

**Supplementary Information for the  
MB-System NSF Proposal**

**Collaborative Research: Development and Support of the MB-System Software  
Package for Processing and Display of Swath-Mapping Sonar Data**

Submitted to NSF-OCE-MG&G August 15, 2012 by:

David W. Caress (Monterey Bay Aquarium Research Institute)  
Dale N. Chayes (Lamont-Doherty Earth Observatory of Columbia University)

The purpose of this renewal proposal is to fund five years of continued development and support of the MB-System software package. MB-System is used for the processing and display of swath mapping sonar data, and has been supported since 1993 by four successive OCE-MG&G grants. The software is distributed and licensed as open source, and is widely used in both the U.S. and international MG&G communities.

The five-year work plan presented in our proposal involves software development efforts by several other groups. Supplement 1 includes letters of collaboration from seven of our separately funded MB-System development partners.

Also, in order to justify our request for software development support from NSF, we need to document the user base and community support for MB-System. Two additional supplements include (2) a listing of the groups that are known to be currently using MB-System, and (3) a listing of peer-reviewed publications that explicitly cite MB-System and therefore demonstrate long-term use of the software.

## Supplement 1: Collaboration Letters

We include here letters of intent to collaborate with our MB-System project from our MB-System development partners.

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### UNIVERSITY OF NEW HAMPSHIRE

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Dr. D. W. Caress  
Monterey Bay Aquarium Research Institute  
7700 Sandholdt Road  
Moss Landing, CA 95039

2012-01-31

Dear Dave,

**Re.: CHRT integration in MB-System future development**

Thanks for inviting me to the MB-System development meeting at the start of the year. I was very enthusiastic about the developments that you're suggesting, which should really help in supporting current users and making it easier to port the code into many new environments. This is a very good thing for the whole community.


As we discussed, I think it would be a very interesting project to get a version of our CHRT (CUBE with Hierarchical Resolution Techniques) algorithm for computer-assisted processing of dense MBES data into MB-System. Our previous generation of the CUBE (Combined Uncertainty and Bathymetry Estimator) algorithm would have been difficult to integrate due to the licensing agreements that we had arranged with CCOM's Industrial Associates; the new model that we're working on for CHRT should make it possible, however, and that's something that we're (corporately) enthusiastic about seeing happen.

We intend CHRT's distribution to be implemented through a co-development model. That is, each co-developer will sign a license agreement with UNH that provides them access to the code base for the algorithm. They will have the right to modify and use the code in their own software, so long as it passes the validation test suite provided at the project's website. We will also encourage, and expect, all of the co-developers to contribute fixes back to the code base; the validation test suite will only ever be defined with respect to the reference version of the code base managed by CCOM, which should be a big incentive to have it as the 'usual' model. Source code redistribution, except for the public header files, will not be allowed. Typically, for-profit organizations are required to become CCOM Industrial Associates before they can negotiate a license, providing aide-in-kind to CCOM as part of the arrangement. For non-profits, research organizations, etc., these terms are difficult to support, but for CHRT we intend that non-profits could sign licenses and contribute their "sweat equity" to the development of the project as their aide-in-kind to CCOM. That's the mechanism under which I see MB-System taking part in the project.

CHRT is implemented as a client-server model, so that the user interface (in this case MB-System) only has to link with a small library in order to take advantage of any server instances running on the local network. This means that MB-System would be able to be released with just the client interface files (to allow compilation) and binary versions of the client and server libraries. We intend to host at CCOM any binary versions of the libraries that are provided to us by the co-developers, and allow all co-developers to download them for distribution (although the co-developers will of course be responsible for supporting what they distribute). I don't know in advance how many different versions we'll have contributed, but we will at least support Mac OS X and Windows (in 64-bit mode) and possibly some variant of Linux (likely Ubuntu) ourselves from our internal requirements. We may get others from the co-developers.

Details of the agreement and final license terms are still developing as we negotiate with our current Industrial Associates, but I will keep you apprised of the developments. I would hope that a version of CHRT should be available for integration sometime in the second quarter of 2012. I look forward to working with Dale and you on the MB-System integration!

Regards,



Brian Calder, M.Eng(Merit), Ph.D., MIEE, MIEEE  
Associate Research Professor  
Associate Director, CCOM

Universität Bremen Fachbereich 5 · Postfach 33 04 40 · 28334 Bremen

To  
**David Caress**  
Monterey Bay Aquarium Research Institute  
7700 Sandholdt Road  
Moss Landing, CA 95039, and  
**Dale Chayes**  
Lamont-Doherty Earth Observatory  
Columbia University, 61 Route 9W  
Palisades, NY 10964-1000 USA



**DFG-Research Center |  
Cluster of Excellence  
-Vice Director**

Prof. Dr.  
**Gerhard Bohrmann**  
Marine Geologie

Ihr Zeichen:

Ihre Nachricht vom:

Unser Zeichen:

Datum: 10.02.12

Telefon 00 49 (421) 218 -65050  
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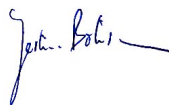
**Dear colleagues**

MARUM, the Center for Marine Environmental Sciences at the University of Bremen is strongly supporting your initiative to continue further developments of the software MB-System. MB-System is becoming increasingly important within the marine community in Germany. This open source software has been used since its origin (in the 90's) at GEOMAR as well as at other places, and slowly increasing its use at the BSH (the German Hydrographic Agency). At MARUM several groups have used MB-System besides other software packages like CARIS HIPS&SIPS, CARAIBES, PDS2000, FLEDERMAUS etc. The Seafloor Imaging Group at MARUM has now adopted MB-System as the primary software for processing both, shipboard and AUV survey data.

We are very supportive of the priorities for future development of MB-System that were identified at the planning meeting at Lamont in January, where Christian dos Santos Ferreira represented the MARUM group. Now we are excited about your plans to add water column data display and processing capabilities to the package. We also noted that some issues that are high priority for MARUM, are unlikely to be addressed within your NSF and Packard Foundation funded projects. These include support for data from sonars that are not used in the U.S. academic community, like Kongsberg GeoAcoustics Geoswath+, Benthos C3D, SEA Swath+, and multibeam data logged using EIVA-Naviscan, Hypack Hysweep and QPS Qinsy. We are also very interested in adding capabilities to MB-System that allow identification of soundings as compliant or non-compliant with IHO standards. Such features can only be added after some of your proposed modifications, specifically those enabling the software to store and use a variety of quality values. The BSH will use MB-System also for educational purposes within their internal training courses for hydrographers.

We would like to confirm that it is our intention to lead a MARUM/GEOMAR proposal for a software development project that will add the capabilities mentioned above to MB-System. This proposal in collaboration with the BSH has submission planned for the end of 2012 or the beginning of 2013.

Sincerely Yours,



Prof. Dr. Gerhard Bohrmann (Vice director of MARUM)

**Sekretariat**  
Angelika Rinkel  
Greta Ohling

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[gohling@marum.de](mailto:gohling@marum.de)

**Postanschrift:**  
Universität Bremen  
GEO-Gebäude, Raum 1080  
FB 5, Klagenfurter Str.  
28359 Bremen

**LAMONT-DOHERTY**  
**EARTH OBSERVATORY**  
OF COLUMBIA UNIVERSITY  
P.O. Box 1000 61 ROUTE 9W Palisades, NY 10964-8000 USA

February 10, 2012.

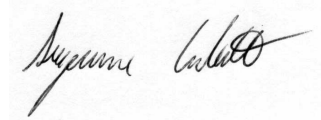
Dear Dave,

I'm writing to confirm our intent to collaborate with you on your proposal for ongoing development and support of MB-System. MB-System tools are an integral part of the data management activities of both the MGDS and the Rolling Deck to Repository (R2R) programs that I manage here at Lamont. For our MGDS activities, MB-System tools are used to extract data set metadata needed for registration of multibeam datasets and for submission to NGDC. We also make extensive use of your tools in our workflow for adding new multibeam datasets to our gridded Global Multi-Resolution Topography (GMRT) Synthesis (for scripted first-pass evaluation of new multibeam data sets, for sound velocity corrections, ping editing, and editing of embedded navigation prior to gridding into the GMRT).

An important component of our R2R program is to develop procedures for and conduct automated quality assessment (QA) of underway data types collected with the UNOLS fleet. For multibeam data, our automated QA procedures are built around existing MB-System tools with extensions we have built for additional QA functionality. As we complete this work, these extensions will be provided to the MB-System code archive so as to become part of the regular distributions available to the broader community.

It would be very difficult for us to perform the swath processing work for MGDS and R2R without the tools available in the MB-System package. In the coming years, we expect to continue to make new modifications and enhancements to support our ongoing data archiving and dissemination activities and we look forward to working with you to include any functionality of use to the broader community in future MB-System distributions.

Best Regards.



Suzanne Carbotte  
Heezen Lamont Research Professor  
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**David Caress**  
Monterey Bay Aquarium Research Institute  
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**Dale Chayes**  
Lamont-Doherty Earth Observatory  
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U. S. A.

**Dr. Wilhelm Weinrebe**  
Senior Staff Scientist

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weinrebe@geomar.de

13. Februar 2012

Dear colleagues,

GEOMAR, the Helmholtz Centre for Ocean Research Kiel is strongly supporting your initiative to continue further developments of the software MB-System. MB-System is our basic software for the processing of all our multibeam echosounder data since 1994. We have processed multibeam data of more than 100 major cruises of German research vessels using MB-System. MB-System will definitely remain the standard processing software for multibeam data at GEOMAR in the future because of its broad functionality, high performance, streamlined workflow and its open software architecture.

Though we were not able to participate personally in the planning meeting at Lamont in January 2012, we fully agree with the conclusions of that meeting, in particular with the list of future developments and extensions of MB-System. We realize that some topics of the list are unlikely to be addressed within your NSF and Packard Foundation funded projects. These include support for data formats from sonar systems that are not used in the U. S. academic community, e. g. Benthos C3D, Geoacoustics Geoswath+, multibeam data logged using Hysweep or water column data of Seabeam 3050 systems.

We confirm that we are preparing a proposal for software development to add the capabilities mentioned above to MB-System jointly with MARUM at the University of Bremen and in collaboration with BSH, the German Hydrographic Service. This proposal will be submitted to German funding agencies at the end of 2012 or the beginning of 2013.

Sincerely Yours,



Prof. Dr. Peter Herzig, Direktor | Ursula Frank-Scholz, Verwaltungsdirektorin (m.d.W.b.)  
MinDir Dr. Karl Eugen Huthmacher, Vorsitzender des Kuratoriums

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Deutsche Bank AG Kiel  
BLZ 210 700 24  
Kto. 144 8000  
SWIFT/BIC DEUTDEDB210  
IBAN DE 69210700240144800000  
Steuer Nummer 1929400468  
USt.-IdNr. DE232115773

**February 13, 2012**

**Subject: Letter of Collaboration for MB-System**

Attention: MB-System Development Team

Tekmap Consulting is a Canadian Company working in the field of Ocean Science since 1994. Tekmap uses the MB-System suite of multibeam processing tools on an almost daily basis.

Because the software is Open Source (GPL), Tekmap is able to modify existing programs and to develop new programs that meet the specific needs of our clients. In addition, Tekmap contributes back to MB-System in the form of bug-fixes, program enhancements, and format support.

MB-System is an essential part of the multibeam processing services offered by Tekmap. Therefore, Tekmap will continue to actively use and contribute to MB-System.

MB-System provides a valuable set of tools to the Ocean Science sector. The features outlined in the 2012 NSF Proposal ensure that MB-System will continue to be a valuable tool to the Marine industry.

Sincerely,



Robert Covill  
President



## WOODS HOLE OCEANOGRAPHIC INSTITUTION

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Feb 14, 2012

David Caress  
Monterey Bay Aquarium Research Institute  
7700 Sandholdt Road  
Moss Landing, CA 95039,

Dale Chayes  
Lamont-Doherty Earth Observatory Columbia University  
61 Route 9W  
Palisades, NY 10964-1000 USA

Dear Dave and Dale,

It's my pleasure to outline our current and planned collaboration with you with regards to MB-System development and its continued use for multibeam processing for data from our autonomous, remotely-operated vehicles and the human-occupied vehicle Alvin. MB-System is the main processing software we use to generate our multibeam maps, and it's also the platform used by our collaborators (University of South Carolina, University of Hawaii).

We are both users of MB-System as well as contributors. In addition to providing feedback to other MB-system developers, we've made additions and improvements to source code for the automated editing program (mbedit). These include a revised "rail" filter, filters for min/max height, and a filter to eliminate data in turns. We now can provide well-edited data to our users with no manual editing. We've added features to mb7kpreprocess that let us repair small sound speed errors that create incorrect beamforming. Additionally, we have also developed some bug fixes in the sidescan processing.

We've also developed a Matlab input/output capability for the generic MB-system fbt data format. This has been useful for importing MB-system data into Matlab for algorithm testing and refinement. For example our improvements to mbedit were developed first in Matlab, then ported to the mbedit program where they can be executed very efficiently on large files. We have also used the Matlab import capability to diagnose problems in real-time acquisition code supplied by our vendor. Recently our vendor inadvertently "discontinued" support for the mechanism we had been using to synchronize our main system clock with the clock in the sonar. We were able to track down this problem by examining the data carefully in Matlab, which then allowed us to convince our vendor they had a problem, then engineer a solution.

In the future, we anticipate continued participation in MB-System development. Our contributions will include improved automated editing, improved ability to correct sound speed beamforming errors, and

we will update the Matlab import/export capability to reflect the improved fbt format. We are also starting an effort to extract geological changes from multibeam data sets made at different times. Separating geological change from mapping artifacts will be a real challenge. We will develop these methods by importing the data into Matlab, but we will also add our resulting algorithms to the MB-System base.

regards

A handwritten signature in black ink, appearing to read "Dana R. Yoerger", with a long horizontal flourish extending to the right.

Dana R. Yoerger  
Senior Scientist



BUNDESAMT FÜR  
SEESCHIFFFAHRT  
UND  
HYDROGRAPHIE

BSH · Neptunallee 5 · 18057 Rostock · Germany

**Dr. David Caress**  
Monterey Bay Aquarium Research Institute  
7700 Sandholdt Road  
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CA 95039, USA

**Mr Dale Chayes**  
Lamont-Doherty Earth Observatory  
Columbia University, 61 Route 9W  
Palisades,  
NY 10964-1000 USA

Rostock Office

Date 20.02.2012

Extension:  
+ 49 (0) 381 4563 - 719  
Reference:  
N1317

**Letter of Intent for the support of the NSF proposal for further activities of the MB-System**

Dear Dr. Caress, dear Mr. Chayes,

the Federal Maritime and Hydrographic Agency (BSH) as the NHO of Germany, is happy to support your initiative of a NSF funding for further developments of the MB-System software package. MB-System is used intensively as a tool for processing multibeam data, which was acquired by German Research Vessels worldwide for further use within the German Bathymetric Database. At BSH the MB-System is also used for educational purposes, especially in training courses for hydrographic surveyors.

With respect to the lack of time, no representative of the Hydrographic Office was able to attend the MB-System workshop at Lamont in January 2012, but the results of this workshop are being supported. The further development of MB-System, mainly the integration of additional proprietary data formats of sonars and of third party processing software would be appreciated by the BSH. The MB-System software is one of the few independent and perhaps Open Source software packages for processing multibeam sonar data. With respect to the proposed enhancements, the BSH could imagine that MB-System offers the possibility to compare processing results with the results of commercial multibeam sonar software.

The BSH will also support the funding initiative of MARUM, University of Bremen and GEOMAR, Centre of the Helmholtz Community for Oceanographic Research, Kiel to realize several contributions for MB-System enhancements, especially the S-44 compliance.

Best regards  
Dr. Mathias Jonas

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Tel.: + 49 (0) 381 4563 716  
-Fax: + 49 (0) 381 4563 - 948  
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## Supplement 2: MB-System User Community Estimate

We all periodically need to justify our existence (at least with respect to funding), and a key way to justify the resources devoted to MB-System by MBARI and NSF is to document a significant user community. Since we don't sell MB-System, and we don't ask users to register in any way, usefully estimating the scale of the MB-System user community is a difficult endeavor. We do have three sources of information: membership in the MB-System Discussion List (<http://listserver.mbari.org/sympa/info/mbsystem>), emails to us not routed through the Discussion List, and our records of source distribution downloads. We generally seek to estimate the list of organizations rather than of individuals that use MB-System.

We assume that signing up to receive ~400 emails per year regarding MB-System indicates a fair degree of interest, and therefore regard all list members as "users". However, there are clearly many users that do not sign up for all these emails. Some read the posts through the online interface, some choose to email us separately, and some apparently just don't need any help. During 2011, there were 412 posts to the Discussion List. As of January 25, 2012, the MB-System Discussion List had 235 members successfully receiving emails. On August 10, 2012, there were 245 registered members, and there had been 335 posts so far this year.

Inferring usage from the records of downloads is more problematic. The download list consists of the IP addresses associated with downloads and the files downloaded. During 2011, MB-System source distributions were downloaded 2535 times from 925 unique IP addresses. In many cases, the IP addresses are resolved to identifiable domain addresses (e.g. somemachine.mbari.org) that allow us to know which organization is associated with the download, but the great majority of download IP's are either unresolved or resolve to commercial ISPs like comcast.net. Further, compiled MB-System distributions are available for Mac OS X through the Fink Project, for Red Hat Linux systems through the Scripps Institution of Oceanography's Shipboard Technical Support group, and as part of the Poseidon Linux distribution (an Ubuntu variant). We have no tracking of MB-System installations through these other distributions, but it is anecdotally clear that these are increasingly popular. Thus, a large part of the community that downloads the MB-System source distributions is undocumented. However, it must also be noted that downloading does not necessarily imply usage, and very likely some of the organizations that we identify as downloading MB-System may in fact not be installing and using it. For instance, it seems likely that a past download by someone at National Cash Register (NCR) was probably not related to any major NCR product development projects. Finally, we frequently receive emails from people using old MB-System installations; these users are certainly users, but they do not show up in recent download logs because they haven't downloaded anything lately.

Despite the above uncertainties, we have used a combination of Discussion List membership and identified source distribution downloads to construct a list of organizations that have recently expressed a significant level of interest in MB-System. For better or worse, this represents our best estimate of the current user base.

The following 197 organizations are inferred to have used MB-System during 2011 because at least one of the following is true:

- The software distribution was downloaded to an IP address resolved to the organization domain at least once between January 1, 2011 and February 14, 2012.
- A member of the organization was enrolled in the MB-System Discussion List on January 25, 2012 or August 10, 2012.
- A member of the organization emailed us regarding their use of MB-System after January 1, 2011.

### **U.S. Academic (41)**

American Museum of Natural History	University of Alaska
California State University Humboldt	University of California Davis
California State University Monterey Bay	University of California Irvine
Florida Atlantic University	University of California Riverside
Florida State University	University of California Santa Barbara
Lamont-Doherty Earth Observatory, Columbia University	University of California Santa Cruz
Massachusetts Institute of Technology	University of Hawaii
MBARI	University of Houston
Medical University of South Carolina	University of Maine
Miami University	University of Minnesota
North Carolina State University	University of Mississippi
Ohio State University	University of New Hampshire
Oregon State University	University of North Carolina
Scripps Institution of Oceanography, UCSD	University of Oklahoma
San Diego Supercomputer Center, UCSD	University of South Carolina
Santa Clara University	University of South Florida
Stanford University	University of Texas Austin
Texas A&M University	University of Washington
University Corp. for Atmospheric Research	University of Wisconsin
University of Alabama	University of Wyoming
	Woods Hole Oceanographic Institution

### **Non-U.S. Academic (68)**

Alfred Wegener Institut, Germany	Institute for Systems and Robotics Lisbon, Portugal
Anadolu University, Turkey	Institute of Marine Research, Norway
Australian National University, Australia	Institution du Physique du Globe de Paris, France
Ben-Gurion University of the Negev, Israel	Instituto Superior de Engenharia do Porto, Portugal
Burapha University, Thailand	Jacobs University, Germany
Chiba University, Japan	Kumamoto University, Japan
Delft University of Technology, Netherlands	Kunsan National University, Korea
Ecole Nationale Supérieure de Techniques Avancées Bretagne, France	Leibniz Institute for Baltic Sea Research Germany
Fluminense Federal University, Brazil	MARUM, University of Bremen, Germany
Friedrich-Schiller-Universität Jena, Germany	Memorial University, Canada
GEOMAR, Germany	Moscow State University, Russia
HafenCity Universität Hamburg, Germany	Northumbria University, United Kingdom
Hellenic Centre for Marine Research, Greece	Oxford University, United Kingdom
Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, Germany	
Institut Pierre Simon Laplace, France	

Plymouth University, United Kingdom  
 Pontificia Universidad Catolica de Valparaiso,  
 Chile  
 Russian State Hydrometeorological University,  
 Russia  
 Sheffield University, United Kingdom  
 Sun Yat-Sen University, China  
 Tokyo Institute of Technology, Japan  
 Trinity College Dublin, Ireland  
 Universidad de Granada, Spain  
 Universidad Nacional Autonoma de Mexico,  
 Mexico  
 Universidade de Brasilia, Brazil  
 Universidade do Algarve, Portugal  
 Universita Degli Studi di Parma, Italy  
 Universitat de Girona, Spain  
 Universitat Hamburg, Germany  
 Universitat Kiel, Germany  
 Universitat Oldenburg, Germany  
 Universitat Politecnica de Catalunya Barcelona,  
 Spain  
 Universitat Wurzburg, Germany  
 Universitatea Alexandru Ioan Cuza, Romania

Universite Brest (France)  
 Universite Laval, Canada  
 Universiteit Gent, Belgium  
 Universitet Stockholm, Sweden  
 Universitetet i Oslo, Norway  
 University of Auckland, New Zealand  
 University of British Columbia, Canada  
 University of Cambridge, United Kingdom  
 University of Durham, United Kingdom  
 University of Galway, Ireland  
 University of Iceland, Iceland  
 University of Manitoba, Canada  
 University of Otago, New Zealand  
 University of Patras, Greece  
 University of Stirling, United Kingdom  
 University of Southampton, United Kingdom  
 University of the Highlands and Islands, United  
 Kingdom  
 University of Tokai, Japan  
 University of Tokyo, Japan  
 University of Victoria, Canada  
 Yamaguchi University, Japan

### **U.S. Government Agency (11)**

Coastal Services Center, NOAA  
 Cooperative Institute for Research in  
 Environmental Sciences, NOAA  
 National Geophysical Data Center, NOAA  
 National Geospatial-Intelligence Agency  
 Oregon Department of Geology and Mineral  
 Industries

Pacific Marine Environmental Laboratory,  
 NOAA  
 United States Antarctic Program  
 United States Bureau of Reclamation  
 United States Coast Guard  
 United States Geological Survey  
 United States Navy

### **Non-U.S. Government Agency (40)**

Applied Geoscience and Technology Division,  
 SOPAC, Fiji  
 British Antarctic Survey, United Kingdom  
 Bundesamt fur Seeschiffahrt und Hydrographie  
 (BSH), Germany  
 Bundesanstalt für Geowissenschaften und  
 Rohstoffe (BGR), Germany  
 Centre Mediterrani d'Investigacions Marines i  
 Ambientals, Spain  
 Consejo Superior de Investigaciones Cientificas,  
 Spain  
 CSIRO Marine and Atmospheric Research,  
 Australia  
 Defence Research and Development, Canada  
 Department of Defense, Australia  
 Direccion Nacional de Recursos Acuaticos,  
 Uruguay  
 Directorate of Fisheries, Iceland  
 Fisheries and Oceans Canada, Canada

Fundacao Centro Tecnologico de Hidraulica,  
 Brazil  
 Geoscience Australia, Australia  
 GFZ German Research Centre for Geosciences,  
 Germany  
 GNS Science, New Zealand  
 Iceland Geosurvey, Iceland  
 IFREMER, France  
 Instituto de Investigaciones Electricas, Mexico  
 Instituto di Scienze Marine, Italy  
 Instituto Nacional de Investigacion u Desarrollo  
 Pesquero, Argentina  
 Institutul National de Cercetare-Dezvoltare  
 pentru Geologie si Geocologie Marina,  
 Romania  
 Istituto di Scienza e Tecnologia  
 dell'Informazione, Italy  
 Istituto Nazionale di Geofisica e Vulcanologia,  
 Italy  
 JAMSTEC, Japan

KORDI, Korea  
Korea Advanced Institute of Science and  
Technology, Korea  
Mamara Research Center, Turkey  
Marine Research Institute, Iceland  
Ministry of Energy and Mineral Resources,  
Indonesia  
National Defense and Canadian Forces, Canada  
National Institute of Advanced Industrial  
Science and Technology, Japan

National Institute of Oceanography, India  
NATO NURC, Italy  
Natural Resources Canada, Canada  
NIWA, New Zealand  
Petroleum Agency South Africa, South Africa  
Swedish Maritime Administration, Sweden  
Urząd Morski w Szczecinie, Poland  
United Kingdom Hydrographic Office, United  
Kingdom

### **Commercial (37)**

IOcean, (United States)  
Abyss Diving and ROV Services, (Norway)  
ALBUS, (Australia)  
Altas Electroniik, (Germany)  
Atlantide, (France)  
Baars-CIPRO, (Netherlands)  
C&C Technologies, (United States)  
Chevron, (Global)  
Consciousystems, (United States)  
Falkanger Snyder Martineau & Yates, (U.S.)  
Fielax, (Germany)  
General Dynamics, (United States)  
Geonautics, (Italy)  
Google, (United States)  
Hitachi, (Japan)  
Intec Sea, (Global)  
ISE, (Canada)  
Kawasaki Geological Engineering, (Japan)  
KESTI, (Korea)

Kinsale Angling, (Ireland)  
Korea Seabed Information, (Korea)  
MMT, (United Kingdom)  
Nomad Labs, (Germany)  
Ocean Floor Geophysics (Canada)  
Ocean Imaging Consultants, (United States)  
Oceanworks International, (U.S., Canada)  
Petrobras, (Brazil)  
Scanbio, (Norway)  
Stone Aerospace, (United States)  
Tekmap Consulting, (Canada)  
Teledyne, (United States)  
Thales, (Global)  
Tokyo Cartographic Company, (Japan)  
Viking Yachts, (United States)  
VITO, (Belgium)  
Wood Group, (Global)  
Z-pulley, (United States)

### Supplement 3: Publications That Cite MB-System

We include here a list of peer-reviewed publications that cite MB-System. This list does not include papers authored or co-authored by either David Caress or Dale Chayes. These papers were identified using Google Scholar. These publications may have cited the software distribution itself, or one of the few publications that have been focused on the MB-System package, as shown in this list:

- Caress, D.W., and D.N. Chayes, MB-System Version 3, Open source software distributed from the L-DEO ftp site, 1993.
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