CODAR
CURRENTS

CODAR
OCEAN SENSORS

Seymour Discovery Center
& Long Marine Lab
in Santa Cruz, California.

CODAR Ocean Sensors, Ltd. Announces its Fall 2005 Session HF Radar Training Course:

CODAR Ocean Sensors Fall Training Course will be held at the Seymour Discovery Center (UC Santa Cruz's Long Marine Laboratory).
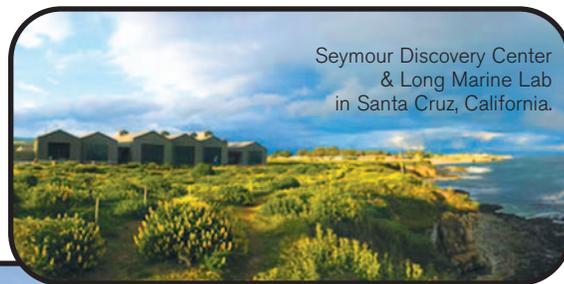
Tuesday 1 November at 9:30AM
through Friday 4 November at 3:00PM

Course Fee:
Tuition is USD $750 per person, and includes course materials, 4 lunches, two dinners. New SeaSonde owners should contact Company for priority reservations.

Training Schedule:
A DRAFT schedule is available on our website for download (Word document - 24K).
Software sessions will focus on SeaSondeRadialSuite_10 and SeaSondeCombineSuite_10 (Mac OS X).

Class instruction during
Spring 2005 Training Course

Course Reservations and Payment:
Registration Form (PDF 20K) is available on our website for download. Please fill-in and FAX to +1 (408) 773-0514, or send an e-mail containing the same information to: support@codaros.com.

Registration and payment must be received by October 1st. Payments can be made via check (U.S. only) written to CODAR Ocean Sensors, Visa credit card, or issuance of a Purchase Order from your institution.

Mail check to: CODAR Ocean Sensors, 1914 Plymouth Street, Mountain View, CA 94043 USA, Attn: TRAINING COURSE. If paying by credit card, please fill in Credit Card Authorization section at bottom of Registration form and FAX to:
+1 (408) 773-0514.

For more information on Group Lodging & Driving Directions, Please visit our website.

Are you up to date?

SeaSonde10 users should be running:
SeaSondeRadialSuite10 Release 3 with Updater3 installed.
SeaSondeCombineSuite10 Release 3 with Updater3 installed.
Mac OSX 10.3.9 (Jaguar) or 10.4.2 (Tiger)

Third Party Software:
Timbuktu 7.0.4 (required for latest Timbuktu scripting).
Timbuktu 8.1.1 is currently undergoing testing for compatibility.

OS9 SeaSonde users should be running:
SeaSonde 4.4f6
Mac OS 9.2.2

NOTE: SeaSonde10 Release4 is scheduled for release November 1, 2005.
The following features are specifically in Release 4:

• Wave Model Method data output for multiple user-specified range cells.

• Default file output is now LLUV (Latitude/Longitude positions with u and v components) for radials and totals. The LLUV files contain much more meta data of the settings used, the tool versions, and diagnostic info over the radial's coverage time.

• LLUV radials now contain more quality factors: Temporal, Spatial, maximum velocity, and minimum velocity. Only the Temporal or Spatial is available to the older radial output.

• Enhanced LLUV and SeaDisplay grid and vector positioning from use of the great circle calculation.

• New Transponder controller in SeaSondeController should make it much easier to setup the receiver and the transponder for antenna pattern measurements.

• SeaSondeAcquisition raw cross spectra files are now named with the standard spectra date stamping so that they can be easily archived.

• New utility SpectraScrambler that can unscramble cross spectra that were generated with swapped antenna channels.

ECO Updates (Engineering Change Orders):
ECO_050601_TR_chip_replacement - This change order is only for users experiencing firmware lock-ups of the AWG and or T/R modules that produce a loss of transmitted power and require site visits to cycle power to the receiver hardware. The D4 chip replaces the older D2/D3 chips and is user installable. This chip upgrade is NOT recommended if you are not experiencing these problems. Contact COS for additional information. (link to details/ECO document).

Waves from the SeaSonde

Background:
Currents are mapped based on scatter from waves. So why isn't getting wave information even simpler, i.e., like the first step? The answer is: these dominant echoes that contain current information come from short, not-very-high ocean waves that are not

all that interesting. True wave information comes from a weaker, more complicated part of the echo spectrum, called second order. Barrick (of CODAR) was the first to derive the model relationship that explained this echo 35 years ago. Lipa (of CODAR) was the first to use this model to "invert" the echo and get wave information nearly 30 years ago. She and Barrick did this first for HF radars with big phased array antenna systems, and later for SeaSonde-type radars with compact antennas. During the interim, we have been working on making wave extraction robust and meaningful (as have others). We're there! It's taken a long time, hasn't it? But then, it's "second order", and that's more complicated.

A Quick Lesson on Waves:
Waves in deep water are statistically the same over a large distance (called fetch) and for a long time period (called duration). For example, 3-m high waves (significant waveheight) change very little over fetch distances of 150 km and time durations of 10 hours. At particular locations for short periods of time, their random nature can cause much larger (or smaller) waves to appear briefly and then die just as quickly. But these "rogue waves" cannot be observed by any HF radar. The radar can only obtain statistical averages over an area several kilometers on a side. Hence, it doesn't make a lot of sense to "map" waves in deep water over distances of ~40 km (the maximum for wave monitoring from second order echo with affordable HF radars). The interesting "sea-state waves" just don't change over these scales, like currrents do.
Waves do begin to change statistically when any of three things happen. (1) They move into shallow water near shore; (2) They diffract around a headland or are funneled through offshore islands; (3) They encounter strong current shears. For example, the 3-m high wave with period 10 seconds and wavelength 140 m will begin to change when the depth is less than about 30 m. Its direction changes (it comes in more perpendicular to shore), its speed changes (it slows down), and its wavelength shortens; its temporal period (10 s) always remains the same. The bathymetric impacts will transform the deep-water non-varying offshore wavefield, causing it to vary with position along the coast. And, it really is the waves coming onto the coast that everyone wants to know -- these are the ones that do the damage.

What the SeaSonde Measures:
With the above in mind, SeaSonde wave algorithms were created to measure the onshore deep-water wave spectral parameters, of which waveheight, period, and direction are the simplest and most important descriptors. Our algorithms right now assume the measurements take place in deep water. We've found these to be adequate perhaps 95% of the time. We will soon have versions that account for shallow water. But remember, they still find the deep-water wavefield, the part that doesn't change with position. It was these waves that produced the near-shore variations along the coast in the first place. However, these variations are obtainable from the same shallow-water refraction/dispersion relations used in our inversion algorithms. Therefore, you will have "mapped" the wavefield to positions along the coast by starting with the non-varying deep-water wavefield. SeaSonde wave parameters are outputted typically every 10 minutes, but then are usually averaged over an hour to reduce the natural random statistical fluctuations, as is done with wavebuoys.

Limitations:
There are limitations to ours or any HF radar's ability to measure waves that must be disclosed. (1) Radars that operate at higher frequencies (e.g., 25 MHz) cannot measure high wave conditions (e.g., greater than 4-m significant waveheights). The theoretical model needed for the algorithm doesn't permit it. (2) Strong currents across the radar cells will limit wave information obtainable. This also becomes worse at high radar frequencies (e.g., a 2 knot current at 25 MHz will not allow observations of waves whose periods are greater than 8 seconds). (3) On the other hand, although low radar frequencies (5 MHz) can extract any waveheight under any current conditions, the second-order spectral echo is weaker and more prone to be buried by noise or interference. For the SeaSonde, this means robust and continuous wave measurement pretty much ceases when waveheight is less than 1 m at 5 MHz, but is super for higher wave conditions. With these disclosures, what's left still encompasses an awful lot of the coastal wave climatology of interest. All the while, you are mapping currents with your SeaSondes. And, you don't have anything in the water to get fouled or lost! It's the only "non-contact" coastal wave monitoring system
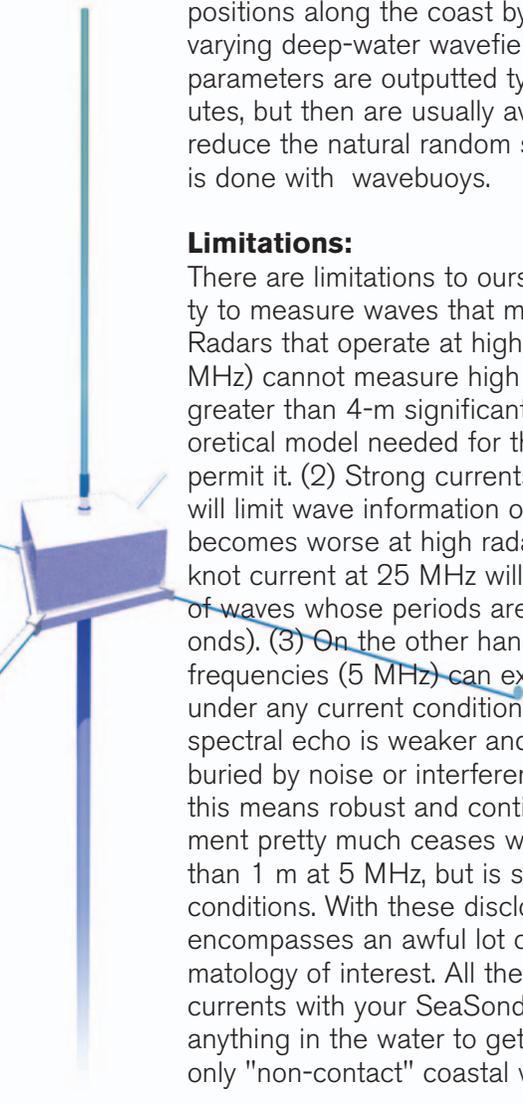
that has proven its salt over many years' operations and tens of radar locations. And finally, you didn't pay anything extra for a wave software package -- it comes free with your SeaSonde!

Setup Specifics:
CODAR staff want to help you set up your software for your coastal radar location, at least the first or second time. First of all, based on the frequency band of your radar, we will look at: (1) the depth offshore; (2) the maximum expected current flows close to shore. We can then advise you whether and when wave measurements may be meaningful.

Secondly, we can help determine the required parameters for your set-up files (Preferences). These include: (1) angles subtended by the local coastline; (2) which range cell(s) to use for wave processing; (3) noise threshold; (4) parameters that help find the boundaries between first and second order echo -- the former used for currents and the latter for waves. And then we will monitor your system performance for waves during the subsequent weeks to help fine-tune these parameters.

Tech's Corner

Wave Processing in Multiple Range Cells Simultaneously!!
-- New With SeaSonde10Release4 --

What's New With SeaSonde Wave Processing:
SeaSonde10Release4 software provides two wave algorithms for estimating wave parameters from sea echo. The Wave Model method has undergone a number of refinements this year and we are very excited about the quality and close agreement of data from SeaSondes with corroborative data available from nearby wave buoys. This algorithm processes each CSS file into a wave measurement point . The wave height, period, wind and wave direction parameters are stored as individual lines of text in a monthly summary WVLM* (ASCII) files. The text files can be plotted with WaveDisplay or easily imported into users' custom scripts.
The alternative algorithm is Wave Spectral and uses a spectral inversion approach for estimating wave parameters. This algorithm processes CSA (hourly averaged CSS) files into hourly wave measurements which are then stored as individual lines of text in a monthly summary WVLS* (ASCII) file. Hourly Wave*.wv4 spectral files are also produced. The spectral files contain period, spectral energy and direction for each of the frequencies sampled. This algorithm does not support multiple range cell processing. Follow the links below for additional details about Tsunami wave detection and wave measurements with SeaSondes.
http://www.codaros.com/images/about/2005Lipa_Tsunami.pdf and
http://www.codaros.com/images/about/2005Lipa_Nyden_wave.pdf

New Features in WaveDisplay:
Simultaneous plots of measurements in multiple range cells are now possible with our latest version of WaveDisplay. This provides an invaluable check for wave measurement consistency from range cell to range cell (note wave height trends in the plot below). The "Multiple Ranges" checkbox found in the "Radial History Adjuster" window activates this new feature. Checking this box allows you to plot a single "Wave Model" parameter for up to three of the selectable range cells using the tabs in the window. If WaveDisplay is set as a "Startup Item" at your radial site a real-time plot will be displayed and updated with each CSS processed. A jpeg or png image is also created automatically and stored in the directory
/Codar/SeaSonde/Data/Pictures/Latest/WaveFit Model.jpg
This is a ready-to-use graphic that can be posted to the user's web site.
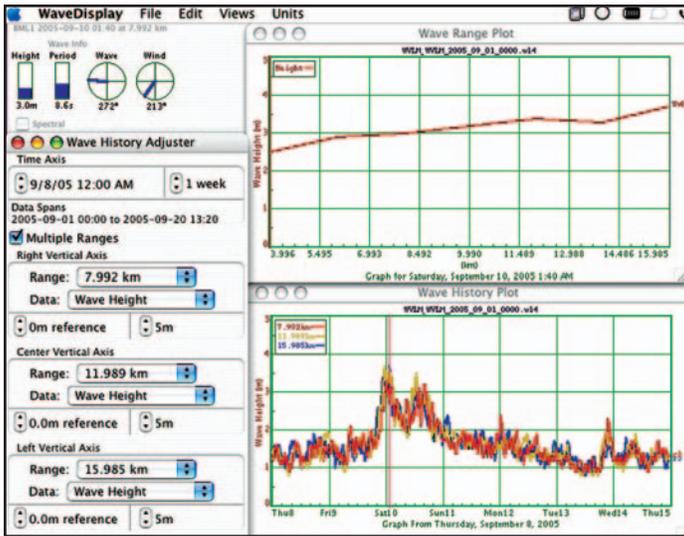
Wave Parameters in Up to Three Range Cells Can Be Plotted at Once

Can't Wait?:

CODAR staff want to help you set up your software at least for the first time. But if you're the type that can't wait to try out our new tools and would like to turn on wave processing just to have a look, here's the "Easy Install" method. The method and settings below are appropriate for many (but not all) SeaSonde installations. If the default software settings below produce unexpected results (or no results at all) please contact us.

### Steps for Turning on Wave Processing:

First have a look at: (1) the depth offshore; (2) the and maximum expected current flows close to shore. Then decide if your site has the appropriate wave environment to process waves (based on Barrick's recommendations in the preceding article).

Configuring the Software:

Two important parameters must be set manually* in the header.txt file (located in the RadialConfigs folder) using a text editor. Line #15, Parameters 3 & 4 ("factor down peak nulls" & "wave noise factor" should be set to 10 & 3 respectively. The maximum number of range cells for wave processing is set with "parameter 1" in Line #14 of header.txt. If you put in "5", you will get wave measurements in range cells 1-5 provided that you have second order peaks in your CSS files out to range cell 5. If no second order peaks are present then no data should be produced. Second order peaks are rarely detectable beyond range cell 5 so this is a good starting point for first-time setups.

The coastline coverage bearings can be set using the RadialSiteSetup utility (/Codar/SeaSonde/Apps/RadialTools/RadialSiteSetup). We recommend that you stick this icon in your computer's dock for quick and easy adjustments to wave and current processing parameters. As you face out to sea measure the true north (unobstructed) bearing to your right and to your left. If you

have a compass, you can use the program MagneticDeclination to convert to true north. Alternatively, you can estimate True North bearings using SeaDisplay in conjunction with your site file. The total span must be at least 160 degrees and less than 200 degrees.
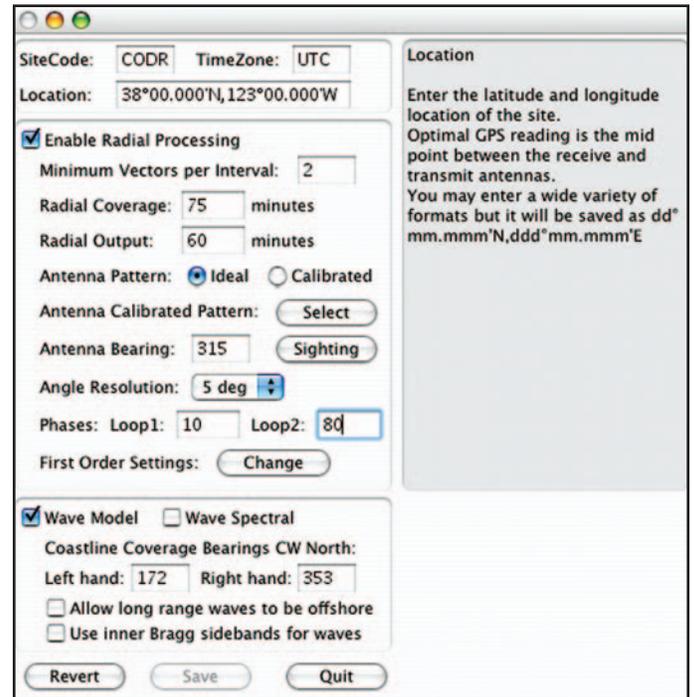
Configuring Wave Processing With RadialSiteSetup

If your site is a 5Mhz Seasonde located on an offshore platform or a small island that may have waves coming from behind the SeaSonde, then the "allow long range waves to be offshore" box needs to be checked. The coast angles can then be set with no limit to the span.

The "Use inner Bragg sidebands for waves" should be left unchecked unless advised otherwise by CODAR staff.

Lastly, check the appropriate box to activate "Wave Model" processing (best option) and/or "Wave Spectral" processing. Relaunch the SeaSonde processing software and note the comments in the Terminal window as the processing tools are run. Report any errors or problems to our support staff. On first startup it may take up to 30 minutes for the "WaveModelForFive" file (for Wave Model Processing) and/or the "WaveForFive" (for Wave Spectral Processing). This only occurs the first time the new wave parameters are run. If the wave parameters are changed the initial startup will repeat this step to create updated WaveForFive and WaveModelForFive files.

Need Help? If you need assistance evaluating your preliminary data or if your software is not performing as expected, please email us support@codaros.com or call 408-773-8240, Ext. 24. We're here to help and will be more than happy to help you fine-tune your wave processing parameters.
*The new version of SpectraPlotterMap utility in Release4 also provides an interactive method to set first order (currents) and second order (wave) parameters.

Help is Available if You Ask

CODAR has a dedicated and experienced Support team available to help customers with potential problems, and can provide instant feedback if you suspect something is not right with your data.

Examples of situations that might precipitate contacting our support staff: (1) Significant variations in maximum coverage, e.g., radial map patterns fluctuate by 40% over a 24 hour period. (2) Noticeable, regular gap regions appear in specific positions on your maps. (3) Wild vectors occasionally are spotted in circular bands at ranges from one or the other site from 100-130 km (for Long-Range systems).

Any change from data outputs that you had been getting, or from what you expected, can probably be remedied … But we need to know what you are seeing that you don't like! We will then swing into action, diagnose your problem, fix it, and educate you as to what happened.

At the lower operating frequency bands, late-afternoon and nighttime radio interference is known to occur, even in systems that had not been seeing this before. Nighttime is when radio broadcasters use the lower HF band, and usually for only a few hours. Such interference appears as noise to our processor. Maximum range will decrease during these periods, even though vectors closer in are perfectly valid. Remedies are to shift positions within your present authorized frequency band, or move to another frequency that you were granted. We can diagnose this immediately, and teach you how to do it also.

PLEASE NOTIFY US OF ANY PLANNED CHANGES BEFORE OR WHEN YOU MAKE THEM

Often a customer will change frequency bands, move one of the antennas, or rotate the receive antenna, perhaps for a very good reason. We can often advise you before such a change what kind of "domino effect" this could result in. Also, immediately after the change, we can monitor your system to verify that it is operating correctly, or make recommendations for additional modifications. Again, we will keep you informed as to what we find. Nearly 85% of problems happen as a result of a change to system settings (software or hardware) that we are unaware of. We only want your systems to be producing the best possible data for you. When that happens, we both look good. But we can only do that with input from you.
Don't hold back!

If you have any questions please email us: support@codaros.com

CODAR
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1914 Plymouth Street
Mountain View, CA 94043 USA
Phone: +1 (408) 773-8240
Fax: +1 (408) 773-0514
www.codaros.com