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REMOTE SENSING ASSESSMENT OF LAND SURFACE TEMPERATURE AND VEGETATION COOLING IN VILNIUS, KAUNAS AND KLAIPĖDA

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Abstract – Urbanisation in many parts of Europe is still ongoing, and as cities continue to expand, natural surfaces are increasingly being replaced by artificial materials, which absorb and retain heat more effectively than vegetation. This intensifies surface heating, increases thermal stress and creates challenges for public health, energy demand and climate adaptation. European Green Deal, EU and national climate adaptation strategies emphasize the need for evidence-based approaches to cooling and green infrastructure. The aim of this study is to assess surface thermal patterns and vegetation related cooling in Vilnius, Kaunas and Klaipėda municipalities using remote sensing data, and to evaluate how local changes in tree cover density impact the cooling effect in different city neighbourhoods. Landsat 8/9 data were used to calculate and map warm season baseline and heatwave land surface temperature, while tree cover density was characterised using Copernicus HRL Tree Cover Density product. Tree related cooling was estimated by modelling the relationship between land surface temperature and tree cover density for each city. In selected city neighbourhoods, increased and reduced tree cover scenarios were applied to determine how changes in tree cover density affect the cooling of surrounding areas. Vilnius is the most vegetation dominated city, with trees covering 57.6 % of the municipal area, while Kaunas has the highest built-up surface share (33.3 %). Accordingly, warm season baseline land surface temperature was highest in Kaunas (28.3 °C), average temperature in Vilnius and Klaipėda was 1.5 °C and 2.0 °C lower, respectively. During heatwaves, average land surface temperature was up to 10 °C higher compared to baseline conditions. Tree cover related cooling was strongest in Vilnius, where mean modelled cooling reached 2.2 °C under baseline conditions and 2.3 °C during the heatwave case, compared with 1.1–1.3 °C in Kaunas and 0.7–1.1 °C in Klaipėda. Scenario analysis in selected neighbourhoods showed that reduction of around 50 % in tree cover density caused local losses of cooling reaching up to 4.9 °C in the area where changes were made, while the same increase strengthened local cooling by up to 2.9 °C. At neighbourhood scale, the effect was smaller, typically within about 0.1–0.6 °C, however the modified sites represented only about 7 % of the wider neighbourhood areas. The results show that this approach can support urban planning aligned with climate adaptation by helping to understand how changes in tree cover influence the local cooling effect.

Keywords – Heat mitigation; thermal stress; tree cover density; urban climate