# Enhancing Economic Growth through Air Quality Data Analysis and UX Design in Low-Economic Regions of Michigan

*Dr. Dirk Colbry and*

*Deepak Reddy*

Michigan State University

# Agenda

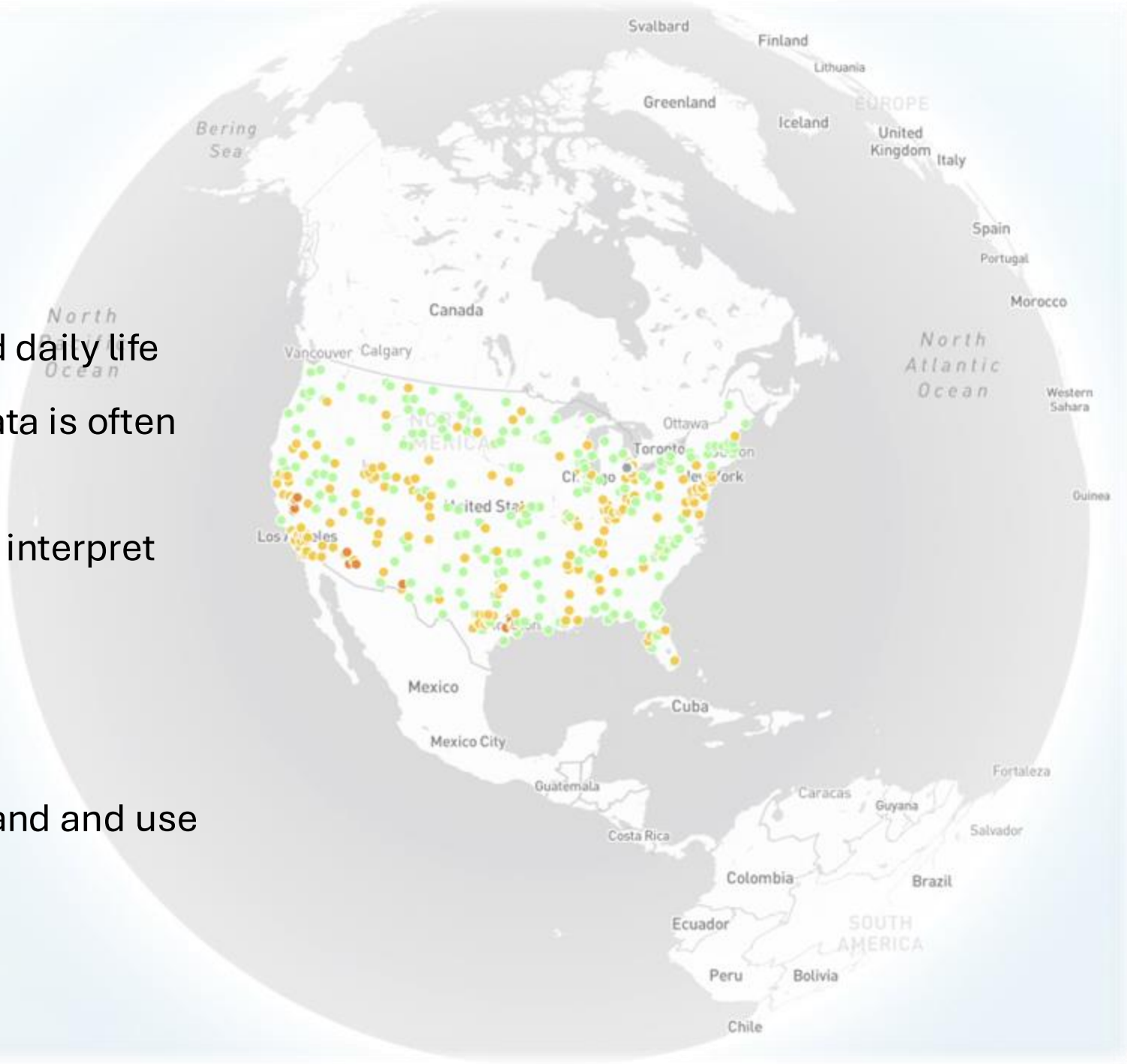
- ***The problem***: Making air quality data usable
- ***The project***: Partnership, students, and goals
- ***The work***: Data analysis and UX redesign
- ***The insight***: Connecting data and usability
- ***The impact***: Communities and student learning

# The Problem

- Air quality directly impacts health and daily life
- Pollution varies block by block, but data is often limited or hard to access
- Even when data exists, it is difficult to interpret and act on

Data alone does not create impact

People need tools they can understand and use

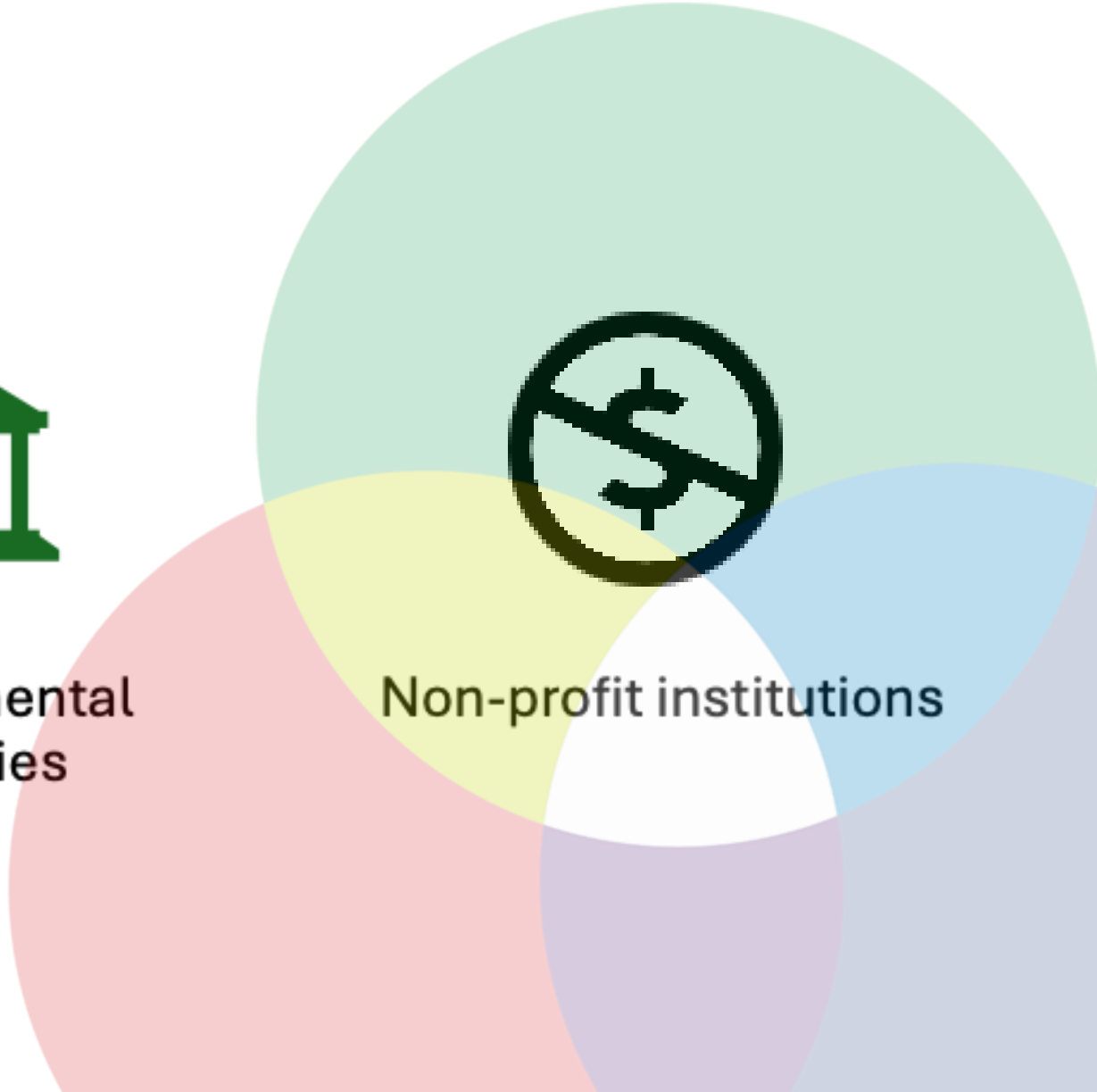


# Data Science Capstone

Goals:

- Provide practical, semester long, team-based project experiences for senior undergraduate data science students.
- Help community partners connect with data science students to support technical and recruiting needs.

# Seeking a Variety of Partners



# Looking for Projects with Impact

Social Issues

State of Michigan

Student Lives

# Community Partner Expectations

***Project Development:***

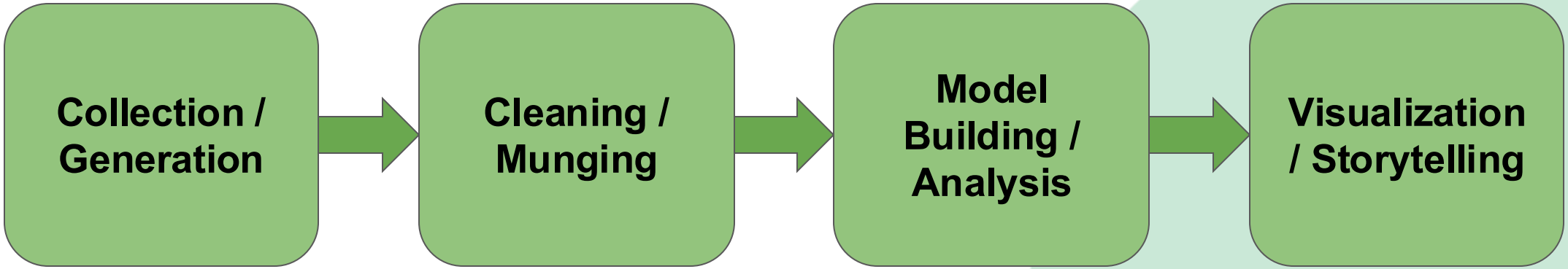
- Collaborate with course instructor to develop a suitable data science project.
- Teams of 4-5 seniors, familiar with multiple programming languages and data science skills.
- 10-15 hours/week per student over 10-12 weeks (~400-900 person-hours/project).

***Partner Commitment During Semester:***

- Regular feedback and mentoring with team. Ideally weekly or bi-weekly 30-60 minute meetings (not required)
- Email responses to student questions and feedback on project deliverables including; project plan video, minimum viable product video and final project code/video/report.

Project partnership typically includes a $5,000 donation to the CMSE department; this donation is often waived for projects partnered by units at MSU, non-profits or in the state government.

# Data Science Project Pipeline



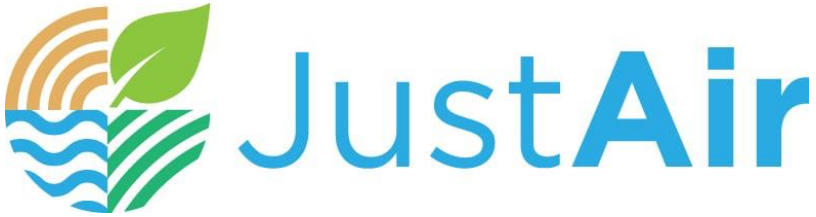

Examples of Projects:

- Existing dataset with key questions:
  - software development, model generation, results visualization.
- Existing dataset without specific questions:
  - data parsing, model generation, data exploration.
- Questions without data:
  - data generation/mining, cleaning, visualization, model application.

# Finding Partners



- Data science capstone course
- Partnership with JustAir
- Real air quality data from Wayne County

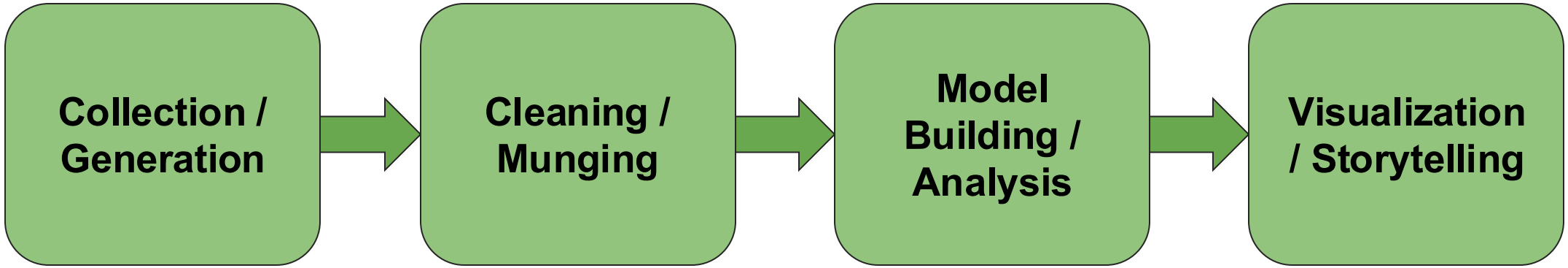



- Goal:
  - Help analyze and visualize complex environmental data

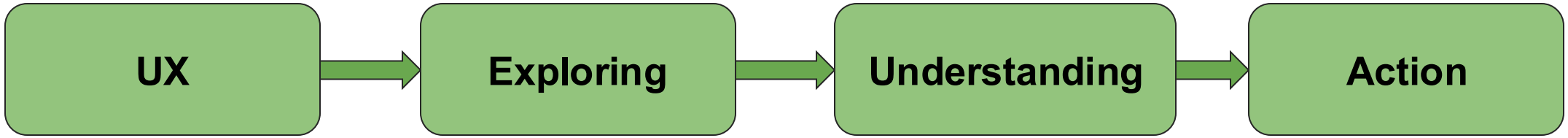
# Student-Led, Faculty-Guided (SLFG) Projects


- Part of MSU's Regional Economic Innovation (REI) program
- Supports student-led projects that address real challenges in Michigan communities
- Prioritizes the ALICE demographic (Asset Limited, Income Constrained, Employed) working families who struggle to afford basic needs
- Focus on economic development, especially in underserved regions
- Connects universities, industry, and local partners

# Where Data Science Stops and UX starts




- Semester long capstone projects can build prototypes NOT production.
- It is easy to build a Graphical User Interface (GUI). It is hard to build a good GUI.



# Expanding the Team

- Partnered with MSU UX program (Jeff Siarto)
- Used MSU REI funds to hire MSUX student (Deepak)

- Deepak's Role:
  - UX mentor for all capstone teams
  - Focused support for the JustAir project
  - Conducted a full usability and accessibility study

- Result:
  - Extended  all capstone student learning beyond analysis
  - Helped JustAir design a usable system Tow

Deepak Reddy Sannapareddy

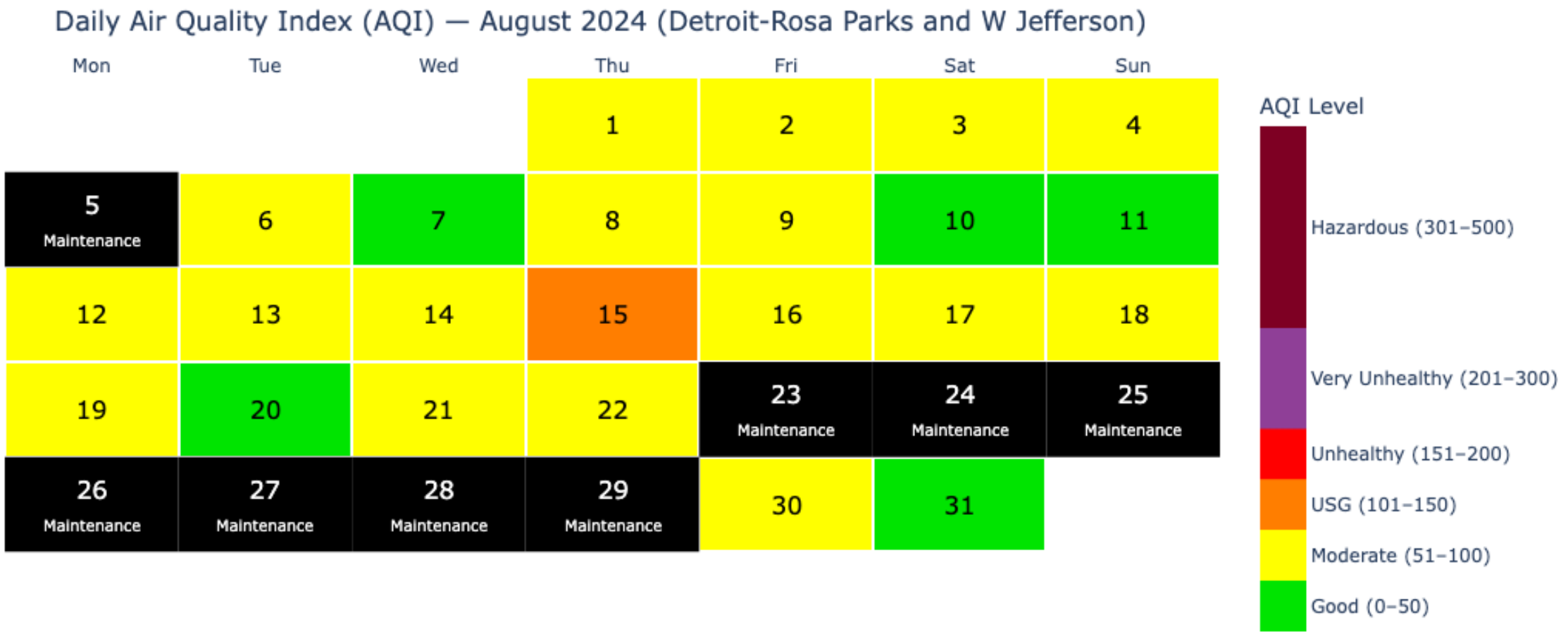
Jeff Siarto

# JustAir Capstone Team

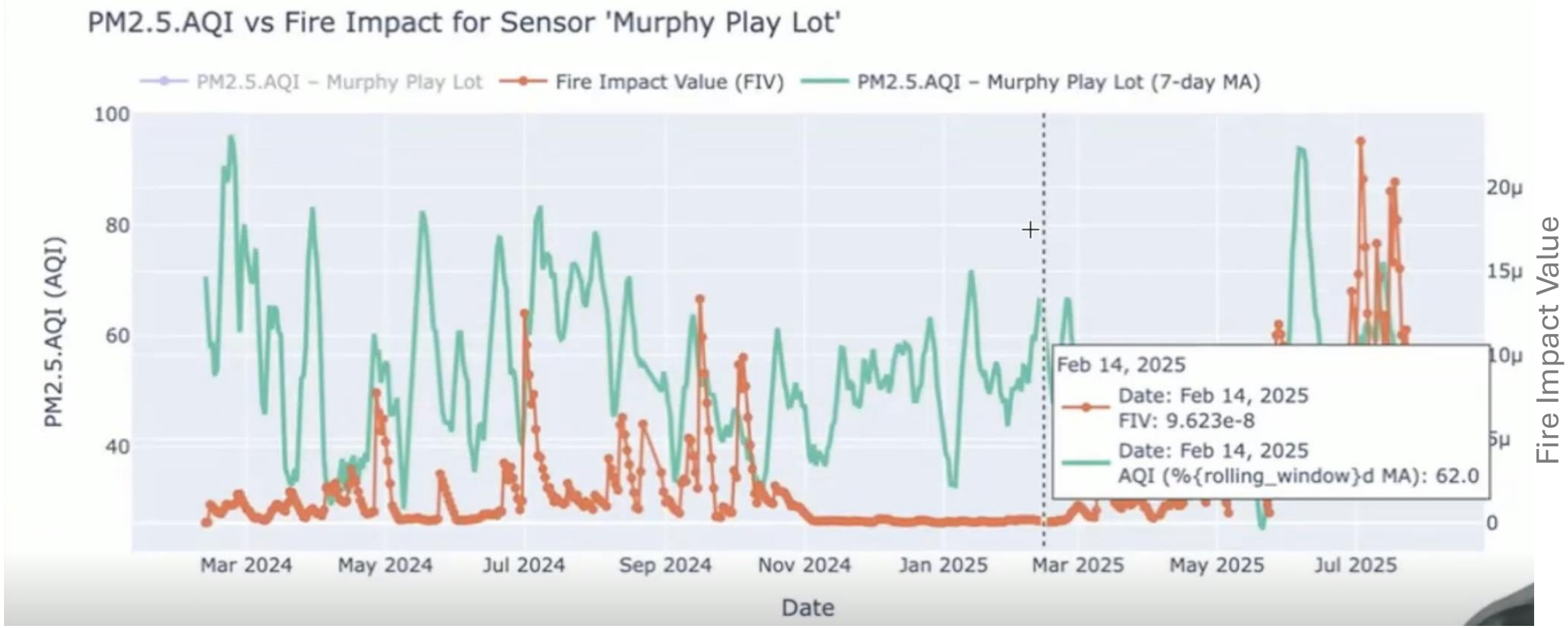
- Data visualization toolkit
  - Quality Calander
  - NASA Fire Data Website
  - Outlier Detection

Bhavya Jain, Adam Cooper,
Moumend Alaoui, River Mechstroth

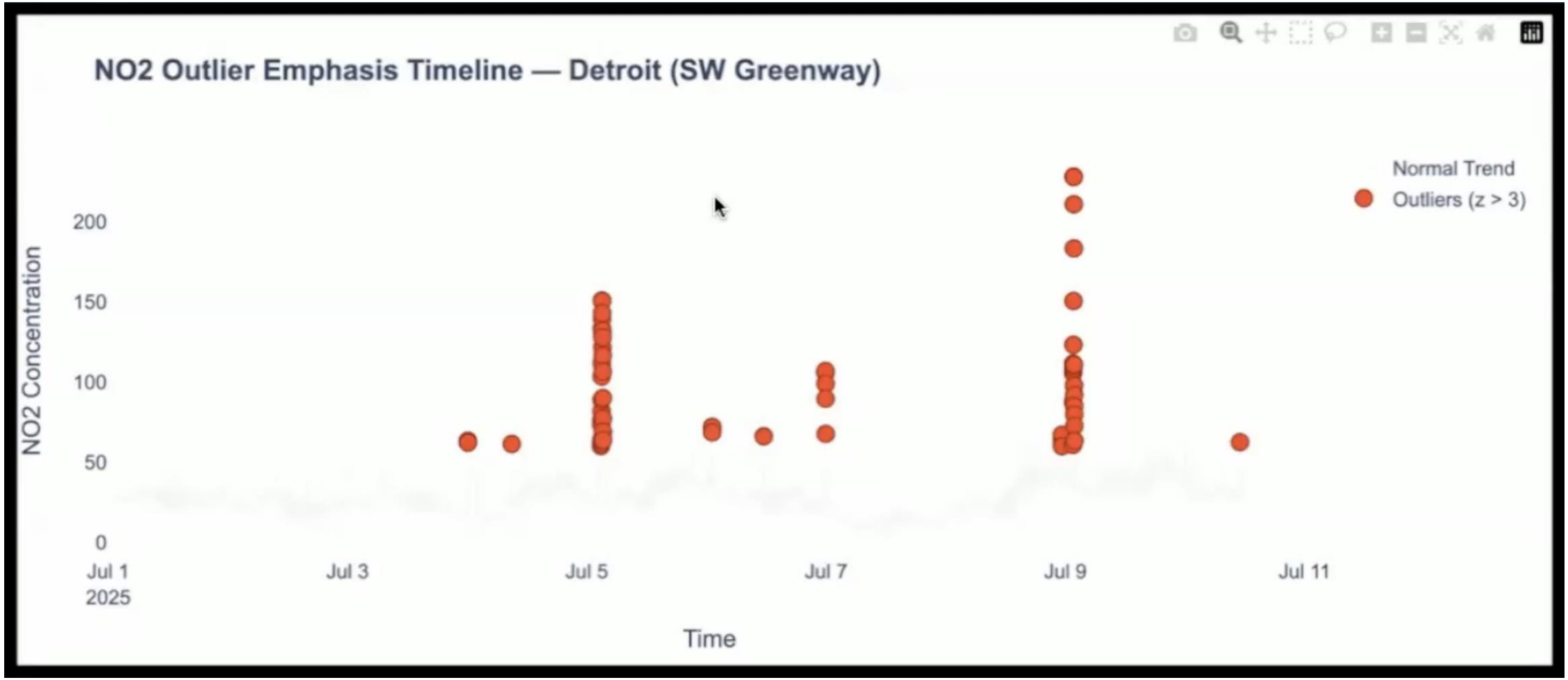
# Quality Calendar



# NASA Fire Data Website



# Outlier Detection



# What is Accessibility Testing?

- Accessibility testing checks whether your product can be
  - Perceived
  - Operated
  - Understood and
  - Reliably used

by people with disabilities. Guided by the Web Content Accessibility Guidelines (WCAG) standard (levels A/AA/AAA).

# Why Accessibility Testing?

It serves a huge audience. An estimated **1.3 billion people** (about 16% of the world) experience significant disability. Excluding them leaves users (and revenue) on the table.

W3C's WAI highlights that accessible products **extend market reach, enhance brand, drive innovation, and reduce legal risk**. Accessibility improvements often raise overall UX quality for everyone.

**It improves quality & performance.** Meeting WCAG typically pushes toward semantic HTML, keyboard support, captions, and better color usage. Patterns that can improve usability, SEO, and maintainability

# Deepak Accessibility Study

## Audit Strategy & Outcomes

**The Objective:** Conduct a comprehensive evaluation to ensure an inclusive, accessible, and frictionless experience for all users.

- Benchmarked strictly against WCAG 2.1 AA guidelines, looking beyond basic compliance to true usability.
- Utilized a hybrid testing model, bridging the gap between automated algorithmic scanning and real-world manual testing.

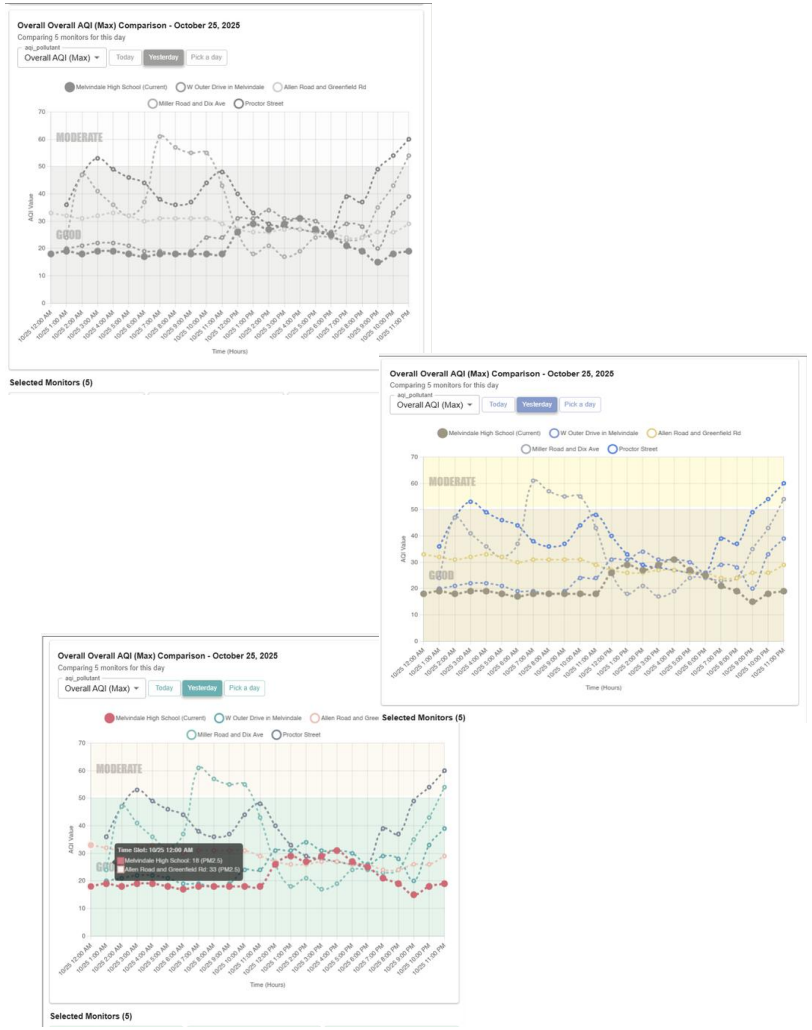
Successfully identified, documented, and prioritized 83 actionable UX improvements across accessibility, clarity, and interaction design.

# Deepak Accessibility Study

## Testing Framework & Tooling

Leveraged Google Lighthouse and Axe for baseline code, contrast, and performance analysis.

- Conducted extensive manual testing using the ChromeVox screen reader to ensure context wasn't lost for visually impaired users.
- Mapped and tested core pathways exclusively using keyboard-only traversal to identify focus trapping, missing labels, and logical flow issues.
- Performed in-depth color comparisons and ran UI simulations for four distinct types of color vision deficiencies (Protanopia, Deuteranopia, Tritanopia, and Achromatopsia).



# Deepak Accessibility Study

## Key Insights & Examples

| AQI value | AQI category | AQI color |
|---|---|---|
| 0–50 | Good | Green |
| 51–100 | Moderate | Yellow |
| 101–150 | Unhealthy for Sensitive Groups | Orange |
| 151–200 | Unhealthy | Red |
| 201–300 | Very unhealthy | Purple |
| 301–500 | Hazardous | Maroon |

- Color-blindness simulations revealed that the standard EPA color palette caused "Good" (green) and "Moderate" (yellow) Air Quality Index levels to be completely indistinguishable for certain users. To resolve this, we redesigned the core color palette to establish clear contrast and full accessibility for everyone.
- Manual ChromeVox testing revealed that invalid ARIA attributes (like role="group") caused screen readers to completely skip or misread the primary pollutant data cards, stripping away crucial context.
- Sequential tabbing highlighted non-interactive UI background containers. This created false affordances that severely slowed down navigation for keyboard-only users.

# Reducing Visual Clutter

Streamlined the axes and grid system to make the data easier to read:

X-axis labels now appear **every 5 hours** instead of every hour.

Y-axis labels appear only at **standard AQI thresholds (50, 100, 150, etc.)**.

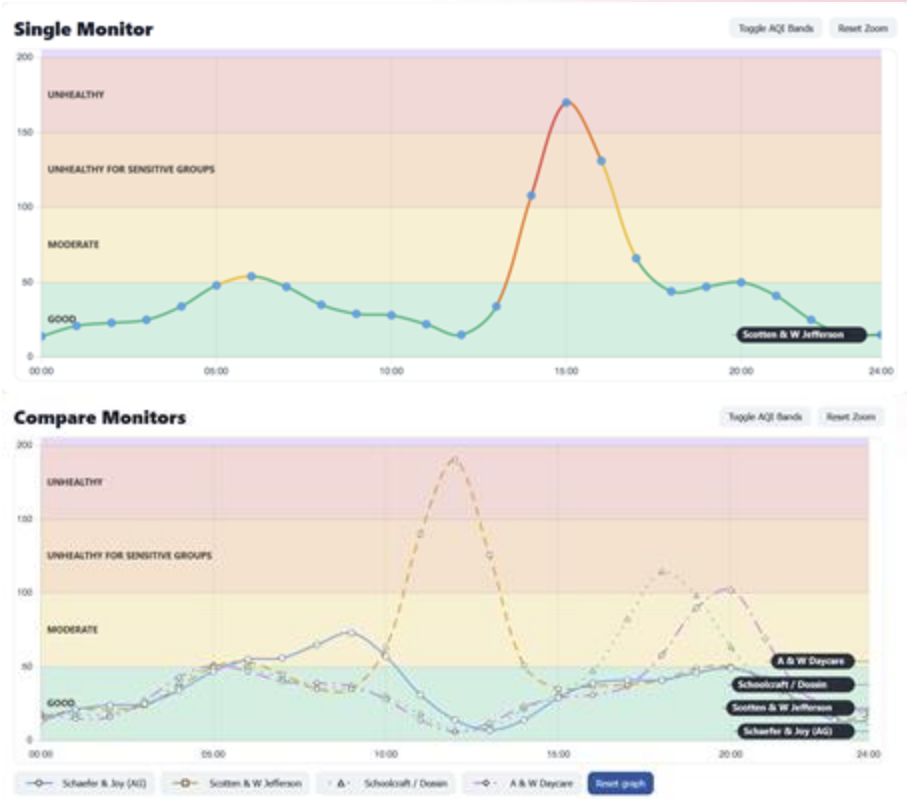
**Grid lines are removed** from the default view and only appear on hover or click.

Each **plotline is labeled directly on the line itself**, so users don't have to look back and forth between the chart and the legend.

These changes significantly improve readability and reduce visual clutter.

## Default View


## Hover / Clicked View



# Core layout features

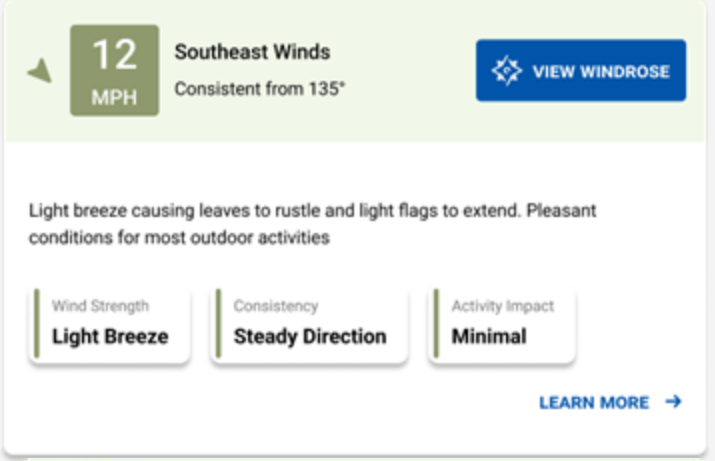
Wind **speed and direction** are displayed upfront for immediate clarity.

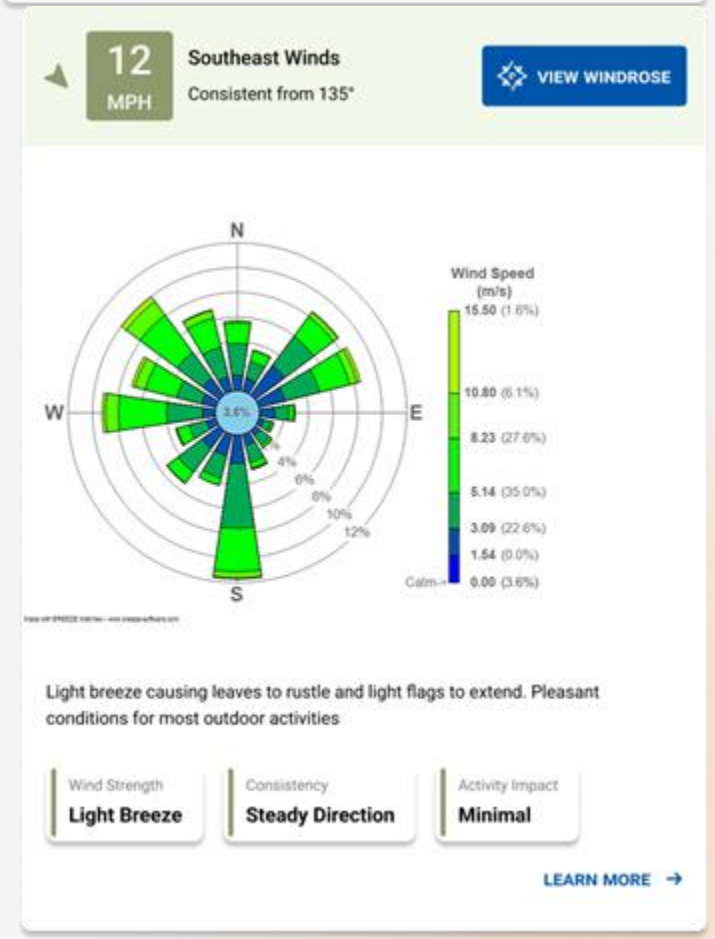
A **contextual message** accompanies the speed and direction, giving users a quick sense of current conditions.

Below that, there's **extra context about wind behavior**

A **button reveals the full window**, catering to **expert users** or those who want deeper insights.

This allows users to **see real wind behavior scenarios**, including more complex situations that may not be obvious at first glance.



# The Team

Justin Gambrell & Dirk Colbry

Bhavya Jain, Adam Cooper,
Moumend Alaoui, River Mechstroth

Deepak Reddy Sannapareddy

Jeff Siarto

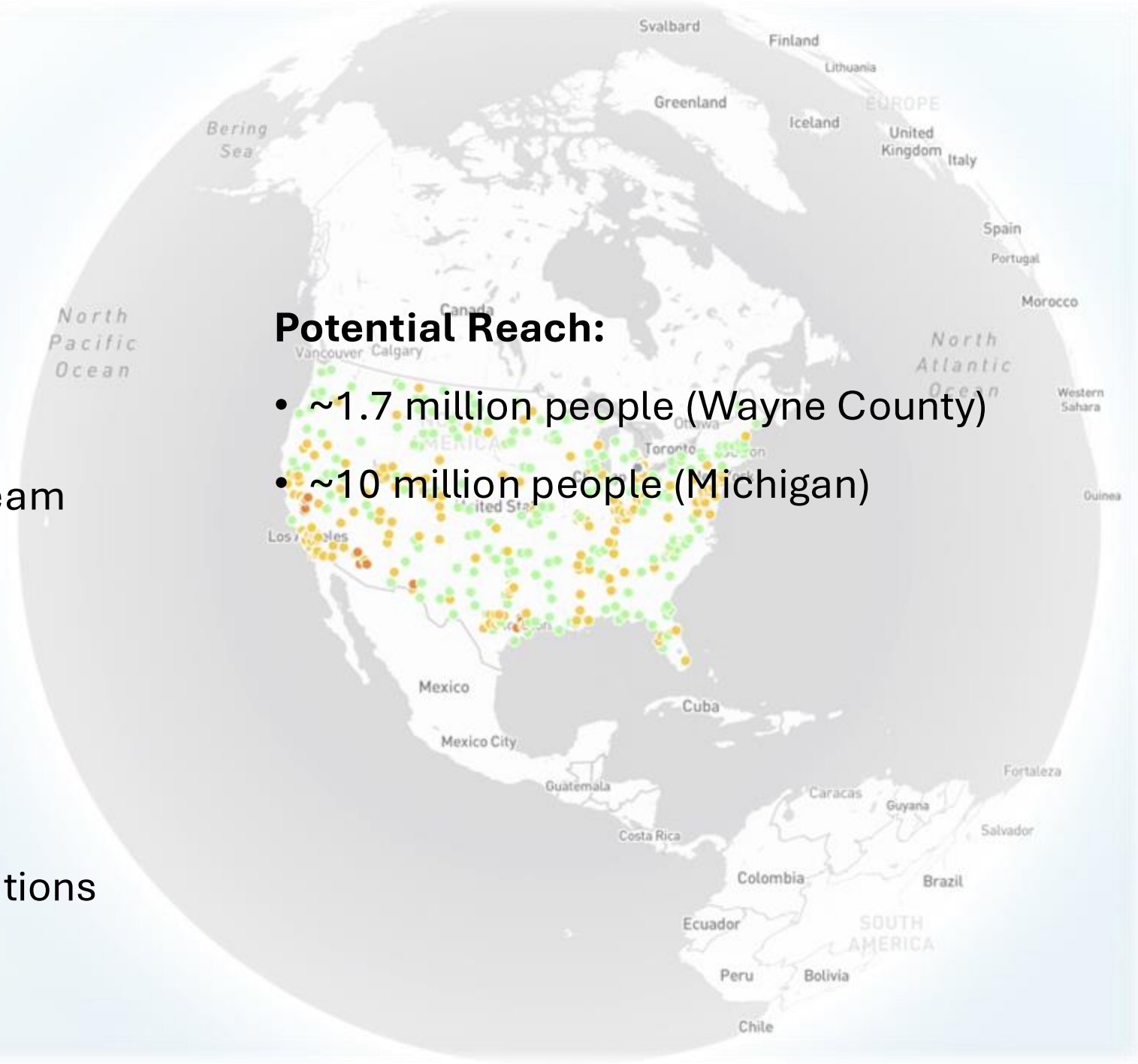
# The Impact

**People:**

- 26 students in capstone
- 4 students on JustAir  capstone team
- 1 MSUX student (Deepak)
- 3 Faculty (Dirk, Justin and Jeff)

**Work Produced:**

- Data visualization toolkit
- 83 UX improvement recommendations




**Potential Reach:**

- ~1.7 million people (Wayne County)
- ~10 million people (Michigan)

# Questions?

cmse_capstone@msu.edu