GovLoop's 4th Annual Government Innovators Virtual Summit
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Sensing our air: the quest for big data about our air quality

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Purpose of this talk

- Share emerging technology trends for measuring air quality and migration from “small, high quality data” towards “big, variable-quality data”
- Tee up for discussion some significant gaps

Measuring the air

Air quality is in the public consciousness

New York Times, April 1, 2013

Air Pollution Linked to 1.2 Million Premature Deaths in China

Chicago Tribune, June 27, 2014

EPA finds rail yards transfer pollutants as well as freight

Agency says diesel soot can trigger number of health conditions

June 27, 2014 | Michael Hawthorne and Alex Richards, Tribune reporters

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From the sidewalk in front of her apartment in Cicero, Yolanda Foster can see long freight trains and an endless line of trucks rumbling day and night through the sprawling rail yard across the street.

What she can't see are the clouds of microscopic lung- and heart-damaging particles that drift into the low-income, largely Latino neighborhood overlooking one of the Chicago area's freight terminals.

Diesel pollution from locomotives and the vehicles that move freig...

USA Today, March 20, 2015

Air quality can affect students' decisions to study abroad

By Kylee Madison Berger, NYU Shanghai March 20, 2015 1:00 pm

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...jiazui Financial District in Pudong, seen from the 100th floor of the Shanghai... n smog in Shanghai on October 16, 2014. (Johannes Eisele, AFP Getty Images)

ABC Eyewitness News, March 25, 2015

AIR POLLUTION LINKED WITH BEHAVIORAL ISSUES IN CHILDREN, STUDY SAYS

Paris mayor races to improve air quality ahead of marathon

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© Franck Fife, AFP file picture | The Eiffel tower in Paris was barely visible when the French capital briefly topped a list as the world's most polluted city on March 18, 2015

Text by Louise NORDSTROM

France 24, April 10, 2015

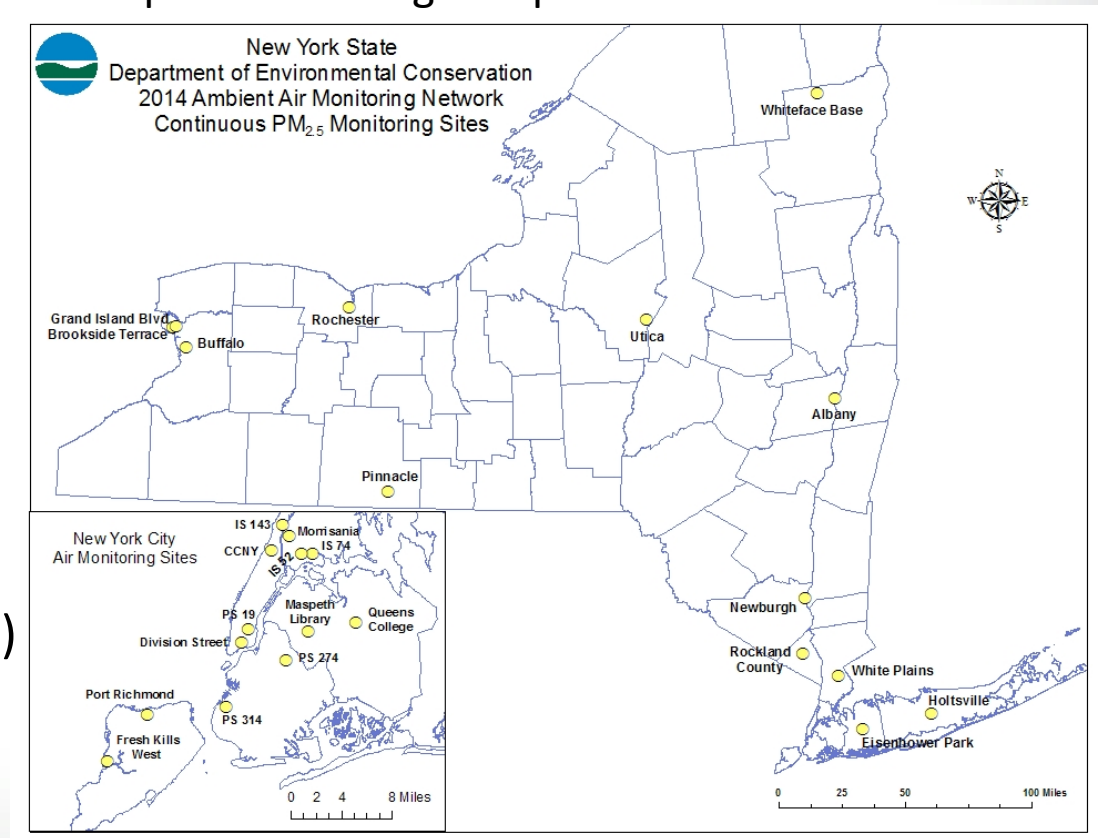
Measuring the air

In the United States, traditional paradigm for air quality monitoring:

Rigorous protocols and methods for regulatory applications

- Expensive instruments (>$10K)
- Specialized training required
- Large physical footprint
- Large power draw

Example: Measuring fine particles in New York



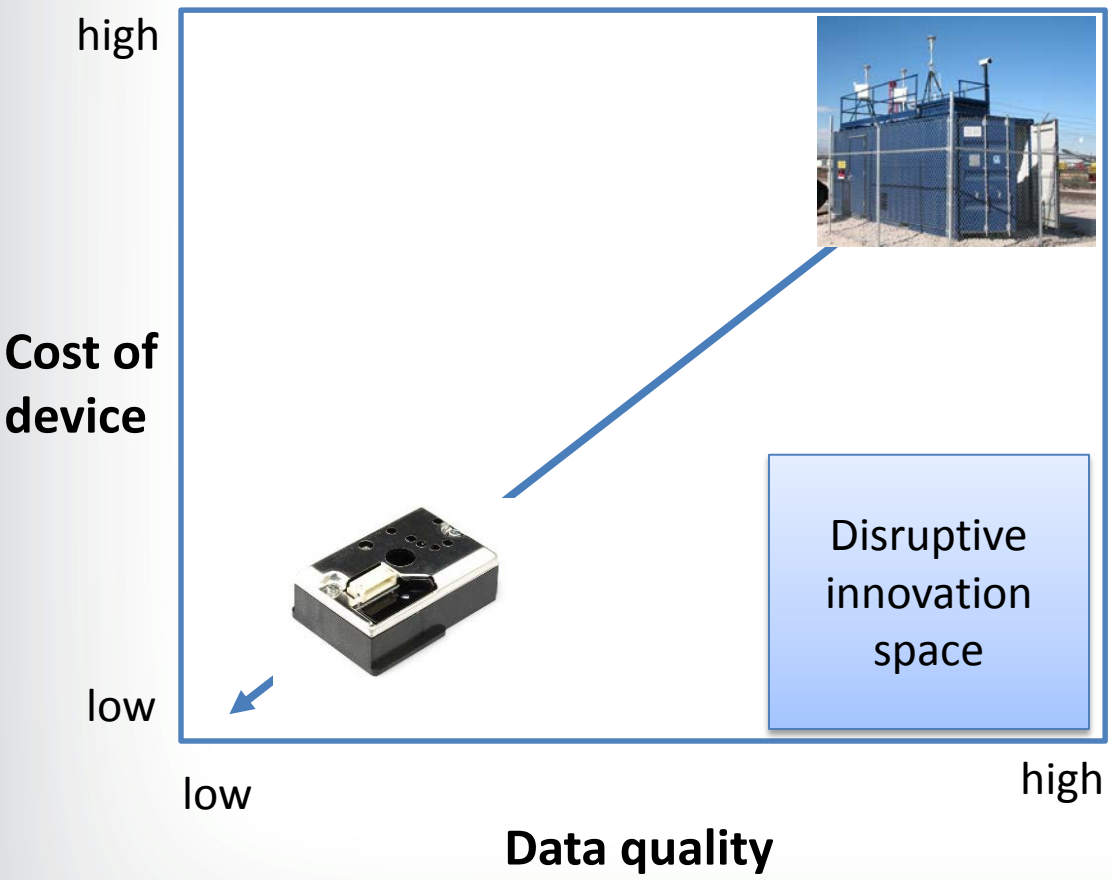
Map from: dec.ny.gov

Measuring the air

Recent explosion of lower cost sensor technology for measuring air quality:

The driver: What is my exposure? What is my child's exposure? What is the air quality like in my neighborhood?

Measurement challenges



Researchers using advanced data processing strategies to get meaningful information from low-cost (~$20) sensors:

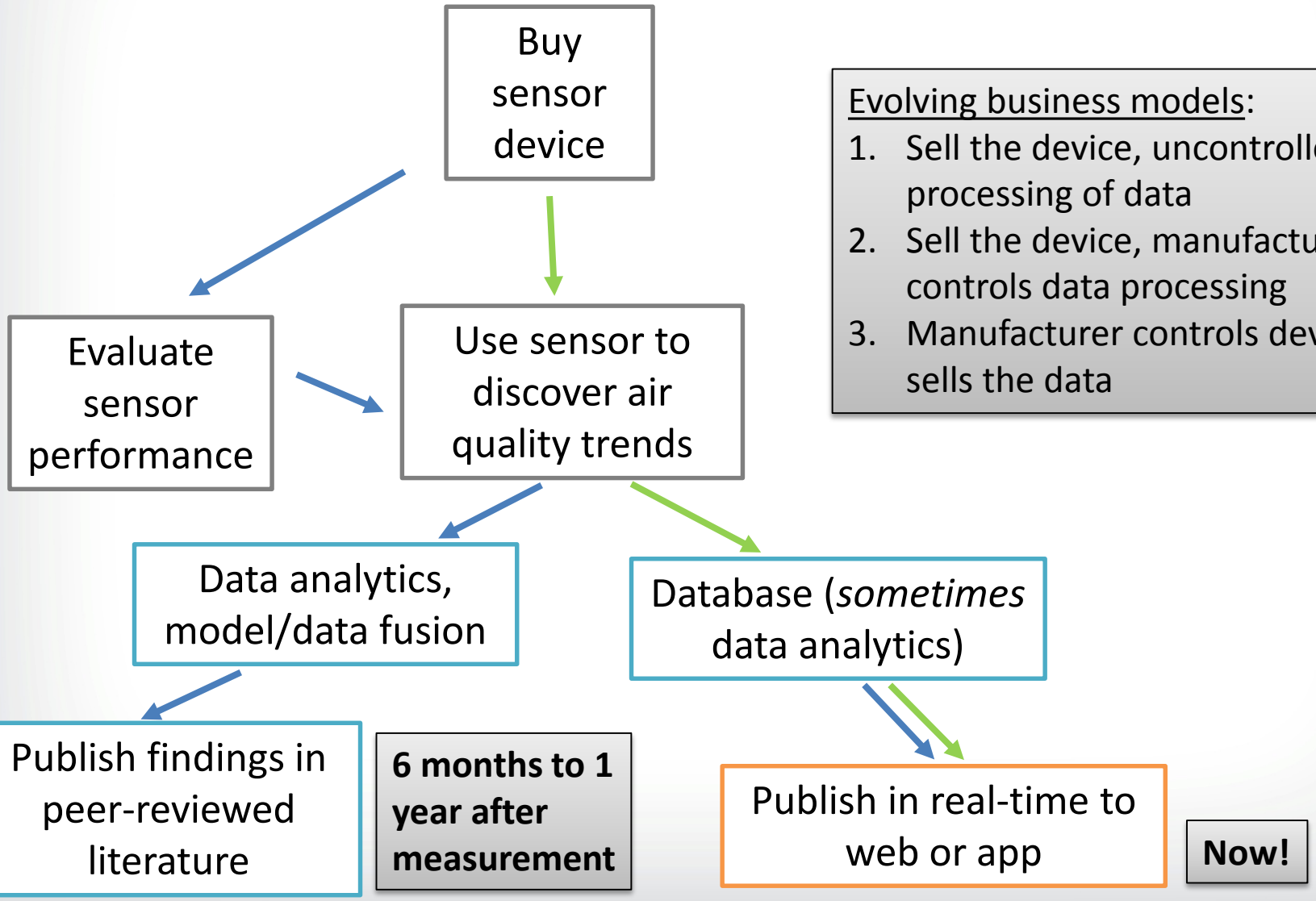
"We're compensating for a bad sensor with machine learning…"

- Illah Nourbakhsh, sensor developer at Carnegie Mellon University, during a recent interview

"…**a separate model was selected for each sensor**….**Fifth order polynomial models** that included relative humidity (RH %) and temperature (C) was found to best convert PUWP signals into $PM_{2.5}$…"

- Gao et al., 2015, A distributed network of low-cost continuous reading sensors to measure spatiotemporal variations of $PM_{2.5}$ in Xi'an China. Environmental Pollution

Currently a disordered evolution

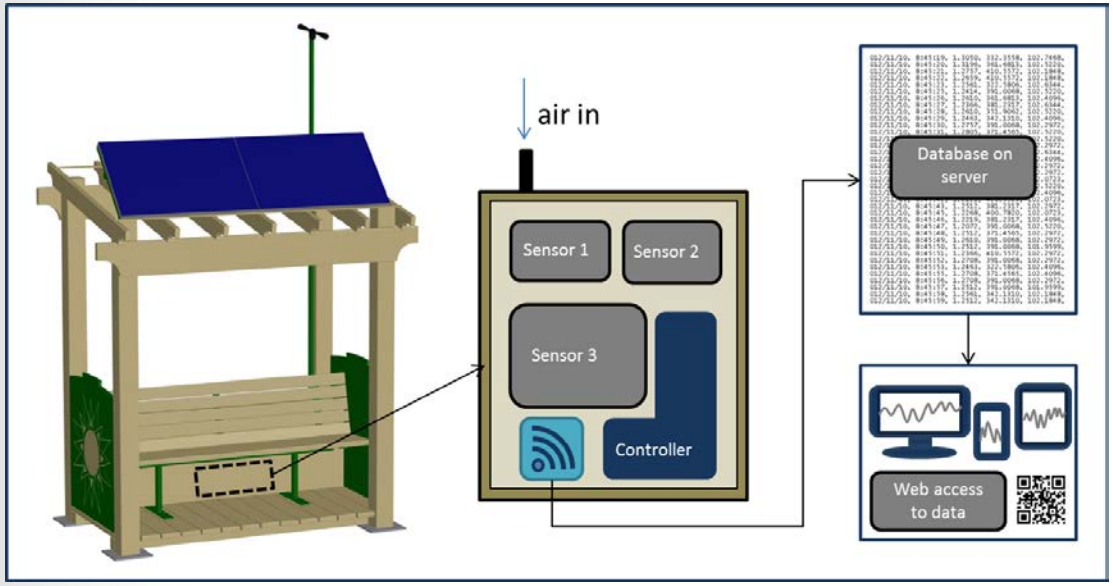


Evolving business models:

1. Sell the device, uncontrolled processing of data
2. Sell the device, manufacturer controls data processing
3. Manufacturer controls device, sells the data

Our case study: Village Green

- Data pushed to web server every minute
- Data quality reviewed by algorithms
- Quality-checked data made available to public immediately



Project website: epa.gov/villagegreen

Locations: Durham, NC; Washington, DC; Philadelphia, PA; Kansas City, KS; Oklahoma City, OK*, Hartford, CT*; Chicago, IL* (*to be installed in summer 2015)

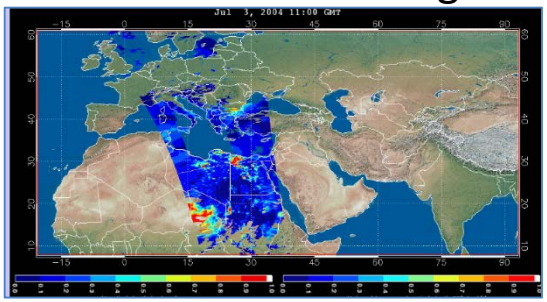
Where this is tracking

Exponential increase in new measurements

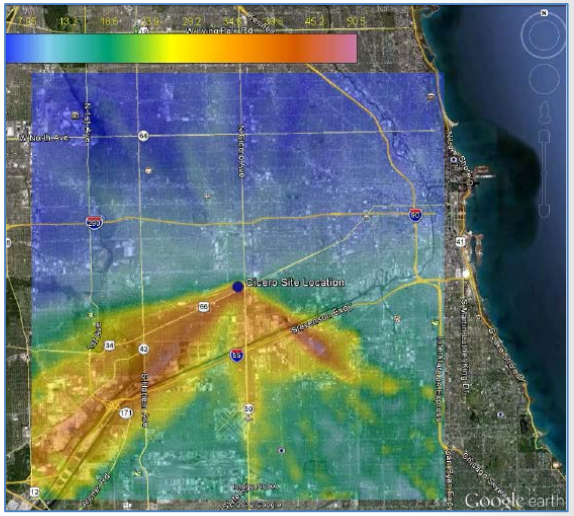
Existing data sources

Monitoring networks

Satellite remote sensing data



Data analytics, data fusion, model-data fusion



Timely and detailed information to manage air quality

Individual action

Community action

Industry action

Government action

Big opportunities, big questions

Challenges:

- Who has access to the data?

- What are the best practices – sensor use, data analytics, data communication?

- Who provides the database, data schema, data rules?

- What can be said about data collected at unprecedented rates (1 second, 1 minute) in advance of relevant health research?

- Should there be a certification process for sensors?

- How to minimize erroneous information to the public but not stifle the evolution of IoT and IoE for air?

image: nasa.gov