Right of Way Automated Monitoring

"RAM"

Leak Detection

PHMSA Research & Development Forum

June 24-25, 2009

Gary Shane, PMP – BP Pipeline N.A.

RAM Project Team

- TransCanada
- Williams
- El Paso
- Enbridge
- AOPL
- PG&E
- Chevron
- EPCO
- Shell
- ConocoPhillips
- Buckeye
- Gassco
- Colonial
- PHMSA
- ExxonMobil
- National Grid
- SoCal Gas
- Marathon
- BP
- GE
- Total
- Petrobras
- TransGas
- CenterPoint
- Explorer
- NASA Ames Research Center

So… what's the problem?

Cost effective LEAK DETECTION for:

170,000 miles of hazardous liquid lines,

295,000 miles of gas transmission lines, and

1,900,000 miles of natural gas distribution lines

No single, automated system, service or suite of technologies has been developed to apply over the entire pipeline system network to address LEAK DETECTION.

Leak Threat

Can you see the Leak?

Photo courtesy of ITT Corporation, Airborne Natural Gas Emission Lidar (ANGEL) Services

Dial LIDAR Scan

Methane Leak
located

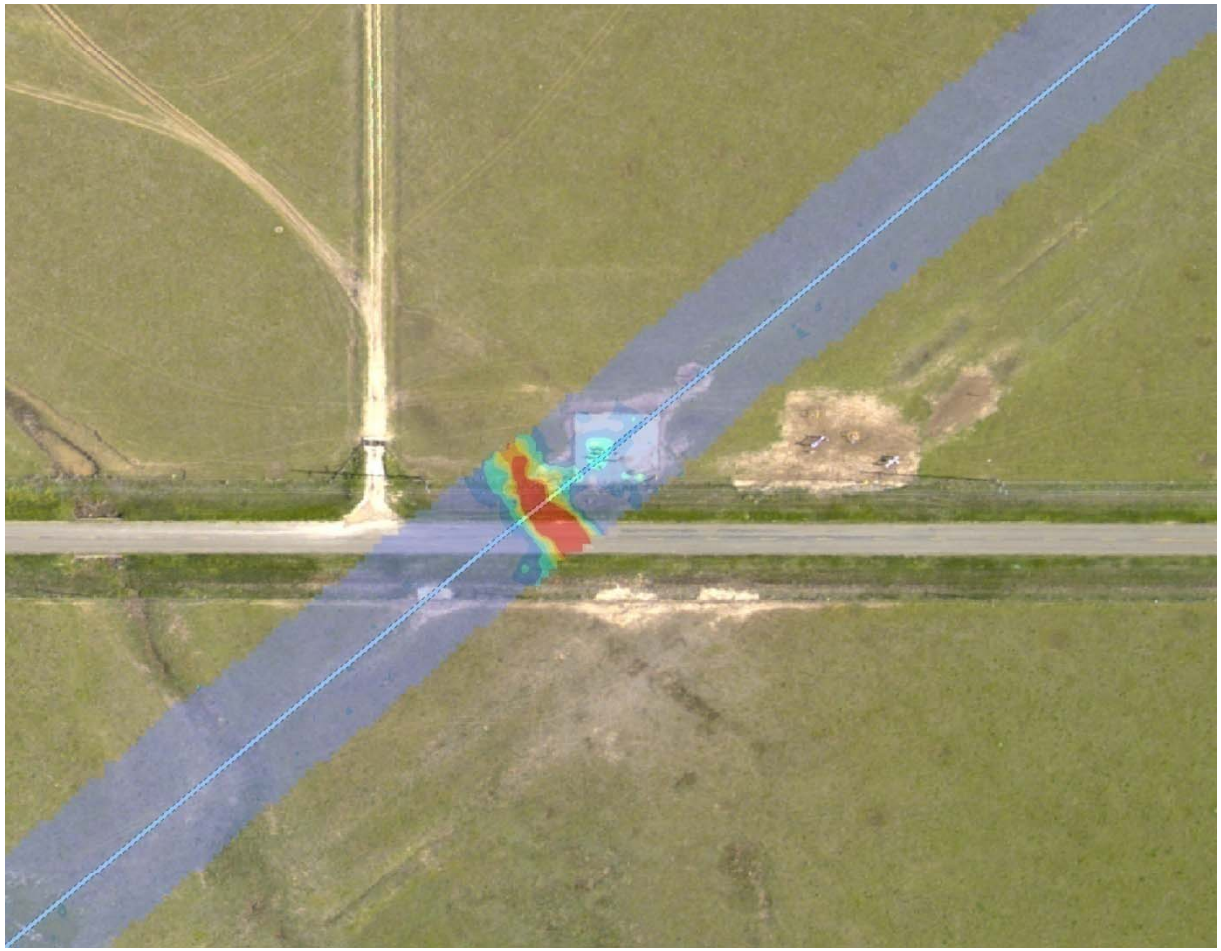
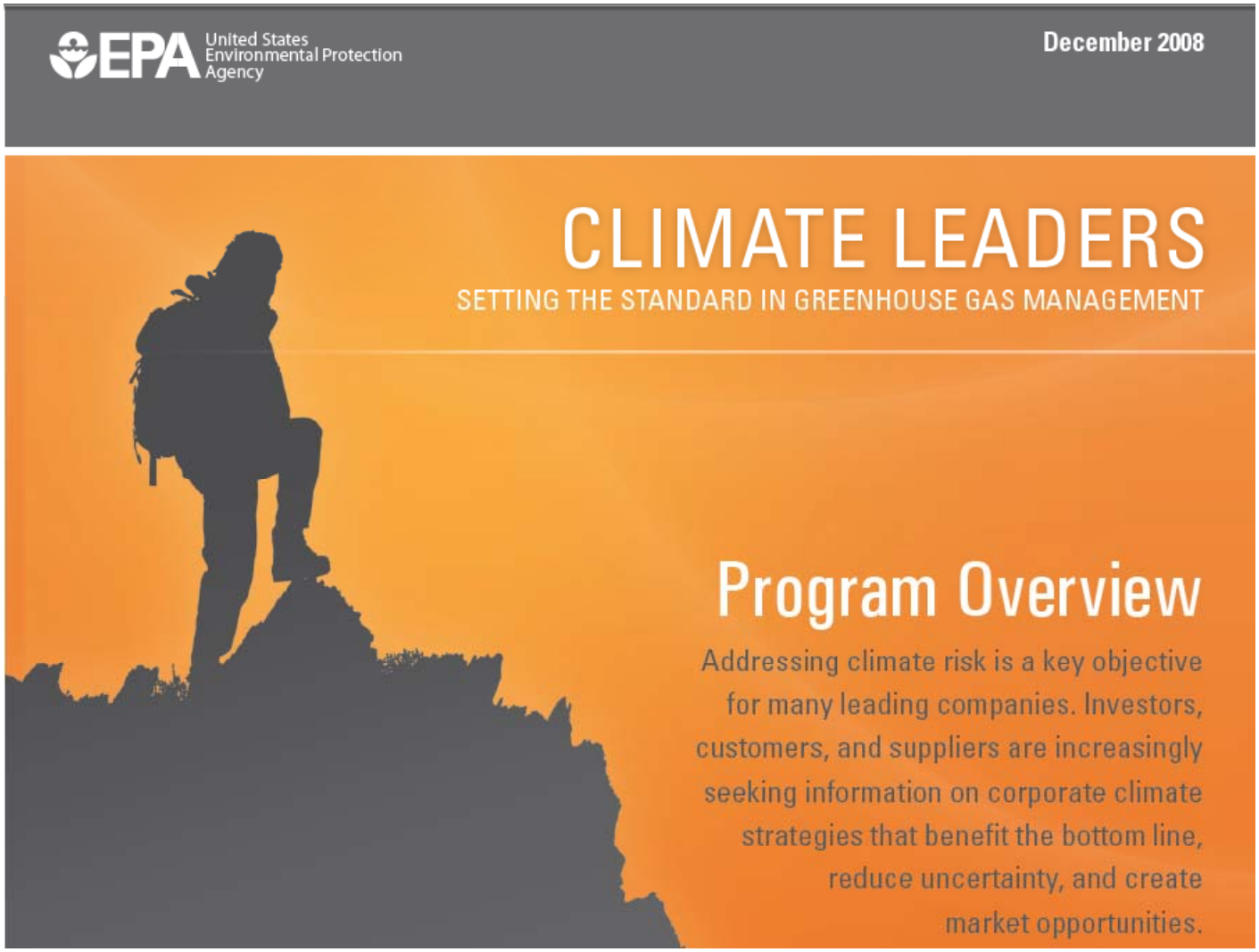


Photo courtesy of ITT Corporation, Airborne Natural Gas Emission Lidar (ANGEL)

Operator Objectives

- Enhance public and environmental safety
- Automate detection and improve threat identification reliability
- Automate notification process for near real-time delivery
- Automate distribution of geo-referenced data to designated operations centers (Control Center, One Call Center, etc.)
- Customize suite of sensors to fit geographical or operational need
- Enable operators to receive better data for better decisions in the deployment of response resources more effectively
- Enhance record keeping and archiving of data
- Enhance cost effectiveness of right-of-way monitoring

Environmental Protection Agency's CLIMATE LEADERS Program



RAM Program Vision

Program Vision

Realize enhanced aerial surveillance of the ROW through a suite of cost effective advanced technology to prevent infrastructure damage.

Program Objective

Identify, validate and advance the next generation technology. Implement solutions near-term on manned aircraft with a long term view to satellite & unmanned surveillance.

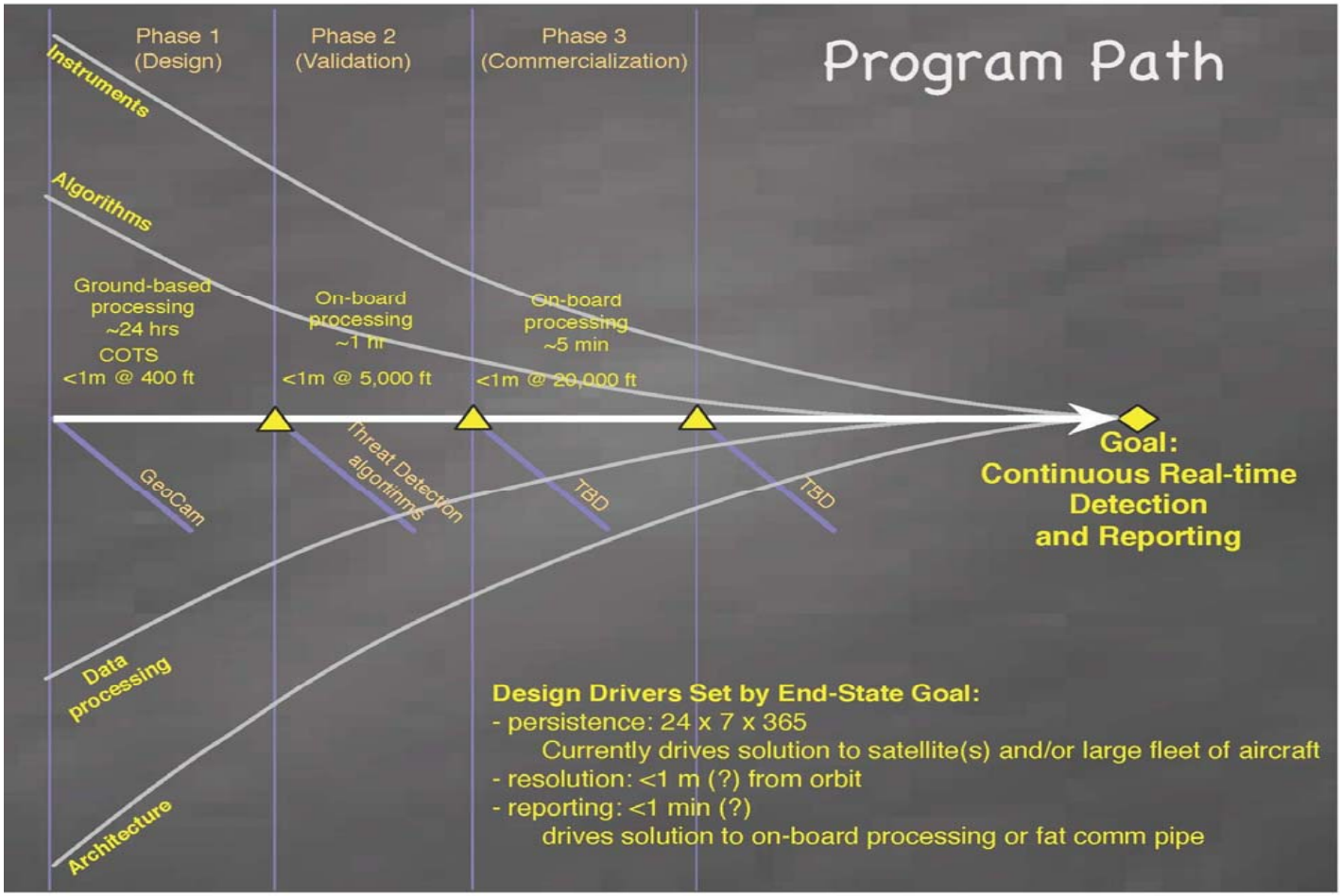
Scope – Automated Detection

- ROW Encroachments/machinery intrusions
- Machinery/leaks underneath tree canopy
- Ground disturbances, erosion, etc
- ROW Leak Detection – Gaseous and Liquid Hydrocarbons

Integration of sensors to:

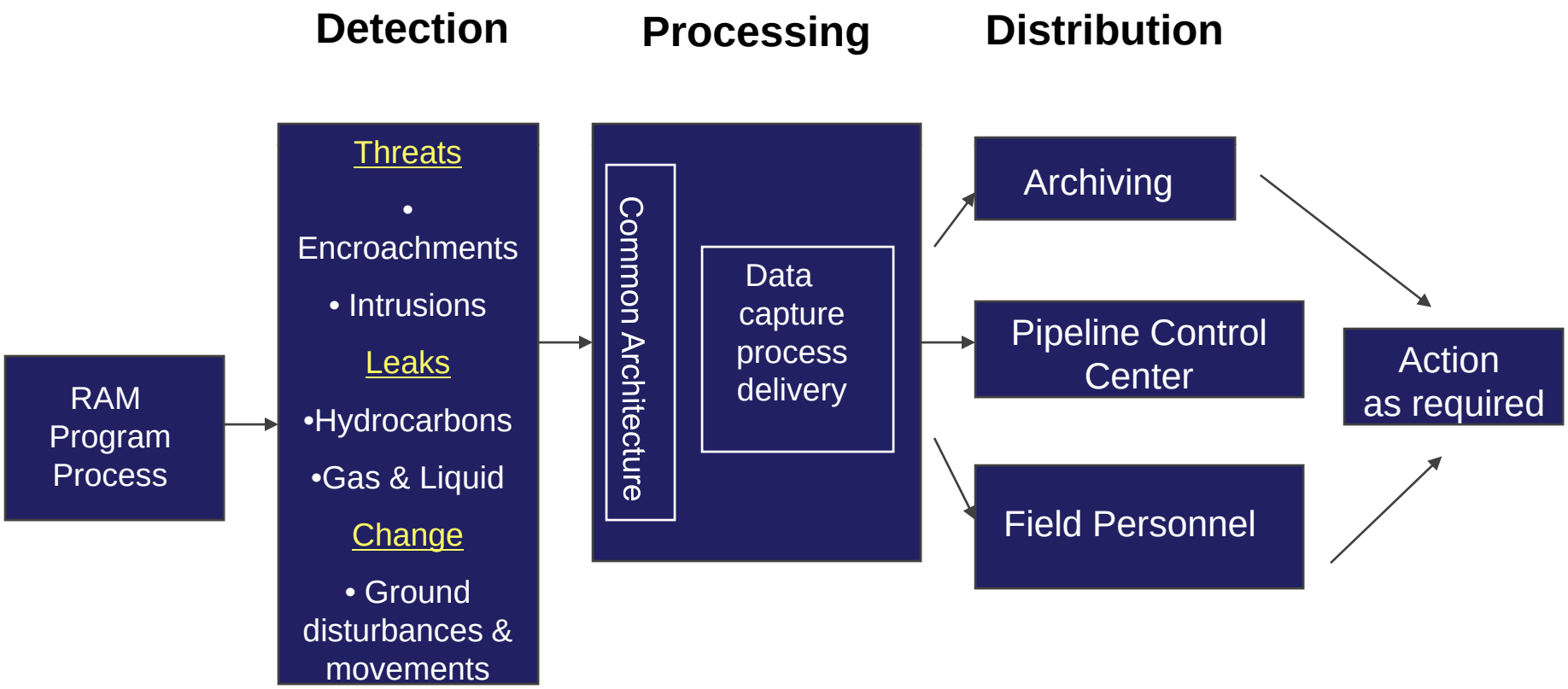
- ✓Airborne Threat detection systems
- ✓Near real-time detection & reporting
- ✓Long range communications
- ✓Multiple data systems
- ✓Image management systems
- ✓Predictive Modeling

RAM Program Overview

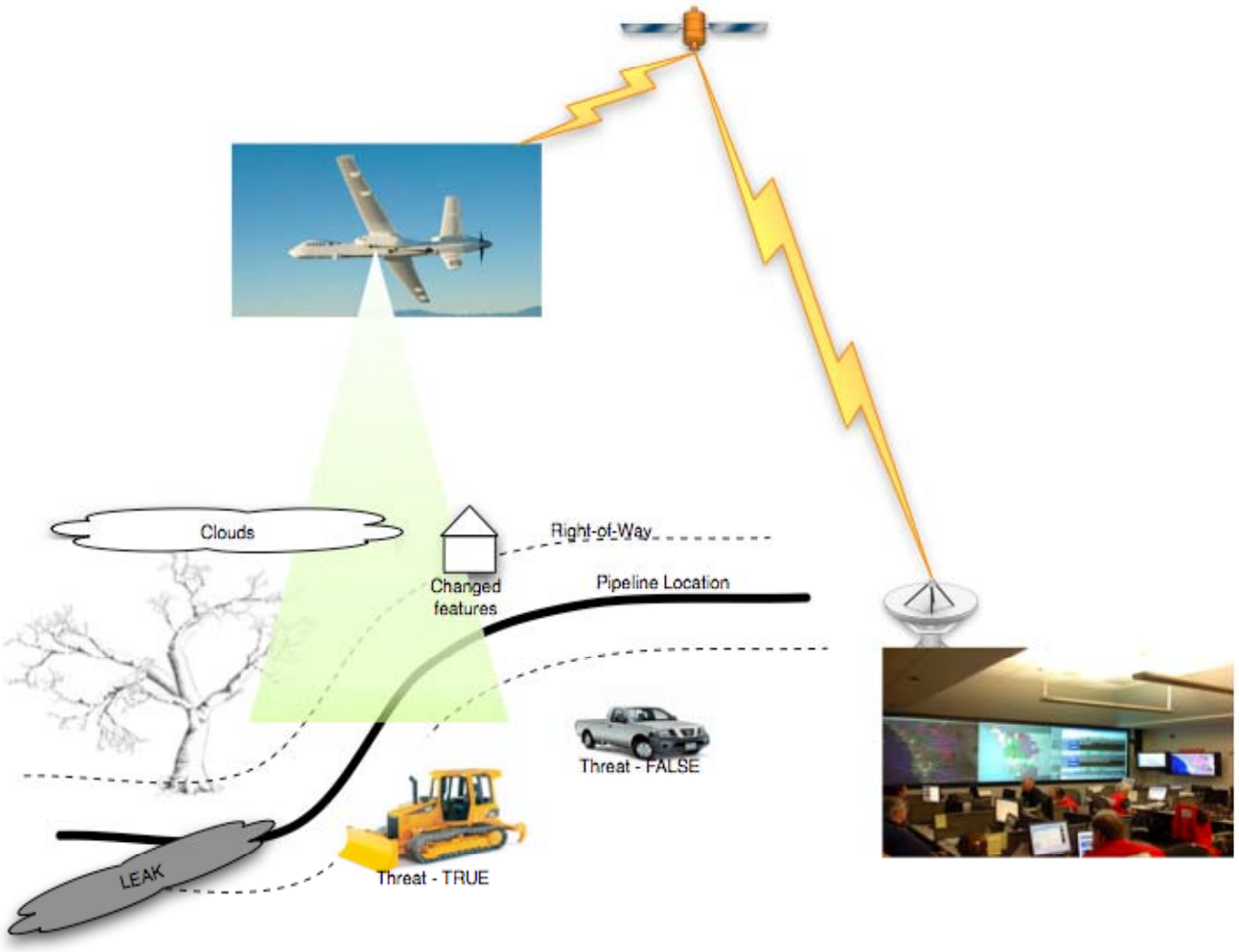


Courtesy of NASA Ames Research Center

RAM Concept Overview



Concept of Operation



Courtesy of NASA Ames Research Center

RAM – Concept of Operations

- Suite of sensors mounted on various aerial platforms to **detect** hydrocarbon leaks (as well as other threats such as machinery and ROW changes)
- Automated recognition and identification of leaks and **process** data on board aerial platform
- Via communication link (wireless, radio) **notify** operations center and/or designated field locations of threat with appropriate alarm indicating severity
- Download and **archive** data

Leak Threat

- **Objectives**
  - Develop technology to enhance natural gas/hazardous liquid detection
  - Direct detection of gases in the air above ROW
    - Soil
    - Water
    - Ice and snow
  - Plant stress detection to map small underground leaks
- **Approach**
  - Utilize DIAL LIDAR / Hyperspectral imagery
  - Automated processing of imagery and data

Leak Threat

- **Schedule**
  - **Phase 1: Imagery acquisitions**
    - **Site characterizations**
    - **Imagery acquisition**
    - **Imagery analysis**
    - **Analysis verifications**
  - **Phase 2: Automation of analysis methods**
    - **Automation of commercial analysis software**
    - **Re-acquire imagery to test automation**
  - **Phase 3: Refine analysis systems and field testing**

Current RAM Program Focus

- Algorithms for plant stress detection
- Automating image capture and data processing
- Verification studies – DIAL LIDAR, hyper-spectral, SAR, INSAR
- PHMSA and NASA working together on Gap Assessment and Request For Information (FedBizOps RFI #DTPH56-09-1000001)
  - Industry
  - National Labs
  - Academia
  - Commercial
- System Level Design Requirements

Challenges and Additional R&D Needs

Algorithms

- Development
- Speed of processing

Sensors

- Defining minimum requirements
  - Type
  - Resolution
  - Calibration & maintenance requirements
- Sensor miniaturization and payload optimization
- Automated leak detection sensors that detect leaks in various environments, terrains, and background conditions
  - Snow, grass, dirt, sand, etc.
  - Mountain, swamp, forest and variable terrains
  - Under crops

Challenges and Additional R&D Needs

Data Processing and Communications

- **Near-real time to real time**
  - Detection, analysis & processing – eliminate post-processing of data
  - Dissemination and appropriate & timely notification
- **Over the horizon, high band-width communications**
  - Systems architecture challenges
- **Full integration with aircraft and ground systems**
- **Data management and archiving challenges**
- **Human factors**

Monitoring Platforms

- **Manned aircraft – near-term focus**
- **Unmanned aerial systems – mid to long term goal**
- **Satellite – long-term goal**

RAM - Benefits to Pipeline Operators

- **Enhance community safety and environmental protection**
- **Increase pilot safety**
- **Increase pipeline integrity, security and reliability**
- **Significant improvement to detection capabilities**
- **Detect and respond more rapidly**
- **Reduce consequences and impacts**
- **Synergistic cost/benefit when combined with surveillance monitoring**

RAM - Other Potential Applications

- **Enhance localized aerial surveillance**
- **Focus surveillance during spill/event**
  - Marine oil spill, wildfires, hurricanes
- **Security surveillance of ancillary facilities**
  - Refinery, tank farm, or marine terminals
- **Leak detection for other linear industries or critical infrastructure in same ROW**

For More Information

Contact Mark Piazza

PRCI

678-339-3645

mpiazza@prci.org