Properties and Accuracy Assessment of Climate Changes using Hyperspectral Imaging

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Abstract- *This system aims to detect the natural disaster due to climate changes at the earliest and to alert the people to avoid the serve damages. The proposed empirical model analysis the characteristics of the hyper spectral imaging to produce the accuracy. The assessment of the climate change is done by comparing the properties of the hyper spectral imaging to the database. The advanced method for hyper spectral change detection has been used in this paper. The methods are multivariate alteration detection (MAD), iteratively reweighted MAD (MAD-IR), covariance equalisation (CE), cross correlation (CC).*

Keywords- climate changes, MAD, MAD-IR, CE, CC.

I. INTRODUCTION

The most of the traditional change detection methods deals with single-band or multispectral remote sensing images. The hyper spectral remote sensing images provide detailed information and the spectral changes to present changes detection performance. The accurate change detection of the earth's surface features is extremely important for monitoring environmental changes and resource management. And the change detection by remote sensing has been widely used in many applications such as land-use/land-cover, monitoring, urban development, ecosystem monitoring, and disaster monitoring. Most of them are based on single-band or multispectral remote sensing images. Recently, hyper spectral images have attracted increasing attention due to the wide range of potential applications. Hyper spectral imagery offers more abundant and more detailed information on spectral changes in multi temporal scenes than multispectral images, which can improve the change detection performance. In hyper spectral data, the presence of real change is represented by the change of a spectral signature from one material to another material. Therefore the hyper spectral change detection is more reasonable to directly measure the difference in the spectral signatures of different materials.

II. TECHNIQUES USED IN CHANGE DETECTION FOR HYPER SPECTRAL IMAGES

i) Principal component analysis (PCA):

A method of analysis which involved finding the linear combination of a set of variables that has maximum variance and removing its effect. PCA is a statistical procedure that uses an orthogonal transformation to convert a set of observation of possibly correlated variables called principal components. The number of principal component has the largest possible variance, and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. The resulting vectors are an uncorrelated orthogonal basis set.

ii) Change vector analysis (CVA):

Change vector analysis is a change detection method that characterizes the magnitude and change direction in spectral space between two times. A change vector is the difference vector between two vectors in n-dimensional feature space defined for two observations of the same geographical locations (corresponding pixels) during two dates.

iii) Image differencing :

Image differencing is a image processing techniques used to determine changes between images. The difference between two images is calculated by finding the difference between each pixel in image and generating an image based on the result. These techniques are commonly used in astronomy to locate objects that fluctuate in brightness or move against the star field.

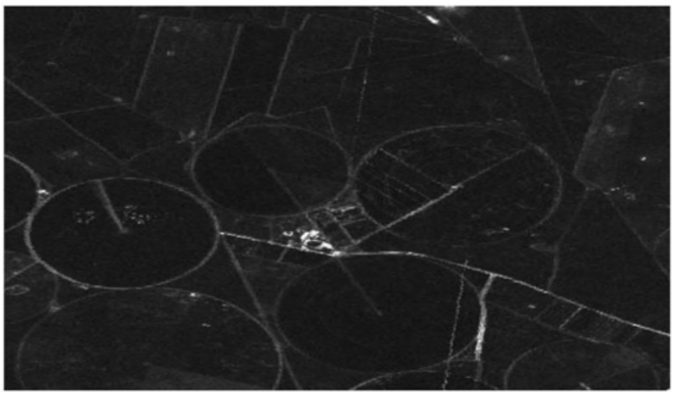
iv) Image rationing:

In image rationing the image ratios and band ratios involve the same logic expect a ratio is computed and the pixels did not change have a ratio value near 1in the ratio image. The technique is simple and may mitigate problem with viewing condition especially sun angle.

III. ADVANCED METHODS FOR HYPER SPECTRAL CHANGE DETECTION

1) Multivariate alternation detection (MAD):

The MAD method is used to detect change between two HyMap scenes. The changes observed by MAD in the two selected scenes are primarily due to the differences in flight directions and sun angle changes. The methods find differences between linear combinations of the spectral bands from the two acquisitions. These differences are orthogonal and they are constructed so that they explain maximum variance which is a healthy criterion for a change detector.



2) Iteratively reweighted MAD (MAD-IR):

The iteratively reweighted MAD (MAD-IR) method is a series of iterations places increasing focus on difficult observations. The method is based on the established technique of canonical correlation analysis, for the multivariate data acquired at two points in time and covering the same geographical region, we calculate the canonical variates and subtract them from each other. The method first calculates ordinary canonical and original MAD variates.

3) Temporal principle component analysis(TPCA):

The change detection is the process of automatically identifying and analysing regions. The detecting and representing change provide valuable information of the possible transformation. Change detection in hyperspectral images is complicated by the fact the change can occur in the temporal and the spectral domains. Two additional methods were implemented in order to compare its results with TPCA. The methods are image differencing and conventional component principle analysis.

4) Covariance equalisation (CE):

The physics based transformation connecting two multivariate sets of spectral radiance of the data of the same scene collected at two disparate times is approximately linear in hyperspectral remote sensing. The covariance structure of two data sets provides partial information about linear transformation. The possible transformation consistent with measured pairs of hyperspectral covariance structure particularly simple and accurate one has been found. This "rotation free" "covariance equalisation" (CE) has led to a simplified signal processing architecture that has been implemented in a real time VNIR hyperspectral target detection system.

5) Cross correlation (CC):

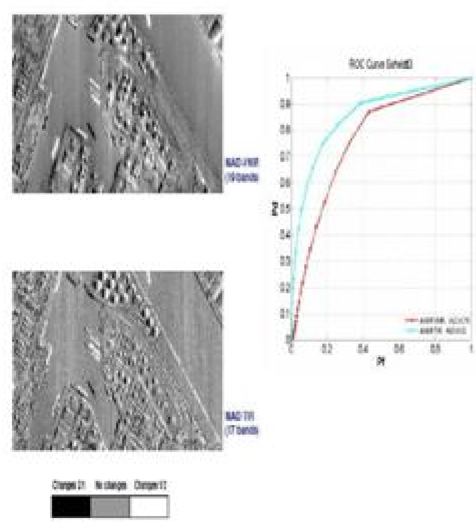
The cross correlation is a measure of similarity of the two series as a function of the lag of one relative to the other. This is known as the sliding dot product or sliding inner product. It is commonly used for searching a long single for a shorter known feature.

Table: Comparison between various techniques

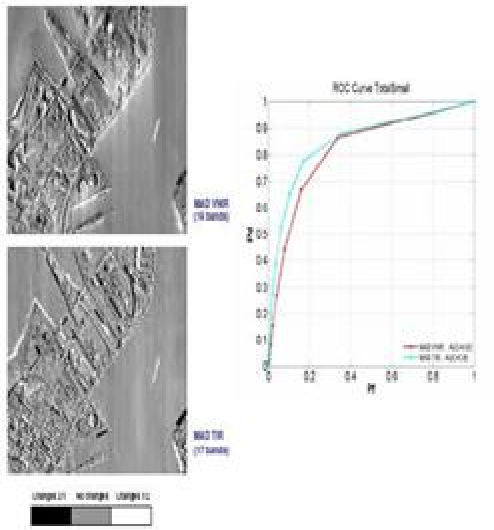
Techniques	Based on	Advantages	Disadvantages
PCA technique	Pixel using threshold level.	-	Large complexity
Hyper spectral remote sensing	Subspace based change detection	Effectively deal with signature difference	-
Segment based approach	Segment based classification	Less complexity	-
Change detection of object	Global information system functionality	-	Require some prior knowledge of elements

IV. OUTPUT FOR THE ADVANCED CHANGE DETECTION METHOD

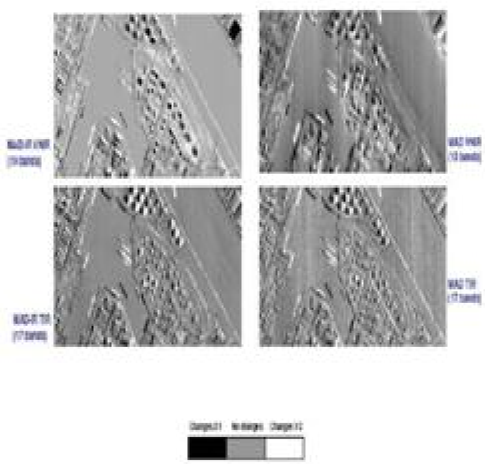
MAD change detection for zone 1:



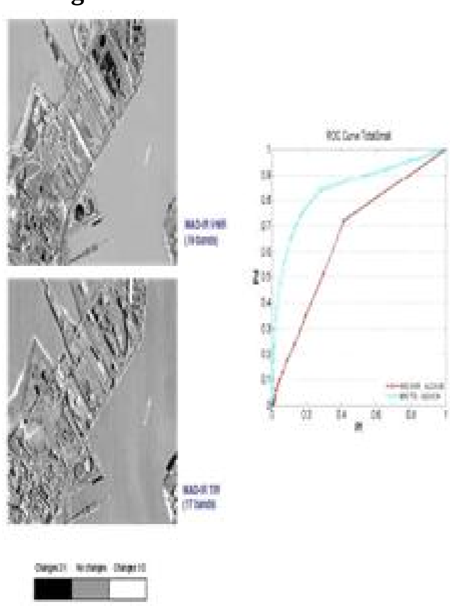
MAD change detection for zone 2:



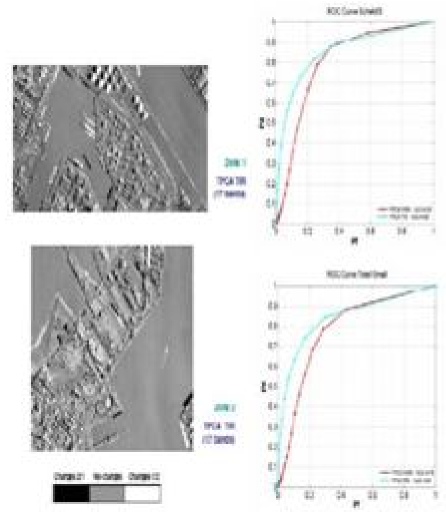
Iteratively reweighted MAD (MAD- IR) change detection for zone 1:



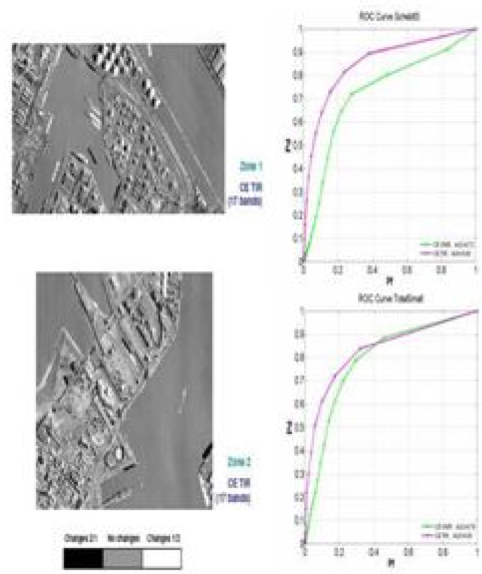
MAD-IR change detection for zone 2



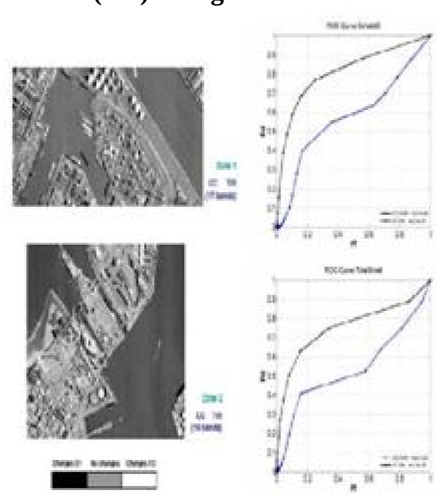
Temporal principle component analysis (TPCA) change detection:



Covariance equalisation (CE) change detection:



Cross correlation (CC) change detection:



V. CONCLUSION

Hyperspectral remote sensing studies have shown a variety of applications. A large part of hyperspectral data may be redundant in climate change application. It is important to identify and remove the redundant bands from further analysis to ensure most effective and efficient use of hyperspectral data in climate change. Change detection is based on multivariate technique, are simple and rapid methods and are producing quality results mainly by using hyperspectral data sets.

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