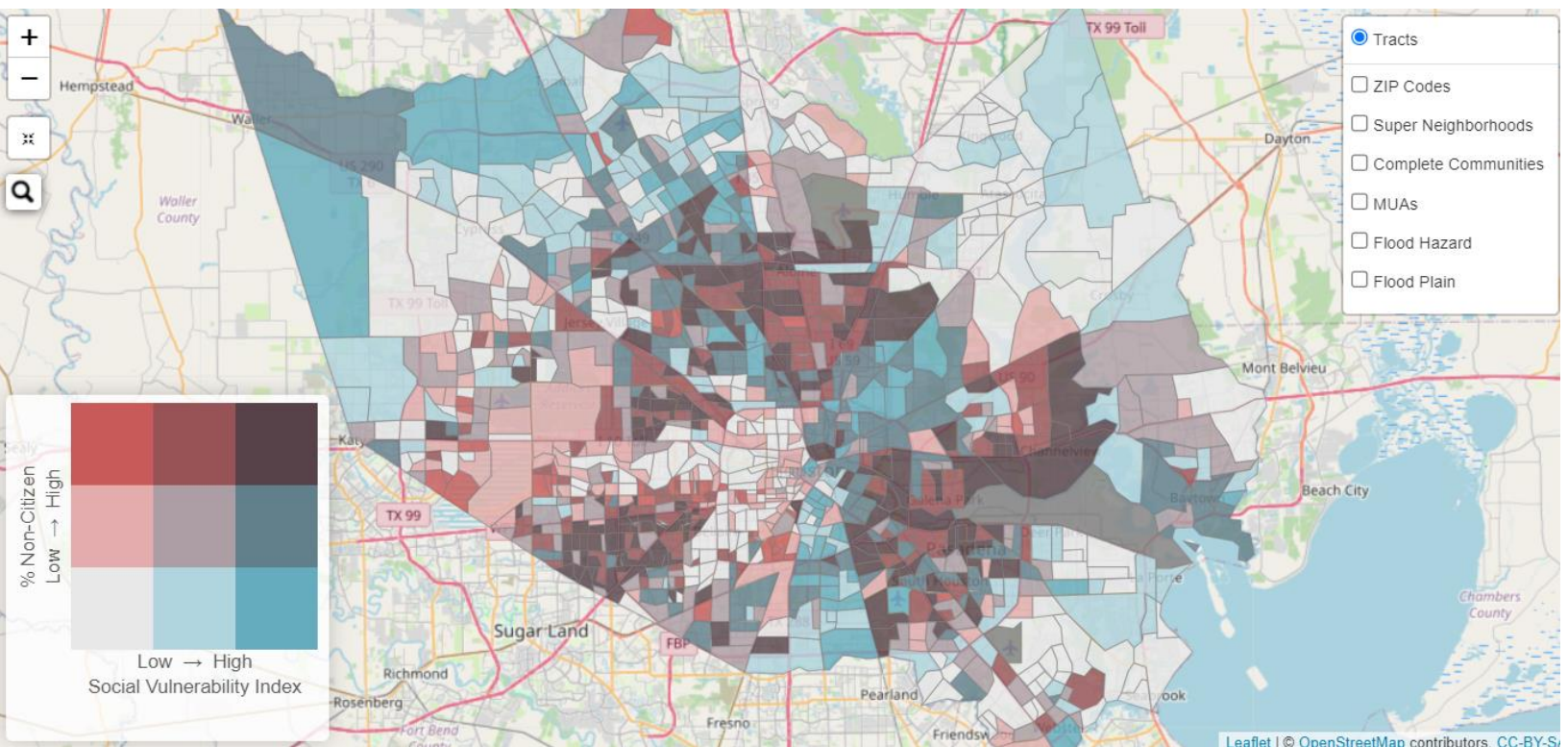


Houston VRAP Dashboard

Technical Documentation



Hobby School of Public Affairs
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Contents

Contents	ii
List of Figures	iii
1 Overview of Houston-VRAP	1
1.1 What is Houston-VRAP?	2
1.2 Relevance for Houston	3
2 Houston VRAP Definitions	4
2.1 What is Vulnerability?	4
2.2 What is Resiliency?	4
2.3 What is Adaptive capacity?	5
2.4 What is Preparedness?	5
3 Methods and data	6
3.1 Variables by topic	6
3.2 Boundaries of interest	7
4 Uses and applications of Houston VRAP	8
5 Limitations of Houston VRAP	12
6 FAQ	13
6.1 What is Houston VRAP dashboard?	13
6.2 Why is Houston VRAP dashboard different to other platforms?	13
6.3 What type of measures or indicators can I see in the dashboard?	13
6.4 What kind of geographies are shown in the Houston VRAP dashboard?	14
6.5 How should I cite Houston VRAP dashboard?	14
6.6 Who can I contact to get to request additional data or ask a question?	14
7 Appendix A: Codebook	15

List of Figures

1.1	VRAP framework	2
4.1	Percentage of home renters distributed in Harris' Zip codes	8
4.2	Description of census tract	9
4.3	Top tracts by variable selected	9
4.4	Neighborhoods with 0-risk factors and their proximity to flood zones (100 and 100 years floodplains)	9
4.5	Most vulnerable areas in Harris County without internet access	10
4.6	Description of a census tract	10
4.7	Top tracts by variable selected	10
4.8	Distribution of vulnerable minorities with high percentage of uninsured in Harris' MUAs	11
A1	VRAP data	15
A2	VRAP data	16

Overview of Houston-VRAP

Recent years witnessed continuous and unprecedented economic and social disruptions due to shocks such as extreme weather, power outages, economic hardship, and a global pandemic which have exposed the weaknesses in the country's sustainable infrastructure, including but not limited to emergency response systems, healthcare, supply chains for food and necessities, access to clean water, gas, electricity, and public services in general. These economic, social, and environmental disruptions have differential impacts on individuals and groups in our communities and have highlighted disparities in the underlying exposure to risk.

Many current indices of vulnerability are and constructed at the national level; at the community, however, these indices prove to be too broad or inapplicable to the local context and do not provide an executable picture of vulnerability across communities and their ability to respond to shocks. There is a need to look at a more complete picture and elements that are unique to each community.

The Hobby School of Public Affairs at the University of Houston has developed an online data dashboard to allow local leaders, policy makers, students, and the public to gain a better understanding of Houston's communities. One of the goals of this online tool is to highlight underserved areas and populations in the context of Vulnerability, Resiliency, Adaptability, and Preparedness (VRAP) for natural hazards.

After conducting projects in the Houston area for Hurricane Harvey, businesses, policy issues, and other relevant topics for Houston's neighborhoods, The Hobby school team has identified a need for a better identification of underserved and often, hard to reach communities. Due to the lack of more granular publicly available data, relying of various sources of information is key to characterize communities. This open-source tool aims to gather and combine some of the most relevant publicly available data sources for Houston with the objective of helping inform policy decisions, the proper allocation of resources, and the public.

As the dashboard evolves, more unique measures of Houston VRAP will be constructed for the dashboard.

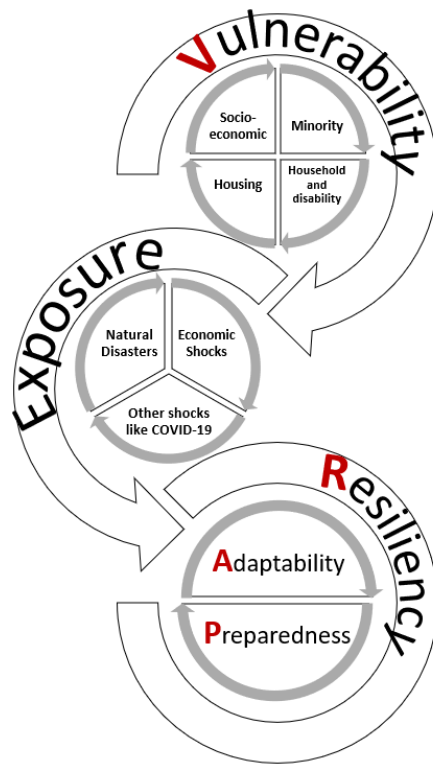
1.1 What is Houston-VRAP?

We call the Houston VRAP a set of indicators that help characterize Houston's communities and their specific vulnerabilities in the context of natural hazards or other shocks that Houston could face. Houston VRAP includes indicators for Vulnerability, Resiliency, Adaptability, and Preparedness. However, these concepts can have many dimensions and interpolate with other socio-economic and demographic conditions (e.g. income, education, ethnicity, housing characteristics).

Vulnerability, as characterized by the CDC, is understood as those social variables related to a household's socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. **Resiliency** refers to a household's **Adaptive capacity** after shocks and their capacity to go back to pre-shock conditions. As a household adapts it also generates strategies of **Preparedness** for future events, and for becoming more resilient.

Figure 1.1 shows how the main concepts within each Houston-VRAP element interconnect. A household's vulnerability level determines the level of exposure it has to external shock (e.g. natural disasters, economic shocks, among other). This level of exposure, given the vulnerability status, explains households' resiliency. A household is more resilient as it becomes able to adapt and go back to pre-shock conditions and as it develops strategies to prepare for future events.

Figure 1.1: VRAP framework



1.2 Relevance for Houston

For the case of Houston, Households have been heavily affected over the years by shocks such as natural disasters like flooding and hurricanes. Within this context, VRAP is relevant for the region as differences vulnerability levels, may lead to differential exposure to shocks and the need for different response strategies.

The development of the VRAP indices also allow us to identify further hard-to-reach populations who are traditionally underrepresented in public opinion surveys but who are also the most in need of policy intervention.

VRAP in Houston over time is important beyond academic research; it also helps inform public policy debates about the design and implementation of policy responses to shocks. This tool is also relevant from a normative standpoint: building more resilient cities demands public policies targeted at the most vulnerable neighborhoods and populations. In particular, policy responses should address inequities in opportunities and the persistent differences in access to resources which help mitigate the impact of natural disasters, environmental, health, and economic shocks.

Houston VRAP Definitions

In this section we define the VRAP concepts. We use definitions based on literature and publicly available measures. Based on these definitions we group the data available into indicators or indices for each VRAP concept: **Vulnerability**, **Resiliency**, **Adaptive capacity**, and **Preparedness**.

2.1 What is Vulnerability?

Vulnerability can have many dimensions: physical, social, human, ecological, political, etc. For VRAP we focus on Social Vulnerability as defined by the Centers for Disease Control and Prevention (CDC) [Social Vulnerability Index \(SVI\)](#). The SVI is widely used by policy makers and practitioners to make policy decisions and to understand pre and post disaster outcomes.

The SVI focuses on 16 social factors grouped into four dimensions to measure Social Vulnerability: household's socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. Each social factor comes from the Census Bureau's American Community Survey (ACS) estimates and ranked by geography. In the case of the Houston VRAP dashboard we use the SVI's census tracts data. The SVI ranking goes from 0 (lower vulnerability) to 1 (higher vulnerability).

At the local level, Harris county officials often use the SVI to make decisions or prioritize populations (distribution of COVID vaccines, Flood control projects, emergency food banks locations, etc.). Within this context, SVI provides some level of familiarity.

2.2 What is Resiliency?

While resiliency can have many definitions and measurements¹, we define it as the capacity a household has to adapt, to return pre-shock conditions, and to develop preparation strategies for future events.

As indicator of community resiliency, we use the Census Bureau's [Community Resilience Estimates \(CRE\)](#). The estimates are based on data from Census Bureau's the American Community Survey

¹Ibid. fn. ??

(ACS) microdata and Population Estimates Program at the tracts level ². The data is based on 10 risk factors that determine individual and household resiliency to disasters, which is in part explained by the community vulnerability. Poverty level, ability to speak English, and disabilities are examples of risk factors that impact resiliency, but also factors that define vulnerability. Resiliency is shown as a categorical measure of a community's risks for zero risks, one to two risks, or more than three risks.

Other indices have identified the number of registered voters at the local level as a good indicator of resilience ³ Being an active voter, reflects community engagement, social capital, as well as social and political trust building up community resiliency. The number of registered voters in Harris county is included in the Houston VRAP dashboard.

2.3 What is Adaptive capacity?

In Houston VRAP, Adaptive Capacity is defined as a household's capacity to adjust and cope after being affected by a natural disaster shock ⁴.

As an initial indicator of adaptive capacity, we include short term strategies that can potentially help households cope with the affects of natural disasters. These include having access to insurance and receiving FEMA funds. As the Houston-VRAP dashboard evolves, we plan to update this measure.

2.4 What is Preparedness?

We define Preparedness as the as the plans that households made in anticipation to natural hazards and other economic shocks. White it is hard to find global measures of preparedness at the community level, we include access to internet as an indicator of the capacity of individual to access emergency notifications and information on ways to prepare.

As the Houston VRAP dashboard evolves, we plan to add community measures of preparedness as well as results from Hobby School previous surveys that identify the ways in which Houstonians prepare for natural hazards.

²Data is also provided for the nation, states, and counties and for additional supplements like Heat index. For further explanation on their methods and technical documentation, visit: <https://www.census.gov/programs-surveys/community-resilience-estimates.html>

³Ibid. fn. ??; See also, CCDRI: Rifat, S. A. A., & Liu, W., 2020, [Measuring Community Disaster Resilience in the Conterminous Coastal United States](#). ISPRS International Journal of Geo-Information.

⁴Brooks, N., Adger, W. N., & Kelly, P. M. (2005). The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global environmental change*, 15(2), 151-163.

Methods and data

The Houston VRAP dashboard compiles publicly available data from different sources. The result is an user friendly interactive tool that allows the mapping and download of the data.

3.1 Variables by topic

We selected a list of 35 variables at the census tract level that are grouped into six different topics: Demographics (19 variables) Economic (5 variables), Housing characteristics (12 variables), Mobility (6 variables), Education (10 variables), and Health (2 variables). These variables can be either components of the VRAP measures or variables of interest for the Houston area. The dashboard displays the following groups of variables:

- **Demographic variables:** Total population, total number of households, population over 65, children (under 17), single parent households, minorities, English fluency, non citizens, not Hispanic, non Hispanic white, black, AIAN, Asian, HPI, Hispanic, Other racial categories, and two or more races.
- **Economic variables:** Median Household income, unemployment rate, persons under poverty line, percent unemployed, percapita income.
- **Housing variables:** Housing in structures with 10 or more units, Housing units, Mobile homes, Occupied housing units with more people than rooms Households with no vehicle available, Percentage of persons in group quarters, Average Cars owned by renters, Average Cars owned by home owners, Household size of home owners, Household size of renters, Owners, Renters, Price of electricity, rent burden
- **Mobility variables:** Use public transportation to job, Walk to job, Have lived in the same residence for the past 12 months, Moved from out of state in the past 12 months, Average number of cars, Price of electricity
- **Education variables:** Persons with high school education, Persons with GED education, Some college (<1yr), Some college (>1yr, no degree), Associate's degree, Bachelor's degree, Master's degree, Doctorate degree, No schooling completed, No high school diploma.
- **Health variables:** Percentage disabled, Percentage uninsured

These variables can be visualized either by themselves at the tract level or with another variables in bi-variate maps. These maps are displayed with a choropleth to identify the different levels for the two variables being mapped. The list of 35 variables can be compared to VRAP measures.

- **Vulnerability:** the dashboard shows five indices from the CDC-SVI at the tract level. These are the global measure of social vulnerability and each of its four components (household's socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation). These indices go from 0 (less vulnerable) to 1 (more vulnerable).
- **Resiliency:** the dashboard includes resiliency as the percentage of residents living with 0, 1-2, and 3 or more risk factors for the different census tracts in Harris County.
- **Adaptive Capacity:** as the dashboard evolves, measures of adaptive capacity will include access to insurance and applicants and recipients of FEMA emergency funds among other.
- **Preparedness:** as initial indicator the dashboard displays the percent of the population by tract with no internet access and percent with an internet subscription.

3.2 Boundaries of interest

In addition to visualizing bivariate maps, the Houston VRAP dashboard has 5 map layers that can be overlaid on top of census tracts. These layers are geographic boundaries for which the data is not aggregated but that identify areas of interest for the analysis of Houston's most vulnerable communities. These layers are:

1. Medically Underserved Areas (MUAs): these are designated census tracts with a shortage of health care services as defined by the [Health Resources & Services Administration \(HRSA\)](#)
2. ZCTAs: are Census Bureau's generalized areal representations of United States Postal Service (USPS) ZIP Code service areas that the Census Bureau references as [ZCTAs](#)
3. Flood Hazard layer (100-year and 500-year)¹: layers designated by the Federal Emergency Management Agency (FEMA) for [floodplain](#) areas that are at risk for flooding during a 1 percent (100-year) or a 0.2 percent (500-year) flood in a given year.
4. Super neighborhoods: this layer has the boundary of the 88 [Super Neighborhoods](#) in the City of Houston each of which has a council to address the need and issues of the community.
5. Houston complete communities: are designated borders for 10 historically under-resourced neighborhoods of the City of Houston. [Complete Communities](#) are an initiative by The Mayor's Office to revitalize and create more equitable neighborhoods.

¹ See The Harris County Flood Control District's [Flood Education Mapping Tool](#) for additional information

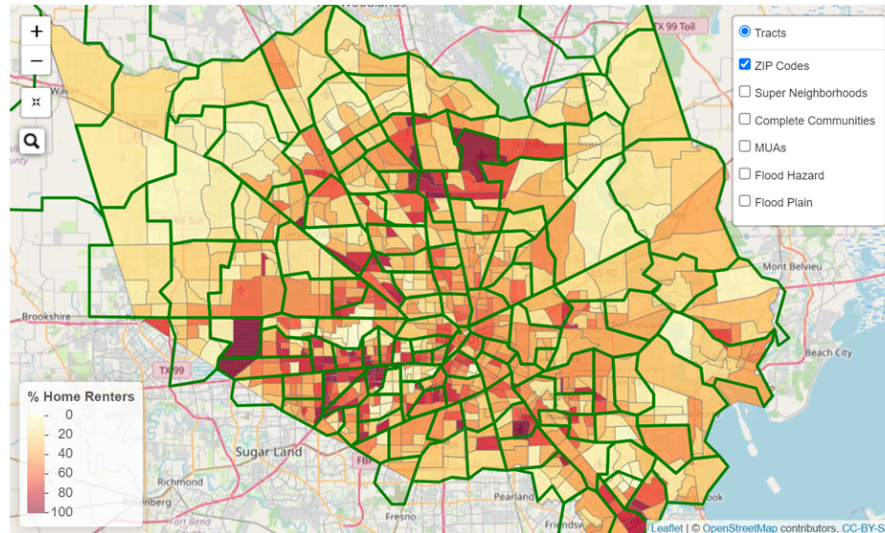
Uses and applications of Houston VRAP

In this section we provide examples of the Houston VRAP dashboard capabilities. We advice to analyze results with caution¹.

Single variable maps

Figure 4.1 shows an example of a single variable map with the percentage of home renters by census tract. On top of the layer the Zip codes boundaries are shown in green.

Figure 4.1: Percentage of home renters distributed in Harris' Zip codes



When the different areas are highlighted, a pop up window appears (Figure 4.2) with the information of each tract (4544): Zip code where it is located (77094), super neighborhood (Eldridge/West oaks), and value of the variable selected(100% of the households are home renters). The bottom of the dashboard also shows a bargraph (Figure 4.3) of the top ten tracts with the highest values of the variable selected.

¹ Please, refer to the limitations of the Houston VRAP dashboard in section 5 of this document

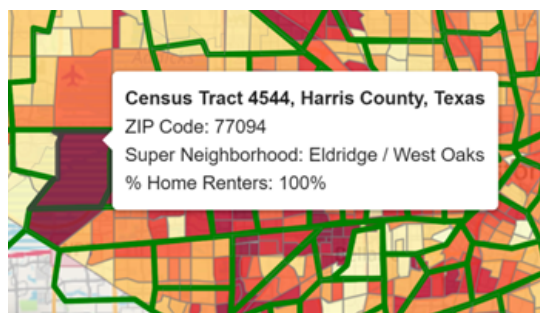


Figure 4.2: Description of census tract

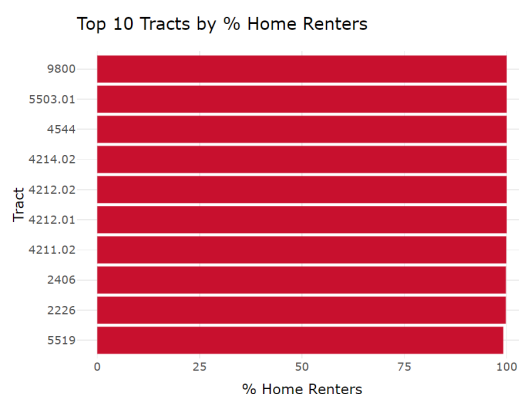
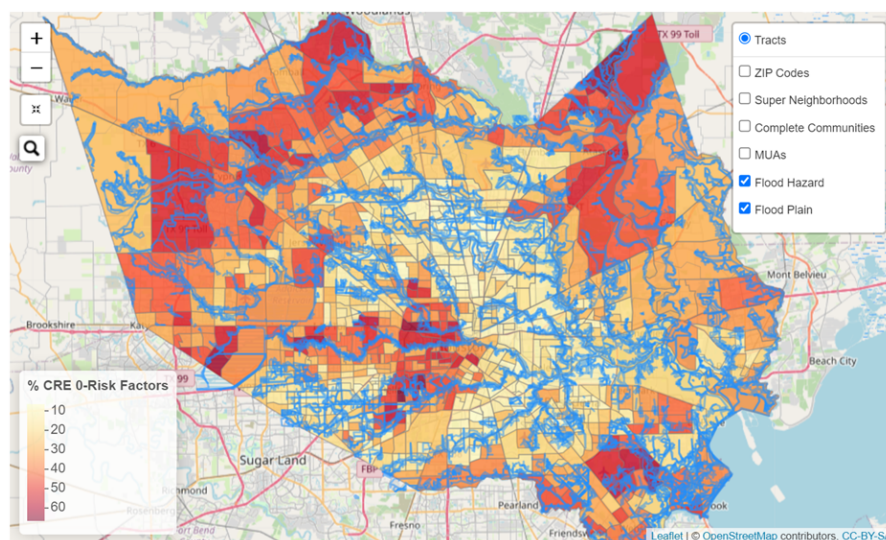


Figure 4.3: Top tracts by variable selected

Figure 4.4: Neighborhoods with 0-risk factors and their proximity to flood zones (100 and 100 years floodplains)



Another example of a one variable Figure 4.4 is a map of the census tracts that have 0-risk factors (as defined by the Census Bureau's CRE) with the 100 and 500 year flood plains overlaid.

Bivariate maps

The dashboard can also generate maps of two variables. The example below (Figure 4.5) shows a map with social vulnerability and percent of households without internet access in Harris' census tracts. As in single variable maps, the areas of interest can be highlighted to see additional information (Figure 4.6 and Figure 4.7).

Figure 4.5: Most vulnerable areas in Harris County without internet access

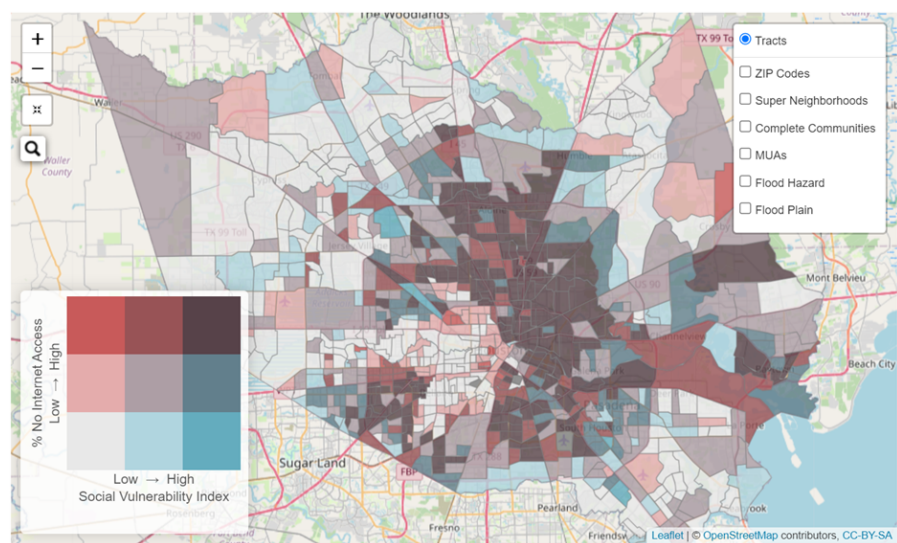


Figure 4.6: Description of a census tract

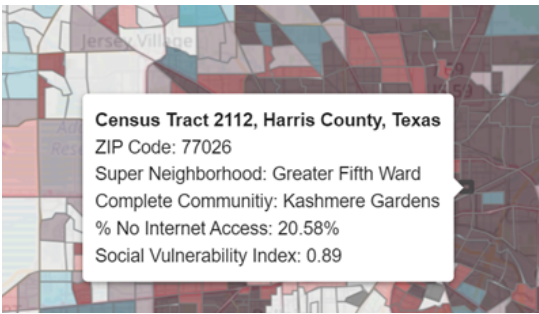
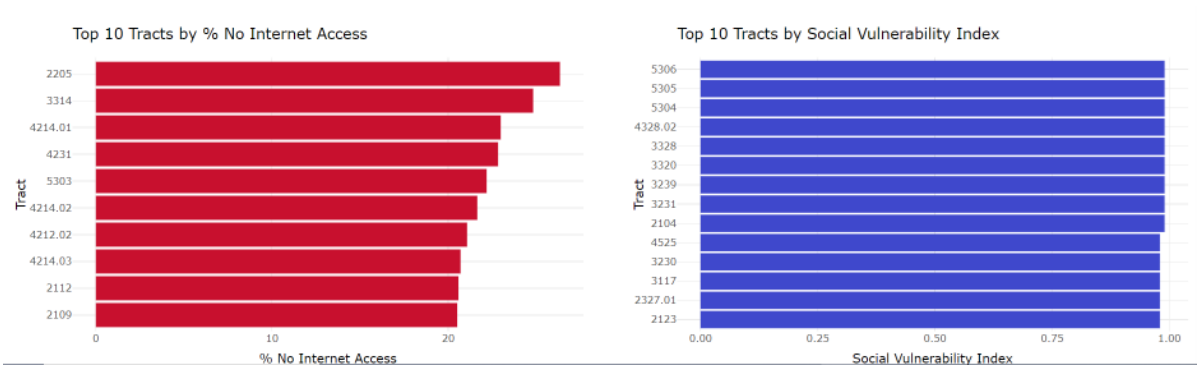
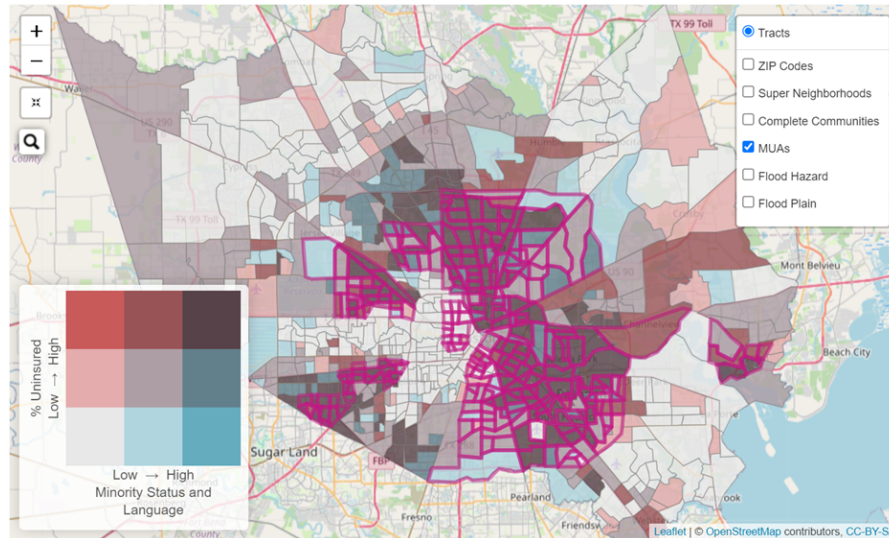


Figure 4.7: Top tracts by variable selected



The dashboard can also generate bivariate maps with overlays of areas or boundaries of interest. An example of this in Figure 4.8. It shows a map of the census tracts with minority status and language vulnerability (as defined by the CDC-SVI) and highlights those tracts that are MUAs.

Figure 4.8: Distribution of vulnerable minorities with high percentage of uninsured in Harris' MUAs



Limitations of Houston VRAP

The Houston VRAP dashboard was created to analyze local characteristics of the population and capture elements and geographies that are unique to Houston. These nuances may or may not necessarily be captured by the data and visualization methods offered by the dashboard. Each variable mapped and each combination of variables may yield different results so we advice to conduct further analysis, read the dashboard technical documentation, and download the data dictionary.

The dashboard variables come from different sources cited in this document, we advice to refer to those for further explanation on the methodology.

FAQ

6.1 What is Houston VRAP dashboard?

The Houston VRAP dashboard is an integrated spatial data set from different sources that facilitate the understanding of socioeconomic and demographic characteristics of Houston's communities. The goal is to make data available for local leaders, policy makers, and the public in general to assess communities specifically in the context of Vulnerability, Resiliency, Adaptability, and Preparedness (VRAP). We aim to inform policy decisions, community planning, students, and other stakeholders. We also provide additional documentation to understand data sources, concepts, definitions and other relevant information on the dashboard.

6.2 Why is Houston VRAP dashboard different to other platforms?

Houston VRAP dashboard integrates various publicly available data sources (e.g. Census data) that can be mapped simultaneously or independently. These variables have been identified as relevant for Houston after research conducted by the Hobby School in previous years (Please go [here](#) to learn more about the Hobby School work. Our team of researchers have also incorporated measures calculated specifically for the Houston VRAP dashboard that may provide more information on Houston's communities.

6.3 What type of measures or indicators can I see in the dashboard?

Indicators on several socioeconomic and demographic characteristics including education, health, demographics, and mobility (Please see the full list and codebook [here](#)). Additionally, measures in the context of natural hazards on Vulnerability, Resiliency, Adaptability, and Preparedness are also included.

6.4 What kind of geographies are shown in the Houston VRAP dashboard?

While most of the data is gathered at the census tract data level (add link to census data geographies), the dashboard allows the option of overlaying other geographies such as ZIP codes and complete communities.

6.5 How should I cite Houston VRAP dashboard?

Please, use the following citation: 'Houston VRAP dashboard, Hobby School of Public Affairs, Version 1.0'

6.6 Who can I contact to get to request additional data or ask a question?

If you have any questions, data requests, or issues with the Houston VRAP dashboard , please send us an email to: mpperez@central.uh.edu or gjbuttor@central.uh.edu

Appendix A: Codebook

For more details on the data codebook, please go to data dictionary in the data tab of the dashboard.

Figure A1: VRAP data

Indicator/topic	Label	Description	Source	Year(s)
Demographic	Total population	Population estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Total Households	Households estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Elder (over 65 years)	Percentage of persons aged 65 and older estimate, 2016-2020 ACS	CDC-SVI	2018, 2020
	Children (under 17 years)	Percentage of persons aged 17 and younger estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Single parent households	Percentage of single-parent households with children under 18 estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Minorities	Percentage minority (non-white etno racial categories) estimate, 2016-2020 ACS	CDC-SVI	2018, 2020
	Persons (age 5+) who speak English "less than well"	Percentage of persons (age 5+) who speak English "less than well" estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Noncitizens	Percentage of non-U.S. citizens, estimate	ACS	2018, 2020
	Non Hispanic	Percentage of non-Hispanic or Latino, estimate	ACS	2018, 2020
	White non Hispanic	Percentage of White, not Hispanic or Latino estimate	ACS	2018, 2020
	Black non Hispanic	Percentage of Black, not Hispanic or Latino estimate	ACS	2018, 2020
	AIAN non Hispanic	Percentage of American Indian or Alaska Native, not Hispanic or Latino estimate	ACS	2018, 2020
	Asian non Hispanic	Percentage of Asian, not Hispanic or Latino estimate	ACS	2018, 2020
	HPI non Hispanic	Percentage of Hawaiian or Pacific Islander, not Hispanic or Latino estimate	ACS	2018, 2020
	Hispanic	Percentage of Hispanic or Latino estimate	ACS	2018, 2020
	Other	Percentage of other race, estimate	ACS	2018, 2020
	Two races	Percentage of two or more races, estimate	ACS	2018, 2020
	Two races	Percentage of two or more races, estimate	ACS	2018, 2020
	Two races	Percentage of two or more races, estimate	ACS	2018, 2020
Economic	Median Income	Median income in the past 12 months, estimate	ACS	2018, 2020
	Unemployment rate	Civilian (age 16+) unemployed estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Persons under poverty line	Percentage of persons below poverty line estimate	CDC-SVI	2018, 2020
	Unemployment rate	Unemployment Rate estimate	CDC-SVI	2018, 2020
	Per capita Income	Per capita income in the past 12 months, estimate	CDC-SVI	2018, 2020
	Housing units	Percentage of housing in structures with 10 or more units estimate	CDC-SVI	2018, 2020
Housing	Housing in structures with 10 or more units	Percentage of housing in structures with 10 or more units estimate	CDC-SVI	2018, 2020
	Mobile homes	Housing units estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020
	Mobile homes	Percentage of mobile homes estimate	CDC-SVI	2018, 2020
	Occupied housing units with more people than rooms	Percentage of occupied housing units with more people than rooms estimate	CDC-SVI	2018, 2020
	Households with no vehicle available	Percentage of households with no vehicle available estimate	CDC-SVI	2018, 2020
	Percentage of persons in group quarters	Percentage of persons in group quarters estimate, 2016-2020 ACS	CDC-SVI	2018, 2020
	Average Cars owned by renters	Average total number of cars owned by renters, estimate	ACS	2018, 2020
	Average Cars owned by home owners	Average total number of cars owned by home owners, estimate	ACS	2018, 2020
	Household size of home owners	Average number of people that live in the household for homeowners, estimate	ACS	2018, 2020
	Household size of renters	Average number of people that live in the household for renters, estimate	ACS	2018, 2020
Mobility	Owners	Percentage of owners, estimate	ACS	2018, 2020
	Renters	Percentage of renters, estimate	ACS	2018, 2020
	Use public transportation to job	Percentage of people that use public transportation to job, estimate	ACS	2018, 2020
	Walk to job	Percentage of people that walk to job, estimate	ACS	2018, 2020
	Have lived in the same residence for the past 12 months	Percentage of people that have lived in the same residence for the past 12 months, estimate	ACS	2018, 2020
	Moved from out of state in the past 12 months	Percentage of people that moved from out of state in the past 12 months, estimate	ACS	2018, 2020
Education	Average number of cars	Average total number of cars, estimate	ACS	2018, 2020
	Price of electricity	Avera price of montly cost of electricity	ACS	2021
	Persons with high school education	Percentage of people with high school education estimate	ACS	2018, 2020
	Persons with GED education	Percentage of people with a GED education, estimate	ACS	2018, 2020
	Some college (<1yr)	Percentage of people with a some college education (<1 year), estimate	ACS	2018, 2020
	Some college (>1yr, no degree)	Percentage of people with a some college education (>1 year, but no degree), estimate	ACS	2018, 2020
	Associate's degree	Percentage of people with an Associate's degree, estimate	ACS	2018, 2020
	Bachelor's degree	Percentage of people with an Bachelor's degree, estimate	ACS	2018, 2020
	Master's degree	Percentage of people with an Master's degree, estimate	ACS	2018, 2020
	Doctorate degree	Percentage of people with an Doctorate degree, estimate	ACS	2018, 2020
	No schooling completed	Percentage of people with no schooling completed, estimate	ACS	2018, 2020
	No high school diploma	Percentage of people with no high school diploma, estimate	ACS	2020
Health	Percentage disabled	Percentage of civilian noninstitutionalized population with a disability estimate, 2016-2020 ACS	CDC-SVI	2018, 2020
	Percentage uninsured	Percentage uninsured in the total civilian noninstitutionalized population estimate, 2016- 2020 ACS	CDC-SVI	2018, 2020

Figure A2: VRAP data

Indicator/topic	Label	Description	Source	Year(s)
V	Socioeconomic Status	Percentile ranking for Socioeconomic Status theme summary	CDC-SVI	2018, 2020
	Household composition & Disability	Percentile ranking for Household Characteristics theme summary	CDC-SVI	2018, 2020
	Minority Status & Language	Percentile ranking for Racial and Ethnic Minority	CDC-SVI	2018, 2020
	Housing Type & Transportation	Percentile ranking for Housing Type/ Transportation theme	CDC-SVI	2018, 2020
	SVI -2020	Overall percentile ranking	CDC-SVI	2018, 2020
R	CRE 0-risk factors	Community Resilience Estimates, 0 risk factors, Low risk, percent	Census CRI	2018
	CRE 1or2-risk factors	Community Resilience Estimates, 1 to 2 risk factors, Medium risk, percent	Census CRI	2018
	CRE 3-risk factors	Community Resilience Estimates, 3 or more risk factors, High risk, percent	Census CRI	2018
	Registered voters	Registered voters as percent of the population		
A				
P	Percentage with no internet access	Percentage without internet access, estimate	ACS	2018, 2020
	Percentage with internet subscription	Percentage with internet subscription, estimate	ACS	2018, 2020
Other layers	Medically Underserved Areas	Health Resources & Services Administration designated census tracts with a shortage of health care services	HRSA	2023
	ZIP Code Tabulation Areas (ZCTAs)	Census Bureau generalized areal representations of United States Postal Service (USPS) ZIP Code service areas	ACS	2023
	National Flood Hazard Layer(100 and 500 year)	FEMA layer designating current effective flood hazard	FEMA	2023
	Super neighborhoods	Designates borders of the 88 Super Neighborhoods of the City of Houston	The City of Houston	2023
		Designates the borders for the 10 historically under-resourced neighborhoods of the		
	Houston Complete Communities	Complete Communities in Houston	Houston complete communities	2023