

# ***Pipeline Research Council International, Inc.***

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## **Leak Detection R&D Natural Gas Transmission Pipelines**

### **Game Changers & Changing the Game**

**PHMSA Leak Detection Workshop  
Rockville, MD  
March 27, 2012**

**Mark Piazza  
PRCI**



**LEADING PIPELINE RESEARCH**

## Presentation Topics

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- **PRCI – who we are and what we do**
- **Current R&D Focus – RAM Program**
  - **Aerial Platforms**
  - **Ground-based systems**
- **Changing the Game**

# PRCI Membership

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- **37 Energy Pipeline Operating Companies**
  - 23 Natural Gas Transmission; 9 Liquid
  - 5 Liquid/Natural Gas
  
- **4 Pipeline Industry Organization (PIO) Members**
  - Association of Oil Pipe Lines (AOPL) /API
  - Operations Technology Development (OTD)
  - Australian Pipeline Industry Association (APIA)
  - Electric Power Research Institute (EPRI)
  
- **25 Associate Members & Technical Program Associate Members**
  - Australia, Canada, China, Europe, Japan, Mexico, U.S.
  
- **Worldwide Research Organization**
  - 38 U.S. Companies
  - 23 Non-U.S. (Australia, Brazil, Canada, China, Europe, Japan, Mexico, Saudi Arabia)



# RAM Program Concept of Operations

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No single, cost-effective system, service or suite of technologies has been developed to apply over the entire pipeline system network to address these various threats

## Automating ROW Monitoring & Surveillance:

**Detect** – sensing & imagery collection

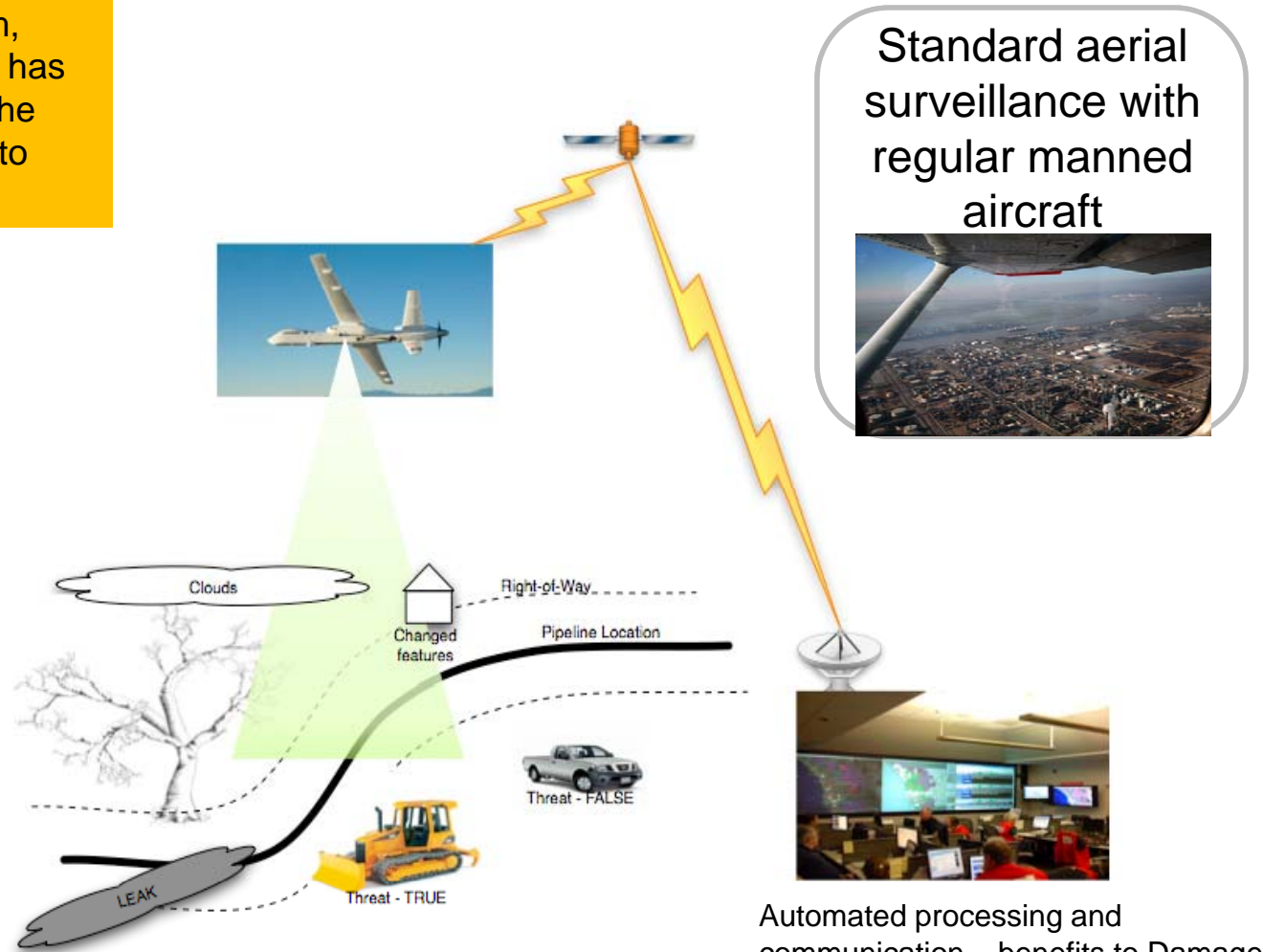
**Process** - data analysis via algorithms

**Distribute** – communication

**Archive** – improved data management processes and predictive modeling

## LEAK DETECTION

**Gas + Liquids**

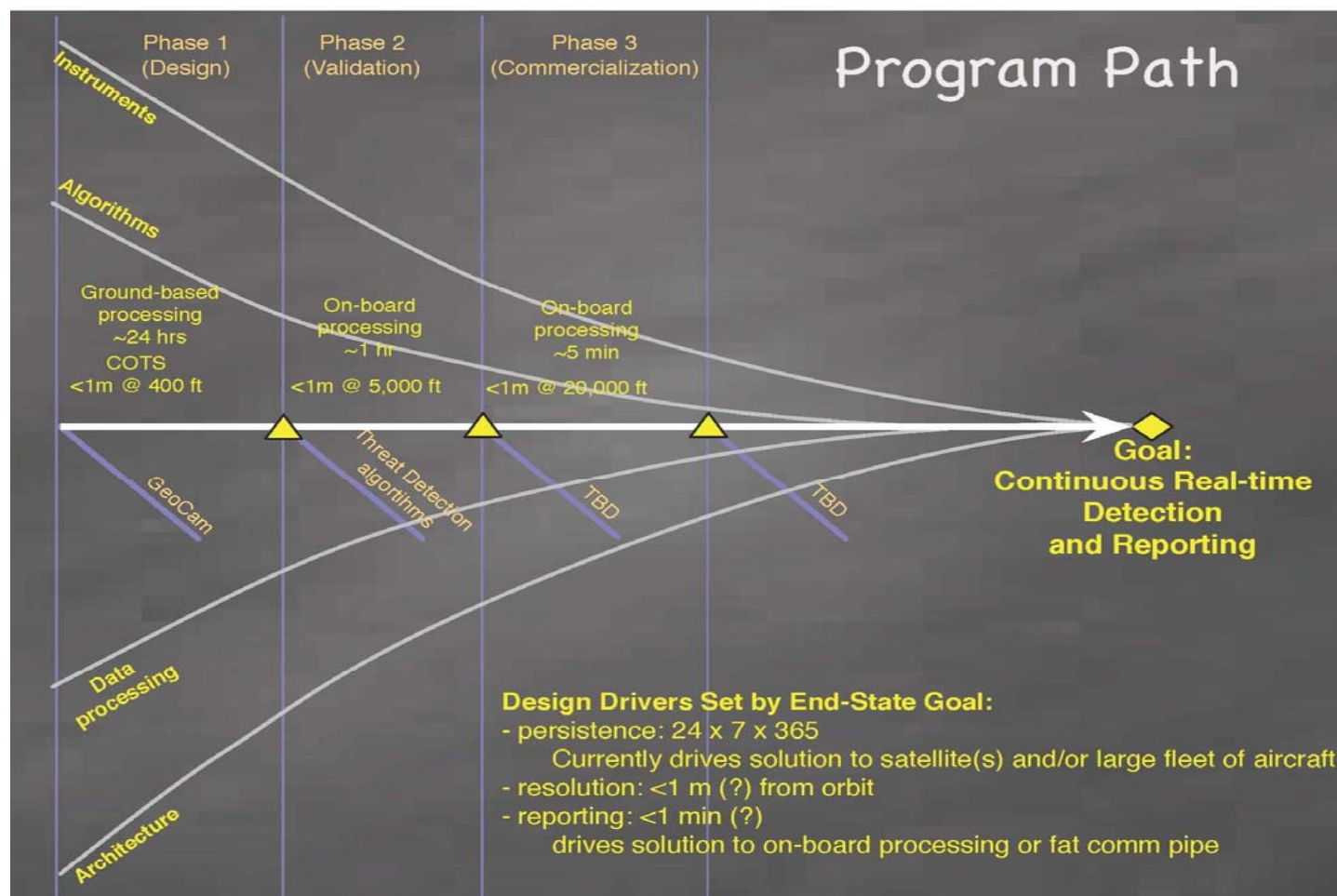


Courtesy of NASA Ames Research Center

Automated processing and communication – benefits to Damage Prevention, Emergency Response & Crisis Management

# RAM Technology Roadmap

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Progressive Development Path

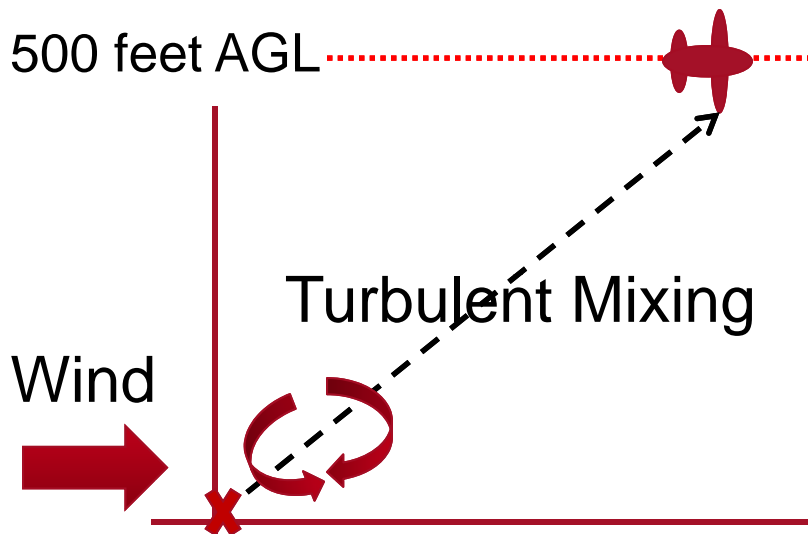
Gen 1 is current target - fixed wing with vision to future platforms

**RAM Success**  
Hyperspectral sensing confirmation for Natural Gas Leaks



# Detecting Leaks from Aerial Platforms

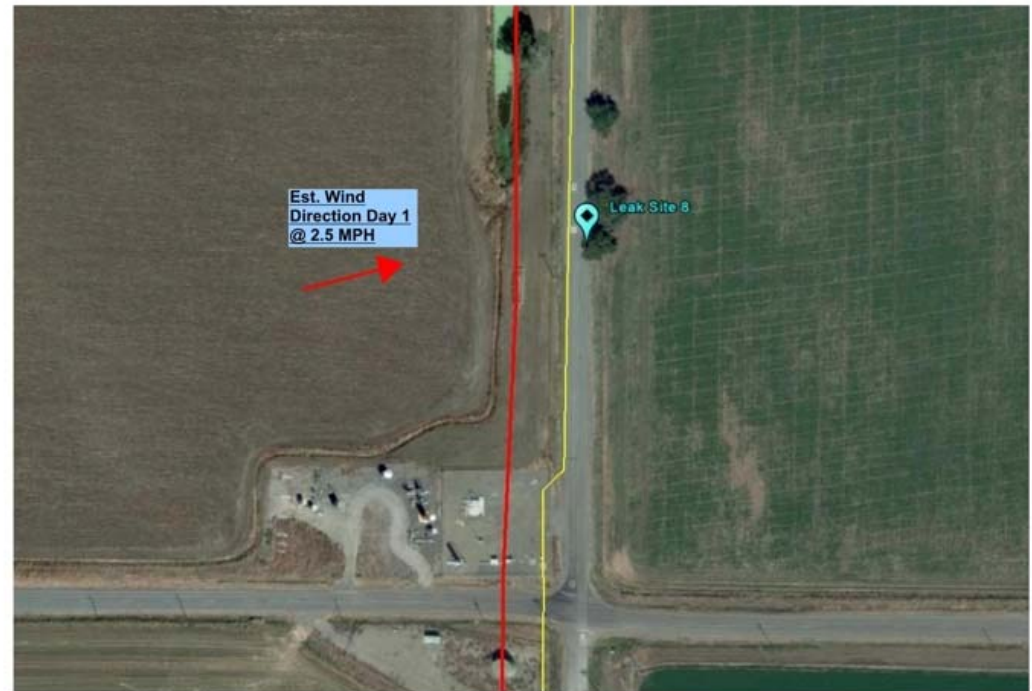
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Real-time weather data to optimize sensor placement

**Leak Site 8: Flight Day 1 - Aircraft out of Position (Upwind or Parallel to Gas Release)**

Helicopter was too far upwind of the GPS Pipeline to see the Leak Site. On the 2nd day no wind direction was reported. Wind speed was taken from Field Data Sheet to show more accurate ground wind speed. Yellow Line = GPS Pipeline



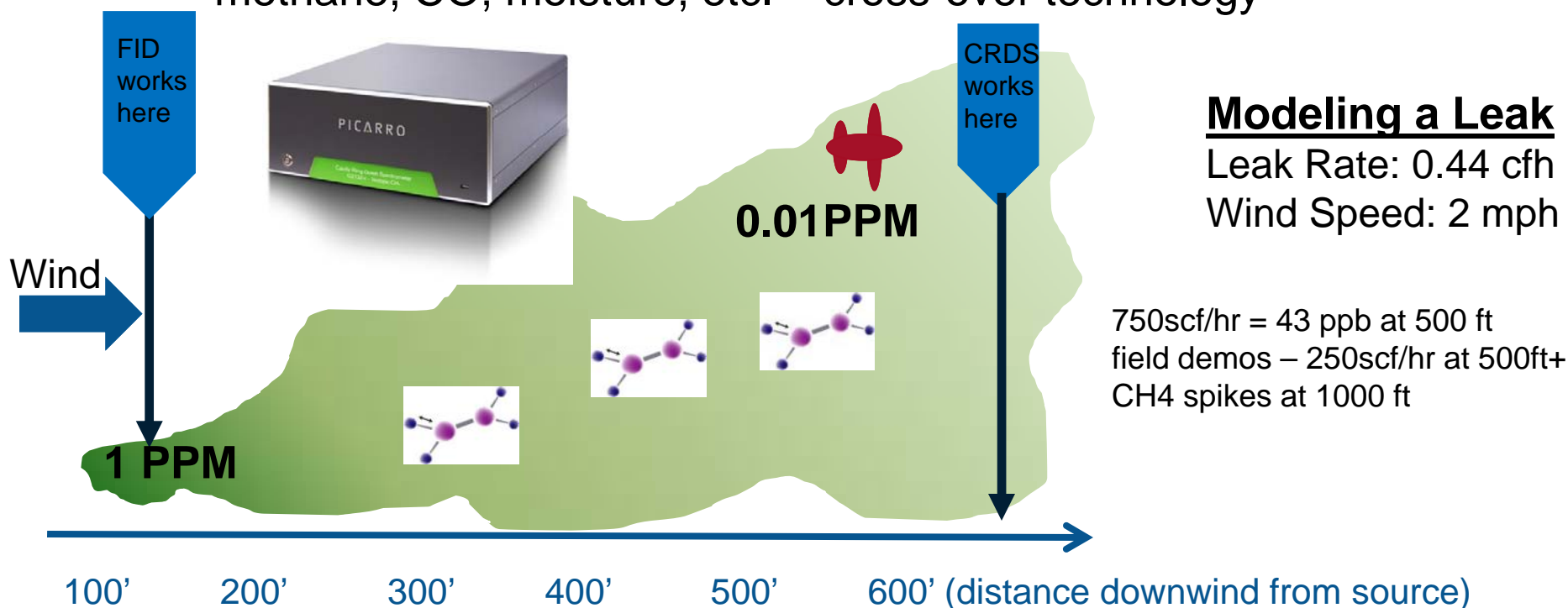
Turbulence acts to disperse the plume both laterally and vertically while the mean wind simply moves the plume downwind of the release.

# Aerial Platforms for CRDS - Sensitivity

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## ■ Cavity Ring-Down Spectroscopy (CRDS)

- laser based, tunable technology – ppb levels, very sensitive
- isotopes of carbon for differentiation of sources – C12/C13 ratios
- Developed initially for atmospheric monitoring – GHG focus - methane, CO, moisture, etc. – cross-over technology



# Aerial Platforms for CRDS – Sensitivity (cont)

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- **Cavity Ring-Down Spectroscopy (CRDS) – successful testing in 2011 & 2012**
  - NASA Unmanned Aerial System testing
  - Field Proof of Concept (ground-based as well)
  - A number of controlled release test flights (3 total)
- **Calibration of instruments – isotopes and methane; use NIST standards to confirm sensitivity, drift**
- **Develop pilot interface & algorithms – optimize flight path for leak detection**
- **Full-scale pipeline ROW test – planned June 2012**



CRDS in aircraft

Cockpit Display (shown in C172)





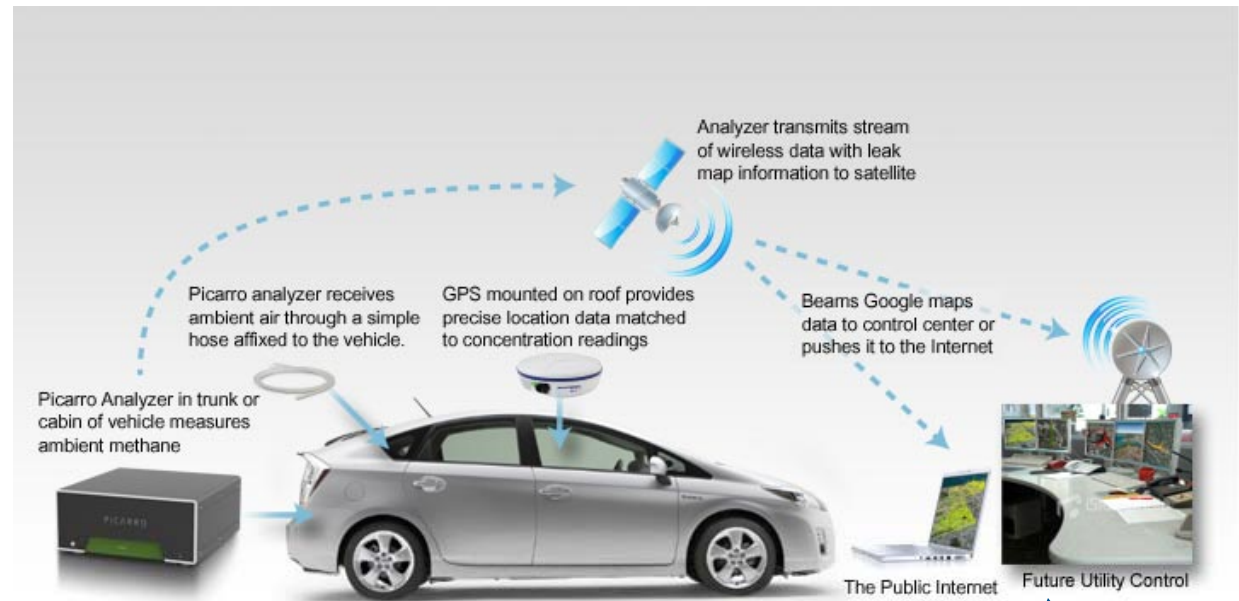
# Ground-based Gas Leak Detection - CRDS

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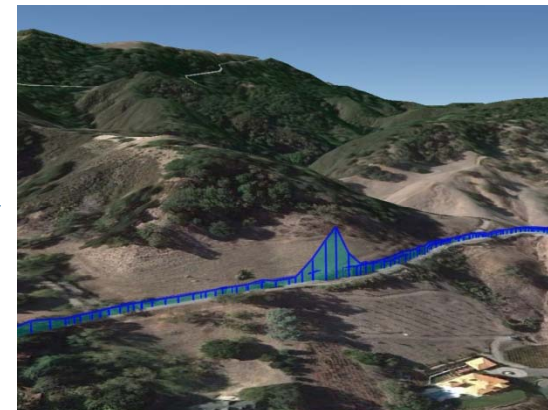
**Picarro CONOPS  
Synergy with RAM  
Program**

**Fully integrated system  
Real-time data  
Concentration maps  
User Flexibility**

**Up to 45 mph**

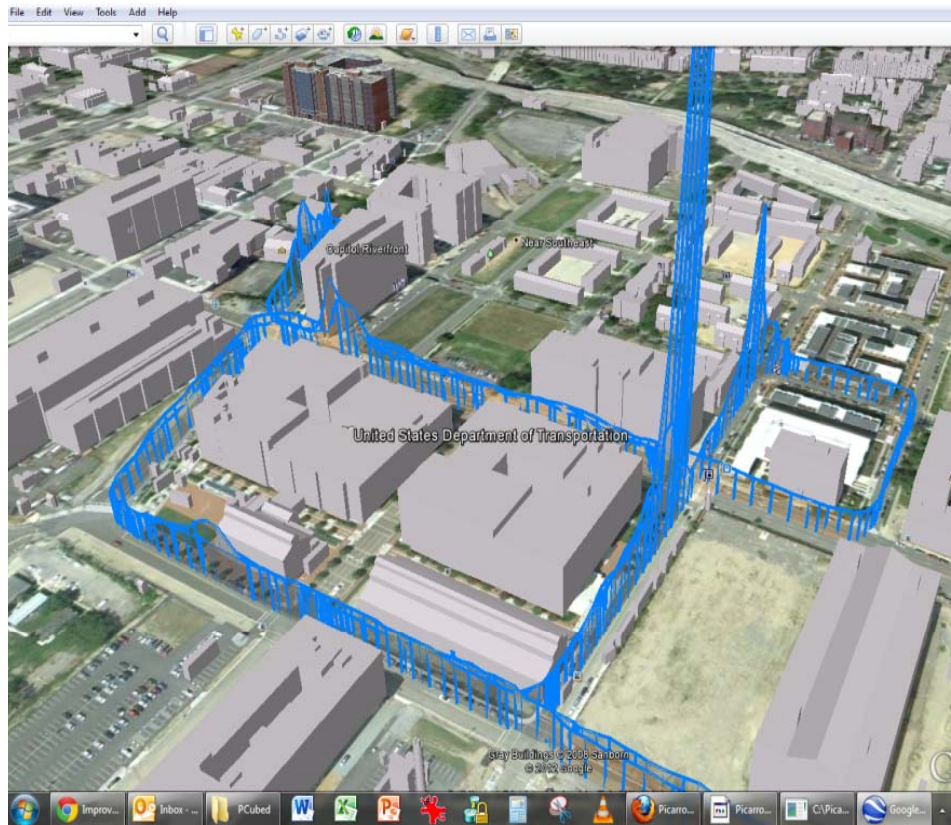


**Little “r” & Big “D”**

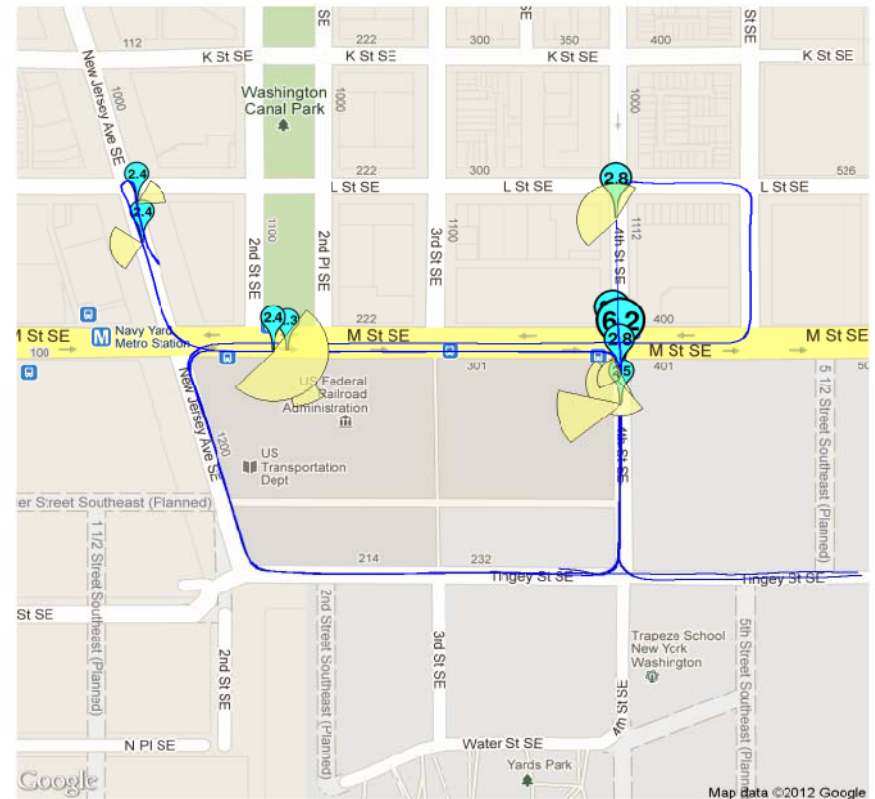


# Ground-based Gas Leak Detection - CRDS

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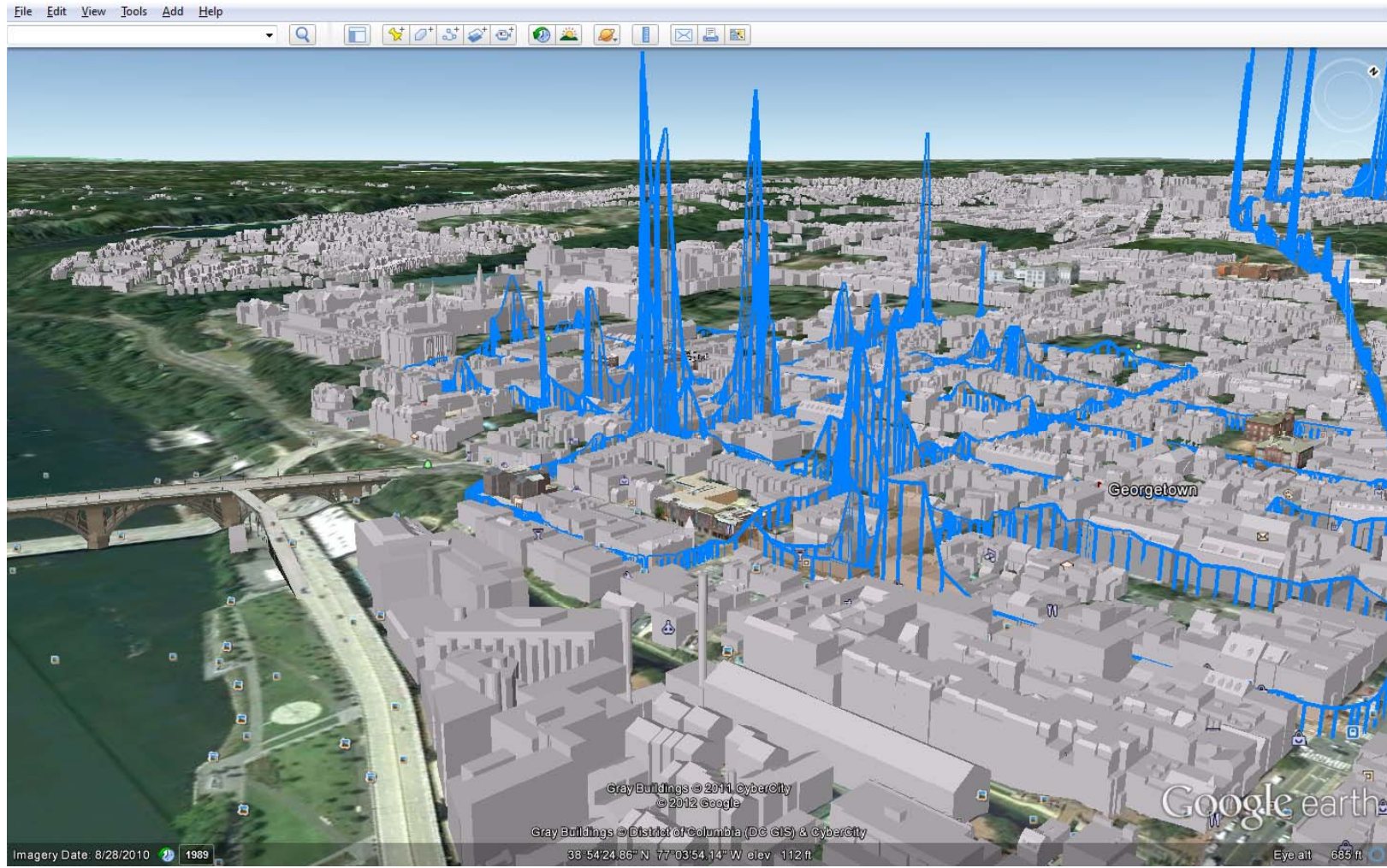


Start Time 25 Mar 2012 20:21, MinAmp 0.100



# Ground-based Gas Leak Detection - CRDS

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# Ground Based Gas Leak Detection - CRDS

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- **Recognition that many transmission line ROWs are in urban and suburban areas – aircraft challenges**
- **Link to distribution assets of PRCI members**

## 2011 & 2012 Testing Program

- **2 controlled release tests – leak indications and locating**
- **Full complement of high precision weather data and continuous monitoring of conditions**
- **Data drives work to further develop/improve algorithms and software systems for data processing and management**

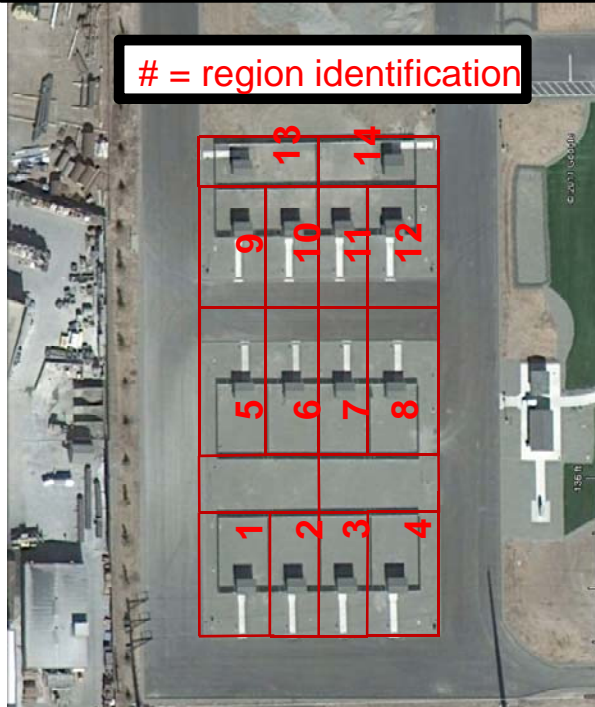
# Ground Based Gas Leak Detection - CRDS



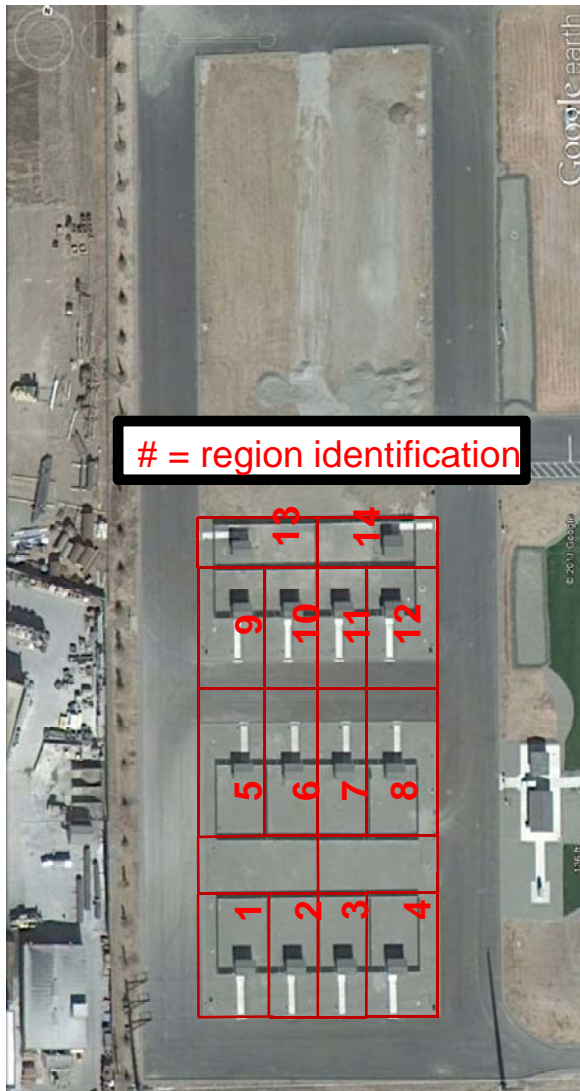
20 controlled leaks – all detected (85% locating accuracy)

Leak Types: Service connections, under road, underground, in buildings, etc.

- Leak rates: 0.44 to 3.7 scf/hr
- Measured two small plumes from 0.44 scf/hr leaks at 300 ft from source
- Found leaks in test site piping



# Ground Based Gas Leak Detection - CRDS



## Ground Based Gas Leak Detection - CRDS

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### Next Steps

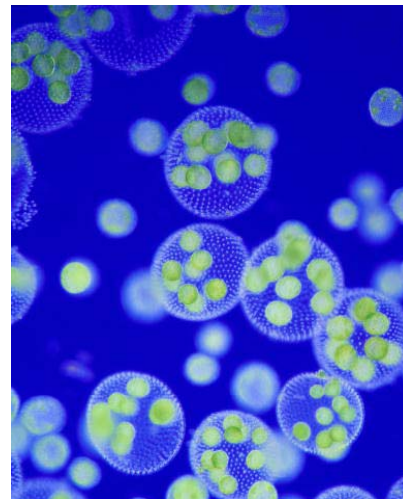
- Side by side testing – ongoing
- Possibly link with aerial study in June 2012
- Testing in field – **volunteers welcome**

# Changing the Game – Some Things to Consider

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## Engineer the Environment

- Bugs – CO<sub>2</sub>, Temperature/Thermal
- Plants
- Other?

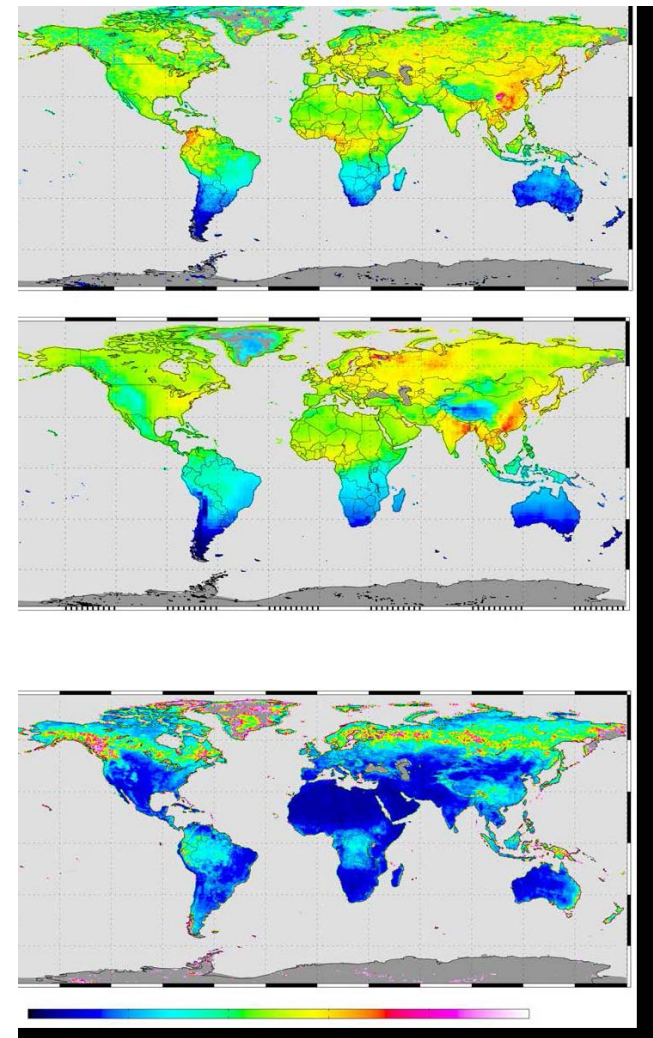


DRA-like substances  
Unmanned Systems

## Satellites

- Move to automation - iPad Generation
- Current capabilities vs future
- How does pipeline industry help define next generation?
- Of, by, and for the people? Government role

**Expand our view of the world**



From Frankenberg et. al., Journal of Geophysical Research, Vol. 111, 2006



# Closing Thoughts

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**PRCI R&D Roadmap – Leak Detection is a top priority**

**Leak Detection for Facilities**

**The first adopter – drives innovation**

**Seize opportunities**

**Developing the Program for 2013; 5 target areas for Roadmap + RAM Program**

**Collaboration**



LEADING PIPELINE RESEARCH

# Questions?

Any follow up to:

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