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Assessment of the cooling effect of a vegetated gridshell in urban environment

Julien Cravero (1,2), Pierre-Antoine Versini (1), Adélaïde Feraille (2), Jean-François Caron (2), and Ioulia Tchiguirinskaia (1)

(1) HM&CO, Ecole des Ponts , UPE, Champs-sur-Marne, France , (2) Navier, UMR 8205, Ecole des Ponts , IFSTTAR, CNRS, UPE, Champs-sur-Marne, France

The revegetation of cities seems relevant to mitigate urban heat island effects while providing multiple ecosystem services, e.g. biodiversity enhancement, stormwater management and air purification. Hence, this strategy is often referred to as a 'no-regrets approach' or a sustainable solution for adapting to climate change. However, the potential benefits due to green infrastructures are not properly understood and quantified, which prevents urban planning policies to be consistent. In addition, current technical solutions employed to green dense urban spaces are rarely adaptable to existing buildings or public spaces and need major works to be carried out.
Monitoring green infrastructures is required to assess their real cooling performance, and particularly the part played by evapotranspiration (i.e. the latent heat flux provided by the plants and the soil). For this purpose, an elastic gridshell in composite materials has been built at Ecole des Ponts ParisTech (Champs-sur-Marne, France) as a support for climbing plants. This spatial vegetated structure is a light large-span doubly-curved lattice which provides evaporative cooling and shading. The parametric design framework Rhinoceros/Grasshopper is employed to design the structure and link its geometry to other models (e.g., Karamba for structural analysis, Ladybug tools for building physics and environmental design, OpenFOAM for CFD simulations), in order to make the evaluation of microclimatic effects adaptable to various gridshell geometries and urban configurations. The collected thermo-hydric data can be compared with numerical simulations performed with OpenFOAM to understand how the vegetated structure modifies the microclimate. The environmental impacts attributed to the structure as well as some ecosystem services provided by the vegetation are considered in a life cycle assessment in order to develop sustainable design strategies.