



CATÓLICA  
ESCOLA SUPERIOR  
DE BIOTECNOLOGIA

PORTO

# **GREEN ROOFS VEGETATION AS A BIOTECHNOLOGICAL SOLUTION TO IMPROVE BUILDINGS THERMAL PERFORMANCE IN URBAN AREAS**

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# Abstract

Rapid urban expansion to accommodate the growing population (74% of the European population lives in urban areas) led to the replacement of vegetation by construction buildings (heat absorbing structures), bringing negative impacts to the urban environment. Strategies for increasing the use of green infrastructures, such as green roofs (GR), has improved in recent years due to the major role they can play in rising resilience in urban development. Rooftops accounts for ca. 50% of the unused urban surface area and can play a major contribution to the European Green Deal Project goals.

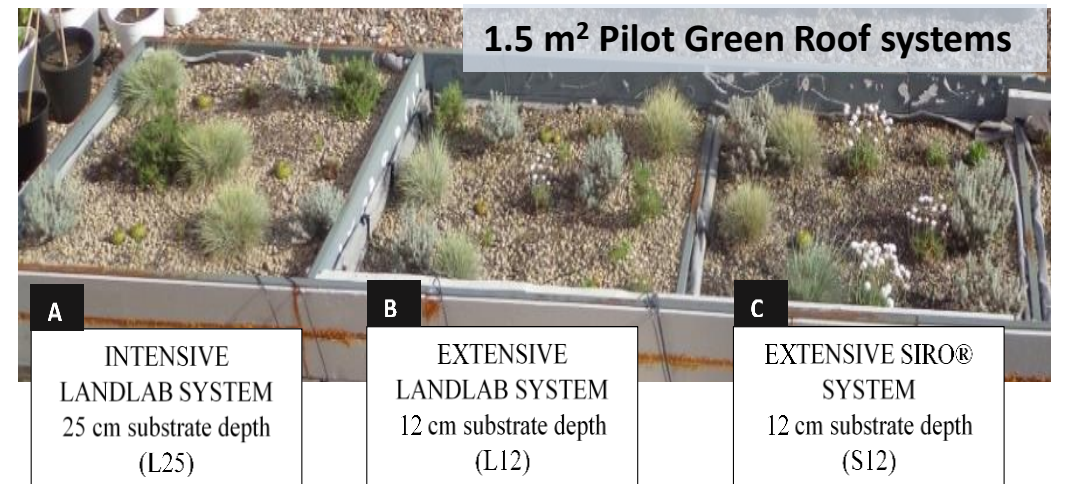
In the present study, thermal performance of GR structures (varying vegetation, substrate composition and depth) in the Mediterranean climate conditions have been studied. Results validated that aromatic plants could successfully establish and grow on the harsh environment of the Mediterranean rooftops. Substrate temperature profile was measured and potential to minimize temperature fluctuations in the roof structure was assessed. Vegetation surface temperatures were compared to bare substrate to sustain the conclusion that urban vegetation in GR can help to decrease air temperature and mitigate the urban heat island (UHI) effect.

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# Experimental Setup



a- impermeabilization membrane; b- geotextile membrane (470 g/m<sup>2</sup>); c- drainage layer; d- geotextile membrane (150 g/m<sup>2</sup>); e- substrate mixture; f- vegetation



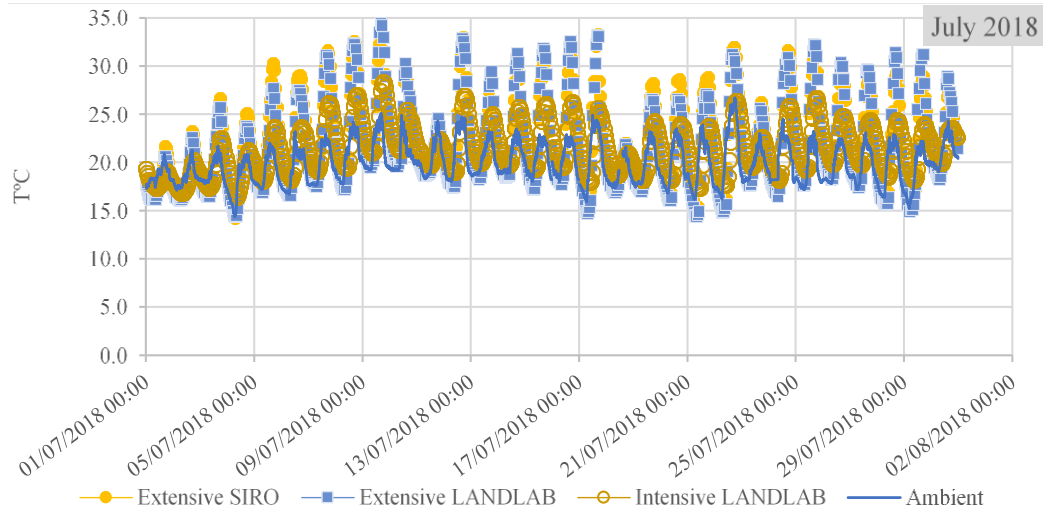
*Festuca glauca*  
*Satureja montana*  
*Sempervivum tectorum*

*Armeria maritima*  
*Santolina chamaecyparissus*  
*Santolina chamaecyparissus - Lemon Queen*

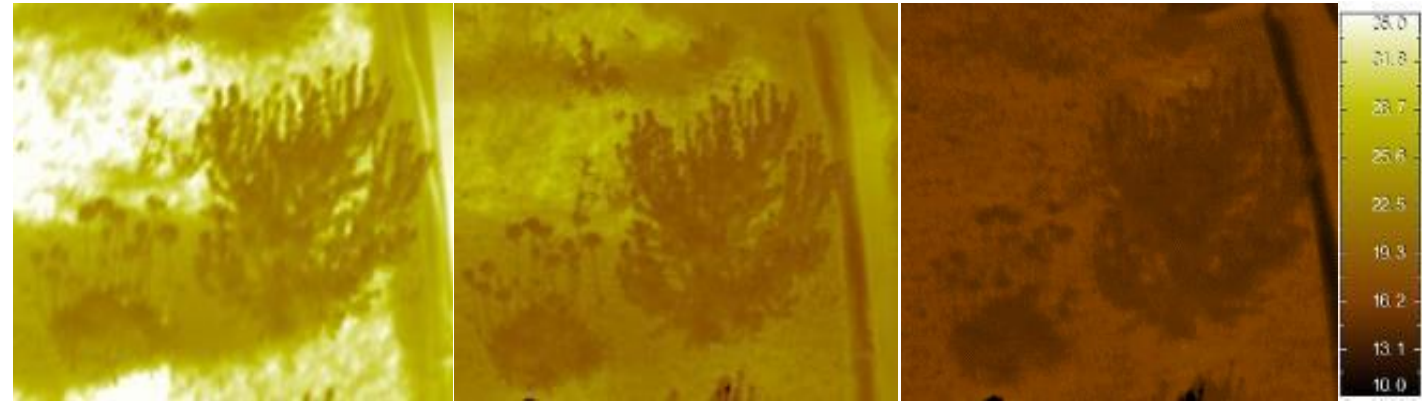
Vegetation

# Results

## Substrate core temperature variation - July 2018



## T°C decay thermogram on extensive GR system



✓ Bare substrate surface always presented higher T°C than vegetation

## Conclusions

1. Substrate depth of GR systems influences substrate T°C fluctuations, due to thermal insulation:
  - Intensive GR system showed lower maximum T°C values than extensive systems;
  - Higher substrate depth from Intensive GR system minimizes T°C fluctuations when compared to extensive GR systems.

2. GR substrate surface presented higher T°C, showing that GR systems should be fully covered by vegetation in order to minimize heat transfer through the system and maximize the contribution to the UHI reduction.

3. Tested growing substrates and tested GR depths were adequate for plant development.

