

TRACS A-B-C Acquisition and Processing and LandSat TM Processing

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TRACS: Level A

A

AIRCRAFT
Ocean Imaging
Corporation

**Multispectral/TIR
Cameras (i.e. TRACS)**



Provides wide-area spill
detection, thickness
interpretation, and oil
distribution mapping

Acquisition Considerations:

- Aircraft to be used, port hole, power requirements, etc.
- Preplanned flight path or 'scouting' mode?
- Frame overlap, flight line overlap
- Altitude = horizontal spatial resolution or ground sampling distance (GSD)
- Season and time of day – overflights around solar noon result in sun glint contamination (in RGB imagery only)
- Direction of flight lines (avoiding sun glint)
- Amount of data collected
 - What is intended purpose of acquired data?
 - Available 'pipe' size (Internet throughput capability) to offload/upload data for additional processing



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TRACS: Level A – Tactical Real-Time Information

Acquire RGB & TIR imagery

Re
res

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MSRC

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TRACS: Level A – Near Real-Time Oil Classification Maps

Acquire RGB & TIR imagery

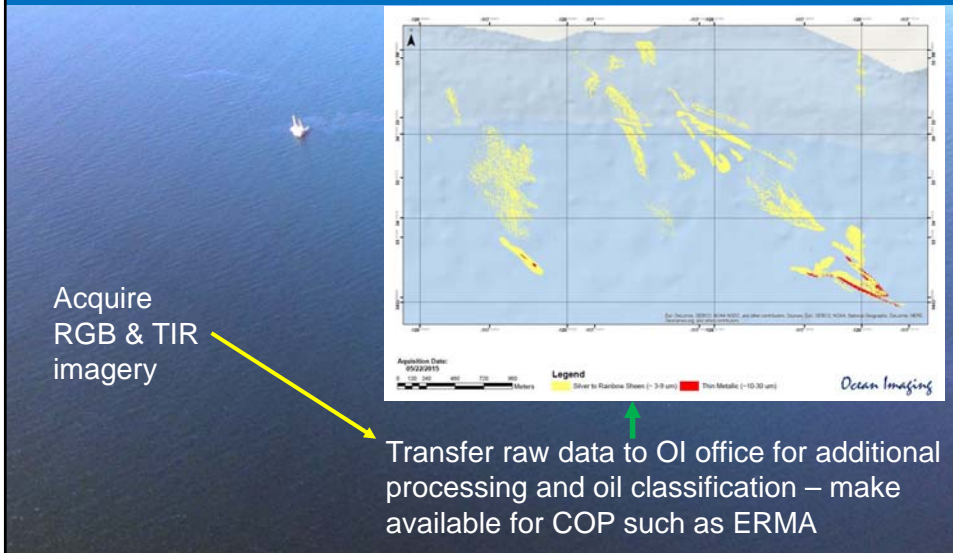
Use system for near real-time oil classification

Transfer raw data to OI office for additional processing and oil classification – make available for COP such as ERMA

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TRACS: Level A – Near Real-Time Oil Classification Maps





Acquire RGB & TIR imagery

Transfer raw data to OI office for additional processing and oil classification – make available for COP such as ERMA

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MSRC Level B & C Remote Sensing for Tactical Oil Spill Surveillance

| | |
|---|--|
| <p>B BALLOON Maritime Robotics</p> | <p>C CLOSE-IN</p> |
| <p>TIR & HD Cameras</p> | <p>X Band Radar & TIR Camera</p> |
|  |  |
| <p>Tethered up to 500 ft. Medium range coverage with long "hang" time</p> | <p>Optimizes close-in recovery techniques</p> |

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MSRC Level B - BALLOON

Maritime Robotics Aerostat

Battery powered, non-wired tether

- Up to 12-hour “hang time”
- Rechargeable battery

Package includes:

- HD Camera
- TIR Camera
- AIS Repeater

Small, compact easily transportable package

Proprietary viewing software and gimbal

WiFi transfer to host vessel

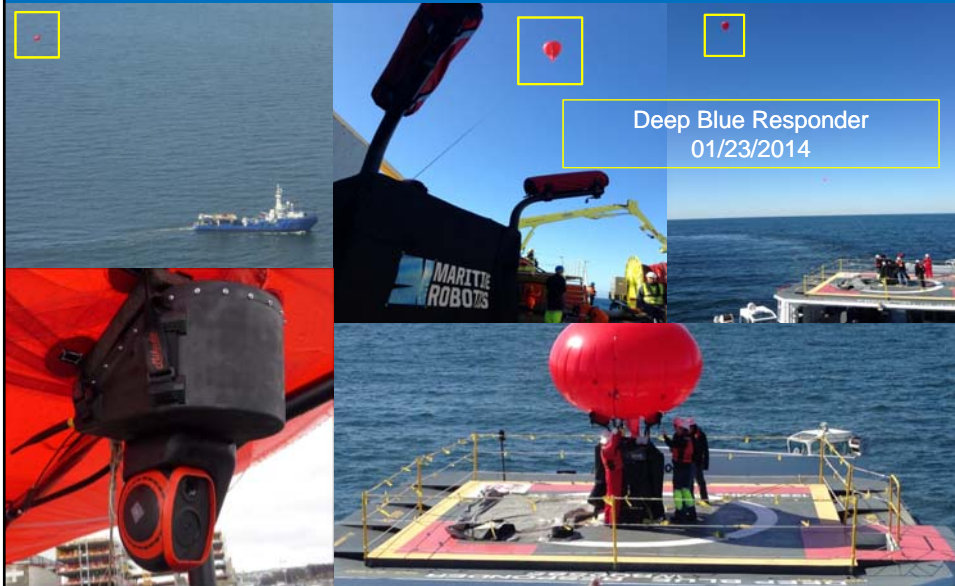


NOFO: Oil On Water 2012



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MSRC Level B – BALLOONS (Aerostats)



Deep Blue Responder
01/23/2014



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Manufactured by Maritime Robotics: Ocean Eye



NOFO: Oil On Water 2012



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Screen Snapshots:

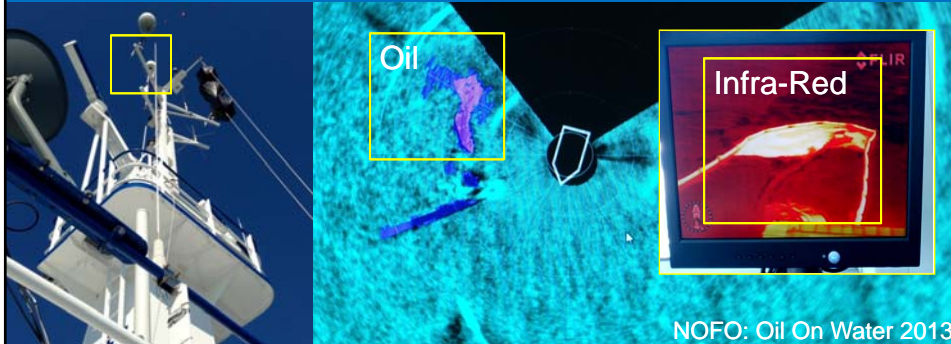
- Geo-positioned display
- Data collection
- Target data e-mailable

Viewing: IR/HD Image Fusion

- ~75% IR overlaid with
- ~25% HD Visual

MSRC Level C – CLOSE IN

OSRV-Mounted Systems for Tactical Optimization



X Band Radar and Thermal Infrared (TIR) on Responder Class Vessels

- Oil detection (X Band Radar)
- Better view of oil
- Stack oil vs. entrainment

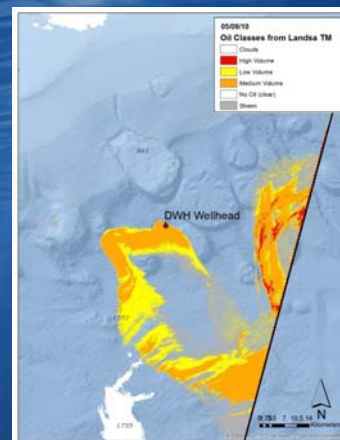


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Landsat TM – Classification Methodology Brief

As part of DWH NRDA work, eight TM scenes or two-scene mosaics acquired between 04/25/10 – 07/28/10 were classified into volume per surface area classes

Classifications were used to help determine the amount of oil on the ocean's surface during the DWH incident.

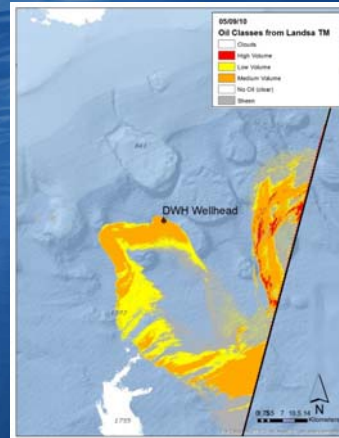


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Landsat TM – Classification Methodology Brief

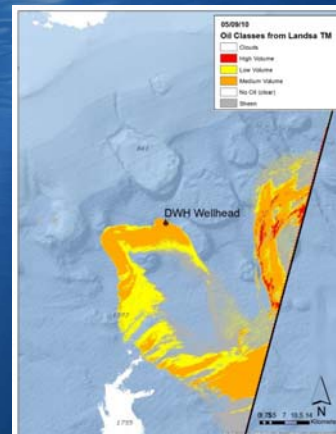
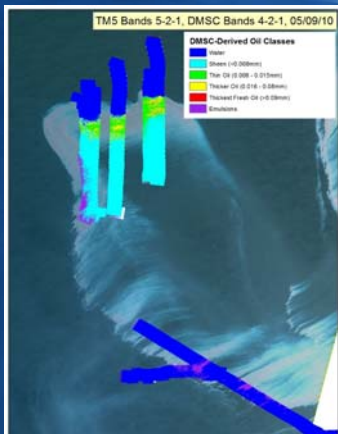
Found that in the DWH TM imagery there was a significant amount of oil thickness/type heterogeneity within each 27m pixel. Therefore, the reflectance profile of each pixel is related to the amount of surface area covered by the major oil features present.

Classification of TM imagery requires some type of higher resolution (preferably calibrated) data set to use for creation of training set used in a supervised classification such as 'maximum likelihood'.



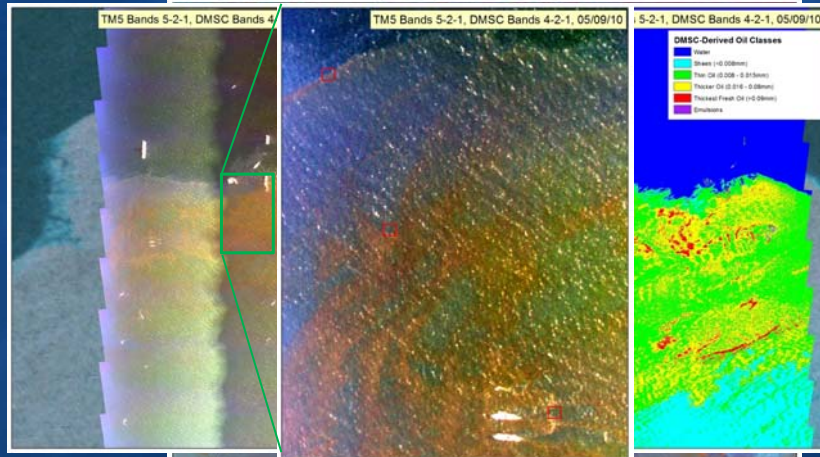
Landsat TM – Classification Methodology Brief

Used 4 meter multispectral imagery from DMSC sensor & aerial photographs to help train classification routines and guide relative calibration of TM data



Landsat TM – Classification Methodology Brief

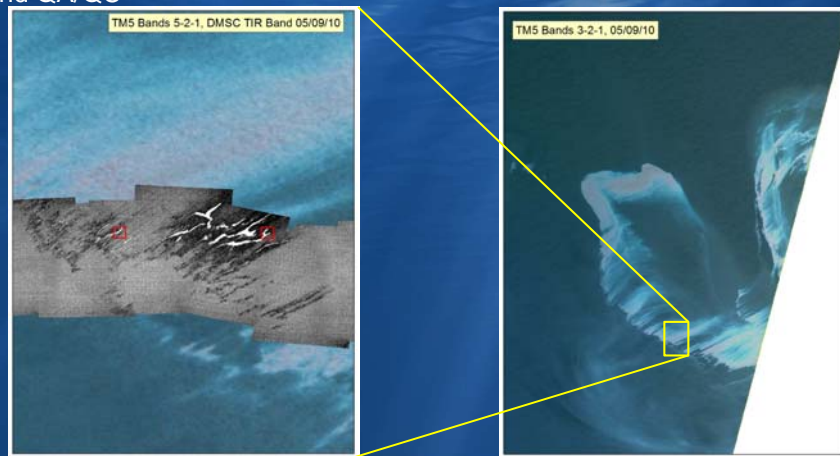
2.4 meter WorldView-2 satellite and 4 meter DMSC aerial imagery show the level of heterogeneity within the 23 meter TM pixel size



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Landsat TM – Classification Methodology Brief

4 Meter TIR imagery & high resolution photographs also show the level of heterogeneity within the 23 m TM pixel size as well as used for training sets and QA/QC

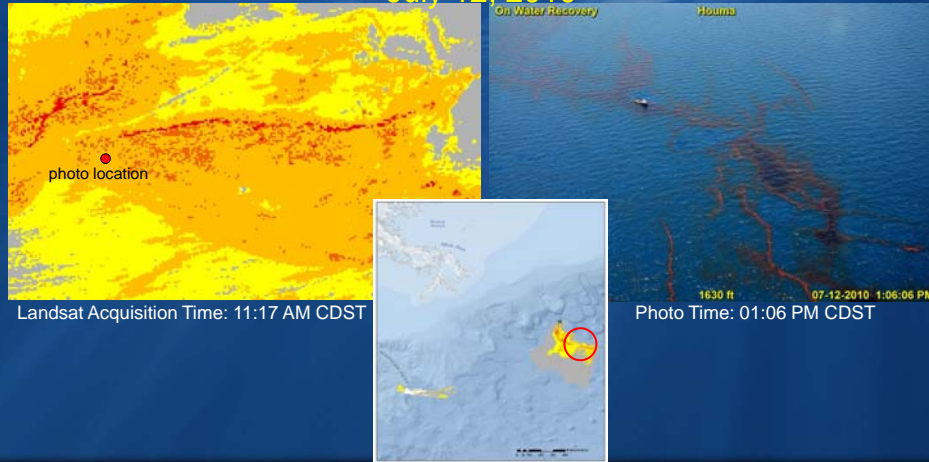


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4 Meter TIR imagery & high resolution photographs also show the level of heterogeneity within the 23 m TM pixel size as well as used for training sets and QA/QC

July 12, 2010



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Landsat TM – Classification Methodology Brief

Ocean Imaging Landsat TM Classification Processing Steps

- 1) Mosaic TM image path/row scenes if available
- 2) Use high resolution DMSC and TIR imagery along with high resolution photographs to create classification training sets
 - Use different thickness/type 'markers' seen in multispectral and TIR imagery (eg. thermal cooler than water cut-off and hotter than both water and oil transition, also bright orange reflectance of highly emulsified and weathered oil)
 - "Hot" to "cool" thermal cut-off corresponded well with thickest oil → higher volume per area
 - Subdivide the TM signal containing thick 'fresher' and emulsified oil patches into two classes based on multispectral reflectance intensity, with the higher reflecting class likely representing a greater portion of the sea surface covered by dense emulsion patches (versus thinner oil and sheen-covered water areas).

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Landsat TM – Classification Methodology Brief

- **Sheen:** Invisible in thermal IR aerial, invisible or elevated reflectance in blue band of aerial and TM. IF included in TM classification, sheen derived from SAR-based total oiling footprint outlines derived by TCNNA analysis derived by Oscar Garcia
- **Low Volume:** Invisible in thermal aerial but detectable in aerial and TM multiple visible bands. Low reflectance in near-IR.
- **Mid-Volume:** Can contain both unemulsified and emulsified oil features covering an average of 10% surface area in each TM pixel. Visible in thermal IR aerial as negative contrast to surrounding water. Elevated reflectances in TM's longer visible and near-IR wavelengths.
- **High-Volume:** Can contain both unemulsified and emulsified oil features covering an average of 20% surface area in each TM pixel. Visible in thermal IR aerial as mostly negative and sometimes sparse positive contrast to surrounding water. Elevated reflectances in TM's longer visible and near-IR wavelengths are significantly higher than for the mid-volume class.
- **Super High Volume:** Elongated features showing very high values in TM Band7 – Band1 difference. Often emulsified and significantly weathered strands of oil showing a bright orange-red reflectance in visible bands

Landsat TM – Classification Methodology Brief

Ocean Imaging Landsat TM Classification Processing Steps

- 3) Run supervised classification (eg Maximum likelihood) routine to classify TM mosaic (all 7 TM bands used as input to the classification)
- 4) Edit classes using DMSC and TIR imagery along with high resolution photographs for QC/QA

.....3.5) In a few cases using an unsupervised classification method (i.e. ISodata), starting with many classes and using the DMSC, TIR & photographic data to pare down the classes worked better than supervised method.

THANK YOU!

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