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The effects of trees on outdoor thermal comfort in cities

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Nature-based solutions appear to be an interesting option for enhancing the thermal comfort of the urban population during summer, while providing multiple services (e.g. biodiversity enhancement, the reduction in buildings energy consumption, stormwater management, acoustic insulation or air purification). However, the effects of green infrastructures on thermal comfort are not properly characterized, which prevents urban planning policies to be consistent.

The impacts of a single idealized tree on its microclimate are studied. The sensible heat flux emitted by the soil to the air is computed by solving the heat equation in a semi-infinite domain with a Robin boundary condition representing the energy balance of the soil. The sensible heat flux emitted by the vegetation is computed in two ways: with Newton's law and with an energy-balance approach. This model is applicated to a tree-shaped structure supporting climbing plants and compared with the experimental data collected. The prototype has been built to assess the cooling performance of this type of vegetation, and particularly the part played by soil shading, evapotranspiration (i.e. the latent heat flux emitted to the air by the plants and the soil) and absorbed solar radiation. These results may permit to estimate the contribution of vegetation for mitigating urban heat island effects on a larger scale.