Meeting Summary
Submarine Arctic Science Program
Science Advisory Committee (SAC) Meeting
October 5 -6, 2009
Arlington, VA

Attendees

SAC members attending:
Jackie Richter-Menge (Chair) – Cold Regions Research and Engineering Laboratory
Tim Boyd – Scottish Association of Marine Science
Margo Edwards – University of Hawaii
Ray Sambrotto – Lamont-Doherty Earth Observatory
Bill Smethie - Lamont-Doherty Earth Observatory
Mark Wensnahan – Polar Science Center, University of Washington
Terry Tucker – Terry Tucker Research
Jeff Gossett – Arctic Submarine Laboratory
CAPT Douglas Marble – Office of Naval Research
Martin Jeffries – National Science Foundation

Interagency Committee (IAC) members attending:
John Farrell – US Arctic Research Commission
Simon Stephenson – National Science Foundation
Larry Estrada – Director, Arctic Submarine Laboratory

Other Attendees:
CAPT David Harrison - Office of Naval Research
Kate Moran – Office of Science and Technology Policy
CDR Tim Gallaudet - OPNAV N84, Task Force on Climate Change
George Newton, - Advisor to US Arctic Research Commission
Bill Wiseman – National Science Foundation
Florence Fetterer - National Snow and Ice Data Center
Ann Windnagel - National Snow and Ice Data Center
Bob Arko - Lamont-Doherty Earth Observatory
Dale Chayes - Lamont-Doherty Earth Observatory
Kathy Farrow – US Arctic Research Commission
CDR Warren Fridley – US Navy
LT Jamie Smith US Navy, N873D1
Renee Crain – National Science Foundation
Pat Haggerty – National Science Foundation

Meeting Objectives and Review:

Chair Jackie Richter-Menge reviewed the objectives of the meeting. She reiterated the goals of the SCICEX program and briefly reviewed the past history of the program. She showed previous SCICEX cruise tracks and emphasized that SCICEX is a unique program during this crucial time when the Arctic is undergoing enormous change. Data from past SCICEX cruises has provided key insights and findings regarding seafloor

topography, ocean and ice cover. The region is currently of extremely high scientific interest and of probable interest to the Navy given future implications for Naval operations as a result of the declining sea ice cover. The job of the SCICEX SAC is to re-invigorate and to grow the program. SCICEX has transitioned from dedicated science cruises during the 1990s to science accommodation missions (SAM). The challenge to the SAC in 2007 was to design a science program that could be carried out on cruises with little or no advance planning and no embarked science personnel. The committee designed a planning matrix assigning priorities for a variety of scientific data to be collected within given transit corridors. The matrix has been reviewed by the science community. The goal is that the matrix will be used by the Arctic Submarine Laboratory (ASL) to guide data collection on cruises designated as SAMs.

State of SCICEX from ASL Perspective

Jeff Gossett reviewed a variety of issues related to SCICEX. Currently, one to two submarine Arctic transits per year are made for the purpose of moving boats from the Pacific to Atlantic or vice-versa. An ice camp operation for the purpose of classified testing is scheduled every two years. The submarine classes were reviewed. He then reviewed science accommodation mission requirements. Accommodated science will be that which can be conducted during a classified mission whose duration is based on submarine availability. The data collected will typically consist of baseline data aimed at monitoring, not individual experiments. Examples include evolving oceanography, ice distribution or contaminant concentrations. There would be no embarked scientists or any proprietary use of the data. The SCICEX data would be collected only within the designated data release area with the submarine operating at unclassified depths and speeds (≤800 ft, ≤25 kt). There would be no or only minor added equipment/instrumentation other than ASL temporary equipment. The accommodation timeline consists of: the fleet identifying an operation, ASL developing a classified tailored test plan, ONR/NSF agreeing to the test plan and providing required funds. Following execution of the test plan, the SAC and scientific community are notified upon data release. Data will be released to the National Snow and Ice Data Center (NSIDC) which has been designated as the repository for SCICEX data by ONR.

There was brief discussion of the possibility of EEZ expansion by nations given the current decline in sea ice extent with the result of shrinking the current designated release area. George Newton explained that the international Law of the Sea will likely not allow expansion of EEZs even if nations declare an expanded continental shelf.

Jeff reviewed the ICEX 2009 ice camp activities that were carried out for SCICEX. Sixteen underice submarine expendable CTDs were carried for testing. These Mk – 21 CTD probes, purchased from Sippican, have had poor success rates in the past (~55%). Sippican had developed an improved launch procedure attempting to improve the success rates. Of the probes deployed on the ICEX 2009 test using the new launch procedure, 12 of the 16 probes were successful.

Jeff also described tests of the ice profiling topsounder at different depth/speed combinations which had been requested an earlier SAC meeting. One boat, a 688 class,

(USS Helena) carried the OD-84 topsounder which records the ice draft on an analog paper chart. The other boat, a back-fit 688I (USS Annapolis), carried the new digital Common Topsounder which records the ice draft along with other sonar data. Extraction of the ice draft data from the digital record will rely on a third party. The test consisted of two racetrack patterns of ~8 km long legs, with each boat running its pattern at depth/speed combinations of 180 ft/ 5 kt, 440 ft/12 kt, and 650 ft/24 kt. The boats then swapped patterns. On the second run the deep and mid-depth patterns were completed but time constraints precluded the shallow/slow combination.

ICEX 2009

Tim Boyd discussed the XCTD experiment in more detail. The goal of the experiment was to demonstrate that the XCTD probes are reliable, not to assess accuracy of the measurements. Of the 16 probes, 2 failed the pre-launch tests and 2 returned no data after deployment. The data quality from the 12 successful seems acceptable. Still needing attention are the relatively high failure rate of the probes and that the depth maximum being reached during the launches ranged from 300 to 450 m rather than the published 1000 m.

(ACTION: T. Boyd and D. Marble to work with Sippican on further improvements in reliability and quality of data)

Mark Wensnahan then discussed the necessity for the topsounder experiment. There is a significant amount of ice profile data in the NSIDC archive which was collected at greater depths and higher speeds than 440 ft and 14 kt, the depth speed combination providing most of the usable scientific data. Also a large amount of transit data which has not been processed but which could be released under the current guidelines was and is being collected. Much of this transit data is likely at greater depth and speed. Examples of how this data would affect the derived thickness (draft) distribution were shown.

Terry Tucker discussed the topsounder tests previously described by Jeff. A number of tasks will be involved in assessing the results of the tests. The analog chart data from the OD-84 topsounder on the 688 need to be scanned and processed. An analysis of the data at the different depth/speed combinations is necessary to assess the quality of the deeper/faster data. The ice draft data recorded by the digital Common topsounder carried by the 688I requires stripping from the sonar records by a third party followed by an assessment of data quality at the different depth/speed combinations. Finally, the ice draft data produced by the OD-84 needs to be compared to that from the digital topsounder. An issue to be resolved is finding support (funding) for the data processing and analysis of the ICEX 2009 topsounder experiment. Additionally, sustainable support is necessary for ice profile data processing of SCICEX data and non-SCICEX data which can be declassified within normal restrictions. This latter issue is important because topsounder data is not useful in its raw form requiring considerable effort obtain useful ice draft information suitable for archiving. This basic processing effort is not appropriate for individual principle investigator (PI) proposals which may or may not be funded.
(ACTION: M. Wensnahan and D. Marble to discuss possible support for ICEX09 ice draft data analysis via ONR)

SCICEX Science Plan, Part 1
Jackie presented the SCICEX science plan and discussed the history of its development. The committee has worked closely with ASL in the development of the plan. The suitable science disciplines of ice draft, ocean hydrography, chemistry, biology and bathymetry were identified as areas that could be addressed on SCICEX science accommodation missions. The discipline areas were described and justified in the plan by SAC members. A community review of the plan drew about 25 responses. The plan is currently being finalized and will soon be published and implemented.
(ACTION: SAC to complete report and hand over to text editor identified by J. Farrell. Target date for completion: 1 Jan 2010)

An important point brought out by the community review was there was little guidance on how to access the SCICEX data. The solution is to have the SCICEX Plan Part 1 address Data Collection while Part 2 will address Data Management. The Data Management Plan will include discussions of quality control, archiving and community access.

Jackie then went into detail with the SCICEX Data Collection Plan. The plan was designed to be flexible, adaptable and executable by ASL and the submarine force. The SAC prioritized sampling corridors. A matrix of desired measurements was developed and prioritized with the context of the sampling corridors.

Issues remaining include: establishing SCICEX as a priority with the scientific community and the Navy, the routine availability of basic equipment, notification of a SCICEX data collection event, routine data transfer and basic analysis, the requirement of a program to produce derived products that is non-PI driven, and encouraging and supporting new initiatives.

A lively and very worthwhile discussion ensued led primarily by CAPT Harrison, CDR Gallaudet, CAPT Marble, George Newton and Jeff Gossett regarding the value of the SCICEX program to the Navy. There is little doubt that the program is valuable to the science community, but in these austere times it is incumbent on the SAC to demonstrate that the program will benefit the Navy. Specifically, how is SCICEX going to improve Navy operations? What is an extra 2 days added to an Arctic transit going to do for the country and the Navy? The associated cost must be justified by demonstrating tangible benefits before the Navy is likely to commit to extra time for science data collection. Suggestions included how is our increased knowledge of ice thickness affecting submarine design, how is the changing water column affecting acoustic propagation, and will ice draft data be useful for improving satellite interpretations of ice thickness which the National Ice Center can use in its ice forecasts transmitted to submarines. Is the data collected used for ice-ocean model initialization and boundary conditions? The two issues that need to be addressed are tactical – day-to-day operations, and strategic – long term climate change that will affect future operations and infrastructure.

The outcome of the previous discussion is that the SAC needs to develop a white paper which describes tactical and strategic benefit of SCICEX to the Navy. When ever

possible, these benefits should be quantified (e.g. how much will the current level of uncertainty in ice forecast models be improved by using ice thickness data collected from SCICEX?). The points made in the white paper will be used to sell and justify the program to the Navy.
(ACTION: SAC to develop white paper. Target date: 1 Jan 2010)

Data Management and Archiving
Florence Fetterer gave an overview of the NSIDC. She described how it was supported and gave examples of the types of data that NSIDC archives and makes available to the public. She showed examples of the ice draft data collected by US and UK submarines that NSIDC currently holds. Florence made the point that she feels that NSIDC is a logical repository for the SCICEX and non-SCICEX submarine data since it has a history of long-term public archiving of snow and ice data and particularly submarine collected ice draft data. Efforts will be made to assure robust coordination with the Arctic Observing Network Cooperative Arctic Data and Information Service (CADIS).

Bob Arko of Lamont Doherty Earth Observatory (LDEO), discussed the R2R (rolling deck to repository) program. The program consists of a fundamental transformation of underway cruise data to a long-term repository. A catalog of cruises and products has been created. Within the program, data quality can be assessed and timely feedback can be provided to the operator. Some examples of underway data types included in the repository are gravity, magnetics, CTD data, and winch parameters.

Ann Windnagel of NSIDC discussed the specifics of SCICEX data management. NSIDC will do the data archiving providing stable long – term archives for public access. It will have a web presence. The process includes connecting with those that provide the data, creating the citation, documenting the data and finally releasing the data. The major effort will include tracking down historical SCICEX data and building an archive for new SCICEX data.

The data and archiving presentations stimulated a major topic of discussion involving the availability of past SCICEX data (primarily of those data from the 1990s SCICEX cruises). A major effort will be required to track down and retrieve this historical data which is currently in the hands of PIs for those cruises. NSIDC will need a list of existing data and the responsible PIs if it is to be successful in this data rescue.

Dale Chayes discussed the potential SCICEX data flow. For new SCICEX data Dale advocates keeping metadata along with the primary data. For instance, ASL should continue the current practice of providing detailed logs, spreadsheets etc that accompany new raw SCICEX data. The next step is to transfer the data (and metadata) to the R2R from which it makes its way to national archives such as the NODC, NGDC and NSIDC. Finally, derived data (that which needs significant processing to be useful – such as ice draft data) goes directly to NSIDC.

Some discussion of support for the SCICEX web site and data archiving took place. Florence asked whether the ongoing data rescue effort seemed valid for the past SCICEX

cruises. Margo made the point that the navigation data is extremely important and one of the first steps in correcting the navigation data should be to use known bathymetry in the correction process. Currently neither the SCICEX web site at LDEO nor the data archiving effort at NSIDC are funded. Martin asked to what extent data being collected are driven by the user community versus what can be collected by the submarine without major alteration. Another point was that retrospective data collection/archiving was much more difficult to convince panelists/reviewers to support than new cruise data. The result of the discussion was that the data archiving/web site information and data produces needs to be broken out into a white paper such that Doug and Martin can decide which can be supported. Tim mentioned that water sample data may be lumped into the derived products. Martin commented that, under some circumstances, RAPID (Rapid Response) proposals to NSF might be an appropriate way to fund some SAM activities, and under any circumstances, prospective proposers would need to discuss their plans with an NSF program officer. This led into a discussion of exactly how a SAM cruise will work – regarding whether only the added SAM days have unclassified SCICEX data or whether the entire cruise that occurred within the data release area at unclassified operational parameters (≤800 ft, ≤25 kt) will be unclassified and considered SCICEX? Larry Estrada had questions about what data can be released and how new improvements to the submarines will result in getting the necessary data (e.g. navigation). The SAC needs to develop a table of historical SCICEX cruises clearly define which data are derived products.
(ACTION: NSIDC and LDEO will prepare a pre-proposal for support to ONR and NSF.)
(ACTION: SAC to the compilation of a table of past cruises, which will be reviewed by ASL to assure completeness.)
(ACTION: SAC to develop a list of derived SCICEX products)

October 6, 2009

Review of Meeting Highlights
On Tuesday Jackie recapped Monday's discussions. A significant show of interest in SCICEX was indicated by Monday's attendees including a large Navy presence, a significant NSF presence and the OSTP. The Navy has requested a white paper addressing the value of SCICEX to strategic and tactical issues to help establish SCICEX as a priority. Regarding recent SCICEX activities, ICEX 2009 provided tests of the XCTDs using the new launch protocol. It also provided tests of the new and old topsounder systems at different depth/speed combinations. The SCICEX Science Plan, Part 1 is nearing completion.

Jackie also recapped SCICEX data management activities. NSIDC and LDEO are collaborating on data archiving, management and web site development. There is a need to recover historic data from earlier SCICEX cruises. New data will be able to be quickly accessed through the R2R program. NSIDC and LDEO will prepare a pre-proposal for support to ONR and NSF.

The SAC action list includes:
- Making a table of previous cruises

- Completing the Science Plan, Part 1
- Developing a white paper showing the value of SCICEX to the Navy
- Defining derived products
    - Quality control, basic analysis and documentation

More discussion took place regarding the white paper for the Navy. George suggested making a laundry list of model input that that helps the Navy make strategic and tactical decisions. It was also suggested that quantification of the ice cover within 5, 10 and 15 years in the future would be useful to the Navy. Margo also suggested that we need a plan to assure that the science community buys into SCICEX. George suggested that we do an ArcticInfo summary of this meeting including what the SAC has accomplished thus far.

Jackie then discussed Implementation and Data Collection. The issues include:

- Establishing SCICEX as a priority (the Navy white paper)
- Routine availability of basic equipment
- Notification of a SCICEX data collection event
- Routine data transfer and basic analysis for derived products
  This requires a program (support) that is non-PI driven
- Encouraging and supporting new initiatives

Doug Marble mentioned that the processing for derived products may be a candidate for sustained support as a Navy function.

Regarding new initiatives Tim noted that the sail mounted CTD could be much more valuable if other sensors were installed. The question of whether certain sensors could be installed without a TempAlt should be explored. ASL indicates that the answer is no with one minor exception. Our CTD TEMPALT already has a provision to add supplemental sensors, up to the capacity of the CTD, as we did during the dedicated SCICEX cruises. Doug made the point that this should be mentioned in the science plan, part 1.

The Navy will soon roll out its Arctic roadmap and perhaps the SAC could make use of points in the roadmap in the white paper that will be prepared. The Navy may well be inclined to show that it is active in the Arctic and is assisting climate change research by leveraging operational assets.

The remainder of the morning was used to discuss derived products and what they would include. The products discussed included:

- Navigation – quite a discussion here on cleaning up outliers, co-registration with bathymetry and GPS and having one source of highest quality navigation data
- Ice draft
- CTD
- XCTD
- Bathymetry
- Water samples

This discuss revealed the relative complexity of collecting water samples for chemical and biological analyses. The reality is that these complexities may limit the routine collection of these data during a SCICEX accommodation mission. This concern should be put in the science plan to mitigate expectations.

The meeting ended at about 1230.