BC〇-DM〇

Description of the Biological and Chemical Oceanography Data Management Office (BCO-DMO)

Please note that this document is available online at: http://www.bco-dmo.org/about/.

The Biological and Chemical Oceanography Data Management Office (BCO-DMO, URL: http://bco-dmo.org/) was created to serve principal investigators funded by the National Science Foundation (NSF) Biological and Chemical Oceanography Sections and Division of Polar Programs Antarctic Organisms & Ecosystems Program as a facility where marine biogeochemical and ecological data and information developed in the course of scientific research can easily be disseminated, protected, and stored on short and intermediate time-frames. The Data Management Office also provides research scientists and others with the tools and systems necessary to work with marine biogeochemical and ecological data from heterogeneous sources with increased efficacy. To accomplish this, two data management offices (former- U.S. JGOFS[1] and U.S. GLOBEC[2]) were united in 2006 and enhanced to provide a venue for submission of electronic data and metadata and other information for open distribution via the World Wide Web.

The software and procedures developed to handle the data and information produced during the US JGOFS (Glover et al., 2006) and US GLOBEC (Wiebe et al., 2011) programs have been further enhanced to manage the data and information generated by current NSF funded projects. The BCO-DMO data system can accommodate many different types of data including biological, chemical, and physical measurements and results. It is important to note that our system provides access to the data (numbers, images, and/or documents) in a consistent manner, with sufficient metadata, so that others can make full use of these data for their own purposes. The existence of sufficient metadata enables the discovery and accurate reuse of data by more than just the initial investigators who collect and process the data. The BCO-DMO data system is not simply a catalog of data resources, but a system that takes full advantage of a MySQL database storing documentation (metadata) for each data set, and a data management backend that allows data to reside at multiple sites (including the originating investigator's location if they wish).

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[1] United States Joint Global Ocean Flux Study
[2] United States GLOBal Ocean ECosystems Dynamics

Our data management philosophy is based on many years of experience in collecting, processing and managing biological, chemical, geological, and physical oceanographic measurements and can be summarized as providing support "from proposal to preservation". Consistent with this philosophy, our methodology is to:

- partner with individual investigators and those associated with collaborative research projects;

- provide data management support throughout the project;

- capture and record documentation (metadata) sufficient to support data reuse and re-purposing;

- load metadata into a relational database, provide easy access to the processed data, and ensure their availability online; and safeguard the metadata and data by archiving them at the appropriate national data center (e.g. NODC); and contribute to special repositories (e.g. CDIAC, OBIS, GenBank) if appropriate

The BCO-DMO data management system is composed of a metadata database, the distributed client-server JGOFS/GLOBEC data system, and a Web browser interface with simple text-based and map-based user interfaces that provide access to the information and data available from the BCO-DMO repository. A distinguishing characteristic of the BCO-DMO approach is the provision of direct access to data, not just the metadata. To accomplish this, the underlying object oriented JGOFS/GLOBEC

Figure 1. A drawing of the BCO-DMO data management system framework.
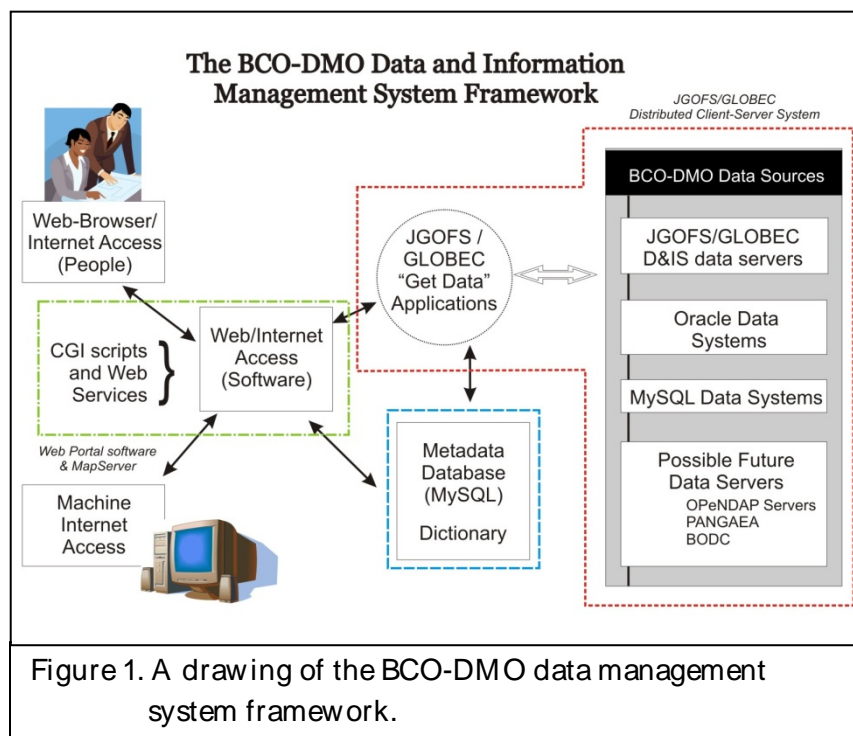
data management system (Flierl, et al., 1992), used by both US JGOFS (Glover et al., 2006) and US GLOBEC (Wiebe et al., 2011), was retained as a very flexible, Web-based system that easily serves both data and images. It is compatible with all standard browsers. The JGOFS/GLOBEC data management system supports both distributed data servers and distributed clients through the use of standard Web protocols. It provides a simple and relatively straightforward way to make ASCII data and images available on the Web. Consequently, the BCO-DMO data management system is composed of three major components (Figure 1): the metadata database, the JGOFS/GLOBEC data management system, and the Web interface supporting simple text-

based and geospatial user interfaces that provide access to the information and data available from the BCO-DMO repository.

The office manages existing and new data sets from individual scientific investigators and collaborative groups of investigators, and continues to make these available online. The office works with principal investigators and other data contributors on data quality control; maintains an inventory and program thesaurus of strictly defined field names; generates metadata Directory Interchange Format records required by Federal agencies; ensures submission of data to national data centers; supports and encourages data synthesis by providing new, online, web-based display tools; and facilitates regional, national, and international data and information exchange. The data being served provide the scientific investigators with an opportunity to explore the complex and multifaceted data sets wherever they reside world-wide and to collaborate with colleagues in addressing pressing environmental questions, problems, and challenges.

The BCO-DMO collection of data sets is a publicly available resource accessible via the BCO-DMO website (http://www.bco-dmo.org). It supports synthesis and modeling activities, reuse of oceanographic data for new research endeavors, availability of "real data" for teachers/students at K-12 and college level to use in their classes, and provides decision-support field data for policy-relevant issues.

The website for the geospatial interface to the BCO-DMO managed data is http://mapservice.bco-dmo.org/mapserver/maps-ol/index.php. Below are sample screen shots displaying some of the features of the system interfaces.
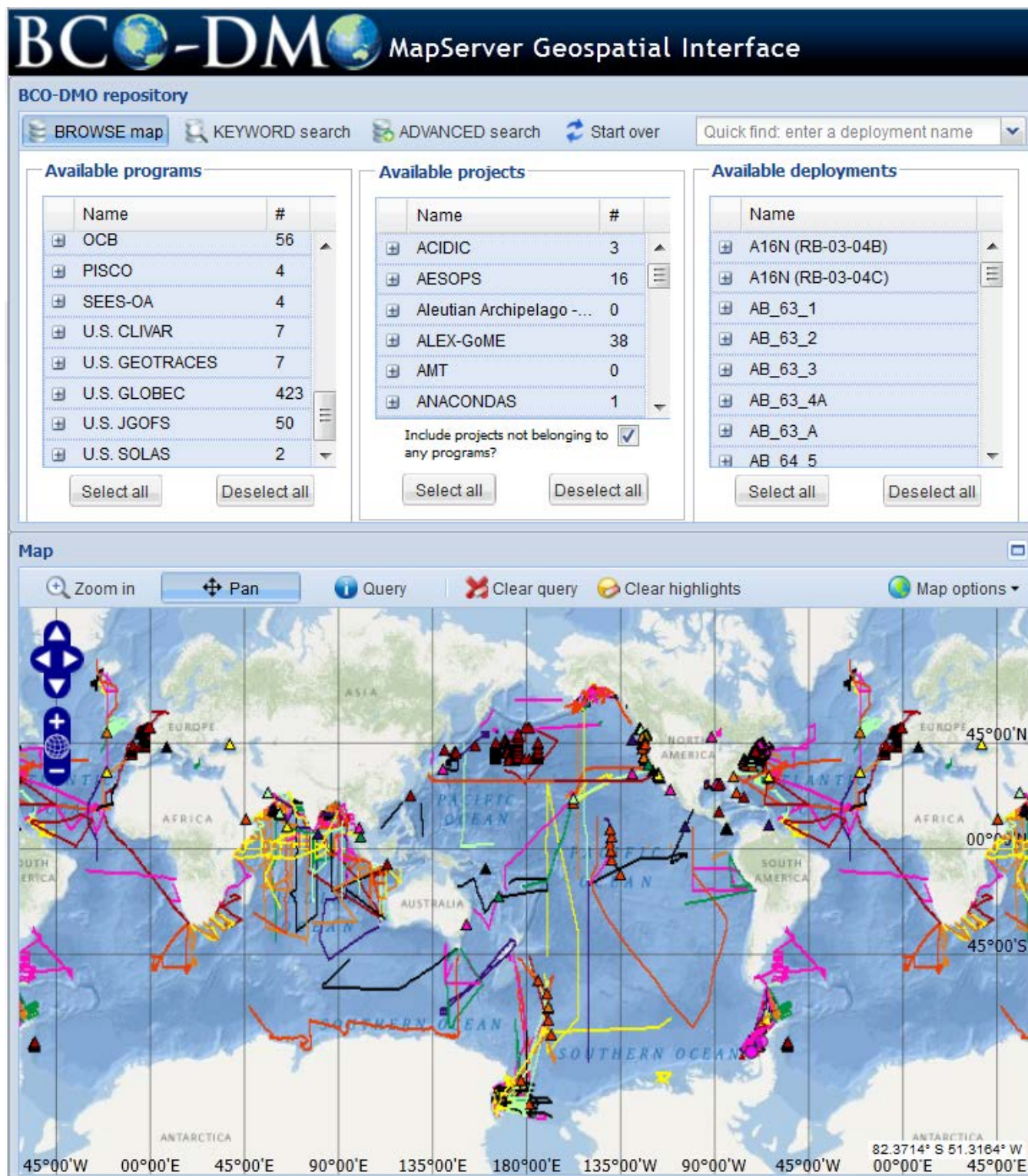
This screen shot shows the initial display of all available deployments (cruises, moorings, etc.) from which data are available through the BCO-DMO system.

This composite of screen shots highlights several of the features of the geospatial interface. We selected a particular program (U.S. GLOBEC), then a project within this program (SOGLOBEC -- Southern Ocean GLOBEC), and then a particular cruise (LMG0104). We clicked on the cruise to display some options and the available list of data sets taken during this cruise (data sets are listed in the lower right hand panel). We clicked on one of the data sets (seals_general) which caused the locations of the data to be displayed (several of the pink dots are seen near the bottom of the map). We then right clicked on the data set name (lower right panel), and selected "View full data set on-line" which brought up the display of the data (overlaid panel in lower right corner.) This panel provides access to several additional download (export format) options including flat (ASCII) text (comma, space or tab separated), Matlab binary file, Ocean Data View (ODV) compatible file, and NetCDF.
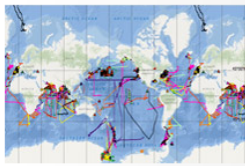
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Biological & Chemical Oceanography Data Management Office

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GEOSPATIAL ACCESS

List of programs

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Program	Acronym	Geolocation	Year
Arctic Summer Cloud Ocean Study	ASCOS	High Arctic Ocean (87degs N, 1-6degs E)	2008
Census of Marine Life	CoML	global	2001
Comparative Analysis of Marine Ecosystem Organization	CAMEO		2008
Dimensions of Biodiversity	Dimensions of Biodiversity	global	2010
Emerging Topics in Biogeochemical Cycles	ETBC	global	2007
Gulf of Mexico - Deepwater Horizon Oil Spill	GoMX - DHOS	Northern Gulf of Mexico	2009
Historical datasets	Historical	global	
Integrated Marine Biogeochemistry and Ecosystem Research -US	IMBER-US	global	2004
Iron Synthesis	FeSynth	Global	2007
Laurentian Great Lakes Ecosystem Studies	Laurentian Great Lakes Ecosystem Studies	Laurentian Great Lakes with an emphasis on Lake Superior	1998
Long Term Ecological Research network	LTER		1980
NACP-OCB Coastal Synthesis	NACP-OCB Coastal	global coastal zones	2008
National Marine Fisheries Service / Northeast Fisheries Science Center	NMFS/NEFSC	U.S. Continental Shelf	1977
North American Carbon Program	NACP	North America	2005
NorthEast Consortium	NEC	Georges Bank, Gulf of Maine	1999
Ocean Carbon & Biogeochemistry	OCB	Global	2006
Partnership for Interdisciplinary Studies of Coastal Oceans	PISCO	West coast of North America from Mexico to Alaska	1999
Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification	SEES-OA	global	2010
U. S. Climate Variability and Predictability	U.S. CLIVAR	global	
U.S. GEOTRACES	U.S. GEOTRACES	Global	2003
U.S. GLOBal ocean ECosystems dynamics	U.S. GLOBEC	Global	1991
U.S. Joint Global Ocean Flux Study	U.S. JGOFS	Global	1984
United States Surface Ocean Lower Atmosphere Study	U.S. SOLAS	Global	2006

This screen shot of the online BCO-DMO data catalog shows some of the programs currently supported by BCO-DMO. Clicking on one of the program names or acronyms in the actual display then lists the names of the projects comprising that program. This screen shot shows part of the text-based interface that provides access to the metadata available for data sets, as well as access to the actual data sets.