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### WeARE Research Area

- Sustainability
- Urban Planning
- Green Building

### Motivation or Background

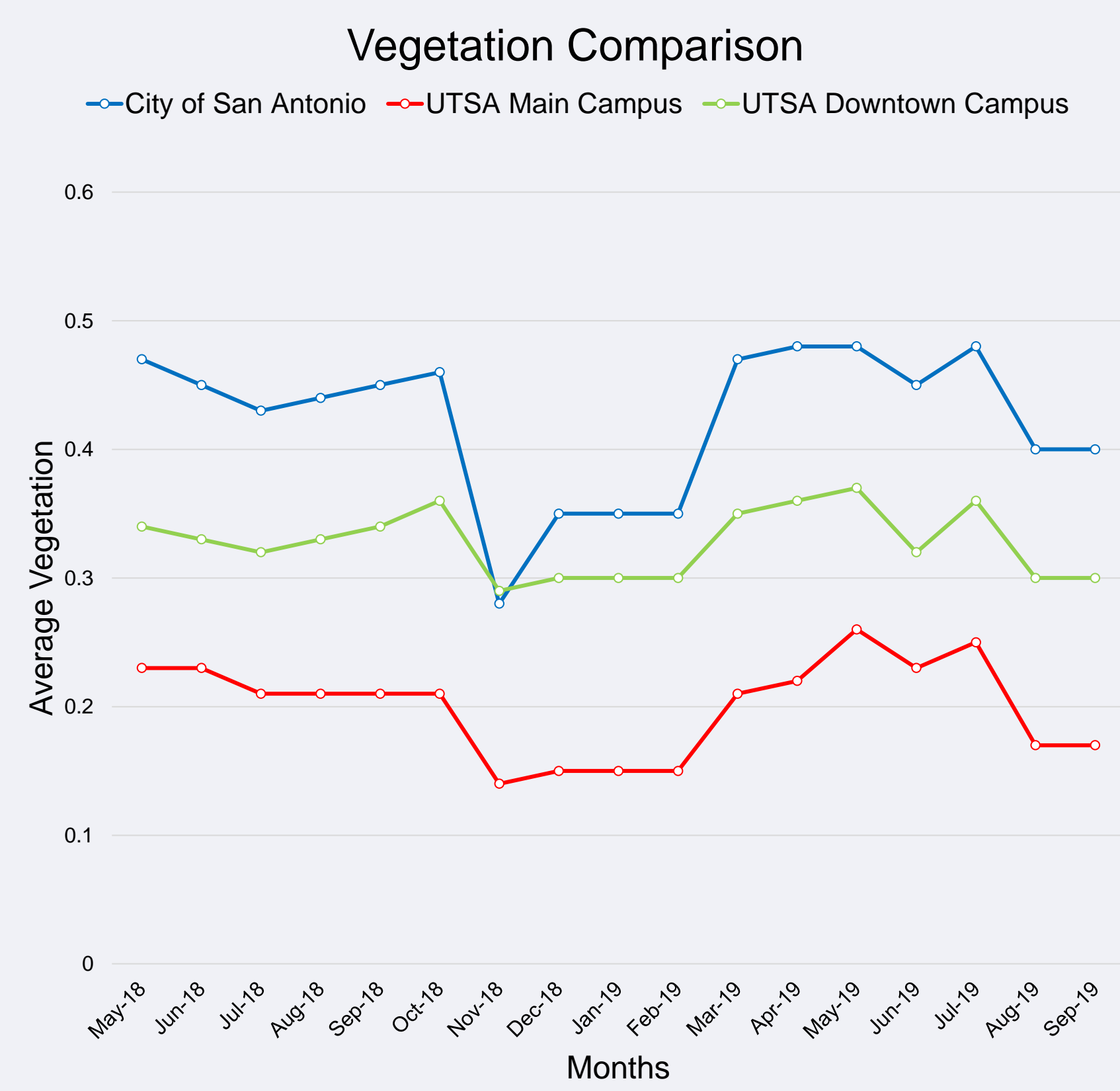
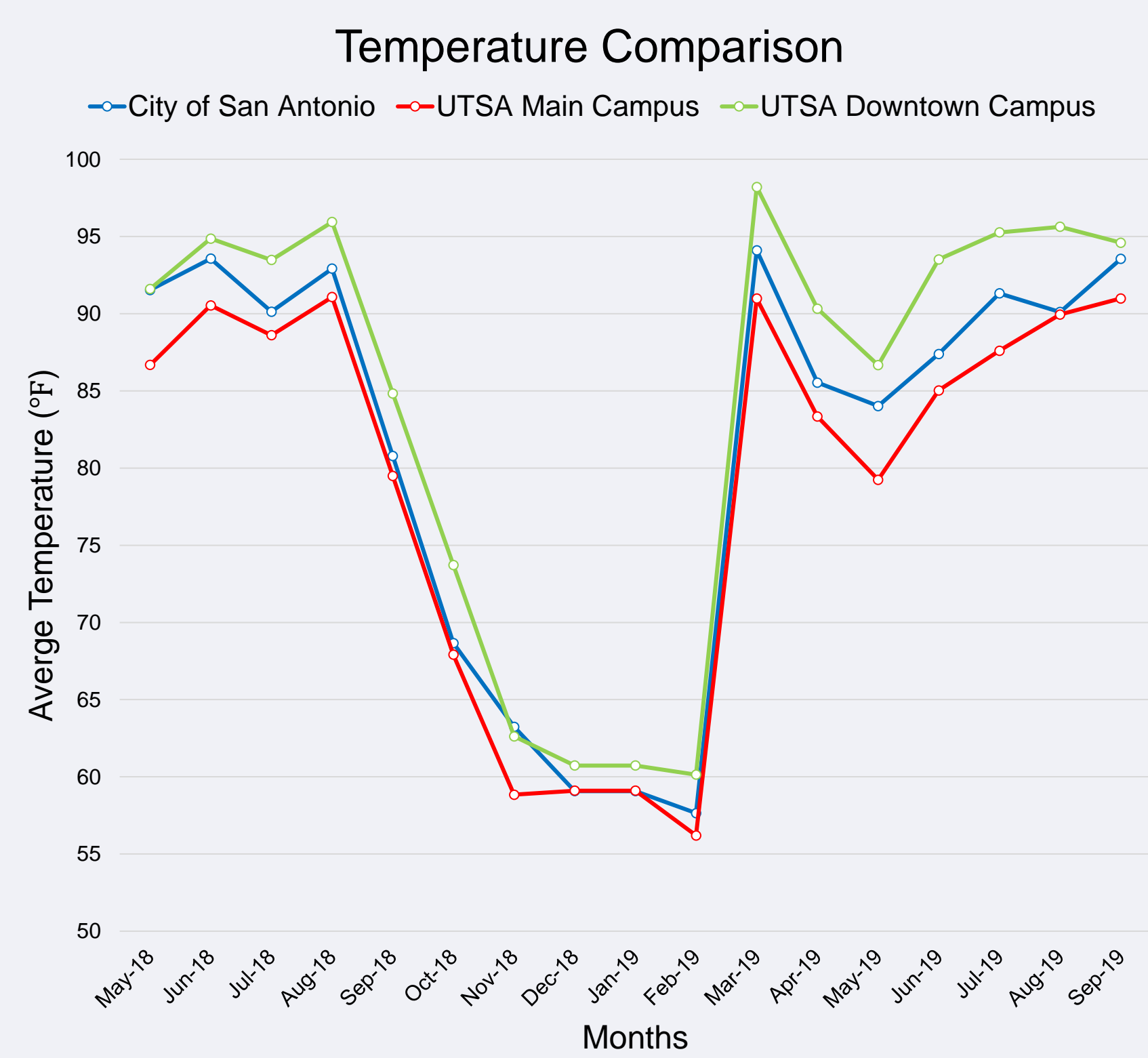
The number of students at UTSA is expected to grow dramatically in the following years, along with major growth at both the Main and Downtown campuses. Therefore, UTSA will serve as a perfect example of the current challenges that urban planning faces. Studies have proven that green areas and vegetation increases physical human health and the air quality while reducing air temperature and thereby decreasing the heat island effect. This heat island effect is a critical factor on energy consumption in San Antonio and South Texas.

### Objectives

1. This research project seeks to measure the ecological performance of vegetation on both UTSA Main and Downtown campuses utilizing two critical metrics provided by Geographic Information System (GIS) mapping: surface temperature and vegetation.
2. The main goals of this urban science research project are to answer the question of the energy and ecological impact of vegetation at UTSA campuses and to identify the areas where improvements could have the most impact.

### Methodology

The methodology to calculate Land Surface Temperature is based on the mono-window algorithm, using satellite images from Landsat 8, from the Thermal Infrared Sensor (TIRS), band 10, at 100x100 meters resolution. The USGS Earth Explorer service is used to download the images. In order to calculate the vegetation quality, we used the NDVI index with the equation  $NDVI = \frac{NIR - RED}{NIR + RED}$ .

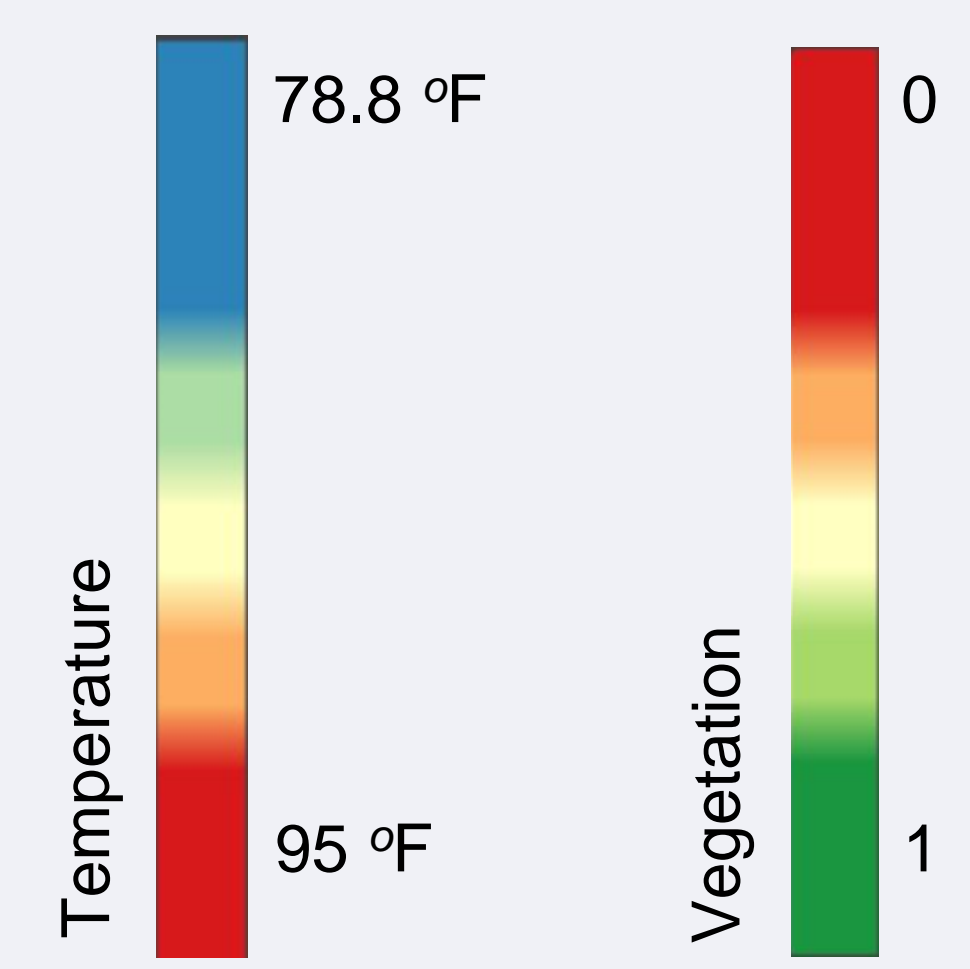


### Results



- June and February are usually the hottest and coldest months, respectively.
- Higher temperatures are concentrated on the football field.
- West side of Downtown campus is hotter than East side.
- West of Downtown campus heats up before East side.
- Heat is more concentrated in paved zones.
- All green areas remain relatively cooler during summer months
- Downtown campus grass area is the only zone that does not reach 90°F in summer.
- Thermal leap between the coolest and hottest month of the year is very significant in both campuses.
- Poor vegetation quality in downtown campus during the winter months make the ground temperature more consistent.
- Vegetation quality does not change as drastically from winter to summer as ground temperature does.

UTSA Main Campus (Orange outline)  
 UTSA Downtown Campus (Green outline)



### Skills and Experience

My research abilities have benefited from this opportunity by letting me personally face common problems on these kinds of projects and finding solutions to drive the research through the right track. This project has definitely contributed to my career as a researcher in sustainable architecture. Also it has helped me develop my skills as a designer, since the consideration of the energy consumed by a building is of high importance, and this research addresses that issue in a very smooth manner.

### What I Learned

As an architecture student, taking all site issues into consideration is the first step before designing any building. Acknowledging the climate conditions of the site is the most important to first consider, especially for a city placed in a hot climate zone with accelerated urban growth. This research taught me not only the incredible shift in surface temperature between a dense urban zone and a more vegetated zone, but also how to approach to it using vegetation to decrease the outside surface temperature and therefore decrease the use of energy needed to cool down the building in question.

### Future Plans

This project is the steppingstone for an integrated study of population well-being and energy consumption. With measurable urban environmental and climatic factors included, this study is poised to make a large impact on a local scale and will serve as a pilot project for a larger national data collection effort.

### Acknowledgments

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### References

- Wang et al. *An Improved Mono-Window Algorithm for Land Surface Temperature Retrieval from Landsat 8 Thermal Infrared Sensor Data.* (2015), Remote Sensing, 7, 4268-4289; doi:10.3390/rs70404268
- *Green Urban Data, Environmental Intelligence for Healthy Cities,* <https://www.greenurbandata.com/en/>