DETECTION OF THE VEGETATION CHANGE COVER USING LANDSAT TM5 IN THE BURABAY STATE NATIONAL NATURAL PARK, KAZAKHSTAN

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The SNNP «Burabay» is the famous touristic place in Kazakhstan, where the frequent climate change and anthropogenic activities has a significant impact in land cover change. Especially, there is significant impact on vegetation lost and these changes have a detrimental impact on biodiversity, as SNPP is defined as a home for 305 animal species and 800 flora species (https: // kazakhstan. orexca.com/ national park burabay.shtml). The tourism industry has become the dominant contributor to Burabay»s development, so many vegetated areas, green spaces are reducing in order to build hotels, restaurants and different types of entertainment centres. Thus, the SNNP « Burabay» is under the control of the International Union for Conservation of Nature (1UCN) in the category 2 which aims: «to protect biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation)) (1UCN, 2017 https://www.iucn.org/).

Change detection is widely used in the process of identifying differences on the earth»s surface covers over time (Al-doski et al., 2013). Researchers have shown an increased interest in support vector machine and their effectiveness and accuracy was compared with other advanced remote sensing techniques (Sha et al., 2013).

Support Vector Machine (SVM) has been defined as a new approach of the supervised remote sensing techniques which can be widely used for different purposes (Al-doski, et al., 2013; Sha et al., 2013). Tt is also has been proved by Al-doski, et al., (2013), Sha et al., (2013), Mountrakis et al., (201 I) that SVM has better accuracy and less sensitivity then other classification methods.

The post - classification comparison is the advanced technique of remote sensing which identifies changes between each independent classified image (Al-doski et al., 2013). However, the accuracy of the post - classification comparison depends on classification, where testing areas should be carefully digitised for classification manually.

This project aims to detect vegetation cover change in SNNP « Burabay» for 1990 and 2011 years using Landsat data to apply SVM classification and post - classification comparison methods in order to identify changed classes «from» and «to» and evaluate the effectiveness and accuracy of the SVM.

The SNNP «Burabay» is located in the north part of Kazakhstan, in Burabay region, Akmola oblast, surrounded by lakes, rocks, forests and urban areas. It is located within 53°04'41.4^{M} N latitude and 70°25'59.5"E longitude. Preferable boundary of the national park was drawn manually, but it is not exact boundary.

National park Burabay, was established as the State National Nature Park (SNNP) « Burabay» in 2000 and it is under the supervision of the Administration of

Presidential Affairs. In 2010, the area of the park has been expanded from 83,51 1 ha to 129 935 ha (SNNP «Burabay» http://www.udp-rk.kz/ru/organizations/45471/).

The Landsat Thematic Mapper (™) satellite images of the year 1990 and 2011 for the National Park « Burabay» were freely downloaded from Earth Explorer USGS .

Two satellites Landsat 5 TM data was downloaded with surface reflectance which so they are atmospherically and geometrically corrected. Additionally, E N VI 5.3 and A r c GI S 10.2.1 software and Photoshop Adobe Illustrator were used in this study; for technical and design and annotation parts, respectively. The acquired images were clipped using regions of interest (R OI). The image enhancement is the fundamental requirement in remote sensing, because usually, it is difficult visually interpret and distinguish each class of land use (http://web.pdx.edu/-emch/ipl/bandcombinations.htm). Thus, standard false colour composite was used and linear 2% was performed to easily distinguish and clearly identify land use and land cover class pixels. S V M is a new generation of supervised non - parametric classification based on the principle of statistical learning theory (Oommen et al., 2008; Mountrakis et al., 2011). The overall accuracy of the S V M classification has been justified by many papers. The advantages of S V M are: unlimited numbers of training pixels and there are no misclassified classes, all pixels randomly classify for more suitable class. However, there is controversial point, that S V M Thus, training areas for S V M classification should be properly created. Less gullible to noise and unbalanced number of size for each class are also valuable advantage of the S V M classification. The S V M seeks to create model that predicts the destination of value of testing data from the training values (Karan and Samadder, 2016). In this project R O I were digitised for 8 classes (agriculture, forest, water, bare land, grassland, commercial areas, residential areas and other land use). T w o images were classed in S V M using kernel function. Therefore, the Majority/ Minority are used in order to avoid from salt and pepper effects.

The accuracy assessment is an important aspect in remote sensing, so all classified images should be assessed using error matrix or confusion matrix (Karan and Samadder, 2016). In the accuracy assessment process, classified images w i l l be assessed against reference ground truth data. In this project, confusion error matrix has been used, and Landsat 8, 28 April 2017 data was used as a ground truth data.

Post- classification comparison w a s used to detect land cover change during the two decades. T w o classifieds (1990 and 2011) were used as input file. The post- classification comparison represents the areas of changed and provides statistics which include classes are changed «from» and «to». The results of post- classification indicate high, low or 0 value which means, increasing, decreasing or no change, respectively.

Results and discussion

The S V M results show different percentage for each class. According to classified map, some land cover classes are increased, decreases or almost constant. There are noticeable changes from the output map can be visually interpreted. For example, agriculture has been reduced by 2011, overall commission and omission errors were calculated for each class separately. Alternatively, bare soil, other land use and residential areas are increased. There are minor changes in water and commercial areas to compare with 1990. Commercial areas and other land use category have the highest omission errors, above the 90%. However, bare land has the highest commission error, which is over 70 % and 0% omission error. There is no omission error in water. However, for 2011, residential areas have the highest in error commission and commercial areas the highest omission error. However, during the iteration process, just *water* had clearly identified pixel values, to compare, for example with other land use classes. In these project residential areas, *commercial areas* and *other land use* were quite difficult to distinguish pixels from each other, they are pretty similar. Figure 1 represents the S V M output map, where significant changes have happened.

Several, iteration processes have been done in this project, in order to avoid wrong classification and misclassified areas. At the first time, only 6 land use classes have been selected *(agriculture, forest, wafer, grassland, bare land and urban areas). Accuracy*

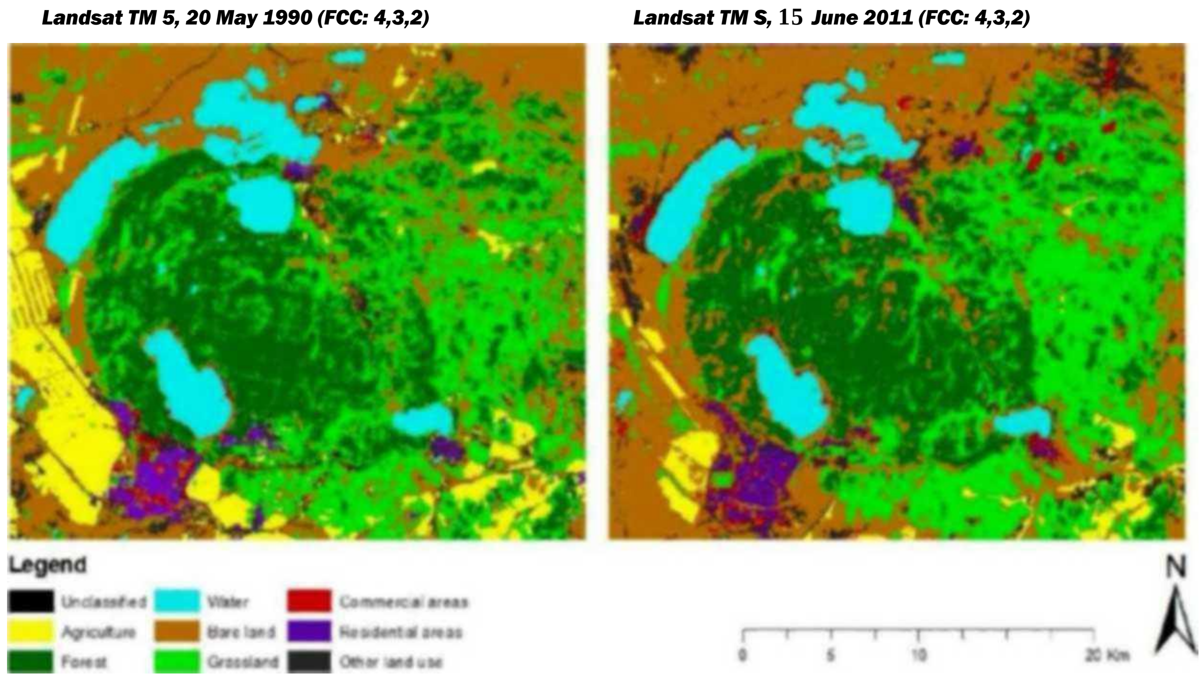

Figure 1. Classified output

assessment

Confusion matrix with ground truth R O I was used for accuracy assessment. The overall accuracy of the two images was higher.

Classification accuracy of Landsat TM 20 May 1990: (478 + 157+389+ 70+ 67+ 8+93+19)/ 184I = 1281/ 1841 =0.6958 = 70%; Kappa coefficient: 0, 6374

Overall classification accuracy of Landsat TM 15 June 2011: (329+ 179+ 389+ 70+ 87+ 22+ 80+ 33)/ 1189 = 0.6458 = 6 5 % ;

K A P P A coefficient = 0, 5888. *Post classification*

Thematic Change workflow was performed for post - classification process, where two classified images were undertaken for time series I and 2. According to the change detection statistics, *58 % of agriculture* has been changed to *hare land* over the last two decades, and overall *76% of agriculture* has been changed. *15% offorested* area became as grassland. The highest percentage of changing areas is in commercial areas and other land use, 88% and 85% respectively.

This is because, the boundary of the national park is expanded in 2010, and variety of buildings and construction projects is in progress. Land use in agriculture is decreasing because expanded space is needed for implementation of projects (F A O, http ://www.fao. oru/docrep/v6800e/V6800E0h. htm)

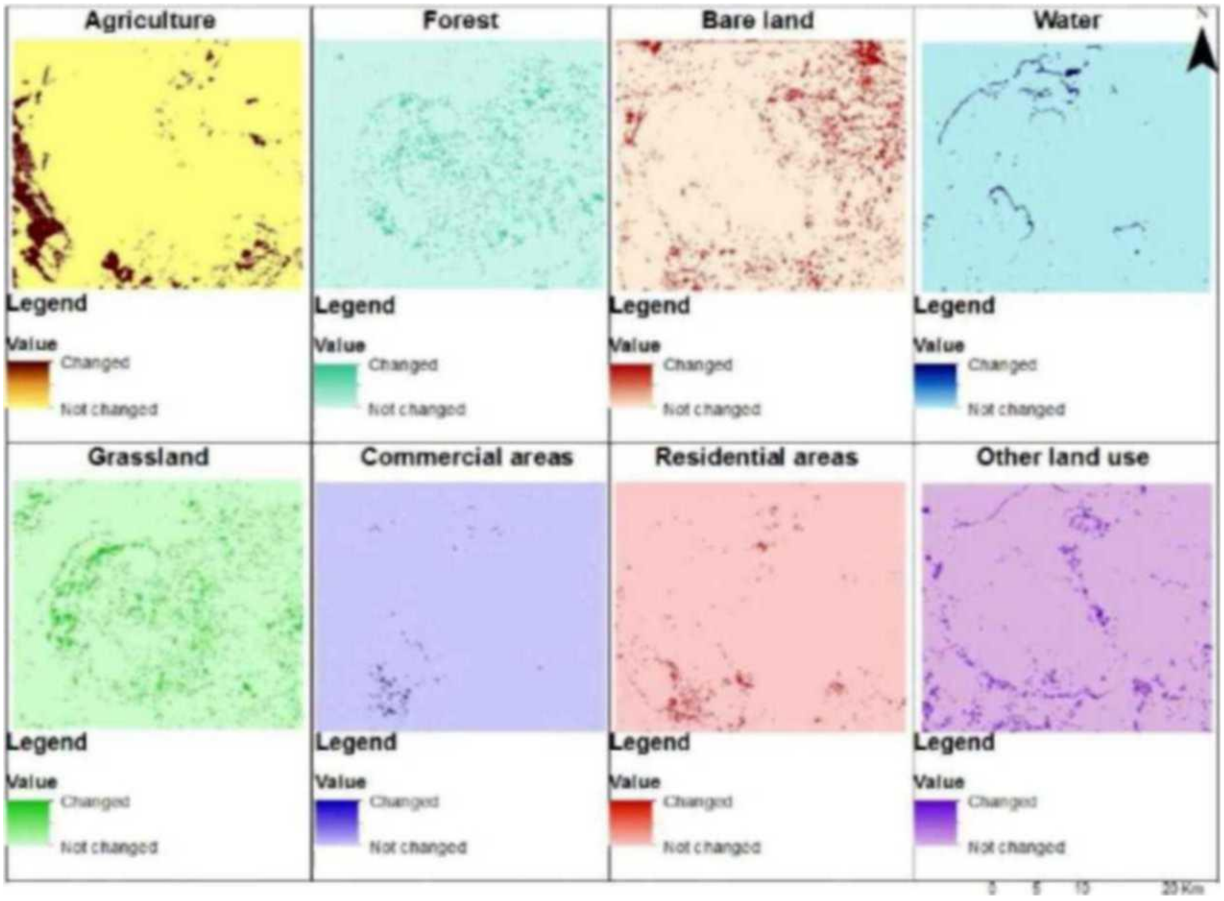

Figure 2 Vegetation change map

Figure 2 Vegetation change map

Conclusion. The main aim of this paper was to evaluate S V M classification accuracy using Landsat TM data of 1990 and 2011. The study was conducted in the State National Nature Park «Burabay». In the Burabay national park noticeable changes, especially, from one land category to another due the expansion of S N P P «Burabay»over the two decades. S V M was a potential method to detect vegetation cover change and by using post - classification comparison we could identify changed classes during that period. The accuracy of classified images of 1990 was 70%, kappa coefficient is 0.64; and for 2011 data accuracy was 65%, kappa coefficient is 0.59. However, further researchers are still needed. Also, certain limitations of this research have to be mentioned in order take into account for further researches, such as lack of valuable sources, scientific and GIS data. Thus, the integration effort of the local people and stakeholders is important to rescue the situation by engaging on planting trees and any human activities should be taken to avoid ecological problems and increase green areas, green environment and infrastructure

References:

1. Al-doski. Jwan, Shattri B. Mansor. and Hclmi ZM Shafri. "Support vector machine classification to detect land cover changes in Halabja Citv. Iraq " *Business Engineering and Industrial Applications Colloquium (HI-.IAC). 2013IEEE.* IEEE. 2013.

2. FAO. Agriculture in Kazakhstan http:Avww.fao.org/ docrcp/v6X00c/V6800E0h.htm

3. FCC band combinations: http: /Aveb.pdx.edu/-cmch Zip!/ bondcombinations. html

4 International Union for Conservation of Nature (IUCN.20I7) https://www.iucn.org/.

5. Karan. S.K. and Samadder. S.R.. 2016. Accuracy of land use change detection using support vector machine and maximum likelihood techniques for open-cast coal mining areas. *Environmental monitoring andassessment, 188(8), p.486.*

6. Mountrakis. Giorgos. Jungho Im. and Caesar Ogolc. "Support vector machines in remote sensing: A review." *ISl'RS Journal of Photogrammetry and Remote Sensing* 66.3 (2011): 247-25У

7. Oommen Thomas, et al. "An objective analysis of support \ector machine based classification for remote sensing." ***"Mathematicalgeoseiences*** 40.4 (200X): 409-424.

8. Oriental Express Central Asia, Burabay (Borovoe) National Nature Park Kazakhstan nature reserves. Kazakhstan recreation zones https://kazakhstan.orcxca.com/national park burabay.shtml

9. Sha, Zongyao. and Yongfei Bai. "Mapping grassland vegetation cover based on Support Vector Machine and association rules. *Natural Computation (1CNC), 2013 Ninth International Conference on.* I E E E 2013.

10.SNNP «Burabay» - http://www.udp-rk.kz/n.i/or[A]anizations/45471/ official site.