

From the Ground to the Cloud: Big data analytics for air quality

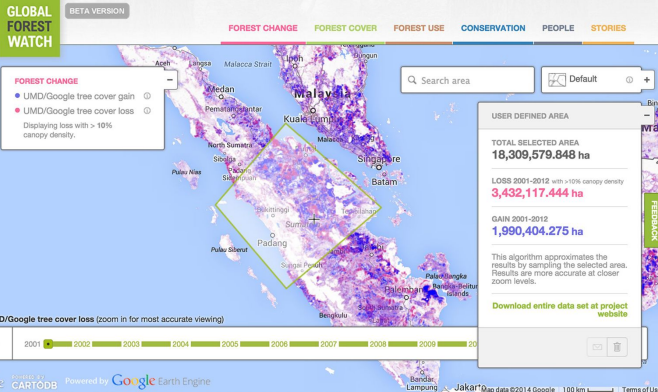


Air quality data from Google / Aclima

Karin Tuxen-Bettman
Program Manager

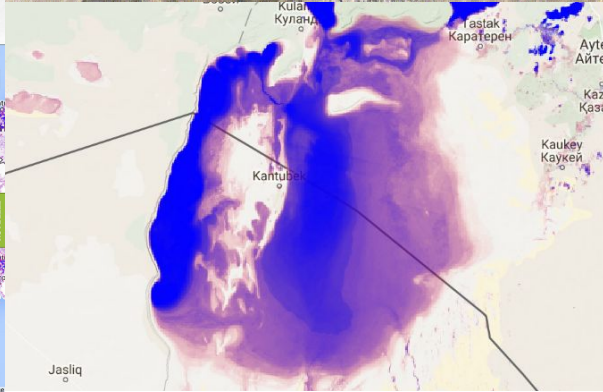
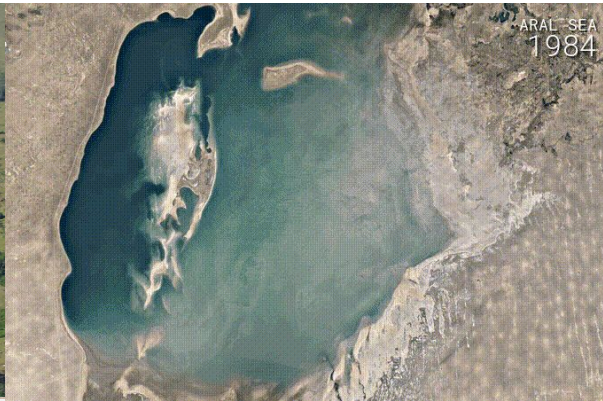
Google Earth

Monitoring deforestation



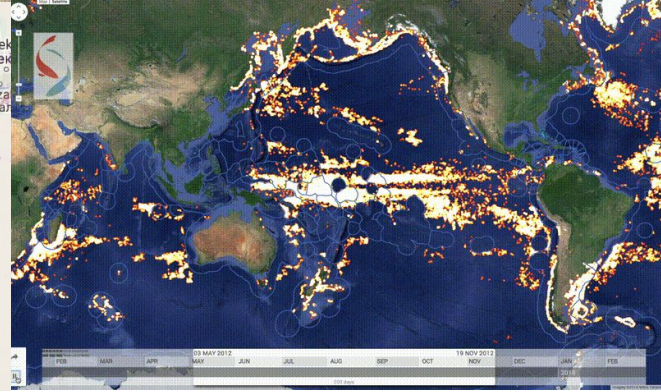
globalforestwatch.org/map

Mapping surface water over time

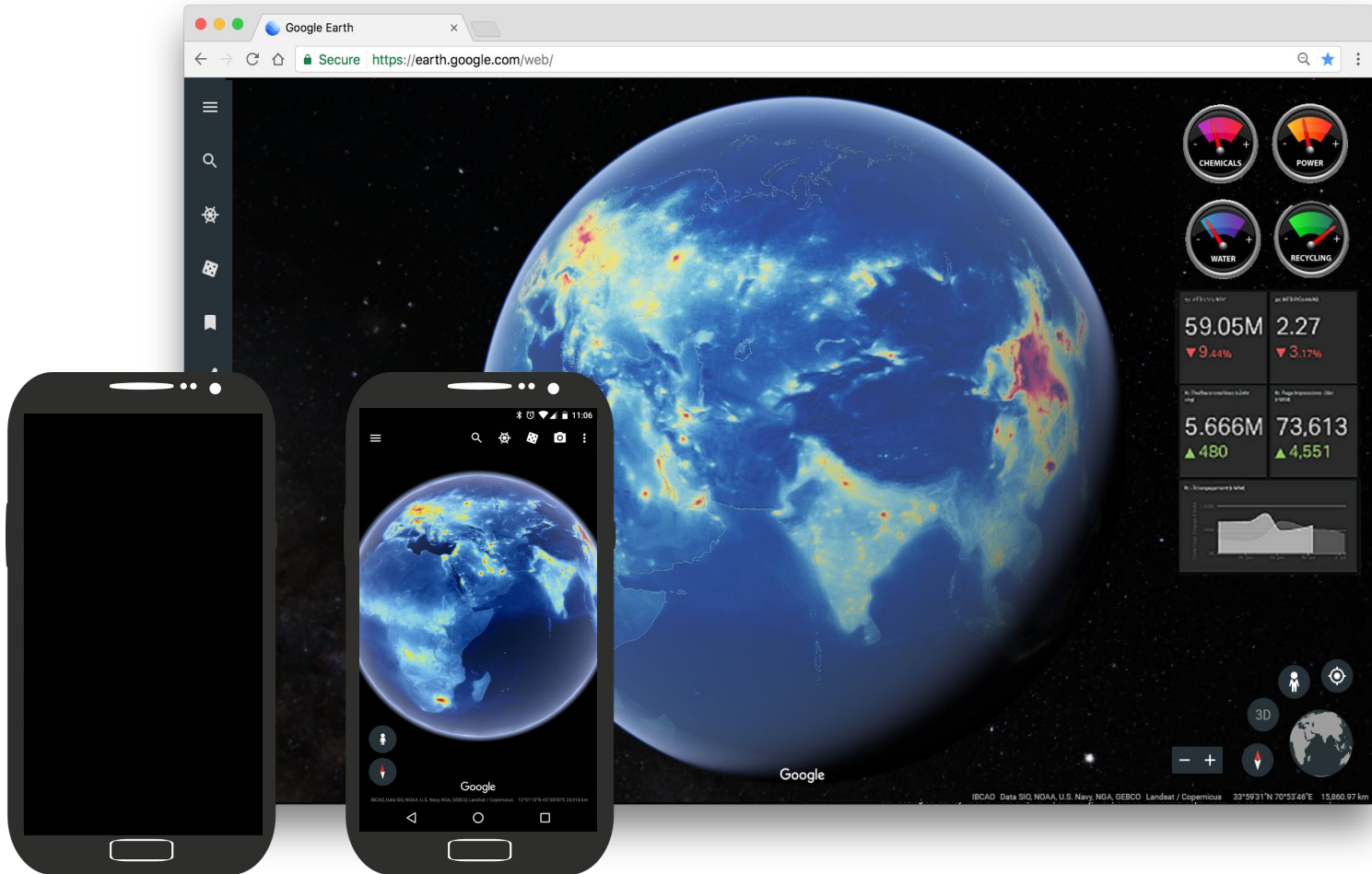


global-surface-water.appspot.com

Tracking fishing activity



globalfishingwatch.org



Source: <https://www.nasa.gov/topics/earth/features/health-sapping.html>



Clean Ride Mapper

Informing cyclists on Air Quality in Montreal

[Français](#)

[Disclaimer and background information.](#)

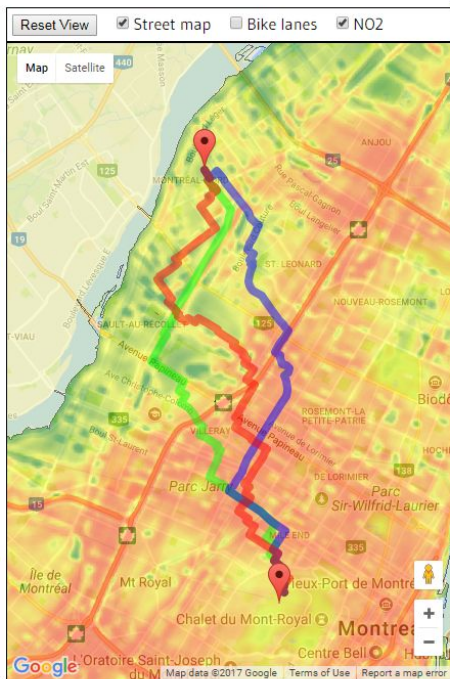
Click on the map to define the origin and destination of your trip.

In addition to the shortest route, two other routes will be shown. The cleanest route is the one over which cumulative exposure to NO2 (in kilometers times parts per billion, km.ppb) would be the lowest. The quietest route is the one over which the least amount of traffic would be encountered. The table below summarizes how each route scores on the different criteria. The traffic measure estimates the number of vehicles encountered along a route.

Additional clicks will extend the route.

		Shortest Route	Cleanest Route	Quietest Route
<input type="button" value="Clear"/>				
Length	Total (km)	14.76	15.03	17.08
NO2	Cumul. (km.ppb)	207.05	183.16	220.92
	Avg (ppb)	14.03	12.19	12.93
Traffic	# Vehicles	3017.95	3974.43	893.82

[Current Air Quality in Montreal](#)



Clean Ride Mapper

Informing cyclists on Air Quality in Montreal

[Français](#)

[Disclaimer and background information.](#)

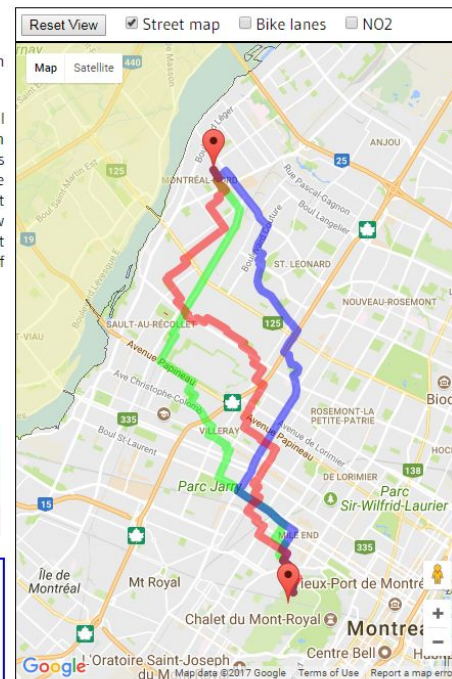
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[Current Air Quality in Montreal](#)



Source: <http://traq-research.mcgill.ca/cycleapp/montreal/index.html>

“The Cloud”

Devices deployed by cities, universities, and companies



Wearables & Portable consumer devices



...and other mobile fleets



Street View cars

Government & regulatory monitoring stations





public data

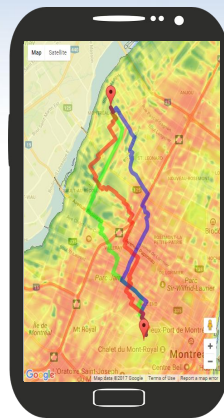
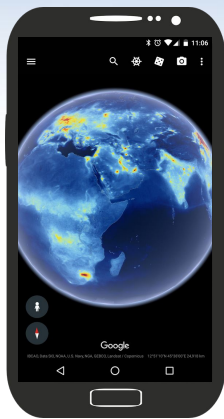
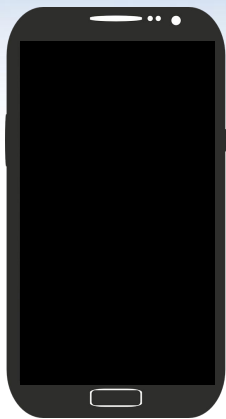
public data

public data

Other people's shared data

your own private data

"The Cloud"





Sensors

GPS

Wind anemometer

Scientific-grade equipment:
Methane (CH₄)

Air input tube

Boston

[About leaks in Boston](#)

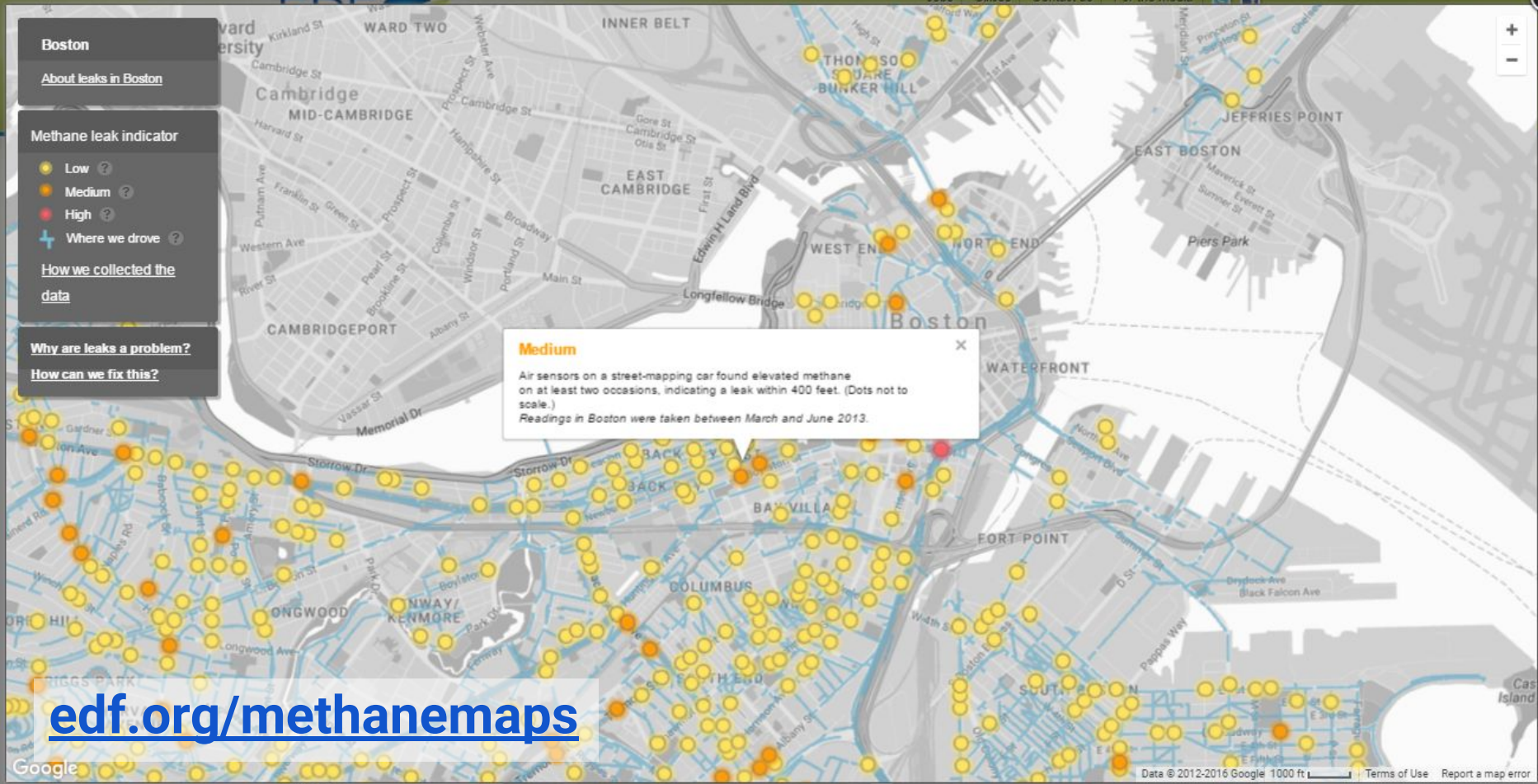
Methane leak indicator

- Low ?
- Medium ?
- High ?
- + Where we drove ?

[How we collected the data](#)

[Why are leaks a problem?](#)

[How can we fix this?](#)



Medium

Air sensors on a street-mapping car found elevated methane on at least two occasions, indicating a leak within 400 feet. (Dots not to scale.)
 Readings in Boston were taken between March and June 2013.

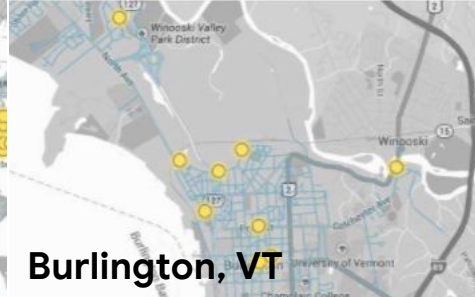
edf.org/methanemaps



Birmingham, AL



Boston, MA



Burlington, VT



Chicago, IL



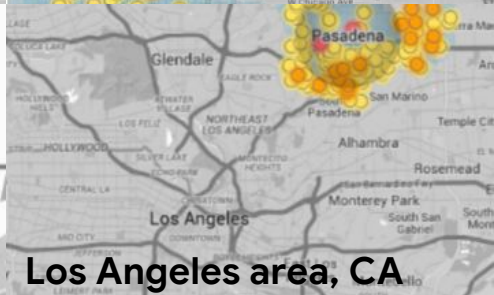
Dallas, TX



Indianapolis, IN



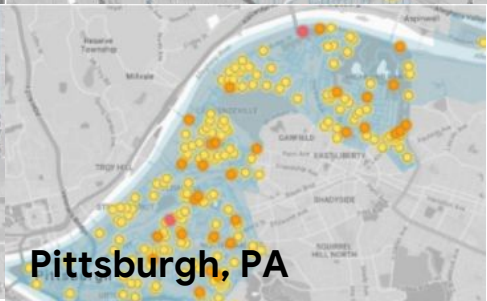
Jacksonville, FL



Los Angeles area, CA



Mesa, AZ



Pittsburgh, PA

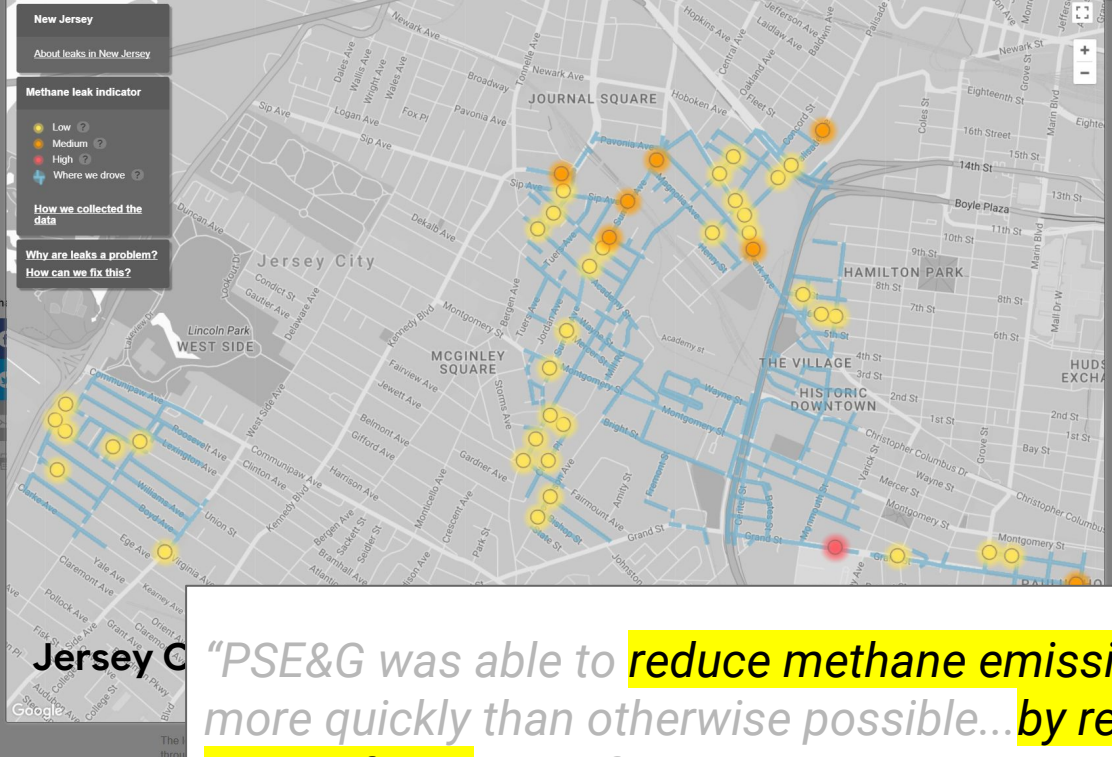


Staten Island, NY



Syracuse, NY

and its partners, Google Earth Outreach and Colorado State University. Using cutting-edge spatial analytics methods developed by scientists at



Jersey C

“PSE&G was able to **reduce methane emissions...by 83%**, and do it more quickly than otherwise possible...**by replacing 35% fewer miles of pipe** than if the utility had not used the data.”

edf.org/methanemaps

NEWSROOM /

Media Contacts

Press Releases

Social Media

Investor Relations

PSEG in the Community

Directions to PSEG Headquarters

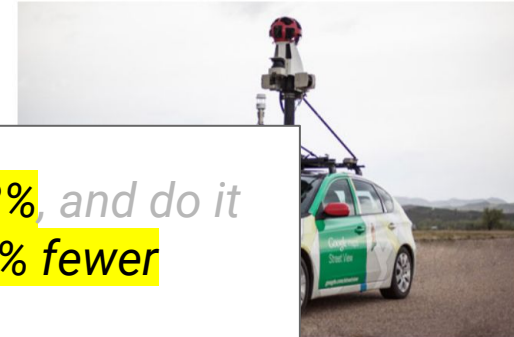
December 13, 2016



PSE&G Teams with Google, EDF to Stop Methane Leaks

Google Cars Mapped and Measured Methane Escaping from Natural Gas System; Unique Approach Helps Focus \$905 Million Infrastructure Investment; Utility Achieves Big Methane Cut with One-Third Fewer Miles of New Pipe

(Newark, N.J. – December 13, 2016) Working closely with Environmental Defense Fund and Google Earth Outreach, Public Service Electric & Gas (PSE&G), New Jersey’s largest utility, is reducing methane leaks from its natural gas distribution system much faster than before, thanks to new technology developed by EDF, Google and Colorado State University. The technology is helping the utility prioritize which aging pipes are replaced first during its three-year, \$905 million gas infrastructure replacement program.



...as escaping, and not just the number of leaks. PSE&G was able to reduce methane emissions from targeted areas by 83 percent, and



- Scientific-grade equipment:**
- PM 2.5
 - Ultrafine PM
 - Black Carbon
 - Carbon Dioxide (CO₂)
 - Carbon Monoxide (CO)
 - Nitric Oxide (NO)
 - Nitrogen Dioxide (NO₂)
 - Ozone (O₃)

Oakland study released



Black Carbon in Oakland, CA
(from diesel trucks and other sources)
www.edf.org/airqualitymaps



Apte et al 2017. "High-Resolution Air Pollution Mapping with Google Street View Cars: Exploiting Big Data" Environmental Science & Technology.

Launch of California data in November

Request access: <https://goo.gl/EJMcCD>

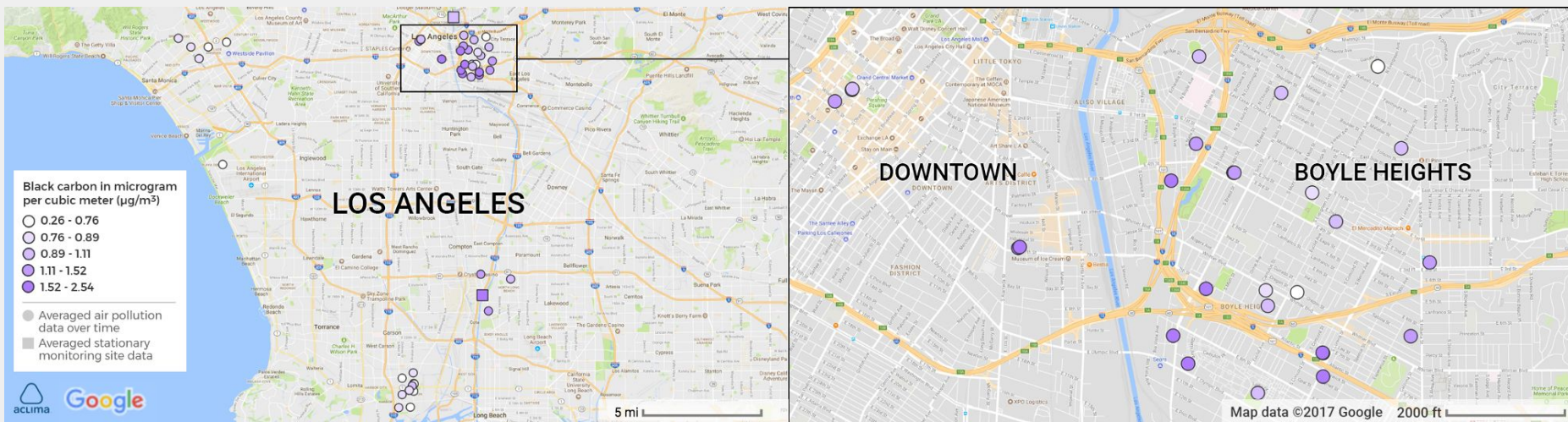


Air quality data from Google / Aclima

Los Angeles

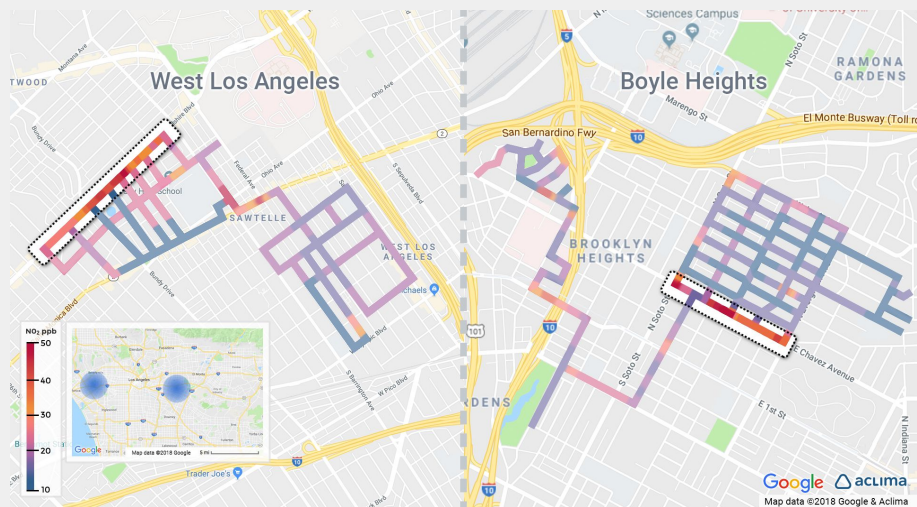


Google Earth



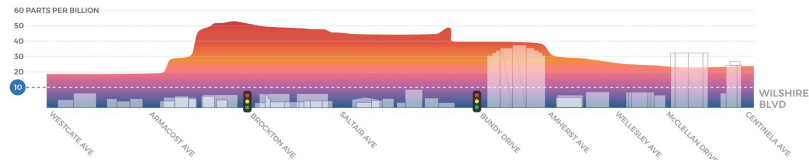
- We drove over our three month period in Los Angeles.
- Mean black carbon concentrations measured within 500 m around schools.
- Schools further from the coast tend to have higher levels of black carbon.
- Downtown and Boyle Heights stand out as the regions where we measured the highest levels of black carbon nearby schools. Boyle Heights is surrounded by four freeways, and is located near industrial and manufacturing facilities.

See [this story](#) and more on Aclima's blog at blog.aclima.io.



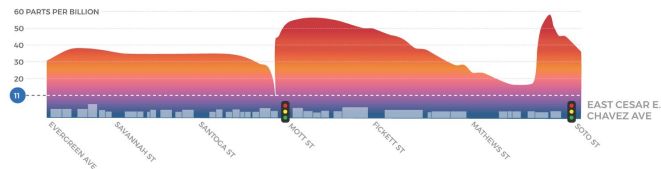
WEST LOS ANGELES

Nitrogen Dioxide Concentrations, Sept. 26, 2016, 11:00AM - 11:03AM



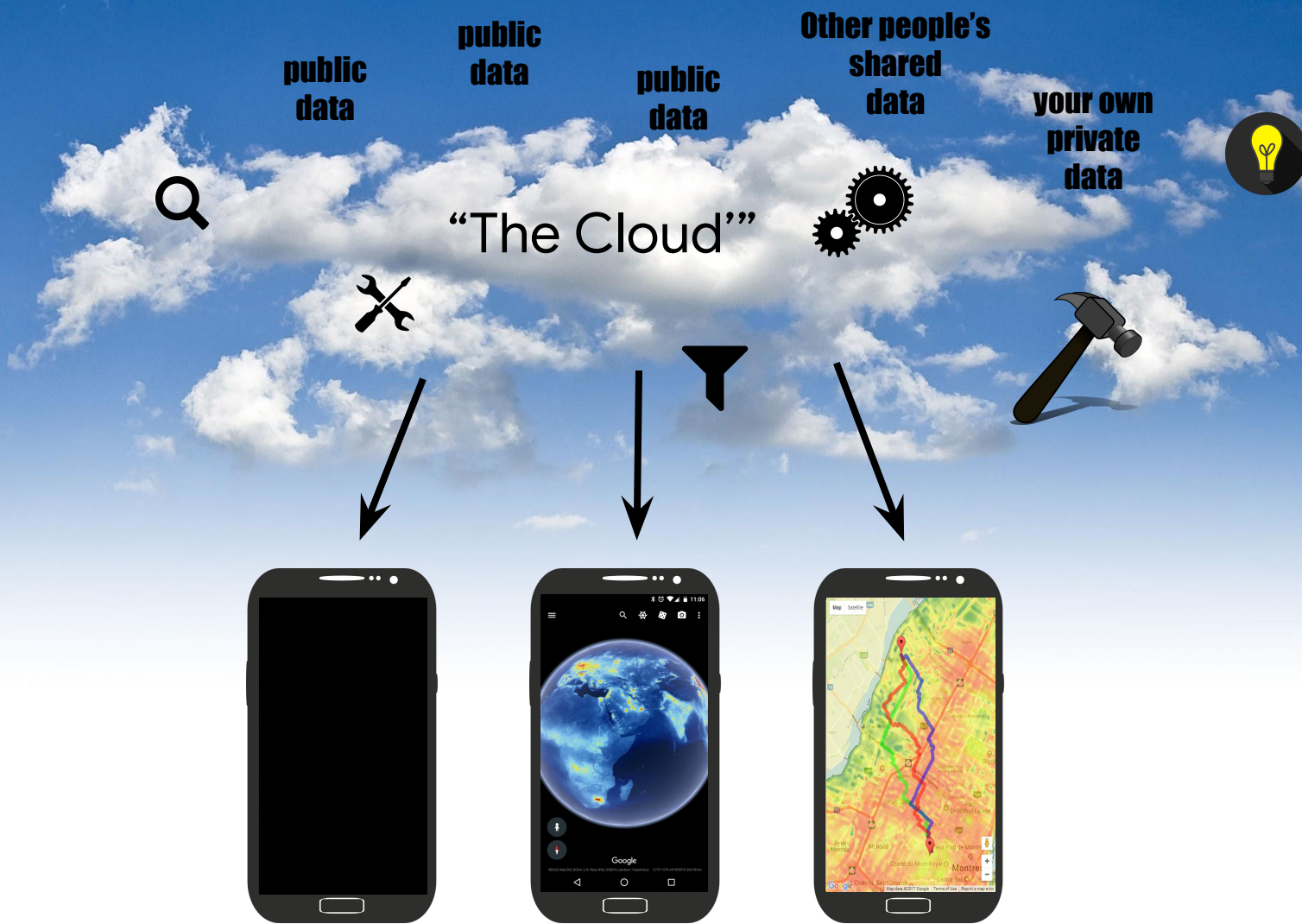
BOYLE HEIGHTS

Nitrogen Dioxide Concentrations, Sept. 26, 2016, 11:28AM - 11:30AM



- On 9/26/2017, we drove down major thoroughfares in two neighborhoods of Los Angeles—Wilshire Boulevard in West Los Angeles and Cesar Chavez Avenue in Boyle Heights.
- The concentration of NO₂ changed as we drove down each street in the late morning.
- We found that the concentration of NO₂ increased when cars moved forward after being stopped at the indicated traffic lights.

See [this story](#) and more on Aclima's blog at blog.aclima.io.



GOOGLE CLOUD BIG DATA AND MACHINE LEARNING

Innovation in data processing and machine learning technology



U.S. EPA and OpenAQ air quality data

Wednesday, June 7, 2017

By Mike Hamberg, Partner Operations Manager, gTech Feeds

Using these new public datasets in BigQuery is a great way to understand air quality

Take a deep breath: The average person takes between 17,000 and 23,000 breaths every day. How do you know if the air in your town is clean?

We're helping answer those questions. We've leveraged decades of data from thousands of air quality datasets to the [Google Cloud Public Datasets](#) program:

- OpenAQ, which includes [real-time air quality](#) from 47 countries around the world
- EPA, which includes the [last 27 years of air quality](#) from around the United States

Search

Why Google Products Solutions Launcher Pricing Customers **Documentation** Support Partners
BigQuery > Documentation
☆☆☆☆☆
SEND FEEDBACK
Internal Count: 1, Average: 3.0

Resources

- All Resources
- Pricing
- Quotas & Limits
- Release Notes
- Support & Troubleshooting
- ▾ Public Datasets
 - Overview
 - 1000 Cannabis Genomes Project
 - Bay Area Bike Share Trips Data
 - Chicago Crime Data
 - Chicago Taxi Trips
 - [EPA Historical Air Quality Data](#)
 - GDelt Books Corpus
 - GitHub Data
 - Hacker News
 - Healthcare Common Procedure Coding System (HCPCS) Level II
 - IRS 990 Data
 - Major League Baseball
 - Medicare
 - NHTSA Traffic Fatality Data
 - NOAA GHCN Weather
 - NOAA GSOD Weather
 - NOAA ICOADS
 - NYC 311 Service Requests
 - NYC Citi Bike Trips
 - NYC TLC Trips
 - NYC Tree Census

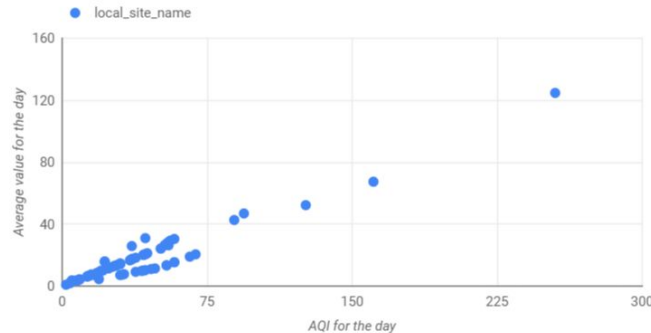
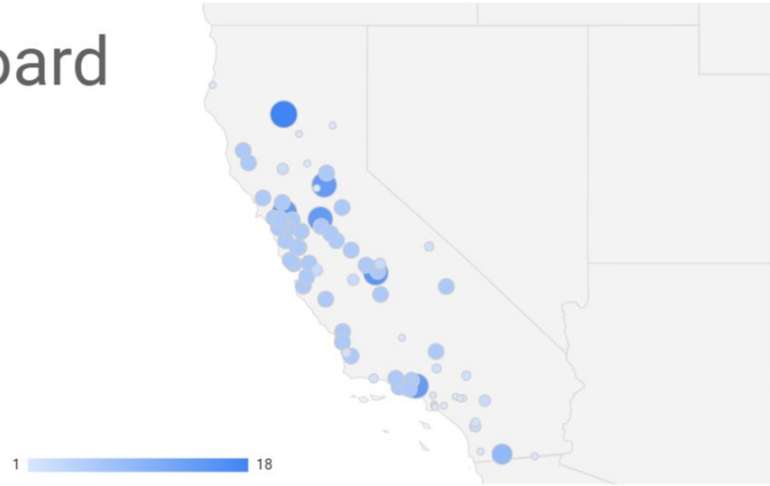
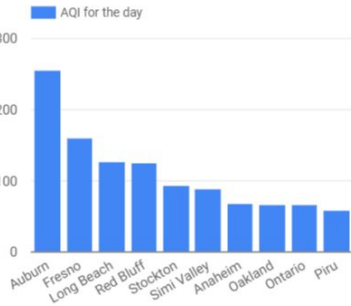
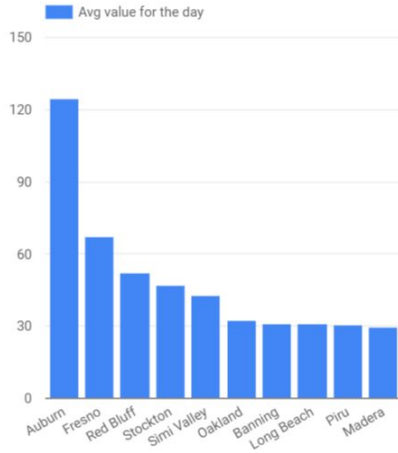
EPA Historical Air Quality Data

The United States Environmental Protection Agency (EPA) protects both public health and the environment by establishing the standards for national air quality. The EPA provides annual summary data as well as hourly and daily data across the following categories:

- Criteria Gases
 - Carbon monoxide (CO)
 - Ground-level Ozone (O3)
 - Nitrogen Dioxide (NO2)
 - Sulfur Dioxide (SO2)
- Particulates
 - PM2.5 FRM/FEM Mass
 - PM2.5 non FRM/FEM Mass
 - PM10 Mass
 - PM2.5 Speciation
- Meteorological
 - Barometric Pressure
 - Relative Humidity and Dewpoint
 - Temperature
 - Winds (Resultant)
- Toxics
 - Lead (Pb)
 - Hazardous Air Pollutants (HAPs)
 - Nitrous Oxides (NONoxNOy)
 - Volatile Organic Compounds (VOCs)

[Link](#)

Karin's Dashboard



You can use Data Studio to make reports with big data.

datastudio.google.com

[Link to Karin's Dashboard](#)



public data

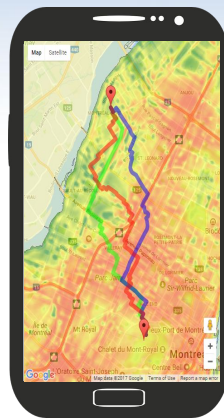
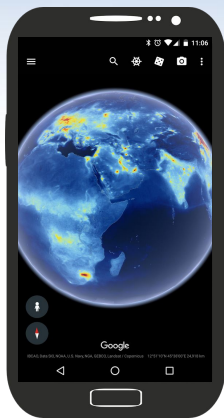
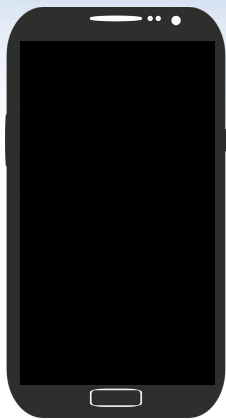
public data

public data

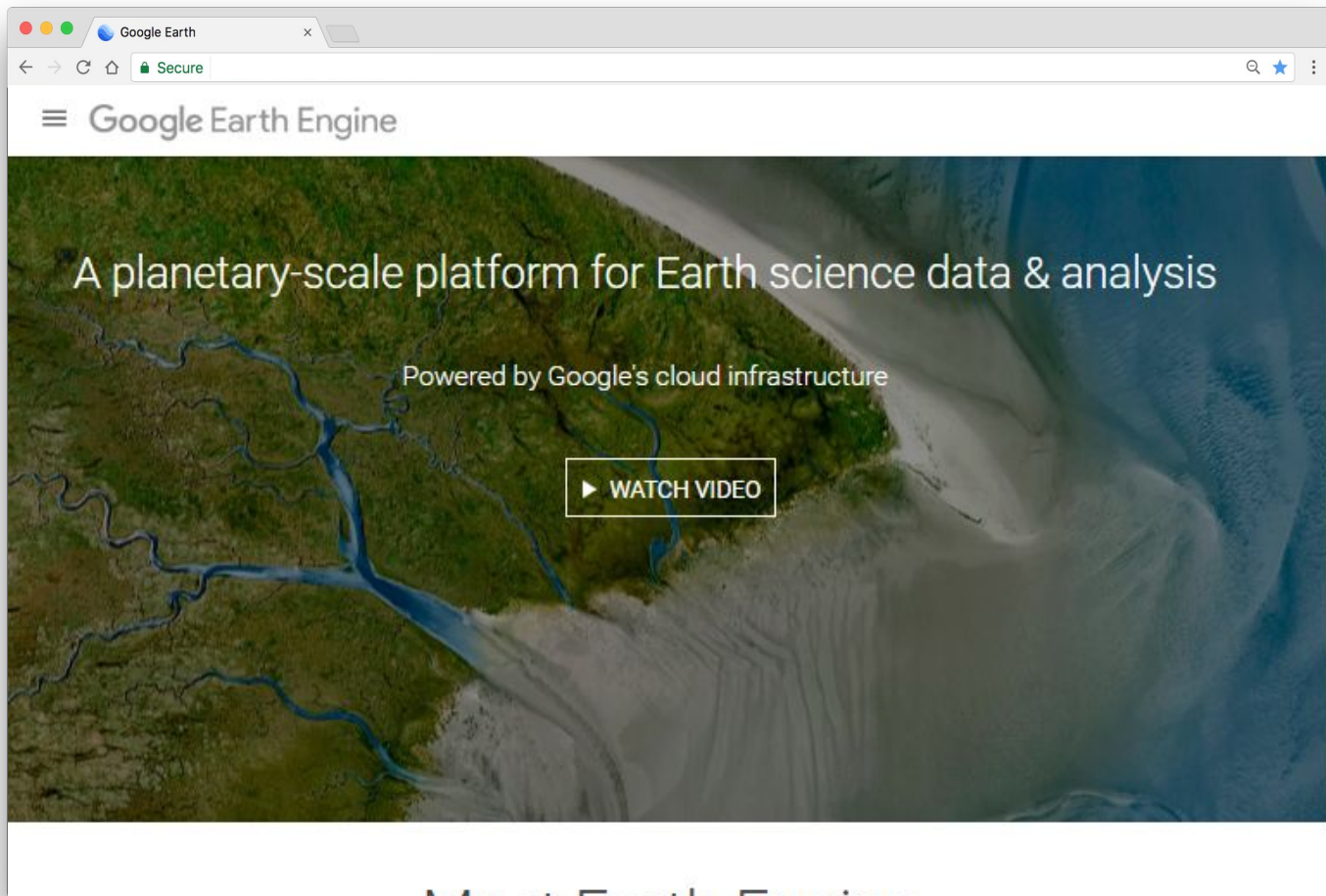
Other people's shared data

your own private data

"The Cloud"



earthengine.google.com



The image shows a browser window displaying the Google Earth Engine website. The browser's address bar shows "Secure" and the page title is "Google Earth". The main content area features a satellite-style background image of a river delta. The text "A planetary-scale platform for Earth science data & analysis" is prominently displayed in white. Below this, it says "Powered by Google's cloud infrastructure". A central button with a play icon and the text "WATCH VIDEO" is visible. At the bottom of the page, the words "Map", "Learn", and "Engage" are partially visible.

Google Earth Engine

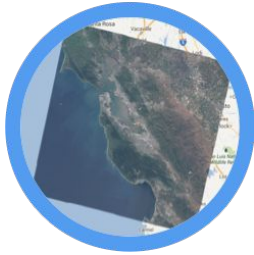
A planetary-scale platform for Earth science data & analysis

Powered by Google's cloud infrastructure

▶ WATCH VIDEO

Map Learn Engage

The Earth Engine Data Catalog



Landsat & Sentinel

10-30m, 14-day

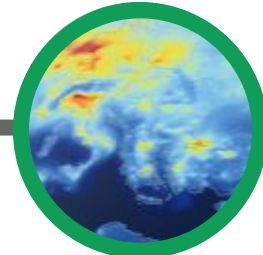


MODIS

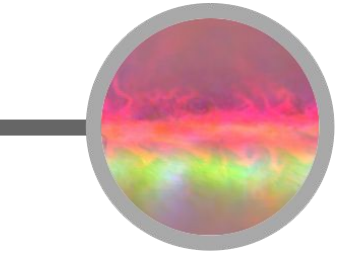
250m daily



**Your own data
can be added**



Air Pollution



Weather & Climate

NOAA NCEP, OMI, ...

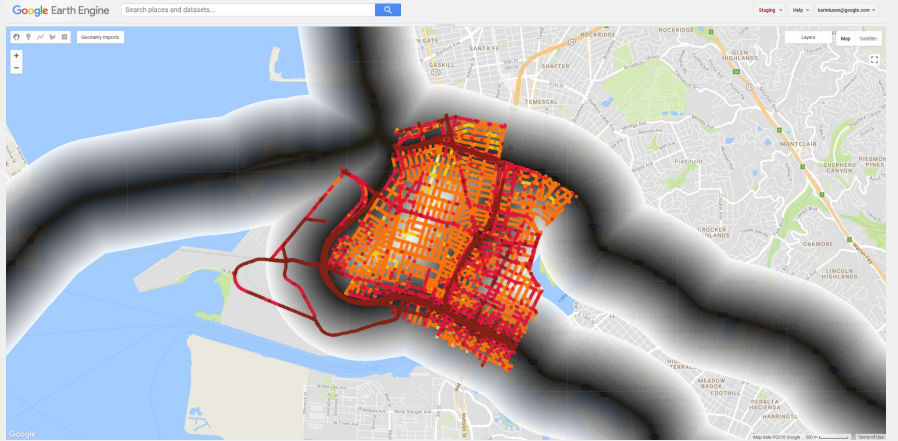
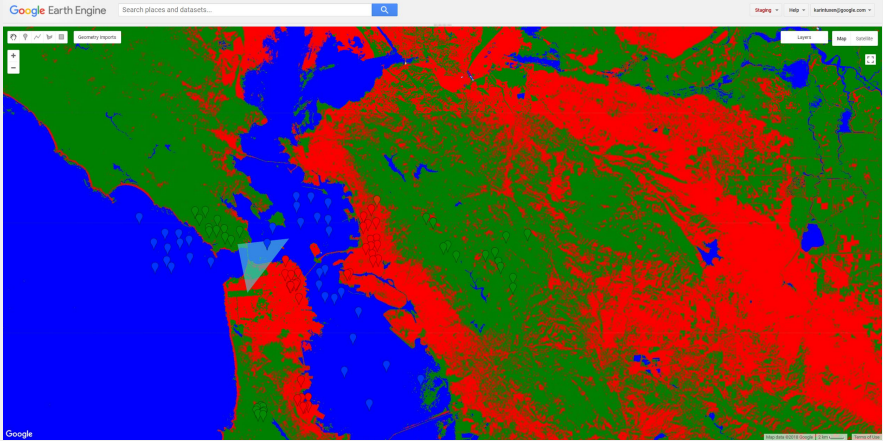
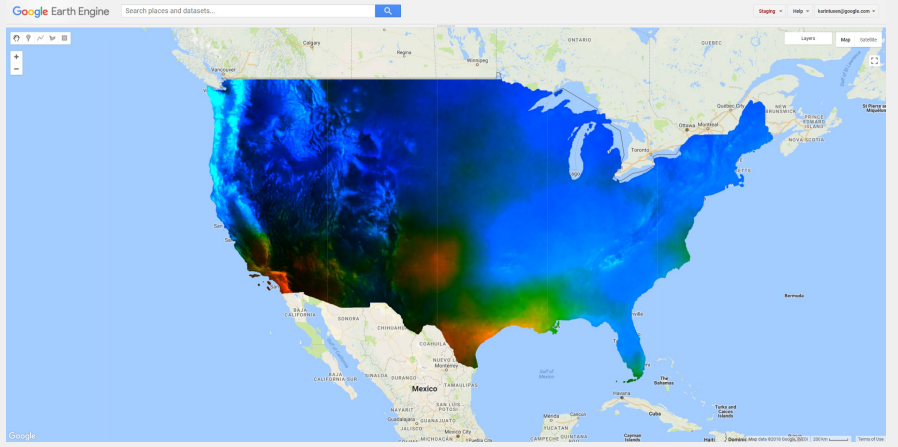
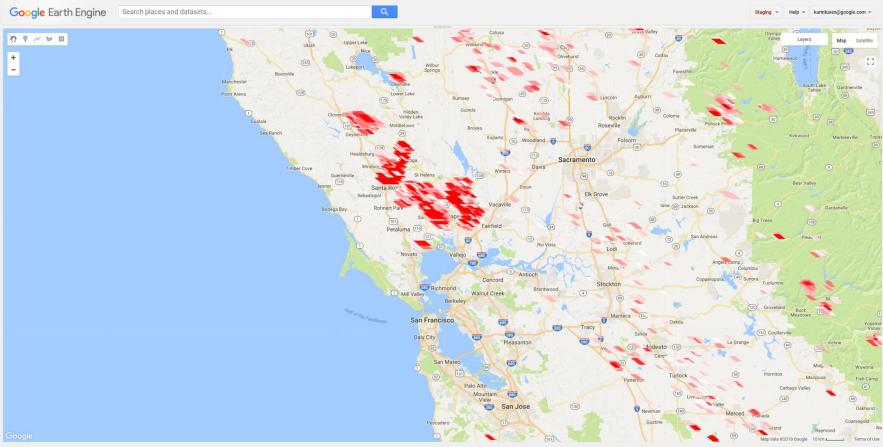
... and many more, updating daily!

> 200 public datasets

> 5 million images

> 4000 new images every day

> 5 petabytes of data



Earth Engine Workshops

sites.google.com/earthoutreach.org/earth-engine-workshops

[Jan 18, 2018 - Dublin](#)

[Jan 29, 2018 - Warsaw](#)

[Jan 31, 2018 - Paris](#)

[Feb 2, 2018 - Stockholm](#)

[Feb 5, 2018 - Berlin](#)

[Feb 7, 2018 - Munich](#)

[Feb 9, 2018 - London](#)

[Feb 20 - Ann Arbor, MI](#)

[Feb 23 - Chicago, IL](#)

[Feb 26 - Boulder, CO](#)

[Mar 1 - Flagstaff, AZ](#)

[Mar 2 - Salt Lake City, UT](#)

[Mar 5 - Atlanta, GA](#)

[Mar 6 - Cambridge, MA](#)

[Mar 8, Washington D.C.](#)

Google Earth x

Secure

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Air Sensor Workgroup

edf.org/asw

Collaborative development of standards and infrastructure for air quality data

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The Air Sensor Workgroup (ASW) is a broad-based group established to support the rapidly growing community of people developing and using sensor-based air quality devices. The ASW's goal is to help advance this technology sector with infrastructural support that includes adoption of data standards and provision of an open data platform.

EDF has organized this group which consists of participants from state and federal government, academic institutions, instrument manufacturers, and other organizations and stakeholders interested in furthering the principles of air quality data being open and FAIR (Findable, Accessible, Interoperable, and Reusable).

Data standards will enable the use of uniform definitions and data

ASW resources

- [Date and timestamp guidelines](#)
Derived from standards of ISO, IETF, and W3C
- [Glossary of terms](#)

External resources

- [AirNow](#)
- [AQ-SPEC sensor evaluations](#)
- [Marine Metadata Interoperability Ontology](#)

Thank you!



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