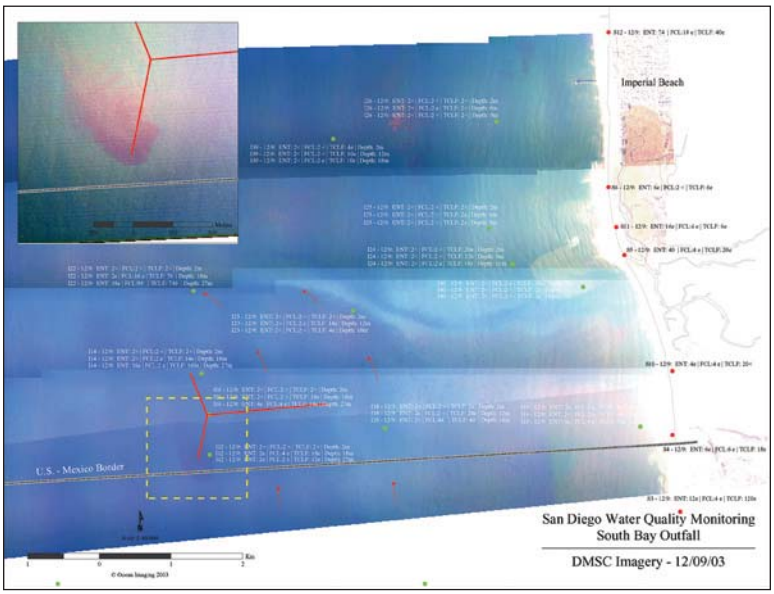
A view ABOVE ALL
News From Ocean Imaging Corporation
Volume 3 Issue 1
Winter 2004

OI Goes to Court!



Aerial DMSC mosaic of the IBWC sewage outfall and surrounding shoreline, documenting the effect of northward currents on the trajectories of the wastewater plume and coastal turbidity.

In the days following the Nicole Simpson murder, we received calls from two local TV stations asking for satellite images to pinpoint the location of (could it be?!) O.J. Simpson's white Bronco near the murder scene. Regretably, we had to decline the offers…but the inquiries definitely sparked ideas.

Remote sensing, the objective eye-in-the-sky, should be a great aid in criminal or legal proceedings. Many RS potential market surveys list "litigation" or "legal evidence" as one of the new-age uses of multispectral satellite and aerial imaging. Yet, this application has not yet expanded as widely as it could. The most frequently cited reason is credibility issues: the technology is considered so new and hence "experimental" that attorneys fear remote imaging-based evidence could be easily discredited in court.

Ocean Imaging has begun to turn these opinions around. In the past few years we have provided evidence for a variety of legal issues. One example is coastal pollution. The most common way to compromise water quality is to release toxic effluents into coastal waters. Yet another way is to cause silt-laden runoff to choke-off nearshore ecosystems through, for example, housing developments whose construction denudes coastal vegetative ground cover and may result in excessive erosion and silting. A few years back, OI was asked to provide high-resolution satellite evidence of the runoff effects from a major housing development in Orange County, California. The task was to review historical imagery from the region and assess whether the regional runoff patterns and silt amounts were altered after the extensive earth grading done by the developer.

As some of you may recall, OI has pioneered the use of RS technology for the monitoring of water quality related to offshore sewage outfalls. The sewage disposal issue is especially important in the San Diego, California area because of its immediate proximity with Tijuana, one of Mexico's fastest growing cities. Tijuana has historically released huge amounts of raw sewage along U.S. beaches via the Tijuana River, which flows through the Mexican city but terminates on U.S shores. An attempt at a multinational solution to this problem resulted in the construction of the International Wastewater Treatment Plant operated by the U.S.

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Win a T-Shirt!

Do you know someone who may have an interest in OI's capabilities and services? Send us their name and address and help us expand our Newsletter mailing list. All readers who submit at least one reference will be entered into a drawing for an OI T-shirt (5 will be awarded).

E-mail your references to kristen@oceani.com - and don't forget to state T-shirt size (M, L or XL). (Note that we do not forward or otherwise disclose our mailing list info to anyone.)

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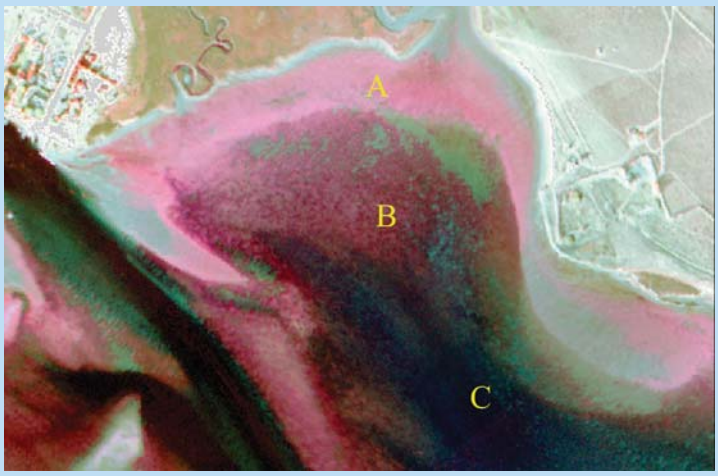
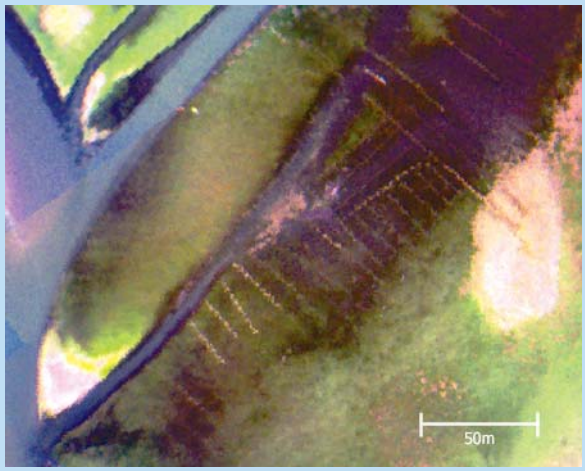
MAPPING duck food



The three spectral signatures of variously submerged eelgrass.

Since getting into the aerial sensor business, OI has done a number of habitat mapping projects related to waterfowl. Numerous species of ducks and geese that nest in the northern latitudes come down to California or Baja, Mexico for the winter. Our work involves mapping habitat and vegetation food sources in coastal lagoons used by the overwintering birds.

One important species is the black brant. This small goose is the fastest flying of all waterfowl, reaching speeds in excess of 60mph. Until the mid-1950s west coast brants spent their summers in the Arctic, then most of them overwintered in coastal lagoons between Puget Sound and California. Development, hunting and other disturbances began pushing the birds further south, however, and in 1958 they were discovered in Mexican lagoons. Meanwhile, the number of birds wintering in California plummeted by 85%. These days, the majority of black brants undertake a 3000 mile migration, departing Alaska and arriving in Baja, Mexico 60 to 90 hours later!



Scars left by oyster racks in an eelgrass bed.

The primary winter food for the brant and many other ducks and geese is eelgrass, a submerged marine plant. In addition to providng food for waterfowl, eelgrass beds also serve as very important habitat for a variety of marine animals. OI has mapped eelgrass distributions in several Mexican lagoons using our aerial sensors. Recently, we also mapped eelgrass in Morro Bay, California, which is one of the few places left in the U.S. that support overwintering black brant flocks.

Unfortunately, waterfowl habitat is often not safe even in the remote and relatively unpopulated lagoons of Mexico's Baja Peninsula. Oyster farming and other human activities are expanding there and, in some cases, result in the destruction of the eelgrass beds. Periodic monitoring is thus important to track the health of those important habitats.

Accurate mapping of eelgrass with remote sensing is a somewhat tricky proposition. We generally coordinate the imaging overflights with peak low tides to maximize depth penetration and minimize turbidity interference. Under such conditions the eel grass has three different radiometric signatures: high green reflectance in areas above the water line where the large, green blades lie flat on the ground, low overall reflectance and a brown peak in areas of deep water where the green blades are suspended vertically and the camera above mostly records the old, brown-leaf understory, and a mixed reflectance spectrum with a secondary green peak in areas where the grass is only partly submerged and parts of the green blades float horizontally on the surface.

Through experience, we have compiled the subtle differences of the various eelgrass reflectance spectra and are able to accurately distinguish them from other substrates. We hope our work will help preserve the much needed "all-you-can-eat" buffets for the brants - who lose a full third of their body weight during their migrations.

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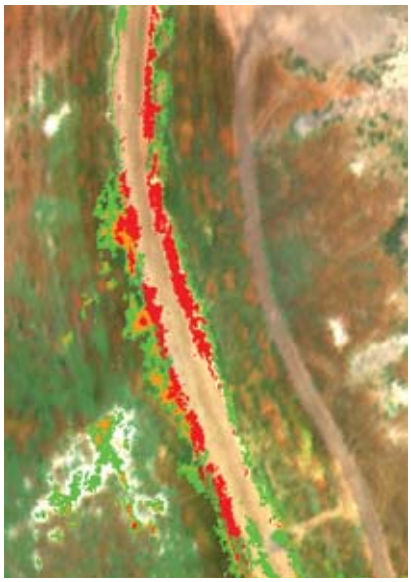
International Boundary Waters Commission (IBWC). The IBWC has been subject to several lawsuits in the past few years claiming some of the present outfall's effluent returns to shore and endangers the beach-going public's welfare. One problem faced by both sides of the issue was the great sparsity of data on the outfall plume's true behavior. Likewise, the available field sampling could not positively separate effects of the outfall plume from contamination due to runoff sources along the shore. The lawsuits were filed before any remote sensing information was available. Since then, OI has compiled an unprecedented 2+ year image record of the outfall plume's trajectories, as well as the effects of nearby oceanic processes that influence the wastewater effluent's shoreward transport. This year OI was retained as an expert witness by the U.S. Department of Justice to present opinions about the IBWC's outfall's extents and trajectory trends. OI's unique data and their analyses served prominently in the mitigation of the lawsuits which, in the Justice Dept. case, resulted in an out-of-court resolution.

Diesel floating in a Suisun Marsh channel (image courtesy CDFG).

OI has also been involved in providing evidence on *terra firma*. In May a pipeline running through the Suisun Marsh east of San Francisco Bay burst while carrying diesel fuel. OI was contracted by the State of California to use its aerial DMSC multispectral sensor technology to detect and map environmental changes in the area. Through multiple image acquisitions we were able to extract vegetation stress levels and other changes (at 30cm resolution) in and around the accident region. Our analyses are being used in the damage settlement negotiations of the case.



Classification of damaged vegetation along the edges of a marsh channel drained after the spill accident.

The well known phrase that " a picture tells a thousand words" has, in our opinion, been underestimated when it comes to using remote sensing for legal evidence. As always, here at OI we're looking forward to expanding that frontier.

OI Summer Internships .....and how we learned to surf!

OI has supported a number of summer interns through the years, ranging from high school to college students. We believe this opportunity provides interested students with an important experience not attainable through academic training. There are many differences between applying remote sensing in an academic environment and "the real world". Foremost among them is the need to complete the work on-time and profitably. That's not always easy, especially with aerial sensor work. Adverse weather or aircraft logistic issues hamper data acquisition. Processing problems due to heavy haze contamination or less-than-optimal water clarity (when mapping submerged substrate) can easily double the anticipated processing labor requirements. Our interns learn hands-on how we deal with these issues while maximizing efficiency to preserve profitability. They also have an opportunity to learn how remote sensing technology is being used in non-research environments and, in some cases, how we turn novel applications into new market opportunities.

Our 2004 intern was Ms. Neomi Mustain, a college junior at U. of California, Los Angeles. Neomi proved to be an excellent worker and soon was helping us on several projects. She mosaicked and classified imagery for regional wetland restoration surveys and helped develop a method for reliably distinguishing areas of bare ground from areas covered by dry, dead vegetation. Later, she helped apply this method to vegetation change detection for the Suisun diesel spill incident work. "Working at OI let me experience a broad range of RS applications," she says, "from developing new techniques to generating environmental information for legal settlements." She also got a chance to go along on an aerial survey and see how the data are acquired.

Besides her quality work, OI scored another benefit – surfing lessons - from Neomi, who is an expert surfer and surfing instructor. Our staff includes recently relocated landlubbers from Wisconsin, who now brag to their snowbound friends back east about "hanging ten" and "shooting the curl, dude"!

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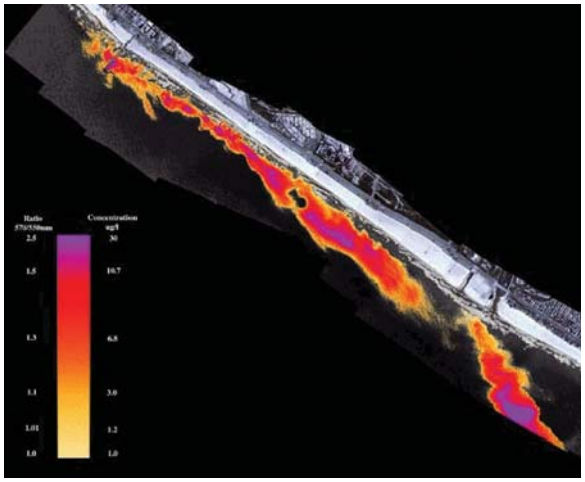
An Image To DYE For

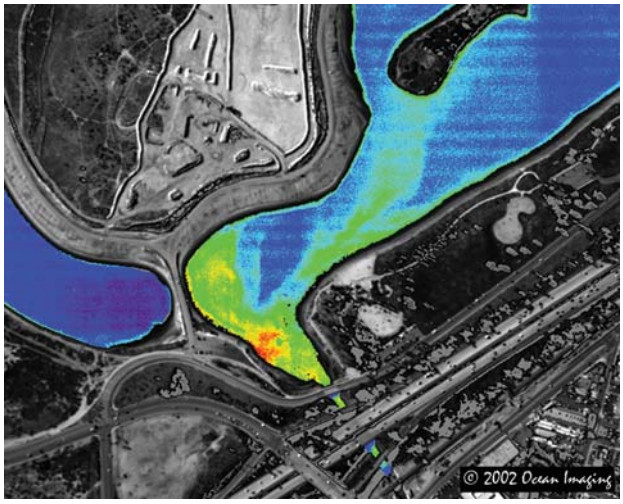


Concentration map of two dye releases along Huntington Beach, California obtained with OI's specially configured DMSC aerial sensor.

The ability to customize the channel wavelengths of our DMSC aerial sensor has often allowed us to discern hard-to-detect features or changes. Configuring the instrument for wavelengths at which the target substrate has a unique increase in reflectance or absorbance allows its efficient separation from the surrounding habitat. But what if the subject has no unique spectral signature at all? For example, what if we need to detect nearshore currents or trace the origin of effluent that is indistinguishable from the surrounding water? One technique is to use tracer dyes. Environmentally safe substances like rhodamine and fluorescein are released at the point of origin and their flow trajectories are traced visually and with specialized instruments. The amount of a dye's unique fluorescence can be measured with fluorometers and its concentration at various locations is then computed from the data. Such studies provide information on dilution rates and other variables.

The problem with handheld fluorometers is that they provide information only at the specific sampling locations. As the dye disperses, it becomes less and less visible to the naked eye and it thus gets difficult to know where to take the next sample. The OI team has developed methodology to detect even minute amounts of the tracer dyes with the 4-channel DMSC, and has used it with great success in several dye tracer studies. The trick is to configure the instrument to detect the dye's fluorescence in one channel, near maximal absorbance in another, and use the two remaining channels for background reflectance correction. The ratio of the two dye-specific channels then provides very sensitive detection capability, as well as a measure of concentration when calibrated to simultaneously acquired in-situ fluorometer readings.

We have used this technique to create image time-series documenting the spread and dilution rates of cooling water discharge from a coastal power plant, and traced the fate of potentially polluted discharges from rivers and streams. The dye studies can be quite an adventure in populated areas. When still concentrated, rhodamine turns the water blood-red. One study along a heavily used beach in Orange County caused quite a media stir when surfers suddenly found themselves swimming in the Red Sea. Our imaging data then included the outlines of TV helicopters buzzing beneath us while filming the spectacle.



Rhodamine dye distribution in part of Mission Bay, San Diego was used to track runoff from a polluted creek.

OI Helps NOAA Design NEW SENSOR

OI's President, Dr. Jan Svejkovsky was recently appointed to the Coastal Ocean Applications and Science Team (COAST) created by NOAA to help in the design of a new hyperspectral sensor. The Hyperspectral Environment Suite (HES) is planned for launch in 2012 on the next generation GOES-R satellites. Through COAST, NOAA is hoping to define applications and fine-tune NES' initial design parameters. Of particular interest is development of operational uses for HES, for which OI's multifaceted expertise in coastal monitoring is especially valuable.