

8th EGO Meeting and International Glider Workshop

May 21–23, 2019

Rutgers University, New Jersey

Presented by



8TH EGO MEETING AND INTERNATIONAL GLIDER WORKSHOP

May 21-23, 2019

Rutgers, The State University of New Jersey
Ludwig Global Learning Center
9 Suydam St
New Brunswick, NJ 08901

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Basis for the Meeting

The European (EGO) and U.S. (UG2) Autonomous Underwater Glider User Groups are coming together to host the 8th EGO Meeting and International Glider Workshop.

Meeting Goal

The goal of this meeting is to strengthen international collaboration through community dialogue, exchanges of information, sharing of experiences, and development of best practices to support the glider community.

Meeting Objectives

The planned meeting objectives follow:

- 1) Harmonize glider efforts: International data management, leveraging partnerships, documenting best practices, international collaboration;
- 2) Promote new developments: Sensors, emerging requirements, novel glider applications;
- 3) Explore extreme environments: Sea ice, currents, severe weather conditions;
- 4) Refine operational activities: Reliability, sampling strategies, sustained monitoring; and
- 5) Prepare for OceanObs'19: Strategy for the next decade of regional, national, and global ocean observing using glider technologies.

Meeting Components

This international meeting will offer a mix of presentations, panels, breakout groups, a poster session, and open community dialog. It will provide a forum in which scientists, engineers, students and industry can exchange knowledge and experience on the development of glider technology, the application of gliders in oceanographic research, and the role of gliders in ocean observing systems.

Oral Presentations. Energetic and captivating speakers were invited to educate and inform the community with up-to-date science, practice, and unique case studies. Practitioners representing the full scope of the international glider community, from federal, state, and local agencies, to industry, and academia, will cover a wide breadth of examples, methodologies, and general uses of gliders.

Breakout Sessions. Breakout Groups are an important aspect of the 8th EGO Meeting and International Glider Workshop. These sessions create opportunities to interact with colleagues and work toward a specific outcome or goal such as developing best practices for data management, international collaboration, or engaging in structured information exchange about OceanObs'19.

Poster Presentations. Poster presentations play a key role in the success of the 8th EGO Meeting and International Glider Workshop. In order to promote networking between participants, the poster session will coincide with the evening reception on Tuesday, May 21, 2019. Research, tools, and information can be showcased with a 3.5' x 4' poster.

Breakout Sessions

Breakout Sessions are an important aspect of the 8th EGO Meeting and International Glider Workshop. These sessions create opportunities to interact with colleagues and work toward a specific outcome or goal, such as developing best practices for data management, international collaboration, or engaging in structured information exchange about OceanObs'19. You will have daily opportunities to participate in a facilitated breakout group. The topics of focus will be Best Practices, Capacity Building, and Glider Coordination. Each of these Breakout Groups will have the following topical sessions:

Glider Coordination Breakouts

- International Cooperation: How do we effectively enable sharing and access across EEZs to collectively address science challenges?
- Exploring Extreme Environments: How do we optimize glider missions to meet scientific objectives in demanding situations (e.g., sea ice, currents, storms, maritime traffic, etc.)?
- Leveraging Partnerships and Collaboration: What types of partnerships have worked and should be models for advancing glider capabilities?
- U.S. Glider User Group: How do we empower a robust and active community of glider users in the U.S.?

Best Practices Breakouts

- Data Management and New Requirements: What are some near-term, practical implementation strategies towards achieving sound data management for glider activities and meeting new requirements?
- Documenting Best Practices: How can we collect, develop, verify, and communicate best practices most effectively?
- Reliability and Sustained Monitoring: What are the fundamental strategies for minimizing operational reliability risks for sustained glider missions?
- New Sensors and Sampling Strategies: How can new and existing sensors be more effectively deployed on gliders?

Capacity Building Breakouts

- Training and Education: How do we enhance training and education opportunities for students, operators, managers, and users?
- Asset Sharing and Funding Opportunities: How do we promote collaborative opportunities for glider missions and build the case for more funding?
- Communication Tools: What are the best ways for sharing knowledge about gliders across the community?
- OceanObs'19 and UN Ocean Decade: What is the strategy for the next decade of regional, national, and global ocean observing using glider technologies?

Agenda

Tuesday, 21 May 2019

0800 – 0900 Registration, The Ludwig Learning Center

8th EGO Meeting and International Glider Workshop

0900 – 0910 Welcome to Rutgers

Robert Goodman | Rutgers University School of Environmental and Biological Sciences

0910 – 0912 Welcome to the MARACOOS Region

Gerhard Kuska | Mid-Atlantic Regional Association Coastal Ocean Observing System

0912 – 0917 Welcome from UG2

Barb Kirkpatrick | Gulf of Mexico Coastal Ocean Observation System

0917 – 0927 Welcome from EGO

Pierre Testor | Centre National de la Recherche Scientifique (French National Centre for Scientific Research)/Laboratory of Oceanography and Climate: Experiments and Numerical Approaches

0927 – 0937 OceanGliders: Introduction and Overview

Brad deYoung | Memorial University

0937 – 0947 Setting the Stage for Best Practices

Emma Heslop | Intergovernmental Oceanographic Commission/United Nations Educational, Scientific and Cultural Organization

0947 – 0955 JCOMMOPS: Introduction and Overview

Victor Turpin | Joint Technical Commission for Oceanography and Marine Meteorology in situ Observations Programme Support Centre

0955 – 1100 Plenary Session I, Schonberg Room

Session Chair: Mike Crowley

Topic #1: Studies of Air-Sea Interactions During Storms and Hurricanes

Oral Presentations

Scott Glenn (Rutgers University) | Ocean gliders in tropical cyclone forecasting

Gustavo Jorge Goni (National Oceanic and Atmospheric Administration, Atlantic Oceanographic and Meteorological Laboratory) | A NOAA plan to enhance underwater glider observations during the 2019 Atlantic hurricane season

Hak Soo Lim (Korea Institute of Ocean Science and Technology) | Deintensification of Typhoon Soulik by a rapid ocean destratification in the coastal waters of west Jeju Island, Korea

Joanne O'Callaghan (National Institute of Water and Atmospheric Research) | Oceanic extent of buoyant river plume after high-intensity rainfall from storm events revealed by an ocean glider

Maria Aristizabal (Rutgers University) | Impact of glider data assimilation on the Global Ocean Forecasting System during the 2018 hurricane season

Plenary Session Recap

Mike Crowley

1100 – 1115 Break

Coffee and Refreshments

1115 – 1130 Glider Coordination Warm-up, Schonberg Room

Nick Rome

1130 – 1230 Glider Coordination Breakout Groups

- International Cooperation, Schonberg Room
- Exploring Extreme Environments Classroom 008
- Leveraging Partnerships & Collaboration, Classroom 002
- U.S. Glider User Group, Classroom 017

1230 – 1330 Lunch

Buffet Lunch

1330 – 1400 Breakout Group Report Outs, Schonberg Room

Nick Rome

- International Cooperation
- Exploring Extreme Environments
- Leveraging Partnerships & Collaboration
- U.S. Glider User Group

1400 – 1530 Plenary Session I, Schonberg Room

Session Chair: Brad deYoung

Oral Presentations

Steven DiMarco (Texas A&M University) | Applications of Buoyancy Gliders in the Western Gulf of Mexico: Loop Current Dynamics, Coastal Hypoxia, Ocean Noise, Acidification, and Hurricane Intensification

W. Douglas Wilson (Ocean and Coastal Observing - Virgin Islands) | Glider Operations in the U.S. Virgin Islands in 2018

Topic #2: Sustained Observations of Boundary Currents

Daniel Rudnick (Scripps Institution of Oceanography) | OceanGliders Boundary Ocean Observing Network

Emma Heslop (Intergovernmental Oceanographic Commission/United Nations Educational, Scientific and Cultural Organization) | Monitoring and resolving sub-seasonal to inter-annual variability through a choke point in the Western Mediterranean Sea circulation using gliders and models

Bàrbara Barceló-Llull (Applied Physics Laboratory, University of Washington, USA and Mediterranean Institute for Advanced Studies (the University of the Balearic Islands-the Spanish National Research Council), Spain) | Temporal and spatial hydrodynamic variability in the Mallorca channel (western Mediterranean Sea) from eight years of underwater glider data

Joleen Heiderich (Massachusetts Institute of Technology/Woods Hole Oceanographic Institute Joint Program) | Along-stream evolution of Gulf Stream transport

Robert E. Todd (Woods Hole Oceanographic Institution) | Observations of shelf-deep ocean exchange at Cape Hatteras

Plenary Session Recap

Brad deYoung

1530 – 1600 Break

Coffee and Refreshments

1600 – 1730 Plenary Session II, Schonberg Room

Session Chair: Emma Heslop

Oral Presentations

Loic Houpert (National Oceanography Centre, Southampton, UK) | Structure and transport of the North Atlantic Current in the eastern subpolar gyre from sustained glider observations

Donglai Gong (Virginia Institute of Marine Science - William & Mary) | Glider Observations of the Arctic Ocean: Opportunities, Challenges, and Next steps

Katherine Zaba (Scripps Institution of Oceanography) | A Climatology of the California Underwater Glider Network

Guilherme Castelão (Scripps Institution of Oceanography) | A Climatology of fluorescence off the California Coast

Topic #3: Water Transformation Phenomena, Vertical and Horizontal Mixing Processes

Pierre Testor (Centre National de la Recherche Scientifique (French National Centre for Scientific Research)/Laboratory of Oceanography and Climate: Experiments and Numerical Approaches) | OceanGliders water mass transformation

Alejandra Sanchez-Rios (Oregon State University) | Coordinated surveys using Slocum gliders and free-floating drifters for tracking frontal features

Plenary Session Recap

Emma Heslop

1730 – 1800 Day 1 Recap, Schonberg Room

Ben LaCour

1800 Adjourn to Evening Reception

1800 – 1930 Evening Reception with Poster Session, New Jersey Institute for Food, Nutrition, and Health (located at 61 Dudley Rd, New Brunswick, NJ 08901)

Poster Presentations, Room 101

1. Melany Belzile (Fisheries and Oceans Canada) | First-year experience with SeaExplorer gliders
2. Loic Houpert (National Oceanography Centre, Southampton, UK) | TERIFIC [Targeted Experiment to Reconcile Increased Freshwater with Increased Convection] project: Autonomous vehicles in the Labrador Sea
3. Harrison Smith (University of Delaware) | Comparing Satellite and AUV [Autonomous Underwater Vehicle]: Observations of chlorophyll and sea surface temperature
4. Dave Hebert (Fisheries and Oceans Canada) | Glider measurements as an enhancement of a monitoring program on the Scotian Shelf
5. Elizabeth Wright-Fairbanks (Rutgers University) | Glider-based observation of seasonal pH and saturation state variability in commercial shellfishery management zones in the Mid-Atlantic Bight
6. Mark Ohman (Scripps Institution of Oceanography) | Resolving zooplankton and marine snow from a new autonomous Zooglider
7. Stephanie Henson (National Oceanography Centre) | GOCART [Gauging ocean Organic Carbon fluxes using Autonomous Robotic Technologies] project: Novel use of gliders for biological carbon pump research
8. Kimmo Tikka (Finnish Meteorological Institute) | A multinational glider mission study of water exchange in the Baltic Sea

9. Elena Mauri (Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS)) | The South Adriatic Sea as a deep-water convection site in the Mediterranean Sea
10. Jeffrey W. Book (U.S. Naval Research Laboratory) | Using Glider Teams for Ocean Forecasting
11. Kai Salm (Department of Marine Systems, Tallinn University of Technology, Estonia) | Submesoscale variability during the formation of the seasonal thermocline in the Baltic Sea
12. Anthony Cossio (NOAA) | Oops! We sampled under an iceberg
13. Daniel Haixing Wang (Virginia Institute of Marine Science) | Glider observations of submarine canyons off the U.S. East Coast
14. Laura Nazzaro (Rutgers University) | Lessons learned in the practical application of glider quality control tests in an ocean observing system
15. Alice S. Ren (Scripps Institution of Oceanography) | Calibrations for Long-Term Dissolved Oxygen Measurements on CUGN [California Underwater Glider Network] Gliders
16. Matthew Palmer (National Oceanography Centre) | An Alternative Framework to Assess Marine Ecosystem Functioning in Shelf Seas (AlterEco)
17. John Kerfoot (Rutgers University) | Temperature and salinity corrections of SBE41 pumped CTD [Conductivity, Temperature, and Depth] profiles on Slocum gliders for real-time and delayed mode datasets
18. Carlos Barrera (Oceanic Platform of the Canary Islands) | PLOCAN: A gliderport infrastructure in the East-Central North Atlantic
19. John Moloney (JASCO Applied Sciences) | Observer/AMAR [Autonomous Multichannel Acoustic Recorder] G4 passive acoustic monitoring system for autonomous maritime observation
20. Guilherme Castelao (Scripps Institution of Oceanography) | Spray data management
21. Emma Slater (British Oceanographic Data Centre - National Oceanography Centre) | UK glider workflow
22. Yui Takeshita (Monterey Bay Aquarium Research Institute) | Performance of the Deep-Sea-Durafet pH sensor on a spray glider in the Central California current system
23. Rob Gregor (Commonwealth Scientific and Industrial Research Organization) | Glider operations in Chiloe Sea, Chile
24. Francis Bringas (National Oceanic and Atmospheric Administration) | AOML-CARICOOS [Atlantic Oceanographic and Meteorological Laboratory-Caribbean Coastal Ocean Observing System] contribution to NOAA hurricane underwater glider operations in support of tropical Atlantic and Caribbean Sea hurricane intensification studies and forecasts
25. Marcia Pearson (Dalhousie University) | Measuring deep copepod populations with a 4-

frequency echosounder mounted on a Slocum glider

26. Leila Belabbassi (Baghdad-Brahim) (Rutgers University) | Python Module Functions To Evaluate Science Data from Ocean Observatories Initiative (OOI) Gliders

Wednesday, 22 May 2019

0815 – 0830 Welcome and Recap Day 1,

Schonberg Room

Ben LaCour

0830 – 1000 Plenary Session III, Schonberg Room

Session Chair: Pierre Testor

Oral Presentations

Félix Margirier (Sorbonne Université - Laboratory of Oceanography and Climate: Experiments and Numerical Approaches - Institut Pierre Simon Laplace - Centre National de la Recherche Scientifique (French National Centre for Scientific Research)) | Sustained intense monitoring of the deep convective area in the Northwestern Mediterranean

Khushboo Jhugroo (National Institute of Water and Atmospheric Research), New Zealand + University of Auckland, New Zealand) | Fine-scale glider observations of submesoscale eddies in Central New Zealand

Katia Mallil (Laboratory of Oceanography and Climate: Experiments and Numerical Approaches/École Nationale Supérieure des Sciences de la Mer et de l'Aménagement du Littoral [National School of the Sciences of the Sea and Coastal Development] (Algiers)) | Assessing submesoscale activity in the Algerian Basin and its role in the horizontal water mass distribution using gliders

Taku Wagawa (Japan Sea Fisheries Research Institute, Japan Fisheries Research and Education Agency) | Observations of oceanic fronts and water-mass properties in the central Japan Sea: Hydrographic surveys from gliders

Wendell Brown (University of Massachusetts, Dartmouth/School for Marine and Science Technology) | The summer warming of the MAB [Mid-Atlantic Bight] cold pool from an ocean glider perspective

Richard Arena (University of Massachusetts - Dartmouth) | 3D visualization of glider data through Eigenmode Expansions

Lina Eyouni (King Abdullah University for Science and Technology (KAUST)) | Physical and biochemical characteristics of the Central and Northern Red Sea during winter 2019

Plenary Session Recap

Pierre Testor

1000 – 1015 Break

Coffee and Refreshments

1015 – 1030 Best Practices Warm-up,

Schonberg Room

Nick Rome

1030 – 1200 Best Practices Breakout Groups:

- Data Management and New Requirements, Classroom 017
- Documenting Best Practices, Classroom 002
- Reliability and Sustained Monitoring, Classroom 008
- New Sensors and Sampling Strategies, Schonberg Room

1200 – 1300 Lunch

Buffet Lunch

1300 – 1330 Breakout Group Report Out, Schonberg Room

Nick Rome

- Data Management and New Requirements
- Documenting Best Practices
- Reliability and Sustained Monitoring
- New Sensors and Sampling Strategies

1330 – 1500 Plenary Session IV, Schonberg Room**Session Chair:** Barb Kirkpatrick**Oral Presentations**

Nikolaos Zarokanellos (Balearic Islands Coastal Ocean Observing and Forecasting System) | Physical and biochemical high-resolution variability of the Almeria-Oran front in the spring to summer transition

**Topic #4: Observing the Ocean
Geochemistry and Biology**

François Bourrin (Centre of Education and Research on the Mediterranean Environments - Centre national de la recherche scientifique (Center for Scientific Research) - CNRS (FRANCE)) | Study sediment dynamics using coastal gliders

Kathryn Tremblay (University of Massachusetts, Dartmouth/School for Marine and Science Technology) | Using ocean glider observations to assess upwelling and hypoxia along the Northern New Jersey Coast during September 2013

Filipa Carvalho (National Oceanography Centre, UK) | Insights on the Biological Carbon Pump from high-resolution glider measurements

Laura Wiltsee (Rutgers University) | Glider-based assessment of the susceptibility of important commercial fishery habitats to ocean acidification

Adam Comeau (Coastal Environmental Observation Technology and Research) | Tracking marine animals and measuring their habitats using gliders

Katherine Hudson (University of Delaware) | Using a coordinated glider fleet to investigate drivers of a biological hotspot in the Western Antarctic Peninsula

Plenary Session Recap

Barb Kirkpatrick

1500 – 1530 Break

Coffee and Refreshments

1530 – 1700 Plenary Session V, Schonberg Room**Session Chair:** David Legler**Oral Presentations**

Schuyler Nardelli (Rutgers University) | Tracking krill distributions using a glider in Palmer Deep canyon, a West Antarctic Peninsula penguin, and whale foraging hot spot

Topic #5: Glider Data Management

Dan Hayes (University of Cyprus) | OceanGliders data management

Dawn Petraitis (NOAA/National Data Buoy Center) | NDBC [National Data Buoy Center] Distribution of glider data

Justin Buck (National Oceanography Centre, UK) | Oceanids Command and Control (C2) data, the UK glider DAC [Data Assembly Center] status, and connecting glider data infrastructure in the SeaDataCloud project

Bob Fratantonio (RPS) | Recent and Upcoming Developments at the U.S. IOOS [Integrated Ocean Observing System] Glider Data Assembly Center

Kevin O'Brien (University of Washington/Joint Institute for the Study of the Atmosphere and Ocean, NOAA/Pacific Marine Environmental Laboratory) | Harmonizing glider data access with ERDDAP [Environmental Research Division's Data Access Program]

Oral Presentations (continuation)

Mark Bushnell (U.S. Integrated Ocean Observing System) | Quality assurance of real-time ocean data and ocean best practices – tools to support harmonized glider quality control and best practices

Plenary Session Recap

David Legler

1700 – 1730 Day 2 Recap, Schonberg Room

Ben LaCour

1730 Adjourn Day 2

1730 – 1830 Guided Open House, Rutgers Marine Science Department

The Rutgers Marine Science Department will be hosting a guided open house wherein participants will have the opportunity to tour the state-of-the-art Rutgers University Center for Ocean Observing Leadership (RUCOOL) Lab, engage with other participants over refreshments, and explore the Rutgers University glider fleet.

Thursday, 23 May 2019

0815 – 0830 Welcome and Recap, Schonberg Room

[Insert speaker here]

0830 – 1000 Plenary Session VI, Schonberg Room

Session Chair: Dan Rudnick

Topic #6: Operations and Infrastructure

Oral Presentations

Christian Reiss (NOAA) | Gliders and the U.S. AMLR Program: Developing an autonomous monitoring and assessment program in the Antarctic.

Jeanne Melkonian (Le Centre national de la recherche scientifique (National Center for Scientific Research) - Division Technique de Institut National des Sciences de l'Univers (Technical Division of the National Institute for Earth Sciences and Astronomy)) | Managing failures and issues in the French National Glider Facility DT INSU CNRS [Division Technique de Institut National des Sciences de l'Univers Le Centre national de la recherche scientifique (Technical Division of the National Institute for Earth Sciences and Astronomy, National Center for Scientific Research)]

Alvaro Lorenzo-Lopez (National Oceanography Centre) | Oceanids - developing a command and control system for the UK long-range fleet

Robert Currier (GCOOS-RA/TAMU - Gulf of Mexico Coastal Observing System-Regional Association/Texas A&M University) | GANDALF: The Gulf AUV [Autonomous Underwater Vehicle] Network and Data Archiving Long-term Storage Facility

Rich Delgado (The University of Southern Mississippi) | Development of unmanned maritime system pilot training

Carlos Barrera (PLOCAN - Oceanic Platform of the Canary Islands) | Expanding observational capabilities in the Macaronesia region with ocean gliders

Dario Diehl (Southern California Coastal Water Research Project) | Hurdles encountered with AUVs [Autonomous Underwater Vehicles] for routine offshore water quality monitoring in Southern California

Plenary Session Recap

Dan Rudnick

1000 – 1015 Break

Coffee and Refreshments

1015 – 1030 Capacity Building Warm-up,

Schonberg Room

Nick Rome

1030 – 1200 Capacity Building Breakout Groups

- Training and Education Classroom 008
- Asset Sharing and Funding Opportunities Classroom 017
- Communication Tools Classroom 002
- OceanObs'19 & UN Ocean Decade Schonberg Room

1200 – 1300 Lunch

Buffet Lunch

1300 – 1330 Breakout Group Report Out,

Schonberg Room

Nick Rome

- Training and Education
- Asset Sharing and Funding Opportunities
- Communication Tools
- OceanObs'19 & UN Ocean Decade

1330 – 1500 Plenary Session VII, Schonberg Room

Session Chair: Ben LaCour

Topic #7: Glider and Sensor Technology**Oral Presentations**

Adeniyi Adenaya (National Oceanography Centre, Southampton) | An explanation of how we can communicate with a Slocum glider's science bay with a non-pumped CTD [Conductivity, Temperature, and Depth] and a Sea-glider's CT [Conductivity and Temperature] boards

George Cutter (NOAA) | Glider-based acoustics in the Antarctic

Gerd Krahmann (GEOMAR) | Nitrate observations with autonomous gliders

Grace Saba (Rutgers University) | The development and validation of a profiling glider deep ISFET [Ion-Sensitive Field-Effect Transistor]-based pH sensor for high-resolution observations of coastal and ocean acidification

Lucas Merckelbach (Helmholtz Zentrum Geesthacht, Institute for Coastal Research, Germany) | A glider flight model for ocean microstructure gliders

Pierre Cauchy (University of East Anglia) | Passive Acoustic Monitoring from gliders to monitor the oceanic environment: Applications to air-sea interaction studies, ecology, and conservation; good practices, challenges, and suggested developments

Plenary Session Recap

Ben LaCour

1500 – 1530 Break

Coffee and Refreshments

1530 – 1700 Plenary Session VIII, Schonberg Room

Session Chair: Stephen Howden

Oral Presentations

Travis Miles (Rutgers University) | Suspended particle characteristics from a glider integrated LISST [Laser In-Situ Scattering and Transmissiometry] sensor

Karen Heywood (University of East Anglia) | A new approach for deploying an ocean glider in remote locations

Mathieu Gentil (University of Perpignan) | Coastal current estimates from Glider mounted ADCP [Acoustic Doppler Current Profiler]

Atle Lohrmann (Nortek) | Low-drag glider development

Catherine Edwards (University of Georgia) | Expanding autonomy - integrating data streams to optimize glider sampling

Plenary Session Recap

Stephen Howden

1700 – 1800 Day 3 and Event Recap, Schonberg Room

Mike Crowley, Ben LaCour, Nick Rome

1800 Adjourn Day 3 and Workshop

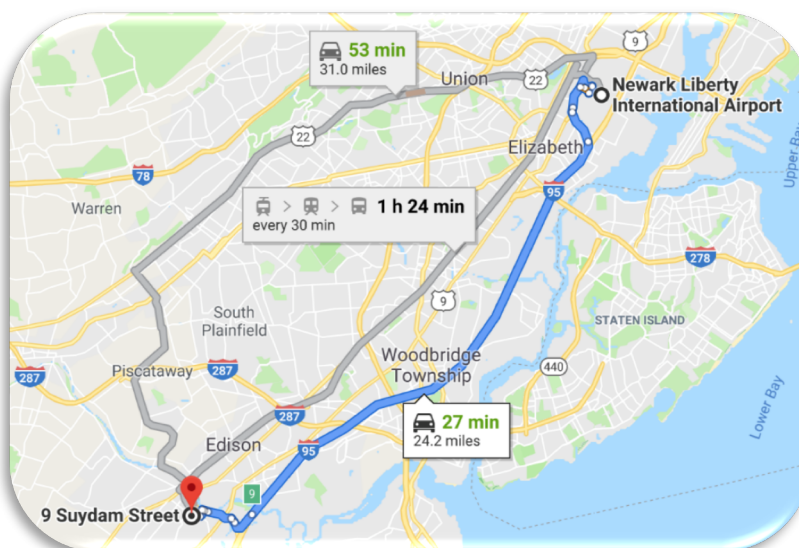
Logistics

When: May 21-23, 2019

Where: Ludwig Global Learning Center, Rutgers University | 9 Suydam St | New Brunswick, NJ 08901

Travel Details:

- **Newark Liberty International Airport (EWR):** EWR is located 25 miles northeast of New Brunswick. Information for public transportation from the airport is available [here](#).
- **AirTrain Newark:** Information available [here](#) (to, from, and around the airport).
- **Hotel:** Hyatt Regency New Brunswick | 2 Albany St | New Brunswick, NJ 08901



Shuttle from the Hotel to the Ludwig Learning Center:

A free shuttle to the Ludwig Learning Center is available to all Workshop participants. Shuttles back to the hotel are available at the end of the day, too. Please see below for more information regarding pick-up/drop-off times, locations, and meeting areas. [All times listed in EDT.]

- Tuesday, May 21st: The shuttle will depart from the Hyatt Regency at [time]. Please gather at [location] no later than [time minus 5 min] to ensure an on-time departure. The shuttle will depart from the New Jersey Institute for Food, Nutrition and Health at both 7:30 p.m. and 8:00 p.m. to return participants to the Hyatt Regency. Please gather [location] no later than 7:25 p.m. or 7:55 p.m., depending on your preferred transfer time.
- Wednesday, May 22nd: The shuttle will depart from the Hyatt Regency at [time]. Please gather at [location] no later than [time minus 5 minutes] to ensure an on-time departure. The shuttle will also be available to transport participants from the Ludwig Learning Center to the Rutgers Marine Science Building for the guided open house. Please gather [location] no later than 5:25 p.m. The shuttle will be available to transport participants back to the Hyatt Regency at both 6:30 p.m. and 6:45 p.m. Please gather at [location] no later than 6:25 p.m. or 6:40 p.m., depending on your preferred transport time.
- Thursday, May 23rd: The shuttle will depart from the Hyatt Regency at [time]. Please gather at [location] no later than [time minus 5 minutes] to ensure an on-time departure. The shuttle will return participants to the Hyatt Regency at 5:30 p.m. and 6:00 p.m. Please gather at [location] no later than 5:25 p.m. or 5:55 p.m., depending on your preferred transport time.

Meals and Beverages:

- Bring your reusable water bottle; individual bottles of water will not be available.
- A light breakfast and a buffet lunch will be provided each day of the conference.

Dinner Options near the Hyatt Regency:

Restaurant	Address	Phone	Website
Glass Woods Tavern	2 Albany St	732-867-2300	https://www.hyatt.com/en-US/hotel/new-jersey/hyatt-regency-new-brunswick/ewrrn/dining
Delta's	19 Dennis St	732-249-1551	www.deltasrestaurant.com
The Frog and the Peach	29 Dennis St	732-846-3216	http://www.frogandpeach.com/
Old Man Rafferty's	106 Albany St	732-846-6153	http://www.oldmanraffertys.com/
My Way Korean Restaurant	351 George St	732-545-5757	http://www.mywaynj.com/
Esquina Latina Restaurant and Lounge	25 Liberty St	732-543-1630	http://esquinalatinarestaurant.com/dinner.html
Clydz	55 Paterson St	732-846-6521	http://www.clydz.com/
Harvest Moon Brewery & Café	392 George St	732-249-6666	https://www.harvestmoonbrewery.com/
Veganized	9 Spring St	732-342-7412	http://veganizedfoods.com/
Panico's Restaurant and Bar	94 Church St	732-545-6161	https://panicosbrickovenpizzanewbrunswick.com/9674
Dashen Ethiopian Cuisine	88 Albany St	732-249-0494	https://www.dashenethiopiannj.com/dinner-menu.html

Contact: We welcome your questions and are good at solving problems. Please reach us at Andrew George, 906-399-3034 (call/text) or andrew.george@noaa.gov; or Emily Wallace, 804-245-0320 (call/text) or emily.wallace@noaa.gov.

Appendix A: Organizing Committee

The organizing committee would like to thank the community for coming together to highlight the successes of the International Glider Community and for taking the time to tackle the difficult challenges we face. The organizing committee includes:

- Mr. Michael Crowley | Technical Director for RUCOOL and MARACOOS | Rutgers University
- Ms. Ruth Curry | Senior Research Specialist | Woods Hole Oceanographic Institution
- Ms. Kruti Desai | Program Associate for the Integrated Ocean Observing Committee | Consortium for Ocean Leadership
- Dr. Brad deYoung | Professor, Department of Physics and Physical Oceanography | Memorial University
- Dr. Scott Glenn | Co-Director, Center for Ocean Observing Leadership | Rutgers University
- Dr. Emma Heslop | Programme Specialist | Global Ocean Observing System
- Dr. Stephan Howden | Associate Professor, Department of Marine Science | University of Southern Mississippi
- Mr. John Kerfoot | Lead Software Developer, Department of Marine and Coastal Sciences | Rutgers University
- Dr. Barb Kirkpatrick | Senior Scientist and Program Manager | Mote Marine Laboratory
- Lieutenant Commander Ben LaCour | Executive Officer, NOAA Ship Pisces | National Oceanic and Atmospheric Administration, NOAA Corps
- Dr. Craig Lee | Senior Principal Oceanographer, Applied Physics Laboratory | Washington University
- Dr. David Legler | Director, Ocean Observing and Monitoring Division | National Oceanic and Atmospheric Administration, Climate Program Office
- Mr. Kevin Martin | Senior Marine Instrumentation Specialist | University of Southern Mississippi
- Dr. Ruth Perry | Marine Scientist and Regulatory Policy Specialist | Shell
- Mr. Nick Rome | Program Manager for the Integrated Ocean Observing System | Consortium for Ocean Leadership
- Dr. Dan Rudnick | Professor, Climate, Atmospheric Science and Physical Oceanography | Scripps Institution of Oceanography
- Dr. Oscar Schofield | Distinguished Professor and Department Chair, Department of Marine and Coastal Sciences | Rutgers University
- Dr. Emily Smith | Program Manager, Tide Gauges | National Oceanic and Atmospheric Administration, Climate Program Office
- Dr. Pierre Testor | Researcher | French National Centre for Scientific Research
- Mr. Victor Turpin | Physical Oceanographer Engineer | French National Centre for Scientific Research

Appendix B: U.S. Glider Workshop Report (January 18-19, 2017, Mississippi)



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The U.S. Underwater Glider Workshop was publicly announced on the Interagency Ocean Observation Committee's website (www.iooc.us). This public workshop proceeded according to the meeting agenda. A summary of the meeting follows.

OVERVIEW

Autonomous underwater gliders provide an advanced and cost-effective mechanism for collecting essential oceanographic data at spatial and temporal scales that help the United States achieve critical research and operational objectives. In 1989, Henry Stommel and Doug Webb proposed the first Slocum Glider with a buoyancy engine powered by a heat exchanger, which has led to the development of new underwater glider vehicles (e.g. SeaExplorer, Seaglider, Slocum, Spray) and sophisticated data software products. The broad technical and geographic expansion of underwater gliders presents a unique opportunity for greater coordination among the ocean observing community for organizing decision-makers, glider operators, and data users to enhance science, marine services, and maximize societal benefits.

Presented with this opportunity, the Interagency Ocean Observing Committee (IOOC), whose mission is to enhance the efficiency of and motivation for ocean observing networks, commissioned a Glider Task Team comprised of regional and national glider experts and federal resource managers. The Glider Task Team first conducted a survey of the glider community to obtain more information about observing data gaps that could be met with gliders, priority areas for science coordination, and resource sharing opportunities for the glider community. Survey results from 17 agencies and science organizations indicated a need for community-wide scientific collaboration and a desire for resource and information sharing. The opinions of those surveyed reflects the importance of gliders to meet scientific requirements and suggests that most missions are research-based. The survey also indicated that the lack of capacity to respond to events and constrained funding are among the limitations identified by some members of the glider community. To overcome these challenges:

- 92 percent of surveyed agencies and institutions are open to facilitating joint glider missions, including data sharing, deployment/recovery resources, and platform sharing
- 86 percent of the survey takers would use a community forum.

Following the survey, the Task Team convened a U.S. Underwater Glider Workshop attended by 90 national and international glider experts from government agencies, universities, nonprofits, and industry. The workshop provided a platform for:

- Exchanging information on advances in glider capabilities, operations, and data processing;
- Exploring how gliders enable new scientific breakthroughs;
- Identifying gaps and coordination opportunities for planning, operations, and resources;
- Assessing best practices for observations, operations, and data management; and
- Designing the scope and aims for a coordination mechanism.

Attendees participated in a high-level plenary by federal agencies, scientific poster presentations, and guided discussion in breakout sessions on Sustained and Event Ocean Monitoring, Harmonizing Glider Efforts, and Developing a Glider User Group. The workshop resulted in diverse ideas broadly presented as:

- Initiate a US Underwater Glider User Group;
- Increase glider data assembly center robustness;
- Explore and encourage asset and platform sharing;
- Improve data and information services; and
- Engage international underwater glider groups.

GLIDERS FOR OCEAN MONITORING

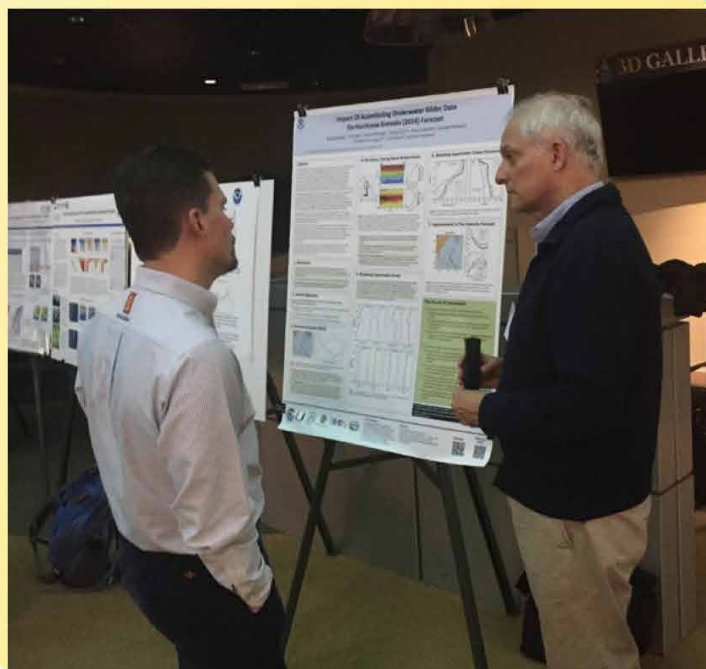
The workshop divided ocean monitoring gliders into two categories: (i) event monitoring, used to target or to respond to specific events and (ii) sustained monitoring, used to establish baseline conditions and to identify trends.

EVENT MONITORING

Operational and scientific glider missions targeting specific features or events covered a wide range of scientific and geographic areas. Example features or events span various disciplines: physical (fronts and plumes, storms, deep water formation, meso- to submesoscale variability, internal waves, the marginal sea ice zone), biological (marine mammal and fish tracking, harmful algal blooms (HAB) and phytoplankton blooms), chemical (eutrophication, hypoxia, acidification), geological (sediment plumes, hydrocarbon seeps). Some events are specifically related to human activity (oil spills, marine pollutants, search and rescue, geopolitical). Event monitoring may begin with low-level detection, progress to more frequent environmental assessments with extensive sensor suites during the event, and continue after its conclusion for persistent impact assessment.

Many workshop delegates identified methods to enhance coordination, addressing science, technical, and data gaps. More effective use of existing glider assets can be improved through:

- Shared data from existing missions via national networks i.e. Integrated Ocean Observing System Glider Data Assembly Center (IOOS Glider DAC);
- Coordinated water space management of glider deployments, flights, recoveries and rescues by multiple groups;
- Shared use of spare glider inventory and sensors, mission planning and analysis software, and technical and regional expertise;
- Dedicated training through glider schools; and
- Enhanced federal and state government coordination and funding with academic, government, and industry glider operators.



Existing gaps in glider capabilities could be improved through:

- Longer duration glider deployments in an even broader range of operating environments
- Development of new low-powered, autonomous sensors;
- Development of rapid all-weather deployment capabilities;
- Development of on-board decision making and improved onshore path planning to reduce human piloting involvement;
- Simplification of glider repairs, refurbishment, and sensor calibrations; and
- Improvement of shared data through standardization, improved quality assurance and control procedures, and assimilation of a wider range of variables into models.



SUSTAINED MONITORING

Sustained glider monitoring missions have been used to collect regional data, to couple with or replace other observational platforms, and provide information to ocean circulation and biogeochemical models. Gliders are most effective at spatial and temporal scales associated with regional processes, which may include the physical circulation of the ocean's boundary currents, marine mammal monitoring and fisheries stock assessment, and ecosystem health (hypoxia, HABs). Many regions already implement sustained glider monitoring in select regions throughout the U.S. and Canada. Sustained glider missions in remote areas are logistically challenging, however implementation is happening at the Ocean Observatories Initiative (OOI) remote Global sites.

In general, workshop delegates provided technical information suggesting that effective sustained monitoring depends on increased collaboration between glider operators and continuous funding pathways. A synopsis of the specific collaboration opportunities includes:

- Facilitation of public/private partnerships;
- Formation of instrument/sensor pools or glider centers with partnering agreements;
- Operator collaboration and resource sharing (glider preparation, deployments, piloting, recoveries);
- Implementation of a user forum to share experiences; and
- Facilitation of data flow through data handling guidelines, data quality assurance and control, and shared pathways to modelers and other customers for the same data.

There are many regions that would benefit from the expansion of sustained glider monitoring (e.g. Gulf of Mexico, high latitudes, multiple Exclusive Economic Zones of the Caribbean/Pacific Islands) with the appreciation of resource limitations and the utility of gliders in certain environments. To address future monitoring activities, some workshop delegates suggested:

- Prioritizing any glider network expansions (in consultation with University-National Oceanographic Laboratory System (UNOLS), National Oceanic and Atmospheric Administration (NOAA), US Integrated Ocean Observing System (IOOS), and academic fleets);
- Determining how to maintain the critical mass of personnel required for sustained operations in more locations; and
- Identifying the best practices for coupling sustained monitoring with event response capabilities.

Cost savings could significantly improve sustained monitoring activities; this could benefit from extending glider deployment durations through energy source enhancement, improving deployment and recovery techniques, minimizing glider loss or the financial implications through insurance, and standardizing additional and/or new sensor integration.

HARMONIZING GLIDER EFFORTS

OPERATIONAL RELIABILITY

The key to glider mission success is often less about the hardware and more about the human interfacing with the hardware. Although some mistakes or errors always happen, many of them are likely preventable. Several key actions for glider operators were suggested that will minimize such errors and improve success:

- A dedicated glider team to develop required expertise and skill sets in operating and piloting gliders- this is not something people can 'jump in and jump out' of. If interns or students are used, clear mentoring and supervision needs to occur.
- A tiered-approach to piloting, used in larger glider operations, where a less-experienced pilot has an experienced pilot to call for assistance and/or advice.
- Knowledgeable glider teams that understand the waters of the area they are flying in. Issues such as currents and shipping lanes may be more obvious than fresh water plumes from rivers, fishing 'hot spots' attracting numerous vessels, and shallow bathymetry, to name a few (see complete list in addendum).

Workshop delegates presented many ideas and opportunities to improve operational reliability. These included:

- Encouraging deployment teams to avoid mistakes by not rushing glider deployments.
- Establishing talent and resource pools, i.e., documenting contacts and local expertise that can be made available when a group is flying in a new area.
- Improving communications with glider producers to provide feedback for strengthening reliability and development of products.

The greatest challenge to achieving these opportunities is a sustained funding source to allow for dedicated personnel and routine missions. Better communication within the glider community, specifically more effective ways to share knowledge, will improve operational reliability. Near-term steps over the next one to three years should include formalizing testing procedures and creating working groups.

DATA MANAGEMENT

Many opportunities were cited regarding glider data management with the need for shared formatting and data integration common themes (see Appendices). Near-term priorities should include standardization across glider operators and a glider data management working group. It was suggested that a glider data management group initially convene in 2017.

INTERAGENCY COLLABORATION

Workshop discussions focused on opportunities to better message the value of collaboration to federal agencies and to encourage them to share mission requirements for gliders. Challenges primarily focused on how to improve communication. Suggestions for moving interagency collaboration forward started with the formation of a Glider User Group. Existing interagency agreements should be reviewed and revised as needed.

INTERNATIONAL COLLABORATION

Sharing best practices will yield significant benefits to international glider operators and users. Moreover, establishing a common set of standards to exchange data would be beneficial to all. There are a number of areas where international planning and coordination of glider missions and linked research would rapidly advance knowledge and glider capabilities. The specific discussion topics should be widely distributed to the international glider community and communicated through the U.S. participants engaged with groups such as OceanGliders, posted on relevant webpages, and included in Glider User Group resources. Several other action items (see appendix) address access to foreign exclusive economic zones (EEZs), and review of existing IOOS and NOAA international agreements to incorporate gliders and glider operations.

UNDERWATER GLIDER USER GROUP (UG)²

The overarching goal of an Underwater Glider User Group is to establish a community that facilitates sharing and cooperation in the following areas:

- Share experiences related to glider and sensor technology;
- Communicate the most recent scientific and operational accomplishments;
- Share approaches to logistical and operational challenges;
- Compare approaches to handling data collected by gliders, including quality control, formats, and distribution; and
- Disseminate news about opportunities and needs for gliders.

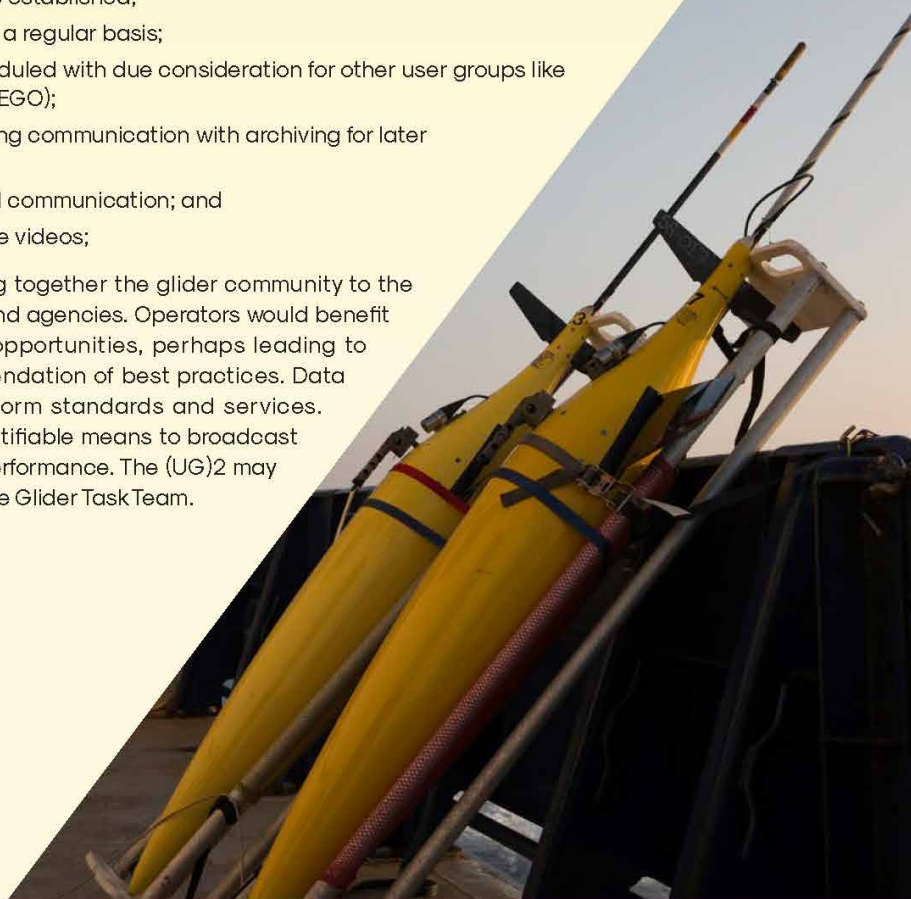
In the context of the mission areas above, (UG)² might sponsor the following activities:

- Establish a forum for question and answers about gliders;
- Create a "hotline" to contact for help about glider emergencies;
- Host a software exchange for glider operations and data;
- Be a nexus for standards in data services;
- Foster communication between glider groups and users, including modelers;
- Set up a mechanism for sharing of glider resources; and
- Create a site for glider news, including the areas of ongoing operations.

The (UG)² would function through the following means:

- Sponsorship and funding should be provided through federal agencies;
- A national steering team would be established;
- Virtual meetings would be held on a regular basis;
- In person meetings could be scheduled with due consideration for other user groups like Everyone's Gliding Observatories (EGO);
- An online forum would allow ongoing communication with archiving for later reference;
- An email list would facilitate broad communication; and
- Training and tutorials could include videos;

If fully successful, (UG)² would bring together the glider community to the benefit of operators, data users, and agencies. Operators would benefit from sharing experiences and opportunities, perhaps leading to the development and recommendation of best practices. Data users would realize more uniform standards and services. Agencies would have an identifiable means to broadcast opportunities and assess performance. The (UG)² may prove to be the legacy of the Glider Task Team.





WORKSHOP OUTCOMES

Many workshop delegates expressed a strong interest in finding opportunities for collaboration and coordination of resources to enable glider missions and subsurface data collection. Discussions also showed broad agreement for connecting the glider community between managers, operators, and data users. The following overarching suggestions below represent a framework for how to meet these goals and begin tackling specific challenges identified by the glider community.

INITIATE THE UNDERWATER GLIDER USER GROUP (UG)2

Initiating the Underwater Glider User Group (UG)2 is the top priority to provide the centralized platform needed to springboard many of the recommended actions. A steering team comprised of national representatives will drive the agenda and activities for (UG)2, maintaining international connections.

IMPROVE DATA AND INFORMATION SERVICES

Improved glider data management results in optimized utility for ocean stakeholders. Sending open glider data through the IOOS Glider Data Assembly Center (DAC) is a method to build on an established platform integrating glider data in the same formats and making the data accessible to all users. There is also a need for a glider data management working group to drive standardization across glider programs and address other data issues, which could serve as a sub-group of (UG)2 and boost Glider DAC activities. These efforts will likely require staff support and additional logistics to facilitate glider data standard development.

EXPLORE AND ENCOURAGE ASSET AND PLATFORM SHARING

Many workshop attendees are eager to leverage resources to expand the reach of the gliders and the data collected. Platform sharing business models, such as the University-National Oceanographic Laboratory System (UNOLS) fleet, Uber/Lyft ride-sharing services, or even a rental car organization, are the types of innovative mechanisms needed to get gliders that are on shelves into the water collecting valuable subsurface data. All of these models would require significant discussions and agreements to ensure fairness and safety to all parties. At a minimum, a forum could be established for operators to share plans and needs. Those with resources could post planned missions to which they are willing to add sensors, while those seeking glider support in the form of deployment and recovery, piloting, and maintenance could solicit help in a shared space.

ENGAGE INTERNATIONAL UNDERWATER GLIDER COMMUNITIES

Many of the international participants in the workshop were interested in working with U.S. operators and data users to expand their glider capacity and networks. Conversely, U.S. glider program managers are eager to learn from established glider operations abroad. The glider community should expand coordination on international forums such as Everyone's Glider Observatories (EGO), Integrated Marine Observing System (IMOS), Ocean Networks Canada, Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) International Steering Team, and potentially others. Beyond strategic planning and information sharing, the U.S. community can seek out specific opportunities to collaborate directly with international glider operators and on shared interest projects.

Appendix C: Sponsors

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