UT City Climate Colab

Empower communities with climate data and tools

A framework for cities to build climate smart infrastructure (netzero, heat/health, fire, investments..)

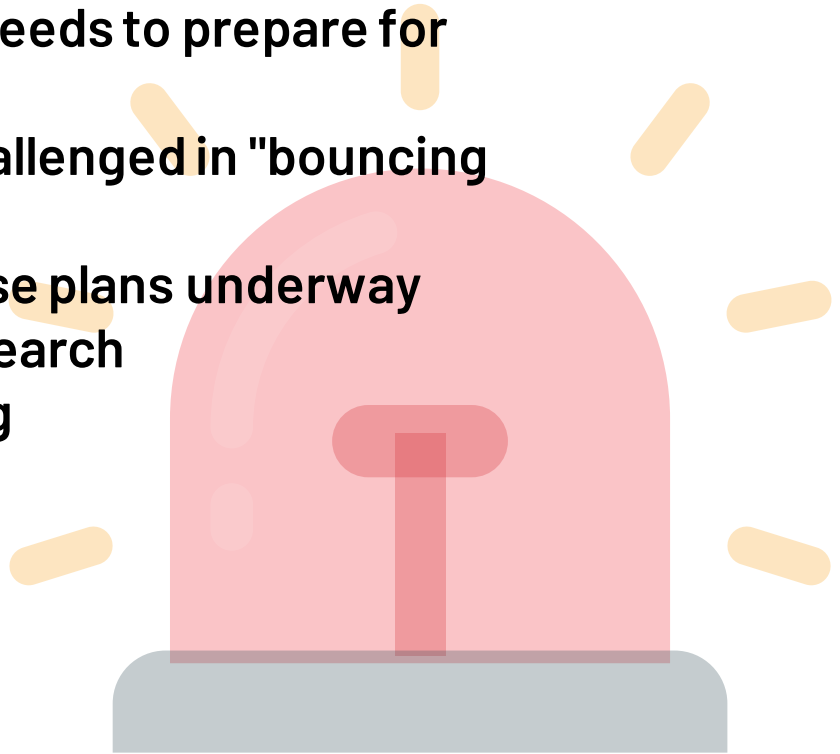
Dev Niyogi[1] Allysa Dallmann[1], Marc Coudert[2], Zach Baumer[2], Patrick Bixler[1], Paola Passalacqua[1], Junfeng Jiao[1], Yang Zong Liang[1], Zoltan Nagy[1], Heidi Schmalbach[1]

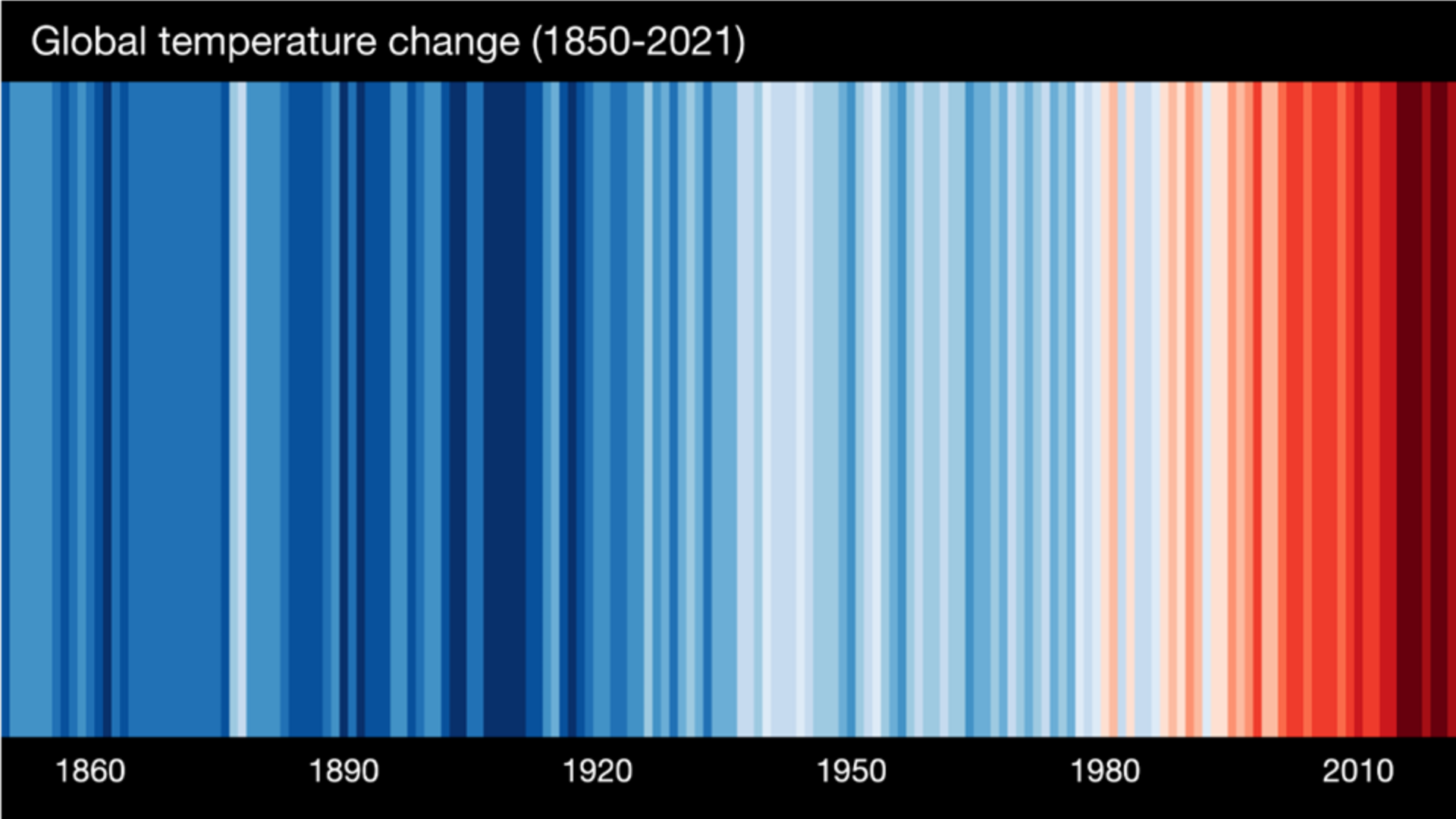
1. The University of Texas at Austin
2. The City of Austin

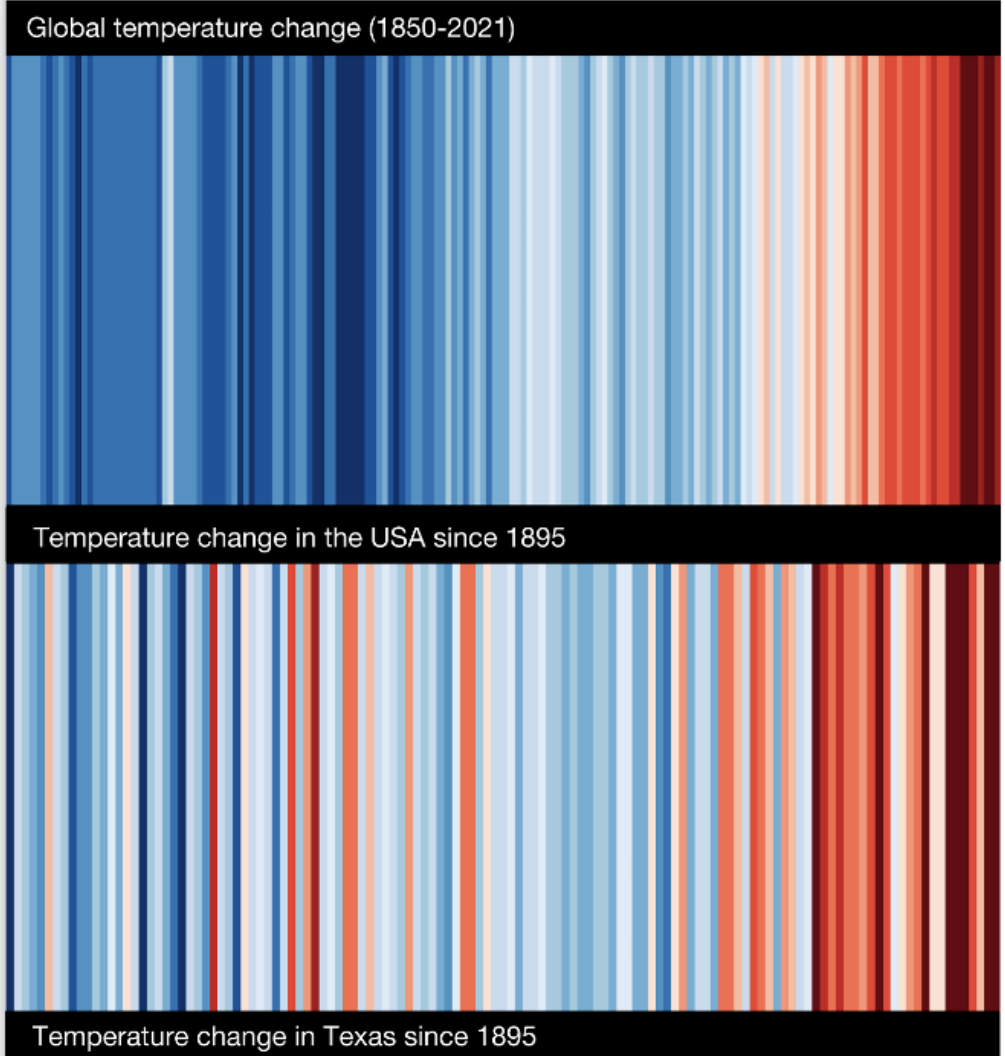
utcitycolab.org

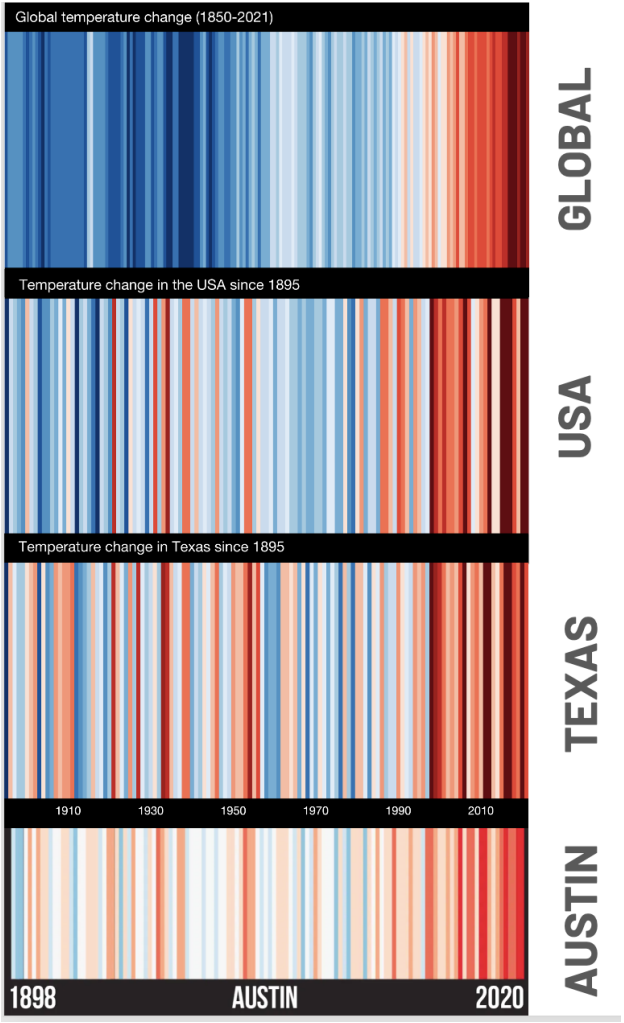
URGENCY

- Increase in the climate extremes; city needs to prepare for eventualities
- Disadvantaged communities greatly challenged in "bouncing back"
- Infrastructure investments and response plans underway
- Students interested in place-based research
- Federal grant opportunities are growing




Global temperature change (1850-2021)
1860
1890
1920
1950
1980
2010


Global temperature change (1850-2021)
GLOBAL
Temperature change in the USA since 1895
USA
Temperature change in Texas since 1895

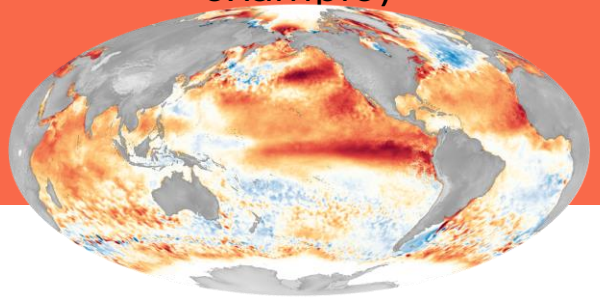


TEMPERATURE One of the "simplest" climate variables

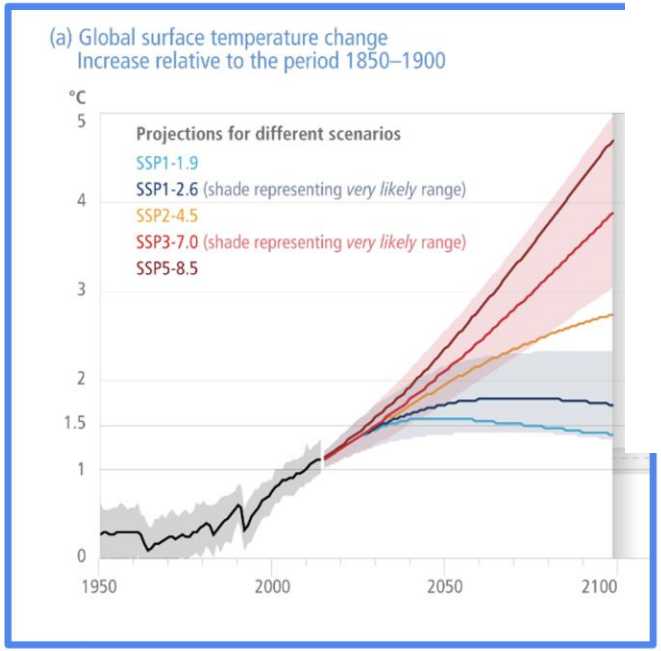
Austin changes not explains by global changes alone

City scale information needs bottom up rather than top down approach only

(Top down is global to local which is what we see for El Nino, La Nina effects for example)

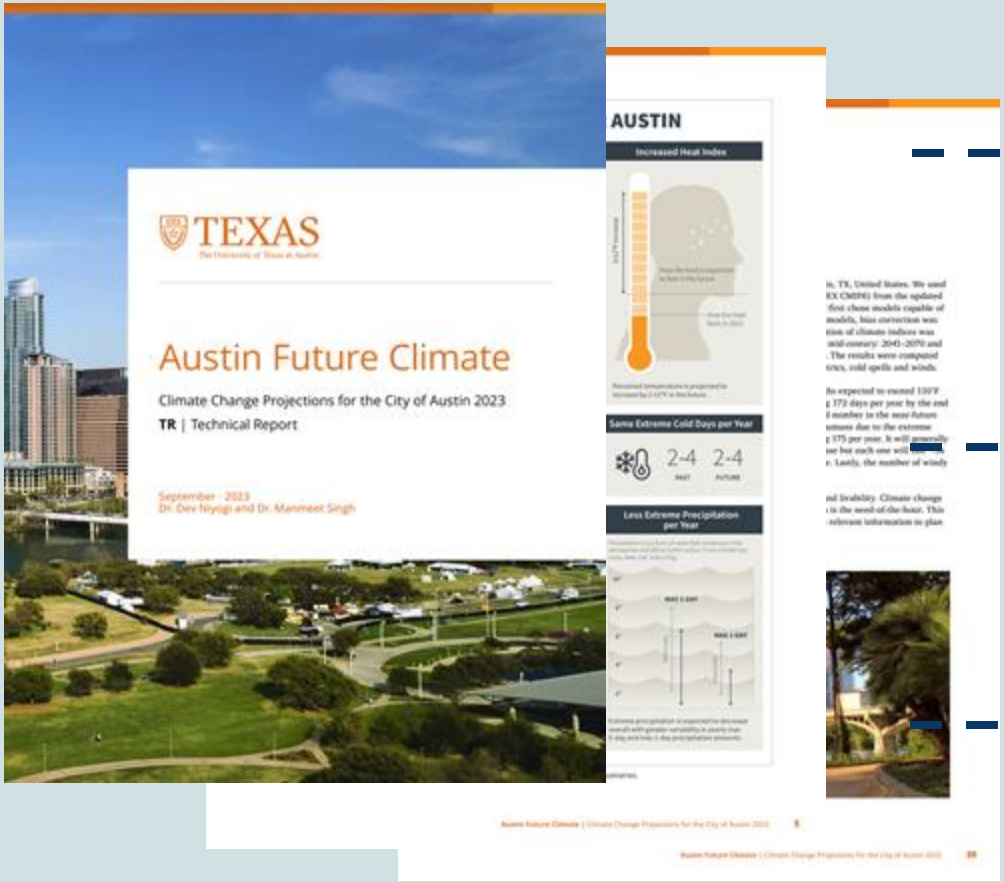


Climate Downscaling(coarse grid(100 km x 100 km) global information statistically brought to local scale(10km or finer) – This is top down and most common way of getting climate information

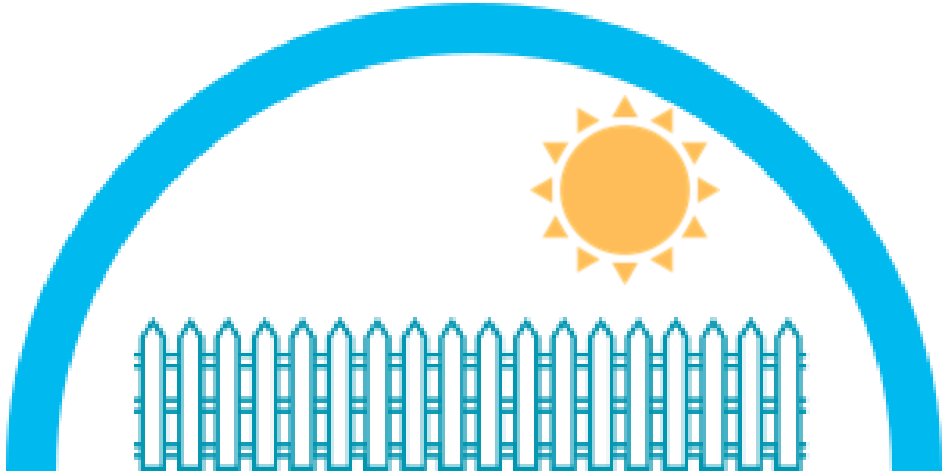


IPCC report
https://www.ipcc.ch/report/ar6/wg2/downloads/figures/IPCC_AR6_WGII_FigureSPM3abcde.png

AUSTIN'S FUTURE CLIMATE



- Rain events will become more intense and less frequent
- Temperatures will become hotter
- Less frequent, but more intense cold events



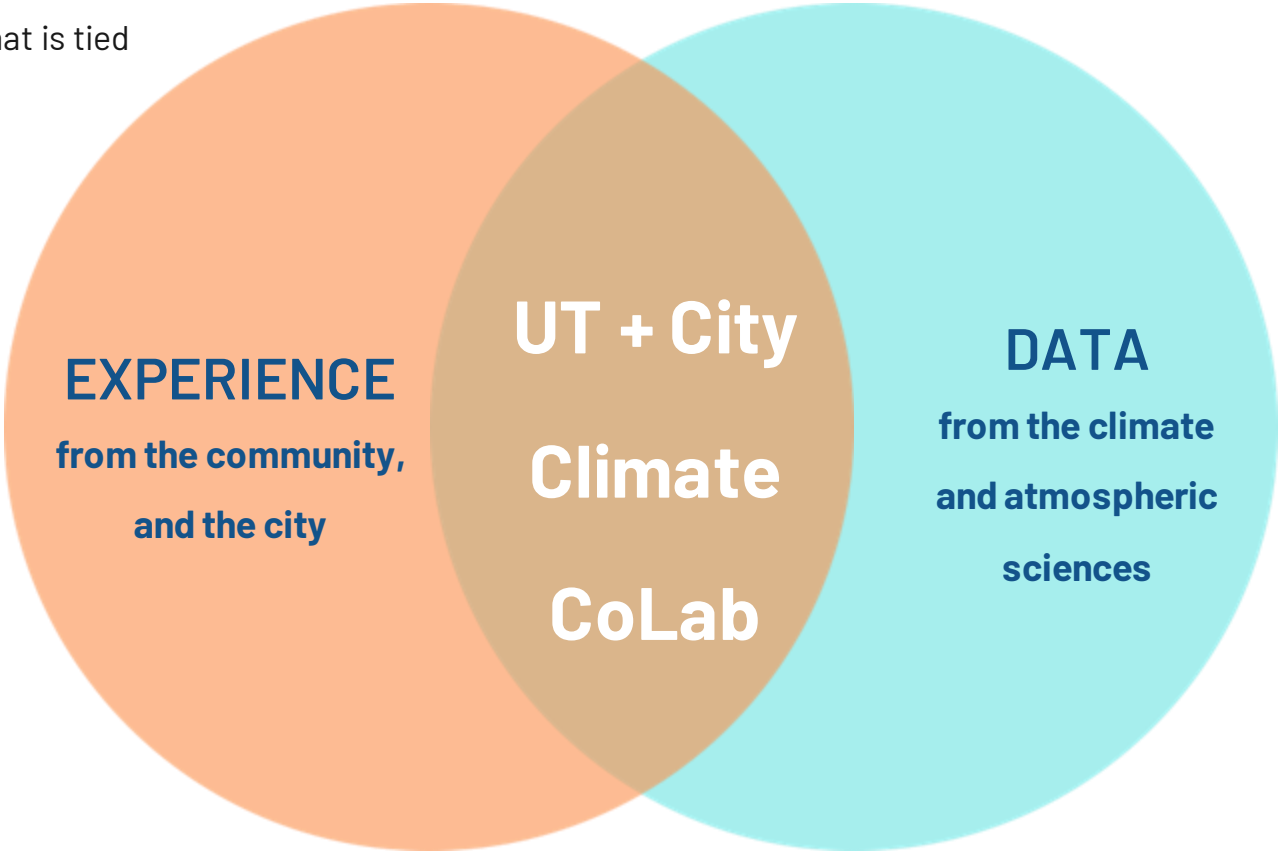
CIMBY

CLIMATE IN MY BACKYARD

There is a need to localize data climate information
To complement community experience

UT City Climate CoLab

This creates a framework that is tied into local city departments, communities, and UT



USEFUL TO USEABLE

UT City Climate CoLab

Fills a void of directly supporting City climate data needs.

- National - NOAA NCEI
- Texas has State Climate Office
- Regional Climate Hubs (for agriculture)

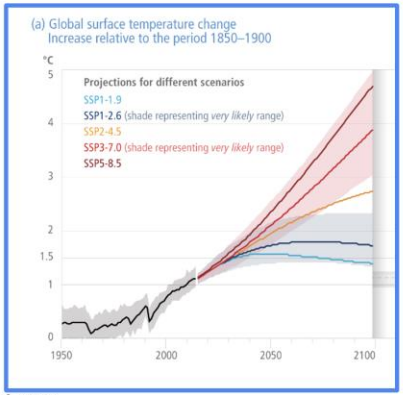
UT City Climate CoLab

- City needs are unique
- Data needs are localized

UT City Climate CoLab

Specific data and models are often confusing for community and staff. The goal is to make research accessible to all.

- Climate models are complicated
- Scenarios, Resolutions, Model Choices
- Reanalysis, Data, AI/ML output



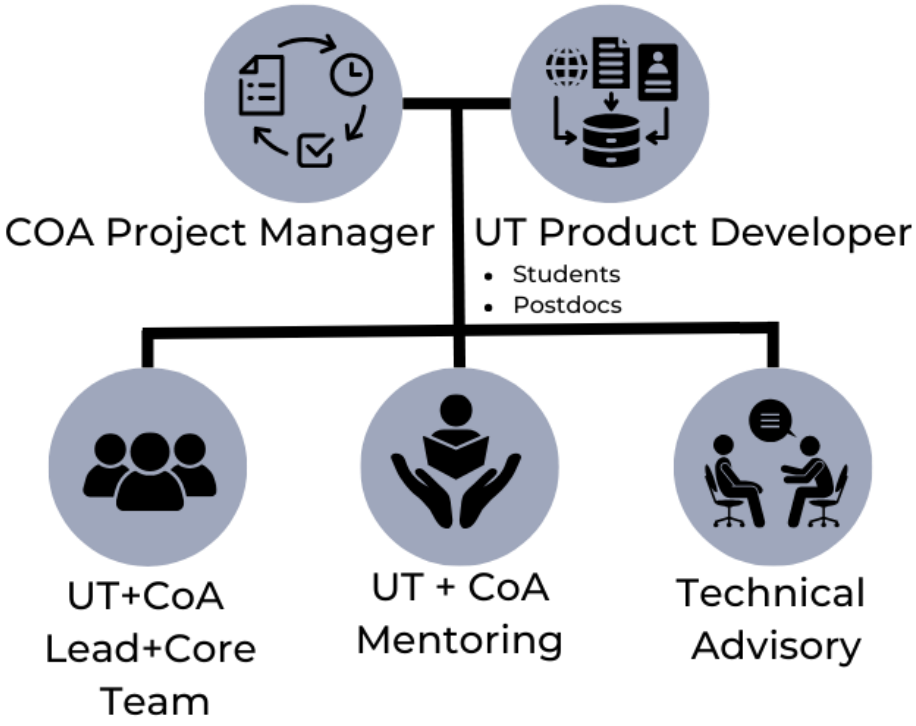
IPCC report
https://www.ipcc.ch/report/ar6/wg2/downloads/figures/IPCC_AR6_WGII_FigureSPM3abcde.png

UT City Climate CoLab

- Localizing data and information with lived experience is important to develop local policies and investment decisions.

CO-LAB STRUCTURE

UT Investments
-Climate Program Coordinator (Allysa Dallman JSG + PT2050)
- 2 postdocs (JSG; Ali and Manmeet)
- LBJ 5 summer GRAs, part of Program Manager (Deidra Miniard)
- Faculty time
- Research Grants



City Investments
-CoLab Program Manager (Alexia Leclercq)
- Product Developer (advertised)
- ILA projects (e.g. Water Fwd; AFD)
- Office of Resilience/ Sustainability
- Access/Partnership

NEXT STEPS

- Make recently downscaled data accessible to community
- Develop inventory of actions taking place - resource database activities in climate mitigation & adaptation
- Climate Decision Calendar – working with AFD, and other departments
- Create a climate resilience, heat mapping/ mitigation tool kit
- Finalize Governance and Reporting Structure for Co-Lab

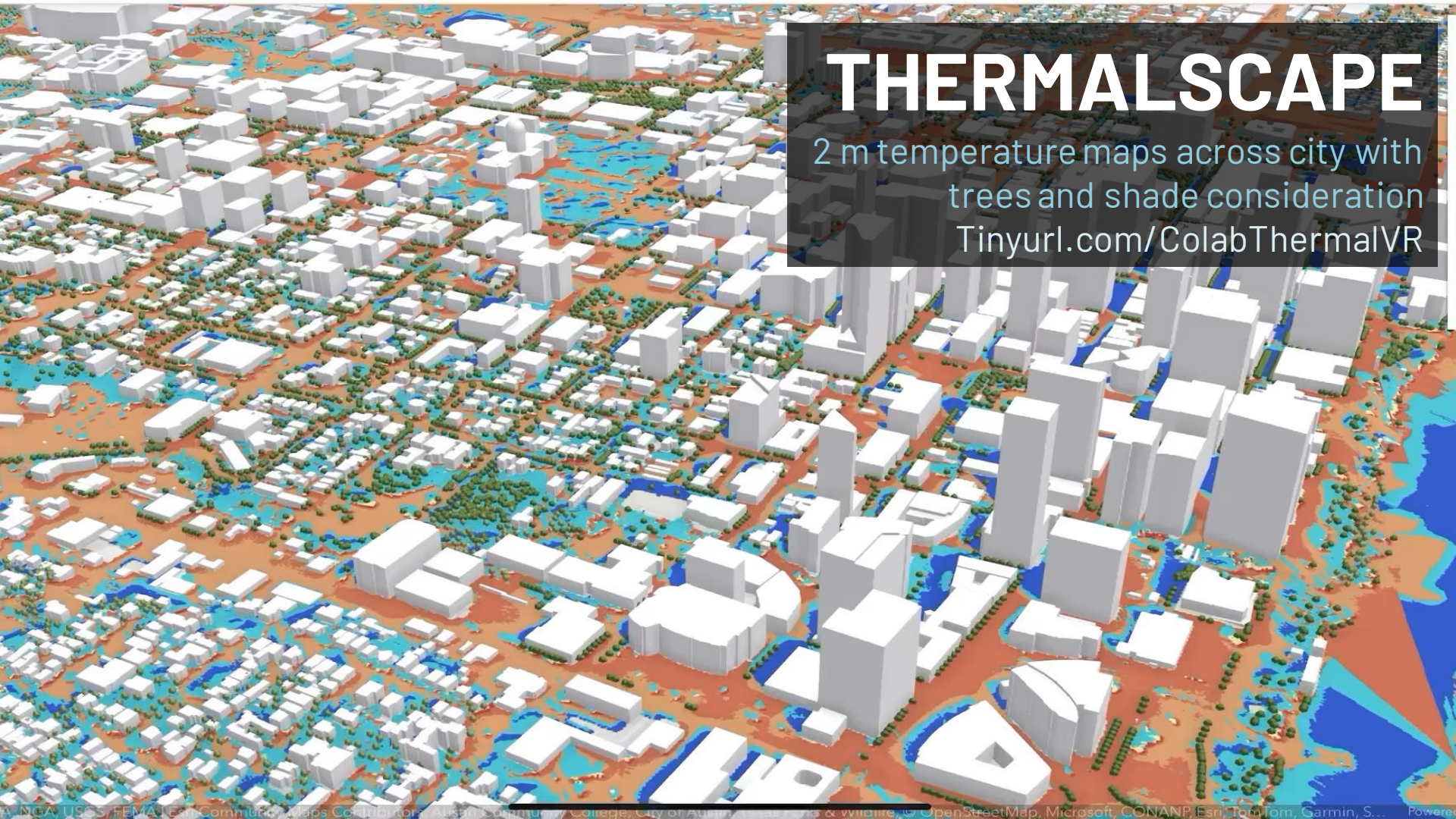
At least 1 decision workflow
Launch Climate Internship
2024 Output 2

UT GLObal Building Heights for Urban Studies (UT GLOBUS)

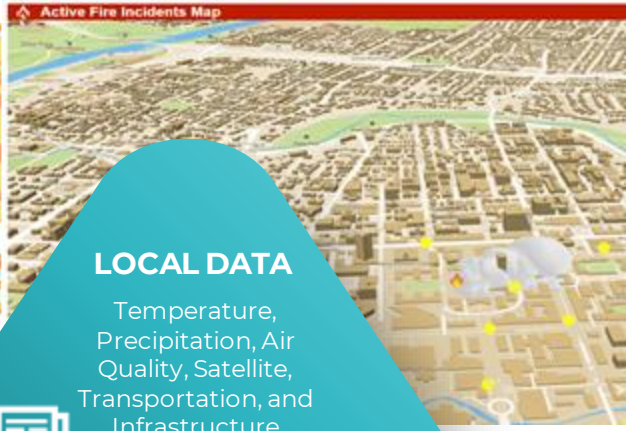
There is a growing interest in modeling urban microclimate at finer scales to ensure a detailed representation of cities. Currently, while models have the capacity to simulate urban microclimate at city- and street- scales, the lack of detailed building information for model input often acts as a bottleneck. To tackle this issue, we introduce GLObal Building heights for Urban Studies (UT-GLOBUS), a level of detail-1 building dataset that utilizes open-source spaceborne data and a random forest model to predict building-level information. Model simulations with UT-GLOBUS shows that there is an improvement in the simulation of city-scale urban temperatures. Further, UT-GLOBUS can be used to inform environmental justice decisions for heat from street-scale modeling and to perform if-then analysis to test the efficacy of heat mitigation strategies.

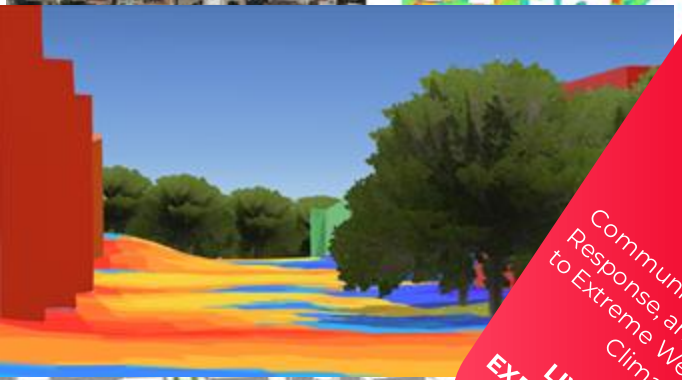
Harsh Kamath

Open source, Build height data sets for cities globally (See https://texuslab.org/)


THERMALSCAPE
2 m temperature maps across city with
trees and shade consideration
Tinyurl.com/ColabThermalVR

HEAT MAPPING





LOCAL DATA

Temperature, Precipitation, Air Quality, Satellite, Transportation, and Infrastructure

Academia, City, Community Partnership

Community Feedbacks, Response, and Exposure to Extreme Weather and Climate

LIVED EXPERIENCES

Lived experiences combined with local data

INFORMED DECISIONS

GOOD SYSTEMS

Ethical AI at UT Austin

Lewis, R.H., Jiao, J., Seong, K., Farahi, A., Navrátil, P., Casebeer, N. and Niyogi, D., 2024. Fire and smoke digital twin–A computational framework for modeling fire incident outcomes. *Computers, Environment and Urban Systems*, *110*, p.102093.

Gratefully acknowledge AFD Justice Jones+Braniff Davis & OoR Marc Coudert

ADDITIONAL PROJECTS

EXTREME WEATHER ACADEMY

POLICY BRIEF WORKSHOP

DECISION MAKING CALENDAR

ADVANCED DIGITAL TWINS

and many more...

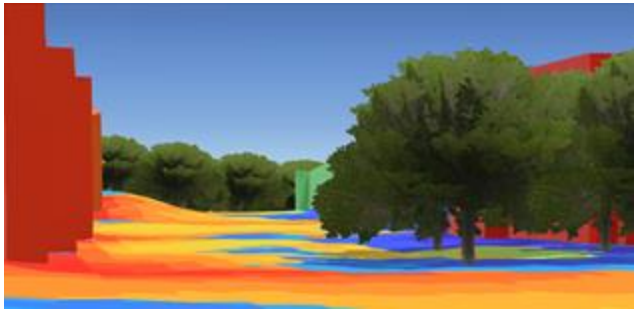
Many potential topics to focus on

- White Roads/pavement impacts on neighborhood (Public Works)
- Building energy and carbon estimation for future climate (e.g. Passive Building Pilot)
- Seasonal Outlooks
- Extreme Weather Academy (LBJ + JSG+ PT2050)
- Impact of trees(and where to plant trees for heat mitigation, carbon sequestration)
- Graduate Theses

AUSTIN

Austin, University of Texas study cool pavement technology on roadway

by: Dylan McKim
Posted: Aug 11, 2023 / 05:35 AM CDT

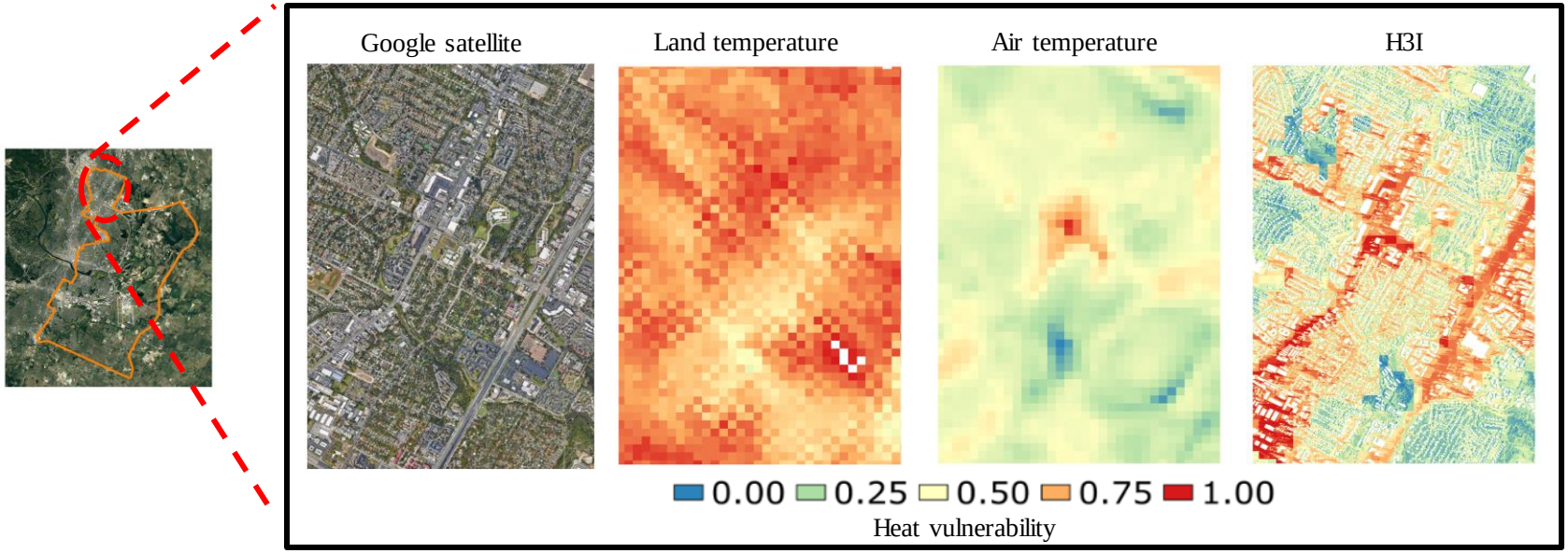


UT NEWS

Nov 09, 2023

Digital Twin of UT Campus Visualizes Present, Past, Future Energy Needs

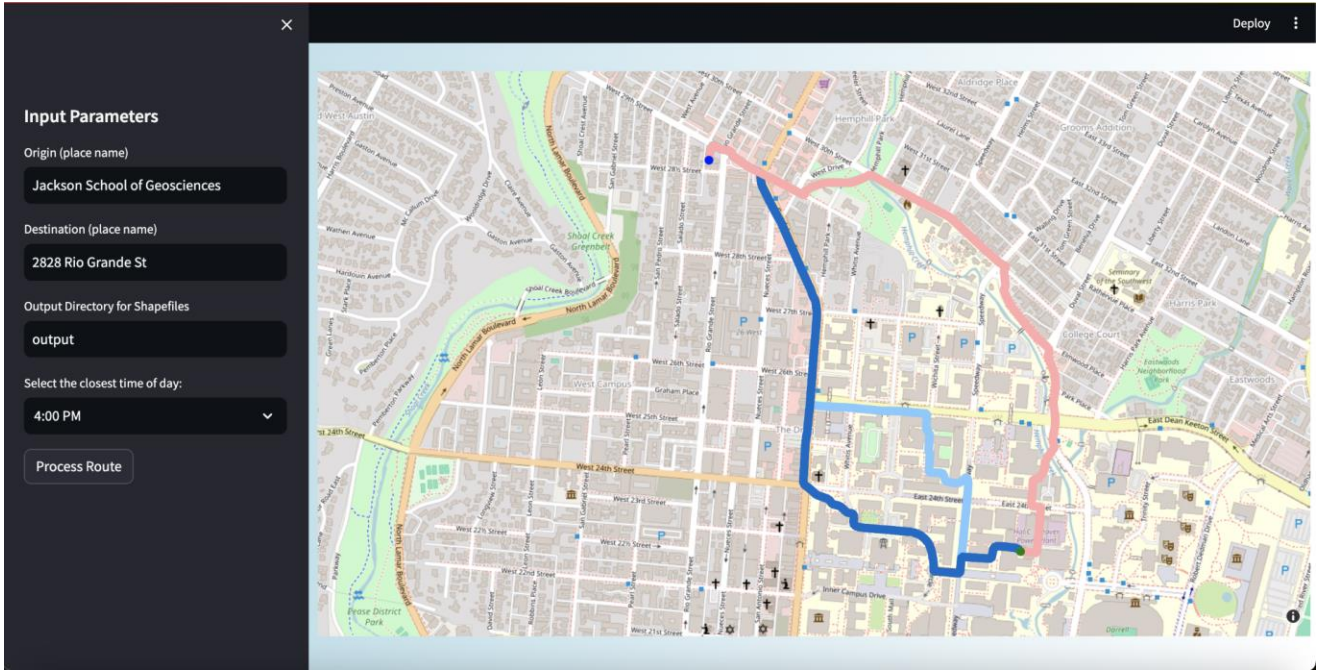
Example of Graduate Thesis
Human Heat Health Index (H3I)



$$H3I = SoVI \times \sum_{time=i} \{\max(UTCI_i - 32), 0\} \times E_i$$

Ref: H3I, Kamath, 2023

Heat exposure google map walk app for Austin (under development)



How to optimize urban tress for heat mitigation? (Part-1)

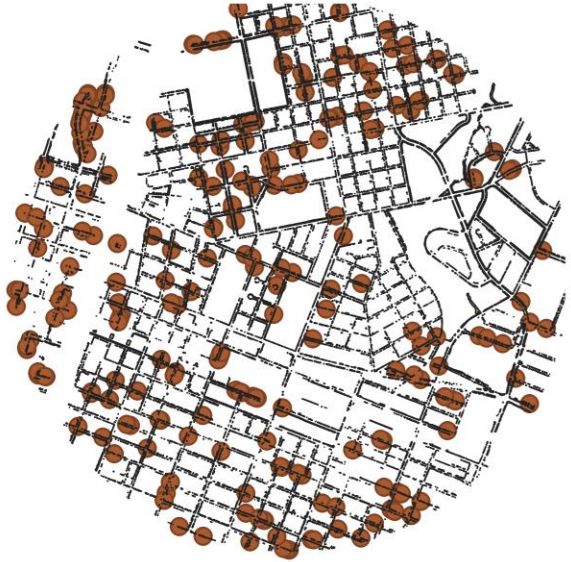
Only public spaces considered in 1-mile buffer

Step 1: Identify potential locations

How to optimize urban tress for heat mitigation? (Part-2)

Step 2: Calculate UTCI

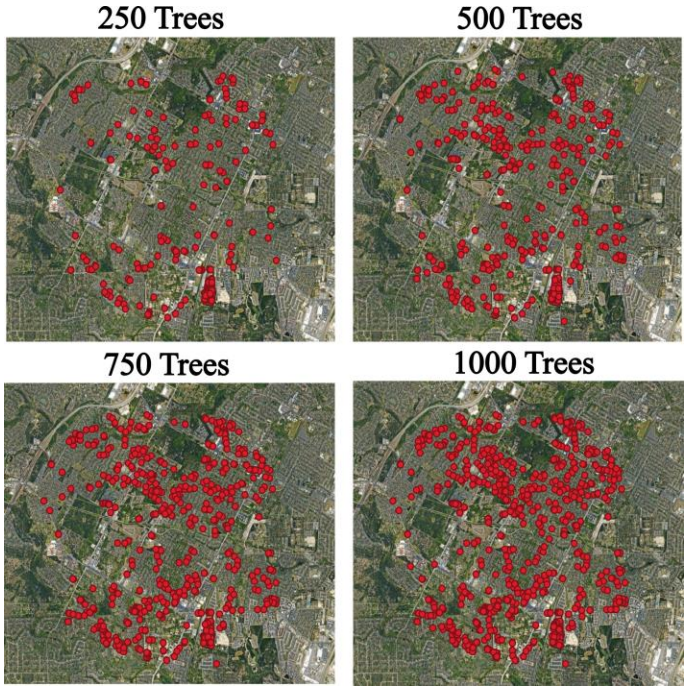
How to optimize where to place 250 new trees for heat mitigation? (Part-3)



Step 3: Optimize tree planting locations for *n* trees (*n= 250*)

Step 4: Recalculate UTCI and estimate the heat stress reduced

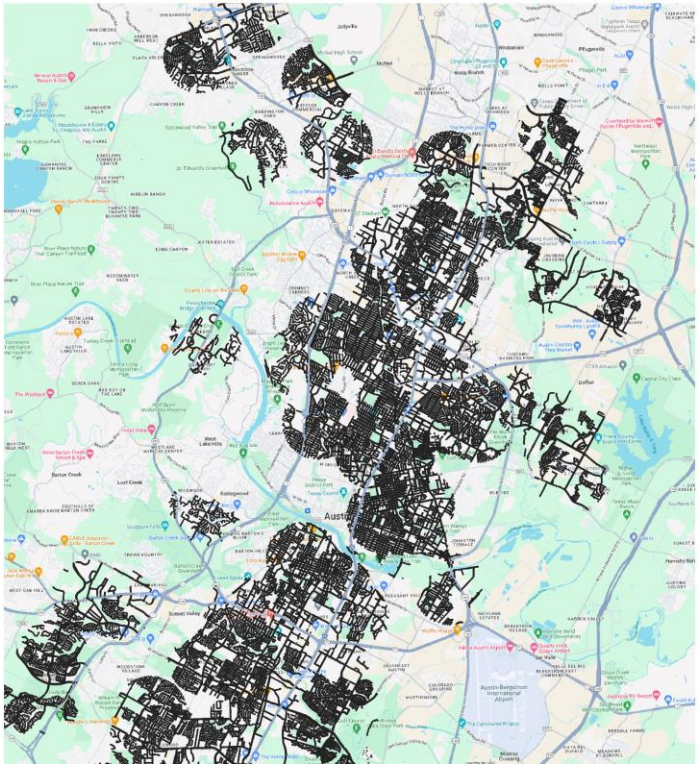
How to optimize urban tress for heat mitigation? (Part-4)
Within 2-mile buffer



Step 5: Try with different number of trees

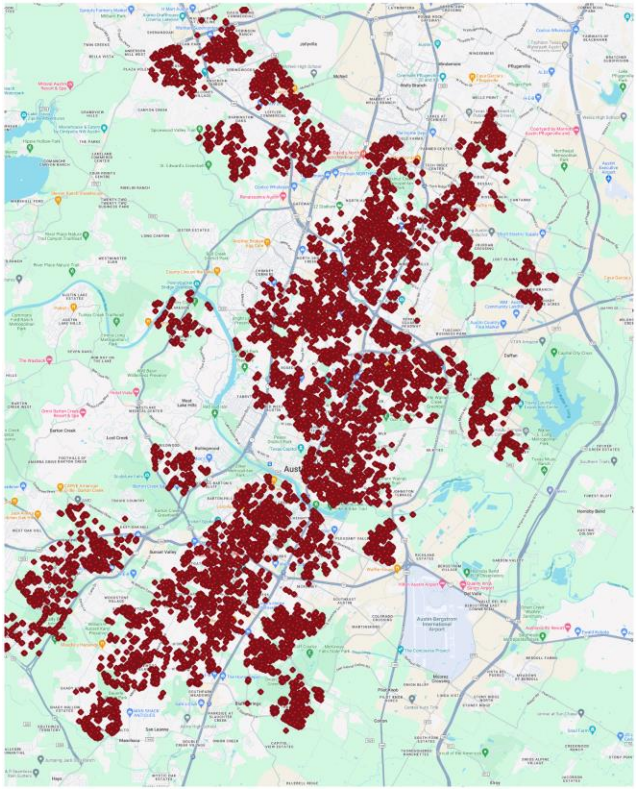
Austin open public spaces

Available public space



About 18,000 trees optimized

New tree locations



CityTFT: Temporal Fusion Transformer for Urban Building Energy Modeling, TY Dai, D Niyogi, Z Nagy

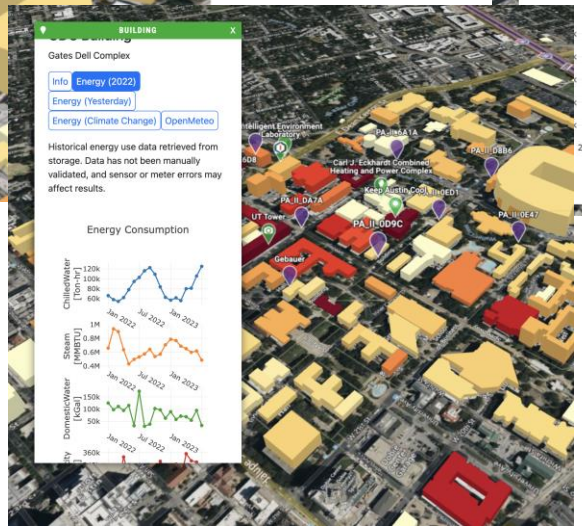
Dai, T.Y., Dilsiz, A.D., Niyogi, D. and Nagy, Z., 2023, November. A Comparison of Different Deep Learning Model Architectures and Training Strategy for Urban Energy Modeling. In *Proceedings of the 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*(pp. 316-317).

UTwin: A digital twin of the UT Austin campus, BuildSys23 Calvin Lin, TYDai, AD Dilsiz, D Crawley, D Niyogi, Z Nagy

UT NEWS

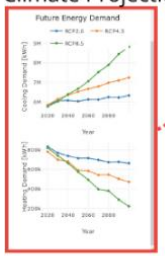
Nov 09, 2023

Digital Twin of UT Campus Visualizes Present, Past, Future Energy Needs

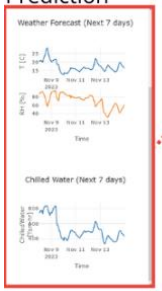


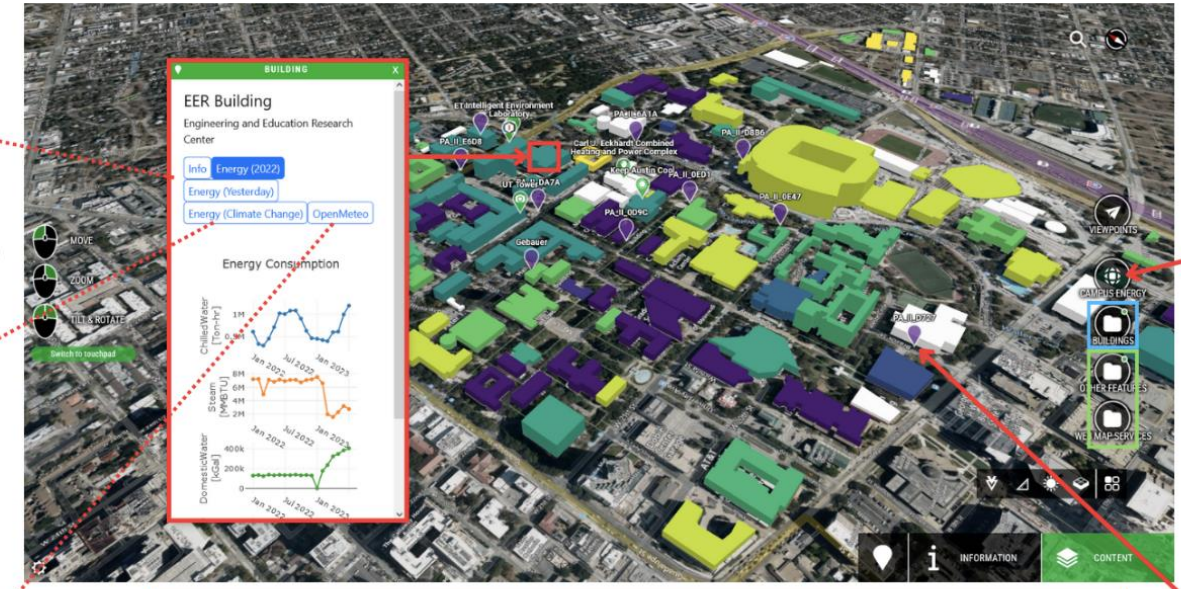
Building Metadata

Climate Projection (RCP)

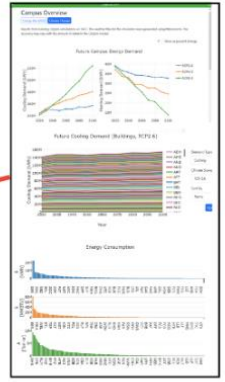


Cooling Demand Prediction





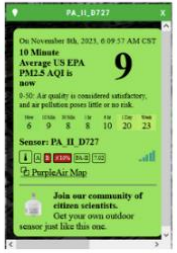
Campus Overview



Building Layers

Additional Datasets

Outdoor Air Quality



Ask...

1. Prioritize Climate CoLab projects?
2. Sustained Support/ Development? (“projects need X+ Y”)
3. 4 yearly City Climate Assessments?
4. ”Independent” climate brief/ policy / technology vetting?

utcitycolab.org

Supplemental Slides

ADDITIONAL PROJECTS

EXTREME WEATHER ACADEMY

POLICY BRIEF WORKSHOP

DECISION MAKING CALENDAR

ADVANCED DIGITAL TWINS

and many more...

KEY TAKEAWAYS

1

There is a need to bring together 3 elements

- Academia
- City Departments
- Community

2

We want to make climate data from useful to useable, and work with what the cities and communities need (more localized data)

3

Co Production and continuation of collaborations is necessary and essential

ACKNOWLEDGEMENTS

The efforts and support of City of Austin and University of Texas at Austin leadership, the Community groups including the COmmunity Grant from US Congressman Doggett is greatly appreciated. The work also benefits from NASA IDS, DOE Urban Integrated Field Lab, NSF CISE and AGS, and NOAA NIHHIS. **Framework for IPCC City Climate Assessment Special Report.**

CONTACT

Allysa Dallmann dallmann@utexas.edu

Dev Niyogi dev.niyogi @jsg.utexas.edu

utcitycolab.org

USEFUL TO USEABLE

"Climate is not the only culprit.. The lack of tools that the community can use to make decisions and take actions that can not only increase resiliency but also improve profitability is the real issue."