Welcome to the Spring/Summer 2019 issue of **THE ZONE**, the CZCA newsletter.

Iqaluit 2020 Conference: Update and Overview of Pre-Conference Planning Workshop

Organized by the Coastal Zone Canada Association and the Marine Environmental Observation, Prediction, and Response Network (MEOPAR)

Iqaluit will host the next CZC conference from from June 14th to the 17th, 2020, at the Frobisher Inn. To get input from individuals living and working in Canada's north, the Steering Committee held a pre-conference planning workshop at the Le Franco-Centre in Iqaluit. Attendees included 20 individuals with broad representation from Inuit organizations, government, ENGOs, academia, and industry. Our attendees did not disappoint! They helped us shape the conference theme and will remain engaged in the organization of the conference. We left with a wealth of information that will be shared in upcoming issues of The Zone and on our website
http://www.coastalzonecanada.org/

Conference theme

Inuit Qaujimajatuqangit (IQ) is founded on four Maligait or natural laws, including: 1) Working for the common good; 2) Protecting all living things; 3) Maintaining balance; and 4) Continually planning and preparing for the future. IQ speaks to the interconnectedness of the world and Inuit society's respect for our place in the universe.

These natural laws are also excellent principles for the sustainable management and protection of our coastal communities and environment.

They have helped us shape the conference agenda and select our conference theme:

"Inuit Qaujimajatuqangit: Planning and Preparing for the Future"

In this issue

THE ZONE

1 Conference Update and Overview of Pre-Conference Planning Workshop

3 Workshop Summary: Climate-Resilient Coastal Natural Infrastructure Workshop & ACCESS 2019

5 Call for pictures

6 Natural and Nature-Based Infrastructure Capacity Building for Engineers, Land Use Planners and Environmental Organizations in New Brunswick (BRACE Project)

Stay tuned for our next issue - a special edition that focuses on Northern Canada

Workshop Attendees representing Inuit Organizations, Government, Academia, Industry and ENGOs

Planning Your Attendance at IQALUIT 2020

SAVE THE DATE: June 14th to 17th, 2020
Never been to northern Canada? Here is your opportunity for a once-in-a-life-time chance to combine professional development and exploration of Nunavut!

THE VENUE-THE FROBISHER INN: A world-class venue in the heart of Iqaluit with breathtaking views of Frobisher Bay. A block of rooms has been reserved and reservation details will be provided in future updates.
https://www.frobisherinn.com/

ALTERNATIVE ACCOMMODATIONS: Iqaluit offers a range of alternative accommodations, including student residences at the Arctic College, a new hotel under construction, and of course Airbnb.

TRAVEL:First Air is our conference airline and will offer discount travel to Iqaluit. Direct flights are available from major hubs across Canada, including Montreal, Ottawa, Winnipeg, and Edmonton. **https://firstair.ca/**

REGISTRATION: We will be posting registration information on our website and our next issue of the Zone

While you are in Iqaluit

EXPLORE AND SHOP IN IQALUIT- A WALKABLE COMMUNITY: No car needed, as Iqaluit is completely accessible by foot! Explore the local shops and artisans, visit the Legislative Assembly of Nunavut, pickup tips from the Information Centres, purchase fresh country food, or simply stroll along the shores of Frobisher Bay! Before long, you will reach the original Hudson Bay settlement established in 1670!

VISIT THE SYLVIA GRINNELL TERRITORIAL PARK: The Arctic Tundra Is Just A Few Steps Away - an easy walk or taxi ride from the Frob, the park offers an abundance of trails to explore the park's wild tundra valley, meandering river, and waterfall. The conference will host two meals at the park's pavilion on Monday and Tuesday evening (June 15th and 16th, 2020). Cast your line in the river and catch the freshest Arctic Char you've ever tasted!


Sylvia Grinnell Pavilion

https://www.nunavuttourism.com/things-to-see-do/parks-special-places/sylvia-grinnell-territorial-park/

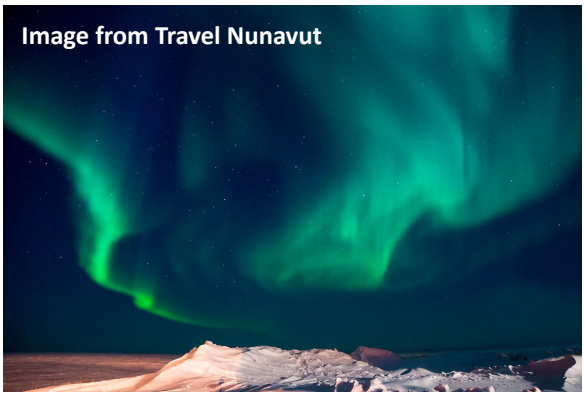


Image from Travel Nunavut

NUBREWCO: Craft Beer Brewed Right in Iqaluit
On your way back from Sylvia Grinnell, stop in at NuBrew, Iqaluit's own microbrewery. We sampled the beers after the workshop, and they were excellent!
http://nubrewbeer.ca/

PRE- AND POST-CONFERENCE TOURS - ADVENTURE AWAITS: The conference will conclude in the afternoon on Wednesday June 17th, leaving the remainder of the week to sign up for a host of special excursions and tours. Explore the links below and start planning now for this amazing opportunity to explore Nunavut!
https://www.nunavuttourism.com/
http://destinationnunavut.ca/


NuBrewCo

Original Hudson Bay settlement established in 1670


Image from Travel Nunavut

Workshop Summary: Climate-Resilient Coastal Natural Infrastructure Workshop & ACCESS 2019

Joint-Event Hosted by: TransCoastal Adaptations: Centre for Nature-Based Solutions
May 6-10, 2019 | Halifax, Nova Scotia

Truro managed dyke realignment site

The Cold Regions Living Shorelines Community of Practice (CRLS CoP) and the Atlantic Canada Coastal & Estuarine Science Society (ACCESS) successfully united 120 coastal practitioners for the Climate-Resilient Coastal Natural Infrastructure Workshop & ACCESS 2019 joint-event which took place from May 6-10 at Saint Mary's University in Halifax, Nova Scotia. This 7-day joint-event boasting 85 presentations kicked-off with a 2-day field trip from May 4-5 to 3 managed dyke realignment sites across NS and NB for knowledge-mobilization and skills-transfer around the dynamics of the Bay of Fundy and the phases of managed dyke realignment process.

Click on the image below to see a selection of speaker presentations! (Registration for the Cold Regions Living Shorelines Community of Practice required to access the slides

CRLS CoP
Cold Regions Living Shorelines
Community of Practice

Throughout the Climate-Resilient Workshop, speakers and attendees engaged in productive discussions focused on defining success & developing frameworks, collaborations & cross-disciplinary boundaries, barriers & drivers to nature-based adaptations (NbA), coastal geomorphology & engineering perspectives, successes, challenges & problem solving, capacity building, knowledge gaps, research needs & opportunities, tools & technology, communicating with stakeholders & communities, and Indigenous-led perspectives. While ACCESS presenters spoke to coastal habitat restoration & climate change adaptation, climate change adaptation and mitigation: tools & technology, estuarine science, and coastal systems & climate change. To access all of the presentations, please register on the Cold Regions Living Shorelines Community of Practice website for free.

Brian McFall, PhD, PE, Civil Research Engineer with the U.S. Army Engineering Research and Development Center (ERDC) introduced the Climate-Resilient Coastal Natural Infrastructure Workshop as the keynote speaker, highlighting the USACE Engineering With Nature® (EWN®) project portfolio. Attendees were later honoured by special guest, Patricia Fuller, Canada's Climate Change Ambassador, who delivered important messaging around Canada's international leadership on climate change and the role of natural infrastructure. Registrants and public met during the Free Public & Practitioner Tech-Vendor Trade Show for NbA poster sessions and vendor conversations. The 3-day workshop concluded with Roger Lewis, Curator of Ethnology at the Nova Scotia Museum of Natural History, and Ursula Johnson, Multidisciplinary Mi'kmaq Artist, who provided crucial Indigenous perspectives around nature-based approaches to climate change.

Aulac managed dyke realignment site

Aulac managed dyke realignment site

Tech-Vendor Trade Show

Panel Discussion

Dr. Ariana Sutton-Grier, Director of Science with The Nature Conservancy was the distinguished CERF keynote speaker for ACCESS 2019, May 9-10, enlightening audiences on green infrastructure and blue carbon and using science to inform management, policy and decision making. ACCESS Student Awards were generously provided by Hoskin Scientific to Graeme Matheson, Rebeca Linhart, and Jiali Gu for their outstanding presentations.

Overall, the CRLS CoP gained a bounty of insights related to the factors that shape the uptake of NbA as a practical alternative to hard infrastructure, lessons learned in the design, implementation, and planning phases of NbA, barriers and enablers to implementation of NbA, opportunities for collaborations, and persistent knowledge gaps.

Stay tuned for details on upcoming events, sharing of outcomes from the conference in Halifax, and other knowledge sharing and capacity building opportunities from the Cold Regions Living Shorelines Community of Practice.

This joint-event would not have been possible without generous support from Natural Resources Canada, Saint Mary's University, CERF (Coastal & Estuarine Research Federation), Hoskin Scientific, CBCL Limited, CB Wetlands & Environmental Services (CBWES Inc.), and our trade show sponsors (Confederacy of Mainland Mi'kmaq, Helping Nature Heal, Ducks Unlimited Canada, Clean Foundation, Canadian Integrated Ocean Observing System Atlantic (CIOOS-Atlantic), Pro-Oceanus, Dr Drone, ROMOR, VEMCO (InnovasSea Systems), NSCC Nautical Institute, and Tensar). With special thanks to TransCoastal Adaptations: Centre for Nature-Based Solutions, for hosting this remarkable event.

Until next time!

Co-Chairs
Jeffrey K. King, Ph.D., P.E.
Danker Kolijn, PEng., M.Sc., M.Eng
Phil Osborne, Ph.D., P.Geo.
Article contributions by Lydia Ross.
Contact: dkolijn@cbcl.ca

Brian McFall, PE, PhD, USACE Keynote Speaker

GET IN THE ZONE

Submit your news items for the next issue of The Zone. We wish to continue the dialogue of coastal zone work across Canada between our biennial conferences, so please consider sharing an update with us to be included in the next issue.

News Items

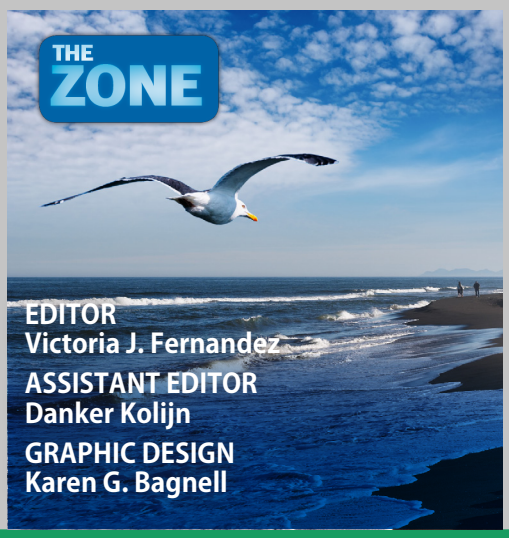
To submit a news item (maximum 500 words) please send to thezone@coastalzonecanada.org

Subscribe to THE ZONE

Follow this link:

www.coastalzonecanada.org/newsletter

We would like to sincerely thank all of the contributors to this edition of the Zone, the authors of the papers and articles herein, as well as the reviewers.



CALL FOR PAPERS

Please consider submitting a paper to the next issue of the CZCA Newsletter. We are looking for paper submissions of 1000-2000 words on a wide range of topics covering Canada's coastal zone: governance and policy, engineering, ocean science, and social science.

If you wish to submit a paper please submit your abstracts (maximum of 250 words) to thezone@coastalzonecanada.org by October 15, 2019. Papers are due November 15, 2019.

Image from Travel Nunavut

Call for pictures! Please send your best coastal related shots to:
thezone@coastalzonecanada.org

Call for French Editors

The Zone is looking for French speaking or bilingual (French and English) volunteer editors. For further information please contact us at **thezone@coastalzonecanada.org**

CZCA Membership

Registration at the biennial conferences automatically includes CZCA membership dues for two years. If you missed the 2016 conference and would like to update your membership or become a new member, please visit our website for more details. The fee is $20/year or $40 for two years.
www.coastalzonecanada.org

Natural and Nature-Based Infrastructure Capacity Building for Engineers, Land Use Planners and Environmental Organizations in New Brunswick (BRACE Project)

Sabine Dietz[1], Adam Cheeseman[2], Raissa Marks[3], Surabhi Sheth[4]

Overview

Land use planners, engineers and environmental organizations in New Brunswick have long been engaged in adaptation projects. Each of these sectors plays a different role in adaptation and faces different challenges and barriers. The project, funded by NRCan, addresses this gap by bringing together land-use planners, engineers and environmental non-governmental organizations (NGOs) to build their capacity to collaborate and to use natural and nature-based infrastructure. The project focuses on natural infrastructure (e.g. conservation and restoration of natural systems) as it is generally cheaper, easier to implement, has lower maintenance costs than engineered infrastructure; and is of interest to all three sectors. Over the next three years, the project will implement a community of practice, link various initiatives that deal with natural and nature-based infrastructure*, provide professional learning opportunities and develop education materials to increase our collective knowledge and expertise on this approach.

Project scan

As a part of the project, Nature NB has conducted a scan of 90 different natural infrastructure and nature-based adaptation projects to identify different initiatives as well as common approaches and challenges. Sixty in-person and telephone interviews were conducted with engineers, planners, NGOs and academics from New Brunswick, Nova Scotia, Prince Edward Island and beyond. Out of these 90 projects, 77 are from Atlantic Canada, 54 of which are from New Brunswick. The project information was compiled in an Excel data base and map, which will be available online as part of a web-based community of practice in the coming months. The projects are divided into different categories including conservation, planning, stormwater management, capacity building, wetlands, living shorelines and education. The project scan will be updated based on information collected from new and existing projects happening across Atlantic Canada.

Community of Practice (CoP):

Recognizing the need for peer-to-peer learning and information sharing across sectors on natural and nature-based infrastructure, a web-based CoP will be established as part of the project. Some of the key elements to be included in the CoP are learning opportunities, webinars, list of projects (from the scan), discussion forums and informational materials. The goal of the online CoP is to have important web resources located centrally.

Learning opportunities

As a part of the project, Nature NB has conducted a scan of 90 different natural infrastructure and nature-based adaptation projects to identify different initiatives as well as common approaches and challenges. Sixty in-person and telephone interviews were conducted with engineers, planners, NGOs and academics from New Brunswick, Nova Scotia, Prince Edward Island and beyond. Out of these 90 projects, 77 are from Atlantic Canada, 54 of which are from New Brunswick. The project information was compiled in an Excel data base and map, which will be available online as part of a web-based community of practice in the coming months. The projects are divided into different categories including conservation, planning, stormwater management, capacity building, wetlands, living shorelines and education. The project scan will be updated

Conclusion

The role of the project is to primarily focus on building the capacity of engineers, land use planners and NGOs to use natural and nature-based infrastructure to address climate change impacts. Education and external communications are an integral part of the project and in collaboration with the Maritime Natural Infrastructure Collaborative (MNIC, www.planwithnature.ca), stakeholders will have better access to information about natural and nature-based infrastructure projects. In implementing and sharing information about multiple projects of this nature, lessons learned can be shared, and the Community of Practice can easily be expanded across other provinces.

For more information on this project please contact Surabhi Sheth at surabhi.sheth@nben.ca

** We refer to nature-based infrastructure as created systems that resemble natural systems and become systems that function naturally, and natural infrastructure as existing ecosystems that provide many diverse functions including, e.g., flood risk reduction services. Natural infrastructure is defined as "strategic use of networks of natural lands, working landscapes, and other open spaces to conserve ecosystem values and functions and provide associated benefits to human populations" (Allen, 2014).*

References and Resources

IISD. s.d. Natural Infrastructure. Retrieved from:

https://www.iisd.org/topic/natural-infrastructure

Allen, W. (2014). The Conservation Fund (referenced in World Resources Institute, Natural Infrastructure - Investing in Forested Landscapes for Source Water Protection in the United States) . Retrieved from:

https://wriorg.s3.amazonaws.com/s3fs-public/wri13_report_4c_naturalinfrastructure_v2.pdf

---

[1]Environment and Climate Change Adaptation Consultant, Aster Group, sabine.dietz@astergroup.ca

[2]Program Coordinator, Nature NB, climate@naturenb.ca

[3]Executive Director, New Brunswick Environmental Network, raissa.marks@nben.ca

[4]Project Coordinator, New Brunswick Environmental Network, surabhi.sheth@nben.ca

Improved Characterization of Waves and Coastal Flood Hazards in New Brunswick and Canadian Coastal Waters

E. Murphy[1], V. Pilechi[1], J. Cousineau[1], J. Boisvert[2], R. McLean[2], L. Sushama[3], Z. Liang[3], A. Cornett[1]

Introduction

Canada's coastal communities, infrastructure and ecosystems are vulnerable to flood hazards under present-day conditions[9]. There is high confidence that the frequency and magnitude of extreme high water level events contributing to flooding will increase across much of Canada's coasts[8], as a consequence of relative sea level rise and declining sea ice cover. The confidence in projections of extreme wind, waves and storm surges is somewhat lower; but there is broad consensus that Canada faces escalating coastal flood risks in coming decades. New Brunswick is not exempt from this threat, and frequently experiences coastal flooding. Coastal communities and infrastructure in the province are vulnerable to flood hazards associated with tides, extreme storm surges, wave and coastal erosion events. Without intervention, it is anticipated that rising sea levels will lead to increases in the frequency and severity of coastal flooding in the future. Developing reliable, province-wide predictions of areas affected by extreme flooding events is an important step towards flood risk mitigation, climate change adaptation and enhanced community resilience.

Extreme sea level predictions are available for parts of the New Brunswick coast[4]. However, a complete set of coastal flood hazard maps based on a consistent mapping methodology does not yet exist. New Brunswick's Flood Risk Reduction Strategy[6] and Climate Change Action Plan[7] call for the renewal and expansion of the province's coastal and inland flood hazard maps, motivating the establishment of the Coastal Flood Hazard Mapping project. Under the Coastal Flood Hazard Mapping project, the province has funded studies to evaluate future extreme sea levels, including allowances for tides, extreme storm surges (atmospheric pressure setup and wind setup), and projected relative sea level rise to the year 210014. A set of 14 coastal flood hazard zones were identified, based on spatial variations in tides and storm surges (Figure 1). Wave-related contributions to the total extreme water levels (such as wave run-up) were excluded from this initial analysis.

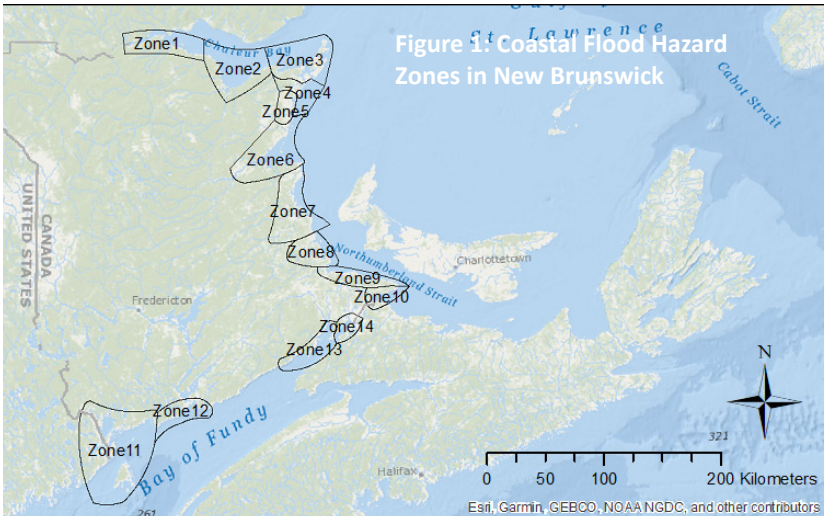


Figure 1: Coastal Flood Hazard Zones in New Brunswick

Regional Wave Run-Up Study for New Brunswick

To better characterize wave run-up contributions to coastal flood hazards across the province, a regional wave run-up analysis was carried out. The analysis involved developing estimates of nearshore extreme (storm) waves and associated wave run-up heights for the 14 identified coastal flood hazard zones.

A statistical analysis of extreme (storm) wind and wave conditions in New Brunswick offshore waters was conducted. The analysis relied on the Meteorological Service of Canada and Oceanweather (MSC50) hindcast dataset[15], which provides time series data on a 0.1°-resolution grid at hourly intervals for 21 wind and wave parameters, derived from a reanalysis of historical surface winds and waves off the east coast of Canada for the period 1954-2015.

Offshore extreme wave conditions in the Gulf of Saint Lawrence and the Gulf of Maine were transformed to the New Brunswick nearshore using SWAN (Cycle III version 41.20A), a third-generation numerical model that computes the propagation of random, short-crested wind-generated waves in coastal regions and inland waters[1,11]. Nearshore wave conditions resulting from extreme winds blowing over local fetches were also investigated. Two systems of nested SWAN wave transformation models were set up; one covering the Bay of Fundy and extending offshore to the Gulf of Maine (referred to as the Southern Region), and one covering the Gulf of Saint Lawrence offshore region (Northern Region). The models were set up using an uncoupled nested approach, whereby a series of rectangular grids (300-500

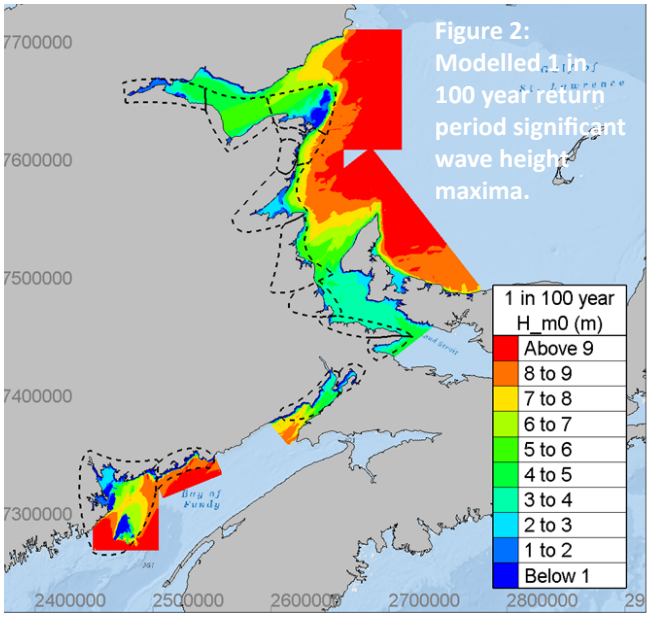
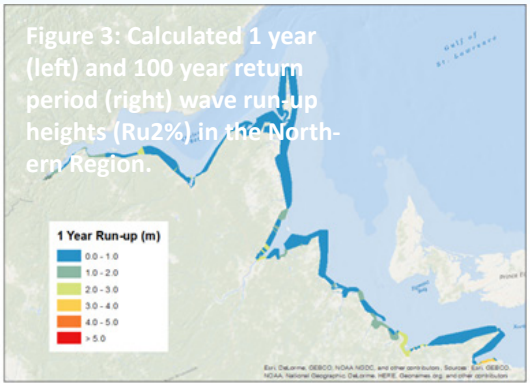


Figure 2: Modelled 1 in 100 year return period significant wave height maxima.



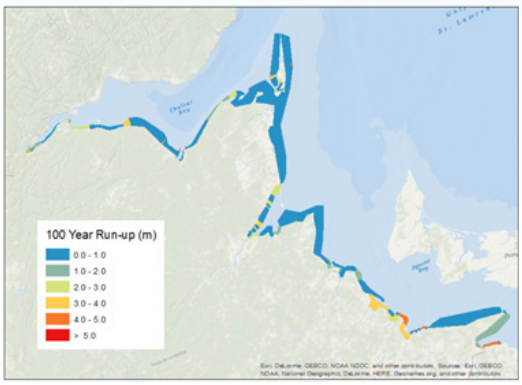
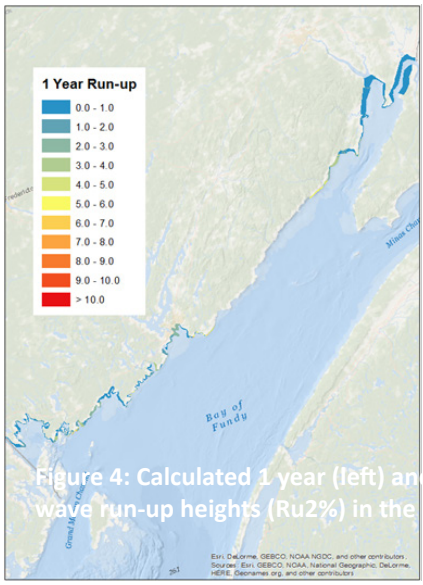


Figure 3: Calculated 1 year (left) and 100 year return period (right) wave run-up heights (Ru2%) in the Northern Region.

m resolution) were used to generate boundary conditions for input to successively finer resolution (100 m) grids (Figure 2). The models incorporated topography and bathymetry data from various sources, including high resolution (1 m) LiDAR data covering much of the New Brunswick coast (https://geonb.snb.ca/li/), and multi-beam bathymetric survey data, obtained under license from the Canadian Hydrographic Service for the study. The models were calibrated by simulating a series of storms and comparing model output parameters (significant wave heights and peak wave periods) with available wave buoy data from Fisheries and Oceans Canada (MEDS) online archives.

Output from the regional wave transformation modelling (e.g. Figure 2) was used as the basis for evaluating extreme wave run-up heights (above the still water level) in each of the 14 coastal flood hazard zones. The methodology for evaluating wave run-up involved two principal steps:

1. Classification of the New Brunswick shoreline to define wave run-up sub-zones. The 14 identified coastal flood hazard zones were sub-divided into wave run-up sub-zones, categorized based on slope (mean backshore slope within 200 m of the coast) and surficial material type (e.g. rock, sand and gravel, clay and silt). Geospatial information on backshore slope and materials was obtained from the CanCoast database[10], and available satellite imagery. Six distinct shoreline classification types were established, resulting in a total of 614 sub-zones; and
2. Application of empirical formulae to calculate wave run-up. For each sub-zone, wave run-up associated with the 1 and 100 year return period wind/wave conditions was estimated using an appropriate empirical formula, selected based on the shoreline classification type. Calculated wave run-up heights for each sub-zone (Figures 3 and 4) were expressed in terms of 2% run-up limits (Ru2%).



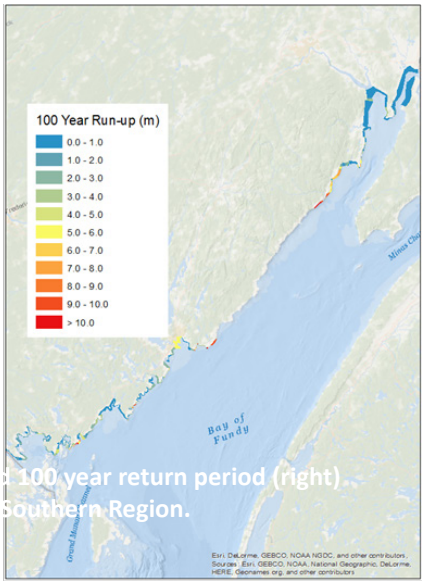


Figure 4: Calculated 1 year (left) and 100 year return period (right) wave run-up heights (Ru2%) in the Southern Region.

The extreme wave run-up heights shown in Figures 3 and 4 are regional estimates, based on nearshore extreme wave conditions and shore types (slope and physical features) characteristic of each identified sub-zone. They represent wave run-up heights associated with the predominant shore type in each sub-zone. Localized differences in shore conditions, the presence of structures, and changes in morphology may result in actual wave run-up values that are higher or lower than the estimates. In addition, where run-up heights exceed the crest height of structures or dikes, wave overtopping will occur and may exacerbate flooding.

The output from the study was used to inform coastal flood hazard mapping for the province and to support the development of a web-based data visualization tool, to facilitate improved public awareness of coastal flood hazards. The web-based map application, which will be publicly accessible, is intended to inform coastal flood risk management and climate change adaptation efforts in New Brunswick. Further results and details of the regional wave run-up study are presented in Cousineau et al.[3] and Murphy et al.[11]. These include discussions of model calibration, validation, and sources of uncertainty.

Future Research and Data Needs

To date, much of the research directed towards understanding the impacts of climate change on coastal flood hazards in Canada has emphasized the role of long-term, climate-driven sea level change. Work is needed to address the low confidence in future projections[8] of many dynamic metocean climate parameters in Canadian oceanic waters, to enable improved characterization of coastal flood hazards. In combination with relative sea level rise, dynamic contributions to coastal water levels can disproportionately increase the frequency and extent of flood exposure[1]. Enhanced, multi-disciplinary collaborations are necessary to ensure advances in climate science lead to meaningful and useful information to support strategic decision-making and climate change adaptation. Recently, the National Research Council Canada has been collaborating with researchers at McGill University to investigate the potential to apply downscaled Canadian Regional Climate Model (CRCM5) projections to evaluate climate change impacts on wave conditions in New

Brunswick coastal waters. Similar approaches are being investigated for British Columbia coastal waters, where the National Research Council Canada is working with transportation asset owners and operators to develop a new database detailing the impacts of climate change on extreme storm surges and waves[12], as well as a new user-friendly interactive visualization tool designed to make the data easily accessible to stakeholders. This research is being funded by Transport Canada, through the Transport Asset Risk Assessment (TARA) initiative.

Coastal flood hazards and risk assessments in Canada are often limited by the assumption that bathymetry and topography remains stationary. During intense storm events, significant seabed deformation, erosion, breaching of beaches and shore protection structures (such as seawalls), and other morphological changes can occur, altering the incident wave conditions, wave run-up/overtopping performance, and potential for flooding. Longer term changes in coastal morphology affect both hydrodynamic processes in nearshore areas, and direct exposure to coastal flood hazards. The importance of including coastal change in flood hazard assessments is increasingly being recognized and understood, with concrete examples demonstrating the benefits1. Significant effort is needed to address current model limitations, and to enable improved use of multi-scale (Global-Regional-Local), physics-based numerical models (or systems of models) for assessing coastal flood hazards in Canada. The availability of long-term, high-quality metocean and coastal zone field measurements is a fundamental prerequisite to support improved characterization of coastal flood hazards and risks in Canada, and many other applications.

Acknowledgments

The regional wave run-up study for New Brunswick was funded by New Brunswick Department of Environment and Local Government with contributions from the National Disaster Mitigation Program, and supported by the National Research Council's Marine Infrastructure, Energy and Water Resources Program. The authors wish to thank Gavin Manson and Thomas James (Geological Survey of Canada), Dominique Berube (New Brunswick Department of Energy and Resource Development), Carrie Brayall (Canadian Hydrographic Service), and Bruce Bradshaw (Fisheries and Oceans Canada) for sharing insights and data.

[1]National Research Council Canada
[2]New Brunswick Department of Environment and Local Government
[3]McGill University

References

1. *Barnard, P.L., Erikson, L.H., Foxgrover, A.C., Hart, J.A.F., Limber, P., O'Neill, A.C., van Ormondt, M., Vitousek, S., Wood, N., Hayden, M.K. and Jones, J.M., 2019. Dynamic flood modeling essential to assess the coastal impacts of climate change. Scientific reports, 9.*
2. *Booij, N., Ris, R. C., and Holthuijsen, L. H. 1999. A third-generation wave model for coastal regions 1. Model description and validation, J. Geophys. Res., 104(C4): 7649-7666.*
3. *Cousineau, J., Pilechi, V., and Murphy, E. 2018. Regional Wave Run-Up Study for the Province of New Brunswick. National Research Council Canada Report, OCRE-TR-2018-026, Ottawa, Ontario, 81 pp.*
4. *Environment Canada. 2006. Impacts of Sea-Level Rise and Climate Change on the Coastal Zone of Southeastern New Brunswick.*
5. *EurOtop II, Manual on Wave Overtopping of Sea Defences and Related Structures. An Overtopping Manual Largely Based on European Research, but for Worldwide Application., 2016.*
6. *Government of New Brunswick. 2014. New Brunswick's Flood Risk Reduction Strategy.*
7. *Government of New Brunswick. 2016. New Brunswick Climate Change Action Plan.*
8. *Greenan, B.J.W., James, T.S., Loder, J.W., Pepin, P., Azetsu-Scott, K., Ianson, D., Hamme, R.C., Gilbert, D., Tremblay, J-E., Wang, X.L. and Perrie, W. (2018): Changes in oceans surrounding Canada; Chapter 7 in (eds.) Bush and Lemmen, Canada's Changing Climate Report; Government of Canada, Ottawa, Ontario, p. 343–423.*
9. *Lemmen, D.S., Warren, F.J., James, T.S. and Mercer Clarke, C.S.L. editors (2016): Canada's Marine Coasts in a Changing Climate; Government of Canada, Ottawa, ON, 274p.*
10. *Manson, G. K., Coutoure, N., Forbes, D., Fraser, P., Frobel, D., James, T., Jenner, K., Lemmen, D., Lynds, T., Smith, C. and Szlavko, B. 2012. CanCoast: a national framework for characterising Canada's marine coasts, Coastal Zone Canada Conference, Rimouski.*
11. *Murphy, E., Boisvert, J., McLean, R., Pilechi, V., Cousineau, J., Sushama, L., Liang, Z. (In Press). Wave Run-Up Contributions to Coastal Flood Hazards in New Brunswick. Canadian Society for Civil Engineering Annual Conference, June 12-15, Laval, QC.*
12. *Rahman, A., Murphy, E., Cornett, A. (Abstract Accepted) Numerical Investigation of Climate Change Effects on Storm Surges and Waves in British Columbia Coastal Waters. IAMAS/IAHS Symposium on Hydrometeorologic and coastal extremes in current and future climates, Montreal, 9 July 2019.*
13. *Ris, R. C., Holthuijsen, L. H., and Booij, N. 1999. A third-generation wave model for coastal regions 2. Verification, J. Geophys. Res., 104(C4): 7667-7681.*
14. *R.J. Daigle Enviro. 2017. Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections.*
15. *Swail, V. R., Cardone, V., Ferguson, M., Gummer, D., Harris, E., Orelup, E., and Cox, E. 2006. The MSC50 Wind and Wave Reanalysis, 9th International Workshop on Wave Hindcasting and Forecasting.*