75th Multibeam Sonar Training Course
Bologna, Italy - May 21 to 26, 2018

Co-hosted by
Istituto di Scienze Marine –
Consiglio Nazionale delle Ricerche
(ISMAR – CNR)

When: From 0800H Monday May 21, 2018
To 1600H Saturday May 26, 2018

Where: Room 215 & 216, Conference Centre, C.N.R., Bologna Research Area
Via P. Gobetti, 101
40129, Bologna, Italy
[44°31'20.29"N 11°20'18.02"E]

Cost: The registration fee is $3,800, which includes course materials and lunch for 6 days, but not accommodation.

Accommodation: The course venue is a short bus or taxi ride from the centre of Bologna and there are many hotels in the city. However, this is a busy time of year in Bologna and if you intend to attend the course it is recommended that you book your hotel soon. Some suggestions will be provided when participants register for the course.

For more details, do not hesitate to contact:

Lindsay Gee
email mbcinfo@hydrometrica.com
tel +1 603 957-1461

Alessandra Mercorella
email alessandra.mercorella@bo.ismar.cnr.it
tel +39 051 6398922

Elisa Leidi
email elisa.leidi@bo.ismar.cnr.it
tel +39 051 6398922

Course Description and Outline

This six-day, 36-lecture course is designed to provide a theoretical and practical background in marine swath survey technology and techniques for hydrographic surveys, continental shelf boundary delimitation, offshore engineering, harbour dredging, fisheries habitat, route survey and scientific research, and provides overviews of:

- the technology and problems associated with shallow water multibeam surveys,
- processing and visualization techniques designed to address the complexities of swath mapping,
- constraints on using swath bathymetry to produce highest quality data.

Day	Lecture	Topic	Instructor
Monday		**INTRODUCTION AND REVIEW OF FUNDAMENTAL CONCEPTS**	
	01	Historical Perspective and Course Overview	JHC
	02	Underwater Acoustics A	TW
	03	Oceanographic and Geologic Concepts	LM
	04	Underwater Acoustics B	TW
	05	Spatial Referencing Terms and Concepts	DW
	06	Visualization Terms and Concepts	LM
Tuesday	07	Hydrographic Performance Standards	DW
		SWATH SONAR ISSUES	
	08	Sidescan Sonar Methods	JHC
	09	Multibeam Sonar Methods	JHC
	10	Bottom Detection Methods	TW
	11	Sidescan / Multibeam Backscatter Imaging	TW
		ANCILLARY SENSOR ISSUES	
	12	Multisensor Integration for Swath Bathymetric Systems	JHC
Wednesday	13	Sound Refraction in the Water Column	JHC
	14	Refraction Operational Limitations due to Watermass Variability	JHC
	15	Positioning Requirements: Horizontal, Vertical & Orientation	DW
	16	Inertial and Acoustic Methods	IC
	17	GNSS Methods: Global Navigation Satellite Systems	DW
	18	Uncertainty Estimation in Swath Methods	LM
Thursday		**SEABED ACOUSTIC BACKSCATTER**	
	19	Acoustic Seabed Interaction Theory	TW
	20	Acoustic Backscatter Image Interpretation	JHC
	21	Introduction to Seafloor Characterization	LM
	22	Oblique Incidence Characterization Methods	LM
		SURVEY DESIGN AND QUALITY CONTROL	
	23	Survey Design and Planning	LM
	24	The Patch Test and Sensor to Ship Reference Frame Alignment	JHC
Friday	25	Field Quality Control: Dynamic Error Recognition and Analysis	JHC
	26	Achieving Decimetre Bathymetry via Ellipsoid-Referenced Surveys	DW
		DATA PROCESSING	
	27	Swath Bathymetry Data Cleaning – Interactive and Automated	JHC
	28	Data Reduction for Chart Compilation Purposes	JHC
	29	The Swath Processing Pipeline	LM
	30	Impact and Management of Dense Digital Bathymetry	DW
Saturday		**CURRENT & FUTURE TECHNOLOGY**	
	31	Midwater Mapping	TW
	32	Alternative Approaches for High Density Bathymetric Data Collection	LM
	33	MBES Specifications	TW
	34	Operational Field Trials: Assessing Performance	JHC
	35	New Data Presentation Methods	LM
	36	Course Roundup and Discussion on Emerging Issues	ALL

Instructors

John Hughes Clarke
Center for Coastal and Ocean Mapping
University of New Hampshire
Durham NH 03824 USA
email jhc@ccom.unh.edu

Larry Mayer
Center for Coastal and Ocean Mapping
University of New Hampshire
Durham NH 03824 USA
email lmayer@unh.edu

Dave Wells
Department of Marine Science
University of Southern Mississippi
Stennis Space Center MS 39529
Email dew@unb.ca

Ian Church
Ocean Mapping Group
University of New Brunswick
Fredericton N.B. E3B 5A3 Canada
Email ian.church@unb.ca

Tom Weber
Center for Coastal and Ocean Mapping
University of New Hampshire
Durham NH 03824 USA
Email weber@ccom.unh.edu

Advance preparation by attendees

This course is very intensive and fast-paced. Attendees come from various backgrounds and some have found they benefited from some pre-reading for the course. There is no mandatory preparation but we recommend the resources listed below be consulted by those feeling the need for such preparation.

Attendees at previous courses recommended that we provide access to some course materials in advance of the course. Hence, a download link is included in the receipt for payment of course fees, for binder 1 of 3 (we recommend looking at the first 7 lectures in particular). Printed copies will still be provided at the course.

Available at no cost:

International Hydrographic Organization Publication C-13 *Manual on Hydrography* (2005, corrected Feb 2011), particularly chapters 2, 3, 4 and 7
http://www.iho.int/iho_pubs/CB/C13_Index.htm

International Hydrographic Organization Special Publication S-44 *IHO Standards for Hydrographic Surveys*, 5th Edition, February 2008
http://www.iho.int/iho_pubs/standard/S-44_5E.pdf

L3 Seabeam's *Multibeam Sonar Theory of Operations Manual* (2000) at
http://www.mbari.org/data/mbsystem/sonarfunction/SeaBeamMultibeamTheoryOperation.pdf

US Army Corps of Engineers *Hydrographic Engineer Manual* (2013-11-30)
particularly chapters 3, 6 and 7, and appendices D and F (example projects appendices H to Q). download at
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1003.pdf

de Jong, Lachapelle, Skone & Elema (2003) *Hydrography* Second Edition, e-book with corrections (2010) 354 pp. ISBN: 90-407-2359-1. Particularly Chapter 11 *Sounding Methods*. Free download from
http://www.ucalgary.ca/engo_webdocs/SpecialPublications/Hydrography_2ndEdition_eBook_2010.pdf

The MB-System Cookbook (version 2006-02-16)
http://www.mbari.org/data/mbsystem/mb-cookbook/index.html

FIG Guide on the Development of a Vertical Reference Surface for Hydrography (2006), FIG Pub. No. 37.
http://www.fig.net/pub/figpub/pub37/pub37.pdf

Lurton & Lamarche (Eds) (2015) *Backscatter measurements by seafloor-mapping sonars. Guidelines and Recommendations*. GeoHab Backscatter Working Group Report. 200p.
http://geohab.org/wp-content/uploads/2014/05/BSWG-REPORT-MAY2015.pdf

Available for purchase:

Xavier Lurton (2010) *An Introduction to Underwater Acoustics: Principles and Applications* Second Edition, (Particularly Chaps 2, 5, 6, 7, 8) 480 pp. Springer Verlag ISBN13: 978- 3-540-78480-7 $419
http://www.springer.com/earth+sciences+and+geography/oceanography/book/978-3-540-78480-7

R.J. Urick (1983) *Principles of underwater sound*, 3rd Ed. Peninsula Publishing, ISBN 0-932146-62-7 $74
http://peninsulapublishing.com/index.php?main_page=product_book_info&cPath=16&products_id=18

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Instructions:
Download free Acrobat Reader <http://www.adobe.com/go/reader>. Open this document and fill in under Acrobat. Save and **email to <mbcinfo@hydrometrica.com>**

Name:

Company:

Address:

Phone:

Mobile:

Official E-mail (which, in some organizations, may restrict document downloads):

Personal E-mail (for download of the course materials):

Briefly describe your past experience with Multibeam Sonar Systems; and/or

future plans for work with Multibeam Systems.

Upon receipt of registration, we will email you an **invoice** with payment & accommodation info.
Upon receipt of payment, we will email you a **receipt**, with download link for course binders.