A view ABOVE ALL

News From Ocean Imaging Corporation Volume 1 Issue 1

OI expands past watery horizons

Since my company's "fishy" beginnings, I have strived to grow the business by balancing both research activities and commercial services. This formula has often provided new, unexpected growth opportunities when our grant-supported research work led to findings that subsequently guided new commercial applications. We continue to maintain our multifaceted nature and have now added a number of projects on *terra firma*.

Using our DMSC aerial scanner we recently completed the mapping of inter-tidal and sub-tidal substrate along the coast of San Diego County. We also expanded our habitat mapping work to cover coastal wetlands and surrounding areas. Our Colorado office is concurrently coordinating projects to develop remote sensing capabilities for the detection of invasive plant species such as tamarisk around the Rocky Mountains.

In the late 1990s, OI received research funding from NASA's Commercial Remote Sensing Program for the development of new-coastal remote sensing applications. One of them was the utilization of this technology for improving coastal water quality monitoring – particularly discharges from offshore sewage outfalls and polluted runoff from metropolitan storm drains. While our developed methods were effective, we initially met reactions ranging from skepticism to fear that our "Big Brother is watching you" approach will only complicate local issues. We did not give up, however, and our efforts paid off last year when a remote sensing-based monitoring component was actually added to two sewage discharger permit specifications by California state agencies. The project has recently been extended for at least 2 more years.

Of course, we have not abandoned our oceanographic research slant. Our research work includes a long-running NSF-funded GLOBEC Program grant as well as NASA-funded work targeting the monitoring of Alaska's kelp resources. Another new Alaska-oriented project will evaluate whether environmental causes are responsible for the recent devastating declines of salmon populations in the Bering Sea.

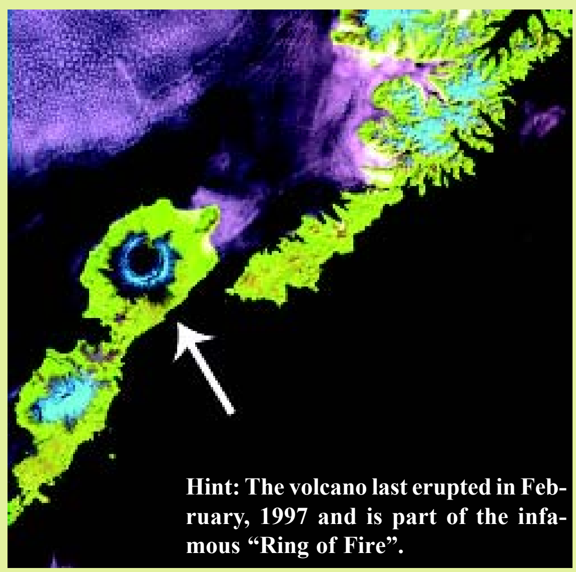
As our diversified product and service base continues to grow, we have decided to begin highlighting some of them in this periodic newsletter. I hope you find its material interesting and that you will consider Ocean Imaging for any remote sensing needs you may have in the future.

Sincerely,

Jan Svejkovsky

Dr. Jan Svejkovsky
President
jan@oceani.com

CONTEST: *Where in the* WORLD *are we?*



Above is a satellite image of an island volcano in a region of one of Ocean Imaging's future DMSC projects.

First 5 persons who correctly identify the island and/or volcano will win an Ocean Imaging "La Jolla Canyon" poster!

E-mail answers to kristen@oceani.com

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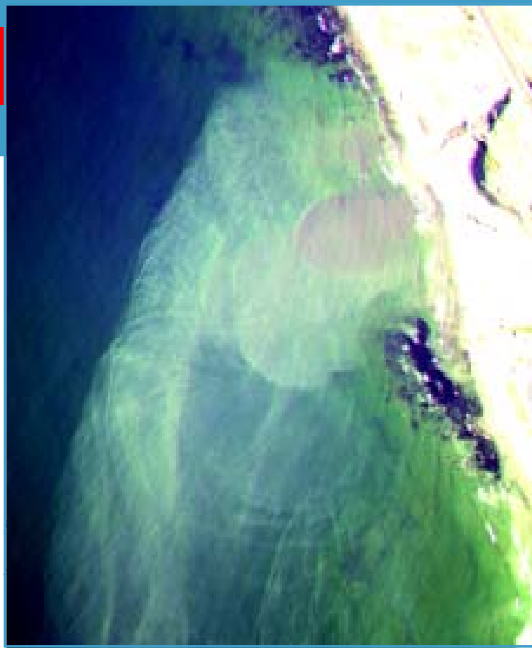
Can WATER POLLUTION Be Seen From Space?



Sewage discharge in Mexico as imaged by OI's DMSC

Storm water and dry-weather runoff from coastal metropolitan areas has been increasingly recognized as a major source of marine pollution. Runoff escaping into the ocean through storm drains and creek beds includes bacteria and anthropogenic components from sewage as well as fuel, oil, brake, tire and asphalt-related compounds from roadways, and industrial and agricultural substances. Studies of urban runoff have commonly relied on samples taken inland or at the mouth of storm drains and creeks. Sampling the runoff plume in the ocean is considerably more difficult. Likewise, state and EPA-mandated sewage outfall monitoring programs mostly rely on infrequent (monthly or bi-weekly) offshore and daily shoreline field sampling to determine the outfalls' environmental effects and to guide beach closures in areas of high contamination.

OI pioneered the utility of satellite and aerial remote sensing for detection of polluted coastal runoff and sewage outfall effluent plumes in the mid-'90s as part of coastal applications development work funded by NASA's Commercial Remote Sensing Program. That research led to several "demo studies" with promising results. The EPA and California state agencies took notice of OI's work and in 2002 a remote sensing-based monitoring component was formally added to two sewage discharger permits in the San Diego-Tijuana, Mexico region. Successes in the project's first year resulted in its recent extension for at least 2 more years, funded by both the state of California and the dischargers themselves.

So how can we monitor ocean pollution from space? There are several ways. Storm water runoff generally includes more suspended sediment than the surrounding ocean water contains, so plumes from rivers, streams and large storm drains are easy to identify with aerial and high-resolution satellite imagery. In our case, we have used our extensive experience in this field to customize our DMSC aerial scanner with wavelengths (colors) to specifically target the spectral signatures of runoff sources, and even let us distinguish between them. Similarly, we can enhance and track plumes from the offshore sewage outfalls. This ability lets us, in turn, separate the outfall plumes' effects from impacts caused by shoreline sources – and thus more objectively identify the sources of local beach closures. The high resolution and on-call nature of a well calibrated, airplane-mounted sensor has proven to be critical for an operational monitoring program.

There is yet other way to track coastal pollution. Many discharges contain surfactants, i.e. compounds that float on the water's surface. These include cooking grease and some proteins in sewage, road oil and brake dust in roadway runoff and fertilizer compounds in river discharges from agricultural areas.

Plume of surfactant-laden stormwater runoff discharge can be seen in this SAR image (original data © ESA)

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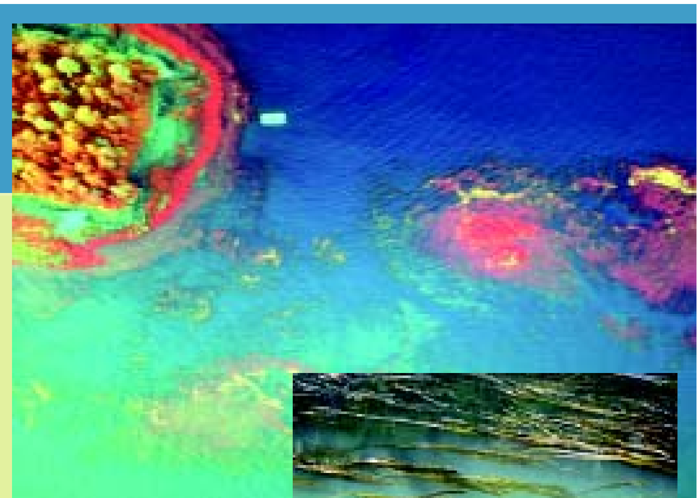
These substances tend to smooth very small wavelets generally present on the ocean surface, creating “slicks”. Such slicks can be often detected with satellite and aerial Synthetic Aperture Radar (SAR). OI used SAR data to study sewage plumes in Mexico as well as storm runoff from Los Angeles (see Svejkovsky and Jones, 2001. Satellite Imagery Detects Coastal Storm Water and Sewage Runoff. EOS-Trans. American Geophys. Union, Vol. 82(50)). In the Los Angeles case, the study revealed the existence of a strong “First Flush Effect” – the existence of very high pollutant concentrations in runoff from the first few rainstorms of the season. Coastal southern California goes for months without rain during the summer, allowing plenty of time for massive amounts of road oil and other substances to accumulate. A large amount of the stuff then gets washed out to sea when the rains finally begin.

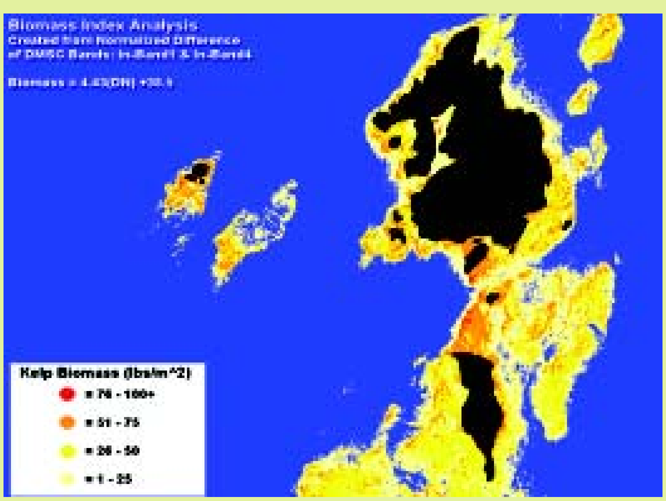
Offshore sewage outfall plume revealed by OI's DMSC.

M A P P I N G
Alaska's Kelp



The harvesting of kelp seaweeds for manufacture of food additives and agrochemical products is a significant business in Asia, Europe and parts of North America. You very likely eat kelp every day and don’t even know it! Kelp-derived algin is a thickening agent used in a myriad of food products ranging from yogurt to beer. Kelp harvesting is presently an underutilized industry in Alaska, which could provide great benefits to numerous communities. Two pioneer companies are active in this business under temporary harvesting permits. Long-term permits will be made available from the Alaska Dept. of Fish and Game only after viable kelp harvesting management plan is developed. One of the fundamental components of such a plan is the ability to quickly and economically assesses the existing kelp biomass. That information can then be used to establish annual harvest quotas and monitor year-to-year health of the resource. OI is presently in the second year of a NASA funded project to-develop and validate rapid biomass assessment methodologies using aerial multi-spectral remote sensing. The project is being done in collaboration with Dr. Mike Stekol from U. of Alaska, Juneau and kelp harvesters based in Point Baker, Southeast Alaska.

Curiously, the last detailed kelp surveys in the Pt. Baker area were done in the 1940s (from boats) because kelp-derived compounds were then used in the manufacture of gunpowder. (Is there anything that kelp hasn’t been added to?!) We did our first aerial imaging and coordinated field sampling by the U. Alaska team in July 2002. The obtained data led to our development of algorithms that provide kelp biomass estimates from the multi-spectral imagery. During summer, 2003 we will once again meet Dr. Stekol’s group at Pt. Baker and validate the accuracy of the algorithm. We will also image the entire harvesting area before and after harvest to document the effects on the regional ecosystems.



The work at Pt. Baker is quite an adventure. Because no roads lead to the Pt. Baker community, our travel and imaging are all done with a floatplane. The abundance of wildlife in the region is astounding! Last year we had bald eagles sit on the roof of our house, deer and black bears running around outside, and whales swim back and forth within 30 feet of the shore. Waiting for that

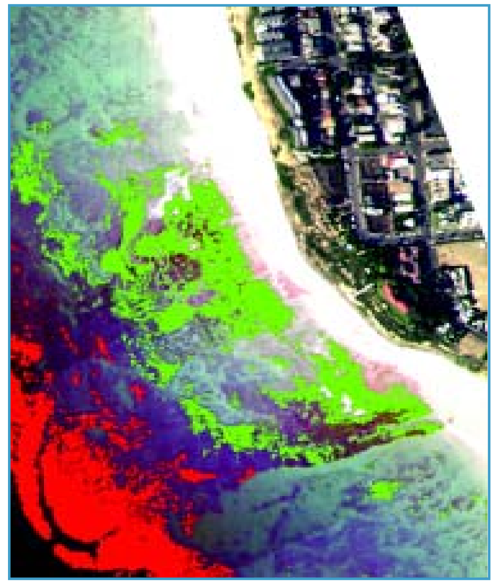
continued on the next page

OI Maps Disappearing Coastal Habitats

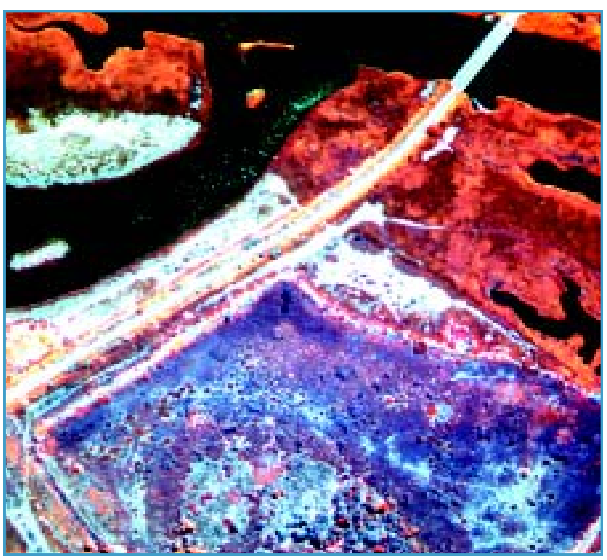
From coral reefs to coastal wetlands, near shore natural habitats are disappearing at a frightening rate. Much of this is due to direct human effects: dredging, increased siltation, draining wetlands to accommodate urban sprawl, polluted runoff. Large-scale human-induced effects are also responsible: global warming-caused water temperature and sea level increases kill coral reef communities, and cause drastic changes in intertidal ecosystems. OI has been actively involved in mapping coastal natural resources to aid preservation and restoration efforts.

Utilizing our DMSC aerial sensor, we map shallow water bottom substrate type. How deep we can accurately do such work depends on the local water clarity, but is significantly aided by our knowledge of the best light wavelength specifications for the type of substrate in the area of interest. Using this expertise, we customize the DMSC's 4 channels to match the wavelengths that allow deepest water penetration while adequately separating the various bottom substrates. We often pair with companies that use ship-mounted multi-beam sonar to map the bottom in deeper waters. Since ship-mounted equipment becomes ever more difficult (and expensive) to use in shallow water, the combination works perfectly to offer a cost effective solution for mapping habitats from above the tide line to a mile or more offshore.

Mapping submerged habitat with multi-spectral imagery is no easy task. While plants or rocks above the water line generally have the same light absorption characteristics wherever they are, the same is not true underwater. Light is quickly - and unevenly -absorbed by water: the longer wavelength (red-yellow) colors are absorbed first with increasing depth, while shorter wavelengths (greens and blues) are absorbed more slowly. Therefore, the same plant, rock or coral will "look" different at different depths. We use various algorithms to eliminate or reduce the "depth attenuation effects" and accurately identify what is on the bottom.



Kelp (red) and Surfgrass (Green) isolated in DMSC imagery



Vegetation mapping in San Dieguito Lagoon

Recently, we expanded our coastal mapping work to include wetlands and surrounding highland areas. In California, less than 10% of the original wetlands remain, primarily due to their draining for land to expand metropolitan areas. Ironically, the draining activities also suppressed river sand transport to the beaches, resulting in increased beach erosion and beach property destruction. Similar trends are happening nation and worldwide. Several programs in Southern California are presently trying to preserve and even restore wetlands. One problem is to identify spots with native vegetation vs. invasive species, which occupy large areas and displace native plants. OI's DMSC imaging work is successfully helping guide the remediation processes and monitor their progress.

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uncommon day of fog-free weather so we could do our aerial imaging was hardly a problem since the salmon fishing was phenomenal. If only all projects had such fringe benefits! Stay tuned for this year's adventures, to be included in the next issue.

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