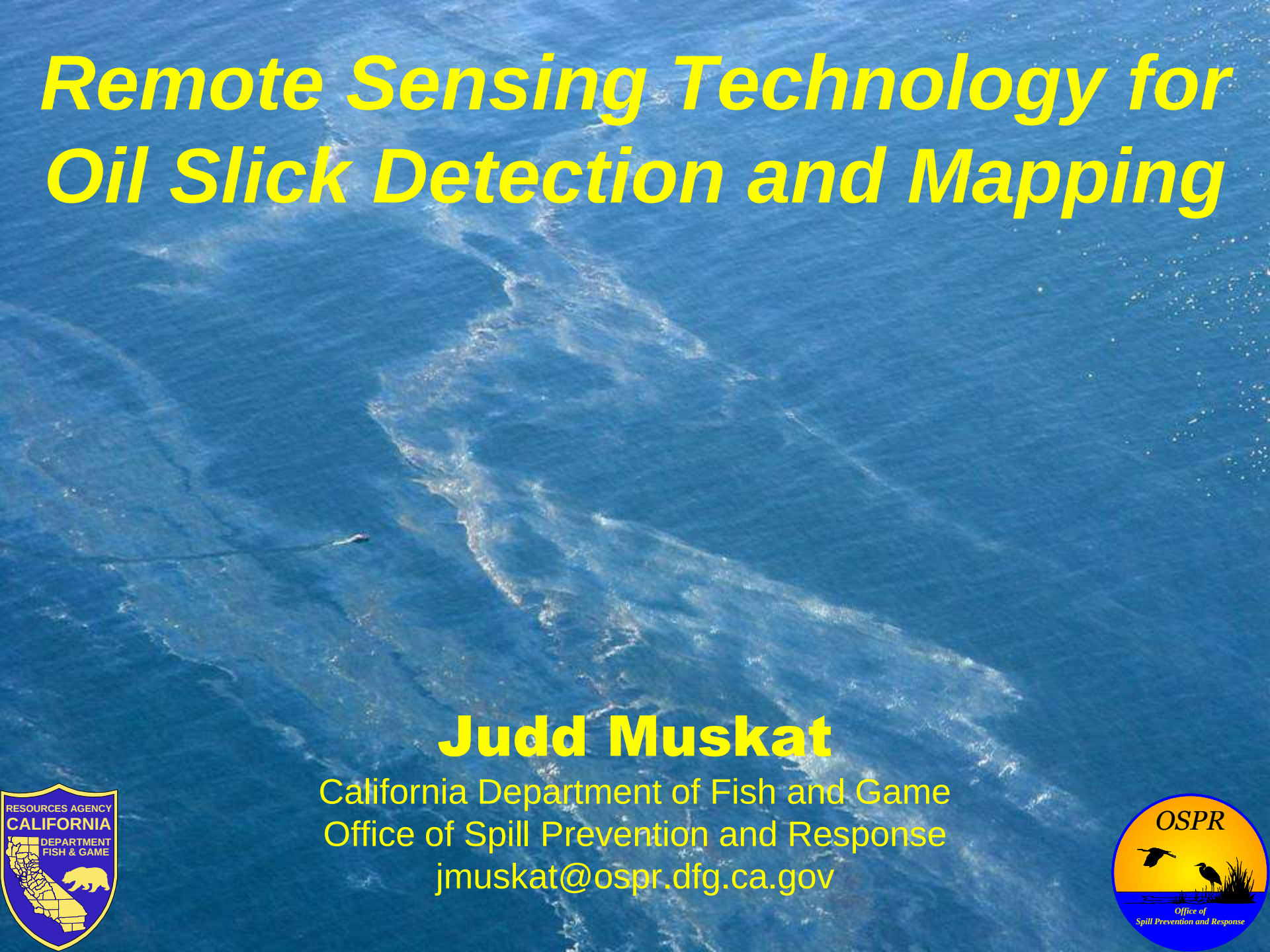
Remote Sensing Technology for Oil Slick Detection and Mapping



Judd Muskat

California Department of Fish and Game
Office of Spill Prevention and Response
jmuskat@ospr.dfg.ca.gov

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”

RESOURCES AGENCY
CALIFORNIA
DEPARTMENT
FISH & GAME

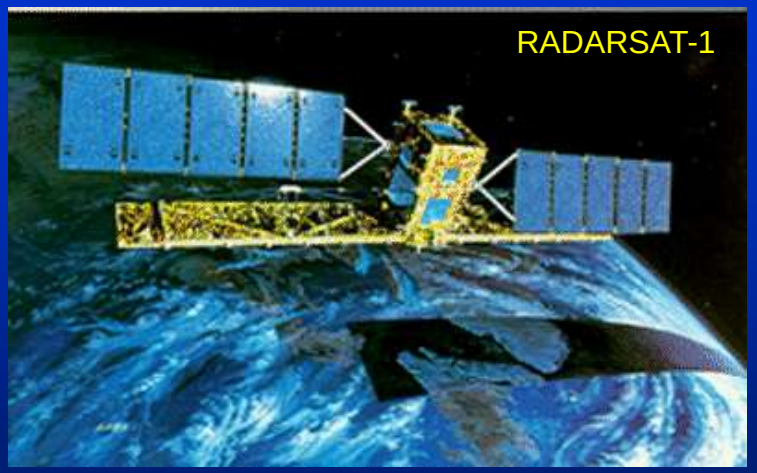
OSPR
Office of
Spill Prevention and Response

"Best Achievable Technology"

- GIS (Data Collection, Data Management, Data Analysis and Map Production)
- **Remote Sensing**
  - **Satellite Imaging RADAR**
  - **Airborne Multispectral, Thermal**
- HF Radar (CODAR) Ground Based, Non-Imaging
- **Web-Based GIS Spill Response Data Dissemenation (Real-Time)**

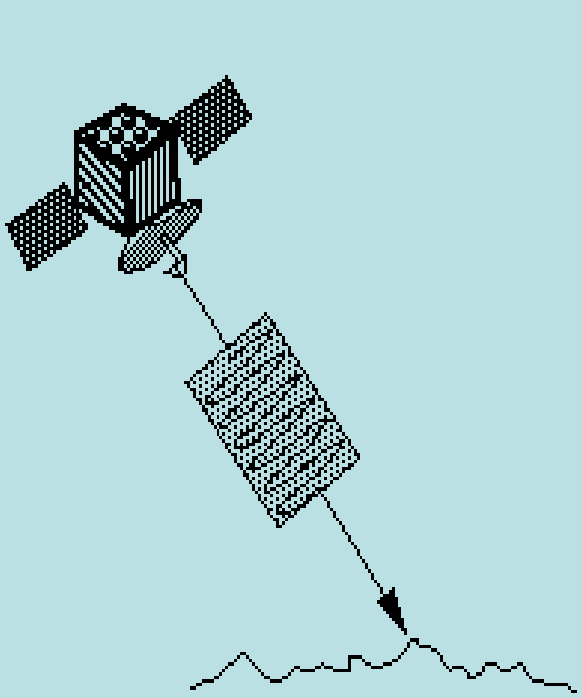
Satellite RADAR Marine Monitoring

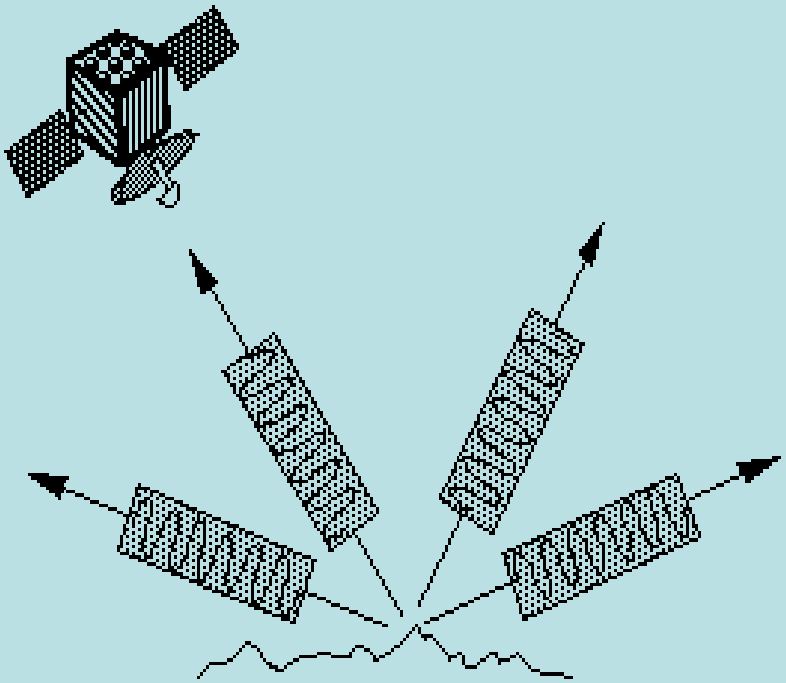
- 1978, Seasat satellite carried the first civilian synthetic aperture radar into space showed the ability to detect oil in the marine environment (Santa Barbara Channel natural seeps)
- Current Marine Surveillance projects or programs in place in Canada, Europe (North Sea Pollution Bonn Agreement, 1983), Mexico, Brazil, Japan, Australia, Indonesia and Nigeria
- In USA, California project only



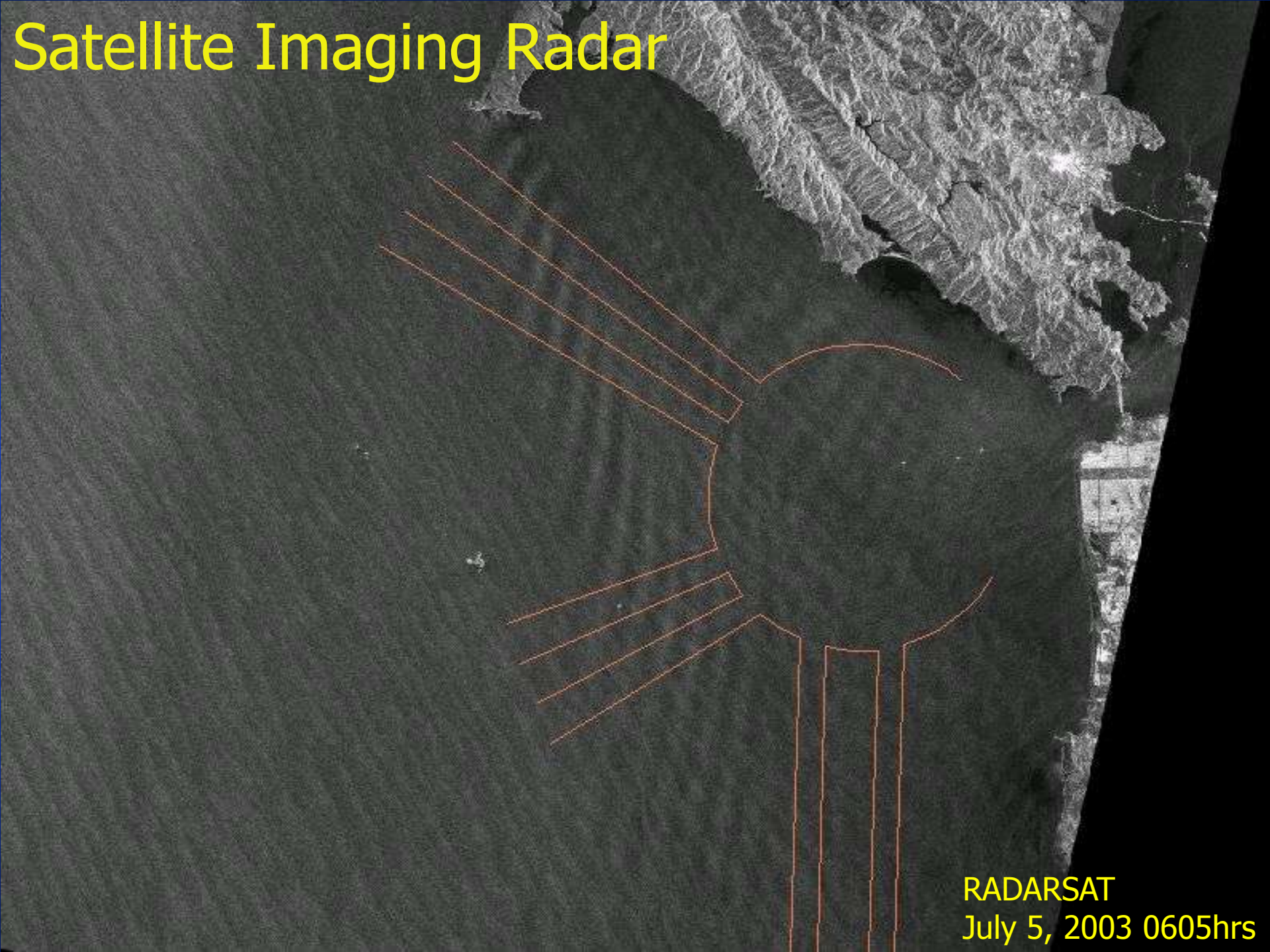
How Does Imaging Radar Work?

Satellite Transmits a Microwave Pulse and Measures the Reflected Echo (Backscatter)

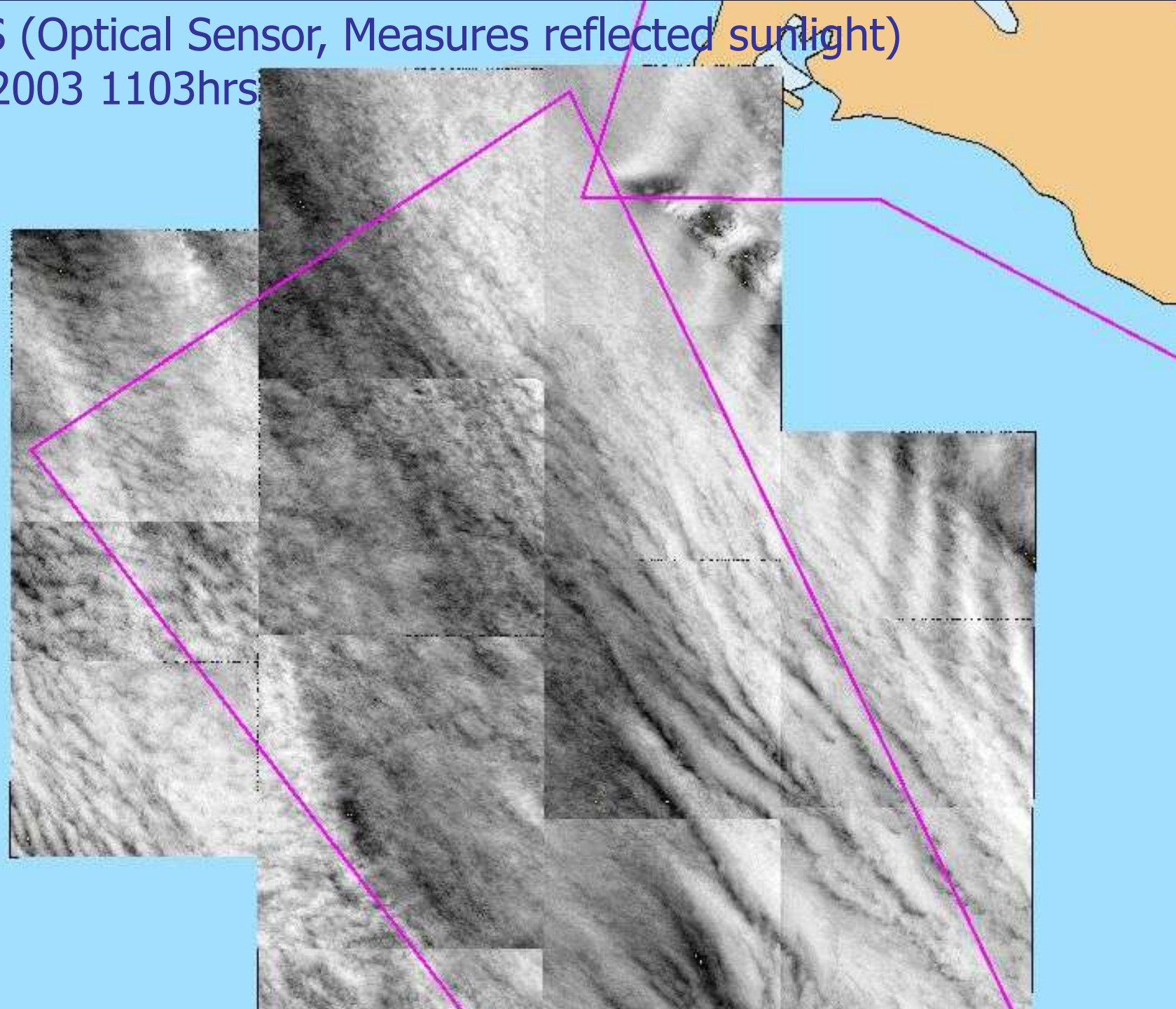




Satellite Imaging Radar



IKONOS (Optical Sensor, Measures reflected sunlight)
July 5, 2003 1103hrs



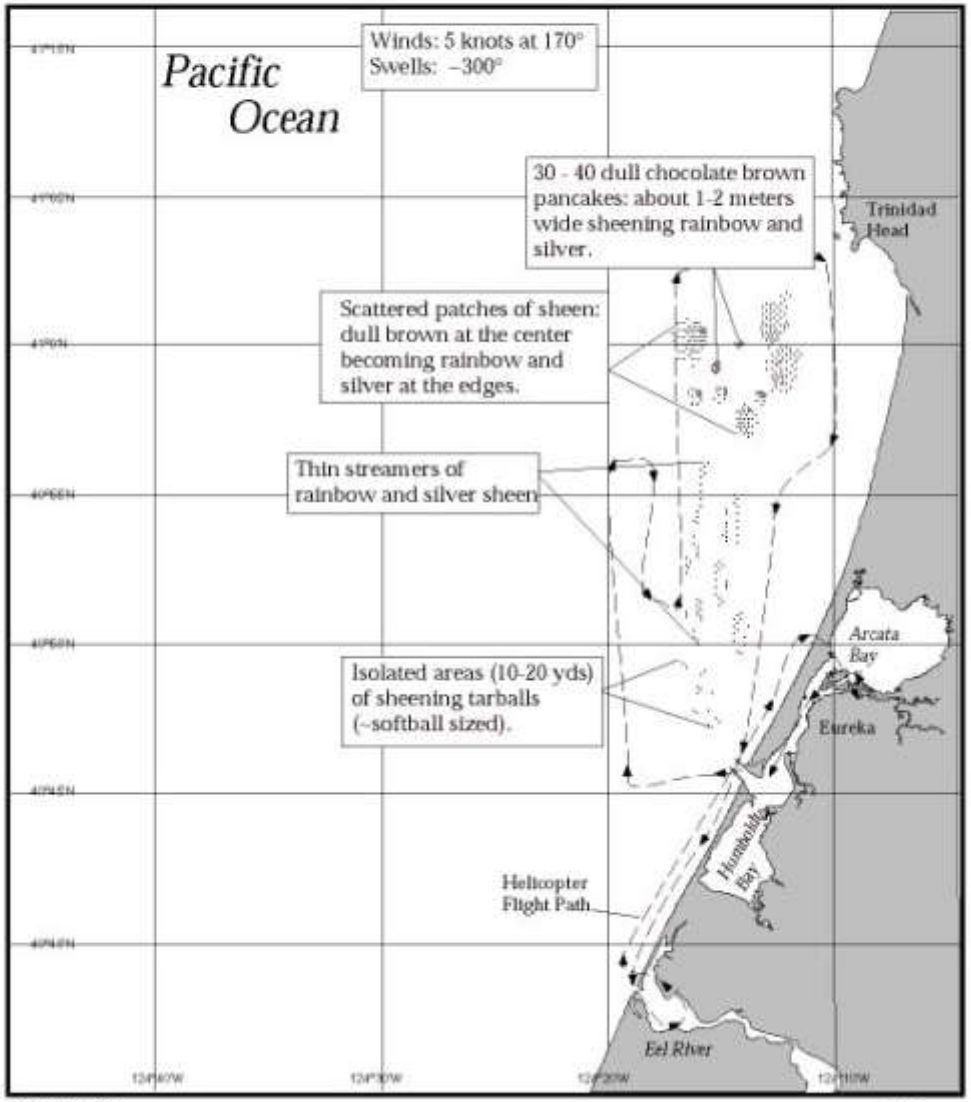
M/V Stuyvesant Incident

Overflight Map
prepared by NOAA

Date/Time: 08 SEP 99, 1200-1330
Platform: H-65
Observers: ParkerHall (NOAA), McCleneghan (OSPR)

USE ONLY AS A GENERAL REFERENCE

Graphic does not represent precise amounts or locations of oil



990908.1200

GSS

Radarsat 1 Image
SCANSAR Wide Mode
9/8/99 (1830hrs PST)

Areas of reduced Radar backscatter which correspond to over flight observations of oil on water

Arcata Bay

Humboldt Bay

MV Stuyvesant - 1999

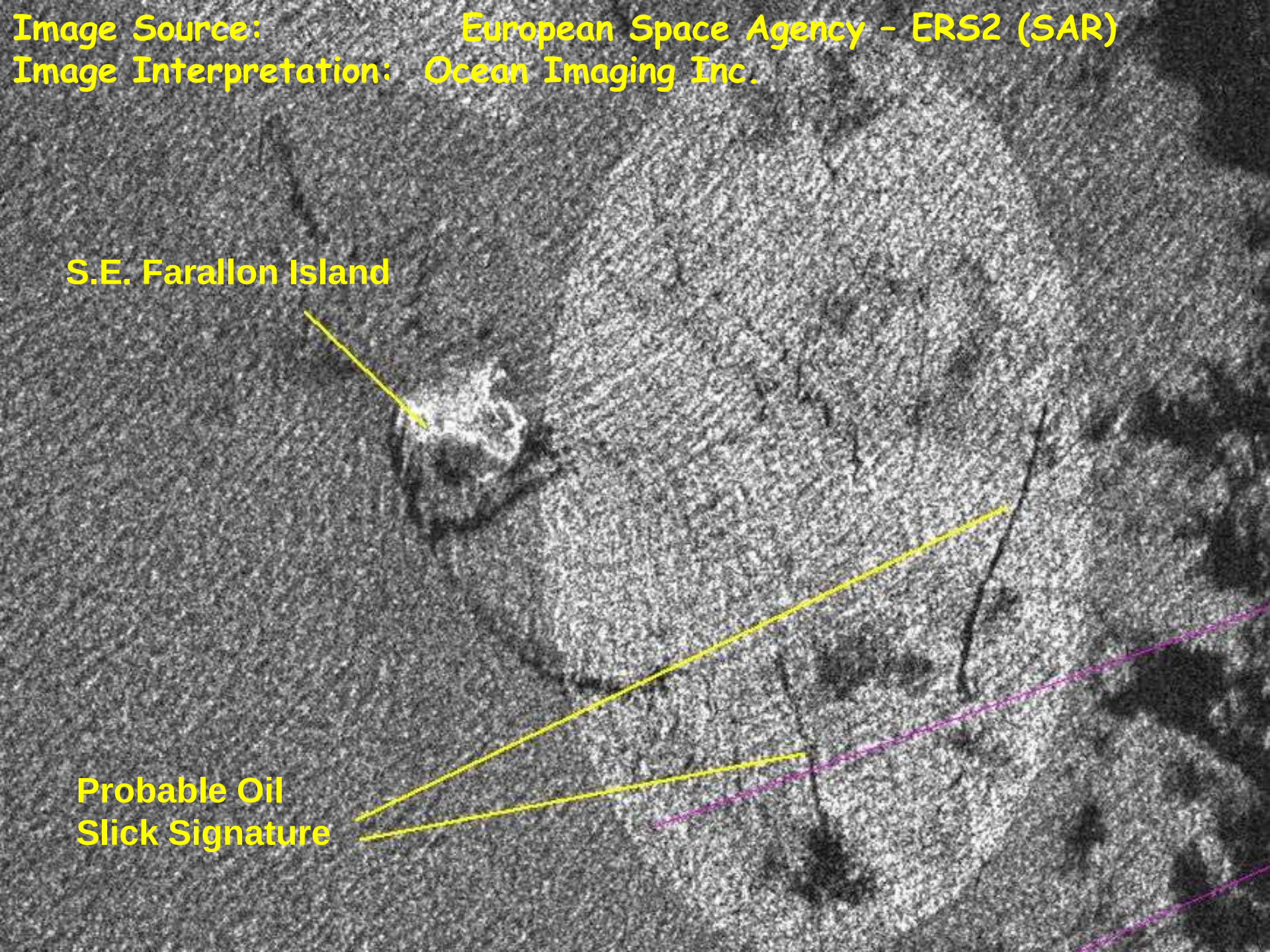
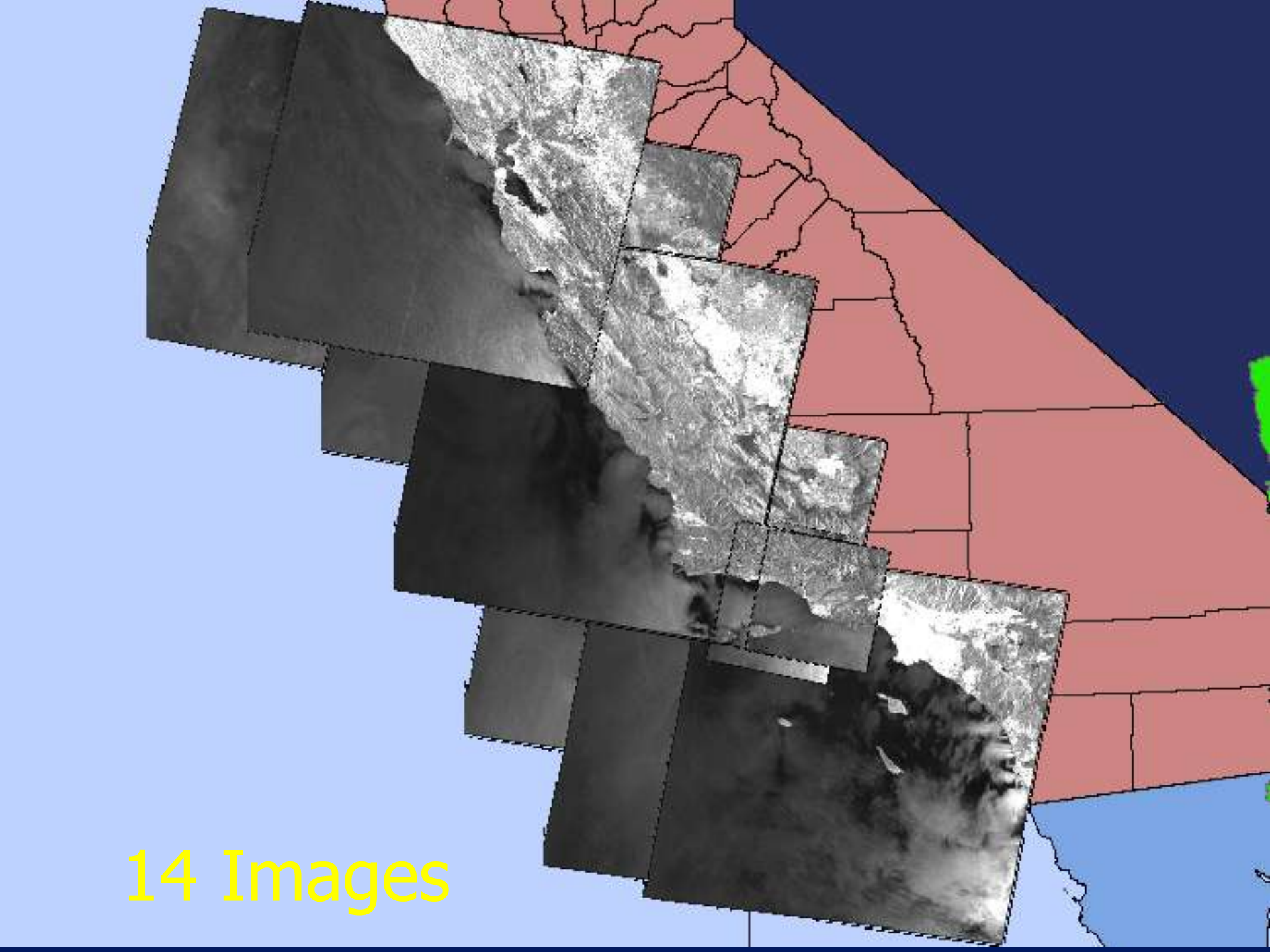
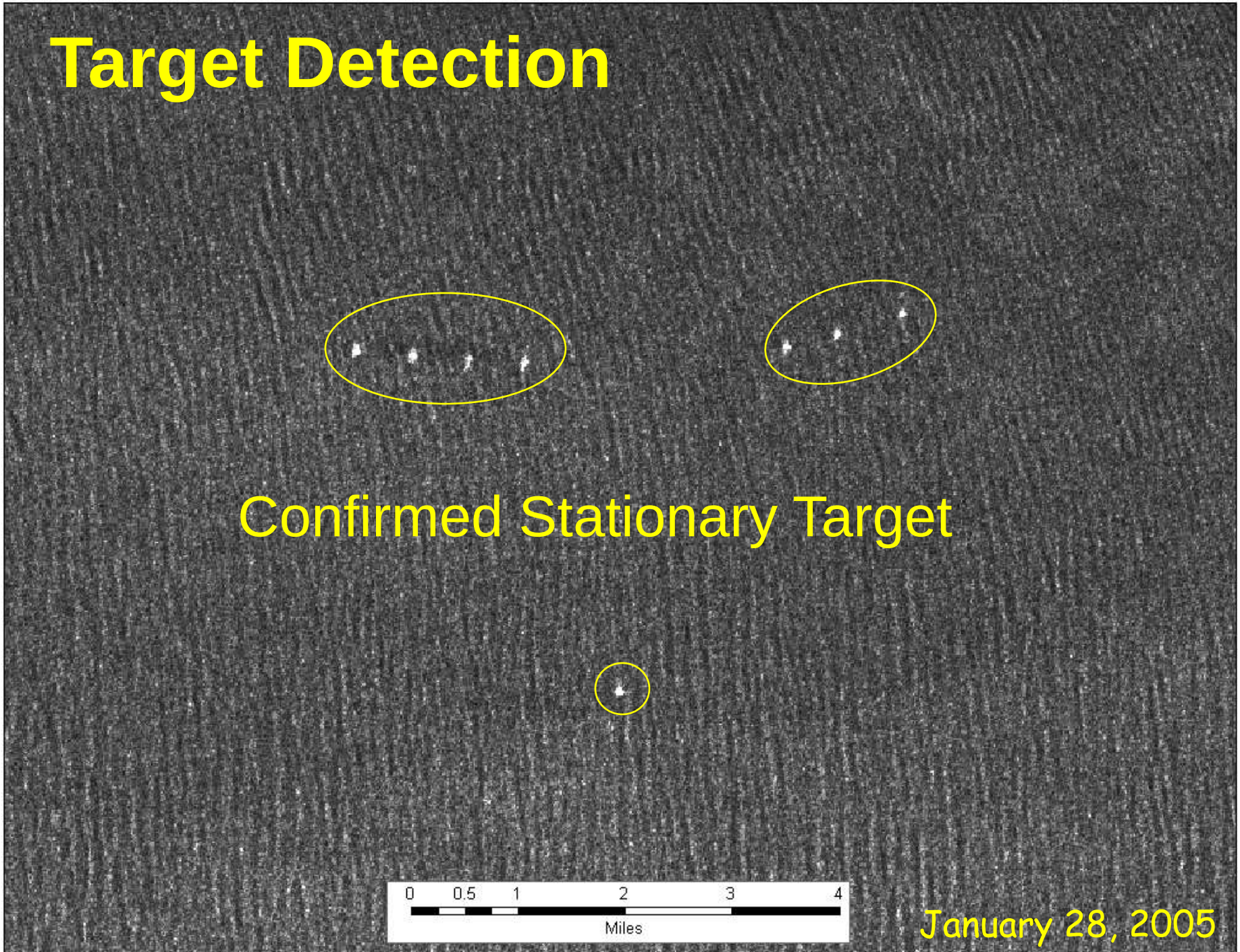


Image Source: European Space Agency - ERS2 (SAR)
Image Interpretation: Ocean Imaging Inc.
S.E. Farallon Island
Probable Oil
Slick Signature

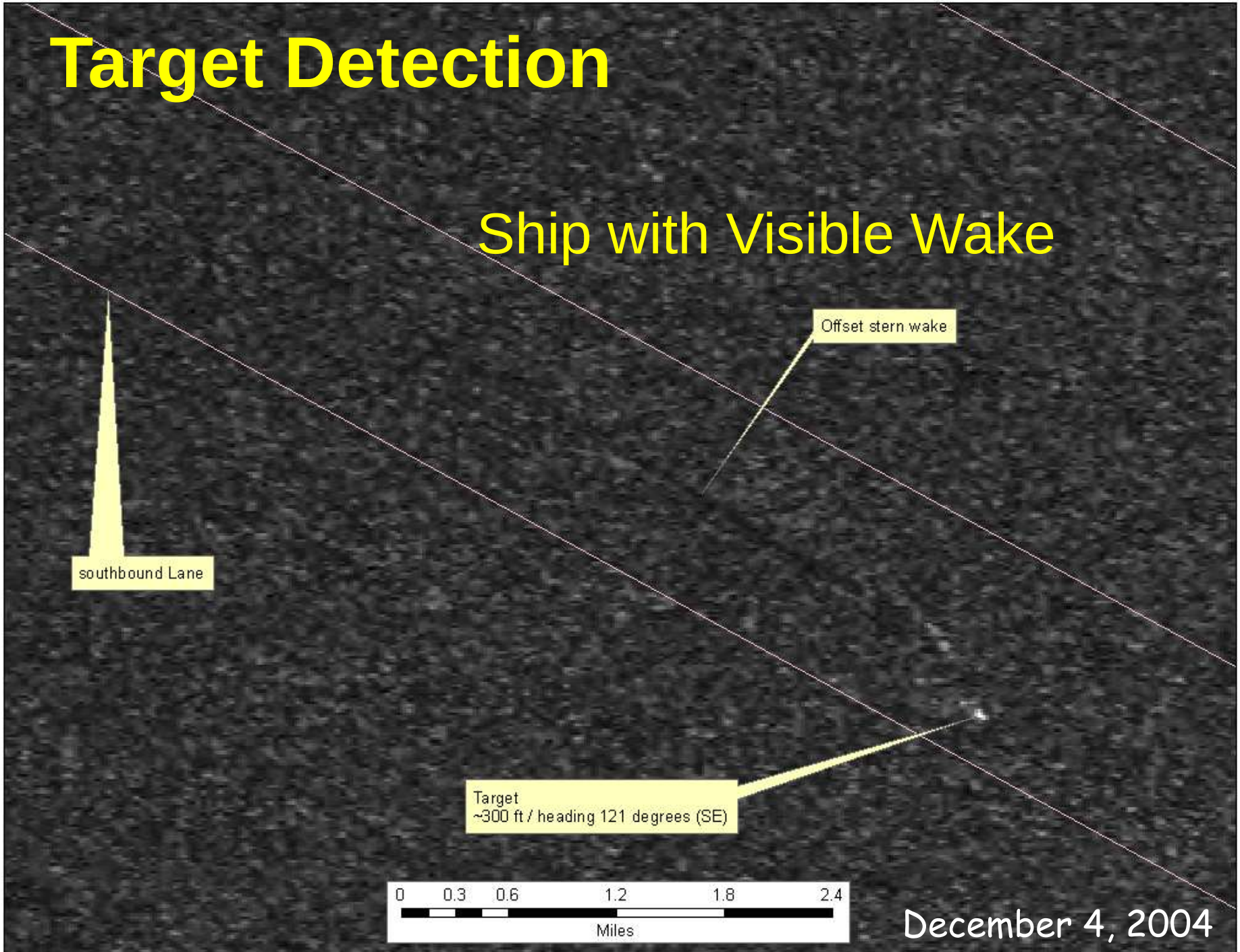

14 Images

Target Detection

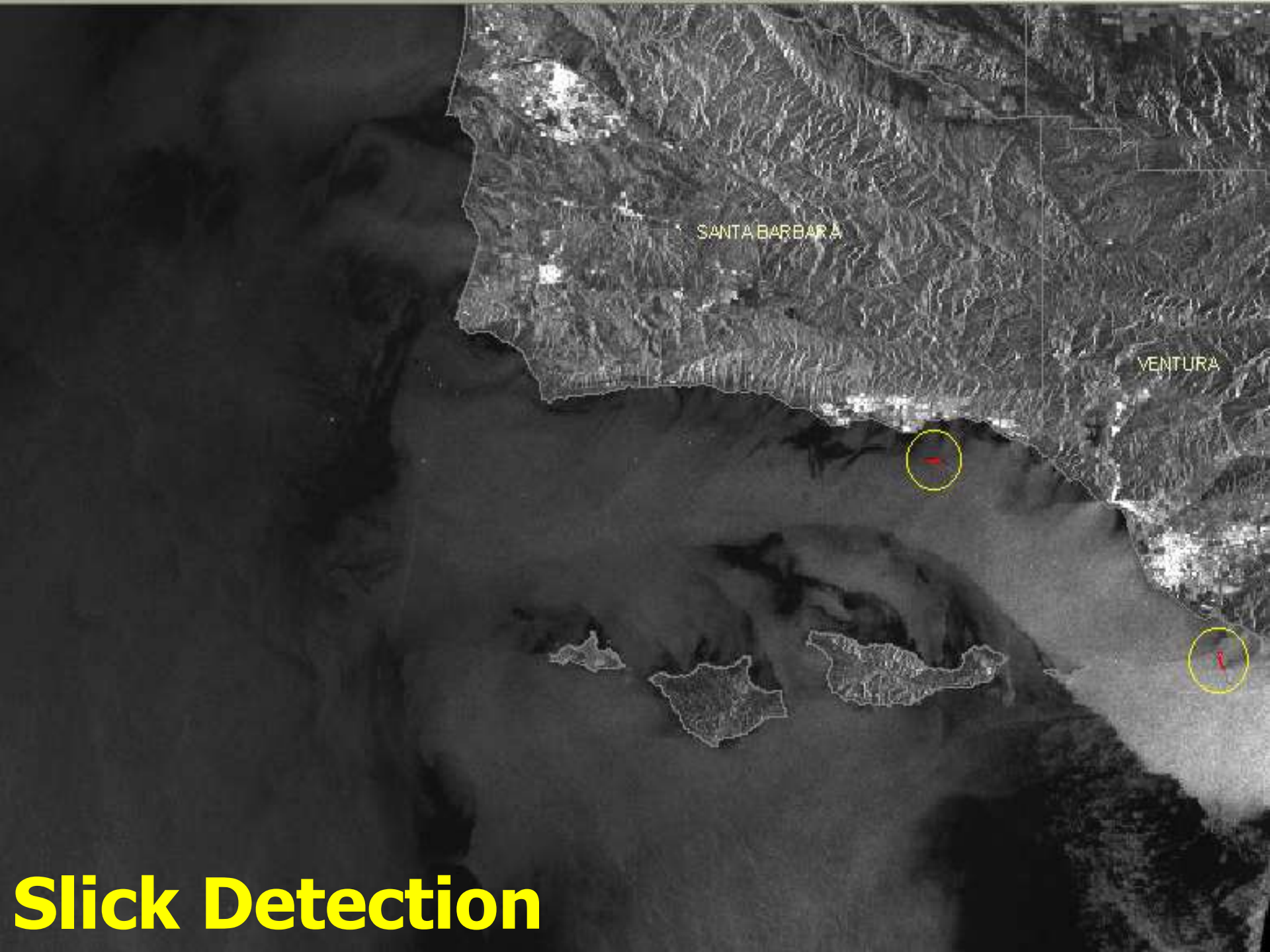


Target Detection

Ship with Visible Wake

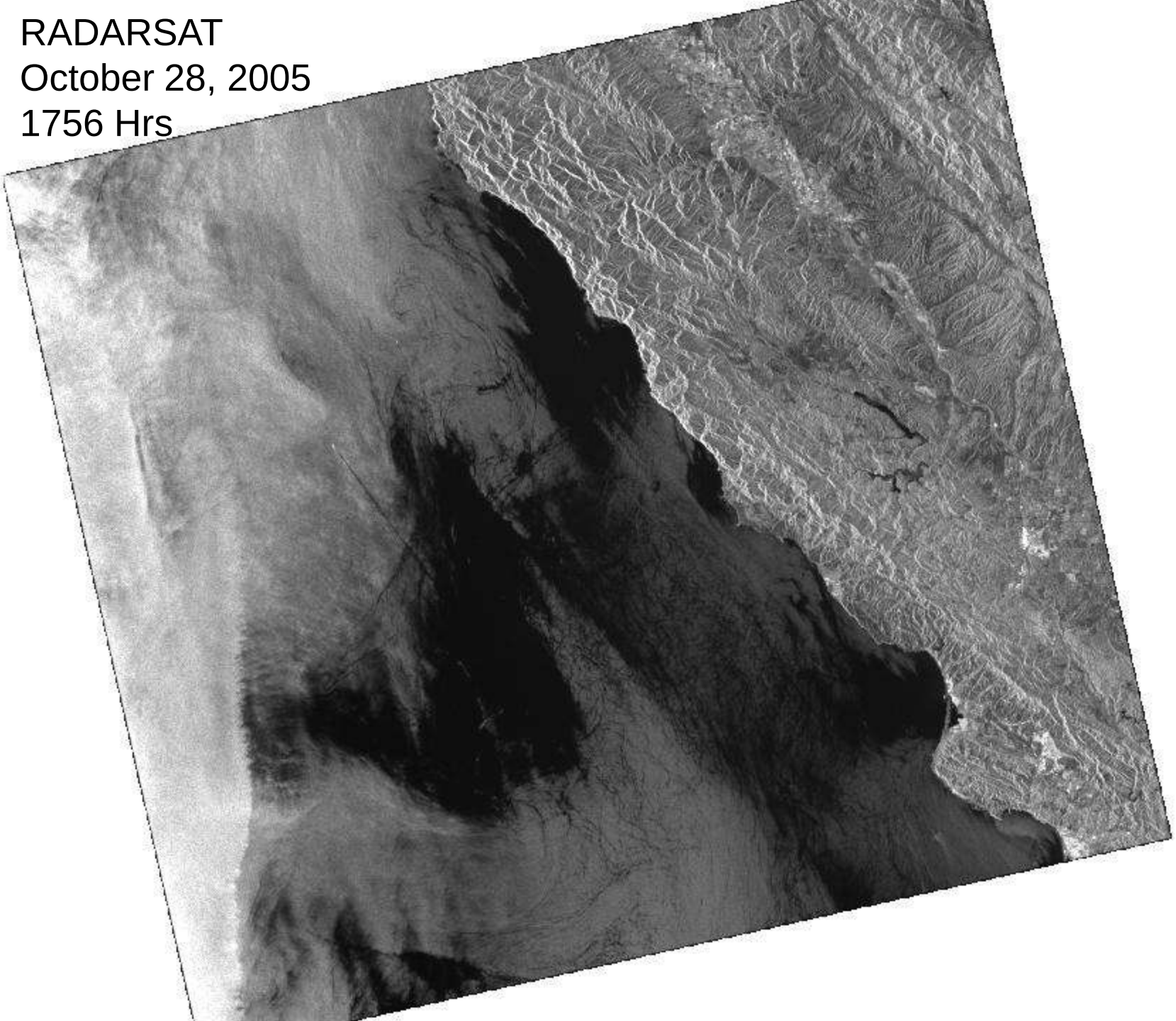


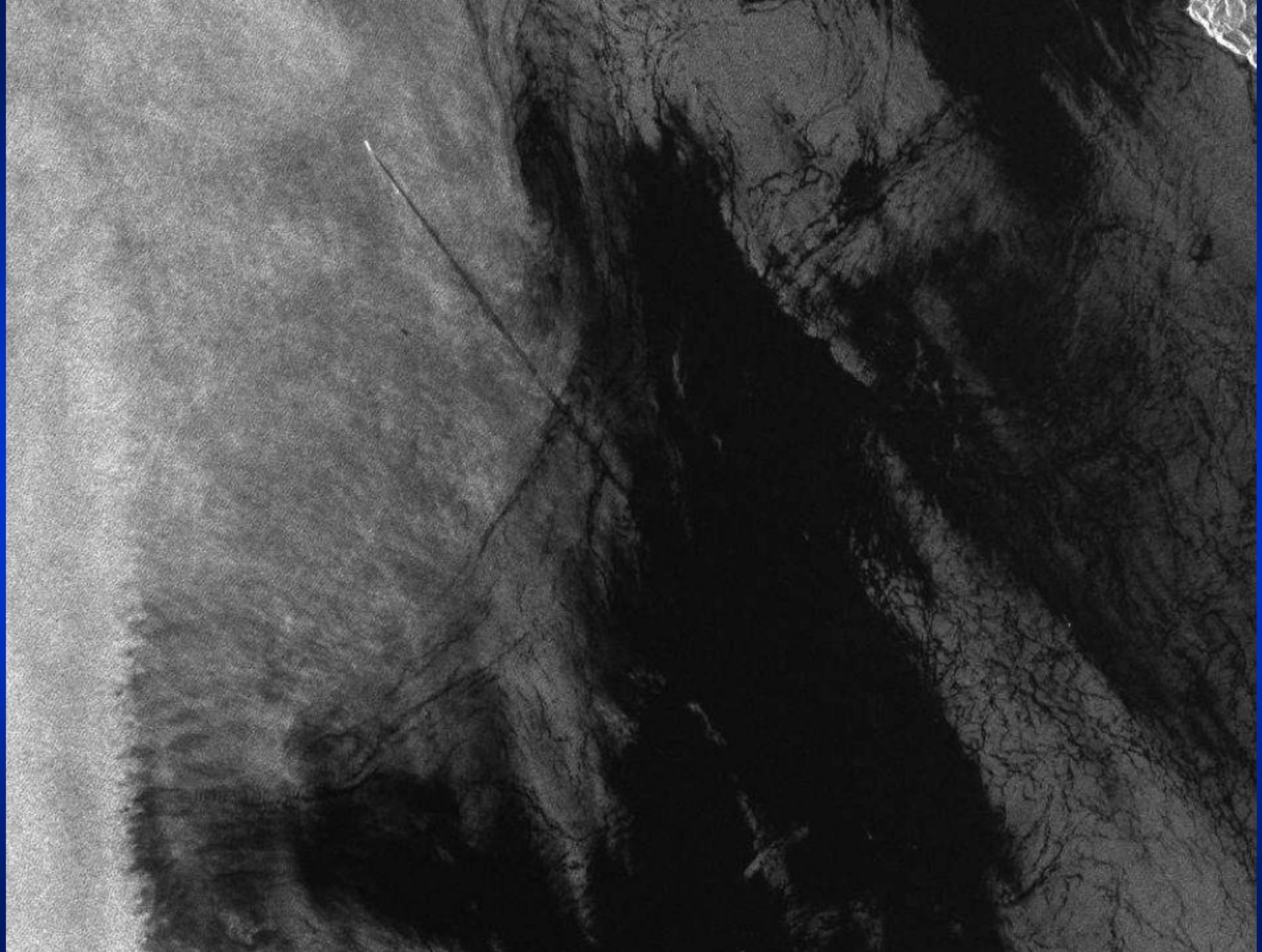
December 4, 2004

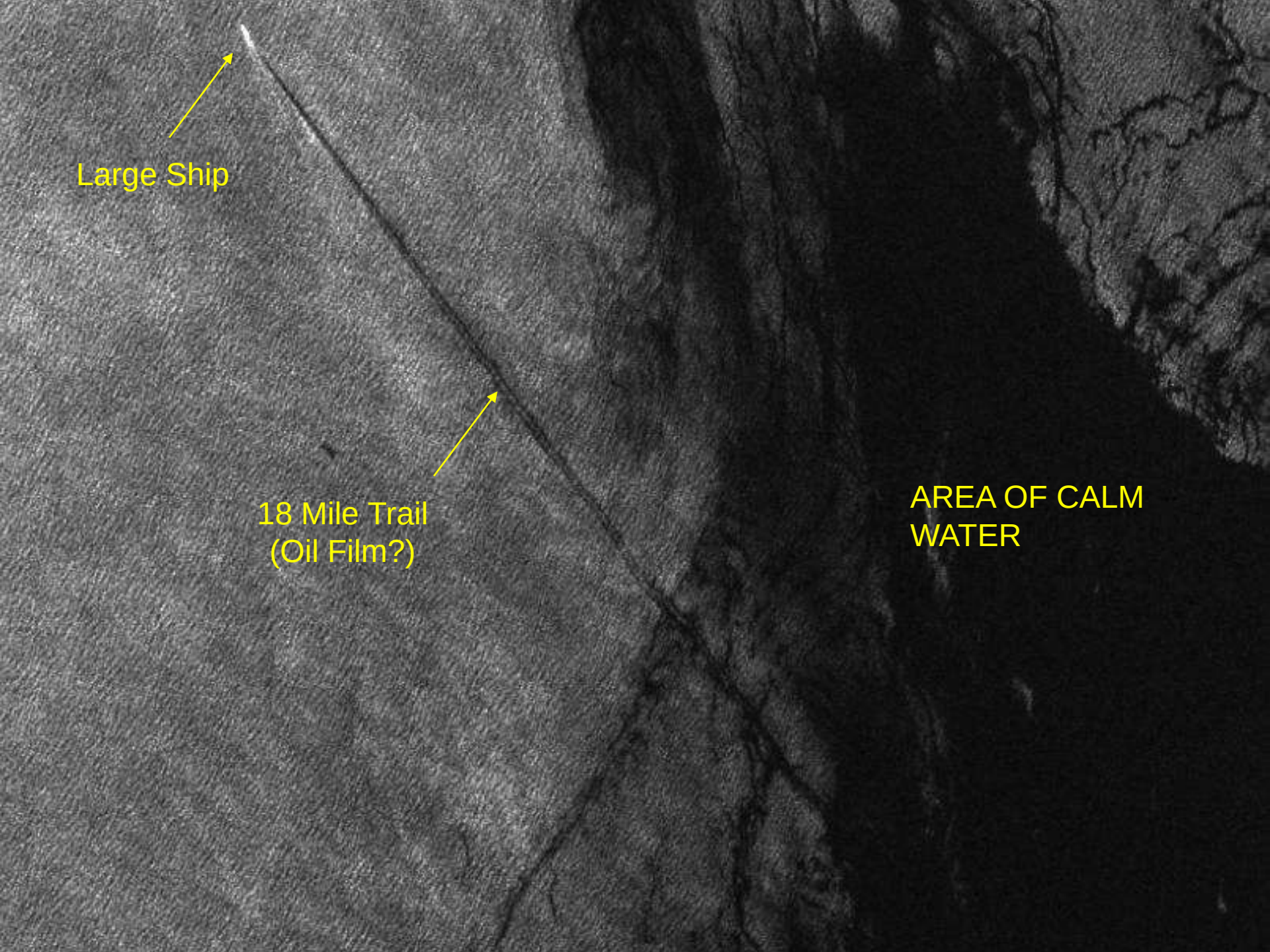


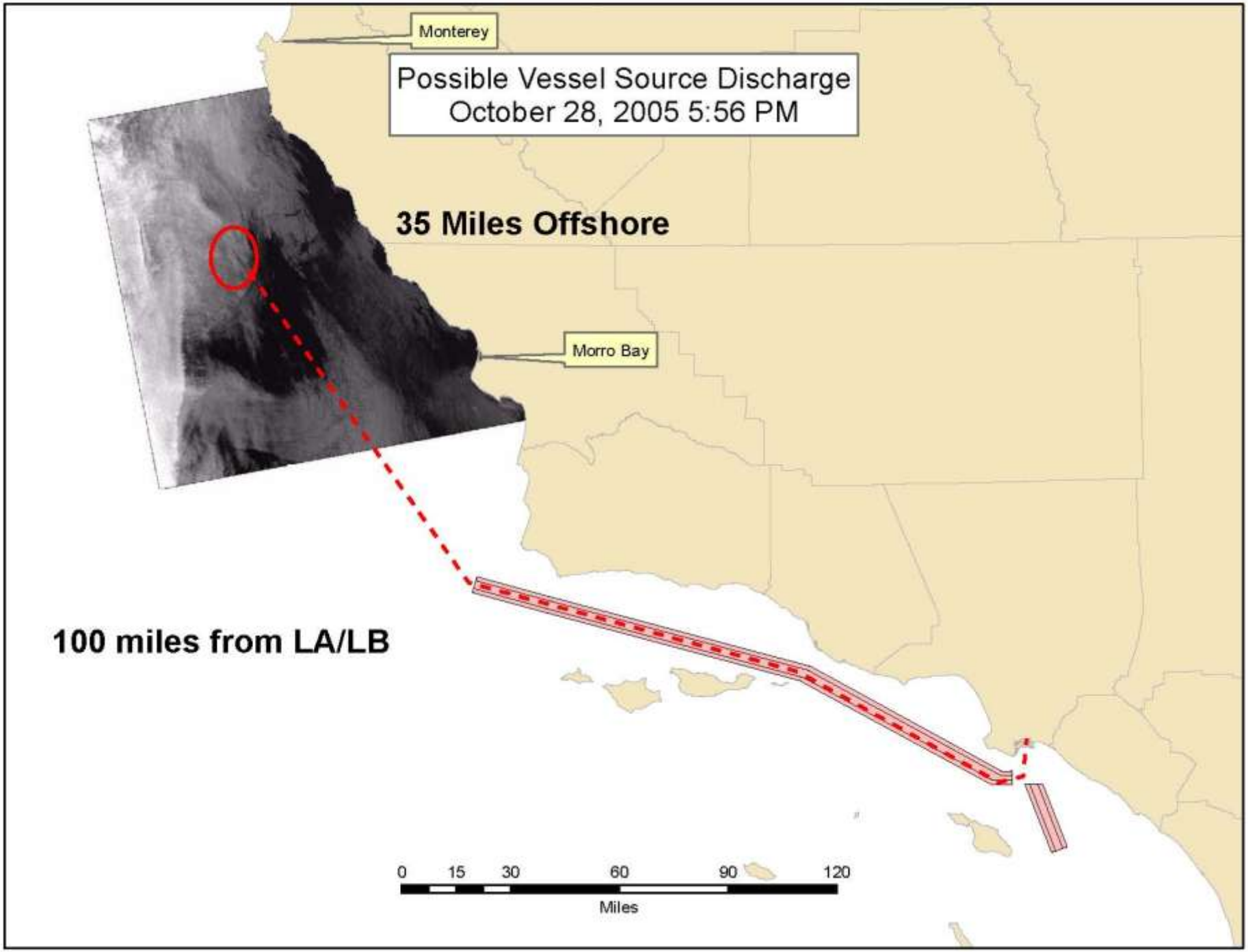
Slick Detection

RADARSAT
October 28, 2005
1756 Hrs






Large Ship
18 Mile Trail
(Oil Film?)
AREA OF CALM
WATER


Monterey
Possible Vessel Source Discharge
October 28, 2005 5:56 PM
35 Miles Offshore
Morro Bay
100 miles from LA/LB
0
15
30
60
90
120
Miles

Satellite SAR Imagery

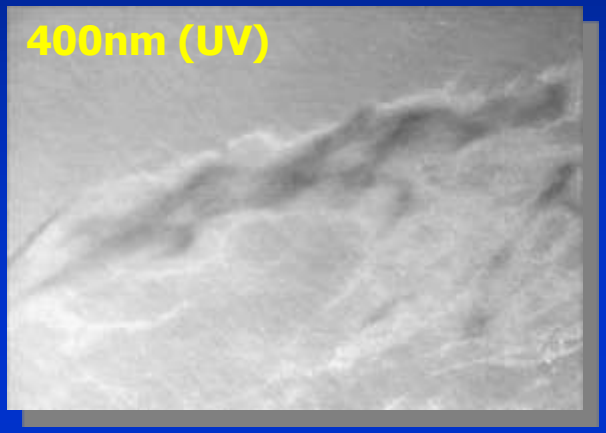
- Active Sensor – Provides Own Energy Source
- Independent of Time of Day or Cloud Cover
- Image is Generated from Surface Roughness Information
- Oil Film Suppresses Surface Capillary Waves Will Appear Black on the RADAR Image
- Requires Surface Winds 7-25 mph, Below all Smooth, Above Waves Too Large
- False Positives, Kelp, Natural Biogenic Surfactants, Wind Shadow can Mimic Oil
- $ Expensive $

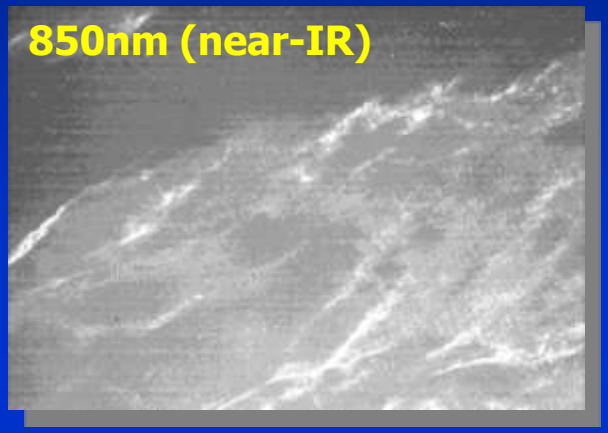
OSPR Airborne Remote Sensing Research

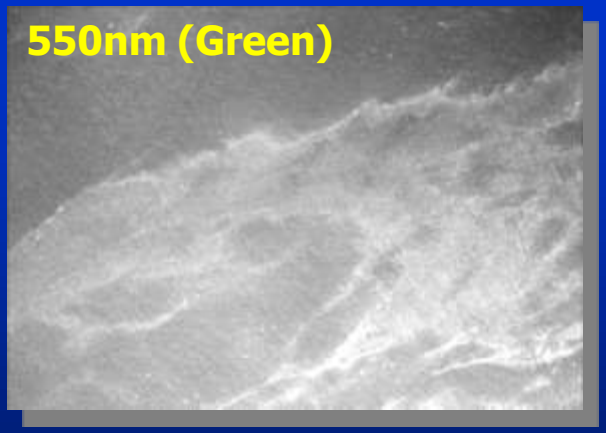
PROJECT OBJECTIVE: DEVELOP AN OPERATIONAL AERIAL IMAGING TECHNOLOGY THAT WOULD ENABLE REAL-TIME OIL SPILL MAPPING IN GIS FORMAT, ELIMINATE FALSE TARGETS, WITH AN EASILY DEPLOYABLE AND PORTABLE SENSOR

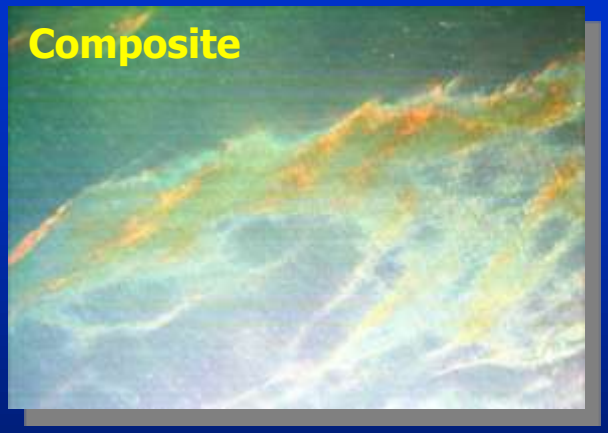
Ocean Imaging's DMSC-MK2 Four Channel Aerial Sensor

Oil on Water Detection

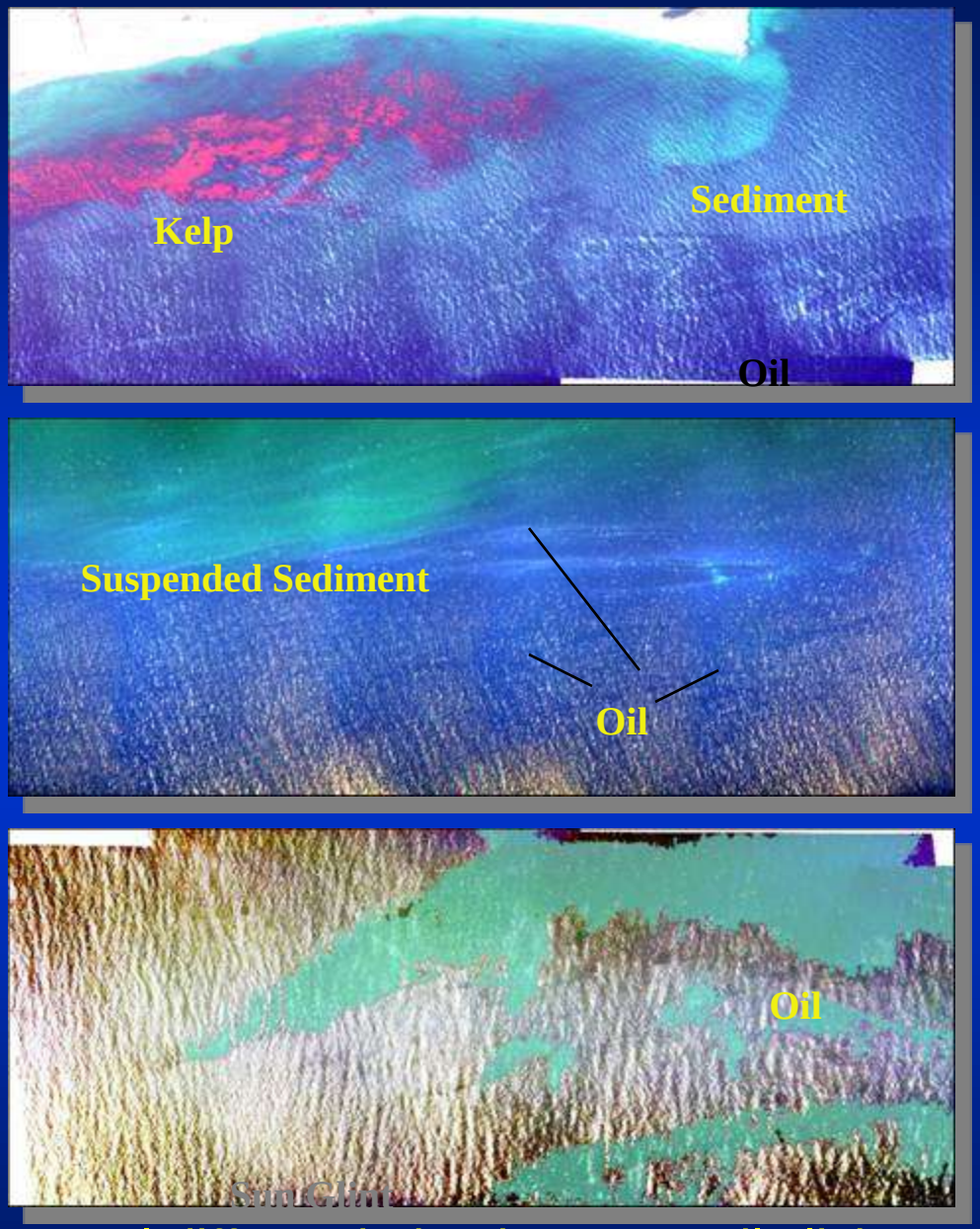








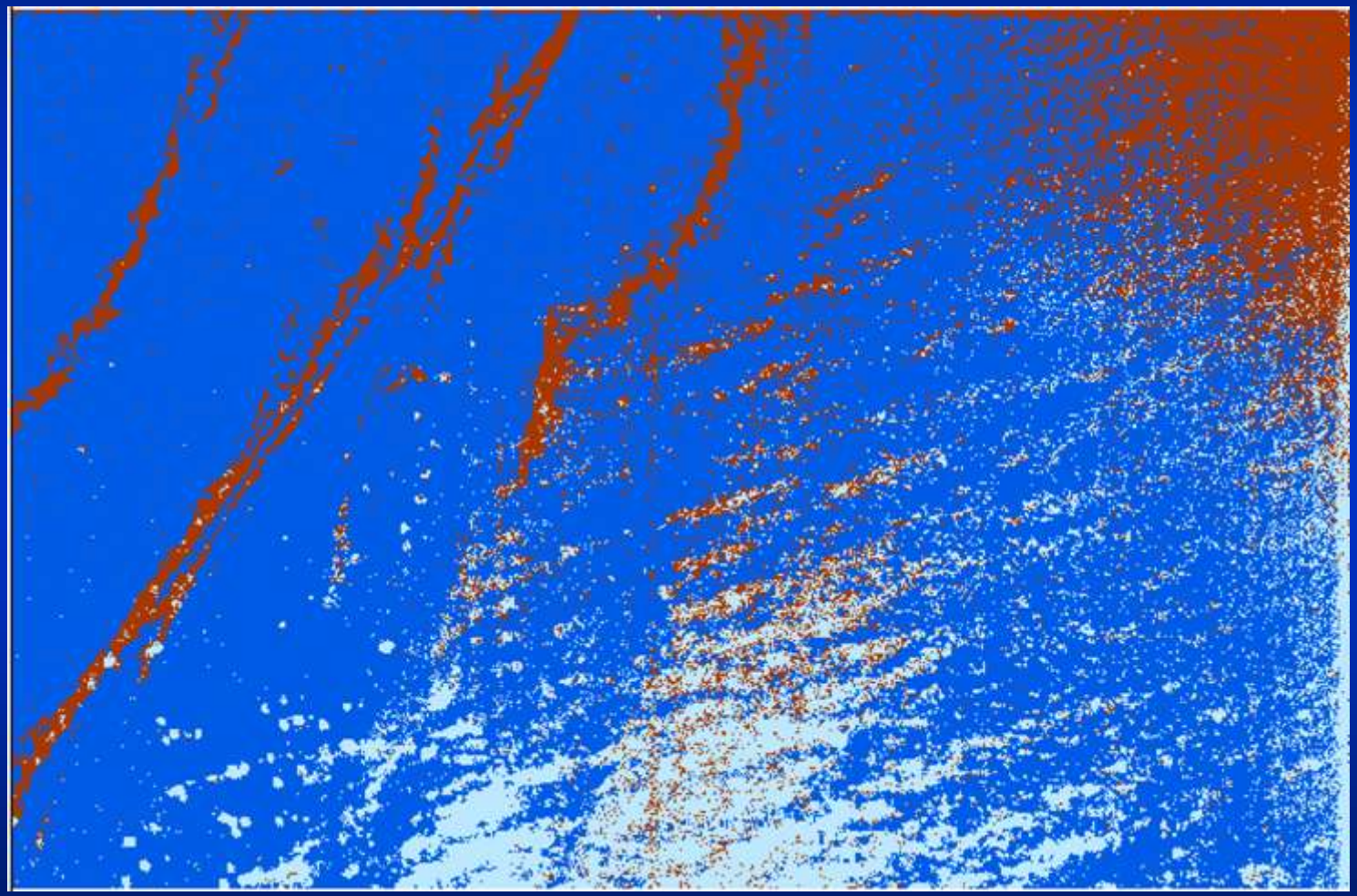
Two test flights over Santa Barbara Channel seeps were conducted in mid-2004



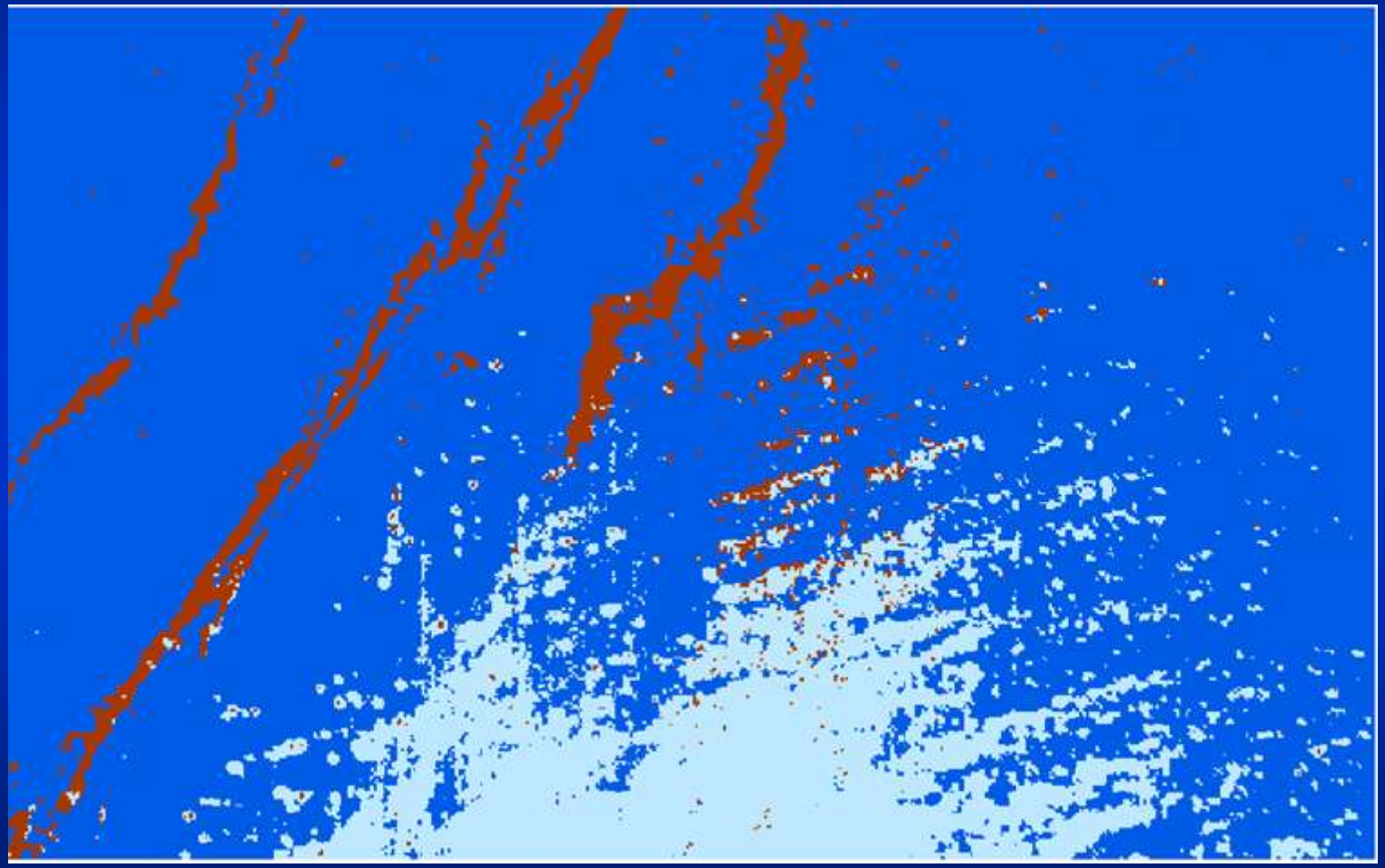
Examples of multispectral differentiation between oil slicks and potential false targets caused by kelp, suspended sediment and sun glint

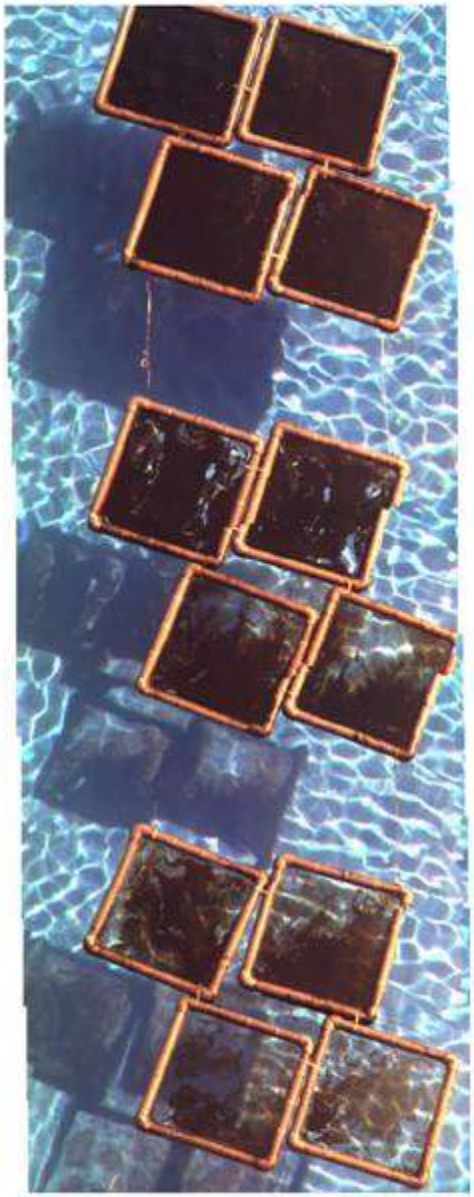
Composite Image

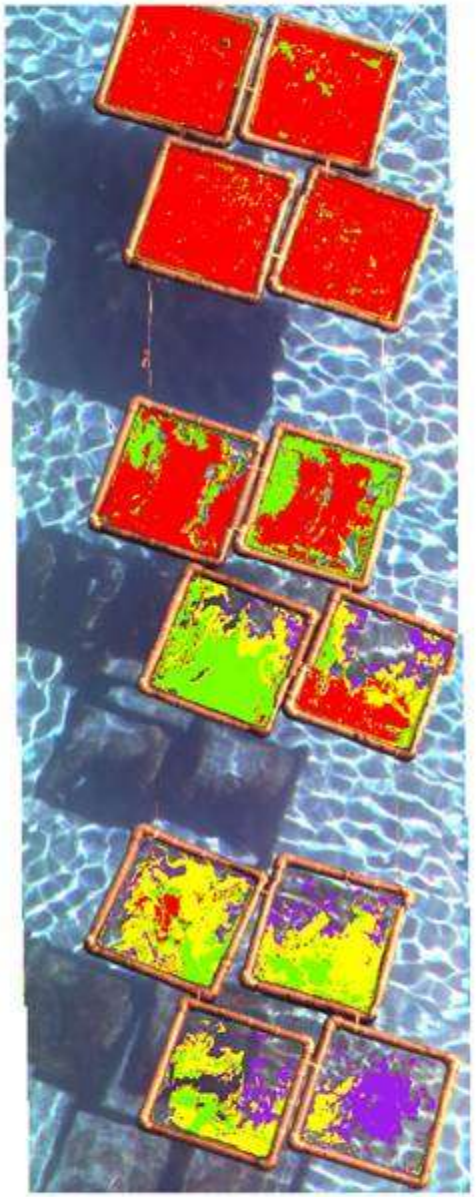
Initial Processing



Neural Result

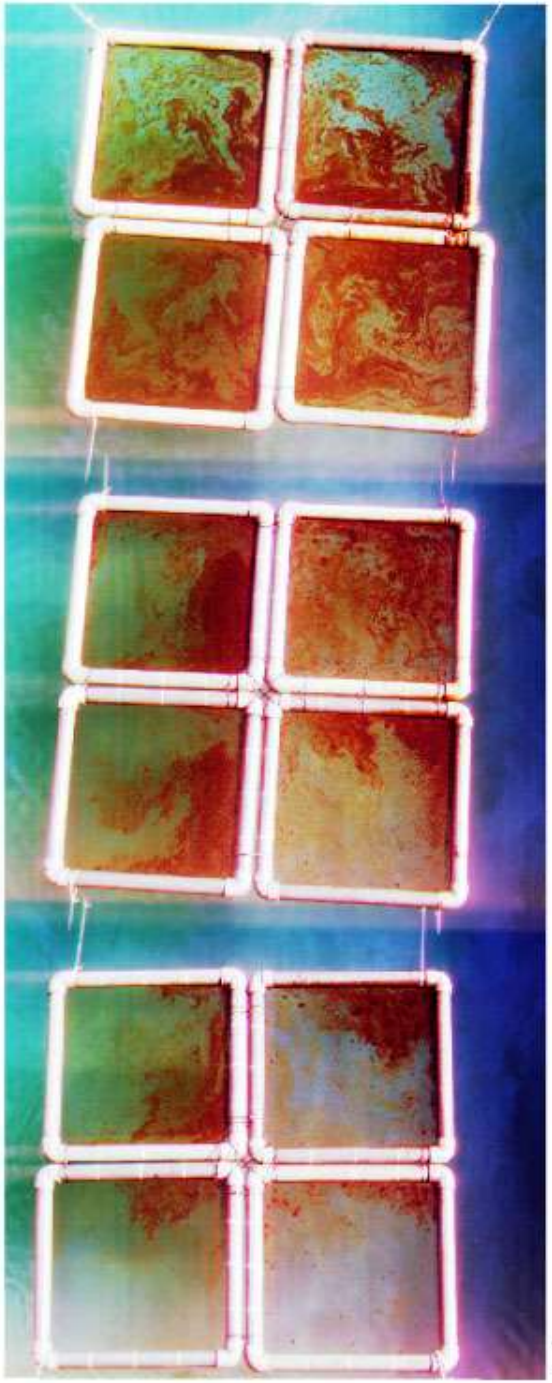






Ohmsett - 05/18/06

- Thinnest ~ 0.01 - 0.05 mm
- Thin ~ 0.05 - 0.20 mm
- Medium ~ 0.20 - 0.40 mm
- Thickness ~ > 0.40mm



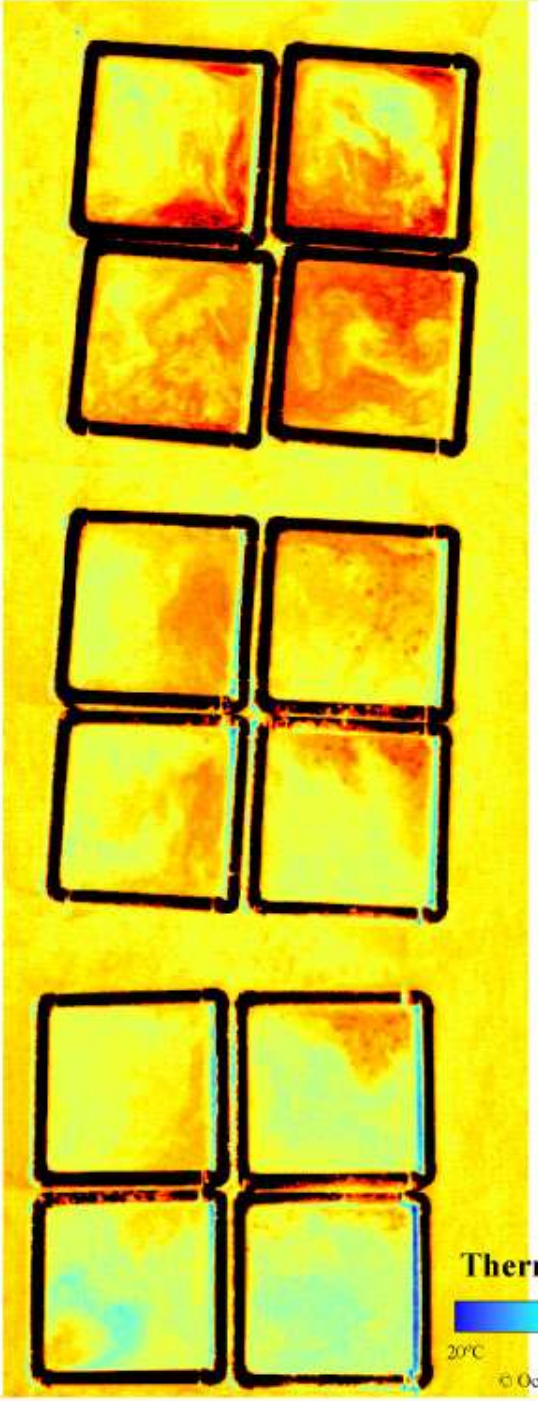
DMSC Imagery

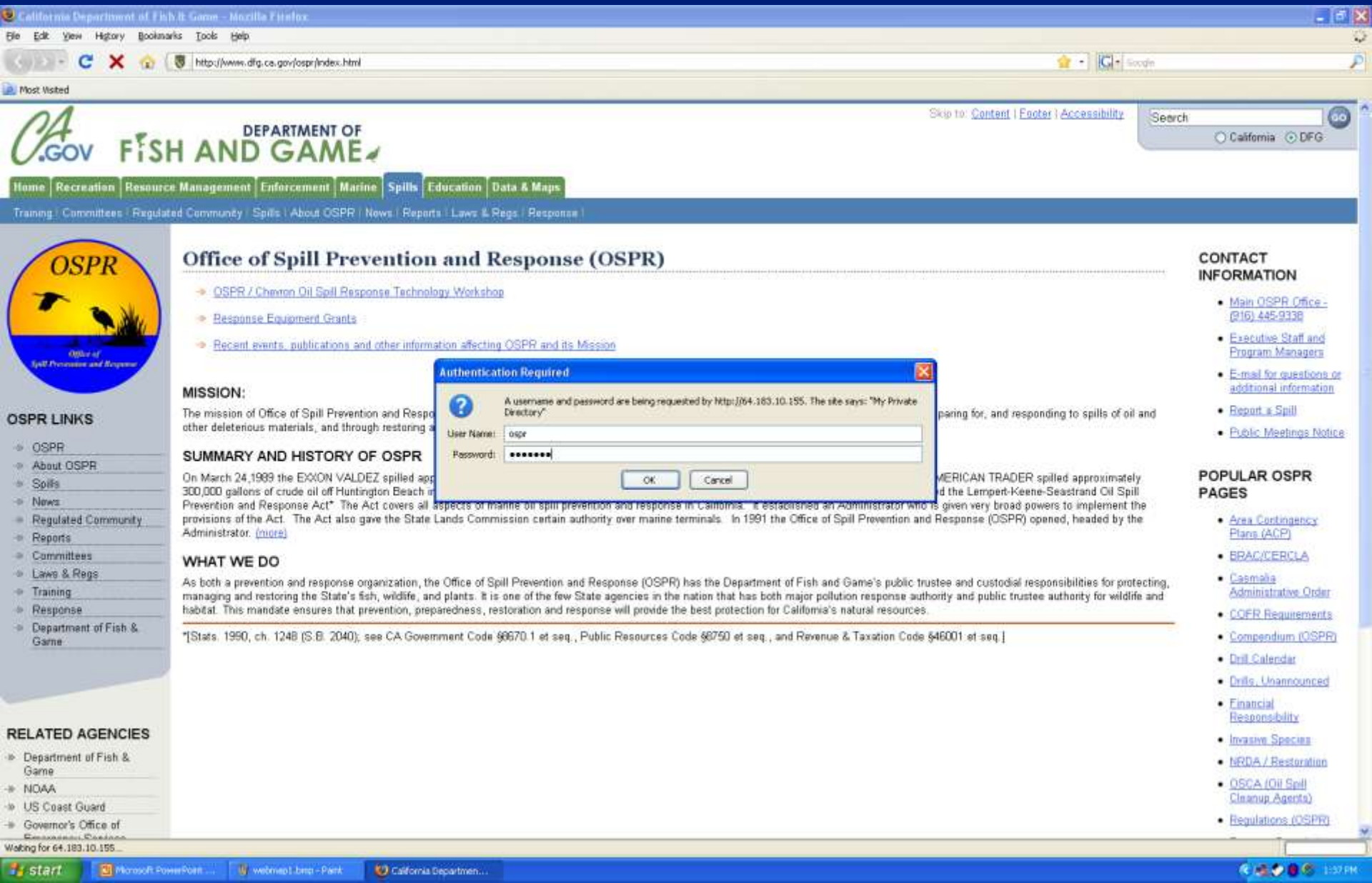
Alaska North Slope

0.15mm	0.15mm
0.125mm	0.125mm

0.10mm	0.10mm
0.075mm	0.075mm

0.05mm	0.05mm
0.025mm	0.025mm

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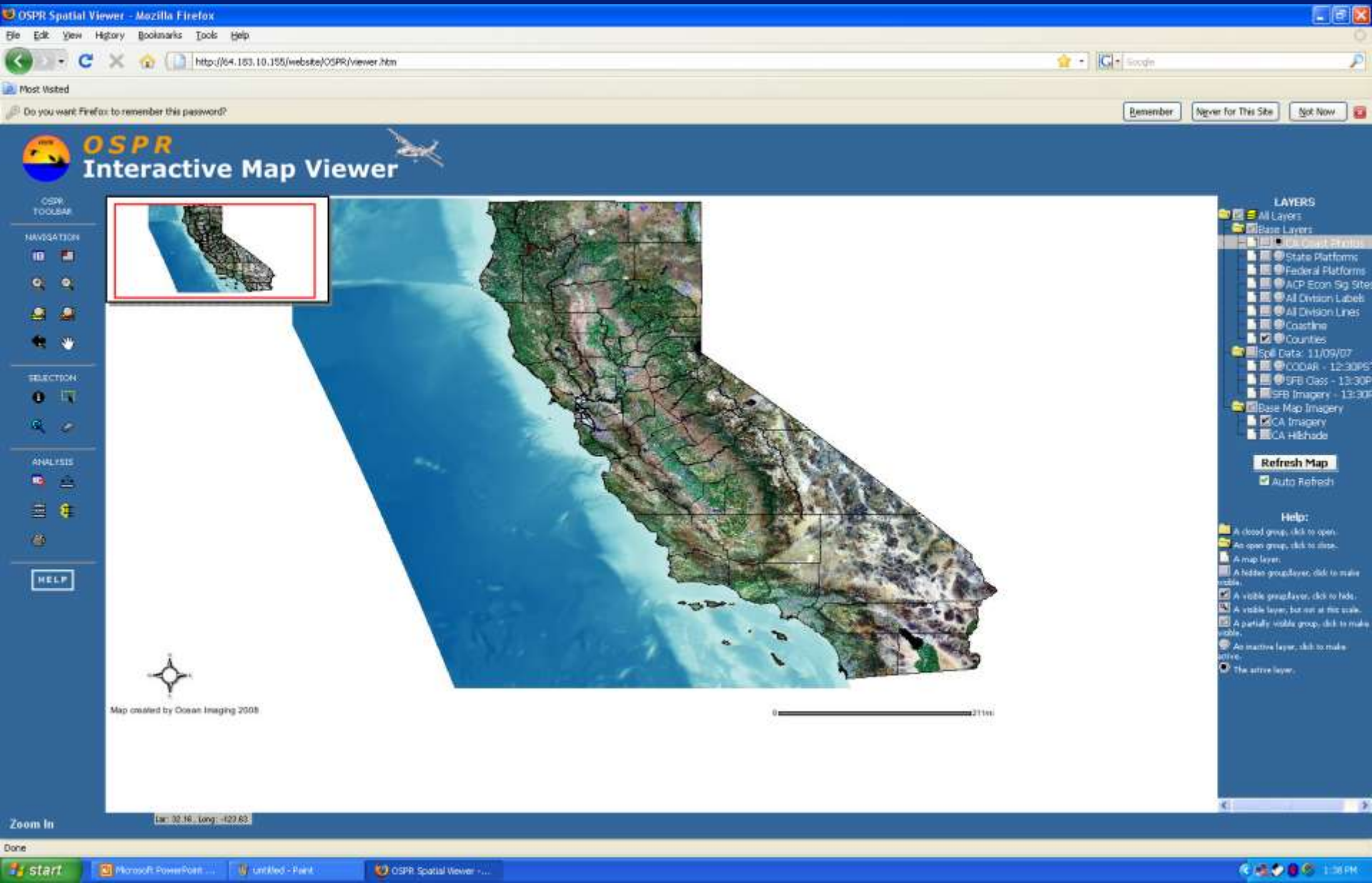
Department of Fish & Game
RELATED AGENCIES
Department of Fish & Game
NOAA
US Coast Guard
Governor's Office of
Office of Spill Prevention and Response (OSPR)
OSPR / Chevron Oil Spill Response Technology Workshop
Response Equipment Grants
Recent events, publications and other information affecting OSPR and its Mission
Authentication Required
A username and password are being requested by http://64.183.10.155. The site says: "My Private Directory"
User Name: ospr
Password: ••••••••
OK
Cancel
MISSION:
The mission of Office of Spill Prevention and Respo
paring for, and responding to spills of oil and other deleterious materials, and through restoring a
SUMMARY AND HISTORY OF OSPR
On March 24,1989 the EXXON VALDEZ spilled app
MERICAN TRADER spilled approximately 300,000 gallons of crude oil off Huntington Beach i
d the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act* The Act covers all aspects of marine oil spill prevention and response in California. It established an Administrator who is given very broad powers to implement the provisions of the Act. The Act also gave the State Lands Commission certain authority over marine terminals. In 1991 the Office of Spill Prevention and Response (OSPR) opened, headed by the Administrator. (more)
WHAT WE DO
As both a prevention and response organization, the Office of Spill Prevention and Response (OSPR) has the Department of Fish and Game's public trustee and custodial responsibilities for protecting, managing and restoring the State's fish, wildlife, and plants. It is one of the few State agencies in the nation that has both major pollution response authority and public trustee authority for wildlife and habitat. This mandate ensures that prevention, preparedness, restoration and response will provide the best protection for California's natural resources.
*[Stats. 1990, ch. 1248 (S.B. 2040); see CA Government Code §6670.1 et seq., Public Resources Code §8750 et seq., and Revenue & Taxation Code §46001 et seq.]
CONTACT INFORMATION
Main OSPR Office - (916) 445-9338
Executive Staff and Program Managers
E-mail for questions or additional information
Report a Spill
Public Meetings Notice
POPULAR OSPR PAGES
Area Contingency Plans (ACP)
BRAC/CERCLA
Casmalia Administrative Order
COFR Requirements
Compendium (OSPR)
Drill Calendar
Drills, Unannounced
Financial Responsibility
Invasive Species
NRDA / Restoration
OSCA (Oil Spill Cleanup Agents)
Regulations (OSPR)
Waiting for 64.183.10.155...
start
Microsoft PowerPoint ...
webmap1.bmp - Paint
California Departmen...
1:37 PM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Do you want Firefox to remember this password?
Remember
Never for This Site
Not Now
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Interactive Map Viewer
OSPR TOOLBAR
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SELECTION
ANALYSIS
HELP
LAYERS
All Layers
Base Layers
State Platforms
Federal Platforms
ACP Econ Sig Site
All Division Labels
All Division Lines
Coastline
Counties
Spill Data: 11/09/07
CODAR - 12:30PST
SFB Class - 13:30P
SFB Imagery - 13:30P
Base Map Imagery
CA Imagery
CA Hillshade
Refresh Map
Auto Refresh
Help:
Map created by Ocean Imaging 2008
Zoom In
Done
start
Microsoft PowerPoint ...
untitled - Paint
OSPR Spatial Viewer - ...
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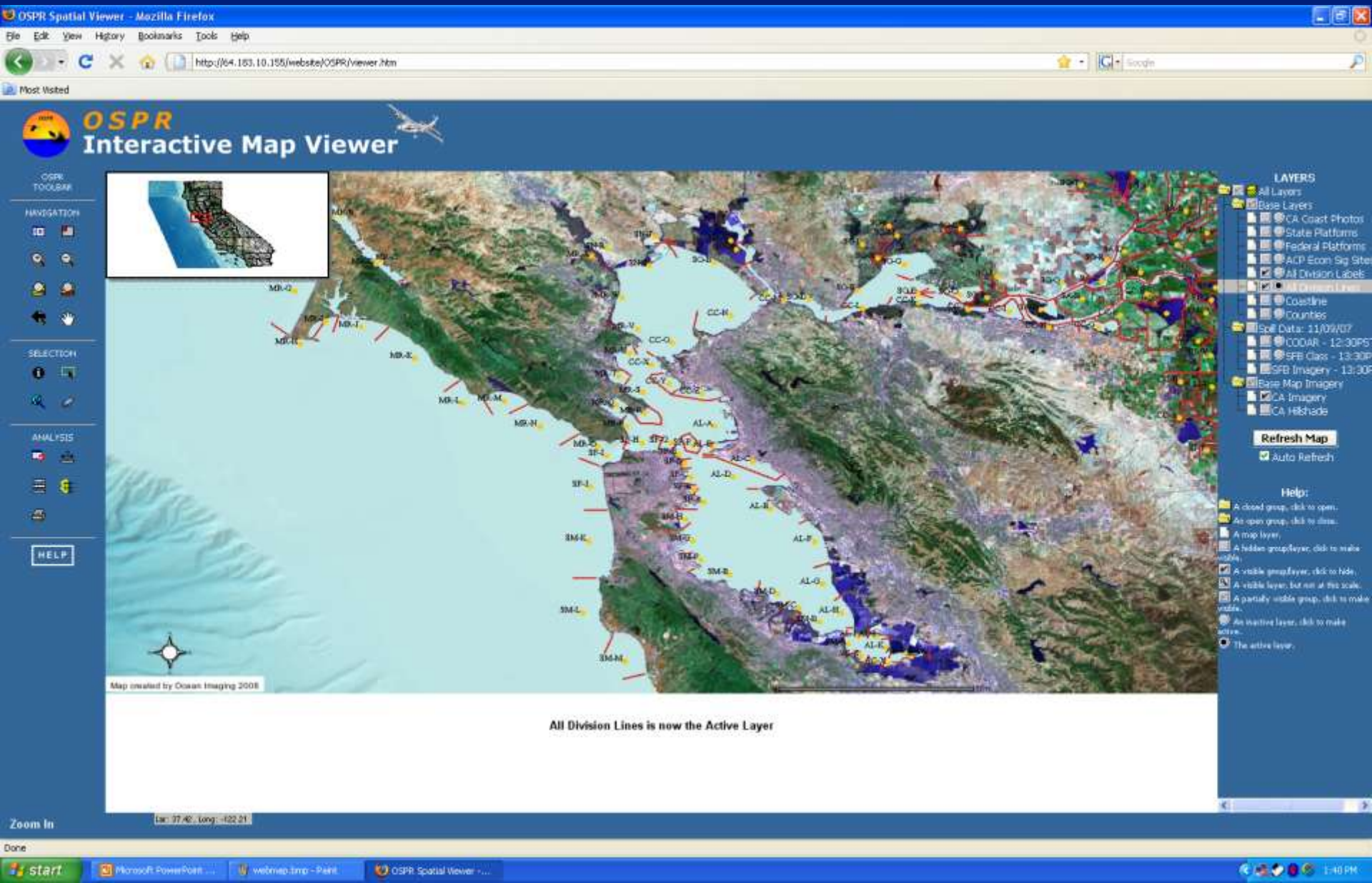
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All Layers
Base Layers
CA Coast Photos
State Platforms
Federal Platforms
ACP Econ Sig Site
All Division Labels
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Counties
Spill Data: 11/09/07
CODAR - 12:30PST
SFB Class - 13:30P
SFB Imagery - 13:30P
Base Map Imagery
CA Imagery
CA Hillshade
Refresh Map
Auto Refresh
Help:
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All Division Lines is now the Active Layer
Zoom In
Done
start
Microsoft PowerPoint ...
webmap.bmp - Paint
OSPR Spatial Viewer - ...
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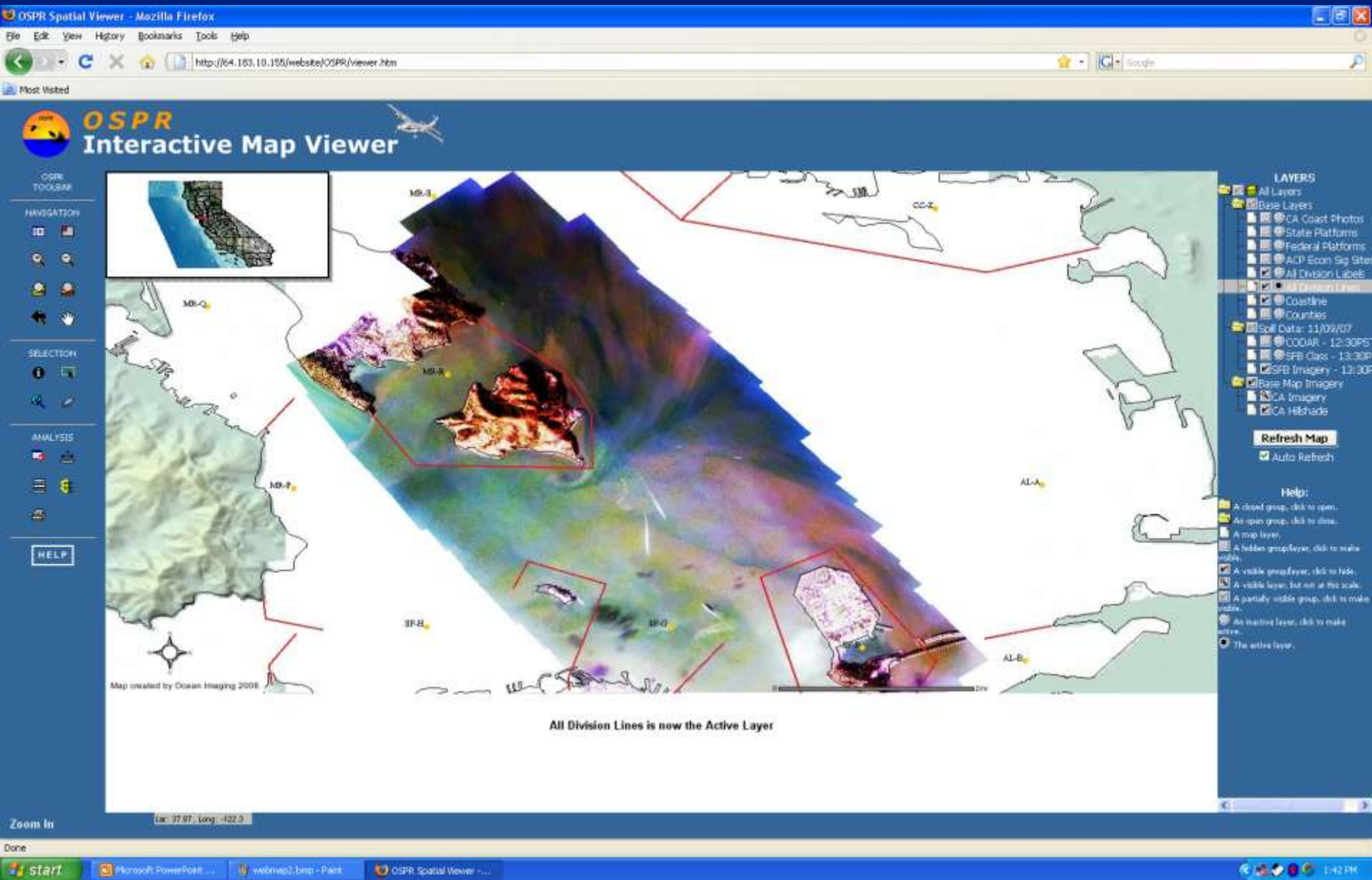
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All Layers
Base Layers
CA Coast Photos
State Platforms
Federal Platforms
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CODAR - 12:30PST
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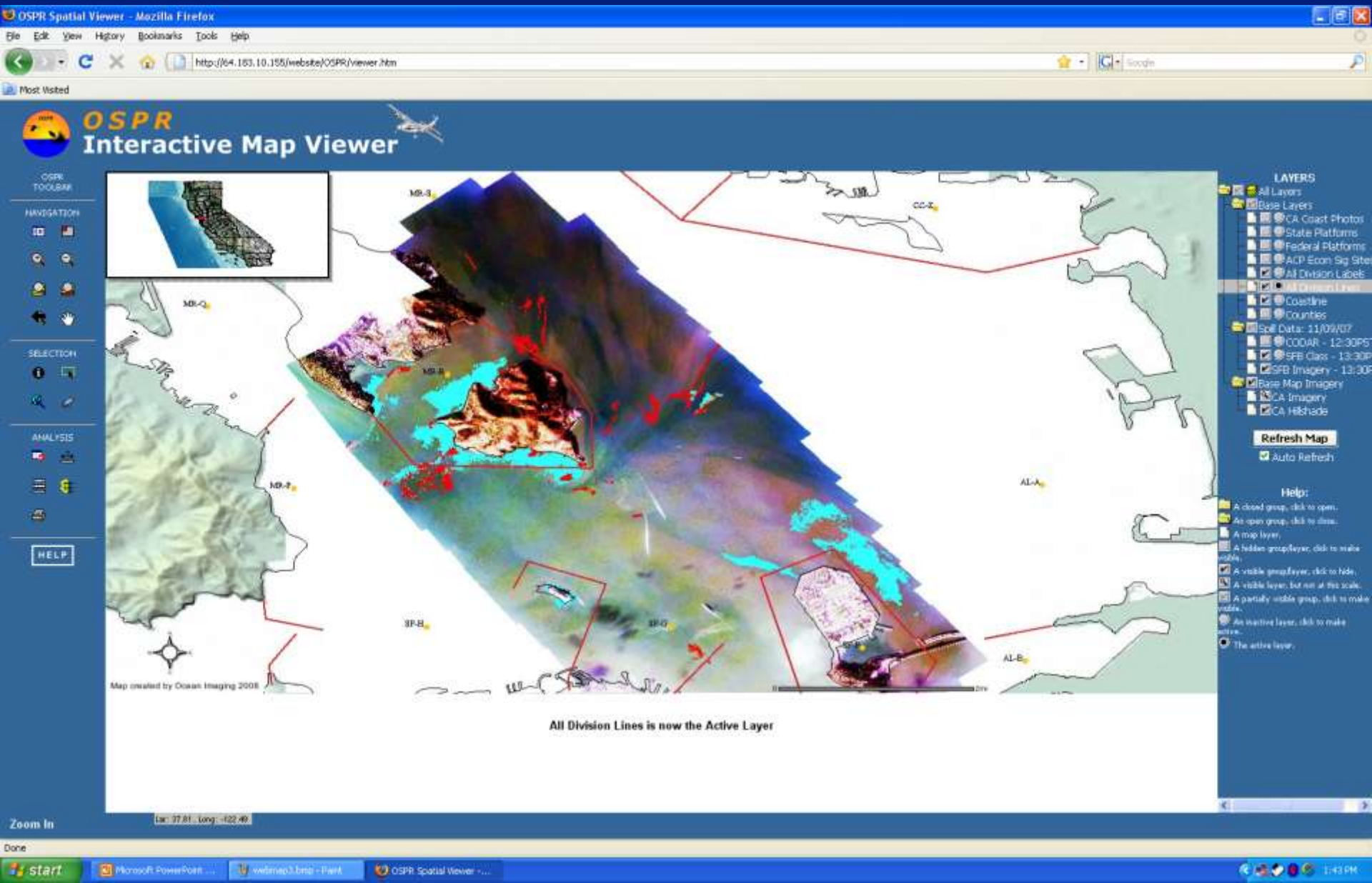
SFB Imagery - 13:30P
Base Map Imagery
CA Imagery
CA Hillshade
Refresh Map
Auto Refresh
Help:
MR-Q
MR-P
SF-B
SF-O
AL-A
AL-B
CC-E
Map created by Ocean Imaging 2008
All Division Lines is now the Active Layer
Zoom In
Done
start
Microsoft PowerPoint ...
webmap2.bmp - Paint
OSPR Spatial Viewer - ...
1:42 PM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CODAR - 12:30PST
SFB Class - 13:30P
SFB Imagery - 13:30P
Base Map Imagery
CA Imagery
CA Hillshade
Refresh Map
Auto Refresh
Help:
MR-3
CC-3
MR-2
MR-1
SF-B
SF-C
AL-A
AL-B
Map created by Ocean Imaging 2008
All Division Lines is now the Active Layer
Zoom In
Done
start
Microsoft PowerPoint ...
OSPR Spatial Viewer - ...
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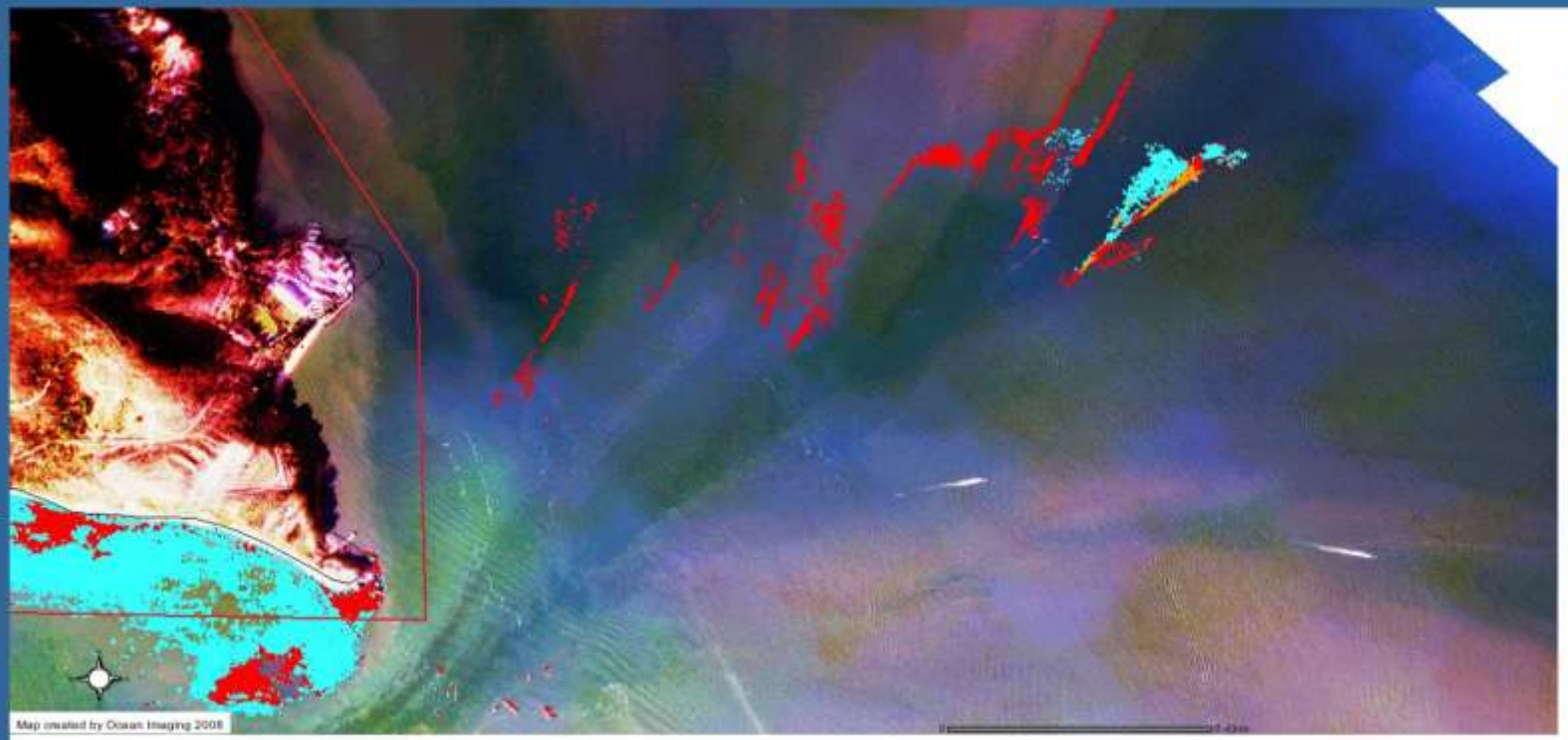
OSPR TOOLBAR

NAVIGATION

SELECTION

ANALYSIS

HELP



Legend

All Division Labels

All Division Lines

Coastline

SFB Class - 13:30PST

Emulsified

Thick Oil (>0.2mm)

Thin Oil (<0.2mm and sheen)

SFB Imagery - 13:30PST

CA Hillshade

All Division Lines is now the Active Layer

Zoom In

Lat: 37.85 , Long: -122.41

Done

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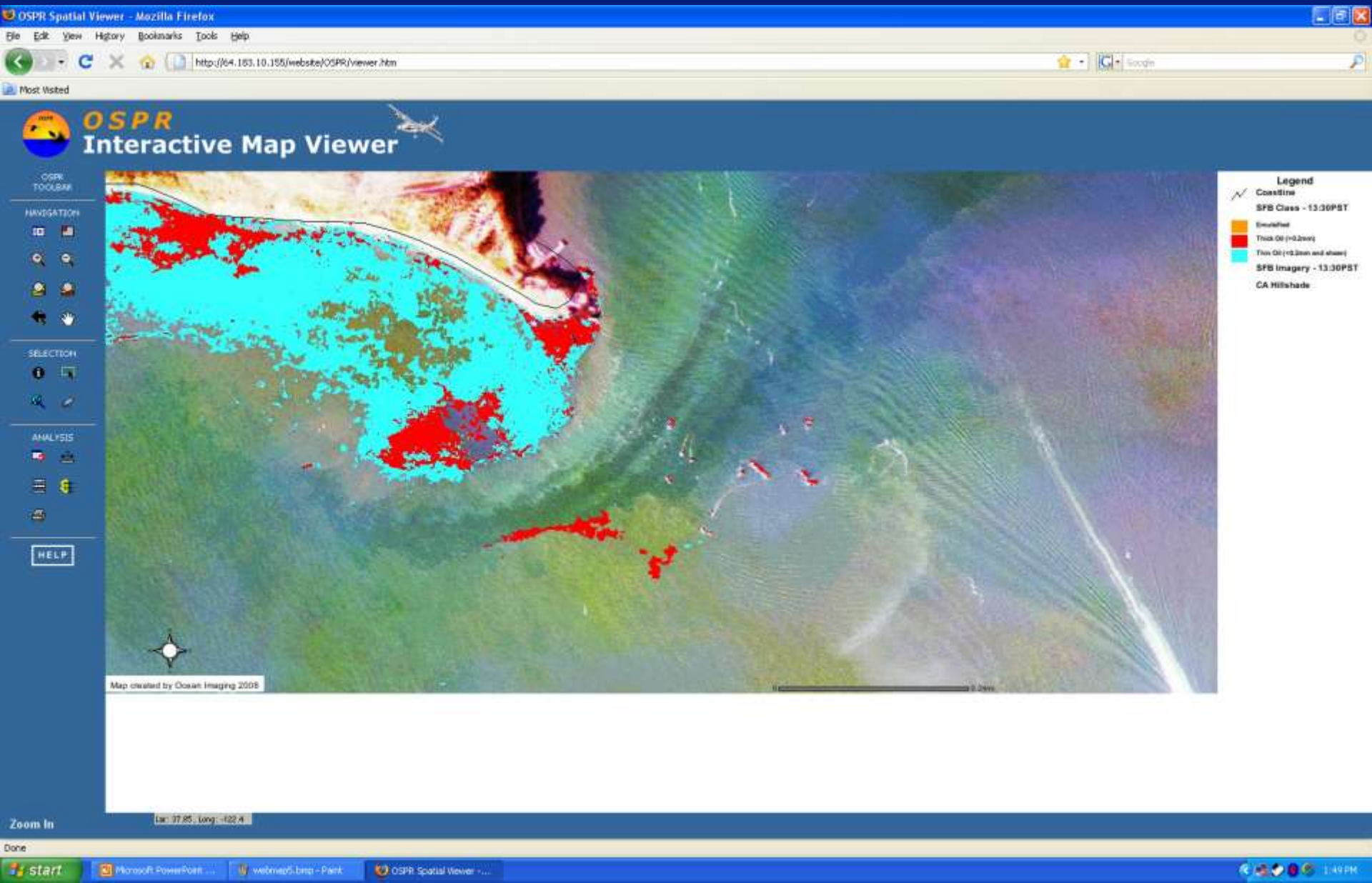
start Microsoft PowerPoint ... webmap4.bmp - Paint OSPR Spatial Viewer - ... 1:45 PM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NAVIGATION
SELECTION
ANALYSIS
HELP
Legend
Coastline
SFB Class - 13:30PST
Emulsified
Thick Oil (>0.2mm)
Thin Oil (<0.2mm and sheen)
SFB Imagery - 13:30PST
CA Hillshade
Map created by Ocean Imaging 2008
Zoom In
Done
start
Microsoft PowerPoint ...
webmap5.bmp - Paint
OSPR Spatial Viewer - ...
1:49 PM

OSPR Spatial Viewer - Mozilla Firefox

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OSPR TOOLBAR

NAVIGATION

SELECTION

ANALYSIS

HELP

Legend

Coastline

SFB Imagery - 13:30PST

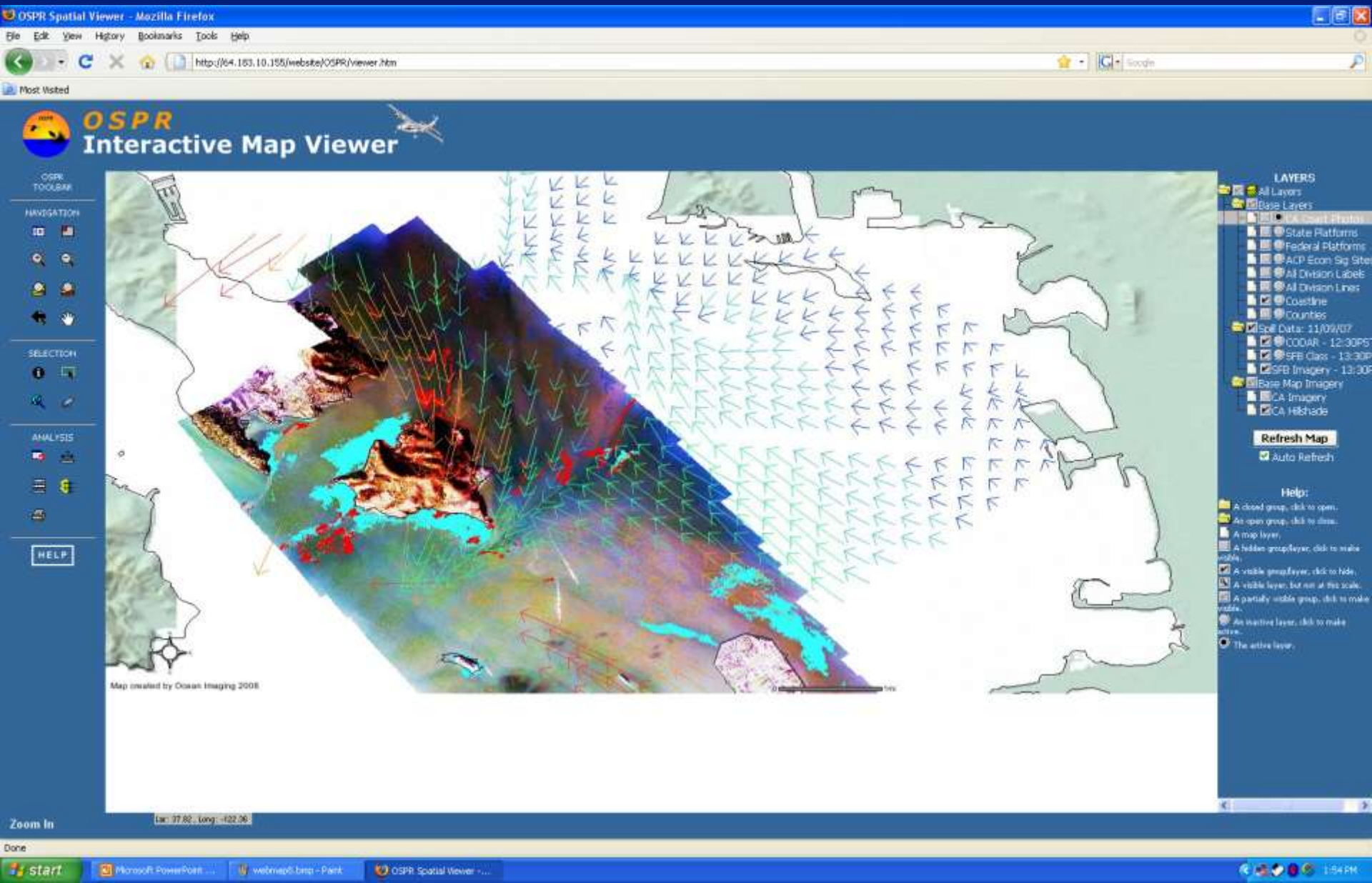
CA Hillshade

Zoom In

Lat: 37.84 Long: -122.42

Done

start Microsoft PowerPoint ... webmap6.bmp - Paint OSPR Spatial Viewer - ... 1:50 PM


OSPR Spatial Viewer - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://64.183.10.155/website/OSPR/viewer.htm
Most Visited
OSPR
Interactive Map Viewer
OSPR TOOLBAR
NAVIGATION
SELECTION
ANALYSIS
HELP
Map created by Ocean Imaging 2008
LAYERS
All Layers
Base Layers
State Platforms
Federal Platforms
All Division Labels
All Division Lines
Coastline
Counties
Spill Data: 11/09/07
Base Map Imagery
CA Imagery
CA Hillshade
Refresh Map
Auto Refresh
Help:
Zoom In
Done
start
1:54 PM

Questions?

Thank
You

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