Lighnting Presentations

Slide 1 — THE UNIVERSITY OF TEXAS AT AUSTIN / CENTER FOR TRANSPORTATION RESEARCH. Hack for Resilient Communities — Transportation, Pollution, Weather & Health. COLLABORATE. INNOVATE. EDUCATE.

Slide 2 — Introductions

Bridging Barriers
- Solve real-world problems using fundamental knowledge across disciplines.

Planet Texas 2050
- Making Texas resilient
- Water
- Energy
- Urbanization
- Ecosystems

TRAP
- Understanding the correlation between transportation, air pollution, and health.
- Exploring varying impacts within urban regions.

Hackathon Team: CTR, TACC, CAEE, Dell Medical School, LBJ School, City of Austin, GAVA

COLLABORATE. INNOVATE. EDUCATE.

Slide 3 — Hackathon Overview

GOALS
- Awareness of TRAP & health implication
- Share data sources & computing resources
- Collaborate in developing tools/ideas to:
  - Measure the problem
  - Communicate impacts
  - Propose solutions/relevant issues

WORK TRACKS
- Data Visualization & Integration Tools
- Sensor Networking & Sensor Data Interfaces
- Data Analysis & Problem Solving Ideas
- Other

PRIZES
- Best working product
- Best idea for solving a community resiliency problem
- Best visualization
- Best research potential

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Slide 4 — Schedule

Lighting Talks	11:00–11:45
Data & resources	11:45–12:15
Group formation	12:15–12:45
	→ 12:45 Lunch
Work 12:45-6:00	→ 2:30-3:00 Check-In
	→ 5:00 Dinner
Presentations	6:00–6:45
Prizes	7:00–7:15

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Slide 5 — Rules & Code of Conduct

- Please share your products in GitHub or DataX!
- Please do not re-distribute staged datasets without permission.
- No question is too insignificant. Please ask a mentor!

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Slide 6 — Lightning Talks

Does something catch your interest? Please make note of it for your breakout group!

- Marc Coudert and Phoebe Romero, Office of Sustainability, City of Austin
- Carmen Pulido, Go Austin / Vamos Austin
- Jonathan Gingrich and Hagen Fritz, CAEE
- Elizabeth Matsui, MD, MHS, from Dell Medical School

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Marc Coudert and Phoebe Romero
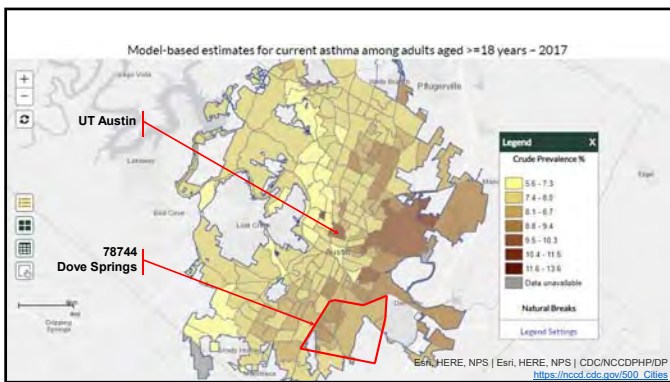Office of Sustainability, City of Austin

Carmen Llanes Pulido
Go Austin / Vamos Austin

HACK FOR RESILIENT COMMUNITIES

Transportation, Pollution, Weather & Health

Go Austin/Vamos Austin (GAVA)
&
City of Austin Office of Sustainability

Model-based estimates for current asthma among adults aged >=18 years – 2017

UT Austin

78744
Dove Springs

Legend
Crude Prevalence %
5.6 - 7.3
7.4 - 8.0
8.1 - 8.7
8.8 - 9.4
9.5 - 10.3
10.4 - 11.5
11.6 - 13.6
Data unavailable

Natural Breaks

Legend Settings

Esri, HERE, NPS | Esri, HERE, NPS | CDC/NCCDPHP/DP
https://nccd.cdc.gov/500_Cities

CHALLENGE

- Social Determinants of Health = Disproportionate asthma rates

- Bad Air Quality (AQ) aggravates asthma

- Climate change may make AQ worse, potentially increasing incidences of asthma


WHO ARE WE?

- Go Austin/Vamos Austin (GAVA)
  - Community Organizing for Health Equity
  - Pushing for equitable infrastructural investments that protect people from climate shocks and stressors
  - Organizing anti-displacement and leadership development efforts to promote neighborhood stability, preparedness and response via "Climate Woke" community planning and a "People's Agenda" for Climate Justice

- City of Austin Office of Sustainability
  - City Office
  - Council Directed
  - Work on climate, food system, green infrastructure, etc.

NEEDS

- **Identify:** What are the sources of bad air quality in Dove Springs?

- **Stop:** Identify actions to stop emissions of bad air quality.

- **Act:** Create a plan to ameliorate bad air quality.

- **Lift:** Community engagement process to help those impacted by bad air quality.

- **Transform:** Devise a plan that empowers communities to take control of local air quality

PurpleAir Monitors
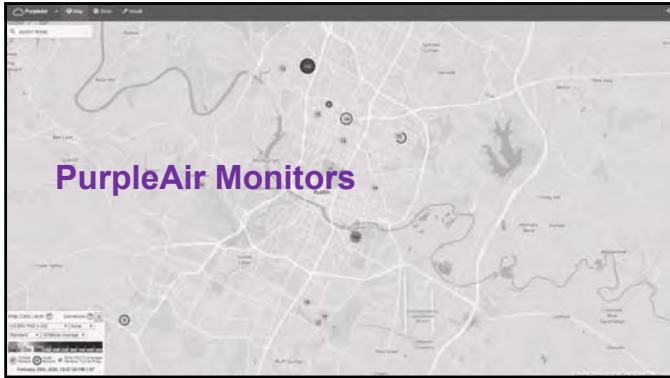
SOLUTIONS

- **Can be:**
  - Technological
  - Programs/Projects
  - Capital Improvement Funding
  - Landscape/urban design
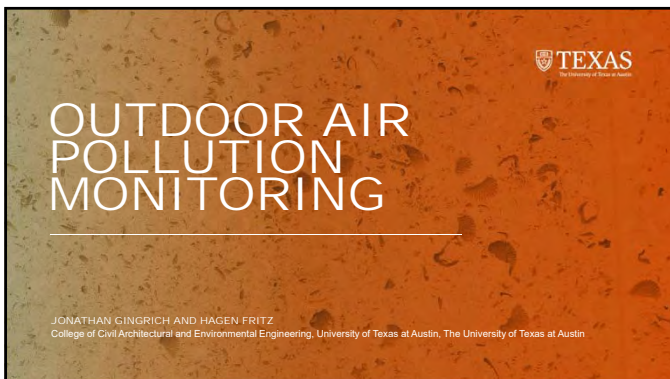 - Community engagement strategies
  - …you tell us!

Questions?

Photo: Celine Rendon

Jonathon Gingrich and Hagen Fritz
College of Civil and Architectural Engineering, UT

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TEXAS
The University of Texas at Austin

OUTDOOR AIR POLLUTION MONITORING

JONATHAN GINGRICH AND HAGEN FRITZ
College of Civil Architectural and Environmental Engineering, University of Texas at Austin, The University of Texas at Austin

TEXAS

What's the problem?

What's the problem?

- Air pollution kills

What's the problem?

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    - 4.2 million deaths worldwide[1], 100,000 in the US[2]

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What's the problem?

- Air pollution kills
    - 4.2 million deaths worldwide[1], 100,000 in the US[2]
- Most of the burden is on minoritized communities[3]
- Transportation related air pollution (TRAP) accounts for about 20% of total pollution in the US

What's the problem?

- Cannot address problem of air pollution without data

What's the problem?

- Cannot address problem of air pollution without data
- Data gaps exist

How do we address the problem?

How do we address the problem?

- Need to use different measurement methods to address data gaps
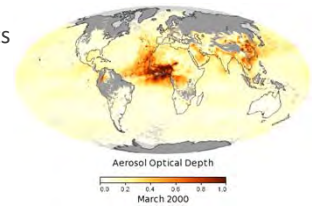

How do we address the problem?

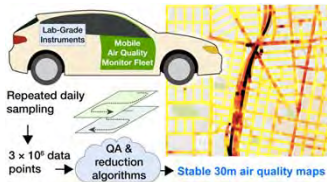- Stationary reference monitors

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How do we address the problem?

- Stationary reference monitors
- Satellite measurements

Aerosol Optical Depth
March 2000

How do we address the problem?

- Stationary reference monitors
- Satellite measurements
- Mobile monitoring

How do we address the problem?

- Stationary reference monitors
- Satellite measurements
- Mobile monitoring
- Low-cost sensor networks

Mobile Monitoring in Austin

- Measurements made by GSV cars Summer 2018
- Measurements taken
  - Particulate Matter
  - Black Carbon
  - NO_2
  - NO
  - Ultrafine Particles
  - CO_2
- **How do on-road measurements of air pollution vary in Austin?**

NO_2 concentrations (ppb)

Preliminary data: Do not share.

UT Austin Low-Cost Sensor Network

- 16 commercial-grade sensors
- Measure
  - Particulate Matter (PM) number and mass concentrations
  - Temperature
  - Relative Humidity
- **Is the UT Community exposed to unhealthy levels of PM pollution?**

Research questions we have

- What are the spatial and temporal patterns of air pollution?
- Where are there hotspots in the city/campus? What could be causing them?
  - Weather?
  - Traffic?
- Can we improve the performance of low-cost sensors?
- Who experiences the most pollution?

Proposed projects for today

Hotspot identification
- Level I: Determine which locations tend to read high
- Level II: Compare temporal trends
- Level III: Overlay major events, weather, and/or traffic data

Sensor Verification
- Level I: Compare to local TCEQ/EPA monitoring stations
- Level II: Compare against mobile monitoring data
- Level III: Develop multivariate regression to correct PurpleAir data

Demographic Evaluation
- Level I: Apply the mobile monitoring to census blocks
- Level II: Combine with demographic data
- Level III: Determine which demographic factors result in higher exposure to TRAP

Sources

1. https://www.who.int/health-topics/air-pollution#tab=tab_1
2. https://vizhub.healthdata.org/gbd-compare/
3. Tessum CW, Apte JS, Goodkind AL, et al. Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure. *Proc Natl Acad Sci U S A*. 2019;116(13):6001-6006. doi:10.1073/pnas.1818859116

THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSLATIONAL RESEARCH

ELIZABETH C. MATSUI, MD, MHS
Director of Clinical and Translational Research,
Dell Medical School
Professor of Population Science
Professor of Pediatrics

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The University of Texas at Austin
Center for Health and Environment,
Education and Research
Dell Medical School

UNDERSTANDING HEALTH EFFECTS OF (TRAFFIC-RELATED) AIR POLLUTION

ELIZABETH C. MATSUI, MD MHS
Professor of Population Health and Pediatrics
Director of the Center for Health and Environment: Education and Research (CHEER)
The University of Texas at Austin

The University of Texas at Austin
Center for Health and Environment,
Education and Research
Dell Medical School

CHEER
Center for Health and Environment
Education and Research

Connecting Environment to Health in Texas & Beyond

CHEER is a hub for multidisciplinary environmental health sciences research and education. Housed within the Department of Population Health at Dell Medical School, the center brings together experts from the Cockrell School of Engineering and the College of Natural Sciences at The University of Texas at Austin.

What is TRAP?

- Exhaust from motor vehicles
  - carbon dioxide (CO_2), carbon monoxide (CO)
  - hydrocarbons (HC)
  - nitrogen oxides (NO_x)
  - particulate matter (PM)
  - mobile-source air toxics (MSATs)- e.g. benzene, formaldehyde, acetaldehyde, 1,3-butadiene
- Non-combustion
  - Resuspended road dust, tire wear, brake wear
  - With increasing emissions controls for exhaust PM, proportion of TRAP PM from noncombustion sources increases
- Secondary pollutants: e.g. ozone
- Contribution to ambient air pollution: "In U.S. cities, the results show that motor-vehicle contributions range from 5% in Pittsburgh, Pa., under conditions with very high secondary aerosol, to 49% in Phoenix, Ariz., and 55% in Los Angeles, Calif."

https://www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health

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How is causality established? –Bradford Hill Criteria

- Strength of association
- Specificity
- Consistency
- Biologic Plausibility
- Analogy

- Coherence
- (semi)-experimental evidence
- Biologic gradient
- Temporality

Dominici & Zigler. Best Practices for Gauging Evidence of Causality in Air Pollution Epidemiology, AJE, 2017
https://www.ncbi.nlm.nih.gov/pubmed/29020141

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Air pollution acute health effects

- Cardiovascular events (MI, TIA, stroke)
- Respiratory symptoms and events
  - COPD, asthma symptoms, ED visits
- Respiratory infections
  - Upper respiratory tract infections, in children

https://www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health

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Air pollution chronic health effects

- Effects on outcomes that are a result of exposure over a period of months or years
  - "incident" vs "prevalent" disease
- Asthma
- Lung function growth
- Birth weight, preterm birth

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Biologic markers of exposure or effect

- epigenetics
- visualization of particles in olfactory nerve, brain, placenta
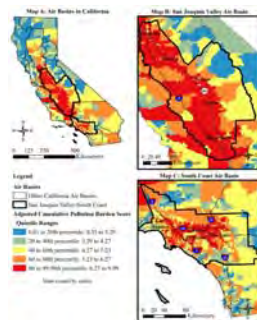- elevation of blood markers of inflammation

Bove et al, Nature communications. https://www.nature.com/articles/s41467-019-11654-3
Maher et al, PNAS https://www.ncbi.nlm.nih.gov/pubmed/27601646

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Air pollution emerging health effects

- Dementia
- Developmental disorders
  o Autism spectrum disorder
  o ADHD
- Psychosis

Liang et al, Environ Pollut 2019. https://www.ncbi.nlm.nih.gov/pubmed/30326384
Suades-González et al. Endocrinology 2015 https://www.ncbi.nlm.nih.gov/pubmed/26241071

CHEER

Environmental justice and disparities

Int J Environ Res Public Health. 2018 Apr 16;15(4). pii: E762. doi: 10.3390/ijerph15040762

CHEER

The Art of Data Science

https://leanpub.com/artofdatascience

Linking exposure to health: What is the question?

Characteristics of a good question

- of interest
- hasn't already been answered

- answerable
- plausible
- specific

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Linking exposure to health: Refining the question

What is the exposure of interest?
- How is it measured?
- How will you determine exposure for each individual?
- Over what time? Over what geography?
- Will it be directly measured? Will it be modeled? Or both? How "good" are the models? Are the measurements?

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Linking exposure to health: Refining the question

What is the health outcome of interest?
- How is it measured?
  - Over what time? Over what geography/space?
  - Is it a chronic (prevalent or incident outcome) or an acute outcome (asthma exacerbation)?
  - What is the expected time course from the exposure to the outcome?
    - Lags

Translating the question to an analysis

Does exposure (x) predict health outcome (y)?

ID	Distance of home from major roadway (meters)	Modeled annual average $PM_{2.5}$ at home address (mcg/m³)	$PM_{2.5}$ yesterday	days of coughing, last two weeks (no.)	Asthma diagnosis, ever	ED visit for asthma
1	30	5	8	3	1	1
2	450	12	11	0	0	0
3	300	8	4	5	0	0
4	75	6	17	2	1	0

Thank you!

Contact Information:
email: ematsui@utexas.edu
twitter: @elizabethmatsui

Podcast on Academic Life:
The Effort Report
effortreport.libsyn.com
twitter: @theeffortreport
Co-host: Roger D. Peng
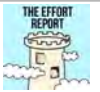
Je'aime Powell
Texas Advance Computing Center

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PLANET TEXAS 2050

PTDataX

Hack for Resilient Communities
Transportation, Pollution, Weather, and Health

PT2050 Cyberecosystem

Adaptive Sensing → DataX Science Gateway → Model Integration → Participatory Modeling / Digital Objects of Research

Combining Computational Capabilities with Information for Resiliency

PLANET TEXAS 2050

Slide 1

What is DataX?

Overloaded Terms
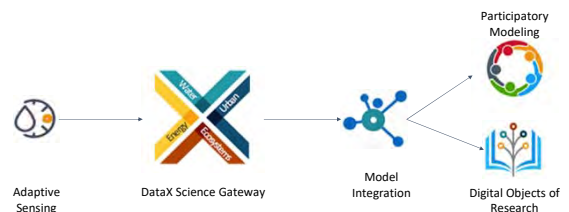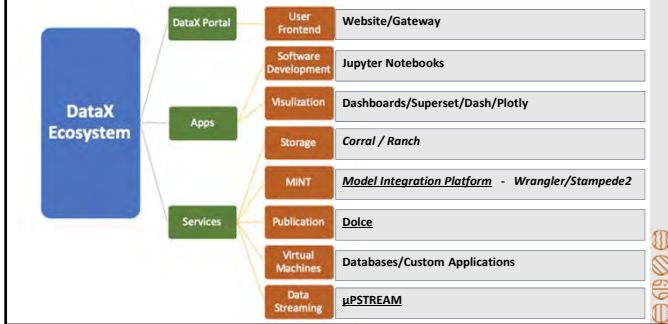

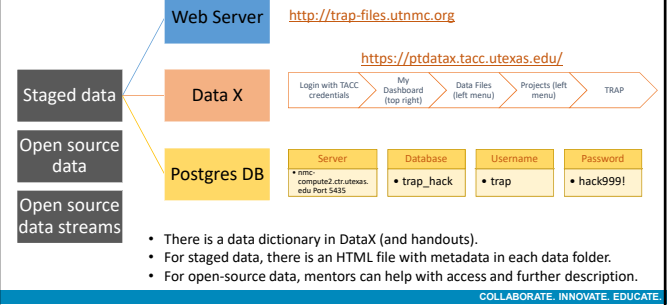|	
DataX Portal → User Frontend	Website/Gateway
→ Software Development	Jupyter Notebooks
Apps → Visulization	Dashboards/Superset/Dash/Plotly
→ Storage	Corral / Ranch
Services → MINT	Model Integration Platform - Wrangler/Stampede2
→ Publication	Dolce
→ Virtual Machines	Databases/Custom Applications
→ Data Streaming	µPSTREAM

(DataX Ecosystem)

Slide 2

Getting access to PTDatax

1. Create a TACC portal account (`portal.tacc.utexas.edu`) [Note: the 2-factor token or DUO can sometime be a sticking point]

2. Add the TACC portal user account to the PT2050-DataX Project (Suzanne Pierce or Je'aime Powell)

3. Sign in to: **ptdatax.tacc.utexas.edu**

PLANET TEXAS 2050

Slide 3

Ken Perrine
Center for Transportation Research

Slide 4

Data Access

Web Server	http://trap-files.utnmc.org
Data X	https://ptdatax.tacc.utexas.edu/
Postgres DB	

Staged data → Web Server, Data X, Postgres DB
Open source data
Open source data streams

Data X flow: Login with TACC credentials → My Dashboard (top right) → Data Files (left menu) → Projects (left menu) → TRAP

Postgres DB:
- **Server**: nmc-compute2.ctr.utexas.edu Port 5435
- **Database**: trap_hack
- **Username**: trap
- **Password**: hack999!

- There is a data dictionary in DataX (and handouts).
- For staged data, there is an HTML file with metadata in each data folder.
- For open-source data, mentors can help with access and further description.

Slide 5

Staged Data Categories & Overview

Transportation
- Traffic speeds every 15min for small segments (UT Campus, Dove Springs and Downtown Austin).
- Data from CoA sensors (various locations).

Air Pollution
- Medical visits by month, condition and zip code.

Health
- Google cars (2 regions in Austin).
- Sensors in pay stations (3 stations in Downtown Austin).
- Low-cost sensors in UT Campus and Dove Springs.

Other
- Resilience Survey
- Geometries
- Demographic data
- Weather
- Transit
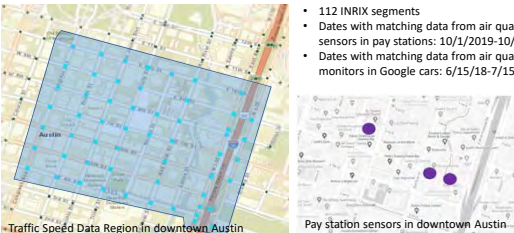- Water level

Slide 6

Transportation/Air Pollution Regions
UT Campus
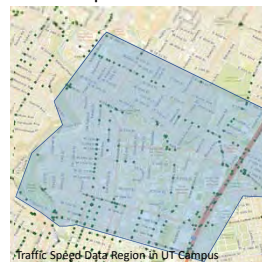
- 482 INRIX segments
- Dates with matching data from air quality monitors in Google cars: 6/15/18-7/15/18
- Dates with matching Purple Air Sensor Data (online and in Google cars): 2/1/2020-2/15/2020, 10/1/19-10/30/19.

Traffic Speed Data Region in UT Campus

Purple Air Sensors in UT Campus

Slide 1

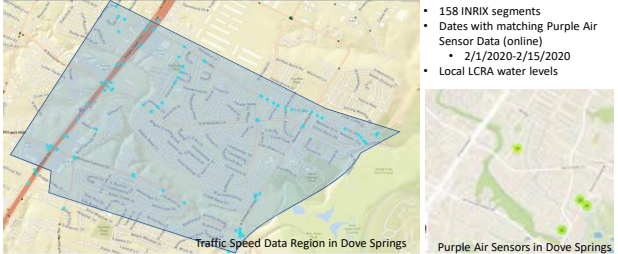Transportation/Air Pollution Regions
Downtown

- 112 INRIX segments
- Dates with matching data from air quality sensors in pay stations: 10/1/2019-10/31/2019
- Dates with matching data from air quality monitors in Google cars: 6/15/18-7/15/18

Traffic Speed Data Region in downtown Austin

Pay station sensors in downtown Austin

Slide 2

Transportation/Air Pollution Regions
Dove Springs

- 158 INRIX segments
- Dates with matching Purple Air Sensor Data (online)
  - 2/1/2020-2/15/2020
- Local LCRA water levels

Traffic Speed Data Region in Dove Springs

Purple Air Sensors in Dove Springs

Slide 3

Air Quality in Dove Springs

Josephine Houston Elementary School: Thanks, Naomi Vanmunster and Mike Lohrstorfer

Brassiewood Street: Thanks, Frances Acuña

Mendez Middle School: Thanks, Naomi Vanmunster and Josephine Rowley

Austin Public Library Southeast Branch: Thanks, Todd Smith and Chip Pryor

Slide 4

Data analysis needs & suggestions

Purple Air Sensors	Sustainability Indicator Survey	Data for Neighborhoods	Flooding Impacts

• Sensor validation
• Hotspot identification
• Demographic evaluation
	• Spatial analysis of trends by mapping responses to zip-codes or census blocks.	• Simple instructions on how to visualize environmental impacts or dangers on a neighborhood	• How to mix:
			  • FloodPro
			  • Creek bed photos
			  • Elevations
			  • LCRA gauges
			  • Weather
			  • Traffic, etc…

Slide 5

Data analysis needs & suggestions

- Time is short: how to best use today's opportunity?
  - Try for *really simple ideas*
    - Example: community advocates might just want to know how to *put together a good visualization*
  - New connections, new ideas, follow-on projects!
- Today's data samples may be spotty or dated…
  - With additional work, fresh new data can be obtained.
  - You can "prove" your product with old data, and have it ready to receive new data.

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    }
  }
}, {
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  "vehicle": {
    "trip": {
    ...
```

Slide 6

Groups

- Please gather in groups organized by your interests
- Mentors will facilitate further grouping into groups of 4.
- Mentors
  - Natalia Ruiz Juri
  - Jonathan Gingrich
  - Je'aime Powell
  - Charlie Dey
  - Brandi Kuritz
  - Jack Gaither
  - Marc Coudert
  - Phoebe Romero
  - DataCore
  - GAVA
  - Health
  - CAEE

Schedule

Lighting Talks	11:00–11:45
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Presentations	6:00–6:45
Prizes	7:00–7:15

Group Presentations

- Judges
- Natalia RuizJuri (CTR)
- Heidi Ross (CTR)
- Je'aime Powell (TACC)
- Charlie Dey (TACC)
- Brandi Kuritz (TACC)
- Jack Gaither (TACC)
- DataCore
- Health
- CAEE
- Phoebe Romero (CoA)
- GAVA

Wrap-up and Prizes

- Best working product - Amazon gift card ($50 x 4)
- Best idea for solving a community resiliency problem (with the data) - Amazon gift card ($50 x 4)
- Best visualization - Amazon gift card ($50 x 4)
- Best research potential - Amazon gift card ($50 x 4)