ICUC10

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Urban Morphology Parametrization for Climate Modelling in Urban Planning

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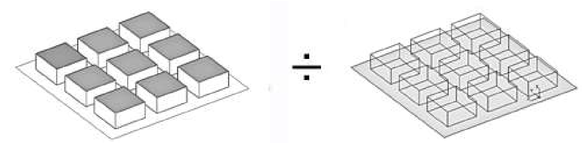
Aim and key findings:

AIM: The Local Climate zone (LCZ) classification (Stewart & Oke 2012) has been introduced to integrate urban climate knowledge into urban planning. However, **the LCZ method has significant limitations regarding the possibility to cover the many urban layouts that characterise real cities.** The aim of this study is to show that a **different set of morphology parameters would be more effective in capturing the summer and winter climate performance of real urban textures.**
METHOD: A comparative analysis of UHI intensity was performed with the Urban Weather Generator model (Bueno et al. 2013) considering representative urban textures of Rome (Italy), Barcelona (Spain) and Santiago (Chile).
RESULTS: **A significant variability of UHI intensity was found among urban textures classified as "compact mid-rise" (10< h <25) and "compact high-rise" (h > 25) in the LCZ.** Regression analyses highlighted **differentiated contributions of the three urban morphology parameters** used by UWG on summer and winter UHI intensity **and the importance of the density of facades during both seasons**. Therefore, the results suggest that the three parameters used by UWG could be used in urban planning to compare and optimise the climate behaviour of urban structures.

Urban morphology parameters in UWG:

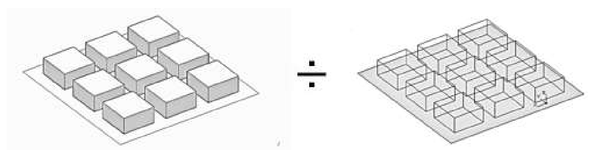
Site Coverage ratio (ρ)

$\Sigma A_{bld} / A_{site}$
A_{bldg} = Building footprint
A_{site} = Total Site area



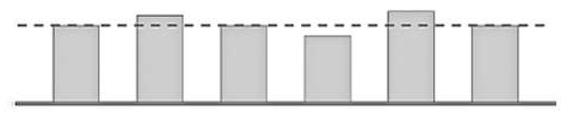
Facade-to-site ratio (VH_{bld})

$\Sigma PH_{bld} / A_{site}$
P = Building perimeter
H_{bld} = Average building height, weighted by
A_{site} = Total site area

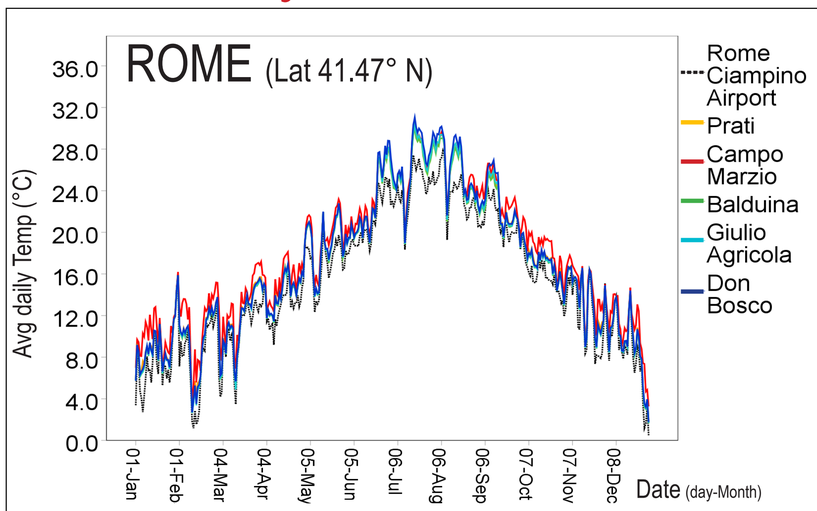


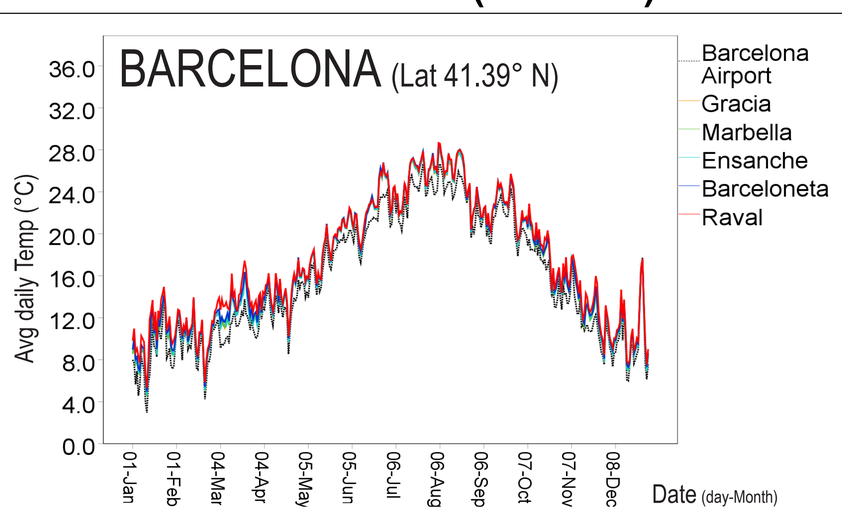
Average Building Height (H_{bld})

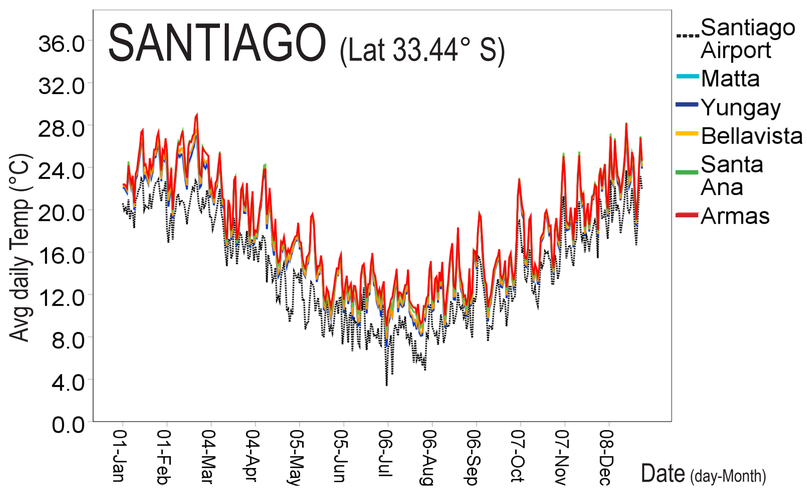
H_{bld} = Average building height, weighted by footprint



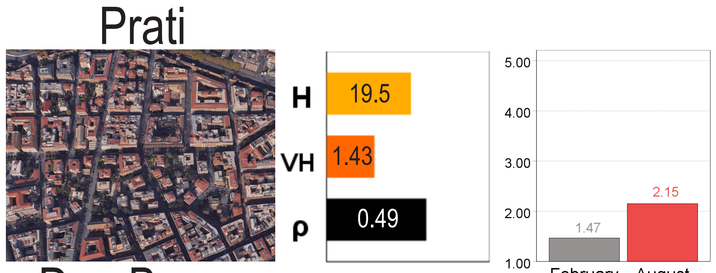
UHI analysis with Urban Weather Generator (UWG)

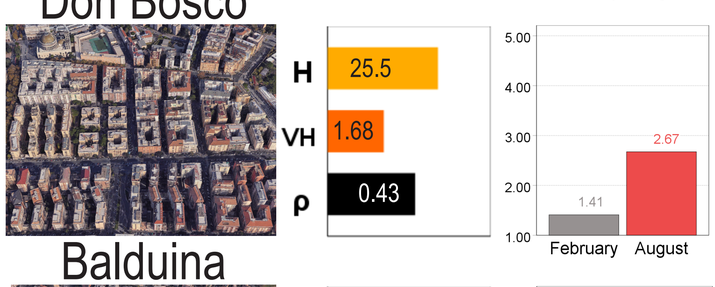


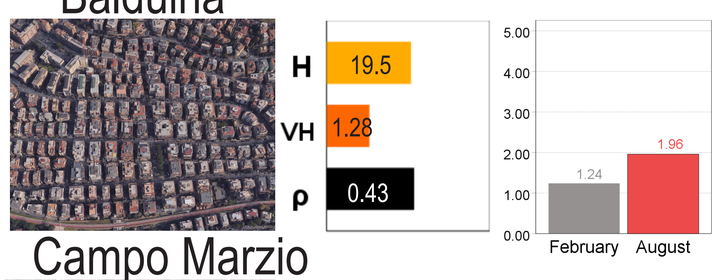


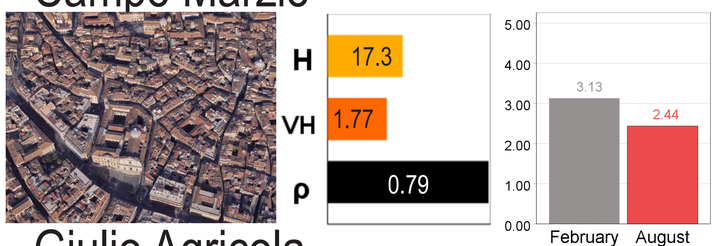


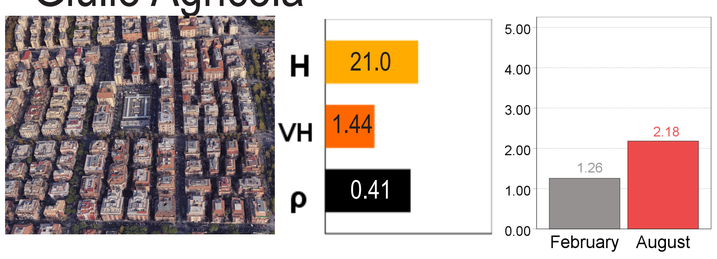
Rome (Italy)



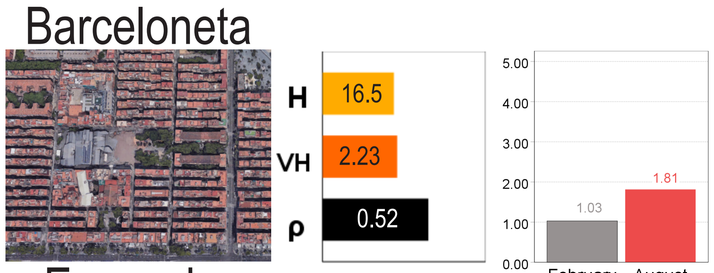


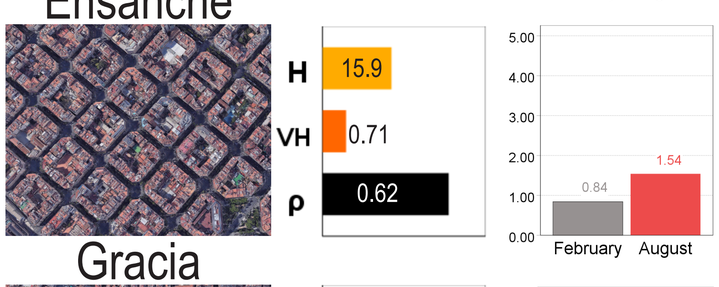


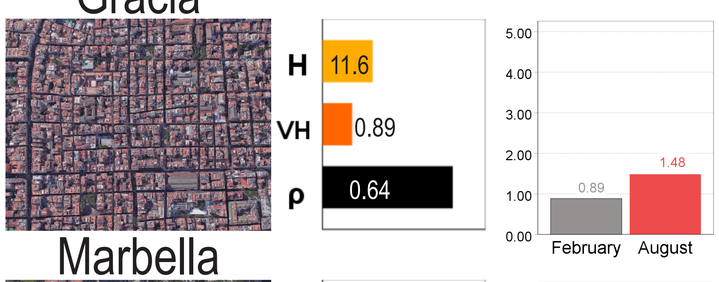


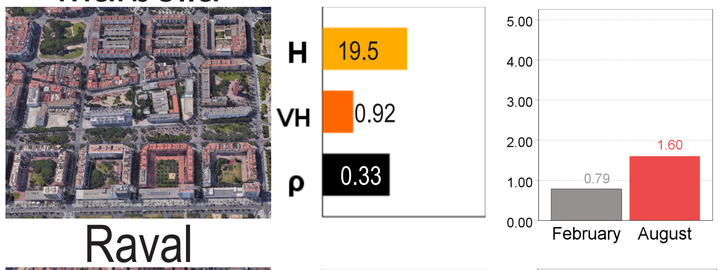


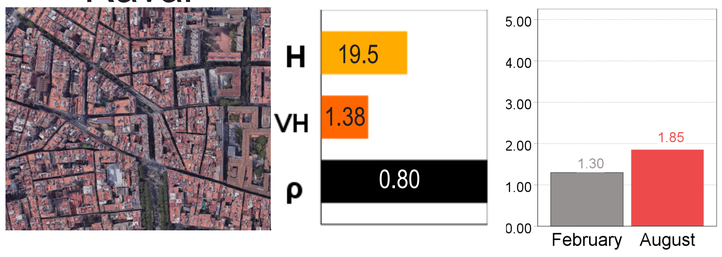
Barcelona (Spain)



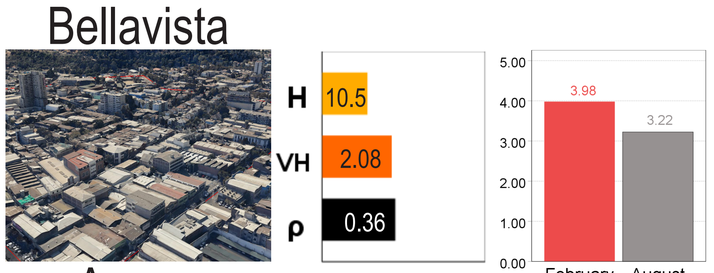


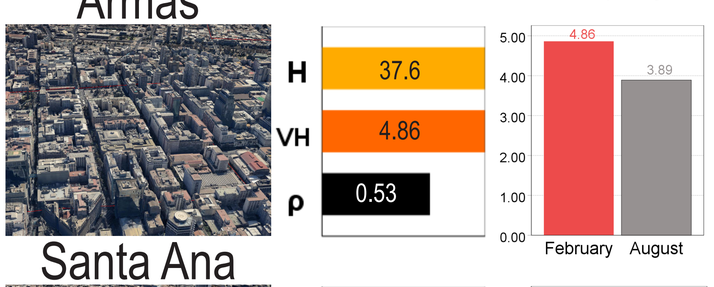


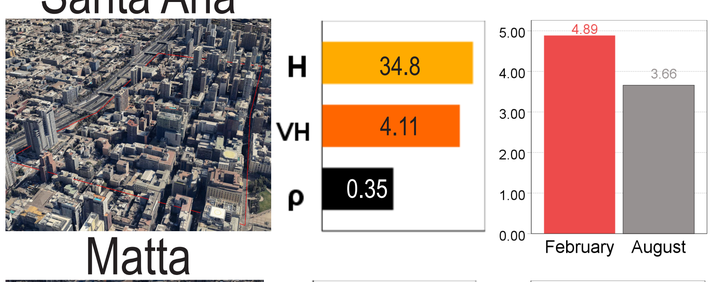


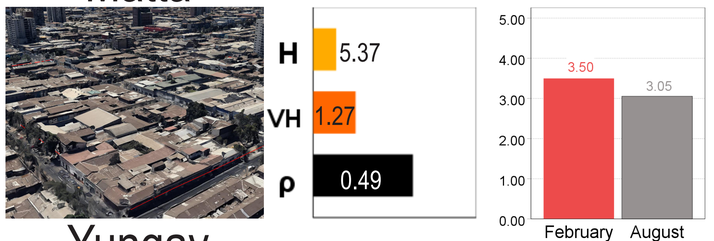


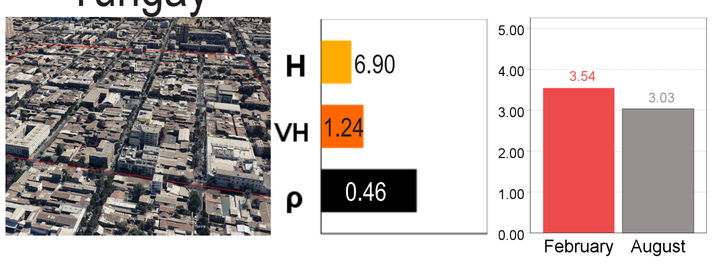
Santiago (Chile)











Regression equations:

$$\text{WINTER } UHI = \mathbf{0.5}\, Z\rho + \mathbf{0.57}\, ZVH_{urb} + 0.15\, ZH_{bld} \quad (\text{adjusted } R^2=0.7)$$

$\longrightarrow$ **ρ and VH_{urb} are determinant in WINTER**

$$\text{SUMMER } UHI = 0.1\, Z\rho + \mathbf{0.67}\, ZVH_{urb} + \mathbf{0.56}\, ZH_{bld} \quad (\text{adjusted } R^2=0.9)$$

$\longrightarrow$ **VH_{urb} and H_{bld} are determinant in SUMMER**

Z_i = Normalized values of ρ, VH_{urb} and H_{bld}