

Better planning can reduce the urban heat island effect

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In his Ph.D. thesis, EPFL researcher Martí Bosch proposes a method for spatially quantifying the impact of mitigation measures—planting green spaces and using different building materials—on the urban heat island



effect.

During hot weather, cities are warmer than the surrounding rural areas. This well-known phenomenon—known as the <u>urban heat island effect</u> —is particularly acute at night when concrete and asphalt release the heat stored up during the day. In downtown Lausanne, for instance, nighttime temperatures can be as much as 8°C higher than in the suburbs. The answer to this problem lies in planting green spaces wherever possible and, in the longer term, factoring this consideration into urban land-use planning. Martí Bosch, who just completed his Ph.D. in <u>environmental engineering</u> at EPFL's School of Architecture, Civil and Environmental Engineering (ENAC), used his thesis to examine ways of measuring the environmental implications of urban sprawl. He proposes a tool for spatially quantifying the impact of mitigation measures on the urban heat island effect.

"Most research into the urban heat island effect has focused on small neighborhoods because the simulation models are complex," explains Bosch, who carried out his thesis research at the Urban and Regional Planning Community (CEAT), an EPFL research group led by Jérôme Chenal. "But our simpler <u>model</u> means we can study the effect across an entire urban area, which makes it easier to identify and measure heat islands."

First real-world application

The team began by gathering whatever data they could, beginning with temperature records from 11 monitoring stations across Lausanne. As expected, the researchers found nighttime variations between the city center and the <u>outer suburbs</u>. Given the nearly 400-meter elevation difference between the lowest and highest points in the conurbation, they also expected altitude to play a role. Surprisingly, it had almost no effect. "Vegetation is the key differentiating factor," says Bosch. And that



comes as good news, since it's easier to plant trees than to move an entire city. The model made no allowance for the potential cooling effect of Lake Geneva, however.

Bosch's next step was to apply an as-yet unused model developed by the Natural Capital Project, based at Stanford University. Working with the model's design team, he showed how it could be used to simulate the impact of urban heat mitigation measures in a city—Lausanne—based on three key biophysical mechanisms: tree shade, evapotranspiration and albedo (how well a surface reflects solar energy).

"Our research has methodological limitations because it uses a simplified approach," says Bosch. "But the model is a useful tool for assessing the impact of planning proposals on urban heat, and to see how they might mitigate this effect."

High- or low-density development?

As part of his research, Bosch also quantified spatiotemporal patterns of urbanization in three Swiss cities—Bern, Zurich and Lausanne—between 1980 and 2016. His conclusions show that, while low-density development still dominates in the outer suburbs of Bern and Lausanne, the same zone around Zurich is nearly as dense as the city center. Will the other two cities follow a similar path? "The model can be used to assess the implications of future urbanization trends—low-density development in the outer suburbs or high-density development in the inner suburbs—on urban heat island intensity," explains Bosch. Ultimately, planners everywhere face the same delicate balancing act: limiting the number of people exposed to the excessive heat of the city without sacrificing too much farmland. Bosch's model can help inform their decisions.



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