



Delivering REMUS for Bermuda and REMUS data to the world

**Ocean Tech** is dedicated to collaborative marine research and oceanographic STEAM education to advance understanding of the ocean and its vital connection to the health of the planet's systems and to communicating this understanding in inspiring ways to benefit society.

Ocean Tech is a Bermuda registered not-for-profit company No. 52233 and a Bermuda Registered Charitable Organization No: 980. Bermudian philanthropists and corporate donations support Ocean Tech.

Our mission is to use our financial resources to provide local teachers, students, relevant government departments and research scientist, both domestic and international, with access to one of the world's most advanced marine research tools, a REMUS 100, at heavily subsidised rates, and in many cases, for free. We will deliver all Ocean Tech data to the Ocean Tech open source online portal, and encourage collaborative use of this data to improve global STEAM education and speed up oceanographic discoveries to help protect the ocean.

Our goals are:

- To provide local students and teachers with "hands-on" and "real world" experience using the REMUS to enrich the current STEAM curriculum in private and public schools from primary to senior level.
- To improve and accelerate current marine research activities and support new research projects in Bermuda by providing scientists and researchers with access to a unique REMUS 100 research vehicle for free.
- To encourage inbound marine research activities to Bermuda by offering free use of a REMUS 100.
- To provide global access to a bank of REMUS data from all our projects and to encourage collaborative use of that data to solve problems and environmental challenges & questions.
- To help create a Bermuda based focus area around high tech marine research tools and deployments, and generate local jobs in that area.
- To help sustain REMUS in Bermuda indefinitely.

At the heart of Ocean Tech is a unique underwater autonomous vehicle called REMUS. REMUS stands for Remote Environmental Measuring UnitS. REMUS is a crewless underwater marine research vehicle, manufactured by Hydroid Inc, that is capable of autonomously carrying out a wide range of impressive marine research tasks.



We are delighted to announce that a new REMUS 100 has been exclusively secured and will arrive in Bermuda during February 2019.

This remarkable autonomous underwater vehicle will be permanently based in Bermuda at the Bermuda Aquarium Museum and Zoo. The public will be able to learn more about the vehicle and its capabilities by visiting the Aquarium. The 6ft vehicle will be stationed directly in front of the circular jack tank, just beyond the Aquarium main entrance.

The REMUS 100 is owned by an offshore company called Cerulean BVI Ltd, which has among its backers local Bermuda business interest. Ocean Tech will grant charitable use of vehicle through Cerulean so schools and organisations can use the vehicle at no cost. If organisations and individuals wish to use the vehicle with the support of Ocean Tech, the projects must fit the Ocean Tech charter.

In March 2019, Hydroid Inc. will send a specialist team to Bermuda to train five local Bermudians to become certified REMUS 100 pilots and technicians, working for Cerulean Ltd, initially on a contract basis.

The vehicle is the most advanced REMUS 100 Hydroid has ever built and the only REMUS 100 of its kind in the world. The vehicle has been carefully specified and is capable of completing an extensive range of oceanographic research tasks and impressive subsea imaging missions.

**REMUS Capabilities (top level):**

- Water quality assessments
- Hydrographic / Geophysical surveys (mapping seabed 3D)
- Ecosystem assessments (for example, finding large aggregations of lion fish in deep water.)
- Fish stock assessments (Grouper, Pelagic species etc.)
- Physical oceanography
- Environmental monitoring
- Marine/ Geology investigation
- Marine biology
- Pipeline surveys
- Cabling surveys
- Wreckage detection
- Geology seafloor mapping
  - minerals
  - oil
  - gas
- Water quality
- Route surveys
- Pre-Post dredging impact surveys
- Debris & clearance after storms
- Shipwreck hunting & salvage
- Filming 6 angles around the vehicle

**Vehicle sensors:**

- Sonar system for detailed fish stock assessments
- 6 angle filming in 4k
- Side scan sonar for subsea imaging - wrecks, reef, subsea structures,
- 2D & 3D Bathymetric mapping of the ocean floor
- Measuring oxygen levels
- Measuring conductivity
- Measuring temperature
- Measuring turbidity
- Measuring fluorescence
- Measuring flow & current

### **The Ocean Tech Charter – Charitable use of the vehicle**

Ocean Tech pays for the use of REMUS on projects that fit the Ocean Tech charter. All applications received by Ocean Tech go through a rigorous checking process against this charter. The Ocean Tech advisory committee first reviews applications. This committee consists of the chief Ocean Tech pilot Annie Glasspool BSc (Hons) MSc PhD CEnv MCIEEM MIEMA LEED AP Environmental Scientist, Andrew Smith the Ocean Tech mission manager and two local teachers. The committee grades each proposed project against the Ocean Tech charter before making recommendations to the Ocean Tech board. The Ocean Tech board then chose the projects to support.

The Ocean Tech Charter.

1. The use delivers significant and domestic STEAM education.
2. The project has an active collaborative element at each stage that includes third parties
3. The usage has a significant effect on a pressing marine conservation challenge or problem
4. The usage stands to reveal data that supports the development of domestic and international marine conservation policy.
5. The usage has the potential of delivering data that can be used to solve multiple questions by multiple parties.
6. The usage is deemed to provide a significant and positive impact on the local community
7. The usage is considered vital for the protection of local species and habitat
8. The usage supports the long-term viability of REMUS in Bermuda
9. The usage promotes long-term marine biology and oceanographic research objectives that support global and local marine conservation work.

Vehicle usage is split between the commercial operation of Cerulean and Ocean Tech. Cerulean has initially guaranteed to provide the vehicle to educational and research projects through Ocean Tech for a minimum of 32 days per annum. If the project is of commercial nature or does not suit the Ocean Tech charter, or it's a research project that does not wish to have the support of Ocean Tech, they will be directed towards Cerulean H2O to hire the vehicle at the cost of \$8600.00 per day.

### **Local education integration.**

A key focus for Ocean Tech is to ensure that REMUS is accessible by teachers and their students throughout the local Bermuda education system. There are many reasons why we are focused on achieving this.

1. Teachers and students can use the vehicle in the field as a hands-on STEAM experience
2. Teachers and students can use the vehicle data to significantly enhance the learning environment in multiple modules throughout the key stages.
3. It will deliver a learning opportunity in Bermuda not available anywhere else in the world.
4. It will inspire Bermudian students to follow careers in the STEAM arena.
5. The deployment of the vehicle on one school project will provide data that supports multiple subjects at all ages, from primary through to senior and beyond at all schools.
  - A. Sciences – environmental water conditions, oceanography, pollution
  - B. Mathematics – Navigation systems
  - C. Physics – Buoyancy, movement, light, flow, current
  - D. Engineering – Creating units to sample water elements such as plastics that can be attached
  - E. Programming – plotting missions and vehicle directions
  - F. Computing – Data processing
  - G. Geography – 3D benthic mapping
  - H. English – creative writing
  - I. Arts – Benthic mapping modelling
  - J. Filmmaking

### ***Collaborative Data.***

Ocean Tech is all about collaboration. We strive to bring scientific and educational organisations together through REMUS and its data. We achieve this first by asking all applicants to explain how their project intends to collaborate with others. This is one of the fundamental pillars that must be demonstrated in all applications. The stronger the collaborative nature of the proposed project, the more likely it is the project will receive the support of REMUS through Ocean Tech.

In addition to the above, Ocean Tech will provide global access to all data collected by REMUS. Ocean Tech will own all REMUS data, and the data will be assessable by everyone through the Ocean Tech data portal. To be clear, if Ocean Tech agrees to support a project by covering the cost of a REMUS deployment, Ocean Tech will own the data collected by REMUS. If Ocean Tech decides to cover the cost of a REMUS deployment and provide additional funds to support other parts of that project and those parts also collect data, Ocean Tech will own that data. Ultimately, if Ocean Tech funds allow a project to collect data, Ocean Tech will own that data.

We appreciate that this is not the conventional way of handling data ownership. However, as a charity that provides free use of REMUS to collect data, it's right that we own that data and use it collaboratively and charitably to support conservation, research, discovery and positive development of environmental policy.

All Ocean Tech raw data will be categorised online. The data will be available for download through the Ocean Tech data portal on the Ocean Tech website. The gateway requires the details of the person/organisation using the data to fill out a form and open an account. Once the account is open, the data will be available and categorised by project name and date. In the future, this will allow Ocean Tech to further expand its collaborative approach by analysing the individuals and organisations using Ocean Tech data and physically connecting the organisations that use the same data to help them advance their work together.

Owning all the data will allow us to:

1. Ensure all schools and educational organisations (both domestic and international) have access to raw REMUS data that's been collected by a school project funded by Ocean Tech. All parts of the school project, including the teacher's lesson plans, will be included in the online package.
2. Ensure all research scientist and oceanographic organisations (both domestic and international) have access to REMUS raw data collected by a research project funded by Ocean Tech. Published papers will be included with the original research plan in the online package.
3. Ensure global public and government access to all REMUS data collected, and the subsequent scientific publications.
4. Allow Ocean Tech to analyse who is using the data in the portal and to connect those people using the same data together to develop collaborative partnerships that lead to more productive and influential studies and results.
5. Help those studying long-term marine biology and oceanographic challenges to have free access to data sets that may significantly support their research and make their work more likely to drive positive environmental policy change.
6. Promote Ocean Tech as a charity that delivers access to REMUS and free access to critical data that could help to protect the ocean environment.

We understand that data is essential to research scientists and research institutions, and we appreciate that data is vital to career progression. Consequently and when necessary, Ocean Tech will hold back on publishing data on the Ocean Tech portal to allow scientists the time required to publish their findings. However, all Ocean Tech data, regardless of how long scientists need to process and publish results, will end up as open source data inside the Ocean Tech portal. The portal will include the raw data from the REMUS and the published papers. It is unlikely Ocean Tech will grant a hold back for longer than 12 months.