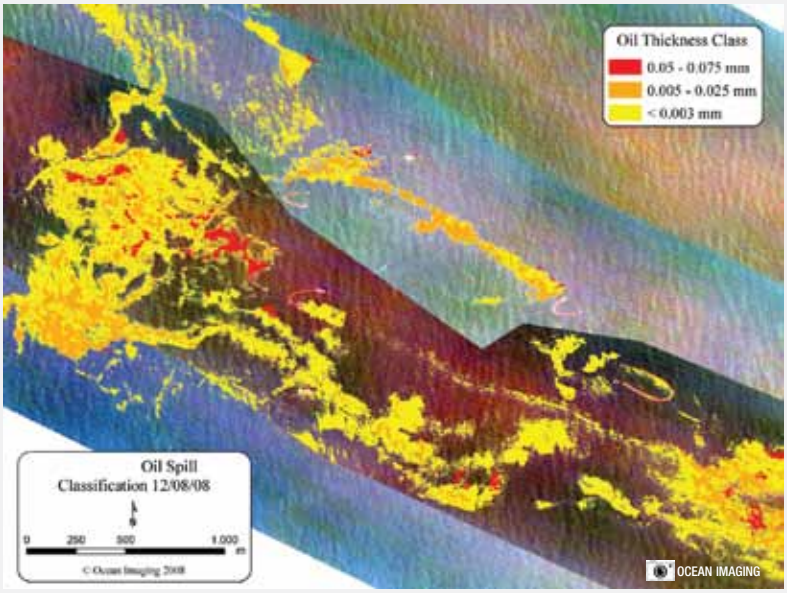
Aerial mapping of oil spill distributions, thickness patterns and weathering state

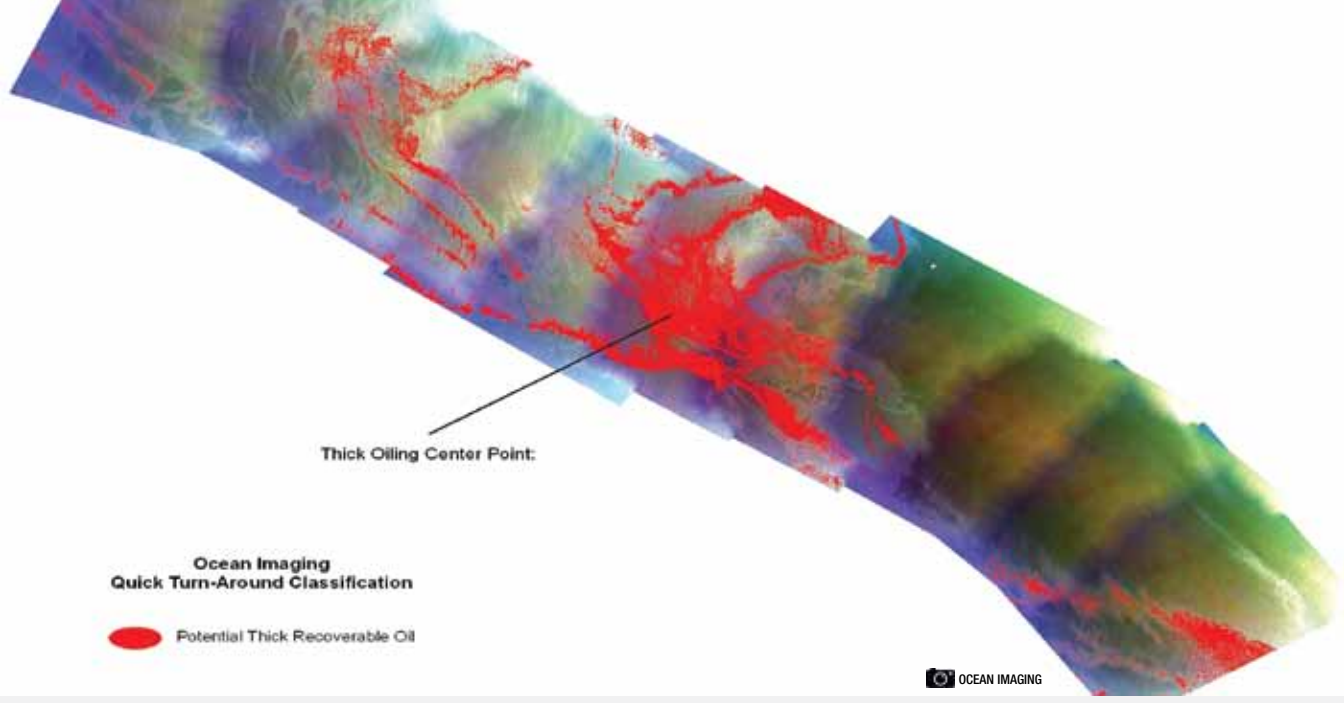
Ocean Imaging Corporation



Map of oil distributions and thicknesses during a response to a spill off California in 2008.

Ocean Imaging (OI) was founded in 1984, initially specializing in satellite-derived ocean temperature analyses for fishing fleets, and derivation of ocean current and ice drift trajectories for the offshore oil industry. Subsequent projects with the United States National Marine Fisheries Service and several universities targeted better utilization of satellite technologies for fisheries and coastal resource management. During the 1990s, OI expanded its ocean monitoring services, broadened grant-funded research activities and purchased several multispectral aerial sensors for coastal and terrestrial mapping. Presently, OI owns and operates two multispectral aerial sensors and a thermal imaging system, which can be utilized simultaneously, thus providing both multispectral visible/near-infrared (IR) as well as thermal IR imagery.

Today, Ocean Imaging is recognized as one of the world's leaders in innovative utilization of remote sensing techniques for oceanic and coastal applications. The firm's unique accomplishments include the commercialization of satellite data-derived fish-finding services for sport and commercial fishing fleets, the development and operational implementation of remote imaging technologies for monitoring coastal water pollution and runoff, and development of aerial sensor-based multispectral mapping and GIS techniques for mapping and monitoring coastal and terrestrial resources for environmental management. Through the years, OI has maintained both research and operational support service facets of its business. In a number of cases, the grant-funded research work resulted in the development of novel methods that led to operational products or services. One of these was the development of near-real-time oil spill mapping capabilities using multiple imaging sensors flow aboard aircraft. The development was initially funded through the State of California then expanded under federal funding from the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). In 2010 the project was awarded the U.S. Department of Interior's *Partners in Conservation Award*.



One of Ocean Imaging's oil spill map products distributed in near-real-time during the *Deepwater Horizon* spill showing location and extents of a large oil patch suitable for recovery with on-water booms and skimmers.

Natural oil seeps off California and BOEMRE's Ohmsett Testing Facility in New Jersey were utilized during the system's development and testing. The system was first applied during a real oil spill on a test basis during the M/V *Cosco Busan* spill in San Francisco Bay in 2007, and was subsequently used operationally on several relatively small spills off California. When the *Deepwater Horizon* spill happened in late April 2010 in the Gulf of Mexico, OI was contracted by British Petroleum to utilize the developed system to aid in the response.

The system utilized during the *Deepwater Horizon* spill consisted of a specially configured aerial multispectral imager and a state-of-the-art thermal IR camera, integrated with a DGPS/IMU unit to allow simultaneous data collection and georeferencing. The entire system is quite portable and can be quickly mounted in a variety of aircraft available on-site. During the Gulf spill, OI's equipment was mounted in a Twin Otter aircraft owned and operated by the U.S. National Oceanic and Atmospheric Administration. One to two multi-hour imaging missions were conducted each day for three months and digital, georeferenced analysis products depicting oil distribution, thickness patterns and weathering state were electronically disseminated immediately upon landing.

The system's novelty lies in the custom-developed image processing and oil thickness classification software. Its ability to distinguish oil films of different thicknesses is highly important for aiding oil recovery planning and on-water resource allocation. Since most oil slick areas tend to be composed of a thin layer of unrecoverable sheen, it is important to direct skimmer vessels and similar resources to areas of thicker, recoverable oil. The developed system can do this with very high spatial resolution and accuracy. Additionally, the system can map beached oil in areas difficult to reach by boat or on foot – such as deep within the marshlands of Louisiana during the *Deepwater Horizon* spill.

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