Utilizing Observed Hourly Weather Station Data to Support Pragmatic Climate Adaptation

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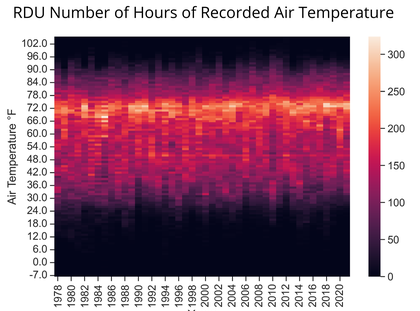
Motivation

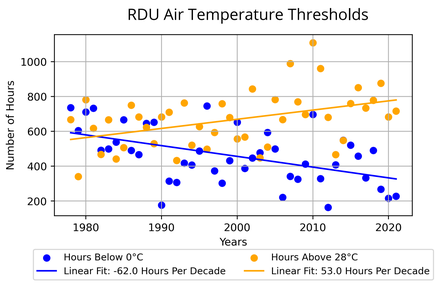
Changes to the average and extreme values of daily temperatures illustrate changing climate but tell only part of the story. The impacts on people, animals, plants, and buildings are substantially different on a day with five consecutive hours at 90°F as compared to one hour at 90°F but would be recorded as the same daily high temperature.

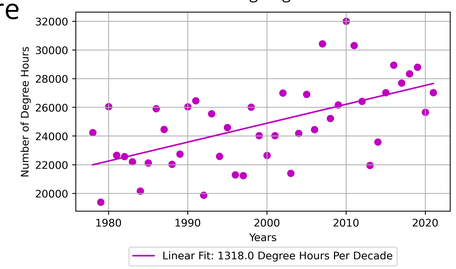
Methods

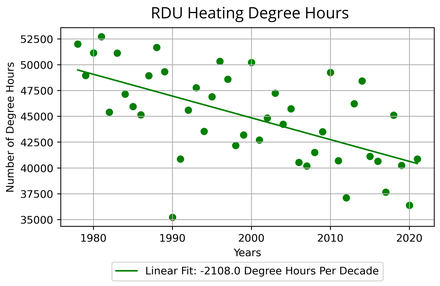
We use observed hourly weather station data from the Integrated Surface Database (ISD) spanning the years 1978 to 2021. For each location, the number of hours at each temperature are determined for each year. Data mining reveals local and regional trends in climate change that have already occurred.

As examples, we use the hourly temperature data to derive metrics related to winter season impacts on agriculture and transportation; summer season impacts related to plant, animal, and human heat stress; and proxies related to residential energy use. Heating and cooling degree hours are calculated using a base temperature of 18°C (65°F).



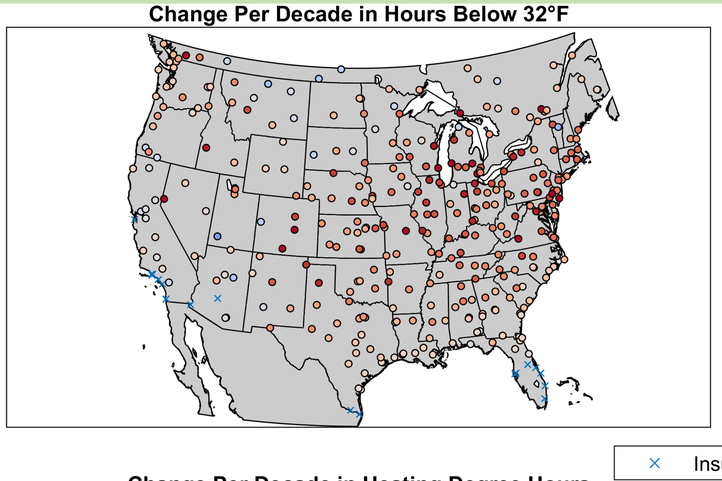


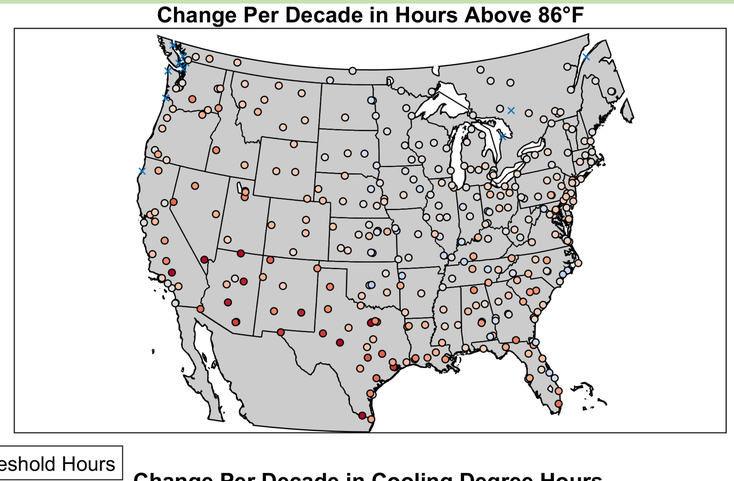




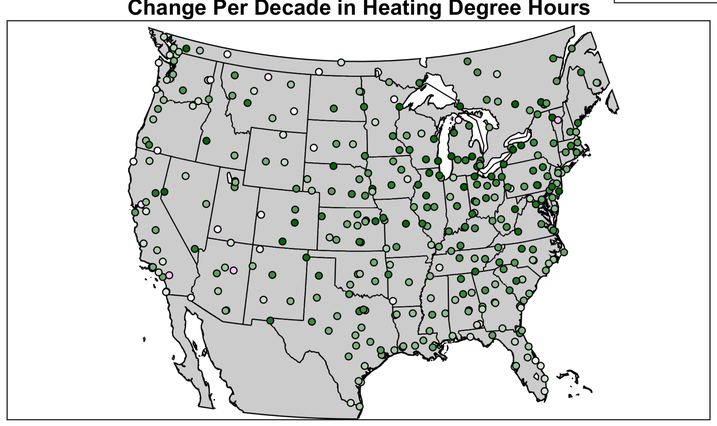
Regional patterns differ between winter warming and summer warming and are key inputs to prioritization of local adaptation strategies.

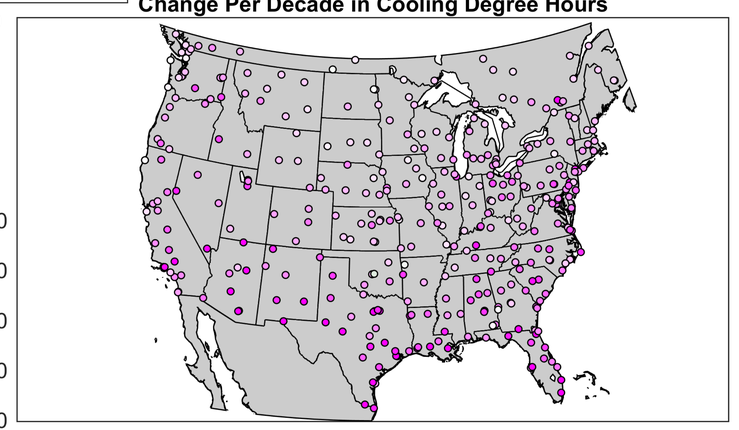
Winter warm spells reduce energy use and snow precipitation frequency but can increase insect pest winter survival. Summer heat waves increase energy use and risks of heat stress to plants, animals, and people.



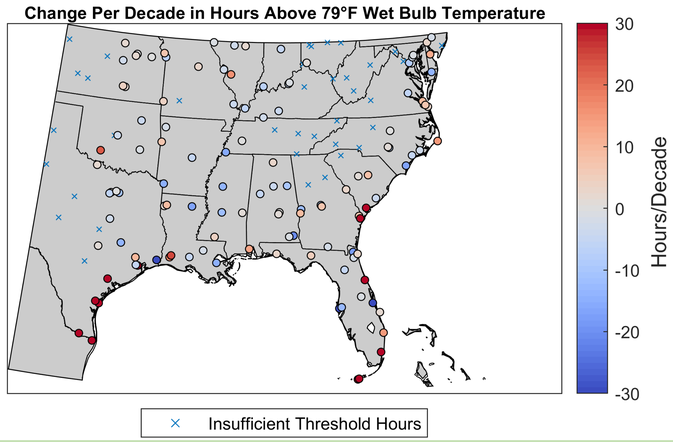


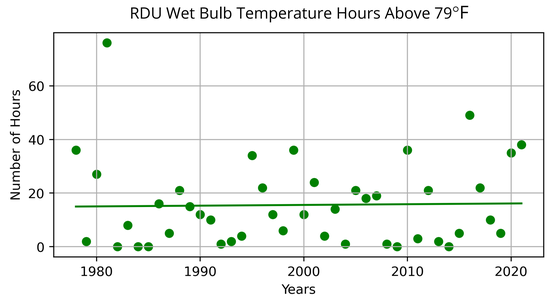
× Insufficient Threshold Hours





Trends are calculated using a linear fit (hours per decade) for each station over the 43-year hourly record.





Wet Bulb Temperature is a function of the air temperature and humidity and is a measure of how effectively the human body can cool itself.

Acknowledgements

ISD is a quality-controlled global hourly weather information database from the NOAA National Centers for Environmental Information https://www.ncei.noaa.gov/products/land-based-station/integrated-surface-database

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