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Evaluation of the application of the multi-temporal method in Sentinel 2 satellite images for the separation of agricultural products

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Abstract

One of the ways to obtain information about the condition of the land is to produce land use maps. In this research, using different time series from Sentinel 2 satellite images, with the aim of choosing the appropriate classification method for the separation of land products in Ravansar city, Kermanshah province. Took based on the growing season, it was first prepared by referring to the agricultural calendar of different products of the region. By determining the time of planting, the peak of greenness, harvesting and plowing of different crops, information was collected and stored in the database for the necessary analysis to determine the time of the images based on the major crops of the study area, including (wheat, corn, barley, road, other-vegetation, other-plough-barren, water, peas, tomato) should be taken from Sentinel 2 images on two dates. By making the necessary corrections on the images, in the next step, the mentioned dates were done with the PCA method and then the classification was done with the maximum likelihood and minimum distance method. The results showed that the maximum likelihood classification was more accurate than the minimum distance method in multiple times with an overall accuracy of 94% and a kappa coefficient of 92%.

1. Introduction

Having regularly updated information on the state of the earth's surface phenomena, various activities can be carried out in the fields of agriculture, industry, animal husbandry, commercial services and transportation, etc.

Gaining awareness and knowledge regarding the cultivation pattern and the area under cultivation plays an important role in the management of agricultural lands and the estimation of the amount of net production (Immitzer et al., 2016).

In order to identify and separate the cultivated lands of different crops and prepare a map of regional crops in Africa, two images (related to the months of May and September) of digital data of Landsat satellite, ETM sensor from 2011 were used. In order to classify the image in each of these two months, the supervised classification method including maximum likelihood and artificial network was used. To compare the images obtained from the two methods, educational and experimental samples and the same working method were chosen for both methods. Electromagnetic waves used in remote sensing provide the possibility of extracting a variety of information from vegetation.

Separation of agricultural lands from other covers is always considered as a major challenge in remote sensing studies. However, one of the most valuable applications of remote sensing in this field is the production of maps of the type of cultivation and the estimation of its cultivated area (Ghazaryan et al., 2018, Lenco et al., 2019).

2. Method

The studied area in Ravansar city is located at longitude 46.39 degrees east and latitude 43.43 degrees

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north, with an average altitude of 1380 meters and an area of 1140 square kilometers, on the slopes of Mount Shahu in the northwest and 47 kilometers from Kermanshah city (Figure 1).

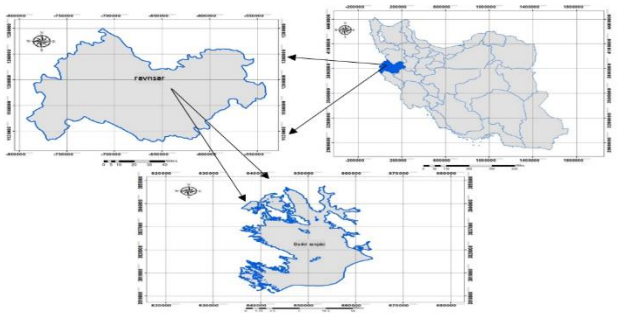

Figure 1. Study area

In this research, two Sentinel 2 images were received from the American Copernicus site on 02/15-11/06, 2016, and were prepared for classification after the necessary radiometric and atmospheric corrections. Then, with color band combination and PCA method (Principal Component Analysis) two images were done to separate the product by visual interpretation method. Layer stacking A new layer was created as a time series and was classified and evaluated for accuracy. The most common supervised classification algorithms are maximum likelihood classification and minimum distance classification

After that, the supervised classification was done using the methods of maximum likelihood and minimum distance according to the ground sample. The land cover classification is based on the spectral signature defined in the soil samples. In this way, the image classification software determines which class is most similar to which of the classes in the educational samples.

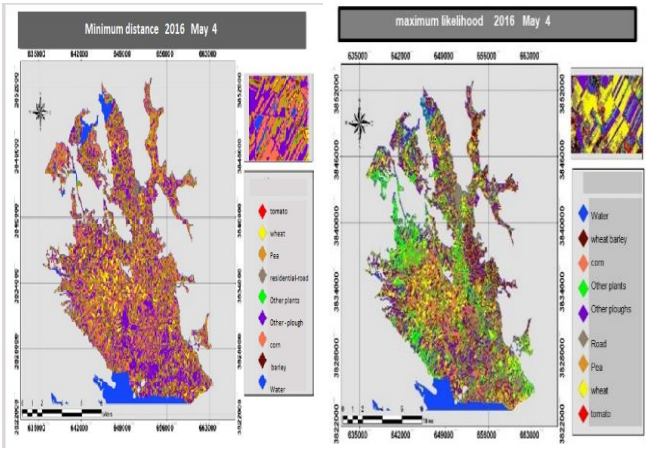

Figure 2. Classification map with the method of Maximum Locklihood and Minimum Distance in May 2016.

And one of the most common methods of expressing the classification accuracy is to prepare the classification error matrix. The error matrix compares the relationship between the known reference data (ground truths) and the relevant results of an automatic classification in a category-by-category manner.

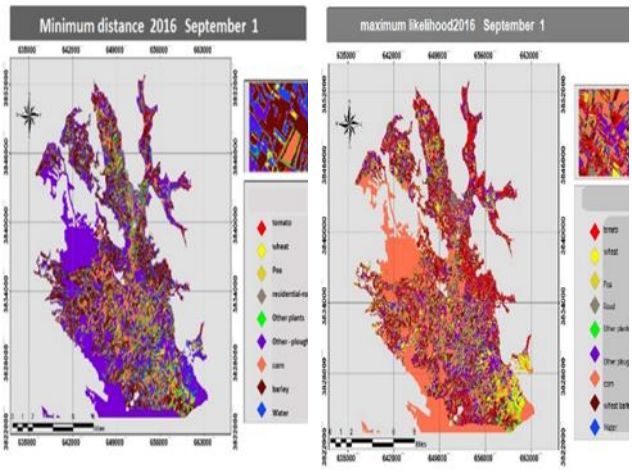

Figure 3. Classification map with Maximum Locklihood and Minimum Distance method in September 2016.

3. Discussion and Results

Investigating land use changes is one of the most important aspects of natural resource management and reviewing environmental changes (Bayatikhatibi and Amiriyan, 2022).

Accuracy evaluation results are usually presented in the form of an error matrix, in which case various parameters and values that indicate accuracy or some kind of error in the results are extracted from this matrix. This matrix is the result of a pixel-by-pixel comparison, and the known pixels are the corresponding pixels in the classification results.

Using 2 classification methods, maximum likelihood and minimum distance were done to analyze land use changes and evaluate the accuracy of classifications.

The most important stage of any research is its results. At this stage of the research, the results of image classification with the supervised classification method are used to evaluate the accuracy of the classification and review and separation.

By using the agricultural calendar of different crops in the region and the collected information and determining the time of planting, peak greenness, harvesting and plowing of different crops, this information was stored in the database and the necessary analyzes were made to determine the time of the images based on the major crops of the study area. (wheat, corn, barley, residential-road, other-vegetation, other-plough-barren, water, peas, tomato) on the date of images (May & September) of 2016 were taken from Sentinel 2 satellite images.

Then, each of the images was resized or resampled to make the size of all the pixels in the image bands the same.

The overall accuracy of the land use map extracted based on the agricultural calendar, for example, in May 2016, the corn plant species is in the stage of planting and sprouting.

Kappa coefficient of corn was mentioned in the date and in maximum likelihood classification, 69 pixels out of 90 pixels were identified And on September 2016, corn has reached its full growth The maximum likelihood classification has detected 80 pixels out of 90 pixels

Also, in the minimum distance classification, 55 pixels out of 90 pixels were detected on the first date and 63 pixels out of 90 pixels were detected on the second date.

4. Conclusion

Regarding the monitored methods, the maximum likelihood method has the highest accuracy compared to the minimum distance method in all dates

As well as knowing the agricultural calendar of any type of plant, better accuracy can be obtained in satellite images

And based on the research, it is suggested to use other images with high spatial and spectral resolution and appropriate time to select the image. And the maximum likelihood method should be investigated in different climatic conditions and multi-temporal data should be used more or less.

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