Managing and Growing the SCICEX Data Collection

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LONG-TERM GOALS

The Submarine Arctic Science Program, SCICEX, is a federal interagency collaboration among the operational Navy, research agencies, and the marine research community to use nuclear-powered submarines for scientific studies of the Arctic Ocean. SCICEX program background and references can be found at http://nsidc.org/scicex/history.html/.

The SCICEX program seeks to acquire comprehensive data about Arctic sea ice, water properties, and bathymetry (Sambrotto et al., 2014). This project's long-term goal is to build a permanent data archive of quality data products for new and old data collected as part of SCICEX, making the data usable by scientists now and preserving data for the future. An ancillary goal is to increase the impact of SCICEX data products by growing the number of researchers that use the products, through outreach and expert data curation.

OBJECTIVES

In 2014 and 2015, our focus was to deliver products from the 2011, 2012, and 2014 Science Accommodation Missions (SAMs) to the research community while working in collaboration with the SCICEX Science Advisory Committee (SAC) PIs, and to publicize the availability of new and old SCICEX program data.

APPROACH

A quality data product is one that can be used for scientific analysis of natural phenomena as well as for input into models, thereby allowing the creation of new data products and knowledge. Providing quality data products that are scientifically useful now and well into the future requires expert quality control analysis, documentation, and curation of the data. NSIDC provides this expertise in knowledge organization for both historical and current SCICEX data.

Quality control analysis of the data is provided in a number of ways. Initially, manual inspection of the data for valid values is done; this is a quick check of the data to make sure that it contains reasonable data values. These data are provided to NSIDC in a declassified format. In this format, the geographic locations provided are at a coarse resolution, rather than one position for each data point. NSIDC

collaborates with the SAC to process, interpolate, and validate navigation data that can be merged with the scientific data for spatial relevance and then documents this process for use on future SCICEX data to maintain the highest quality and consistency. In addition, we create new data products by processing raw CTD data from early cruises into scientific parameters more readily useable by researchers, and collaborate with the SAC to create scientific documentation that provides users with a solid base from which to begin using the data for their research. Every data set is unique, and therefore, analyses, processing, and documentation methods must adapt for each new cruise so that resulting data products are as consistent as possible.

This level of expert data curation demands both considerable subject matter knowledge, and that we work in many ways as research partners with the SAC PIs. It requires the previously described quality assurance work and documentation, as well as detailed metadata for discovery of the data and conversion to a common, easily used format. We provide feedback to the SAC on best practices, and make data decisions for the SCICEX program based on information science. These tasks are essential to the preservation and dissemination of SCICEX data and to creating new data products that will be scientifically useful. Providing quality control analysis, data validation, documentation, and curation have allowed new SCICEX data to be preserved properly and have allowed historical SCICEX data to be rescued and reinvigorated so that all SCICEX data will be available for years into the future.

Ann Windnagel is project manager of the SCICEX collection at NSIDC, and is key to working directly with the SAC members to insure that data from each cruise and instrument meets these high standards and is ready for use by a broad scientific community.

WORK COMPLETED

Material on the SCICEX site documents this work.

Researchers will find the value of SCICEX data curation most evident in the data inventory (http://nsidc.org/scicex/data_inventory.html). Figure 1 gives a quick view of data availability.

In 2014, the SCICEX collection added bathymetry from the 2011, 2012, and 2014 SAMs, and XCTD data from the 2014 SAM.

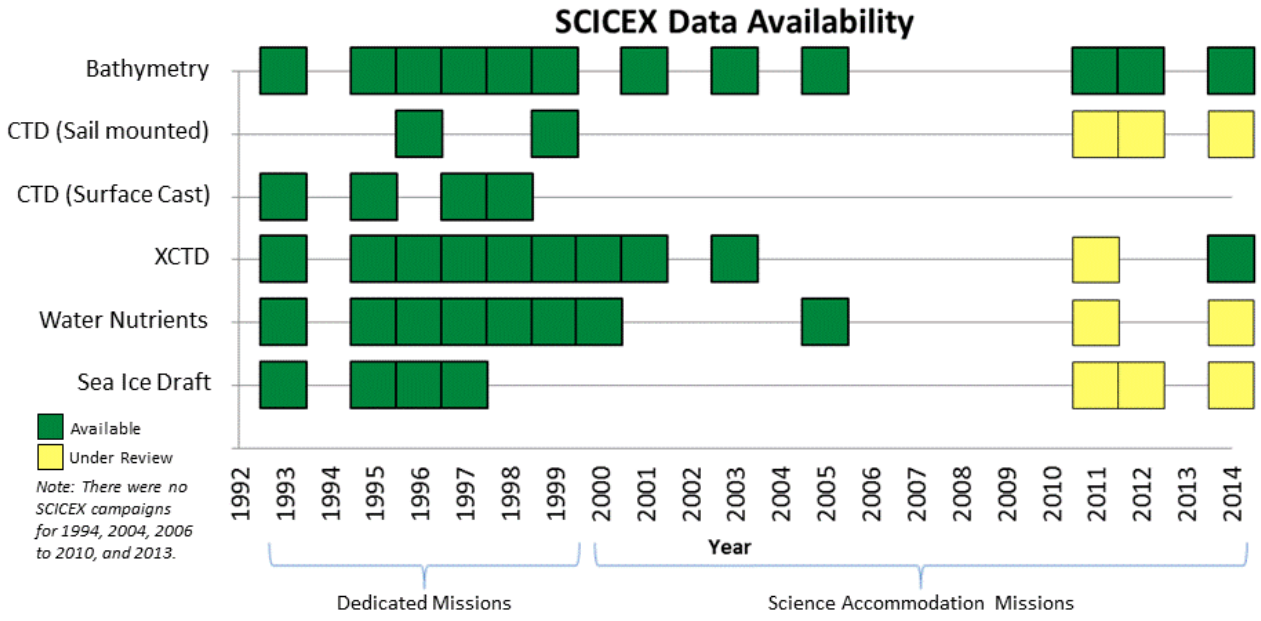

Figure 1. Data availability at a glance

The inventory briefly summarizes the status of all data that have been acquired but are not yet published. In Figure 2, a screen shot of the Data Inventory page, users can easily resister to be notified of data updates, and are provided with instructions on how to cite the data so as to properly credit the SCICEX program or an individual investigator. A Digital Object Identifier (DOI) is part of the collection citation (SCICEX Science Advisory Committee, 2014).

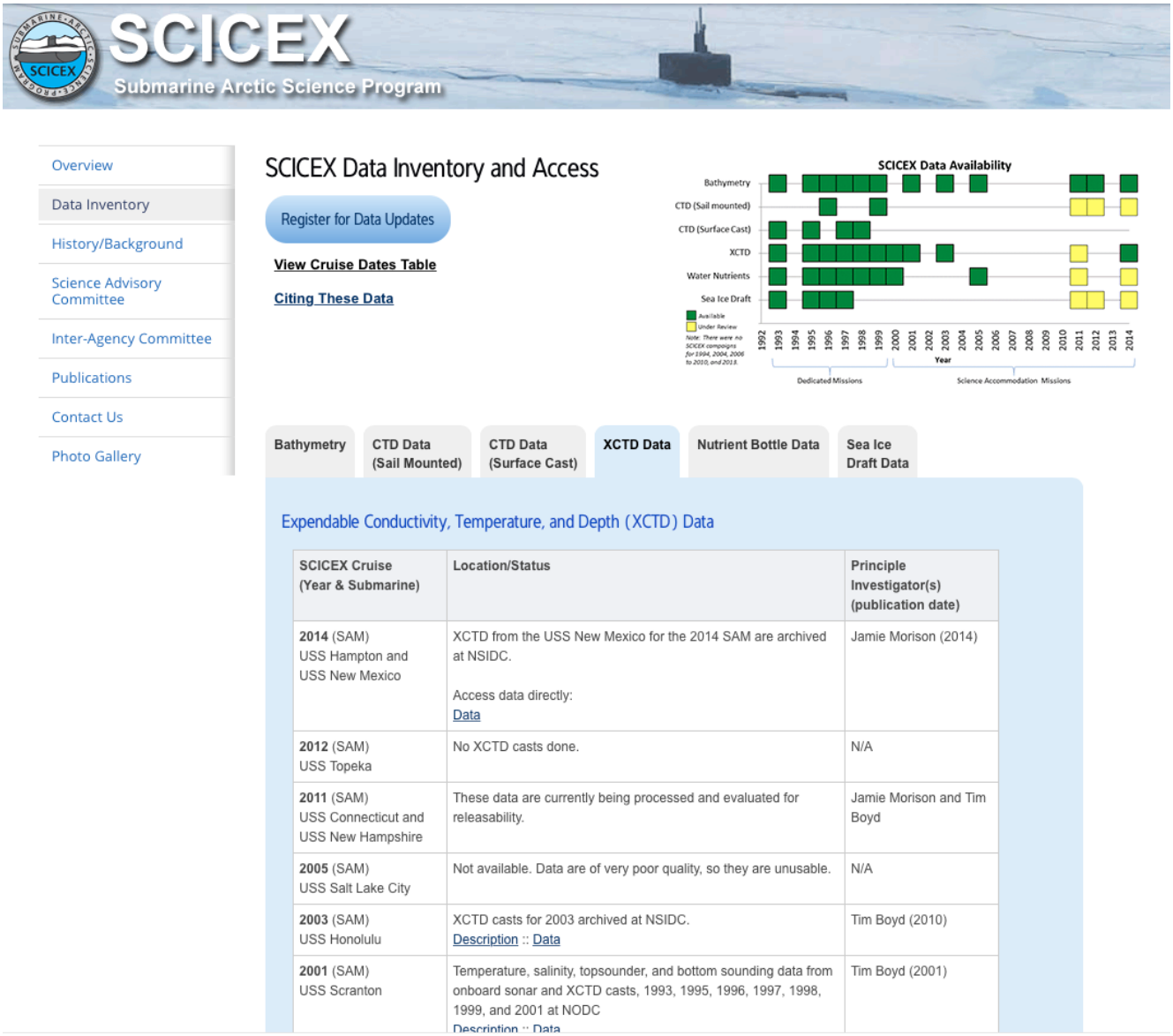

Figure 2. A view of the Data Inventory page

Additional information that supports use of the published data is made available as well. For example, an informal note that Dr. Mark Wensnahan had written concerning how boat speed and depth impacts top sounder measurements was published as an NSIDC Special Report (Wensnahan, 2014). This makes the information citable, and ensures it is available to all who download the sea ice draft data.

When data are added, or when other relevant SCICEX events occur, a news item is published to the NSIDC News page, and to other sites such as CRYOLIST and USARC Arctic Daily Update. There were four such items in 2014 and 2015. Two articles describing SCICEX and the data collection were published in the Arctic Research Consortium of the US Witness the Arctic newsletter.

Program history and context for the acquisition of SCICEX data are made available though a page devoted to the Science Advisory Committee (http://nsidc.org/scicex/sac.html). This includes each

SAC meeting's summary as well as presentations, when available, for the eight SAC meetings to date. Information on the Inter-Agency Committee is provided as well.

In 2013, Ann Windnagel conducted an interview with George Newton and made the oral history available on the SCICEX history page (http://nsidc.org/scicex/history.html). The interview is excellent outreach for SCICEX: George Newton dynamically recounts how an idea grew into a program that benefits both polar science and military operations in a changing national defense setting.

RESULTS

An option to register for updates concerning data became available in July 2014, and since that time, 19 users have registered. Note that registration is not required in order to access SCICEX data. The affiliations of registered users include the Danish Hydrographic Service, DOI BOEM Environmental Studies, North Pacific Research Board, Lamont-Doherty Earth Observatory, Johns Hopkins University Applied Physics Laboratory, and NSF.

Since being released in December 2011, the SCICEX site has averaged over 100 visitors per month with a total of 5450 visitors as of 13 October 2015. There was a significant increase in the number of visits to the site after the Witness the Arctic articles were published. Usage has grown from about 500 visitors to the site in 2011 to about 2300 visitors in 2014. The number of unique visitors to the site increased by about 22% in 2013 and by 20% in 2014. It appears that there will not be an increase in the number of unique visitors in 2015 over the number in 2014, perhaps because no new data were released in 2015.

The number of unique users (determined by unique IP address) that have downloaded data from the NSIDC FTP site since October 2012 is 188. This number does not include the number who have used the links on the Data Inventory page to access data archived in some other repository, such as NOAA NCEI-CCOG for most bathymetric data.

IMPACT/APPLICATIONS

Edwards and Coakley (2003) speak to the impact of SCICEX data: During the 1990s, SCICEX scientists were some of the first to notice marked changes in the Arctic Ocean such as thinning of the present-day arctic ice canopy and changes in water temperature. The importance of the collection has increased with time and as it has grown. SCICEX data provide an extraordinary volume of ice draft measurements that constitute one of the best mappings of the ice canopy in the central Arctic Basin. These data are analyzed on their own or used as validation data in conjunction with other methods of estimating ice thickness (e.g. Kwok and Cunningham, 2015).

Bathymetry from SCICEX cruises has increased the number of depth soundings of the Arctic Basin by orders of magnitude. SCICEX data contributed to the International Bathymetric Chart of the Arctic Ocean (IBCAO), and led to first-order changes in the mapped positions and depths of major bathymetric features.

SCICEX sea ice draft and bathymetric data have had the widest use, but conductivity, temperature, and density data from CTDs and ocean nutrient data from water bottle samples have been analyzed as well. The list of references at http://nsidc.org/scicex/publications.html is not comprehensive but documents some of the studies done with SCICEX data (not all of the listed publications used SCICEX data). A

poster presented at the AGU Fall Meeting in 2014 gives an overview of the scientific impact of SCICEX data (http://nsidc.org/scicex/pdf/agu/AGU-2014-SCICEX-Poster-C53A-0292.pdf)

SCICEX data have been used in the construction atlases such as the University of Washington's Polar Science Center's Unified Sea Ice Thickness Climate Data Record and Hydrographic Climatology.

RELATED PROJECTS

None.

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