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Coastline Change Detection on Tehama City Using Remote Sensing and Cloud Computing

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Abstract: **Change detection is the measure of the distinct data framework and thematic change information that can guide to more tangible insights into underlying process involving land cover and land use changes than the information obtained from continuous change. This research demonstrates how remote sensing techniques can be integrated into monitoring process, allowing the regulatory monitoring coastline to do so more efficiently and help avoid or minimize the adverse effects .The first aim of this study is to test change detection by Discriminate change detection technique on Hodida city –Yemen coastline. Second to test cloud computing benefits on change detection study. Cloud computing is not magic tool to solve all problems, cloud computing Improvement in geo information software will allow easily implement and hence monitoring spatial data with low cost although it is under research. This study investigates the coastline changes in Hodeida, Yemen between 1972 till 2010; using Land sat TM/ETM+images. As they notice erosion of cost and sedimentation in some area. This will need to integrate GIS with remote sensing and could compute server (Apollo). This study has been done after a lot of complaints from area citizens; some area has erosion and reason for that immigration from their home. We used arc gis 10.2, erdas Imagine 2014, erdas Apollo server and Google earth. .**

Keywords: **Cloud computing, Discriminate Change Function, Image Difference, Apollo.**

I. INTRODUCTION

Land use Land Cover (LULC) change has become a topic of tremendous interest within the human dimensions of the Environmental change research community (Meyer W.B.,Turner B.L). Consequently, quantifying and understanding the extent and spatial distribution of LULC is a crucial importance to the study of Environmental change at various scales (Ojima D.S., Kalvin K.A.,and Turner B.L). Moreover this type of analysis provides a valuable tool to increase the efficiency of land use and land cover, and to diminish the negative environmental and societal impacts related to LULC (Daniel et al., 2002; Lu et al., 2004; Berberoglu and Akin, 2009; Tahir et al., 2013). Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy. Remote sensing technology and Geographic Information System (GIS) and could computing (Qihao, 2013) provide efficient methods for analysis of land use issues and tools for land use planning and modelling. Analysis of satellite data in conjunction with drainage, litho logy, and land use land cover collateral data facilitates effective evaluation of geo morphological conditions and status of degraded landforms. This data set is the core of the Geographic Information System (GIS) that provides an excellent means of spatial data analysis and interpretation6. It also provides a powerful mechanism, not only to monitor degraded lands and environmental changes, but also permits analysis of information of other environmental variables (S.Tamilenthi1, J. Punithavathi1, R. Baskaran1 and K. ChandraMohan). In this present study, an investigation has been carried out in coastline in Hodeida to detect sedimentation and erosion of cost line. Many researches in agriculture has been made but not in cost line. studying the beach stretching from Hodeida towards the south to the city of Tehama and a length of 268 km and to identify the characteristics of the geological , environmental and topographic that characterize , where the focus was on sites erosion and flooding and sedimentation and the situation morphological and compositional and human activity , and that using the information derived from the visual space and aerial photographs captured the dates and different years beginning in 1972 Mss. - 1989TM - 2010 ETM and determine the extent of the change in the form of tape beach through the accounts of digital visuals used by the technology of remote sensing and geographic information systems for different periods of time

II. MATERIALS AND METHODS

A. Study Area

The study was conducted for Tihama plain which is located in Hodeida and a length of 88.3 km lies between N1637422 - 1738229 E252631 – 277651(figure 1a) Hodeida, city in south Yemen. Exposed many of the edges of the decline and erosion impact of blows waves , especially in the monsoon period winter South West (November to March), which was clearly evident in the areas of lamene led to the exposure of agricultural areas of the landfill as well as desertification by Activity phenomenon of sand encroachment , which has become threatened continuously.

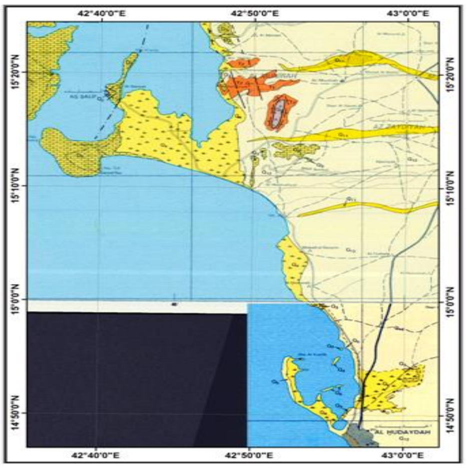


Figure 1(a) Map for study area

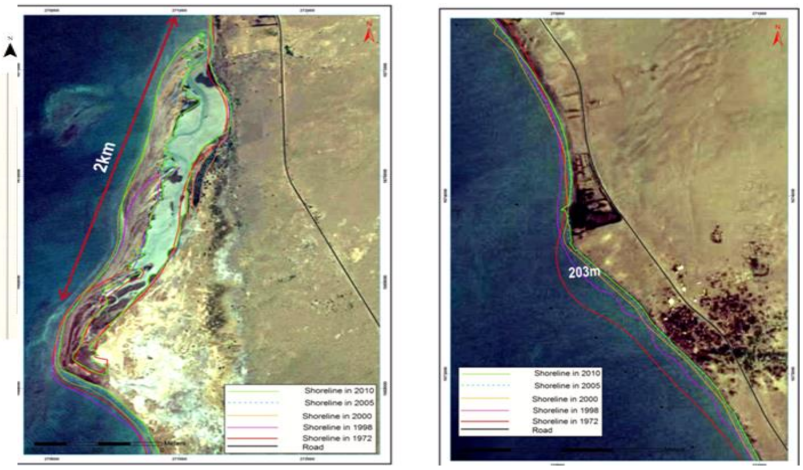
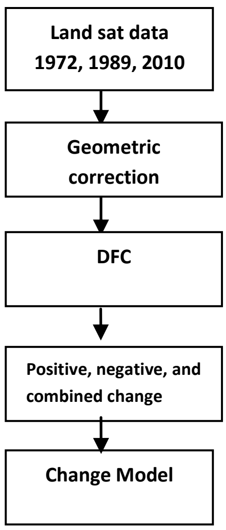


Figure 1(b) Map erosion and sedimentation area

B. Methodology:

1-Image Pre Processing, image classification (Figure 1b) and change detection were performed using Erdas Imagine 2013, while GIS analysis was carried out using Arc GIS 9.3and Google earth.

LULC	General Description
Water	Area covered by water and it appears by blue color
Vegetation area	Area covered by infected plants and it appears by red color
Coral reefs area	Dry area covered by water cause of sedimentation appears by dark blue
Sand	Area covered by sand and appear by brown color
Salt area	Area covered by salt and appear by white color

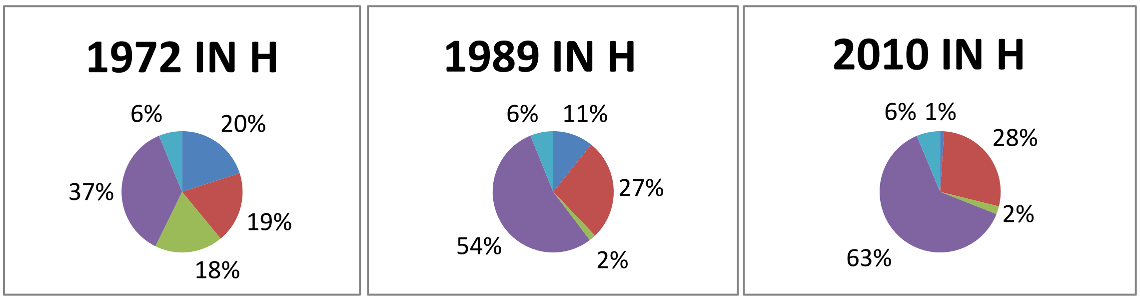


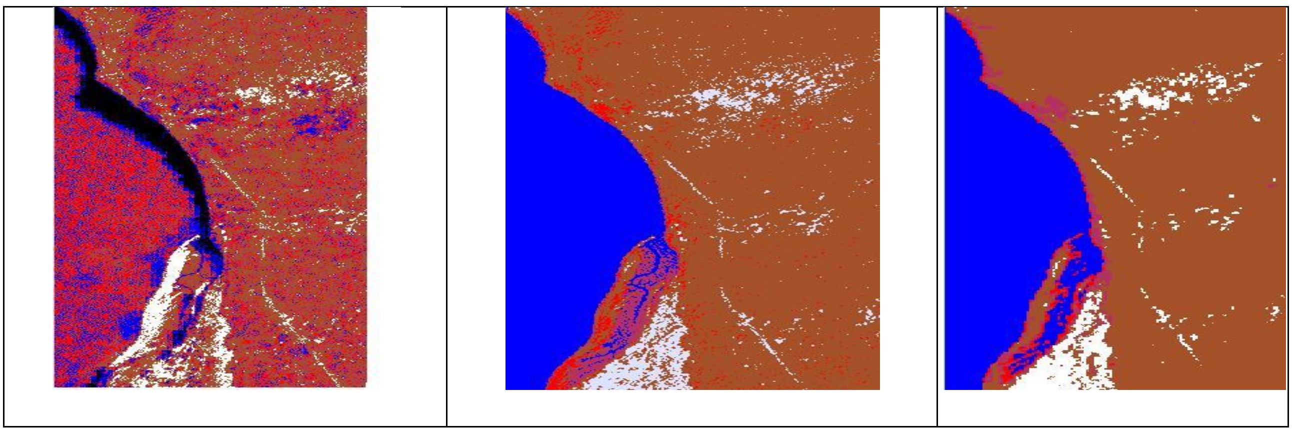
Discriminate Function Change Detection

Discriminate Function Change Detection is used to compute the probability of change per pixel from two images that depict the same area at different points in time (Wu et al., 2006; Mengistu and Salami, 2007; Reis, 2008). The process performs an unsupervised classification on the Input before Image and uses that and discriminate function analysis to compute a probability of change between the Input after Image to generate any of the Output files. The output images generated are composed of single band continuous data with pixel values in the range from 0.0 to 1.0. These values represent the probability that the pixel has changed in a significant way. The algorithm's conceptual procedure includes determination of which image is to be the base image, i.e. which image will we find change against. This algorithm is image-order variant meaning that it will yield different results depending on which image (before or after) is the base. After that an unsupervised classification on base image is to be performed into a reasonable number of spectral classes (64 – 128 classes) and use this thematic image as a zonal mask to extract a set of multivariate signatures (mean vector, M and covariance matrix, Cov) from the other image notated as change image. For each pixel in Change image compute the Mahalanobis Distance (MD) using the signature corresponding to the class to which it is affiliated from the previous step's zonal operation using the formula. The MD metric can be converted to a Probability using a Chi square lookup table. The Probability metric for each pixel is written to an output image.

TABLE I: classes in CLASSIFICATION

Land use Category	1972 IN H	1989 IN H	2010 IN H
agricultural	661.669	407.486	39.942
Water	628.417	1025.0192	1052.5137
Coral reefs	603.705	68.96	80.83
Sand area	1206.699	2051.688	2372.991
Salt area	206.149	232.282	239.147





Land Sat 1972 Land Sat 1989 Land Sat 2010

Figure 2

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Analysis of the change image 1972/1989 and 2010 by Discriminate Function Change Detection Method

The results show the probability of change per pixel from two images that depict the same area at different points in time. The output image is a floating point image with values from 0.0 to 1.0. Values near 0.0 indicate a low probability of change and Values near 1.0 indicate a high probability of change. The obtained image is threshold and clumped into raster. (Figure 3a) It shows from analysis of satellite images that decline in Coral reefs which is act as protect wall .it used to be defence to protect the cost.

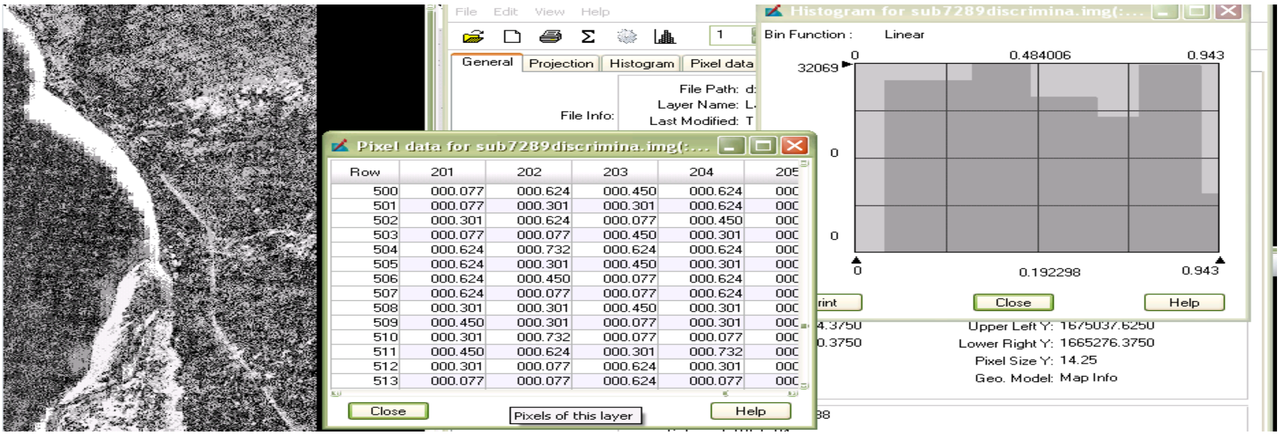
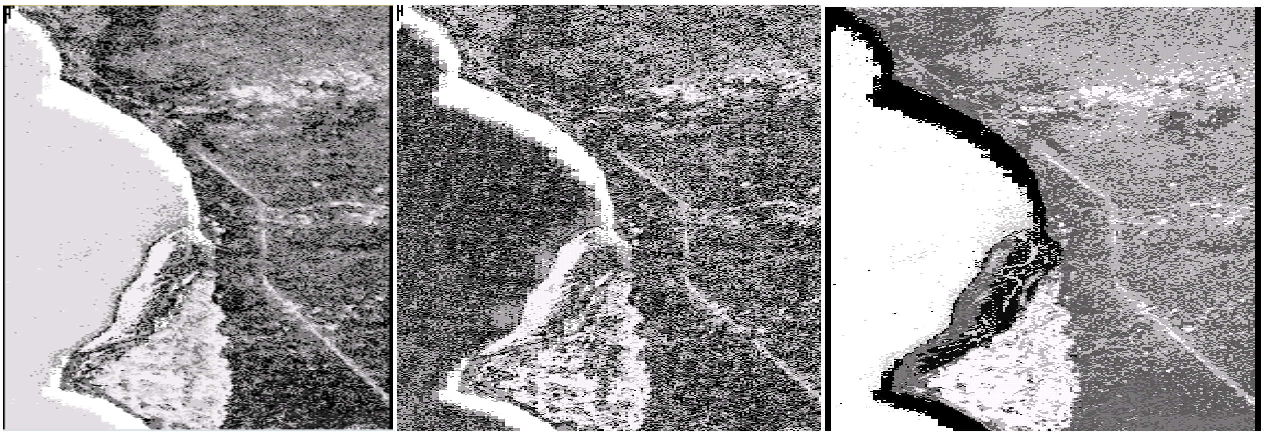


Figure 3(a)



Positive **Combined** **Negative**

Figure 3(b)

These results demonstrate the image order variance of the DFC algorithm. Since DFC computes spectral clusters defined from imagebase and then the statistical outliers in imagechange, it is only sensitive to pixels with new spectral characteristics in imagechange. So by computing DFC both ways, with the before image and after image as the imagebase we can separate out positive change from negative change. Positive change shows the new features that are in the after image that are not in the before image, i.e. features that have appeared (Figure 3b). Negative change shows features that are in the before image that are not in the after image, i.e. features that have disappeared (Figure 3b). The DFC user interface allows for the computation of both the Positive Change Image and/or Negative Change Image. It also provides for the Combined Change Image which is an image with the maximum pixel values from both the positive and negative change images.

Field Survey

In the present investigation stratified random sampling has been done. Satellite data has been classified through visual interpretation as per the classification scheme based on the reconnaissance survey and land cover/ land use classes in the area. Sampling was done on homogeneous units. Samples plots were laid along the gradient and reference to North direction has been provided

Classification Accuracy Assessment

Each of the land use and land cover map was compared to the reference data to assess the accuracy of the classification. The reference data was prepared by considering random sample points, the field knowledge and Google earth. During the field visits a hand held GPS (Global Positioning System) is used to identify the exact position of the place under consideration with Latitude and Longitude and its type by visual observation. The ground truth data so obtained was used to verify the classification accuracy. The most common accuracy assessment method is the preparation of a classification error matrix (or confusion matrix) Ismail,M,H.and Jusoff,K(2008). Error matrix compares, on a category-by-category basis, the relationship between known pixel reference data and corresponding results of an automated classification. The most common elements of the error matrix accuracy assessment include overall accuracy, producer's accuracy, user's accuracy and kappa coefficient (Lillesand and Kiefer, 2000).

	Reference data					**Total Row**
Predicted class	agricultural	Water	Coral reefs	Sand area	salt	
agricultural	**17**	**1**	**3**	**1**	**0**	**22**
Water	0	16	3	0	0	19
Coral reefs	0	2	15	1	3	21
Sand area	0	0	2	13	2	17
salt	0	4	0	0	10	14
overall	17	23	23	15	15	93

Error Matrix calculation:

Overall Accuracy: (total #correct/#matrix total)*100=71/93=%76.34

Producer's Accuracy :(total correctly predicted class X/total reference class x)*100

User's Accuracy :(total correct class x/total classified as class x)*100

Cover Class	Producer's Accuracy	User's Accuracy
Agricultural	**17/17*100=100**	**17/22*100=77.2**
Water	**16/23*100=69.5**	**16/19*100=84.21**
Coral reefs	**15/23*100=65.2**	**15/21*100=71.4**
Sand area	**13/15*100=86.6**	**13/17*100=76.4**
Salt	**10/15*100=66.66**	**10/14*100=71.4**

Kappa Statistic:

K-hat=(overall classification accuracy-expected classification accuracy)/1-expected classification accuracy

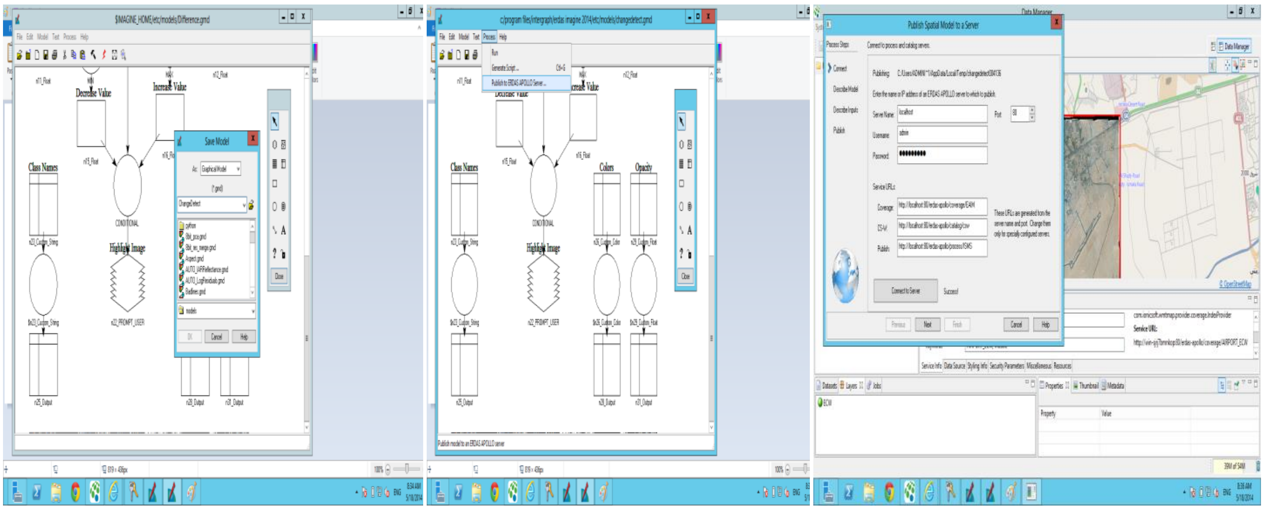
$$\kappa = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} \times x_{+i})}{N^2 - \sum_{i=1}^{r}(x_{i+} \times x_{+i})}$$

Where N is the total number of sites in the matrix, r is the number of rows in the matrix, xii is the number in row i and column i, x+i is the total for row i, and xi+ is the total for column I (Jensen1996) Result showed that an overall accuracy from 30 reference data was 83.5 % (kappa value 0.7502459), which was considered acceptable or good for optical data.

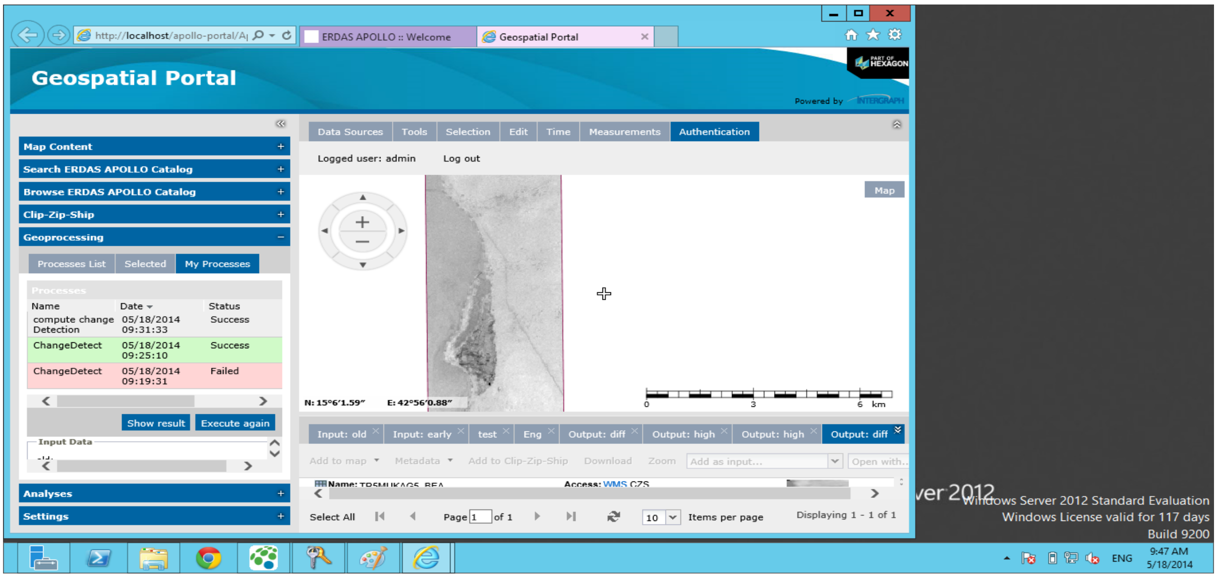
III. RESULT

Overall changes in the cost line have shown increased in water area and sand by 58% that because of Coral reefs decreased and human careless. Such development is guided or often times constricted by various environmentally sensitive or protected areas. The study has revealed that satellite data has the unique capability to detect the changes in land use quickly. From the analysis it is found that the satellite data is very useful and effective for getting the results of temporal changes. With this effective data it is found that the agriculture land is decreasing at the rate of increasing the erosion and sedimentation in most agriculture area.

A. 2- Publish change model on Cloud: After developed change detection model using Erdas Imagine. Publishing model on Apollo server to let many user to access it at the same time, cloud computing server for WMS (Web Mapping Service), server failed to process huge data and can't load allot of process at the same time.



Change Detection Model Connection with server Publish model on server



Change process on Apollo Server

B. Result: change model loaded successfully to cloud server and system shows ability to upload more data and capability to process but system field to process complex function with many users at the same time. As the system slow and stopped, this show that capability of cloud computing is limited and Erdas Apollo can't replace Erdas Imagine in processing complex function as CDF.

IV. CONCLUSION

Change detection has been applied to successfully to classify Land Used and Land Cover (LULC) IN Tehahma coastline .the Themetic maps of 1872, 1989, and 2010. Discriminate Function Change is a novel process for change detection in multi-temporal image pairs. It is computed by selecting one image as the base and then detecting statistical outliers the other image .for the reason, it can separate two different types of change, finding features that are in one image and not the other. Given images collected at different dates the results can be thought as positive change (features that appear) and negative change (features that disappear) between collecting dates. Because having no manual interpretational process it needs no manual efforts but requiring some experience to interpret and analyze the result and shows the good results. By integrating cloud computing with remote sensing, capability to study change detection was limited and result did not show good improvement in processing time .and that explain whatever cloud computing benefits in current studies. in minimizing cost, efforts, and time, has small progress on change detection. .this study focuses in how important to do monitor Tehama cost line and should make urgent work to reduce the recent problems. The study advice to plant such plants from coral reefs to protect the cost line from declination .make laws to protect cost and around environmental area.

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