International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 18 (2015) pp 39223-39227

Analysis of Land Surface Temperature Corresponding to Biotop Index for Eco-friendly Urban Management

Jong-Sin Lee[1], Hee-Cheon Yun[2*]

[1]Dept. of Civil Engineering, Graduate School, Chungnam National University
99 Daehak-ro, Yuseong-gu, Daejeon, Korea E-mail: merrysc@lycos.co.kr
[2]Dept. of Civil Engineering, College of Engineering, Chungnam National University
*99 Daehak-ro, Yuseong-gu, Daejeon, Korea * Corresponding author. E-mail: hcyoon@cnu.ac.kr*

Abstract
Biotop as the surface of spatially bounded and spatial features directly affected or by contact by means of human land use and usage patterns or animal and plant populations and current template can be defined as spatial units that have the potential to format. In this study, we calculated land surface temperature using Landsat images about 4 seasons. Then we computed and analyzed the results of temperature according to 12 Biotop indexes (area, shape, height, slope, ratio of green coverage, vegetation layered structure, vegetation diversity, ratio of porous pavement, use intensity, formation period, serration distance with road, accessibility with water resource) to grasp the relationship between land surface temperature and Biotop indexes. As a results, we could find out the indexes which is more related than others.

Keywords: BiotopIndex, Land Surface Temperature, Landsat Satellite, Urban Management

Background and Purpose

What is biotope it can be defined as "human land use and spatial units as directly or indirectly to the surface of spatially bounded characteristic flora and fauna communities currently affected or have the potential that can be formatted or is formatted by using the form" [1]. In more simple and easy to understand pools represents an or the flora and fauna communities form and minimal spatial units that can be formatted in the portmanteau place and 'bio' means the species, which means space 'top' [2]. That is, the biological object elements can be analyzed because the minimum unit of the spatial effect of each material exchange with the environment takes place is a central biotope [3][4].
Recently, research and sustainable development, utilizing secure green area ratio biotope for the mitigation of global warming and the urban heat island phenomenon has been carried out [5][6].
In this study, we detected a sustainable urban management and biotope type metrics by surface temperature changes in order to identify the impact of each type [7][8]. Surface temperature change using Landsat satellite images to calculate the temperature for the entire city area [9][10].

Acquisition of Images and Data Processing

In this study, we acquired the Landsat satellite images on January, September, October in 2014 and March in 2015 to grasp the effects of eco-friendly urban management and surface temperature. Studies were selected destination to destination for eco-friendly, Chungcheongnam-do Buyeo. Figure 1 shows the target area, Buyeo-gun.

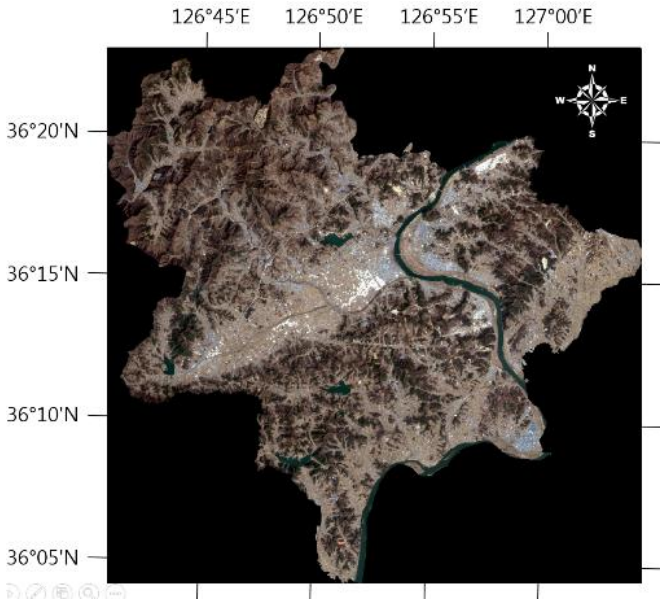


Figure 1: Target area

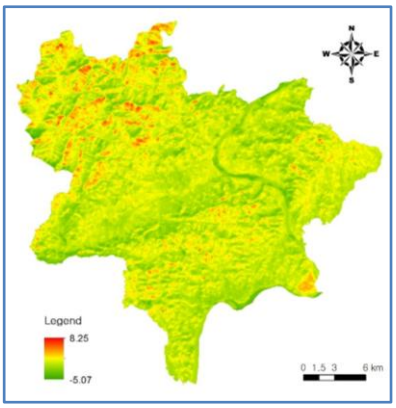
The standards for data processing and evaluation are structural aspect (area, shape, height, slope), natural aspect (ratio of green coverage, vegetation layered structure, vegetation diversity, ratio of porous pavement, use intensity, formation period), environmental aspect (separation distance with road, accessibility with water resource) [11][12].
In the case of structural aspects of the area, the scenery becomes high ecological area of greenery is likely to persist in the greenery itself wider when viewed from the side, forms an area that also can be broadened, the wider the area gives a high rating. Because the shape of the outline of the various biotope habitat for flora and fauna of the biotope complex shape compared to the monotonous shape formed to represent the more complex shapes and large number of projections on the outskirts of ecologically valuable rated as high. Elevation is the change of wind and temperature depending on altitude, humans may be predicted by various ecological characteristics

of the high points of human interference decreases from the surface to live. In particular, the high altitude and has a scarcity of biotope itself, causing it to predict the ecological rarities were evaluated in the higher grade the higher the altitude. Gradient can act as an important factor in the shade, as well as a resistance formed in the direction of the wind as an index for evaluating the degree of slanting of the biotope. Therefore, it is high if the slope can be more diverse vegetation and animal species than in paper format lower if higher the slope gave a high score.

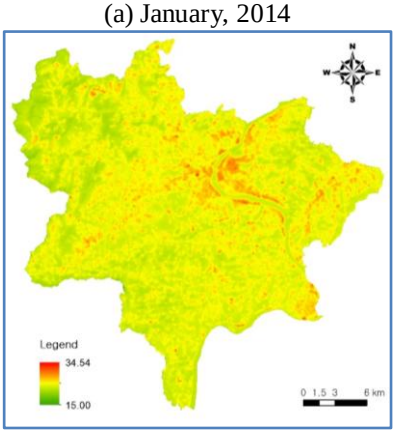
The ratio of green coverage among the natural aspect means the area of a side portion of the percentage of vegetation growing in the soil and biotope as land cover ratio, and a part covered with the vegetation when viewed from above can be used as an index to a two-dimensional evaluation. The more diverse the vegetation layered structure vegetation structure as an indicator to assess the vertical sides of the vegetation structure high evaluation on the basis of the ecological functionality. Vegetation diversity as an indicator of plant species like wild animals, oak, as well as hardwoods and lower vegetation has developed mixed forest animals and insects like sap and flowers, etc. There is a lot that insects prefer to format them, since these animals are gathered is preferred that the top item on the consideration of the role as food resources or habitat for wildlife. Ratio of porous pavement decreases and because of the wrapping, and off the contact with air. And it can lead to a poor state of a variety of conditions for such organisms that form a very important factor for reducing the amount of sunlight. As the use intensity of the strength of the human intervention on the environment can be said about the ecological value of the natural environment it is improved. Thus forming period denotes a period of the biotope formed, may rating index of the restore potential damage.

In the case of road clearance of the environmental aspects, the road is rob and destroy the forest habitat of wild animals and plants. In particular, a very important factor leading to fragmentation and disconnection of the habitat, such as large forests. The accessibility of the water source is a resource that provides drinking water to wildlife because it is one of those absolutely necessary for the survival resource considerations.

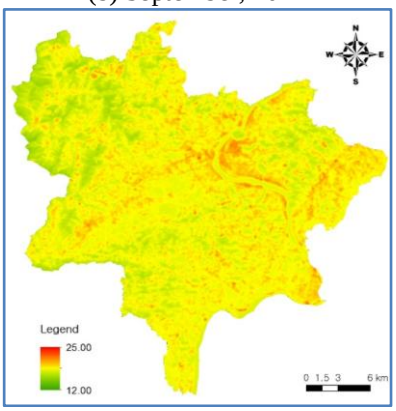
As above, to determine the characteristics of the surface temperature of 12 types of biotope detailed evaluation index calculates the surface temperature using Landsat satellite images and analyzed the distribution of each evaluation index by temperature. Figure 2 shows land surface temperature results using Landsat satellite images. As shown in this figure (a), the region of forest is warmer than flatland in winter. On the other hand, the region of flatland is warmer than forest in fall. We could know that forest buffers warm in winter and cool in fall.



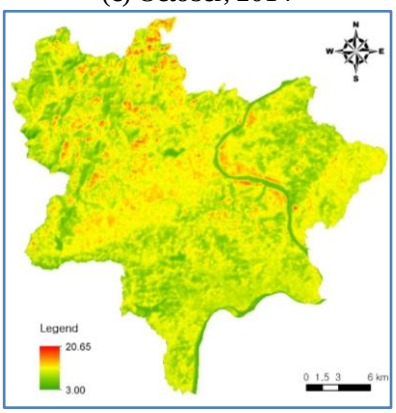
(a) January, 2014



(b) September, 2014



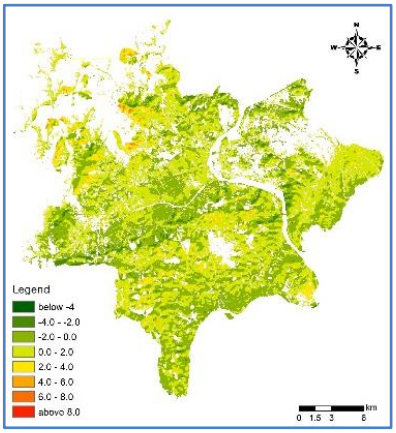
(c) October, 2014



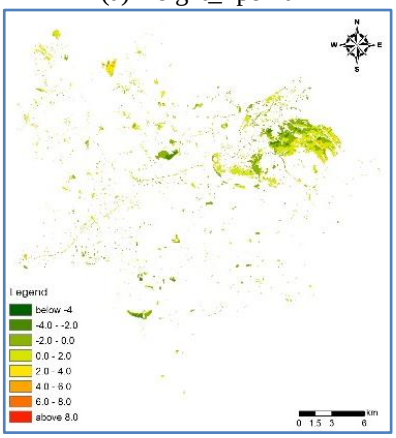
(d) March, 2015

Figure 2: Land surface temperature results using Landsat satellite images

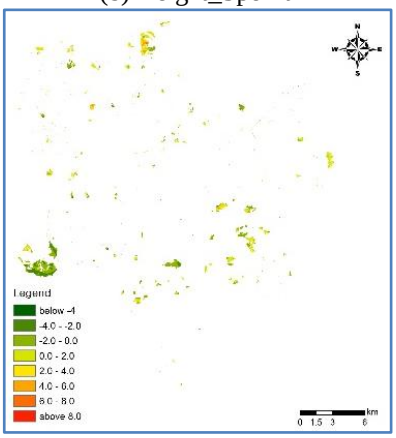
We divided the result images of land surface temperature by index to recognize the effects in accordance with Biotop indexes. Average temperature for each score was calculated separately using the evaluation score from 1 to 5 according to Biotop indexes. This is because we wanted to know the detail relation between land surface temperature and each index. Figure 3 shows the land surface temperature results according to Biotopindexes on January, 2014. As seen in this figure, we masked and calculated the results of land surface temperature about the other three period.



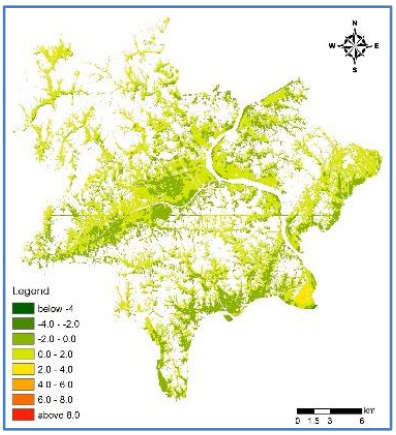
(a) Height_1point



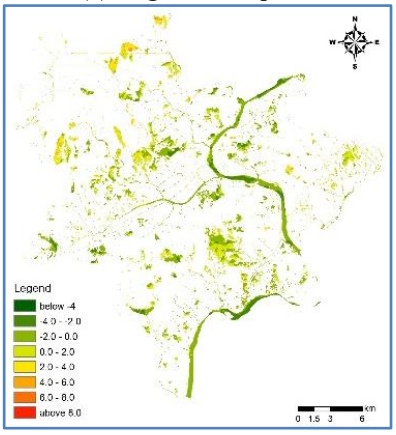
(b) Height_3point



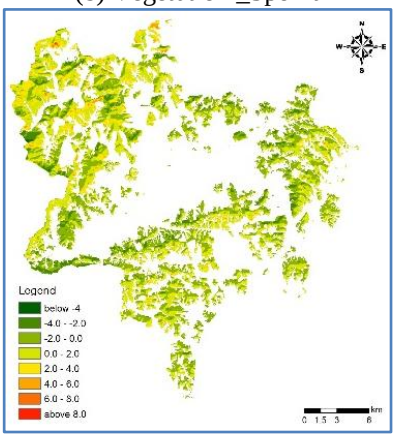
(c) Height_5point



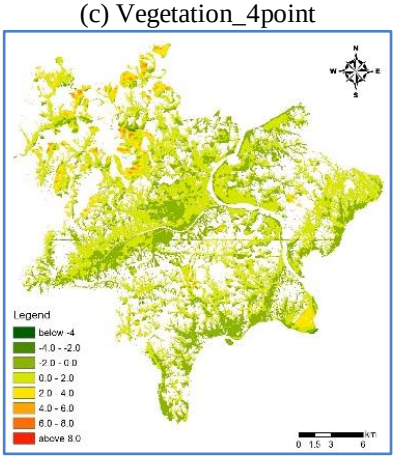
(a) Vegetation_1point



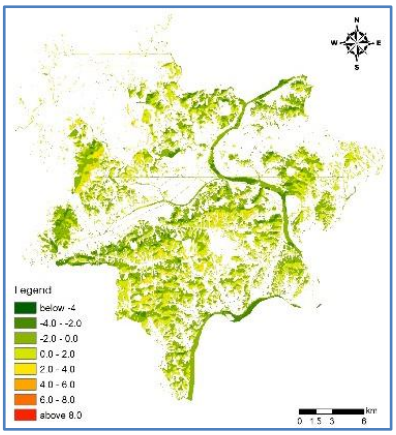
(b) Vegetation _3point



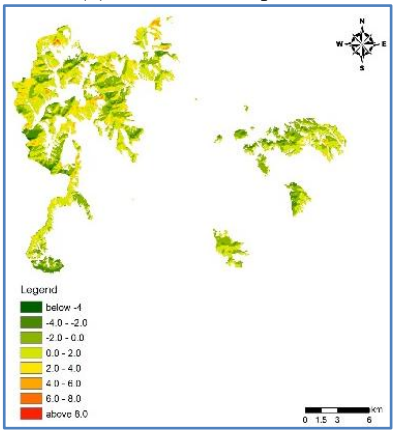
(c) Vegetation_4point



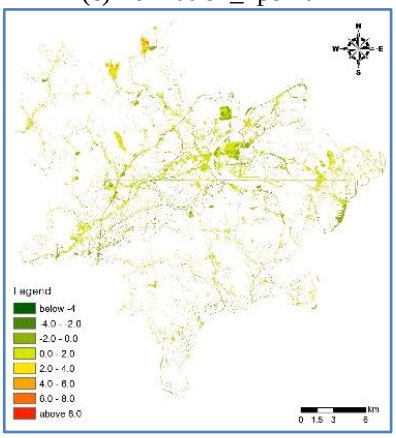
(a) Formation_1point



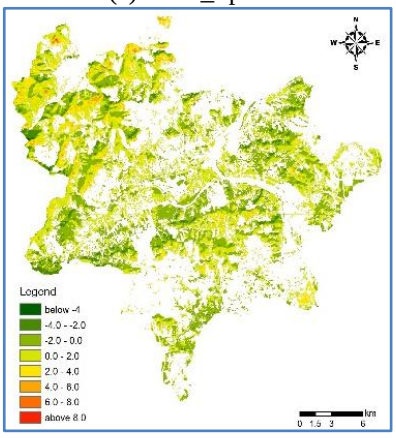
(b) Formation _3point



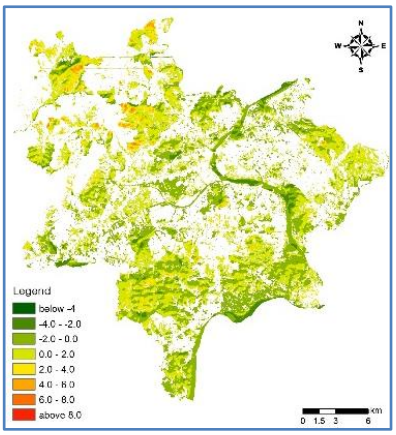
(c) Formation_4point



(a) Road_1point



(b) Road_3point



(c) Road_5point

Figure3: Land surface temperature results according to Biotopindexes on January, 2014

Analysis of Processing Results

We arranged the time serial land surface temperature resultsaccording to twelveBiotop indexes in Table 1. The characteristic things in this table are the indexes of height, vegetation layered structure, formation period, and separation distance with road. In case of height index, it can be seen that the higher score is lower temperature on the same period. Also, in case of vegetation layered structure, formation period, and separation distance with road, it can be seen that the higher score is lower temperature.

Table 1: Time serial land surface temperature results according to Biotopindexes (unit :℃)

Slope	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.278599093	22.32843003	16.74100885	11.96005469
2points	-0.088701183	22.16174028	16.66116189	10.85672652
3 points	0.720746777	20.60288022	15.16041154	10.60232393
4 points	-0.042420786	20.85839833	15.51095253	9.999731955
5 points	0.090669968	21.41310403	15.78655942	10.66542746
Area	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.630077000	22.78337325	17.00968572	12.44159287
2points	0.607539928	23.30390983	17.42354939	12.95659582
3 points	0.279564124	22.52188217	16.97893382	12.60932416
4 points	0.280631091	22.20534586	16.53780451	11.84844466
5 points	0.154592055	21.14388470	15.73801645	10.27377429
Shape	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.404291872	22.65338682	17.01574403	12.47387855
3 points	0.337211444	22.69993061	17.08735687	12.69517104
5 points	0.229561660	21.57572797	16.07140157	10.86925455
Height	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.218323781	22.22197038	16.67769889	11.83718708
2points	0.110249351	22.23161901	16.70266767	11.37551413
3 points	0.267630912	22.45065212	16.64195842	11.34966148
4 points	0.703075448	20.87802528	15.37702175	10.84278659
5 points	0.137130768	21.43251378	15.99056558	10.73550497
Green	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
0 point	0.372139757	23.61292722	17.62966594	12.71271534
1 point	0.44012548	23.78825490	17.60316780	12.77533679
2points	0.664872586	24.01321021	17.84057272	12.96498062
3 points	0.240481459	21.85824536	16.37946956	10.96454134
4 points	1.083828776	22.49687415	16.68483742	12.93654280

5 points	0.197765158	21.66429975	16.22926663	11.33200781
Vegetation	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
0 point	0.372134976	23.61294345	17.62964016	12.71275025
1 point	0.331841644	22.65051904	17.07953055	12.75797505
2 points	1.077868887	22.77152901	16.85740267	12.72477998
3 points	-0.058419280	22.01556222	16.49936611	10.67896608
4 points	0.125180078	21.02351598	15.60769167	10.26502147
Use	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.488021170	22.55724845	16.96603828	12.80466745
3 points	0.527170156	23.51147216	17.41205035	12.22483621
5 points	0.088335784	21.44268081	15.96161514	10.47741585
Layer	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
0 point	0.372134976	23.61294345	17.62964016	12.71275025
1 point	0.294340150	22.44640794	16.92254385	12.33697795
3 points	0.899031604	23.37243661	17.26641816	12.90131021
5 points	0.160987976	21.22243915	15.75896997	10.46841141
Pavement	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
0 point	0.373493440	23.47221445	17.56575409	12.75829305
1 point	0.636693184	24.02780604	17.71679419	13.50001841
2points	0.579001358	24.77608050	18.29857535	13.18797370
3 points	0.643936165	23.96140176	17.80155618	12.83824259
4points	0.660859268	24.39851897	18.05036038	12.58618184
5points	0.232038935	21.72349183	16.26939161	11.33668078
Formation	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.485407806	22.68021551	17.02624943	12.75445080
3 points	-0.126327202	21.72465928	16.26642450	10.45945550
5 points	0.478771415	20.67233144	15.23124772	10.31495987
Road	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.512868158	23.69786958	17.62041954	12.86910796
3 points	0.262188495	21.73916229	16.18823416	11.43820653
5 points	0.246445766	21.93279047	16.49136863	11.43028577
Water	**6 Jan. 2014**	**19 Sep. 2014**	**5 Oct. 2014**	**14 Mar. 2015**
1 point	0.329269885	23.55512852	17.60131559	12.71773273
3 points	0.592181283	24.01994959	17.75719569	12.66447524
5 points	0.271299404	21.93519222	16.40672017	11.51431882

However, we could not find the correlation between the Biotop indexes and land surface temperature except for these four indexes.

Conclusions

In this study, we acquired and processed the Landsat satellite images of four seasons to recognize the relationship between Biotop indexes and land surface temperature in Buyeo-gun.At first, we calculated the land surface temperature using NASA equation. Then we separated the results of temperature according to Biotop index. As a result, we could recognize the followings.

First, we could know that the higher score is lower temperature on the same period in case of height index. Also, in case of vegetation layered structure, formation period, and separation distance with road, higher score is lower temperature.

Second, we could recognize that the other indexes except for four indexesheight, vegetation layered structure, formation period, and separation distance with road) are low relevant with land surface temperature.

These results will be able to utilize the basic data on eco-friendly urban management. Also, it is expected to analyze the land surface temperature and Biotop indexes through the continuous study.

Acknowledgments

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education(No. NRF-2012R1A1A2009156).

References

[1] "The Korea Society of Environmental Restoration Technology", 2004, Landscape Ecology, Bomoondang.

[2] Sukopp, H., and Weiler, S., 1988, "Biotop mapping and Nature Conservation Strategies in Urban Areas of Federal Republic of Germany, Landscape and Urban Planning", 15, pp.39-58.

[3] Leser, H., 1991, "Landschaftsökologi(3. Aufl), UTB", Stuttgart: Eugen Ulmer.

[4] Cho, H. 2012,"The Development and Application of Landscape Planning Model based on Biotop Mapping", Thesis of the degree of Doctor, pp.7-8.

[5] Lee, J., Yun, H., Kim, W., and Baek, S. H., 2014,"Calculation of the Average Earth Surface Temperature according to Biotop Type using Satellite Image". Proceedings of Korean Society of Civil Engineering 2014 Conference, pp.1691-1692.

[6] Liu, Y., and Yue, H., 2015, "Vegetation Monitoring in Shendong Mining Area by Remote Sensing", International Journal of Signal Processing, Image Processing and Pattern Recognition, 8(6), pp.135-144.

[7] Yun, H., Jung, K., and Lee, J., 2013,"Monitoring of Temperature Change about Cheonji for Bio Ecology Environmental Management", International Journal of Bio-Science and Bio-Technology, 5(4), pp.81-90.

[8] Yun, H., Kim, M., and Jung, K., 2013,"Analysis of Temperature Change by Forest Growth for Mitigation of the Urban Heat Island", Journal of the Korean Society of Surveying, Geodesy, Photogrammetry and Cartography, 31(2), pp.143-150.

[9] Luo, Y. M., andLiao, M. H., 2014, "A Clonal selection Algorithm for Classification of Mangroves Remote Sensing Image", International Journal of Control and Automation, 7(4), pp.395-404.

[10] Jee, J. B., and Choi, Y. J., 2014,"Conjugation of Landsat Data for Analysis of the Land Surface Properties in Capital Area", Jour. Korean Earth Science Society, 35(1), pp.54-68.

[11] Kwon, H., Yang, H., Yi, C., Kim, Y., and Choi, Y., 2015, "Urban Climate Impact Assessment Reflecting Urban Planning Scenarios", J. Environ. Impact Assess., 24(2), pp.134-153.

[12] Lee, J., and Yun,H., 2015, "Space Analysis between the Biotop Index and Land Surface Temperature of Satellite Image", Proceedings of International Workshop Architecture and Civil Engineering 2015, 100, pp.139-142.