Oil and Gas Spill and Pipeline Condition Assessment Using Remote Sensing

Using New Tools for Situational Awareness

By: William E. Roper
George Mason University
Subijoy Dutta
S&M Engineering Services

Presentation Outline

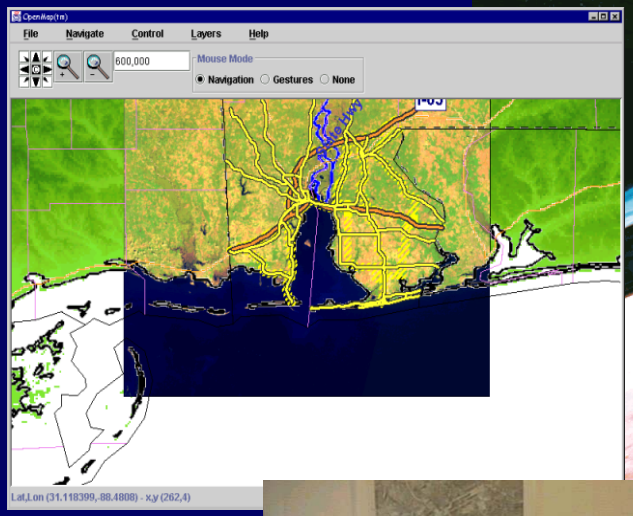
- Introduction
- Pipeline Monitoring
- Hyperspectral Oil Spill Characterization
- Conclusions

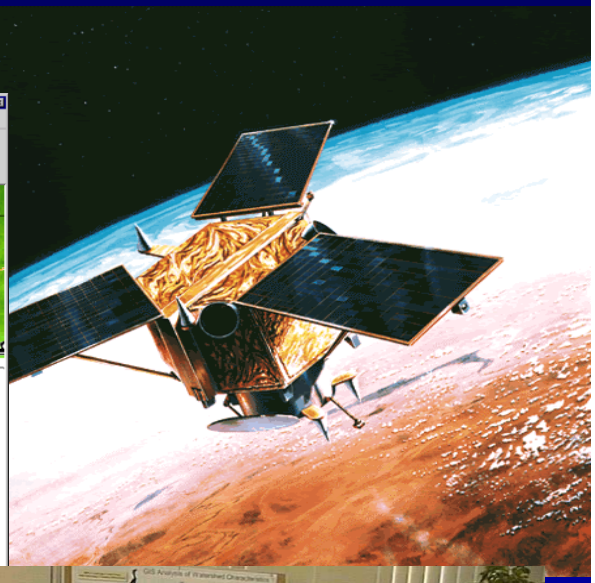
Visualization

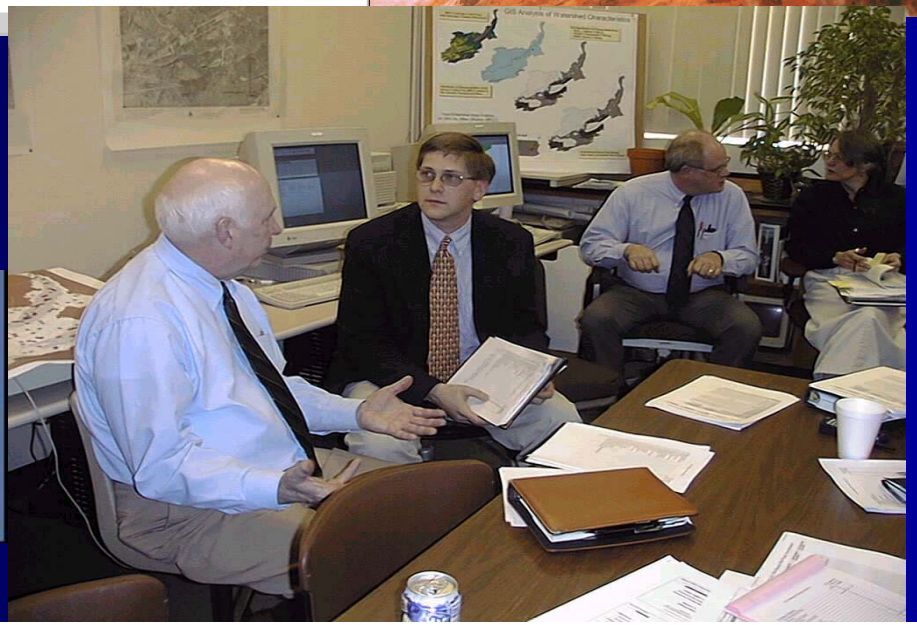
- Assists the understanding of data
- Able to represent temporal changes
- A more challenging integration requirement
- New software and hardware developments are in this direction

Pipeline Monitoring and Condition Assessment

- Imagery products in multiple resolutions and characteristics
- Integration of data sources
- Visualization Products
- Tailored products for the decision maker







Motivation for Advanced Detection of 3rd Party Encroachment

- Mechanical Damage is #1 Pipeline Hazard
- Mechanical Damage Related to Encroachment
  - 29% of incidents and 20% of fatalities
  - Incident Distribution
    - 72% Class 1 (rural land use)
    - 11% Class 2
    - 15% Class 3
    - 2% Class 4 (high density land use)

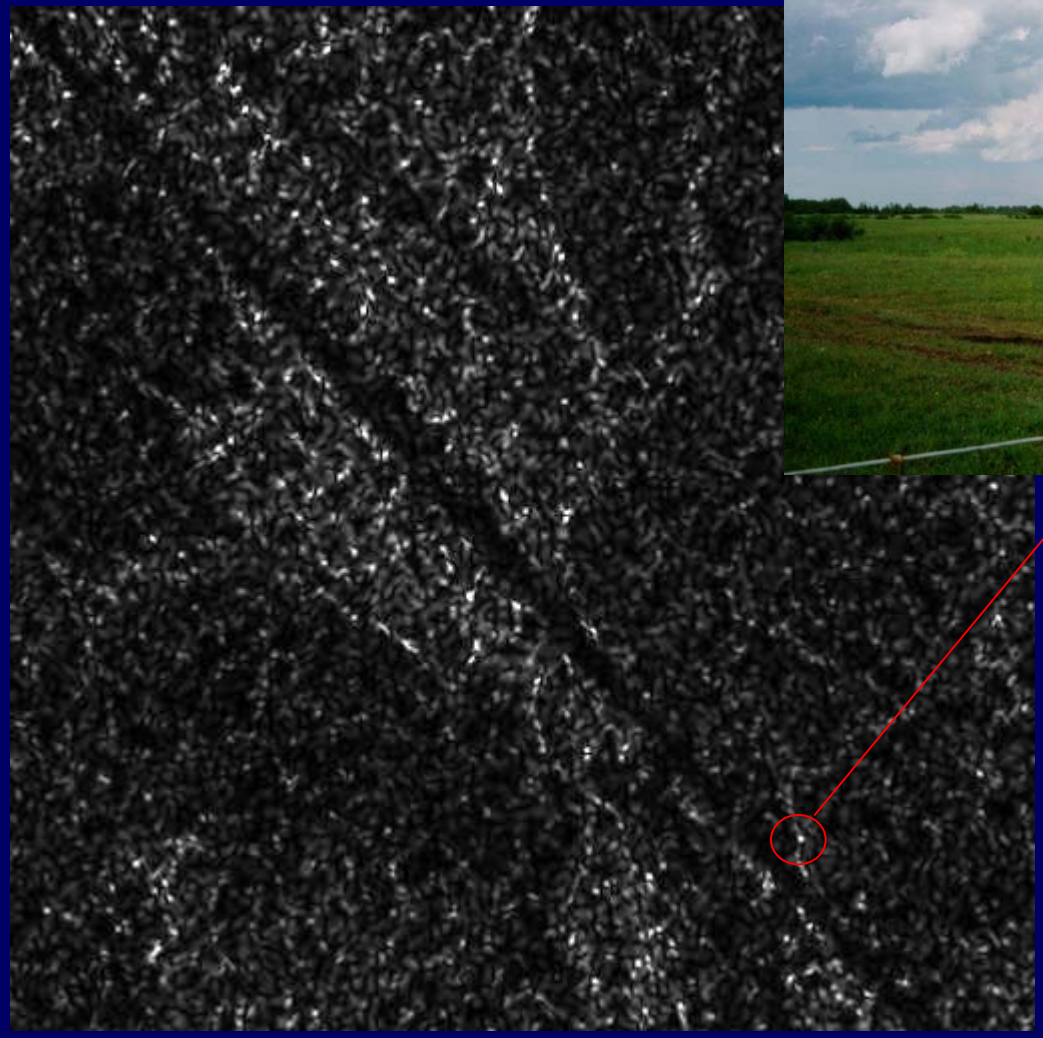
Satellite Monitoring for Pipeline Asset Safety and Security Assessment

- To develop and deliver a practical, reliable, and economical means of monitoring pipeline assets using earth observation data in two fundamental areas of pipeline safety
- Third party encroachment
- Ground motion

Encroachment Monitoring

Encroachment Monitoring

Encroachment Monitoring



Encroachment Monitoring

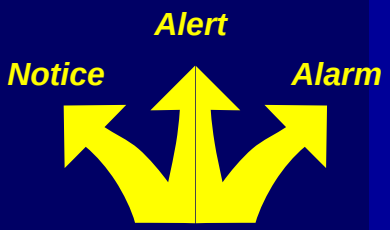
Encroachment Monitoring
Combined Radar & Optical

Encroachment Monitoring Concept Service

Encroachment Event

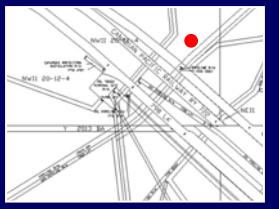
Field personnel are notified

Satellite Monitoring



Time Sequence Acquisitions

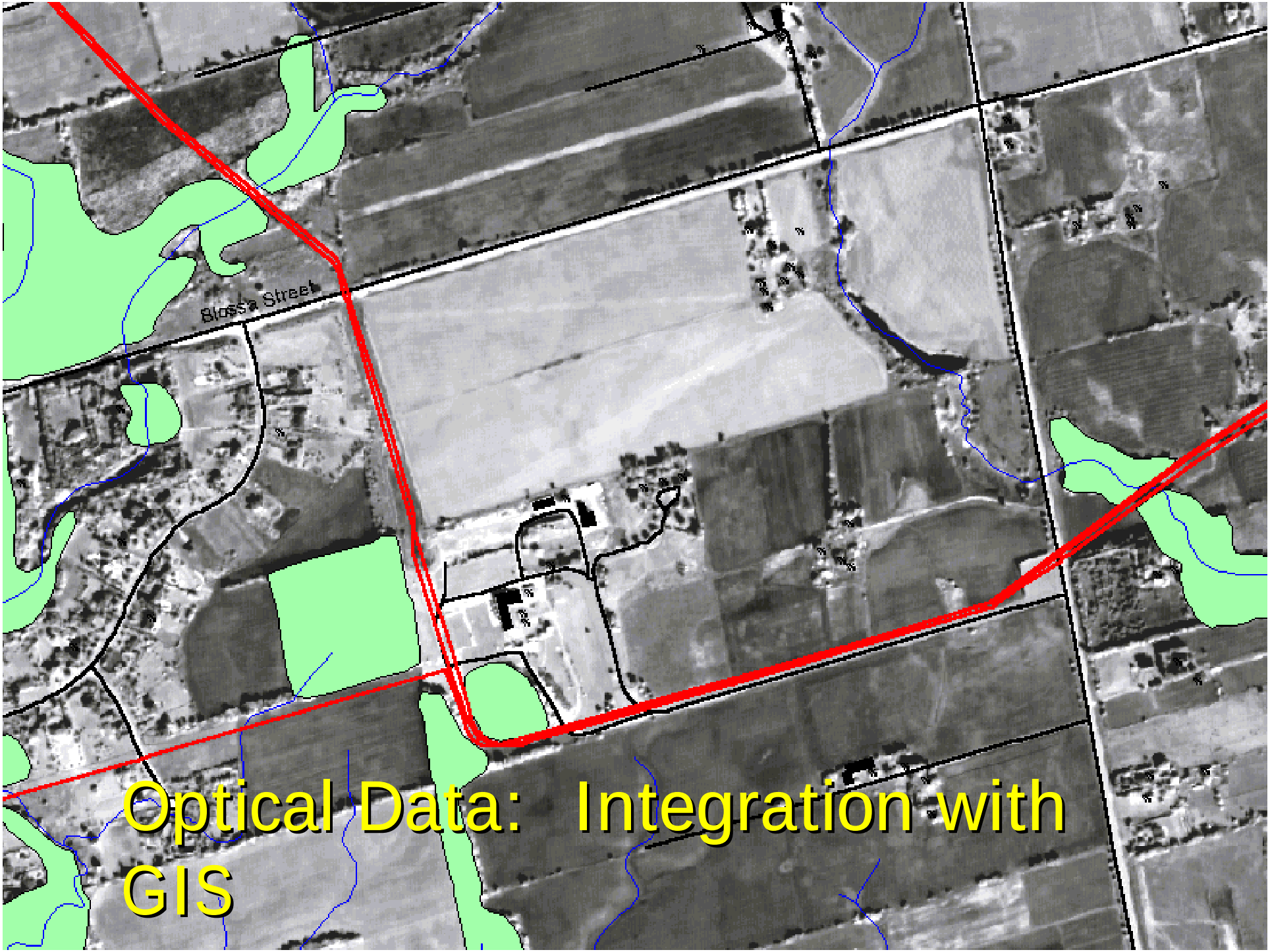
Satellite detected encroachment event



Geo-referenced encroachment event

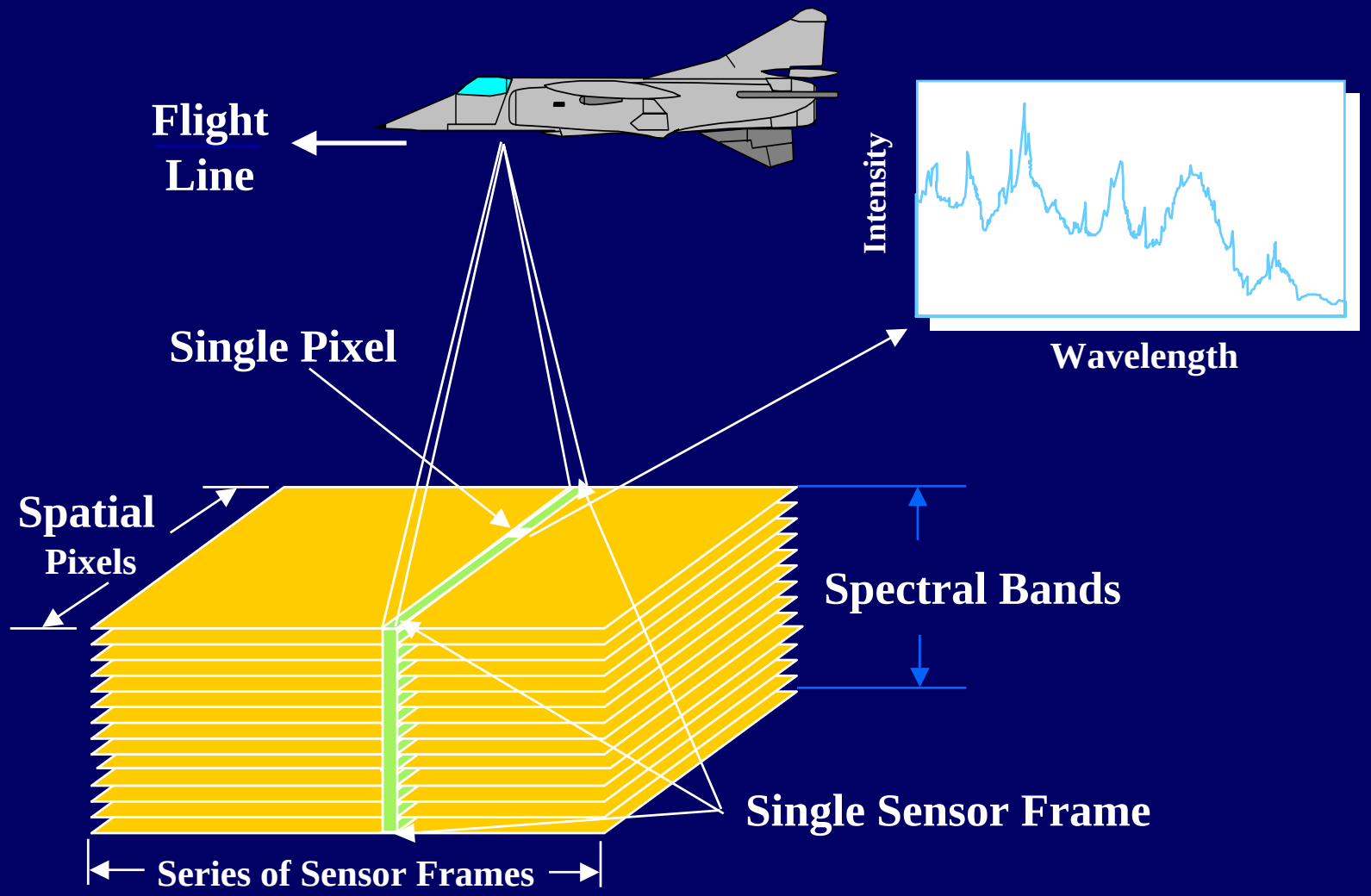
Computerized change detection analysis

Frequency of Imagery Collection	Probability of Detection (%) With Aerial Sensor Systems	Probability of Detection (%) With Satellite Sensor Systems
Once per year	0.4%	
Once per 6 months	1.0%	
Once per 3 months	2.0%	
Once per month	5.0%	
Once per week	20.0%	32% to 55%
Twice per week	40.0%	50% to 70%
Once per day	70.0%	78% to 93%
Twice per day	88.0%	

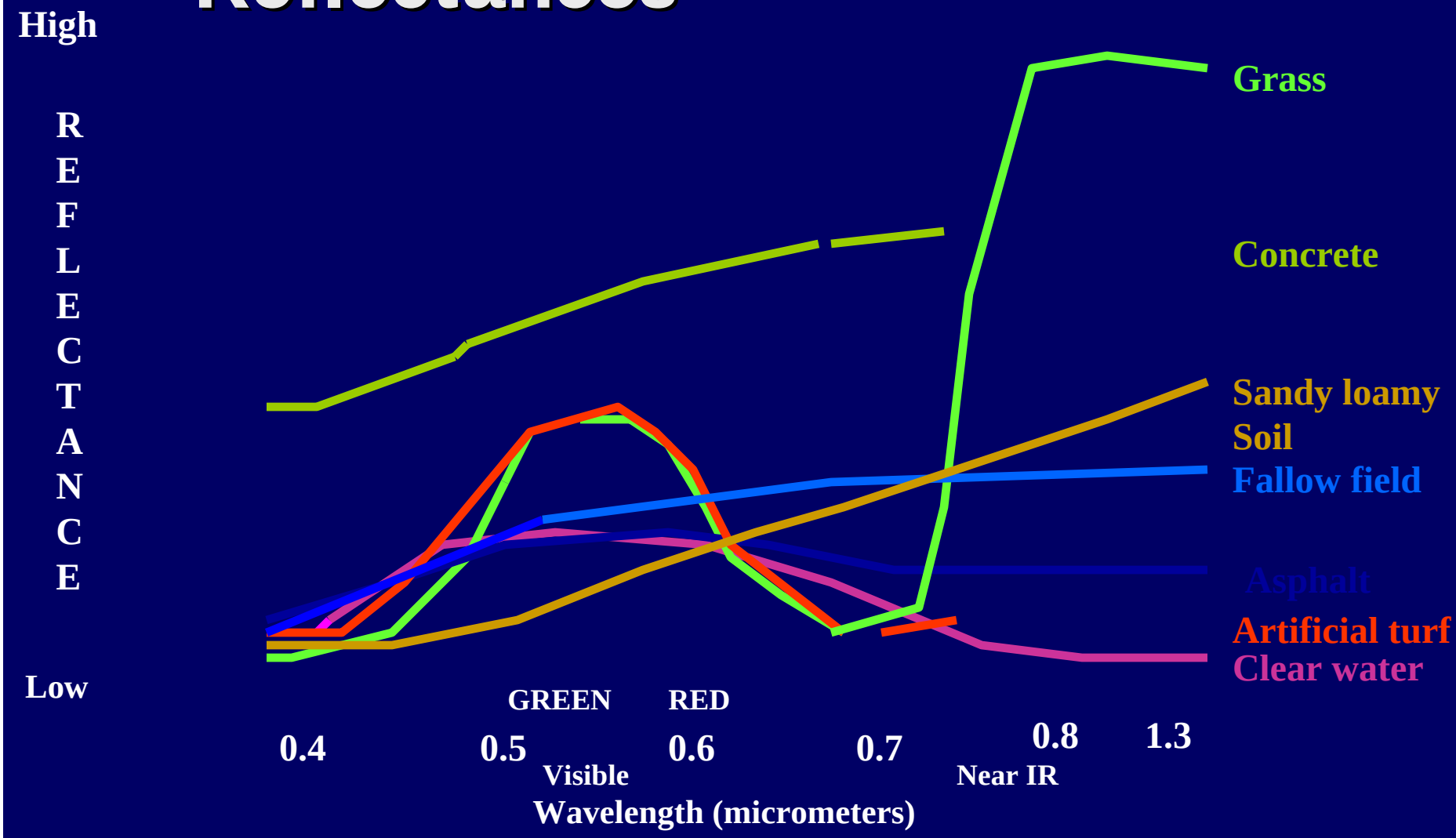


Optical Data: Integration with GIS

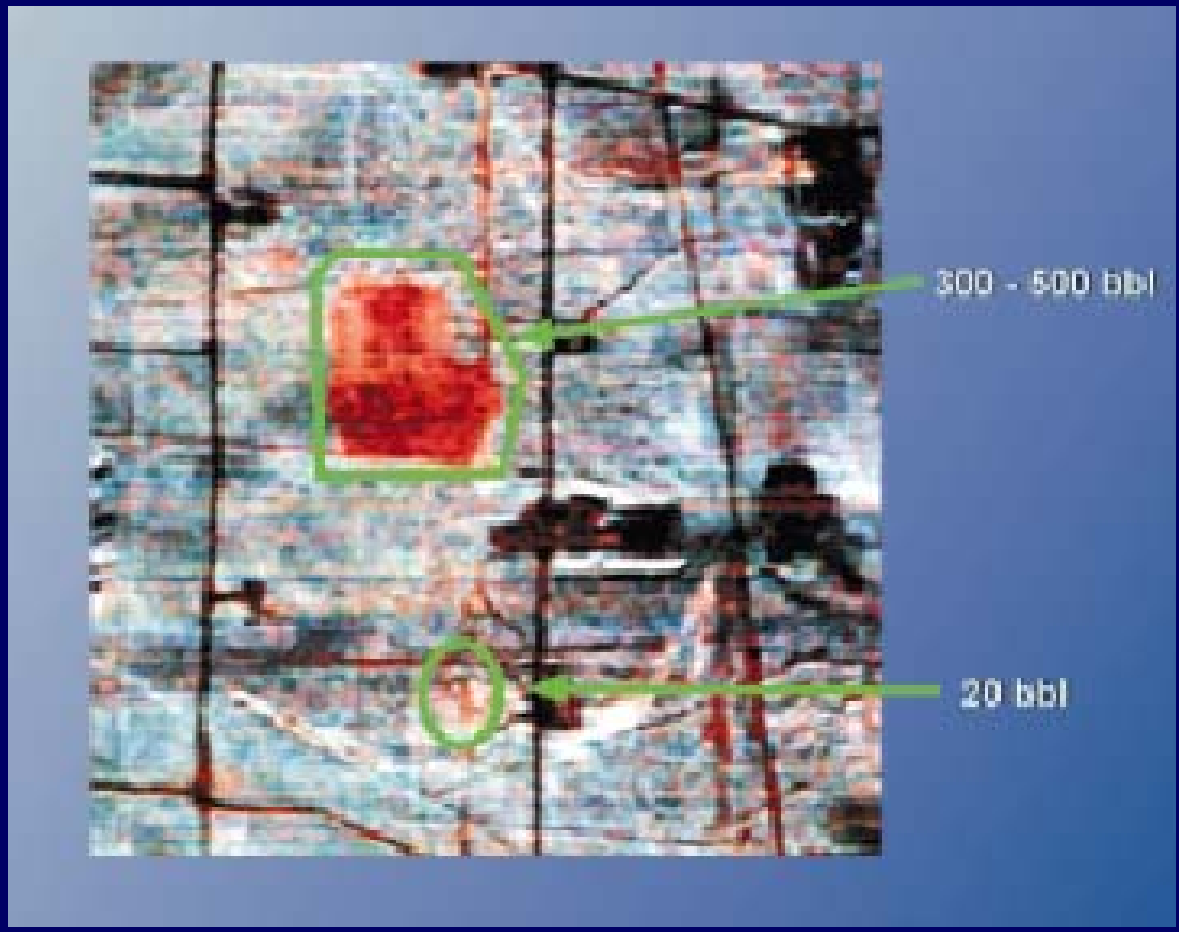
Hyperspectral Sensing



Manmade and Natural Reflectances



Detected Large and Small Gas Leaks



Putuxent River Oil Spill Study Area

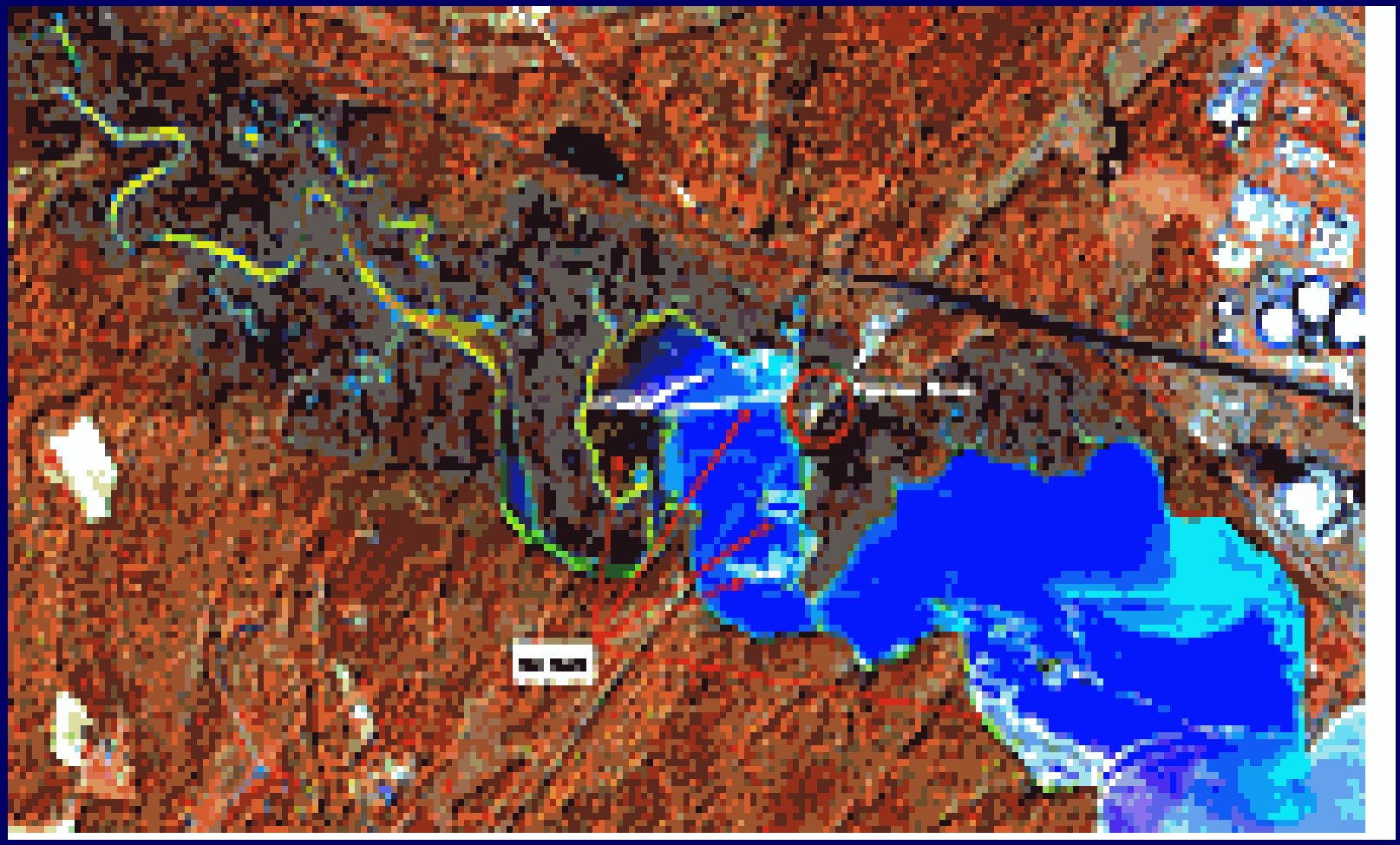
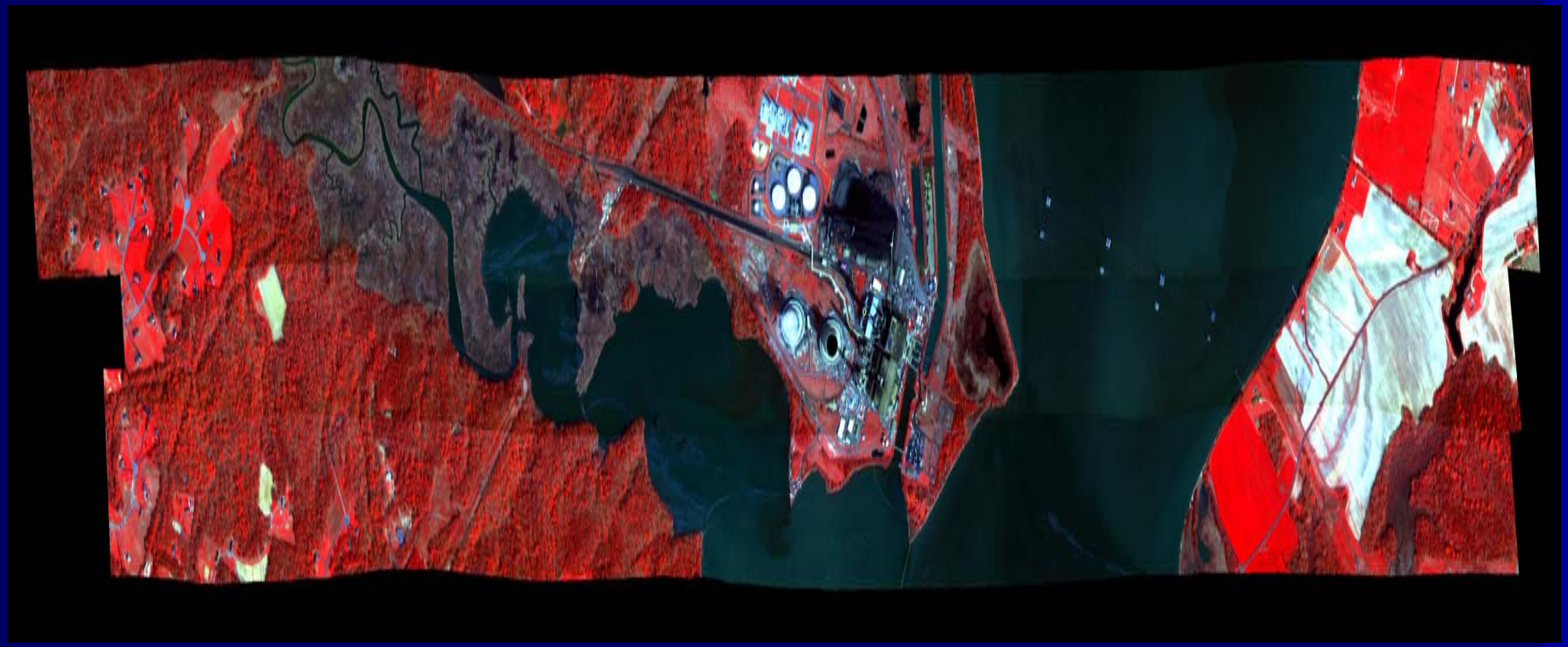
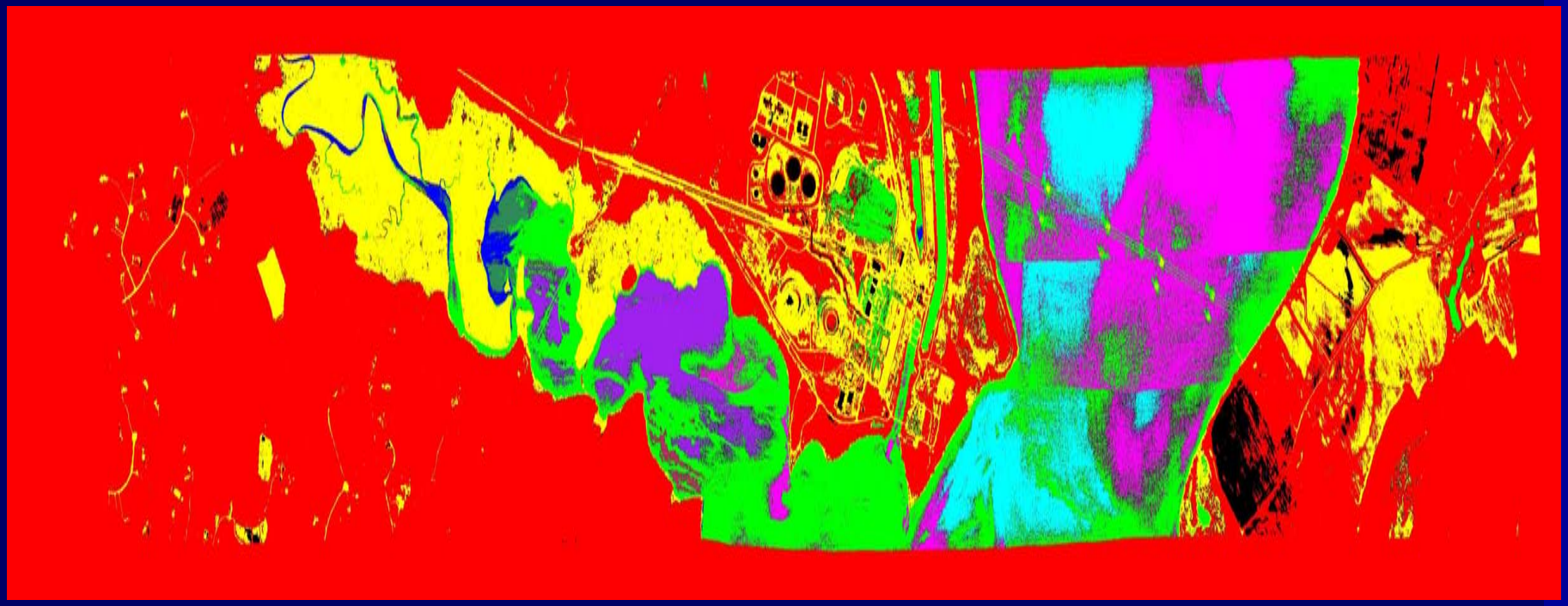


Illustration of Data Collected with the AISA Hyperspectral System



Supervised Classification of the Image Data using ENVI



Challenges

- Methods and authorities for improved data sharing
- Disciplinary differences between developers and users
- Multi sensor data integration
- Interdisciplinary approach to needs development and product requirements

Research Directions

- Information Integration and Visualization
- Expand Applications Studies
- Development of fuzzy classification systems
- Applications of neural networks
- Echelon analysis methods
- Data fusion and data mining
- Integrated Scenario Modeling

For More Information Contact:

William Roper
George Mason University
Ph:703 993-1648
Email: wroper@gmu.edu