Comparison of the Impacts of Coniferous and Deciduous Trees on Land Surface Temperature Changes (Case Study of Shahid Chamran Park in Karaj and Chitgar Park in Tehran)

- Mohammadreza Rafighi [1]
- Mehry Akbary [2]
- Mohammad Hassan Fakharnia [3]
- Mohammad Hassan Vahidnia [4]

[1] Kharazmi University

[2] Associate Professor, Faculty of Geographical Sciences, Khwarazmi University

[3] MSc in Remote Sensing and GIS, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran

[4] Assistant Professor, Department of Remote Sensing and GIS, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran

Introduction

Although the air layer adjacent to the earth's surface - the boundary layer - is a small fraction of the entire atmosphere, the processes that take place on a small scale are very important to human life and activites. Among living organisms, plants and especially trees have undeniable effects on surface temperature and especially in urban environments have several balancing effects. This research was carried out using Landsat 8 satellite imagery and with Arc GIS software to compare the surface temperature of the earth in two areas with vegetation of coniferous trees (Chitgar Park) and broadleaf trees (Shahid Chamran Park).

The values of Radiance, Reflectance, Brightness Temperature, Normalized Difference Vegetation Index, Proportion of Vegetation and Emissivity and then Land Surface Temperature were calculated and generated. A total of 1700 points were harvested from Chitgar Park and 800 points from Chamran Park. In SPSS software, Leven test (F) statistics was used to prove the homogeneity of variances of the samples and parametric tests (T with two independent samples) were used to prove the significant difference between the surface temperature of the earth in the mentioned areas. According to Leven test, the value was Sig = 0.409 (P_value), which confirms the homogeneity and equality of variance of the studied samples. Also, in the T test, the value was Sig = 0.000, which is less than 0.05, which means a significant difference. Therefore, the difference between the surface temperature data of the two parks was proved. Also, by comparing the graphs of LST values in the two groups, we found that Chitgar Park has a higher surface temperature than Chamran Park. In the current dilemma of the century, global warming, knowing these local realities and providing logical solutions to reduce surface temperature at the regional and regional scales as a whole can effectively solve the problem of global warming on a global scale.

Data and Method

The data used in this study is a Landsat 8 satellite imagery with the acronym: 8 (LC08_L1TP_165035_20190706) is LANDSAT.

Retrieved July 6, 2019 from the USGS website.

Production of component images for Shahid Chamran Parks in Karaj and Chitgar in Tehran:

The surface temperature image was generated step by step using the Landsat 8 satellite image using the Raster Calculator command in the ArcMap software environment. First, relevant and effective indicators in calculating the surface temperature of the earth, Top of atmospheric radiance, reflectance, Brightness Temperature, normalized difference vegetation index, proportion of vegetation, emission coefficient (emissivity), calculation and their images are produced and then the land surface temperature, It was calculated and produced according to the following mathematical formulas.

Step 1: Produce a spectral radius image from above the atmosphere

To obtain the brightness temperature, the image must first be converted to radius. Therefore, the gray DN values of bands 10 and 11 of the Landsat 8 satellite TIRS sensor should be converted to high atmospheric radius separately with the help of the MTL file, which is an extension of the Landsat image (Tables 1, 2 and 3).

Formula (1) :Calculate the radius of the upper atmosphere

TOA (Lλ) = ML * Qcal + AL

Lλ = (Watts / (m2 * srad * μm)) The radius of the atmosphere in terms of

ML = Multi-band radius_ 10 band

Step 2: Produce an image of the light temperature above the atmosphere

After converting the DN values of bands 10 and 11 to high atmospheric radii, we converted these two corrected bands to Brightness Temperature.

BT = (K2 / (ln (K1 / L) + 1)) - 273.15 Formula (2): Calculation of Brightness Temperature BT = Atmospheric Brightness Temperature (° C)

Lλ = (Watts / (m2 * srad * μm)) Radius of the atmosphere in terms of

BT = (1321.0789 / Ln ((774.8853 / "% TOA%") + 1)) - 273.15

K1 = K1 Constant Band (No.), K2 = K2 Constant Band (No.)

Step 3: Produce vegetation index image

formula (3): normalized difference vegetation index image was generated using

NDVI = (Band 5 - Band 4) / (Band 5 + Band 4)

Step 4: Produce a proportion of vegetation image

The proportion of vegetation image was generated using normalized difference vegetation index.

formulas (4):Calculate the proportion of vegetation

PV = (NDVI - NDVImin / NDVImax- NDVImin) 2

PV = Square (("NDVI" - 0.216901) / (0.632267 - 0.216901))

Step 5: Produce the Emissivity image

Emissivity image was generated using formula (5)

ε = 0.004 * PV + 0.986 Formula (5): Calculate the Emissivity coefficient

Step 6: Produce an image of the earth's surface temperature

Land surface temperature image was generated using formula (6).

Formula (6) :Calculate ground land surface temperature

LST = (BT / (1 + (0.00115 * BT / 1.4388) * Ln (e)))

Results and Discussion

Text Comparison of surface temperature phenomena (LST)

According to Table (6), the highest land surface temperature with 44.42 ° C belongs to Chitgar Park, which is covered with coniferous trees, and the lowest in Shahid Chamran Park, in Karaj with 28.09 ° C with broadleaf trees. Has been. According to Tables (7) and (8), the lowest temperature of Chamran Park is 28.09 ° C and the highest is 36.51 ° C and the lowest temperature of Chitgar Park is 34.74 ° C and the highest is 44.42 ° C. . According to Figure (22), Chitgar Park

with an average surface temperature of 38.92 ° C is warmer than Shahid Chamran Park with an average land surface temperature of 31.39 ° C. Figure (23) shows a red graphic showing the surface temperature of the ground in Chitgar Park with coniferous species (pine) and the blue diagram shows the surface temperature of Shahid Chamran Park in Karaj with broadleaf species. It is clear that the temperature is significantly higher in Chitgarh Park. The range of temperature fluctuations in Shahid Chamran Park is between 36.51 - 28.09 ° C and in Chitgar Park is between 42 / 44-74 / 34 which is exactly shown in the diagram. The fact that the red chart is higher than the blue chart explains this correctly. This is due to the lower density of trees in Chitgarh Park as well as the predominant tree species (needle-shaped) due to less shading and more input radiation.
T test with two independent samples:

This test, which is a parametric test, was used to prove a significant difference between the earth's surface temperature in areas with coniferous and deciduous trees. Leven test (F) was used to prove the homogeneity of sample variances and t-test with two independent samples was used to examine the homogeneity of the means of the two statistical populations, which resulted in the following results. As can be seen in Table (12), the value = 0.409 Sig, which is the same value as P_value, is greater than 0.05, ie the variance of the communities is homogeneous and equal. 0.05 is less, which means that the difference is significant. Due to religion, the difference between the land surface temperature data of Shahid Chamran and Chitgar parks is proved.

Conclusion

According to all the findings, Chitgar Park has a higher land surface temperature than Chamran Park, which is due to the lower density of trees and also the type of dominant tree species (needle-shaped). Coniferous species that take up less space than broadleaf species and have less shading. They also make it possible for the sun to collide with the ground due to the fact that the leaves of the adjacent trees do not meet, and this is an important factor in raising the surface temperature in the mentioned park. Species compatible with the climate of the study areas are broadleaf species because they have more leaves shading and care than coniferous species and ultimately cause more climate adjustment. The difference in temperature between the two parks confirms this fact. In the current dilemma of the century, global warming, knowing these local realities and providing logical solutions to reduce surface temperature at the regional and regional scales as a whole can effectively solve the problem of global warming on a global scale.

Key Words: broadleaf, coniferous, land surface temperature, Shahid Chamran Park, Chitgar Park

Refrences:

آزموده مریم؛ حیدری شاهین. (1396). تأثیر دیوارهای سبز شهری برکاهش دمای خرداقلیم ها و اثر جزیره گرمایی شهری، علوم و تکنولوژی محیط زیست، 19(5): 606 -599 .

اسماعیلی مرضیه.«بررسی تاثیر ریشه گونه-های سوزنی برگ و پهن برگ جنگلکاری شده در مسلح سازی خاک)مطالعه موردی: جنگل آموزشی و پژوهشی خیرود، نوشهر(» پایان نامه کارشناسی ارشد در رشته مهندسی جنگل، گروه جنگلداری و اقتصاد جنگل دانشکده منابع طبیعی پردیس کشاورزی و منابع طبیعی دانشگاه تهران، 1394

جمشیدنیا زهرا؛ ابراری واجاری کامبیز؛ سهرابی اکبر؛ ویس کرمی غلام حسن. (1395). تأثیر جنگل‌کاری گونه‌های سوزنی‌برگ و پهن‌برگ بر برخی ویژگی‌های خاک جنگل‌کاری ریمله-لرستان، فصلنامه علمی پژوهش-های خاک وزارت جهاد کشاورزی، 30(3): 365-357.

حجازی رخشاد؛آبادی پریسا. (1381). تاثیر گیاهان بر دمای محیط اطراف (مطالعه موردی پارک طالقانی) نشریه علوم و تکنولوژیِ محیط زیست، 12(1): 45-62.

خسروی محمود؛ قبادی اسدالله. (1386). تبیین جایگاه سامانه بام سبز در تعدیل جزیره حرارتی شهر (نمونه موردی کرج)، دو فصلنامه پژوهش-های بوم شناسی شهری، 2(4): 78 - 67 .

رجب بیگی الهام؛ عرفانیان سلیم رامین؛ جعفری سید محمد. (1393). مروری بر کارایی گیاهان در تعدیل اثرات و سازگاری با تغییرات اقلیمی در محیط-های شهری با تأکید بر صفات عملکردی گیاهان، فصل نامه علوم محیطی، 12(4): 13-24.

روشنی احمد؛ قائمی هوشنگ؛ حجازی زاده زهرا. (1393). تغییرات زمانی- مکانی درازمدت تابش خالص در گستره ایران، جغرافیا و مخاطرات محیطی، 3(9): 72-55.

صالحی آزاده؛ مسعود طبری کوچکسرایی. (1392). امکان سنجی بهبود اقلیم و خاک از طریق توسعه فضای سبز در یک منطقه خشک، علوم و تکنولوژی محیط زیست، 12(1): 41-31

قیصری مهدی؛ اسلامیان سید سعید؛ شفیعیون الهام؛ علیخاصی علی؛ غفاری ششجوانی عباس. (1392). پهنه بندی خرداقلیمی شهر اصفهان بر اساس نوع پوشش سطح، جغرافیا و مخاطرات محیطی، 1(2): 31-21.

علیجانی، بهلول و کاویانی، محمد رضا. (1388). مبانی آب و هواشناسی. انتشارات سمت.

متین کیا معصومه؛ پیله ور بابک؛ متین فر حمید. (1390). اثر جنگلکاری با گونه-های سوزنی برگ و پهن برگ بر برخی از خصوصیات شیمیایی و فیزیکی خاک(مطالعه موردی: پارک جنگلی شهرستان دورود) فصلنامه علمی پژوهشی اکو سیستم-های طبیعی ایران، 2(2): 97-89.

محمد نژاد کیاسری شیرزاد؛ اکبرزاده محمد؛ جعفری بهنوش. (1386). بررسی تنوع زیستی گیاهی در جنگلکاری دست کاشت سوزنی برگ، علوم و فنون کشاورزی و منابع طبیعی، 42(11): 625 –

معماریان فرشید؛ طبری مسعود؛ حسینی سید محسن؛ بانج شفیعی عباس. (1386). مقایسهٔ تنوع زیستی تودهٔ آمیخته سوزنی برگ با تودهٔ آمیخته پهن، محیط شناسی، 42(2): 108-103.

ضوابط طراحی فضاهای سبز شهری، نشریه شماره 203 تجدید نظر اول (معاونت نظارت راهبردی).

Adams, J., (2009), Vegetation-Climate Interaction: How Vegetation Makes the Global Environment, Springer, 1-266.

Bright, M.R., Davin, E., Halloran, O. T., Pongratz, J., Zhao, K., Cescatti, A., (2017), Local temperature response to land cover and management change driven by non-radiative processes, Nature Climate Change, 7: 296–302.

Buis, A., (2019), Examining the Viability of Planting Trees to Help Mitigate Climate Change, NASA's Jet Propulsion Laboratory.

Gordon, H., Scott, C., (2016), Trees Are Way Better at Cooling The Climate Than We Thought, The Conversation.

Gordon, B., David, P., Starly, L, T., (1992), Effects of boreal forest vegetation on global climate, Nature, 359: 716–718.

Kermavnar, J., Vilhar, U., (2017), Canopy precipitation interception in urban forests in relation to stand structure, Urban Ecosystems,20: 1373–1387

Komatsu, H., Kume, T., (2020), Modeling of evapotranspiration changes with forest management practices: A genealogical review, Journal of Hydrology, 585.

Liu, C., Westman, J.C., Berg, B., Kutsch, W., Wang , Z.G., Man, R., Ilvesniemi, H., (2004), Variation in litterfall-climate relationships between coniferous and broadleaf forests in Eurasia, 13(2): 105-114.

Meng, X., Cheng, J., Zhao, S., Liu, S., Yao, Y., (2019), Estimating Land Surface Temperature from Landsat-8 Data using the NOAA JPSS Enterprise Algorithm, Remote Sensing, 155(11): 1-18.

Milius, S., (2019), Planting trees could buy more time to fight climate change than thought, Science News.

Monahan, P., (2016), Europe's trees have been warming the planet,

Naudts, K., Chen, Y., McGrath, J.M., Ryder, J., Valade, A., Otto, J., Luyssaert, S., (2016), Europe's forest management did not mitigate climate warming, Science, 6273 (351): 597-600

Potter, S., Solvik, K., Erb, A., Goetz, J.S., Johnstone, F.J., Mack, C.M., Randerson, T.J., Román, O.M., SchaafL.C., Turetsky, R.M., Veraverbeke, S., Walker, J.X., Wang, Z., Massey, R., Rogers, M.B., (2019), Climate change decreases the cooling effect from) postfire albedo in boreal North America, Global Change Biology, 26(3):

Sheeren, D., Fauvel, M., Josipovi, V., Lopes, M., Planque, C., Willm, J., Dejoux, J.F,. (2016), Tree Species Classification in Temperate Forests Using Formosat-2 Satellite Image Time Series, Remote Sensing, 8(9): 734

Trimarchi, M., (2019), How trees affect the weather Trees' water-use strategies can intensify droughts, University of Utah.

Vatani, L., Hosseini, S.M., Sarjaz, M.R., Alavi, S. J., Shamsi, S.S., Zohd Ghodsi, M.J., (2019), Tree species effects on canopy albedo in temperate forest plantations: comparing conifers and broadleaf trees, Journal of Solar Energy Research, 4(3):188-199

Wade, J., (2017), Forests fight global warming in ways more important than previously understood Trees' role extends beyond carbon consumption, study finds, Ohio State University.

https://isa.ir

http://know.sibche.ir

http://www.iana.ir

https://www.zoomit.ir/2016/10/17/147289/trees-are-way-better-at-cooling-the-climate

https://www.ramgol.com/tag

https://www.ahvaz.ir/news/ID/16293. .(1392 ،کریمی)

https://www.hamshahrionline.ir/news/307040

http://greenlife2020.blogfa.com/post/20. .(1389 ،تیموری)

http://girs.ir/lst-in-arcgis/ .(1398 ،اخوان)

http://girs.ir/lst-remote-sensing/.(1398 ،احراری)