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Land use impacts on microclimate regulation in Vilnius (Lithuania)

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Land use has important impacts on microclimate, especially in urban environments with complex morphology, and surface materials have different properties (e.g., colour or composition, natural/anthropogenic). Mapping microclimate regulation in urban areas is challenging since it can change over short distances. Therefore, high-resolution images are key to assessing it at a fine scale. Unmanned aerial vehicles (UAVs) are a good tool for collecting information in a detailed resolution under different meteorological conditions. In this work, we aim to map microclimate regulation in an area located in Vilnius, using a thermal UAV and land surface temperature as a proxy. The study site has an area of 104 ha. It comprises diverse land use (buildings, parking areas, equipment, roads, other paved areas, sidewalks and bike lines, construction sites, grassland and scrubland, agriculture, water and wetlands, trees and forests). Six UAV missions were conducted on July 10, 11, 14, 16, 18 and 19 of 2024, during a heat wave in Eastern Europe. The results showed statistically significant results ($p<0.05$) among days and land uses. The hottest days were July 11 and 16, and the coolest were July 14 and 19. Buildings and parking areas were the areas that showed the highest temperatures (>45 °C), while the lowest were identified in water and wetlands, trees and forests (<30 °C). As expected, urban green areas were the most efficient in regulating the microclimate. However, the differences between land uses were impressive for a small study area. On average, the amplitude between land uses was more than 15 °C, showing that surface type had an important impact on microclimate regulation. Even though heatwaves were not as common, frequent, and severe in this part of Europe as in the Mediterranean, this scenario has been changing in recent years, and the highest temperatures have been observed. The results obtained during this short study period showed that national and local authorities need to consider the risk of heatwaves and the implications on well-being in their plans. For this, improving urban green areas that can mitigate them is mandatory.

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