

Center for Coastal and Ocean Mapping NOAA/UNH Joint Hydrographic Center



Operations Began ~ Jan 2000

~\$1.9 M earmark from Senator Gregg

JHC becomes line item in President's budget

2009 - A Joint Hydrographic Center authorized under PL111-11

2013 - Part of
School of Marine
Science and
Ocean Engineering

Oct. 2008

Oct. 2003 - Second
Floor

Feb 2000
First Floor

2010 competed for and awarded 5 yr JHC grant

May 2015 - submitted proposal for 2016-2020 JHC competition

November 2015 - awarded 2016-2020 grant

New addition... 2018 - 9 new offices and 85 seat amphitheater
classroom/seminar room



Center Goals

- To be a world leader in the development of hydrographic & ocean mapping technologies and approaches
- To expand the scope of ocean mapping clients and constituencies through the development of innovative applications and collaborative work with both the private sector and government labs



Industrial Associates (46)

ACOUSTIC IMAGING PTY, LTD
AIRBORNE HYDROGRAPHY AB
ALIDADE HYDROGRAPHIC
AML OCEANOGRAPHIC
ANTHROPOCENE INSTITUTE
ASV GLOBAL, LTD
BLUEFIN ROBOTICS
CHESAPEAKE TECHNOLOGY, INC
CLEARWATER SEAFOODS
EDGETECH
EIVA MARINE SURVEY
SOLUTIONS
ESRI
EXXON MOBIL
FUGRO PELAGOS
HIGGS HYDROGRAPHIC TEK
HYDROID
HYPACK
IFREMER
IIC TECHNOLOGIES
INSTITUTO HIDROGRAFICO (IH)
KONGSBERG
KLEIN ASSOCIATES

LEIDOS
NORBIT SUBSEA
NOVATEL
OCEAN HIGH TECHNOLOGY INSTITUTE
OCEANIC IMAGING INC
PHOENIX INTERNATIONAL
QPS US
R2 SONIC
ROLLS ROYCE
SEA MACHINES ROBOTICS
SEVENCs
SMT KINGDOM
SUBSTRUCTURE
SURVICE ENGINEERING COMPANY
TELEDYNE BENTHOS
TELEDYNE CARIS
TELEDYNE OCEAN SCIENCE
TELEDYNE ODOM HYDROGRAPHIC
TELEDYNE OPTECH
TELEDYNE RESON
TRITON IMAGING INC
TYCOM LTD
YSI, INC



Center Goals

- To educate a new generation of hydrographers and ocean mappers that can meet the growing needs of both government agencies and the private sector.



Educational Programs

- M.Sc. and Ph.D.
 - Multiple tracks:
 - Ocean, Electrical, Mechanical Engineering
 - Earth Sciences/Computer Science/Oceanography/Natural Resources
- Graduate Certificate Program
- Nippon Foundation/GEBCO Training Program
- Non-Degree Programs
 - Short Courses and Seminars
 - SURF Scholars
 - Hollings Scholars



Educational Programs

- Forum for the Future of Ocean Mapping - Monaco 15-17 June
 - 175 leaders in the field of ocean mapping from academia, government and industry plus 47 alumni of our GEBCO program



Nippon Foundation announced -
GEBCO Alumni Fund &
commitment to see ocean
completely mapped by 2030



Educational Programs

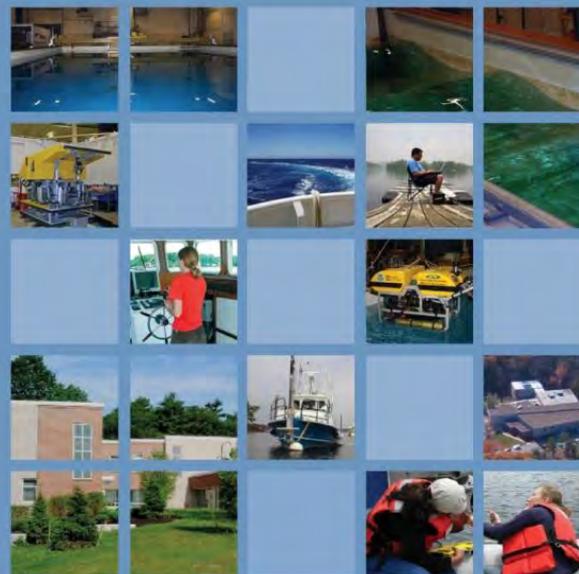
IHO CAT A Certification
- July 2001

RENEWED JUNE 2011
RENEW AGAIN NEXT YEAR!

Restructure of Ocean
Mapping Curriculum

1st year of new BS Ocean
Engineering!!

IHO/FIG/ICA Category A Course Program Submission
Graduate Program in Ocean Mapping with Optional Unit 5—Remote Sensing



Center for Coastal and Ocean Mapping / Joint Hydrographic Center
University of New Hampshire



Complementary Centers

- NOAA/UNH Joint Hydrographic Center (JHC)
- A Government and University Organization

OCS

OAR^G - Ocean Exploration, NGS, NCEI, Sanctuaries, IOOS, CO-OPS, NCCOS, OR&R, NMFS.....



Complementary Centers

UNH Center for Coastal and Ocean Mapping (CCOM)

Provides for participation of private sector and other government agencies

NSF, ONR, NRL, DARPA, CICEET, USGS, Tyco, ACoE, U.S. Coast Guard, Nippon Foundation/GEBCO, BBN, EPSCOR, NHIRC, IHO, NE Consortium, NP Research Bd, GoM Research Institute, Jet Propulsion Lab, Blodgett Foundation, Conoco Phillips, National Park Service, 3001 Inc, Sea Grant, Exxon Mobil, Woods Hole Oceanographic, University of Delaware, NH Coastal Programs, UNH Advance Collaborative Scholarship, Schmidt Ocean Institute, Ocean Exploration Trust, Teledyne Benthos, NH Dept. of Env. Services, UCAR, Consortium of Ocean Leadership, Maine Natural Resources, Sloan Foundation, BOEM, PNAS, United Kingdom, NERACOOS, Kongsberg Maritime, Swedish Polar Research/Stockholm University, IOGP

\$~3.60 M this year from non-NOAA sources



Who are we?

Research and Teaching Faculty:

Lee Alexander, Andy Armstrong, Jonathan Beaudoin, Margaret Boettcher, Tom Butkiewicz, Brian Calder, Dale Chayes, Jenn Dijkstra, Semme Dijkstra, Diane Foster, Jim Gardner, John Hughes Clarke, Jim Irish, John Kelley, Tom Lippmann, Tony Lyons, Giuseppe Masetti, Larry Mayer, Jennifer Miksis-Olds, Dave Monahan, Dave Mosher, Chris Parrish, Shachak Pe'eri, Yuri Rzhhanov, Kurt Schwehr, Colin Ware, Larry Ward, Tom Weber, Neil Weston, Dave Wells, Rochelle Wigley

Research Staff and Scientists:

Roland Arsenault, Jason Greenlaw, Tianhang Hou, Kevin Jerram, Paul Johnson, Carl Kammerer, Carlo Lanzoni, Erin Nagel, Val Schmidt, Briana Sullivan, Firat Eren (Post-doc), Kerri Seger (Post-doc)



Who are we?

Support Staff: Ben Smith, Andy McLeod, Mike Tuttle, Will Fessenden, Jordan Chadwick, Jon Hunt, Emily Terry, Colleen Mitchell, Tara Johnson, Irene Blinn, Abby Pagan-Allis, Linda Prescott, Wendy Monroe, Dan Tauriello

NOAA/IOCM/OER/SSS: *Glen Rice (OCS), Meme Lobecker (OER), Lindsay McKenna (OER), Sarah Wolfskehl (OCS) Derek Sowers (OER), Juliet Kinney, Cassie Bongiovanni, Michael Bogonko, Michael White*



Who are we?

Visiting Scholars:

Jorgen Eeg-Danish Hydro Office

Don House-Texas A&M Univ.

Ralf Doerner-Fraunhofer Inst. Germany

Goran Alm-Univ. of Stockholm

Ron Boyd-Newcastle Univ., Australia

John Hall-Geological Survey of Israel

Martin Jakobsson-Univ. of Stockholm

LCDR Tony Withers-RAN, Australia

Walter Smith, NOAA-NESDIS

Lysandros Tsoulos-National Tech. Univ of Athens

Jean Marie Augustin-IFREMER

Xavier Salsamendi Guinda-IH Cantabria Spain

Sanghyun Suh - KORDI-Korea

Xavier Lurton-IFREMER

Seonjeong Lee-Korean Maritime Univ.

Gideon Tibor-IOLR and Univ. of Haifa

Xavier Lurton-IFREMER

Angelia Vanderlaan -U. Mass Amherst

Ann Albright-Blomberg-Univ. of Oslo

Julian Le Deunf-CIDCO

Rabine Keyetieu-CIDCO

Christian Stranne-Stockholm Univ.

Tor Inge Birkenes Lønmo-Kongsberg



Who are we?

22 Current Students-- MSc and PhD:

Mashkoor Malik (PhD), Glen Rice (PhD), Derek Sowers (PhD), Ashley Norton (PhD), Ricardo Freire (PhD), Scott Loranger (PhD), Kelly Nifong (MS), Massimo Di Stefano (PhD), Onni Irish (MS), John Kidd (MS), Andersen Pecanha (MS), Andrew Stevens (MS), Matthew Birkebak (MS), Salme Cook (PhD), Erin Heffron (MS), Shannon Hoy (MS), Igor Kozlov (MS), Tiziana Munene (MS), Alexandra Padilla (MS), Samuel Reed (MS), Kevin Rychert (MS), Elizabeth Weider (MS), Damian Manda (MS)

6 GEBCO Scholars 2015-2016

Evgenia Bazhenova-Russia, Brandon Maingo-Barbados, Renzo Menacho-Peru, Wasim Muhammad-Pakistan, Azmi Rosedee-Malaysia, Chikara Tsuchiya,-Japan



**Graduates 2001-2016 (138) -- PhD(6) + MS(50) + NOAA MS(15) +
Certificate(2)+ GEBCO(65)**

Shep Smith (MS)
Briana Sullivan (MS)
Caleb Gostnell (MS)
Daniel Brogan (MS)
Arsen Zoksimovski (MS)
Carthid Nathan (MS)
Jim Glynn (MS)
Peter Mitchell (MS)
Stephen Schaeffer (MS)
Ed Sweeney (MS)
Val Schmidt (MS)
Brian O'Donnell (MS)
Janice Felzenberg (MS)
Bert Franzheim (MS)
Sam Greenaway (MS)
Mashkoor Malik (MS)
Rick Brennan (MS)
Matt Quinn (MS)
Hugo Montoro (MS)
Gretchen Imahori (MS)
Rebecca Conrad (MS)
Lorraine Robidoux (MS)

Nick Forfinski (MS)
Brian Heap (Cert/MS)
Lynn Morgan (MS)
Luis Soares Rosa (MS)
Michelle Weirathmueller (MS)
Marc Moser (MS)
Nathan Wardwell (MS)
Tyler Clark (MS)
Rachel Soraruf (MS)
Gerd Glang (Cert)
Nikki Kuenzel (MS)
Rachot Osiri (MS)
Jorge Alavera (MS)
Anastasia Abramova (MS)
Tami Bedhun (MS)
Sean Denny (MS)
Carlo Lanzoni (MS)
Anna Berry (Cert)
David Pilar (MS)
Matthew Wilson (MS)
Chukwuma Azuike (MS)
Olumide Fadahunsi (MS)

Maddie Schroth-Miller (MS)
Kittisak Nilrat (MS)
Giuseppe Masetti (MS)
Christy Fandel (MS)
Lindsay McKenna (MS)
Kevin Jerram (MS)
Briana Welton (MS)
Fang Yao (MS)
Carmen St. Jean (MS)
Mezgeb Mehtsentu (MS)
Felipe Barios Burnett (MS)
Ashton Flinders (MS)
John Heaton (MS)
Dandan Miao (MS)
Katrina Wyllie (MS)
Han Hu (MS)
Eric Bajor (MS)
Cesar Borba (MS)
Liam Pillsbury (MS)
Damian Manda (MS)
Josh Humberson (MS)



"TELEPRESENCE CONSOLE"

Real-time data transmission, processing, and ship-board support - with OER



Panoramic Display

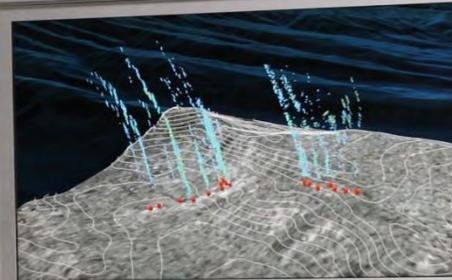


TOOL FOR HUMAN FACTORS STUDIES



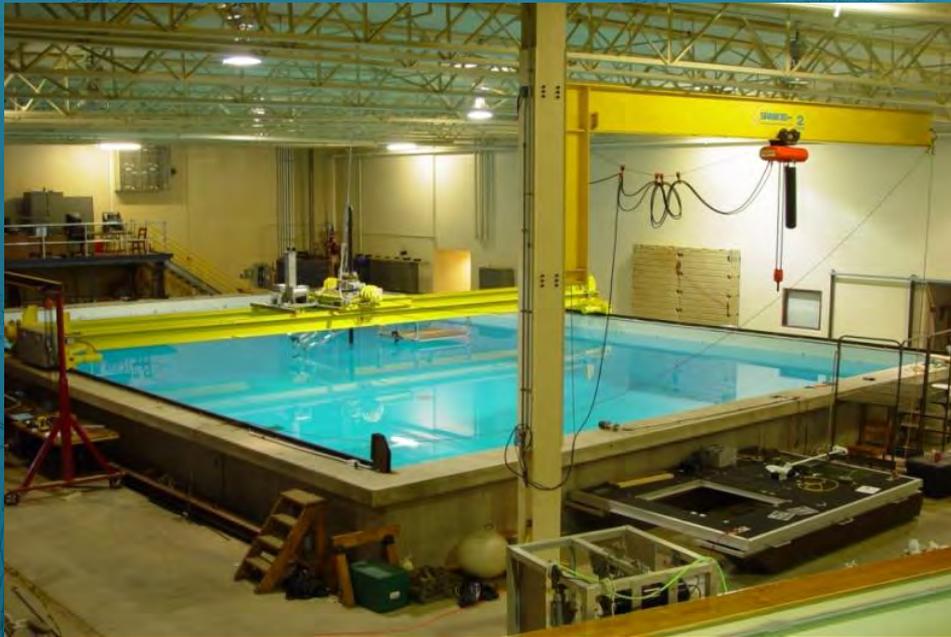
Joint Hydrographic Center Annual Review • July 26–29, 2016

GeoWall



Acoustic and Wave Tank Test Facilities

Acoustic Calibration Tank



60' x 40' x 20'

Wave and Tow Tank



120' x 12' x 8'



R/V Coastal Surveyor



**Customized bow ram
for mounting sonars**

Hydraulic stabilizers

**Odom Echo-Track
profiler and Digibar**

Trimble RTK GPS

POS-MV 320 V4

**Dell server with and
GPS displays**

**Available for install:
Seabird CTD**

C-NAV

Omnistar

Knudsen 320P/ 320M



NOAA Launch 3401 *R/V Cocheco*



Multipurpose vessel with open aft deck Hydraulic A-Frame and winch for towing (1000 lbs tow load)

300 ft of 10 conductor coax

10 conductor slip-ring

Trimble DSM212H GPS

Available for install:

Grab Samplers

RTK GPS

Omnistar

C-NAV

Echotrac SBES

Knudsen 320P/320M



New Build
R/V Gulf Surveyor



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New Purchase *Zego Boat*



Lippmann in collaboration with Higgs Hydrographic Inc.



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Research Themes

- *Sensor Technology*
- *Data Processing*
- *Seafloor and Habitat Characterization - Water Column Mapping*
- *Visualization*
- *Chart of the Future*
- *Law of The Sea Mapping*
- *IOCM*



FEDERAL FUNDING OPPORTUNITY

FOUR PROGRAMMATIC PRIORITIES

- 5.1 Innovate Hydrography (4)
- 5.2. Transform Charting and Change Navigation (3)
- 5.3. Explore and Map the Continental Shelf (3)
- 5.4 Develop and Advance Hydrographic and Nautical Charting Expertise (4)

Fourteen Research Requirements

60 Individual Projects



THE GRAND TABLE.....

PROGRAMMATIC PRIORITIES	RESEARCH REQUIREMENTS	THEMES	SUB-THEMES	PROJECTS	POC	REF. #	
INNOVATE HYDROGRAPHY	DATA COLLECTION	SENSOR CALIBRATION AND SONAR DESIGN	SONAR	Tank Calibrations	Lanzoni	1	
				PMBS Evaluation	Schmidt	2	
				Circular Array Bathymetric Sonar	Weber	3	
			LIDAR	Synthetic Aperture Sonar	Weber and Lyons	4	
				Lidar Simulator	Pe'eri	5	
				SOUND SPEED	Pe'eri	6	
		SENSOR INTEGRATION and REAL-TIME QA/QC	Deterministic Error Analysis/Integration Error	Hughes Clarke	7		
			Data Performance Monitoring	Calder	8		
			Auto Patch Test Tools	Calder	9		
			INNOVATIVE PLATFORMS	Nav Processing and Boot Camp	Schmidt	10	
				ASVs	Add-on Sensors and Hydro Applications	Schmidt	11
			TRUSTED PARTNER DATA	Trusted Hardware	Calder	12	
	DATA PROCESSING	ALGORITHMS and PROCESSING	CHRT and Expanded Processing Methods	Calder	13		
			Multi-Detect Processing	Weber and Calder	14		
			Data Quality and Survey Validation Tools	Calder	15		
			Phase Measuring Bathymetric Sonar Processing	Schmidt	16		
			Automatic Processing for Topo-Bathymetric LIDAR	Calder and Pe'eri	17		
			FIXED AND TRANSIENT WATERCOLUM AND SEAFLOOR FEATURES	SEAFLOOR	Hydro-significant Object Detection	Calder and Masetti	18
			WATER COLUMN	Watercolumn Target Detection	Weber	19	
		COASTAL AND CONTINENTAL SHELF RESOURCES	SEAFLOOR CHARACTERIZATION	Mapping Gas and Leaky Pipelines in Watercolumn	Weber	20	
				Identification of Marine Mineral Deposits	Ward	21	
				GeoCoder/ARA	Masetti	22	
	SONAR		Singlebeam Characterization	Lippmann	23		
			Multi-frequency Seafloor Backscatter	Hughes Clarke and Weber	24		
			LIDAR and IMAGERY	Lidar Waveform Extraction	Pe'eri	25	
			CRITICAL MARINE HABITAT	Object Based Image Analysis	J. Dijkstra	26	
				Video Mosaics and Segmentation Techniques	Rzhanov	27	
				Margin-wide Habitat Analysis	Mayer, J.Dijkstra, and Mosher	28	
	COASTAL RESILIENCE and CHANGE DETECTION	Shoreline Change	Pe'eri	29			
		Seabed Change	Hughes Clarke	30			
		Change in Benthic Habitat and Restoration	"Sandy Team"	31			
		Marine Coastal Decision Support Tools	Butkiewicz and Vis Lab	32			
	TEMPORAL STABILITY of the Seafloor	Labwide	33				
	THIRD PARTY DATA	Assessment of Quality of 3rd Party Data	Calder	34			
		NON-TRADITIONAL DATA SOURCES	ALB	Assessment of ALB data	Pe'eri	35	
			SDB	Development of Techniques for Satellite Derived Bathymetry	Pe'eri	36	
THIRD PARTY and NON-TRADITIONAL DATA							
TRANSFORM CHARTING AND NAVIGATION	CHART ADEQUACY and COMPUTER-ASSISTED CARTOGRAPHY		Managing Hydrographic Data and Automated Cartography	Calder and NEW HIRE	37		
			Chart Adequacy and Re-survey Priorities	Calder, NEW HIRE, and Masetti	38		
			Hydrographic Data Manipulation Interfaces	Calder, Hughes Clarke, Butkiewicz, and Ware	39		
	COMPREHENSIVE CHARTS AND DECISION AIDS	INFORMATION SUPPORTING SITUATIONAL AWARENESS		Currents Waves and Weather	Ware, Sullivan, and Vis. Lab.	40	
				Under-keel Clearance, Real-time and Predictive Decision Aids	Calder and Vis. Lab.	41	
		CHARTS and DECISION AIDS		Ocean Flow Model Distribution and Accessibility	Sullivan	42	
			ChUM	Sullivan	43		
			Augmented Reality Supporting Charting and Nav	Butkiewicz	44		
VISUALIZATION AND RESOURCE MANAGEMENT	GENERAL ENHANCEMENT OF VISUALIZATION		Tools for Visualizing Complex Ocean Data	Ware and Vis. Lab.	45		
			New interaction techniques	Butkiewicz	46		
EXPLORE AND MAP THE EXTENDED CONTINENTAL SHELF	EXTENDED CONTINENTAL SHELF		Lead in Planning, Acquiring and Processing ECS	Gardner, Mosher, and Mayer	47		
			Extended Continental Shelf Taskforce	Mosher, Gardner, and Mayer	48		
			Best Approaches for Legacy Data: Delineation Techniques	Mosher, Gardner, and Mayer	49		
	OCEAN EXPLORATION		ECS Data for Ecosystem Management	Mayer, Mosher, and J. Dijkstra	50		
	TELEPRESENCE AND ROVS		Potential of MBES Data to Resolve Oceanographic Features	Weber, Mayer, and Hughes Clarke	51		
		Immersive Live Views from ROV Feeds	Vis. Lab.	52			
HYDROGRAPHIC EXPERTISE	EDUCATION		Revisit Education Program	Hughes Clarke and S. Dijkstra	53		
	ACOUSTIC PROPAGATION AND MARINE MAMMALS		Modelling Radiation Patterns of MBES	Weber and Lurton	54		
			Web-based Tools for MBES Propagation	Johnson and Arsenault	55		
			Impact of Sonars on Marine Mammals	Mikus-Olds and Ellis	56		
	PUBLICATIONS AND R2O		Continue Publication and R2O Transitions	Labwide	57		
	OUTREACH		Expand Outreach and STEM Activities	Hicks-Johnson and Mitchell	58		
DATA MANAGEMENT	EXTENDED DATA MANAGEMENT PRACTICE		Data Sharing, ISO19115 Metadata	Johnson and Chadwick	59		
			Enhanced Web Services for Data Management	Johnson	60		



INNOVATE HYDROGRAPHY

Data Collection

Innovative Platforms

ASVs -

Add-on sensors and Hydro Applications -
Schmidt, McLeod and others (11)



C-Worker 4



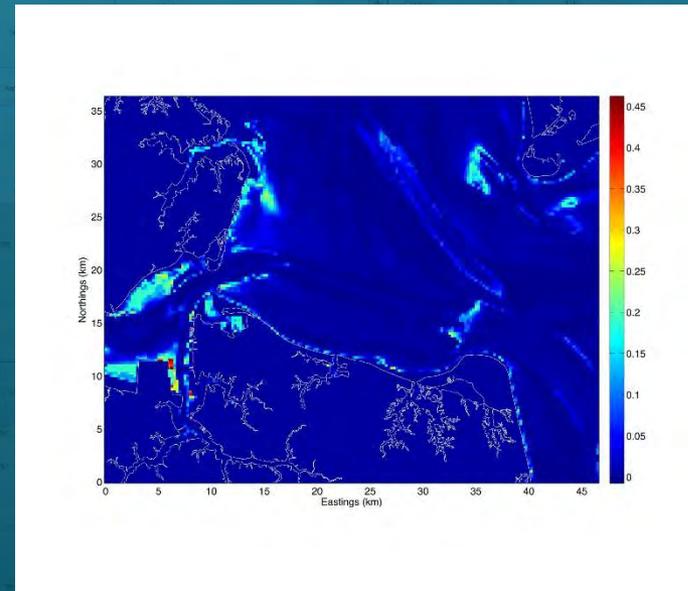
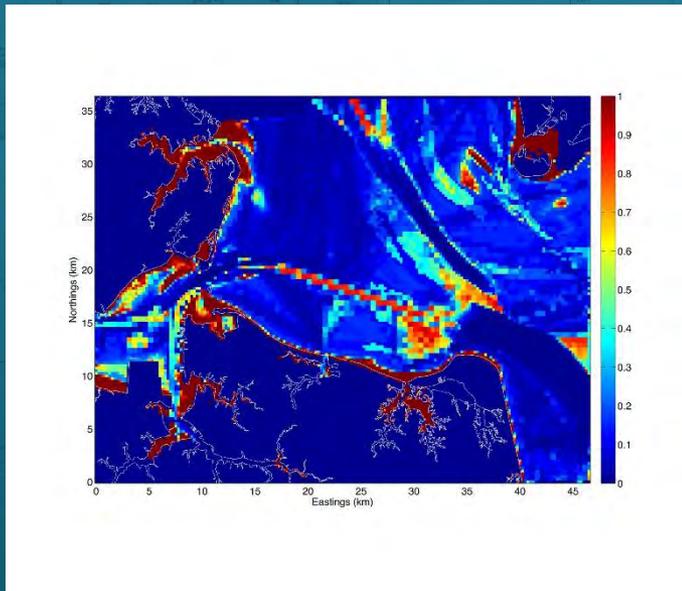
TRANSFORM CHARTING AND NAVIGATION

Chart Adequacy and Computer-Assisted Cartography

Information Supporting Situational Awareness

Chart Adequacy and Re-survey Priorities - Calder,
New Hire and Masetti - (38)

Under-Keel Clearance, Real-time and Predictive
Decision Aids - Calder and Vis. Lab (41)



HYDROGRAPHIC EXPERTISE

Acoustic Propagation and Marine Mammals

Modeling Radiation Patterns of MBES - Weber and Lurton (54)

Impact of Sonars on Marine Mammals - Miksis-Olds (56)

30: Mobile Seabed

EM710 0.5 degree transmit; EM 2040 (> 200 kHz); A generic SBP

100 line km per year / New England Coastal Waters / up to 150 m

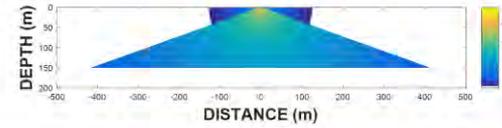
Using fall temperature/salinity (T = 11.6 degC, S = 32.1)

Using scenario with largest volumes: 70 kHz at SL = 232 (e.g., contrast with Ward's SBP)

Modeling Notes:

- Modeled at 70kHz
- 3 dB beamwidth 140 degrees
- SL = 232 db re 1 uPa @ 1m in 70-100 kHz band, 'gradually falling off' to 216 at 40 kHz. Vol estimates in km³/1000 km at 50/150 m depth:
 - 40 kHz (216): 1.8/15.4
 - 50 kHz (221): 2.0/15.7
 - 60 kHz (225): 2.2/16.0
 - 70 kHz(232): 3.4/17.2
- 0.5 x 1 degree transmit
- SLL = 26 dB (constant level)

Acoustic System: EM710 MK2
 Depth = 50 (m) Area = 0.0137 (km²)
 Depth = 150 (m) Area = 0.0666 (km²)



Species - Annual	Species - Monthly	Area Density (Animals/km ²) New Hampshire - 20NM	Area Density (Animals/km ²) New England - 24NM	Area Density (Animals/km ²) Shallow (0 to 200m) New England - 24NM	Area Density (Animals/km ²) Deep (> 200m) New England - 24NM
Atlantic Spotted Dolphin		0.0000	0.0305	0.0005	0
Beaked Whale		0.0002	0.0002	0.0002	0
Blue Whale		0.0000	0.0000	0.0000	0
Clymene Dolphin		0.0000	0.0000	0.0000	0
Fraasers Dolphin		0.0000	0.0000	0.0000	0
Killer Whale		0.0000	0.0000	0.0000	0
Kogia Whale		0.0000	0.0000	0.0000	0
Melon Headed Whale		0.0000	0.0000	0.0000	0
Pantropical Spotted Dolphin		0.0000	0.0000	0.0000	0
Pilot Whale		0.0004	0.0024	0.0022	0
Rough Toothed Dolphin		0.0000	0.0000	0.0000	0
Spinner Dolphin		0.0000	0.0000	0.0000	0
Striped Dolphin		0.0000	0.0000	0.0000	0
White Beaked Dolphin		0.0001	0.0001	0.0001	0
	Atlantic White Sided Dolphin - January	0.0161	0.0281	0.0267	0
	Atlantic White Sided Dolphin - February	0.0071	0.0139	0.0131	0
	Atlantic White Sided Dolphin - March	0.0050	0.0119	0.0112	0
	Atlantic White Sided Dolphin - April	0.0107	0.0214	0.0201	0
	Atlantic White Sided Dolphin - May	0.0326	0.0571	0.0539	0
	Atlantic White Sided Dolphin - June	0.0337	0.0734	0.0691	0
	Atlantic White Sided Dolphin - July	0.0309	0.0670	0.0633	0
	Atlantic White Sided Dolphin - August	0.0293	0.0644	0.0608	0
	Atlantic White Sided Dolphin - September	0.0333	0.0715	0.0668	0
	Atlantic White Sided Dolphin - October	0.0312	0.0721	0.0664	0
	Atlantic White Sided Dolphin - November	0.0398	0.0781	0.0729	0
	Atlantic White Sided Dolphin - December	0.0309	0.0540	0.0512	0



EDUCATION AND OUTREACH

Hicks, Mitchell

Cub Scouts "Floats and Boats" badge



~900 students
from local
schools



Ocean Discovery
Day in September

