Journal of Education for Pure Science- University of Thi-Qar
Vol.9, No.2 (June, 2019)
Website: jceps.utq.edu.iq Email: jceps@eps.utq.edu.iq

DOI: http://doi.org/10.32792/utq.jceps.09.02.04

Adaptive Hyper Classification Technique for Satellite Images

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Received 20/08/2018, Accepted 23/12/2018, Published 02/06/2019

Abstract:

The satellite image classification system intends to differentiate between the objects being present in the image. It is highly challenging because the coverage area of the satellite is large such that the objects appear so small. This makes the process of object differentiation complex. Additionally, the classification accuracy is an important factor, which the classification system must pass through. This work presents a satellite image classification system which can classify between the vegetation, soil and water bodies, etc. Current research work is in the development of a hybrid classification technique for satellite images. High-resolution satellite images that we deal with using SVM and low accuracy through the use of k-means. It is necessary to provide accuracy and speed of satellite images and obtain this through the modulation method suggested through the integration of these technicians, where technology can classify all satellite images .We note that the proposed system is able to classify any satellite image by highlighting each region and what indicates that area and what percentage when applying the proposed system of classification whether the satellite images are based on high accuracy or low accuracy, where the system also shows the time taken to classify each satellite image. We note that the time does not exceed 30 seconds for the number of images used within our database.

Keywords: satellite image, classification, k-means cluster, support vector machine classifier.

1-Introduction

Satellite images are rich and plays a vital role in providing geographical information [1]. Satellite and remote sensing images provides quantitative and qualitative information that reduces complexity of field work and study time [2]. Remote sensing technologies collects data/images at regular intervals. The volumes of data receive at datacenters is huge and it is growing exponentially as the technology is growing at rapid speed as timely and data volumes have been growing at an exponential rate [3]. There is a strong need of effective and efficient mechanisms to extract and interpret valuable information from massive satellite images. Satellite image classification is a powerful technique to extract information from huge number of satellite images. Digital image classification process involves grouping the image pixel values into meaningful categories. There are many methods and techniques for classifying satellite images. The methods of classification of satellite images can be categorized over a wide range into three classes. Automatic, manual, hybrid. The two general approaches which are used most often are: supervised and unsupervised classification [4].

2- Literature Review

This section presents the related review of literature with respect to satellite image classification: **In (2009), Ahmed , R., Mourad , Z., Ahmed, B., H . and Mohamed , B. [5]:**An efficient unsupervised classification scheme is proposed for high resolution satellite images . This work can provide the combination of topic models and random fields has been frequently and successfully applied to image classification due to their complementary effect. However, the number of classes is usually needed to be assigned manually. **In (2011), Gordo O., Martinez E., Gonzalo C., Arquero A.[6]:** The work proposed introduces a rule based system for satellite image classification, which is based on fuzzy logic. Additionally, genetic algorithm is employed to choose the optimal set of fuzzy rules to make the process simpler. The accuracy rates of this work is claimed to be better **.In(2013),Yu C., Qiu Q., Zhao Y., Chen X.[7]:** The author proposed a high-resolution satellite image classification method using morphological component analysis of texture and cartoon layers. The construction of the dictionary matrix used in the algorithm is based on independent component analysis. After the decomposition, we obtain the morphological coefficient vectors in both texture and cartoon layers which are termed as the sparse representation of the input high-resolution satellite image**.In (2013), Xu K., Yang W., Liu G., Sun H.[8]:** An efficient unsupervised classification scheme is proposed for high resolution satellite images .This work can provide accurate segmentation and the number of segments are automatically set **.In(2013), Shabnam Jabari and Yun Zhang,.[9]:**Introduced supervised satellite image classification method to classify very high resolution satellite images into specific classes using fuzzy logic. This method classifies -satellite images into five major classes: shadow, vegetation, road ,building and bare land. This method usesm image segmentation and fuzzy techniques for satellite image classification **.In(2013), Chandrakala, M. and Amsaveni, R.[10]:** Presents a supervised satellite image classification method to determine water, urban and green land on satellite images. **.In (2015),Banerjee B., Bovolo F., Bhattacharya A., Bruzzone L., Chaudhuri S., Mohan B. K.[11]:** an unsupervised land cover classification scheme for multispectral satellite images is presented. The proposed scheme utilizes the concept of self-learning and cluster ensembles. The cluster ensembles deal with the iterative expectation-maximization (EM) algorithm, which generates the cluster attributes. The classifier being employed in this work is maximum likelihood classifier and is trained by the cluster attributes formed by EM algorithm. This classifier does not require any supervision. **.In (2016), Papa JP, Papa LP, Pereira DR, Pisani RJ.[12]:**An unsupervised land cover classification system is proposed .This approach employs genetic algorithm with several met heuristic algorithms. This work concludes that one in four satellite images is correctly classified. **.In (2016), Karalas K., Tsagkatakis G., Zervakis M., Tsakalides P.[13]:** A multi-label classification scheme for satellite imagery is presented . In order to prove its capability, the same work is applied over hyper spectral satellite images **.In (2017) , Maggiori E., Tarabalka Y., Charpiat G., Alliez P. A.[14]:** Convolutional Neural Network (CNN) based satellite image classification system is presented ,This work proposes a two-step training process, in which the initial step may involve several irrelevant data and so, the next step refines the data. The classification process is achieved by multiscale neuron module. **.In(2017) , Xia J., Falco N., Benediktsson J. A., Du P., Chanussot J. [15]:** A new ensemble based technique is proposed for image classification. The technique is named as 'rotation random forest', which is made possible by Kernel Principal Component Analysis (KPCA). The initial feature set is decomposed into several feature subsets, followed by which the KPCA is applied over each and every subset. The KPCA extracts statistical features and are clubbed together to train the Random Forest.

3-Image Classification Methods[16]:

The classification technique of remotely sensed data are used to assign corresponding levels with respect to groups with homogeneous characteristics[17] , with the aim of categorize multiple objects from each other within the image. The level is called class. Classification will be executed on the base of spectral or spectrally defined features, such as density, texture etc. in the feature space. It can be said that classification divides the feature space into several classes based on a decision rule[18-19]. Classification methods divide into three approaches :Automated ,manual and hybrid.

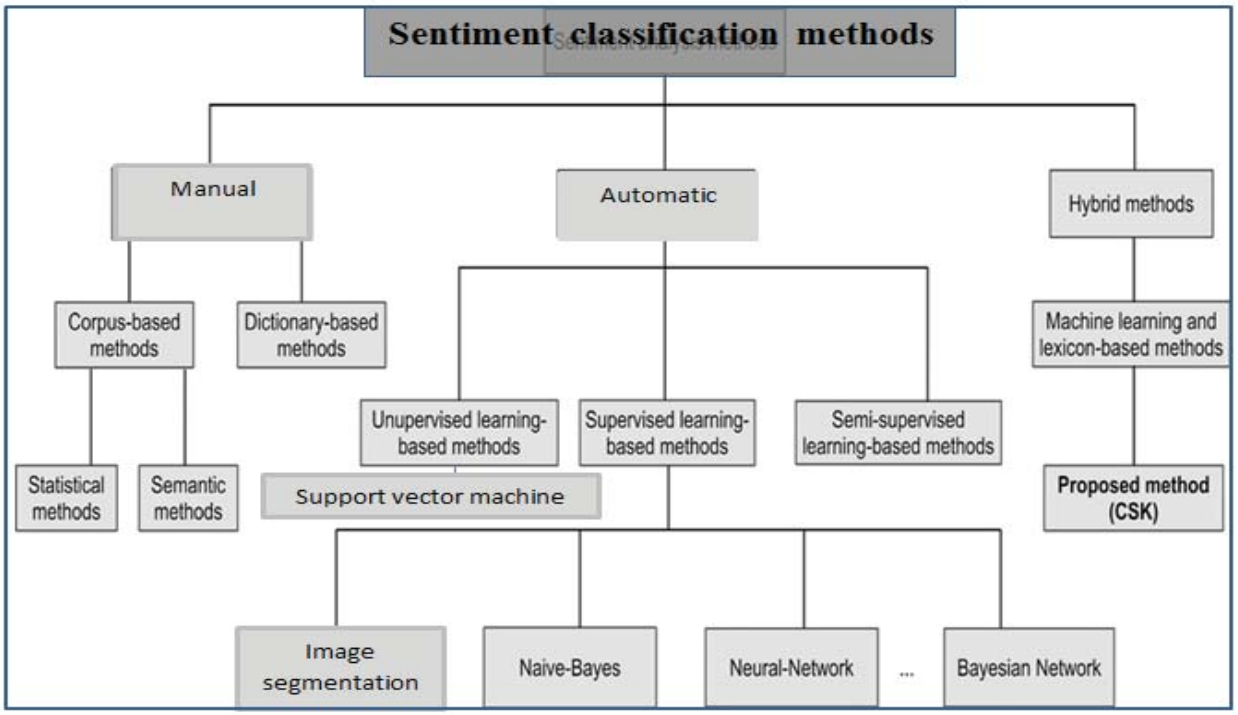

Figure1: Block diagram of satellite image classification methods hierarchy[4].

Automated satellite image classification methods includes algorithms that implemented systematically the entire satellite image to group pixels into special categories. Where the majority of the classification methods fall under this category. Automated satellite image classification method further classified into two categories: supervised and unsupervised classification methods[20].Supervised classification technique need input from an Analyst . The input from analyst is called as training set. Training sample is the most important factor in the supervised satellite image classification techniques. Accuracy of the techniques highly depends on the samples taken for training. Training samples are two types , one used for classification and another for supervising classification accuracy. Training set is provided before classification is activated . Main supervised classification techniques uses the following statistical techniques: Artificial Neural Network (ANN) ,Binary Decision Tree (BDT),Image Segmentation[21].Unsupervised classification technique uses clustering mechanisms to group satellite image pixels into unlabeled clusters . The analyst assigns indication labels to the clusters /classes and product well classified satellite image. Most common unsupervised satellite image classification is ISODATA[22] , support vector machine (SVM) and K-means[12].The methods of classifying manual satellite images are powerful and efficient but consume more time , manual methods in which the

analyst must be familiar with the area covered by the satellite image. Accuracy and efficiency of the classification, towards a branch of study [21].Hybrid ways to classify satellite images are integrated between advantages of both automatic and manual methods. Hybrid approach uses automated satellite imagery classification methods to do the initial classification, there are other manual methods used to develop classifica-ation and error processing[21].

4-Satellite Image Classification Problems

The lack of clarity of the terrestrial phenomena that these satellites capture because of their orbit, rotation of the globe ,the presence of spray or dust on sensor lenses, radiation distortions that appear on the visuals, geometrical distortions that appear on the visual space, the abundance of information due to its large size.

5-Methods used in research

5.1-Satellite image classification using K-means:

Clustering is the process by which discrete objects with similar characteristics can be assigned to groups. Clustering is used to group together like species , survey results ,or satellite image data , among others .Clustering algorithm has been used as a tool to analyze varieties of data. According to
this concept has been researched by many clustering practitioners, indicating how useful it is in data analysis .It is the unsupervised classification of patterns derived from observations , data items and feature vectors into groups or clusters[23].

To implement the k-means algorithm, the following steps are used:

Step 1. Read satellite image.
Step 2. Image resize.
Step 3. Convert RGB space to l* a* b* space.
Step 4. Classify the colors in 'a* b*' space using K-Means clustering.
Step 5. Label every pixel in the image using the results from K-means.
Step 6. Using (pixel-labels) we can separate the objects in the image by color which leads to several images.
Step 7- Display all the results.

5.2-Satellite image classification using Support Vector Machine(SVM):

SVM is the unsupervised classification algorithm that intends to classify between the objects by setting a boundary .However ,binary SVM is feasible for the works with multiple categories. In this case ,multiclass SVM is employed. In this work ,multiclass SVM is employed as the work considers several different classes such as soil , vegetation and water body. This work differentiates between soil, vegetation and water body. This way of classification ends up with accurate decision in a reasonable span of time. The of the following section analyses the performance of the proposed approach[24].

To implement the SVM algorithm, the following steps are used:

Step 1-Load the sample data(clusters output from the application algorithm K-means).
Step 2-Creat data , a two column matrix containing length and width.
Step 3-From the species vector, create a new column vector, groups ,to classify data.
Step 4-Randomly select training and test sets.

Step 5-Train an SVM classifier using a linear function .
Step 6-Use the svmclassify function to classify the test set.
Give each class a certain color distinguish it from the other class..Step 7
Step 8. Evaluate the performance of classifier of time and classification ratio for each category.

6-The proposed method

The main intention of this research article is to present an accurate satellite image classification system, which relies on image pre-processing classification phases. The image pre-processing phase processes the satellite image so as to make it suitable for the forthcoming phases.This phase denoises and improves the contrast of satellite images .The median filter technique is utilized to eliminate unwanted information and enhance the contrast of satellite images respectively. The first stage is preprocessing through which the satellite image is transferred to the class extraction stage using (k-means cluster) where each category is assigned to represent a specific region. These categories are classified from the previous stage using (support vector machine) to give each class a specific color , to represent one image in the same way. The second stage is k-means divides the satellite images into the soil cluster, vegetation cluster, and water bodies cluster , with the knowledge gained in the training phase. The previous categories are classified into specific areas and in a specific color, where the speed, accuracy and classification ratio of each category should be available in this work using SVM classifier as shown in figure 2.

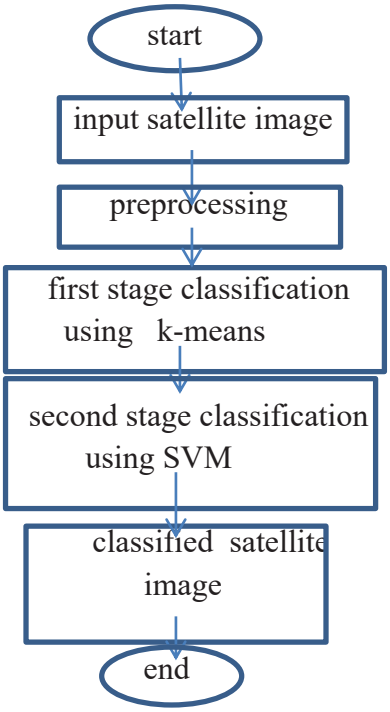

Figure 2: Block diagram of the proposed approach

7- Results and Discussion

This work takes the images of the second from June into account for the purpose of image classification. This section analyses the performance of the proposed approach by varying the feature extraction and

classification techniques in terms of accuracy, sensitivity and specificity. The proposed approach is tested by considering the satellite images downloaded from Turkish MODIS site. The experimentation is done in the matlab environment. This work trains and tests the system with 50 from the images each respectively. The sample classification results are shown in the figure 4. The dimensions of each image are 2000 rows and 2000 columns and are classified with a time of (32.9078) second, (29.8091) second. The picture that we will take as an example where we applied the proposed method of classification on them, shown below in figure 3 and figures 4,5,6.

Figure 3: shown satellite image

Figure4: shown satellite image

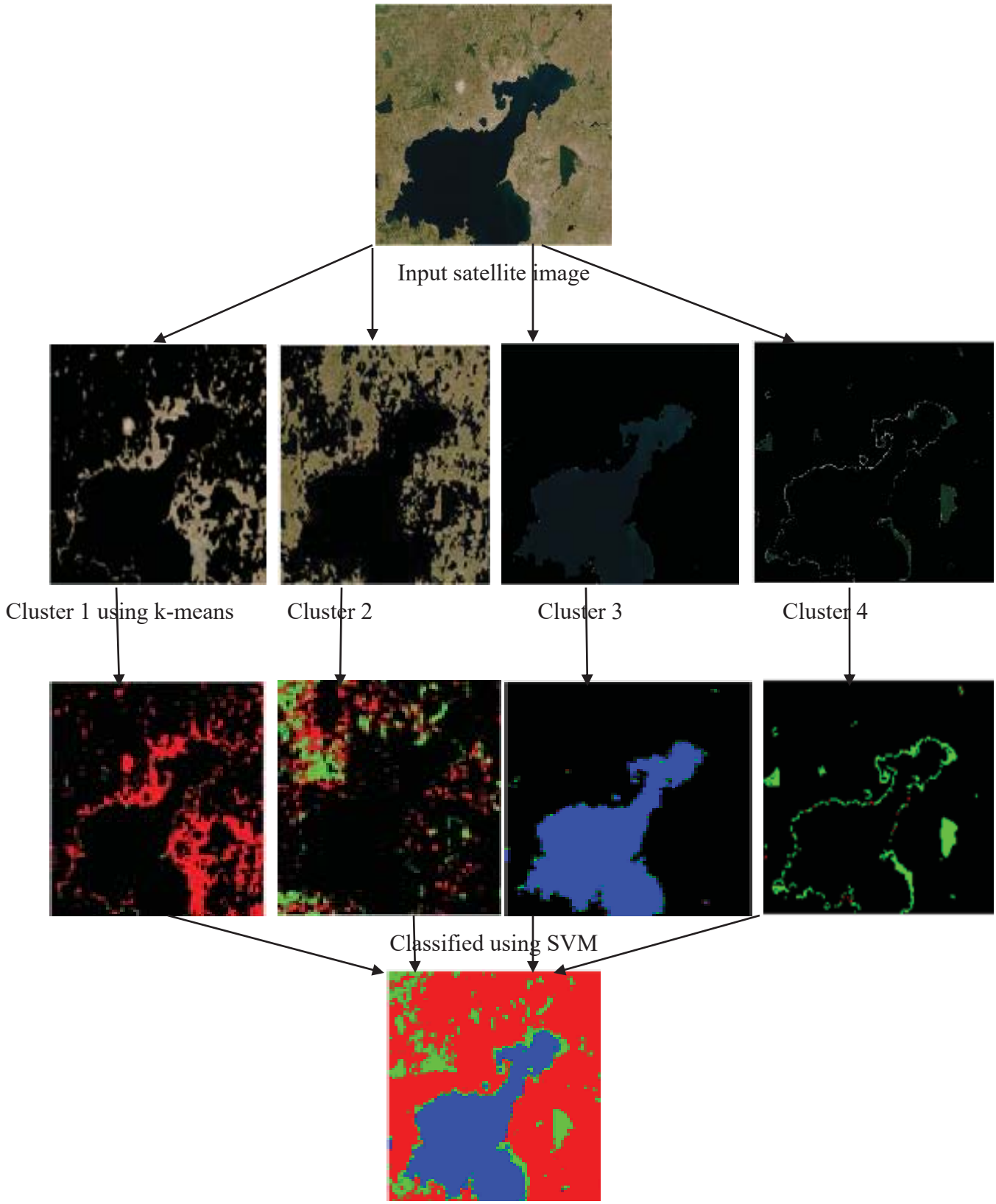

Figure 5: classification of satellite image 1

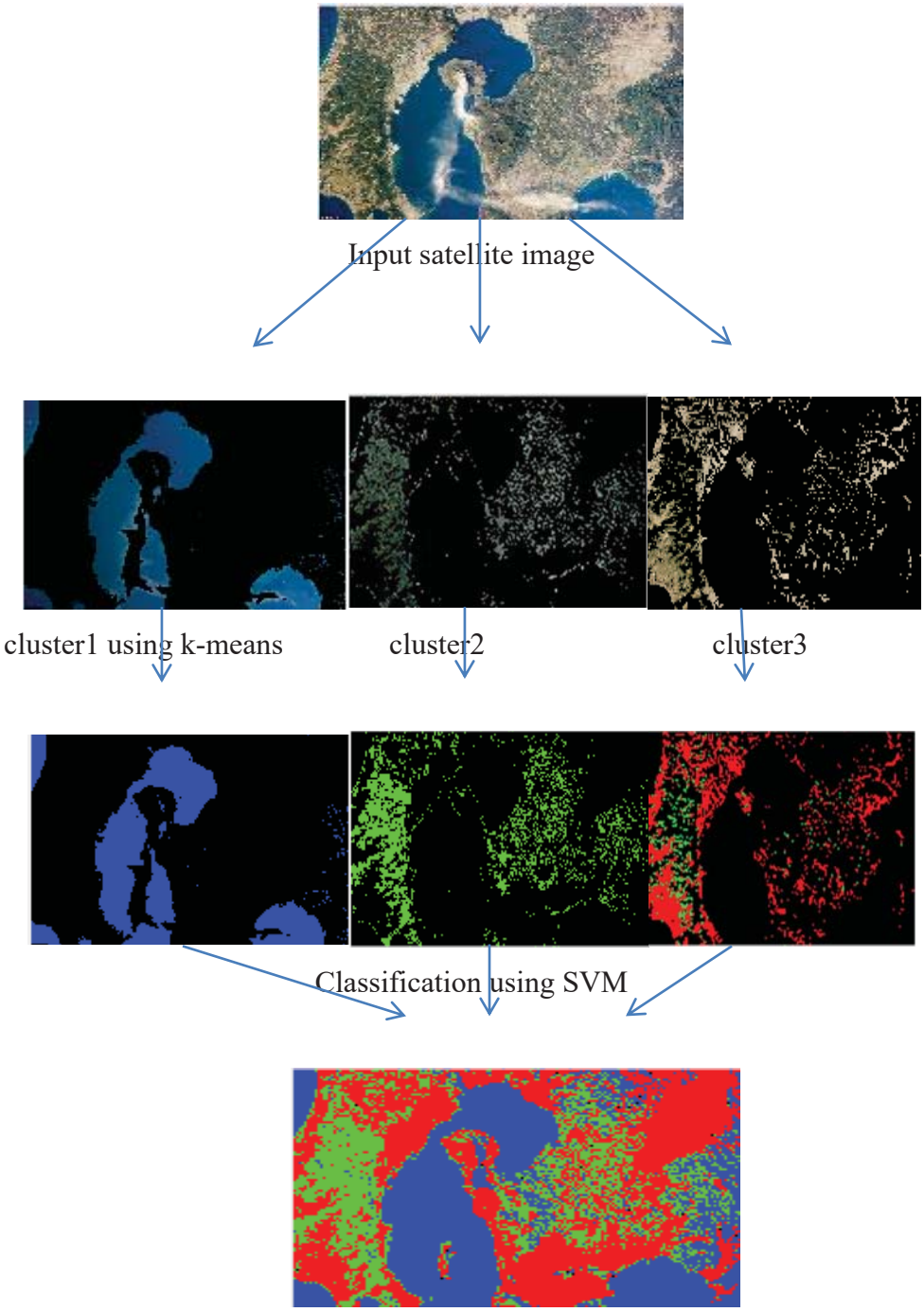

Figure 6: classification of satellite image 2

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