



November 2015

Ocean Science and Climate Change

by Martha Crago and Nikki Macdonald

The Conference of the Parties ([COP21](#)) to the United Nations Framework Convention on Climate Change is taking place in Paris from 30 November to 11 December, 2015.

Decision-makers from across the globe will be coming together to make commitments to reduce the impact of human activity on our global environment. Ocean science will be a critical part of the discussion, recognizing the important role that oceans play, not only in supporting life but also in mitigating some of the effects of climate change.

The purpose of this brief is to provide an introduction to the importance of oceans in climate change and to introduce the coordinating capacity of the Consortium of Canadian Ocean Research Universities (CCORU) as a source of expert advice for Canadian policy makers.

Key Messages:

- The ocean plays a key role for climate and sustaining life on Earth, providing tremendous economic benefits, and helping to feed the 7 billion people on this planet. The ocean has been delaying some of the effects of climate change, by absorbing excess heat and carbon dioxide.
- Although the global ocean has absorbed significant excess heat and carbon dioxide, it has done so at a price. Large volumes of the ocean have warmed measurably and sea ice cover in the Arctic is decreasing significantly. As more and more CO₂ dissolves in the ocean, the capacity of the ocean CO₂ sink becomes less effective and ocean acidification accelerates. Collectively, these impacts of climate change have produced negative changes in ice cover, sea level rise, extreme weather events and ocean acidification, with parallel changes in ocean life.
- Canada, which already experiences obvious impacts of climate change in the North, has a unique and important role to play in understanding the ocean and climate change based on our extensive ocean space, research capacity, ocean economy and history.
- The Consortium of Canadian Ocean Research Universities (CCORU) was formed in 2011 to coordinate ocean science research in universities from coast to coast, unite a body of expertise to provide advice when needed, and create a national voice for Canada's oceans.

What is the relevance of oceans to climate change?

Most people recognize the importance of the ocean, which covers 70% of our planet and holds 97% of our water. The ocean provides fisheries, transport and trade, oil and mineral resources, as well as other ecosystem services including tourism. The upper 2.5 metres of the ocean hold as much heat as the entire atmosphere, and the ocean has absorbed the vast majority of the “added heat” associated with anthropogenic greenhouse gases, resulting in thermal expansion and related sea-level rise. Similarly, the ocean has absorbed over one third of the carbon emissions we have pumped into the atmosphere over the last century. Our planet would be much warmer, much different, and inhospitable to humans as a result of greenhouse gases—without ocean buffering.

Against the backdrop of climate change effects, fish stocks are collapsing, oxygen deficient dead zones are expanding, and pollutants and debris are increasing, with poorly understood cumulative effects on ocean life and ocean processes. Scientists around the world are focused on trying to understand what the oceans of tomorrow will look like, how to better govern use of the ocean and its resources, and how to mitigate the negative aspects of these changes.

How can Canada contribute to the climate change discussions through ocean science?

As stated, Canada has a unique and important role to play in understanding the ocean and climate change. Canada has the longest coastline in the world, spanning three oceans and 12 biologically distinct regions and encompassing vast areas of seafloor. Canada has invested significantly in ocean sciences and must continue to do so. Because of the ocean’s pivotal role, most of the universities in eastern and western Canada, and many in between, have made ocean sciences one of their top research priorities. The result of this focusing of resources and energy is that Canada holds a strong international reputation in ocean science and technology.

Our location also brings responsibility. As stewards of much of the Arctic, Canadians must play a leadership role in understanding the impacts that climate change brings to the Arctic and its connected waters further south.

On the east coast, the Labrador Sea is one of the most important locations in the global ocean for capturing heat from the atmosphere and removing carbon dioxide.

The west coast has seen an unprecedented warming of surface ocean waters in the eastern Pacific dubbed the “warm blob” that, along with the one of the strongest El Niños ever observed, will impact agriculture, fisheries, tourism, and energy production in most of the western provinces over at least the next several years. Understanding and forecasting the impact of these ocean-based phenomena are directly linked to our economy. Sea level rise is impacting all coasts for which an understanding is needed to adapt to this reality.

Climate change may also be exacerbating other ocean-related problems. The Grand Banks once supported one of the most productive fisheries in the world. The collapse of that industry, and the complex story of how overfishing is linked to a changing physical

environment, is now a textbook example of how not to achieve sustainable balance.

Ocean acidification, recent dead zones and ocean warming events threaten important fisheries, marine biodiversity and aquaculture. Given our extensive coastline spanning three oceans, a changing ocean is a challenge for Canada's economy and well being.

With our strong science capacity, Canada can—and must—play a leadership role in addressing the issues surrounding this challenge. One example of this international leadership is Canada's role as host of PICES (www.pices.int), an intergovernmental scientific body established in 1992 to promote and coordinate marine research in the North Pacific and adjacent seas. Canada's academic ocean scientists are also making critical contributions to understanding our changing ocean, and their efforts and expertise are being coordinated by the Consortium of Canadian Ocean Research Universities (CCORU).

Who is CCORU?

The Consortium of Canadian Ocean Research Universities (CCORU) was formed in 2011 to coordinate ocean science research in universities from coast to coast, unite a body of expertise to provide advice when needed, and create a national voice for Canada's oceans. CCORU began by enlisting the Canadian Council of Academies to bring together academic and government experts to identify the 40 most important research questions for Canadian ocean sciences¹. Not surprisingly, the role of the ocean in climate change, and the impacts of climate changes on ocean health featured significantly in these 40 priorities.

CCORU has also worked to unite Canadian, European, and US scientists to share science infrastructure, and coordinate research on large-scale problems such as the ocean and climate change that require collaboration across borders and disciplines.

Finally, CCORU unites leaders across ocean research networks currently funded in Canada to address ocean issues, including climate, and to ensure thought leaders can share ideas and develop a common, multifaceted vision for research on Canada's oceans. In summary, Canada has excellent capacity in ocean sciences and climate research, and CCORU offers the coordinating mechanism.

¹CCA (Council of Canadian Academies) (2012). *40 Priority Research Questions for Ocean Science in Canada*. Ottawa, ON: CCA, The Core Group on Ocean Science in Canada.

http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/oceans_1/oceansworkshopreport_web_en.pdf

²CCA (Council of Canadian Academies) (2013) *Ocean science in Canada: meeting the challenge, seizing the opportunity* / The Expert Panel on Canadian Ocean Science. Canadian Council of Academies.

http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/oceans_2/oceans_fullreporten.pdf

Related reading :

- [the critical role of ocean science in responding to climate change](#)

For more information about CCORU:

Dr. Martha Crago, Vice-President Research, [Dalhousie University](#), Halifax, NS.
Martha.Crago@dal.ca

Nikki Macdonald, Executive Director, Corporate Operations, [Ocean Networks Canada](#), University of Victoria,
Victoria, BC. nikkimac@uvic.ca