PLANET TEXAS 2050
A UT Grand Challenge

Final Report, FY20 Projects

Project Title: Transportation Related Air Pollution (TRAP)

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Project Team

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Project period: September 1, 2019 through February 28, 2021 (extended from August 31, 2020 due to COVID-19)

Section 1. Project description + top few results and findings.

This project explored the relationships between transportation and community resilience, TRAP, and health through data collection, integration and modeling. The goals of the research project included:

- Generate a dataset that integrates multiple data types on a common geographic area to support the proposed cross-disciplinary research and provide intuitive and efficient access to available data. Researchers used the DataX data repository as a place to centrally located datasets. A data dictionary of datasets used in the project hackathon (many of which were staged in DataX) was prepared in advance of the hackathon and provided to participants. CTR maintains the staged datasets in DataX, the PostgreSQL DB and UT Box shared folder.
- Develop a better understanding of the complex relationships between TRAP, community resilience, the transportation system, and health. The Hackathon event resulted in a series of project ideas and presentations made on the day of the event. These presentations have been saved in the DataX TRAP project folder along with all code and working products. In addition, low-cost sensors are being studied as a valid possibility for determining epidemiologically significant variances of PM2.5 in an urban area. Local sensors were installed in SE Austin and are still collecting data for future analyses.
- Explore the suitability of existing planning tools to estimate the impacts of transportation and urbanization on TRAP and health, propose and implement extensions as time permits. The original plan for the final project phase involved further promoting the use of the data collected for the hackathon through "Data Analysis Sprints" and conducting workshops to identify future funding opportunities. We determined that further analyzing available data was more productive than virtual Data Sprints given constraints related to COVID-19. We explored the impacts of COVID on traffic and related air pollution. Findings suggest a noticeable impact on traffic but not a clear pattern in terms of air pollution.

- Engage the UT community and relevant Austin stakeholders in the identification of meaningful research outcomes, further data needs, and future research directions. The February 29, 2020, project hackathon was a successful event that promoted the use of the prepared datasets while engaging the UT community and other Austin stakeholders. Participants were provided samples of datasets from a variety of sources and access to air quality sensors and computational resources for use in responding to one or more of a series of project prompts. The hackathon was also an opportunity to collect input from participants concerning the project vision and products, desirable research directions, data needs, and potential partnerships. The feedback collected from the hackathon informed the long-term project vision and the pursuit of funding opportunities.

Section 2. Final status of activities and outputs

ACTIVITY	DESCRIPTION
Task 1. Identify and Prepare Data	The project team explored data sources to inform research on the relationship between transportation-related air pollution (TRAP), urbanization and health, and identified 12 candidates for inclusion in a prototype data-sharing environment. The datasets include transportation, environmental, and socio-demographic information. Initial datasets were selected considering their value for the proposed research and the feasibility of obtaining samples to support exploratory analyses. Researchers also identified five health data sets; due to accessing and sharing restrictions, most health data was not integrated into the initial data-sharing framework. A sample aggregated dataset generated through Data Core was prepared and shared for the Hackathon event. Other health datasets considered include Texas Healthcare Information Collective (THCIC), Data Core from the Dell Medical School, Medical Access Plan (MAP) from Travis County Central Health, Center for Healthcare Data (CHCD) and National Emergency Medical Services Information System (NEMSIS).
Output 1.1:	List of datasets that may inform research on the relationship between TRAP, urbanization and health.
Task 2. Integrate Data	In efforts to support the Planet Texas 2050 initiative, the Texas Advanced Computing Center (TACC) developed a collaborative data analytics platform, DataX. To access DataX and its capabilities, an interested party must first create a TACC ID to access a DataX allocation through the DataX portal. Data files are stored in a project repository, which may be shared among collaborators within DataX, and used in programs run through the system. Several tools in DataX help create visualization and data analysis workflows that can be shared among collaborators. These tools include a QGIS application for mapping geospatial data, a Jupyter Notebook tool for processing, visualizing and analyzing data as well as a WINGS workflow launcher. Within DataX, the TRAP project repository is organized in directories by data type: micro-mobility data, traffic data, transit data, air pollution and weather data as well as socio-demographic data. Each directory contains a README HTML file that describes the data files stored and data table definitions. Figure 1 in Section 8 of this report outlines the TRAP DataX repository structure. The data contained in the micro-mobility data directory is dockless (scooter) data from the City of Austin. The traffic data directory includes Bluetooth, Wavetronix and GRIDSMART data. The transit data directory stores GTFS, APC and AVL data. In the air and weather directory, air station and mobile-monitoring data as well as weather station data is placed. Lastly, the socio-demographic directory consists of LODES and CTPP data.

Output 2.1:	Planning and documentation of pre-processing workflows.
Task 3. Additional Data Analysis and Visualization Tools	Apart from the TRAP data repository within DataX, CTR maintains a database with the aforementioned data so that it can be accessed directly (provided an individual has the correct credentials). An open-source visualization platform, Apache Superset, is also tied to the database for data access and visualization. Tests performed with Apache Superset evaluated the tool's capabilities, ease of use and limitations. It is an innovative and impactful platform to place above a database to query and create informative plots and dashboards that can be shared among collaborators. These capabilities are similar to the proprietary software Tableau. Nonetheless, Apache Superset has greater ability to be customized and support various types of charts, including geospatial maps. Knowledge of basic SQL and JavaScript enhances the user's ability to create and customize plots and maps. For the next fiscal year, CTR plans to deploy an Apache Superset instance with access to the existing database framework. DataX, and other collaborative and visualizing tools, are imperative to research the relationship between TRAP, urbanization and health. Because of the interdisciplinary nature of the research, the collaborative aspects and powerful analytic tools within these platforms facilitate research insights. In turn, research insights, and subsequent actionable initiatives, inform community members on the issues that affect them now and in the future, leading to robust and empowered communities.
Output 3.1:	Data Repository and Tools. Data was staged in DataX and a relational database, and Apache Superset was tested as a potential tool to facilitate data visualization. The Data X repository can be accessed with proper credentials, and access instructions have been provided to all TRAP team members. Credentials for accessing the relational database can be provided upon request.
Task 4. Internal Team Workshop	An internal team workshop was held on July 26, 2019 to discuss the status of staged datasets and brainstorm about interdisciplinary research topics that could make use of these datasets. Meeting minutes were provided in a separate document, along with a copy of the PowerPoint presentation presented to the group.
Output 4.1:	Workshop meeting minutes and presentation materials.
Task 5. TRAP Data Analysis and Continued Research	Researchers explored the value of air pollution data collected by mobile sensors (Google car) in assessing the spatial variation of congestion within Austin. Data analyses showed interesting trends, although spatial aggregation was necessary in order to derive meaningful metrics. A second line of work involves investigating the use of low-cost sensors as an approach for assessing exposure to PM2.5 in an urban environment. As part of this effort, the research team deployed low-cost sensors in Dove Springs (Austin), enlarging an existing network of sensors that provide open access to the air pollution data collected on a continuous basis. In order to evaluate the performance of low-cost sensors, researchers also started measuring PM2.5 in a city in India, where pollution is higher than in Austin and sensors must be accurate for a wider range of conditions. Since the pandemic began, we have had problems with keeping our sensors online, however, we have plenty of data to look at before the sensors started going offline. There was a plan to go back to India this summer to do some post campaign calibration, but we are looking at utilizing our colleagues in India to accomplish that this fall. The Austin sensors are still in place and collecting data. The original plan for the final project phase involved further promoting the use of the data collected for the hackathon through "Data Analysis Sprints" and conducting workshops to identify future funding opportunities. We determined further analyzing available data was more productive than virtual Data Sprints given constraints related to COVID-19. We explored the impacts of COVID on traffic and related air pollution. Findings suggested a noticeable impact on traffic but not a clear pattern in terms of air pollution. The work continues to understand and explain these findings.

	We also worked on examining environmental justice of TRAP related pollutants using an LUR model created by CACES. Looking at these concentrations and demographic information for Texas, it is found that minoritized populations have a higher average exposure to TRAP than dominant populations. These findings have been submitted for presentation at a conference.
Output 5.1:	A draft journal article on sensor PM2.5 data analysis is expected by summer 2021.
Output 5.2:	TRAP data sample in DataX and deployed purple air sensors which continue to generate data.
Output 5.3:	Technical Memorandum: "COVID & TRAP study report"
Task 6. Data collection and integration with existing collaboration tools.	The TRAP dataset was collected for this project. In addition, researchers collected pollution and environmental data by installing PurpleAir sensors in the Dove Springs neighborhood, in advance of the project hackathon on 2/29/2020. We also collaborated with Dell Medical School to obtain health datasets through the DataCore data hub. We have compiled data for health, transportation, weather, and pollution, and staged many of the datasets on the PT 2050 data analytics platform, DataX. This data will be accessed by hackathon participants.
Output 6.1: DataX data repository	Researchers have used the DataX data repository as a place to centrally located datasets. The data dictionary of datasets used in the project hackathon and staged in DataX are contained in the Data Dictionary table in Section 8 of this report.
Output 6.2: DataCore platform	The datasets were requested and obtained from DataCore and staged on the DataX platform. See the Data Dictionary table in Section 8 of this report.
Task 7. Faculty/Stakeholder meetings	Researchers held a series of meetings with participating faculty, researchers and community stakeholders. The goal of these meetings was to collectively identify critical research questions that may be addressed using the data collected during Year 1, additional research directions based on preliminary findings, and needs for additional data. The meetings also informed the selection of a meaningful theme for the Hackathon (Task 8), as well as the identification of funding alternatives to support the project vision beyond 2020.
Output 7.1: Meeting with TRAP and pollution sensor faculty and researchers	TRAP researchers met with Drs. Josh Apte and Zoltan Nagy in November 2019 to understand data collection challenges and identify critical research questions. These discussions were useful in planning the hackathon event.
Output 7.2: Meeting with health faculty and researchers	TRAP researchers conducted a series of meetings with members of the Dell Medical School to better understand critical research questions and datasets needed. We attended and presented at the November 2019 CHEER meeting to solicit faculty input on research direction and the hackathon.
Output 7.3: Meeting with community stakeholders – City of Austin and GAVA	TRAP researchers met with the City of Austin and GoAustinVamosAustin representatives in December 2019, to gain a better understanding of community resiliency issues in the Dove Springs neighborhood. This meeting and subsequent follow-up conversations informed the theme of the hackathon and the PurpleAir pollution sensor data collection plan.
Task 8. Hackathon – Hack for Resilient Communities: Transportation, Pollution, Weather & Health	The project hackathon was conducted on 2/29/2020. Participants designed and implemented projects to explore the relationships between weather, health, air pollution, and transportation. Projects developed during the Hackathon as listed in Section 8 of this report. The goal was to understand how these factors affect the well-being of a community in order to support policy development and technical decision making. Speakers from the City of Austin, the Dell Medical School, GAVA, and the Cockrell School of Engineering introduced the topic. Samples of datasets from a variety of sources were provided, in addition to access to air quality sensors and computational resources.
Output 8.1:	Project descriptions, source code, and presentation materials, saved in the DataX TRAP project folder.
Output 8.2:	Hackathon Follow-Up Report submitted March 2020.

Section 3. In a nutshell (Elevator pitch / cocktail party explanation)

The Transportation Related Air Pollution (TRAP) project explored the relationships between transportation and community resilience, TRAP, and health through data collection, integration and modeling. Researchers collected air pollution data using mobile sensors and low-cost sensors, some of which were deployed specifically for this project. We generated a dataset that integrates multiple data types on a common geographic area to support cross-disciplinary research and provide intuitive and efficient access to available data via DataX. A Hackathon event engaged the UT community and encouraged students to explore the data, resulting in a series of project ideas and presentations made on the day of the event. Research supported by this project explored the challenges of using data collected from mobile sensors to understand the impacts of TRAP on health, the feasibility of using the project dataset to understand the impact of COVID-19 on air pollution and traffic, and the possibility of determining epidemiologically significant variances of PM2.5 in urban areas, including SE Austin, using low-cost sensors.

Section 4. Engaging with stakeholders

Researchers have engaged with stakeholders during this reporting period in a variety of ways, including the following activities:

1. Faculty/Stakeholder meetings – Researchers have meet with faculty from Dell Medical School, the Cockrell School of Engineering, and with Texas Advanced Computing Center to solicit feedback on a variety of relevant topics such as sensor deployment, health and pollution data availability, direction on research questions, and refining of research vision. Meetings were held with the following:
    a. Josh Apte, CAEE
    b. Zoltan Nagy, CAEE
    c. Elizabeth Matsui, Dell Medical School
    d. Lourdes Rodriguez, Dell Medical School
    e. Andrew Payne, DataCore, Dell Medical School
    f. Je'aime Powell, TACC
    g. Patrick Bixler, LBJ School
2. Community Stakeholder meetings – Researchers met with the City of Austin and GAVA representatives to understand the community resilience issues being faced by the Dove Springs community. The input of community stakeholders informed the theme of community resiliency for the project hackathon. In addition, with the assistance of GAVA, air pollution sensors were placed in the Dove Springs neighborhood so that a community dataset would be available for the project hackathon.
    a. Marc Coudert, City of Austin
    b. Phoebe Romero, City of Austin
    c. Andrea Caseres, GoAustinVamosAustin
    d. Carmen Pulido, GoAustinVamosAustin
    e. Jes Jones, UT Community and Regional Planning
3. Hackathon – The project hackathon was held on 2/29/2020, with over 60 members of the community attending. This event promoted the use of the prepared datasets and engaged the UT community and other Austin stakeholders. Participants were provided samples of datasets from a variety of sources, and access to air quality sensors and computational resources for use in responding to one or more of a series of project prompts. The hackathon generated more awareness of TRAP among the UT community, and supported the dissemination of project findings. It was also an opportunity to collect input from participants concerning the project vision and products, desirable research directions, data needs and potential partnerships. The feedback collected from the Hackathon informed the long-term project vision and the pursuit of funding opportunities.

Section 5. Updates on broader impacts

To date, the research has had an impact outside of the university through coordination with the Dove Springs Community. Air pollution sensors have been placed at a local library and a resident's home, and at a neighborhood school. The vision is to inform neighborhood school children and the broader community of the readings taken from these local sensors and continue communicating this information long-term so that the community is more aware. With the onset of COVID-19, these plans were placed on hold, but the sensors are still collecting data and we do plan to involve the community when conditions allow. The collaborative effort of planning the hackathon, involving GAVA, the City of Austin, and many UT areas of discipline has resulted in the development of shared data sets and a broader understanding of the need for community resiliency.

The project team also participated in the preparation of a proposal for the Smart and Connected Communities Program ("SCC-IRG Track 2: Integrating Information Flows and Supporting Communities as Decision-Makers in Response to Acute and Chronic Stressors"), which involved significant cross-disciplinary collaboration and engagement of community stakeholders, including the City of Austin Department of Sustainability and GoAustinVamosAustin. The proposal was awarded and is expected to have significant broader impacts.

The project hackathon promoted engagement from the community and identification of desirable and sustainable problem identification and solutions for community resiliency using health, transportation, air pollution, and weather datasets.

The original plan for the final project phase involved further promoting the use of the data collected for the hackathon through "Data Analysis Sprints" and conducting workshops to identify future funding opportunities. We determined that further analyzing available data was more productive than virtual Data Sprints given constraints related to COVID-19. We've explored the impacts of COVID on traffic and related air pollution. Findings suggest a noticeable impact on traffic but not a clear pattern in terms of air pollution. We're continuing to work to understand and explain these findings.

Section 6. Academic Publications

TRAP researchers have made substantial progress on an evaluation of the performance of lower cost PM2.5 monitoring sensors along a continuum of pollution concentrations and are working on two papers for which most of the analysis has been completed. The first one considers problem of calibrating low-cost sensors, while the second one focuses on the spatial and temporal trends detected by the deployed sensor network. Papers will be submitted to *Atmospheric Environment* and *Atmospheric Chemistry and Physic*s. Researchers submitted a poster for the International Society of Exposure Science conference in Fall 2020, which was the runner-up in the best poster competition. In addition, three students have presented or will present four conference posters on the sensor research, as well as on work on environmental justice and traffic air pollution in Texas. Posters are included at the end of this report. This work is/was supported in part by Planet Texas 2050, a research grand challenge initiative of The University of Texas at Austin.

Section 7: Press, speaking engagements, and buzz

An Earth Day story about the TRAP project and hackathon was published on the PT2050 Medium account. The Hackathon was also featured in the *Daily Texan* (https://thedailytexan.com/2020/03/01/hack-for-resilient-communities-tackles-climate-change-in-austin-communities). The TRAP team has participated in and presented at semi-annual Planet Texas 2050 meetings in addition to interim collaborative workshops.

Section 8. Data and data management

Data samples generated/collected through this project have been placed in DataX, using the repository structure shown in Figure 1. Researchers also prepared a Data Dictionary (Table 1) for the Hackathon, which describes all the data in DataX and additional sources which are either updated periodically or in real time or maintained in external repositories that are publicly accessible.

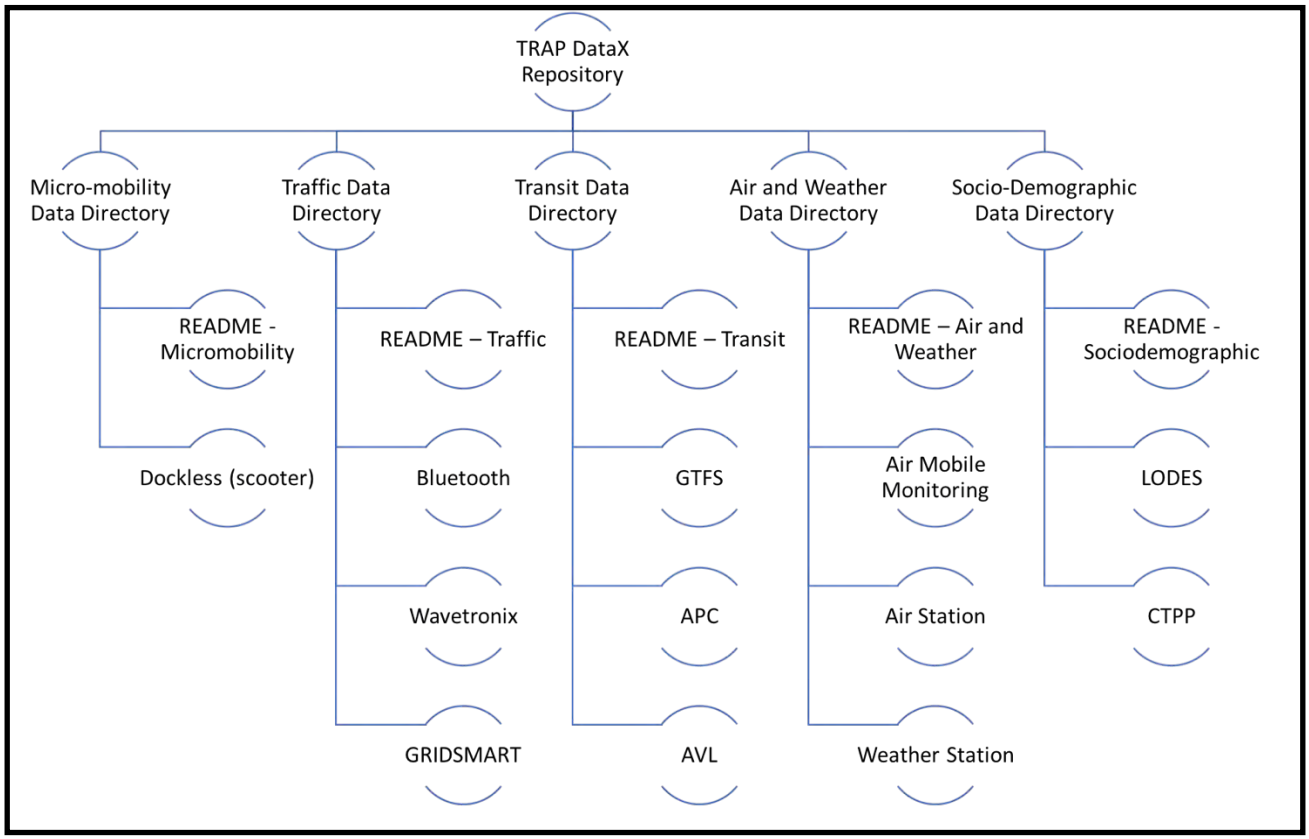

Figure 1. TRAP DataX Repository Structure

Table 1. Hackathon Data Dictionary

Data Category	Folder Name	Description	Date Range	In DataX?	DB Tables	Reference
Geography	Geography	This includes various geographic definitions, including Transportation Analysis Zones (TAZ), census tracts, and census blocks. Other datasets may refer to these geographic areas.	2010	**Yes**	taz2010, ctracts2010, cblocks2010	
Health	Medical Visits	DataCore Aggregate dataset of health information related to medical visits for the following diagnoses, aggregated by patient residence zip code in the Austin Area: Asthma (J45.*) ; Emphysema (J43.*) ; Bronchitis (J40.*, J41.*, J42.*) ; Cardiovascular conditions (I50.*, I51.*, I52.*) ; Diabetes (E08.*-E11.*, E13.*) ; Heat-related conditions (T67.*)	2018	**Yes**		-
Health	500 Cities	The purpose of the 500 Cities Project is to provide city- and census tract-level small area estimates for chronic disease risk factors, health outcomes, and clinical preventive service use for the largest 500 cities in the United States. This dataset includes 2016, 2015 model-based small area estimates for 27 measures of chronic disease related to unhealthy behaviors (5), health outcomes (13), and use of preventive services (9). Data is aggregated by census tract.	2015, 2016	No		https://chronicdata.cdc.gov/browse?category=500+Cities
Pollution	Air Quality Sensors at Pay Stations	This dataset includes air quality measurements collected from sensors deployed on 3 parking pay stations in downtown Austin. Data was collected between 9/2019 and 1/2020.	9/2019-1/2020	**Yes**		-
Pollution	Air Quality Sensors on Google Cars	This dataset consists of air quality measurements collected in 2018 using sensors placed on Google cars. The experiment covered several neighborhoods	2018	**Yes**	air_mobile air_mobile_geom air_mobile_ metadata	-

Data Category	Folder Name	Description	Date Range	In DataX?	DB Tables	Reference
		in Austin, and data is reported at a fine level of spatial disaggregation.				
Pollution	PurpleAir Campus	This dataset consists of the data collected by low-cost air pollution sensors (PurpleAir) at 10-minute intervals at 16 locations on UT Campus. Data is also available online.	10/2019-2/2020	**Yes**		https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#1/15.1/-30
Pollution	PurpleAir Dove Springs Community	Four PurpleAir air quality sensors have been deployed in the Dove Springs neighborhood in Southeast Austin and are running live right now.	2/10/2020 —	No		https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#14.37/30.1894/-97.75138
Pollution	Center for Air, Climate & Energy Solutions	Estimates of outdoor concentrations for six pollutants (four gases: O3, CO, SO2, NO2. Two aerosols: PM10, PM2.5) throughout the contiguous U.S. Model estimates are annual-average values for years 1979 – 2015 (O3, SO2, NO2), 1988 – 2015 (PM10), 1990-2015 (CO), and 1999-2015 (PM2.5). Data are available at national, state, county, census tract, and census block group levels (https://www.caces.us/data).	1975-2015	No		https://www.caces.us/ Related research paper can be found in https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0228535
Pollution, Health, Transportation	Sustainability Indicator Survey	This dataset consists of the responses to a survey that has been conducted yearly since 2004 and includes questions related to air quality, mobility and health. The sample size is approximately 1,000. The data includes zip codes for survey respondents.	2004-2018	**Yes**		-

Data Category	Folder Name	Description	Date Range	In DataX?	DB Tables	Reference
Transportation	Traffic Speed	This is a sample of a proprietary dataset, INRIX, which is used by many transportation agencies to support traffic operations and planning. The data consists of average vehicle speeds every 15 minutes for pre-defined roadway segments, which cover a significant portion of the roadway system.	~2018	**Yes**	segment_metadata segment_speed_ campus segment_speed_ dove_springs segment_speed_ downtown	-
Transportation	Traffic Sensor Data	This dataset includes traffic data for Bluetooth, Wavetronix and GRIDSMART sensors. These sensors continuously collect traffic data at a number of locations in Austin. Researchers generated data samples including all available data from these sensors in 2018. The datasets, obtained through a collaborative effort with the City of Austin, also include sensor location information	~2018	**Yes**	bt_data_unmatched bt_daily_agg bt_segments bt_intersections gs_agg_data gs_raw_data gs_intersections wt_data wt_detectors wt_intersections	-
Transportation	Census Data	This dataset includes Census Transportation Planning Package (CTPP) and Longitudinal Origin-Destination Employment Statistics (LODES) datasets.	2012-2016	**Yes**		CTPP: https://ctpp.transportation.org/2012-2016-5-year-ctpp/ LODES: https://catalog.data.gov/dataset/lehd-origin-destination-employment-statistics-lodes

Data Category	Folder Name	Description	Date Range	In DataX?	DB Tables	Reference
Transportation	General Transit Speed Specification	GTFS is a data standard used by many public agencies worldwide to describe a transit system network. It summarizes daily transit routes, stops and trajectories. The GTFS scheme, composed of 15 tables, is summarized online at https://gtfs.org/reference/static. For this research initiative, we focus on main tables from 2016-2019, as published by Capital Metro, and augment the information with two extra tables that provide metadata and shape geometries: routes, trips, stops, stop times, shapes (i.e. transit path), metadata, and shape geometry.	2016-2019	**Yes**	gtfs_metadata gtfs_routes gtfs_shapes gtfs_shapes_geom gtfs_stop_times gtfs_stops gtfs_trips	https://gtfs.org/reference/static/
Transportation	Micromobility	Shared micromobility vehicle trip data reported to the City of Austin Transportation Department as part of the Shared Small Vehicle Mobility Systems operating rules.	5/2018-7/2018	**Yes**	dockless_data	
Transportation	Automated Transit Measures	Capital Metro periodically releases an Automated Passenger Counts (APC) dataset containing raw passenger counts coded for each bus each time the bus stops. Further, Capital Metro publishes every 15 seconds an update on the vehicle locations for all of its buses; this is Automated Vehicle Location (AVL)	~2018	**Yes**	transit_apc transit_avl	https://data.texas.gov/Transportation/CapMetro-APC-RAW-August-2018/xj6k-5av4 https://data.texas.gov/Transportation/CapMetro-Vehicle-Positions-JSON-File/cuc7-ywmd
Weather	Weather	Weather data was obtained from the National Oceanic and Atmospheric Agency (NOAA) online API. The data contains daily minimum, maximum and average temperature as well as precipitation data for 365 days in 2018 at one weather station in Austin.	2018	**Yes**		

Data Category	Folder Name	Description	Date Range	In DataX?	DB Tables	Reference
Weather	TCEQ	Texas Air Monitoring Information System - TAMISWeb allows users to generate and download predefined reports containing air quality data and associated information stored in the TAMIS database. This data is collected and maintained by the Data Collection Team of the Monitoring Division within the Office of Compliance and Enforcement.	2007-current year	No		https://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=home.welcome
Weather	LCRA Hydromet	Provides data access to USGS and LCRA water level gauges for the local region.	2020	No		https://hydromet.lcra.org/
Weather	City of Austin FloodPro	From the website: "Here you will find useful information about flooding in Austin. Whether you are a homeowner wanting to know if your house is in the floodplain or an engineer designing stormwater controls, you've come to the right place."		No		https://www.austintexas.gov/FloodPro/
Weather	Climate Data Online	Climate Data Online (CDO) provides free access to NCDC's archive of global historical weather and climate data in addition to station history information. These data include quality controlled daily, monthly, seasonal, and yearly measurements of temperature, precipitation, wind, and degree days as well as radar data and 30-year Climate Normals. (Note that the local Weather Forecast Office website is: https://www.weather.gov/ewx/)		No		https://www.ncdc.noaa.gov/cdo-web/
Weather	CoCoRaHS	Community Collaborative Rain, Hail & Snow Network. A volunteer effort to measure precipitation across the United States. Data exporter is available at http://data.cocorahs.org/cocorahs/export/exportmanager.aspx		No		https://www.cocorahs.org/ViewData/

Table 2. Hackathon Projects

Project	Description
DiseaSearch	This project focused on the idea of developing an app to tell you the disease information near your neighborhood. For example, a user could look up cases of flu in her/her neighborhood or compare income level to asthma statistics. The app was planned to have two parts: a correlation diagram and a case-searching ability. Future efforts could include expanding the database, producing social media alerts, as well as an epidemic report.
Pollution from eyes of the user	This project used pollution, survey and medical records in a visualization tool that used GIS to understand how data sources are represented geographically, and the relationship to each other when plotted by zip code over time. One idea discussed by the group was to superimpose pollution levels on hospital visits, sorted temporally by month. Future uses of this tool could be to communicate information to the public and be used for policymaking decisions.
Downtown Congestion charge	This project was built on the idea that rapid population growth, increased pollution and the desire to preserve Austin's culture predicated the need for a downtown congestion charge. The team used health records and overlaid them with air quality data to show a correlation between the two. A proposed solution to improve Austin was a congestion charge on all vehicles entering downtown Austin.
Burden of disease (Team Significance)	This project focused on determining where the burden of disease is located spatially, and why it is the highest, considering race, pollution, and socioeconomic data. The group produced maps of diagnoses and created interactive maps. Future work could include performing predictive models to parse out causes of disease, as well as performing a temporal analysis to see how patterns change over time due to higher allergens or gentrification.
Pollution as an Indicator of Hospital Visits	This project focused on finding a correlation between air pollution and hospital visits. The team did not find a strong correlation with data analysis but visualized all of the pollution components for the data provided.
FloodLineATX	This project focused on flood data in Austin. There is an increase of flooding in Austin, but there is not a real-time warning system to disseminate information beyond the immediate 24-hour period. The group focused on creating an app that used flood data to predict real-time and future flooding. Future work includes improving prediction algorithm accuracy, embedded GIS system, and real-time alerts to app users.
pH and CO2	This project attempted to find a correlation between pH levels in area waters and CO2 levels. The team was unable to determine a correlation given available data and limitations with that data. An attempt to understand the impact of seasons on pH levels was also unsuccessful. Future work could include using a more complete data set and developing an interactive map that lets users select the area/city and variations in pollutants to overlay.

Project	Description
Perception vs Reality: Water Quality	This project uses water outages as a proxy to assess the level of service people in Austin are getting from their water provider. Survey data was used to document people's perception of water service, and the two data sets were overlain to determine spatial equality between neighborhoods. People in Austin have different satisfaction levels of water quality, and the group found satisfaction levels do not match reality. Future efforts could extend the work to include other City of Austin services, as well as a more extensive dataset.
PM2.5 Concentrations at UT	This project focused on mapping PM2.5 concentrations on UT campus over time. The group correlated pollution readings with temperature and humidity and found a closer linkage to humidity than temperature. They also found that during special events like ACL, PM2.5 concentrations significantly increased. Future directions could include a correlation with respiratory health, mitigation planning, development of a web app, and visualization online.
Sound	Project was unrelated to the hackathon and did not use data provided. Disqualified.
NeuroCollective	Project was unrelated to the hackathon and did not use data provided. Disqualified.
Free water	Project was unrelated to the hackathon and did not use data provided. Disqualified.
Q: Communications	This project focused on spreading awareness throughout the community about air quality and the steps that can be taken to improve it. The proposed app would take pollution data and recommend activity level suggestions to users based on those levels. Other features were suggested. The project primarily focused on communicating information to the community.

Table 3. Hackathon Winning Projects

Winning Projects	Category
Downtown Congestion Charge	Community resiliency
DiseaSearch	Working product
Burden of Disease	Research potential
Perception vs Reality: Water Quality	Visualization/Data analysis

Section 9. Funding sources you have pursued or plan to pursue in the coming six months as an outgrowth of your PT2050-funded project

Source and program or grant name (e.g., NSF Smart and Connected Communities)	Internal or external to UT?	Date of submission or future deadline
NSF Smart and Connected Communities	External	Submitted 8/2019 and awarded

Section 10: Photos and miscellaneous media

Photos from the February 29, 2020 hackathon event have been uploaded to the Google Drive folder.
https://drive.google.com/drive/folders/1tjXiUamoy0rt227X2dvhfYLZErXXz1HF?usp=sharing

Section 11. Additional Contributions

Health: As described previously, the TRAP project incorporates a health lens, with researchers attempting to understand the relationship between health, transportation, pollution, and weather. Health datasets were obtained for use in the 2/29/2020 project hackathon.

Equity: The project incorporates an equity lens by focusing on the Dove Springs community, a community that is historically disadvantaged and where vulnerable populations reside. The hackathon theme is community resiliency and researchers are hoping to understand how this community can improve resiliency through a better understanding of the relationships of the datasets.

Capacity building:

- Undergraduate – The project hackathon is open to the community but will likely include undergraduate and graduate level students. Participants will use transportation, health, pollution, and weather datasets to develop tools and conduct analysis to better understand the relationship between these previously disparate data sources. Resulting work efforts from the hackathon will inform future research visioning.
- Graduate and/or post-doc – The project hackathon is open to the community but will likely include undergraduate and graduate level students. Participants will use transportation, health, pollution, and weather datasets to develop tools and conduct analysis to better understand the relationship between these previously disparate data sources. Resulting work efforts from the hackathon will inform future research visioning.
- K-12 – The project includes installation of air pollution sensors in the Dove Springs neighborhood, two of which are at neighborhood schools. The goal is for students to use these sensors as an educational tool to learn about pollution in their communities. Data will be available online via the sensor vendor website for students to continuously access.