, No 2 July 2012, ISSN (Online : 1694-0814.
3) R. Kalaivani and P. Thangaraj. River Water Level Preditction in Satellite Images using Support Vector Machine. International Journal of Computer Applications (0975-8887), Volume-43- No. 23, April 2012.
4) Rajiv Kumar Nath & S K Deb. Water-Body Area Extraction from High Resolution Satellite Images-An Introduction, Review , and Comparison. International Journals of Image Processing (IJIP), Volume(3) : Issue (6)
5) Shilpi, Raj Mohan Singh and Satya Prakash Maurya. River Network Identification using Remote Sensing and GIS. 978-1-4799-4939-7/14/$31.00©214 IEEE.
6) Pierre Soille and Jacopo Grazzini. Extraction of River Networks from Satellite Images by Combining Mathematical Morphology and Hydrology.
7) Guangliang Cheng, Feiyun Zhu, Shiming Xiang, Ying Wang and Chunhong Pan. Accurate urban road centerline extraction from VHR imagery via multiscale sementation and tensor voting.
8) D. Arun Kumar, Saroj K. Meher and K Padma Kumari. Knoledge-Based Progressive Granular Neural Networks for Remote Sensing Image Classification.
9) John Fairfield and Pierre Leymarie. Drainage Networks From Grid Digital Elevation Models. Water Resources Research, Vol-27, No. 5, Pages 709-717, May 1991.
10) Korada Hari Venkata Durga Rao, Vala Venkaeshwar Rao, Vinay Kumar Dadhwal, Gandarbha Behera and Jaswant Raj Sharma. A Distributed Model for Real-Time Flood Forecasting in the Godavari Basin Using Space Inputs. Int. J. Disaster Risk Sci. 2011, 2 (3) : 31-40 doi: 10.1007/s13753-011-0014-7.