The cooling potential of urban vegetation during Paris heat events in summer 2022

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Résumé

Many regions across Europe experienced extreme heat during summer 2022. Three heatwaves between June - August caused a high number of excess deaths (321 in Paris; 2,816 in France). In Paris, daytime maximum temperatures exceeded climatological records on multiple occasions. While synoptic flow and advection of hot air contributed to the formation of the heat waves at the larger scale, the urban environment severely exacerbated the heat hazard. At night, the air in the city was found to be warmer than the rural surroundings by up to 9 ∘C. This strong urban heat island intensity poses severe health risks for humans, affecting also the functioning of plants, soils and atmospheric chemistry. To mitigate the heat risk in urban settings, nature-based solutions are increasingly implemented in Paris and other cities. In this study, we assess the nocturnal cooling potential of vegetation both at the city and the local 'neighbourhood' scale based on a combination of high-resolution surface station observations and novel vertical profile measurements (ANR H2C). We find that the cooling effect of urban green spaces increases with the size of the vegetated area. While small urban parks can be cooler than the built-up settings by 3-4 ∘C, the air temperature in urban woods decreases even more effectively and over a deeper layer, with signatures at times similar to those in rural backgrounds. The efficient surface cooling of the rural surroundings of Paris frequently causes the nocturnal atmospheric boundary layer to detach from surface roughness: we detect the formation of a nocturnal low-level jet in 70% of the

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nights between June-August 2022. This regional-scale wind then again interacts with the urban atmosphere, whereby reducing spatial thermal contrasts between the city and the rural background but also intra-urban differences between the built environment und urban green spaces via transport and mixing processes.

Mots-Clés: urban vegetation, urban heat island, heat wave