

CANADIAN OCEAN SCIENCE NEWSLETTER
LE BULLETIN CANADIEN DES SCIENCES DE L'OcéAN

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OCEAN SCIENCE NEWS

A Report on a MEOPAR Ocean Acidification Workshop, 23-24 March 2017

Submitted by Ken Denman, Maurice Levasseur, Denise Joy, Ron Pelot, and Doug Wallace

Canada has the longest coastline in the world; our Exclusive Economic Zone (EEZ) including territorial waters for all three of our oceans encompasses 6 million km², equivalent to 60% of our land area. As a result of increasing CO₂ in the atmosphere and a changing climate, we expect Canada's oceans to become warmer, fresher, more acidic, and, below the surface ocean, to become less oxygenated. Observations and models indicate that acidification will proceed more rapidly and more strongly at high latitudes. During the last three years, the MEOPAR Network of Centres of Excellence supported research projects and two workshops aiming at understanding the causes and the consequences of the ongoing acidification of Canadian Coastal waters.



This second workshop on Ocean Acidification in Canadian waters was held in Ottawa on 23-24 March 2017 sponsored by the NCE MEOPAR. The workshop had two main objectives: (1) To provide a venue especially for graduate students and post doctoral fellows supported under MEOPAR projects to present their research, and (2) To identify opportunities, gaps, and a plan for the future research on ocean acidification in Canadian waters.

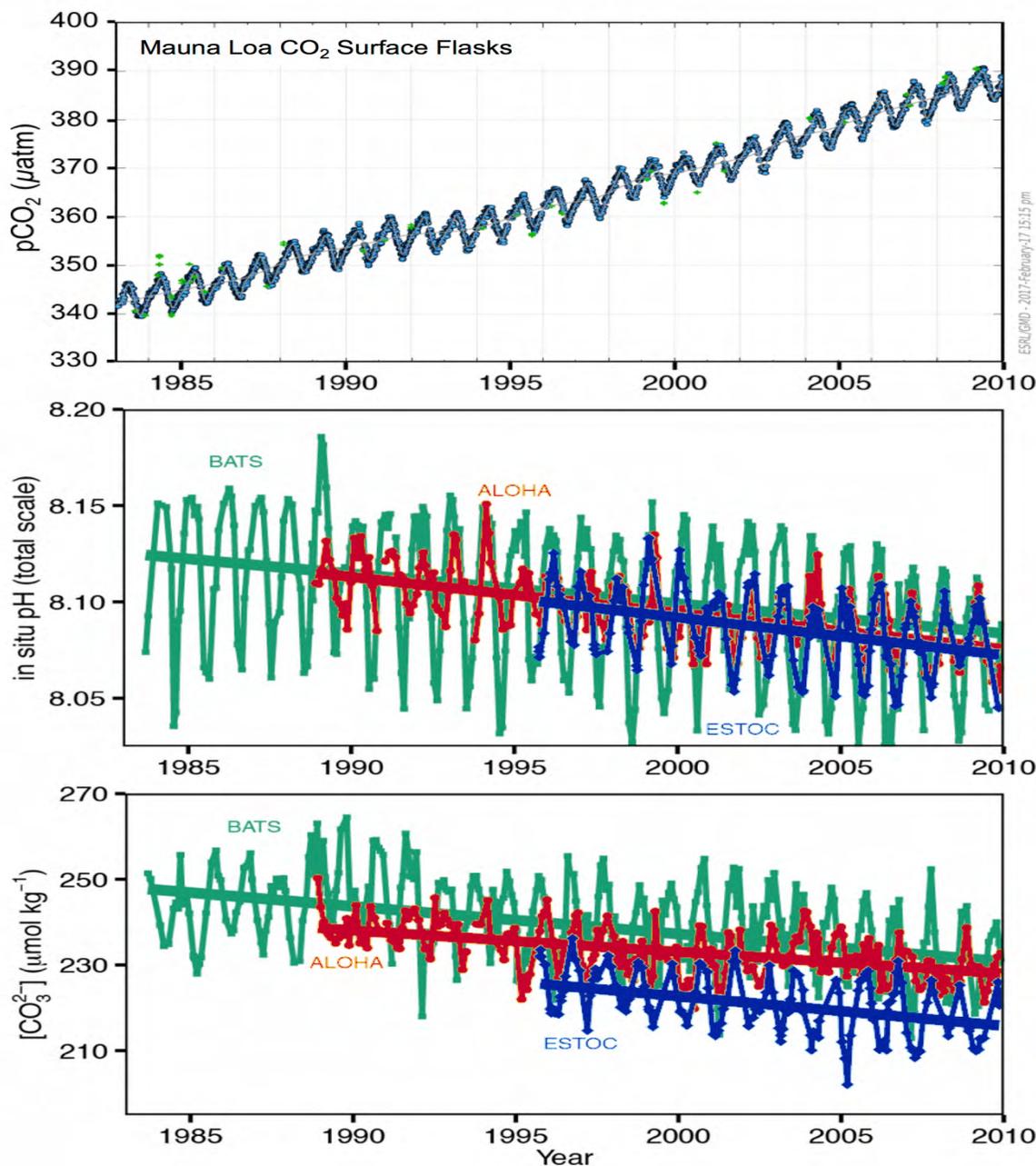
MEOPAR (Marine Environmental Observation, Prediction and Response Network) was established in 2012 through Canada's federal Networks of Centres of Excellence Program. MEOPAR is a national network of academic researchers and students, government scientists, and partners in the private, NGO and community sectors working together to reduce vulnerability and strengthen opportunity in Canada's marine environment. Primary activities include:

- Supporting interdisciplinary research and development at Canadian universities
- Providing training and work experience to bolster Canadian workforce capacity
- Mobilizing scientific knowledge, technology and people through cross-sector engagement

MEOPAR, which is hosted at Dalhousie University, in Halifax, Nova Scotia, has been awarded another 5-years of funding starting on 1 April 2017.

About 25 people attended the workshop. mostly from within MEOPAR. All participants were invited to present talks on their research findings. Talks were organized into five clusters of similar topics, each cluster followed by a discussion period. Talks were also presented by representatives of Ocean Networks Canada, the Hakai Institute, and the Department of Fisheries and Oceans. Three breakout groups met for 45 minutes, each asked to come up with three questions/issues/gaps to be considered in future research. These were presented briefly in

plenary followed by an open discussion on the future of OA research in Canada. To demonstrate the depth and diversity of the ongoing research, we include here the Agenda for the meeting.



Time series showing annual cycles and long term trends in ocean acidification from three open ocean sites: (Upper panel) Increasing atmospheric CO₂ from Mauna Loa observatory Hawaii; (Middle panel) Decreasing near surface ocean pH from waters near Hawaii (ALOHA green), near Bermuda (BATS red), and near the Canary Islands (ESTOC blue); (Bottom panel) Decreasing carbonate ion (CO₃²⁻) from the same sites. The carbonate ion is needed by plants and animals that form their skeletal structures from calcium carbonate; for a lower ambient concentration of carbonate, more energy must be expended to build their skeletal structures. [Modified from NOAA ESRL and IPCC WG1 AR5].

AGENDA - MEOPAR Ocean Acidification Workshop 23-24 March 2017

Thursday 23 March Morning

0900h - Greetings and brief remarks

0915h - Cluster #1 - Krysten Rutherford, Katja Fennel (Dalhousie)

Source or Sink? Elucidating the carbon transport mechanisms that drive air-sea CO₂ flux on the Scotian Shelf

0935h - Alfonso Mucci and Ashley Dinauer (McGill)

Spatial variability of pCO₂ and gas exchange in the ice-free surface waters of a macrotidal estuary: the St. Lawrence Estuary (Canada)

0955h - Susan Allen, Tereza Jarnikova, Michael Dunphy, Elise Olson and Debby Ianson (UBC, IOS/DFO)

Spatial and Temporal Variation of pH and Aragonite Saturation in the Salish Sea : A Modelling Approach

1015h - Questions and Discussion

1030h - Refreshments

1100h - Cluster #2 - Travis C. Tai, U. Rashid Sumaila, William W.L. Cheung (UBC)

Projections of biophysical responses to ocean acidification and its impacts on global fisheries

1120h - Tyler Wilson, Travis Tai¹, Sarah Cooley, Peter Tyedmers (Dalhousie, ¹UBC)

Socioeconomic implications of ocean acidification in Atlantic Canada

1140h - Barbara Patterson (Saint Mary's University)

Integrating multi-disciplinary research to assess risk of ocean acidification for Canadian coastal communities

1200h - Questions and Discussion

1230h - Lunch

1330h - Cluster #3 - Helen Gurney-Smith^{1,2*}, Kayla Mohns¹, Caitlin Smith¹, Tamara Russell^{1,3}, Tammy Blair², Vicky Merritt², Nicole Leavitt², Erin Miller² and Wiley Evans⁴ (¹Vancouver Island University, ²St. Andrews Biological Station, DFO, ³Microthalassia Inc., ⁴Hakai Institute)

Overview: biological responses of important commercial invertebrates to in situ and controlled ocean acidification conditions

1350h - Piero Calosi, Fanny Noisette, Kayla Menu-Courey, Mathilde Chemel, Sarah Piedalue, Dounia Daoud, Lara Cooper, Tammy Blair, Helen Gurney-Smith, William Cheung, Kumiko Azetsu-Scott (Université du Québec à Rimouski + others)

*The impact of low pH sea water on the survival, development and physiology of the American lobster **Homarus americanus**: toward understanding global changes impacts on lobsters recruitment and distribution*

1410h - Stephen F. Gonski, Wei-Jun Cai (Advisor)¹, William Ullman¹, D. Tye Pettay¹, Todd R. Martz¹, Brent Else (U. Calgary, ¹U. Delaware, ²Scripps/UCSD)

An evaluation of the performance of an ISFET pH sensor in a dynamic estuarine system

1430h - Questions and Discussion

1500h - Refreshments

1530h - Cluster #4 - Debby Ianson (DFO), Karen Kohfeld (SFU), Susan Allen (UBC), Ellie Simpson (SFU), Tereza Jarnikova (UBC), Paul Covert (ETH-Z), Marty Davelaar (DFO), Kenny Scozzafava (DFO) Amelia Hesketh (UBC), Elise Olsen (UBC)
Ocean acidification challenges in inlets and nearshore environments on the Pacific Canadian Coast

1550h - Julie LaRoche, Jackie Zorz, Jennifer Tolman, Jenni Ratten, Dhvani K Desai, Dariia Atamanchuk, Douglas Wallace (Dalhousie)
The importance of microbial community observations in assessing the impact of ocean acidification in coastal waters and in aquaculture settings

1610h - Dhvani Desai, Jackie Zorz¹, Jennifer Tolman¹, Kumiko Azetsu-Scott², Julie LaRoche¹ (¹Dalhousie, ²Bedford Inst. Ocgy)
Assessing the microbial community structure in the context of shifting environmental baselines in pH, oxygen and temperature in the Northwest Atlantic Ocean

1630h - Questions and Discussion

1700h - Adjourn

Friday 24 March

0900h - Cluster #5 - Rachel M. Horwitz , Helmuth Thomas, and Alex Hay (Dalhousie)
Seasonal, diel, and tidal CO₂ variation in the Bay of Fundy

0920h - Wanying Ji, Helmuth Thomas (Dalhousie)
A study of inorganic carbon cycling in Scotian Shelf waters using stable carbon isotopes

0940h - Stefanie Mellon, Markus Kienast, Helmuth Thomas, Stephanie Kienast (Dalhousie)
Investigating the Suess Effect in Atlantic Canada: A history of carbon isotopes recorded in fossil foraminifera

1000h - Cecilia Engler, David L. VanderZwaag, Katja Fennel (Dalhousie)
Ocean acidification post-Paris: Gauging law and policy responses in light of emerging scientific projections

1020h - Questions and Discussion

1040 - Refreshments

1100h - Programmatic talks each 20 min (including questions) - Richard Dewey (ONC), Wiley Evans (Hakai Institute), Denise Joy (DFO)

1215h - Lunch

1300h - Breakout groups - Come up with 3 questions/issues/gaps

1345h - Reporting back from break-out groups

1400h - Discussion of future of OA in Canada, including a Community of Practice - led by Doug Wallace and the OACC

1500h - Adjourn

Issues arising from discussions within the break-out groups:

- 1• partition biological responses into chronic (long term) and acute (short term)
- 2• develop protocols for experimental study of 'multiple stressors'
- 3• closer links between chemistry and biology
- 4• observations should be made in close proximity to target organisms
- 5• a big challenge is forecasting the reorganization of ecosystems (i.e. the community structure)
- 6• need to progress from the scientific findings towards 'indicators/indices' of stress in different systems (ecological and social) for 'end users'
- 7• more work needed on the 'Response' part of MEOPAR, i.e. how does your research contribute to effective responses to ocean acidification, e.g. mitigation vs adaptation
- 8• current models need more spatial resolution
- 9• develop best practices and data formats
- 10• determine how to present findings to the public more effectively

What is a 'Community of Practice'?

In the final discussion, Doug Wallace, Director MEOPAR, proposed a loose structure for organizing Ocean Acidification research in Canada under a Community of Practice. The main elements of a Community of Practice include:

- members come from diverse backgrounds including researchers, groups being impacted, regulators, industry, governments, etc.
- they undertake collective learning through dialogue
- they develop and disseminate 'best practices'
- each member is a 'practitioner in their own domain'

For Ocean Acidification research in Canada a Community of Practice would include MEOPAR together with partners and end users, who could raise funding sufficient for a Research Associate and a budget to carry out several activities including:

- training and mentorship
- involving students
- determining how to mobilize knowledge in OA
- determine how Canada could best contribute to the Global Ocean Acidification Observing Network (GOA-ON).

An example of a Community of Practice is NetColor, a Network on Coastal, Oceans and Lake Optics Remote Sensing [<http://www.netcolor.ca/>], led by Marcel Babin, Takuvik Joint International Laboratory, Université Laval and CNRS.

The abstracts from the Workshop are available at [<http://web.uvic.ca/~denmank/PDFdocs/OAabstracts.pdf>]. In addition an 'Issue Paper' on 'Ocean Acidification in Canada's Coastal Waters - Climate Change, Processes and Impacts' has just been completed by Ken Denman and Robie Macdonald. It was commissioned by the Canadian Climate Forum for the Department of Fisheries and Oceans, and is available for download at [http://www.climateforum.ca/?page_id=5286]. [An introduction to this report is found at the end of this newsletter.]

Une vie cachée sous les glaciers

De: [Impact Campus](#). Reportage: Alexandre Prudent. Photo: Philippe Archambault.

« C'est une découverte qui peut sembler mineure pour les gens, mais elle est importante pour la science », lance-t-il d'entrée de jeu. Organisée par l'Institut polaire suisse, l'Antarctic Circumnavigation Expedition (ACE), à laquelle a pris part M. Archambault, est seulement la dixième de l'histoire à effectuer un tour complet de l'Antarctique. Mais, surtout il s'agit de la première 100% scientifique. Le périple a ainsi réuni 22 équipes provenant de partout à travers le monde sur le brise-glace russe Akademik Treshnikov.

En passant de la biologie à la physique, les trois membres de l'équipe Mertz-Diva, Philippe Archambault, Guillaume Massé, aussi de l'Université Laval, et Marie-Noëlle Houssais, de l'Université Pierre et Marie Curie, étudiaient l'impact du réchauffement climatique sur le glacier Metz et de ses écosystèmes associés.

Le glacier, qui s'est brisé en 2010, « est très grand et mesure une centaine de kilomètres », explique M. Archambault. L'expédition a, entre autres, permis de découvrir que le glacier fond par en-dessous, contrairement aux croyances. « On pense que le glacier va fondre au-dessus à cause de l'exposition au réchauffement

planétaire, mais cette découverte implique que c'est l'eau qui s'est réchauffée et qui est responsable de la fonte », synthétise le professeur de biologie.

[L'article complet.](#)



Departure of the French PEACETIME cruise in the Mediterranean Sea

From GEOTRACES News

PEACETIME: ProcEss studies at the Air-sEa Interface after dust deposition in the MEditerranean sea

The PEACETIME cruise departed on May 10 from La Seyne (France) for a 33 days cruise. Onboard the French oceanographic research vessel Pourquoi Pas ?, there is a team of 40 scientists who will study the impact of atmospheric deposition on the ocean. This international and multidisciplinary scientific team is travelling the central and western Mediterranean in search of atmospheric deposition of Saharan dust. Their aim is to study processes at the interface between the atmosphere and the ocean in this region of the world where atmospheric input plays a key role as a nutrient source for the marine biosphere. This campaign will provide a better understanding how atmospheric deposition affects the functioning of the pelagic ecosystem in order to more accurately predict the future of biodiversity in the Mediterranean.

On board, the scientific team will combine in situ observations in the atmosphere and ocean with process studies in the water column. This will allow the characterization of the chemical, biological and physical properties of the atmosphere, the marine surface micro-layer, and the deeper layers of the Mediterranean.

In order to optimize the chances of observing a deposition of Saharan dust in situ during the cruise, the cruise track is in a zone where the probability of this type of event is greatest. In the event of such an occurrence, the vessel will be diverted from its original transect to the identified deposit area. Another specific features of this campaign is to embark "climatic reactors" that are devices reproducing on a small scale the air-sea exchanges under current and future environmental conditions (acidification and increase of the temperature of the sea water).

This coordinated multidisciplinary effort will better characterize the impact of atmospheric deposition in the ocean and their feedback to the atmosphere in a nutrient-poor system such as the Mediterranean Sea. PEACETIME is a [GEOTRACES Process-study](#) (GApr09).



The route of the PEACETIME oceanographic campaign in the central and western Mediterranean is indicated on this map as well as the planned observation stations (Left). Illustration of an event of transport of Saharan dust in the western Mediterranean, part of which is deposited at sea (seen by a satellite, NASA image) (Right).

Follow PEACETIME at: <http://peacetime-project.org/>, Twitter: @peacetimecruise

This section of your newsletter provides an opportunity to highlight your research programs to the Ocean Science Community.

*Your are invited to send contributions to David Greenberg,
david.greenberg@dfo-mpo.gc.ca*

Mettez en valeur vos programmes de recherche en publiant un article dans cette première section de votre bulletin.

*Faites parvenir vos contributions à David Greenberg,
david.greenberg@dfo-mpo.gc.ca*

MEETINGS

51st CMOS Congress Imminent

[Future Earth: Weather, Oceans, Climate](#) June 4 - 8th 2017



[Week at a glance](#)

[Graphic Session Schedule](#)

[Mine into individual abstracts](#)

[Registration](#)

Gordon Research Conference - Chemical Oceanography

July 23-28, 2017, Synthesizing Multifaceted Data in Chemical Oceanography

Chemical Oceanography is a multidisciplinary science that integrates research across elements, environments, and platforms on a variety of space and time scales using a multitude of approaches. Themes highlighting the fundamentally interdisciplinary nature of the field have remained at the heart of the GRC in Chemical Oceanography for almost 50 years. The meeting in 2017 will advance these themes and highlight synthesis of multifaceted data in Chemical Oceanography. Highlights will include new methods of data collection, visualization, analysis, and modeling that allow novel insights and connections to be made in all phases of interdisciplinary work. Synthesizing data on multiple elements, with different chemical behaviors and controls allows us to understand key processes that control the distributions of elements in seawater and marine sediments, as well as to understand how shifts in those distributions may reflect changes at the processes level. New advances in integration of a wide array of measurements on a variety of space and time scales allow scaling from detailed regional studies to global processes in the past, present, and future ocean and create an integrative



understanding of Chemical Oceanography whose whole is greater than the sum of its parts. Applications for [this meeting](#) must be submitted by **June 25, 2017**.

The 2017 GRC will be preceded by a [Gordon Research Seminar \(GRS\) in Chemical Oceanography](#) that will be open to all graduate students and postdocs in Chemical Oceanography and related fields. The GRS provides a forum for early career researchers to present and discuss results from their research in a peer-to-peer setting in advance of the GRC. Applications for this meeting must be submitted by **June 24, 2017**.



Training Course on Marine Radioactivity at the 2017 Goldschmidt Conference IPGP Paris, August 13 2017

A Training Course on Marine Radioactivity will be held in association with the 2017 Goldschmidt Conference at the Institut de Physique du Globe de Paris (IPGP), August 13 2017. The event is organized by [SCOR 146 Working Group: Radioactivity in the Ocean, 5 decades later \(Rio5\)](#). The purpose of this course is to train graduate students and young professionals who are interested in or will pursue research or management positions that require a basic understanding of marine radioactivity. The one-day course will include lectures covering the following subjects: An introduction to Radionuclides; Natural, Anthropogenic, and Cosmogenic Radioisotopes and their General Applications in the Marine Environment; and Radioecology. Specific lectures will delve more deeply into specific applications and will include topics such as applications of radionuclides to sediment age dating, submarine groundwater discharge, and biological mediated carbon export.



The registration fee is € 40, which includes all course materials and coffee breaks.

The complete schedule is available [here](#). Please send any any questions to: Ken Buesseler, kbuesseler@whoi.edu, Minhan Dai, mdai@xmu.edu.cn or Claudia Benitez-Nelson, cbnelson@geol.sc.edu.

*Please send meeting announcements to
David Greenberg,
david.greenberg@dfo-mpo.gc.ca*

*SVP faites parvenir vos annonces de réunion à
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JOBS and TRAINING

Four positions open at the University of Gothenburg, Sweden

The Department of Marine Sciences (<http://marine.gu.se/english/>) is Sweden's most complete environment for marine research and education, and is one of only a few such organisations in Europe. The University of Gothenburg has excellent marine infrastructure facilities including state-of-the-art instrumentation, two large research stations, and a new 49-m research ship that will come into service during 2017 (<http://loven.gu.se/english/>). The University's researchers also have access to the icebreaker Oden for polar research (<http://polar.se/en/>). The Department of Marine Sciences, which was formed in 2015, brings together expertise in physical oceanography, marine chemistry, marine biology, marine geology and marine conservation. The department hence enjoys excellent conditions for addressing the challenges of the future within marine research and education. The department is host to the Centre for Sea and Society (<http://havochsamhalle.gu.se/english/>), an entry point to all marine and maritime activities within the University of Gothenburg. The Gothenburg area is a national hub for management of the sea, including being the location of the Swedish Institute for the Marine Environment (<http://havsmiljoinstitutet.se/english/>), hosted by the University of Gothenburg, and the Swedish Agency for Marine and Water Management (<https://www.havochvatten.se/en>).



Available positions are: [Professor in Marine Chemistry](#), [Senior Lecturer in Marine Chemistry](#), [Senior Lecturer in Marine Benthic Ecology](#) and Professor in [Physical Oceanography](#).

All applications are due by **June 13**.

Research Fellow in Marine Trace Metal Biogeochemistry National Oceanography Centre Southampton, UK

We have an exciting opportunity for researchers to join our study of 'The impact of Mid-Ocean Ridges on the ocean's iron cycle' (FRidge). Recently funded by Natural Environment Research Council (NERC), FRidge is a UK-based multi-institutional project, with strong collaborative links to partners at the Woods Hole Oceanographic Institute (USA) and at the University of Minnesota (USA). Our aim is to combine novel observational and modelling experiments to investigate both the longevity of hydrothermal iron plumes and examine how the ridge affects the vertical mixing of iron. This project is part of international GEOTRACES program. We have funding for a 2-year postdoctoral researcher available from September 2017 at the University of Southampton.



Details [here](#). Applications close **June 6**.

Looking for work? Try the CMOS site ([click](#)).

Vous recherchez un emploi? Visitez le site SCMO ([click](#)).

GENERAL

New SCOR Working Group Proposals

Five working group proposals have been submitted to SCOR for review:

- 1 - Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS)
- 2 - Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change
- 3 - International Network for the Study of How Organisms Respond to Environmental change (INSHORE)
- 4 - Expanding Regional Application of Dynamic Ocean Management (ERADOM)
- 5 - Floating Litter and its Oceanic Transport Analysis and Modelling (FLOTSAM)



The five proposals for 2017 are available at http://scor-int.org/Annual%20Meetings/2017EC/SCOR_EC_2017.htm. One to three of these will be funded at the Annual SCOR meeting in September. Comments from any interested scientist are welcomed. Comments can be sent to CNC-SCOR, either via the Chair (Paul Myers, pmyers@ualberta.ca) or the Secretary (David Greenberg, david.greenberg@dfo-mpo.gc.ca). The deadline for comments for this year is July 4, 2017.

World Ocean Day June 8 2017

Despite the huge challenges facing the world's ocean, by working together we can support a healthy ocean that is able to sustainably provide for the billions of humans, plants, and animals that depend on it every day. On [World Oceans Day](#), people around our blue planet celebrate and honor the ocean, which connects us all.



Among the Canadian events posted so far are:

- [June 10 10:00 Lunenburg Heritage & Marine Stewardship Project - Lunenburg, Nova Scotia](#)
- [June 8-11 Aros na Mara World Oceans Day Festival - Iona, NS](#)
- [June 8 10:00 World Ocean Day/Beach Clean Up - Bonavista, Newfoundland and Labrador](#)
- [June 8 18:00, 21:00 - "A Plastic Ocean" Documentary Screening: Sea Shepherd Toronto - Toronto, Ontario](#)
- [June 8 World Oceans day at the Zoo! Calgary, Alberta](#)
- [June 10 Dorts Cove Beach Clean Up - Dorts Cove, Guysborough County, Nova Scotia](#)
- [June 8 15:00 Surf-abration at White Point, Nova Scotia](#)
- [June 8 11:00-15:00 World Oceans Day at Deep Bay Marine Field Station, Bowser, British Columbia](#)
- [June 4 11:00-15:00 Shaw Centre for the Salish Sea Sidney, British Columbia](#)



The Martin Bergmann Medal for Excellence in Arctic Leadership and Science

Established by the Royal [Canadian Geographical Society](#) in 2012, the [medal](#) recognizes achievement for “excellence in Arctic leadership and science”. It celebrates “Marty” Bergmann, a public servant with an outstanding talent for networking that led him to connect scientists with resources and technology, to inspire business leaders, explorers and innovators towards new goals and to consider and attempt to meet the challenges inherent in opening up the Arctic, whether these were related to logistics, safety, resources, people, knowledge or will.



All [nominations](#) must be made on-line and received at the Society’s office by **11:59 pm EST on June 30**.

Ocean Acidification in Canada’s Coastal Waters

K. Denman, R. Macdonald

[Canadian Climate Forum](#), Issue Paper #6, Spring 2017



Overview: Canada has the longest coastline in the world; our Exclusive Economic Zone (EEZ) including territorial waters for all three of our oceans encompasses 6 million km², equivalent to 60% of our land area. As a result of increasing CO₂ in the atmosphere and a changing climate, we expect Canada’s oceans to become warmer, fresher, more acidic, and, below the surface ocean, to become less oxygenated.



*Scanning electron micrograph of the pteropod (swimming snail) *Limacina helicina* from the Washington, US coast. Rough areas show dissolution/corrosion from low pH waters. [micrograph N. Bednaršek].*

Observations and models indicate that warming and acidification will proceed more rapidly and more strongly at high latitudes. In this paper, we focus on the increasing acidity of Canadian ocean waters — the causes and the emerging and expected consequences to marine ecosystems (from microscopic plants and animals to whales), to commercial fisheries, and to coastal communities. Finally, we recommend a number of actions that should help to minimize the impacts on our coastal ecosystems, and on Canadian communities and industry.

This comprehensive Issue Paper provides an excellent overview of the causes, the processes and the impacts of acidification on Canada's three coastal oceans. It also reveals some of the socio-economic impacts, and offers important recommendations for action to address this very serious threat to the health and productivity of our oceans.

The full paper is available [here](#).

**CANADIAN OCEAN SCIENCE NEWSLETTER
LE BULLETIN CANADIEN DES SCIENCES DE L'OcéAN**

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Newsletter #95 will be distributed in **July 2017**. Please send contributions to David Greenberg david.greenberg@dfo-mpo.gc.ca

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