

**Meeting Summary**  
**Submarine Arctic Science Program**  
**Science Advisory Committee (SAC) Meeting**  
**January 27-28, 2011**  
**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, Univ. of Washington (by phone)

Terry Tucker – Terry Tucker Research

CDR Dan Eleuterio – Office of Naval Research

Buck Sanford – National Science Foundation

Interagency Committee (IAC) members attending:

John Farrell – US Arctic Research Commission

Erika Key – National Science Foundation

Martin Jeffries – Office of Naval Research

Other Attendees:

Scott Harper – Office of Naval Research

Joan Gardner – Naval Research Laboratory

Peter Hacker – National Aeronautics and Space Administration

Kate Moran – Office of Science and Technology Policy (by phone)

Ann Windnagel - National Snow and Ice Data Center

Florence Fetterer - National Snow and Ice Data Center (by phone)

Bob Arko - Lamont-Doherty Earth Observatory

Dale Chayes - Lamont-Doherty Earth Observatory

Courtney St. John – Oceanographer of the Navy, Task Force on Climate Change

Meeting Objectives and Review:

Chair Jackie Richter-Menge reviewed the agenda and objectives of the meeting.

Objective number one was to outline a plan for data management setting the stage for Part II of the science plan. The second objective was to work with the IAC to outline needs for sustainment of the program and develop a plan to address the needs and actively support the SCICEX objectives. Jackie reviewed the unique importance of the SCICEX program and its contributions and potential benefits to Arctic science. She elucidated the goals of the Science Advisory Committee (SAC) as well as the Interagency Advisory Committee (IAC). She explained the difference between the dedicated SCICEX missions of the 1990's and the Science Accommodation Missions (SAMs) which have

taken place since 2000. The SAMs require a science program that can be conducted on cruises with little or no advance planning and no embarked science personnel.

#### SAC report on the State of SCICEX

Jackie then reviewed the state of SCICEX from the SAC perspective. She acknowledged the publication of the SCICEX Science Plan, Part 1 in July 2010 which was developed in close collaboration with the Arctic Submarine Laboratory (ASL). The science plan will be implemented on the U.S. Navy's ICEX 2011 which will have a SCICEX component. She mentioned the increasing visibility of the SCICEX program with the publication of the science plan as well as a brochure and a bookmark which have been widely distributed. Additionally SCICEX has been acknowledged and reported in the Navy Task Force on Climate Change (TFCC) and is being used as a template for the UK Royal Navy in its design of a submarine science program. She also reported on the IAC meeting which was held in September 2010. At that meeting there was discussion of implementing SCICEX and motivating support within the Navy. It was decided at the IAC meeting that the draft white paper for the Navy was too long and perhaps too demanding without giving specific benefits to the Navy for the dedication of submarine time for SAMs. Sending the Navy a "thank-you" letter after ICEX 2011 was perceived as a more appropriate manner to acknowledge and perhaps pique the interest of the operational Navy. Continuing, Jackie reported on a shift of responsibility in data management between Lamont Doherty Earth Observatory (LDOE) and the National Snow and Ice Data Center (NSIDC). Whereas previously LDOE was to transfer new data from the submarine to data archive and host the SCICEX web site with NSIDC being the archive, now LDOE will adapt the Rolling Deck to Repository (R2R) program to SCICEX submarine data and NSIDC will be the data archive and host the SCICEX web site. She also reported on current support for SCICEX activities. NSF is supporting NSIDC for the data archive, ONR is supporting Tim Boyd for XCTD's, Ray Sambrotto and Bill Smethie for water sampling protocol, and Mark Wensnahan for ice draft processing. ONR and NRL will support Joan Gardner and John Brozena for airborne ice thickness measurement on ICEX 2011. Jackie then noted the challenges ahead. There is an expected reduction in the frequency of ICEX programs from the current 2 years to 3 years likely accompanied by a reduction in the ASL budget. SCICEX is a non-PI driven program, motivated by the availability of submarine time, often with little advance notice. She emphasized that sustained support is required for basic equipment and laboratory work, for data transfer and processing to obtain derived products, and for maintaining the data archive and web site.

#### IAC report on the state of SCICEX

Scott Harper mentioned that ONR will be standing up an Arctic program and SCICEX should be a major part of it. ONR will be getting new funds for Arctic research in 2012. He noted that the IAC should consider including other agencies. There will be a meeting in Stockholm in May focused on arctic bathymetry. Data provided by SCICEX and other submarine data will be a topic of discussion at this meeting since it has been a significant source of Arctic bathymetry data.

#### Recent SCICEX science data collection activities

### XCTD update - Tim Boyd

Tim reviewed the use of XCTDs on the dedicated science cruises from 1995 to 1999. There were approximately 100 analog XCTDs per cruise having an 85 – 90% success rate which provided crucial data on changing Arctic Ocean conditions. Digital XCTDs have been used on the SAMS. They have had a higher failure rate and produce noisy data. In 2008 Sippican (the manufacturer) reported that the source of failures was the timeout circuit. On ICEX 2009 improved XCTDs were tested. Temperature, salinity and depth were completely acceptable but the XCTDs failed to reach their design depth. The success rate was fairly high however. In 2010, Sippican identified a data acquisition software problem that affected all XCTDs from reaching design depth and assured the availability of a tested software fix. ONR approved funding for a test of 16 XCTD probes. In December 2010 ASL attempted a launch of 3 of these probes in an open water test. One probe failed the pre-launch test, one returned data to 644 m (short of the design depth) and one returned data to 1088 m. Data was noisier than ICEX 2009 data, suggesting a software problem. Thus the test was inconclusive –not enough probes were launched and possibly the wrong version of data acquisition was used. Current plans include launching the remaining 13 XCTDs on ICEX 2011 following science plan recommendations and ensuring that the correct version of software is used. Discussion ensued regarding the launching of the probes during a SCICEX transect or in the vicinity of the ICEX 2011 camp in a cluster.

### Biogeochemical calibration and validation - Bill Smethie and Ray Sambrotto

Bill and Ray are supported by ONR to conduct sampling on the SCICEX portion of ICEX 2011. The objectives are to calibrate the submarine-based measurements with CTD bottle casts made from the ice camp, to develop the sampling protocols for the newer classes of submarines for use on SAMs, to establish the sample and data handling procedures and to possibly sample data-poor regions of the Arctic Ocean. Bill pointed out scientific objectives of the water chemistry program included monitoring the spatial and temporal variability in distribution and composition of the mixed layer, halocline and upper Atlantic layer as well as to delineate Atlantic and Pacific water circulation pathways and transit times. Ray noted the biological objectives of documenting the response of productivity to reduced ice cover, quantifying biological process interaction and changes in the nutrient and carbon systems, and characterizing microbial populations and megafauna distributions. Both showed examples of existing biogeochemical data which emphasized the dearth of such data in the Arctic. They have discussed calibration and sampling procedures with ICEX 2011 submarine and ice camp participants and will provide equipment and detailed sampling protocols. This SCICEX activity will serve to develop protocol for future biogeochemistry sampling on SAMs.

### Ice Thickness: Ice draft – Terry Tucker and Mark Wensnahan (by phone)

Terry began by showing tracklines of the NSIDC archived ice draft data followed by a figure that clearly shows the decline in mean arctic ice draft (thickness) from 1975 to 2005. He explained the process of getting from submarine recorded data (digital or analog) to usable ice draft data which is a very labor intensive, costly process. A significant part of the NSIDC archived data was collected at greater depths and higher

speeds than the desired 440 ft, 14 kt. An experiment was conducted on ICEX 2009 in which submarines surveyed racetrack patterns at different speed/depth combinations. Mark has recently been funded by ONR to process these data and contrast data quality at the depth/speed combinations. Additionally, one of the submarines collected ice draft data with the new digital common system which can be contrasted to that of the OD-84 topsounder on the other boat. The accessibility of the ice draft data within the common system data stream remains an issue. Another problem area pointed out is the lack of sustained support for routine processing of ice draft data.

#### Ice Thickness: ICEX 2011 coordinated measurements - Joan Gardner and Jackie Richter-Menge

Joan and Jackie described a joint airborne remote sensing, on-ice measurement and submarine program to be carried out at ICEX 2011. Joan outlined the objectives which included developing new algorithms to determine ice/snow thickness from satellite or aircraft sensors, to validate the measurements with airborne and in-situ measurements at ICEX and to use the Navy's coupled ice-ocean model with the new data types to understand the impact of ice and snow volume on Arctic dynamics and thermodynamics. The NRL field effort includes an aircraft equipped with 2 radar altimeters, a scanning topographic lidar and photogrammetric camera which will fly sub-satellite tracks or a grid pattern. Jackie described CRREL/NRL on-ice measurements along 3 survey lines which will include measurements of ice thickness, snow depth, and snow and ice properties characterization using an EM-31, a MagnaProbe, and mechanical and hot water drilling. The submarine will measure ice draft along the survey lines. Additionally, the NASA P-3 with the airborne topographic mapper, a snow radar and digital camera and the AWI Polar 5 aircraft with an EM-31 and Lidar may also participate in the program.

#### NSIDC data recovery, archiving and web site - Ann Windnagel

Ann reviewed the number of inquiries that the SCICEX data site is receiving primarily requesting CTD, bathymetric and ULS data. She has recovered the majority of data from the SCICEX dedicated missions but less from the 4 SAMs conducted during 2000, 2001, 2003, and 2005. She showed the current data inventory table with missing data highlighted. SAC members had suggestions for where to obtain much of the missing data and noted known data that was unusable. Ray suggested dropping the listings for chemistry data which was of poor quality. Margo suggested that navigation data should occupy two columns – one containing the original Ship's Inertial Navigation System (SINS) data, and another containing data which had been corrected by shifting the data to match known bathymetric features. Ann then showed examples of the SCICEX web site and requested ideas for improving the site. NOAA's name will be removed from the header of the web site. Martin suggested that NSIDC is now the official web site and LDEO should reroute users to this site. NSIDC currently has funds only through the end of February 2011.

#### New data capture: R2R – Bob Arko and Dale Chayes

Bob outlined the rolling deck to repository (R2R) program. The goal is to migrate underway data to long-term repositories, create a catalog of cruises and standard products

and assess data quality and provide timely feedback to operators. Bob stressed three rules: always keep the original data, deal with fleet operators rather than individual scientists and use national data centers. Most of the UNOLs and other vessels have joined the R2R program and over 2000 cruises have been cataloged and 7 million files archived. The SCICEX data cannot go directly to R2R and a repository; it must first go to ASL for clearance/processing. Discussion followed regarding how certain data (ULS, navigation) can reach the user most quickly. It was again emphasized that considerable processing is necessary to turn this into a usable product. Sustained support will be necessary to make this processing a routine procedure following a SAM.

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Jackie reiterated the objectives of this meeting:

- Outline a plan for data management thereby setting the stage for Part II of the science plan.
- Work with the IAC to outline needs for program sustainment and develop a plan to address those needs.

Jackie then outlined specific data management issues. A major item was the SCICEX website and the NSIDC data archive. The following issues evolved from yesterday's presentations and discussion:

- Consolidation of the website to NSIDC
- Add a navigation column to the NSIDC historic data inventory table
- Address Ann's list of items needing attention
- Add a data use acknowledgement statement to the web site
- Obtain support to NSIDC for the website.

Jackie outlined immediate needs with regard to SCICEX activities on ICEX 2011.

ICEX 2011 XCTD deployment plan (Tim Boyd and ONR):

- Ensure ASL has the latest software
- Decide whether XCTDs will be deployed in a cluster near the camp or on a transect line
- Make at least 1 XCTD available at the camp.

Regarding ice draft data to be collected on ICEX 2011:

- Wensnahan to generate proposal for support to process ice draft data
- Confirm that ASL can provide topsounder data from the common topsounder
- Carry out comparison between common topsounder (new) and OD-84 ice draft data, probably using data collected on the ICEX 2009 test.

Several other immediate needs and action items were discussed:

Matters that affect future data collection opportunities:

- ASL's viability. It is likely that ASL's budget will be reduced. It has been noted that ICEX experiments will be every 3 years in the future. How will this affect ASL and SCICEX?
- The Navy white paper. The committee decided to revive the white paper outlining accomplishments, recent SCICEX activities and future goals. Discussion addressed targeting either the operational Navy or Task Force Climate Change. Tim noted the white paper should specify what we want and what we can deliver. He volunteered to rewrite/revise the white paper. Joan suggested that the SAC should also write a thank-you letter for any significant event (e.g. SAM, release of bathy data, etc) that would show the science community's gratitude to the operational Navy. The committee agreed that this would be a good idea.
- Logo. Having a SCICEX logo was discussed. John and Ann will consider logo designs.

Data archiving concerns:

- Support to LDEO for including SCICEX in the R2R program. Dale and Bob will prepare a short pre-proposal for the IAC.
- Assure that ASL is on-board with the R2R and data archiving process.

Data Transfer:

Jackie showed a schematic summarizing the data collection and transfer needs.

- Data collection:
  - Promote program utility
  - Revise white paper
  - Establish sampling protocols
  - Supply basic equipment to submarine
- R2R:
  - Support to LDEO
- Transition raw data to derived products
  - Define derived products
  - Outline transition process
  - Define resource requirements
- NSIDC/Archive
  - Support to NSIDC

Expansion of the IAC:

Currently only USARC, ONR, ASL, CNO and NSF are active IAC members. There was discussion of possibly expanding the IAC membership to NASA and NOAA. Other agencies including the Minerals Management Service, Coast Guard, USGS and Oceanographer of the Navy were also considered. There was concern about the IAC losing its effectiveness if it becomes too large.

SAC Membership: Jackie noted the need to develop a plan for rotation of committee members. She suggested 6 year terms with 2 positions rotated ever other year. A new chair would be appointed every 6 years. There was some sense among the committee that 6 year terms were too long. Having 3 year terms with an additional 3 year renewal term

was suggested. As per the MOA, the IAC will need to implement rules regarding membership terms for the SAC.

Increasing the popularity of SCICEX: Brief discussion took place of how to make SCICEX more popular. It was noted that the published science plan, the brochure and bookmark have been fairly effective. Martin suggested putting the minutes of SAC meetings on the website.

UK Arctic Submarine Science Update:

Tim Boyd reviewed a Submarine Arctic Science workshop held at the Scottish Association of Marine Science in April, 2010. There was significant interest by UK researchers in SCICEX and in developing a UK analogue of SCICEX SAC. It is likely that there will be increased access to existing data and to Royal Navy submarines on future Arctic deployments.

SAM data archiving through R2R:

Dale went through 2 specific examples of the data flow from the submarine to data archive for SCICEX SAM data. One example involved a physical sample (e.g. water sample for O18). Another example involved digital data, in this case bathymetry. Dale's walk through showed involvement of ASL in both examples though in somewhat different roles.