

New 'Cool Routes' app maps shadiest routes for your walk

With real-time weather and shade data, the online tool can reduce heat exposure without adding significant distance to a trip

By Joe Rojas-Burke, ASU News
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In the summer, the Arizona sun hits like a blowtorch and the pavement radiates heat like a stove.

To make hot-weather walking less of an ordeal, Arizona State University researchers have created a web-based app that finds the coolest, shadiest ways to reach destinations on foot.

[Cool Routes](#), an online tool developed by [Ariane Middel](#) and colleagues in [The SHaDE Lab](#) at ASU, chooses paths based on forecasts of mean radiant temperature, a measure of the total heat load experienced in a given location, including reflected heat and sun exposure.

“It’s more comprehensive than just using air temperature or land surface temperature,” said senior [Global Futures](#) scientist Middel, an associate professor in The GAME School and the School of Geographical Sciences and Urban Planning.

In sun-blasted Phoenix, mean radiant temperature can exceed 150 degrees F in full sun but drop below 100 in the shade. Shade can make a real difference on people’s heat exposure on a hot, sunny day.

The Cool Routes app updates itself with hourly meteorological forecasts and works with detailed building and tree data to compute sun exposure and location-specific mean radiant temperatures on a map.

The researchers say it is the first navigation app to use real-time heat exposure data.

“Whenever the user makes a request, it has the most current weather,” said Waqar Hassan Khan, a PhD student in computer science who is working on the back-end programming for the project. “The tool will calculate the heat load based on the surrounding buildings, trees and the weather for the appropriate hour.”

The current version covers ASU’s Tempe campus, but it is an open-source framework that can be put to work in other cities to support walking, biking and public transit use.

Cool Routes proved reliable in tests run on the Tempe campus during 12 days in different seasons. The tool identified cooler alternatives for more than 70% of trips. It was able to find routes that reduced heat exposure even during morning and evening periods, when heat load differences are typically smaller. Alternate routes didn't require long detours; added distances ranged from about 25 feet to less than a city block.

On average, alternate routes lowered the experienced heat load by about 4.5 degrees, a meaningful reduction in heat exposure, the researchers said. To validate the predicted heat loads, researchers used [MaRTy](#), a rolling instrument station that measures human thermal exposure and other meteorological data. Researchers traversed suggested routes during record-breaking heat waves.

"When air temperatures exceed 105 degrees F, the physical reality of the urban overheating effect is visceral," said Isaac Buo, a postdoctoral researcher at ASU. "You can feel the intense longwave radiation radiating off the asphalt and building facades like an open oven."

The work paid off. Cool Routes predictions showed strong agreement with the direct measurements for various routes across campus. Buo, Hassan Khan, Middel and co-authors Evan Crabtree, Fletcher Emmott and Devbrat Hariyani presented [full details on Cool Routes](#) in the journal Building and Environment.

Beyond navigation, the researchers listed broader applications for Cool Routes. City planners, for instance, could analyze data from Cool Routes to identify busy walking corridors exposed to high heat and use findings to prioritize actions such as placement of street trees or shade structures. Cities could also use Cool Routes to predict the effectiveness of proposed cooling strategies. For example, planners can simulate the addition of tree canopy or shading structures and assess how these actions change the heat load experienced by pedestrians.

"The tool allows cities to simulate 'what-if' scenarios to visually and numerically calculate the return on investment for green infrastructure," Buo said.

A mobile app is in the works, which will make Cool Routes more accessible and user friendly.

"While the Cool Routes tool is functional, it is not currently designed to serve a lot of traffic," said Emmott, an ASU undergraduate student who is developing the mobile app as his honors thesis project.

But to scale up to cover areas larger than the ASU campus, Cool Routes requires additional computing power.

The computer model used to output mean radiant temperatures would need many hours to complete the task for a whole city or metropolitan area. The researchers said that AI models that compute more efficiently will be used in the future to accelerate model output to support real-time routing at the city scale.

"Fortunately, at the SHaDE Lab, we have already developed the necessary underlying data — the 2.5D digital representation — for the city of Phoenix and several other major cities in the U.S.," Buo said. "With the right computing infrastructure in place, a city like Phoenix could easily have its own functional Cool Routes platform."

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Main image



To validate the predicted heat loads, researchers used MaRTy, a rolling instrument station that measures human thermal exposure and other meteorological data. ASU photo