



Investigation of Surface Temperature Differentiation of Fagus and Quercus Stands by Using Landsat Images

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Abstract. While climatic features of regions affect the variety of tree species and their structures, the vegetation structures of the regions are effective on micro climate. In this study, thermal differentiations in the *Fagus* and *Quercus* stands which are homogenous in structure and are found within the boundaries of Mercanköşk Forest Sub-District Directorate in Şile are presented.

The surface temperature data which is obtained by Landsat TM-5 and Landsat 8 - ETM thermal images during 2011, 2013, 2014 and 2015 is compared statistically in relation to data obtained from the stand. According to the results obtained, it has been found out that there is a difference of surface temperature up to 2.4°C among tree types. This surface temperature difference which is within the boundaries of forest sub-district directorate having similar regional features has an undeniable effect in terms of climate. It has been thought that using this information as a regional inventory in the preparatory studies within the scope of tackling with global warming will be effective on the success to be achieved.

Keywords: Landscape Planning, Micro climate, Remote Sensing, Fagus, Quercus.

Landsat Görüntüleri Kullanılarak Kayın ve Meşe Meşcerelerinin Yüzeysel Sıcaklığı Farklılığının İncelenmesi

Özet. Bölgelerin iklimsel özelliklerinin, ağaç türlerinin çeşitliliğini ve yapısal özelliklerini etkilemesine karşın bitki örtüsü yapısı da mikro iklim üzerinde etkili olmaktadır. Bu çalışmada, bu bilgiye dayanarak, Şile'nin Mercanköşk Orman İşletme Şefliği sınırı içerisinde kalan ve homojen yapı sergileyen kayın ve meşe meşcereleri ele alınarak yüzeysel sıcaklığı farklılıkları ortaya konulmaya çalışılmıştır

2011 Landsat TM-5 ve 2013, 2014 ve 2015 yıllarına ait Landsat 8 - ETM termal görüntüleri üzerinden elde edilen yüzeysel sıcaklığı bilgileri, meşcere verisi ile ilişkilendirilerek istatistiksel olarak karşılaştırılmıştır. Elde edilen sonuçlara göre, iki ağaç türüne ait homojen meşcere alanları arasında 2.4°C'ye varan yüzeysel sıcaklığı farklarının oluştuğu tespit edilmiştir. Bölgesel özelliklerin hemen hemen benzer olduğu şeflik sınırları içerisinde oluşan bu sıcaklık farkı, iklimsel açıdan gözardı edilemeyecek bir etki yaratmaktadır. Özellikle küresel ısınmayla mücadele kapsamında yapılan hazırlık çalışmalarında, bu bilgilerin bölgesel envanter olarak kullanılmasının, elde edilecek başarı üzerinde etkili olacağı düşünülmektedir.

Anahtar Kelimeler: Peyzaj Planlama, Mikro iklim, Uzaktan Algılama, Kayın, Meşe.

1. INTRODUCTION

Recently, the world of science has focused on the anticipated destructions emerging as a result of the global climate changes and has concentrated on developing action plans and adaptation strategies to struggle with probable scenarios. The issue,

which is debated on global warming in the macro scale, is debated on the combined effects of global climate changes and urban climates, which change due to urbanization, and anthropogenic effects in the micro scale. Globally, the factors which have an influence on global climate changes, locally

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have an influence on urban climate and these factors increase the climatic comfort conditions of the cities especially which are on the tropical and mid-latitudes above the critical level [1]. Thus, man who is not in the scope of climatic comfort criteria may encounter with fatal consequences frequently. When current examples are examined, the seriousness of the situation becomes more obvious. Heat waves which are encountered more frequently due to global climate changes have caused the death of 70.000 people in Europe in the summer of 2003 [2], almost 2500 people in 15 days in India in 2015 [3] and 700 people in a week in France in 2015 [4]. Such circumstances have led this issue to be handled under the scope of natural disaster. Besides, the temperatures' increasing above the seasonal normals causes an increase in electric consumption together with agricultural irrigation. For instance it was stated that the increasing electric consumption due to extremely hot weather conditions all over Turkey on 28th July 2015 reached to 866,653 MWh and broke a record and that the electric bill for a day was nearly 333 million lira [5, 6]. That is, increasing human population with its anthropogenic effects together with increasing climatic pressure pose a threat both for health and economy.

Today, humankind is under the pressure of both global climate changes and anthropogenic effects especially in the big cities in the mid latitude. These two incidents have an interdependent and transitive nature; not only they are influenced by the same factors but also they cause pressure on each other. As stated in the abovementioned examples, the incidents, which are not in the scope of comfort criteria, may have fatal dangers. During this process, while man is struggling with global climate changes in the macro scale, he has to struggle with protecting climatic structures of the cities in the micro scale. Heat waves, which are considered as natural disasters by most developed countries, have led to the development of strategies and the preparation of action plans. The preparation process is supported by many scientific studies.

Turkey, where is situated in the mid latitude, is rather unprepared for this problem. Each region has its own climatic characteristics with its geographical location, wind direction and speed, topography, ecological features, surface elements, land use, urban features, population etc. Thus, the strategies, which will be developed, should be prepared by taking the inner dynamics of that region into consideration. This increases the need for regional studies, which will evaluate various factors on climate. Besides, this complex structured problem brings along the need for multidisciplinary studies.

While climatic features of a district have an influence on the vegetation, vegetation also has an influence on the climatic features. The vegetation climate relationship, which influences each other and has a dual interaction, necessitates the development of dual strategies.

In the upcoming years, considering droughts and natural deteriorations when predicting how the climate change in the new climate scenarios will affect forest dynamics and tree adaptations it has become necessary to identify the growth patterns and dispositions of trees under the stand or tree scale [7]. On the other hand, to obtain more fruitful results in the struggle with macro and micro climate changes, conscious forestation efforts which considers structural features of the vegetation have become more important. For instance, the areas covered by leaves from different types of trees can create a temperature differences up to 4°C - 5°C in the micro climate [8].

On the other side, green spaces contribute to the reduction of greenhouse effects by cooling the weather, increasing relative humidity, providing clean air, filtering the air and producing oxygen. The soil and the vegetation first absorb the heat and then send it away by vaporization [9]. These features increase the adaptation ability to climatic changes. Perspiration of the vegetation that retains water or the vaporization in the soil are important factors to cool the air and they can create a difference in temperature up to 1°C – 5°C. The air

stream moving above the trees contribute to cooling the environment by carrying the cool air to the treeless districts [10].

Vegetation, which is used as a natural source to cool the cities decreases the energy amount necessary to cool the air therefore, decreases the use of fossil fuels necessary for electric production. The studies conducted in Atlanta (USA) reveal that in 1975 trees sent 13,6 million tonnes of pollutant away from the atmosphere in one year and made a contribution of 75 million dollars and in 1996 these values were limited to respectively 8,6 million tonnes and 47 million dollars [11]. According to the same study, thanks to the advantages provided by the trees, energy worth 2,8 million dollars is saved. When the issue is dealt with from the point of view of utility theory of value it is obvious that making use of green spaces effectively to struggle with macro and micro climate changes provides great benefits economically.

Today, the importance of conscious forestation is increasing gradually to make the most of forests and green spaces which are necessary natural sources against CO₂ emission speed because of rapidly increasing population, urbanization, consumption and anthropogenic effects.

In the current study, thermal differences are tried to be investigated by examining *Fagus* and *Quercus* stands in the same closeness and growth age, and which have a homogeneous structure in the Şile Mercanköşk Forest Sub-district Directorate, by using remote sensing techniques. The obtained results are aimed to be used in the forestation of both city centres and urban periphery which has an important role in minimizing the temperature rise occurring in the micro climatic structures of the cities and forestation of the district.

2. MATERIALS AND METHODS

2.1. Study Area

The study was carried out within the borders of İstanbul Şile Mercanköşk Forest Sub-district

Directorate. It's neighbours are Yeşilvadi in the east, Ağva in the west, Şile Forest Sub-district Directorate in the North. Within the borders of the directorate there are 9460 ha *Quercus*, 2470 ha *Fagus*, 130 ha carpinus, 201 ha pinus pinea homogenous stands. Together with the other stands there are nearly 12458.3 ha forest areas in sum (Figure 1).



Figure 1. The study area.

Setting is important in certain aspects to reach a reliable result. First of all overall climate features should not have a lot of difference depending on sub-factors and secondly climatic features between homogenous stands of different types should be revealed. In this context, the directory is preferred because the borders of the directory consist of small units and regional characteristics do not have a lot of differences. Besides, anthropogenic effects are decreased by choosing the setting somewhere far away from the city centre.

A district within the borders of the metropolitan İstanbul which has the 1/5 population of the country is preferred as the setting because the study is thought to be a preparation for the landscape practices against increasing climatic brittleness due to the city's rapid growth.

2.2. Data

In the study, satellite imaging and data from the stand are used. In the selection of satellite images, the images from the summer period are used because heat islands are detected more easily then. Besides, since the stand data belongs to 2012, four

years when change of area usage is in the acceptance boundary is preferred. Accordingly, 19.07.2011 Landsat 5-TM and 30.07.2013, 10.07.2014, 29.07.2015 LANDSAT 8 OLI/TIRS data belonging to the area is used. Landsat 2012 image belonging to the area is not used since it could not be found.

As the stand data, data from 2012 belonging to Mercanköşk Forest Sub-district Directorate is used. However, since it is thought that the differentiation of closeness and growth age may create a difference micro-climatically, the areas which have similar closeness and growth age are used together. As a result of this elimination, homogenous *Fagus* and *Quercus* stands which have similar closeness and growth age are used.

2.3. Method

The basic hypothesis of the study is that different tree species have different thermal characteristics which can affect the micro-climatic structure. Climate studies are both multi-parameter studies, which evaluate issues using different scales and details, and have time and period differences. In the climatic studies which have a complex structure, the selection of scale, parameter and period have a great importance for the accuracy of the analysis. Besides, the analysis method of this complex structure is also an important factor influencing the accuracy of evaluation.

In the studies, it is necessary to approach the topic with a far-reaching point of view and to create real-like modelling with up-to-date data. In this respect, geographical information systems (GIS) and remote sensing methods are important tools of the processes such as analysis, evaluation, decision-making and developing strategies. They are necessary tools for climatic studies because they not only pave the way for observing very large areas and identifying problematic points but also they have features such as proving a holistic approach for planning, enabling the integration of multiple data, being updatable and enabling time changes [12]. Especially in the climate studies another advantage of remote sensing is that it

enables visualizing heat on large areas and obtaining a great amount of thermal data at a sitting [9]. Furthermore it also enables measuring many factors about vegetation such as perspiration, vegetation stress, NDVI and canopy temperature [8]. In the light of this information, in this study, which used GIS and remote sensing effectively the workflow, consisted of image processing, arrangement of the stand data on the database, association of thermal images with the stand data, statistical analysis, results and forming planning suggestions.

The study is carried and discussed on the basis of surface temperatures. Surface temperatures are different from air temperatures in terms of measurement techniques. Remote sensing techniques are used as the most effective method for determining surface temperatures [13, 14]. However, there are also many studies that show the high correlation between air temperatures and surface temperatures which are obtained from remote sensing techniques [15-18].

On the other hand, this study is mandatorily handled in this context, because it involves the period between the years 2011-2015 and because we can't make any measurements parallel to past with terrestrial measurements. So, the use of remote sensing techniques have been deemed suitable for this study taking support from researches both mentioned and not mentioned above.

Before image processing, calibrations of the images of Landsat TM-5 and Landsat-8 OLI were made according to the landsat parameters which were given in metadata. By this way, spectral radiance values L_{λ} ($W/(m^2 * sr * \mu m)$) were obtained [19].

In order to calculate surface temperature, emissivity and NDVI values, which highlight reflection characteristics of surface elements, are used. Emissivity emerges with the electromagnetic wave releasing ability of the objects. The emissivity value is not only dependent on the creation of objects but also to

the surface roughness, physical properties of the object, and angle and wavelength. On the large scale, it is very difficult to calculate surface emissivity values, and this process is usually achieved based on certain hypothesis. Van de Griend and Owe [20] by doing a series of thermal band emissivity and normalized vegetation index (NDVI) calculations (eq. 1) in the natural environment, have found that there is a high correlation logarithmic connection between them (eq. 2). Generally the emissivity value of the dry soil is lower since the vegetation is more humid. The ε value is calculated based on Van's formula. Then, according to the radiative transfer equation

(eq. 3) given by Jiménez-Muñoz et al. [21], the radiation brightness values were calculated. Then by using eq. 4, the land surface temperature (T_s) values were calculated and land surface temperature images (Figure 2) were obtained.

$$\text{NDVI} = (\text{Band4} - \text{Band3}) / (\text{Band4} + \text{Band3}) \quad (1)$$

$$\varepsilon = 1.0094 + 0.047 \ln(\text{NDVI}) \quad (2)$$

$$L_\lambda = [\varepsilon_\lambda L_\lambda(T_s) + (1 - \varepsilon_\lambda) L_{\lambda \text{ atm} \downarrow}] \tau + L_{\lambda \text{ atm} \uparrow} \quad (3)$$

$$T_s = K_2 / \ln((K_1 / L_\lambda) + 1) \quad (4)$$

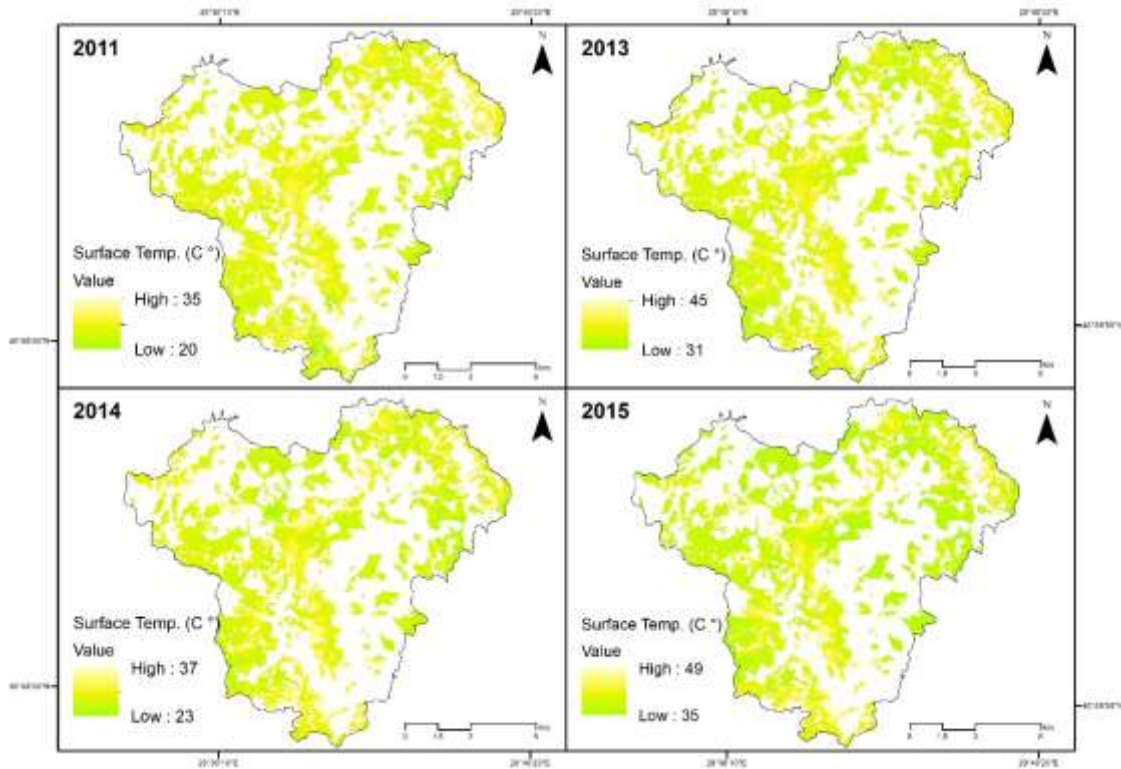


Figure 2. Years of surface temperature images.

In this study, the possible changes in surface temperatures are considered due to the instantaneous meteorological situations or different exogenous factors by using the images of 4 different years and by examining the correlations of these images with each other. Between the surface temperatures of these images, high correlations were determined in the range from 0.701 to 0.866 at 0.01 significance level.

These high correlations show that the images can be evaluated together.

Subsequently, the effects of the elevation, slope and the aspect values on surface temperatures are examined by regression analysis. The results show that, the topographic factors have no significant effect on surface temperatures. So, based on these results, topographic factors are not used as parameters.

As stand data, homogenous structured areas, which are obtained by making use of stand codes in the database are used (Figure 3).

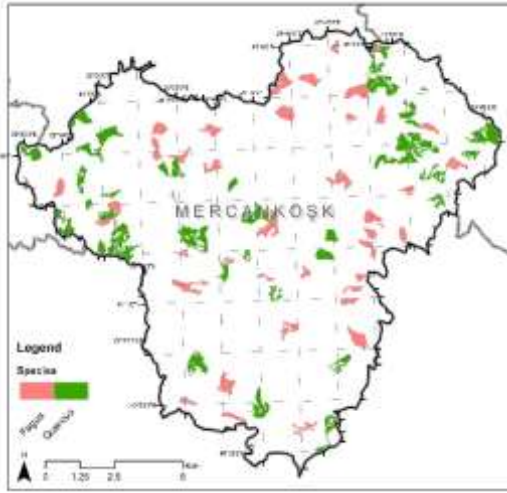


Figure 3. *Fagus* and *Quercus* stands which are used.

In this area, homogenous stands of *Pinus Pinea*, *Carpinus*, *Fagus* and *Quercus* are observed. However, in order to identify the climatic effect created by the vegetation better, taking closeness and growth age, which will make a difference into consideration, *Fagus* and *Quercus* stands with a similar structure, are assessed. In the area the closeness in *Fagus* stands is 3, growth ages are 0-1-2-3; the closeness in the *Quercus* stands is 0-2-3, growth ages are 0-1-2-3-4. Therefore, the study is conducted by taking closeness 3 and growth ages 1-2-3, which are common values in both vegetation species. Since the area proportion of *Fagus* stands is rather lower than the area proportion of *Quercus* stands, areas with a similar size near the *Fagus* stands are selected as sample *Quercus* areas. In this study, which is evaluated based on pixels, data base is formed by associating thermal images belonging to 4 different years to the stand data and surface temperature differentiation of *Fagus* and *Quercus* stands is examined by using independent variables t test with a confidence interval of % 95.

3. RESULTS AND DISCUSSION

According to the results obtained from T tests, the average surface temperature of *Quercus* and *Fagus* stands differentiate from each other within all years of the study. The comparison table which

is prepared based on the results of the T test ($t_{0,05;df} = t$) conducted to compare the surface temperature grades of *Quercus* and *Fagus* stands can be seen below (Table 1). When the significance level of the results are examined, the *Quercus* and *Fagus* stands have significantly differentiated from each other in terms of thermal structure in all years except for the 2013 year which have a closeness level of 3 and growth age level 3 (Table 2). Average surface temperature values of the years 2011 - 2013 - 2014 and 2015 can be seen in Table 2 and surface temperature differences between the two species and their graphical illustrations are shown in Table 3.

When the average temperature values and the temperature differences between the two groups are examined it has been identified that the growth ages of the trees are influential on the thermal characteristics of tree species; the *Fagus* stands are nearly 0.7°C – 1.6°C cooler than the *Quercus* stands in the 1st and 2nd growth ages however the *Quercus* stands are 1.1°C – 2.4°C cooler than the *Fagus* stands in the 3rd growth age.

Different plant species exhibits different thermal characteristics that can be used to control and regulate indoor and outdoor thermal comfort [22], [23]. In recent years, researches on this subject have gained importance. Some of these studies applied with terrestrial measurements and some of them applied with thermal cameras. For instance, a study conducted by Leuzinger and Körner [8] which compared the surface temperatures measured with thermal cameras, the maximum difference was found 4.5°C between *Larix* and *Tilia* species. In the same study, 2.2°C mean temperature difference was found between *Quercus* and *Fagus* species. According to Lin and Lin's [24] research results, Elastic being the most effective tree in the sense of cooling effect, followed by *Parvifolia* and *Microcarpa*. The results of analysis revealed that there were significant differences in the magnitude of temperature reduction, which ranged from 0.64 °C to 2.52 °C, under different tree groups. In another study by Abreu-Harbich et al. [25], a cluster of *S. Siamea*, *C. Pluviosa* and *T.Tipu* trees had the best

cooling effects with their shading reducing the air temperature by 5.9°C – 11.5°C was found.

According to the results obtained from this study, it has been identified that the *Quercus* and *Fagus* species in the 3rd growth age can create 1.1°C – 2.4°C surface temperature difference which can also effect the micro-climate. This range is compatible with the results of Leuzinger and Körner's [8] study where *Quercus* stands mean surface temperature was 2.2°C cooler than *Fagus* stands. On the other hand, 1st and 2nd growth ages results were found different from the 3rd growth age (Table 3). According to this, *Fagus* stands are nearly 0.7°C – 1.6°C cooler than the *Quercus*

stands. This dual result can be caused by the soil effect which increases if the plants have not reached sufficient growth level. But, more detailed studies supported by terrestrial and remote sensing measurements are needed to clarify the causes of this dual situation.

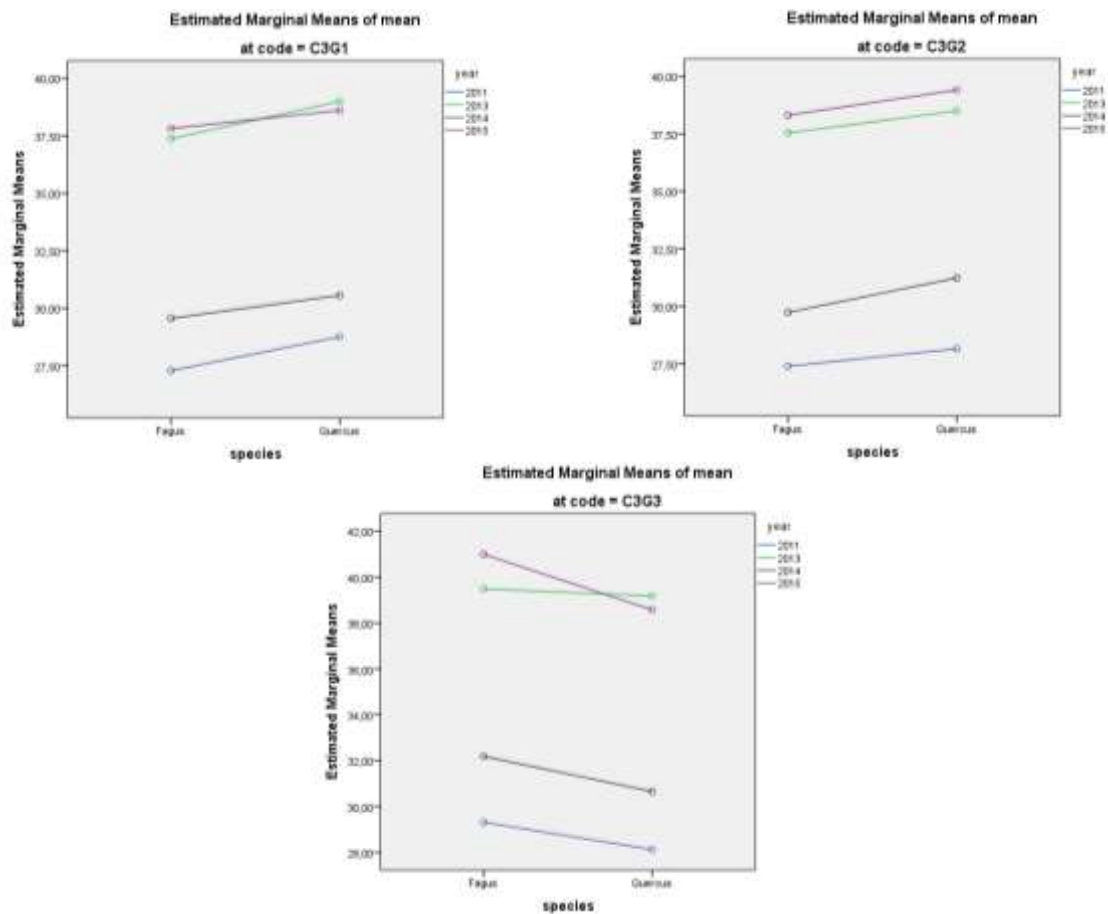
In addition, it must be mentioned here that the stand data used in the study was accepted as correct due to it was obtained via the Forest Directorate. Therefore, it should be noted that possible errors in stand data will affect the results of the study.

Table 1. Descriptive statistics.

Closeness / Growth Age	Year	Species	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
							Lower Bound	Upper Bound		
Closeness: 1 / Growth Age: 1	Ts 2015	Fagus	4233	37.8240	1.48307	.02279	37.7793	37.8687	35.62	48.83
		Quercus	6157	38.6111	1.43125	.01824	38.5754	38.6469	36.01	46.61
		Total	10390	38.2905	1.50313	.01475	38.2616	38.3194	35.62	48.83
	Ts 2014	Fagus	4233	29.5603	1.50698	.02316	29.5149	29.6057	23.97	38.96
		Quercus	6157	30.5653	1.72338	.02196	30.5223	30.6084	24.34	39.00
		Total	10390	30.1558	1.71140	.01679	30.1229	30.1888	23.97	39.00
	Ts 2013	Fagus	4233	37.3802	2.02782	.03117	37.3191	37.4413	32.16	49.04
		Quercus	6157	39.0060	1.87797	.02393	38.9591	39.0530	33.74	49.01
		Total	10390	38.3436	2.09836	.02059	38.3033	38.3840	32.16	49.04
	Ts 2011	Fagus	4233	27.2850	1.79389	.02757	27.2309	27.3391	24.02	39.31
		Quercus	6157	28.7610	2.37858	.03031	28.7016	28.8204	21.51	40.16
		Total	10390	28.1597	2.27801	.02235	28.1159	28.2035	21.51	40.16
Closeness: 2 / Growth Age: 2	Ts 2015	Fagus	762	38.3181	2.28832	.08290	38.1553	38.4808	36.00	47.52
		Quercus	860	39.4200	2.43673	.08309	39.2569	39.5831	35.67	46.04
		Total	1622	38.9023	2.43052	.06035	38.7839	39.0207	35.67	47.52
	Ts 2014	Fagus	762	29.7377	2.06851	.07493	29.5906	29.8848	27.37	38.79
		Quercus	860	31.2395	1.91890	.06543	31.1111	31.3679	28.15	37.46
		Total	1622	30.5340	2.12652	.05280	30.4304	30.6375	27.37	38.79
	Ts 2013	Fagus	762	37.5456	2.27976	.08259	37.3835	37.7078	35.16	46.22
		Quercus	860	38.5041	2.44960	.08353	38.3402	38.6681	34.35	48.29
		Total	1622	38.0538	2.41841	.06005	37.9361	38.1716	34.35	48.29
	Ts 2011	Fagus	762	27.3950	2.08832	.07565	27.2465	27.5435	24.06	35.86
		Quercus	860	28.1542	2.35573	.08033	27.9965	28.3118	22.99	37.05
		Total	1622	27.7975	2.26534	.05625	27.6872	27.9078	22.99	37.05
Closeness: 3 / Growth Age: 3	Ts 2015	Fagus	56	41.0003	2.69988	.36079	40.2773	41.7234	37.22	46.31
		Quercus	69	38.5774	1.15182	.13866	38.3007	38.8541	37.23	42.74
		Total	125	39.6629	2.32899	.20831	39.2506	40.0752	37.22	46.31
	Ts 2014	Fagus	56	32.1892	2.44994	.32739	31.5331	32.8453	29.40	37.65
		Quercus	69	30.6534	.94139	.11333	30.4273	30.8795	29.22	33.25
		Total	125	31.3414	1.93294	.17289	30.9992	31.6836	29.22	37.65
	Ts 2013	Fagus	56	39.4941	2.40828	.32182	38.8491	40.1390	36.37	44.03
		Quercus	69	39.1819	1.40033	.16858	38.8455	39.5183	37.20	43.49
		Total	125	39.3218	1.91628	.17140	38.9825	39.6610	36.37	44.03
	Ts 2011	Fagus	56	29.3145	2.39596	.32017	28.6729	29.9561	26.60	32.73
		Quercus	69	28.1235	1.43669	.17296	27.7784	28.4687	25.77	32.06
		Total	125	28.6571	2.00792	.17959	28.3016	29.0126	25.77	32.73

Table 2. Average surface temperature values and average differences of *Fagus* and *Quercus* stands by years, closure groups and growth ages.

Closeness / Growth Age	Year	Mean		Mean Difference	Sig. (2-tailed)	% 95 Confidence Interval of the Difference	
		Fagus T(°C)	Quercus T(°C)	Quercus – Fagus $\Delta T(^{\circ}C)$		Lower	Upper
Closeness: 3 Growth Age: 1	Ts 2015	37.8240	38.6111	0.7871	0.000	0.7160	0.8344
	Ts 2014	29.5603	30.5653	1.0050	0.000	1.0935	0.9701
	Ts 2013	37.3802	39.0060	1.6258	0.000	1.4457	1.5909
	Ts 2011	27.2850	28.7610	1.4760	0.000	1.4357	1.2785
Closeness: 3 Growth Age: 2	Ts 2015	38.3181	39.4200	1.1019	0.000	0.8708	1.3330
	Ts 2014	29.7377	31.2395	1.5018	0.000	1.3075	1.6960
	Ts 2013	37.5456	38.5041	0.9585	0.000	0.7271	1.1899
	Ts 2011	27.3950	28.1542	0.7592	0.000	0.5411	0.9772
Closeness: 3 Growth Age: 3	Ts 2015	41.0003	38.5774	-2.4229	0.000	-3.1344	-1.7115
	Ts 2014	32.1892	30.6534	-1.5358	0.000	-2.1701	-0.9015
	Ts 2013	39.4941	38.1819	-1.3122	0.367	-0.9950	-0.3705
	Ts 2011	29.3145	28.1235	-1.191	0.000	-1.8765	-0.5054

Table 3. Surface temperature difference charts of fagus and quercus stands by years, closeness groups and growth ages.

4. CONCLUSION

Along with the increasing urbanization, the structure of vegetation, which emerges to be a factor in the solution of many physical and ecological problems, is one of the emphasized issues of recent years. It is considered as a parameter in many topics such as improvement of the urban climate, decreasing air pollution, absorption of noise and productive energy usage. Today many of the urban governments carry out studies of landscape planning and city forestry by making use of biological features of the vegetation with a more conscious approach in order to benefit from the urban vegetation more effectively in their studies.

Green spaces have a great role in the regulation of urban climate. Shading and perspiration and vaporization processes of the vegetation have a natural cooling mechanism function in the urban areas [1]. Many studies conducted in various cities in the world have shown that urban parks and park areas in the city centers create a surface temperature difference of 2°C – 8°C [26]. In this era when we feel the effects of global climate change more day by day, the necessity of creating future-proof plans and strategies is inevitable. In this context, the maximum advantage principal should be taken into account in the forestation practice as one of the most effective tools of the struggle. So, not only natural stands but also in the green spaces and parks which are created artificially; the species, their closure levels, growth ages, and landscaping should be tackled in a planned way.

In this article, it has been emphasized that climatic efficiency should be featured and put on the agenda in the forestation practices and regional inventories should be formed. A meticulous study is necessary for the attempt to associate the climate factor which is a far-reaching and complex issue with forest ecology which also has a complex structure. Therefore, in the study which is conducted within the scope of the information which is obtained by the available data in order to decrease the effects of various factors, the areas with similar features in the homogenous stands

are compared within the borders of the directory. In this study, only *Quercus* and *Fagus* trees are compared since only these trees are found suitable to the study when certain features such as homogenous structure, closeness and growth age are evaluated together. However, in Turkey where there are essentially 37 tree species [27], it is necessary to evaluate other tree species in order to develop future-proof and serious strategies. It is obvious that an inventory which will be prepared in this respect will contribute to urban landscape practices.

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