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OPERATIONAL UTILIZATION OF AERIAL MULTISPECTRAL REMOTE SENSING DURING OIL SPILL RESPONSE: LESSONS LEARNED DURING THE DEEPWATER HORIZON SPILL

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Ocean Imaging

In The Beginning…

THE LEMPERT-KEENE-SEASTRAND OIL SPILL PREVENTION AND RESPONSE ACT

(GOVERNMENT CODE 8670.3.)
"Best achievable technology"
"…that are being developed, could feasibly be developed, or are currently in use anywhere in the world"

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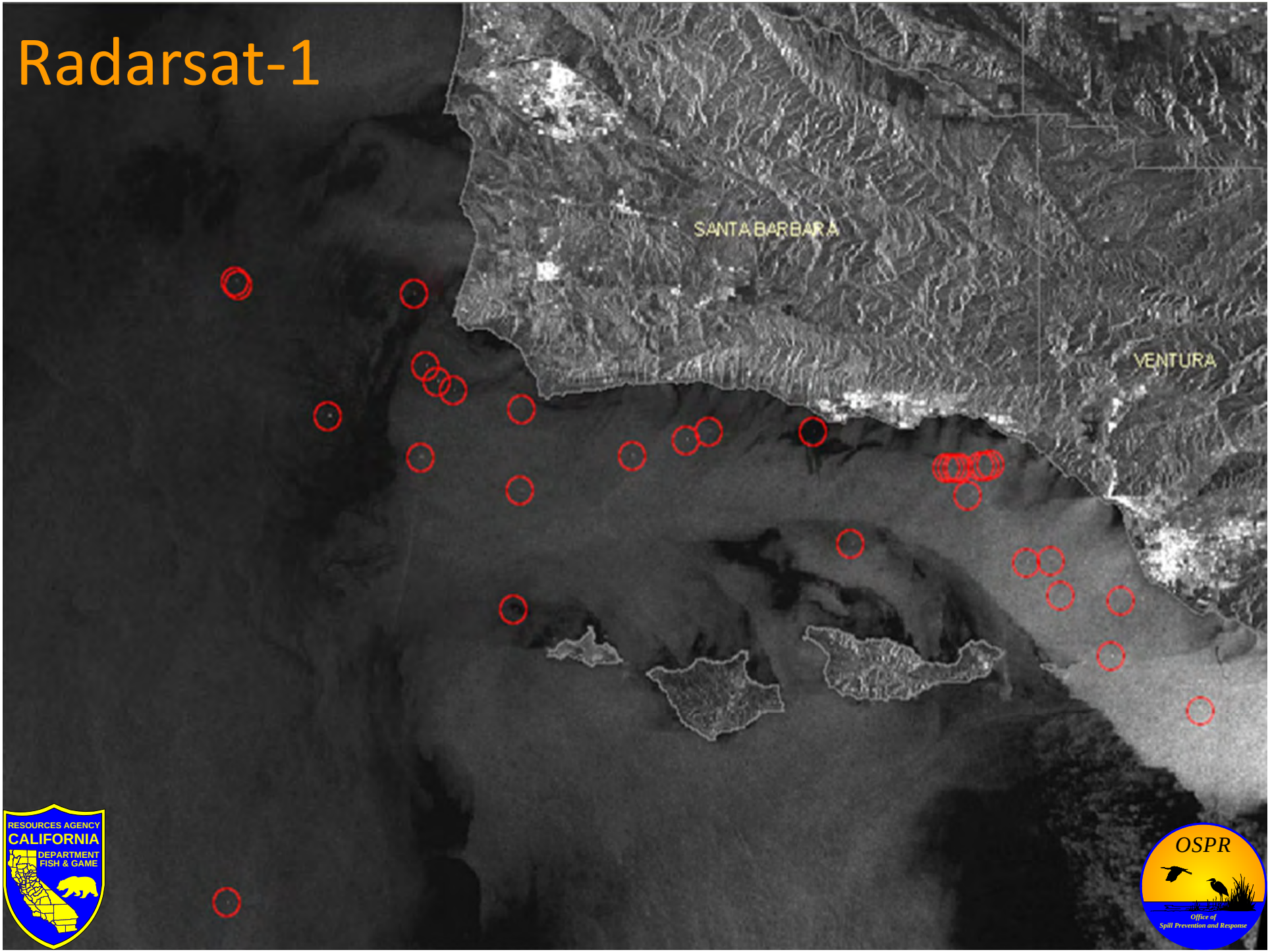
Radarsat-1



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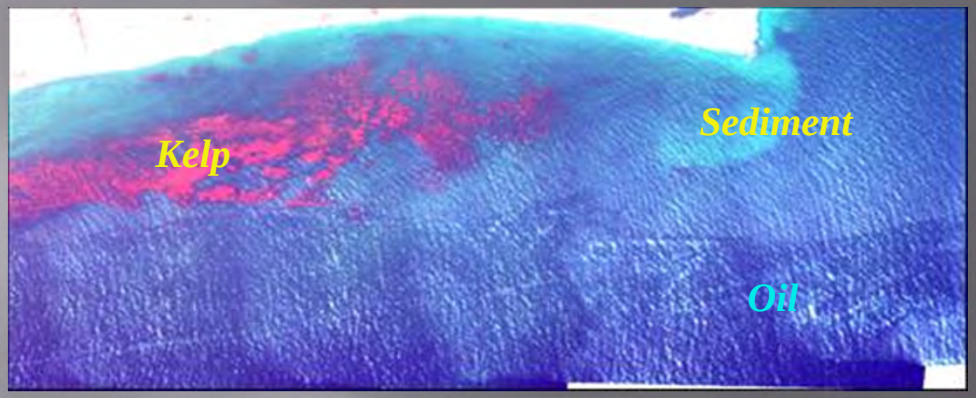
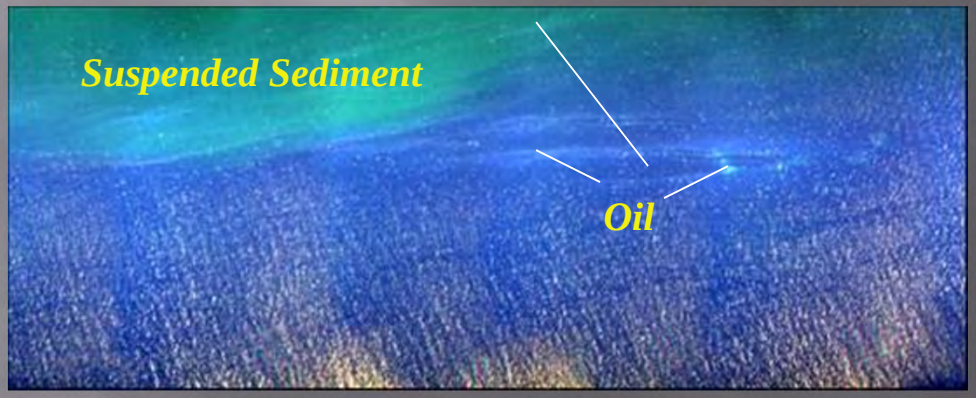
OSPR Airborne Remote Sensing Research

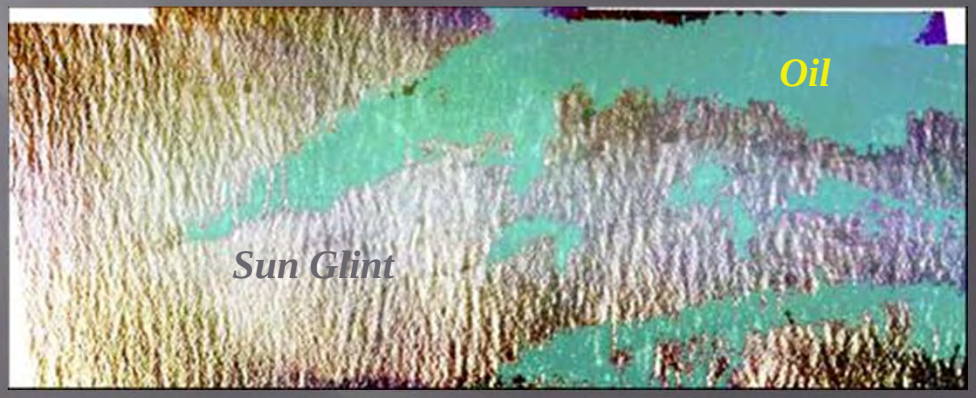
PROJECT OBJECTIVE: DEVELOP AN OPERATIONAL AERIAL IMAGING TECHNOLOGY THAT WOULD ENABLE REAL-TIME OIL SPILL MAPPING IN GIS FORMAT, ELIMINATE FALSE TARGETS, WITH AN EASILY DEPLOYABLE AND PORTABLE SENSOR

Ocean Imaging's DMSC-MK2 Four Channel Aerial Sensor

Elimination of False Targets

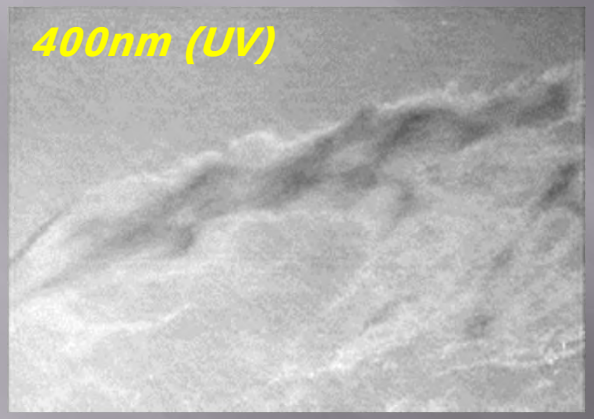


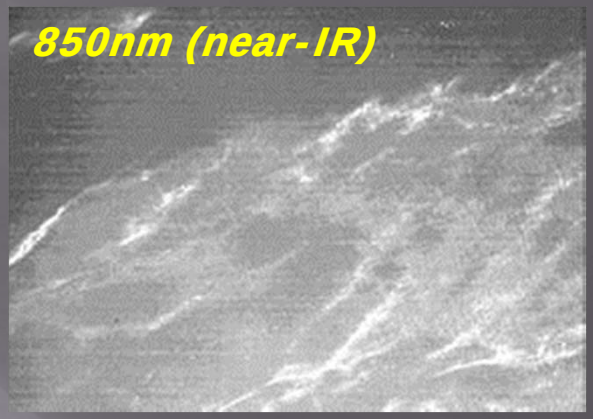


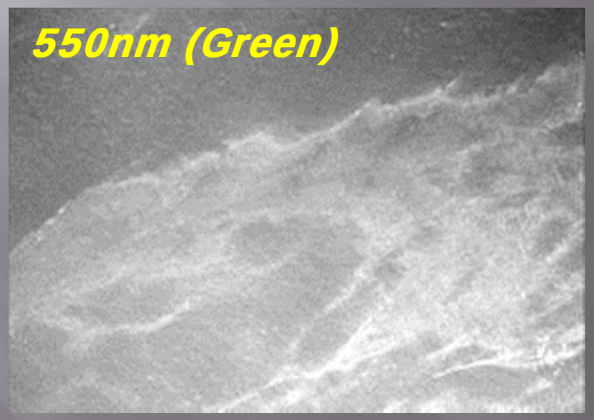


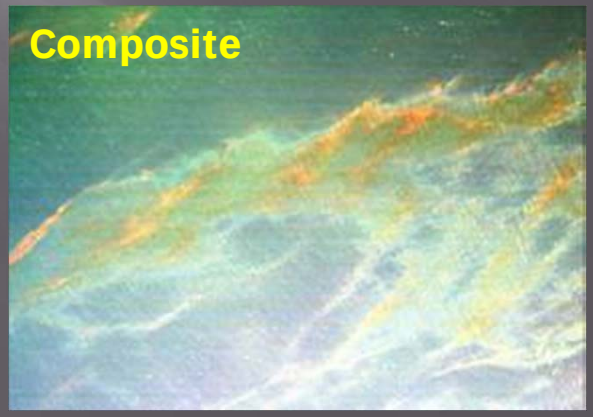
Oil on Water Detection

Two test flights over Santa Barbara Channel seeps were conducted in mid-2004







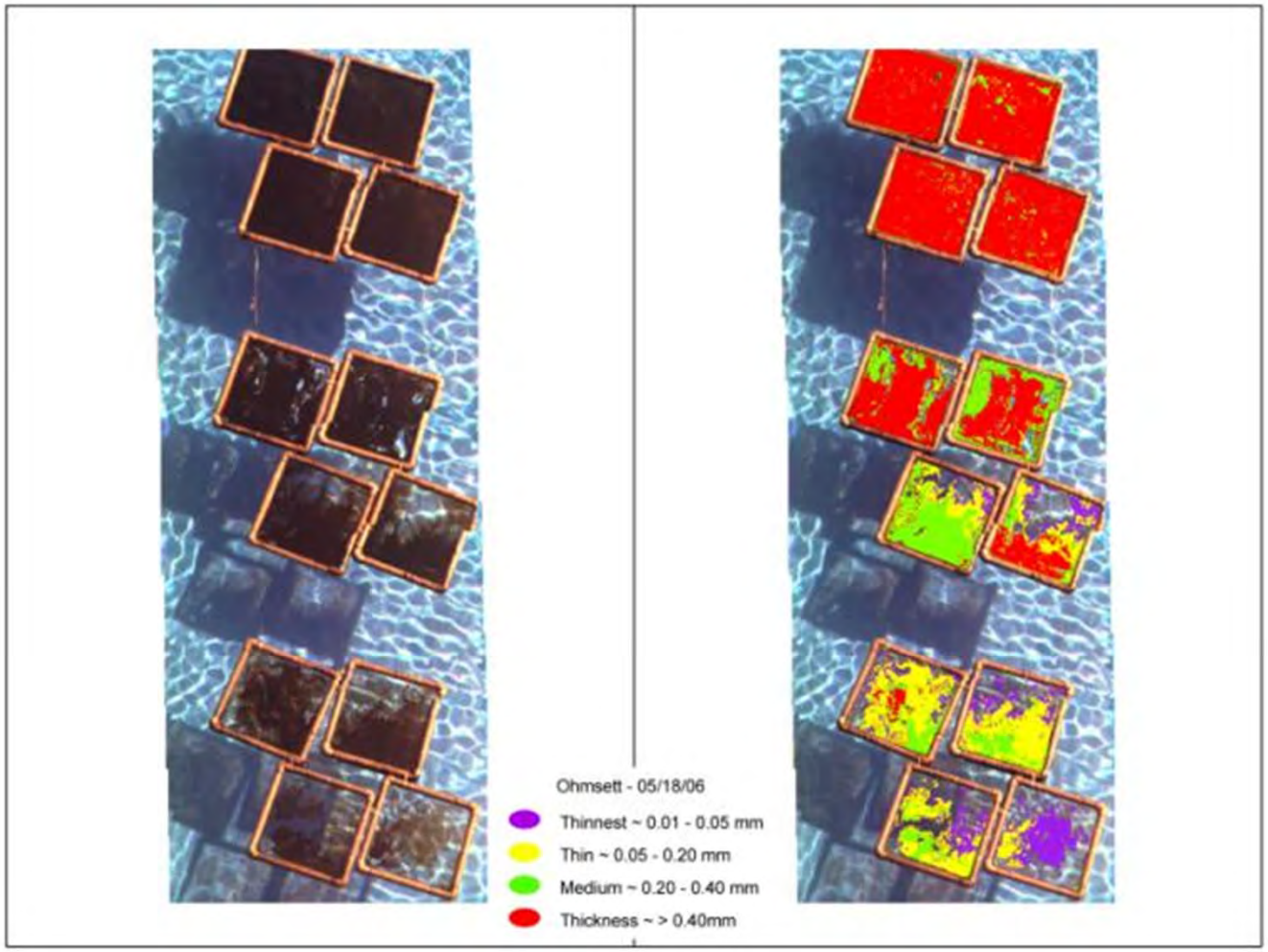


Bureau of Safety and Environmental Enforcement (BSEE)

(Formaly MMS)

Technology Assessment & Research Program

Algorithm Validation and Refinement
(MMS Ohmsett Facility, New Jersey)



Mapping Spills Better and Faster

Traditional Approach: Visual observations from helicopter or aircraft converted to drawing on a map using GPS.

Our Approach: Easily-deployable computerized system utilizing multiple imaging channels in the visible, near-IR & thermal-IR

Advantages over visual methods:

1) System is objective – does not rely on opinion and experience of operator
2) Survey map is in digital GIS format – allows accurate location determinations, direct computation of oil spill area and volume, etc.
3) Survey provides much greater detail

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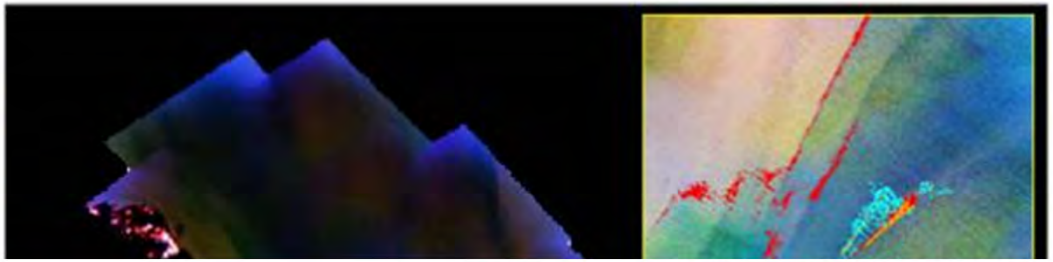
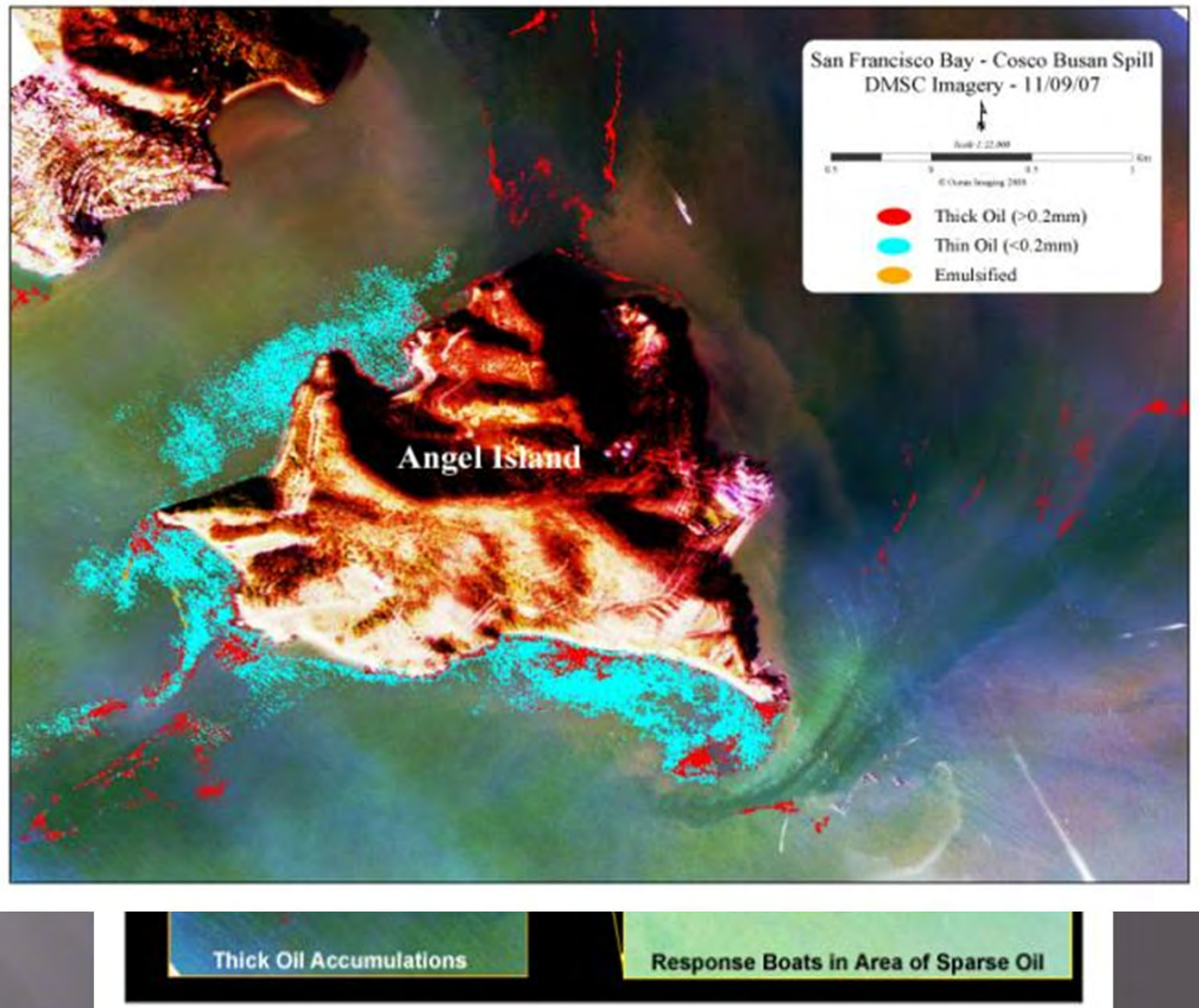
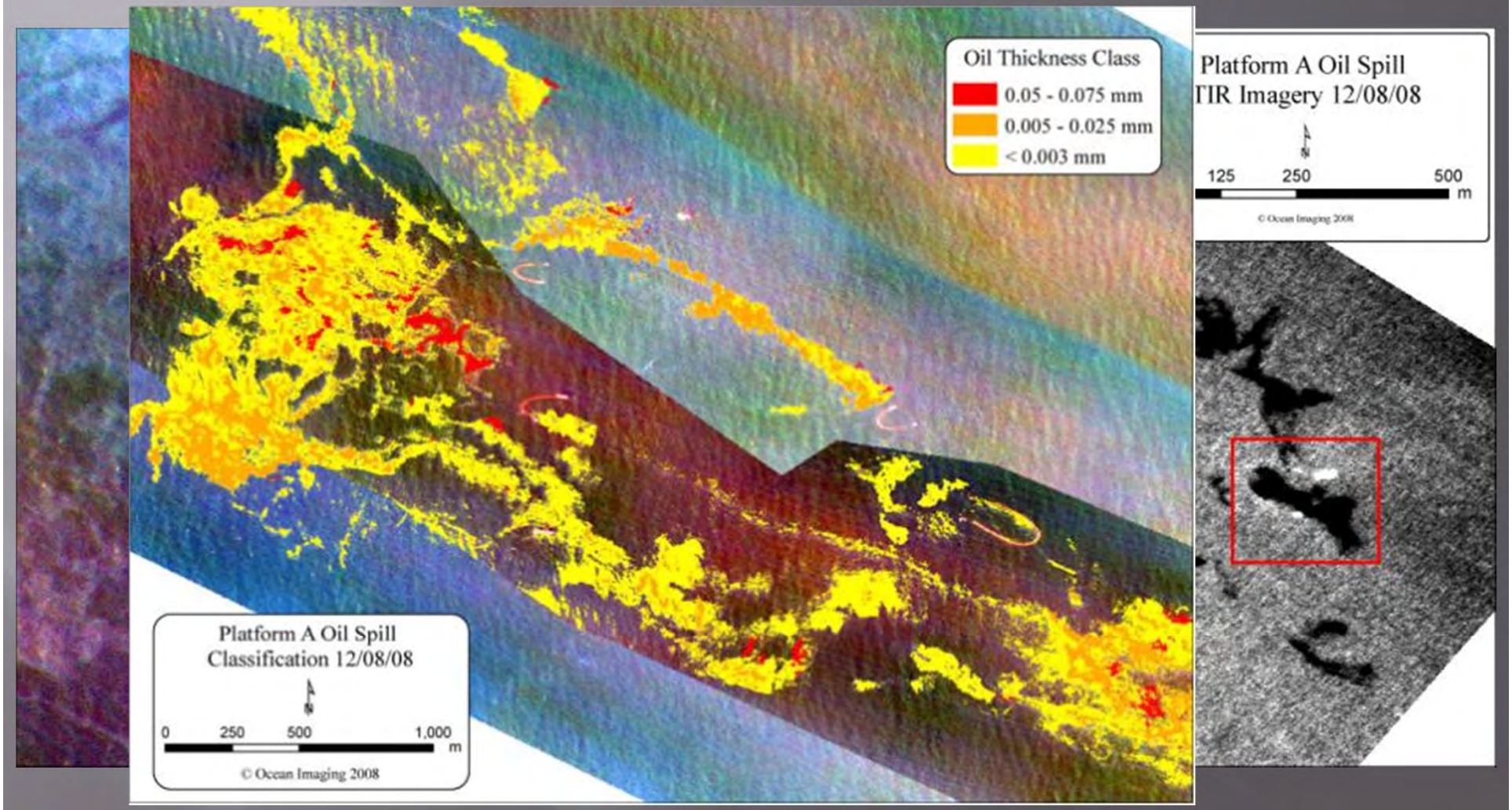


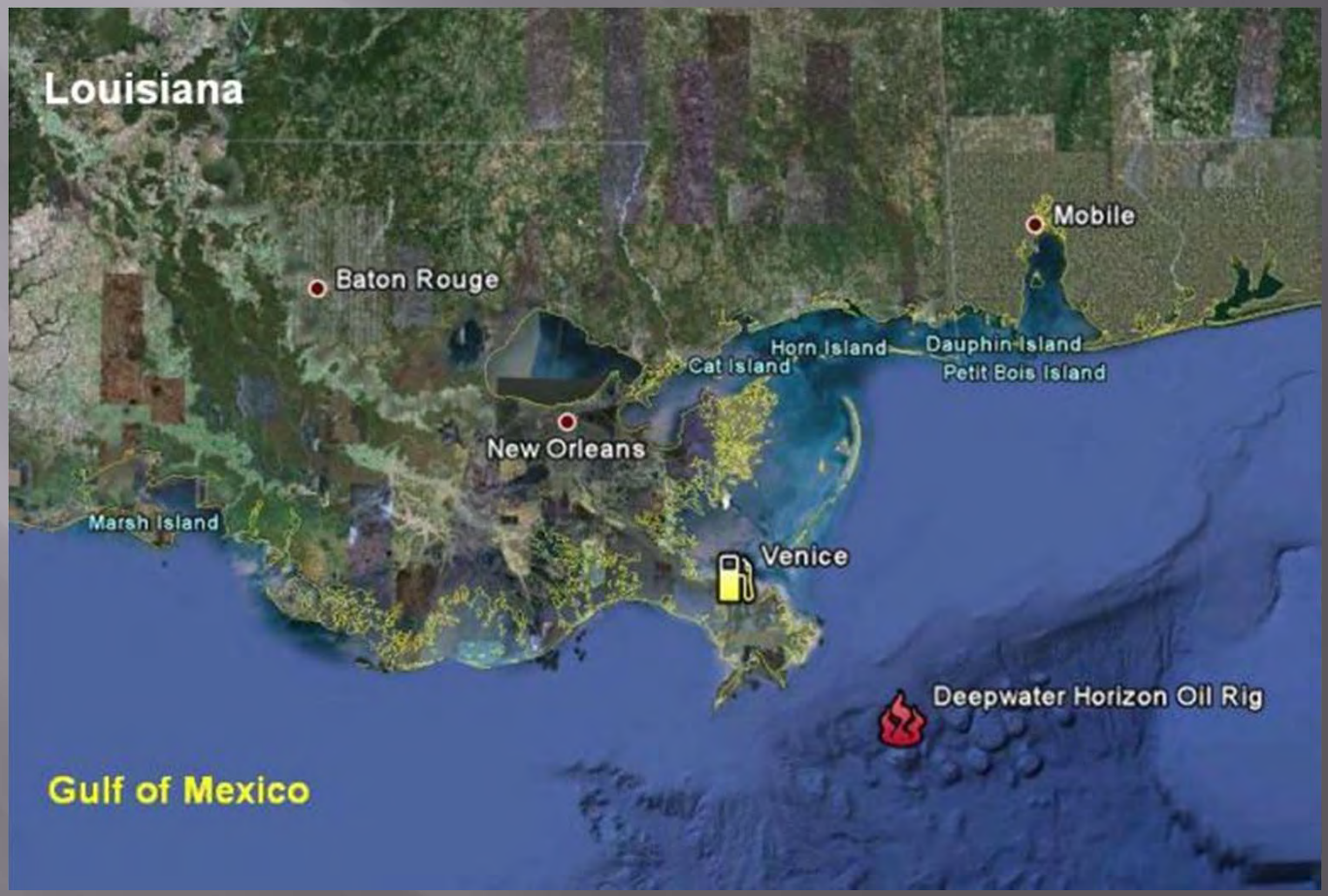


Utilization in an Actual Spill

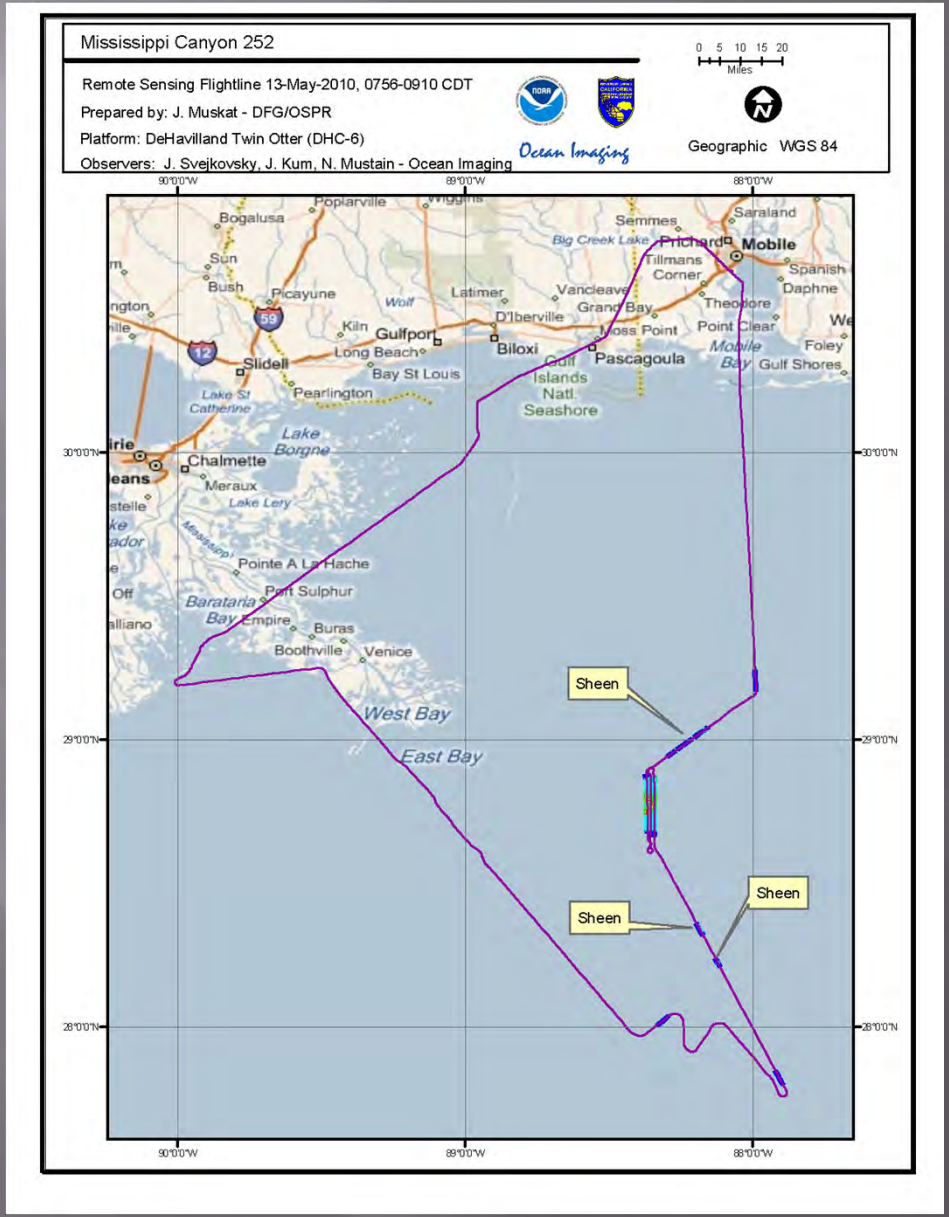
Platform A spill, 12/7/08, Santa Barbara Channel



The Deepwater Horizon Oil Spill: Experiences from the response



Deepwater Horizon (MC-252)



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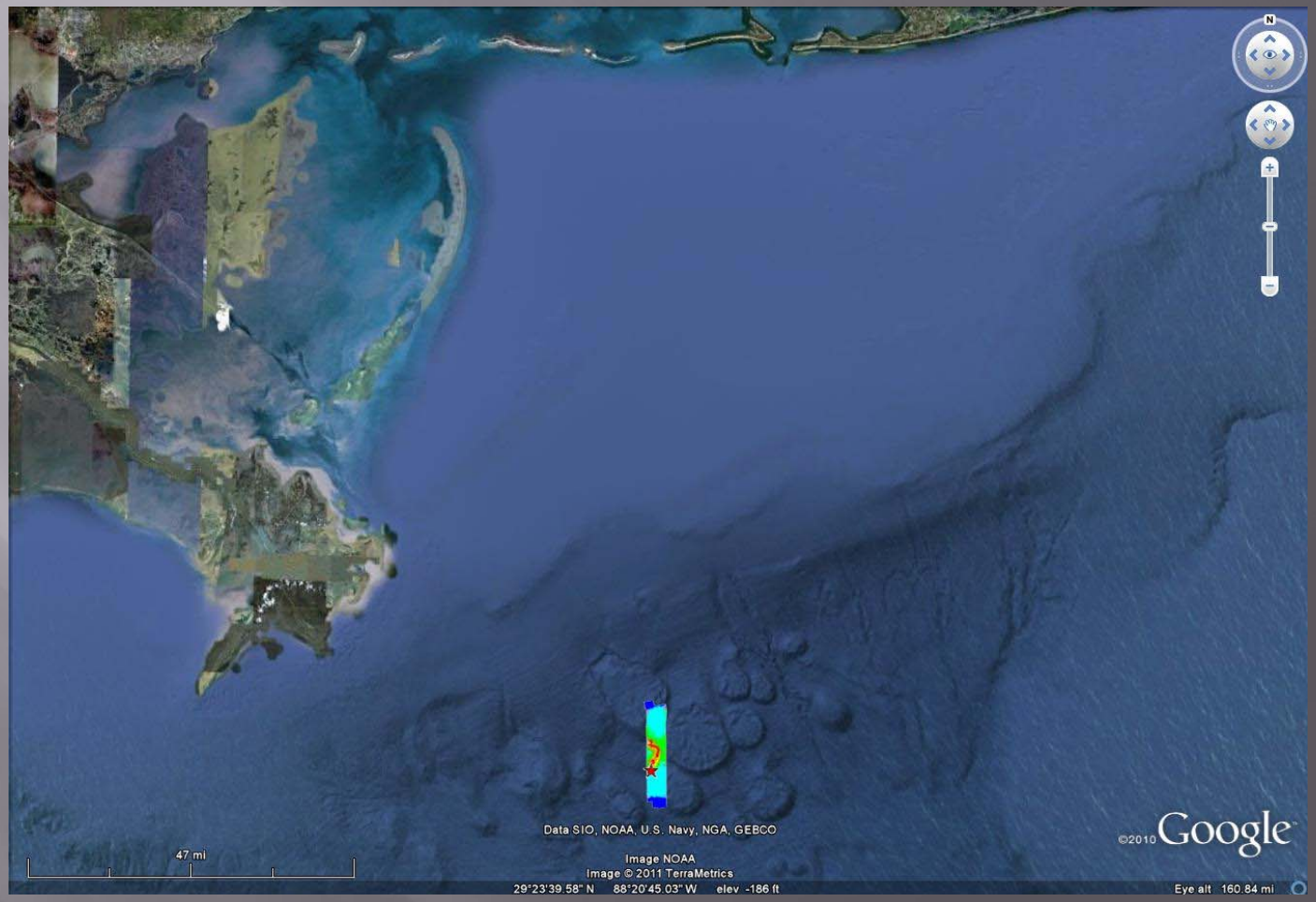
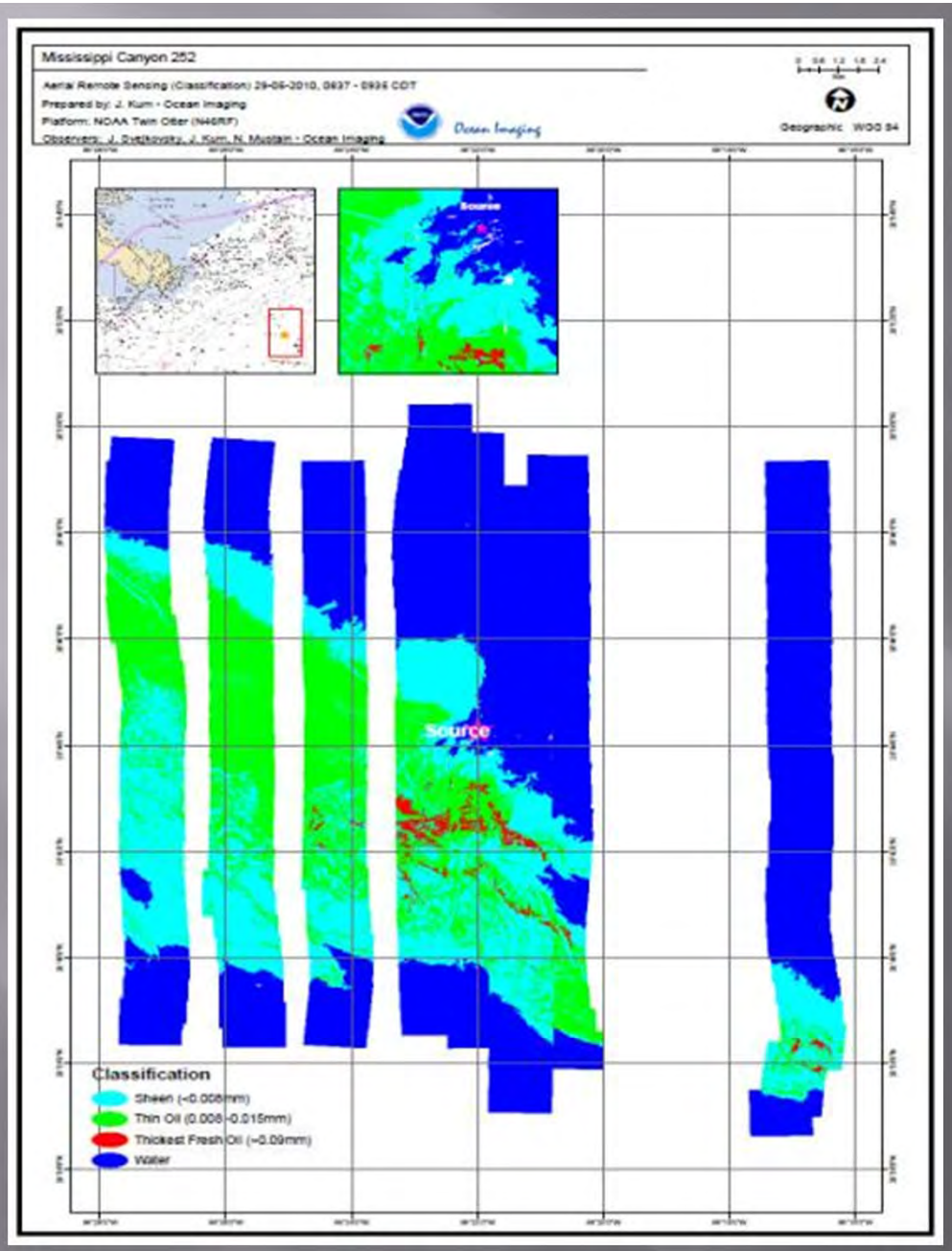
Deepwater Horizon (MC-252)



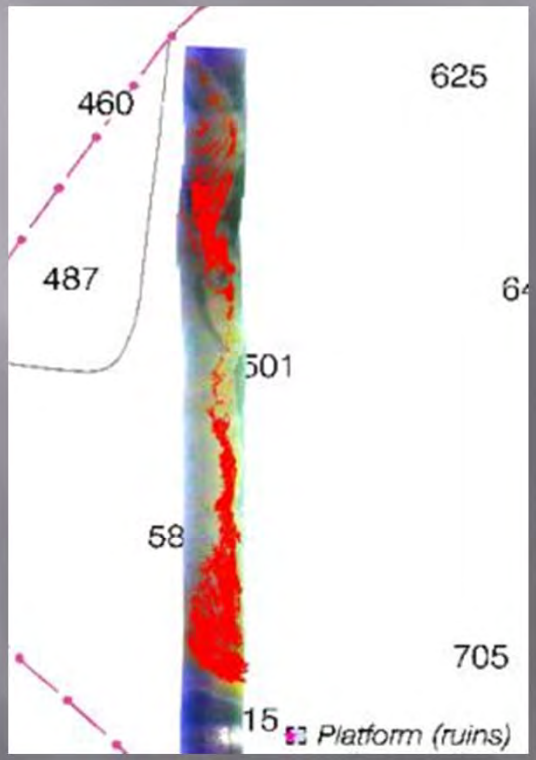


Extreme size of spill necessitated prioritizing of survey areas:

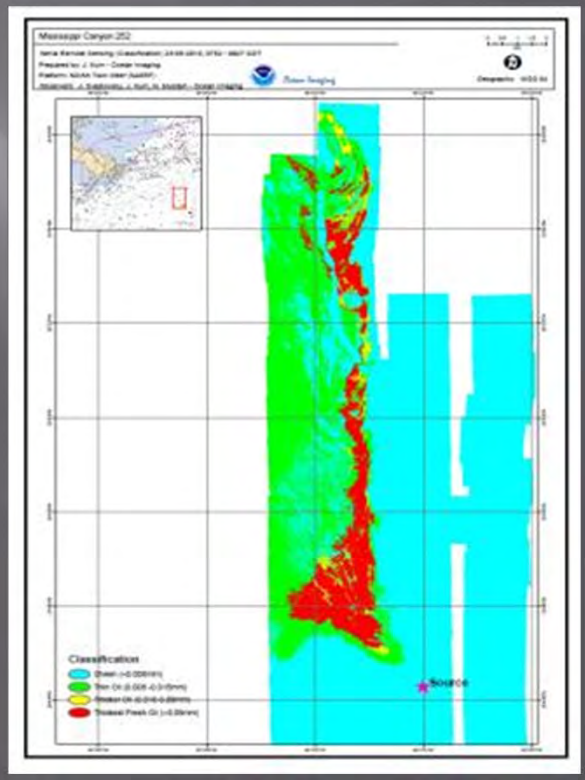
- Source region
- Oil approaching land
- Beached & marsh-entrained oil
- Offshore oil extents

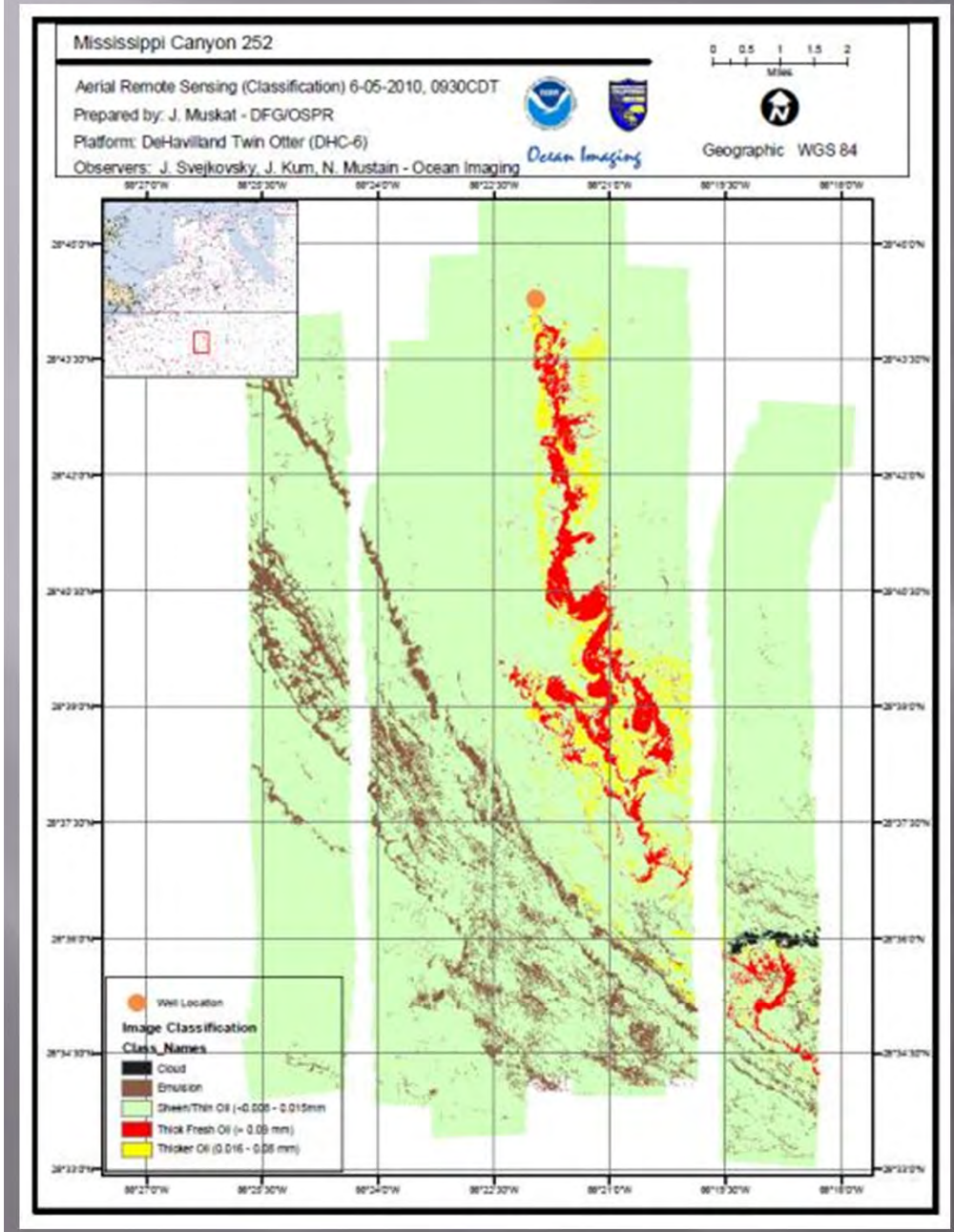
“QTPs” were disseminated via e-mail directly form the aircraft, “Finals” e-mailed and uploaded on ERMA within 2-4 hours of overflight

Quick-turnaround product



Final Classification





Analysis maps were utilized for multiple applications including:

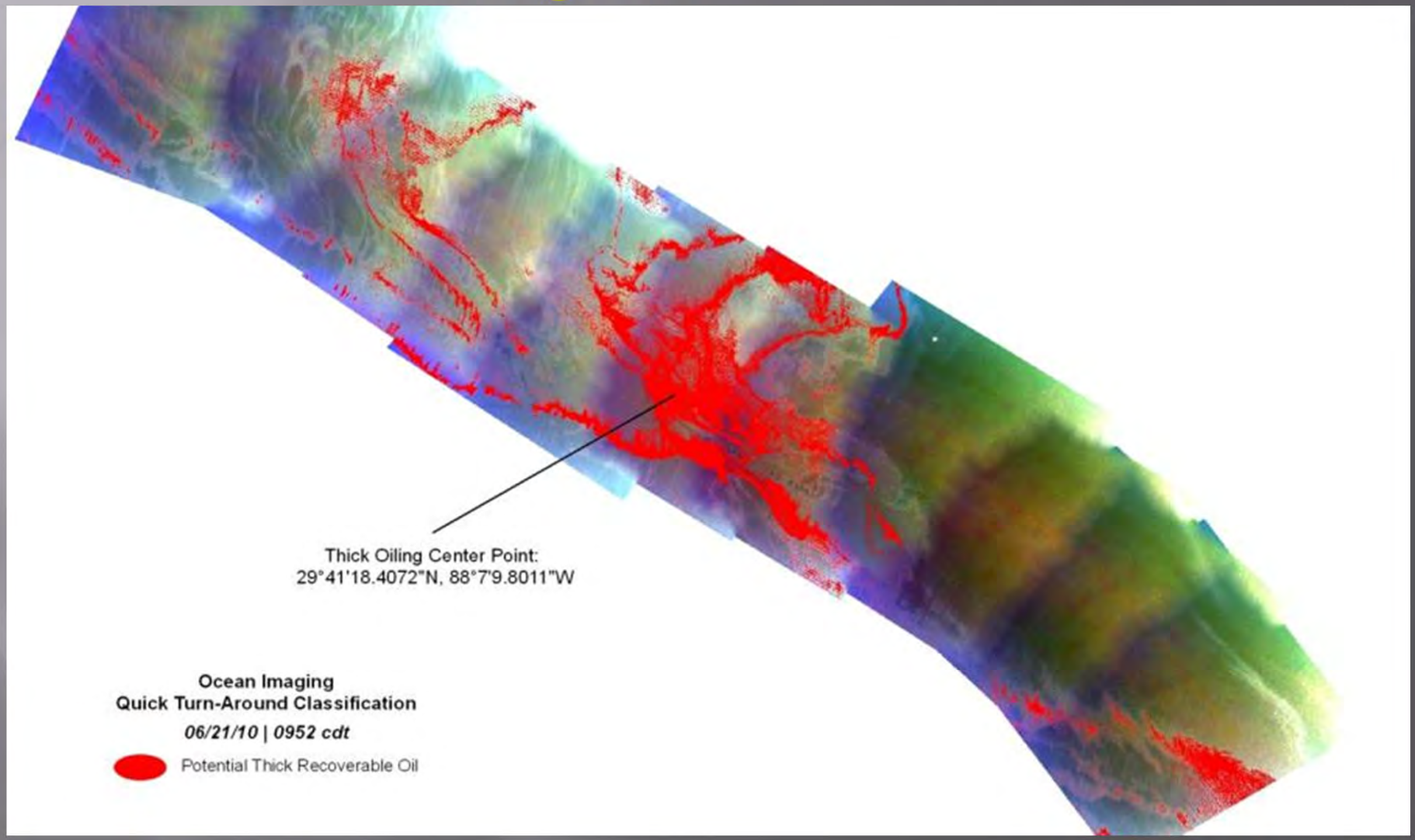
Source area oil distribution for response resource management & trajectory modeling

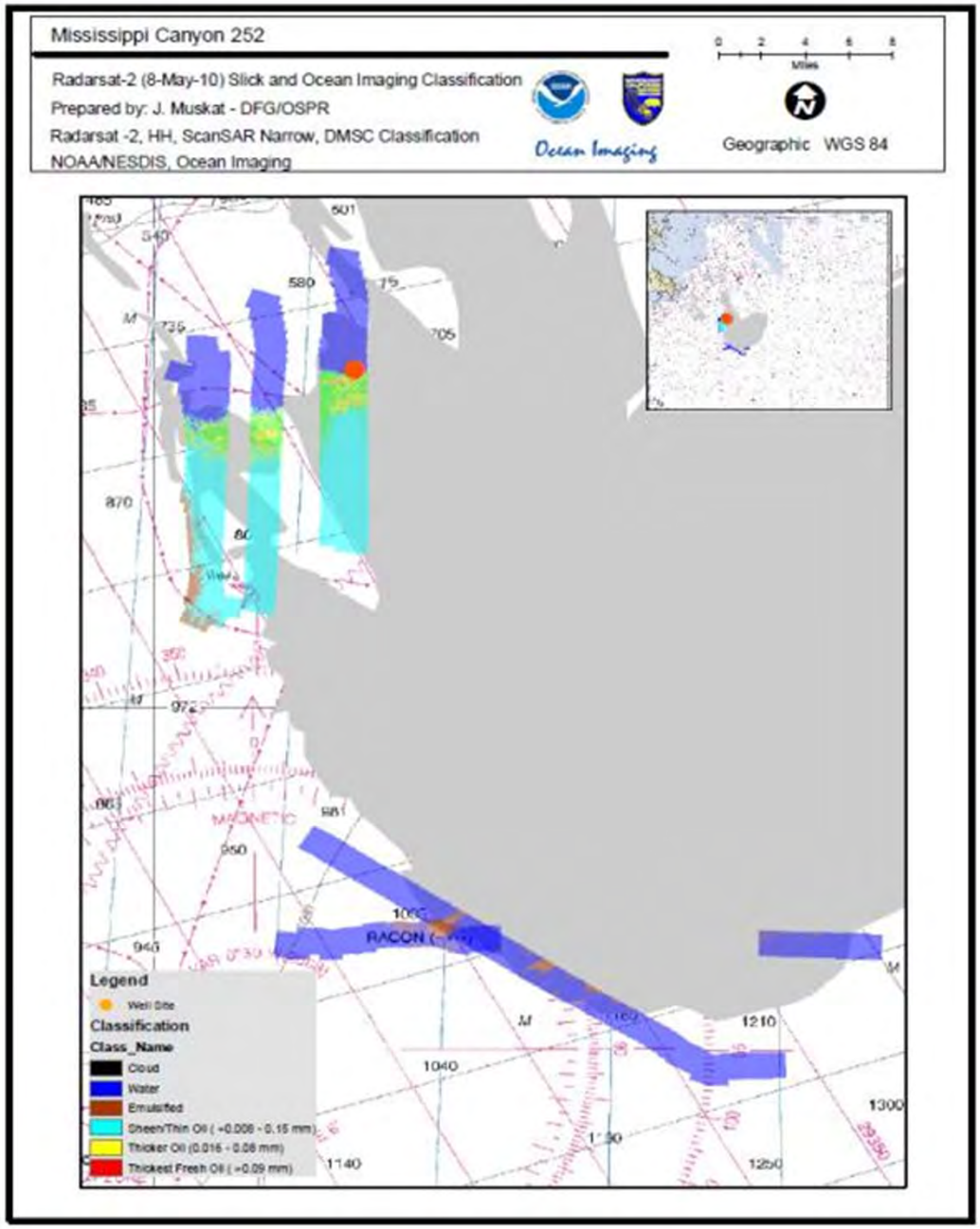
Location of recoverable oil targets

Location/extent of beached and marsh-entrained oil

Effectiveness of dispersants

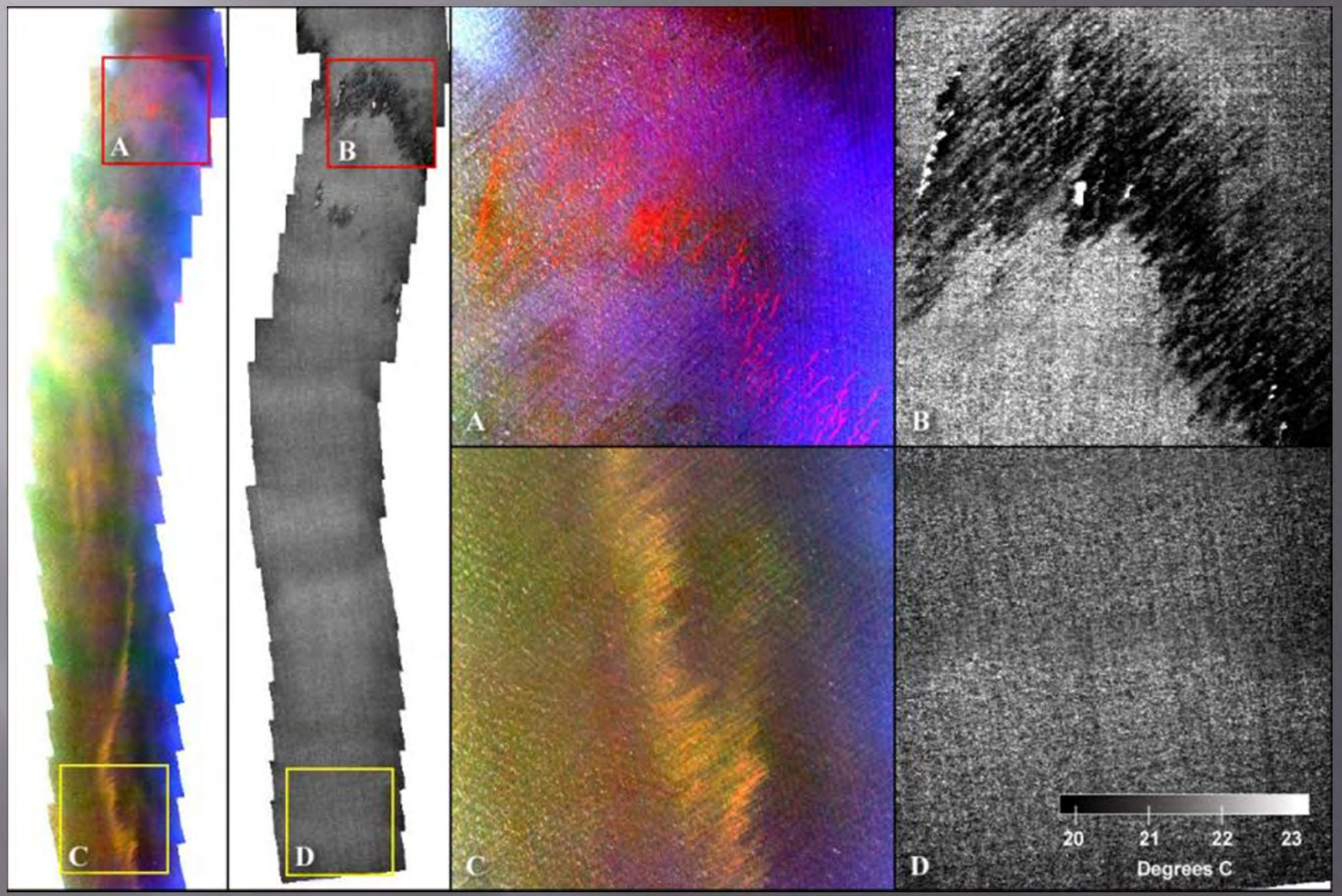
Locating recoverable oil targets



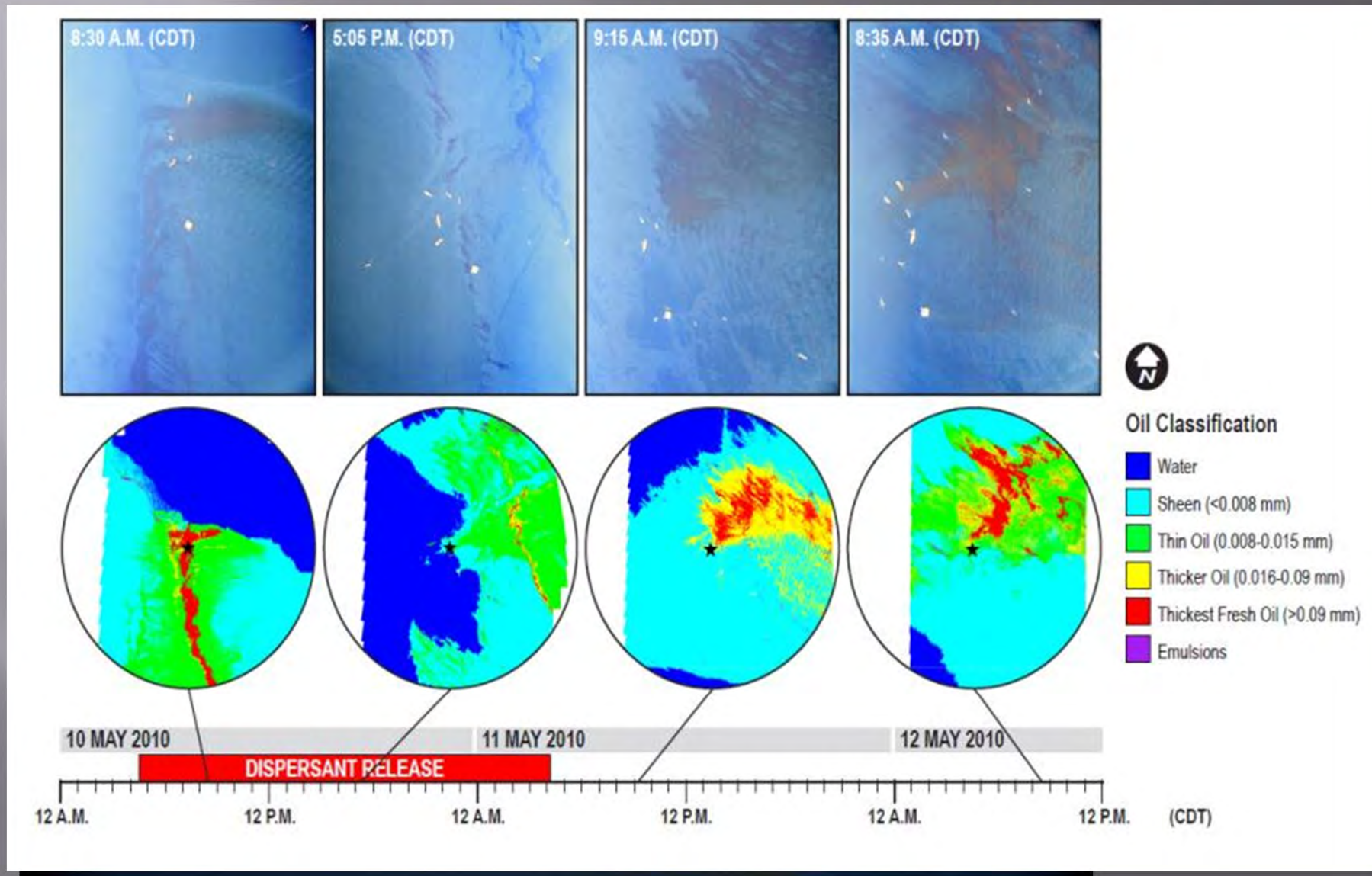


Analyses augmented SAR-derived oiling footprint to provide regional oil quantity information

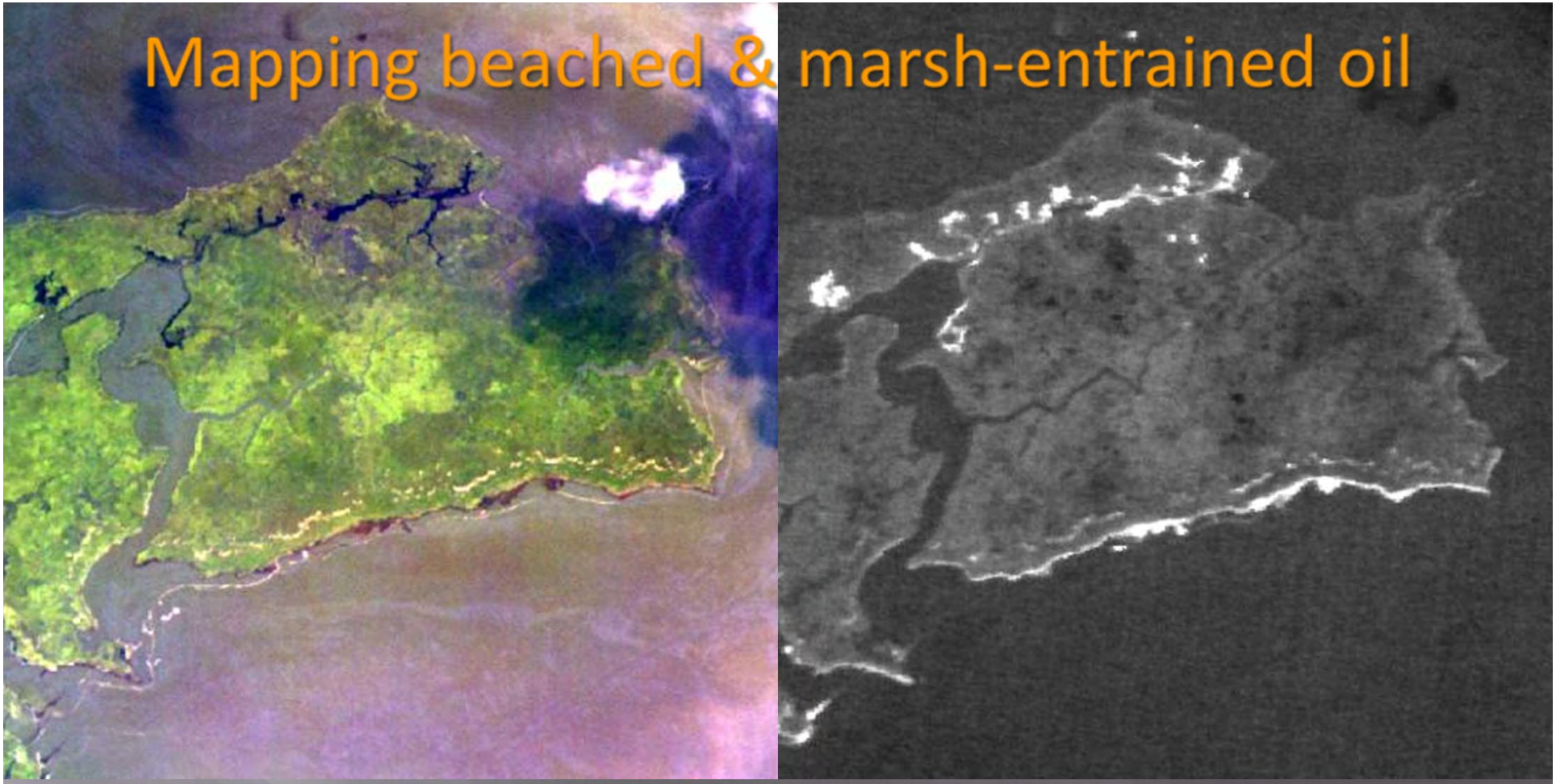
Dispersant Monitoring



Dispersant Monitoring



Typical oiling patterns in marsh habitat



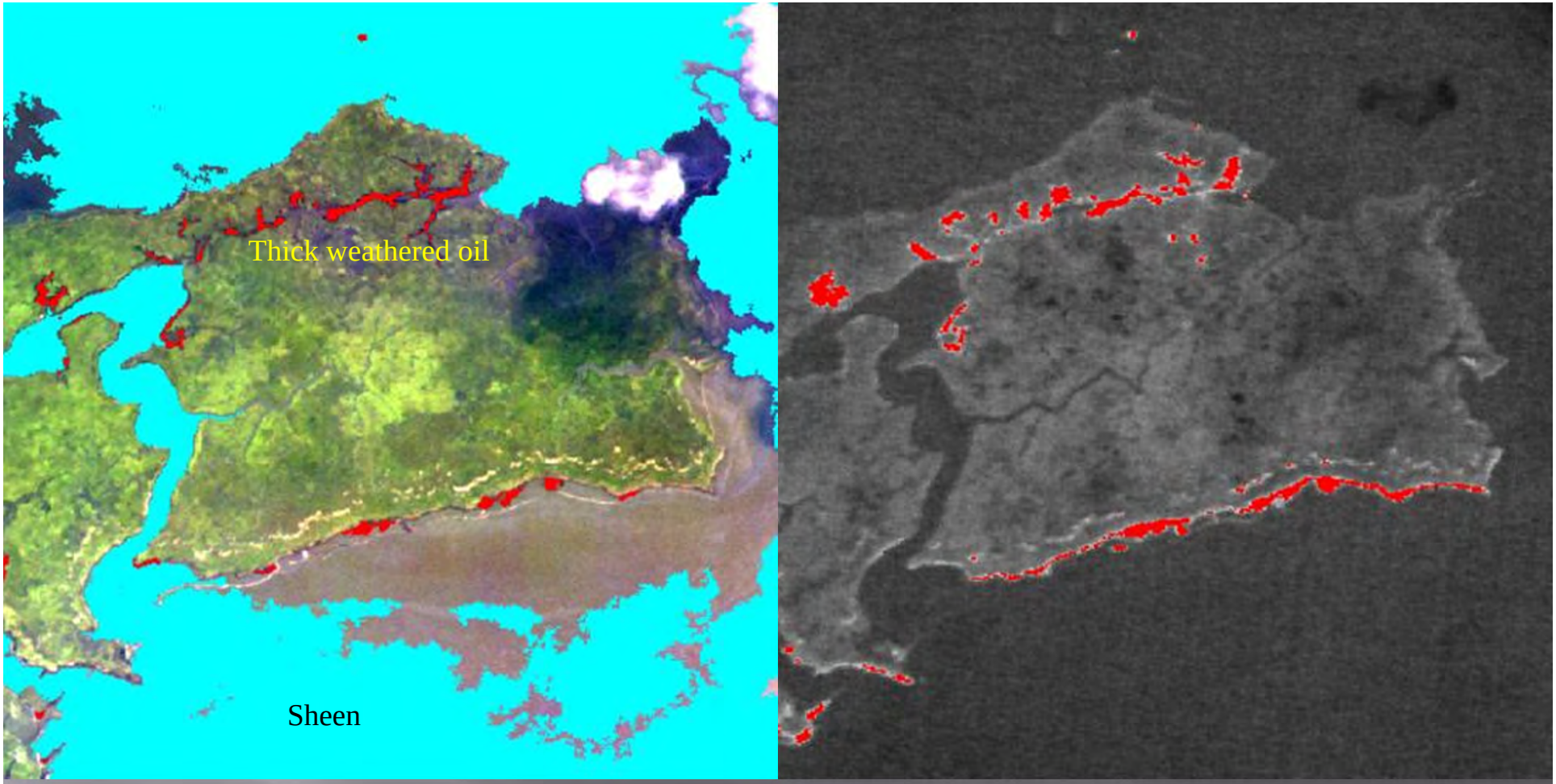
DMSC Multispectral Imagery

(4-band UV-Vis wavelength combo customized for oil detection)

Thermal IR Imagery

(thick oil areas re-emit high heat (white areas))

Barateria Bay – UV-Vis-IR



Final Classification

Thermal Classification

Barateria Bay

Field SCAT vs. Remote Sensing

Field SCAT vs. Remote Sensing

Field SCAT vs. Remote Sensing

Field SCAT vs. Remote Sensing


MC252 SCAT Photos
N 29° 51.204' W 089° 16.269'
07/08/2010 11:49:34 AM


MC252 SCAT Photos
N 29° 51.149' W 089° 16.261'
07/08/2010 11:50:23 AM


MC252 SCAT Photos
N 29° 51.123' W 089° 16.267'
07/08/2010 11:50:45 AM

Lessons Learned:

Advantages:

•Aerial image-derived oil analyses are useful for multiple response applications

•Especially useful for supporting SCAT field activities in hard-to-reach marsh areas

•Potential new aerial dispersant application monitoring method

Limitations:

•Daily spatial coverage is limited for very large spills

• Technology is still novel – not yet fully incorporated in specific response protocols

Peer Reviewed Paper, October 2012 Edition: Photogrammetric Engineering and Remote Sensing

APPLICATIONS PAPER

Operational Utilization of Aerial Multispectral Remote Sensing during Oil Spill Response: Lessons Learned During the Deepwater Horizon (MC-252) Spill

Jan Svejkovsky, William Lehr, Judd Muskat, George Graettinger, and Joseph Mullin

Abstract

A rapidly deployable aerial multispectral sensor utilizing four channels in the visible-near-IR and one channel in the thermal IR was developed along with processing software to identify oil-on-water and map its spatial extents and thickness distribution patterns. Following validation over natural oil seeps and at Bureau of Safety and Environmental Enforcement's (BSEE's) Ohmsett test tank, the system was utilized operationally on a near daily basis for three

activities. Just as importantly, oil thickness distributions are beneficial for proper choice of response methods and spatial allocation of response resources. However, accurate oil film thickness/volume estimation remains a difficult challenge (Lehr, 2010; Brown *et al.*, 2005).

The major remote sensing technique for oil spills is visual observations and recordings by a trained observer. Various formulas have been built to link slick appearance with spill thickness. The earliest reported system in the

Thank You

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