Cooperative Conservation Award 2009

Development of an Aerial Oil Thickness Mapping System

A Partnership Between the Minerals Management Service and California Department of Fish and Game – Office of Oil Spill Prevention and Response

One of the most important initial steps in response to an oil spill at sea is the assessment of the extent of the oil slick and the quantity (i.e. thickness) distribution of oil within it. Since many types of hydrocarbons rapidly spread out to very thin layers when released at sea, accurate determination of which areas contain the most amount of oil is vital for efficiently guiding oil spill response efforts. This includes the ability to operate effectively in bad weather or darkness. A critical gap in spill response is the lack of capability to accurately measure and map the thickness of oil on water and to rapidly send this information to response personnel in the command post. This includes the ability to determine the thickest portions of the oil slick and to operate effectively in bad weather or darkness

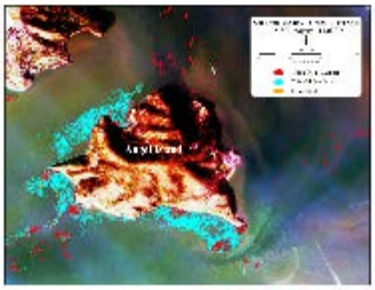
The vast majority of oil quantity distribution assessments are presently done visually from helicopter or aircraft. Such visual observations from aircraft (sometimes supplemented by drawings or digital photographs) suffer from three main complications. First, documentation is usually based only on approximate geo-location information, second, visual estimation of oil film thickness distribution is highly subjective, is affected by varying light and background color conditions and, if not done by specially trained and experienced personnel, tends to be inaccurate, third, comprehensive visual assessments are impossible at night.

What was needed is an economical, portable and easy-to-operate aerial sensor to detect and accurately map the thickness and distribution of an oil slick in coastal and offshore waters in real-time and could disseminate the information down to the “Unified Command Center.” The sensor system must be able to be rapidly mounted and deployed in a variety of aircraft.

In November 2005, the Minerals Management Service (MMS) initiated a research project Ocean Imaging (OI) Corporation, Solana Beach, CA to develop an algorithm that would enable the measurement of oil slick thicknesses using multispectral aerial imagery. The California Department of Fish and Game, Office of Oil Spill Prevention and Response (CA DFG/OSPR) partnered with MMS on this project and provided technical expertise with the Geographic Information System (GIS) component of this project as well as services in kind (plane and pilot). Results from this project proved that the development and operational utilization of a portable multispectral imaging system for oil spill mapping is very feasible and could provide major improvements in oil spill response.

In October 2006, the MMS initiated a second research project to develop a portable, easy-to-operate, aerial sensor to detect and accurately map the thickness and distribution of an oil slick in coastal and offshore waters in real-time. CA DFG/OSPR partnered with MMS again on this project and provided technical expertise and similar services in kind. Over a three-year period the system was developed in a systematic approach. This included overflights of the Coal Oil Point, CA natural oil seeps and over Ohmsett – The National Oil Spill Response Test Facility, in Leonardo, NJ. The full system integration flight was successfully completed in November 2008.

While the aerial mapping system was still under development, the *M/V Cosco Busan* struck a bridge in San Francisco Bay and leaked 58,000 gallons of IFO bunker fuel into the Bay on November 7, 2007. A major response effort was mounted, initially hampered by fog that covered the accident region and also by the strong tidal currents that quickly spread the oil into other parts of the Bay. Traditional visual surveillance overflights were conducted each day by NOAA and maps based on these flights were distributed to the response agencies. On November 9, 2007, CA DFG/OSPR authorized OI to conduct a test overflight with the aerial mapping system over a portion of the oil-impacted region. The processed



imagery showed that most of the spilled oil existed in the form of either sheens or long, narrow streamers of relatively thick (recoverable) oil, aligned with rapidly changing current shear zones. The multispectral GIS map product allowed rapid and accurate pinpointing of the location of each recoverable streamer – an advantage not available from the visual survey map product which outlined only general areas of “sheen with patches of brown oil”.

The aerial mapping system was first utilized in true operational mode during response to an offshore platform spill in the Santa Barbara Channel in December, 2008.

boat.pdf

Imaging was done during oil recovery operations to help guide the recovery effort. The image above shows the thickest oil patches as revealed by the combination of visible multispectral (left) and thermal IR (right) imagers and actually shows a pair of boats booming off a thick patch. The aerial imagery was used to reposition the response vessels to where they could remove the most oil with the greatest level of effectiveness. This image proves that what the instruments picked out as the thick stuff really was the thick stuff, since the boats are moving not along the perimeter of the surrounding sheen but directly along the thick oil edge. Imaging was conducted two days later to verify that no more recoverable oil existed and response operations can be suspended. In each case the processed maps were posted on the web GIS server within 35 minutes of data acquisition and were available to all agencies within the “Unified Command Post” as well as response groups and vessels in the field. The infra-red images provided the fastest and clearest means to rapidly locate patches of recoverable oil. This new aerial oil thickness mapping system allowed the State of California and private industry to mount an effective response and no oil from this spill impacted the state shoreline. The response to this spill off Santa Barbara, CA demonstrates that the results of MMS funded oil spill response research projects are directly used in making regulatory and emergency response decisions.

On October 30, 2009, the Panamanian-flagged oil tanker Dubai Star suffered a leak in one of its fuel lines 2.5 miles south of the Bay Bridge at Anchorage 9 near the Oakland Airport. CA DFG/OSPR mobilized OI and within 2-hours the aerial thickness mapping system was airborne. OI imaged the spill with the developed sensor on Friday and Saturday (October 30 and 31). Within 45-minutes of data acquisition, a GIS map of the “spills” location, extents and thickness distributions were available to all agencies within the “Unified Command Post” as well as response groups and vessels in the field. This enabled the On Scene commander to direct the response vessels to the thickest portion of the oil slick. I am especially proud of our total volume spilled estimates (derived from the thickness measurements). (See attached image)

remote sensing_all.pdf

The best "official" estimate was 100 gallons, but based on our data we estimated 400-800 gallons. As of today, the official estimate (obtained by measurements of oil left in both ships involved) is 400-700 gallons.

The partnership between MMS and CA DFG/OSPR has been very successful and has resulted in a new tool to aid in oil spill response and cleanup. The developed aerial oil thickness sensor is economical, portable and easy to use. It can be regionally owned and rapidly mounted and deployed on a variety of aircraft and helicopters. Overflights of the aerial oil thickness sensor are becoming the standard for spill response exercises and for operational use in the marine environment in California. The aerial oil thickness sensor has the potential to save millions of dollars in cleanup costs as well as reducing the environmental and socio-economic impacts of an oil spill.

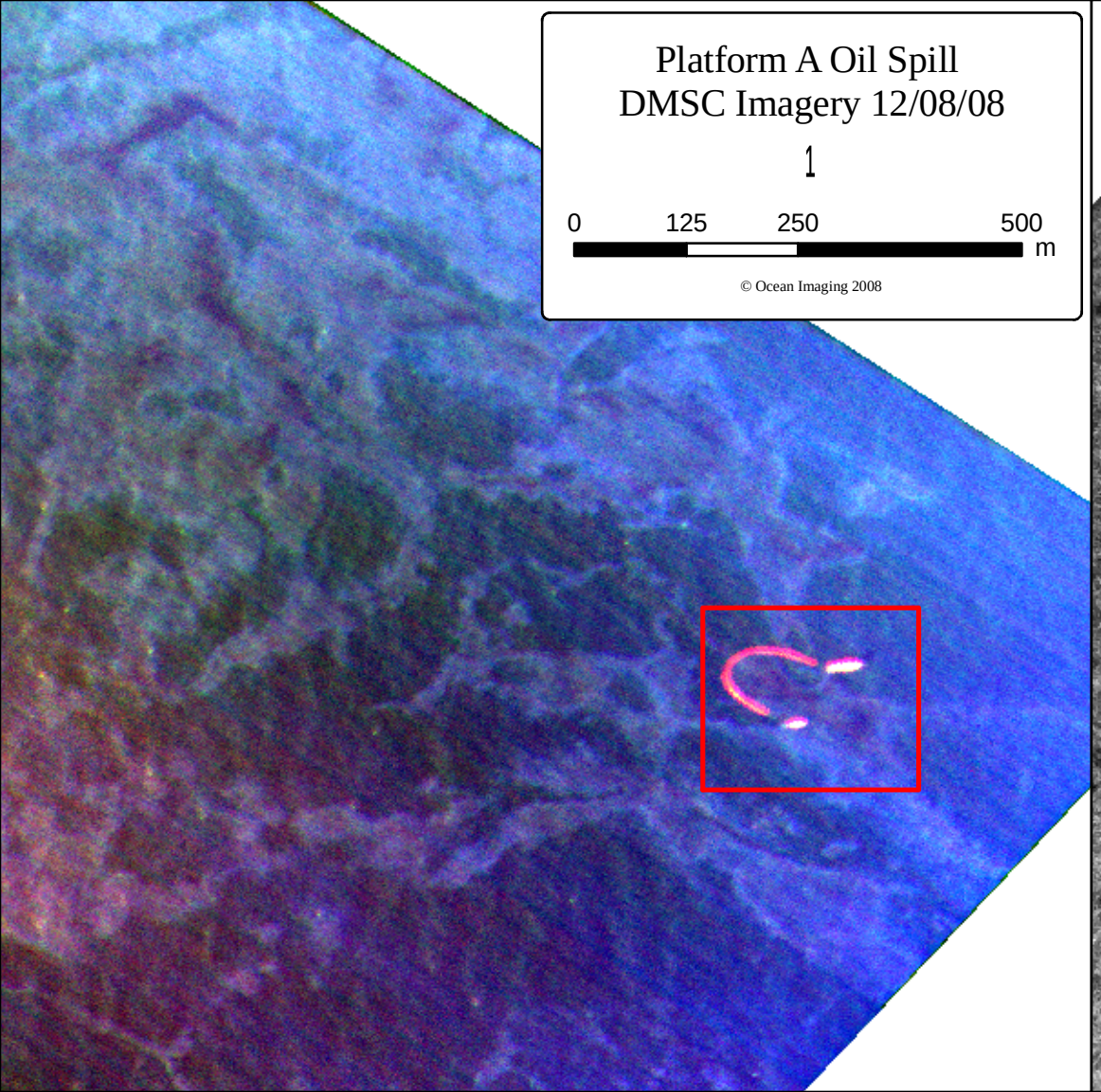
Points of Contact

Minerals Management Service
Mr. Joseph V. Mullin
Engineering and Research Branch
381 Elden St., Mail Stop 4021
Herndon, VA 20170-4817
Phone: (703) 787-1556, E-mail: joseph.mullin@mms.gov

California Department of Fish and Game, Office of Oil Spill Prevention and Response
Mr. Judd Muskat
Office of Spill Prevention and Response
California Department of Fish and Game
1700 "K" Street
Sacramento, CA 95814
Phone: (916) 324-3411, E-mail: jmuskat@OSPR.DFG.CA.GOV

Ocean Imaging Corporation

Dr. Jan Svejkovsky
201 Lomas Santa Fe Dr., Suite 370
Solana Beach, CA 92075
Phone: (858) 792-8529, E-mail: jan@oceani.com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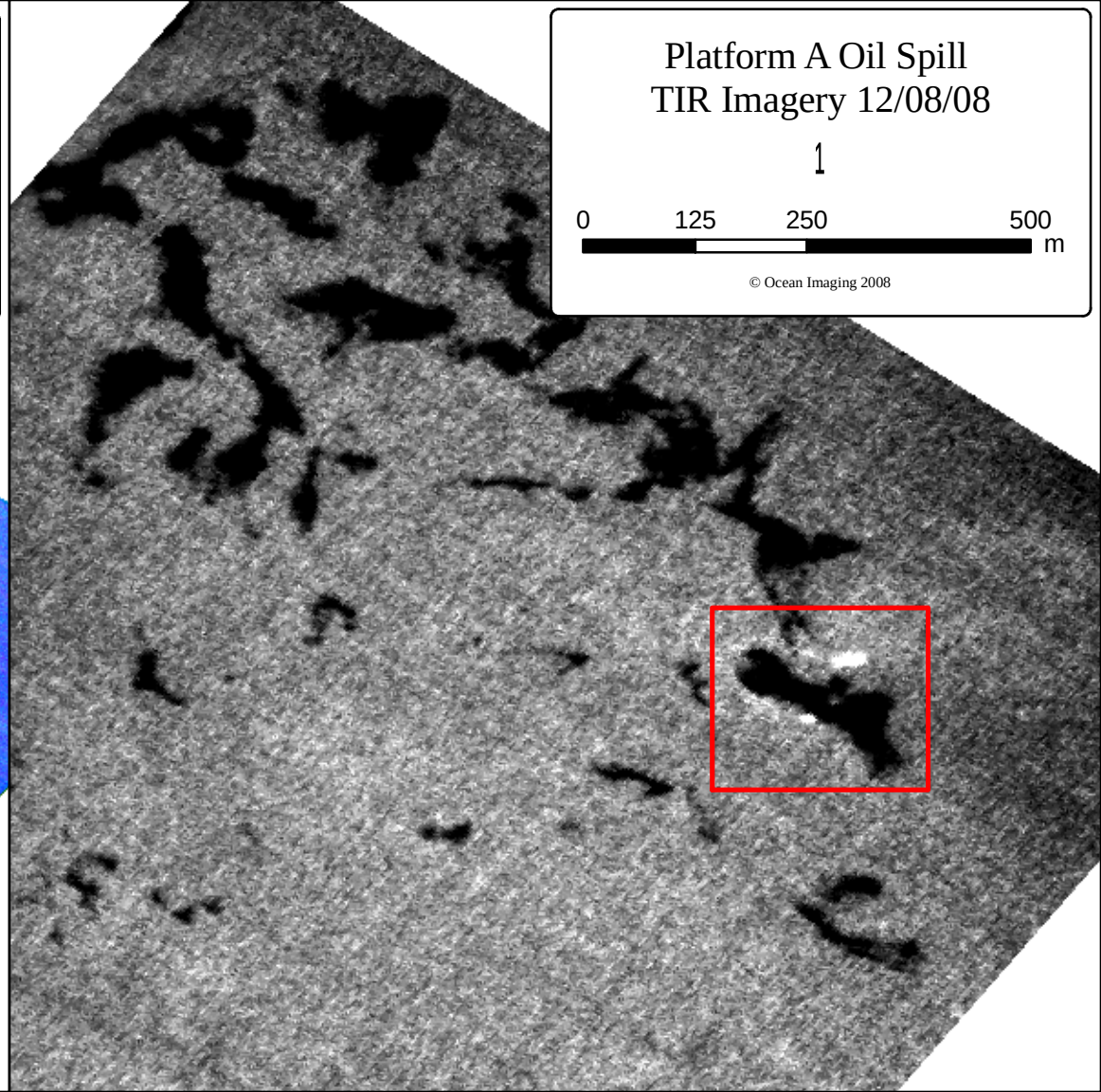
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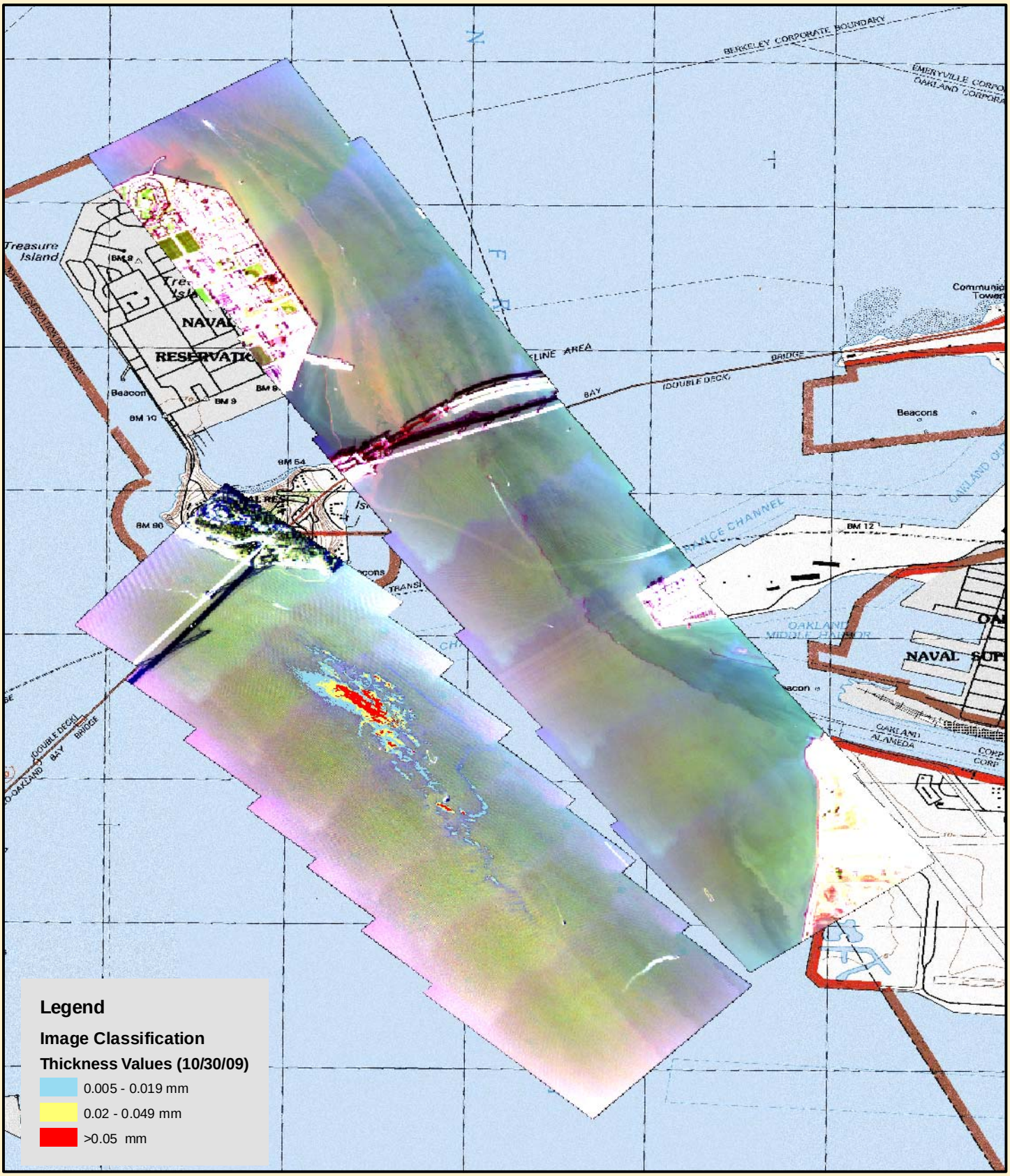

Calif. Dept. of Fish and Game
Office of Spill Prevention and Response

Data Source: OSPR GIS
Date/Time: 10/31/09
Requestor: Environmental Unit Leader
Author: J. Muskat

California (Teale) Albers Projection
NAD 83

Dubai Star Incident
Remote Sensing Images
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