Climate Vulnerability in Austin: A multi-risk assessment

A project of the Austin Area Sustainability Indicators &
Texas Metropolitan Observatory of Planet Texas 2050

City of Austin Environmental Commission

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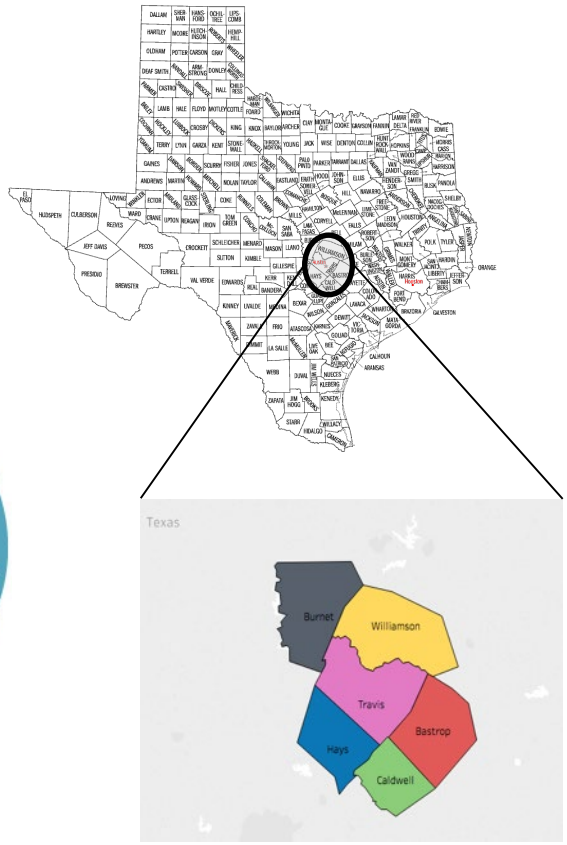
A²SI Austin Area Sustainability Indicators

LBJ SCHOOL OF PUBLIC AFFAIRS

A²SI
Austin Area Sustainability Indicators

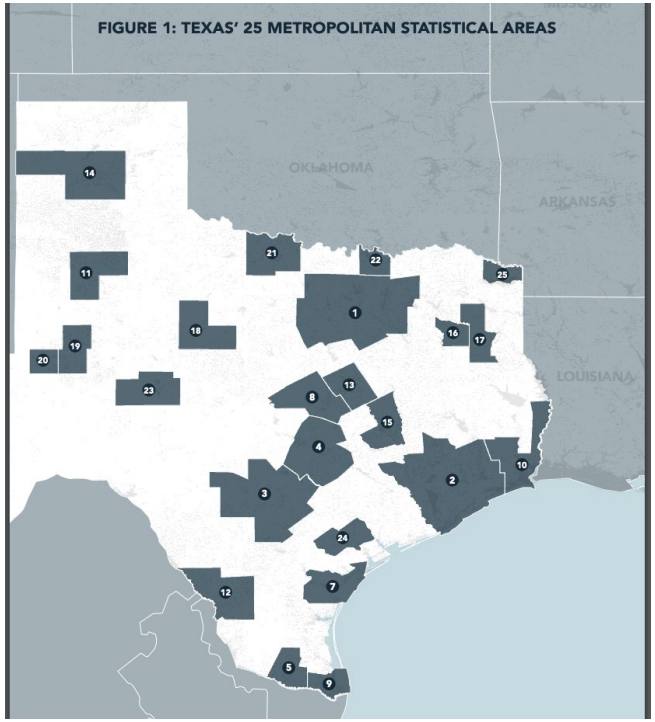
A²SI Mission: To measure quality of life and sustainability trends and serve as the foundation for a systems approach to address the challenges of our region.



www.austinindicators.org

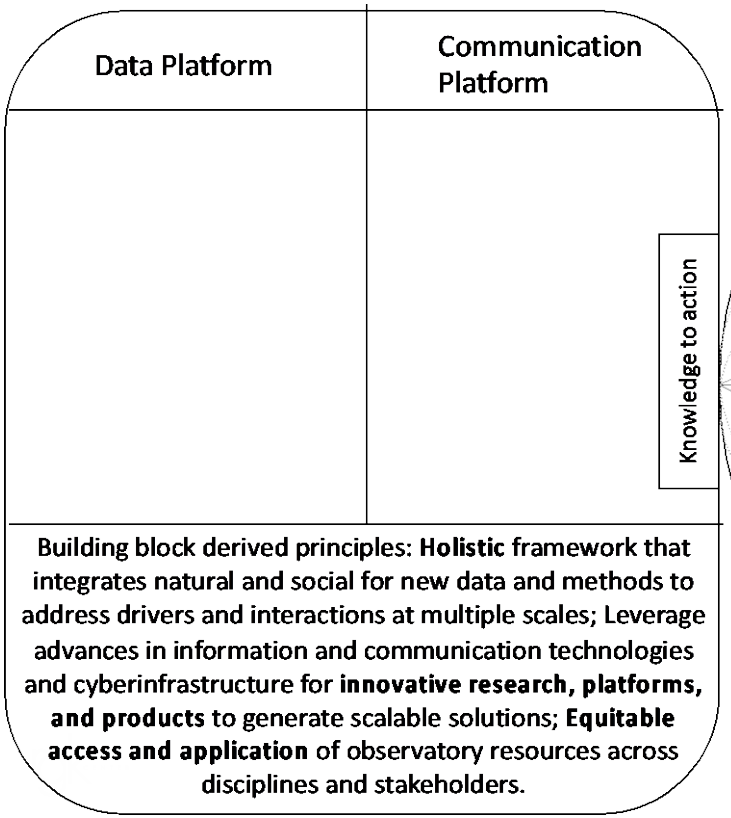
Texas Metro Observatory

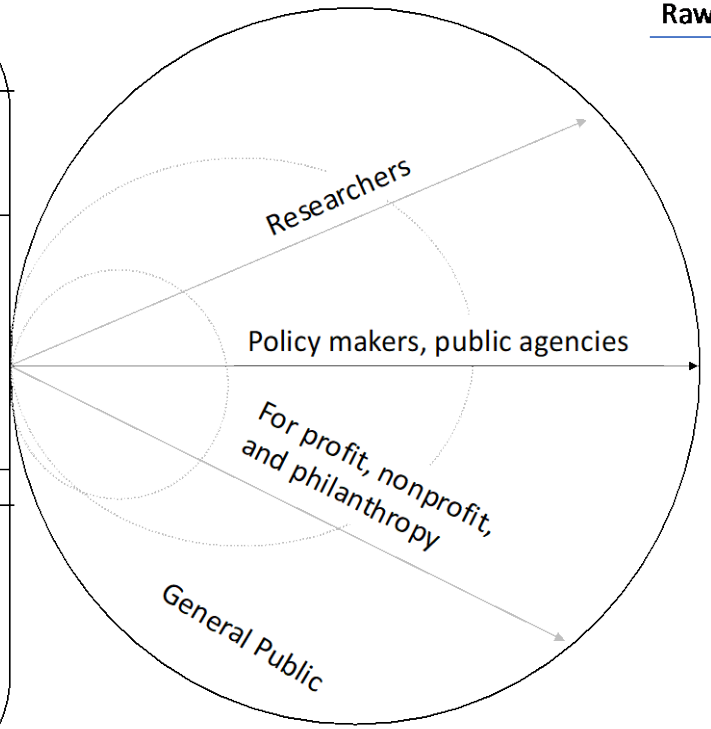
The Texas Metro Observatory (TMO) is a communication and data platform dedicated to sharing information and ideas about Texas' communities, understanding common problems, and developing solutions across the state's metropolitan areas.



https://tmo.utexas.edu/

TMO provides access to data (economic, environmental, health, demographic, governmental, etc.) for all metros in the state and produces unique data visualizations, infographics, and analysis tools that will provide a deeper understanding of issues within and among metro areas[1].





Raw data and maps

Methods / tools for data reporting and standardization

Peer reviewed publications, other reports

Projects / policy prescriptions tailored to local context

Public information, web dashboards, and infographics

Climate Vulnerability in Austin

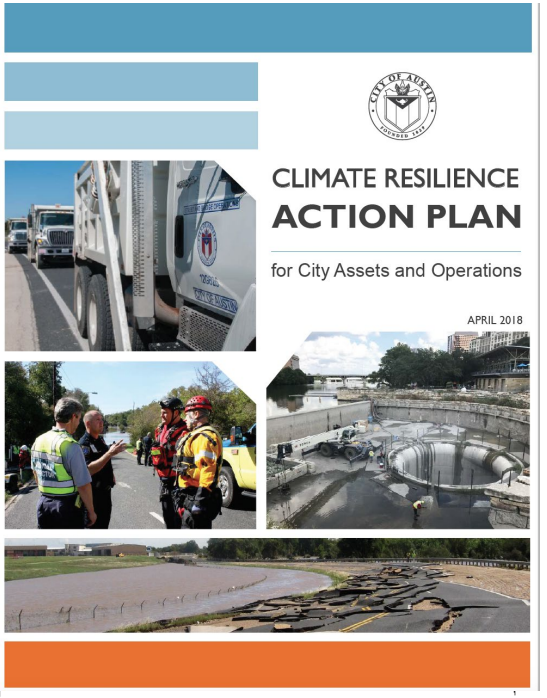
Climate projections for Austin[2]

- Increases in annual and seasonal average temperatures
- More frequent high temperature extremes
- More frequent extreme precipitation
- More frequent drought conditions in summer due to hotter weather

CLIMATE PROJECTIONS FOR AUSTIN	Historical Observed	Near-term (2011-2014)	Mid-century (2041-2070)		End-of-century (2071-2100)	
			Lower	Higher	Lower	Higher
Temperature						
Summer average high temperature (°F)	93.8	96.9	97.9	100.2	98.6	103.8
Cold nights (minimum temperature < 32°F)	16.6	10.8	7.8	6.4	7.0	3.9
Warm nights (minimum temperature > 80°F)	0.5	5.4	10.5	39.5	17.0	86.7
Hot days (maximum temperature > 100°F)	11.7	31.4	40.1	63.2	46.5	92.3
Very hot days (maximum temperature > 110°F)	0.0	1.3	0.4	11.6	0.9	19.5
Precipitation						
Annual precipitation (inches)	33.7	31.8	33.6	33.3	33.0	31.4
Dry days (<0.01 inches in 24 hours)	277.3	280.3	280.6	282.7	281.4	288.1
Longest dry spell (days)	53.1	53.3	54.4	54.7	54.0	60.4
Wet days (>2 inches in 24 hours)	2.2	2.5	2.8	2.7	2.8	2.8
Wettest 5 days (inches of precipitation)	5.8	7.2	7.6	7.7	7.8	7.8

Climate Vulnerability in Austin

Austin can expect more extreme weather in the future



RESOLUTION NO. 20190509-019

WHEREAS, in less than a decade, Austin and surrounding communities have experienced a historic number of abrupt and extreme weather events, causing loss of life, total destruction of properties and ecosystems, and displacement of hundreds of people; and

WHEREAS, in 2011, the City of Austin and Central Texas faced record droughts, high temperatures, and devastating wildfires both in Southwest Austin and Bastrop County, which suffered catastrophic damage with two fatalities and the complete loss of thousands

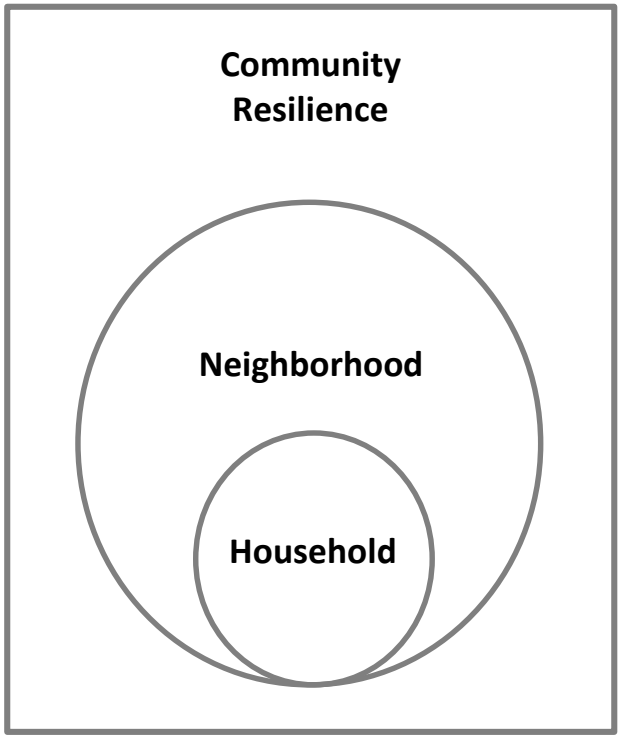
Climate Vulnerability in Austin

Concept	Definition
Hazard	Represents the physical phenomenon related to climate change (e.g., flood, wildfire, heat) that has the potential to cause damage and loss to property, infrastructure, livelihoods, service provision and environmental resources
Exposure	Represents the presence of people, livelihoods, environmental services and resources, infrastructure, economic, social, or cultural assets that could be adversely affected.
Vulnerability	Represents the propensity or predisposition of a community, system, or asset to be adversely affected by a certain hazard.
Social Vulnerability	Social vulnerability is a measure of both the sensitivity of a population to natural hazards and its ability to respond to and recover from the impacts of hazards.
Hazard Risk	It quantifies and classifies potential consequences of a hazard events on the investigated areas combining hazard, exposure and vulnerability.
Multi-hazard	Represents the totality of relevant hazards in a defined administrative area with or without temporal coincidence (cascade effects).
Multi-risk	Represents the whole risk from several hazards, taking into account possible hazards and vulnerability interactions.

Climate Vulnerability in Austin

Community Resilience

Climate Vulnerability in Austin

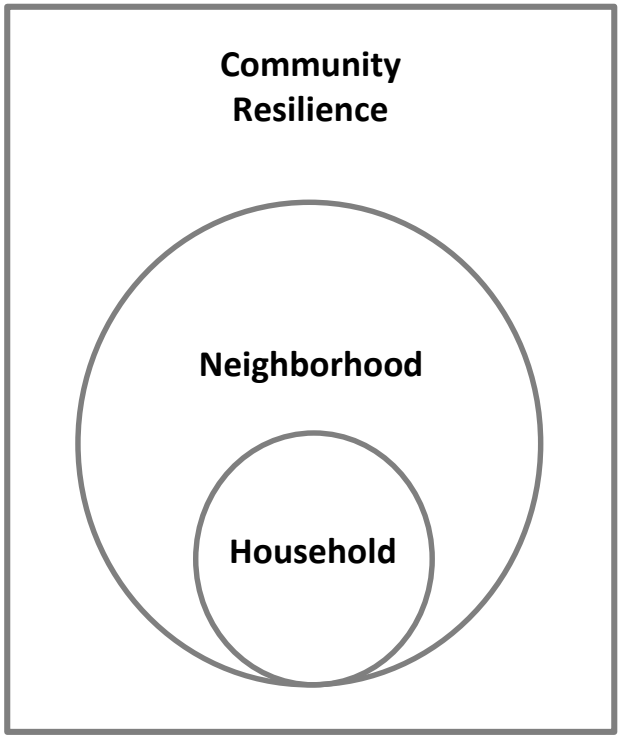


Climate Vulnerability in Austin

Exposure

Sensitivity

Adaptive Capacity



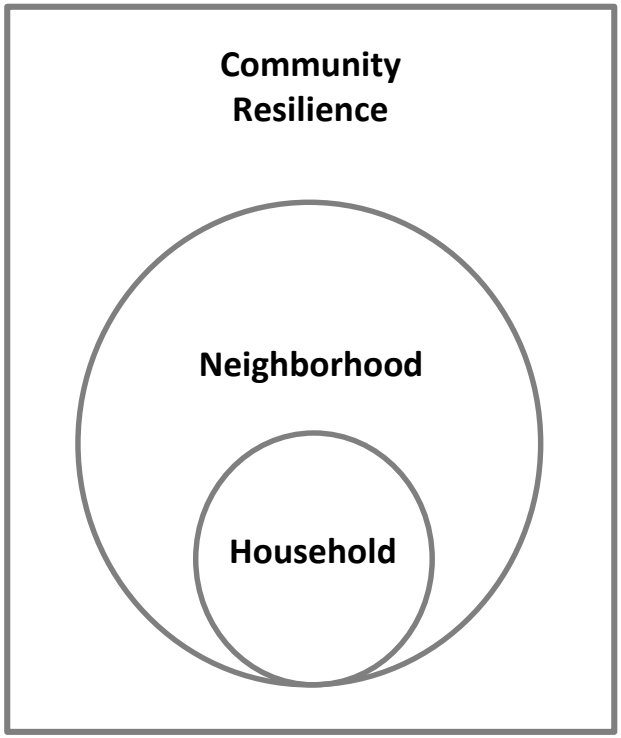
Climate Vulnerability in Austin

Exposure

- Flood hazard exposure
- Wildfire hazard exposure
- Heat hazard exposure

Sensitivity

Adaptive Capacity



Climate Vulnerability in Austin

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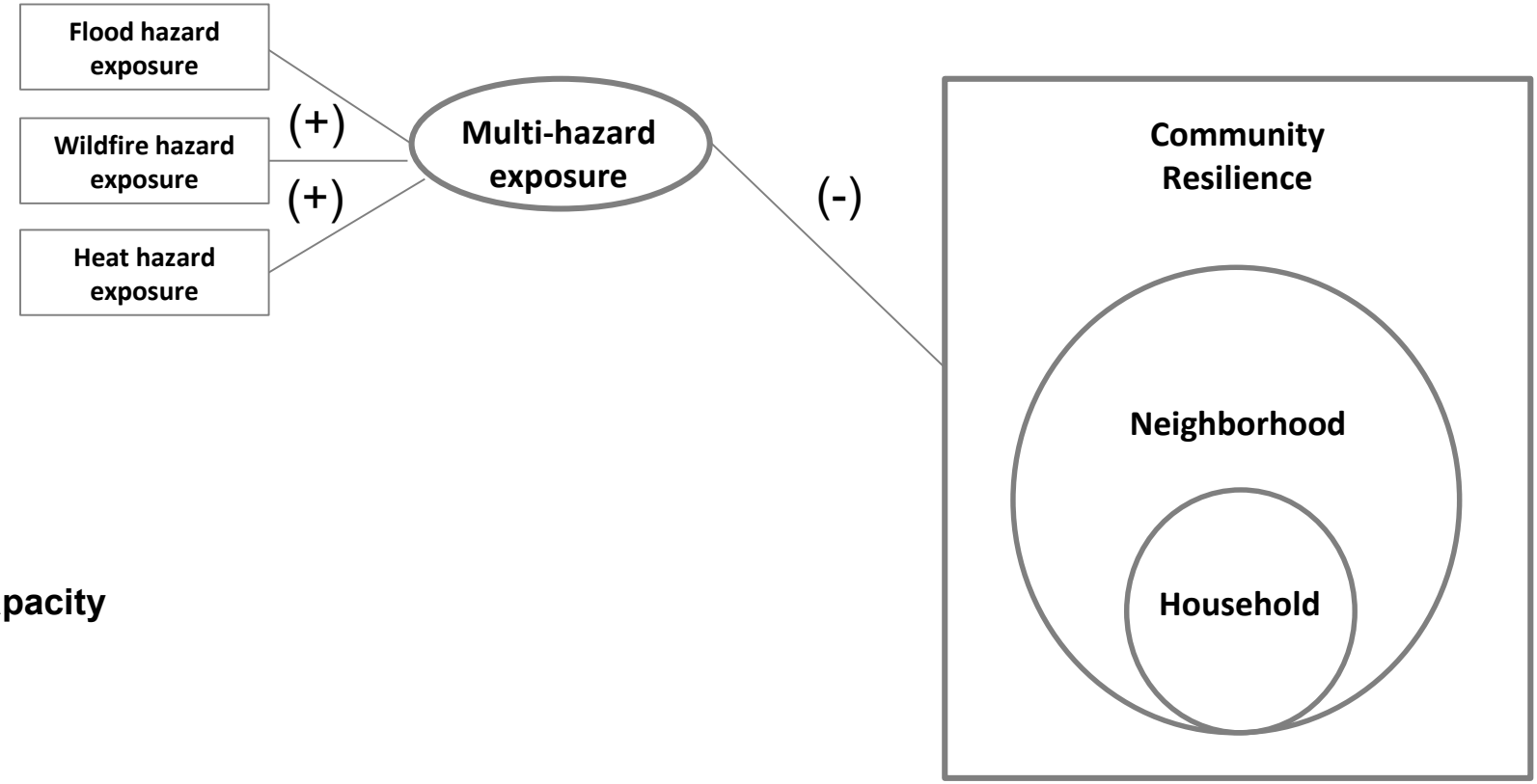

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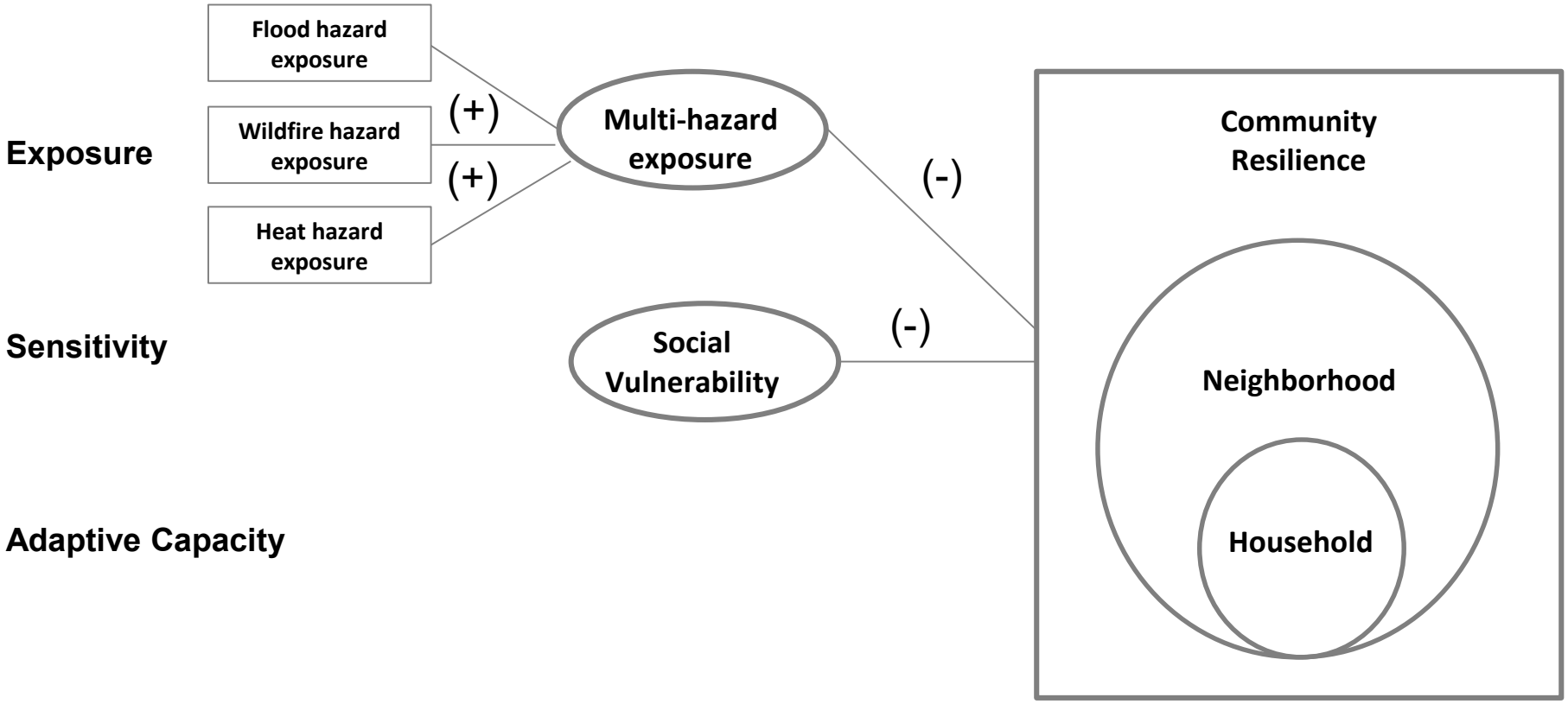

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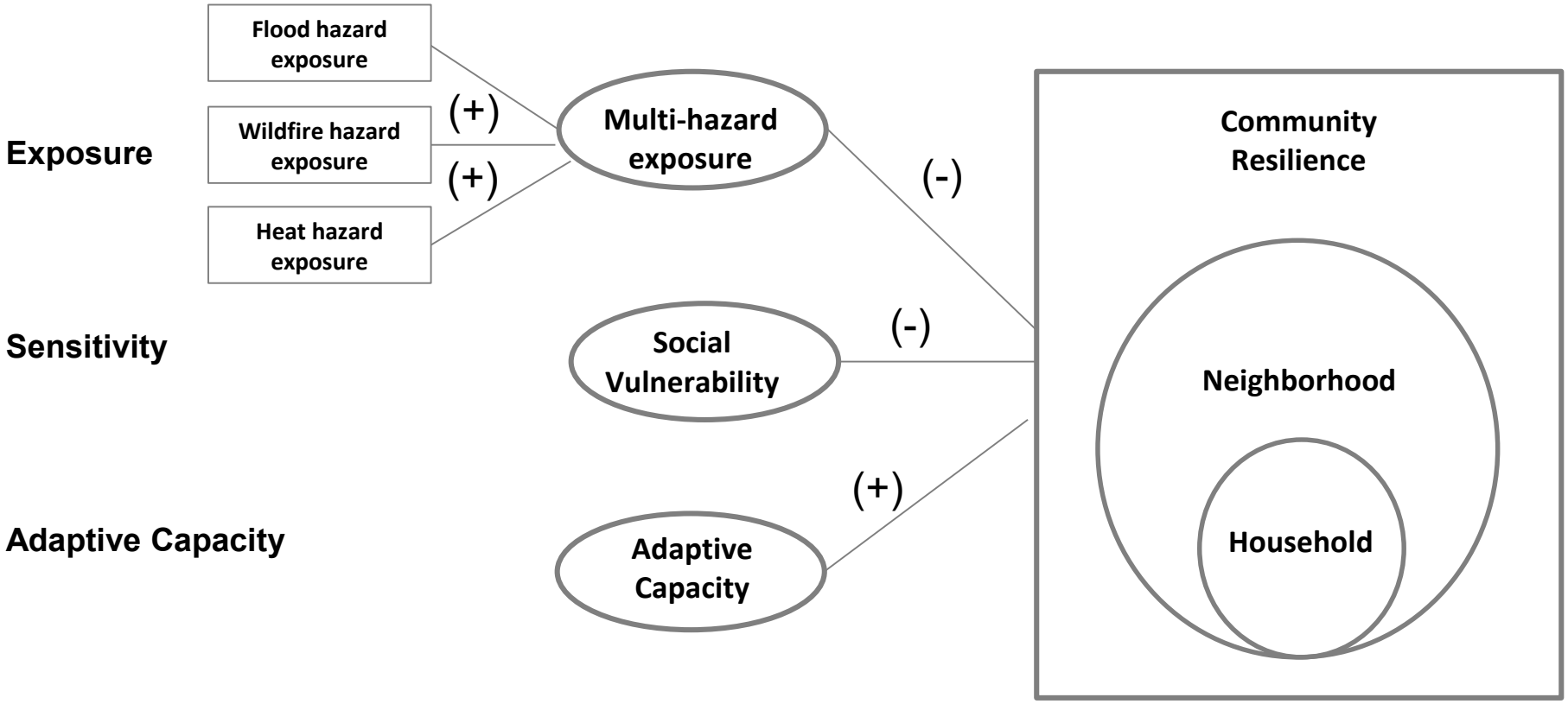


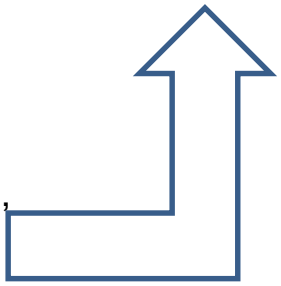
Climate Vulnerability in Austin

Assess the spatial sensitivity to hazards and difference across communities in their overall capacity to prepare for, respond to, and recover from hazards. We do this by adapting a well-vetted and oft-used tool – The Social Vulnerability Index (or SoVI®).

Climate Vulnerability in Austin

Assessing the spatial exposure of independent hazards. These include:

a. Flooding (specifically, riverine/creek flooding)
b. Wildfire
c. Extreme heat



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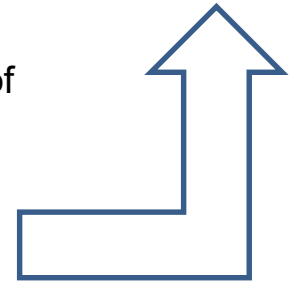
Climate Vulnerability in Austin

Conduct single risk assessments by analyzing the interaction between sensitivity (SoVI®) and exposure for each independent hazard



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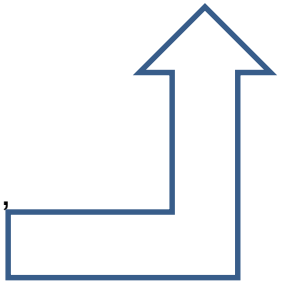

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Conduct single risk assessments by analyzing the interaction between sensitivity (SoVI®) and exposure for each independent hazard

Develop a composite multi-climate risk index.

Social Vulnerability in Austin

- Utilized the Cutter et al. Social Vulnerability Index (SoVI®)[4] methodology, which is well established and oft used
- Related, but includes more parameters than Center for Disease Control (CDC) SVI
- Statistically specified it for for Austin (based on data) resulting in 18 variables across six principal components.

Social Vulnerability Principal Components (Block Group level)

Wealth Variables (-):
- Percent Households Earning over $200,000 annually
- Median Housing Value
- Per Capita Income
- Median Gross Rent

Language & Education (+):
- Percent speaking English as a second language with limited proficiency
- Percent Hispanic
- Percent Less than high school education for population over 25 years and older

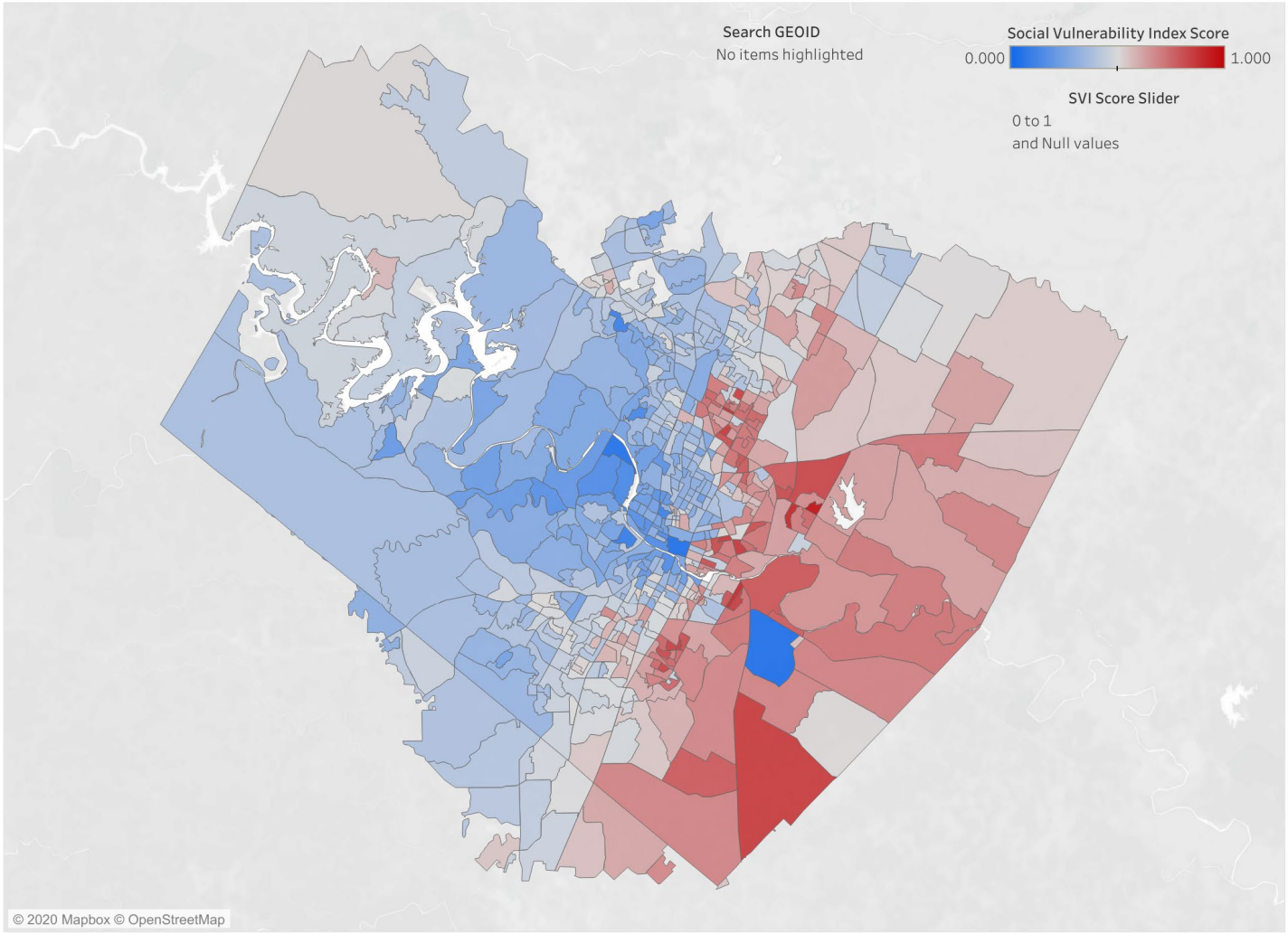
Elderly Variables (+):
- Percent Households Receiving Social Security Benefits
- Percent Population under 5 years or 65 and over..

Housing Status Variables (+):
- People per Unit (Average household size)
- Percent Children Living in Married Couple Families

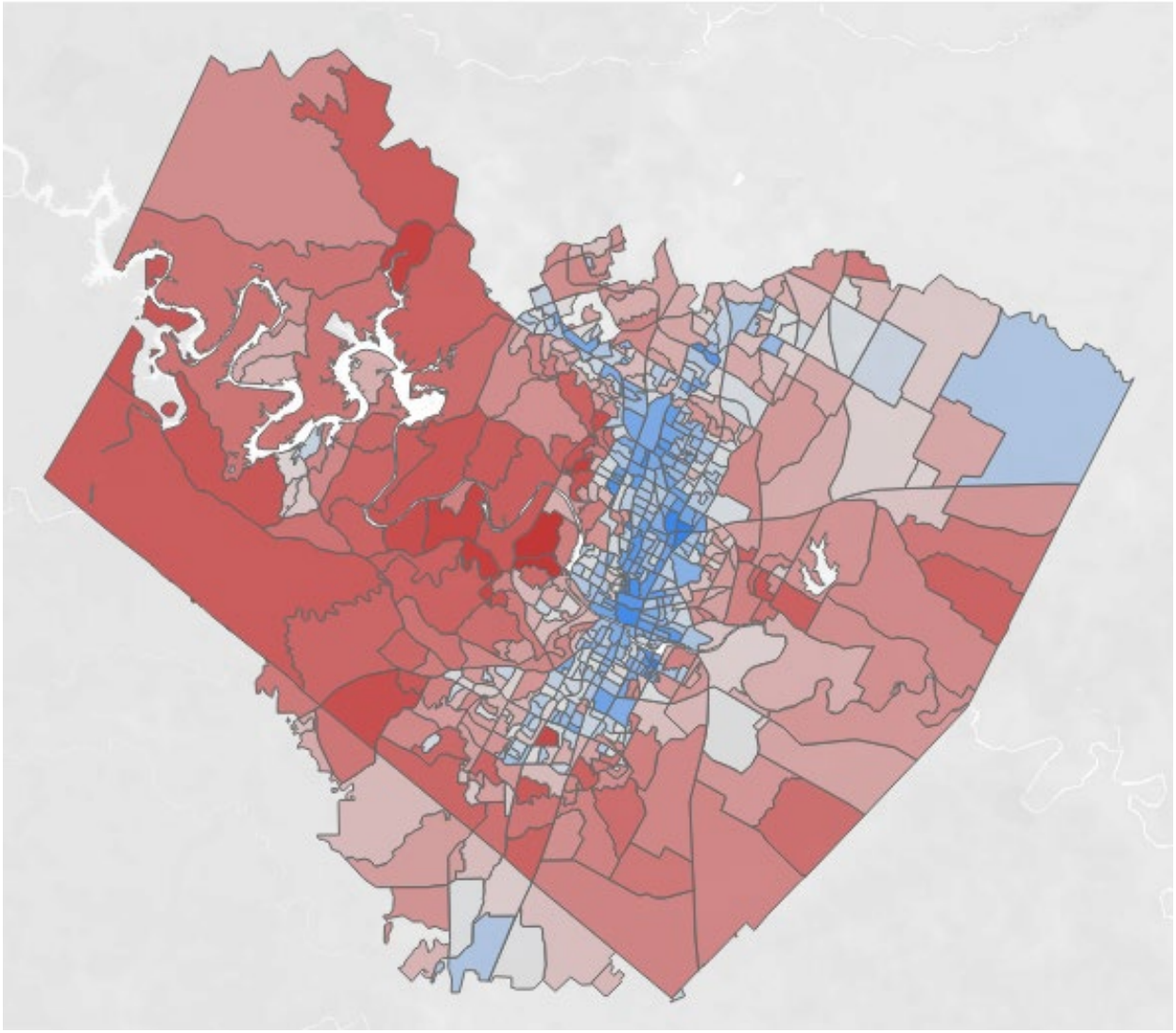
Social Status Variables (+):
- Percent Unemployment for Civilian in Labor Force 16 Years and Over
- Percent Black or African American Alone
- Percent Housing Units with No Car
- Percent Poverty

Gender Variables (+):
- Percent Female
- Percent Female Participation in Labor Force

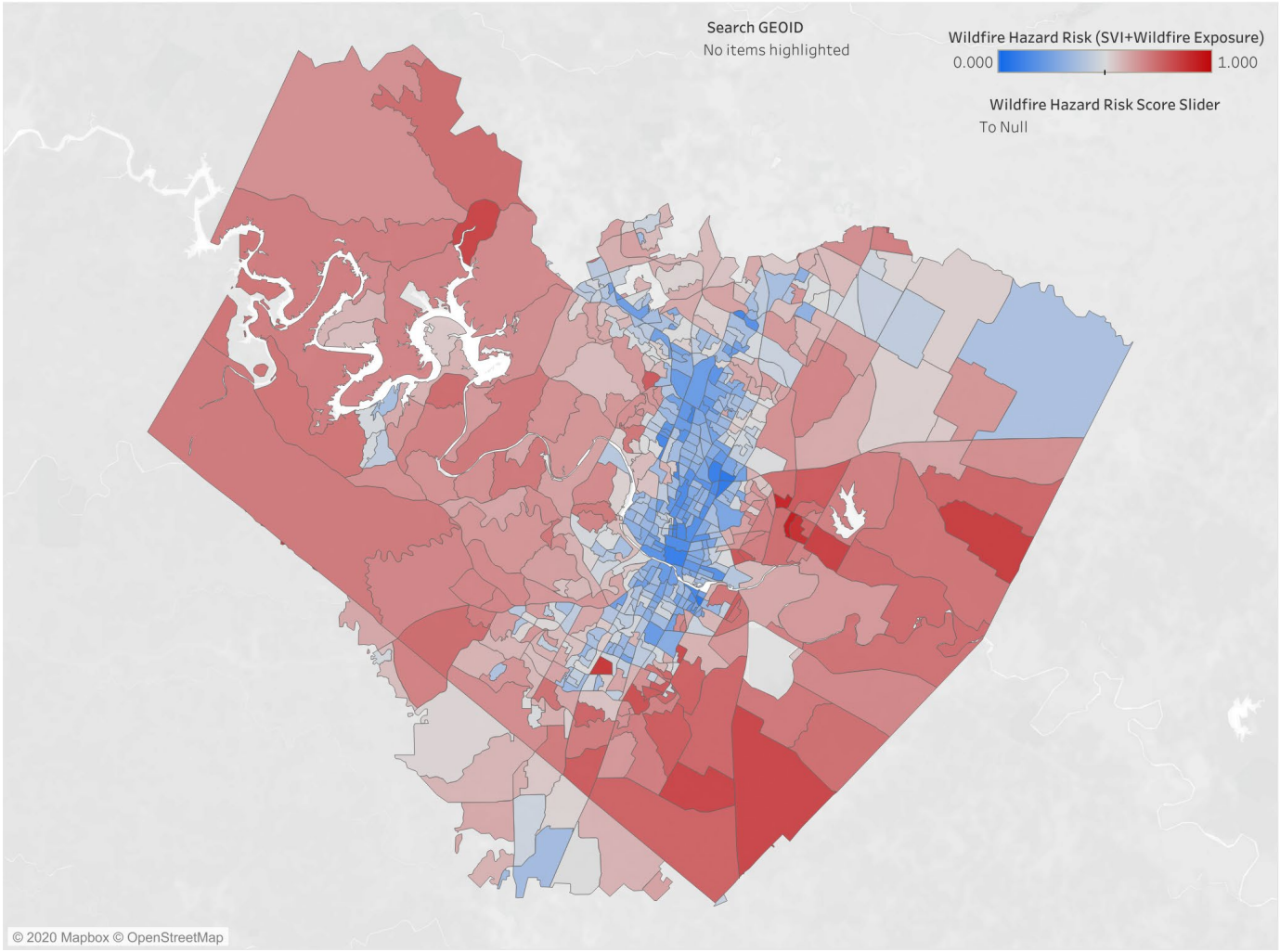
Social Vulnerability in Austin



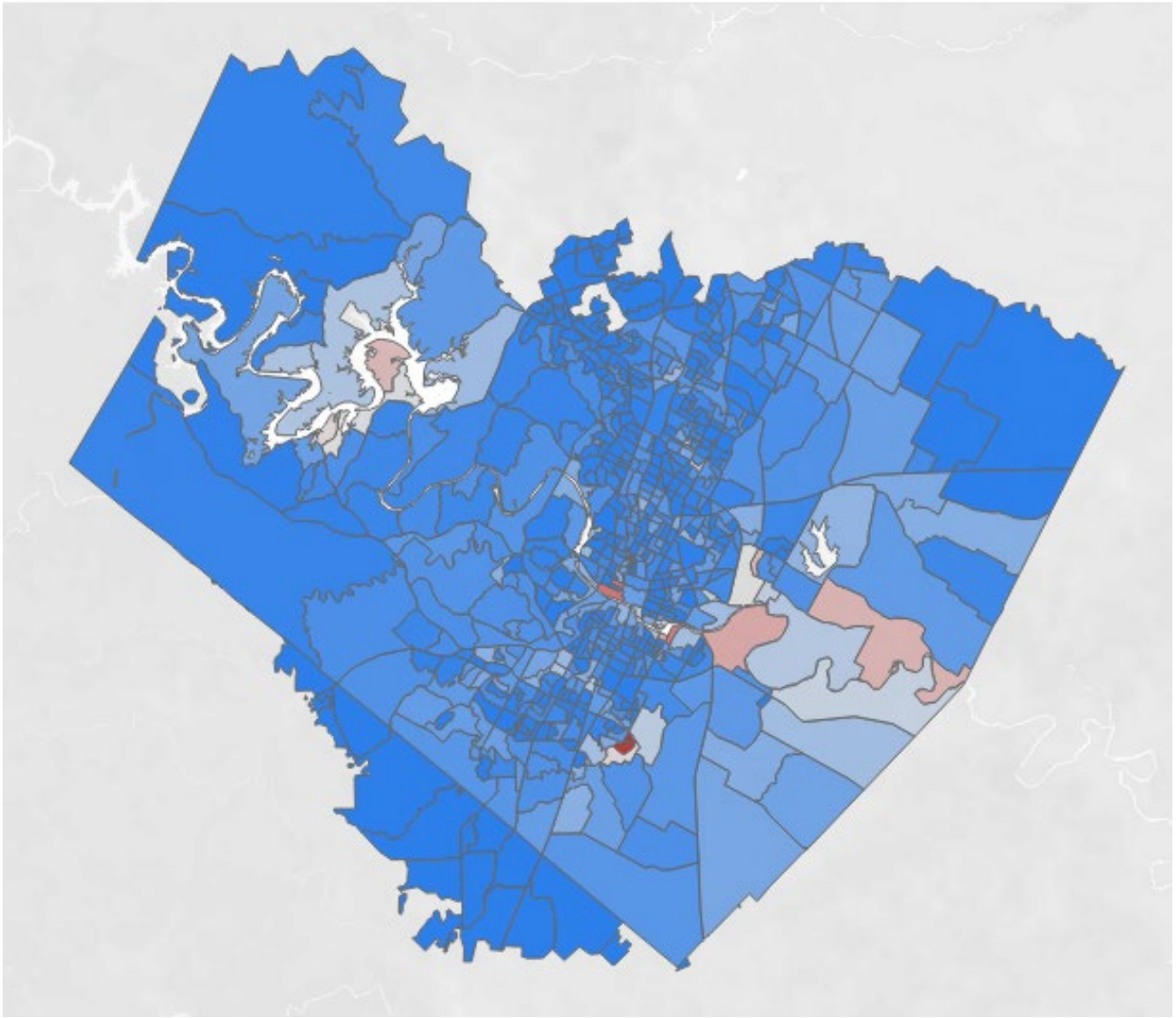
Austin Wildfire Hazard Exposure



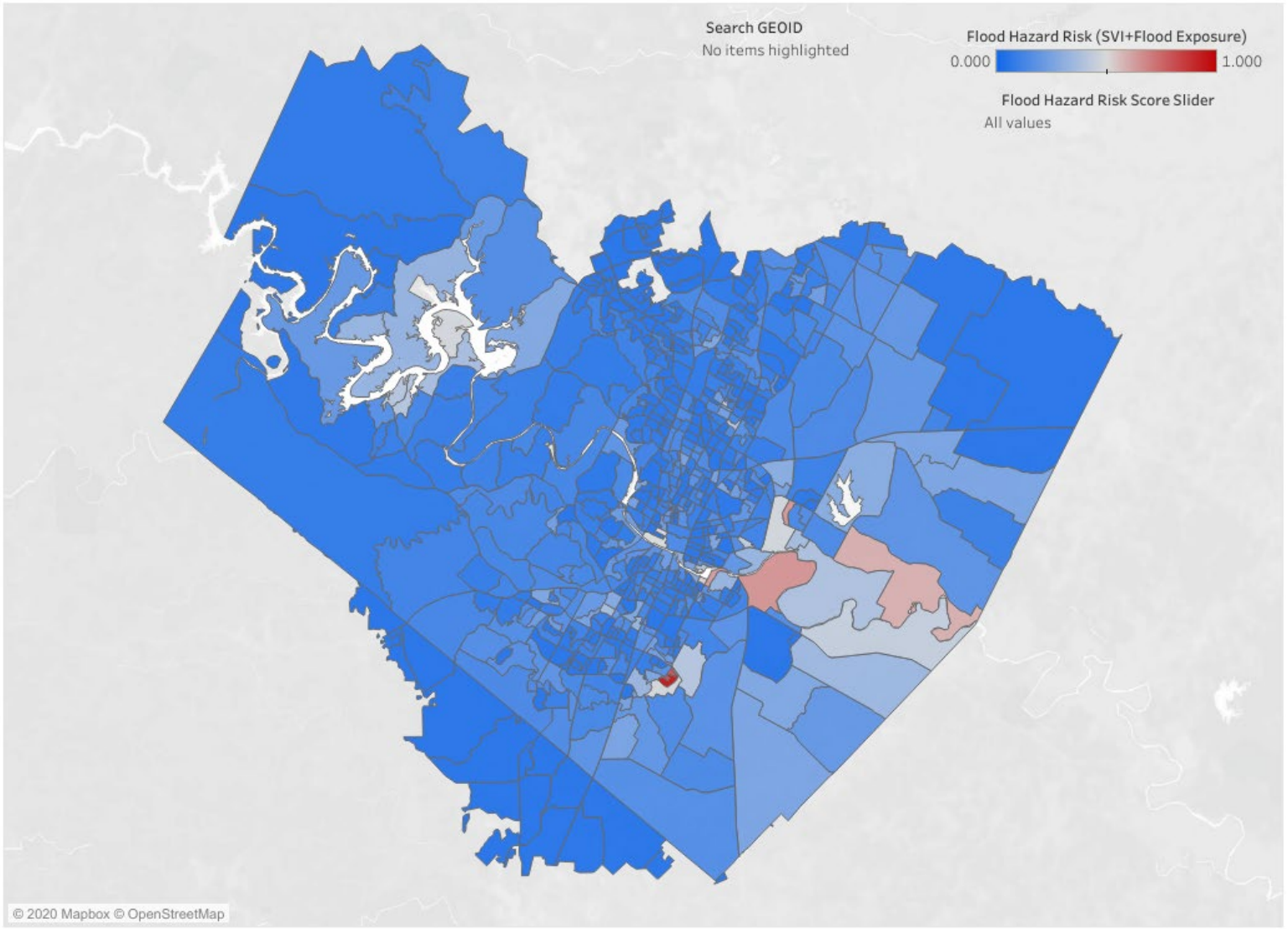
Austin Wildfire Risk (exposure + social vulnerability



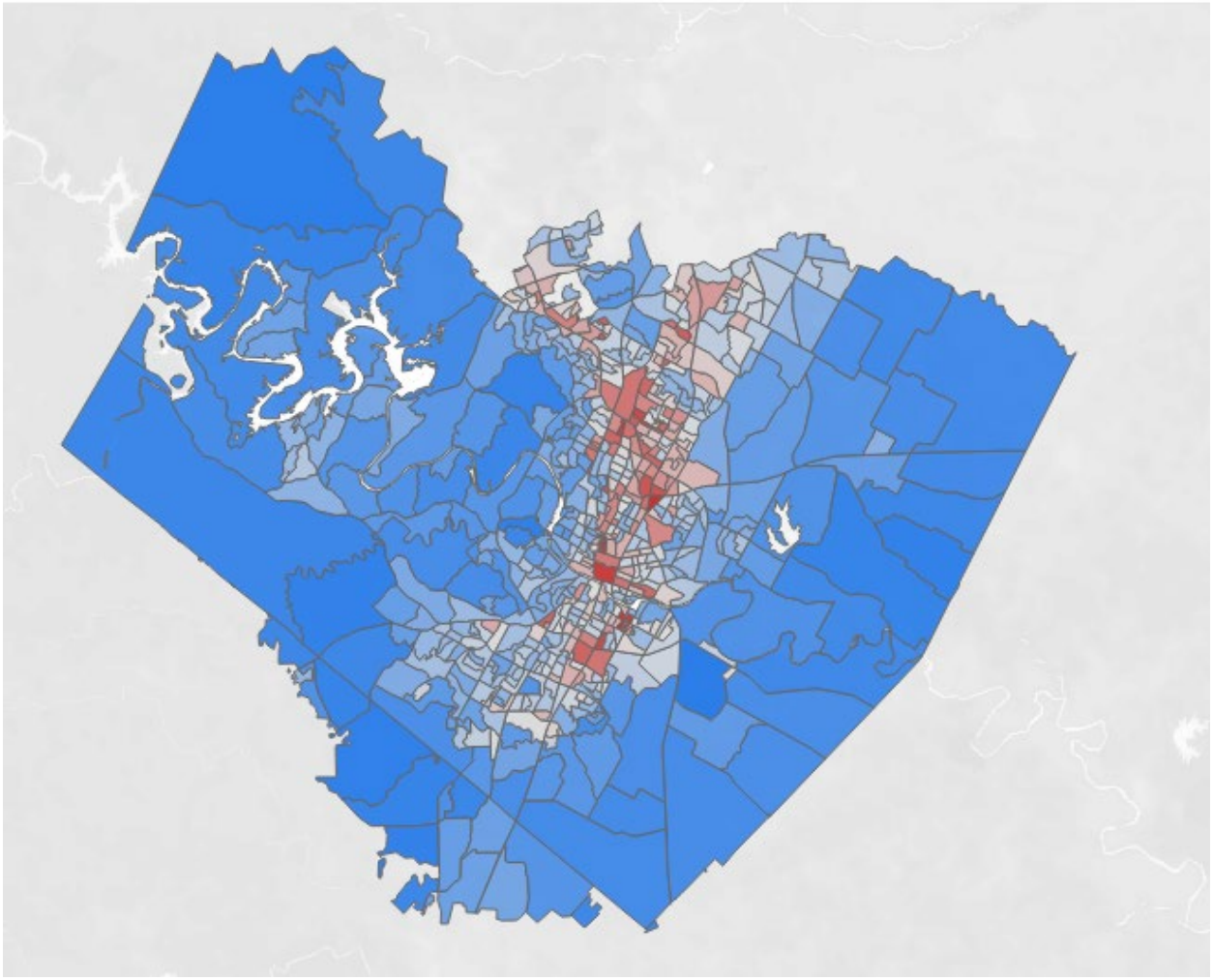
Austin Flood Hazard Exposure



Austin Flood Risk (exposure + social vulnerability)



Austin Heat Hazard Exposure



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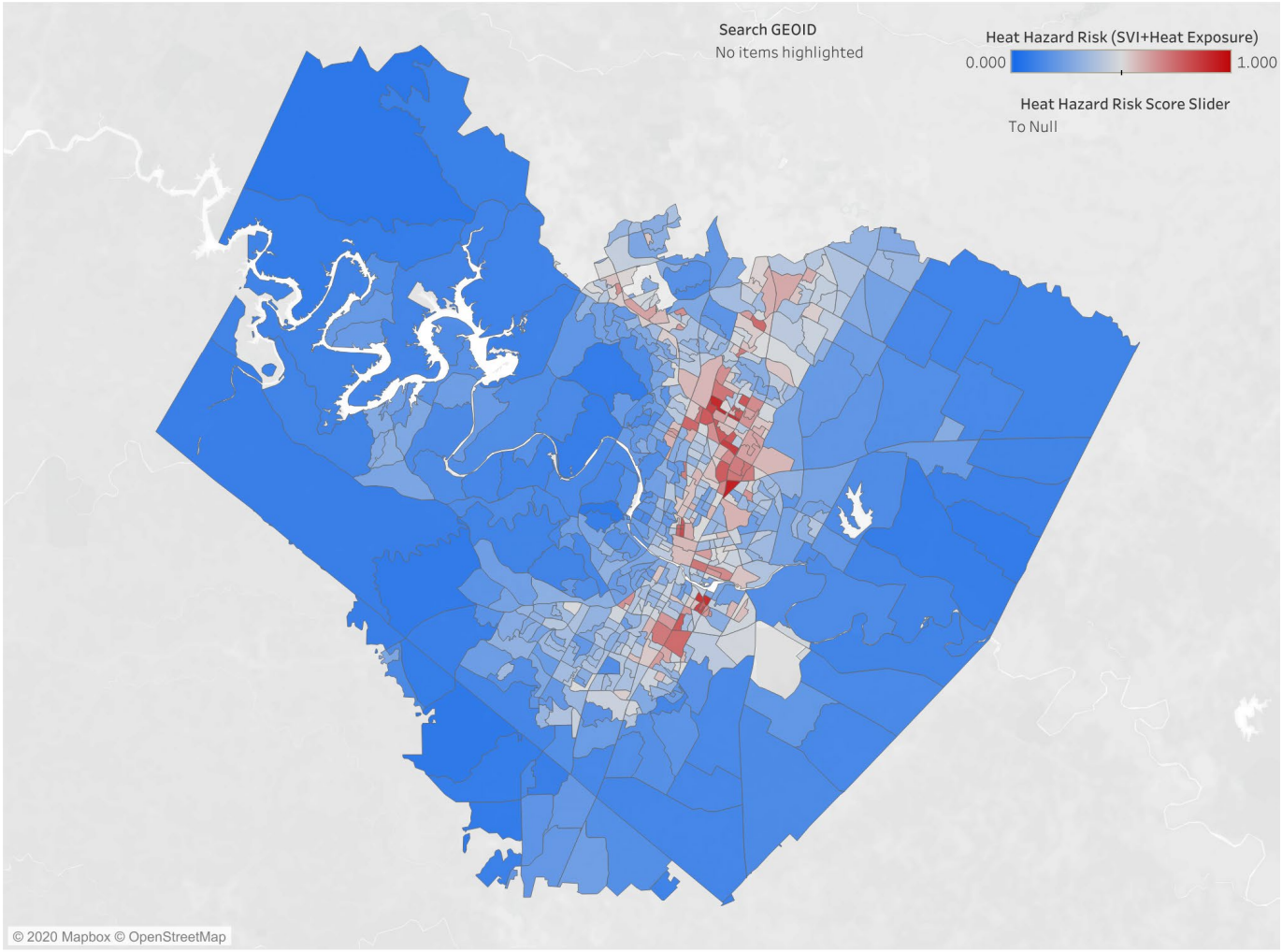
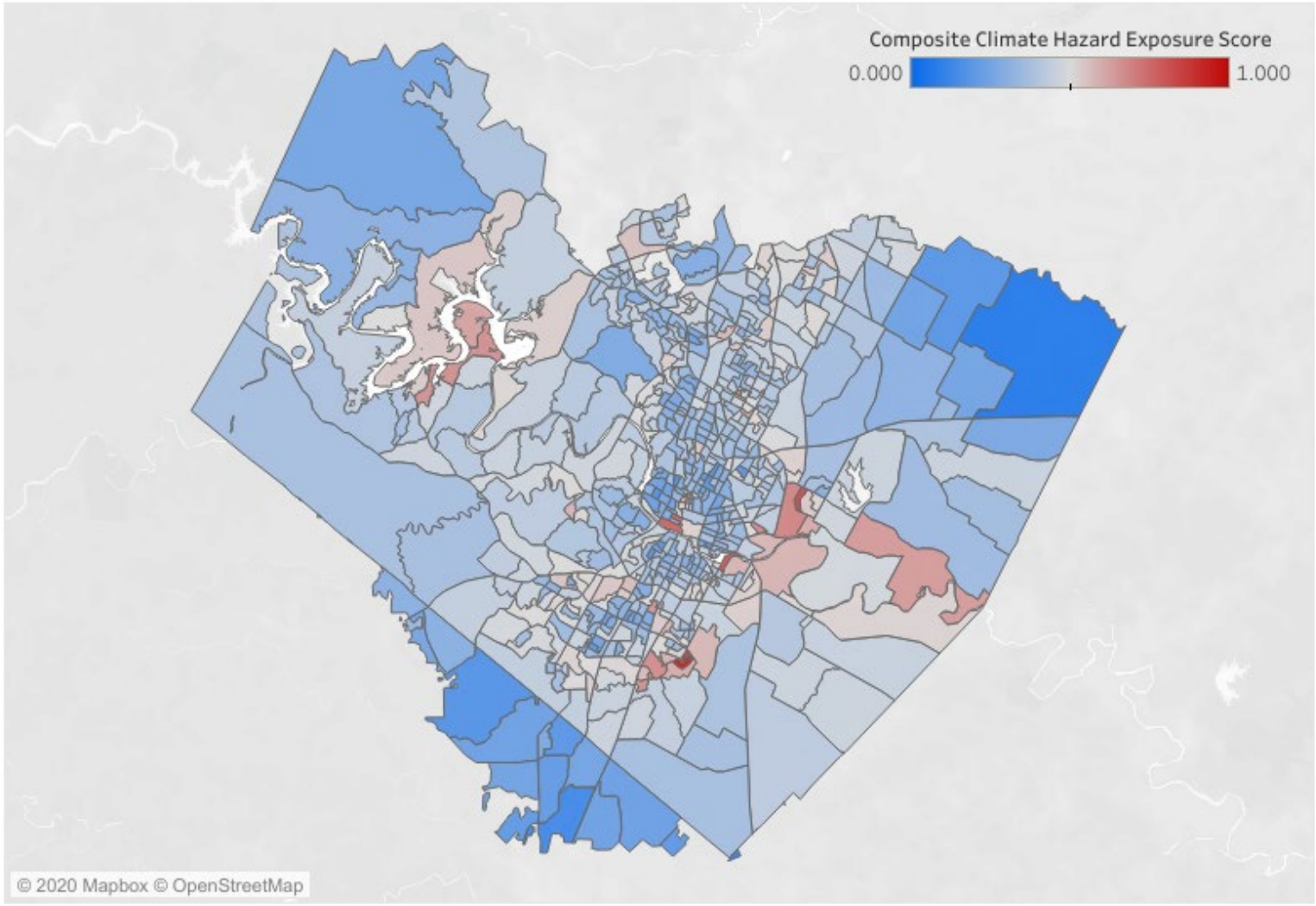
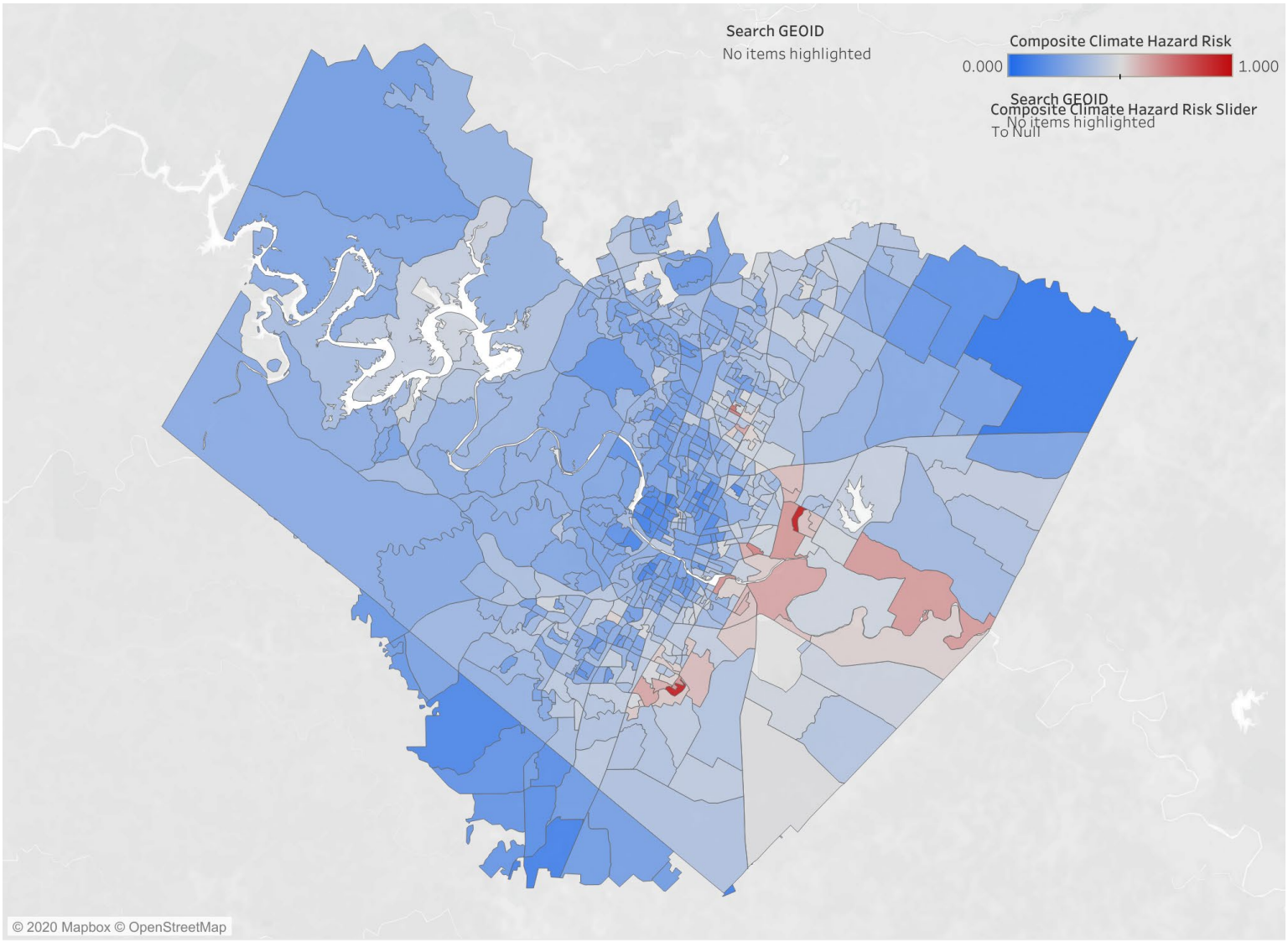


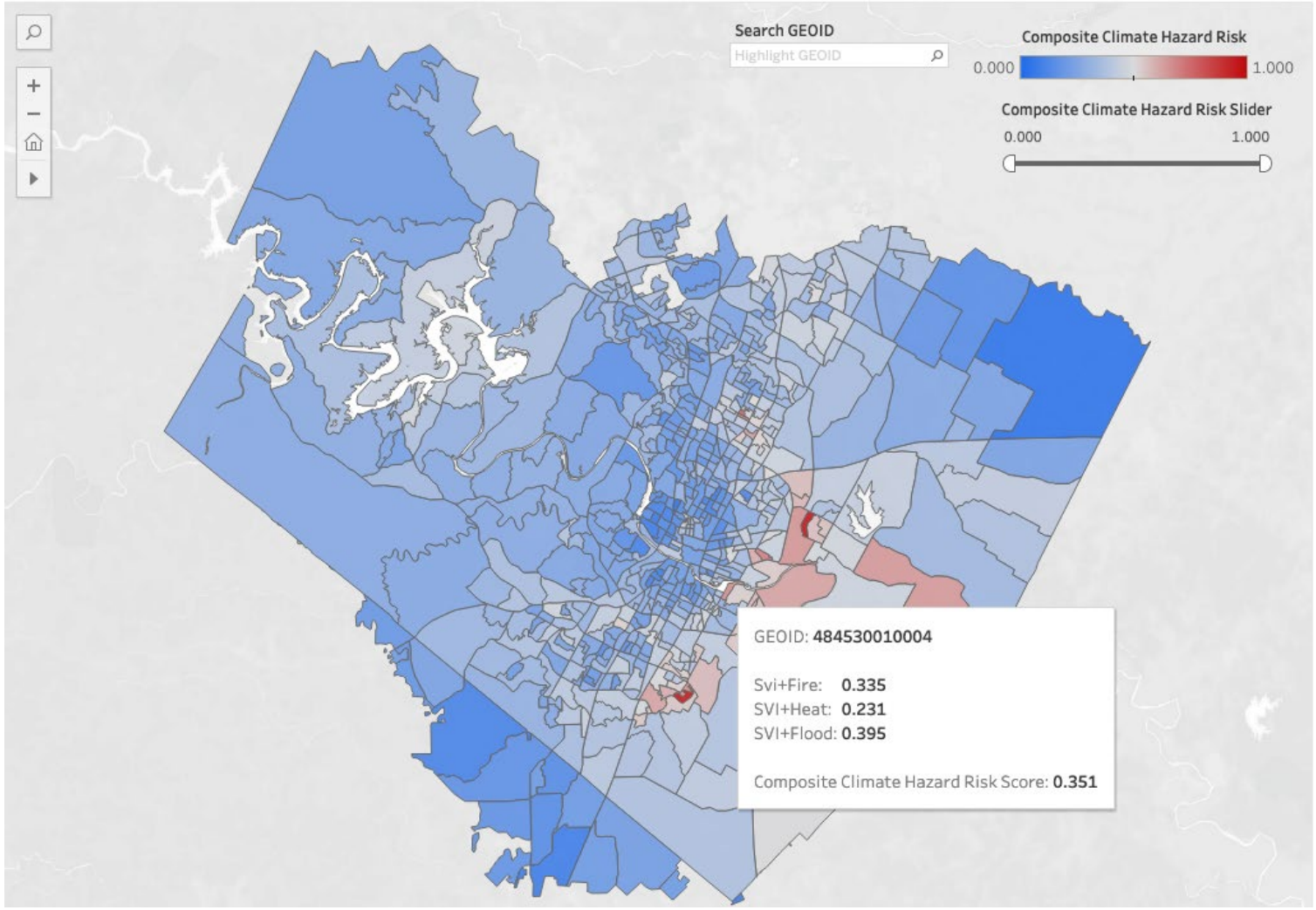
Austin Multi-hazard Exposure



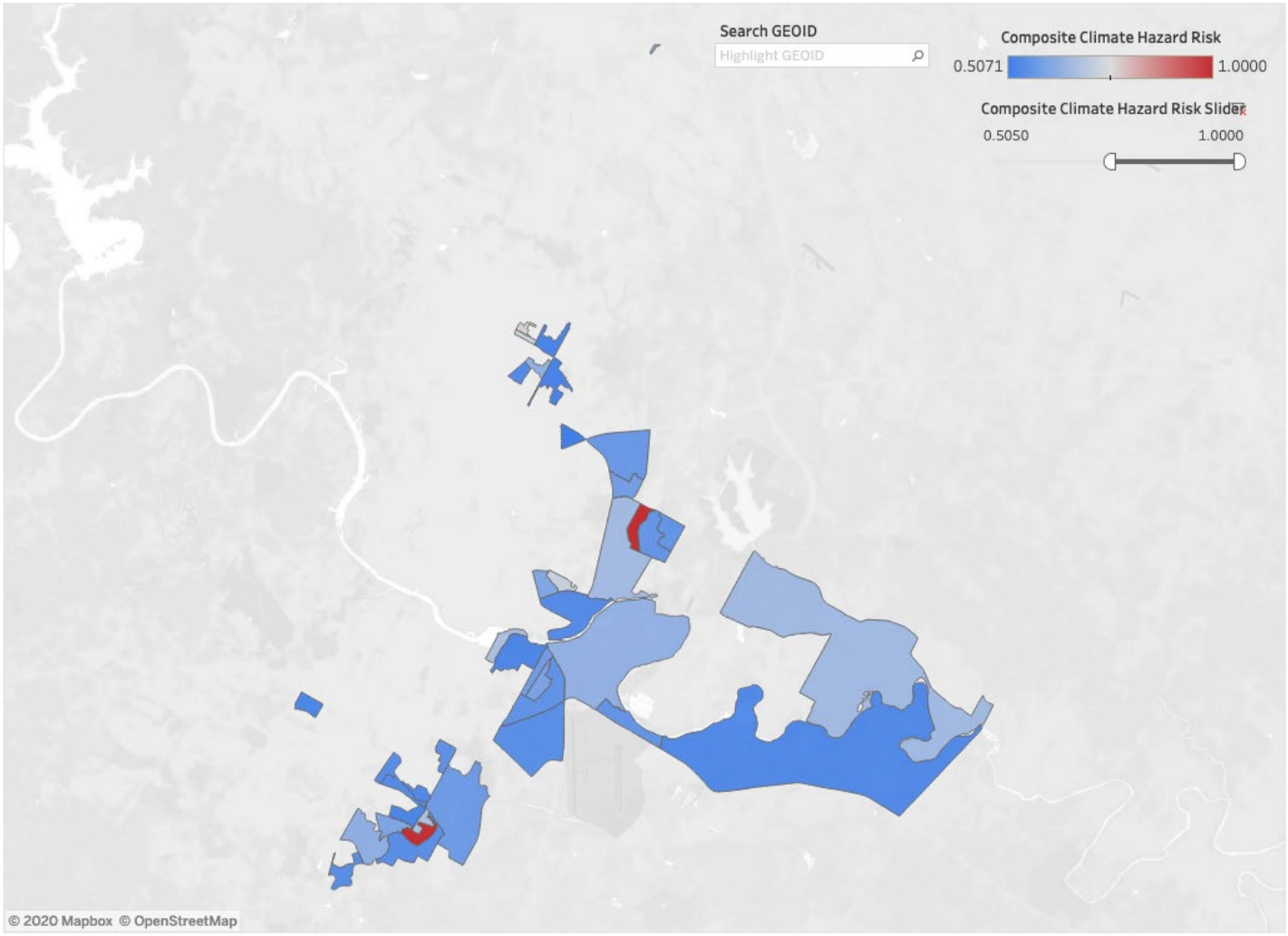
Austin Multi-hazard Risk (Climate Vulnerability)



Austin Multi-hazard Risk (Climate Vulnerability)



Austin Multi-hazard Risk (Climate Vulnerability)



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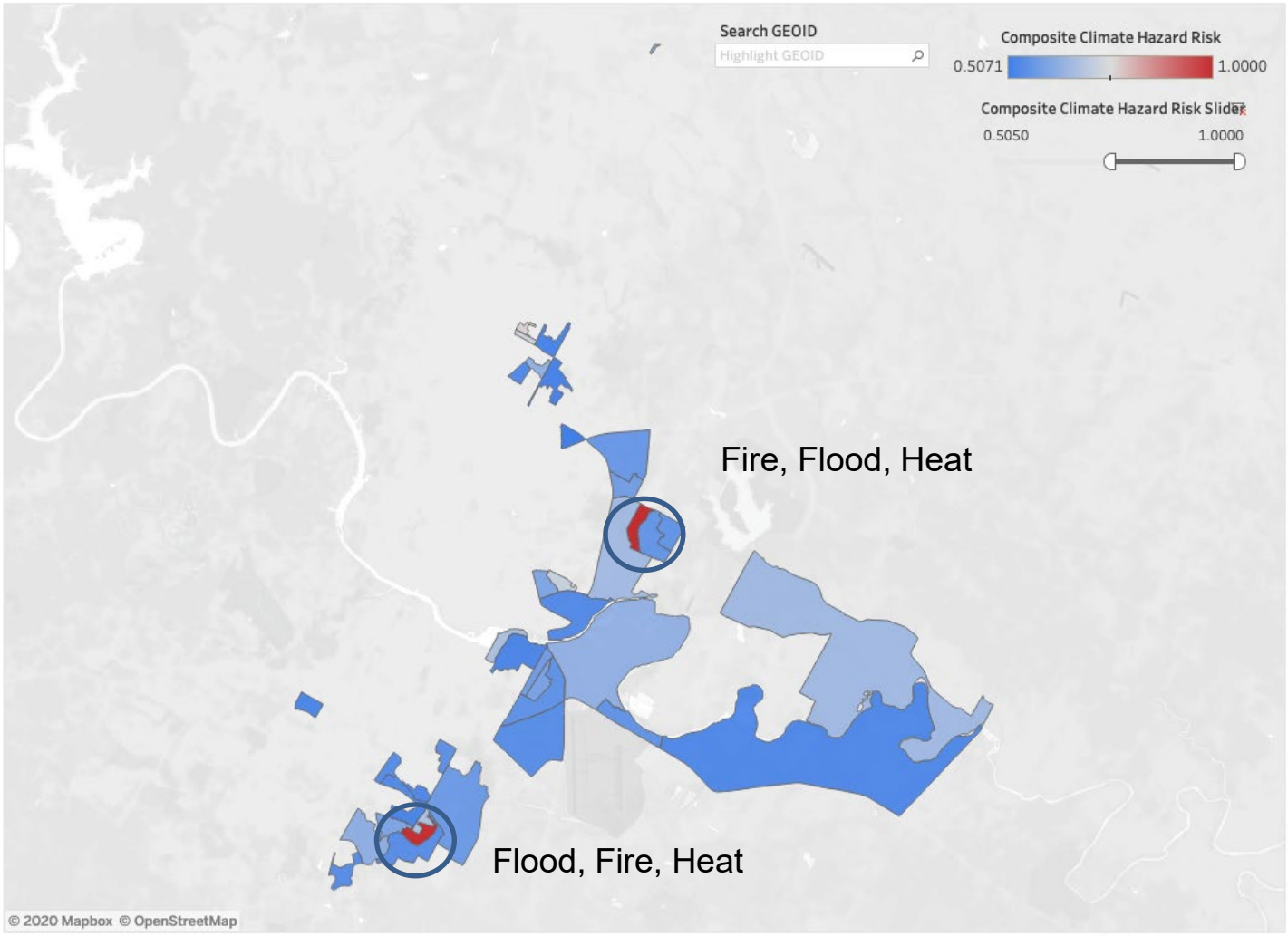
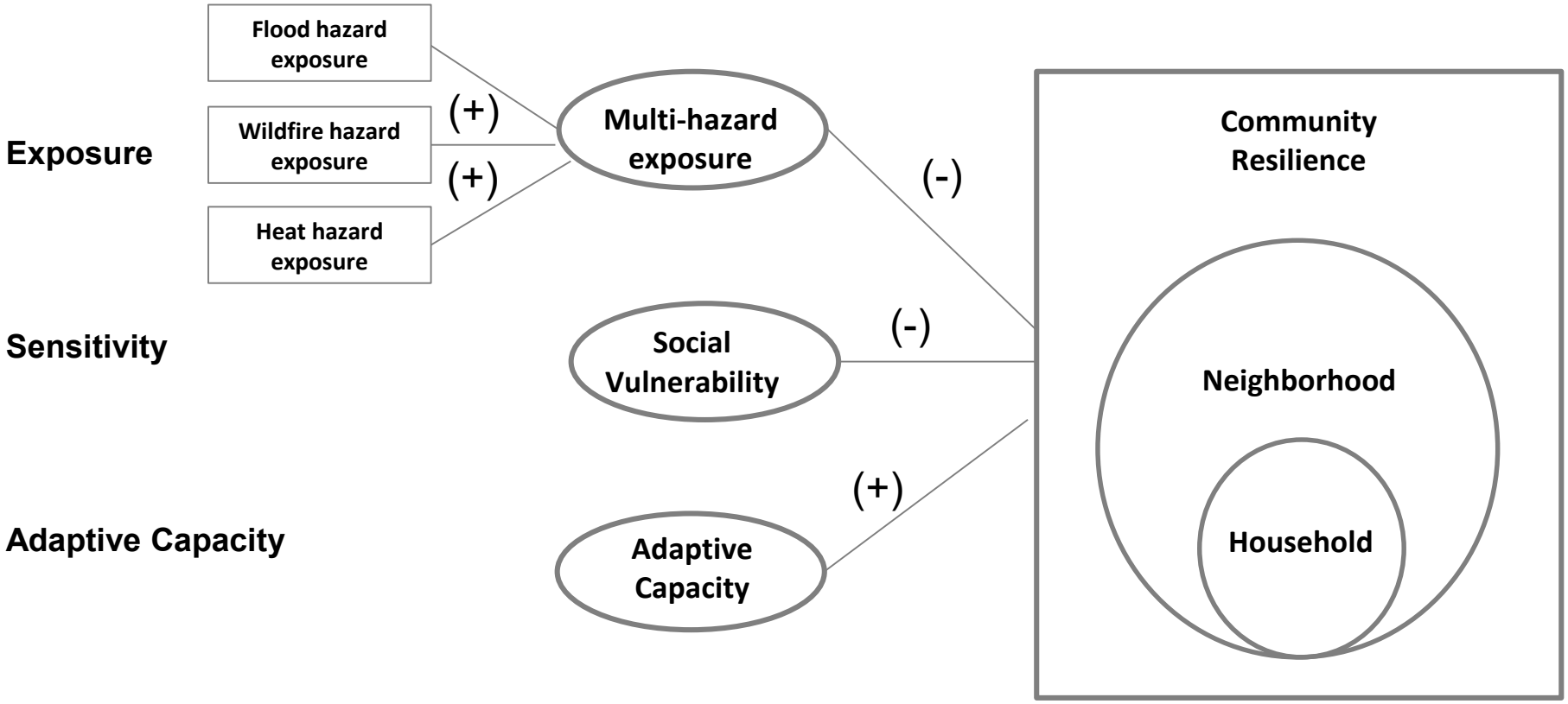
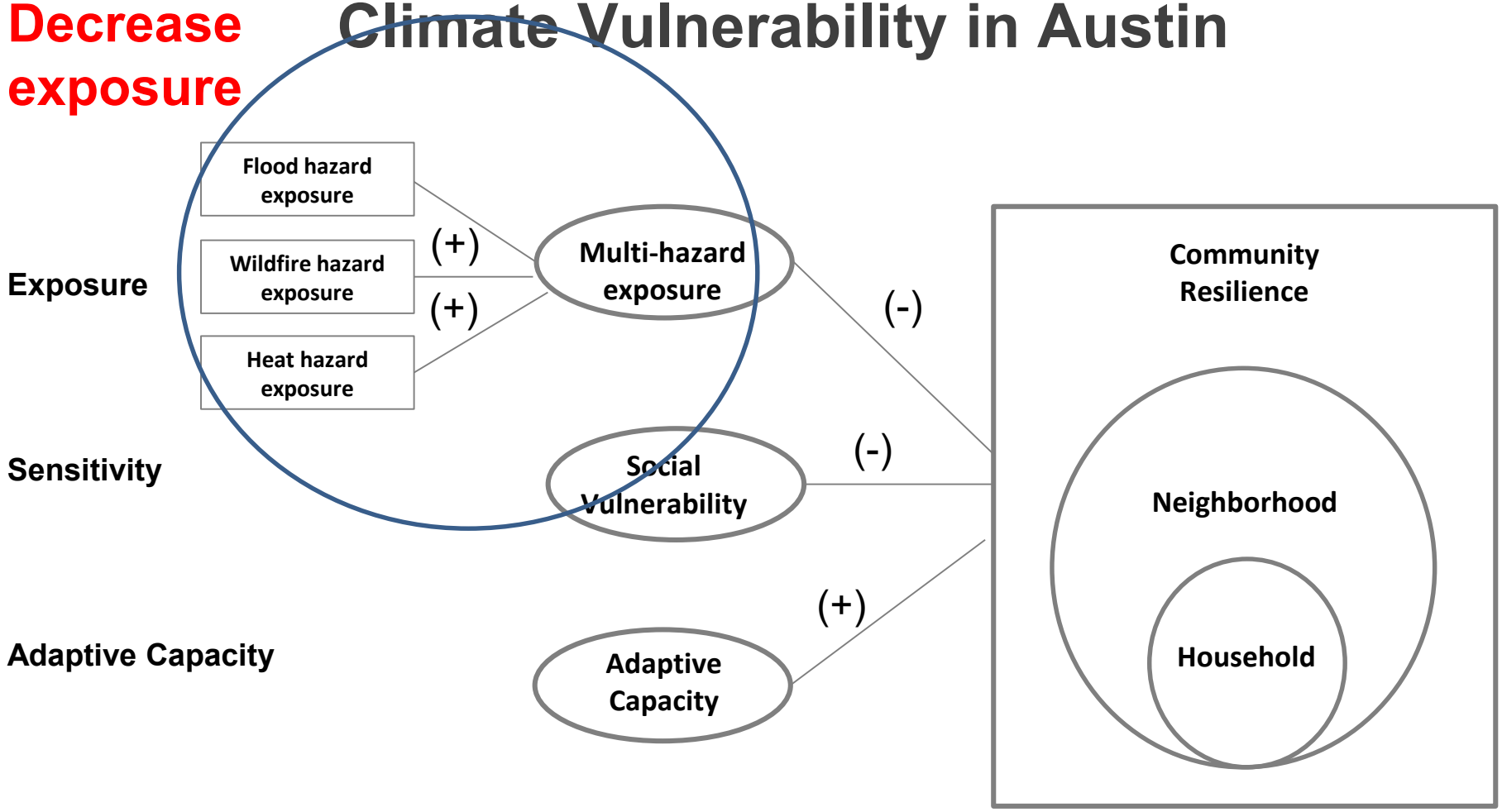


Climate Vulnerability in Austin



Climate Vulnerability in Austin

Decrease exposure



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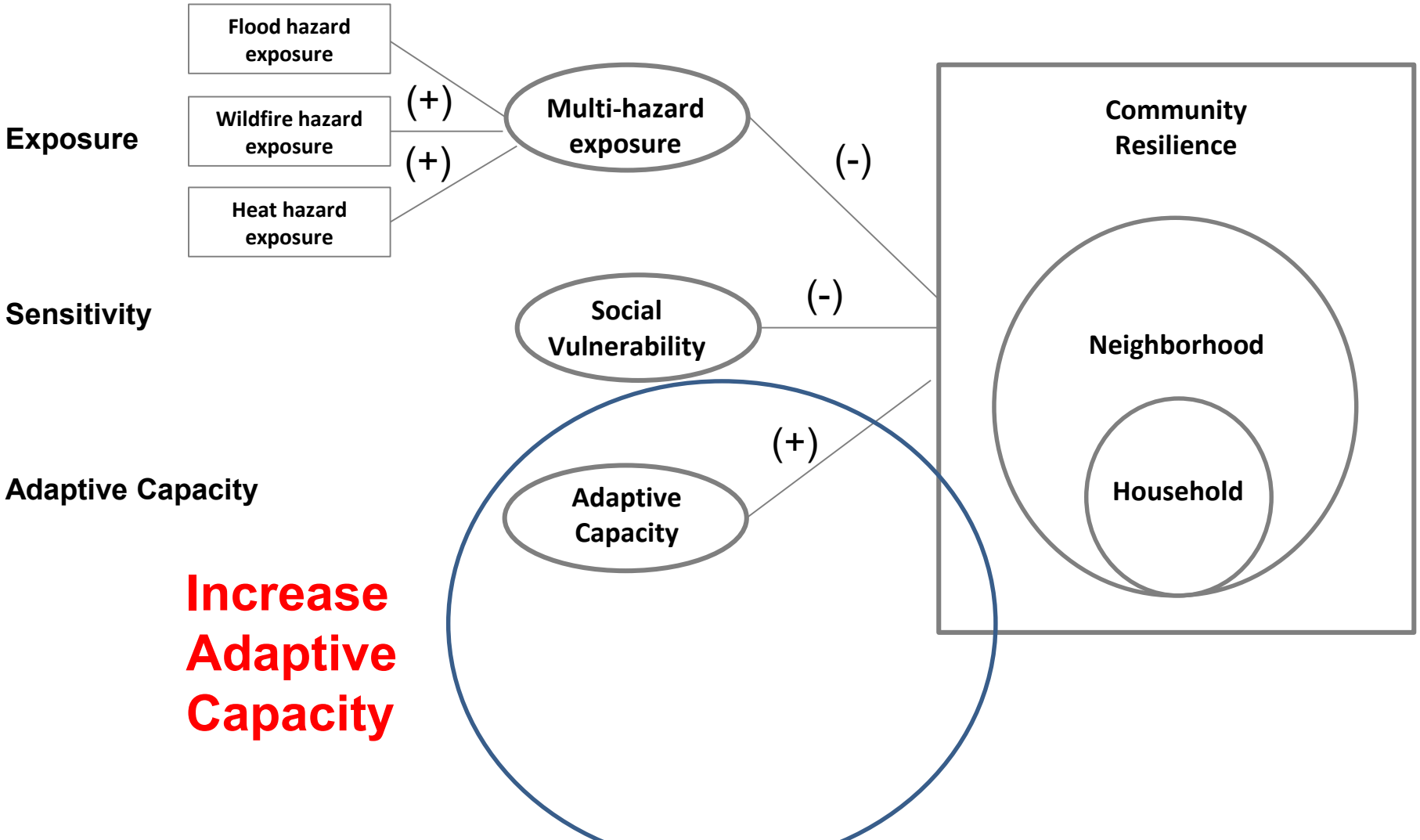

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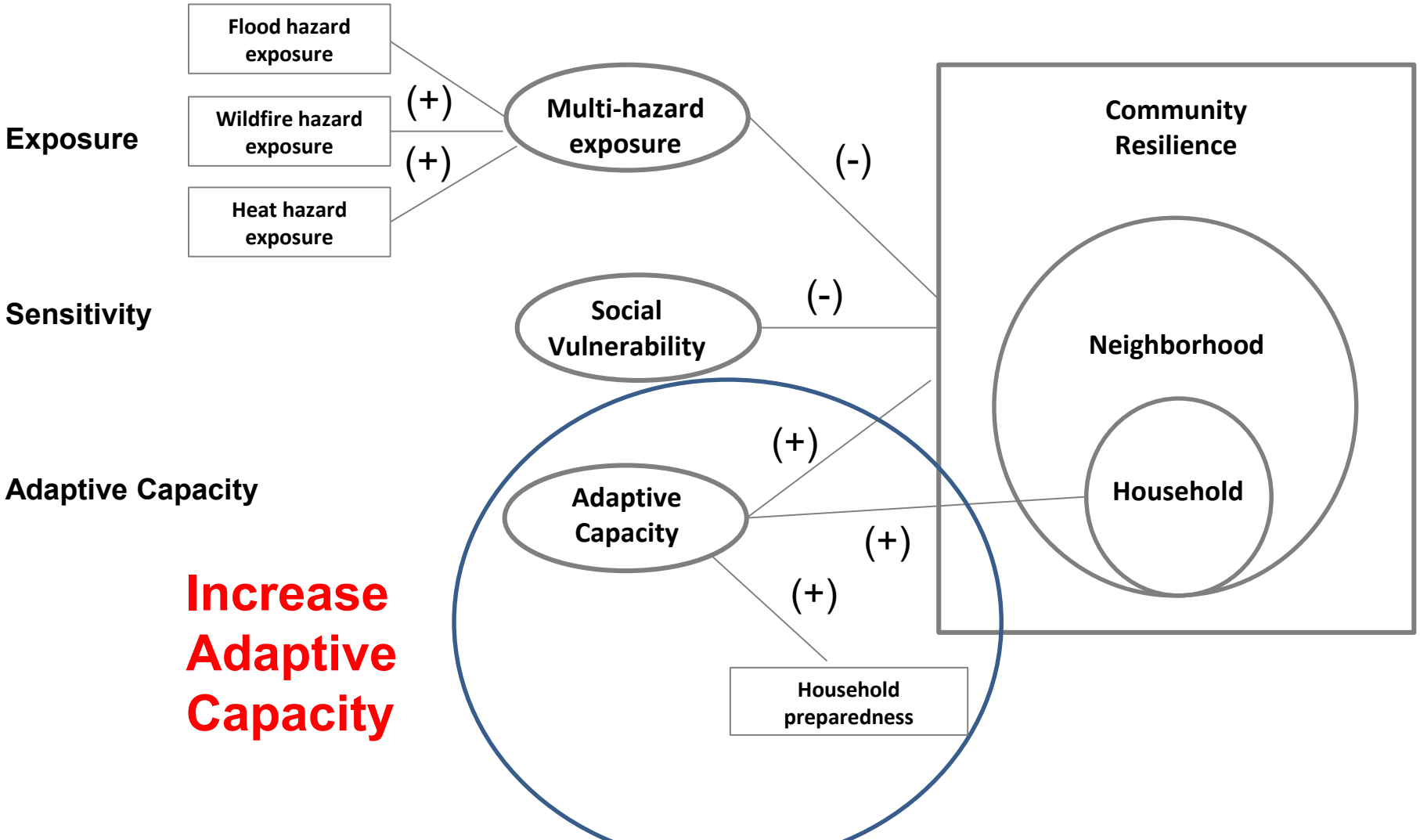

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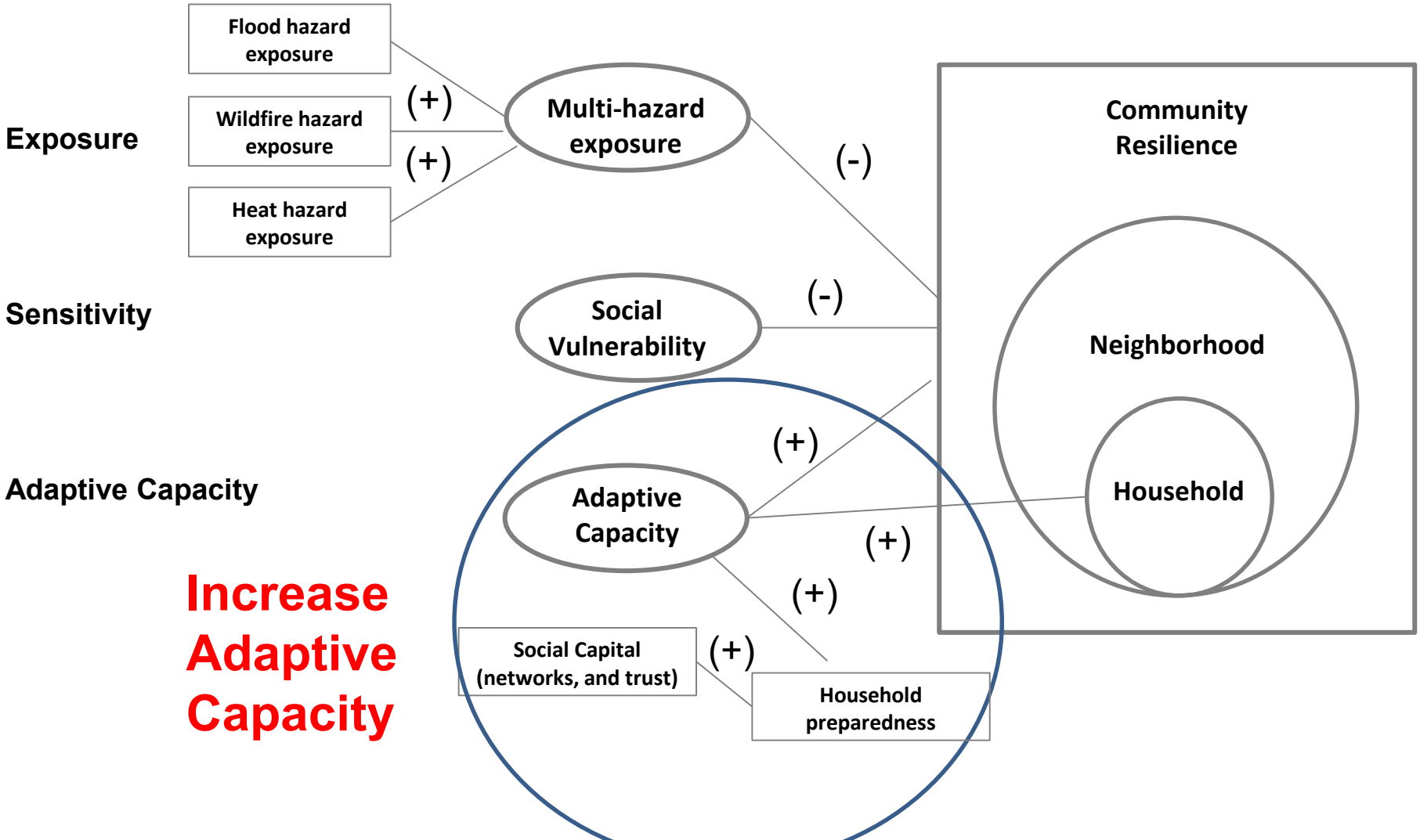

Questions & Feedback

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Works Cited

1. Bixler, R. Patrick, Katherine Lieberknecht, Fernanda Leite, Juliana Felkner, Michael Oden, Steven M. Richter, Samer Atshan, Alvaro Zilveti, and Rachel Thomas. 2019. "An Observatory Framework for Metropolitan Change: Understanding Urban Social–Ecological–Technical Systems in Texas and Beyond." *Sustainability* 11 (13): 3611. https://doi.org/10.3390/su11133611.

2. Cutter, Susan L., Bryan J. Boruff, and W. Lynn Shirley. 2003. "Social Vulnerability to Environmental Hazards*." *Social Science Quarterly* 84 (2): 242–61. https://doi.org/10.1111/1540-6237.8402002.

3. Hayhoe, Katharine. 2014. "Climate Change Projections for the City of Austin." ATMOS Research & Consulting.

Appendix

The Flood Vulnerability Score is calculated as follows:

$$Flood\ Risk\ Score\ for\ block\ group = \left(\sum_{\substack{within \\ Block\ Group}} FT_{Property} \right) * WeightValue$$

$$Weight\ Value = \frac{Area\ of\ floodplain\ within\ the\ block\ group}{Total\ Area\ of\ the\ block\ group}$$

Appendix

$$Wildfire\ Risk\ Score = f\begin{pmatrix} Probability\ of\ wildfire\ events, \\ Fire\ line\ intensity\ +\ Spotting\ distance \end{pmatrix}$$

Appendix

$$Heat\ Vulnerability\ for\ block\ group$$
$$= Imperviousneess - 0.1 * TreeCanopy$$

Appendix

The Composite Climate Vulnerability Index score was calculated as follows.

$$CVI_{Composite} = w_{flood} * CVI_{Flood} + w_{wildfire} * CVI_{Wildfire} + w_{urbanheat} * CVI_{UrbanHeat}$$

The w_{flood},$w_{wildfire}$, and $w_{urbanheat}$ indicate weight factors for each shock/stressor, which were all assumed to be 1, representing the equal importance across the three.