Operation Gulfscan

NEOSGeosolutions's Hyperspectral Technology Deployed to Monitor Oil Spill Impacts in the Gulf of Mexico

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Company Overview

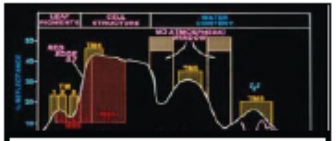
- NEOS Exploration was founded in May 2009 to commercialize the results of technology development project that was initiated in 2006.
- Private Company backed by Kleiner Perkins, Goldman Sachs, Passport Capital, and Bill Gates
- Successful commercial licensing of exploration information in both E&P and mining industries
- Member of the Executive Committee and the Board of GCOOS (Gulf of Mexico Coastal Ocean Observing System)

NEOS Natural Resource Mapping
Data acquisition

Technology

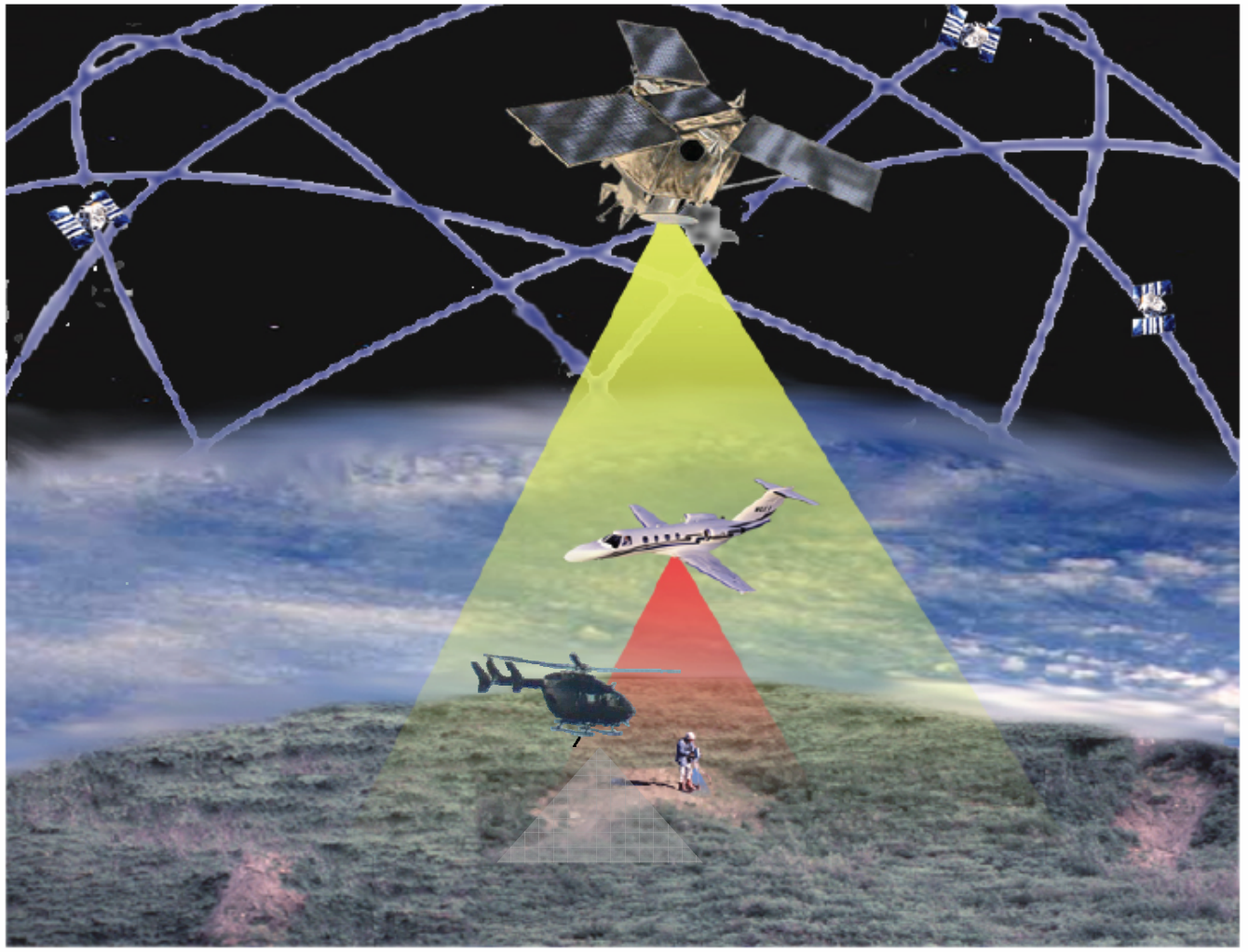
Satellite

19 Sensors



660 Channel Hyperspectral

Terrestrial



NRM™ data acquisition

19 Sensors

Custom-built sensors to TTI Exploration's proprietary specifications

Infosphere Explorer™ Mission Design

- Remote sensing data
- Regional geology & geophysics
- Existing data, public & proprietary
- Data evaluation & interpretation

NRM™ aircraft instrumentation

NRM™ Platforms

Technology

19 Sensors

Satellite
800 km

Fixed Wing Pass 1
2500 m above terrain

Fixed Wing Pass 2
300m above highest point

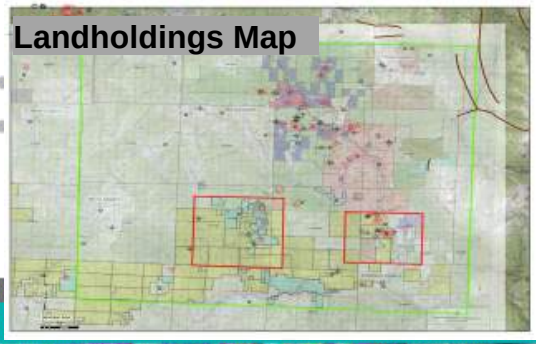
Helicopter
60 m

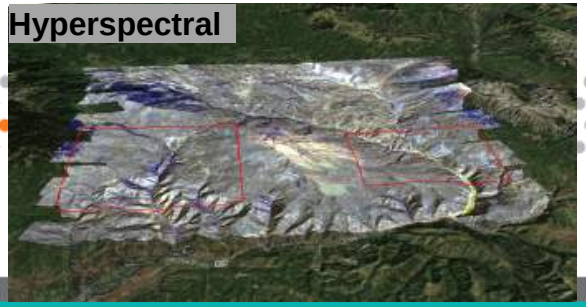
Towed Sensors
30 m

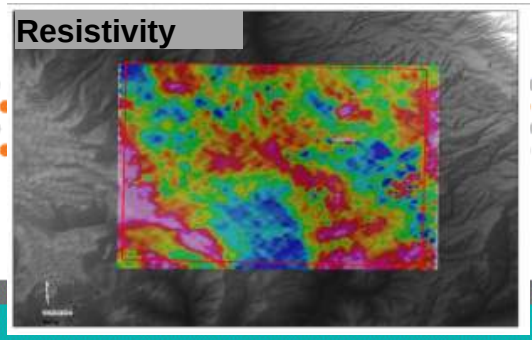
Ground sensors & sampling
0 m

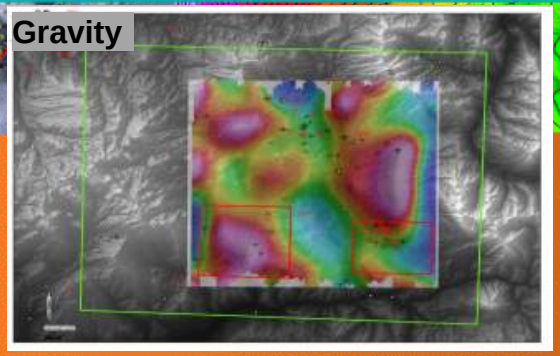
Natural Resource Mapping (NRM™): Example Measurements

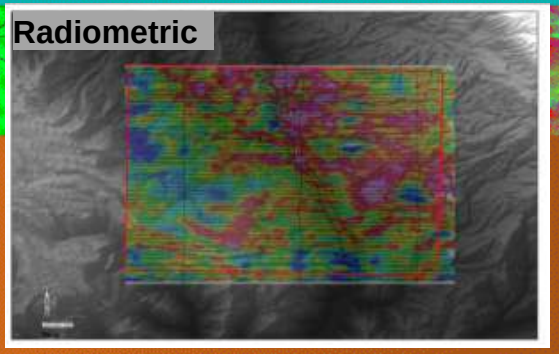
Technology

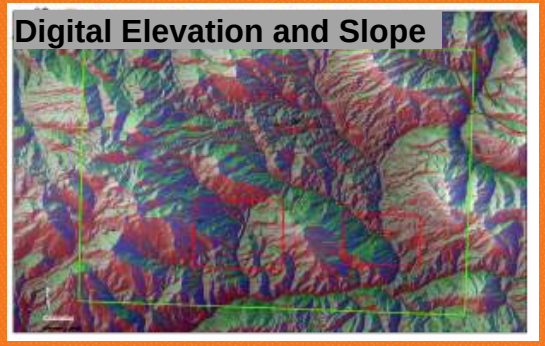


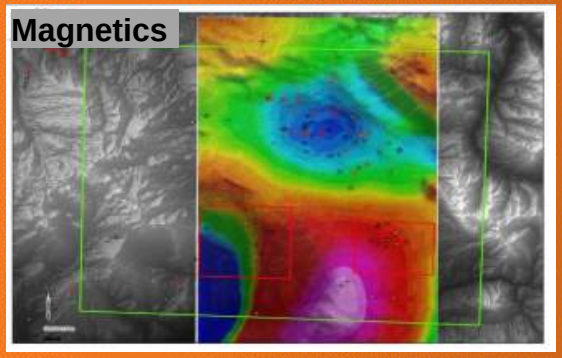


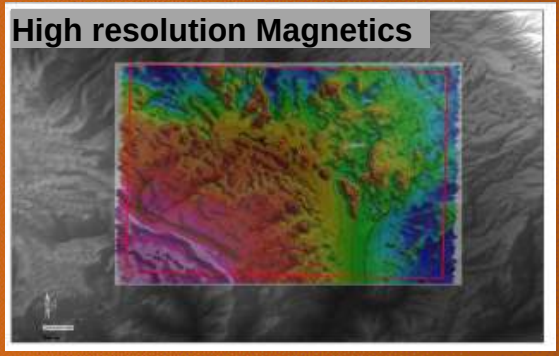












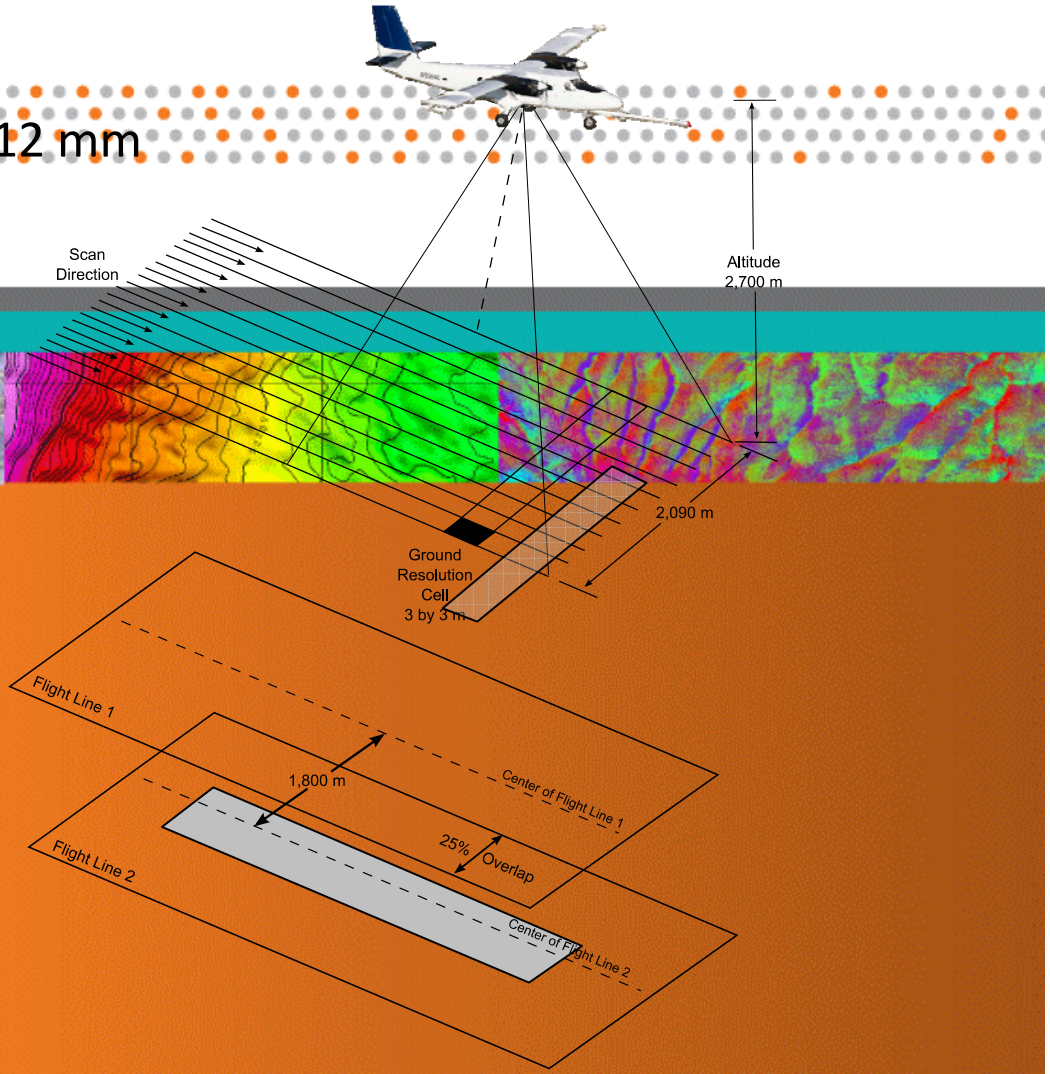
Operation GulfScan
Acquisition Parameters

Technology

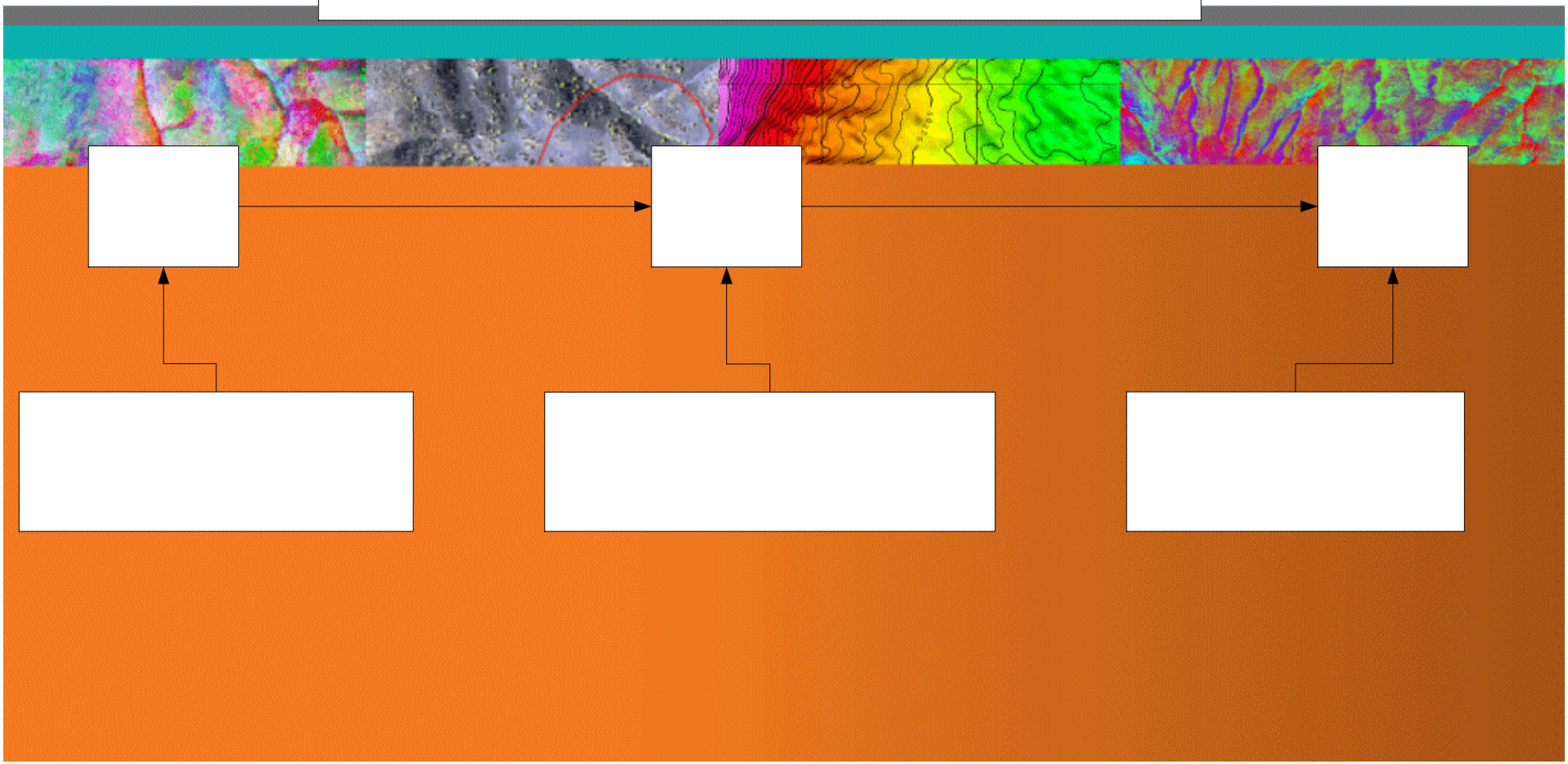
660+ band TTI Hyperspectral System
measuring wavelengths from .350 to 12 mm
(Ultraviolet thru thermal Infrared)

Thermal Cycle Acquisition:
- Day Flights
- Night Flights

Ground Truthing relevant sample areas



Environmental Assessments: Initial and Aftereffects



Operation GulfScan Milestones

- Data Acquisition – May 1, 2010 through July 30, 2010
- Submission of Coast Guard White Paper – May 15, 2010
- Engagement with Press on technology (Bloomberg, 60 Minutes, CNN, NYT, Washington Post) – June 10, 2010
- Presentation to State Governments (LA, AL, MISS) – June 2010
- Discussions with BP's technical team – July 2010
- Pilot Projects Acquired, Processed and Classified – August 15, 2010
- Damage reflected in Pilot Projects confirmed and measured by Biologist – September 20, 2010
- Meeting with BP's Natural Resource Damages Team- September 28, 2010
- White Paper documenting scientific results- October 5, 2010

Operation Gulfscan

Objective:

Provide high-resolution data and relevant analysis to assess and measure the damage (or lack thereof) made to the Gulf Coast ecosystems, including chronicling the effectiveness of remediation and restoration efforts using time variant ("Before" and "After") information.

Deliverables:

Phase 1: Environmental Baseline – A digital data library establishing the health condition of the Gulf Coast habitat before the oil impacted the environment.

Phase 2: Environmental Damage – An assessment of the time variant health condition of the Gulf Coast habitat.

Phase 3: Post Remediation – An assessment of the effectiveness of the clean up efforts and their impact on the habitat

Operation Gulfscan

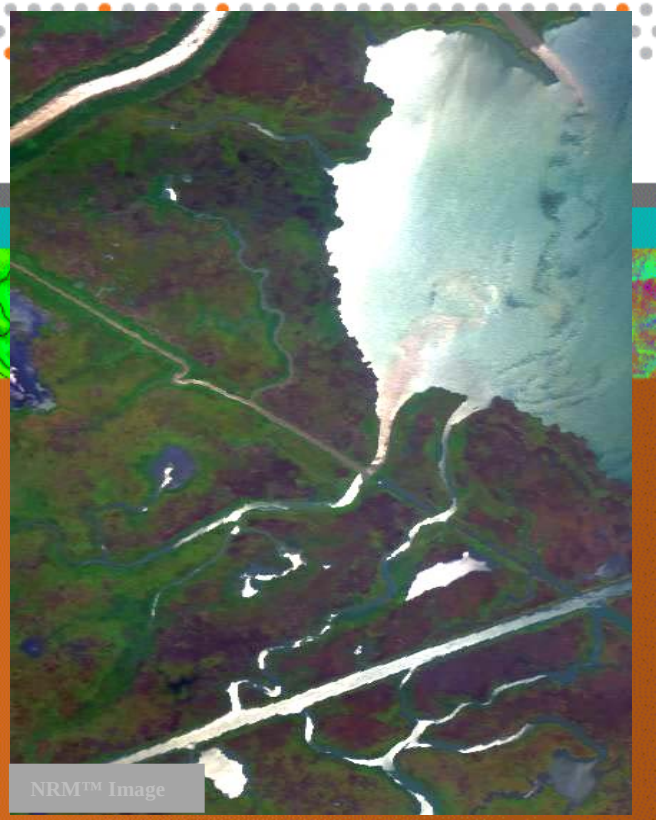
Methodology:
Apply high resolution remote sensing technology, calibrated with ground measurements that efficiently and effectively assess the health condition of the habitat

How it works:

Our NRM™ technology precisely measures and interprets signals emitted from or reflected off of the Earth. These signals are calibrated against ground spectral and biological proof points.

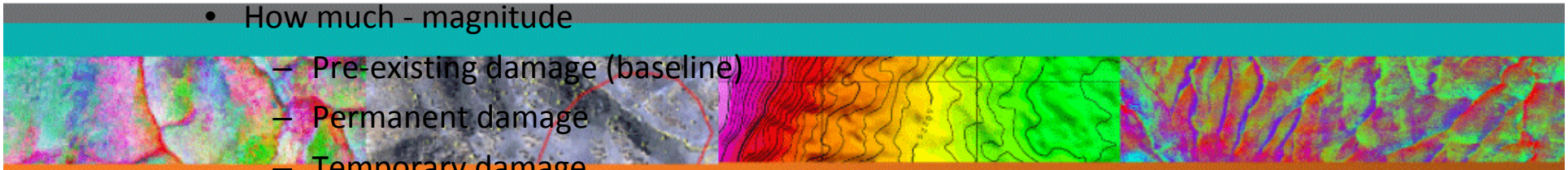
These measurements provide detailed information chronicling:

- The health of a given ecosystem before and after an environmental event through time-variant surveys
- The existence, magnitude and type of damage



Operation Gulfscan

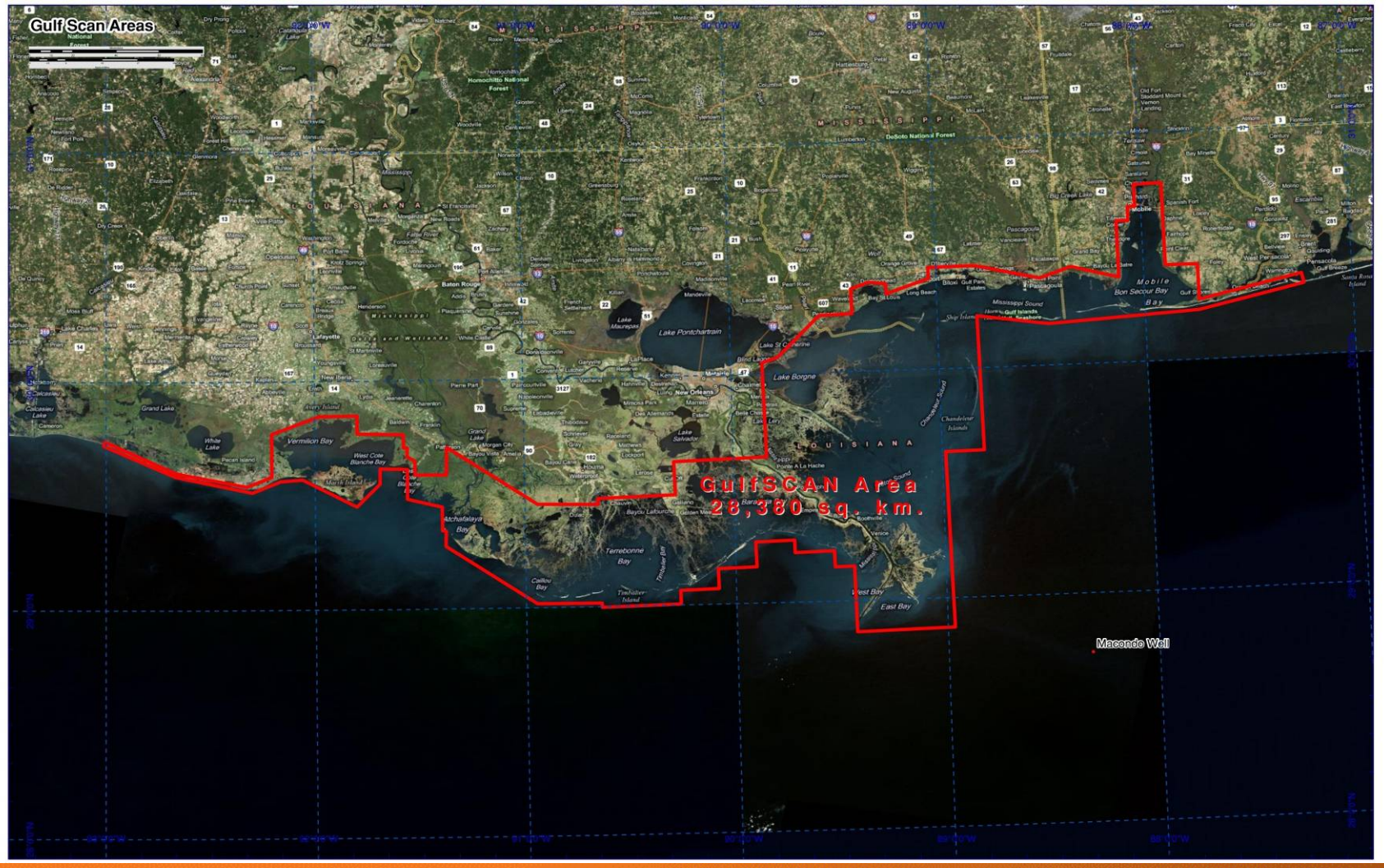
- We Measure Damage (and the Absence of Damage)
- Operation GulfScan data and methodology provides:
  - When - timing
  - Where - areal extent
  - How much - magnitude
    - Pre-existing damage (baseline)
    - Permanent damage
    - Temporary damage
    - Healthy, unaffected



- Damage Impact Measurements are important:
  - Damage to types of Flora
    - Damage to Food chain
    - Destruction of Barrier Islands (vegetation health and growth rates)
  - Targeted remediation of damage
  - Scientific validation of economic damage claims

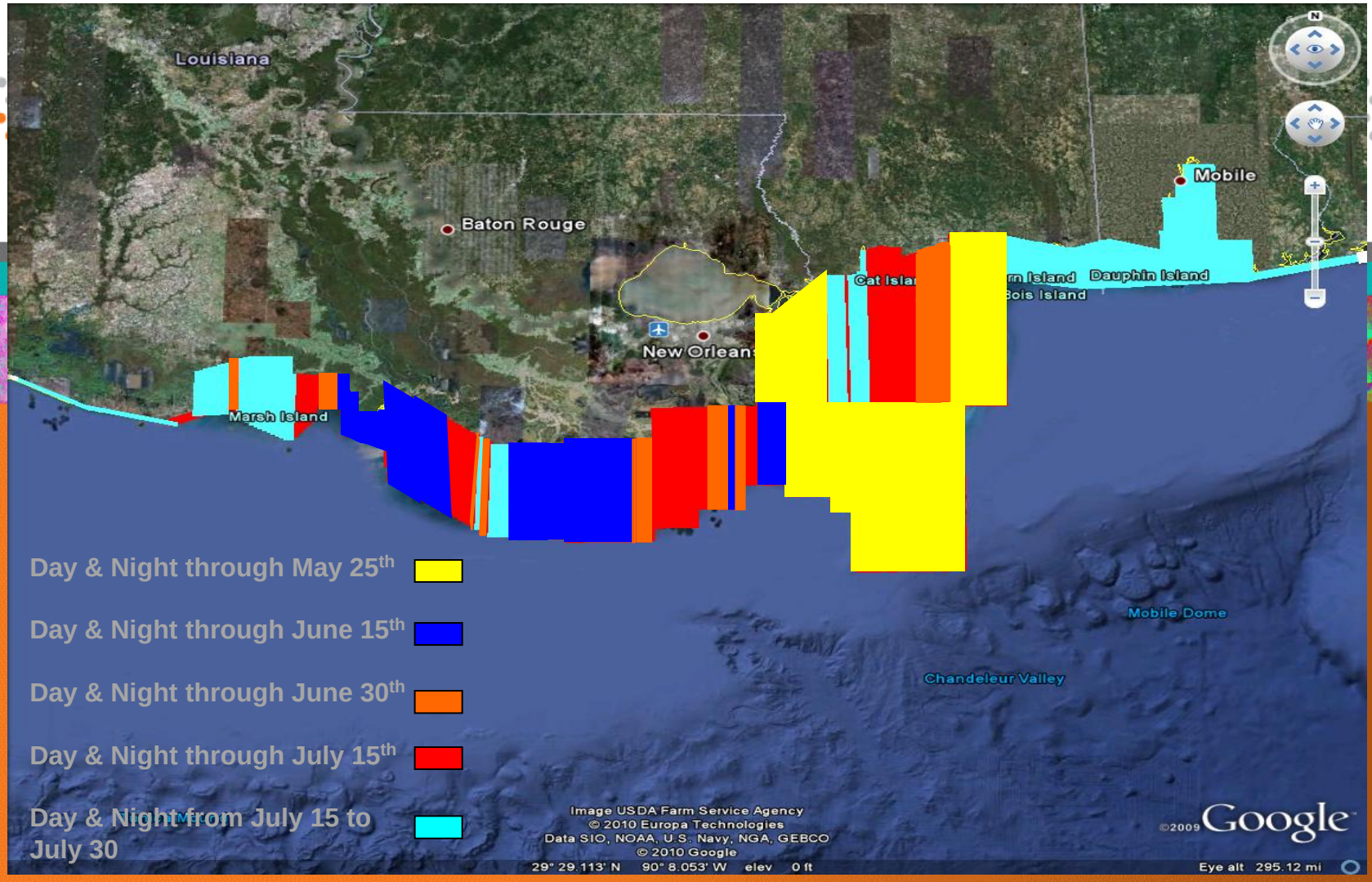
Operation Gulfscan

Environmental Baseline Area



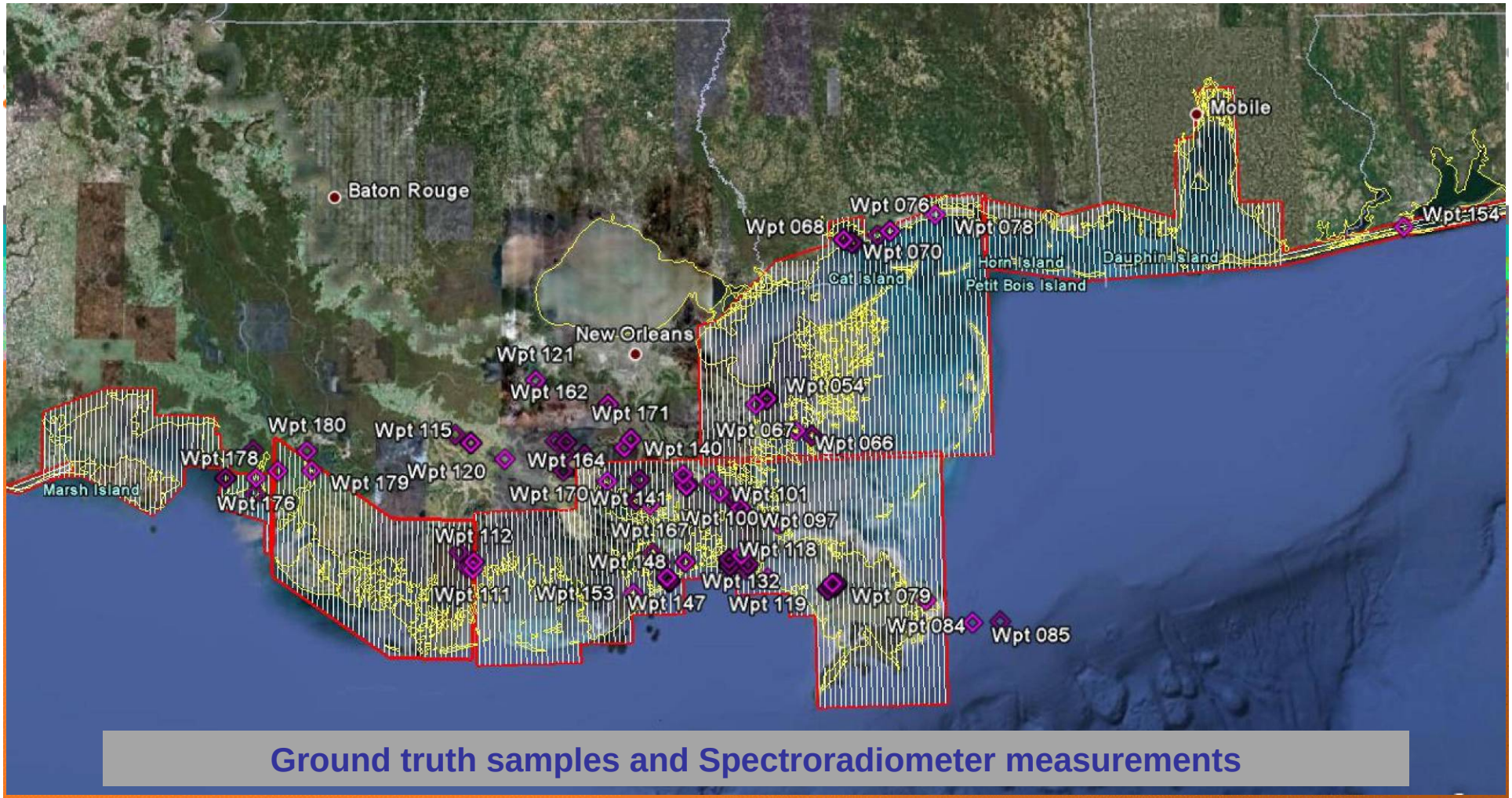
Operation Gulfscan

Baseline Acquisition Timeline



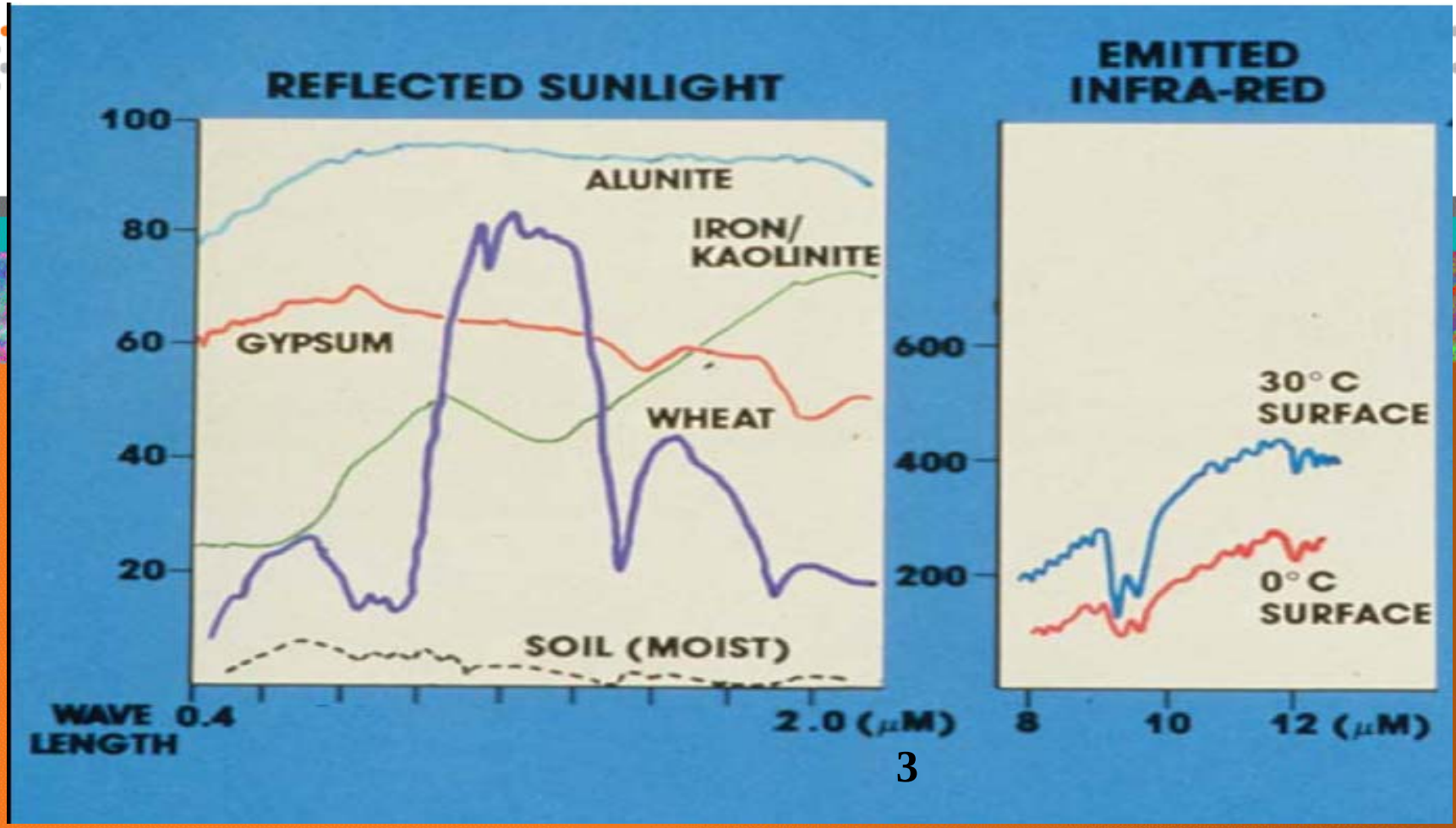
Operation Gulfscan

Ground Sampling



Ground truth samples and Spectroradiometer measurements

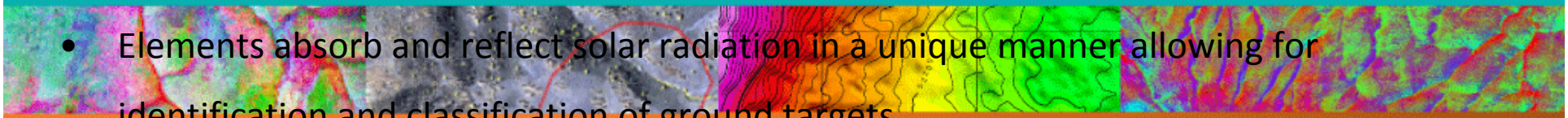
Example: Hyperspectral signatures



NRM™ Hyperspectral Overview

Technology

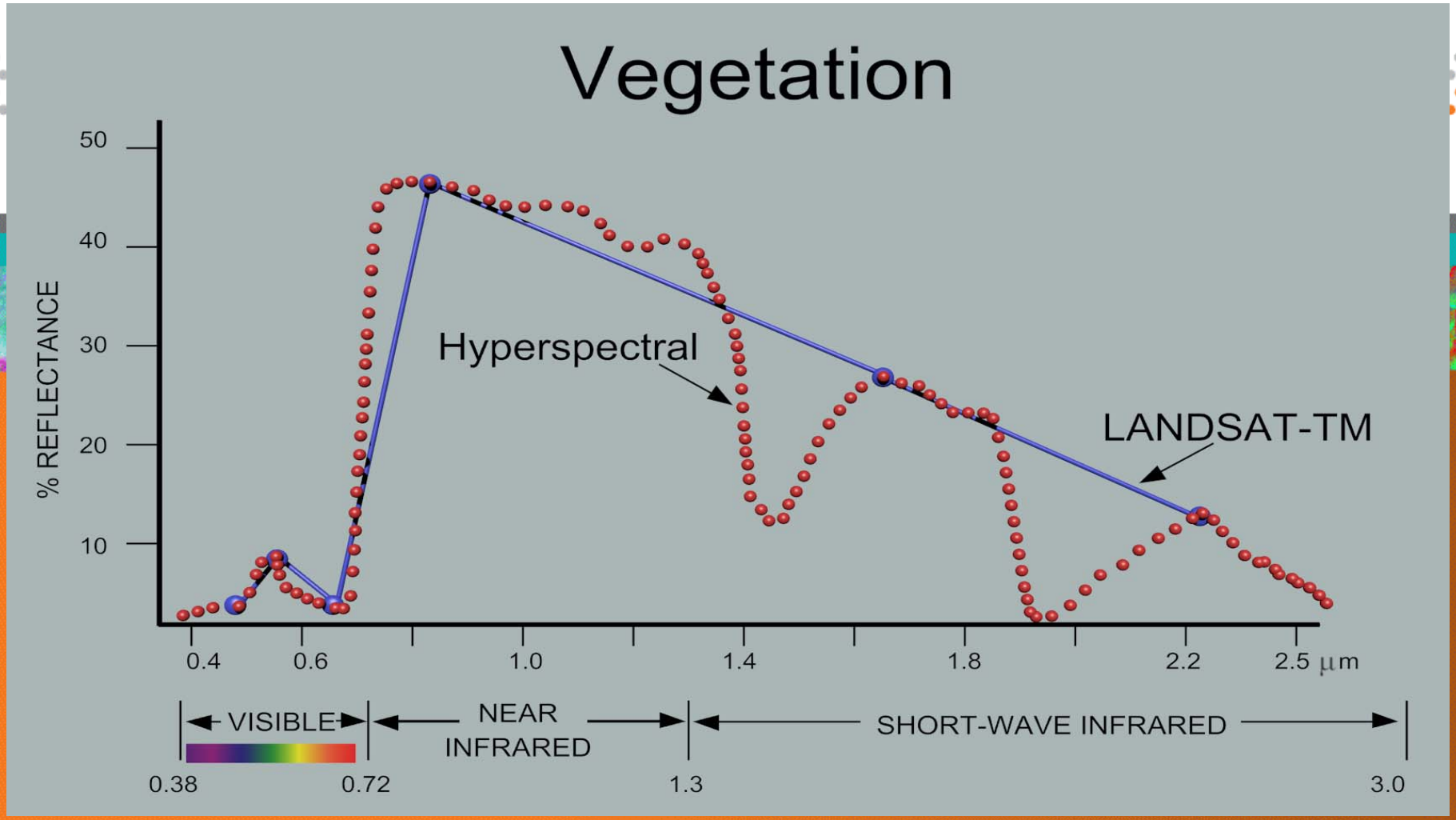
- Airborne sensors collect reflected solar and thermal radiation from selected ground targets over a contiguous high-resolution electromagnetic spectrum (over 660 channels)



- Elements absorb and reflect solar radiation in a unique manner allowing for identification and classification of ground targets
- Advanced digital imaging process identifies unique spectral features imperceptible to the unaided human eye
- Data undergoes proprietary computer processing and analysis to identify and classify the individual elements
- High spectral and ground resolution allows for the differentiation of all elements in the ecosystem including impact from an environmental contamination

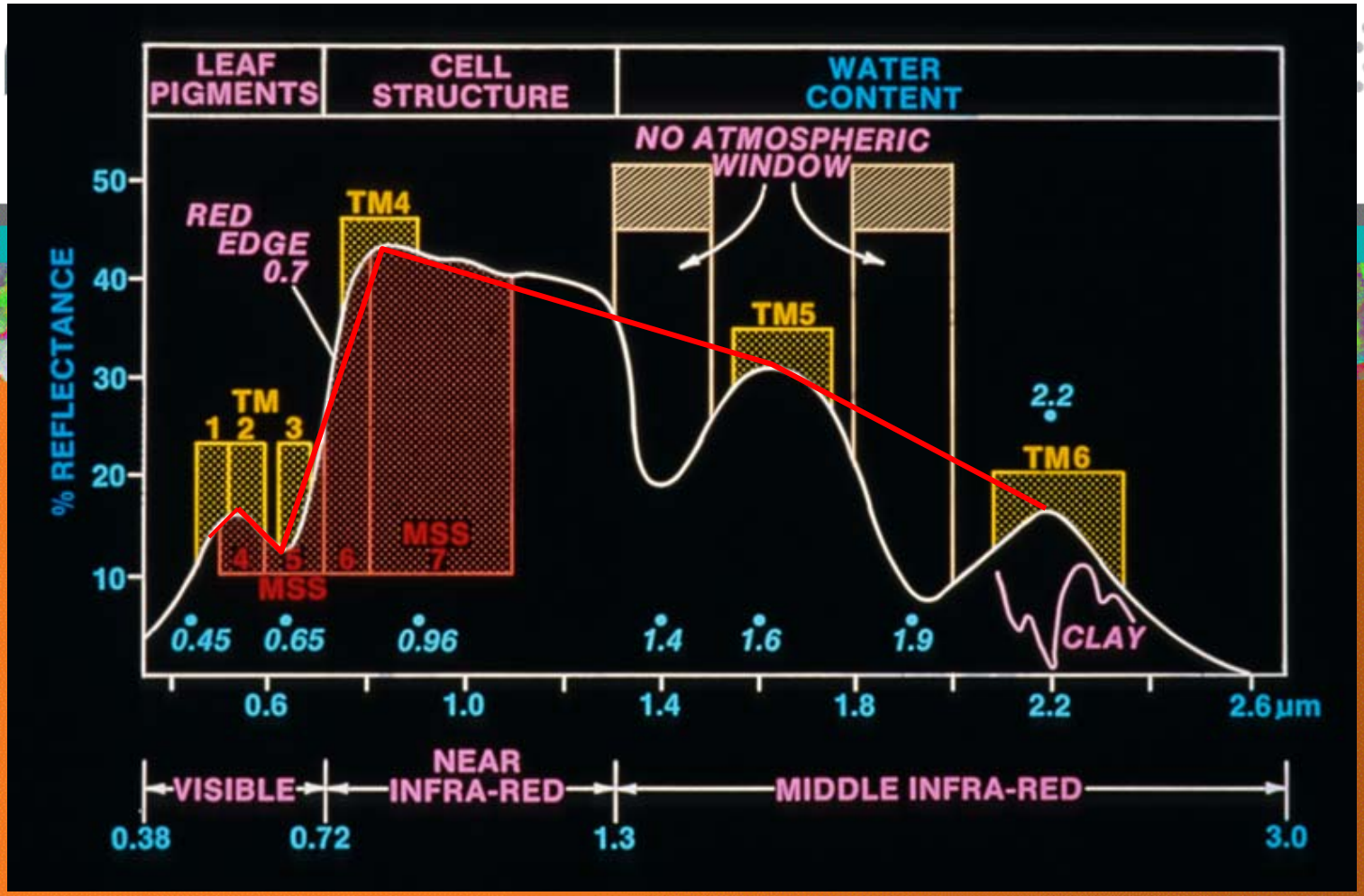
Spectral Signature Vegetation

Technology



Hyperspectral Spectrum

Technology



NRM™ key technologies

Technology

NRM™ technology includes:

•Hyperspectral – Unmatched spectral resolution (660+ wavelengths) providing unique fingerprints of type and condition of ground cover.

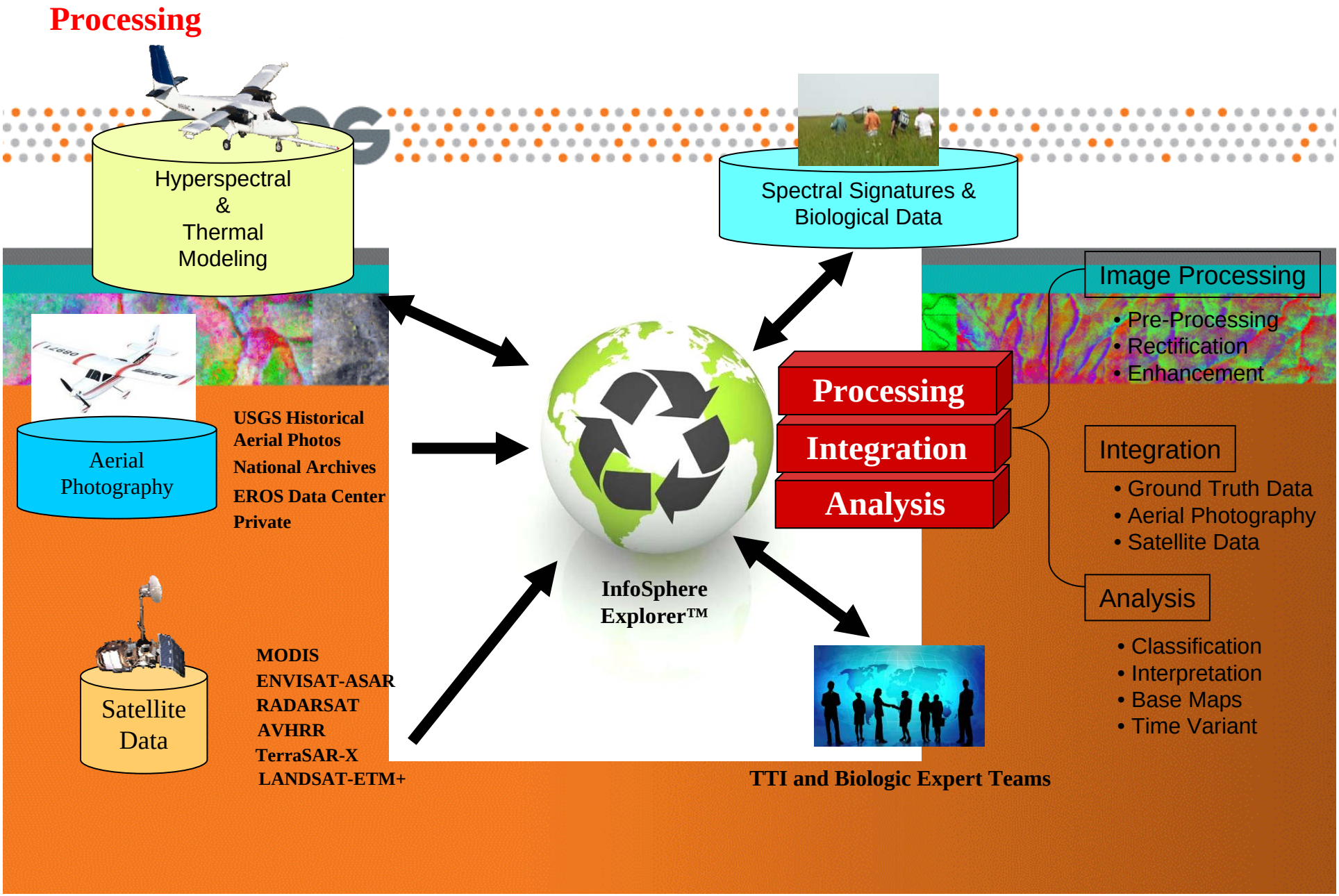
•Thermal Inertia – Locate and determines the concentration and quantity of oil remaining in the habitat

•Proprietary Spectral Libraries – Ground collection of indexed spectral signatures of flora, soil and water

•Classification Technology – Proprietary numerical classification techniques

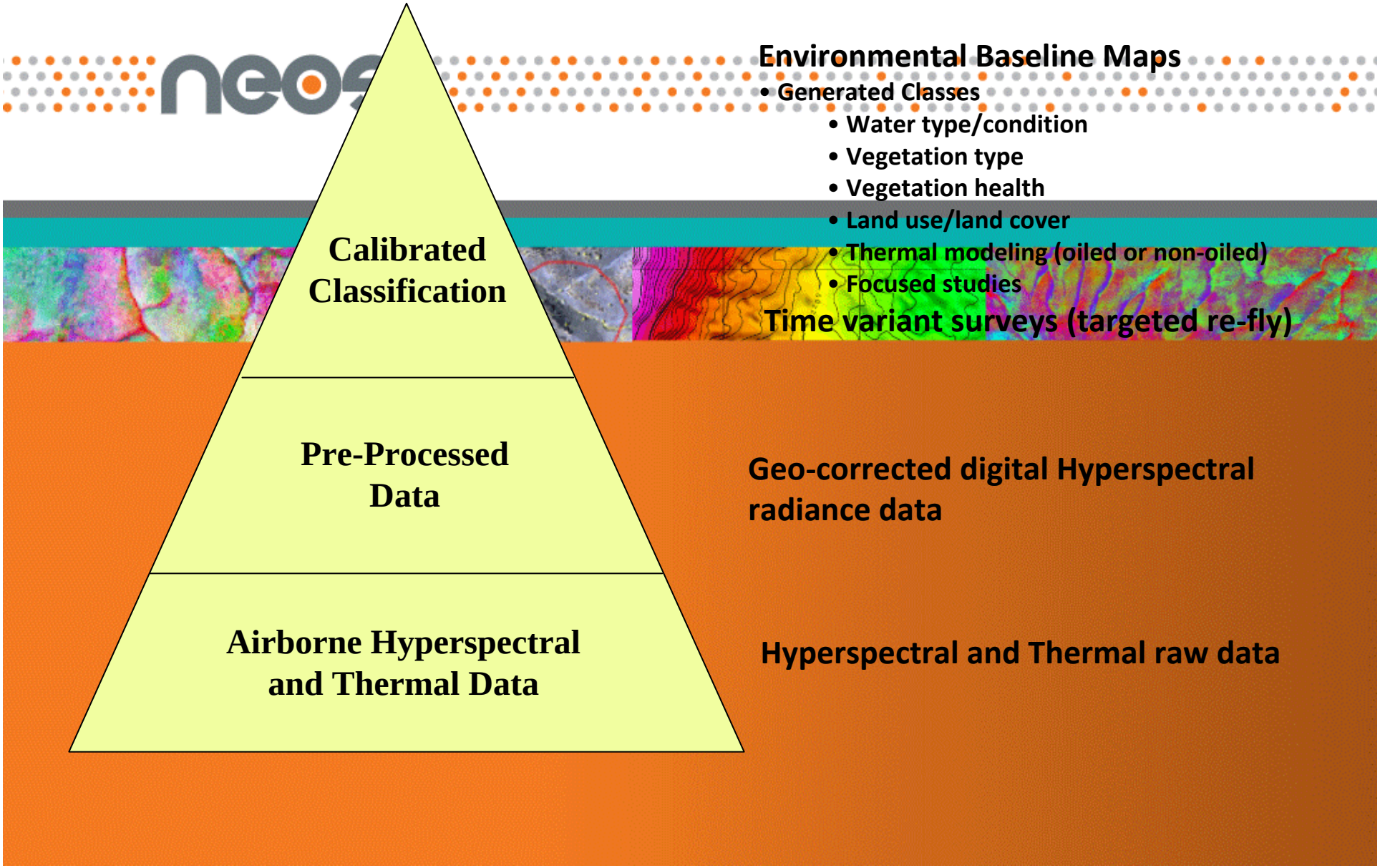
•Biologic Ground Measurements – Confirms biological damage (or lack of damage)

Operation Gulfscan Workflow



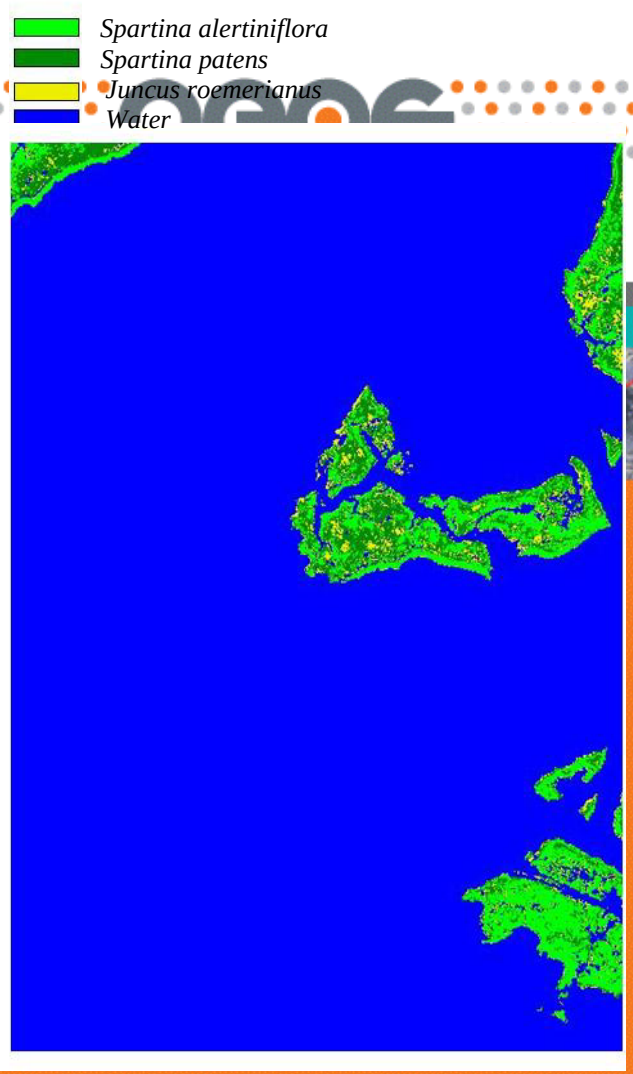
Operation Gulfscan Deliverables

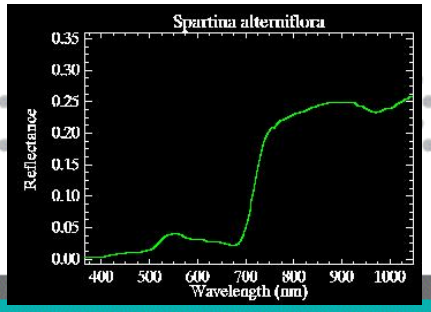
Deliverables

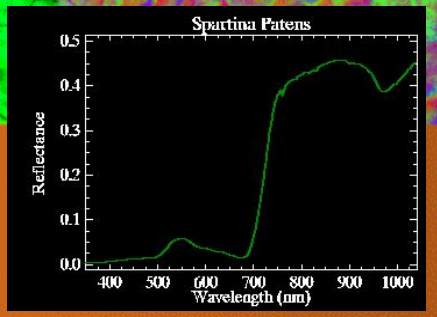


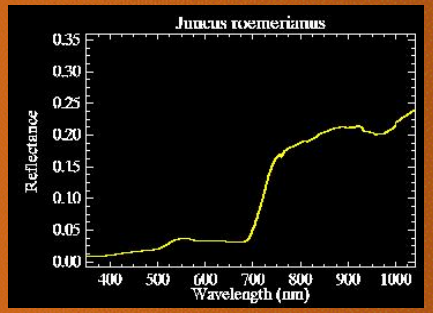
Example: Indexed Baseline

Deliverables

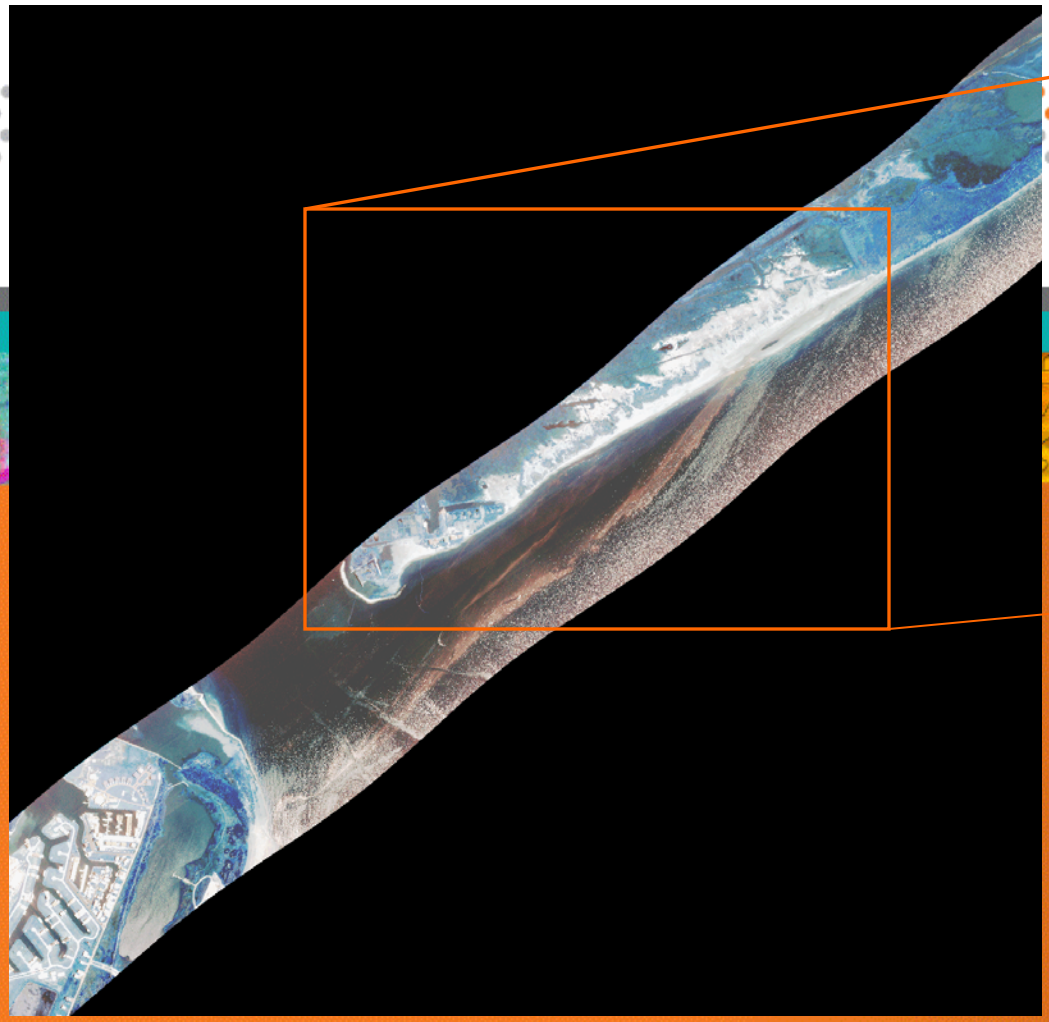




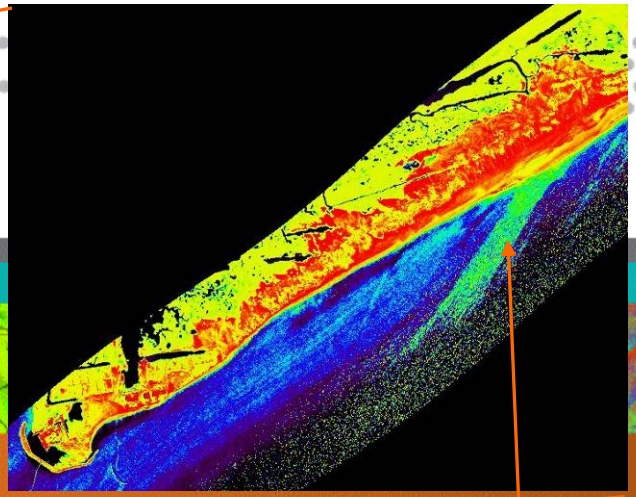




Oil Sheen at Grand Isle May 27, 2010- Pres. Obama visit was May 28, 2010



Thermal Image



Thick oil sheen
Is 1 ° F higher

False Color Composite showing two thicknesses of oil sheen coming ashore at Isle Grande Terre

Sample Data – Oil spill near Chandeleur Islands

This is a color composite of a digital hyperspectral image. The technology allows TTI to determine the specific location, concentration and quantity of oil that is not measurable through photographs, other technologies or the human eye.

Target Areas – Mississippi Delta

Time Variant Pilot Study

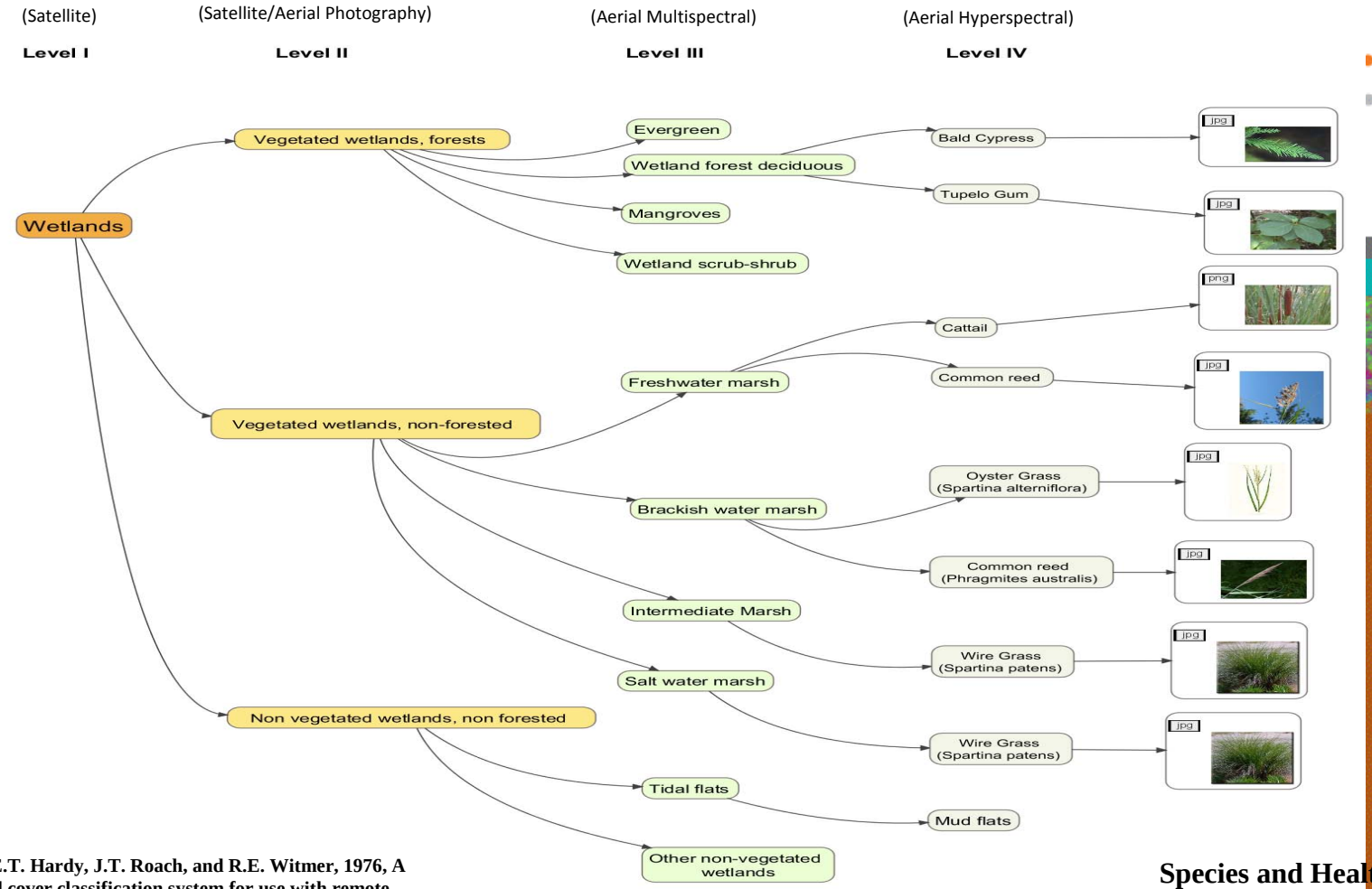
Pilot Bayou area

Micale Bayou area

The tip of the Mississippi Delta was flown on May 21, 2010, then re-flown on July 17, 2010 to measure changes to the ecosystem

Anderson Classification Methodology (USGS)

Gulfscan Methodologies



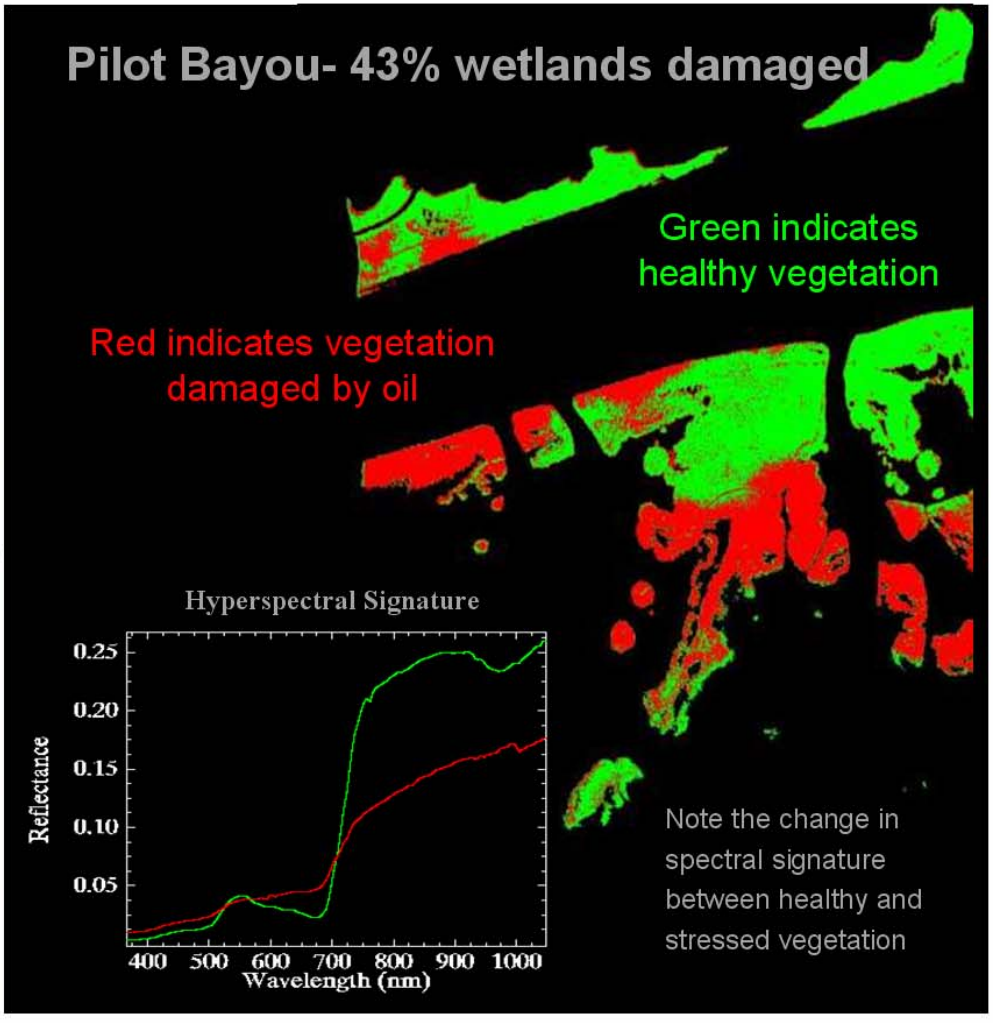
Anderson, J.R., E.T. Hardy, J.T. Roach, and R.E. Witmer, 1976, A land use and land cover classification system for use with remote sensor data: U.S. Geological Survey Professional Paper 964.

Species and Health

Time Variant Pilot Study

May vs. July 2010 Change

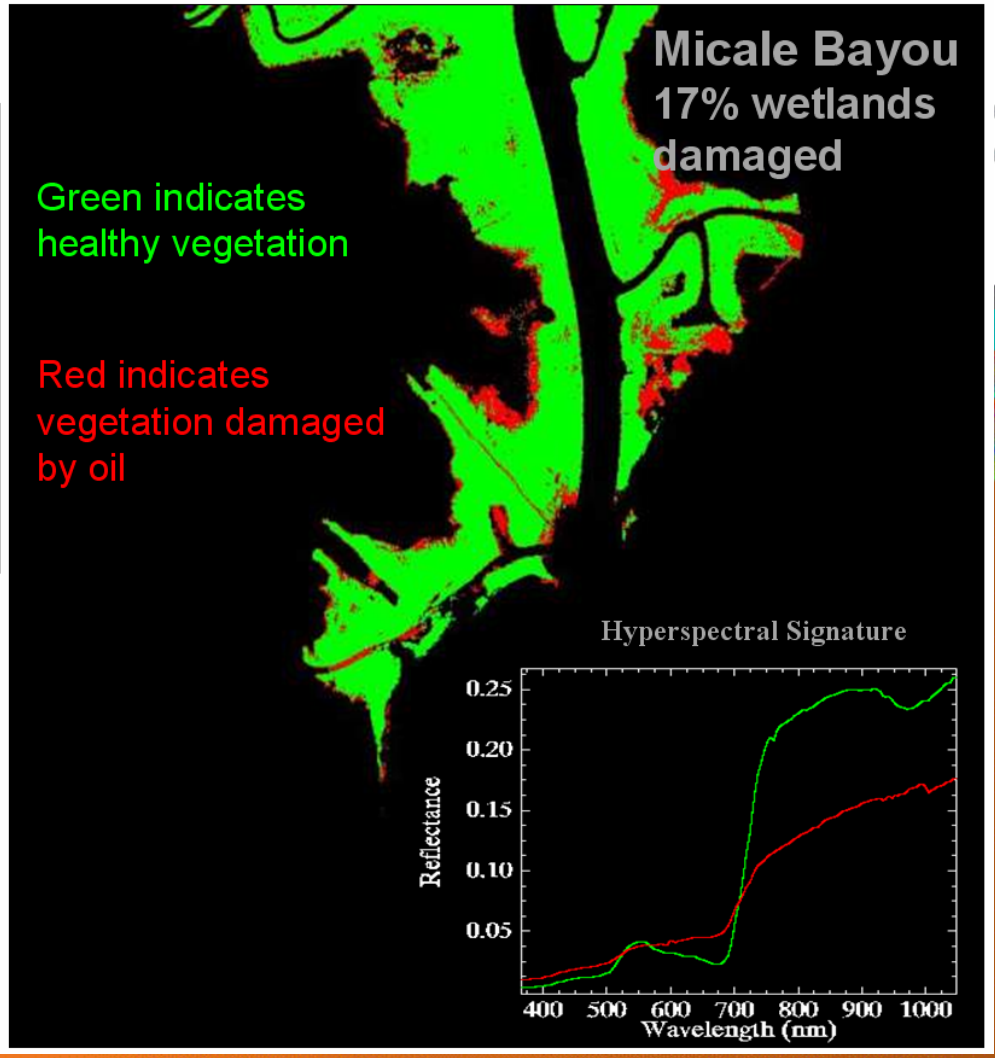
•Field Sampling Photos



Time Variant Pilot Study

May vs. July 2010 Change

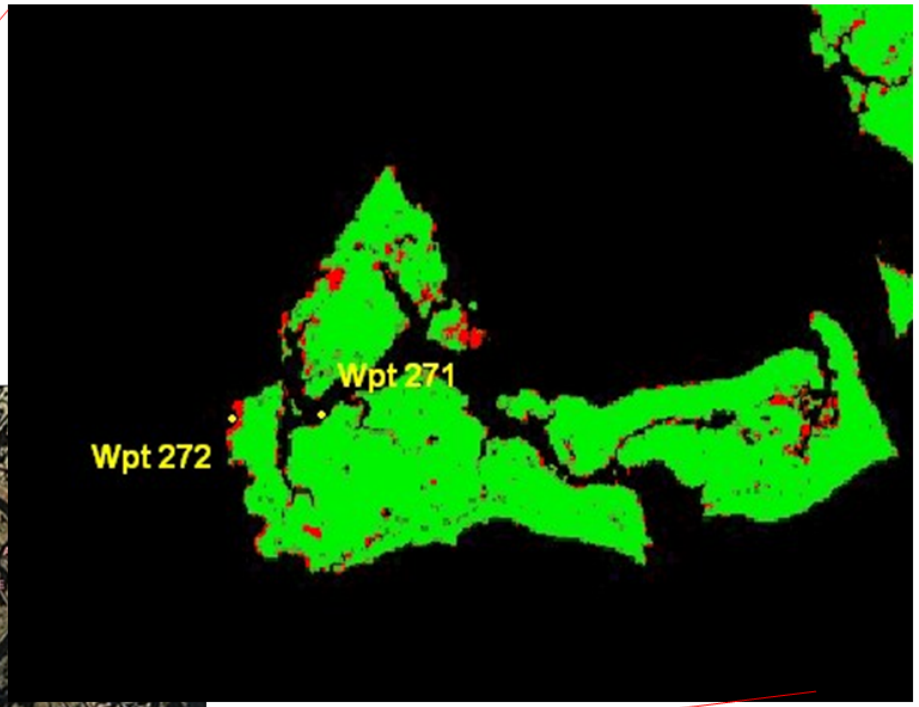
•Field Sampling Photos

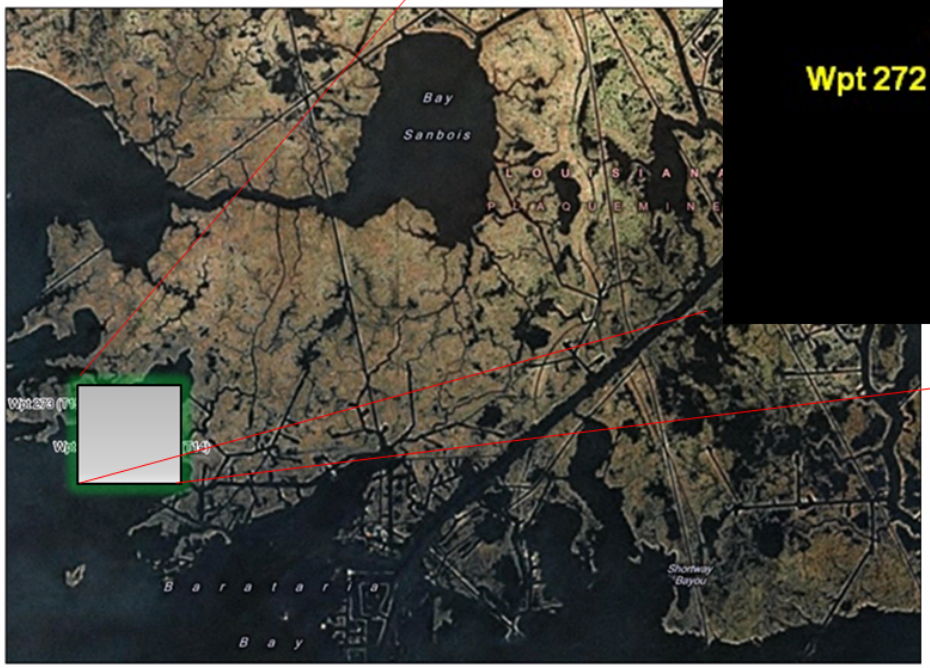


Time Variant
Pilot Study

May vs. July 2010 Change

Barataria Bay

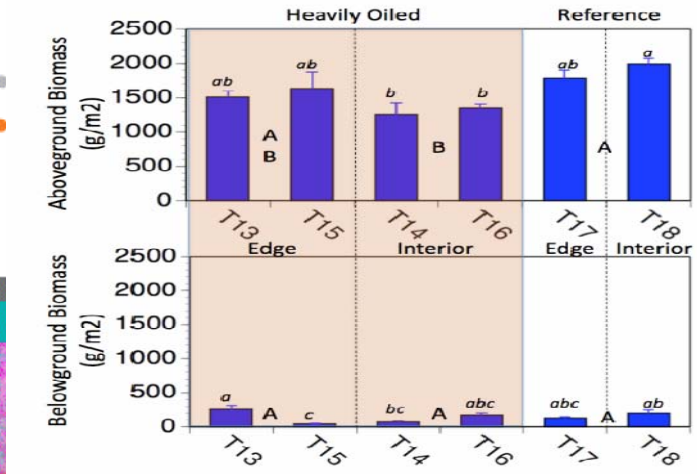




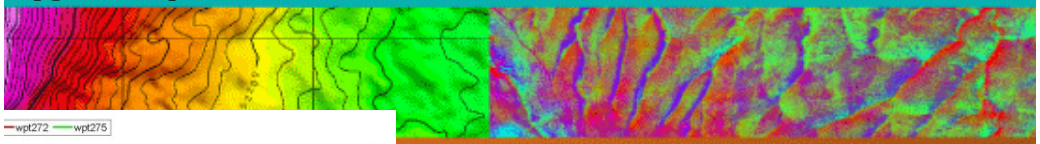
Barataria Bay was flown in May 2010, then re-flown in July to measure changes to the ecosystem

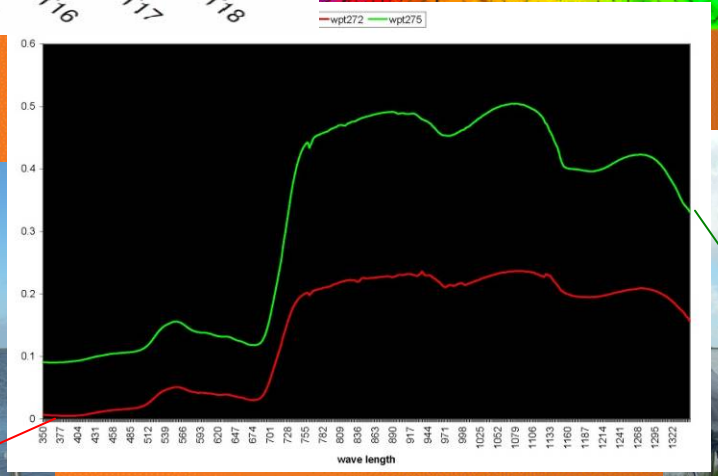
Biological Analysis & Correlation

Time Variant Pilot Study

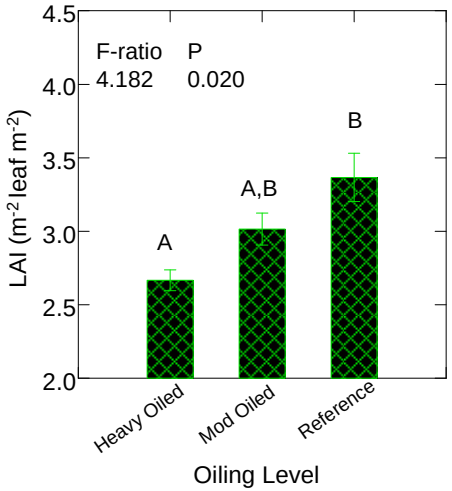


Comparison of Spartina-Alternaflora Field Spectra from a previously oiled site (red) and a non-oiled reference site (green)

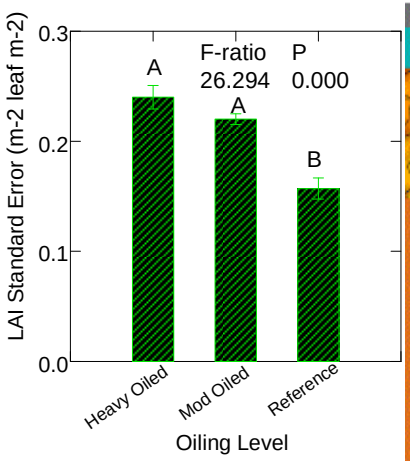




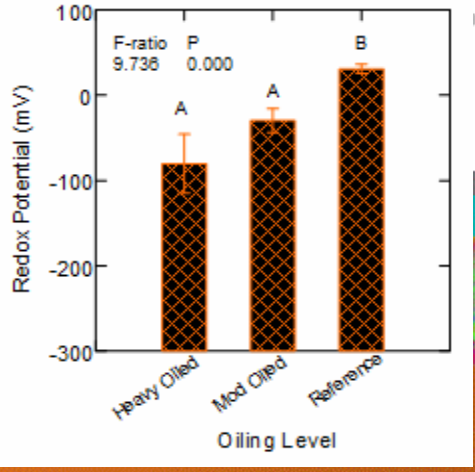
Leaf Area Index (LAI)



Standard Error of LAI



Oxidation-Reduction (Redox)



More oiled = Less biomass

More oiled = Patchier Canopy

More oiled = More Sulfate Reduction

Biological Field Analysis From Time Variant Surveys

Pilot Study

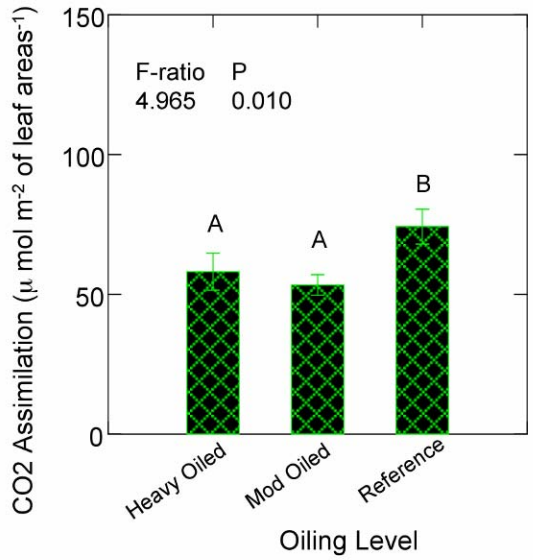
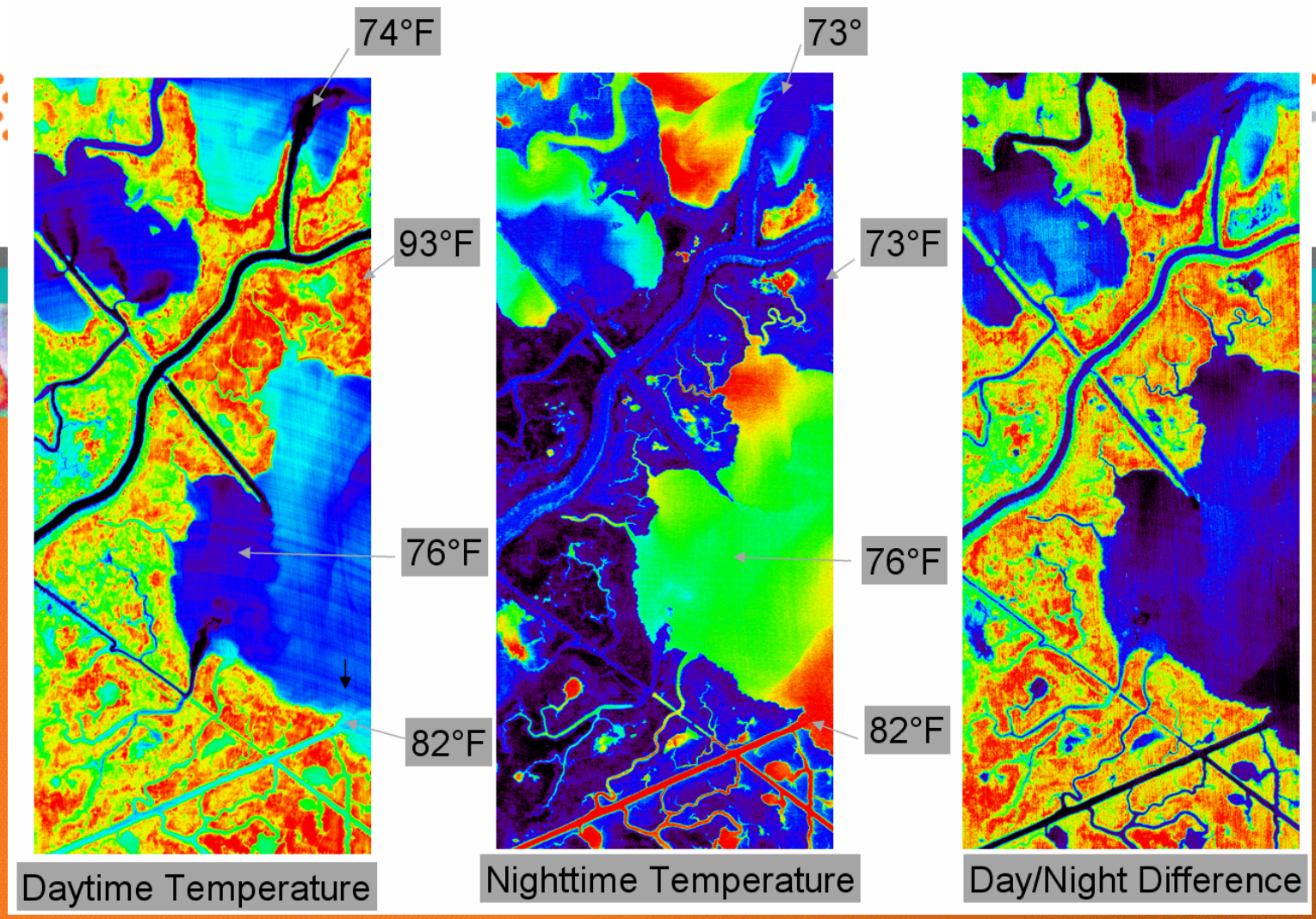


Figure 8. Carbon dioxide assimilation adjusted for canopy closure by multiplying the photosynthetic rates by corresponding leaf area indices. Total carbon dioxide Assimilation (i.e., photosynthetic rate) is lower at oiled sites.

Thermal Analysis over Allen Bay Showing Temperature Gradients of Water and Marshland Day and Night May 25, 2010

Technology



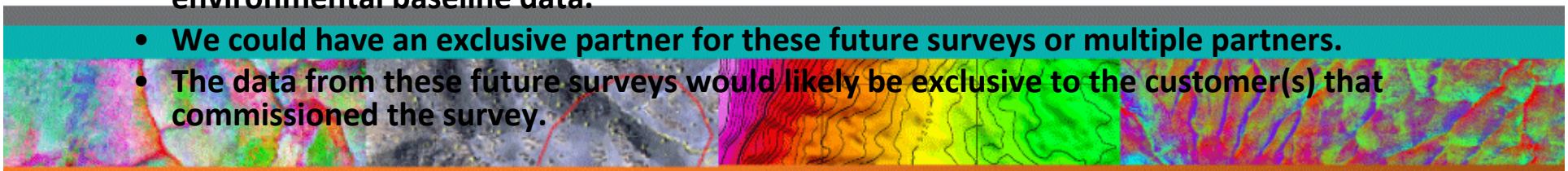
Partnership Options

Environmental Baseline Data

- **Could be licensed on an exclusive or non-exclusive basis to interested parties**

Time Variant Surveys

- **Additional surveys may be commissioned by interested parties to compare against the environmental baseline data.**
- **We could have an exclusive partner for these future surveys or multiple partners.**
- **The data from these future surveys would likely be exclusive to the customer(s) that commissioned the survey.**



Operational Support

- **Assimilate multiple datasets coming in from scientists in the field**
- **Target high value remediation sites**
- **Evaluate effectiveness of remediation efforts to mitigate economic damages**

Litigation Support

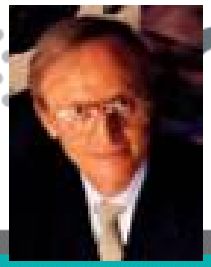
- **Motivated scientific team with great data, solving issues critical to litigators**
- **Challenge economic claims made against BP based on scientific data**
- **Coordinated public messaging**

Future Collaboration

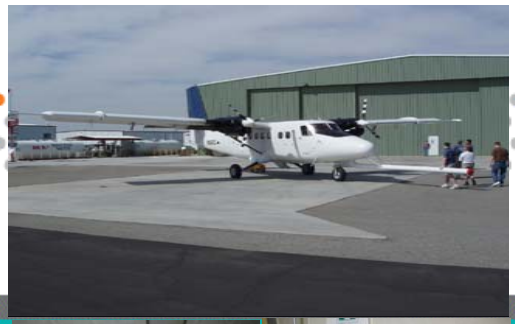
Expert Team Leaders

Time Variant Pilot Study

Dr. Alfredo Prelat - NEOS Exploration's Chief Scientist



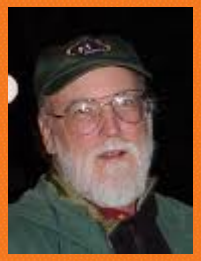
- Remote-sensing expert
- Stanford PhD, Sr Fellow at Boeing and Fellow at Texaco
- Gulf of Mexico Coastal Ocean Observing System Board of Directors
- Best International Paper for use of hyperspectral remote-sensing technology for environmental applications



Dr. John Jacob - Associate Professor at Texas A&M

- Coastal Community Development Specialist with the Texas Sea Grant College Program at Texas A&M
- Director of the Texas Coastal Watershed Program

Dr. John Day - Distinguished Professor Emeritus LSU



- Department of Oceanography and Coastal Sciences, School of the Coast & Environment
- Extensive research on the ecology and management of the Mississippi Delta region