LABO – Institut Pascal (UMR6602 UCA/CNRS) - Group M3G

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Title of the thesis: Impact of bio-based materials on the intensity of urban heat islands.

Abstract :

Urban heat islands are phenomena characterized by localized high temperatures, particularly maximum diurnal and nocturnal temperatures, recorded in urban areas compared to surrounding rural areas. At night, urban heat comes from both buildings and the ground, which release heat accumulated during the day. Various studies on urban heat islands have shown that this phenomenon is quite complex and results from several factors related to human activity and urban planning. To reduce the impact of urban heat islands, it is imperative to review our construction practices by integrating new criteria such as heat storage and release capacity, water infiltration, reduction in natural resource consumption, and greenhouse gas emissions.
Strategies for mitigating UHIs include the use of high emissivity building materials, green roofs, permeable ground coverings, and vegetation. Studies have also shown the effectiveness of natural ventilation and shading in reducing UHIs. It is important to note that materials used in urban environments have a significant influence on UHIs, particularly their reflectivity (or albedo) and emissivity with respect to solar radiation, which are the most important radiative parameters. However, construction methods using multiple bio-based materials and their performance in reducing UHIs are poorly documented in the literature.
Furthermore, passive cooling techniques, which have proven to be effective in buildings, could also be used to reduce the impact of urban heat islands. Bio-based materials, known for their hygrothermal properties, are an interesting solution for reducing energy needs and improving indoor comfort in buildings. Evaluating their impact on reducing the intensity of urban heat islands is therefore crucial. Moreover, these materials have a much lower carbon footprint than conventional building materials, thus limiting greenhouse gas emissions. Thus, their use could indirectly contribute to reducing the intensity of urban heat islands.
The thesis focuses on the impact of bio-based materials on the intensity of urban heat islands. The objective is to evaluate the behavior of bio-based materials in interaction with the urban microclimate and to propose a bio-based construction system that reduces the temperature of urban heat islands.