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81. Green roof set-up analysis: Monitoring and simulation of water and thermal transfer using HYDRUS-1D

**INTRODUCTION**

Urbanization = sealed surfaces poorly covered by vegetation → Increasing water runoff 55% in urban area vs 10% in natural area. Urban Heat Island (UHI) = Man’s modification of the atmospheric environment → the temperature increase may reach up to 10°C. Green roofs (GR) = part of the solution for urban water and thermal management because they can:

- Store and release water with a delay. Storage capacity = 40 to 80% of the total annual rainfall volume depending on the substrates properties (i.e. thickness, characteristics and proportion of its organic and mineral components) but also on type of plants and vegetation (Jurgenson et al., 2005).
- Reduce urban air temperatures by 1.4°C on average 3.2°C at best, which may lead to a reduction in UHI amplitude (Zahr et al., 2012).

But GR are also living systems that are submitted to a significant evolution with time capability to retain water and refresh the climate.

The influence of GR aging on their thermal and hydric performances was yet poorly addressed.

**GREEN ROOF SOLUTION**

7 x 2.3 M² OF EXPERIMENTAL PLOTS

Located in Nantes (47°15′17″, 1°33′18″8′′) temperate oceanic climate Implemented in April 2011

**THE GR SYSTEM CAN:**
- Reduce storm water runoff
- Provide additional roof insulation and extend the underlying membrane life
- Facilitate the implantation of vegetated roofs by homeowners
- Enhance heat island mitigation and carbon sequestration

**THE GR SYSTEM CAN BE:**
- Design insulating structures
- Adsorb pollutants
- Produce oxygen

**IN SITU EXPERIMENTAL GR**

**VARIATION OF HYDROLOGIC PERFORMANCES**

- The corresponding simulated data (using HYDRUS-1D simulation tool) and measured hydrographs for 401 l m⁻² of cumulated rainfall (January to July 2012) show that the simulated soil water content value of the simulated water content is in quite good agreement with the experimental data.
- The figure shows that the model correctly calculates the internal state of the substrate. The water content increases over time during rainfall, and decreases during dry periods.

**HYDRODYNAMIC BEHAVIOR OF GREEN ROOF**

**ET EVALUATION**

The ET calculated as residual of the water balance shows the total ET of 0.4 mm in 24 hours. Measured ET for the same period is comparable to WB.

The ET simulated by Hydrus is overestimated and higher than the measured ET (Evapotranspiration chamber). It suggest that the water content should be simulated more accurately.

**SUMMARY**

- We conduct observations and simulations of temperature and hydraulic behaviour of green roof in Nantes city, France.
- Our work provides a better understanding of the coupled thermal and hydrological processes in green roof technology.
- Our simulations showed that the green roofs have an original behavior: (i) great variations in hot and cold thermal performance, (ii) a strong impact of water inside GR opposite the thermal behavior and (iii) the daily variability of the ET is well observed. The measurement with the evapotranspiration chamber also makes it possible to apprehend the seasonal variability.
- Further simulation of actual evapotranspiration will be performed using Hydrus-1D, incorporating the impact of rock present in the soil using double porosity models.

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