

## Abstract

Many school buildings in the School District of Philadelphia (SDP) do not have air conditioning or proper cooling mechanisms, which poses problems when it is hot out. **This thesis investigates the relationship between the presence of air conditioners in Philadelphia public schools and the surrounding urban thermal environment to evaluate if these schools are well-equipped for rising temperatures.** To do so, 30 schools with and 30 schools without air conditioning in the SDP were randomly selected and mapped using Google Earth Engine. These school sites were then compared to map overlays of vegetation cover, land cover, land surface temperature, and urban heat risk. Schools without air conditioners were found to be in areas with low vegetation cover, medium urban cover, and medium land surface temperatures, which contributed to a medium to high urban heat risk. In addition, school age, governance, and Community Eligibility Provision (CEP) rate were the best factors for determining which schools to prioritize. These findings raise awareness regarding the current conditions of Philadelphia public schools. They also inform which schools in the SDP need to be prioritized for more resources and maintenance to increase resilience to global warming.

## Background

- In 2021, 57% of school buildings in the School District of Philadelphia did not have air conditioning or proper cooling mechanisms.<sup>1</sup> The SDP enacts early dismissals if the school does not have air conditioning and the building temperatures are expected to exceed 85°F.<sup>2</sup>



- Lack of cooling creates inadequate building conditions during hot days. For instance, excessive heat can cause dehydration, heat exhaustion, and heatstroke, as well as disrupt learning and classroom environments.<sup>3</sup>

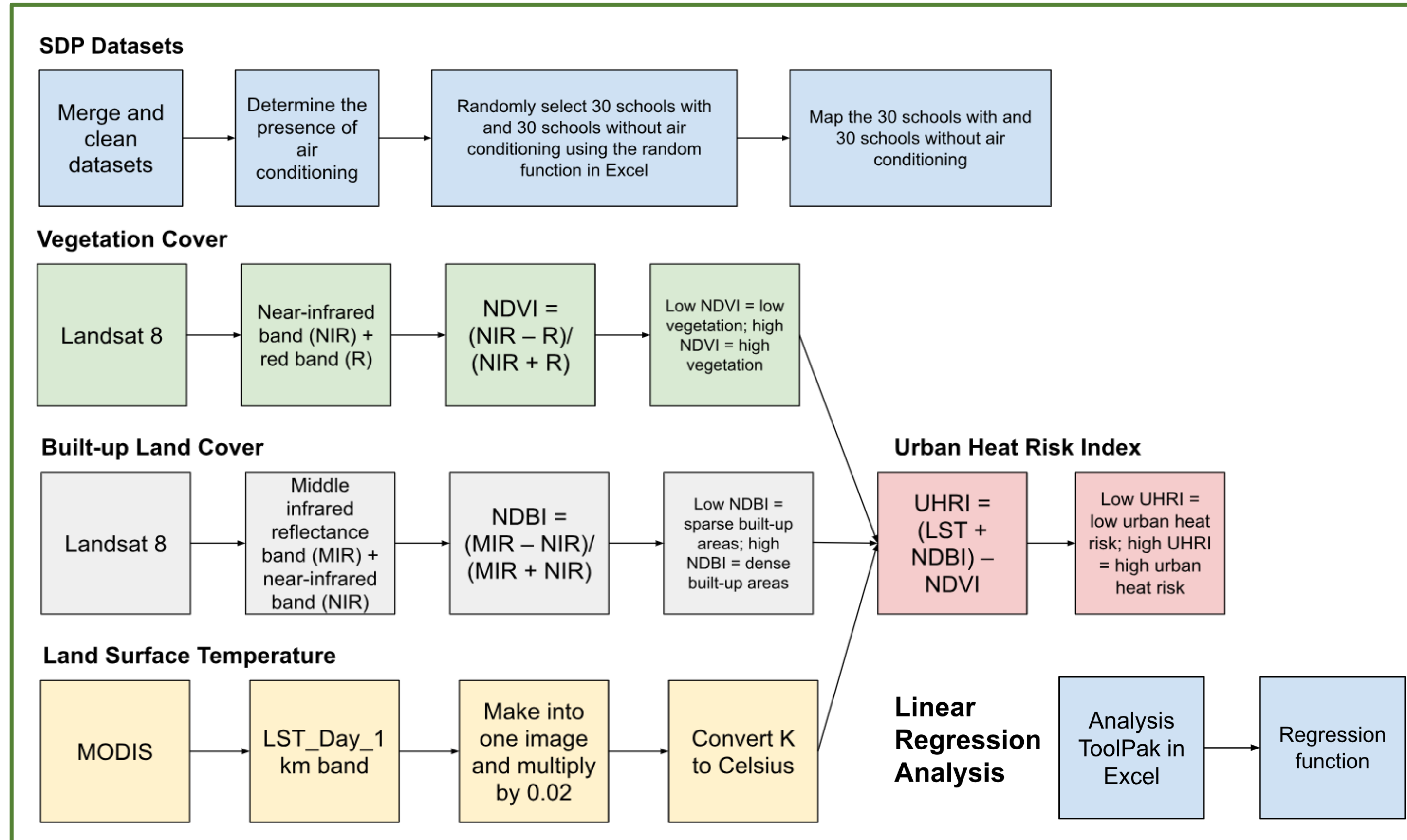


- The number of hot days at the start and end of the school year is increasing due to climate change, further stressing the need to prioritize school investment.<sup>4</sup>



- Historically, low-income and high-minority communities are in areas with low vegetation cover and high land surface temperatures.<sup>5,6</sup> They are also in dense industrial or commercial areas that are dominated by asphalt, pavement, and concrete, which retain heat and amplify the urban heat island effect.<sup>7,8</sup>

## Methods



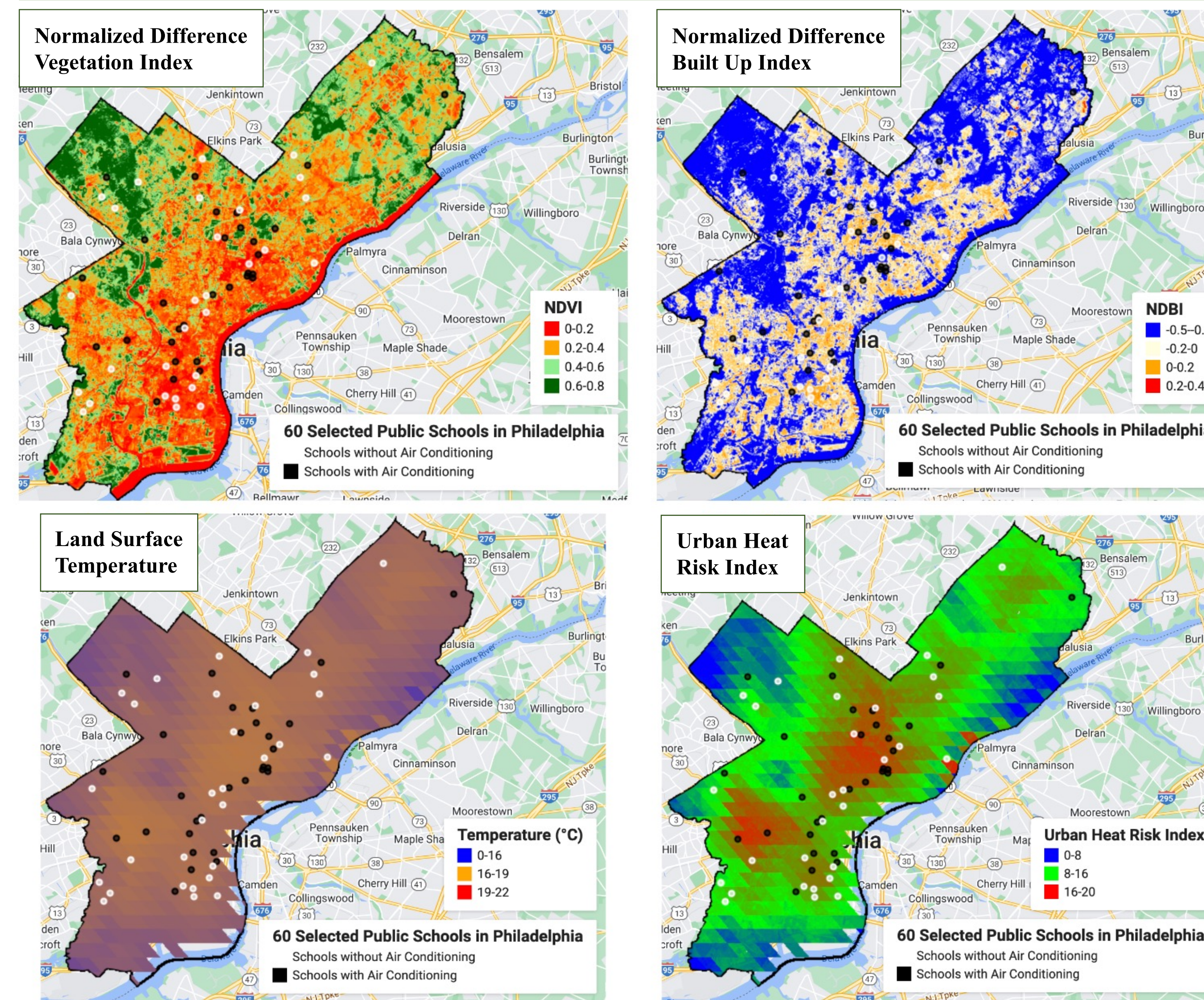
## Results (continued)

Relationship with the Presence of Air Conditioning in Philadelphia Public Schools

Variable	Multiple R	R_squared value	P-value
School Age	0.43236899	0.186942944	0.000560711
Governance	0.5	0.25	4.74893E-05
Enrollment	0.062091794	0.003855391	0.637427464
Ratio of Asian students	0.153631652	0.023602684	0.241210957
Ratio of Black/African American students	0.014949944	0.000223501	0.909735599
Ratio of Hispanic students	0.086157368	0.007423092	0.51275621
Ratio of White students	0.079978186	0.00639651	0.543551846
CEP Rate	0.378886587	0.143555046	0.006111216
Normalized Difference Vegetation Index (NDVI)	0.083714955	0.007008194	0.524821947
Normalized Difference Built-Up Index (NDBI)	0.314634991	0.098995177	0.014348533
Land Surface Temperature (LST)	0.250823421	0.062912389	0.053233272
Urban Heat Risk Index (UHRI)	0.226894391	0.051481065	0.081270505

Figure 5: A table of the relationships of different variables with the presence of air conditioning in Philadelphia public schools. Made in Excel.

## Results



Figures 1-4 (left to right; top to bottom): Maps of Philadelphia for the 2022-2023 school year with the 30 public schools without air conditioning in white and the 30 public schools with air conditioning in black. Made in Google Earth Engine. (1) Normalized Difference Vegetation Index map. (2) Normalized Difference Built-Up Index map. (3) Land surface temperature map. (4) Urban Heat Risk Index map.

## Discussion and Conclusion

- Public schools in the School District of Philadelphia without air conditioning were located in places with low vegetation cover, medium urban cover, and warm land surface temperatures, which created a medium to high urban heat risk.
- These schools were mainly located in North Philadelphia and South Philadelphia. They were identified to be prioritized for additional resources to increase resilience to climate change.
- When determining which schools to prioritize, the variables school age, governance, and Community Eligibility Provision (CEP) rate could serve as a good starting point.
- Ultimately, investigating the relationship between the presence of air conditioning in schools and the surrounding urban thermal environment highlights how many public schools in Philadelphia do not have the necessary resources to support their students.
- Future work includes increase the number of schools analyzed; research policies that allocate resources to education at the local, state, and federal levels; and investigate public school resources across different major US cities.

## References

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