

Growing shade: daytime cooling ecosystem services of common street trees in Phoenix

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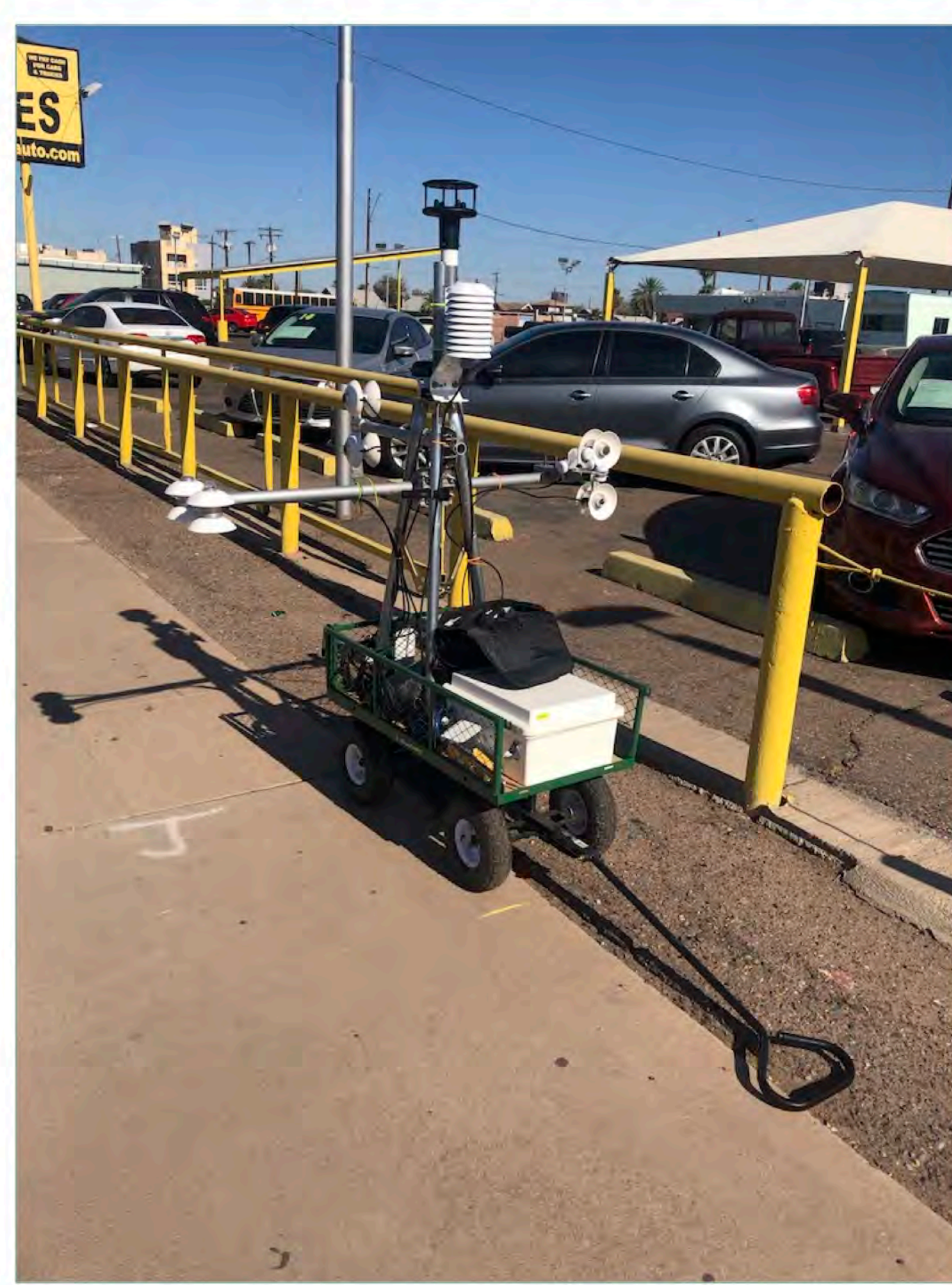
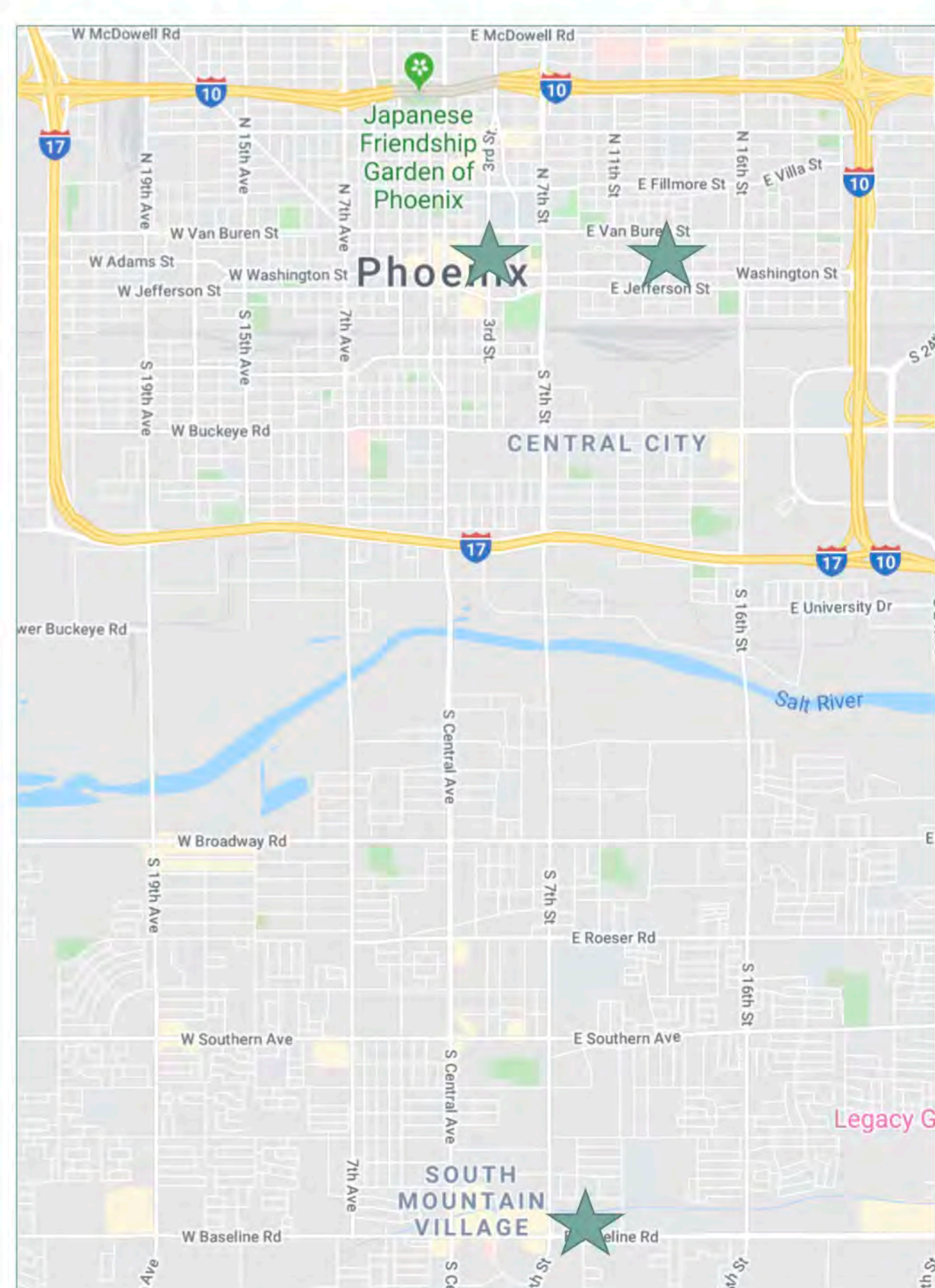
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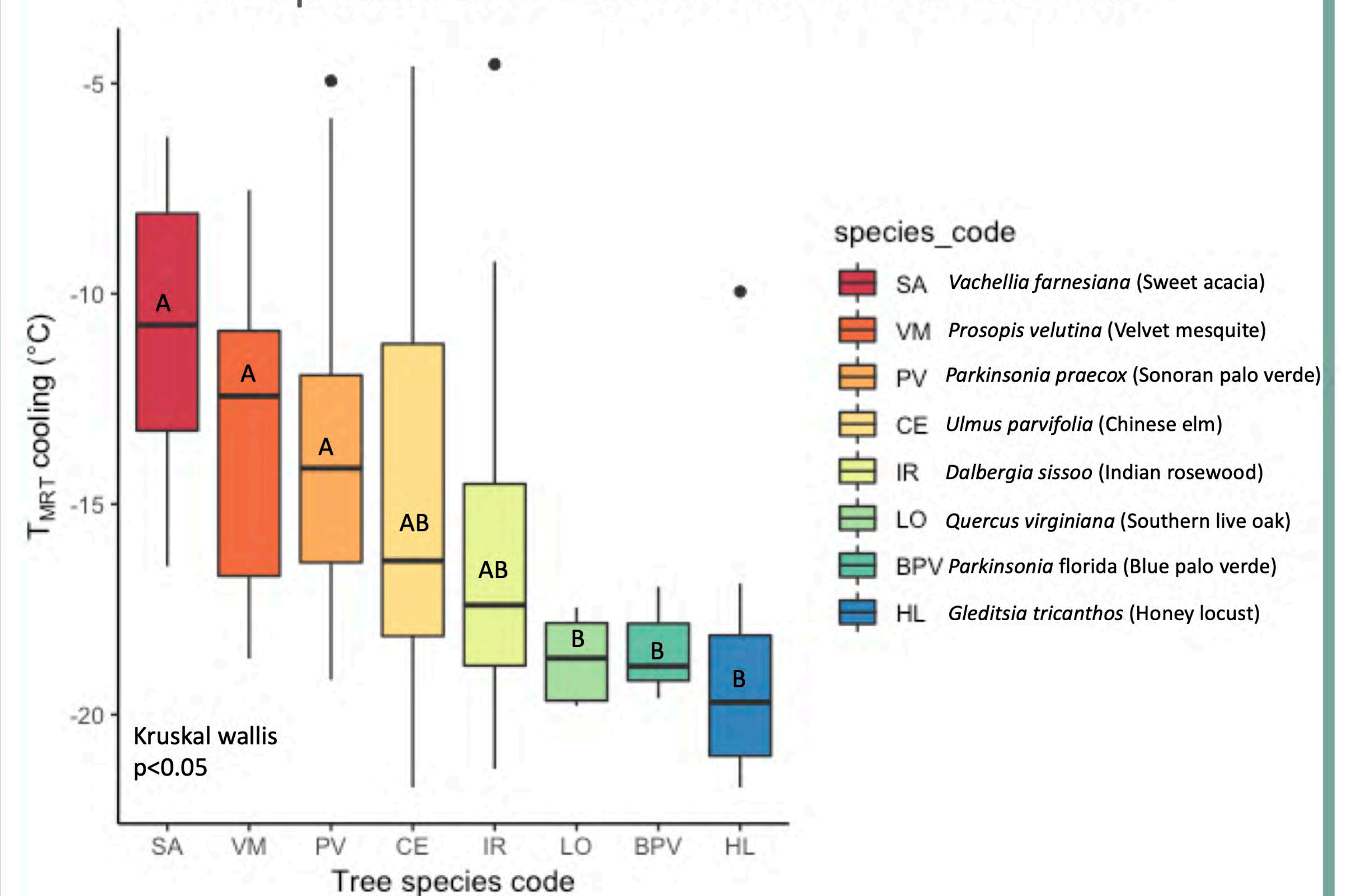
Abstract:

Extreme heat is one of the chief environmental and public health concerns for the City of Phoenix. In 2018 alone, 182 people died from heat related ailments in Maricopa County. To help address heat concerns, in 2010 the City of Phoenix published a Tree and Shade Master Plan with the goal to achieve 25% canopy cover by 2030. While more than doubling current tree canopy cover would assuredly provide many ecosystem services including heat mitigation, the plan offers no details on what tree species to plant. Trees differ in their form and function, so it is important to understand how those differences manifest themselves in terms of ecosystem service provision. **We ask: how do eight common trees species in Phoenix vary in terms of the cooling ecosystem services that they provide?** In the summer of 2019, we walked transects through three Phoenix neighborhoods at three different times of day (morning, around noon, and the late afternoon), collecting measurements underneath individual trees and exposed reference locations with a mobile human-biometeorological station (MaRtY). Here, we focus on mean radiant temperature (T_{MRT}), an important metric for understanding human thermal comfort. We found that all trees provided cooling, but *Gleditsia tricanthos*, *Parkinsonia florida*, and *Quercus virginiana* cooled the most while *Vachellia farnesiana*, *Prosopis velutina*, and *Parkinsonia praecox* cooled the least. There were no differences when comparing Sonoran Desert native species to non-native species. Using a multiple regression model, we found that tree species and the distance from the tree to the sidewalk best explained T_{MRT} cooling.

We sampled three Phoenix neighborhoods to determine whether trees varied in their cooling ecosystem services.



All species cool – some more than others.



Tree species and distance from the tree to the sidewalk best explained T_{MRT} cooling.



- A. Distance from tree trunk to the sidewalk.**
- B. Distance from tree trunk to the street.**
- C. Diameter at breast height (DBH)**
- D. Canopy length and width (used to calculate area)**
- E. Canopy overhang**

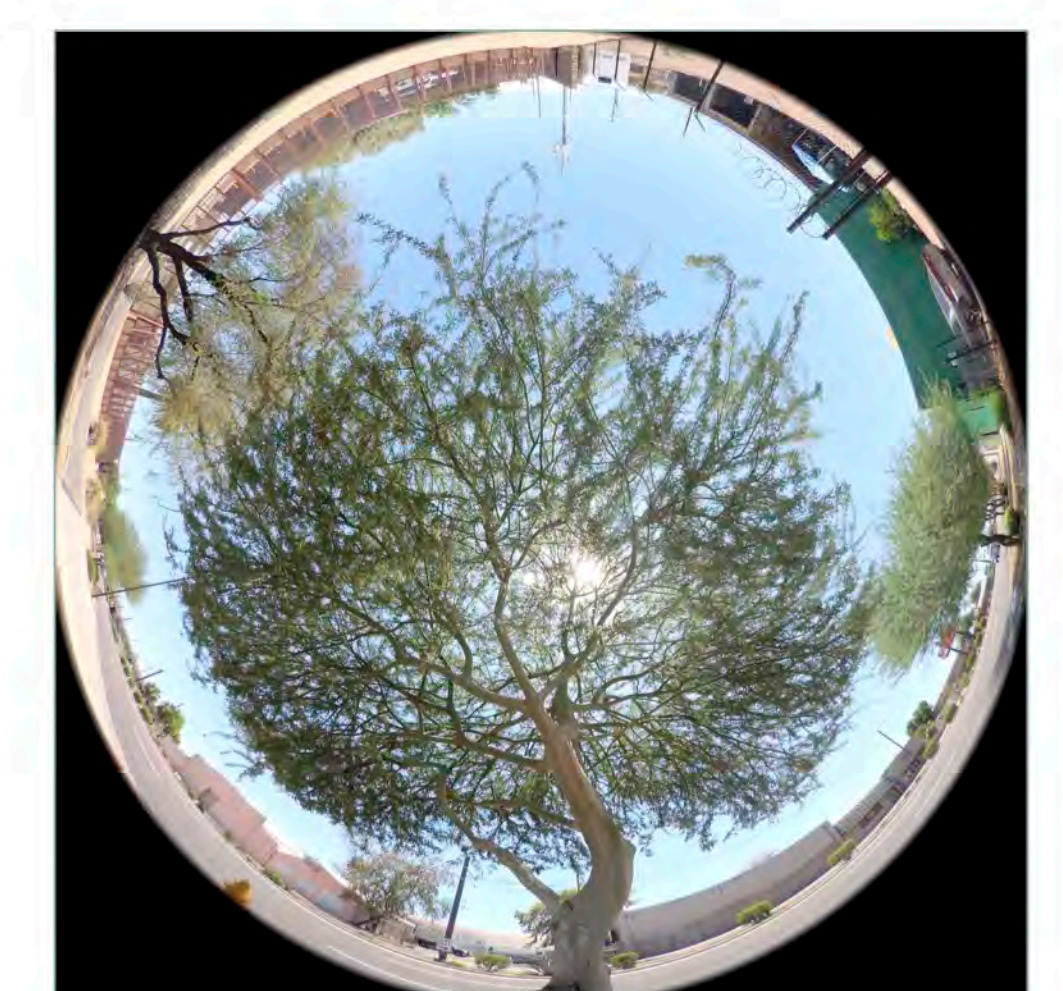
These are the measured continuous variables used to build a multiple regression model.

Model components	AICc
Distance to sidewalk	-103
Canopy area	-104
Species	-116
Species + canopy	-118
Species + distance to sidewalk	-121

Conclusions and next steps.

Our results illustrate that there are significant differences in cooling ecosystem services between common tree species and that the placement of those trees is important in providing those services.

Next, we will develop a more comprehensive model to explain cooling. This model will include sky view factor from hemispheric photos taken over the summer as well data about additional trees, shrubs, buildings, and objects within a 5m radius of each sampling site.



Methods

We used MaRtY to measure T_{MRT} underneath individual trees and at exposed reference locations in three Phoenix neighborhoods on three different days in the summer of 2019. We calculated cooling by subtracting the average reference T_{MRT} for each neighborhood from the T_{MRT} underneath each individual tree. MaRtY takes measurements every two seconds and we left it to record at each sampling site for at least a minute. While we did three transects at different times of day at each site, for the sake of this poster, we are just presenting the midday transect.

Acknowledgements



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