

Urban Heat Island and new water issues

Ilots de chaleur urbains et nouveaux usages de l'eau

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RÉSUMÉ

Dans un contexte de croissance démographique urbaine et de densification de l'espace, la ville doit être en mesure de s'adapter et de répondre aux besoins en confort et qualité de vie de ses populations. En parallèle de cette croissance démographique, les évolutions climatiques de ces dernières années renforcent les périodes de fortes chaleurs, pour lesquelles les conséquences sont plus marquées dans l'espace urbain. Face à ce constat, l'intégration de solutions de rafraîchissement, utilisant l'eau, la végétation et l'albédo, dès la conception des projets d'aménagement apparaît comme une nécessité.

Conscient que les périodes prolongées de fortes chaleurs conduisent également à une réduction de la disponibilité des ressources en eau, l'enjeu est de proposer des solutions innovantes permettant l'utilisation ou la réutilisation de ressources en eau non potable locales et pouvant être des éléments structurants des aménagements des espaces publics.

ABSTRACT

In the context of an urban demographic growth and densification in the urban space, the city and the landscape must be changed to guarantee comfort and life quality to people. Besides, current and future climate changes observed these past years reinforced hard heat periods and consequences of these events are stronger in the urban space. The awareness of this fact drive to promote and implement new solutions using water, vegetation and albedo at the design phase of urban landscaping.

In addition to, long heat period are characterized also by hydric stress events. So the challenge is to define innovating and efficient solutions using local non-potable water and can be used as structural elements in the development of public spaces.

MOTS CLÉS / KEYWORDS

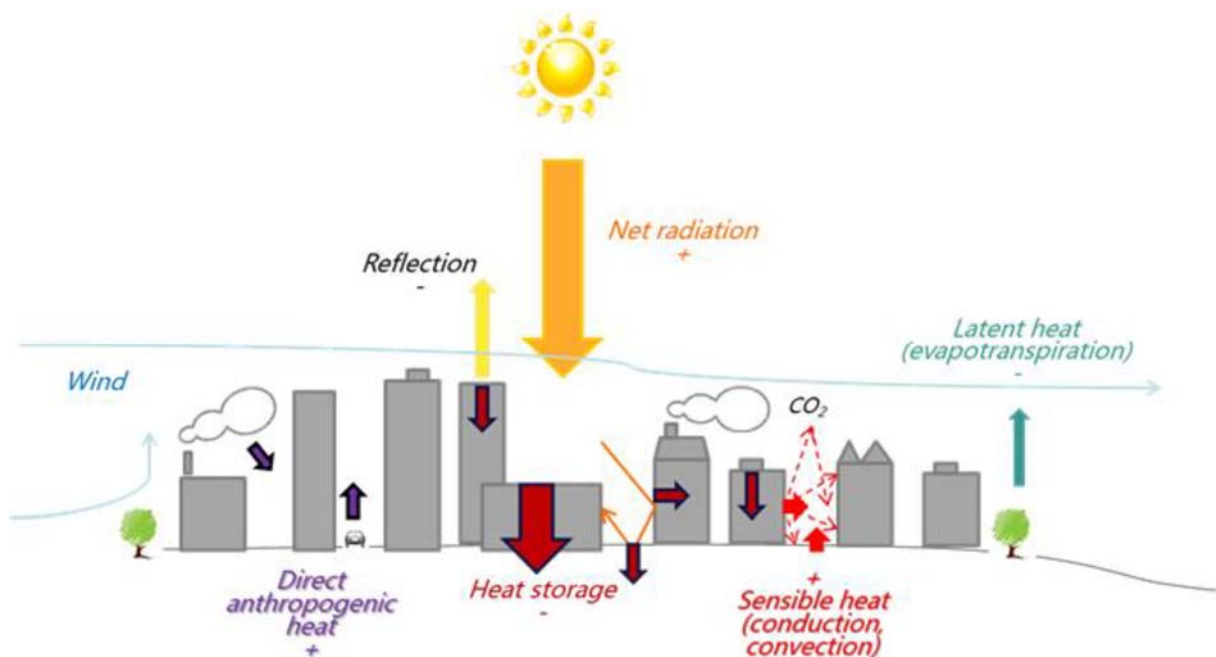
Confort thermique, eaux brutes, eaux pluviales, rafraichissement, ville

1 GENERAL APPROACH

1.1 Definition

Urban Heat Islands (UHI) are created by the over-heating of dense and mineral city centers which store solar radiation and produce discomfort for citizens and health problems for people sensible to heat stress (see references document 1). UHI are occurring in a lot of dense city around the world, whatever the local climate because people sensibility to heat stress depends from it.

As far as public spaces are concerned, UHI can dramatically reduce their attractivity if no counter-measure is implemented. Municipalities, developers, urbanists and architects are more and more taking into account this issue in the design of public spaces, which has created a new skill, the “climate design”. In order to mitigate UHI, a lot of solutions has been investigated and implemented (see references document 1 : street ventilation, heat storage limitation, emissions of anthropogenic heat reduction, latent cooling increase). Modification of albedo, use of vegetation and water are the main mitigation measures which can be implemented.



It is nevertheless not possible to have trees, grass or fountains in every part of a public space, a significant part of them should remain mineral for citizens circulation or to allow exhibitions or other events which need to keep free.

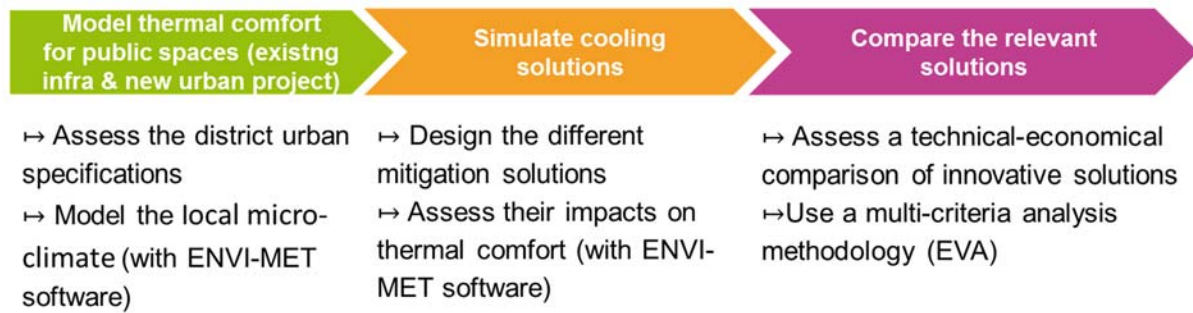
Evaporative pavements could mitigate UHI and keep the surface of public spaces clear for any use. Other types of “cool pavements” (high albedo pavement, water-retentive pavements, have been tried and implemented, but evaporative pavements have many advantages also) have been tried and implemented, but evaporative pavements have many advantages which explains their development in Japan.

1.2 The approach

2EI has developed two different approaches to reduce urban heat island:

- urban risk mapping at city scale design
- design of urban fresh islands solutions and design and operation of fresh islands solutions using non potable water at district-scale.

At district scale, design of urban fresh island solutions takes place in three stages describing below:



This assessment is the first step to identify which solutions is the more relevant in function of the environmental, economic and urban context.

Depending on the results get, urban fresh island solutions using non potable drinking water can be design, implement and monitor.

2 TWO RELEVANT SOLUTIONS OF SOIL HUMIDIFICATION AND URBAN REFRESHMENT

2.1 Road humidification

This solution consists on the humidification of streets by irrigating the soil. Liquid water in contact with the atmosphere is evaporating slowly what contributes to the decrease of temperature.

This kind of solutions is not sufficient by itself but is more and more combine with others, like vegetation or shady.



Système d'humidification de chaussées (source : 2EI)

2.2 Evaporative pavement blocks

Some cities in Japan, such as Tokyo and Osaka, have tested the effectiveness of water retentive pavements as part of using permeable pavements to reduce the urban heat island effect. These porous pavements can be asphalt or concrete-based and have a sublayer that consists of water retentive materials that absorb moisture and then evaporate it through capillary action when the pavement heats up. Some of these systems involve underground water piping to ensure the pavement stays moist. Depending on the location of the implementation and the mapping of the existing network, this solution can use rainwater or raw water.

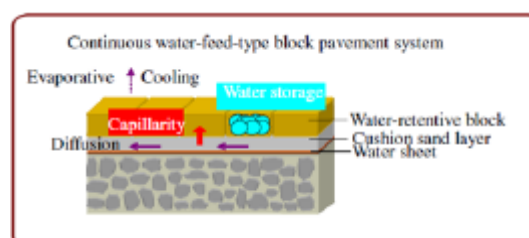


Schéma de fonctionnement des pavés évaporatifs



Dispositifs pilote de pavés évaporatifs sur l'espace public à Nice et Toulouse (source :2EI)

2.3 Automation system

The water injection system is monitored automatically. Indeed, a weather station is located on the evaporative pavement blocks area. This station enables measuring micro-climatic conditions (temperature, humidity, wind speed). As a result water is fed into the water network underneath the pavement blocks.

The automation system launches injection cycles with succession of injection time and rest time. Indeed, water diffusion through the pavement blocks is very slow and there is no need to inject continuously water into the network.



Système d'automatisation et de mesure de la performance, site de Toulouse (source : 2EI)

After these cycles, the weather station allow to measure the evolution of climatic and comfort parameters like Temperature and UTCI and to assess the performance of these both urban fresh island solutions.