ONR Seabed Characterization Experiment 2016 Workshop III

TUE 09 DEC 2014 - THUR 11 DEC 2014

Overview of the Seabed Characterization Experiment 2016

The Seabed Characterization Experiment (SCE2016) is an acoustics experiment sponsored by ONR for the purpose of characterizing seabed physics, particularly the acoustic properties of mud bottoms. The main goals of the experiment, as discussed in Workshop III, are to

1) understand the physical mechanisms of the seabed that control propagation;
2) quantify uncertainties;
3) assess performance of geoacoustic models and inversion techniques.

SCE2016 encompasses several planned experiments to be performed in a shallow water location where acoustic interactions with the seabed can be measured. Individual experiments will use the general form of allowing some sound source to produce acoustic energy which will interact with the environment and be recorded using a receiver, generally a hydrophone array. As of Workshop III, a site off the New England coast covering a 20 km x 20 km square area is the planned location. A preliminary environmental survey of the location was done prior to Workshop III. A geo-physical survey for the purpose of site characterization is planned for July-August 2015, and will consist of a chirp survey, a coring expedition, and a multibeam sonar survey. The survey and associated laboratory analysis is expected to determine physical and geophysical properties of the location and the sediment. The main experiment is planned for April 2016 and will consist of several sets of acoustic experiments which will use either ambient noise or active sound sources and receive acoustic data on various types of receivers. Ambient conditions such as wind speeds, temperatures profiles, and sound speeds will also be measured using a variety of instrumentation. Several institutions, including several international organizations, plan to conduct experiments and/or contribute equipment.

Overview of SCE2016 Workshop III

The 3rd planning workshop for SCE2016 was held at Applied Research Laboratories, The University of Texas at Austin, over three days, Tuesday, December 9, 2014 through Thursday, December 11, 2014. The purpose of the workshop was to

1) discuss the new location and decide on a specific site on the New England shelf; discuss its properties and its challenges, and plan accordingly;

2) develop site characterization plan;
3) develop experimental plan.

As discussed in the previous two planning workshops, a mud patch in the Gulf of Mexico near Corpus Christi was the originally intended experimental site, but based on ONR funding focus, the site has been moved to a location on the New England Shelf within a region 40-41°N, 70-71°W. The new location is more complicated and more scientifically challenging due to much shallower mud overlaying a sandy basement, significant range dependence, and significant anthropogenic activity. Perhaps the most important subject of Workshop III was the discussion and finally the resolution of the exact location for the new site. Because of the complexity and difficulty of the new location, two other locations were proposed, one to the North and East, and another to the south, both approximately adjacent to the first proposed New England site, with all three proposed sites within the 40-41°N, 70-71°W region on the New England Shelf. The pros and cons of each of these locations (or of a new alternate location), and making a decision on which of the three proposed sites became a main focus of the workshop After further discussion in plenum with emphasize on the main objective stated by ONR, by the end of the workshop the group reached consensus in defining the original survey box as the final region to be surveyed during the summer 2015 and as the final region in which to conduct the SCE2016. Ultimately, the first New England location was chosen because it has the deepest mud with the smallest grain size, and the best chance to do experiments with a sediment to water sound speed ratio less than 1, and therefore best fits the purposes of the experiment.

The geophysical and acoustic properties to be measured and the plans to measure them was the other major subject discussed. The survey team gave several presentations addressing the plan for the geophysical survey and one breakout session formed a list of the geophysical properties that the acoustic experimentalists and sediment modelers wanted from the survey team. Several workshop attendees representing a variety of institutions from the United States and Europe gave presentations on previous work, future work, what experiments they would like to perform in SCE2014, what equipment they would require, and what equipment they could contribute. A breakout group produced a white board model of the location indicating where in the 20 km x 20 km box they wanted to deploy equipment and take measurements.

There is a missing link relating geological and geoacoustic seabed properties for mud. For sand this link is established by for instance Biot's theory and/or Buckingham's grain-shearing seabed model. Similar mathematical models depending on geological properties (porosity, bulk density, etc) do not exist for mud, and scientists involved in the SCDE2016 are progressing in developing such a mathematical model for mud. This requires additional laboratory measurements of physical, chemical and wave properties of mud samples compared to measurements required for sand samples. An important aspect of the mud properties is the gradient of the geoacoustic properties as a function of depth into the seabed, in particular the shear properties. The shear properties of the sediment may be linked to more fundamental geophysical quantities than other geoacoustic parameters. [PN]

There were around 35 participants mainly from USA, but also representatives from Norway (FFI), France (ENSTA) and Italy (CMRE) were present to propose measurements, analysis techniques and equipment for possible employment during the SCE2016. The expertise of the participants covered areas in geology, geophysics, oceanography and underwater acoustics including disciplines within numerical modelling and experimentation. [PN]

SCE2016 Workshop III Proceedings

Tuesday, December 9, 2014

Opening Remarks from ONR

A schedule of upcoming events for the ONR program was presented by Kyle Becker of ONR. The Seabed Survey is planned for August 2015. Following that, in April 2016, the Seabed Experiment will take place just south of Martha's Vineyard and Nantucket. There is an Arctic experiment planned for September 2016, and an experiment in a slope region is being planned for 2018. (SS) Becker referred the audience to this website for any questions regarding funding by the Navy: http://www.finance.hq.navy.mil/fmb/pb/books.htm

Introduction

Preston Wilson gave an overview presentation in which he discussed the scientific goals of the experiment and how the new site will affect those goals. A frequency range of 10 Hz to 20k Hz was planned in other meetings, but Wilson pointed out the possible need to downsize and suggested a 500 Hz to 10,000 Hz band. The complications of the New England site selection were discussed. Compared to the Corpus Christi site, the New England area has a shallower mud patch overlying a sand basement, with up to 12 meter mud thickness as opposed to as high as 60 meter thickness in Gulf Coast location. The main acoustic reflections will be from the sand basement, making determination of a mud signature much more difficult. Water depth of the new site is 60 to 80 m with 0-12 meter mud thickness. The original Gulf of Mexico site had a much deeper mud patch than the new New England site has, and so there are new challenges scientifically. Because of the limited mud depth, the majority of sound reflection will most likely be from the underlying sandy bottom. There is no point in the new environment that would be cylindrically symmetric. The main scientific challenge is getting the mud signature from results of this experiment. (/SCE2016_Workshop_3_materials/Wilson_kick_off.pptx)

It was apparent from looking at the topographical maps and the variation of types of deposits in the proposed experiment that the region has complicated, range-dependent propagation. Analyzing this type of data may involve both range-dependent and 3D models. They are proposing the use of sources with frequency bands up to approximately 10 kHz. [SS]

Survey Team

There will be three parts to the geoacoustic survey which will all be performed in August 2015: a CHIRP survey, a multibeam sonar, and a coring expedition. (Twitchell 1981 map). Prior to Workshop III, John Goff and Glen Gawarkiewicz did a preliminary survey of the area with a couple of tracks (related to the PIONEER array).

The survey box proposed for SCE2016 has the dimensions 20-by-20 km, and the proposed location was derived from previous findings presented in [1]. The proposed survey box covered the highest concentration of mud (silt-clay) in the area with a thickness of the mud layer up to 12 m. However, the survey box was located between two busy shipping lanes running in the east-west direction (10-20 heavy ships passing every day) separated by 11 km in the north-south direction, and frequent commercial fishing (trawl, trolling, long lines, lobster/crab cages) between these shipping lanes are expected. The width of each shipping lane is around 3.7 km. This maritime traffic may result in a high risk of damaging deployed equipment and possibly jeopardize acoustic measurements because of high noise levels.

Locations of two alternative survey boxes were discussed with one location to the north-east and the other to the south of the original proposal (see Annex A). The first north-eastern box has less water depth (45-55 m) with a mud extent comparable to the original location but with a smaller thickness (up to 8 m). There was a question about the naval relevance in such shallow water, and concern was expressed regarding the documented higher sand contents in the mud for this area. The high sand content will alter the geoacoustic properties significantly compared to a pure mud seabed.

The second proposed alternative is south of the original proposal and the water depth at this location is between 90-120 m and generally agreed to have more naval relevance compared to the first alternative proposal. The amount of mud is less than for the other two locations, but the sand content should be significantly less than at the first alternative proposal and comparable to the original survey box. However, analysis of the oceanography in this second alternative proposed area reveals that there is a strong dynamic front (temperature change between 2-6°C) appearing close to the 150-m bathymetry contour which may cause difficulties in interpreting and analyzing the acoustic data acquired in this region. Further, the front attracts biologic activities and intense commercial fishing (334 fishing vessels at shelfbreak per year) is expected in this region with the risk of damaging deployed equipment and jeopardizing the acoustic measurements (see Annex B). The center of both alternative survey boxes is around 10 km from the heavy shipping lanes, which minimizes the impact of heavy shipping noise on the acoustic measurements.

After further discussion in plenum with emphasize on the main objective stated by ONR US, by the end of the workshop the group reached consensus in defining the original survey box as the

final region to be surveyed during the summer 2015 and as the final region in which to conduct the SCE2016.

In general, the seabed in the experimental area is considered inhomogeneous with an expectation of different seabed properties at each different deployment location of equipment.

The multi-beam bathymetry survey is planned to be conducted in about 100-m water depth with 20% overlap and 130° across track swath. This will provide an across track beam separation of 0.7 m and a vertical resolution of the bathymetry of 0.1 m. The experimental region of interest consists of 2-12 m thick mud layer over a sand basement. The classic definition of mud is a combination of silt and clay. This area is expected to be a combination of silt and sand (50% sand by weight) but is still characterized as mud. Samples of the seabed will be achieved by vibra-corer, multi-corer and box corer. There is an interest in measuring properties of the seabed from 50 kHz and up to estimate heterogeneity, physical properties (porosity, density), grain size, internal factors (bubbles, gas), attenuation (normally performed at 500 kHz but lower frequencies of high interest), and shear and bearing strength. Seismic surveys will be performed to clarify the seabed stratification by deploying a EdgeTech SB-0512i chirp sonar operating in a frequency band from 0.7-12 kHz (20 ms pulse duration, 5 pings/s). The roughness between the muddy sediment layer and sand basement is an important environmental parameter to characterize. [PN]

<u>CHIRP survey (John Goff)</u>

- /SCE2016_Workshop__materials/Goff_CHIRP.pptx
- 1/2 meter ping (however with the new location, pings might be different)
- The new site is between two shipping lanes.
- There is extensive fishing between the shipping lanes. In Summer there is a lot of squid fishing and butterfish fishing (apparently butterfish are becoming popular)
- There is also lobster trolling in the area. Lobsters migrate to shore during Spring, down to 200m, throughout our area, because lobsters like mud. This may cause significant interference from the lobster traps. However one thing that could work to our advantage is that the lobsters can tell us where the mud is.
- Lobster traps move cross shelf—we should talk to fishermen->they know things like is the bottom solid enough to hold the lobster traps->may give us an idea of the density or other properties of the sediment and in what locations. Perhaps this mud has a higher shear strength than we thought if it's high enough to hold lobster traps
- Need to consider that if there are so many living things, there will by the nitrogen cycle causing lots of bubbles, which can complicate measurements
- Leg 1 of Survey: CHIRP and Multibeam, 11 day
    - 2 days Transit
    - 5 days CHIRP
    - 3 days multibeam fill 10 km x 10 km; Preliminary CHIRP Interpretation to inform coring
    - 1 day contingencies and weather

Coring Team (Allen Reed)

- /SCE2016_Workshop__materials/Reed_coring.pptx
- The area is close to the Naval Academy and we might be able to get some midshipmen and reservists to help with coring.
- most of the sediment is continental Shelf Deposit, which with carbon d-14 dating has been dated up to 10,000 years before present
- mud means silt and clay-sized particles
- there is a 50/50% mud-sand mixture in the first New England location
- trawling will affect mud roughness
- public domain video recorded by Scott, who is sponsored by NOAA, of a trawled seabed shows obvious lobster trawl lines
- ask for experience from fishermen and work with them to not disrupt fishing, but also to make our project viable
- ship wreck areas with no fishing
- Mud Patch Variability-lots of heterogeneity, surface roughness
- measure shear and sound speed of sediment
- Coring->three coring options
- vibracorer-20ft pipe, deepest penetration, but vibrations may affect density, structure, etc.
- multicorer-10cm diameter cores, measure shear strength
- box coring
- Is it possible to get accurate roughness?-somewhat, using methods like slcohol and resin to fix structure
- Discrete Scatterers-if someone wants to look for them

Multibeam sonar (Christian de Moustier)

- /SCE2016_Workshop__materials/Moustier_multibeam_sonar.pptx
- Shipping lanes-could AIS be helpful?
- 12300 map
- 200kHz
- 512 soundings per swath
- 0.7m soundings across track
- draft and heave +/0-4cm(not really dependent on sea state)
- SeaBat ship
- depth of the location will affect this; if a shallower site is chosen, the swaths will be smaller, but resolution will be greater

Concerns and Discussions

- understanding the nature of the mud-sand interface (Marcia)
- need for a central repository of data and measurements--a system similar to what TREX had (Marcia)
- Knobles brought up the idea of doing just a sand site that would allow comparison so that the mud signature could be extracted more accurately, however most believed that there is enough data on sand from previous experiments and good enough models (like Biot).
- The new location experiences dramatic thermals and there was a discussion on where and what time of season these thermals would be most disruptive: the warm water break is around the 100m isobath.

- How deep or shallow should the new location should be? Generally, modelers wanted shallow water to avoid more difficult modes. Coring team wanted shallow. Some experimentalists wanted deeper to avoid complications from surface reflections, reverb, etc.
- shipping lanes affect the site acoustically and logistically—equipment might be in danger

Measurements at the Mud Patch

Altan Turgut

- surface roughness, sea state, wave buoy
- TL, Ambient noise, etc. hydrophones are being refurbished
- 1 towed array
- 200 dB source

Mohsen Badiey and Bill

- New Jersey-AGS off-shore nuclear plant site that didn't end up happening
- 40 m core
- Per Allan Pierce:
- 2,3,4 kHz-Biot works >4 kHz-trouble

Charles Holland

- Sound speed vs. density Wood equation
- There's a section where D is up and SS is down—weird sound speed properties
- Also frequency dependence of attenuation

Inversion Breakout Session

- metric to assess results is needed
- benchmarking? how to be consistent?
- Ensemble average
- Go over the same place more than once so you can get an average
- could they collect enough samples not just cores, to put in a lab and test, or just recreate in lab
- planning to take temp and ssp's ?
- deeper
- towing the other way
- Find a common track where everyone does their experiment
- short range "Y", or "T", or "X", or "L" ?
- bus also need long range for propagation
- CHIRP range
- summer and winter there will be a difference-experiment is planned for April
- Propagation and reverb? Can't get high enough source levels to do anything with reverberation (would need>215 dB)
- NRL, ONR

Oceanographic Processes

A strong oceanographic front exists at the shelfbreak (~150 m bathymetric contour) where the temperature varies 2-6°C across the front. Warm water is trapped in a 10-m thick layer close to the bottom. Currents are normally in the range of 0.2-0.3 m/s, but warm core rings appear and can cause currents in the range 2-2.5 m/s. The experimental area is close to the Pioneer Array planned to operate in the time frame 2015-2020 and will include 6 launched gliders and 2 REMUS underwater vehicles. Underwater docking stations for the autonomous vehicles will be used for re-charging and data transfer. The launch of the vehicles is based on trial-and-error although intensive commercial fishing is expected in the area.

Glen Gawarkiewicz

- /SCE2016_Workshop_3_materials/Gawarkiewicz_oceanographic_processes.pptx
- climatological fields
- Middle Atlantic Bight
- Unstable Gulf Stream: cold pool, salinity, temperature contrasts(shelf break front, very dynamic, sharp gradient
- some properties will change between the survey and the experiments (i.e. thermocline)
- Pioneer Array (NSF) WHOI
- self-powered buoys with solar and wind generators and communicators
- ought to do a propagation experiment
- oceanobservatories.org ->pioneer
- 150 isobath-most fishing
- Where to put the box...

Wednesday, December 10, 2014

Knobles: The goal is for this to be the best experiment in Seabed acoustics.
In order to accomplish this goal we need to bring in Europe.

Proposed Experiments and Equipment Contributions

Peter Nielsen, NATO-STO CMRE, IT

- Autonomous survey of seabed properties
- (see SCE2016_Workshop_3/Nielsen_autonomous_survey.ppx)

D. Tollefsen

- FFI input to SBCX 2016
- Working with University of Victoria
- Long range (cross-province) propagation
- ship noise
- Acoustic data and support data

- AIS for ship tracks
- range-dependent inversion
- 1032 m, 64 hydrophones

Yong-Min Jiang and Peter L. Nielsen, NATO-STO-CMRE, IT

- Seabed Characterization using hydrophone equipped gliders and active sources
- (see SCE2016_Workshop_3/Jiang_hydrophone_equipped_gliders.pdf)

Julien Bonnel, ENSTA Bretagne, Lab-STICC(France)

- Modal filtering without VLA
- (see SCE2016_Workshop_3_materials/Bonnel_modal_filtering_without_VLA.pdf)

W.S. Hodgkiss and P. Gerstoft, Marine Physical Lab, Scripps Institution of Oceanography

- compare passive noise inversions and active source tows
- short-range and long range
- water column and surface variability on uncertainty
- floating array (may be an issue if site is between shipping lanes)
- Could we use a helicopter as a sound source?
- see /SCE2016_Workshop_3_materials/Hodgkiss_Gerstoft_inversions.ppt

Martin Siderius, Portland State

- Passive fathometer

Site Reconsideration Session

- 95% vs 50%mud/50%fine sand Eastern Seaboard grain Size Map
- mean grain size->the coarsest kind of mud
- The grain size gets coarser as you head east
- unexploded ordinance box

Sources, Arrays, and Measurement Capabilities

G. Potty, Univ. Rhode Island

- Thoughts on the experimental design for the proposed mud-patch field study
- see SCE2016_Workshop_3_materials/Potty_Miller_exp_design.pptx
- Gravity Cores AMCOR-6012

Mike Buckingham

- Deep Sound III
- 3Hz-40 kHz
- TREX 2013 Target and Reverberation Experiment (Florida) 400 and 200 kHz Multibeam

Marcia Isakson

- Bottom Loss, Ref. Coeffs
- Lasers used to see surface roughness, Coda Energy Measurement
- ROV to measure interface roughness

David R. Dall'Osto and Peter H. Dahl

- Vector Sensor
- Autonomous vector sensor deployed on bottom
- circularity

WHOI shallow water acoustics group

- 2DPE methods
- fluid elastic , poroelastic
- modal ray-path
- Scour paper
- AUV Source 800-1200 Hz

SAMS

George V. Frisk, Florida Atlantic University FAU

- Geoacoustic Inversion in Shallow Water Using Sonobuoys
- Modal Mapping Experiment (MOMAX)
- see Frisk_geoacoustic_inversion_sonobuoys.pdf

EC Shang

- 1997 JASA 102
- low frequency
- eigenvalues
- rho(x,y,z)
- density
- But especially ssp

Bill Hodgekiss

- floating array
- could we use a helicopter as a source?

Martin Siderius

- Experiments Equipment Portland State Univ.
- ambient noise methods
- mid-freq

CMRE Italy

- layers
- marine mammal detection
- map TL in 2D with glider going up and down

- need better tracking?
- inertial system? too expensive
- Ship interference
- AIS

Charles Holland
- dispersion, scattering, RD propagation/reverberation, layering structure and propagation
- see Holland_exp_design.pptx

Megan Ballard
- fine sediments, sediment samples, house of cards, shear wave measurements
- Field , NC
- very fine, do well in few
- coarser-hight freq, can get shear however deep the core can go with durip proposal
- ~depth^1/3

Lin Wan, Univ of Delaware
- Geo-acoustic parameter estimation using a multi-step inversion technique based on normal mode method
- (see Wan_parameter_estimation.pptx)

APL
- TREX 30 elem line array
- moored autonomously for ~10 days
- 3-5 kHz, up to 200dB
- see APL_source_and_receivers.pptx
- people and organiztions idea
- /APL/trex/new_split.html
- backscatter
- ITC 1007

Eliza Michalopoulou
- Data needs and motivation
- (see Michalopoulou_data_needs_and_motivation.pptx)
- prefers shallow water, lots of receivers, low frequencies
- can tolerate a few modes-not too many

Thursday, December 11, 2014

Draft-What are the critical issues-scientific questions that should be asked
Mohsen, Mike, etc. in morning

Survey group

- 1st thing-box breakout group
- before noon, revised version
- by 9:15 nail down a location
- geology to geoacoustics by 10:30
- survey group 9:15, by 10:30 inversion group
- Mike-Br
- Middle Site
- sample mud range indep
- Knobles: Shallow water 06
- Can find TL

Geo breakout

Additional geophysical properties from seabed samples to be measured in order to establish a link between geophysical and geoacoustics seabed properties. The list of additional measurements, beyond the already existing list composed by Prof William Siegman and Prof Allan Pierce, includes physical properties (horizontal dependence at small and large scales, size distribution of particles and floes), chemical fractions (e.g., smectite, illite) and wave properties, compressional sound speed (frequency from 400 Hz to 30 kHz, and at 500 kHz), shear sound speed (frequency from 100 Hz to 100 kHz) and depth dependence (gradients and layering structure).

- Physical Properties
- Bill's list plus whiteboard
- see whiteboard picture
- also, get Allen to talk to fisheries about potential shells
- could you use a camera and light
- Kevin and Megan can do analysis on samples

Recap

- Central website, database, repository, matrix of goals
- What data?
- Why? What physics can be addressed
- Turn-around time
- deck space
- support personnel
- send list of vessels you can contribute
- Oceana
- Kyle will contact Tim
- WHOT: armstrong
- how noisy is diesel electric
- Louis-How big a ship can you bring and how big do you need
- Mohsen-there's a sand box
- J-15 with calibration phone $8k

Mike's recap:

- 3 sections:
- wave comp, shear speed, shear attenuation
- shear and comp broadband and looking at coupling
- All 4 broadband is very important
- SAKS did no h
- particles size from 0 to clam shell
- As broadband as possible
- Charles depth dependence is critical
- Wave Properties-bradband wave speed
- APL UW Set the bar on website w TREX
- Yes, there will be a website
- email to start though

Proposed measurements and equipment:

- FFI (NOR) Deploy 1032 m long array on the bottom measuring received acoustic signals from dedicated active source runs and radiated noise from ships of opportunity. Apply Bayesian inference theory to estimate range-dependent seabed properties, where the complexity of the environmental model is included in the inversion.
- ESTNA (FRA) Single phone data acquisition and apply modal filtering technique by warping. This will provide time-frequency dispersion curves. Apply compressive sensing technique and particle filtering to track wavenumbers.
- MPL (USA) Seabed characterization using ambient noise and active sources received on bottom moored and drifting arrays. Extrapolation from short to long range information of importance including uncertainties from varying sea surface and water column properties. The frequency band of interest is 0.5-5 kHz.
- ARL-UT (USA) Deploy ROV to measure the reflection coefficient like during the TREX experiment in the Gul of Mexico. The water depth at the New England site proposed for the SCE2016 is deeper than in the TREX which may create difficulties in performing tracks with the ROV as successfully performed during TREX. Measure the shear sound speed in the seabed in the frequency band 300-1000 Hz.
- APL-UW (USA) Proposed deployment of autonomous platforms equipped with vector sensors and the SAMS equipment to measure depth dependent seabed properties. Deploy backscatter sonar, eventually from diver boat.
- WHOI (USA) Deployment of a REMUS AUV equipped with a sound source and sidescan sonar to monitor the three-dimensional evolution of the sound pressure.
- FAU (USA) Perform modal inversion of sound pressure received on a field of deployed sonobuoys from a stationary sound source in the 10-170 Hz frequency band. The inversion assumes two-dimensional propagation while the seabed property mapping will be three dimensional.
- Portland State Uni. (USA) Deploy a glider equipped with two hydrophones mapping the depth-range varying transmission loss from a stationary sound source (J-15). Utilize

moored and drifting arrays in conjunction with MPL (see above), and compare different techniques to infer seabed properties. Long range transmission loss measurements to evaluate the impact of the inferred seabed properties on prediction capabilities.

- Penn-State Uni. (USA) Perform wide-angle reflection measurements using moored hydrophones, a towed sound source and the horizontal FORA. Will join efforts with CMRE in case that the CMRE OEX AUV with towed source and horizontal hydrophone array is available. Interest in separating frequency dependent scattering (sea surface, biologics, etc.) from intrinsic seabed loss mechanisms.
- Uni. of Delaware (USA) Perform multi-step inversion by a matched mode approach.
- CMRE (ITA) Deploy a glider equipped with an eight-element vertical hydrophone array to record natural-made ambient noise for seabed characterization. A bottom moored 32-element is planned to serve as a reference array for the glider. This glider could also make use of active source transmissions. A second CMRE glider equipped with a single hydrophone and a compact volumetric array was proposed to be deployed. It is envisioned to perform wide-angle-type reflection measurements using a single hydrophone, utilize ships as sources of opportunity and controlled active source transmissions for seabed characterization using the data received on the volumetric hydrophone array. Finally, the CMRE OEX AUV with towed source (TOSSA) and horizontal hydrophone array (BENS) was proposed for autonomous wide-angle reflection type processing, traditional matched-field processing and long range transmission loss measurements. Long range transmission loss measurement is of interest in general to evaluate added value in predictions by an improved knowledge of the seabed parameters.

Conclusion

The workshop concluded with a consensus on the experimental site. The site determination was probably the most important aspect of the workshop. Several factors and discussions went into the decision, but ultimately the first New England site was chosen despite its issues with ship traffic, fishing, etc. because this site had the "best mud". This site covers the deepest mud with the smallest particle size and the sound speed ratio of this sediment will be less than one.

The results from the summer 2015 bathymetric measurements, seismic survey and coring within the final survey box are planned to be discussed at the 170th Acoustical Society of America meeting in Jacksonville, Florida, 2-6 November, 2015. [PN]