ISPRS WG VIII/2 Symposium on
"Advances in Geospatial Technologies for Health"

Detection of Natural Gas Pipeline Leaks and their Health Consequences using Airborne Lidar

Mike Renslow

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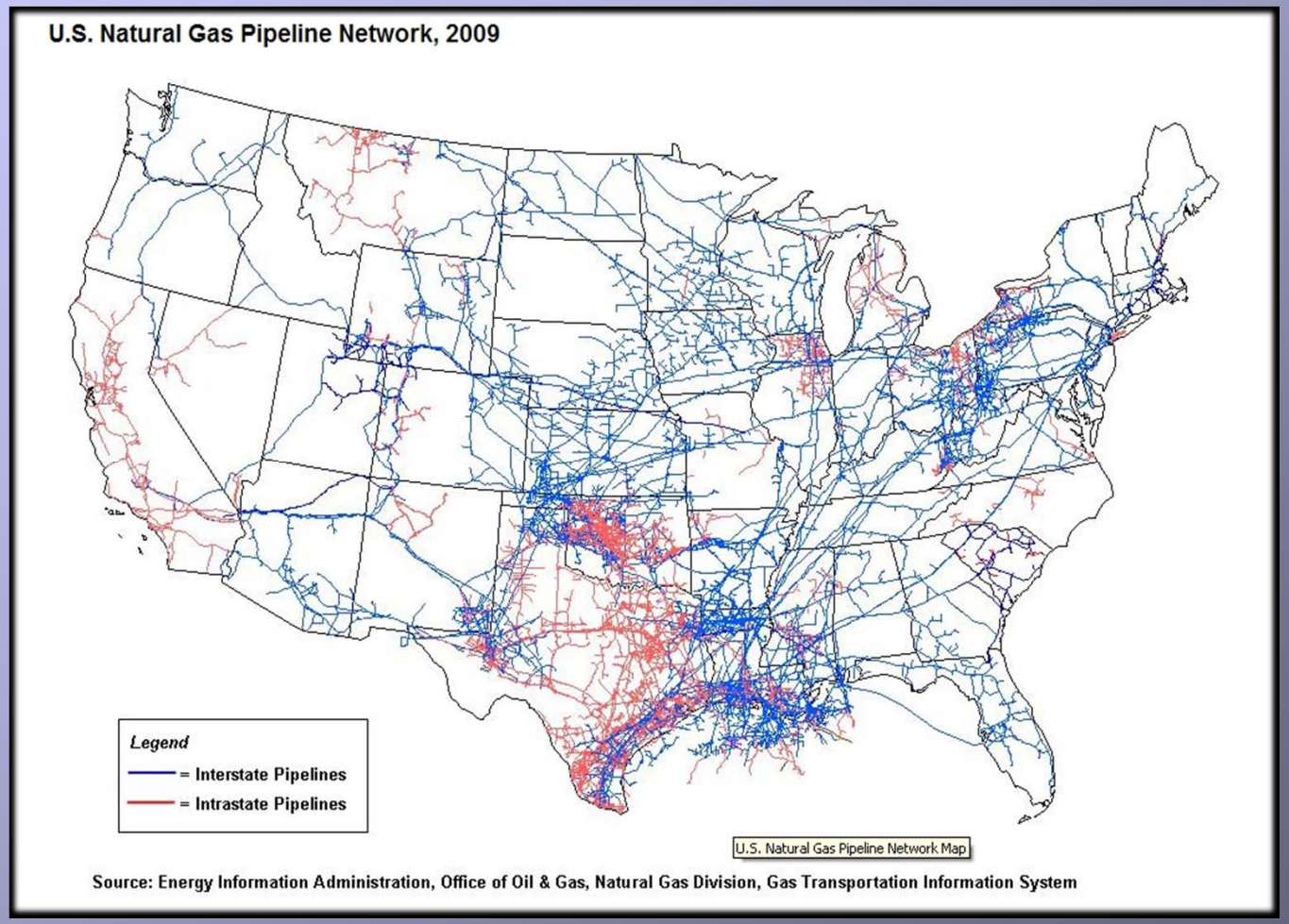
Presentation

- Health Hazard Issue
- Current Detection Methodologies
- The Challenge to Detect Leakages
- Lidar Detection Methodologies
- Advantages for Lidar Detection
- Summary

Health Hazard Issue

- Natural gas (Methane) poses a risk to human health, public safety, and the environment
- Colorless, odorless
- Difficult to locate emissions accurately and quantify the risk
- 2.3 million miles of natural gas pipeline in the US (60,000 miles of primary lines)

US Primary NG Pipelines



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Health Hazard Issue

- Nearly all pipelines leak: old age, aged welds, construction defects, corrosion, third party ruptures, natural/environmental causes
- Government standards mandate “leak surveys” up to 4 times per year which is economically impossible.

Challenge to Detect Leakages

- Most pipelines are 2 to 4 feet underground
- Minor leaks are difficult to locate with traditional methods:
  - Visual Observation along corridors to locate secondary indicators (stressed vegetation)
  - Walking the corridor with a “sniffer”
- Inspection Frequency: 3 to 10 years
- A small leak undetected can result in enormous damage.

Challenge to Detect Leakages

Flame Ionization Spectroscopy

- Hand-held device
- Slow – 1 mph
- Need to come in contact with the plume
- Difficult terrain and property issues
- Industry standard equipment

Pass-through Optical Sensors

- Truck mounted sensor
- Slow – 5 mph
- Need to come in contact with the plume
- Difficult terrain and property issues
- Easily damaged

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Lidar Detection Methodologies

- Possible to use remote sensing technologies: lidar + imagery
- Cover long distances in one day
- Detect, georeference, and quantify leaks
- Provide rapid turnaround time
- Evaluate the health risks in a GIS with current data

DIfferential Absorption Lidar (DIAL)

- Utilize two lasers at different wavelengths
- Calibrated to fit the same footprint
- Measure the difference between the return signals to ‘map’ and detect the concentration of the gas leak
- Lidar pulses at 3,000 pulses per second
- 1 meter pulse spacing at 500 m AGL
- Fly 1,600 km per day
- Deliver results in GIS in 24 hours

ANGEL System

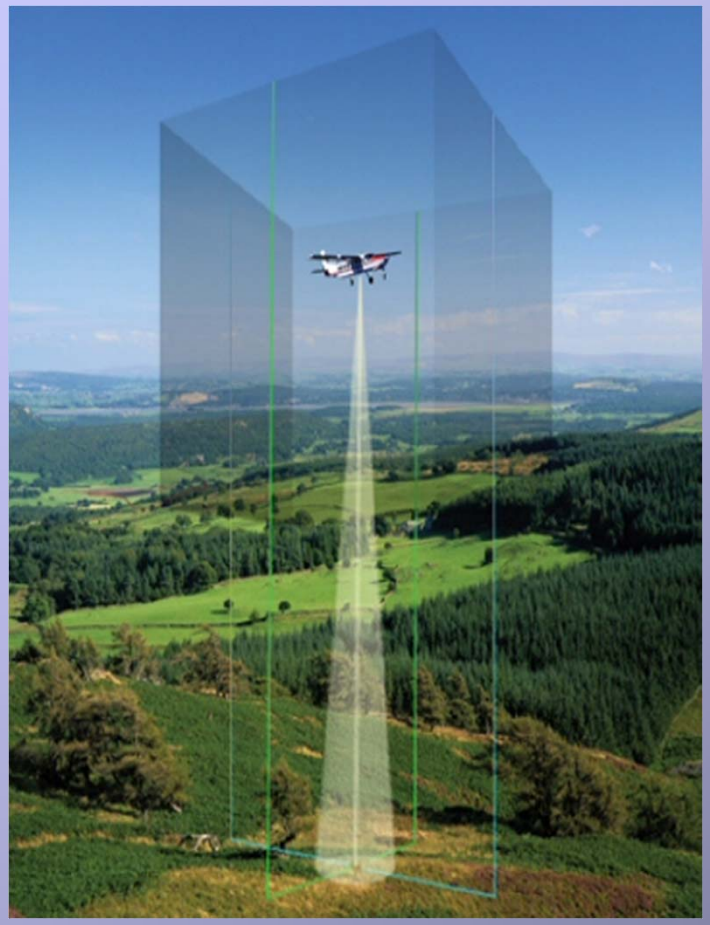
(Airborne Natural Gas Emission Lidar)

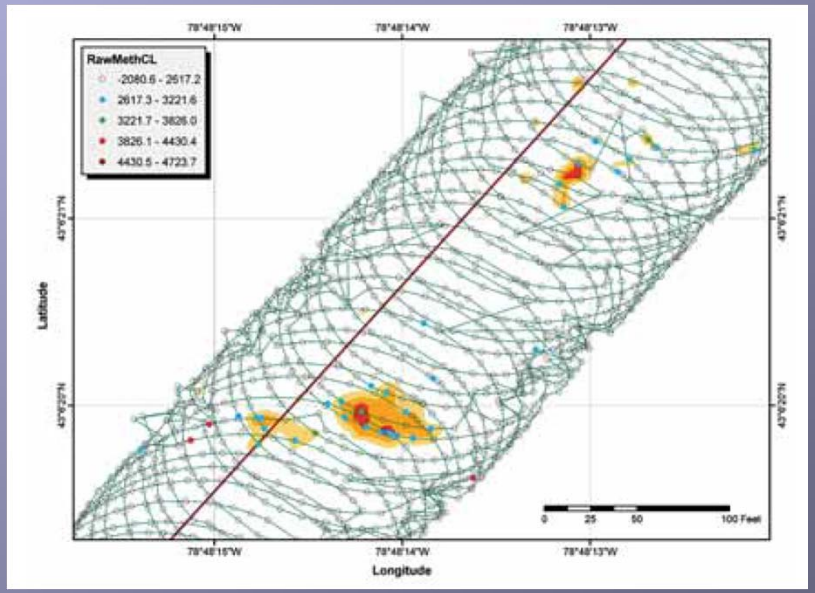
- Developed by ITT Industries Space Systems Division
- Dual Laser System, GPS/IMU, Georeferenced Color Imagery, “Active Pointing”, GIS Workflow
- Final Product: 3D Color-coded Model of Emission, 30 cm resolution Color Digital Orthophoto

ANGEL Operations

ANGEL DIAL Sensor in Cessna 208 B

Operational Characteristics





Elliptical Scan Pattern (Rotating Mirror)

ANGEL Operations

Pipeline Data from Client

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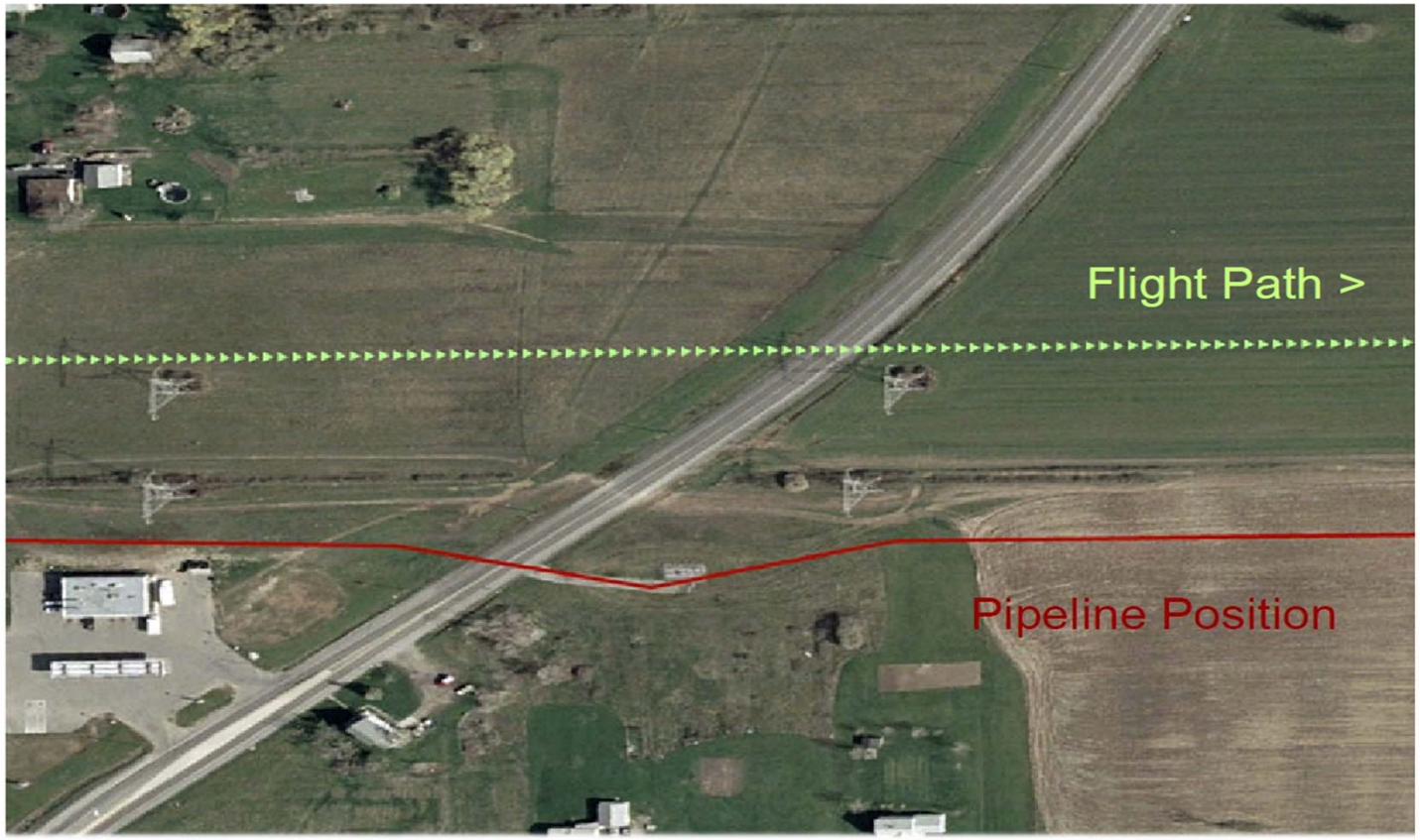
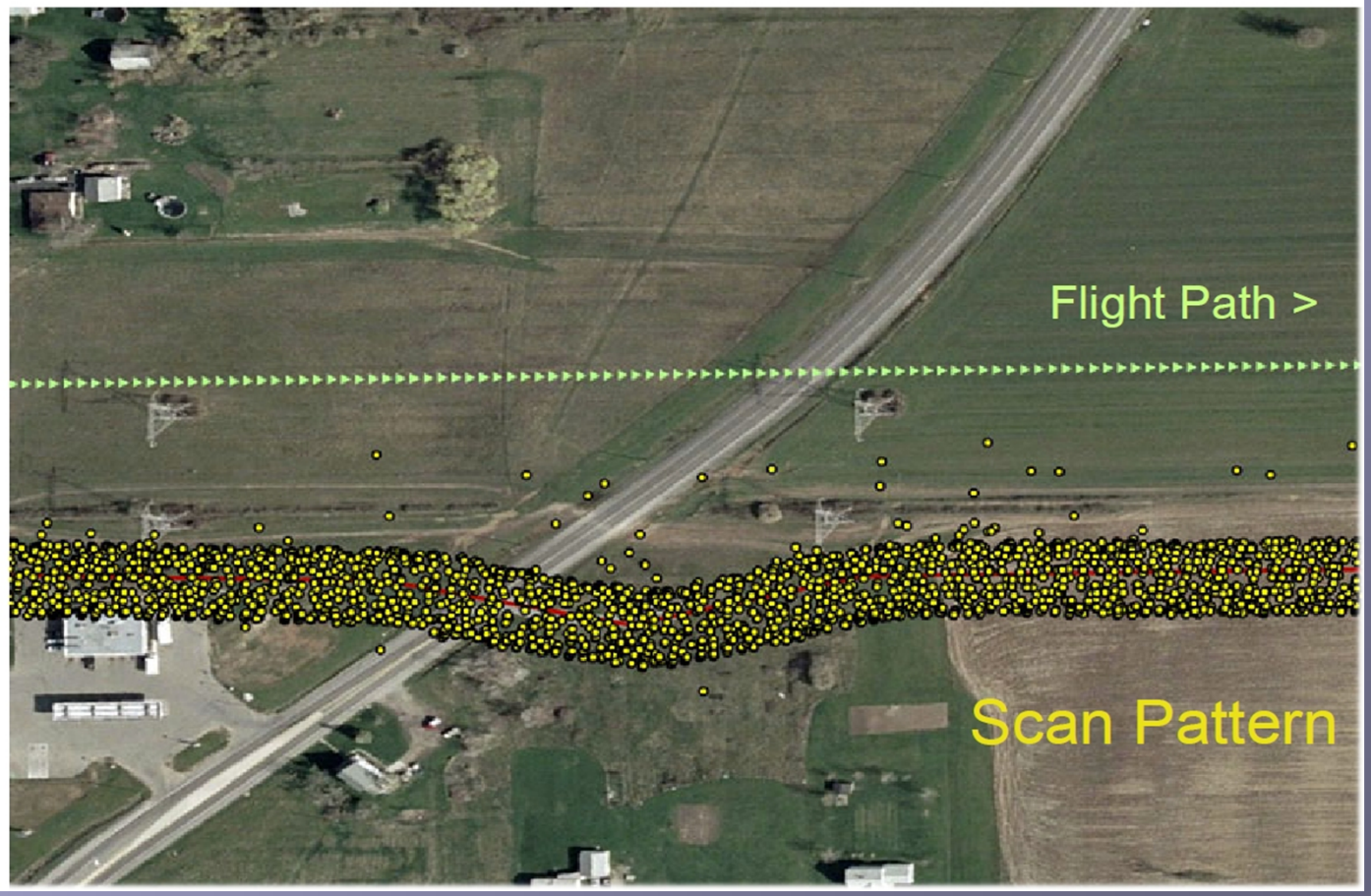
Pipeline Integrated with Flight Path and Imagery



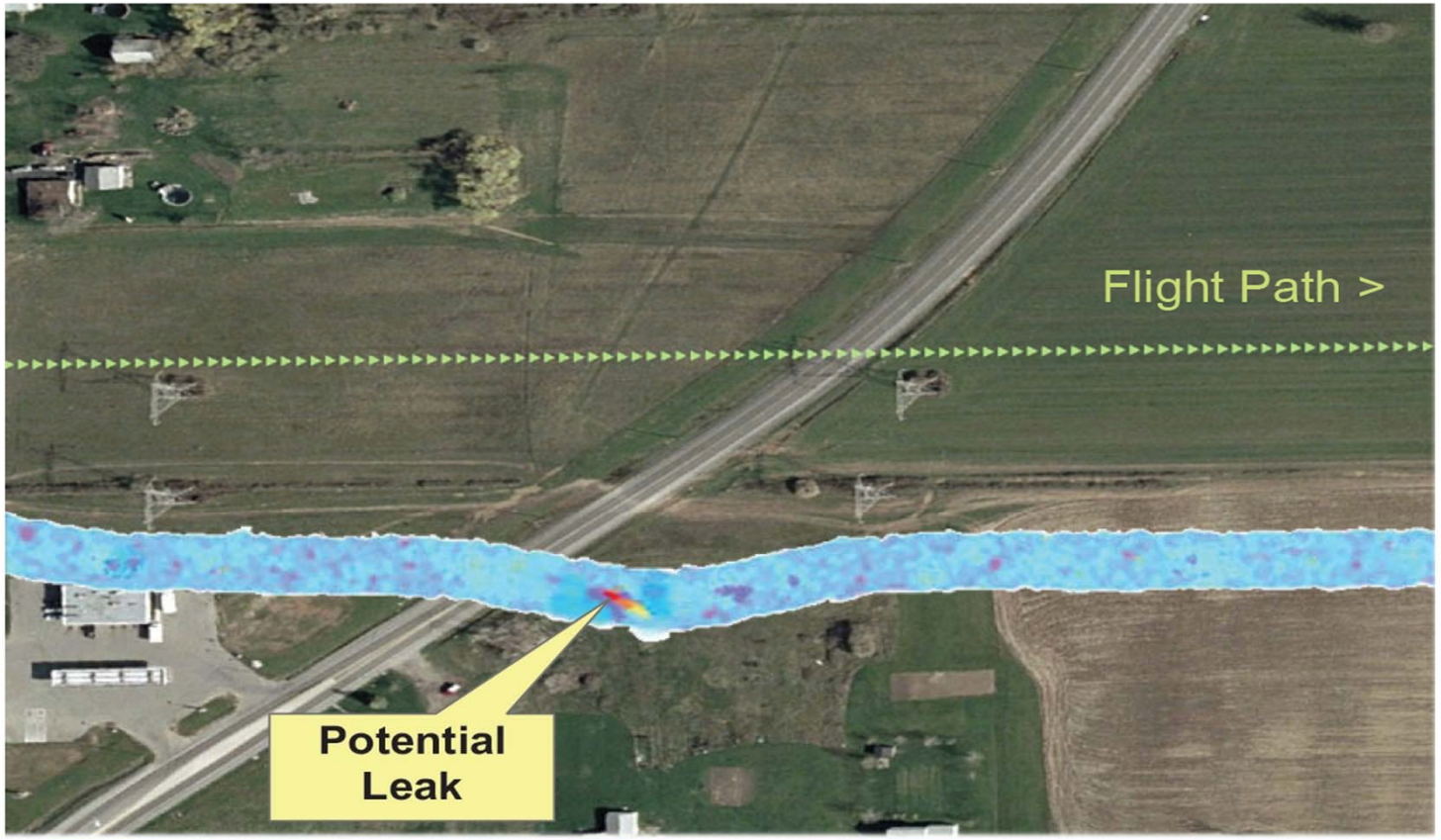
ANGEL Operations

DIAL Scan Overlaid on Pipeline



ANGEL Operations

“Blue Ribbon” Analytical Layer



Emission Identification

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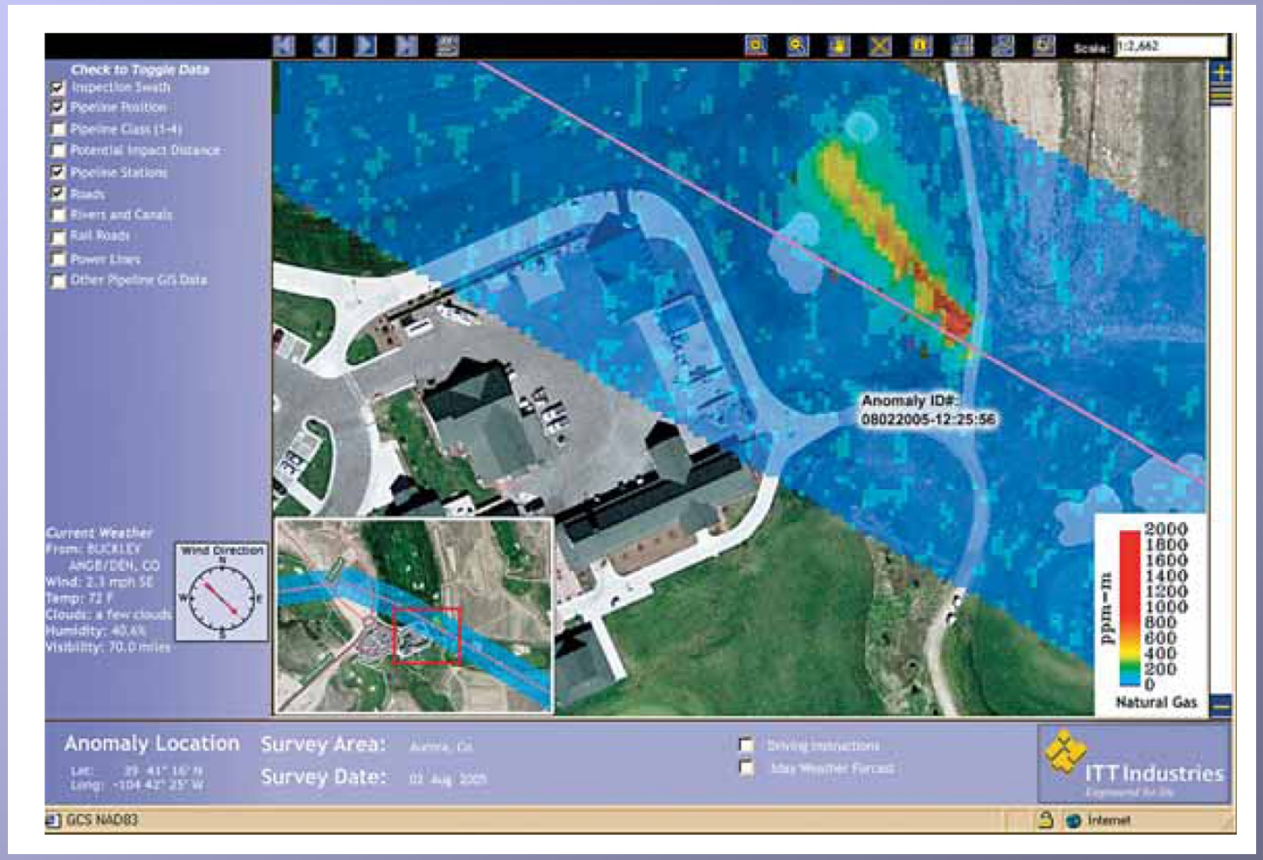
Emission Identification in GIS



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Summary

- DIAL technology provides accurate leak detection and quantification
- Captures color imagery leading to survey-grade orthophotography of corridors
- Captures wide-angle color video of surrounding areas
- Operates ~100x faster than other methods
- Safe methodology & Less Expensive
- GIS –ready, accurate datasets

Additional Applications

- Inspection of NG Storage facilities
- Detection of Other Leaks (re-calibrate lasers)
  - Oil Spills
  - Propane
  - Gasoline
  - Diesel Fuel

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Thank You…….

Mike Renslow, CP, RPP

Renslow Mapping Services

Eugene, OR

(C) 541-335-1251

(E) renslow76@comcast.net