



S A A D

Scuola di Ateneo
Architettura e Design "Eduardo Vittoria"
Università di Camerino



Comune di Ascoli Piceno
MEDAGLIA D'ORO AL VALOR MILITARE PER ATTIVITÀ PARTIGIANA

Development and implementation of TENS Methodology to support the Environmental Design

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Scuola di Ateneo Architettura e Design

Life SEC Adapt Project

14 Dicembre 2017

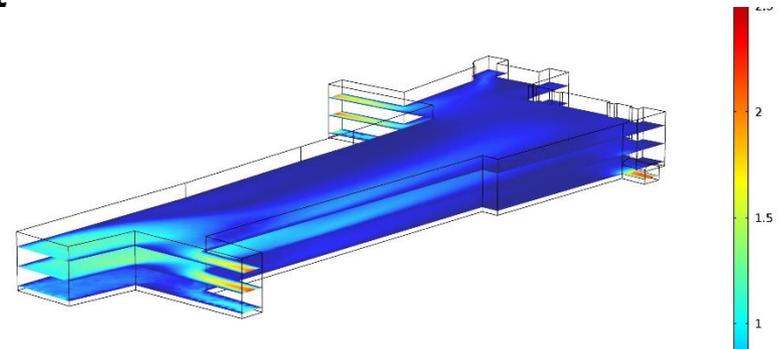
Sala della Ragione_Palazzo dei Capitani_Ascoli Piceno

From climate problems to design solutions

[...2014 will probably be one of the hottest years since 1880 when observations began. Even without El Niño, this year is registering record after record of elevated average monthly temperature...]

NOAA - "State of the Climate: Global Analysis for December 2014"

- ***Adapting buildings to new environmental conditions, decreasing energy consumption, improving indoor and outdoor comfort***
- ***Define public space as a functional, climatic, and acoustic continuation of buildings***
- ***Design urban open spaces like thermodynamic filters to improving environmental quality and outdoor comfort***



Research objectives / TENS Methodology

The **TENS Method** was developed with the aim of identifying and analyzing the close relationships between open urban spaces and buildings by using horizontal and vertical Cross-sections. Computational fluid dynamics software (CFD) allow thermodynamic analysis on 3D models and results can be rendered using two-dimensional images, simplifying the understanding of physical phenomena and extending the design possibilities up to the human comfort

*Why should we use the **TENS Method**?*

The traditional approach to urban design does not currently foresee the introduction of norms or regulations regarding the orientation, use of green areas, paving materials, or building colours, all of which are elements that commonly contribute to climatic heating and, in a wrong way, to the formation of urban heat islands.

Italian historical centre / Ascoli Piceno

Where?

A typical italian historical centre - The city of Ascoli Piceno in the Marche Region

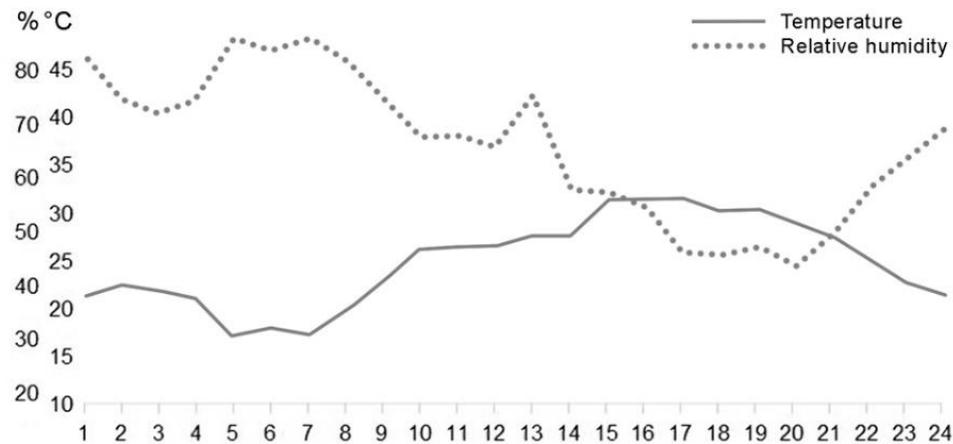
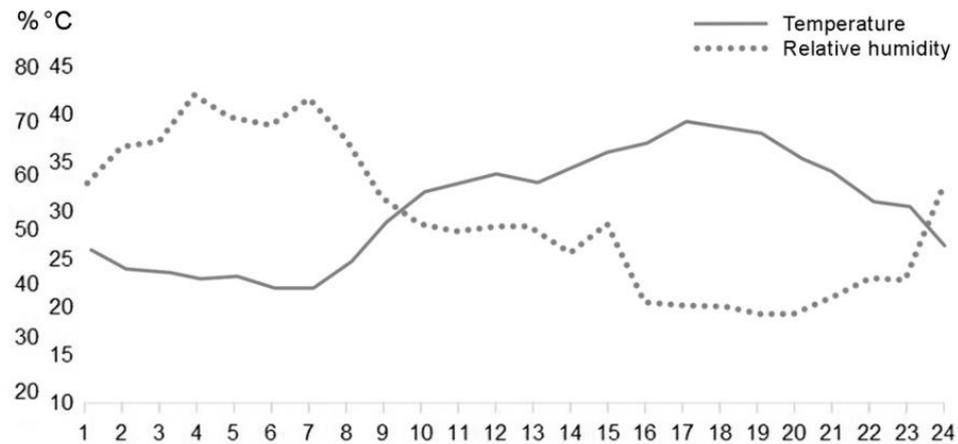
When?

Two summer cases were considered, a representative day (9/06/2010) extracted from the historical period and the hottest day (14/08/2014) ever recorded in Ascoli Piceno

How?

Two different cases were simulated, the current state and the new design proposal.

Ascoli Piceno – Climate analysis

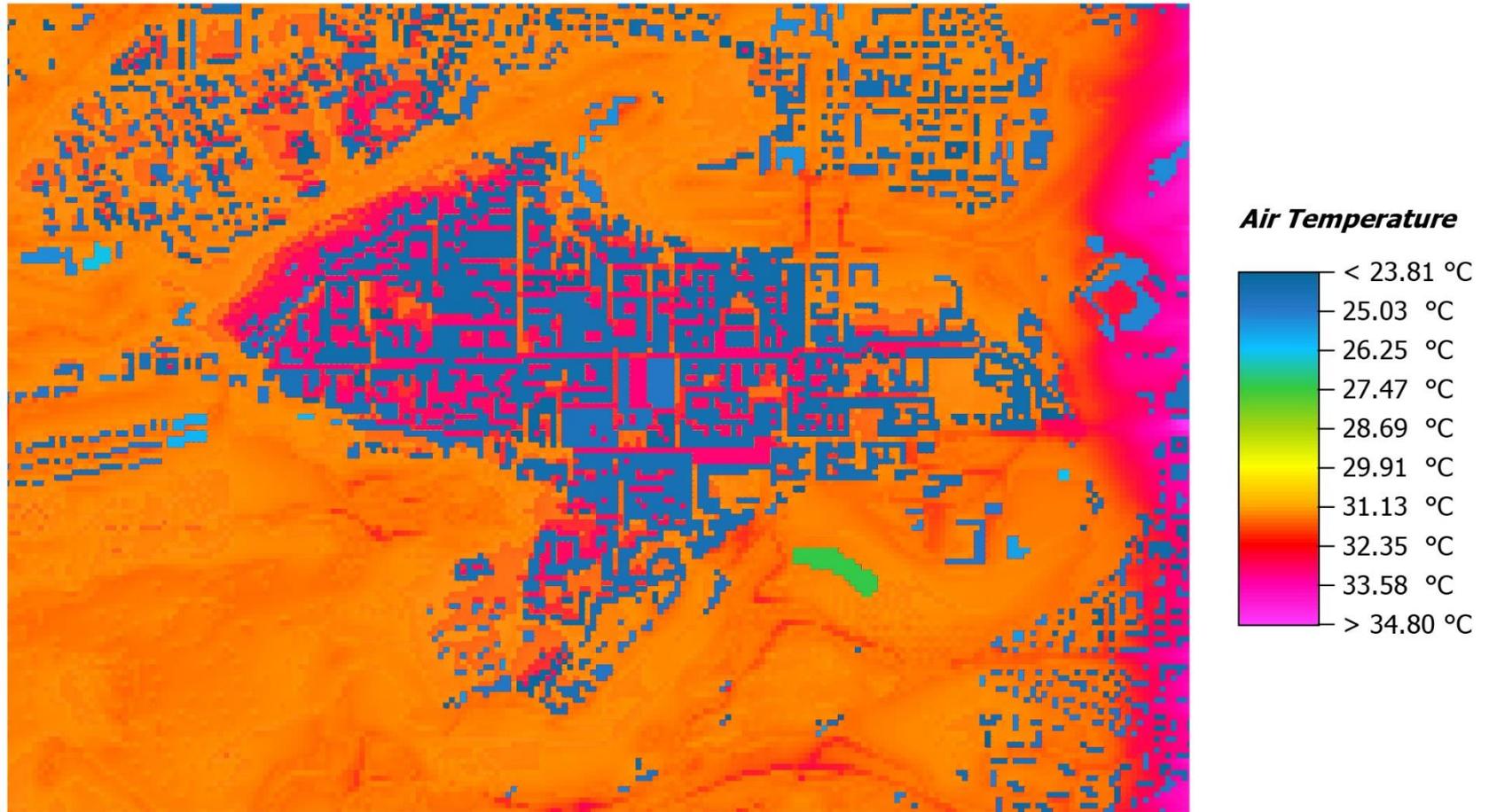


Hottest and Representative day

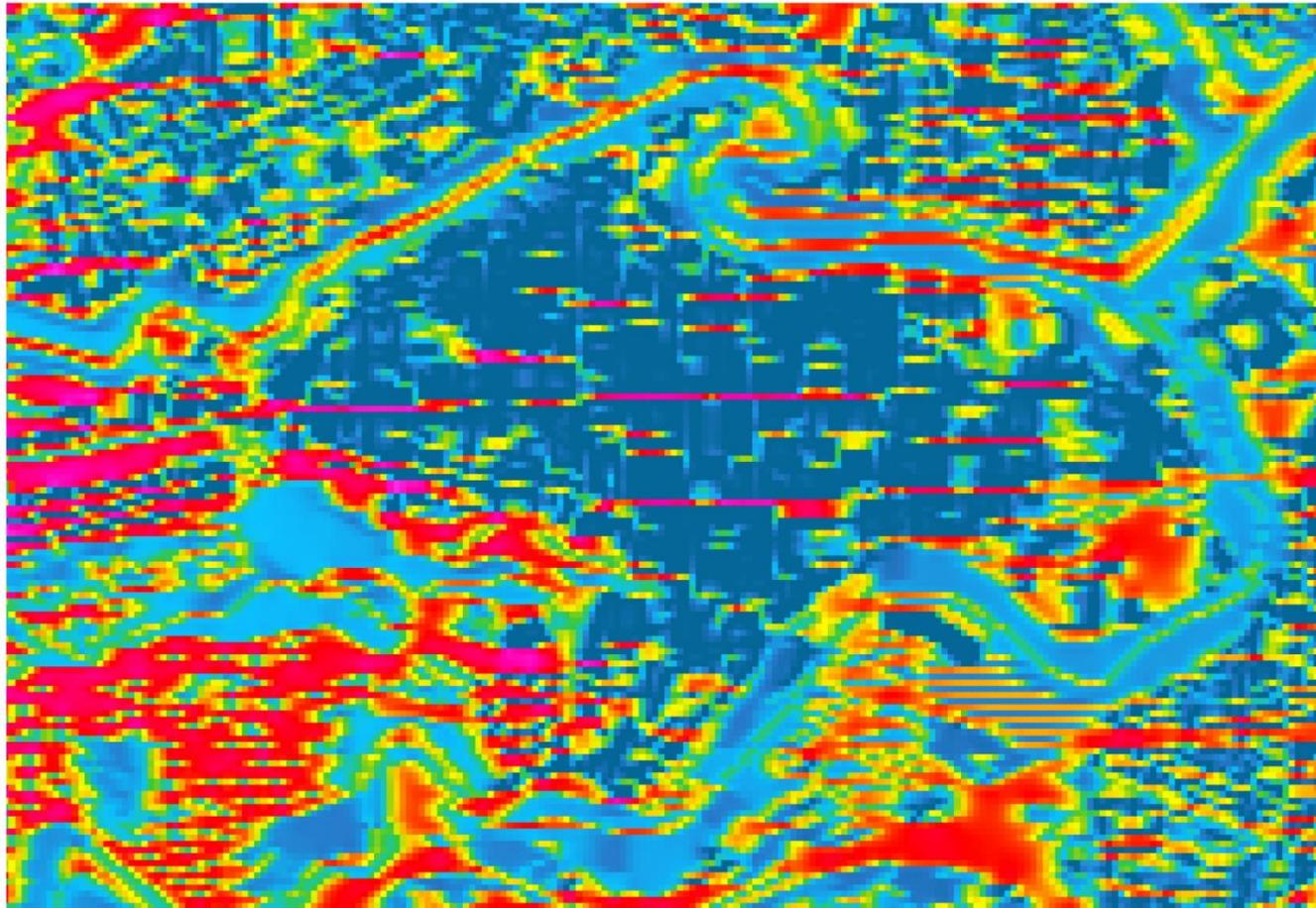


Climate data collection

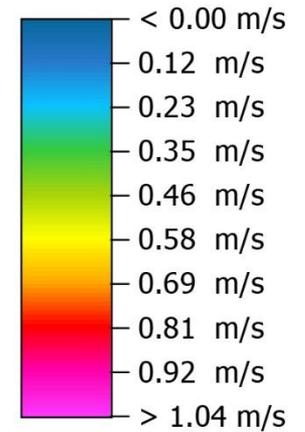
Ascoli Piceno – Climate vulnerability



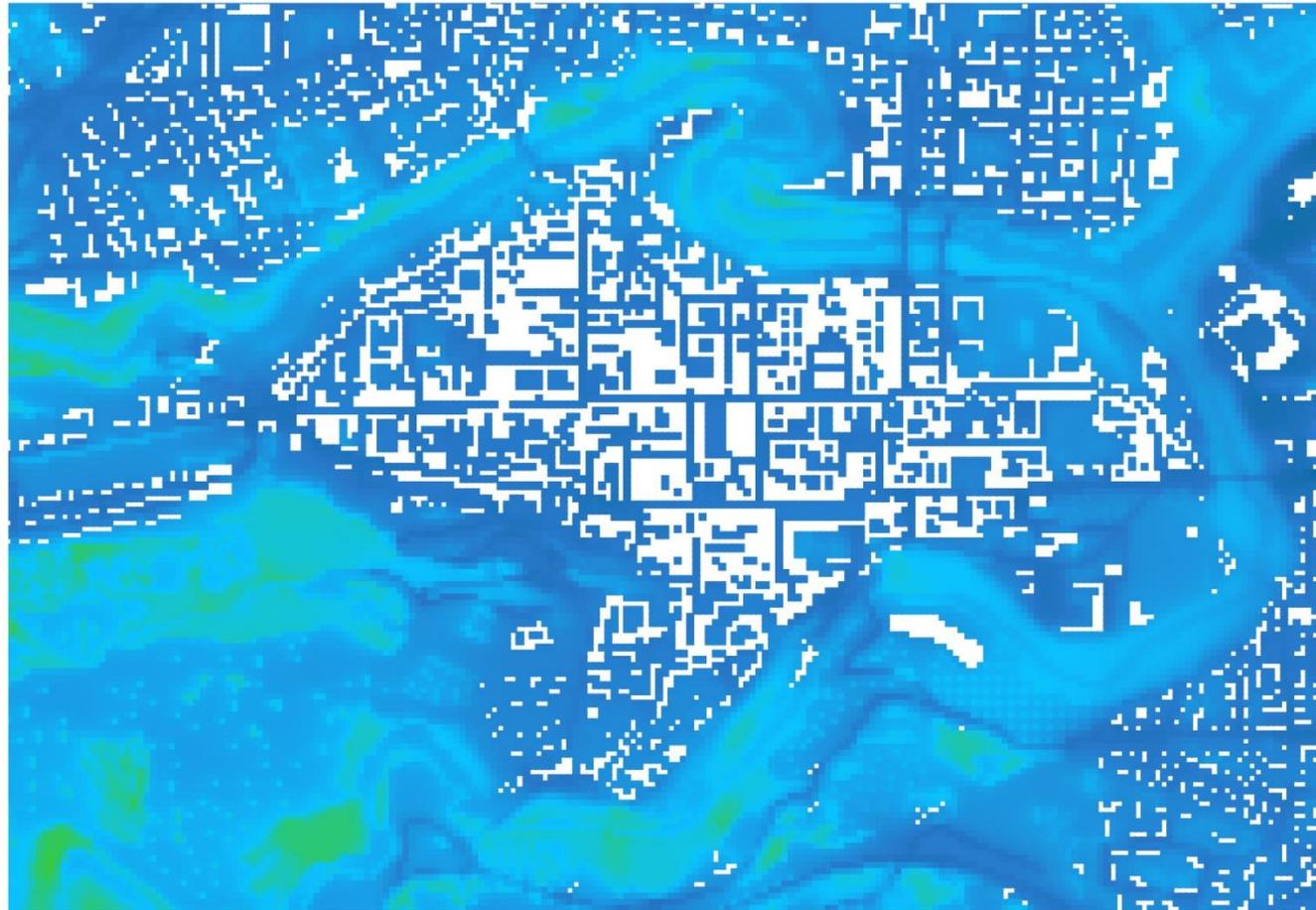
Ascoli Piceno – Climate vulnerability



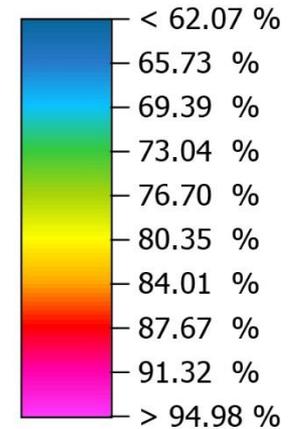
Wind Speed



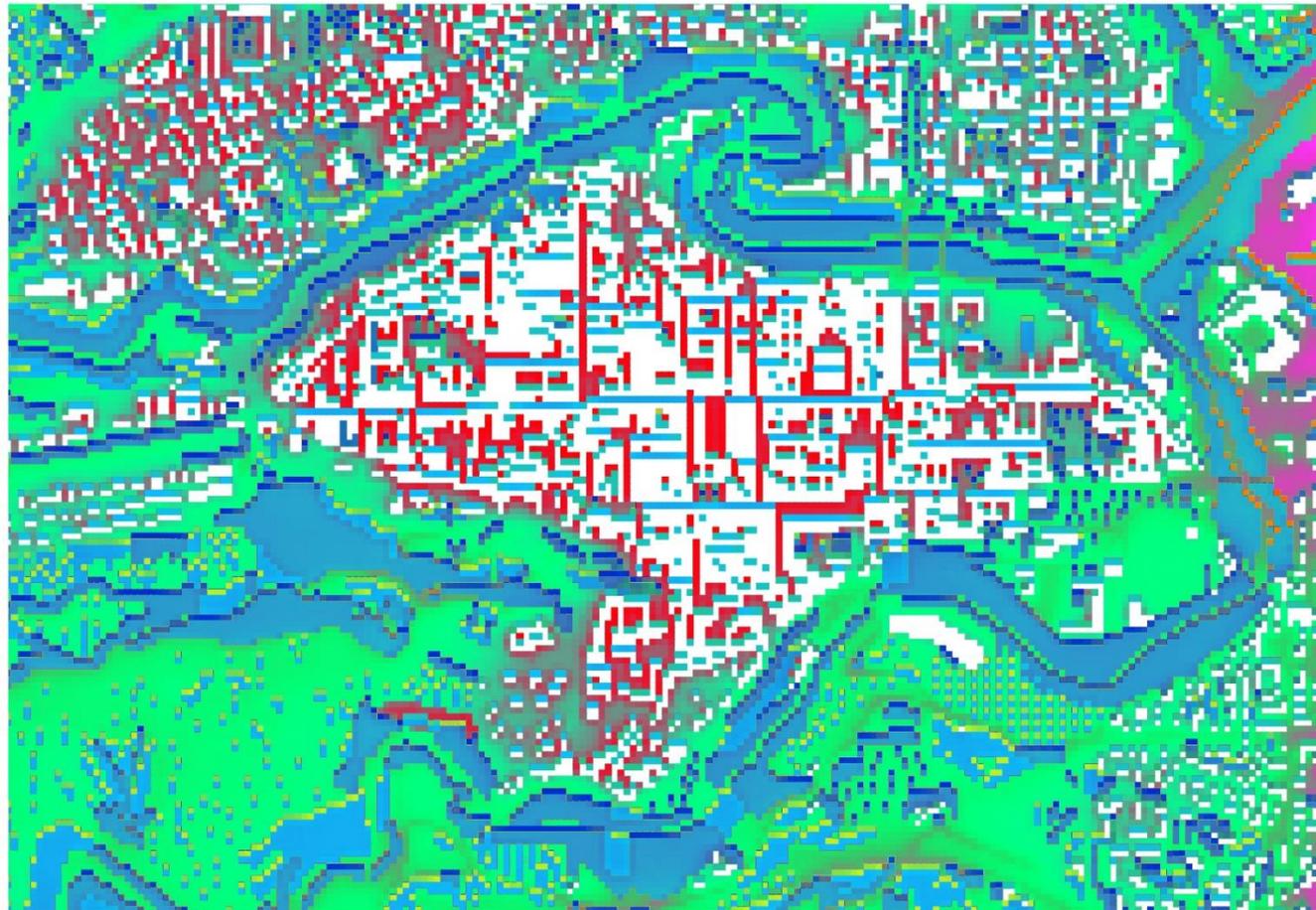
Ascoli Piceno – Climate vulnerability



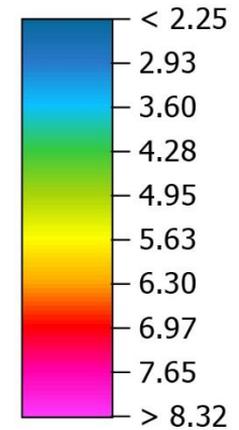
Relative Humidity



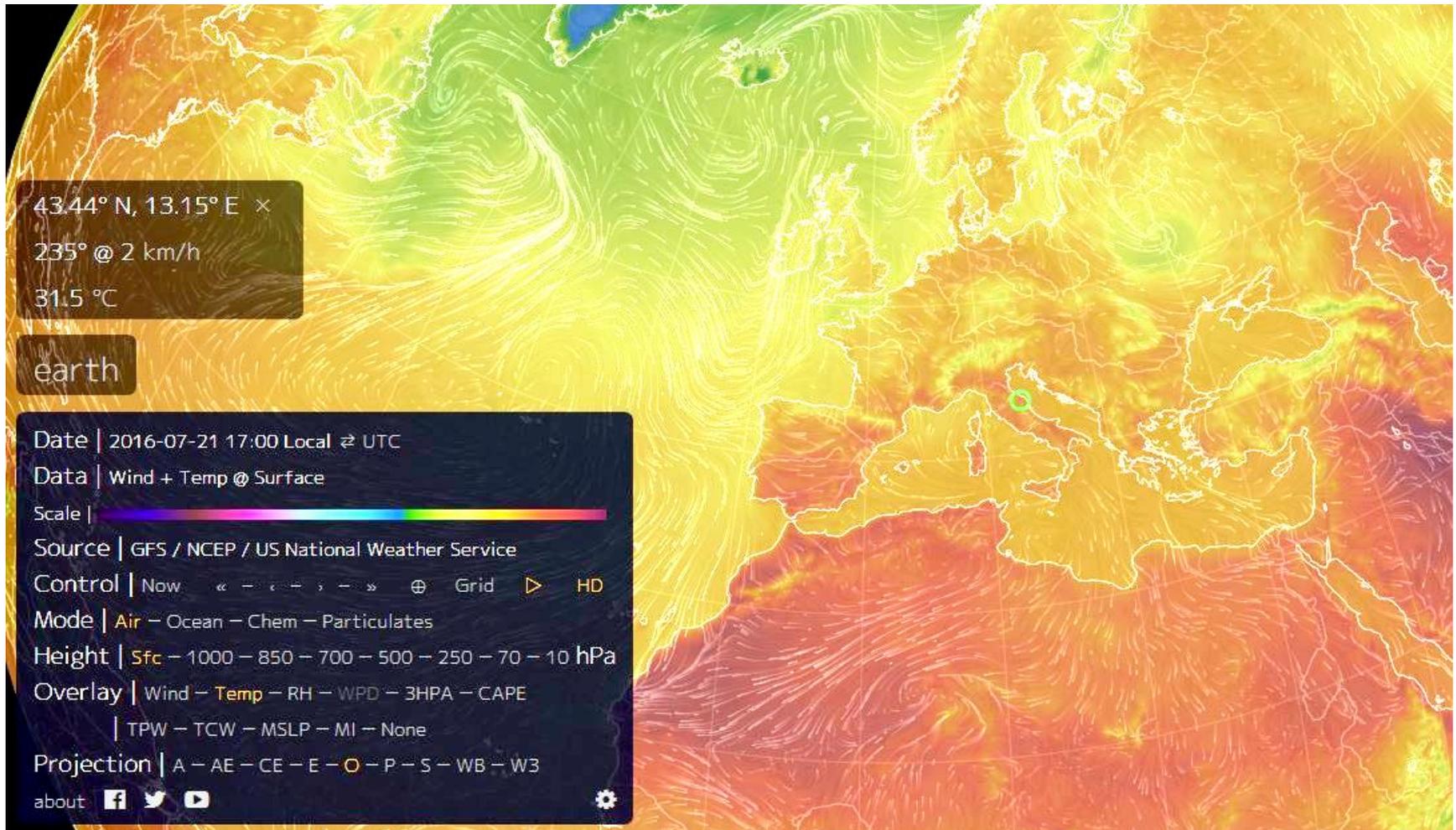
Ascoli Piceno – Climate vulnerability



PMV



Ascoli Piceno – Climate vulnerability



Heat waves global forecast

Ascoli Piceno - Case studies

Convento di Sant'Agostino



Piazza del Popolo



Piazza Arringo

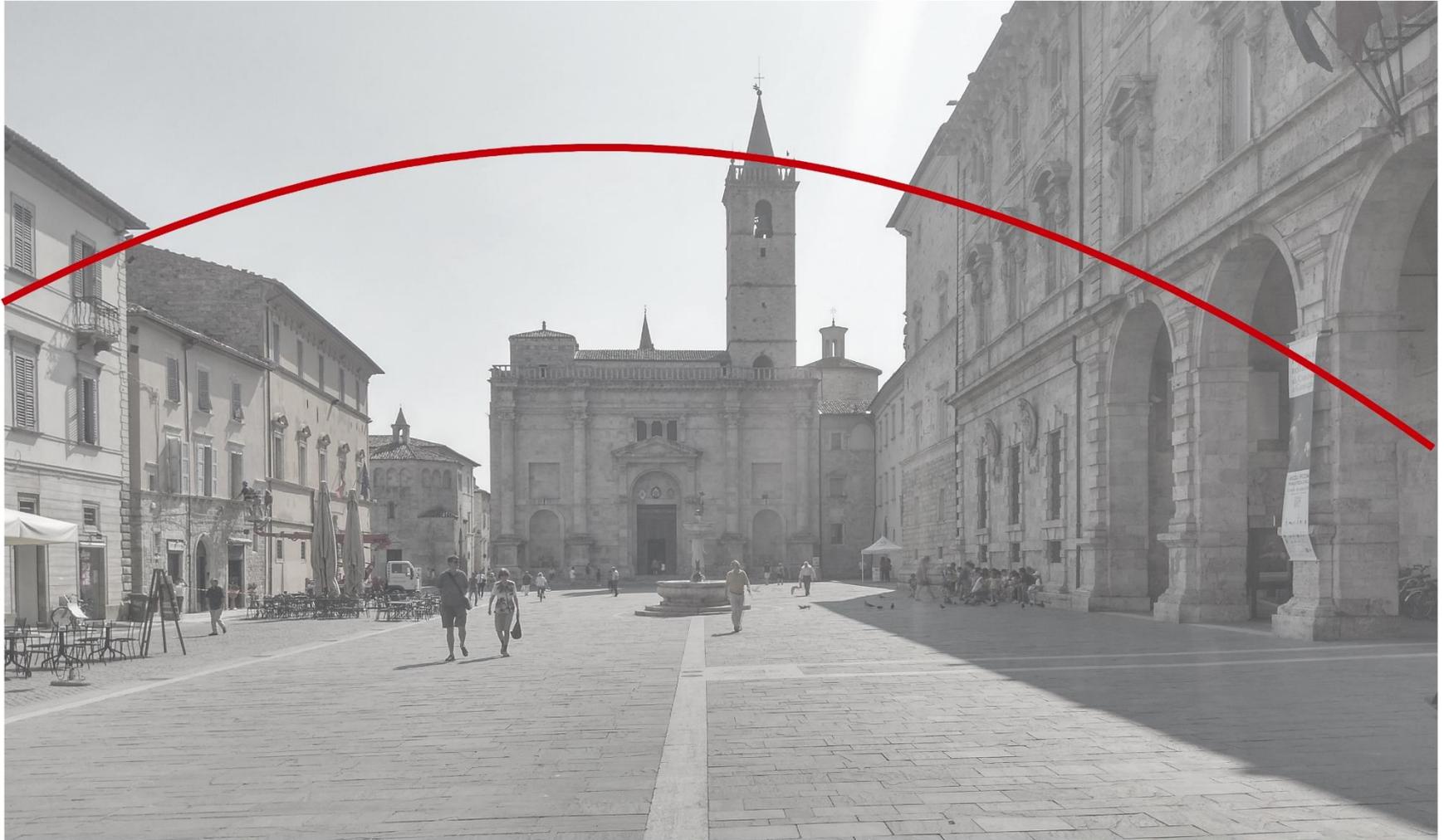


Convento dell'Annunziata



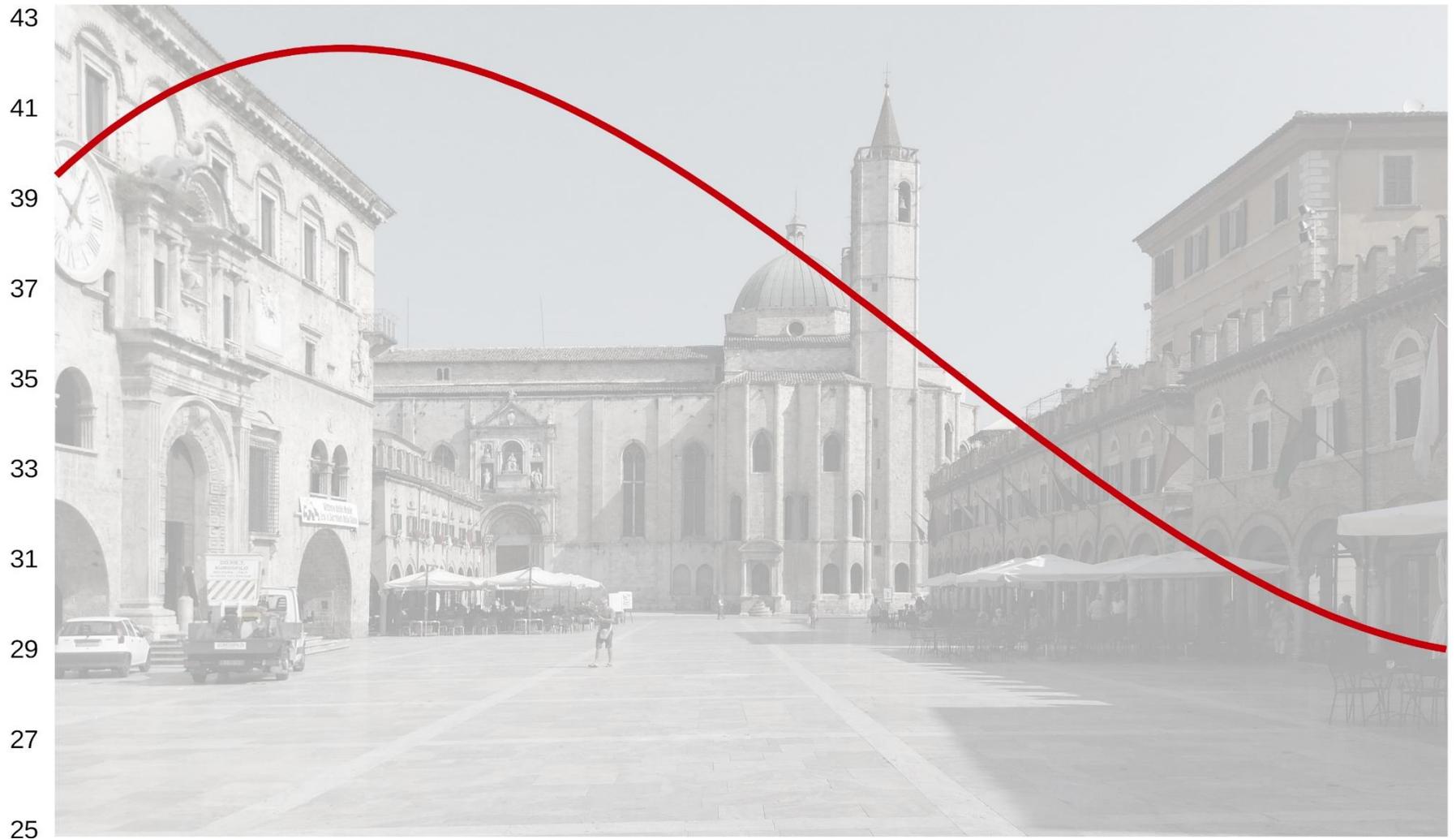
Viale De Gasperi

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Project area

Climate data / Hottest and Representative day

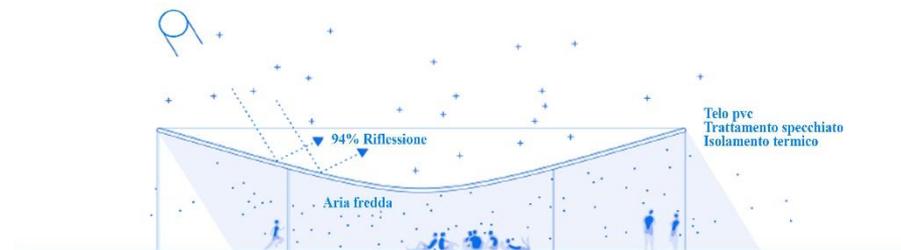


Project area

Climate data / Hottest and Representative day

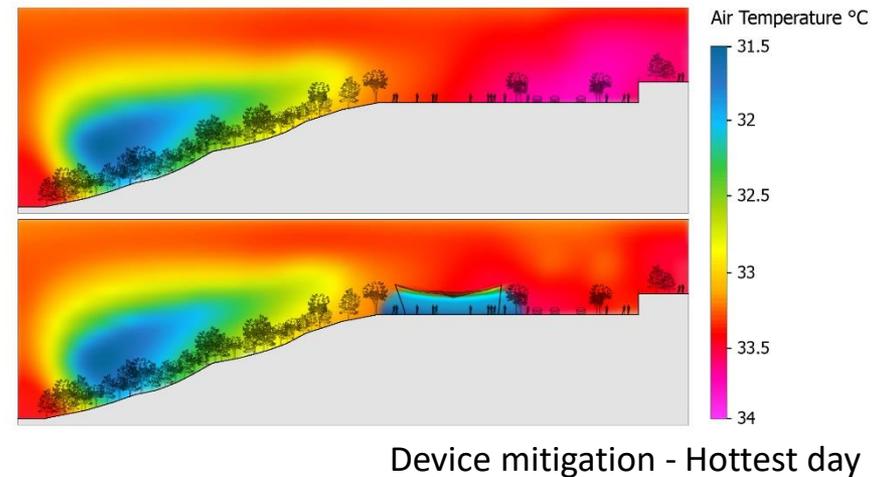
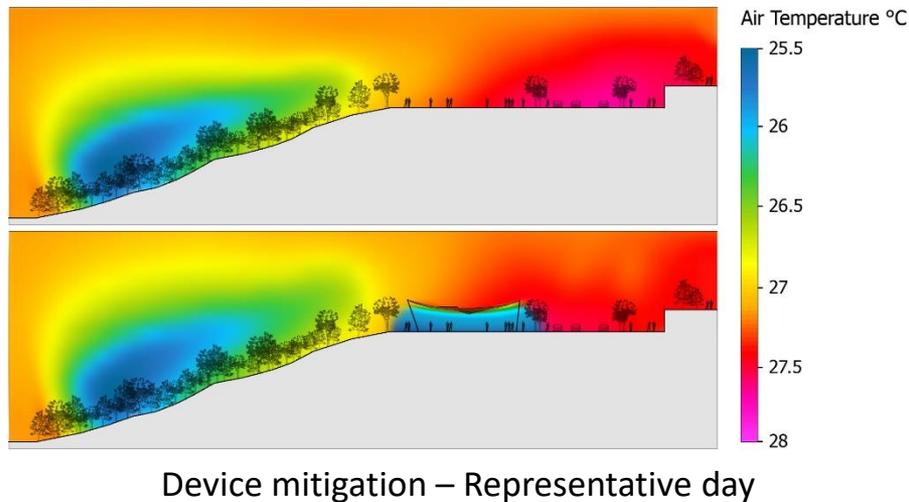
Design proposal

The new design proposal foresees the substitution of the current paving in the square with a green parterre covering at least 50% of the space, doubling the number of tall trees (Tilia platyphyllos) along the street, a tensile shading structure made of reflecting and thermally insulating fabric.



Results and design potential

The analysis shows that effective improvement can be made due to the design proposal and, in the considered area, an average decrease in temperature with a $\Delta T = 1.4$ °C can be seen in the representative day, and a decrease with a $\Delta T = 1.2$ °C during the heat wave (hottest day)

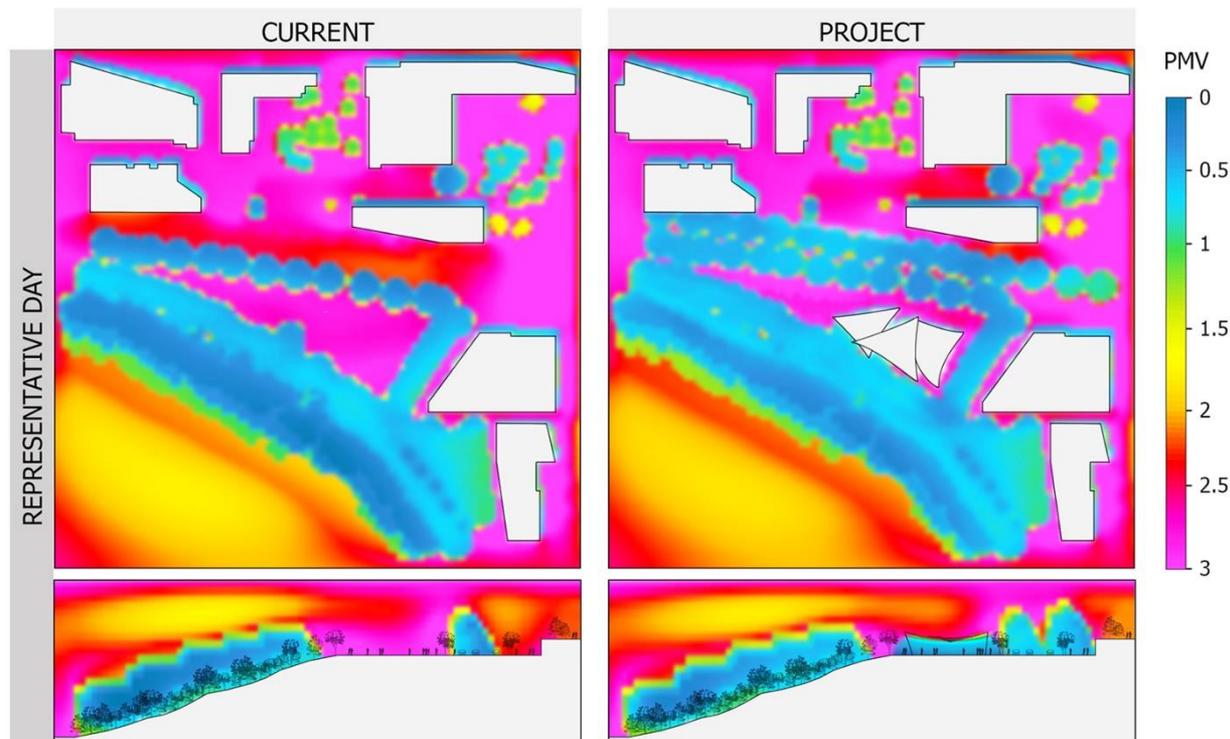


Results and design potential

- *In decreasing the temperature, as measured between the pre- and post-work states, the PMV (Predicted Mean Vote) also changes from a situation of hot discomfort (+ 3) to a climatically acceptable warm one (+ 1.6) during the heat wave. For the representative day, the same spots are of interest to the best neutral condition, with an average variation of about + 2.3 for the current configuration to + 0.3 for the project*
- *The use of the cross-sections makes clear the positive role that vegetation plays in absorbing and mitigating the heat, underlining the direct importance of screens in blocking direct solar radiation and indirectly in the low release of heat in the nearby shaded pavement up to consider trees an environmental device favoured by their natural seasonal adaptability*

Results and design potential

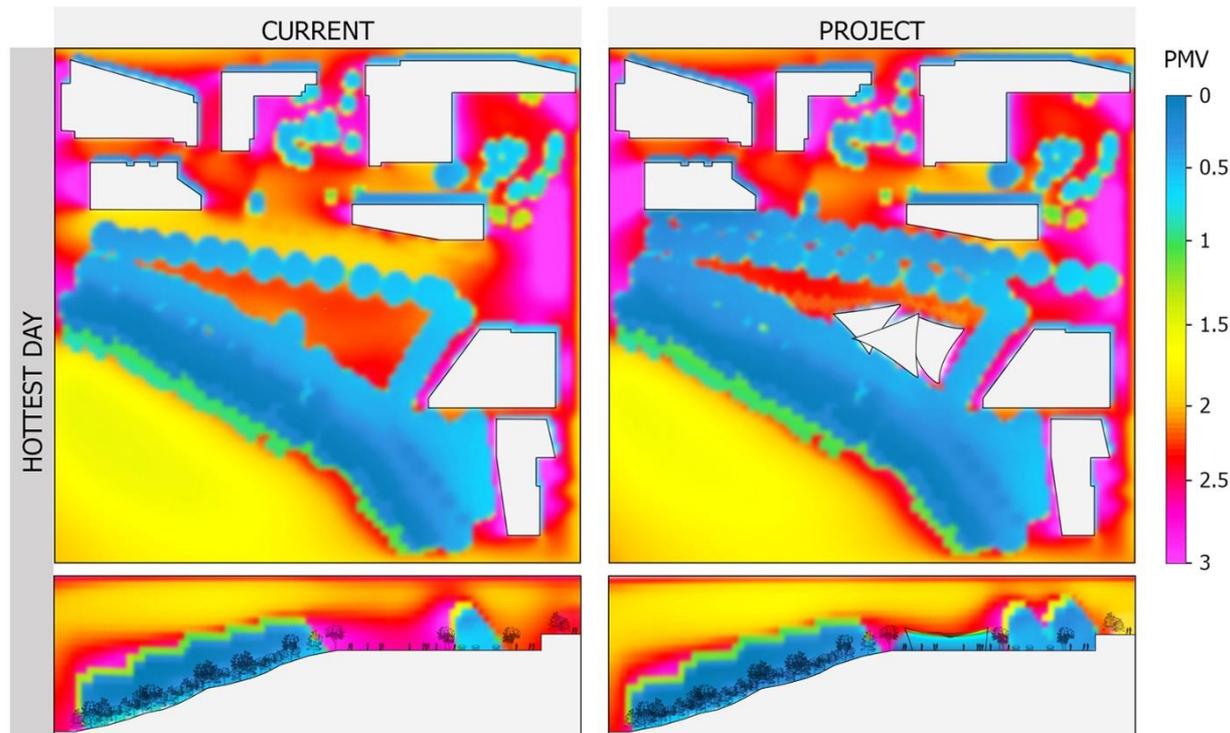
- *The screening, reflecting, and insulating properties of an adjustable shade system guarantee notable protection from solar rays and from the pavement overheating in order to obtain PMV values in line with summer trends even during heat waves, although with some small variations.*



PMV tomographies - Plans and sections

Results and design potential

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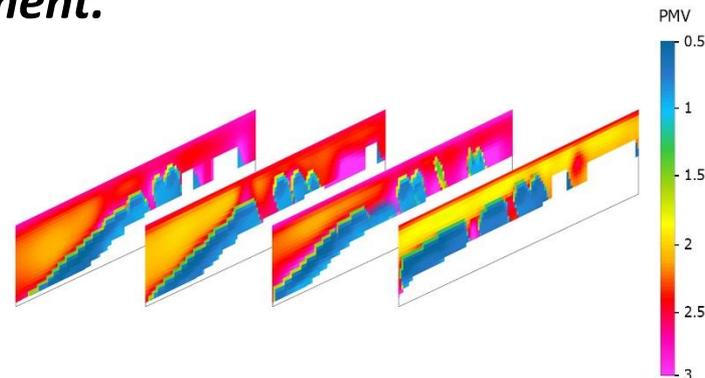


PMV tomographies - Plans and sections

Conclusions

In the end, the TENS methodology is powerful in understanding the richness of micro - climatic, also during severe episodes, and formal characteristics in outdoor urban spaces. It can be employed in the early design stages to evaluate different generic strategies to incorporate comfort requirements in architectural projects.

The TENS investigative tool has opened an innovative field of investigation based on the small-scale design of open spaces (but with effects on the wider urban scale), making the different dynamic elements that contribute to defining environmental comfort interact directly with the user, who is also considered as a dynamic, reactive element.



PMV, Tomographic sections of an urban heat wave



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Thank you!

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