# NP4009 Node of Excellence in High Performance Architecture

# POTENTIAL OF BUILDING SURFACE EVAPORATIVE COOLING USING RAINWATER IN THE HOT HUMID TROPICS

## Research Question

**Water is a powerful heat sink and is abundant in the hot humid tropics, then why it is not positively used for cooling buildings in these regions?**

**How much water could a building consume for envelope evaporative cooling (EC) under hot humid climates? How significant could be the impacts of its extensive application?**

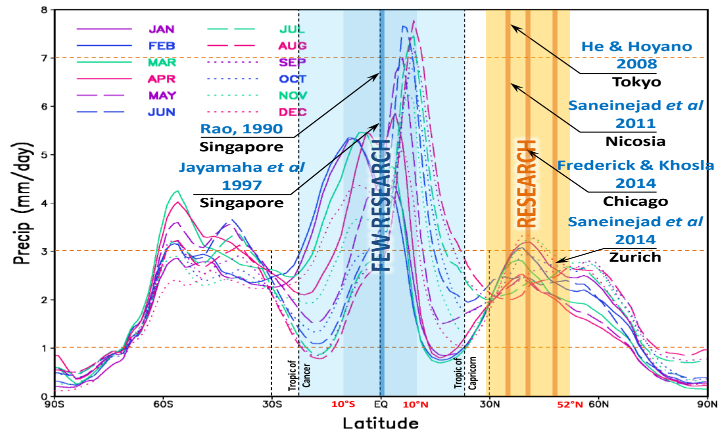

Figure 1: Global mean precipitation (GPCP, 1979-2004)

This research explores the potential of rainwater use for building cooling with a holistic approach (not only thermal and energy performance),integrating criteria from different fields (urban climatology, hydrology, ecology, low energy architecture) to verify its relevance as an integral strategy for disparate problems of cities in the hot humid tropics (overheating, water pollution, environmental degradation).

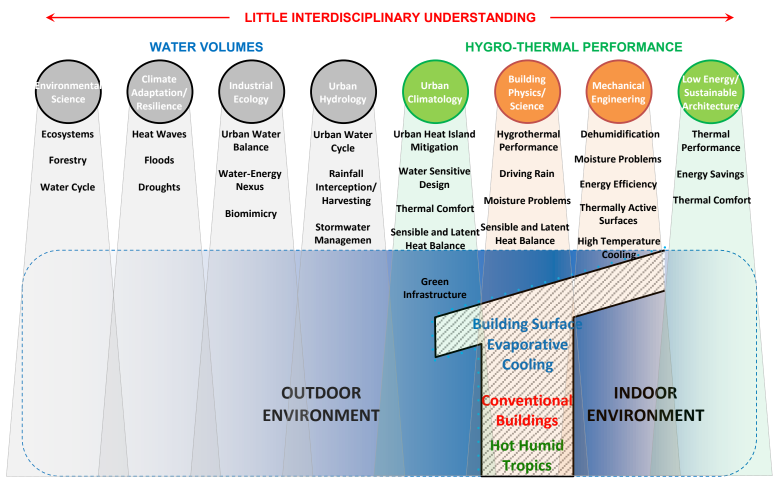

Figure 2: Holistic approach to building envelope EC

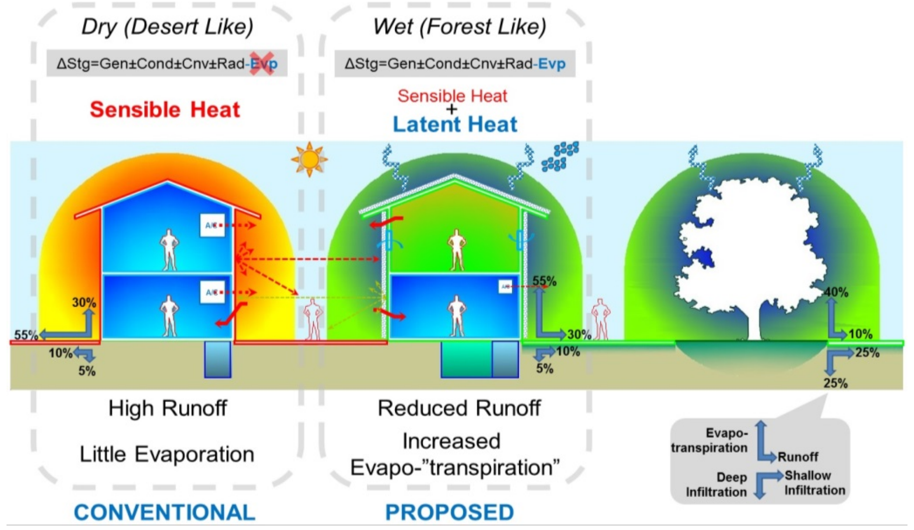


Figure 3: Conceptual analogy of "Buildings as Trees"

## Methodology

Quantitative methods such as infrared thermography, field experiments, hygrothermal and CFD simulation (WUFI Plus, scSTREAM) are used to estimate the influences of climate and the effects of EC on low-rise buildings in hot humid locations (hygrothermal performance, radiative and humidity transfers to surroundings, water consumption).

## Results

Results from simulation show that rain can respectively reduce 4 and 1ºC on outdoor and indoor wall surface temperatures. With controlled water spray these reductions can respectively reach 10 and 4ºC. Reductions observed on field experiments are within this range.

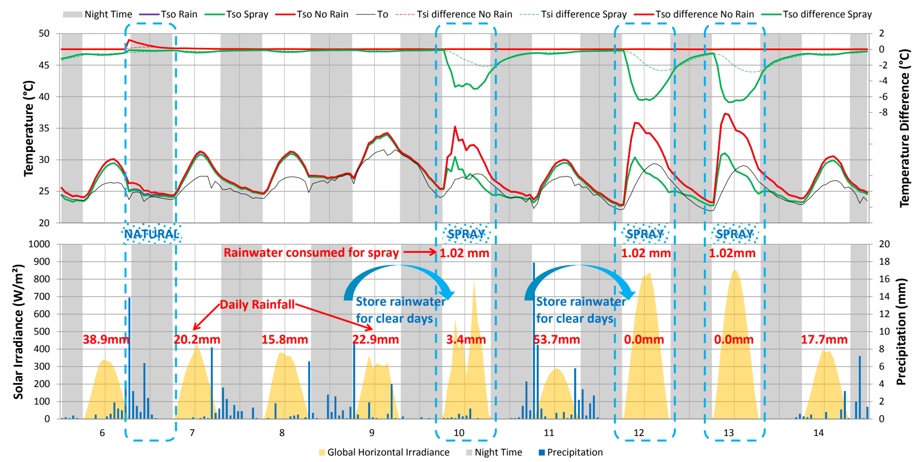

Figure 4: Influences of EC on the northeast wall in Douala, Cameroon (July)

On a rainy month, heat transferred per m² from the whole building envelope to surroundings can be overestimated 19% when rain cooling is neglected. Water spraying can reduce this heat transfer 28% more than rain does, with just 2 L/m²day on walls on clear days (about 1mm of rain). This confirms that evaporation is still effective in hot humid contexts and that the influence of rainfall on the thermal performance of buildings must not be neglected in wet locations. Building surface cooling can consume from two to four times more water than the regular household consumption; take advantage of rainwater usually ignored in cities, and return this to the local atmosphere.

## Anticipated impacts

This study will quantitatively inform building design, urban planning, as well as analyses and strategies in disciplines related to water resources but not usually to building cooling. It will also advise industry about the need and potential for development of alternative technologies for building surface cooling that harness rainwater, such as water spray systems, water absorbing materials and hydrophilic coatings.

In the hot humid tropics, building surface evaporative cooling strategies can be a key component for **integral solutions** to energy, water and environmental problems of the built environment; particularly in fully urbanized areas where ubiquitous green infrastructure is not feasible.

## Further information & Contact


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