

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

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A New Biogeochemical Feedback to Ocean Acidification

Bernard P. Boudreau

Department of Oceanography, Dalhousie University, Halifax, NS B3H4R2, Canada

Research on ocean acidification has, so far, focussed on the means and rate of anthropogenic CO₂ penetration into the oceans over the next 100 or so years. Far less consideration has been given to its longer time-span evolution and the means of future recovery. My colleagues and I have been investigating these latter points and, in the process, we have discovered an additional negative feedback mechanism to surface ocean calcification (Boudreau, Middelburg and Luo, 2018, *Nature Geoscience*, 11, 894-900). This report outlines the essential elements of our findings. (Referencing is omitted below for brevity.)

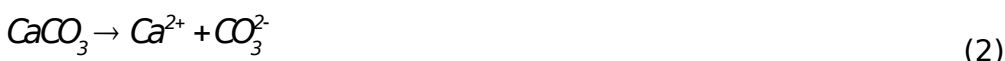
What did we know previously?

There is a well-known negative feedback mechanism in the oceans to counter acidification, known as (*chemical*) *carbonate compensation*. Briefly, the dissolved carbonate chemistry of the oceans is largely determined by a single overall reaction:



where CO₂ is the dissolved carbon-dioxide, HCO₃⁻ is the bicarbonate ion and CO₃²⁻ is the carbonate ion. The acidity, expressed as pH, of the oceans is a measure of the concentration of hydrogen ion, [H⁺], in seawater, i.e., pH = - log [H⁺]. [H⁺] is proportional to the ratio of bicarbonate to carbonate ion concentrations in seawater, i.e., [H⁺] ~ [HCO₃⁻]/[CO₃²⁻].

At the same time, many species of phytoplankton and zooplankton (calcifiers) secrete exoskeletons (tests) of solid CaCO₃ (calcite) in surface waters. Oceanic surface waters are everywhere supersaturated with respect to calcite, so nothing happens there to these tests following the death of these organisms. However, these tests sink, and a large fraction reaches and accumulates in the sediments (Fig. 1). The solubility of calcite increases with depth (pressure), so that there is a depth in the oceans where the water becomes undersaturated with respect to calcite, and the tests start to dissolve on the bottom, i.e.,



This depth is known as the *saturation horizon* (Fig. 1). The deeper one goes, the greater the undersaturation, and this rising undersaturation drives increasing CaCO₃ dissolution. Consequently, the amount of CaCO₃ in the bottom sediments falls systematically with depth below the saturation horizon, and at a certain depth, the rate of dissolution equals the flux of sinking CaCO₃ tests. No more calcite accumulates below that depth, i.e., the *carbonate compensation depth* (Fig. 1).

Because of Reaction 1, adding anthropogenic CO₂ to the oceans causes [CO₃²⁻] to fall and [HCO₃⁻] to increase; consequently, the [HCO₃⁻]/[CO₃²⁻] ratio and thus [H⁺] increase (lower pH), which is acidification. That chemically altered surface seawater, i.e., lowered [CO₃²⁻], can then be transported to the deep ocean via overturning and the thermohaline circulation.

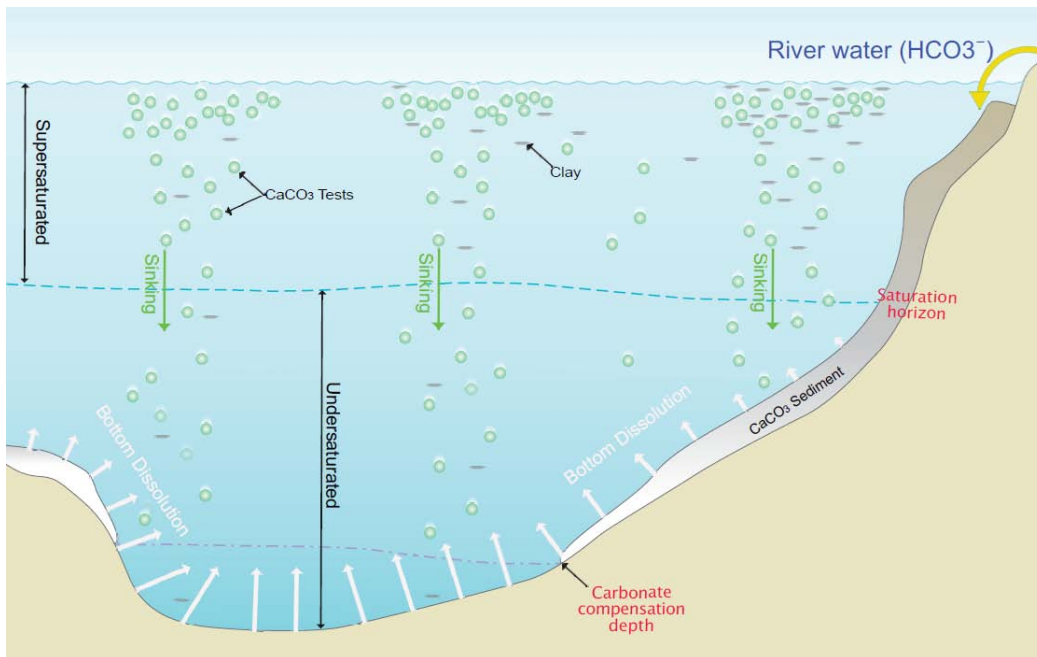


Figure 1. Schematic representation of the processes and conditions affecting solid, biogenic, CaCO_3 tests in the oceans, including surface production of test (calcification), sinking after death, saturation state (supersaturated surface waters, undersaturated deep waters), and dissolution on the bottom increasing with depth.

The sinking of anthropogenically acidified surface water with a lower carbonate ion concentration will decrease the saturation state of the deep water, cause the saturation horizon to shallow, increase the total rate of CaCO_3 dissolution, and drive the compensation depth to rise. The carbonate ion concentration of the altered deep water will increase via Reaction 2, and essentially all the dissolved anthropogenic CO_2 will be converted to bicarbonate via Reaction 1. Collectively this neutralization process is called *chemical carbonate compensation*. While thermohaline circulation works on a time scale of 300-1000 years, chemical compensation takes $\sim 10^4$ years to alter the chemistry of the entire ocean. The existence of this mechanism has been recognized, at least in part, since the Challenger expedition (1872-1876).

What's New?

Let me now ask a question that seems to come from left field: where do the carbonate ions in the ocean come from? They are constantly being supplied to the oceans from rivers, as a result of chemical weathering of rocks. That supply is in the form of bicarbonate ions (yellow arrow at the top of Fig. 1). *Calcification*, i.e., the formation of calcite tests from dissolved carbonate ions, coupled to Reaction 1 and the sinking of the tests, regulates how much of these bicarbonate ions remain dissolved in the surface oceans.

Evidence has accumulated that calcifiers decrease their production with acidification. The geological record contains examples of decreases in the abundance/production of calcifiers following acidification. With reduced calcification, oceanic surface waters become enriched in bicarbonate ions on a time scale associated with the rate of weathering, which is much longer than the rate at which we are now acidifying the oceans. Because of the inverse of Reaction (1), reduced calcification leads to greater $[\text{CO}_3^{2-}]$ in the surface oceans and a lower $[\text{HCO}_3^-]/[\text{CO}_3^{2-}]$ ratio than would otherwise be, i.e., lower $[\text{H}^+]$, thus neutralizing acidification.

When surface waters sink, they now have more carbonate ion than before, and the saturation state of the deep oceans increases; thus, the total CaCO_3 dissolution decreases (Reaction 2).

Less dissolution causes more CaCO_3 accumulation in the bottom sediments, sometimes more than what was preserved before acidification (illustrated below). Increased CaCO_3 accumulation eventually drives the bicarbonate concentration of the surface waters towards its original value. This constitutes a newly recognized, negative feedback that buffers the carbonate system of the oceans; we term this *biological carbonate compensation*.

Biological and chemical compensations can and do occur simultaneously in our oceans. Which compensation mechanism is more important? Chemical compensation will always occur, if overturning is maintained. For that reason, we suggest that it probably dominates the oceanic response to acidification in many situations. Nevertheless, the geological record offers evidence that is not always the case. The big difference between the two compensations is that chemical compensation alone would simply return the CaCO_3 -depth distribution towards its original state after acidification, i.e., both the saturation and compensation depths would first rise with acidification and then simply deepen to their previous positions on a time scale of about 10^4 years or more; therefore, at a given oceanic depth below the saturation horizon, if one cored the sediment with time, one would observe a CaCO_3 drop and then a return to the same pre-acidification amount, in principle.

The observable effects of biological compensation depend on the magnitude of the drop in calcification and its duration. Figure 2 illustrates the changes in the position of the compensation depth, below which no CaCO_3 accumulates, when subject to a present-day “business as usual” scenario for CO_2 emissions and when both compensations operate. The drop in calcification is only 25% in this figure (really not a lot - no extinction here), and three duration schemes for reduced calcification are illustrated. (1) Rapid Recovery (solid line), wherein calcification changes in tandem with emissions. (2) No Recovery, wherein the production falls to 75% of its original value permanently. (3) Delayed Recovery, wherein the reduced calcification does recover to original levels, but only after a “long” lag.

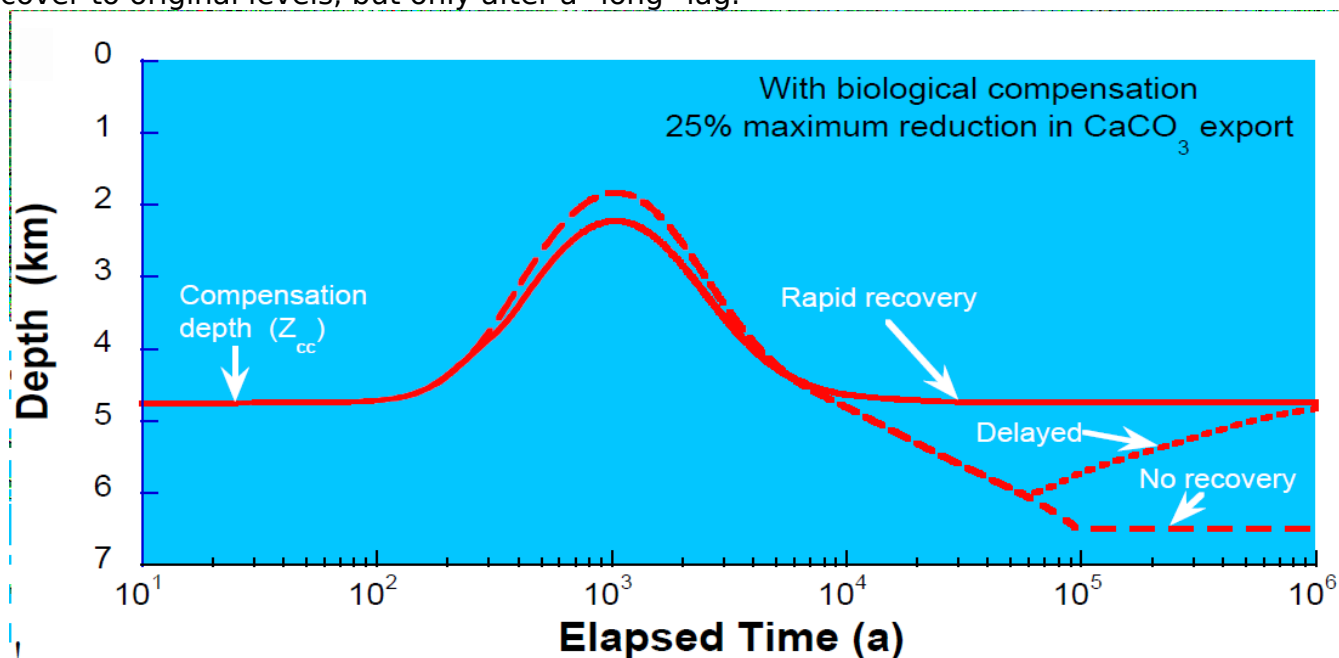


Figure 2. Modelled evolution of the carbonate compensation depth (below which no CaCO_3 accumulates) during an acidification event (5 Gt CO_2 added over 3000 yrs) and an initial 25% drop in calcification, with rapidly recovery of calcification, delayed return of calcification and no recovery of calcification. More CaCO_3 accumulates if the compensation depth deepens.

Rapid Recovery of calcification generates an evolution quantitatively comparable to that of pure chemical compensation. The predicted evolution differs significantly if there is No Recovery or Delayed Recovery - dashed and dotted red lines Fig. 2. In both these cases, there is first an

~150-m extra rise of the carbonate compensation depth beyond that predicted by chemical compensation alone. As acidification wains, input of bicarbonate from rivers restores the carbonate chemistry, but with reduced calcification, the carbonate ion builds up to a higher level. Sinking surface waters then cause the deep waters to increase their calcite saturation state to levels greater than the pre-acidification situation; additional CaCO_3 is thus preserved. The accumulation of CaCO_3 below the pre-perturbation compensation depth is termed *over-deepening* or *over-shooting*. The time scale for this evolution is tens of thousands of years.

Any Evidence?

What evidence exists that biological compensation has played a role in past acidification of the oceans? Looking into the past is always difficult; at best, what is preserved is a CaCO_3 record sampled at a given paleo-depth, not a compensation depth record as in Fig. 2. Sediments from the Paleocene-Eocene Thermal Maximum (PETM, ~55 Ma BP), preserved at the Walvis Ridge in the South Atlantic, display the effects of a serious rise in atmospheric CO_2 over a ~50 Kyr interval, which precipitated ocean acidification - see Fig 3. Note the rapid loss of calcite in the sediment with the start of acidification. This record later contains what is arguably the earmark of a Delayed or No Recovery situation.

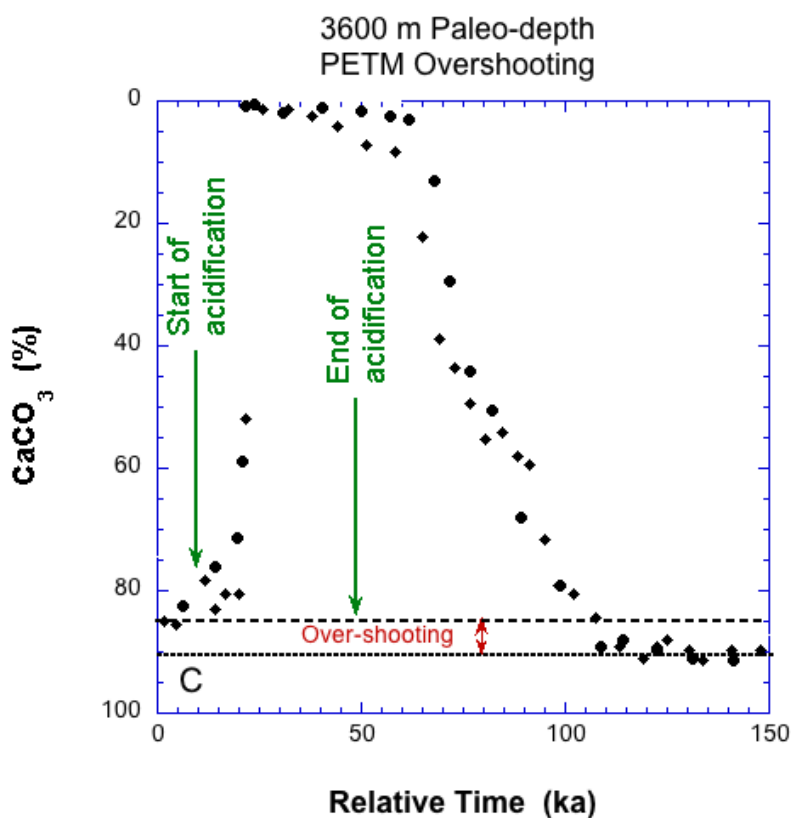


Figure 3. Sampled CaCO_3 (calcite) content of sediments at 3600 m paleo-depth at Walvis Ridge in the South Atlantic (symbols) some 58 Myrs ago. Over-shooting is indicated by the red arrow.

Specifically, Fig. 3 illustrates the amount of CaCO_3 preserved in PETM sediment at 3600 m paleo-depth at that site with time. Note that the amount of CaCO_3 found in the sediment after the acidification is 6% greater than before acidification and that amount is significant, i.e., about 65% more CaCO_3 accumulation because of the strong non-linearities in the sedimentation equations. When we modelled this situation, we found that the calcification rate had actually fallen by ~50% (Luo et al., 2016, Earth Planetary Science Letters, 453, 223-233) over the entire PETM episode. The cause of the over-shooting, we argue, was biological compensation.

It's almost ironic how an initial acidification can lead to alkalinization. This could be the future of the oceans.

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*

Honours

Bernie Boudreau, Killam Professor Emeritus Dalhousie Faculty of Science,
Fellow of the American Geophysical Union (AGU).

From the [AGU announcement](#):

The members of this year's class of Fellows have made exceptional contributions in our Earth and space sciences community through breakthrough, discovery, or innovation in their disciplines. Since 1962, AGU has elected fewer than 0.1% of members to join this prestigious group of individuals.

Thanks to their dedication and sacrifice, AGU Fellows serve as global leaders and experts who have propelled our understanding of geosciences. We are confident that they will remain curious and relentlessly focused on answers as they continue to advance their research, which pushes our boundaries of knowledge to create a healthy planet and beyond.

We are grateful for their invaluable contributions. We also recognize that numerous individuals were pivotal to their success, and we thank them too.

Robin Bell, President, AGU; and LaToya Myles, Chair, Honors and Recognition Committee, AGU

From [Dalhousie News](#):

The AGU is arguably the world's largest association of Earth, atmospheric, ocean, hydrologic, space and planetary scientists, consisting of over 62,000 members from 144 countries. The Union's activities are focused on the organization and dissemination of scientific information in the interdisciplinary and international fields within the Earth and space sciences.

Fellows of the AGU act as external experts, capable of advising government agencies and other organizations outside the sciences upon request. The

program enhances the prestige of AGU and motivates members to achieve excellence in research.

Bernie has been a fellow of the Royal Society of Canada since 2011 and currently serves as chair of the RSC Earth, Ocean and Atmospheric Sciences Committee.

For an example of Bernie's work, see the article above.



Serge Demers, l'Ordre du Canada

Tiré du site UQAR/ISMER

L'Université du Québec à Rimouski félicite Serge Demers pour sa nomination au sein de l'Ordre du Canada. Une distinction méritée pour le premier directeur de l'Institut des sciences de la mer de Rimouski (ISMER-UQAR).

Créé en 1967, l'Ordre du Canada est la plus haute récompense du régime canadien de distinctions honorifiques. Elle vise à rendre hommage aux personnes qui se sont démarquées par leurs réalisations, leur dévouement et leurs innovations. La remise de l'insigne de membre de l'Ordre du Canada à M. Demers aura lieu à une date ultérieure lors d'une cérémonie officielle à Rideau Hall.

Serge Demers a dirigé l'Institut des sciences de la mer de Rimouski de l'UQAR pendant 14 années, soit de 1999 à 2013. « Il a été une figure importante dans l'essor du créneau maritime au Québec. Pendant ses trois mandats à la tête de l'ISMER-UQAR, M. Demers a contribué à en faire le plus important institut de recherche universitaire francophone en Amérique du Nord. L'obtention de l'Ordre du Canada est une belle reconnaissance de son apport au développement des sciences de la mer », observe le recteur de l'UQAR, Jean-Pierre Ouellet.



Le nom de Serge Demers est indissociable du domaine maritime. En plus de l'ISMER-UQAR, il a été un joueur clé dans la création de plusieurs organisations, dont le Centre de recherche sur les biotechnologies marines (CRBM), le Centre interdisciplinaire de développement en cartographie des océans (CIDCO), d'Innovation maritime, de la Technopole maritime du Québec (TMQ) et de l'Observatoire global du Saint-Laurent (OGSL). Rappelons que le Coriolis Il a été acquis alors qu'il était directeur de l'ISMER et qu'il a dirigé la

firme REFORMAR pendant 15 ans.

« Serge Demers a laissé sa marque non seulement à l'ISMER-UQAR, mais aussi dans les organisations dans lesquelles il s'est impliqué. La création de ces organisations a joué un rôle de catalyseur pour le positionnement actuel de l'ISMER-UQAR, de Rimouski, mais aussi du Québec en sciences de la mer et dans le secteur maritime sur les scènes nationale et internationale », souligne le directeur de l'ISMER, Guillaume St-Onge.



Spécialisé en écophysiologie du phytoplancton, Serge Demers a mené une carrière d'une trentaine d'années dans le monde des sciences de la mer. Il a publié plus d'une centaine d'articles scientifiques dans des revues internationales. Originaire de Montréal, il réside depuis quelques années à Lac-des-Aigles, où il assume la fonction de conseiller municipal depuis 2017.

[L'annonce officielle](#)

The Oceanography Society 2020-2021 Honors Recipients

TOS 2020 Fellows

Emmanuel Boss *School of Marine Science, the University of Maine* - For his contributions to and his leadership in ocean optics and its use in mapping biogeochemical processes in the ocean, for his inspirational teaching, and for his unwavering commitment to service and mentoring young scientists



**THE
OCEANOGRAPHY
SOCIETY**

Edward R. Urban Jr. *SCOR International* - For over 30 years of outstanding and sustained contributions to ocean sciences through extraordinary service and leadership in the US and international oceanographic research community.

Dawn Wright *Chief Scientist of Esri, Professor Oregon State University* - For leadership in the development of data science for the oceans, focusing on data quality, open science, and the development of spatial analytic tools to define the oceanic realm

TOS 2021 Early Career Awards

April Abbott *Macquarie University* - For contributions to chemical oceanography, providing a new view of the marine REE cycle, and training the next generation of ocean scientists

Ryan Abernathey *Lamont-Doherty Earth Observatory at Columbia University* - For fundamental contributions on the role of turbulence in the ocean general circulation, and for providing our community with tools that accelerate the pace of scientific discovery

James Watson *Oregon State University* - For excellence in the use of diverse disciplines such as mathematics, economics, behavioral science, and oceanography to study coupled human-natural interactions in the ocean



TOS 2021 MENTORING Award

Claudia Benitez-Nelson *Associate Dean, University of South Carolina* - For her tireless and remarkably successful efforts to engage, mentor, and imbue underrepresented students with her passion for science while also making outstanding contributions to research

TOS 2021 Ocean Observing Team Award

RAPID/MOCHA/WBTS 26°N Team - For transforming our understanding of Atlantic circulation with a breakthrough in observing system design providing continuous, cost-effective measurements

More information on the [TOS Awards](#)

Next Up



OERA webinar series

Maritime Regional Wind Energy Resources:
Determining preferred regions for
additional onshore and offshore
wind energy development

DR. LUKAS SWAN, DALHOUSIE UNIVERSITY
DR. NATHANIEL PEARRE, DALHOUSIE UNIVERSITY

THURSDAY, FEBRUARY 11 | 1PM AST | REGISTER AT oera.ca/OUTREACH

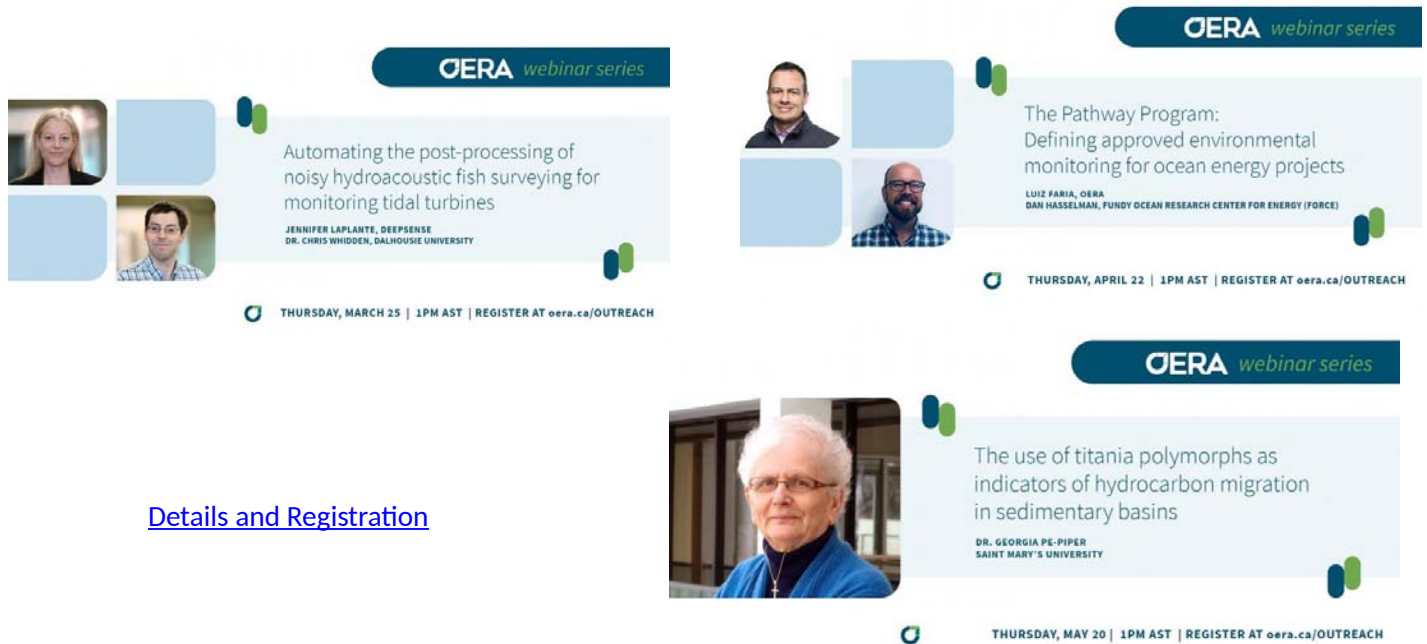
February 11, 2021 1:00pm – 2:00pm AST

Dr. Lukas Swan P.Eng., Renewable Energy Storage Laboratory, Dalhousie University

Dr. Nathaniel Pearre, Renewable Energy Storage Laboratory, Dalhousie University

This webinar presents a model and results that examine characteristics of the wind resource around the Canadian Maritime provinces. While significant wind turbine generating capacity has already been installed, it has sought to minimize cost of energy.

More Upcoming



OERA webinar series

Automating the post-processing of
noisy hydroacoustic fish surveying for
monitoring tidal turbines

JENNIFER LAPLANTE, DEEPSENSE
DR. CHRIS WHIDDEN, DALHOUSIE UNIVERSITY

THURSDAY, MARCH 25 | 1PM AST | REGISTER AT oera.ca/OUTREACH

OERA webinar series

The Pathway Program:
Defining approved environmental
monitoring for ocean energy projects

LUÍZ FARIA, OERA
DAN HASSELMAN, FUNDY OCEAN RESEARCH CENTER FOR ENERGY (FORCE)

THURSDAY, APRIL 22 | 1PM AST | REGISTER AT oera.ca/OUTREACH

OERA webinar series

The use of titania polymorphs as
indicators of hydrocarbon migration
in sedimentary basins

DR. GEORGIA PE-PIPER
SAINT MARY'S UNIVERSITY

THURSDAY, MAY 20 | 1PM AST | REGISTER AT oera.ca/OUTREACH

[Details and Registration](#)

Nova Scotian Institute of Science Talk

Talks in the Nova Scotian Institute of Science Public Lecture Series covers a wide range of topics. This talk will be of interest to the wider Oceanographic community.

Wayfinding Under the Waves

Dr. Russell Wyeth, Dept of Biology, St. Francis Xavier University

Navigation behaviour is something almost every animal does, choosing where to move through their habitat. Animals use a range of cues to find their way towards prey and mates and away from predators. In aquatic habitats, vision is often much less useful: the destination cannot be seen. Instead, natural selection has led to a range of alternate strategies in aquatic animals, involving chemical, mechanical and magnetic senses for wayfinding. This talk will give a taste of how navigation behaviour is different for animals underwater, and how marine biologists and the ocean community are exploring these extraordinary adaptations for survival in the ocean.

The NSIS 2020-2021 Public Lecture series will take place via zoom until further notice. The link to the live presentation will open just prior to the public lecture start time.

For information on other talks and how to join the Zoom session click [here](#).



NSIS - The Nova Scotian Institute of Science

Promoting Science in Nova Scotia Since 1862

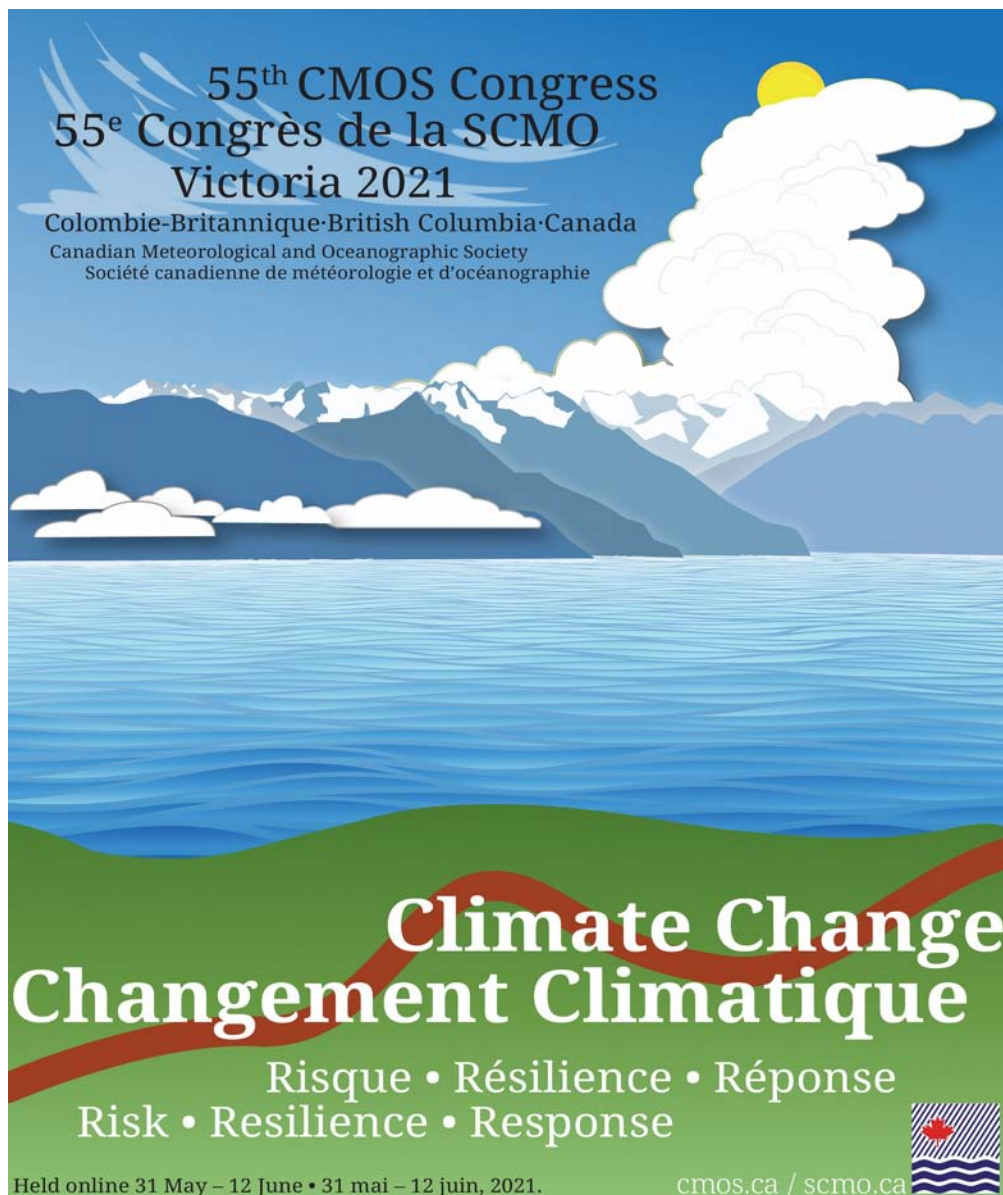
MEETINGS

Canadian Meteorological and Oceanographic Society 55th Congress

Online from Victoria, BC, 31 May - 11 June

Climate Change - Risk Resilience Response

[Note that at the time this newsletter was prepared, the congress website and poster had an incorrect closing date of June 12.]



The Canadian Meteorological and Oceanographic Society (CMOS) 55th Congress will be held 31 May to 11 June, 2021, hosted by the Vancouver Island Centre. The Congress will be held using a virtual (on-line) format, extending over a longer period, 9-10 days, with reduced hours each day to accommodate multiple time zones.

There will be two sets of scientific sessions on most days with 3-4 concurrent groups of oral presentations, along with poster sessions and 8 plenary speakers.

Abstract submission **deadline February 22**

[Congress Website](#)

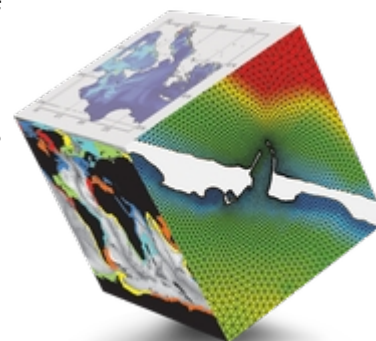
AMEMR 2021 - virtual conference

12-15 July 2021 - online

AMEMR (Advances in Marine Ecosystem Modelling Research) Symposium series provides an opportunity to present, discuss and learn about a wide variety of marine modelling challenges, methods, applications and outcomes.

Marine ecosystem models are a fundamental tool for understanding marine ecosystems and providing projections of potential future states of the marine environment. Marine modelling is continuously evolving, in response to new scientific knowledge, societal needs and computational resource.

AMEMR has a strong focus on the state-of-the-art and articulating future challenges. It also promotes interdisciplinary discussion among stakeholders and modelling, observational and experimental scientists and students who want to contribute to the conceptualisation, design, development and application of improved and new marine ecosystem models.



[Website](#)

Abstract submission **deadline February 14**

ASLO 2021 Aquatic Science Meeting

22-27 June 2021 - Virtual Meeting

Aquatic Sciences for a Sustainable Future: Nurturing Cooperation

Following the pressing needs of the society to ensure a sustainable future, amidst human-influenced environmental changes, the theme of the meeting is Aquatic Sciences for a Sustainable Future: Nurturing Cooperation. Underdeveloped and developed societies face different levels of sustainability problems in aquatic resources and have contrasting capacities to address and adapt to upcoming changes and threats, which makes cooperation paramount for an efficient and increasing exchange of information to find long-term sustainable solutions. Dialogue among scientists, as well as transfer of knowledge for the benefit of the society, are very important in addressing sustainability challenges. To provide a venue for this exchange, we will incorporate the theme into the plenary sessions: The future of seafood resources and the role of cooperation; Restoration of aquatic ecosystems, in line with the United Nations Decade of Restoration; Carbon dynamics in lakes and rivers; Past and future of ocean circulation and its role for the climate system; Linking the health of the oceans to humans; Remote sensing and large scale detection; Integrated management of aquatic resources.



Meeting Schedule - We look forward to having a dynamic meeting. The ASLO 2021 Aquatic Sciences Meeting was originally scheduled to begin in late February. Due to COVID-19, the date had to be rescheduled to June. ASLO meetings normally begin on Sunday with an opening plenary and reception, then conclude on Friday - with the scientific program scheduled Monday through Friday. Due to the revised 2021 dates, the Sunday through Friday pattern had to be changed with the scientific program scheduled Wednesday through Sunday. Because the meeting will be virtual, some of the activities may be outside of these dates.

Abstract Submission **Deadline 5 March 2021**

[Website](#)

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

*SVP faites parvenir vos annonces de réunion à
David Greenberg,
david.greenberg@dfo-mpo.gc.ca*

POSITIONS AVAILABLE

PHD Studies

Department of Earth, Ocean and Atmospheric Sciences, UBC

The distribution and cycling of methane and nitrous oxide in oceanic oxygen minimum zones

Start Date: September 2017

Supervisor: [Philippe Tortell](#)

Methane and nitrous oxide are potent greenhouse gases, with variable and poorly quantified oceanic sources. This research project will include extensive field based measurements of methane and nitrous oxide concentrations in the Subarctic Pacific Ocean and in the Canadian Arctic Archipelago, and experimental measurements of production / consumption rates using isotope-labelling experiments. The project involved close collaboration with Dr. Steven Hallam (UBC Microbiology Dept.).

Probing the oceanic cycle of Dimethylsulfide

Start Date: September 2017

Supervisor: [Philippe Tortell](#)

Dimethylsulfide (DMS) is a climate-active gas, which has been implicated as an important control on the atmospheric radiative balance. This gas, along with several related sulfur compounds, is cycled rapidly through the marine food web. The complexity of the marine DMS cycle has thus far made it challenging to understand the controls on the oceanic production of this gas. Using novel, sea-going mass spectrometric methods, we are currently examining the spatial and temporal distribution of DMS concentrations in the NE Subarctic Pacific, and in coastal Antarctic waters, and we are developing isotope labelling experiments to quantify the rates of DMS production and consumption through various metabolic pathways. This project aims to continue the development and implementation of these methods to gain a better mechanistic understanding of the oceanic DMS cycle.

[Details](#)

Tenure track Assistant/Associate Professor Arctic System Science

University of Manitoba

The University of Manitoba (UM) invites applications for a Natural Sciences and Engineering Research Council (NSERC) Canada Research Chair (CRC) Tier 2 (T2), a tenure-track position at the rank of assistant or associate professor, in the broad field of Arctic System Science. The Government of Canada has established the CRC program to enable Canadian universities to foster world-class research excellence.

The successful candidate will play a major role in Arctic System Science research projects administered through Centre for Earth Observation Science ([CEOS](#)). This will involve leading/collaborating on major interdisciplinary projects focused around: freshwater-marine coupling with glaciers and continental runoff; ocean acidification and carbon exchange processes; physical, biological, or chemical oceanography; Arctic-midlatitude teleconnections; glaciology; climate change; or other related disciplines.

[Details](#)

Applications reviews have started September 8, 2020 and will continue until the position is filled.



**University
of Manitoba**

Professeure/professeur sous octroi en acoustique marine

L'Institut des sciences de la mer de Rimouski (ISMER) de l'Université du Québec à Rimouski (UQAR)

La personne sélectionnée développera des travaux de recherche dans le cadre du projet de station de recherche en acoustique marine (projet MARS) récemment financé par Transports Canada, le ministère de l'Économie et de l'Innovation du Québec et plusieurs autres partenaires. Ce projet de recherche conjoint entre l'ISMER-UQAR et Innovation maritime (IMAR) consiste à implanter et à opérer une station de recherche acoustique sous-marine internationale sur le Saint-Laurent au large de Rimouski afin de documenter l'effet des navires sur l'environnement sonore du Saint-Laurent, mais aussi de proposer des moyens concrets pour diminuer le bruit des navires.



Université du Québec à Rimouski
Institut des sciences de la mer de Rimouski

Au sein de l'ISMER-UQAR, le projet MARS (~6 M\$ de budget total) fédérera une équipe de plusieurs personnes, dont 2 chercheuses ou chercheurs, du personnel de recherche ainsi que des étudiantes et étudiants. Le projet de recherche s'insérera dans des activités de recherche aux niveaux québécois, canadien et international, notamment par le biais de collaborations avec des équipes et des projets de recherche européens.

[Détails](#)

L'analyse des candidatures débutera dès maintenant et se poursuivra jusqu'à ce que le poste soit pourvu.

Chaire de recherche en génie côtier

L'Université du Québec à Rimouski (UQAR)

L'UQAR et le ministère des Transports (MTQ) s'associent pour mettre sur pied une chaire de recherche en génie côtier dédiée à la conception, la construction et la maintenance des infrastructures littorales. La constitution d'une chaire de recherche vient confirmer l'engagement de l'UQAR et du gouvernement du Québec dans une démarche de recherche de solutions concrètes aux enjeux auxquels sont exposées les communautés côtières et riveraines en ce qui a trait à la sécurité, à l'économie et à l'environnement. Au cours des dernières années, l'érosion côtière, plus particulièrement au cours d'épisodes de forte tempête, est devenue un enjeu majeur économique mais aussi de sécurité publique pour le Québec.

Induit par les modifications de la dynamique côtière découlant des changements climatiques, ce phénomène est appelé à prendre de l'ampleur alors que, les changements dans le régime des vents, la diminution de l'étendue du couvert de glace et le relèvement du niveau des océans est appelé à s'accélérer au cours du 21ème siècle. L'érosion progressive du littoral et la submersion aux événements de tempêtes menacent l'intégrité des infrastructures résidentielles, industrielles, portuaires et commerciales, ainsi que des infrastructures de transport régionales.

La chaire de recherche en génie côtier apportera une expertise unique en conception des infrastructures littorales et pourra s'appuyer sur l'une des plus hautes concentrations au Canada de chercheurs en sciences de la mer et des milieux côtiers. Elle pourra s'entourer de ressources qui lui permettront de travailler dans une perspective de gestion intégrée des zones côtières et de développement durable des territoires riverains et littoraux.

[Détails](#)

Date limite : 22 février 16 h 30

Assistant Professor of Environmental Chemistry

State University of New York, Syracuse, NY

The State University of New York College of Environmental Science and Forestry (SUNY-ESF) in Syracuse invites applications to join the Chemistry Department (<http://www.esf.edu/chemistry>) in an academic-year, tenure-track position as Assistant Professor of Environmental Chemistry with a concentration in Water Chemistry.



State University of New York
College of Environmental Science and Forestry

Preferred Qualifications: At least 12 months of relevant postdoctoral experience and research interests in basic or applied water chemistry, ability to teach graduate and undergraduate courses in chemistry, including water chemistry, evidence for the potential to develop an externally-supported graduate research program, and excellent oral and written communication skills. Broad areas of interest include but are not limited to limnology, groundwater chemistry, oceanography, water treatment and environmental biochemistry.

[Details](#)

Application Deadline March 1, 2021

Tenure Track Scientist - Geology & Geophysics

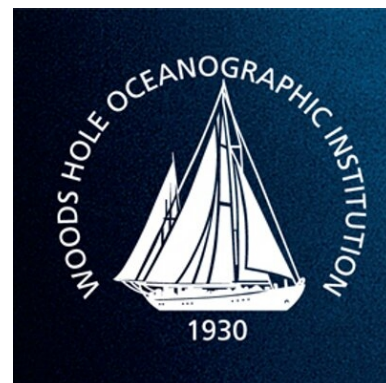
Woods Hole Oceanographic Institution (WHOI), Woods Hole, MA

The Geology & Geophysics Department at the [Woods Hole Oceanographic Institution](#) (WHOI) invites qualified candidates to apply for a tenure-track scientific-staff position with primary expertise in understanding processes related to mass, heat and/or biogeochemical exchange between the seafloor and ocean. Candidates' interests may span a wide range of seafloor settings, including across active and passive plate boundaries. Candidates should have experience and/or strong interest in active sea-going research programs, including the use of deep submergence vehicles and related technologies.

Applicants should have a doctoral degree and a record of scholarly publications commensurate with their career stage. Scientific Staff members are expected to develop independent, externally-funded, and internationally-recognized research programs. They also have the option of advising graduate students and teaching courses through the MIT/WHOI Joint Program in Oceanography/Applied Ocean Science and Engineering.

[Details](#)

Review of applications will begin on March 1st 2021.



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

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

GENERAL

CMOS scholarships / Les bourses d'études de SCMO

The Canadian Meteorological and Oceanographic Society (CMOS), the premier Society for atmospheric and oceanographic sciences in Canada, offers undergraduate and graduate scholarships to students in atmospheric sciences, meteorology, climate, oceanography and related fields (e.g., mathematics, hydrology, limnology).

The undergraduate scholarships offer \$1,000 and \$1,500.

The graduate scholarship is \$5,000 (with an option for a 2nd year).

Information about these scholarships and how to apply can be found at

<http://www.cmos.ca/site/scholarships>.

You do not have to be a member of the Society to receive a scholarship.

The application deadline for the undergraduate scholarships is March 15th.

The application deadline for the graduate scholarship is April 20th.



La Société canadienne de météorologie et d'océanographie (SCMO), la Société principale au Canada pour les sciences atmosphériques et océanographiques, offre des bourses d'études de premier, deuxième et troisième cycle à des étudiants dans des programmes d'études en science de l'atmosphère, météorologie, climat, océanographie et sciences connexes (p.ex., mathématique, hydrologie, limnologie.)

Les bourses du premier cycle offre 1 000\$ et 1 500\$.

La bourse de deuxième ou troisième cycle a une valeur de 5 000\$ (avec une possibilité d'une deuxième année).

Vous trouverez tous les détails nécessaires en ligne au site

http://www.cmos.ca/site/scholarships?language=fr_FR&

Vous ne devez pas être membre de la Société pour recevoir une bourse.

La date limite pour les bourses du premier cycle est le 15 mars.

La date limite pour les bourse du deuxième ou troisième cycle est le 20 avril.

Encouraging the ocean scientists of tomorrow

In the context of the 11th Western Indian Ocean Marine Science Association (WIOMSA) Scientific Symposium in Mauritius in 2019, a National School Art/Science Competition was organized. The Competition involved paintings to reflect on the theme "People, Coasts and Oceans: Opportunities for a changing future". The participants were judged both by the quality of their artwork and by their ability to portray the theme accurately. The competition was open to all primary and secondary schools of Mauritius within three categories: Category A (Grades 4-6, ages 8-11), Category B (Grades 7-9, ages 12-14), and Category C (Grades 10-13, ages 15-18).

[Symposium Newsletter](#)

Below are the winners!



Category A (GRADE 5-6)
1st PRIZE
Keira Lishenpin Mia Yelena
Hampstead Junior School



Category B, (GRADE 7-9)
1st PRIZE
Kandeerally Zahraa
Swami Sivananda SSS



Category C, (GRADE 10-13)
1st PRIZE
Mahamoodally Mushiirah
Swami Sivananda SSS

Nominations Requested

There are several awards that are usually awarded at the CMOS Congress. Nominations are due soon.

CMOS The *President's Prize* is awarded to a Society member or members for a recent paper or book of special merit in the fields of meteorology or oceanography. If for a paper, that paper must have been accepted for publication in ATMOSPHERE-OCEAN, the CMOS Bulletin SCMO or another refereed journal.

CMOS The *François J. Saucier Prize in Applied Oceanography* is awarded to a Society member (or members) for an outstanding contribution to the application of oceanography in Canada .

CMOS The *Neil J. Campbell Award for Exceptional Volunteer Service* is awarded to a Society member for exceptional service to the Society as a volunteer . The award may be made for an exceptional contribution in a single year or for contributions over an extended period. The contribution should have resulted in an important advancement for CMOS and/or its aims, nationally or locally.

CMOS The *J.P. Tully Medal in Oceanography* is awarded to any person whose scientific contributions have had a significant impact on Canadian oceanography.



CMOS-SCMO

Canadian Meteorological and Oceanographic Society
Société canadienne de météorologie et d'océanographie

CMOS The *Tertia M.C. Hughes Graduate Student Prizes* are awarded to graduate students who are, or were within 16 months preceding the nomination deadline, registered at a Canadian university or Canadian students registered at a foreign university for contributions of special merit . The awards are prizes of \$500. for each recipient. There are up to two prizes per year [Note: this is not a scholarship but rather a recognition for previous work.]

CMOS The *Roger Daley Post-Doctoral Publication Award* is granted for excellence of a publication in the fields of meteorology or oceanography that has appeared, or is in press, at the time of nomination. The award is a prize of \$2,000.

The **deadline** for all the above CMOS nominations is **February 15**.

[Information on CMOS awards](#)

DFO The *Timothy R. Parsons Medal* is awarded for distinguished accomplishments in multidisciplinary facets of ocean sciences while working for Canadian Institutions or for the benefit of Canadian science and for excellence during the lifetime of the recipient or for a recent outstanding achievement, both being equally eligible.



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Deadline for nominations **March 31**.

[Information on the Parsons Medal](#)

NSERC Prizes

Brockhouse Canada Prize for Interdisciplinary Research in Science and Engineering recognizes outstanding Canadian teams of researchers from different disciplines who came together to engage in research drawing on their combined knowledge and skills, and produced a record of excellent achievements in the natural sciences and engineering in the last six years. Nomination

deadline: April 1, 2021, 8 p.m. (ET)



Natural Sciences and Engineering
Research Council of Canada

Conseil de recherches en sciences
naturelles et en génie du Canada

Canada



Natural Sciences and Engineering Research Council of Canada

www.nserc-crsng.gc.ca

The Gerhard Herzberg Canada Gold Medal for Science and Engineering is awarded annually for both the sustained excellence and overall influence of research work conducted in Canada in the natural sciences or engineering. Nomination **deadline: April 1, 2021, 8 p.m. (ET)**

The NSERC John C. Polanyi Award honours an individual or team whose Canadian-based research has led to a recent outstanding advance in the natural sciences or engineering. Nomination **deadline: April 1, 2021, 8 p.m. (ET)**

The annual *Synergy Awards for Innovation* recognize examples of collaboration that stand as models of effective partnership between industry and colleges or universities. Nomination **deadline: April 15, 2021, 8:00 p.m. (ET)**

[Details](#)

CMOS Projects Atmosphere and Ocean // Projets Atmosphere et Ocean de la SCMO

In today's heated debate about climate, our teachers need help in the classroom to get the correct knowledge about climate, oceans, the atmosphere and weather to their students. CMOS has a program to help them.

But CMOS needs your help to reach the teachers! Would you please forward this e-mail to your



CMOS
Canadian Meteorological and
Oceanographic Society



SCMO
Société canadienne de météorologie
et d'océanographie

Teacher Summer Workshops

Atmospheric sciences

Ocean sciences

CMOS offers two summer workshops for K-12 teachers with an interest in sciences.
One workshop in Atmospheric Sciences. One workshop in Ocean Sciences.
Only 24 teachers selected each year, with only 1 from Canada for each.
All expenses are paid. A travel subsidy is also included.

**Deadline:
March 15**

Project Atmosphere

National Weather Service Training
Center, Kansas City, Missouri

Project Ocean

Chesterton, Maryland

cmos.ca/site/summerworkshops

In collaboration of the American Meteorological Society (AMS), the US National Oceanic and Atmospheric Administration (NOAA) and the Canadian National Committee/Scientific Committee on Oceanic Research (CNC/SCOR)

local schools, friends and relatives who are teachers inviting them to apply?

Kindergarten to Grade 12 teachers from across Canada are invited to apply. The deadline for application is March 15. One teacher per workshop will be selected by CMOS.

For more information on the workshops, including subsidy details and the application forms, see <http://www.cmos.ca/site/summerworkshops> or e-mail Denis Bourque (see below).

De nos jours où il y a tant de controverse au sujet du climat, nos enseignants ont besoin d'aide dans leur classe pour assurer une bonne connaissance du climat, des océans, de l'atmosphère et de la météo parmi leurs étudiants. La SCMO a un programme à cette fin.

Mais la SCMO requiert votre aide à rejoindre ces enseignants! Pourriez-vous, s.v.p. ,faire parvenir ce courriel à vos écoles locales ainsi qu'à vos ami(e)s ou membres de famille qui seraient enseignants, leur invitant à soumettre leur candidature?

Les enseignant(e)s de la maternelle à la 12ième année (Secondaire 5) sont invité(e)s. La date limite pour la soumission de candidature est le 15 mars. Un(e) enseignant(e) sera choisi(e) pour chaque atelier par la SCMO.



CMOS
Canadian Meteorological and
Oceanographic Society



SCMO
Société canadienne de météorologie
et d'océanographie

Ateliers d'été pour enseignants

Sciences atmosphériques

Sciences océaniques

La SCMO offre deux ateliers estivaux pour enseignants pré-collégiaux. Un atelier en sciences atmosphériques, l'autre en sciences océaniques. 24 enseignants choisis dont un du Canada par atelier. Toutes dépenses payés. Subvention de voyage.

[Note: offerts en anglais seulement.]

Project Atmosphere

National Weather Service Training
Center, Kansas City, Missouri

Project Ocean

Chesterton , Maryland

cmos.ca/site/summerworkshops

En collaboration avec l'« American Meteorological Society (AMS) », la « US National Oceanic and Atmospheric Administration (NOAA) », et le Comité national canadien pour SCOR (CNC/SCOR)

Date Limite:
15 mars

Veuillez consulter http://www.scmo.ca/site/summerworkshops?language=fr_FR& pour plus d'informations sur ces ateliers, les formulaires de candidatures et les subvention. (À noter : le tout est en anglais.)

Vous pouvez aussi communiquer avec Denis Bourque par courriel (voir au bas).

Denis A. Bourque

Awards Coordinator

CMOS Postal address: PO Box 3211 Stn D, Ottawa ON K1P 6H7

Courier address: 200 Kent Street, Ottawa ON K1A 0E6

E-mail: awards-coord@cmos.ca, <http://www.cmos.ca>

Coordinateur des honneurs SCMO

Adresse postale: C.P. 3211, Succursale D, Ottawa, ON K1P 6H7

Adresse messagerie: 200 rue Kent, Ottawa ON K1A 0E6

Courriel: coord-honneurs@scmo.ca, <http://www.scmo.ca>

Canadian Ocean Science Newsletter Le Bulletin Canadien des Sciences de l'Océan

Previous newsletters may be found on the [CNC/SCOR](#) web site.

Newsletter #117 will be distributed in **March 2021**.

Please send contributions to David Greenberg
david.greenberg@dfo-mpo.gc.ca

Subscribing and Unsubscribing

If you wish to subscribe to this newsletter or cancel your subscription, please visit the website:

<http://www.mailman.srv.ualberta.ca/mailman/listinfo/cnc-scor>

Les [bulletins](#) antérieurs se retrouvent sur le site web du [CNC/SCOR](#).

Le Bulletin #117 sera distribué en **mars 2021**.

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

Abonnement et désabonnement

Si vous souhaitez vous abonner à cette newsletter ou annuler votre inscription, veuillez visiter le site web:

<http://www.mailman.srv.ualberta.ca/mailman/listinfo/cnc-scor>

CNC-SCOR

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Le Comité national canadien du Comité scientifique de la recherche océanographique (SCOR) favorise et facilite la coopération internationale. Il reflète la nature multidisciplinaire de la science océanique et de la technologie marine.

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WWW.CNCSCOR.CA