Urban Heat Mitigation: The Influence of Turbulent Mixing in the Nocturnal Boundary Layer on Vegetation Cooling Effects

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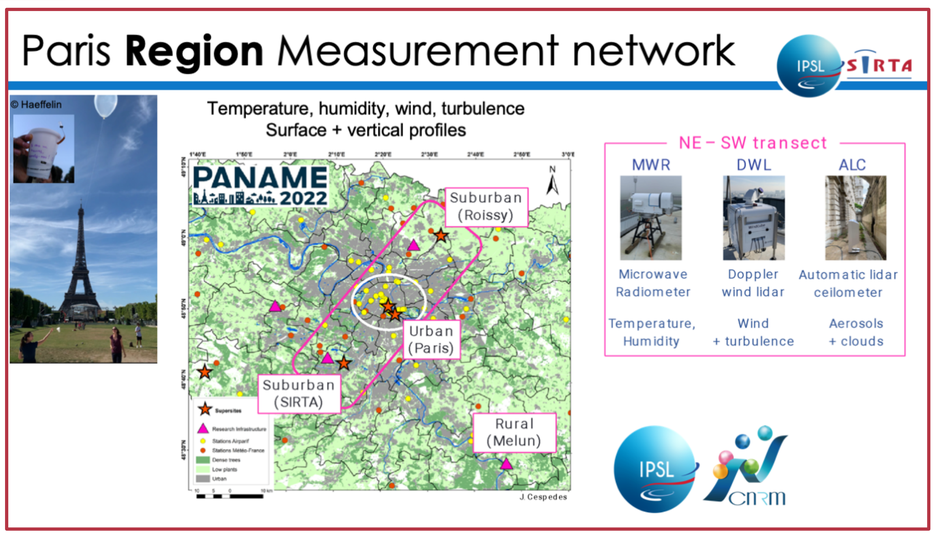
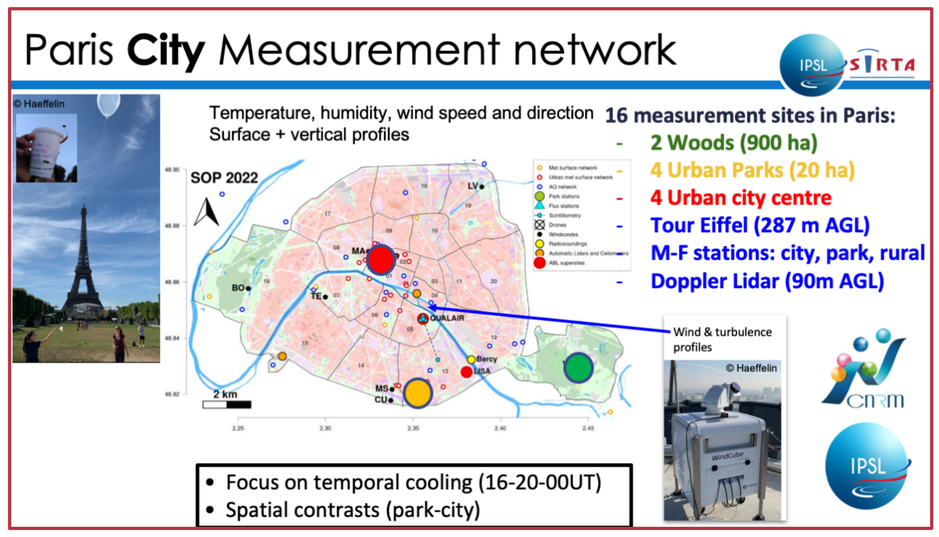
1. Introduction

Excess heat in cities, has impacts on human comfort, productivity, and mortality. To mitigate this urban heat risk, one of the most prominent measures is increasing the vegetation fraction in urban environments.

However, cooling effect intensity of urban vegetation compared to surrounding built-up environments, is highly variable as it depends
- on internal characteristics of the city,
- on the design of urban greening and
- on large-scale weather conditions.

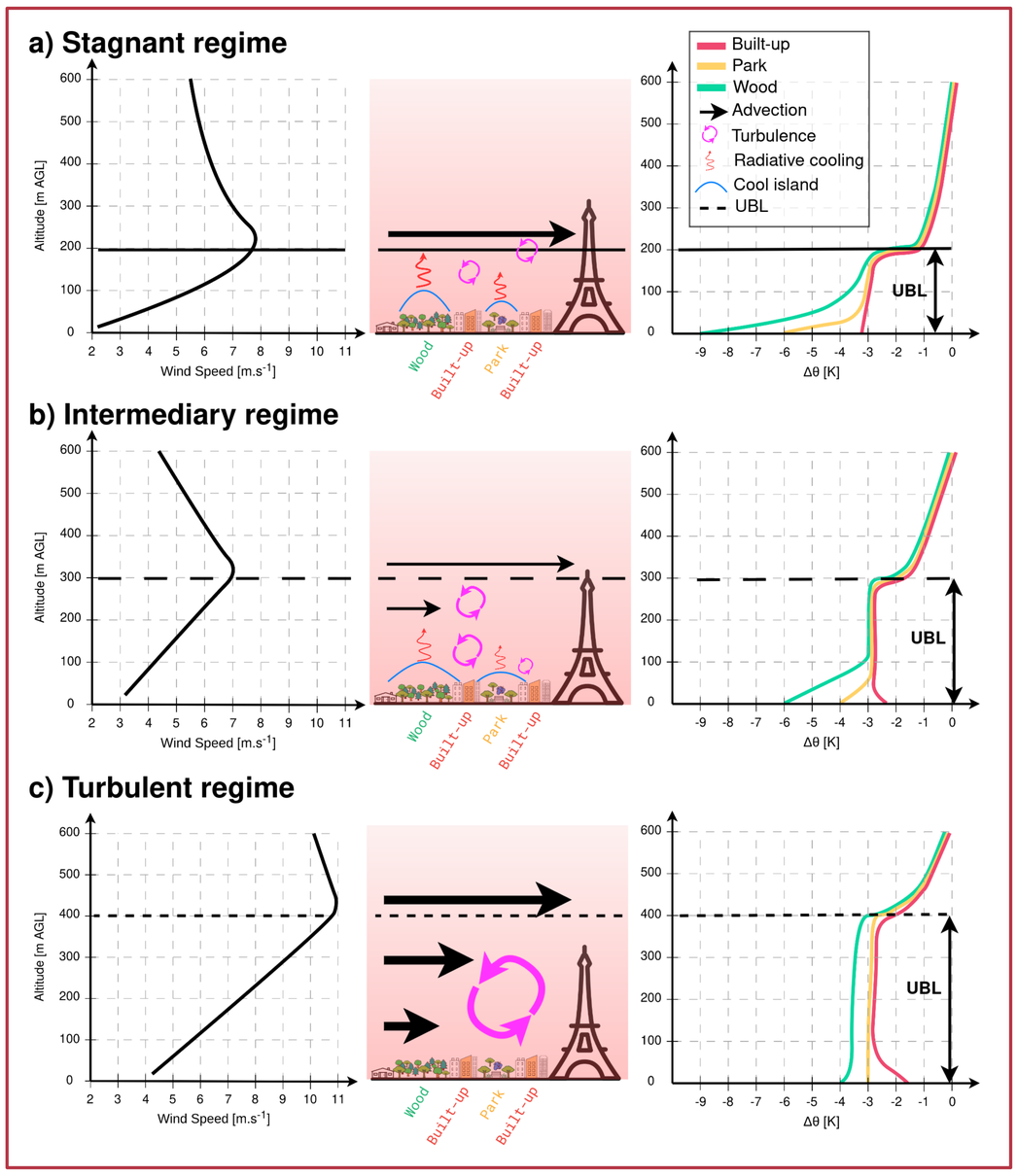
2. Observations





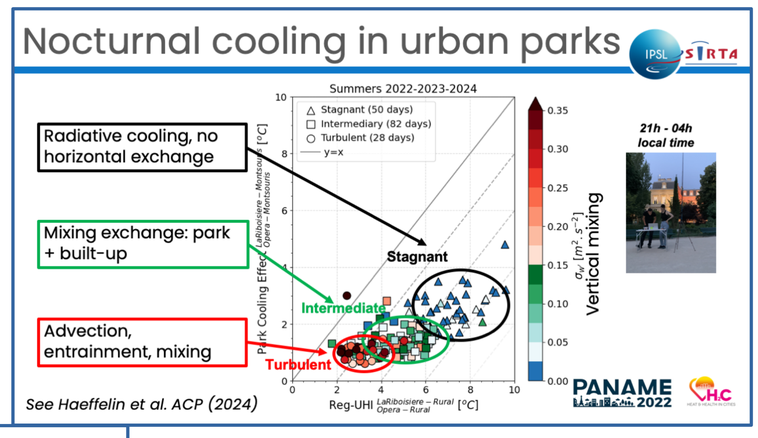
3. Method

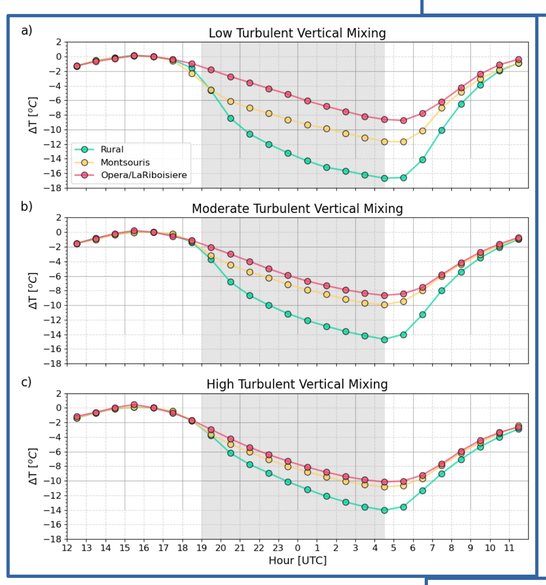
We identify three regimes – defined in terms of atmospheric boundary layer stability and turbulence – that drive the relative importance of radiative and mixing transport cooling processes in the urban canopy layer.



4. Results

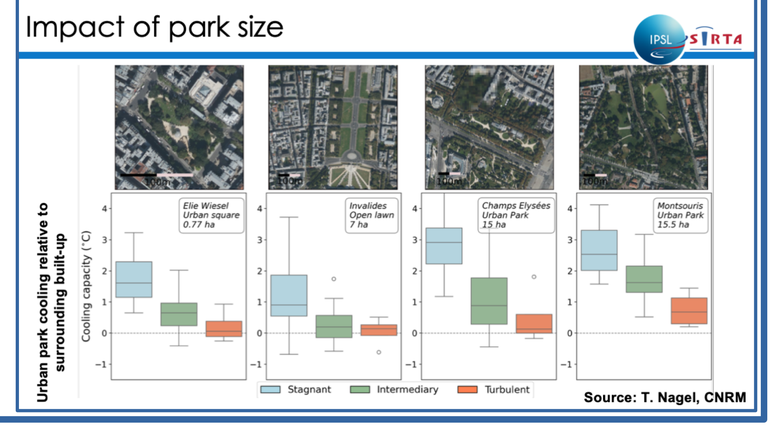
4.1 Nocturnal Urban Heat Island at regional scale and nocturnal intra-urban temperature contrasts are maximised in stagnant regimes





4.2 Urban parks and rural locations cool significantly faster at night than urban built-up environments in stagnant regimes. Temperature evolutions are consistent across different settings in turbulent regimes.

4.3 In stagnant regimes nocturnal cooling in parks depend on park size and vegetation types (grass, shrub, trees).



5. Conclusion

We show that ABL stability and turbulence regimes can explain the variability of nocturnal cooling effect intensity of urban parks.

Regime identification provides a new methodology to quantify the impact of urban and park design on the local cooling capacity of green infrastructures.

Acknowledgments

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