

Stochastic industrial source detection using lower cost methods

AGU, New Orleans LA, December 14, 2017

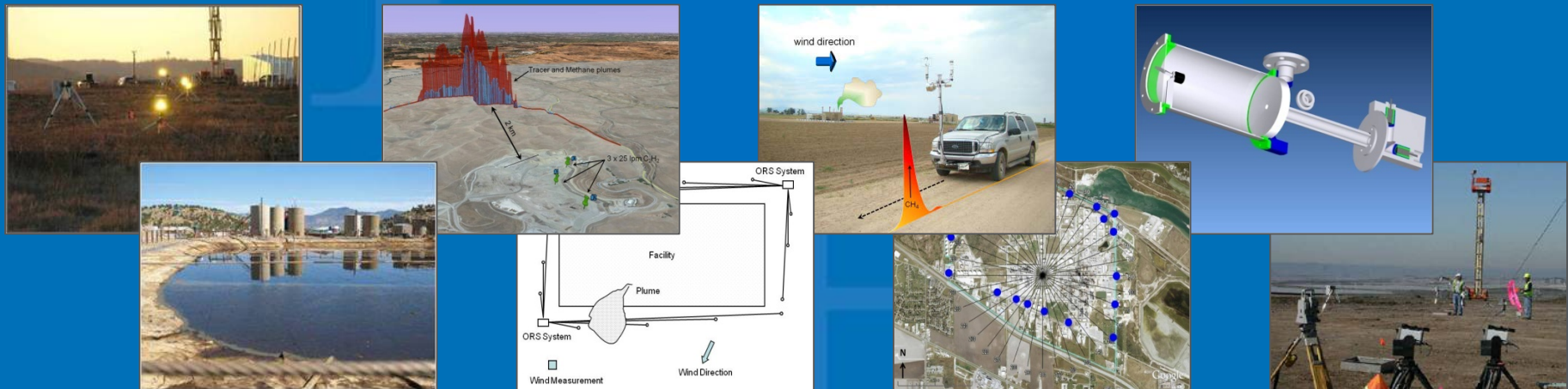
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Stochastic industrial source emissions

An evolving term.....

An air pollutant source that can be:

- Spatially distributed, unknown location
- Temporally episodic, difficult to predict
- Unexpected or unintended
- Not monitored or well understood

*Next Generation
Emission
Measurements
(NGEM)*

Examples:

Fugitive leaks, malfunctions, process upsets, waste water/area sources, vented liquids storage, drains/sumps, startup/maintenance events, etc.

FLIR

HI OFF

AUTO

HIST

WH



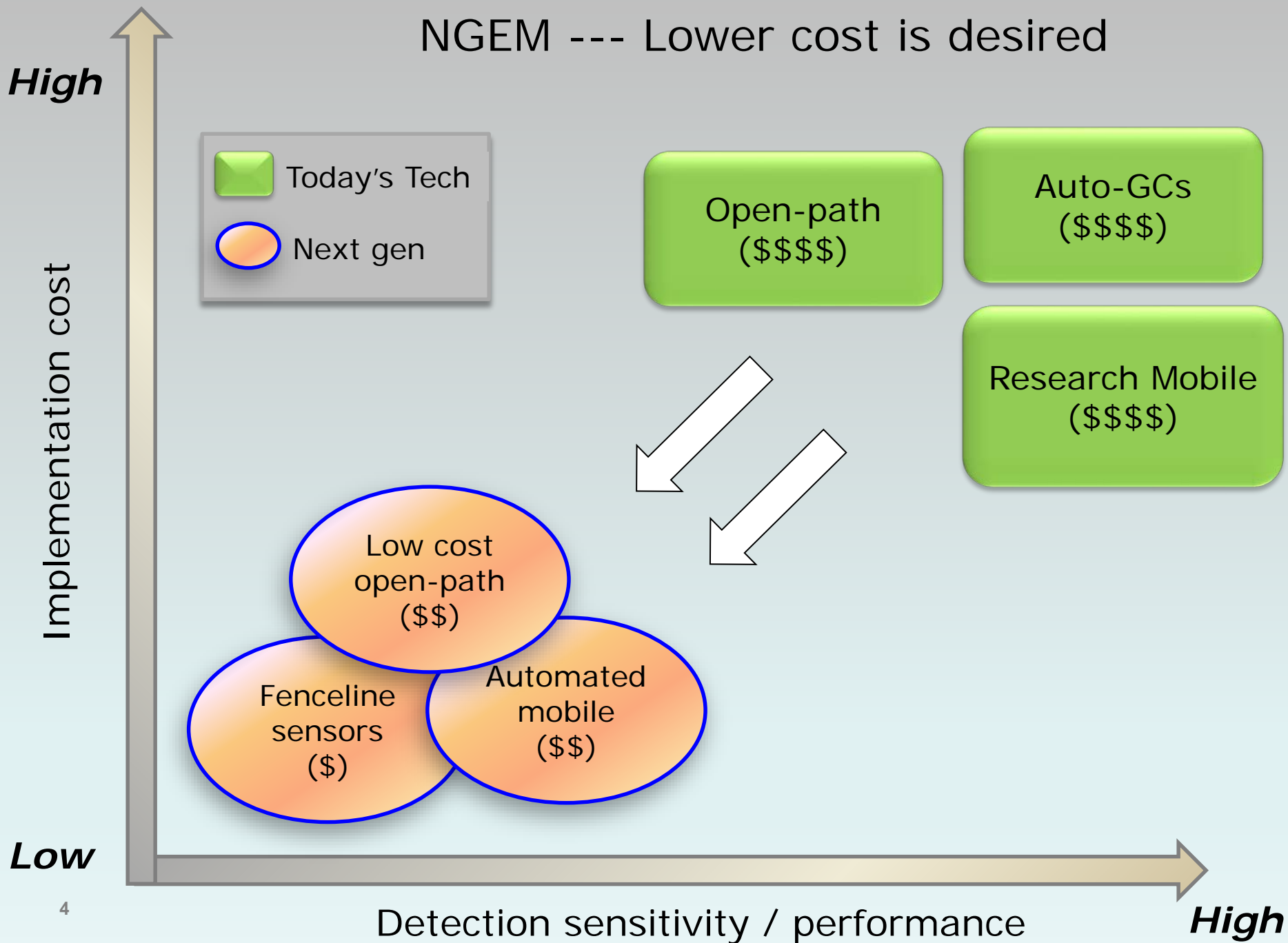
Pipeline Leak

NGEM = Mobile OTM 33 (OGI video)



Process Malfunction
NGEM = Airborne OGI

NGEM --- Lower cost is desired



Lots of NGEM Tools in the Bag.....

- Non-speciating sensors (mobile, fixed, network)
- Single compound sensors (spectroscopic)
- Lower cost field gas chromatographs

Combining with

- Wind field diagnostics
- Time-integrated samplers (sector and geospatial)
- Triggered laboratory acquisitions (grabs)



Examples of NGEM Systems

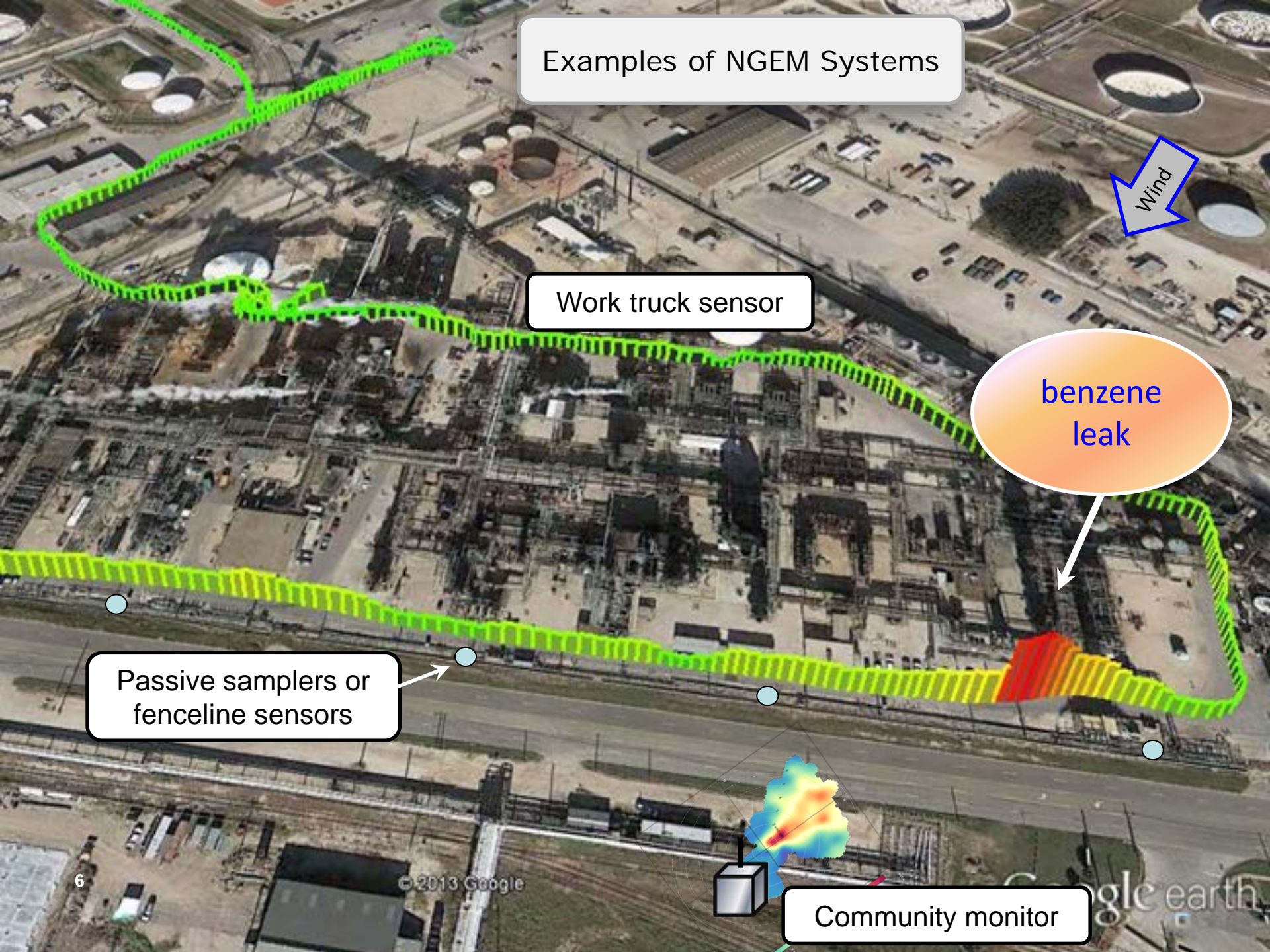
Work truck sensor

benzene
leak

Passive samplers or
fenceline sensors

Community monitor

Wind



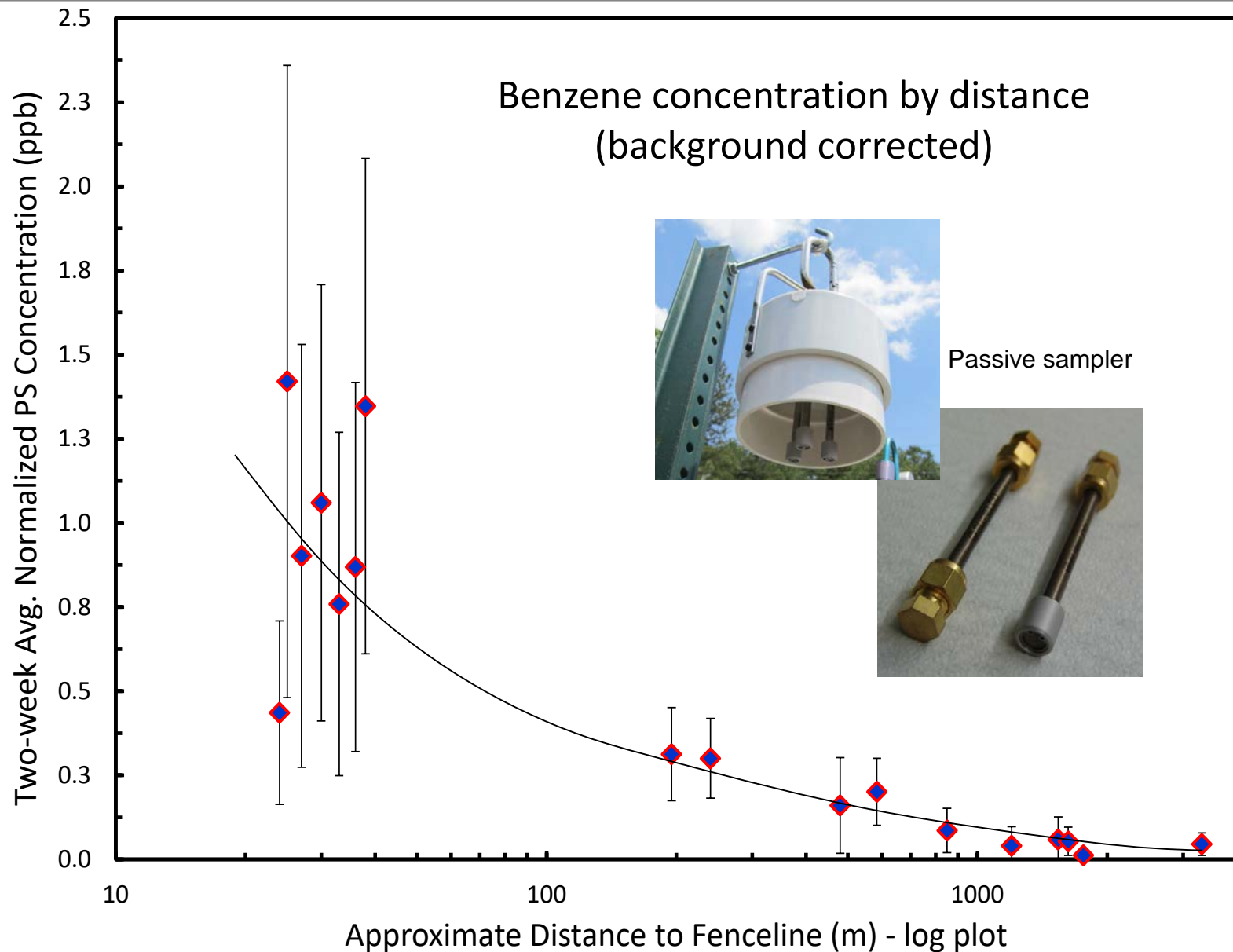
The image shows three vertical poles in an outdoor setting, likely a field or park, with a dense forest of trees in the background. The trees have autumn-colored leaves in shades of yellow, orange, and brown. The poles are made of metal and feature blue, ribbed cylindrical diffusers. At the top of each pole is a square metal frame holding a sensor. The pole on the right also has a white, cylindrical sensor housing with a pattern of small holes. A black cable runs across the top of the frame, and a small white box is attached to the pole on the right.

NGEM Comparisons at EPA test range

- VOC Sensors (SPods and similar)
- Field GCs
- Open path spectroscopy
- Passive samplers
- Mobile measurements

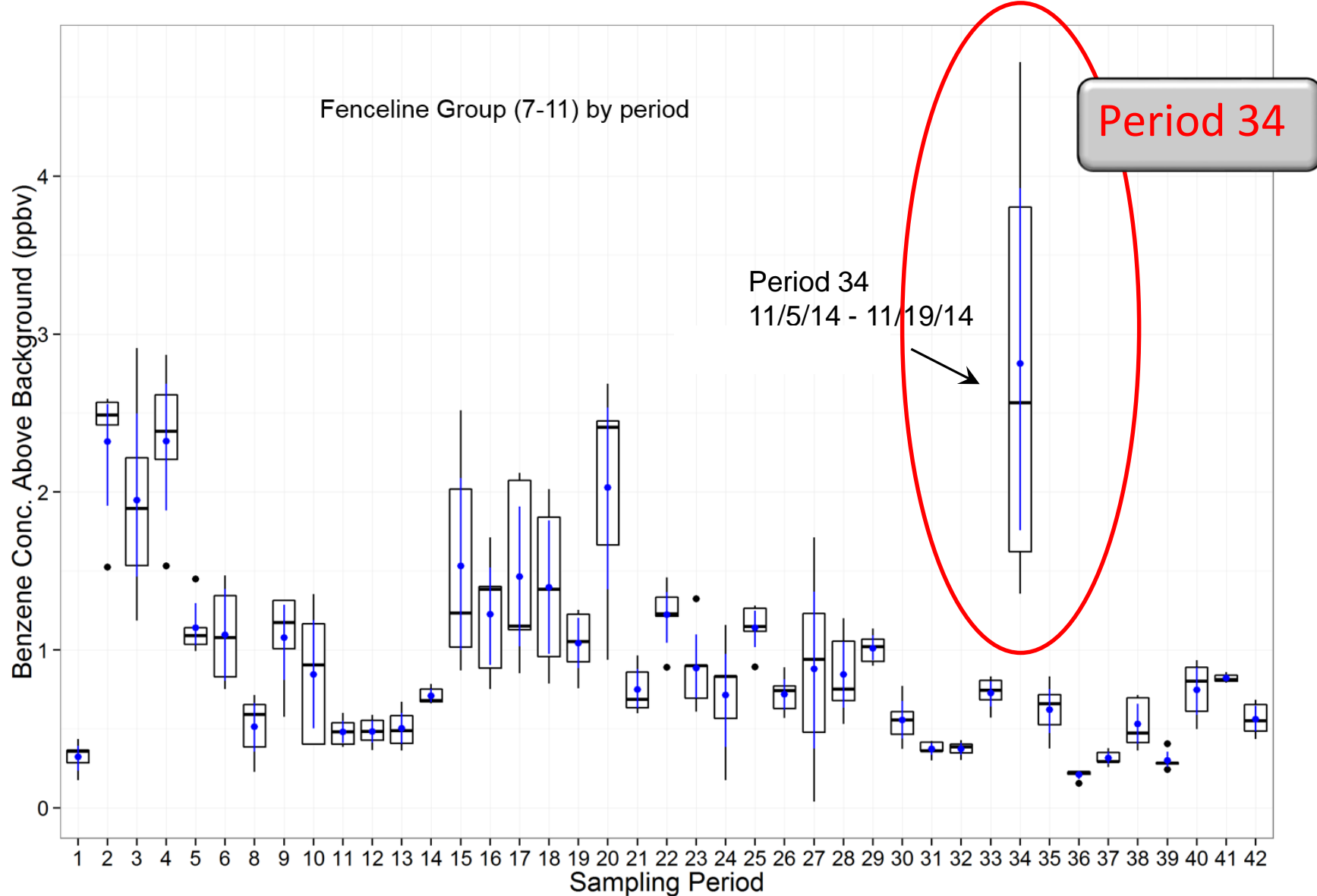
Two-week passive sampler data

Benzene spatial gradient from source (Philly study)



Two-week passive sampler data (fenceline group)

Elevated benzene in sampling period 34 (Philly study)

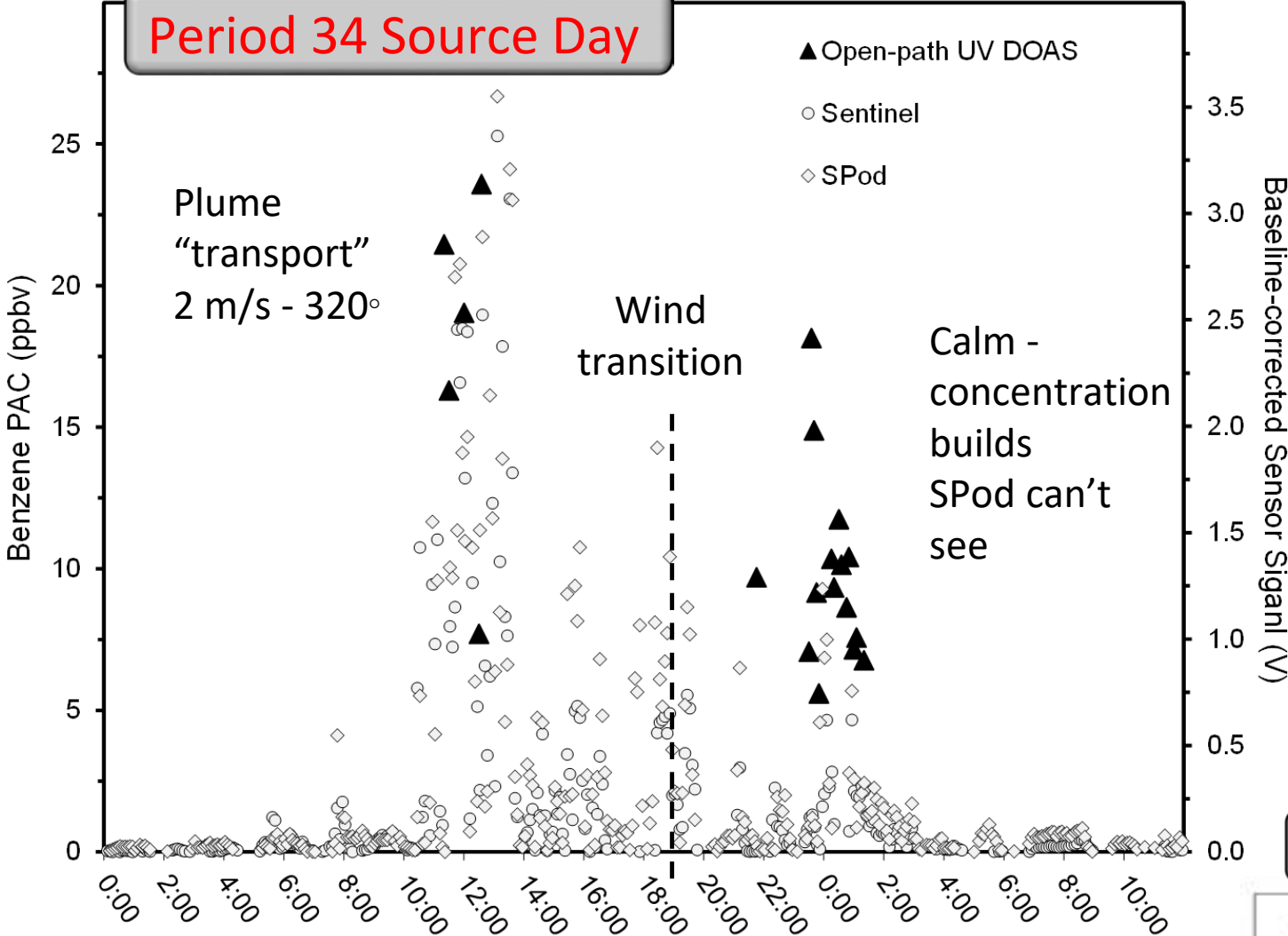
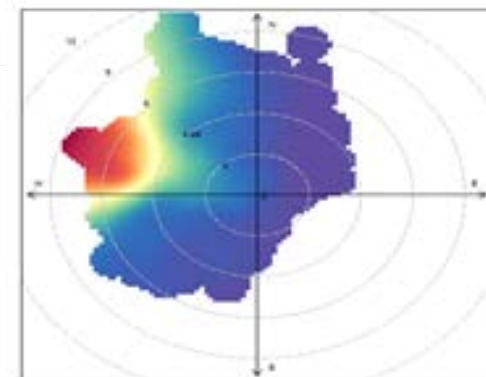


Period 34 Source Day

Early SPod



SPod Source Pointer

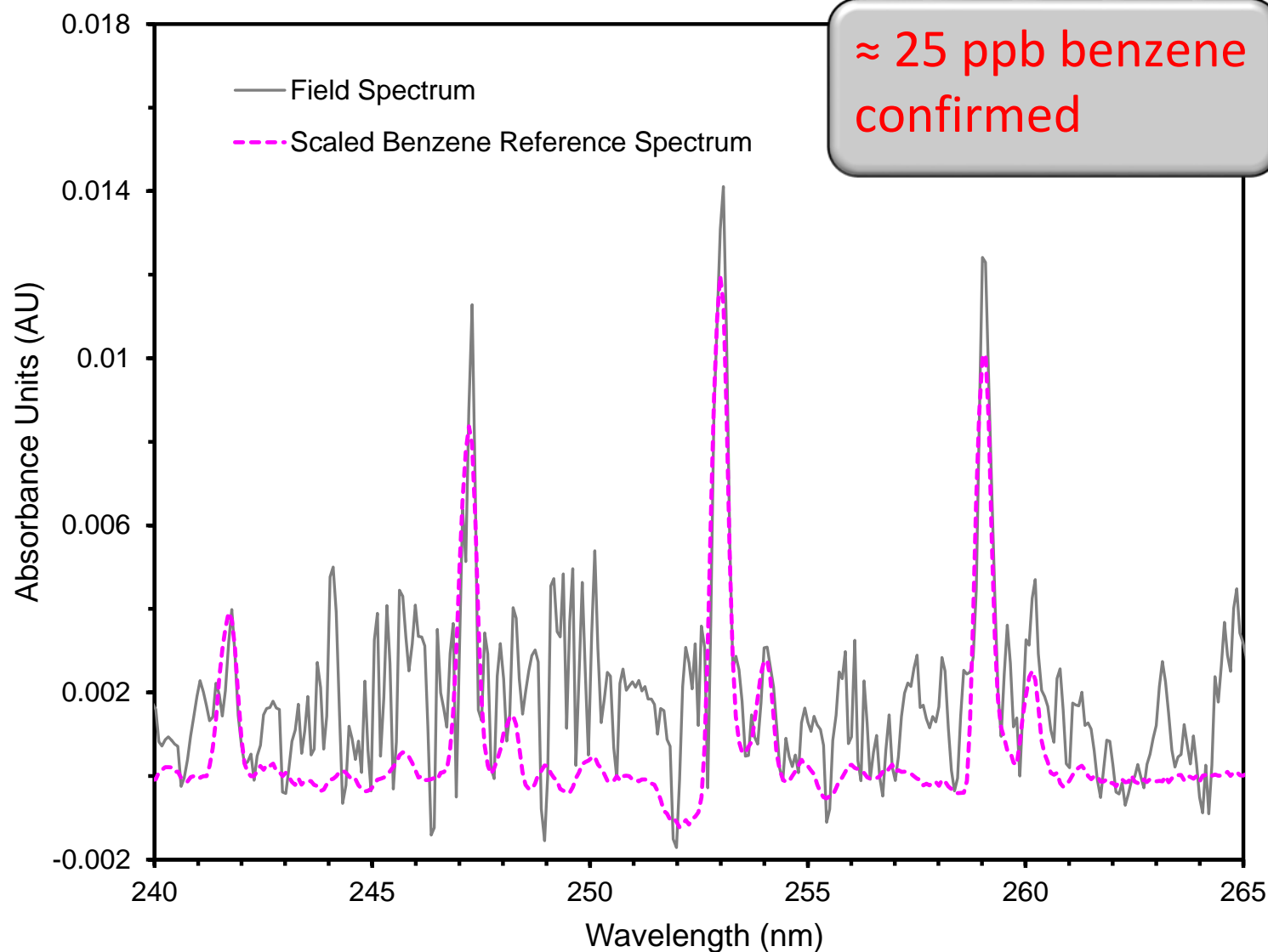


Open-Path UV DOAS (400 m away)

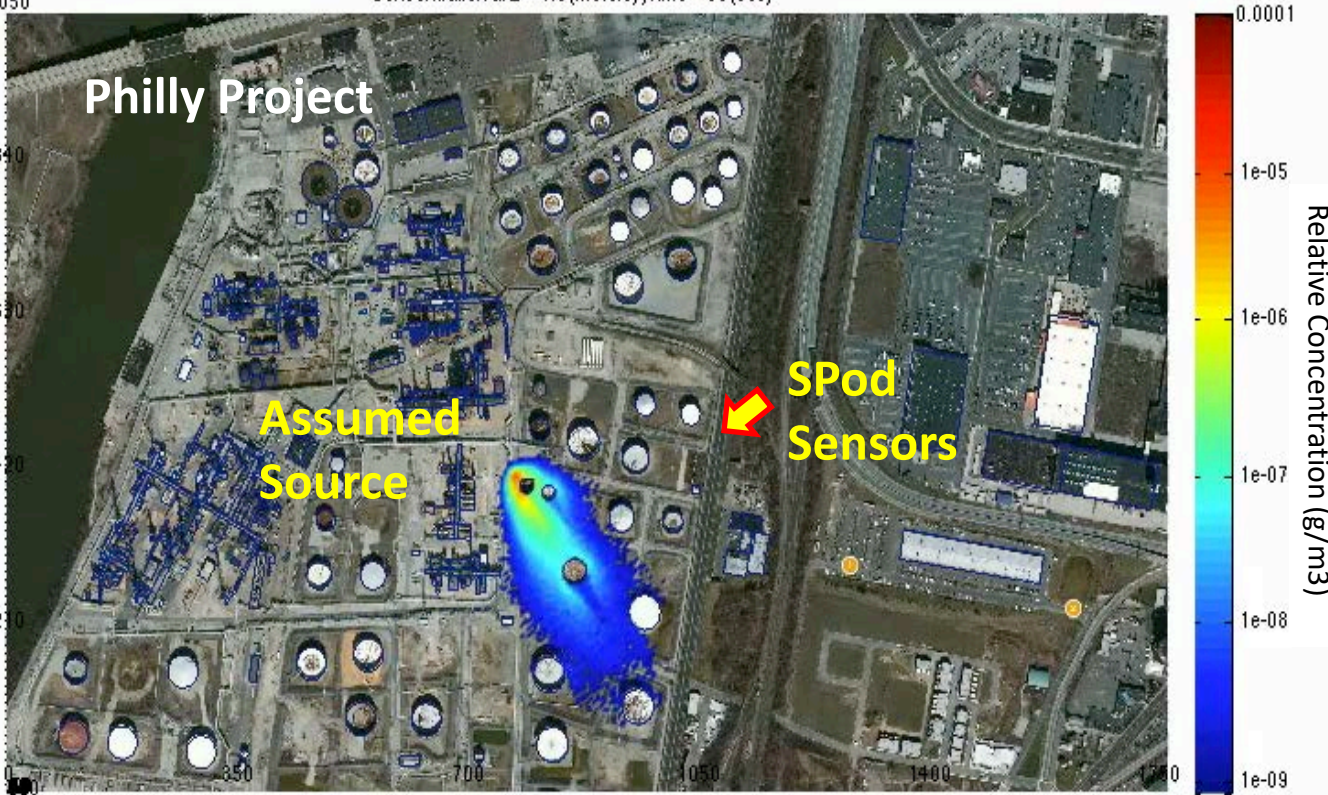


The Importance of QA Validation

UV DOAS *Elevated benzene in period 34 (Philly study)*



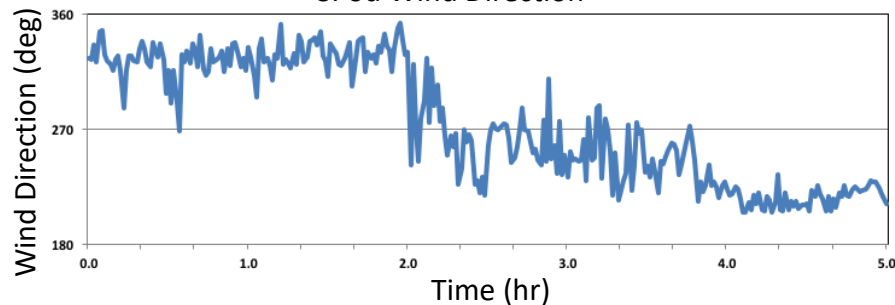
Philly Project



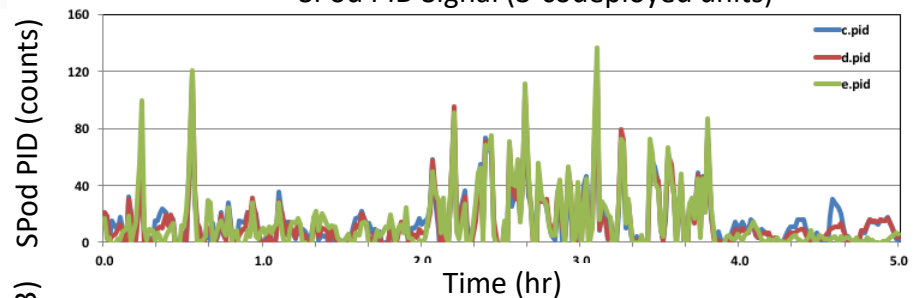
Combining sensor data
and wind flow models

Helps understand
concentration fields
and source locations

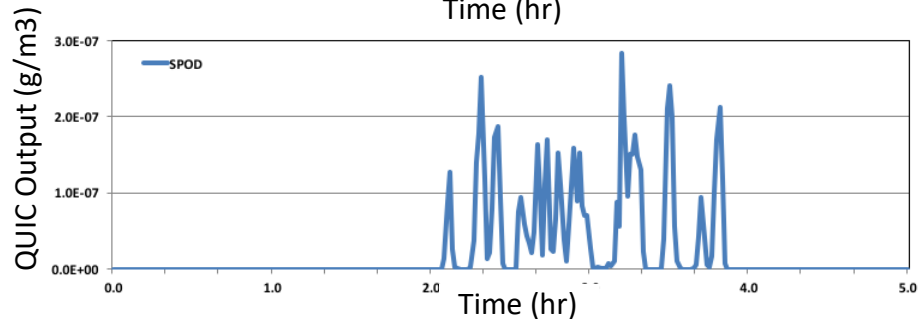
SPod Wind Direction



SPod PID Signal (3-codeployed units)



Los Alamos Quick Urban & Industrial
Complex (QUIC) Dispersion Model
<http://www.lanl.gov/projects/quic/>
Easy to setup, runs on a laptop!



SPod 1

SPod 2

NGEM Comparisons
Louisville study
Started Fall 2017

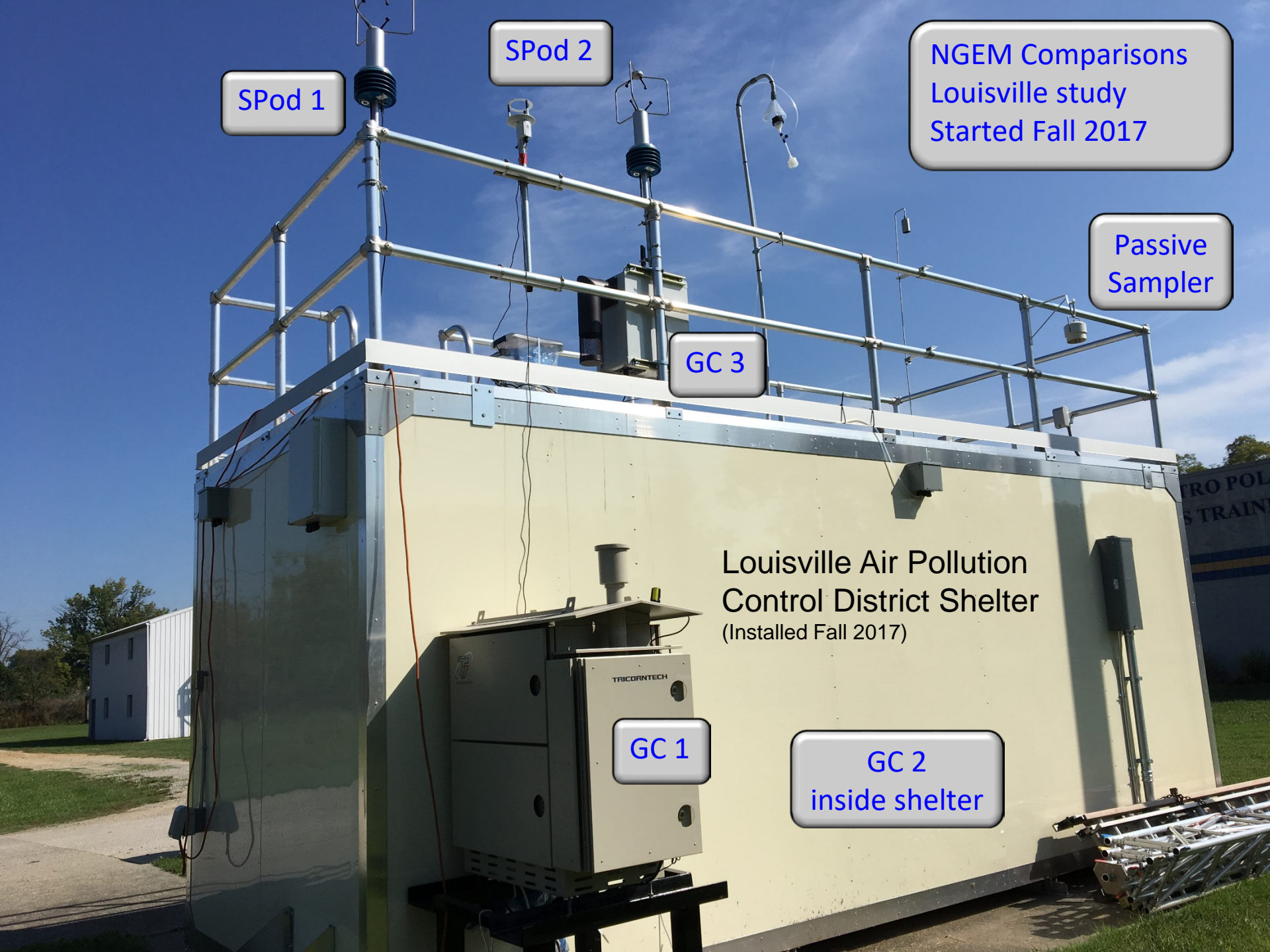
Passive
Sampler

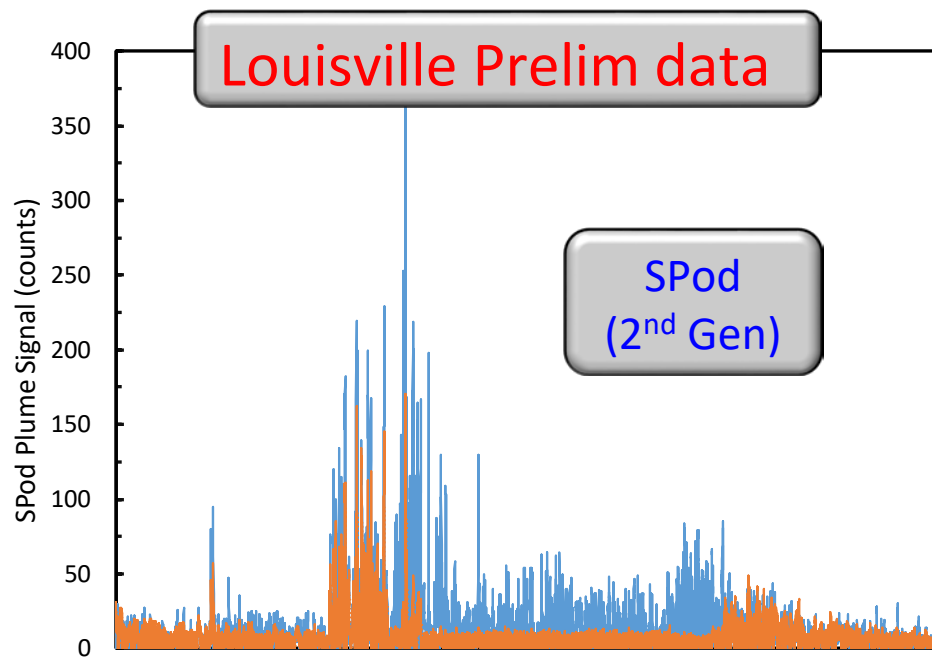
GC 3

Louisville Air Pollution
Control District Shelter
(Installed Fall 2017)

GC 1

GC 2
inside shelter



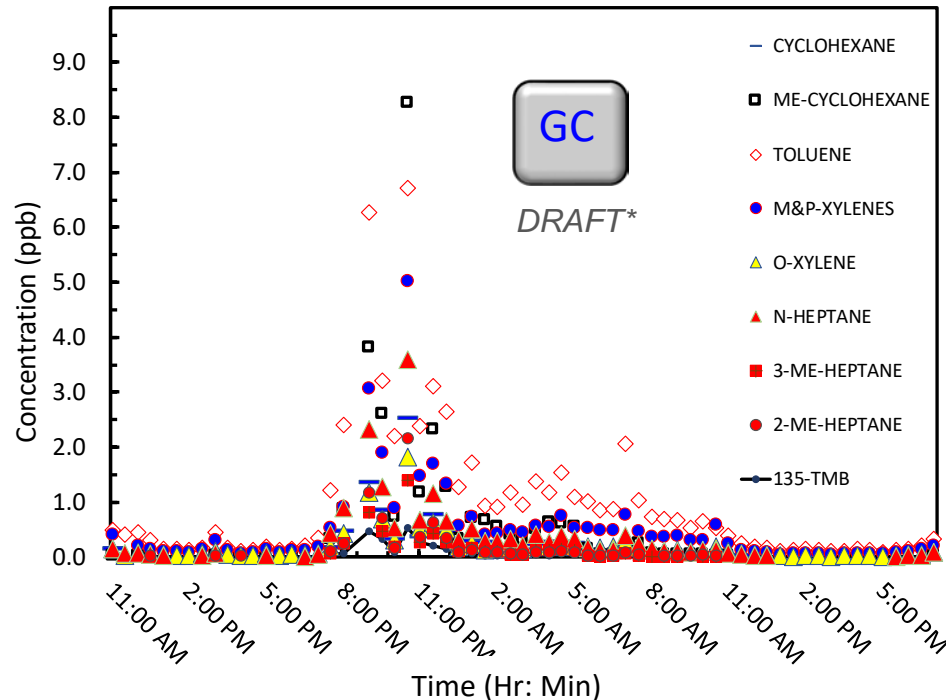


Example Plume Event

Possibly from fuel storage across street

Plume composition complexity is high

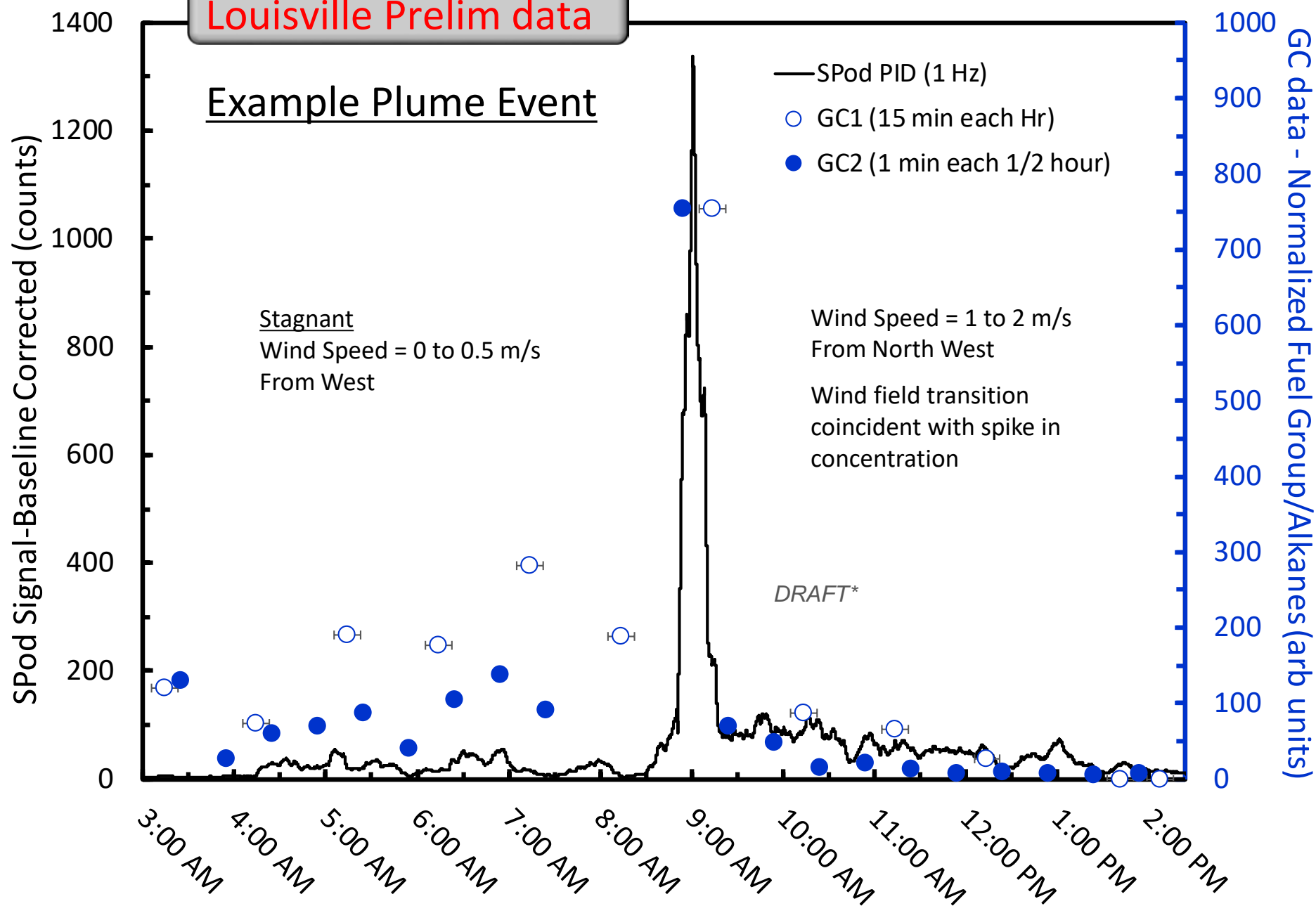
This presents additional challenges



*DRAFT-Prelim data- Subject to change – uncertainty in compound assignment and concentrations

Louisville Prelim data

Example Plume Event



*DRAFT-Prelim data- Subject to change – uncertainty in compound assignment and concentrations

VOC Emissions Tracker (VET)

..... *in development*

SPod

GC

Lab Sample

- SPod or other sensor
 - Fast, nonspecific concentrations
 - Wind field
 - Pressure, temp, R/H
- Field GC (low cost)
 - Compound specific (10 minute)
- Triggered canister grab sample
 - Optimal acquisition (in-plume)
 - Detailed Lab speciation



Combining
NGEM Tools



Thanks!

Stochastic industrial source detection
using lower cost methods

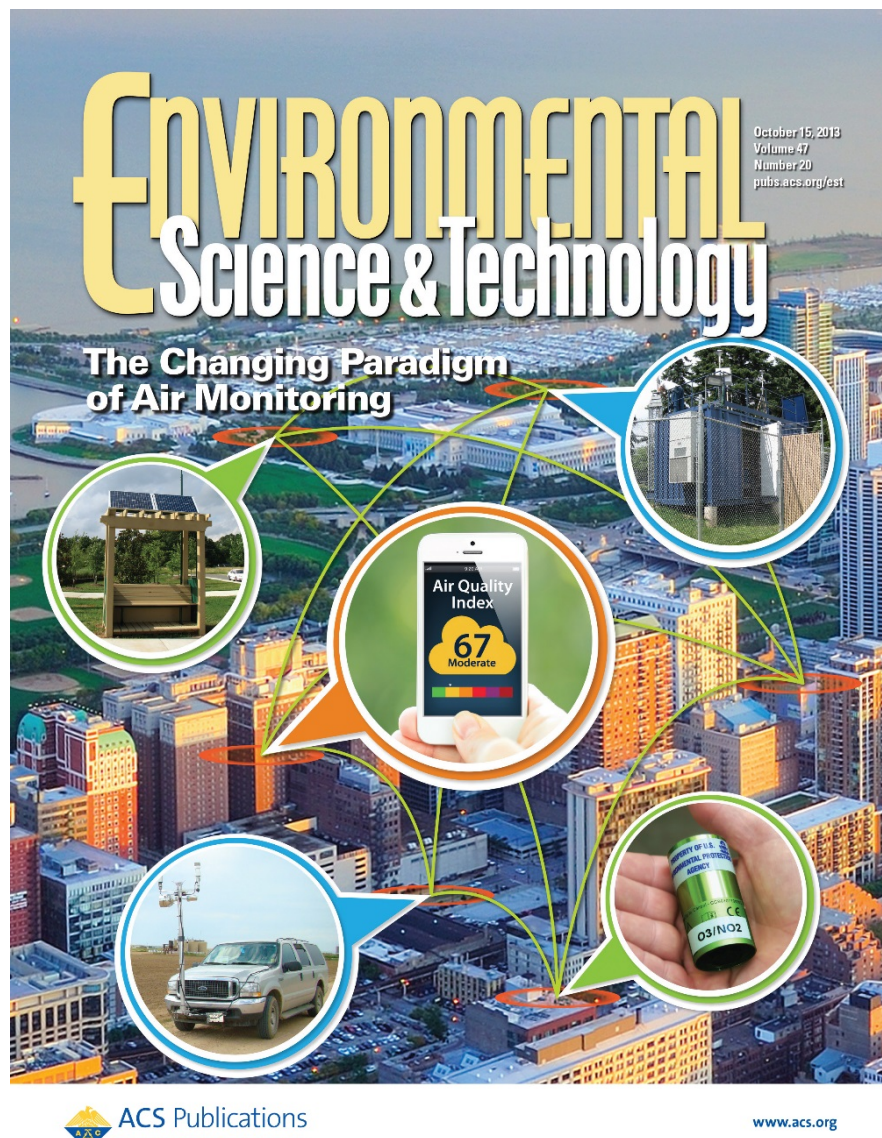
An aerial photograph of a large industrial complex, likely a refinery or chemical plant. The facility is characterized by a dense network of pipes, walkways, and structural steel. Numerous large, white, cylindrical storage tanks are visible, particularly on the right side of the image. The ground is a mix of dirt and paved areas. A semi-transparent blue rounded rectangle is centered in the lower half of the image, containing the text "Backup slides" in a blue, italicized serif font.

Backup slides

Next- gen sensors and such

- Low cost sensors
- Fenceline and facility
- Mobile measurements
- Community monitoring
- Satellites and tower
- Measurement /model system
- Data fusion across scales

<http://www2.epa.gov/air-research/next-generation-air-measuring-research>

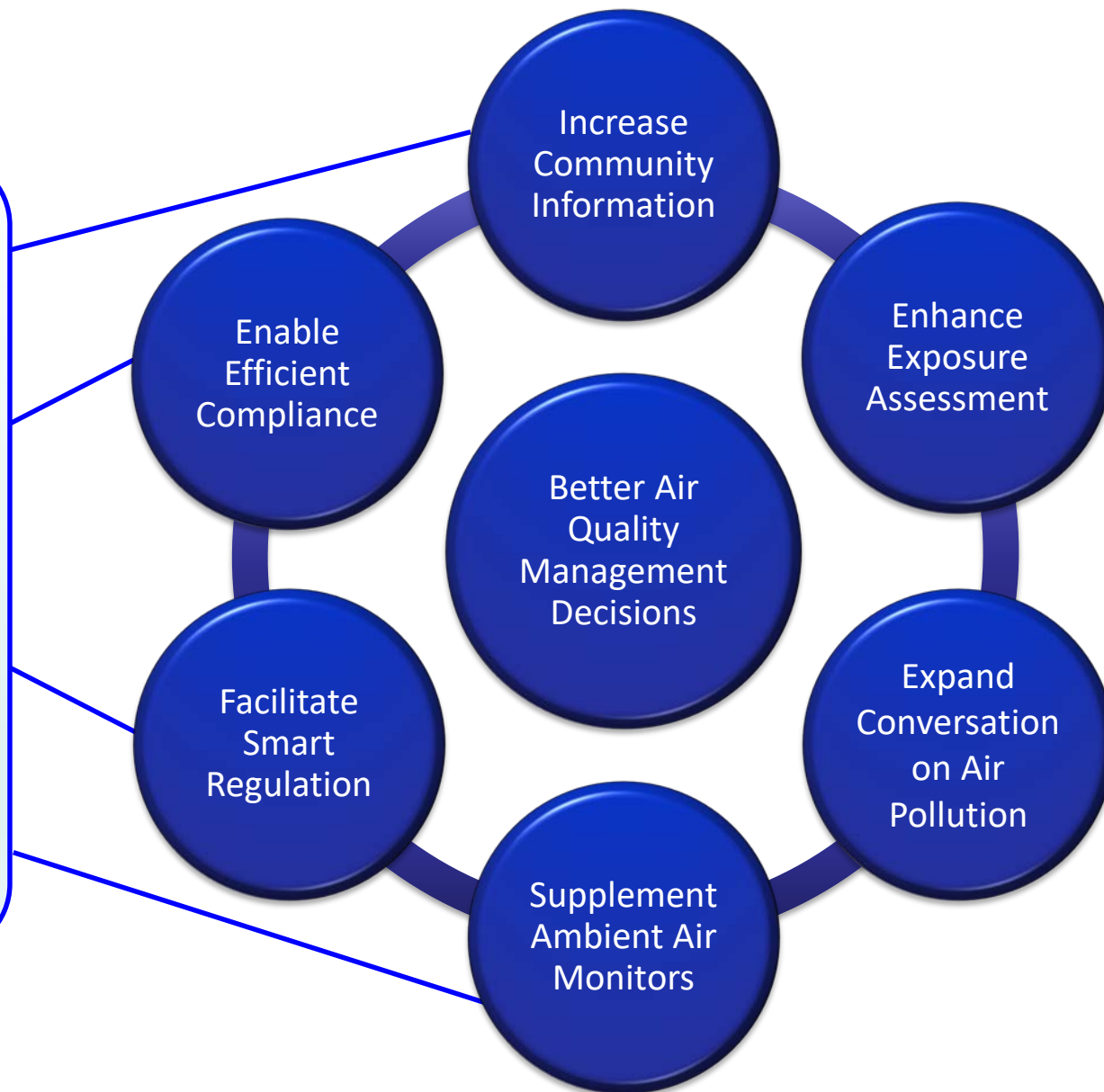


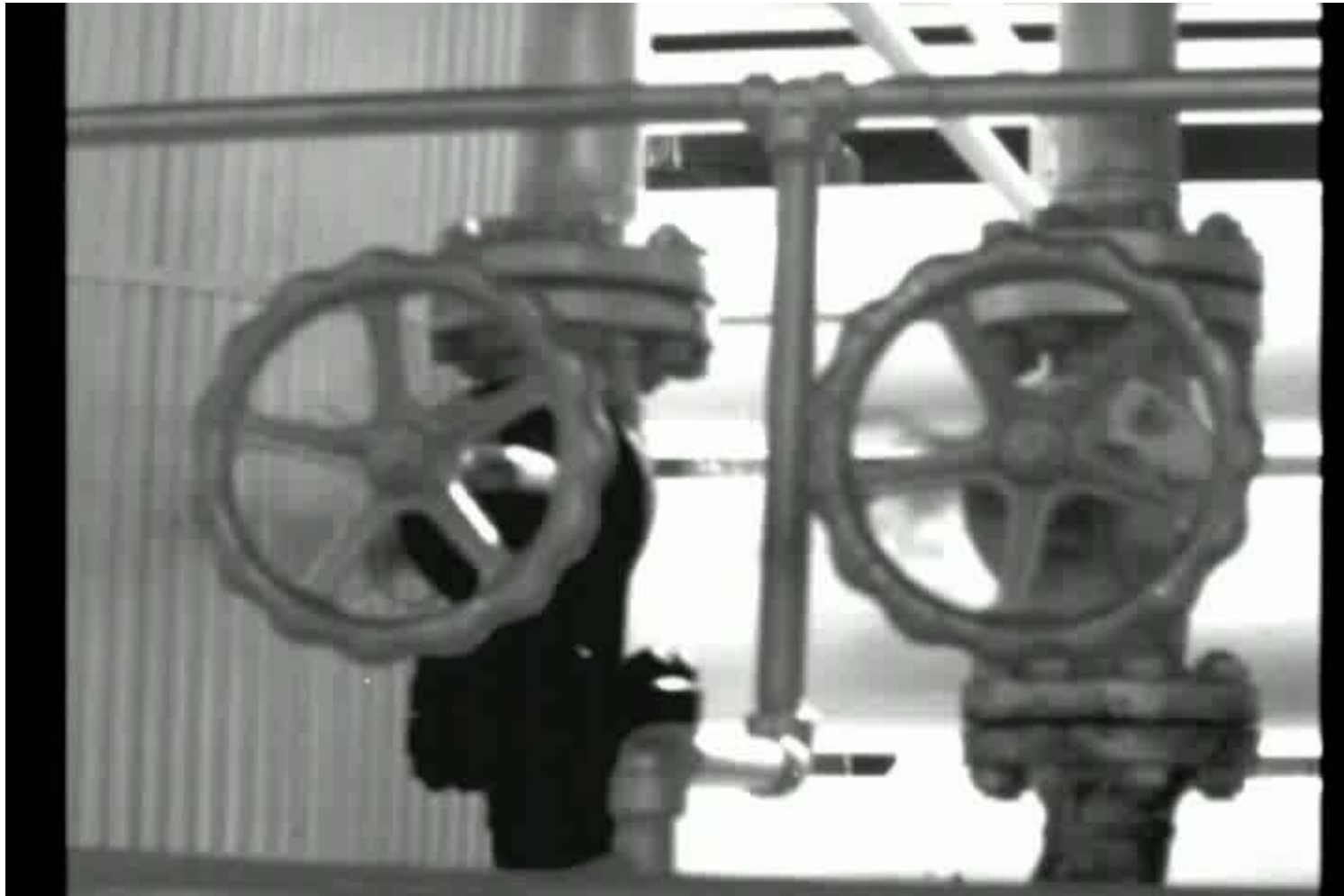
Snyder, E. G. et al. The changing paradigm of air pollution monitoring. Environ. Sci. Technol. 2013, 47 (20), 11369-11377

Next generation air monitoring (NGAM) *and* Next generation emissions measurements (NGEM)

NGEM

- Reduce emissions
- Improve work practices
- Reconcile inventories
- Improve transparency
- Enable new management strategies





<http://www.leaksurveysinc.com/>

Component Leak
NGEM = Optical Gas Imaging (OGI)



Process Malfunction
NGEM = Sensor

