



Oil and Gas Spill and Pipeline Condition Assessment Using Remote Sensing

*Using New Tools for
Situational Awareness*

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Presentation Outline

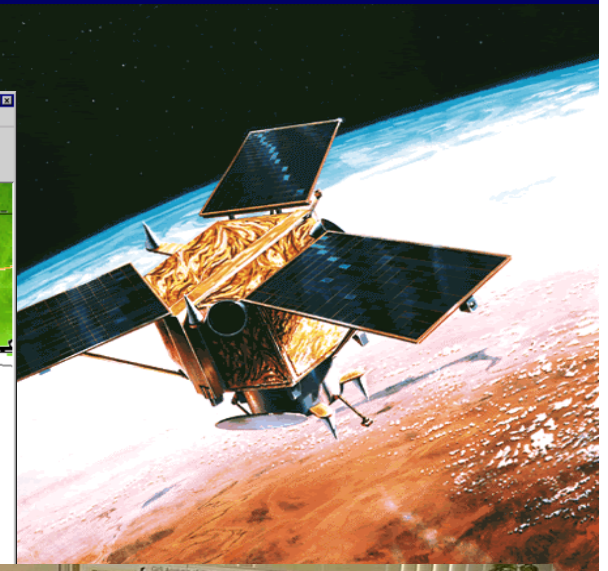
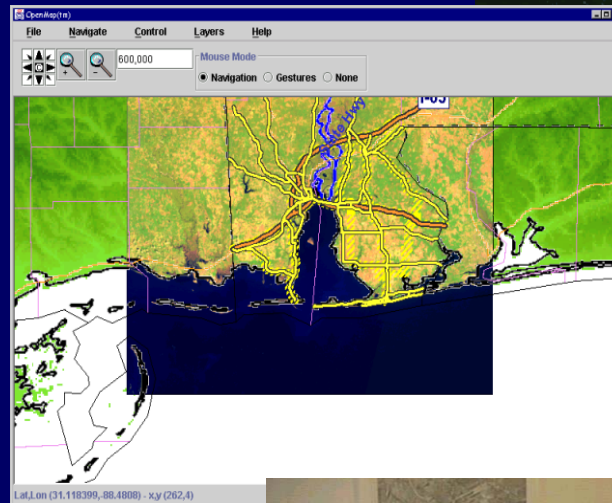
- Introduction
- Pipeline Monitoring
- Hyperspectral Oil Spill Characterization
- Conclusions

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

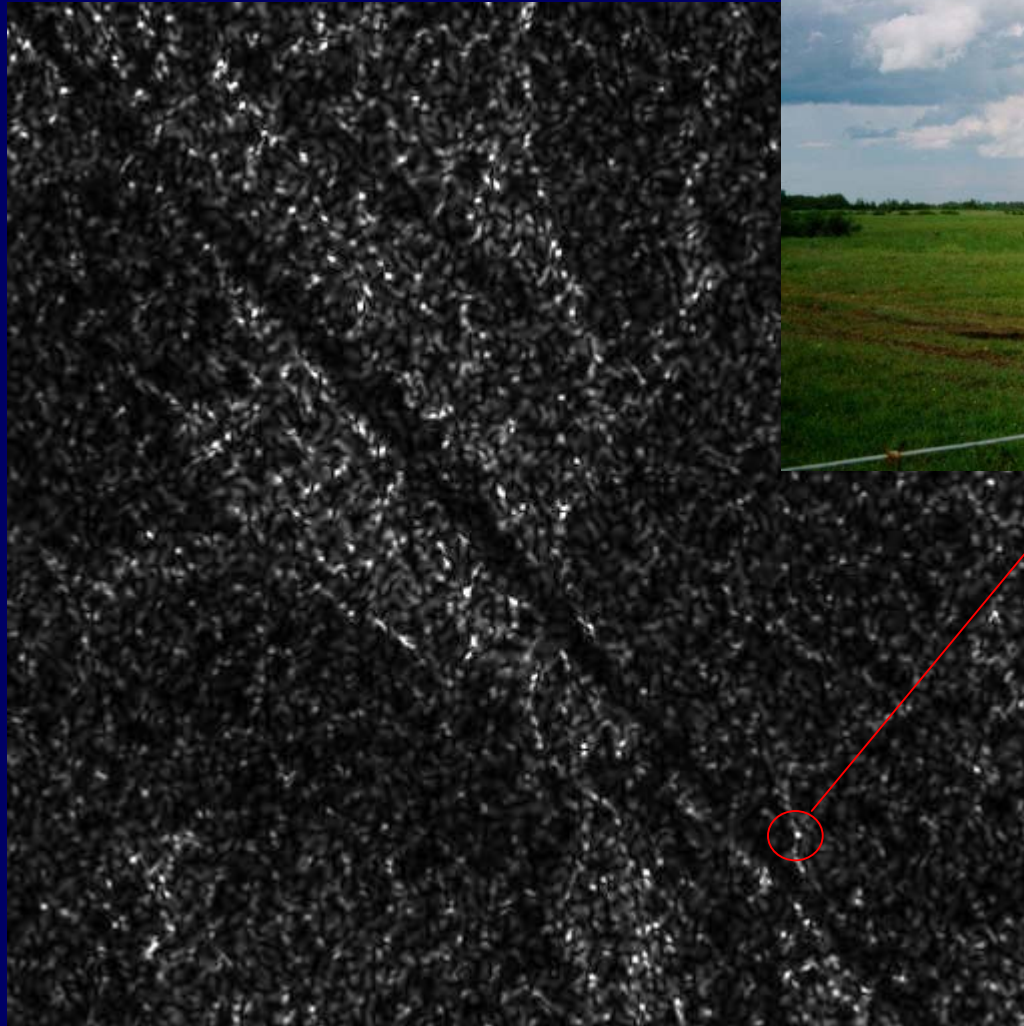
Encroachment Monitoring



Encroachment Monitoring



Encroachment Monitoring

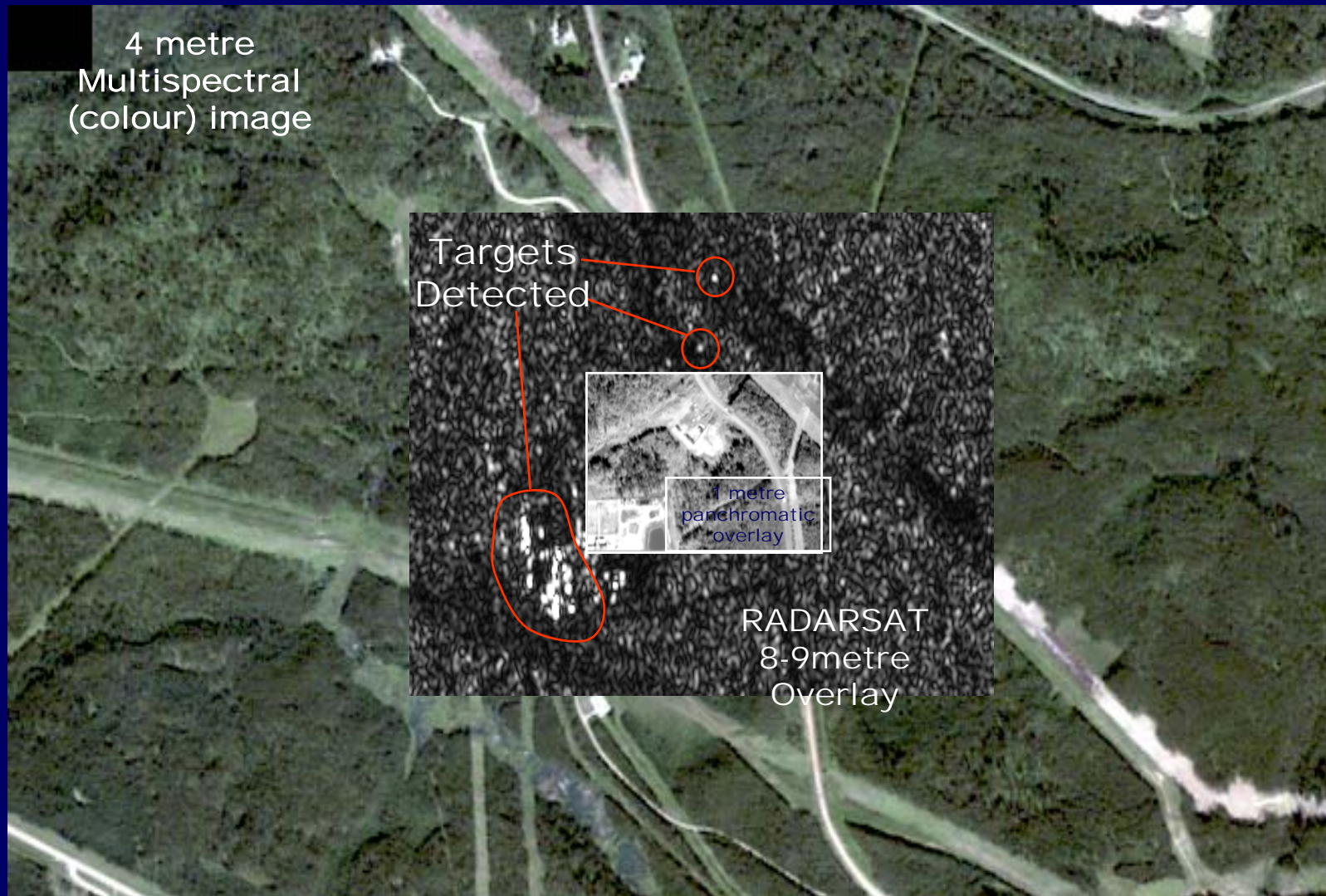


Encroachment Monitoring



4 metre
Multispectral
(colour) image

Encroachment Monitoring Combined Radar & Optical



Encroachment Monitoring Concept Service



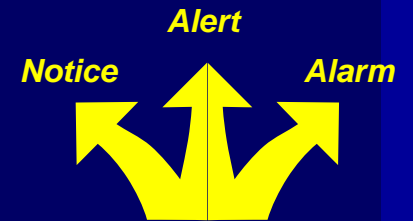
Encroachment Event



Field personnel are notified



Satellite Monitoring



Time Sequence Acquisitions



Satellite detected encroachment event



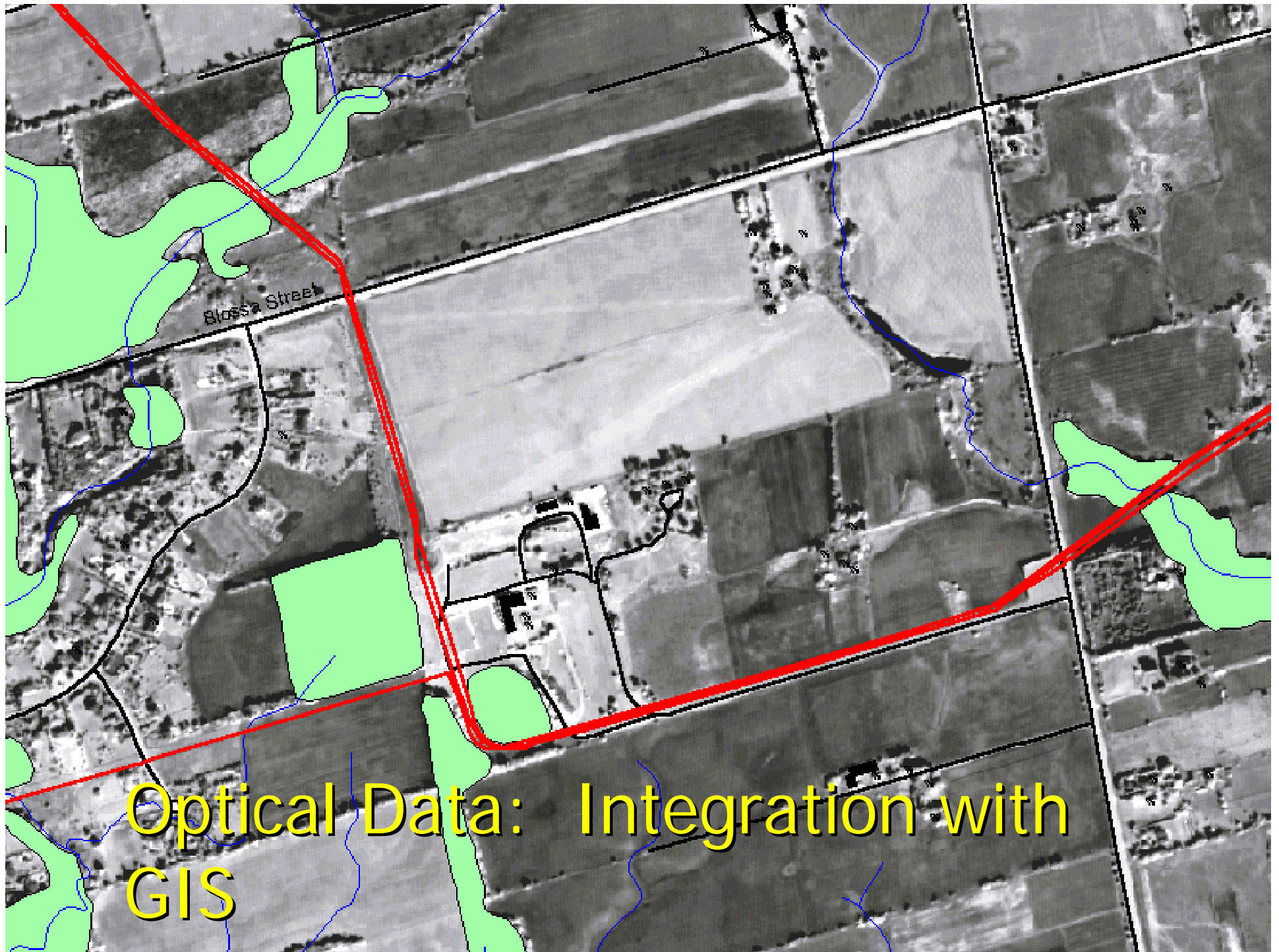
Geo-referenced encroachment event



Computerized change detection analysis

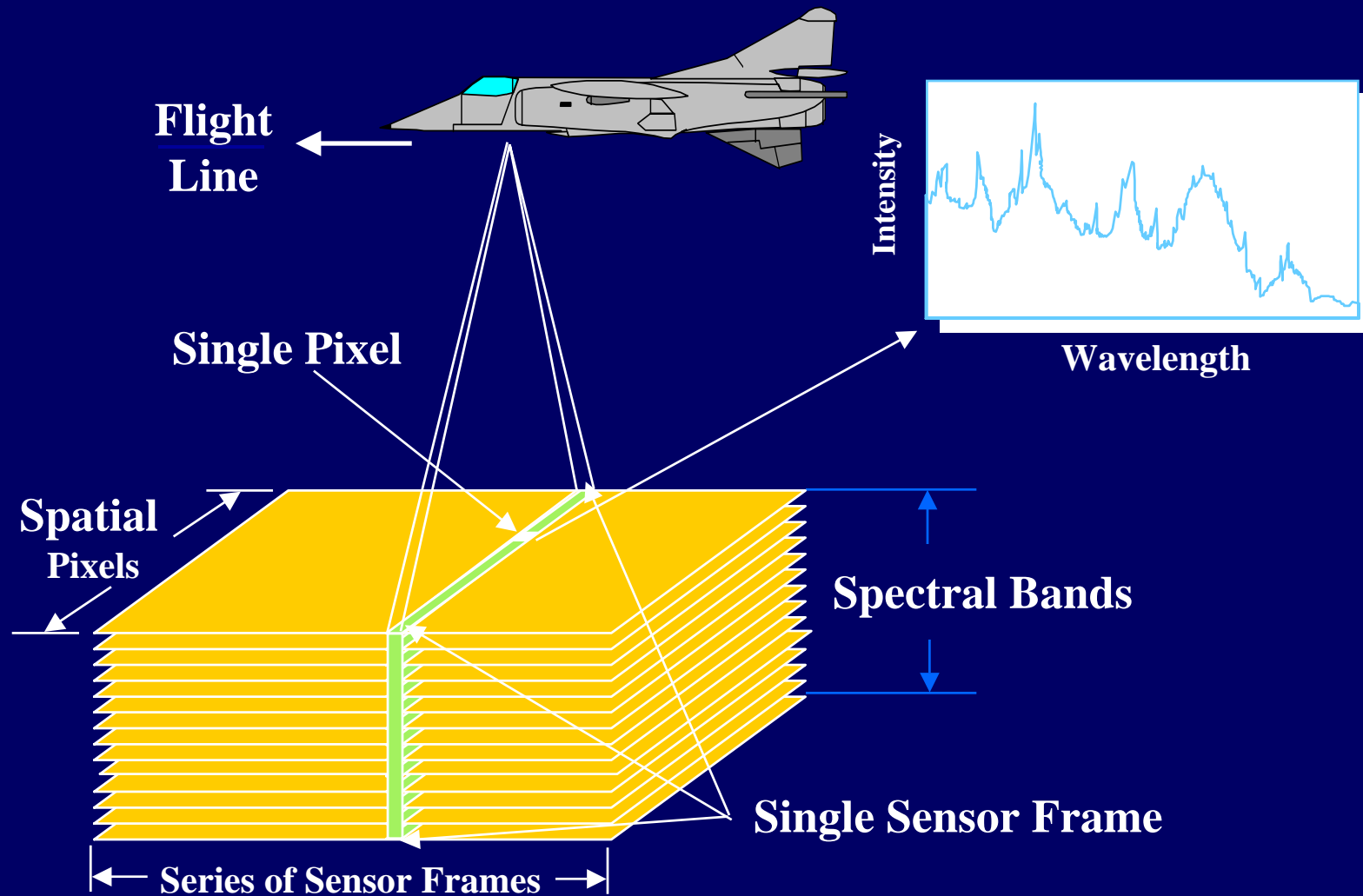


Frequency of Imagery Collection	Probability of Detection (%) With Aerial Sensor Systems	Probability of Detection (%) With Satellite Sensor Systems
Once per year	0.4%	
Once per 6 months	1.0%	
Once per 3 months	2.0%	
Once per month	5.0%	
Once per week	20.0%	32% to 55%
Twice per week	40.0%	50% to 70%
Once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



Optical Data: Integration with GIS

Hyperspectral Sensing

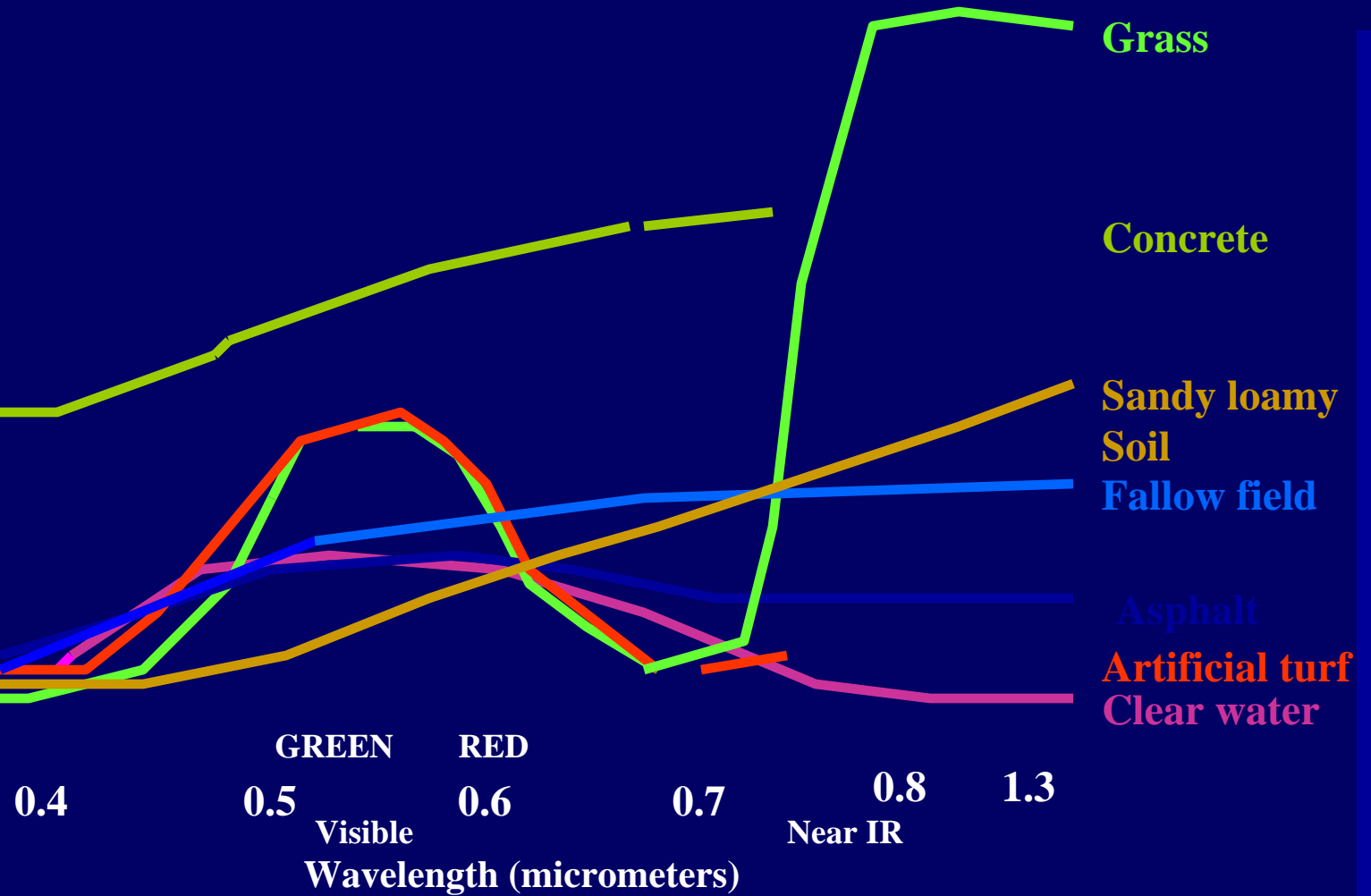


Manmade and Natural Reflectances

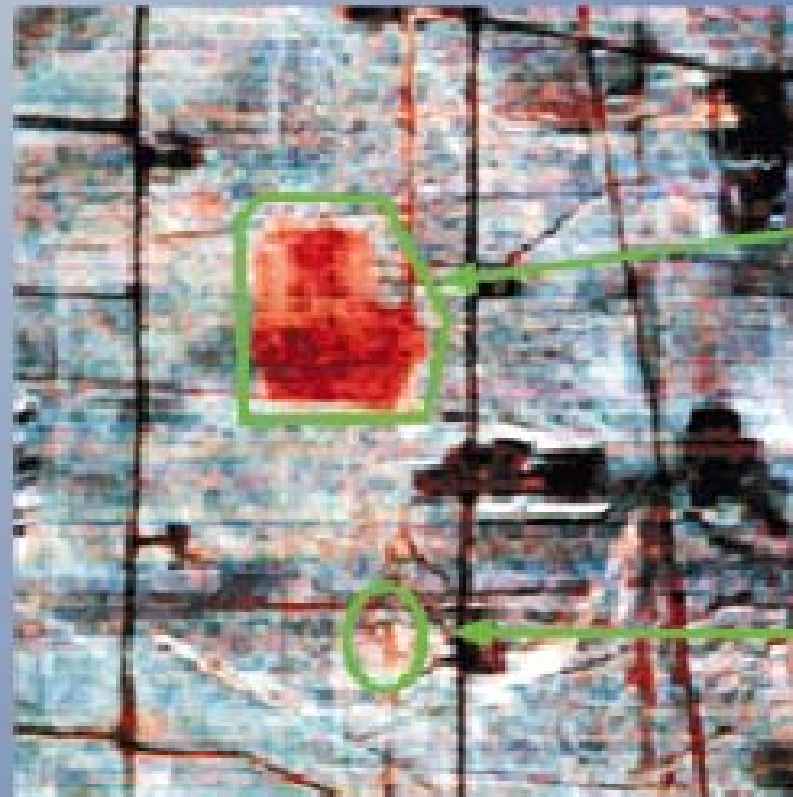
High

R
E
F
L
E
C
T
A
N
C
E

Low



Detected Large and Small Gas Leaks



300 - 500 bbl

20 bbl

Putuxent River Oil Spill Study Area

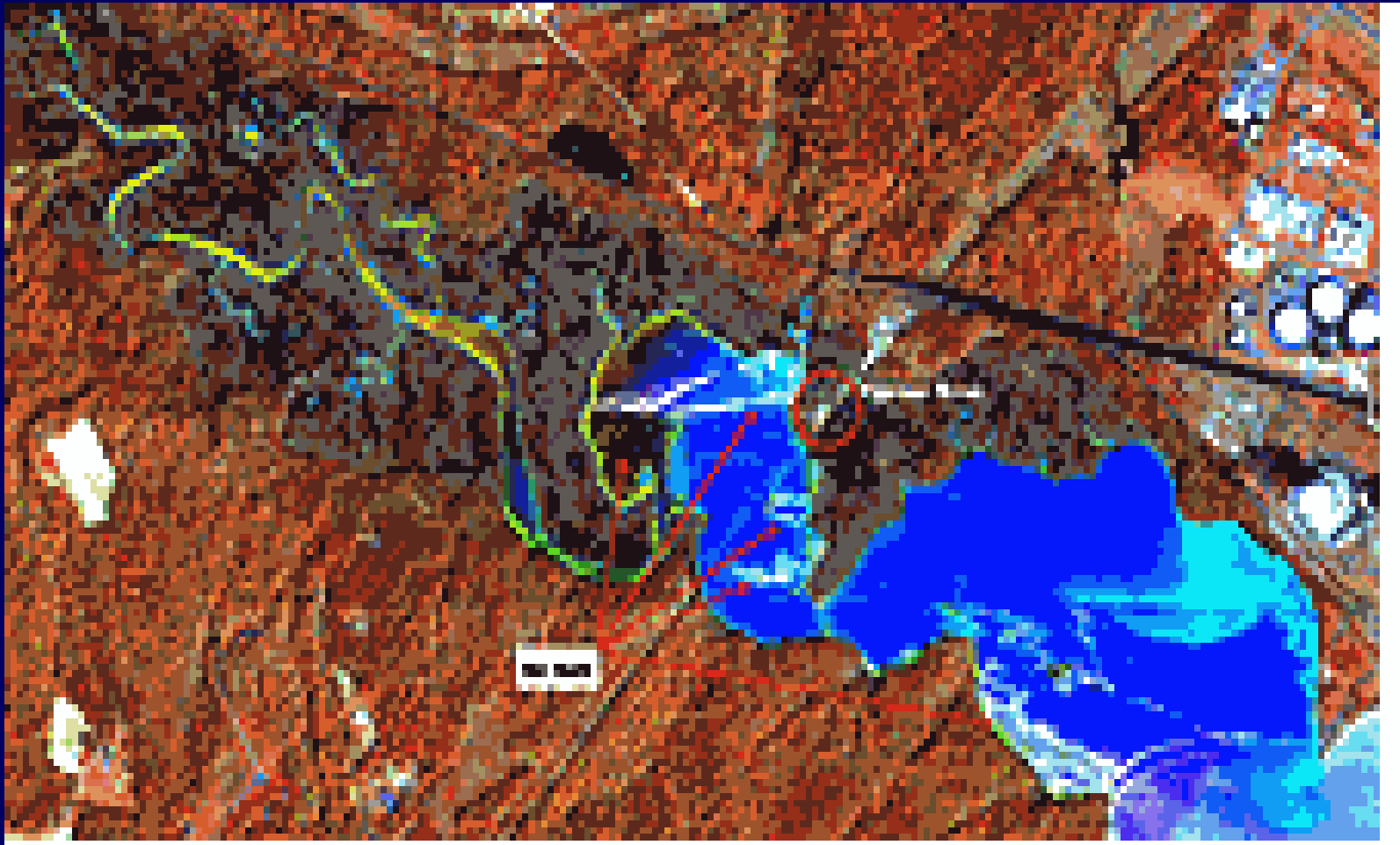
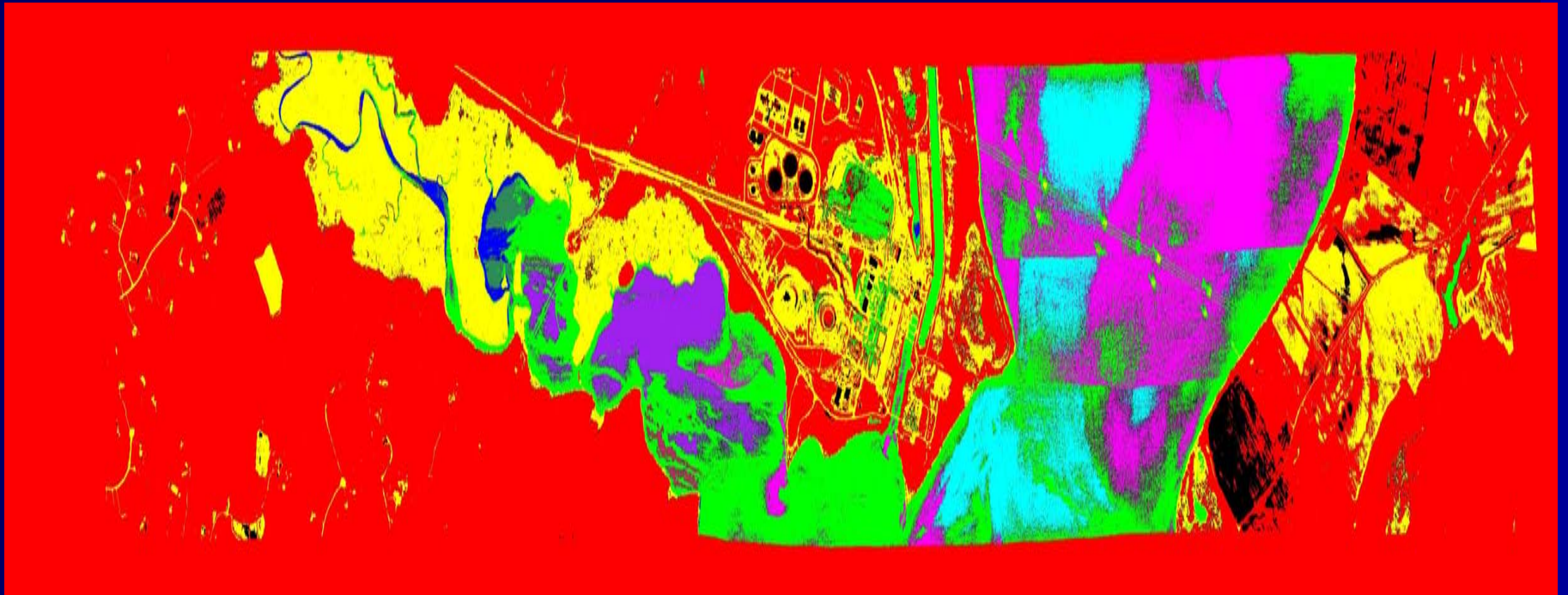


Illustration of Data Collected with the AISA Hyperspectral System



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

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