A view ABOVE ALL

News From Ocean Imaging Corporation — Volume 3 Issue 2

Fall 2005

OI Expands on land and sea....

This summer found us broadening our work horizons with several interesting applications. As you will read in this issue, OI began imaging agricultural targets with the DMSC aerial sensor. We've been eyeing the agro business for a while and are now finally in it. We've already imaged a variety of crops ranging from cotton to citrus trees to grapes. Our recent sea-faring ventures include expanding the SeaView fishfinding services and developing new methodologies for oil spill support. The oil slick research is proving especially interesting. We started out with a pioneer project funded by the State of California and have since added work supported by the Minerals Management Service, specifically targeting abilities to measure oil slick thickness. If the distribution of oil volume becomes known from the area and thickness mapping, response crews can better decide where to go first and what containment or dispersal methodologies to use. In related news, we have also received another year's extension on our San Diego region's coastal water quality monitoring contract, and plan to include the newly developed oil sensing capabilities as soon as they are available and tested. As always, I hope you will enjoy reading through our newsletter and welcome any comments. If you have a need for our expertise, or an idea for a collaborative project, please let us know!

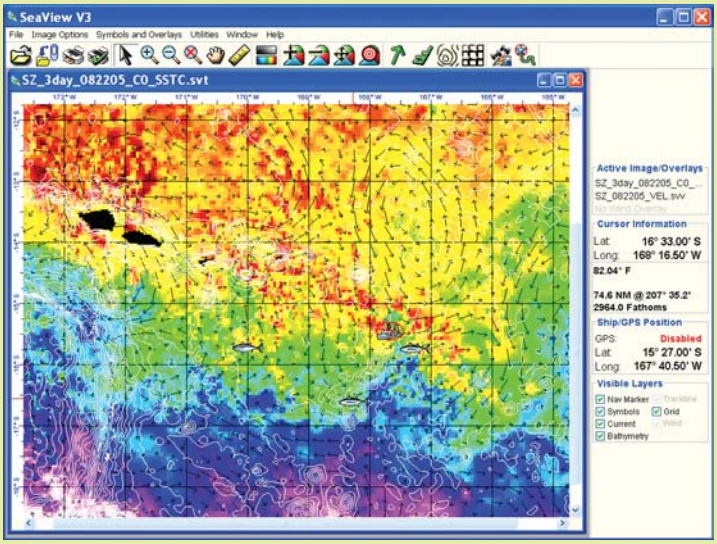
Sincerely,

jan@oceani.com

SeaView 3 Released!

Our fishfinding software "SeaView" got a complete make-over earlier this year and is now hard at work on the world's oceans helping sport and commercial anglers locate the best fishing spots. Evolving from a simple-to-learn image viewing program designed especially for fishermen, the latest SV3 is essentially a fishing-oriented Geographical Information System (GIS). We knew well, however, that our clients are not (with a few exceptions) computer geeks, and don't have the time to ponder over software manuals. So the newest program retains the intuitive feel of the old, while providing truly state-of-the-art access to a wealth of information.

Working closely with our long-term clients, we let them guide the software development. Noteworthy new "bells and whistles" include automatic boat track display through a GPS input, overlaying of bathymetry contours on top of satellite images, as well as several other data 'layers' such as ocean current vectors, ocean surface winds and context-rich symbols that allow the user to mark and track fishing spots. SV3 was beta tested this spring on a number of vessels fishing the North and South Pacific. When we started receiving Inmarsat messages like: "This SV3 is Awesome!", "I'm really impressed with the enhancement capability" and "Addicted to SV3!", we knew we had them hooked!



Temperature, current and bathymetry information yielded tuna school spots near American Samoa.

Back in the early days of our fishfinding services in the early 90s, SeaView was preceded by black and white charts of ocean temperature boundaries transmitted to fishing boats at sea by Weatherfax. Since wefax signals could not be legally scrambled, our charts were sometimes accidentally received by other ships. In one case, the

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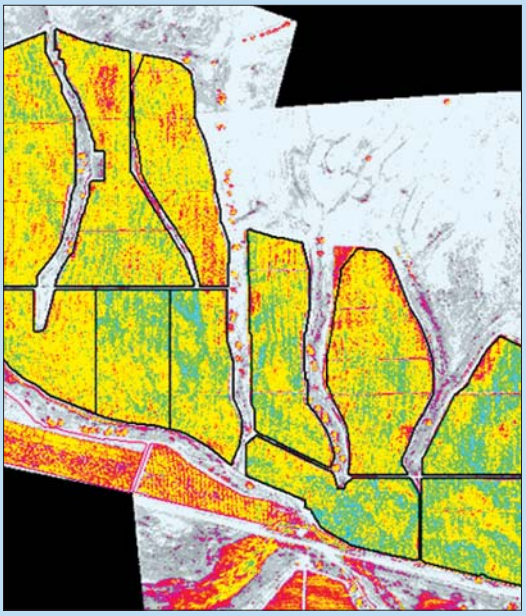
OI Goes Farming



Growth vigor in vineyards as revealed by our aerial DMSC sensor.

The summer of 2005 marks another first in OI's expanding activities: remote sensing for agriculture. While we've long recognized this new business potential for our aerial DMSC sensor, we lacked the sales contacts and insider know how to easily start-up an agro venture. Earlier this year we had an opportunity to partner with EarthMap Solutions, Inc. – a Colorado-based company whose staff comes from several past major agro remote sensing projects. Together we have begun to provide growers with various image products that help them monitor their crop health and maximize their yields. So far, our target crops include cotton and grapes. The vineyards work was heartily welcomed by our oenophile staff members who are now insisting we need to conduct frequent ground-truthing "research" trips into Napa's and Sonoma's wine country.

The technical aspects of collecting and processing multispectral imagery for agricultural applications are a bit more demanding than in some other aerial imaging work. First, the imagery must be very precisely calibrated since slight changes in sun angle or atmospheric attenuation could cause errors in the final plant health or yield algorithms. To accomplish this, we use a spectrometer both on the ground and continuously during flight to record any ambient light level changes at the wavelengths chosen for the DMSC's four channels. The radiance values of individual image frames are then adjusted accordingly. Second, once collected, the data must be processed and delivered to the grower very quickly. On larger missions we sometimes use two on-site crews so that one can begin processing the freshly collected data while the other flies to image the next set of fields.

Perhaps even more challenging than the technical collection and processing aspects is the business side of the work. Presently OI acquires and partially processes the imagery for EMS for a fixed per-acre price. However, each flying mission differs in the locations of the target fields, their orientation and distribution relative to each other, weather concerns, etc. This changes operation costs, primarily the cost of aircraft time. For this reason our staff carefully prepares a flight plan which minimizes flight time while maximizing data acquisition efficiency. The plane's track often looks like we were part of some wild aerial treasure-hunt game, zigzagging here and there over the vast "ocean" of agro fields.

Did you know....

That the birth of agro remote sensing in the U.S. partly has its roots in the Cold War? Back in the early 70s, a project called the Large Area Crop Inventory Experiment (LACIE) was funded by the U.S. government to develop methods for forecasting crop yields using multispectral imagery from the Landsat satellite without the need for ground truth data. This then allowed the U.S. to remotely keep an eye on Russia's crop production and, for example, verify that Russia's call for help due to claimed wheat crop failures in 1974 was indeed justified, rather than a covert ploy to obtain wheat internationally at favorable market prices (as some critics claimed).

Our new "ocean" of fields in California's Central Valley.

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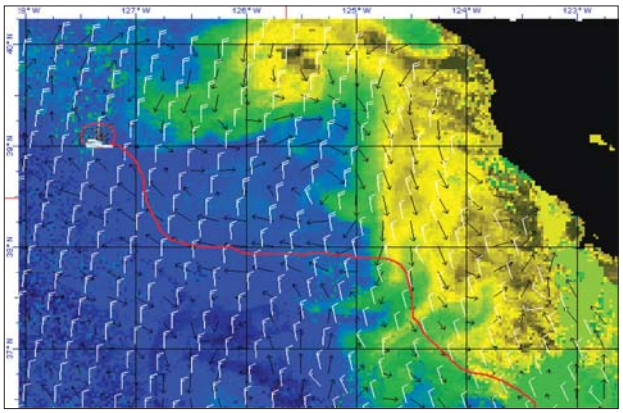
SeaView continued from page 1



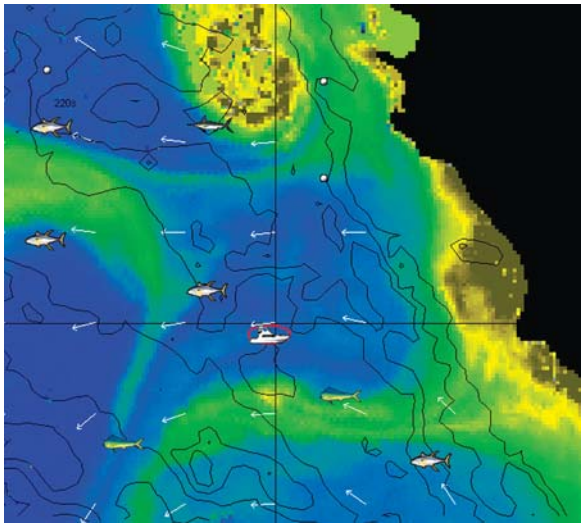
Using current and wind data helped a commercial vessel save fuel and travel time.

accuracy of OI's charts prompted a Navy captain to officially complain that the fishermen get better and faster information than his own ship. SV3 represents our continuous effort to provide the best remote sensing-based fishfinding services possible.

The various image and non-image data are acquired by OI staff, and are then immediately processed, yielding several updates each day. Images from sensors that cannot penetrate clouds (e.g. thermal and ocean color radiometers) are additionally used to create various multi-day composite products which show only cloud-free pixels, thus artificially clearing the ocean regions of clouds (with some unavoidable reduction in temporal accuracy). Automatic messages are then sent to the boats via satellite telephone and messaging systems to notify captains that the latest data's availability. The boats download the products of their choice through the Internet via satellite phone links.

So how do fishermen actually use the plethora of temperature, chlorophyll, sea height, thermocline depth, bathymetry, multi-day composite, surface current, SST anomaly information to catch a fish? The fact is that, with the help of OI's expert staff, most are still learning how to merge the different types of information to get the complete 'picture' of conditions on the fishing grounds. But many have realized links between conditions they know tend to yield good fishing and satellite-derived variables delivered to them by SeaView. If they are just starting a trip, this means using SeaView products as roadmaps to head directly to the best looking spots and thus save time and costly fuel. If they are already on a good spot, SeaView images help them visualize its movement so they don't lose it with time.

One U.S. albacore troller admittedly ponders the changing water structure well into the wee hours of the morning. Satellite email messages such as the one below have literally been written at 3:00 AM (in a condensed form to minimize costly satellite message size – can you read it?): "HiOI….ILikeSSTPttrns,AllTheConvergingCurents,LatitudeEtc,SeemsSomewherArndWilCollectFshMaBInANarrowButConcentratedZone…IReallyLikeTheNewProgram&NowThatWeROnFishCanLearnEvenFastr!"



Tuna schools marked on a plankton image by a long-range sportfishing charter.

CONTEST

Where in the WORLD *are we?*

This past spring a part of our crew ditched their computers for a while and formed the OI Ski Team! Our two trips were to a ski area that peaks at 11,059 feet and got so much snow this year its namesake could have easily been buried in it. (The satellite image is from July!!!!!) The first 5 readers that identify the area by name will **win a free ski vacation** (OK, we can't really do that but we will send them a cool OI tee-shirt)!

E-mail your answers to kristen@oceani.com (don't forget to state your shirt size M, L, XL).

Need Oil, Will Travel

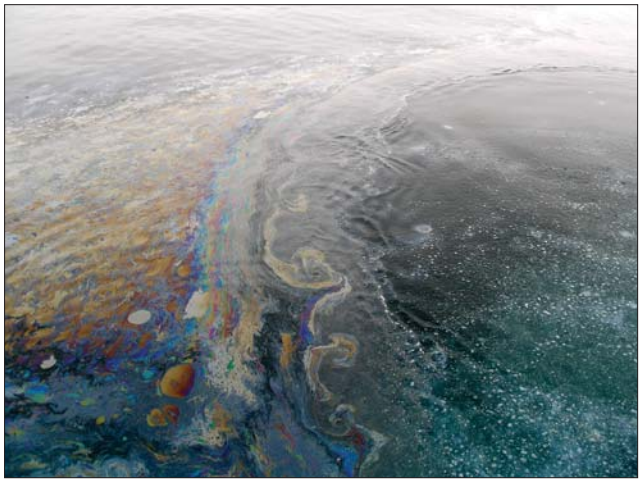
Heading into a natural oil seep....

As we discussed in a previous issue, OI is developing methodologies to identify and map oil on the ocean with aerial sensors that could be quickly deployed during oil spill emergencies. Most recently, under funding from the Minerals Management Service, we are working on algorithms to estimate oil film thickness from multispectral data. The trick is to determine specific wavelengths whose relationships would best correlate with oil thickness. MMS kindly provided us with samples of various crude oil types and we first investigated their spectral properties in lab experiments. Nothing beats studying the real thing, though, especially since the upwelling radiance detected by the airborne sensor over an oil spill is a combination of reflectances from the oil, the oil/water interface, as well as the deep water below the slick. This combination is impossible to accurately reproduce in our modest lab. Not being privy to an existing oil spill nearby, we considered going to sea and dumping some of our samples in the water. To do this legally, however, we needed a variety of permits which, we soon discovered, would be harder to obtain than winning the state lottery.

Fortunately, Mother Nature is providing us with an unusually convenient alternative: natural oil seeps in the nearby Santa Barbara Channel. We have already flown over the seeps and imaged their signatures several times, but our oil thickness detection research necessitated obtaining reflectance spectra directly from a boat with a portable spectrometer. The trip turned out to be even more interesting than anticipated.

Some of the largest seeps release not only oil but gas as well. From the air they appear almost white as the bubbles pop to the surface from 200 feet below. This brought up two questions that we pondered as our chartered boat raced toward one such seep: 1) Can a boat sink in the bubble-laden water? 2) What happens if someone should light a cigarette while passing over the seep?

Our captain assured us that the answer to #1 is "No", since he has passed through the area a number of times before. The answer to #2 was not as certain. Motoring into the midst of the seep was indeed a strange experience. Most of the bubbles are less than an inch in diameter when they reach the surface but thousands of them stream up steadily, giving the visual and audible sensation of floating in a giant glass of champagne. There is strong odor of crude oil in the air but since we did not pass-out after 15 minutes or so, we figured the gas must not be terribly concentrated and dared the boat's mate to "flic the Bic". After some cajoling, he lit up his lighter….with no ill effects to him or the rest of our expedition.



Bubbling gas on right, fresh petroleum on left.

Capturing absorbtion spectra with a fibre optic probe.

We collected our spectra of oil films ranging from sheens to mucky accumulations several millimeters thick. The data should prove invaluable for our algorithm development, and a follow-on experiment with a sampling vessel and aircraft carrying our DMSC imager is planned for October, 2005. Both, MMS and California's Office of Oil Spill Prevention And Response will participate in that one.