

AQTreks (AirQualityTreks)

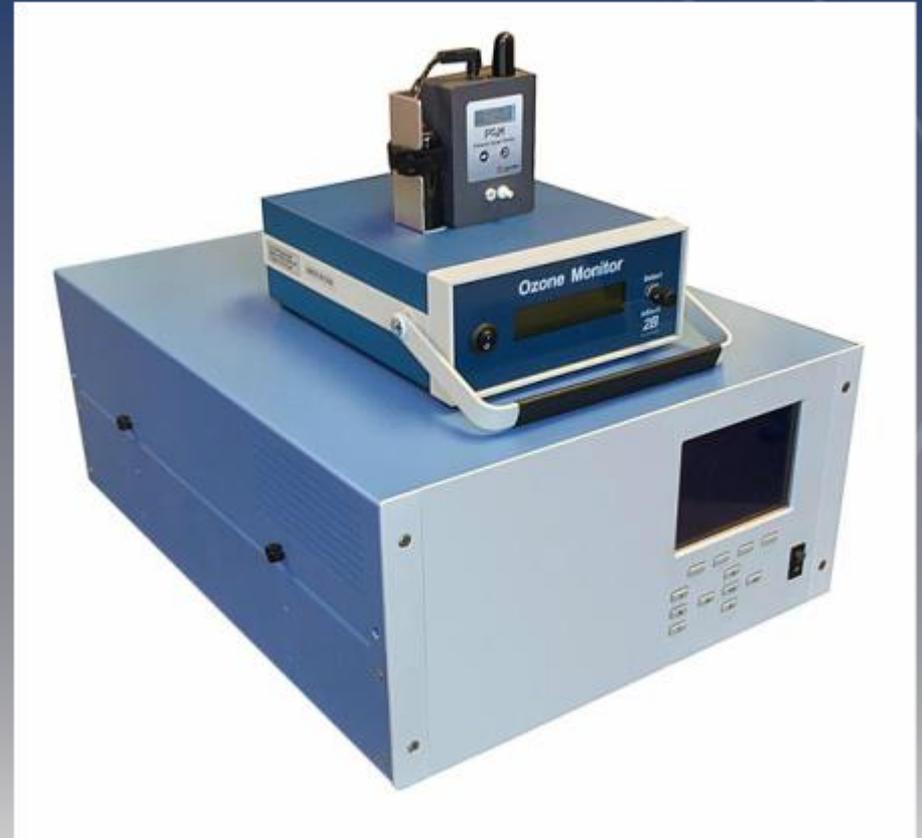


Topics

1. A short history of the evolution of AQTreks
2. AQTreks technology
3. The use of AQTreks in schools
4. The planned use of AQTreks in informal learning settings

2B Technologies

- Founded by Dr. John Birks, an atmospheric chemist in 2000, to miniaturize instruments used to make atmospheric measurements



Global Ozone (GO3) Project

- Founded in 2009 by Dr. Birks to get students involved in air pollution monitoring
- >100 Schools participating around the world
- Ground level ozone measurements uploaded every 15 minutes
- Free curriculum on GO3 website
- Social Network like Facebook where students discuss their data and environmental issues

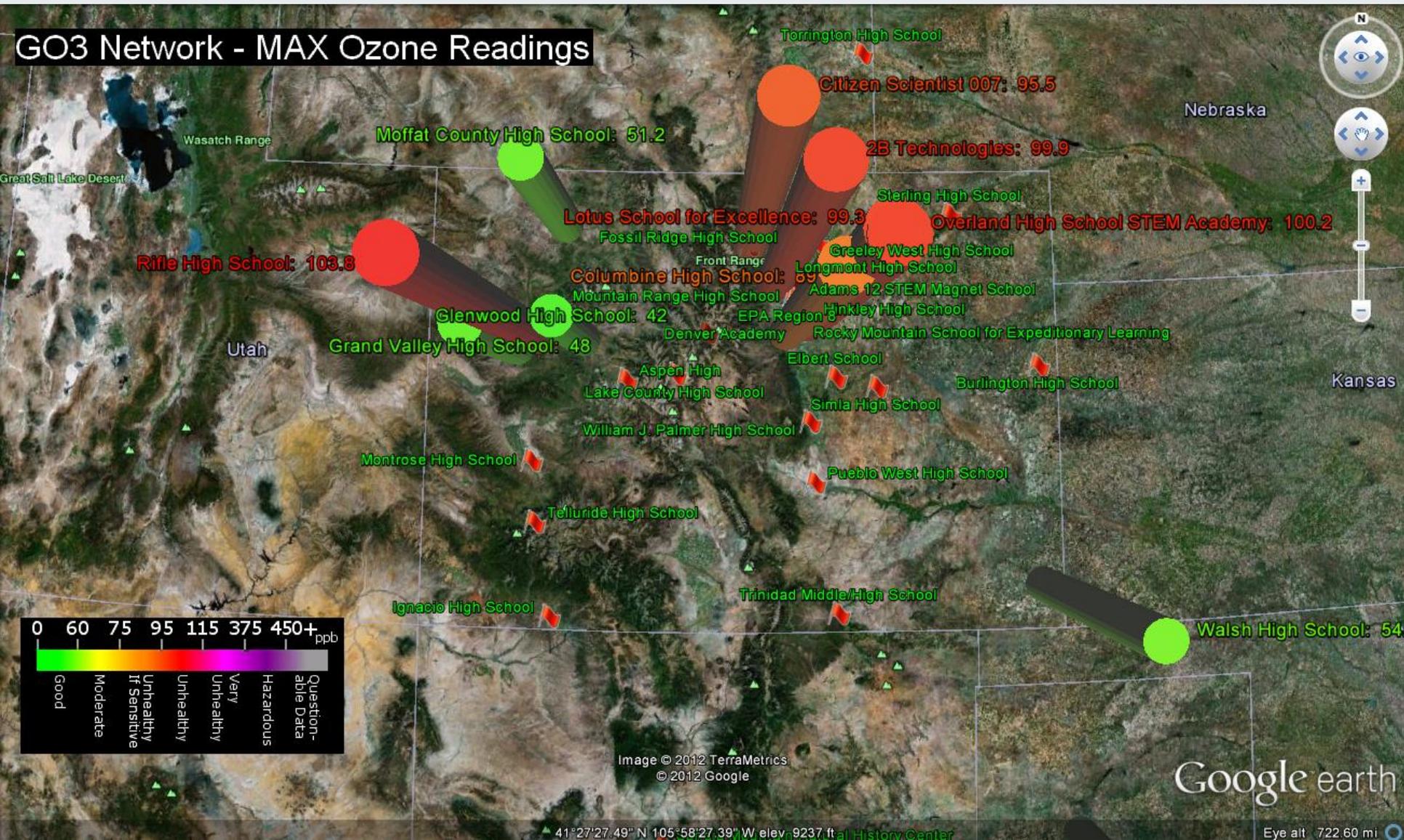




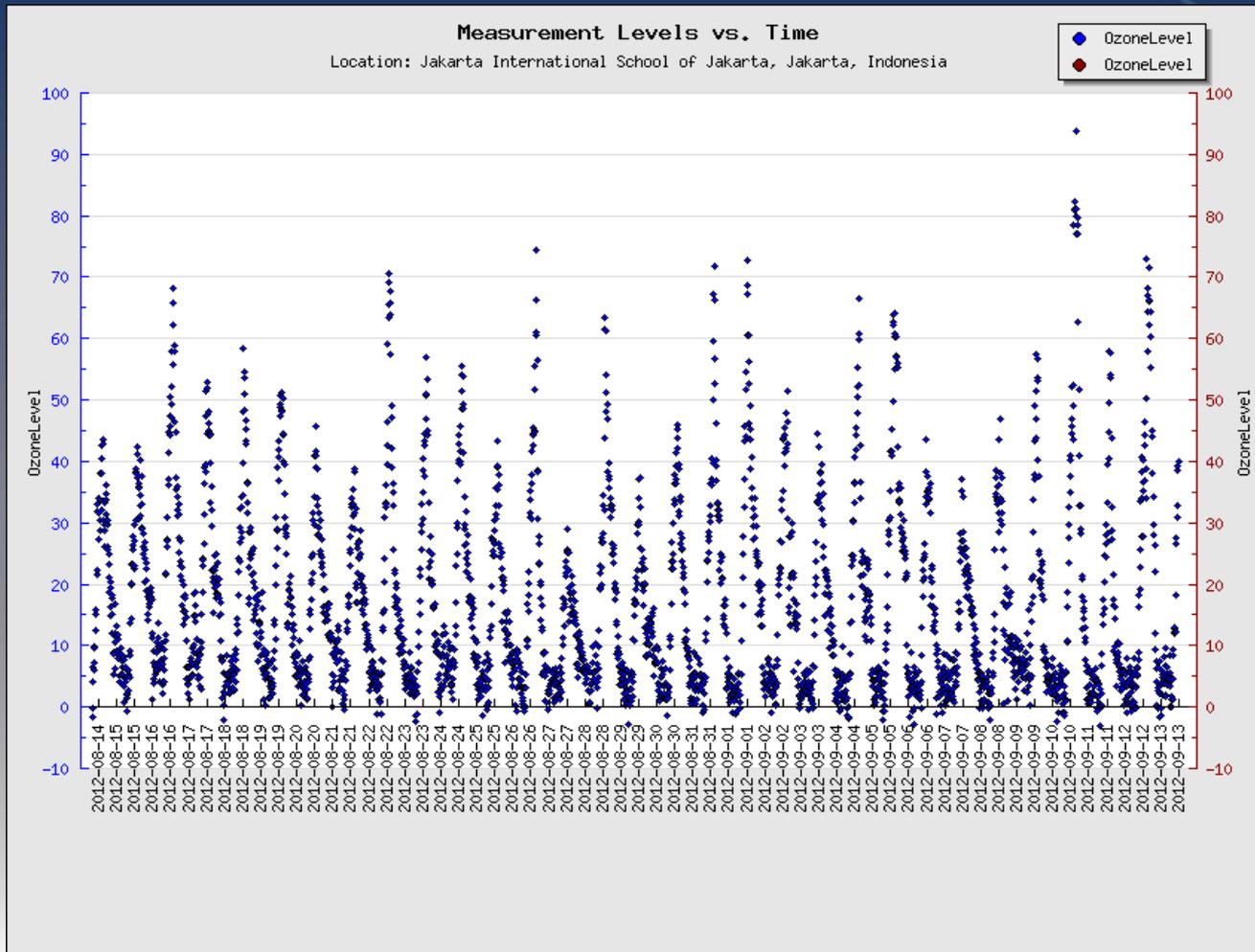
GO3 Project Participating Schools



GO3 Project's Ozone Data on Google Earth



Online Graph of Jakarta, Indonesia's Ozone Data



Lessons Learned from the GO3 Project

- Teachers and students are very interested in making air pollution measurements!
- However, after about one year, teachers and students seemed to lose interest
 - Students checked their data less frequently and participation on the social network declined
 - Schools were not able to maintain the instruments and stopped uploading data

Lessons Learned from the GO3 Project

- Students and teachers became increasingly interested in making mobile measurements
- Providing instruments for a shorter time period would result in higher quality participation

NIEHS SBIR Phase I – GO3 Treks

- Newly developed technology made mobile monitoring possible
- Phase I demonstrated the feasibility of students making mobile measurements
- 105 schools participated in “GO3 Treks”, measuring ground level ozone and black carbon
- Approximately 5,000 students participated and uploaded about 500 Treks

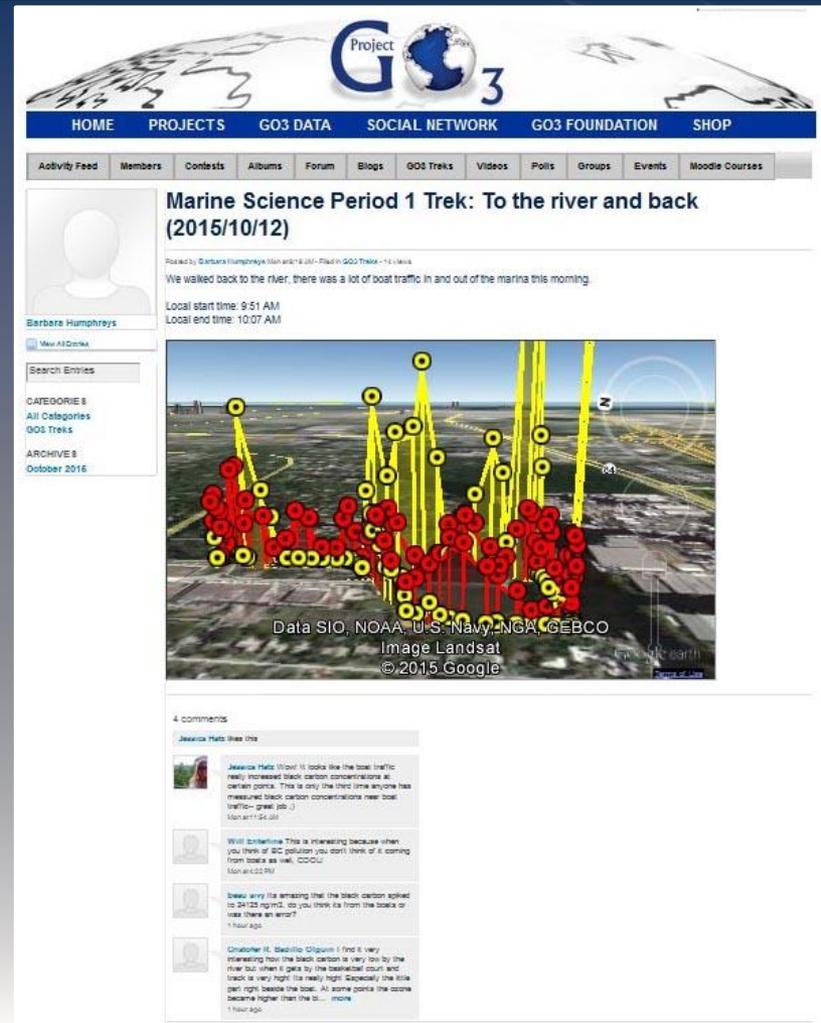


NIEHS SBIR Phase I

- Schools received the POM and MicroAeth for two weeks
 - Teachers signed up to participate after receiving emails describing the project
- Students completed Treks of their own design
- The students connected the instruments to their computer and 2B software transferred the data to the computer and uploaded the data online

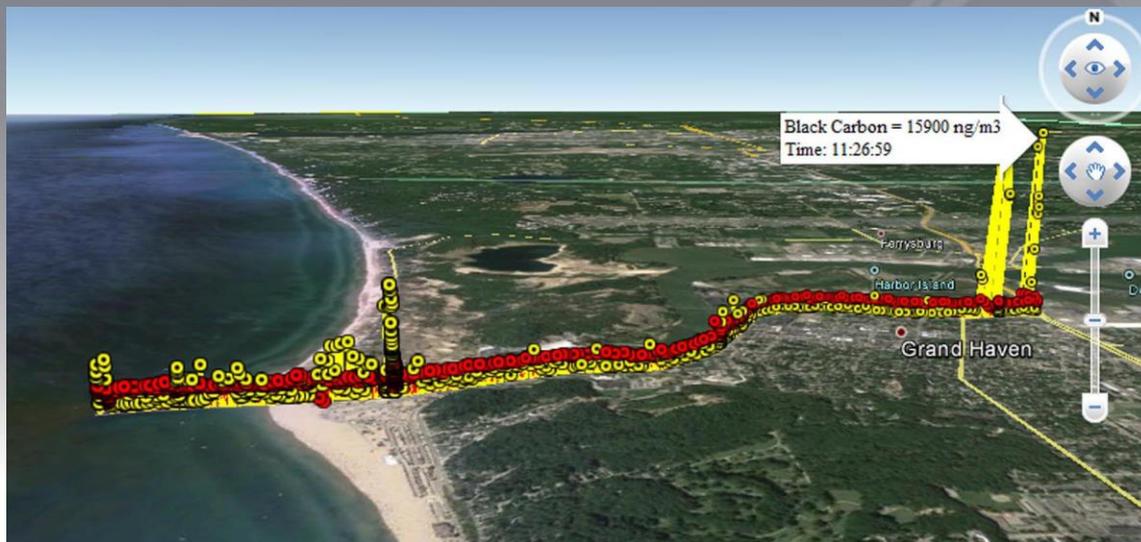
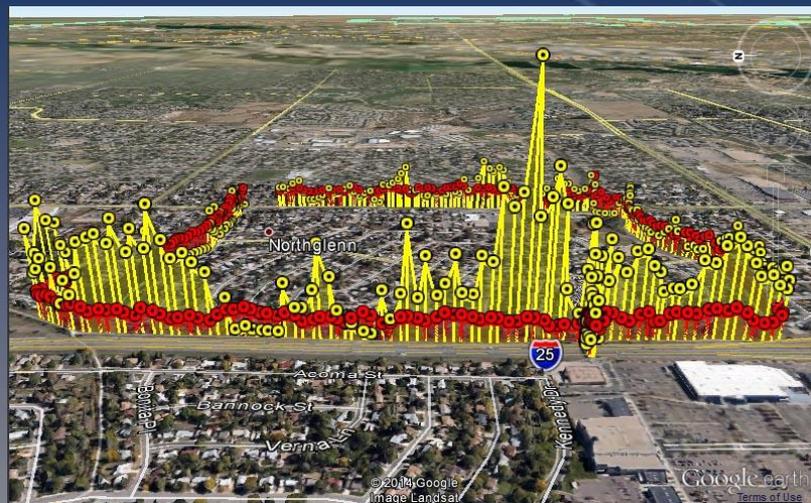
NIEHS SBIR Phase I – GO3 Treks

- In GO3 Treks, data were displayed on Google Earth within a blog where students, teachers and scientists could discuss the results



The screenshot shows a web page for Project GO3. The header includes navigation links: HOME, PROJECTS, GO3 DATA, SOCIAL NETWORK, GO3 FOUNDATION, and SHOP. Below the header is a secondary navigation bar with links: Activity Feed, Members, Contests, Albums, Forum, Blogs, GO3 Treks, Videos, Polls, Groups, Events, and Moodle Courses. The main content area features a blog post by Barbara Humphreys titled "Marine Science Period 1 Trek: To the river and back (2015/10/12)". The post text reads: "We walked back to the river, there was a lot of boat traffic in and out of the marina this morning." It includes a timestamp: "Local start time: 9:51 AM" and "Local end time: 10:07 AM". A central image shows a Google Earth view of a marina with numerous red and yellow circular markers and vertical lines indicating data points. The image is credited to "Data SIO, NOAA, U.S. Navy, NGA, GEBCO Image Landsat © 2015 Google". Below the image, there are 4 comments from users like Jessica Hartz, Will, and others, discussing the data points and boat traffic.

Example GO3 Treks



Survey Results

- Over 3,000 survey responses were received from students
- 26 survey responses were received from teachers about their experience with GO3 Treks
- Teachers utilized GO3Treks in many subject areas, including:
 - AP Environmental Science
 - AP Biology
 - AP Geography
 - Biology
 - Biochemistry
 - Chemistry
 - Earth Science
 - Environmental Science
 - Geography
 - Principles of Engineering

Survey Results

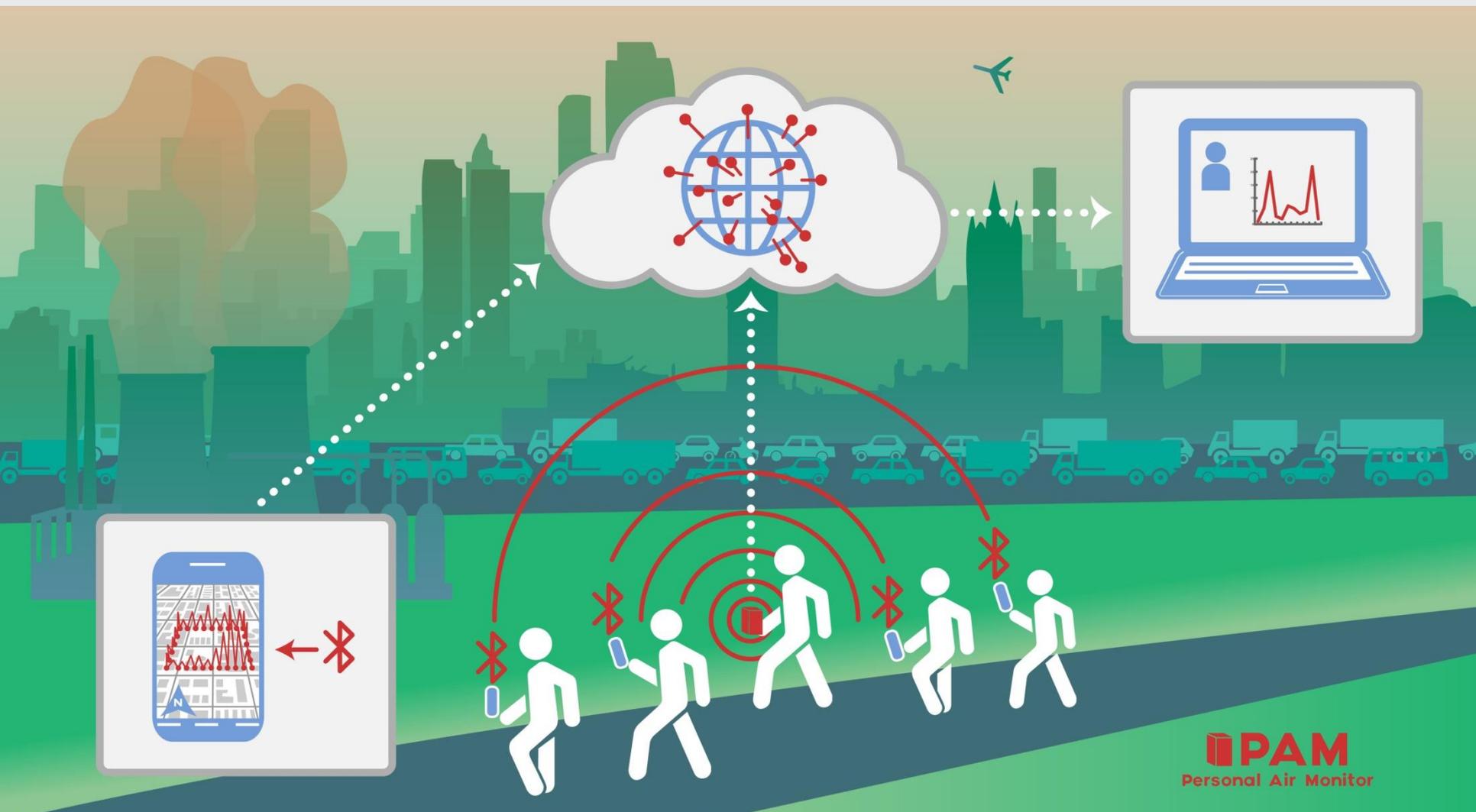
- The number one conclusion we gathered from the students and teachers is that they found great value and enjoyment in *collecting and analyzing REAL data*

“For some reason my students were much more interested in this data than in the data we collect in the lab” -Teacher

Survey Results

- 100% of teachers reported that their students enjoyed GO3 Treks
- Students consistently responded with two favorite aspects of GO3 Treks:
 - They were able to get out of the classroom, go outside, explore, and collect data!
 - They loved seeing their data online in Google Earth and analyzing it in comparison with other schools' data
- Teachers suggested that the project be made to engage more students in the data collection process

NIEHS SBIR Phase II: From GO3 Treks to AQTreks



Personal Air Monitor™ (PAM™)



Sensor	Air Pollutant
Alphasense (HMOS)	CO
Telaire T6713 (NDIR)	CO ₂
Plantower PMS1300 OPC	PM _{1.0} , PM _{2.5} , PM ₁₀
Temperature, Pressure, Relative Humidity	[Blank Cell]

Sensors and Data Quality

- Commitment to maintain high data quality partially dictated the current model
 - The PAM is currently available only for rental, not yet for purchase
 - The PAM is calibrated between rentals
- The data undergo a QA algorithm in the database
- Data from the nearest government monitoring station are shown in the app for comparison purposes

AQTreks in Schools

- Schools select a two week time slot and the PAM is sent during their chosen time
- The school has access to our online Moodle curriculum, including Trek planning ideas and lesson plans
- Teachers choose when and how to implement the project
- 2B Technologies provides full technical support

AQTreks App

- The App is able to:
 - Connect to multiple PAMs
 - Display data graphically and on a map
 - Show data from the nearest EPA station
 - Automatically upload data from Treks to the website via 3G or WiFi
 - Accept user comments during the data collection process



AQTreks Website



The screenshot displays an aerial view of an industrial or commercial area with several large buildings and parking lots. A prominent red path, composed of a series of red spheres connected by a semi-transparent red ribbon, winds through the site. In the top right corner, there is a navigation bar with icons for search, home, globe, map, and help. Below the map, the text "NO COMMENTS" is visible. At the bottom, a legend titled "Conditions" lists various data points with corresponding colored circles: CO2 (light blue), A2 (green), A4 (light purple), Pres (dark purple), PM25 (red), bVolt (pink), PM1 (light green), PM10 (orange), A1 (yellow), A3 (brown), Temp (blue), and Hum (light blue).

NO COMMENTS

Conditions

- CO2
- A2
- A4
- Pres
- PM25
- bVolt
- PM1
- PM10
- A1
- A3
- Temp
- Hum

AQTreks Website

- A story makes data come alive
 - The data are again, like in GO3 Treks, displayed in a blog where others can comment on the data
 - Feedback from GO3 Treks helped solidify the idea that:
 - The website cannot simply house the data; the data need to tell a story
 - Teachers and students valued the interactive nature of the way the data were displayed
 - The data need to be presented in a format that draws students in and captures their attention

Example Studies

- Examples of things students can study:
 - Carbon dioxide levels inside classrooms
 - Particulate levels behind vs. in front of a tree barrier
 - Carbon monoxide and particulate levels during drop off and pickup
- Data empowers students to make change and explore environmental justice issues

AQTreks in School Year 2017-2018

- Indiegogo campaign provided funding for 60 US schools in the fall 2017 semester
- We are seeking to sell directly or raise funding for approximately 100 schools to participate in spring and summer of 2018

AQTreks in Informal Learning Settings

- AQTreks will be piloted in the fall in two informal learning settings:
 - Denver Museum for Nature and Science
 - DMNS is interested in using AQTreks in their summer science camps and possibly for museum visitors
 - Denver Botanic Gardens
 - AQTreks will be demonstrated in their Science Pyramid this fall
- Boulder Public Library is the next target for AQTreks in informal learning settings

Conclusion

- When implementing STEM projects in classrooms where teachers have major time constraints, several things seem to be critical:
 - Short project duration (but can be recurring)
 - REAL data collection
 - Ease of data capture and upload (provide VIDEOS that describe how to execute the project)
 - Each student must be actively involved in the data collection process
 - Display of data on a map
 - A lasting online repository for the data
 - A real-world application
 - Encouragement for students to tell a story with their data
 - Providing the opportunity to interact with other students' data

Thank you!



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