

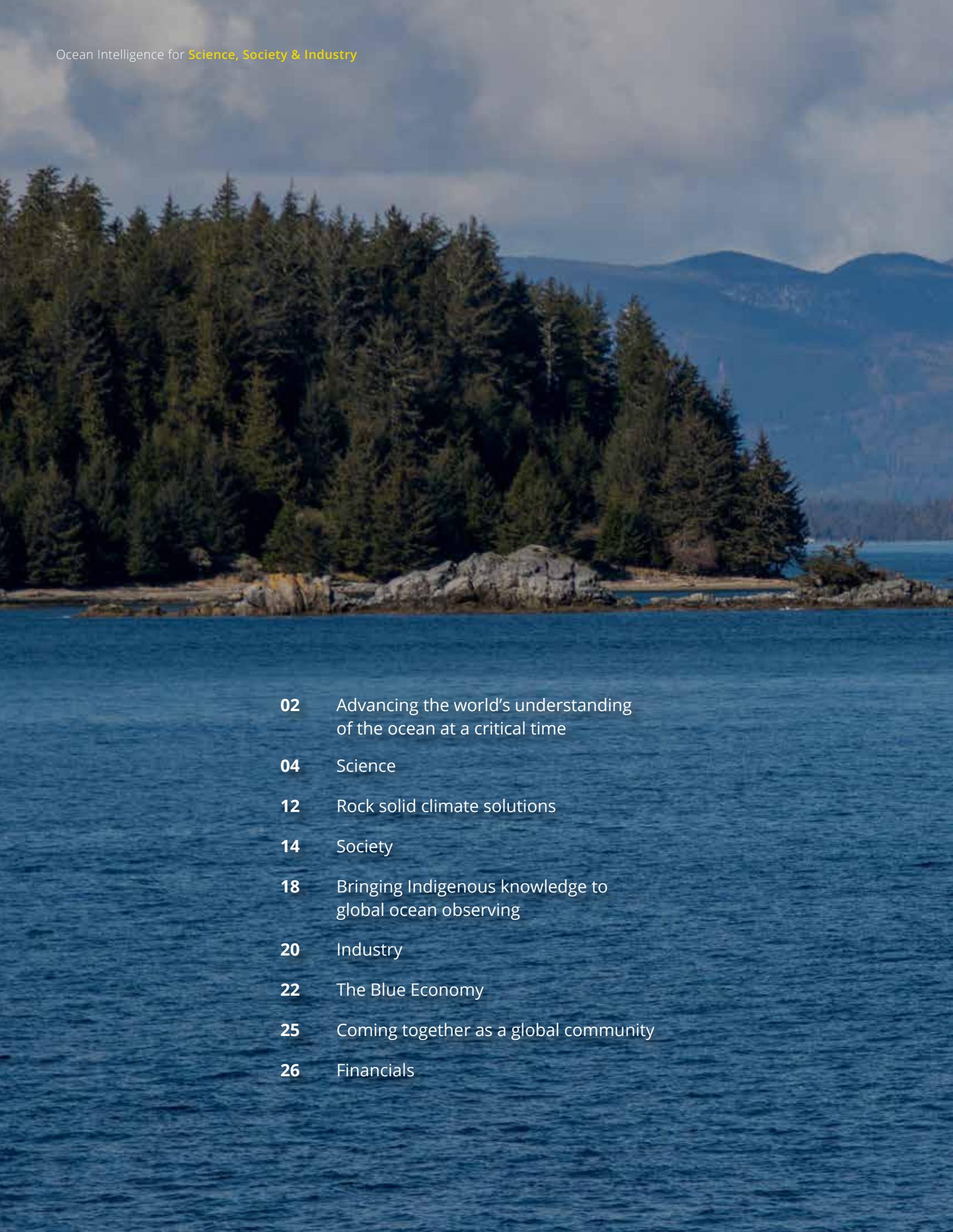


OCEAN INTELLIGENCE

Annual Report | 1 April 2019 - 31 March 2020

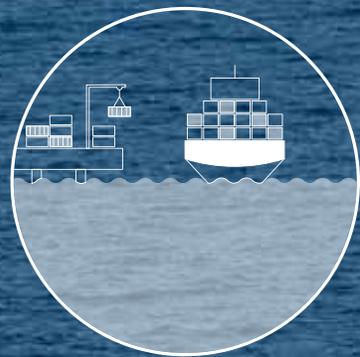
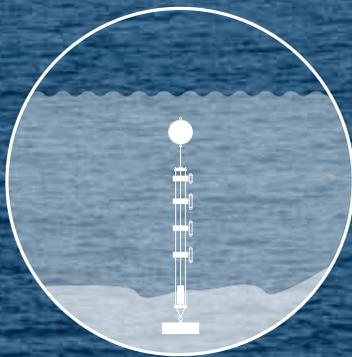
OCEAN
NETWORKS
CANADA

A UNIVERSITY OF VICTORIA INITIATIVE



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Ocean Intelligence for Science, Society & Industry



Advancing the world's understanding of the ocean at a critical time.



Kate Moran
President & CEO

In the spring of 2020, when COVID-19 made its presence felt, Canada made a successful collective effort to “flatten the curve” following excellent scientific information and public health science leadership. The massive societal shutdown and subsequent slowdown gave us quieter seas, cleaner air and improved spaces for wildlife.

With shelter-in-place orders we took more walks and observed the natural world around us with renewed appreciation, amplifying our desire to address the impacts of climate change, the most profound and impactful issue of our time. Thanks to Ocean Networks Canada's (ONC) funders, we continue to fulfill our vision of enhancing life on earth by providing knowledge and

leadership that deliver solutions for science, society and industry.

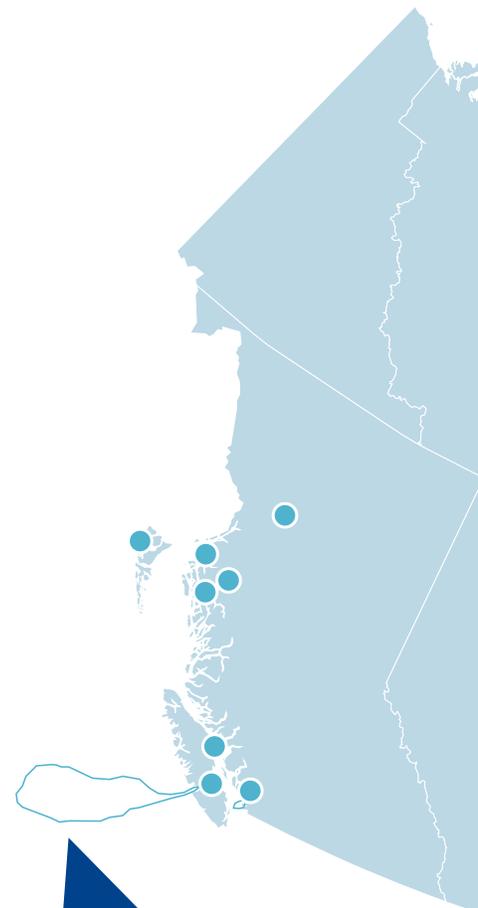
The Canada Foundation for Innovation, the Government of Canada and the Province of British Columbia support the operation of ONC's innovative ocean observing infrastructures that deliver continuous open data on all three of Canada's coasts.

The knowledge derived from these data is ocean intelligence—the bridge that connects data to societal needs, including mitigating (reducing greenhouse emissions and their equivalents) and adapting to climate change.

Gathering ocean intelligence will help us address challenging concerns, such as sea level rise, the warming ocean, increases in ocean acidification and dead zones that degrade ocean life support and cause extreme weather events.

Ocean intelligence will empower Indigenous communities; and it will enhance marine protection, disaster alerting, sustainable coastal businesses and safer shipping, all while showcasing Canada's robust ocean technology, a key cog in the Blue Economy on the global stage.

Join us in our endeavour to understand our changing ocean to protect and enhance life on Earth.



KUGLUKTUK

Vessel traffic monitoring for marine safety in the Northwest Passage

 **Funder: Nunavut General Monitoring Plan**



ONC has thousands of sensors and instruments on our deep sea and coastal ocean observing systems.

PORT AUX BASQUES

Sea state and marine safety at the entrance to the St. Lawrence seaway

 **Partner: Fisheries and Marine Institute of Memorial University**

 **Funder: Canada Foundation for Innovation**



VANCOUVER ISLAND

Advanced seismic infrastructure for British Columbia's Earthquake Early Warning system

 **Partner: Natural Resources Canada**

 **Funder: Province of BC**

Science

Discovery for ocean health and protection



Evidence-based decision making on ocean management relies on long-term observations. In 2021, Ocean Networks Canada (ONC) will celebrate 15 years of providing continuous, long-term, open data from thousands of sensors in the deep sea and on coastal observatories, ferries, gliders, buoys, moorings and land-based installations.

These systems support multidisciplinary research and provide unique scientific and technical capabilities that permit researchers to operate instruments remotely and receive data at their home laboratories anywhere on the globe in real time. Data are collected on physical, chemical, biological and geological aspects of the ocean over long time periods, supporting research on complex Earth processes in ways not previously possible.

Change

Understanding human-induced change in the Northeast Pacific and Arctic Oceans

Monitoring ocean acidification to support Canada's \$20 million shellfish industry

British Columbia is the largest Canadian oyster producer, the second most valuable shellfish aquaculture species in the country. Anthropogenic carbon dioxide emissions leading to increasing ocean acidity makes it difficult for shellfish to build their skeletons, affecting their ability to survive.

In collaboration with Vancouver Island University, Fisheries and Oceans Canada and MEOPAR, a new cabled mooring off the east coast of Vancouver Island enables real-time monitoring of ocean acidity and dissolved carbon dioxide concentrations. Located in Baynes Sound, home to over 50% of the Province's shellfish production, these data allow aquaculture operators to understand shifts—from hourly to interannual—in shellfish stocks, enabling the best decisions for cultivation and harvest.

Sophisticated new tools to monitor ecosystem health

Environmental DNA, or eDNA, studies are game-changers in ocean science, making it possible for scientists to monitor ecosystem health simply by collecting a small sample of water.

Working in collaboration with Laval University and the Global Observation Network, ONC deployed two McLane phytoplankton samplers to enable this sophisticated innovative research in the deep sea at the Endeavour Hydrothermal Vent Marine Protected Area and offshore Cambridge Bay, Nunavut.



Funder: Fisheries and Oceans Canada (DFO)



Partners: Hakai Institute, Laval University, MEOPAR, Vancouver Island University



Hushed Seas: monitoring underwater noise during COVID-19

When COVID-19 put the world on lockdown, David Barclay, assistant professor at Dalhousie University's Department of Oceanography, recognized a unique opportunity to use ONC's hydrophones to monitor changes in underwater noise. Without leaving his home in Atlantic Canada, Barclay was able to remotely study the Pacific Ocean soundscape using ONC's freely available, continuous, real-time ocean data.

"ONC's hydrophones allow us to analyze everything from the force of winter storms to the presence of killer whales—all in near real-time," says Barclay. Published in the Journal of the Acoustical Society of America, Barclay's research indicated a consistent drop of four or five decibels in underwater noise from January – April 2020.

Scientists are continuing to study the impact of noise on endangered southern resident killer whales, who depend on sound to communicate, navigate, socialize and hunt.

 **Funder: Fisheries and Oceans Canada (DFO)**

 **Associate member: Dalhousie University**

Monitoring the changing Arctic Ocean

Since 2012, ONC's commitment to Arctic ocean observing and community engagement has continued to grow in response to increasing climate impacts.

In addition to maintaining and improving ONC's Cambridge Bay underwater and shore station infrastructure, a McLane phytoplankton sampler is enabling Arctic Ocean environmental DNA studies, while an antenna that detects the presence of ships (AIS) deployed in Kugluktuk is monitoring increasing marine traffic in the Northwest Passage.

ONC conducted field testing in the Arctic Ocean to assess the performance of AML Oceanographic's conductivity, temperature and density sensor, an instrument designed for gathering data in the open ocean.

The team explored further opportunities for collaboration with far north partners, including Polar Knowledge Canada, the Nunavut Arctic College Environmental Technology Program and the Arctic Research Foundation.



Find our Cambridge Bay video on ONC's YouTube channel.

Understanding marine heat waves

Long-term monitoring makes it possible to detect anomalies that can affect the entire ocean ecosystem. A decade of data collection helped researchers understand the extent and impact of the 2013-16 marine heatwave in the northeast Pacific Ocean, nicknamed "The Blob". During this period, researchers detected surface ocean temperatures 2.5 degrees Celsius higher in an area the size of Australia.

In September 2019, ocean temperatures increased again, providing an early indication of another warming cycle that is currently being tracked.

Life

Investigating life in the northeast Pacific and Arctic Oceans

As part of its commitment to ocean protection, the Government of Canada is developing a plan to protect 25% of its ocean exclusive economic zone by 2025 in collaboration with provinces and territories, Indigenous peoples and other stakeholders.

ONC is working with Fisheries and Oceans Canada to monitor ecosystem health in offshore marine protected areas, as well as partnering with Indigenous communities in coastal ocean health and ship traffic monitoring. ONC has developed innovative technological solutions for ocean health monitoring in these remote marine protected areas and other areas of interest.

 **Funder: Fisheries and Oceans Canada (DFO)**

ENDEAVOUR Hydrothermal Vent Field

Since 2009, ONC's deep ocean network has provided real-time access to Canada's first marine protected areas, supporting biodiversity discovery and environmental research by scientists all over the world.



FOLGER PASSAGE Rockfish Conservation

This observatory is located in the centre of the Folger Passage Rockfish Conservation Area, designated by Fisheries and Oceans Canada in 2004. ONC's daily video and oceanographic data monitor how oceanographic conditions influence rockfish abundance and behaviour in protected areas.



 **CANADIAN MARINE PROTECTED AREAS**



RACE ROCKS Ecological Reserve

ONC operates an oceanographic radar in this busy marine corridor, which plays a key role in making the area safer for shipping, fishers and incident response, such as search & rescue and hazard spills.



GASCOYNE INLET

ONC worked with Defence Research and Development Canada to install an ocean observatory in the Tallurutiup Imanga National Marine Conservation Area. Using ice drifter buoy data transmission technology to support the platform, this innovation was developed in collaboration with Fisheries and Oceans Canada.



 **Funder: Defence Research and Development Canada**

 **Partner: Fisheries and Oceans Canada (DFO)**

SEAMOUNTS

This year, data from the 2018 northeast Pacific seamounts expedition was released after detailed analysis. The expedition used remotely operated vehicles, autonomous sensor platforms, multibeam mapping and vessel traffic data products to survey and monitor offshore seamount marine protected areas. This cross-sector partnership among government, academia, non-profits and First Nations informed the future protection of these little-understood, biodiverse ecosystems.



ONC uses cameras to monitor and study marine life biodiversity, abundance and behaviour. Check out our YouTube series, "Creatures of the Deep: Mini Bites".

Interconnections

Studying connections between the seafloor, ocean, atmosphere and now the universe

Installing a global neutrino telescope at Cascadia Basin

Neutrinos, produced by nuclear reactions from solar fusion, radioactive decay and exploding stars, are one of the universe's most essential ingredients and most abundant subatomic particles. Increased knowledge about neutrinos could answer some of the fundamental questions in astrophysics about the Big Bang and supernovae, and provide insight into the origin, evolution and fate of the universe.

Detecting these elusive high-energy particles is a challenge and requires cubic-kilometre-sized detector instruments with thousands of light sensors installed in a deep-sea or deep-ice environment. Combining neutrino telescopes as a single distributed planetary instrument would cover almost the entire sky and increase the probability of detection.

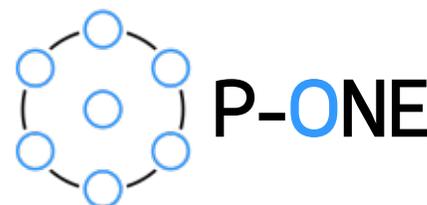
In 2013, the IceCube Neutrino Observatory at the South Pole was the first neutrino telescope to detect high-energy astrophysical neutrinos. A research team led by Professor Elisa Resconi at the Technical University of Munich—whose partners include the University of Victoria, the University of Alberta and Simon Fraser University—envisioned and designed a new large-scale neutrino facility in the northeast Pacific for the pathfinder missions, STRAW (STRings for Absorption length in Water) and STRAW-b.

In 2018, the first STRAW pathfinder experiment was installed at ONC's deepest site, and showed encouraging results. To complete the assessment of whether this deep-sea site and experiment is successful, a second pathfinder experiment was constructed at the Technical University of Munich, and is planned for deployment at Cascadia Basin in 2020.

STRAW-b is composed of ten modules distributed over a 500-metre vertical electrical-optical cable. It will host two spectrophotometers to study the emission spectrum of the ambient light, a lidar to investigate the scattering effect in water, a muon chamber and a set of cameras. The purpose is to test hardware and strategies for the next phase of this experiment, a 10-string array called the Pacific Ocean Neutrino Explorer (P-ONE).



PROFESSOR ELISA RESCONI



 **Funder: Canada Foundation for Innovation**

Seafloor in Motion

Monitoring seafloor and sediment movement

Understanding underwater landslides in the Fraser River delta

The Fraser River delta is laden with thick sediment deposited on its journey from source to sea, causing regular underwater landslides, particularly during spring when glacier snowmelt dramatically quickens and thickens the river flow. In 2008, ONC partnered with Natural Resources Canada to install the first delta dynamics laboratory to measure the underwater forces of these events, which has enabled ground-breaking research.

This year, a newly redesigned platform was deployed, along with two new instruments to measure underwater landslides. One of ONC's largest platforms, it weighs two tonnes, measures six metres in length and is equipped with over a dozen sonars to provide a fuller picture of underwater landslide events.



DR. PHIL HILL
Visiting scientist

As one of the original principal investigators of ONC's inshore observatory project proposal and the Delta Dynamics platform, Hill has a long-standing connection with ONC. During his visiting scientist tenure, he is using ONC data to advance his research on marine geohazards, including submarine landslides and related processes.



Geodesy: understanding tectonic plate movement

Until recently, our ability to measure seafloor tectonic plate movement was not possible because the instruments used to detect onshore tectonic shifts do not work in the ocean. To overcome this challenge and provide critical information about underwater earthquake and tsunami hazards, an innovative seabed geodesy observatory was deployed on the Cascadia subduction zone using long endurance acoustic sensing technology supplied by Sonardyne International Ltd.

Developed in collaboration with the Canada Foundation for Innovation, Province of British Columbia and Natural Resources Canada, this new observatory uses a seafloor acoustic-based positioning system network to monitor movements of the subducting Juan de Fuca plate and the overriding North American tectonic plate.

The observatory backbone comprises 24 Sonardyne fetch autonomous monitoring transponders deployed in water depths of 400 to 2,500 metres.

These subsea sensor logging nodes take hundreds of thousands of precise geodetic observations. The logged data are wirelessly transmitted to the surface on command. The relative distance between the nodes enables scientists to calculate movement between plates with high accuracy.



Partner: Province of British Columbia

Bringing data to the surface

Ocean Networks Canada (ONC) generates world-leading, big data from coastal waters to the deep ocean, making these continuously accessible in real-time through the Oceans 2.0 web portal.

 **Funder: CANARIE**

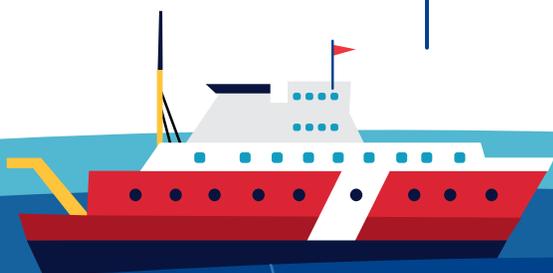


FREE, ACCESSIBLE, INTEROPERABLE AND REUSABLE DATA

Oceans 2.0 provides data 24/7 from a vast and diverse array of sensors and instruments. These data are free, easily accessible, interoperable with other global observing systems and reusable for the foreseeable future.

MAINTAINING AND EXPANDING OCEAN OBSERVING NETWORKS

ONC is continuously improving and expanding its Internet-connected networks along Canada's remote coasts, on land and at sea. Annual at-sea expeditions use ships and remotely operated vehicles to maintain these networks 300 kilometres offshore to depths of 2,660 metres. This challenging work, both technically and operationally, is live streamed over the Internet to allow the public to explore with us.



ROV



NODE



GLIDER



GLOBAL STANDARDS AND CANADA'S NATIONAL PORTAL

ONC's data management follows global protocols and standards, resulting in the first International Technology Office of the World Data System to be located at ONC's headquarters.

Work continued this year on the Canadian Integrated Ocean Observing System (CIOOS) to bring together ocean observing assets from across the country into a single national portal for all Canadians. Three regional associations were formed in the Atlantic, Gulf of St. Lawrence and Pacific. CIOOS-Pacific is hosted by the University of Victoria, and relies on the ocean data expertise of ONC and the Hakai Institute.



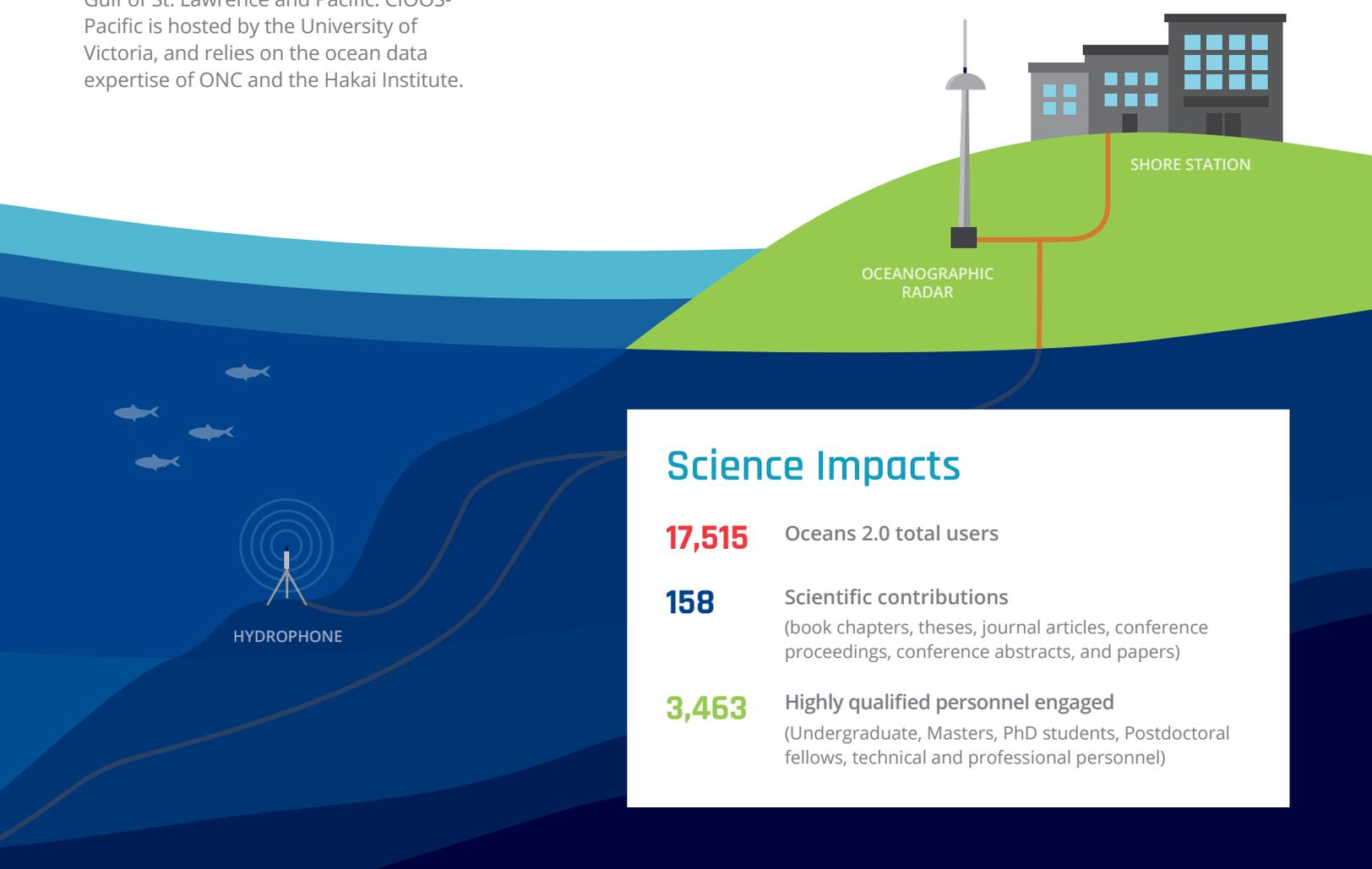
TOOLS THAT ENRICH VIDEO DATA

SeaTube is ONC's video browsing portal that organizes thousands of hours of video collected from expeditions, instruments on the seafloor and time lapse videos generated from on-shore camera footage. SeaTube allows researchers to annotate video in real time during expeditions both from onboard the vessel as well as the comfort of their home—and later from the archive—adding valuable detail to the video.



CITING EVOLVING DATASETS

MINTED (making identifiers necessary to track evolving data) is a new dynamic citation tool funded by the CANARIE Network that addresses the growing need to cite research datasets that change over time.



Science Impacts

- 17,515** Oceans 2.0 total users
- 158** Scientific contributions
(book chapters, theses, journal articles, conference proceedings, conference abstracts, and papers)
- 3,463** Highly qualified personnel engaged
(Undergraduate, Masters, PhD students, Postdoctoral fellows, technical and professional personnel)

Rock solid climate solutions: negative emissions technology

With climate change scenarios showing that negative emissions technologies are needed to limit warming to two degrees Celsius, drastic reductions in greenhouse gas emissions are not enough. We need large-scale, permanent removal of excess carbon from the atmosphere.

A \$1.5 million four-year feasibility study aims to provide a solution for safe and reliable carbon dioxide (CO₂) removal, by designing and delivering a globally applicable ocean-based negative emissions technology by 2040.

The vision is to extract CO₂ from the atmosphere using a direct air capture technology developed by British Columbia's Carbon Engineering. Then, using deep ocean technology powered by ocean-based wind and solar energy, the CO₂ would be injected into the seafloor basalt where it will mineralize and remain safely and permanently as rock.

The study brings together scientists and experts from around the globe to combine years of research on carbon sequestration and mineralization with proven technologies in renewable energy production, carbon capture and offshore drilling.

Globally, more than 90% of basalt resides in the ocean where it is widely distributed, making the technology ideal for world-wide use. One of the study's initial focus areas is conducting modelling and laboratory experiments to demonstrate sequestration of CO₂ into ocean basalts, specifically those that lie beneath the ONC Cascadia Basin off the west coast of British Columbia.

The University of Victoria's Institute for Integrated Energy Systems will lead the investigation into what ocean technology design works best for capturing and then injecting the CO₂ into ocean basalt. Prototypes will then be built for further evaluation.

 **Funder: Pacific Institute for Climate Solutions (PICS)**



Find our Mr. Emissions
video on ONC's
YouTube channel.

“Global appetites for decarbonation and CCS solutions are now picking up. The ‘Solid Carbon’ solution—one focussing on carbon mineralization and storage in offshore basalt using direct air capture—explores many key technical and non-technical issues that must be viable at enormous scale in order to implement this promising CCS option in British Columbia, or elsewhere.”

DAVID GOLDBERG | LAMONT-DOHERTY EARTH OBSERVATORY, COLUMBIA UNIVERSITY

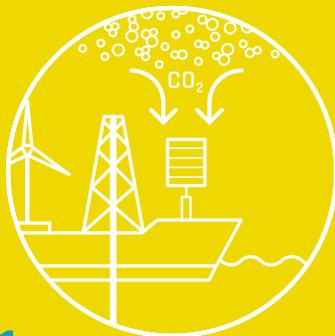


The University of British Columbia will examine the social, regulatory, and investor acceptance for this study, including gaps in current law. And Columbia University Law School in New York City will evaluate the adjustments needed in existing ocean regulations for CO₂ sequestration.

The project is funded by the Pacific Institute for Climate Solutions, is led by ONC and includes scientists,

engineers and social scientists from the University of Victoria; ONC; University of British Columbia; University of Calgary; University of California; Columbia University; the University of Washington; and GEOMAR Helmholtz Centre for Ocean Research in Germany. Other project partners include the K&M Technology Group and Carbon Engineering in Squamish, British Columbia.

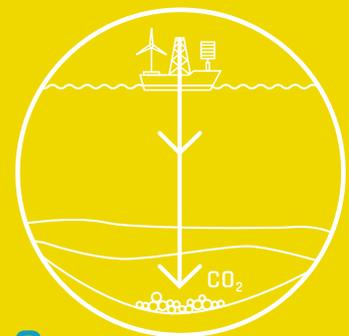
How Solid Carbon works



1. Capture carbon dioxide
Pull CO₂ out of the atmosphere.



2. Pump below seafloor
Pump CO₂ down through the water column into the sub seafloor.



3. Turn into rock
In a short amount of time, the CO₂ becomes rock.

Society

Public safety and empowered coastal communities



Around seven million people live at or near the coastal areas of Canada. These populations and their supporting infrastructures are increasingly at risk from ocean change, storm surge, earthquakes and tsunamis. Canadians need information from sustained observations in the ocean to inform resilience to disasters, climate change mitigation, adaptation and a sustainable future.

Through partnerships with government agencies and coastal and Indigenous communities, Ocean Networks Canada (ONC) developed products and services for earthquake early warning and tsunami inundation that support coastal and Indigenous management of their ocean environment.

Resilience through preparedness

ONC is helping to build resilience in Tofino—and elsewhere in British Columbia—by integrating innovative science and technology into tsunami planning efforts and improving awareness of the risks. Local leaders are partnering with scientists, engineers and tsunami experts to integrate local hazard models, community risk assessments and tsunami mitigation best practices in preparation for the next big earthquake.

Technological advances are making it possible for tsunami information to be disseminated in real time. High-frequency coastal radar, including the WERA radar located at Tofino's Long Beach Airport, delivers real-time, continuous ocean wave height data that can be used for tsunami response decisions and situational awareness.

ONC's real-time observations of earthquake shaking and tsunami wave heights support official tsunami alerts coming from the National Tsunami Warning Center in Palmer Alaska. Working with the National Oceanic and Atmospheric Administration, ONC is now using detailed digital elevation maps combined with tsunami models to inform hazard mitigation and evacuation plans.



Earthquake Early Warning install complete

ONC's land-based earthquake early warning (EEW) system is operating in test mode, a critical step towards utilizing this advanced seismic infrastructure for British Columbia's alerting system. EEW is a collaboration among government, academia, industry and communities, including ONC, Natural Resources Canada, Emergency Management BC, Public Safety Canada, United States Geological Survey, Pacific Northwest Seismic Network and the University of Washington.

Now ready for commissioning, the system consists of subsea and land-based sensors. Eight sensors installed on the Cascadia Subduction Zone provide the first subsea EEW data off the coast of North America. The land-based stations were installed and updated in partnership with Natural Resources Canada.

 **Partner: Natural Resources Canada**

 **Funder: Province of British Columbia**



Find our earthquake early warning video on ONC's YouTube channel.



105

Earthquake sensors, instruments and devices on EEW



52

Earthquake detections by EEW since September 2018



9M

Provincial/Federal funding invested in ONC's EEW



Empowering coastal communities

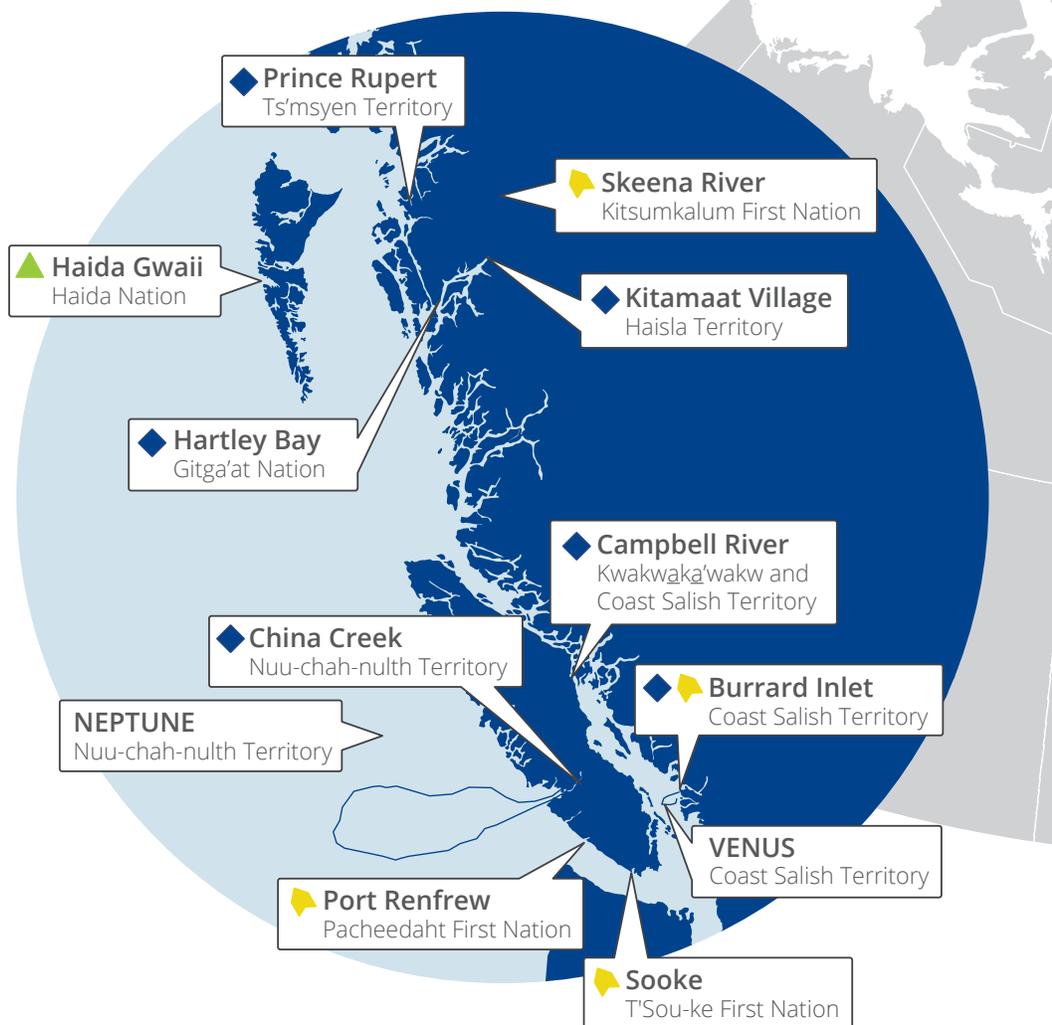
With the longest coastline in the world, approximately seven million Canadians depend upon the health, safety and protection of our ocean resources and coastal waters for food, livelihoods and cultural traditions.

ONC developed partnerships with 29 coastal Indigenous communities on all three coasts; activities include community-based monitoring, school programs, youth training and community engagement to enable each community to advance its ocean and marine environment programs.

To meet local needs and empower youth, Elders and leaders, three complementary products (Community Observatories, Community Fishers, and Marine Domain Awareness) were developed in collaboration with these coastal communities to inform science-based decision making. Ocean data are archived, processed and made freely available via ONC's Oceans 2.0 data portal.

“Under the Oceans Protection Plan and the Enhanced Maritime Situational Awareness initiative, the Government of Canada is taking an innovative approach to improving marine safety and a more collaborative approach to protecting our coasts. The near real-time information being provided to coastal communities makes our coasts and waterways safer than ever before.”

THE HONOURABLE MARC GARNEAU | MINISTER OF TRANSPORT





◆ **Community Observatories**

Custom-designed, high tech, Internet-connected ocean sensor systems installed on the seafloor, the ocean surface and on land to provide real-time data on ocean properties, surface currents and more.

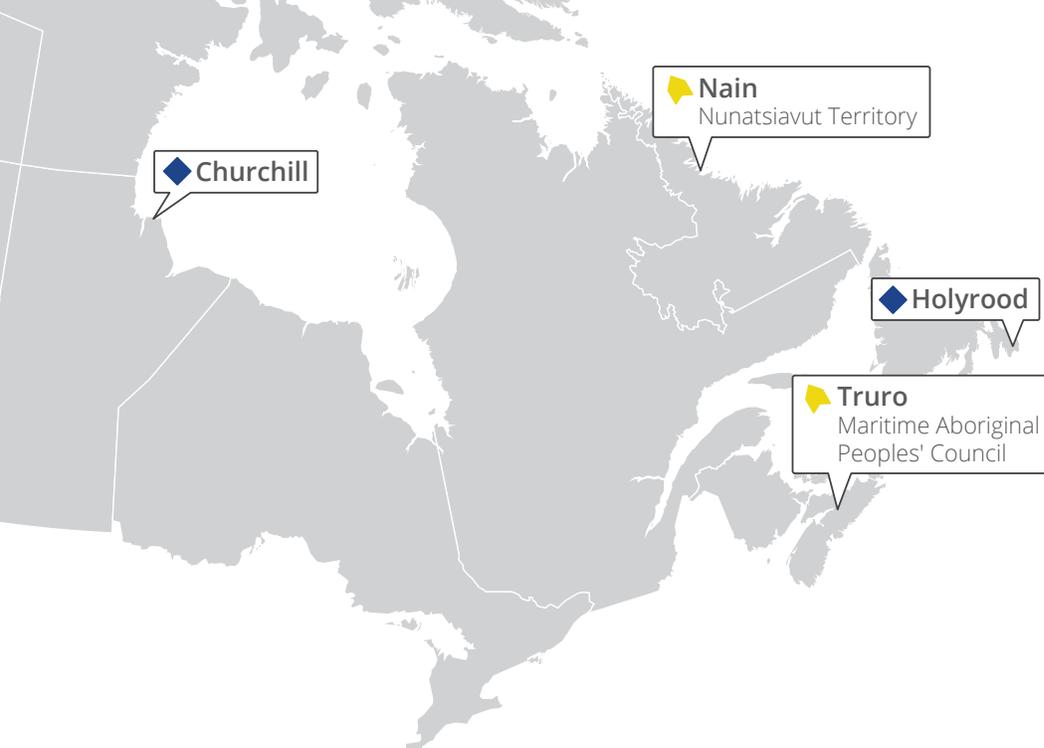
▶ **Community Fishers**

A mobile application that allows local vessel operators, mariners and volunteer citizens to collect ocean water quality data to inform responsible ocean management.

▲ **Marine Domain Awareness**

Develops and delivers information-sharing systems and platforms that provide near real-time information about Canada's marine transportation system and shipping activities.

 **Funder: Transport Canada**



Bringing Indigenous knowledge to global ocean observing

For the past 30 years, the global ocean observing community has gathered once a decade to chart innovative solutions to society's growing needs for ocean information and governance. For the very first time in September 2019 this gathering included 53 Indigenous delegates from Canada, the United States, Hawaii, the South Pacific Islands and New Zealand to contribute to this important conversation with 1,500 ocean scientists and policy makers at the Ocean Obs conference in Hawaii.

Ocean scientists and policy makers have a lot to learn from people who have been living on the edge of the sea and using its resources for millennia. They know how the ocean system works, even if their knowledge is not documented in scientific textbooks or research publications.

During the weeklong conference, the Indigenous delegation—organized by ONC—engaged with the ocean science delegates to discuss the meaning and need for true partnerships, relationships between visiting researchers and Indigenous communities, and the need to support and strengthen ocean stewardship and governance to adapt to climate change.

"We have to try to elevate Indigenous knowledge to balance science so we have the best possible information, the best possible science for our political leaders to make informed decisions," comments Indigenous delegate Ken Paul, Director of Fisheries at Canada's Assembly of First Nations.

 **Funders: MakeWay, Environment Funders Canada**



Find our OceanObs'19 video on ONC's YouTube channel.



"We're not just guides, we are the original Arctic scientists. We're all experiencing the bad sides of climate change. To have such a wide range of Indigenous peoples come together so we can work together on these issues is amazing."

MIA OTOKIAK | NUNAVUT



An important outcome of the conference was an Indigenous authored declaration calling on the ocean observing community to formally recognize the traditional knowledge of Indigenous peoples worldwide, and to establish meaningful partnerships with Indigenous communities, organizations and Nations.

The conference concluded with Vladimir Ryabinin, Executive Secretary of the UNESCO Intergovernmental Oceanographic Commission delivering the Coastal Indigenous Peoples Declaration to the conference, outlining the need to learn and respect each other's ways of knowing, negotiate paths forward to design,

develop and carry out ocean observing initiatives and share responsibility and resources.

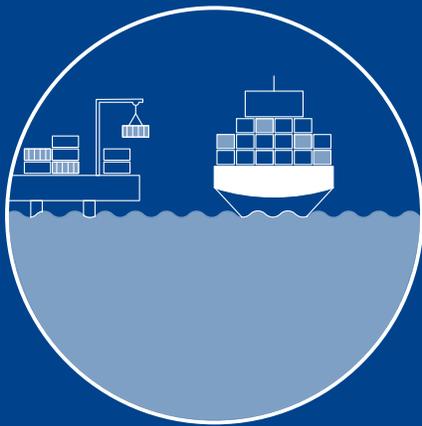
Nine Canadian Indigenous participants represented three of Canada's coasts—Nunavut, British Columbia, New Brunswick and Nova Scotia.

"Ten years from now, I hope to see [Indigenous] Nations with their own scientists, more capacity to answer their own unique questions and greater collaboration and partnerships with academia and research institutions that want to do good work in each Nation's territory," says Michael Vegh, representing Indigenous youth from British Columbia.



Industry

Marine safety and opportunities for ocean technology growth



Canada has the world's longest coastline, and our ocean and coastal waters are one of our most important resources for economic growth, improved livelihoods and jobs. Striking the balance between sustainable economic growth and protection of ocean ecosystems will require innovative ocean technologies.

Ocean Networks Canada (ONC) is a global leader in innovative ocean observing systems, partnering with ocean technology companies in Canada and around the world to improve marine safety, incident response, underwater noise and coastal protection.

Real-time current data for safe navigation

Coastal ocean dynamics applications radar (CODAR) is a land-based, high frequency radar that measures and maps surface ocean currents in coastal waters in real time, making it possible to improve marine safety and incident response.



In 2019, ONC expanded its suite of oceanographic radar by installing a system that covers the Race Rocks Marine Protected Area in the Strait of Juan de Fuca, a high tidal current area with heavy marine traffic for both Canada and the United States, from large tankers to small boats.

In August 2019, ONC hosted an international gathering of scientists to study the oceanographic applications of high-frequency radar. Workshop participants travelled to Race Rocks to witness this newly installed oceanographic radar in action.



Find our Race Rocks video on ONC's YouTube channel.



Monitoring Vancouver's downtown waterways

Vancouver is Canada's busiest port and sits within Tsleil-Waututh Nation's traditional territory. Additionally, the surrounding waters are home to the endangered southern resident killer whales, as well as many other important marine species.

To monitor and improve the health of Burrard Inlet, in March 2019 ONC partnered with the Tsleil-Waututh Nation to develop and install a community observatory east of the Lion's Gate Bridge. The observatory includes a state-of-the-art, Internet-connected seafloor observatory combined with a mobile application that allows vessel operators to collect ocean data. These complementary systems provide comprehensive ocean data from the seafloor to the sea surface.

The Vancouver Fraser Port Authority later joined the partnership, incorporating these data into their ocean modelling program to assist pilots to safely navigate large vessels, including large cruise ships, through the Second Narrows into Burrard Inlet. This multi-partner initiative is an innovative example of real-time ocean observatory data generated by an ONC-First Nation partnership and being used to benefit science, society and industry.

"Having real-time, current data from the Tsleil-Waututh Nation's Burrard Inlet community observatory allowed the Port Authority to be responsive to the British Columbia coast pilots by enhancing our ongoing navigational safety measures in the Inlet. This partnership has been a benefit for all organizations involved."

**VANCOUVER FRASER
PORT AUTHORITY
HARBOUR MASTER**

 **Partners: Tsleil-Waututh Nation, Vancouver Fraser Port Authority**

The Blue Economy

Canada's ocean tech industry poised to lead the way



The Organization for Economic Co-operation and Development estimates that the value of the world's ocean economy, or Blue Economy, will reach \$3 trillion by 2030, with Canada's Blue Economy estimated at \$32 billion in GDP per year.

As we head into post-COVID times when climate change can no longer be ignored, balancing economic growth with sustainability will be critical.

Sustainable management and use of our oceans for shipping, renewable energy, aquaculture, fisheries, tourism and coastal and Indigenous cultures will require us to better understand the ocean and surrounding environment. Ocean observing and innovative technologies are critical to a successful Blue Economy and put Canada in a leadership position on the global stage.

Over the past two decades, ONC has collaborated with dozens of Canadian tech companies to advance innovation and develop new ocean technologies. From instrumenting ferries and installing sensor packages on cabled and community observatories to monitoring our ocean and empowering coastal communities, ONC is playing a key role in growing Canada's contribution towards managing and sustaining the global ocean.

Bounded by ocean on all three coasts, Canada can take the helm in shaping and benefiting the Blue Economy.

What is the Blue Economy?

The World Bank defines the Blue Economy as "the sustainable use of ocean resources for economic growth, improved livelihoods and jobs while preserving the health of ocean ecosystems".



BC Ferries
British Columbia

Three Salish Sea ferry routes are instrumented and collecting continuous data—inspiring the next generation of hybrid ferries to be built with sensor package capacity.



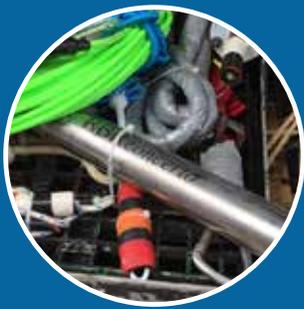
ASL Environmental
British Columbia

For 40 years, this company has been developing, deploying and globally marketing sensors that monitor the ocean environment.



Applied Micro-Systems Limited (AML)
British Columbia

With 45 years of experience, AML provides ocean sensing solutions to organizations around the globe for surveying, environmental monitoring and other subsea applications.



RBR
Ontario

For 38 years, RBR has been designing and manufacturing oceanographic instruments that are helping us understand the ocean from the deep sea abyss to the polar ice caps.



Ocean Sonics
Nova Scotia

With 18 icListen hydrophones on their networks, ONC supports early prototyping and ongoing testing of what is now a global standard for acoustic monitoring, streaming and hydrophone arrays.



Jasco Applied Science
British Columbia

ONC worked with Jasco to develop Vancouver's PortListen® acoustic analysis system and sound scape modelling, technology advancements that improve protection of at-risk whales.



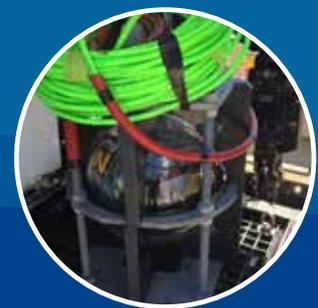
Rockland Scientific
British Columbia

Rockland's sensors, which measure turbulent flow, are used world-wide in a multitude of disciplines, from climate research to renewable ocean energy.



SubC Imaging
Newfoundland

SubC imaging has a global client list spanning 20 countries and provides the most technologically advanced and intelligent subsea imaging equipment and software for ocean research.



Nanometrics
Ontario

A world leader in earthquake science, Nanometrics provide complete, integrated solutions for seismic monitoring and are a key component of ONC's earthquake early warning system.



COAST SALISH ARTIST LUKE MARSTON

Celebrating Queenswood's first anniversary with Coast Salish art

To celebrate the first anniversary of ONC's home at the University of Victoria's Queenswood campus, we unveiled a stunning commissioned artwork in the Indigenous Learning and Engagement Facility by world-renowned Coast Salish artist Luke Marston.

ONC selected Marston as the commissioned artist out of respect for the people upon whose land the University of Victoria's Queenwood property resides. "We didn't want to choose any artist," comments ONC's Indigenous community liaison Pieter Romer. "It had to be a Coast Salish artist to represent the warmth and spirit of the Coast Salish nations. I think you can feel that when you walk into the large room where the four-foot panel hangs.

"Coast Salish peoples have been creating art for thousands of years," says ONC's President and CEO Kate Moran. "Luke Marston continues that tradition today. Luke has brought together long-lived Coast Salish ocean values with Ocean Networks Canada's ocean vision in a single, beautiful carving."



Funder: Western Economic Diversification



"The panel that I've created for ONC was an honour to do because it speaks to looking after our oceans and monitoring our oceans. It's nice to be able to walk into an area and be represented by the people of that territory. So, I'd really like to thank ONC for doing that and staying true to the Coast Salish traditional territories."

LUKE MARSTON | COAST SALISH ARTIST



COAST SALISH ARTIST, LUKE MARSTON, WITH ONC'S BOARD OF DIRECTORS

Coming together as a global community a message from ONC's Board chair

Given the impacts of climate change, the most profound and impactful issue of our time, understanding our changing ocean and coastline has never been more important.

The United Nations General Assembly recently proclaimed 2021-2030 as the Decade of Ocean Science for Sustainable Development to generate the knowledge, data, science, infrastructure and partnerships needed to inform policies to protect and sustain healthy oceans.

Canada began investing in innovative ocean observing systems in the early 2000s, building ONC's coastal and deep sea infrastructures, critical platforms that deliver solutions for science, society and industry.

These networks, and the expertise at ONC that supports them, help us collect terabytes of world-class data, develop innovative tools to turn the data into ocean intelligence and support the advancement of Canadian technologies onto global markets.

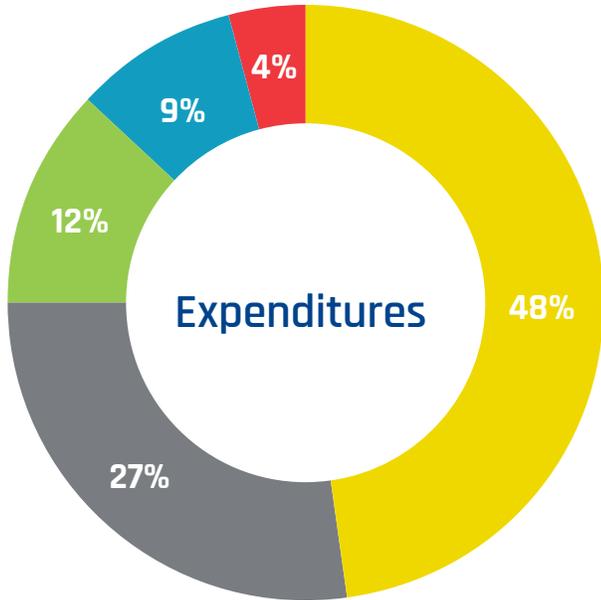
Attracting researchers from around the world, putting ocean intelligence in the hands of influencers and governments, empowering coastal and indigenous communities to monitor and protect their coasts and ecosystems and inspiring the public to #knowtheocean positions ONC to continue contributing to pioneering solutions that address the challenges of this critical next decade.

Let's come together as one to protect and sustain our blue planet for generations to come.



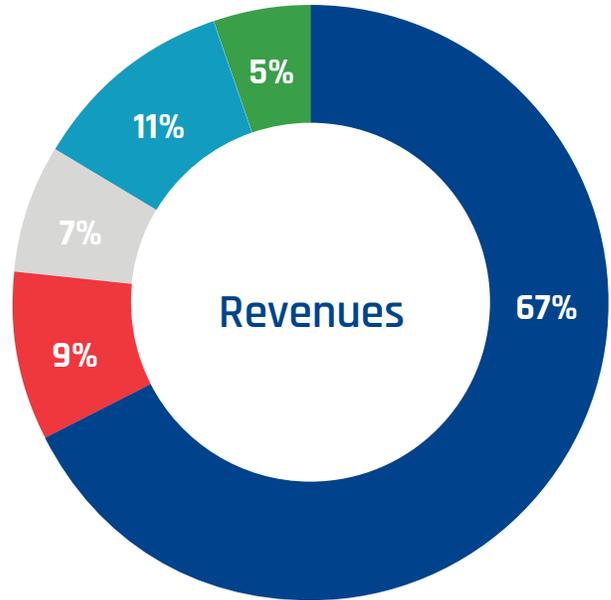
Darcy Dobell
Chair, ONC Board of Directors

Financials FY19/20 (in thousands of dollars)*



- **Personnel**
\$13,346
- **Maintenance & Repairs**
\$7,369
- **Services**
\$3,394
- **Ocean Networks Canada Society**
\$2,606
- **General Administration & Other**
\$1,058

Total
\$27,773



- **Canada Foundation for Innovation**
\$17,762
- **Federal Government**
\$2,482
- **Corporations/Firms & Other**
\$1,900
- **Ocean Networks Canada Society**
\$2,898
- **University of Victoria**
\$1,456

Total
\$26,498

Visit our website to view Ocean Networks Canada Society Audited Financial Statements **FY19/20**

*Net of in-kind

#knowtheocean

K-12 Programs

ONC develops educational ocean science resources and programs for communities, students, educators and the public.



125
Schools



739
Educators



10,025
Students (4,726 Indigenous)

Social Media FY19/20



12,700
Followers



10,826
Likes



3,338
Followers



4,610
Followers



2,416
Followers

Media Metrics FY19/20



377
News articles



33.8 million
Total audience reach



Ocean Intelligence for Science, Society and Industry

As a world leader in ocean observing technology and data, ONC empowers people with knowledge about our rapidly changing ocean.

Monitoring the west and east coasts of Canada and the Arctic, our real-time, continuous, open data supports scientific discovery and informed decision making. We bring ocean data to the surface, providing ocean intelligence to coastal communities, researchers, policy makers and governments.

Dedicated to diversity, collaboration and innovation to #knowtheocean, we act with respect, commitment and integrity while reaching towards our vision: To enhance life on Earth by providing knowledge and leadership that delivers solutions for science, society and industry.

ONC is primarily funded by: the Canada Foundation for Innovation, Government of Canada, University of Victoria, Government of British Columbia and CANARIE.

Associate members: Fisheries and Marine Institute of Memorial University of Newfoundland, Dalhousie University and EMSO-ERIC.

We are thankful for our many partners in industry, government, research and higher education.

