

Digitalizing the urban landscape. Microclimate, energy systems and comfort

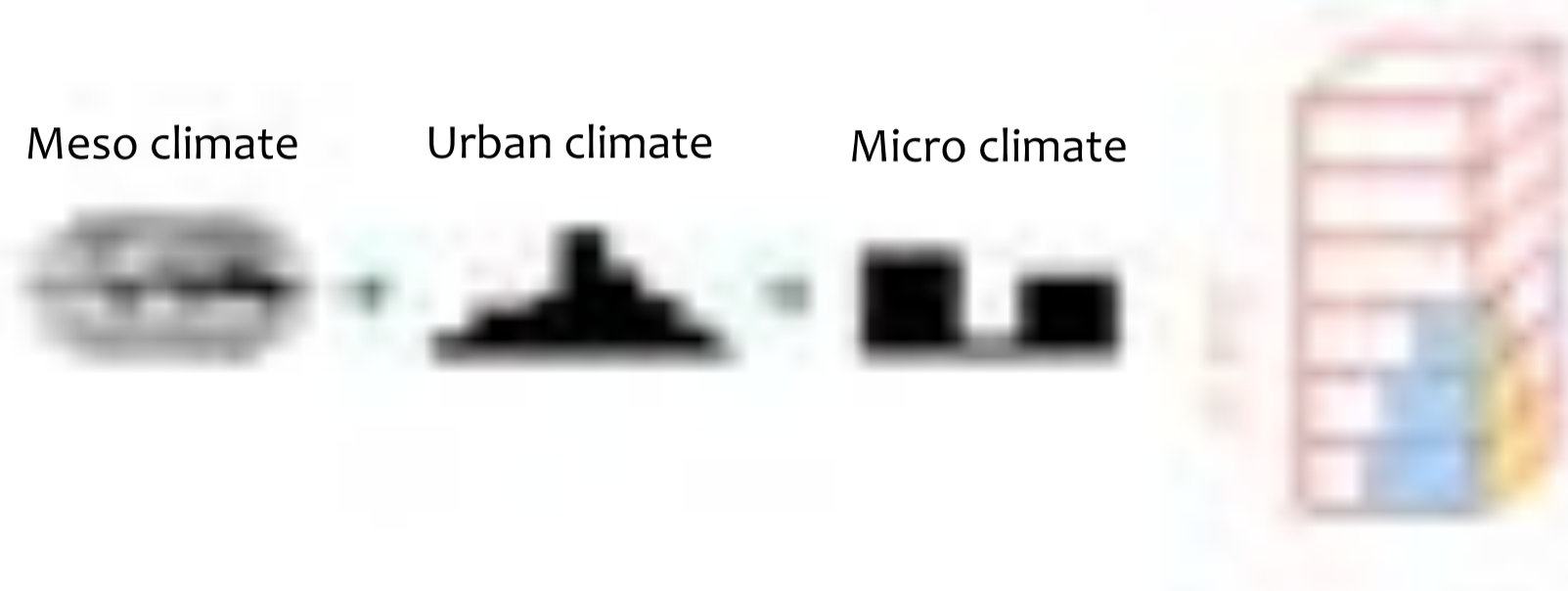
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Inter- and Transdisciplinarity

We combine our disciplines to understand complex urban behaviours

Microclimate

Canopy Interface Model (CIM) to compute “infinite” urban microclimatic conditions



Health and wellbeing

Hourly analysis of the pedestrians thermal comfort within the built environment



Urban Green Infrastructures

Digitalization of trees and grass, to compute their cooling potential



Energy Systems

Dynamic optimization of the urban electrical hubs



Within a human centric design

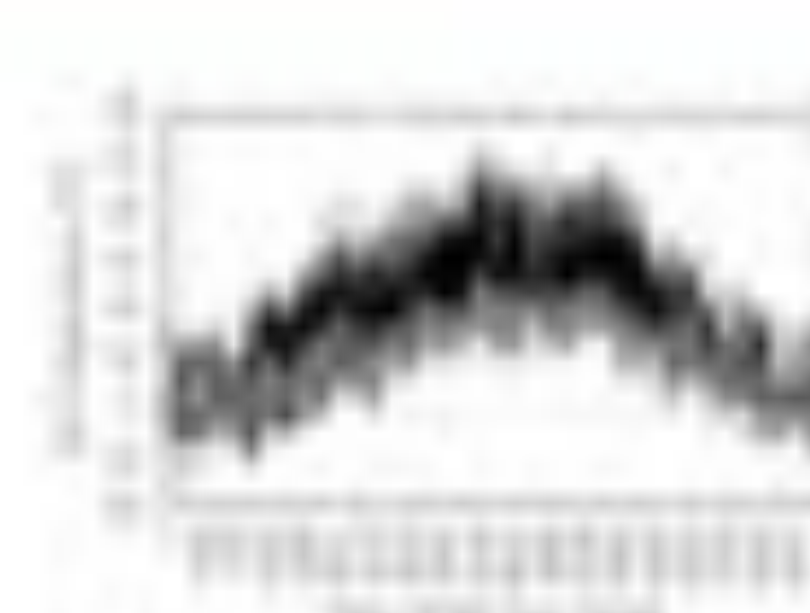
METHODOLOGY_Digitalization



Geometrical model
(GIS, DWG, GML..)



CitySim. Energy model
and greening design



CIM model. Air temperature,
wind speed and direction



Thermal comfort, greening,
energy demand and optimization

RESULTS AND DISCUSSIONS_Urban trees

Daytime cooling and nighttime warming effect of a street tree

Yearly mitigation of the urban climate

Urban green influences energy demand of the building stock resulting significant changes in the energy system

Buildings: major role in decreasing the air temperature, by the shading effect, preventing the direct radiation to heat the urban surfaces

Cold air pools (CAPs) effect during winter time

Impact of LAI: reduction by 3°C the air temperature, from LAI1 to LAI3

Trees reduce the wind speed within the urban environment (e.g. 5% LAI3)

Turbulence within the canyon (C): evening, sunny days



A. Averaged air temperature for a Typical Meteorological Year (TMY) and the Canopy Interface Model (CIM)
July: 23.7°C CIM and 19.1°C TMY



C. Monthly variation of the outdoor air temperature due to the Leaf Area Index



D. Thermal behaviour during a summer evening (20:00 hours)

CONCLUSIONS and KEY READINGS

The proposed digital platform provides an interactive display, a common ground of discussion for urban planners, architects, engineers and biometeorologists. Thanks to the work developed, an interdisciplinary knowledge is defined, which is used as a teaching instrument within the ENAC faculty.

D. Mauree, N. Blond, M. Kohler, and A. Clappier, “On the Coherence in the Boundary Layer: Development of a Canopy Interface Model,” *Front. Earth Sci.*, vol. 4, 2017.
A. T. D. Perera, V. M. Nik, D. Mauree, and J.-L. Scartezzini, “Electrical hubs: An effective way to integrate non-dispatchable renewable energy sources with minimum impact to the grid,” *Appl. Energy*, vol. 190, pp. 232–248, Mar. 2017.
S. Coccolo, “Bioclimatic Design of Sustainable Campuses using Advanced Optimisation Methods,” 2017. EPFL Thesis n. 7756