water

MDPI

Article

Impacts of Small Lakes and Underlying Surface Characteristics on Local Thermal Environments in Summer

Xuejun Qi *, Jingjing Wang and Fang Yao

School of Architecture and Civil Engineering, Xihua University, Chengdu 610039, China; wjingjing0111@163.com (J.W.); lxyf8@163.com (F.Y.)
* Correspondence: xuejunqi@foxmail.com

Abstract: In recent years, rapid urbanization in China has significantly altered land use patterns and surface properties, exacerbating the urban heat island (UHI) effect. This study investigates the microclimatic regulation potential of small lakes and their interaction with three distinct underlying surfaces (granite roads, lawns, and woodlands). Hourly measurements of air temperature and relative humidity were conducted from 15 July to 15 August 2024, at Tianlai Lake. The results demonstrate that granite roads exhibited the highest daytime air temperatures due to their low albedo and specific heat capacity. In contrast, lawns and woodlands can reduce surrounding temperatures via latent heat dissipation. The lake's cooling influence extended approximately 30 m from its boundary, with the air temperature decreasing by up to 2 °C near the shoreline. Relative humidity showed a negative correlation with distance from the lake, declining rapidly within 30 m. These findings highlight the role of small lakes in mitigating UHI effects and provide actionable insights for optimizing lakeside underlying surface planning in urban areas.

Keywords: small lakes; underlying surface; thermal environment; relative humidity; air temperature

check for updates

Academic Editor: Robert Sitzenfrei

Received: 21 March 2025
Revised: 24 April 2025
Accepted: 28 April 2025
Published: 29 April 2025

Citation: Qi, X.; Wang, J.; Yao, F. Impacts of Small Lakes and Underlying Surface Characteristics on Local Thermal Environments in Summer. *Water* **2025**, *17*, 1327. https://doi.org/10.3390/w17091327

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

With the increase in urban populations and the expansion of urbanization, urban underlying surfaces have undergone significant changes [1–3]. Urbanization causes urban areas to heat up faster and results in higher air temperatures compared to suburban areas, forming the urban heat island (UHI) phenomenon [4,5]. Anthropogenic heat emissions and indirect solar radiation are the main contributors to the UHI effect. The other factors contributing to the UHI phenomenon include atmospheric pollution and the lack of green plants and water bodies. Moreover, urban development has led to various ecological and environmental problems that not only affect the thermal comfort of urban residents during outdoor activities but also increase building energy consumption [6–8].

Water bodies play an important role in alleviating the UHI effect and regulating local microclimates [9–12]. In order to mitigate UHI, some researchers have proposed establishing urban cooling islands using water bodies [13–15]. Sun et al. found that the cooling effect of a water body was influenced by its surface area, location, shape index, and the surrounding buildings [16]. Robitu et al. studied energy exchange in relation to pond volume and surface area, showing that water bodies effectively reduce the temperature of the surrounding environment [17]. Du et al. observed that water body-based cold islands can effectively relieve urban heat islands, with an average influence range of 0.74 km, reducing temperatures by up to 3.32 °C [18]. Wu et al. found that the cooling effect of water

bodies exists in all four seasons, with the greatest intensity exhibited in summer, followed by autumn, spring, and winter [19]. Sharma et al. investigated the cooling effect of a water body on the surface temperature of Pune city, finding that the cooling range is 350 m [20]. Xu et al. used experimental methods to investigate the influence of a water body on human thermal comfort, showing that thermal comfort was significantly improved in waterfront areas [21].

Generally, urban lakes are considered crucial for providing ecosystem services such as water supply, purification, recreation, esthetics, and the regulation of the urban climate [22–27]. Mahmoud analyzed the influence of lake water on the thermal environment and human comfort, showing that a combination of water cooling, greening, and shading can achieve a good outdoor thermal environment [28]. Gupta et al. reported a significant cooling effect in the nearby region of Sukhna Lake in Chandigarh to a certain effective distance, which is more pronounced in summer than in winter [29]. Dobson et al. studied the temperature changes between the southern coast regions of Lake Erie and inland regions in Pennsylvania using historical data from 1948 to 2017. They found that the annual average temperature for both regions increased, highlighting the lake's heat-storing capacity. By comparing the first fall frosts in the two regions, they observed that coastal regions experienced a delay of 15–20 days compared to the inland region [30]. Cheval et al. revealed that the average land surface temperature increases by 1.0 °C to 1.7 °C within the first 30 m around the lakes and by 2.5 °C to 5.0 °C within the first 300 m from the lake shoreline [31]. Samra investigated the impact of land use/land cover changes in the Toshka Lakes on the land surface temperature using remote sensing and geographic information system techniques. They found a strong negative correlation between land surface temperature and the area of Toshka Lakes [32].

As can be seen from the above, there are few studies on the influence of small lakes on the surrounding thermal environment. Small lakes can optimize the local microclimate and enhance the thermal comfort of the human body. To deepen the understanding of the relationship between the microclimate regulation function of small lakes and underlying surfaces, this study focused on the influence of small lakes and three different underlying surfaces on the local thermal environment in summer. This research will help people understand how urban small lakes affect microclimates and provide a reference for future environmental transformations around small water bodies. Studying the cooling effects of small water bodies not only helps us to understand the operation mechanism of local ecosystems, but also provides a scientific basis for outdoor thermal comfort and water resource management.

2. Study Area and Observations

2.1. Study Area

Chengdu, located in the Sichuan Basin of southwestern China, is characterized by a subtropical monsoon climate with distinct seasonal variations, high temperatures, and high humidity. During summer, the region is predominantly influenced by the Hawaiian High, which drives southeasterly wind patterns. Notably, calm wind conditions occur frequently, accounting for 42% of annual observations. This study takes Tianlai Lake as the research object. Tianlai Lake (103°47′ E, 30°41′ N) is an irregularly shaped freshwater body covering approximately 32,000 m^2, as shown in Figure 1. It is an artificial lake located in a university campus, and the average depth of the lake water in summer is 1.5 m. The lake is surrounded by roads, teaching buildings, libraries, lawns, and woodlands. The distance from the teaching building to the lake is about 100 m, and the library is next to the lake. Usually, the main groups of people at the lake are students and teachers.



Figure 1. Study area. (A) Granite road, (B) lawn, (C) woodland.

2.2. Data Sources

The air temperature and relative humidity were measured every hour at a height of 1.5 m. The meteorological parameters were recorded from 15 July 2024 to 15 August 2024. Based on the land cover of the study area, three typical underlying surfaces were selected for study: a granite road, lawn, and woodland. The physical properties of underlying surfaces are listed in Table 1.

Table 1. Thermodynamic properties of underlying surfaces.

Underlying Surfaces	Specific Heat Capacity kJ/(kg·°C)	Surface Albedo
Granite road	0.80	0.12
Lawn	3.20	0.25
Woodland	2.70	0.17
Water	4.18	-

Actual scenes of the different underlying surfaces around the lake are shown in Figure 2. The main tree types in the woodland were metasequoia and banyan. The SR15-A1 solar radiation sensor (Hukseflux, Delft, The Netherlands) was used to measure the solar radiation in the study area. The measured results of the hourly average solar radiation intensity parameters are shown in Figure 3. Small weather stations were used to measure air temperature, relative humidity, and wind speed, as shown in Figure 4. The parameters of the small weather stations are shown in Table 2. The measured results of the hourly average wind speeds are shown in Figure 5.

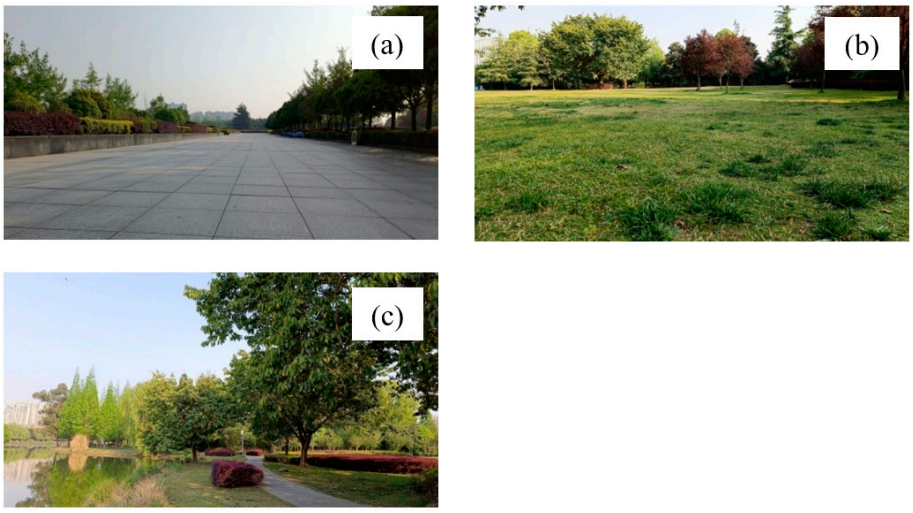


Figure 2. Actual scene of different underlying surfaces around lake. (**a**) Granite road, (**b**) lawn, (**c**) woodland.

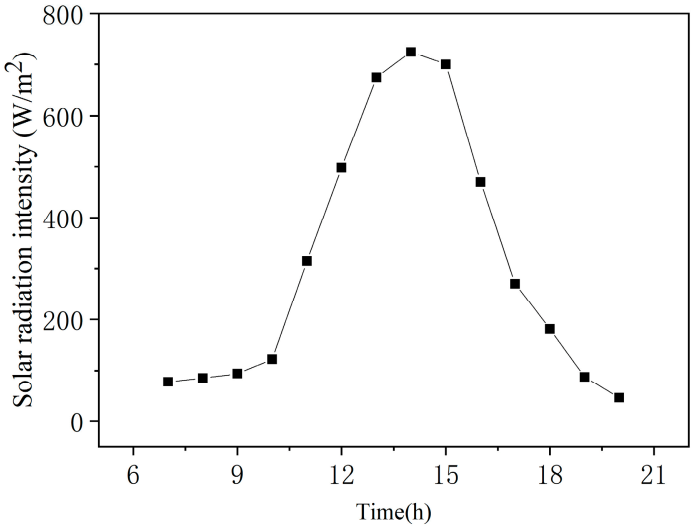


Figure 3. Hourly solar radiation intensity parameters (W/m^2).



Figure 4. Small weather station.

Table 2. Parameters of small weather station.

-	Range	Error
Air temperature (°C)	−30~60	±0.3
Relative humidity (%)	10~100	±3
Wind speed (m/s)	0~50	±0.1
Illuminance (lux)	0~300	±3
Pressure (hpa)	300~1100	±0.25

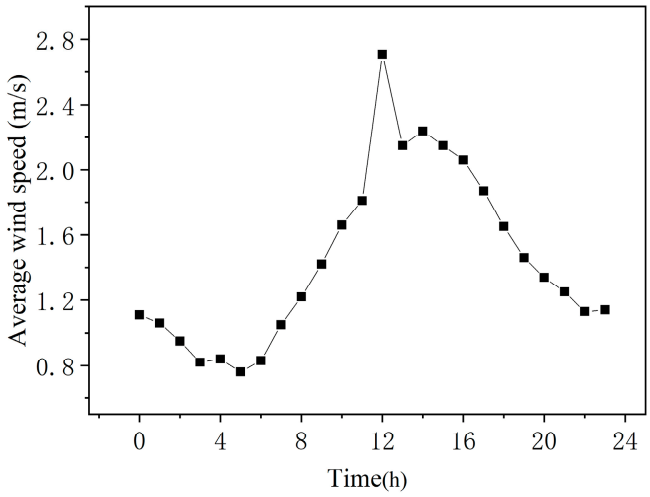


Figure 5. Hourly average wind speed.

3. Results and Discussion

3.1. Change in Air Temperature Above Different Underlying Surfaces over Time

The measurement points were 10 m away from the lake edge. The changes in air temperature above different underlying surfaces over time are shown in Figure 6. During the day, the air temperature was highest above the granite road and lowest in the woodland. The lowest air temperature above the granite road occurred at 6:00, after which the air temperature began to rise, reaching its maximum value at 15:00, and then starting to decrease. It is worth noting that the air temperature above the granite road increased rapidly after 10:00, coinciding with increasing solar radiation intensity.

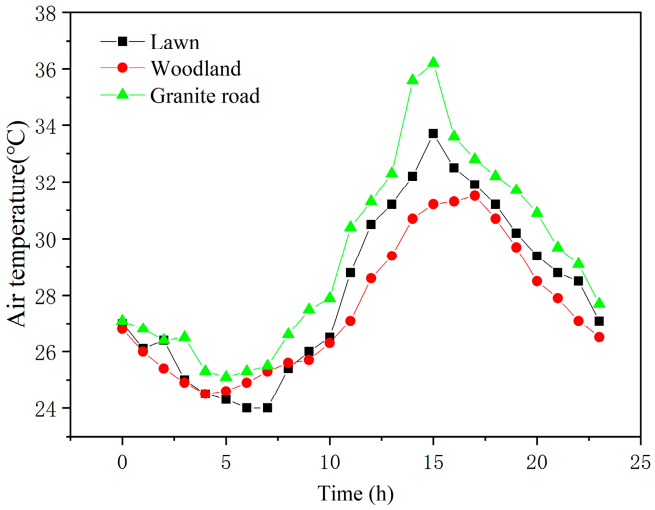


Figure 6. Change in air temperature above different underlying surfaces over time.

The air temperature above the granite road compared to the lawn and woodland primarily stems from differences in surface albedo and thermodynamic properties. Granite exhibits a lower surface albedo relative to the lawn and woodland, where shortwave radiation reflectivity is comparatively higher. This disparity results in a greater absorption of solar radiation by the granite surfaces, thereby increasing the proportion of energy converted to sensible heat flux. Furthermore, the specific heat capacity of the granite is lower than that of the lawn and woodland, resulting in a rapid transfer of heat absorbed during the day to the surface and heating the air near the ground. In contrast, the lawn and woodland release heat via water evaporation from the soil and via plant transpiration,

effectively reducing the surrounding air temperature. Meanwhile, the turbulent mixing effect of the woodland and the lawn is enhanced by increasing surface roughness, which promotes vertical heat diffusion. However, the turbulence of the flat granite road is weak, and the heat is prone to accumulate in the near-surface boundary layer, which intensifies local warming.

In the woodlands, sunlight does not reach the ground due to the shelter of tall trees, especially the dense leaves of banyan trees. This shading blocks long-wave radiation, resulting in the lowest air temperature in the woodland, making it the most suitable area for human activities. This is in good agreement with the results of previous studies that show that the influence of water bodies on land surface temperature is closely related to the type of underlying surface [33]. In short, due to the low albedo, low heat capacity, and lack of latent heat dissipation mechanism, the surface energy balance of the granite road is dominated by sensible heat release, which causes the near-surface air temperature to be significantly higher than that of the lawn and woodland.

3.2. Change in Air Temperature Above Different Underlying Surfaces with Distance from Water

The main factors affecting outdoor human thermal comfort are solar radiation intensity, wind speed, air temperature, and relative humidity. The period with the strongest solar radiation intensity in the study area is from 14:00 to 15:00. Therefore, air temperature and relative humidity at 15:00 were selected as the research object. The changes with distance in air temperature above the different underlying surfaces at 15:00 are shown in Figure 7. As the distance from the lake boundary increased, the air temperature above all three underlying surfaces initially rose rapidly but stabilized within approximately 30 m of the water. This suggests that the lake's cooling influence extended approximately 30 m from its boundary, with air temperature decreasing by up to 2 °C near the shoreline. On the one hand, at 15:00 in the afternoon, the intensity of solar radiation is high, accelerating the evaporation of lake water on the lake surface and lowering the air temperature near the lake. On the other hand, when the wind blows from the lake to the land, the low temperature and moist air carried by it reduce the air temperature on the shore.

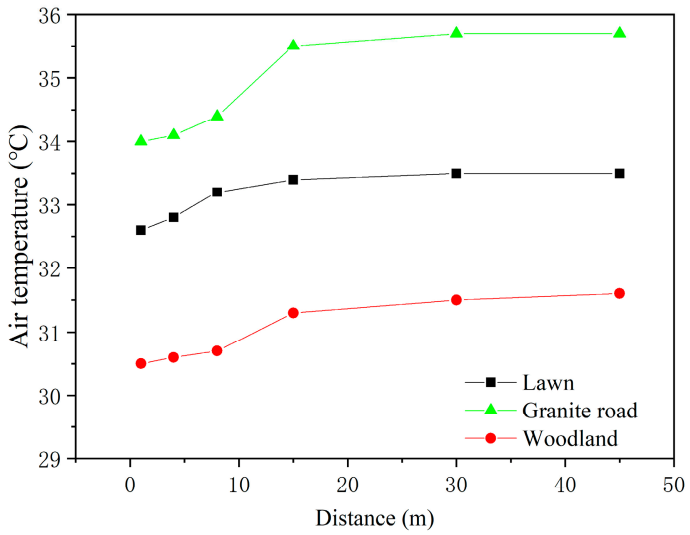


Figure 7. Change in air temperature above different underlying surfaces with distance from water at 15:00.

Among the surfaces, the air temperature above the lawn changed the least. This may be due to differences in the height and density of the underlying surfaces, which affect the reflectance and absorption of the solar radiation. The air temperature above the

granite road is higher than that of the woodland and lawn. The reason is that lawns and trees convert about 70% of the solar radiant energy into latent heat through transpiration. However, granite roads lack water evaporation and plant transpiration, and the sensible heat in the net radiant energy can account for 70%, directly heating the near-surface air and forming a significant temperature gradient.

Additionally, the lawns were densely planted with grass, which absorbs solar radiation for photosynthesis and can effectively reduce the surface temperature. The grass also has well-developed roots that absorb water from the soil and dissipate heat through transpiration, further reducing the surface temperature. This is in line with previous research results, and small lakes also have a good cooling effect on the surrounding thermal environment [34]. Clearly, small lakes have a cooling effect on the surrounding environment, influencing the air temperature up to about 30 m away from the shore.

3.3. Change in Relative Humidity over Different Underlying Surfaces over Time

The changes in relative humidity above different underlying surfaces over time are shown in Figure 8. The relative humidity of the air above the three surfaces was relatively high from 0:00 to 7:00. Subsequently, the value of relative humidity began to decline, reaching its lowest values at 15:00, and then beginning to rise. During daytime, the lake water evaporated into water vapor under the solar radiation, which was continuously transported into the surrounding environment, resulting in a decrease in relative humidity of the air. At night, with the decrease in air temperature, the cooling of underlying surfaces leads to an inversion layer near the underlying surface, which inhibits the vertical turbulent mixing. This leads to the accumulation of water vapor near the lake, creating a high-humidity environment. Finally, the decrease in nocturnal wind velocity diminishes horizontal advection processes, thereby extending the residence time of water vapor. This phenomenon amplifies the cumulative enhancement of relative humidity in the vicinity of the lake.

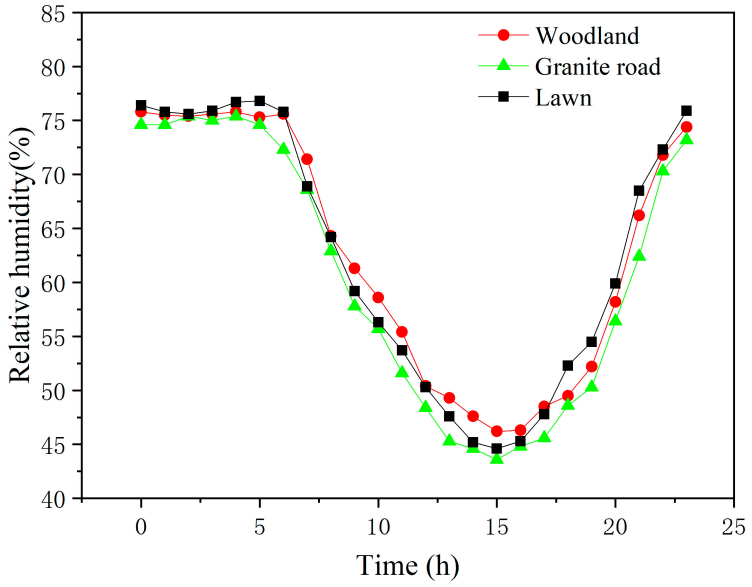


Figure 8. Change in relative humidity over different underlying surfaces over time.

Because the granite road lacks water storage capacity, the relative humidity of the air above the granite road fell faster than that of the lawn and woodland during daytime. At night, underlying surfaces are cooled quickly by long-wave radiation. With the underlying surfaces' temperature dropping, the water vapor in the air reaches a saturated state. At this point, the water vapor condenses into dew, increasing the near surface relative humidity.

The plants in the woodland and lawn respire through their stomata at night, releasing a small amount of water vapor. Therefore, the relative humidity of the air above the lawn and woodland at night is slightly higher than that of the granite road.

3.4. Change in Relative Humidity Above Different Underlying Surfaces with Distance from Water

The changes in relative humidity above the different underlying surfaces with distance at 15:00 are shown in Figure 9. The relative humidity decreased with increasing distance above all the underlying surfaces. The relative humidity declined rapidly near the lake, but the rate of decline slowed with distance and showed hardly any change beyond 30 m. It is worth noting that the differences in relative humidity above the three underlying surfaces are relatively small. This was due to the small area of the lake and its limited water storage capacity, which restricted its influence on the surrounding air. The closer to the water body, the stronger the heat and mass exchange between the lake water and the air. Hence, the evaporated water vapor increases the relative humidity of the air near the waterfront. It can be concluded that the small lakes have a humidifying effect on the surrounding environment, an effect that is negatively correlated with distance from the lake boundary.

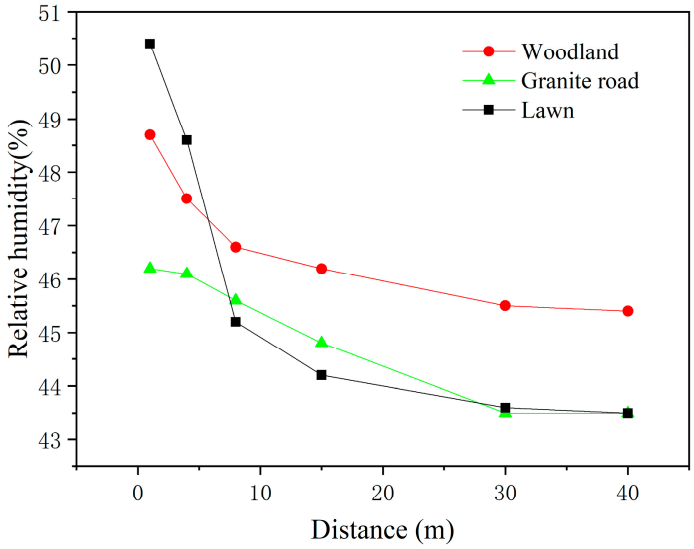


Figure 9. The change in the relative humidity above the different underlying surfaces with distance at 15:00.

4. Conclusions

The present study investigated the impacts of small lakes and underlying surfaces on the microclimate of the waterfront. The key findings are summarized as follows:

1. Granite roads exhibited significantly higher daytime air temperatures compared to lawns and woodlands. This disparity arises from the low albedo and specific heat capacity of granite, which prioritize sensible heat release over latent heat dissipation. In contrast, lawns and woodlands reduce the surrounding air temperature through plant transpiration.
2. Small lakes demonstrated a pronounced cooling effect on their surroundings environment, reducing air temperatures by up to 2 °C within 30 m of their boundary. The cooling intensity diminished with distance from the shoreline, establishing a positive correlation between air temperature and distance to the lake. This spatial pattern underscores the lake's role as a cooling island, primarily driven by evaporative cooling and heat absorption.

3. Relative humidity exhibited a strong negative correlation with distance from the lake, declining most rapidly within the first 30 m. The lake's humidifying effect was attributed to sustained evaporation, which enhanced water vapor concentrations near the waterfront.

These findings emphasize the role of small lakes in mitigating urban heat island effects through thermal regulation. The 30 m influence radius identified in this study provides actionable insights for optimizing land use planning around urban small water bodies, prioritizing vegetated surfaces and strategic lake integration to enhance microclimatic resilience.

Author Contributions: Writing—review and editing, X.Q.; investigation, J.W.; methodology, F.Y. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Luo, Z.; Liu, J.; Shao, W.; Zhou, J.; Jia, R. Distribution of dry and wet islands in the Pearl River Delta urban agglomeration using numerical simulations. *Atmos. Res.* **2022**, *273*, 106170. [CrossRef]
2. Olah, A. The possibilities of decreasing the urban heat Island. *Appl. Ecol. Environ. Res.* **2012**, *10*, 173–183. [CrossRef]
3. Zhang, H.; Yin, Y.; An, H.; Lei, J.; Li, M.; Song, J.; Han, W. Surface urban heat island and its relationship with land cover change in five urban agglomerations in China based on GEE. *Environ. Sci. Pollut. Res.* **2022**, *29*, 82271–82285. [CrossRef] [PubMed]
4. Anjos, M.; Targino, A.C.; Krecl, P.; Oukawa, G.Y.; Braga, R.F. Analysis of the urban heat island under different synoptic patterns using local climate zones. *Build. Environ.* **2020**, *185*, 107268. [CrossRef]
5. Hou, H.; Liu, K.; Li, X.; Chen, S.; Wang, W.; Rong, K. Assessing the urban heat island variations and its influencing mechanism in metropolitan areas of Pearl River Delta, South China. *Phys. Chem. Earth* **2020**, *120*, 102953. [CrossRef]
6. Santamouris, M.; Cartalis, C.; Synnefa, A.; Kolokotsa, D. On the impact of urban heat island and global warming on the power demand and electricity consumption of buildings—A review. *Energy Build.* **2015**, *98*, 119–124. [CrossRef]
7. Yang, X.; Peng, L.L.H.; Jiang, Z.; Chen, Y.; Yao, L.; He, Y.; Xu, T. Impact of urban heat island on energy demand in buildings: Local climate zones in Nanjing. *Appl. Energy* **2020**, *260*, 114279. [CrossRef]
8. Hathway, E.A.; Sharples, S. The interaction of rivers and urban form in mitigating the Urban Heat Island effect: A UK case study. *Build. Environ.* **2012**, *58*, 14–22. [CrossRef]
9. Moyer, A.N.; Hawkins, T.W. River effects on the heat island of a small urban area. *Urban Clim.* **2017**, *21*, 262–277. [CrossRef]
10. Cai, Z.; Han, G.; Chen, M. Do water bodies play an important role in the relationship between urban form and land surface temperature? *Sustain. Cities Soc.* **2018**, *39*, 487–498. [CrossRef]
11. Deng, Q.; Zhou, Z.; Li, C.; Yang, G. Influence of a railway station and the Yangtze River on the local urban thermal environment of a subtropical city. *J. Asian Archit. Build. Eng.* **2022**, *21*, 588–603. [CrossRef]
12. Cruz, J.A.; Blanco, A.C.; Garcia, J.J.; Santos, J.A.; Moscoso, A.D. Evaluation of the cooling effect of green and blue spaces on urban microclimate through numerical simulation: A case study of Iloilo River Esplanade, Philippines. *Sustain. Cities Soc.* **2021**, *74*, 103184. [CrossRef]
13. Steeneveld, G.J.; Koopmans, S.; Heusinkveld, B.G.; Theeuwes, N.E. Refreshing the role of open water surfaces on mitigating the maximum urban heat island effect. *Landsc. Urban Plann.* **2014**, *121*, 92–96. [CrossRef]
14. Rising, H.H.; Deng, L. The effects of small Water Cool(ing) Islands on body temperature. *J. Urban Des.* **2024**, *29*, 167–183. [CrossRef]
15. Norton, B.A.; Coutts, A.M.; Livesley, S.J.; Harris, R.J.; Hunter, A.M.; Williams, N.S.G. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. *Landsc. Urban Plann.* **2015**, *134*, 127–138. [CrossRef]
16. Sun, R.; Chen, L. How can urban water bodies be designed for climate adaptation? *Landsc. Urban Plann.* **2012**, *105*, 27–33. [CrossRef]
17. Robitu, M.; Inard, C.; Groleau, D.; Musy, M. Energy balance study of water ponds and its influence on building energy consumption. *Build. Serv. Eng. Res. Technol.* **2004**, *25*, 171–182.

18. Du, H.; Song, X.; Jiang, H.; Kan, Z.; Wang, Z.; Cai, Y.J. Research on the cooling island effects of water body: A case study of Shanghai, China. *Ecol. Indic.* **2016**, *67*, 31–38. [CrossRef]
19. Wu, J.; Li, C.; Zhang, X.; Zhao, Y.; Liang, J.; Wang, Z. Seasonal variations and main influencing factors of the water cooling islands effect in Shenzhen. *Ecol. Indic.* **2020**, *117*, 106699. [CrossRef]
20. Sharma, K.; Kumar, V.; Gautam, L.; Choudhary, S.; Mathew, A. Geo-physical seasonal deviations of land use, terrain analysis, and water cooling effect on the surface temperature of Pune city. *J. Water Clim. Chang.* **2023**, *14*, 4802–4820. [CrossRef]
21. Xu, J.; Wei, Q.; Huang, X.; Zhu, X.; Li, G. Evaluation of human thermal comfort near urban waterbody during summer. *Build. Environ.* **2010**, *45*, 1072–1080. [CrossRef]
22. Jacobs, C.; Klok, L.; Bruse, M.; Cortesão, J.; Lenzholzer, S.; Kluck, J. Are urban water bodies really cooling? *Urban Clim.* **2020**, *32*, 100607. [CrossRef]
23. Liu, Y. Dynamic evaluation on ecosystem service values of urban rivers and lakes: A case study of Nanchang City, China. *Aquat. Ecosyst. Health Manag.* **2014**, *17*, 161–170. [CrossRef]
24. Hossu, C.A.; Iojă, I.-C.; Onose, D.A.; Niță, M.R.; Popa, A.-M.; Talabă, O.; Inostroza, L. Ecosystem services appreciation of urban lakes in Romania. Synergies and trade-offs between multiple users. *Ecosyst. Serv.* **2019**, *37*, 100937. [CrossRef]
25. Reynaud, A.; Lanzanova, D. A Global Meta-Analysis of the Value of Ecosystem Services Provided by Lakes. *Ecol. Econ.* **2017**, *137*, 184–194. [CrossRef]
26. Schmid, M.; Hunziker, S.; Wüest, A. Lake surface temperatures in a changing climate: A global sensitivity analysis. *Clim. Change* **2014**, *124*, 301–315. [CrossRef]
27. Vilbaste, S.; Järvalt, A.; Kalpus, K.; Nõges, T.; Pall, P.; Piirsoo, K.; Tuvikene, L.; Nõges, P. Ecosystem services of Lake Võrtsjärv under multiple stress: A case study. *Hydrobiologia* **2016**, *780*, 145–159. [CrossRef]
28. Mahmoud, A.H.A. Analysis of the microclimatic and human comfort conditions in an urban park in hot and arid regions. *Build. Environ.* **2011**, *46*, 2641–2656. [CrossRef]
29. Gupta, N.; Mathew, A.; Khandelwal, S. Analysis of cooling effect of water bodies on land surface temperature in nearby region: A case study of Ahmedabad and Chandigarh cities in India. *Egypt. J. Remote Sens. Space Sci.* **2019**, *22*, 81–93. [CrossRef]
30. Dobson, K.C.; Beaty, L.E.; Rutter, M.A.; Hed, B.; Campbell, M.A. The influence of Lake Erie on changes in temperature and frost dates. *Int. J. Climatol.* **2020**, *40*, 5590–5598. [CrossRef]
31. Cheval, S.; Popa, A.-M.; Șandric, I.; Iojă, I.-C. Exploratory analysis of cooling effect of urban lakes on land surface temperature in Bucharest (Romania) using Landsat imagery. *Urban Clim.* **2020**, *34*, 100696. [CrossRef]
32. Abou Samra, R.M. Dynamics of human-induced lakes and their impact on land surface temperature in Toshka Depression, Western Desert, Egypt. *Environ. Sci. Pollut. Res.* **2022**, *29*, 20892–20905. [CrossRef] [PubMed]
33. Wang, Y.; Zhan, Q.; Ouyang, W. How to quantify the relationship between spatial distribution of urban waterbodies and land surface temperature? *Sci. Total Environ.* **2019**, *671*, 1–9. [CrossRef] [PubMed]
34. Saaroni, H.; Ziv, B. The impact of a small lake on heat stress in a Mediterranean urban park: The case of Tel Aviv, Israel. *Int. J. Biometeorol.* **2003**, *47*, 156–165. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.