# Theme 2: Advances in meteorology, weather observation and forecasting

## 210 In situ measurement of precipitation and snow cover: advances, challenges, and ongoing issues

Convenors: Craig D. Smith, Eva Mekis, Michael Earle, (ECCC)

Precipitation is a critical component of the hydrological cycle and is a fundamental observation for water resource and flood forecasting, climate monitoring, and numerical weather prediction and verification. Reliable in situ measurements with known uncertainties are crucial for identifying and characterizing the impacts of climate change, even as remote sensing techniques continue to develop and improve. This session will solicit submissions on the in situ measurement of snow cover parameters (such as snow depth and snow water equivalent) and all phases of precipitation, including but not limited to: 1) emerging observation techniques (such as non-catchment precipitation measurements); 2) precipitation gauge transfer function development and application; 3) challenges with existing observing networks; 4) instrument performance issues; 5) post-measurement data processing and quality control; and 6) future opportunities.

## 220 Canada and the UN Decade of Ocean Science for Sustainable Development

Convenors: Andrea White (Fisheries and Oceans Canada), Helen Joseph (HCJ Consulting)

The United Nations (UN) General Assembly proclaimed the UN Decade of Ocean Science for Sustainable Development (2021-2030) in December 2017. The Ocean Decade offers a once-in-a-lifetime opportunity for all ocean stakeholders to apply critical ocean science and knowledge to reverse the cycle of decline in ocean health and ensure ocean science can fully support countries in achieving the sustainable development of ocean. Under the framework of the Ocean Decade, scientists and stakeholders from all relevant sectors will convene to generate scientific knowledge, enhance infrastructure and partnerships, and bridge the science-policy interface to support a well-functioning, productive, safe, resilient and sustainable ocean - the Ocean We Need for the Future We Want. Under UNESCO's Intergovernmental Oceanographic Commission (IOC)'s leadership, an Implementation Plan for the Ocean Decade has been prepared with input from around the globe. This session will provide an overview of the areas of focus being undertaken within the Ocean Decade at a global level, examples of Canadian activities contributing to the Ocean Decade, and how you can become involved.

## 230 Atmospheric Rivers and Extratropical Cyclones: Dynamics, Classification, and Prediction

Convenors: Rita So (Environment and Climate Change Canada), Stephen Déry (University of Northern British Columbia), Melinda (Mindy) Brugman (Environment and Climate Change Canada)

An atmospheric river (AR) can be generally defined as a long, narrow, and transient corridor of strong horizontal water vapour transport that is typically associated with a low-level jet stream ahead of the cold front of an extratropical cyclone (EC). Each AR-related storm event may be composed of one or more ECs and can produce heavy precipitation when they are forced upwards by mountains or frontal

lifting, which can also lead to severe floods, landslides, and/or avalanches depending on the overall regional sensitivities due to land use, snow cover and antecedent moisture conditions. At times, an EC behind a passing AR can generate a strong wind storm to further worsen conditions. Although scientific understanding of ARs and the associated cyclones has advanced to a remarkable extent in the past decades, accurate operational forecast and communication of the systems and potential hazards remain challenging. This session focuses on various issues of ARs and ECs, including their mutual coupling and feedback mechanisms, thermodynamic responses to climate change, statistical-dynamical forecast methods, tracking algorithms, and classification schemes. Abstracts related to the intraseasonal-to-seasonal variability of ARs/ECs and extreme event case studies are also encouraged.

## 240 Severe Storms and Associated Hazards

Convenors: Dr. David Sills (Western University), Dr. John Hanesiak (University of Manitoba)

Of the top ten most costly natural disasters in Canada, eight were caused by severe storms. Of those, four resulted in losses of over a billion dollars – and three of those occurred in the last decade. Climate change is expected to only increase the probability of such disasters occurring in the future.

This session will be dedicated to severe storms and associated hazards in Canada and abroad over all seasons, ranging from synoptic-scale storms to warm season mesoscale convective systems and supercells. The goal of the session is to highlight new insights that improve our physical understanding and prediction capabilities for such events. Examples include, but not limited to, tornadoes and tornadic storms, storms that produce severe wind, hail, and/or flash flooding, and snow and ice storms. We will be emphasizing research that seeks to answer specific scientific questions rather than provide general overviews of a topic.

It is expected that there will be one 30-min invited presentation to lead off the session.

## 250 General Session - Weather

Convenor: TBA

This session will include contributions related to weather that do not fit into any of the other sessions.

# Theme 3: Arctic change

## 310 Changing Arctic: Science and Policy Studies

Convenors: David Fissel (ASL Environmental Sciences Inc.), Helen Joseph (HCJ Consulting)

This interdisciplinary session will present emerging scientific results on the rapidly changing physical environment of the Canadian Arctic, over the past few decades. The underlying causes of these changes, in terms of the cryosphere, oceanography, hydrology and meteorology, are being addressed through observational- and modeling-based research. Papers will be presented on the changes in the Arctic environment, and their underlying causes. The results of the scientific studies will be relevant to developing policies, including those on the ecosystem, the Indigenous peoples of the Arctic, and commercial activities including shipping. Papers are sought from research and science activities in the following areas: (i) Arctic Meteorology and Climate; (ii) Arctic Oceanography; (iii) the Cryosphere including sea ice, glaciers, terrestrial and marine snowfall and snow accumulation; (iv) interdisciplinary papers on Arctic Ecosystems and (v) policy papers on the Human Dimension of the Changing Arctic.

## 320 The Changing Arctic Ocean

Convenors: Stephanie Waterman (University of British Columbia), Mary-Louise Timmermans (Yale University)

The Arctic region is undergoing the most rapid climate changes on Earth, with unprecedented atmosphere and ocean temperature increases, and melting sea ice, permafrost, glaciers and snow. The ocean is a focal point of change, with warming, freshening, and circulation changes that link to the sea ice, atmosphere, and land. It is imperative to evaluate our present understanding of how the Arctic Ocean works and how it is changing in order to address knowledge gaps and make viable future predictions.

This session invites submissions that investigate physical Arctic Ocean processes. We encourage studies that encompass observational, theoretical and numerical approaches to better understand the Arctic Ocean in a changing climate.

## 330 Environmental monitoring and observation at high latitudes and high altitudes: challenges, solutions and opportunities

Convenors: Michael Allchin (University of Calgary), Ravi Sankar (University of Calgary)

Amplification of atmospheric warming at high latitudes and high altitudes is already impacting natural and human systems, shifting baseline climatologies, and altering the frequency and magnitude of extreme meteorological events. However, understanding of trends affecting specific components of climatological, hydrological, ecological and socio-economic systems, and of the potential for interactions between them, is often hampered by a paucity of long-term high-quality data. Many parts of the North and mountainous regions are difficult to access, hindering the tasks of installing and servicing instrumentation arrays, and substantially increasing logistical overheads. Consequently, datasets are often relatively short, locally-focused, and of limited scope.

This session will provide a forum for discussion of all aspects of the challenges associated with the observation and monitoring of high-latitude and/or high-altitude environments (including, but not limited to, those focusing on meteorological phenomena). We invite presentations describing hurdles encountered, solutions developed, and future opportunities identified. The session's scope is intended to be broad: topics might include, for example, the benefits and pitfalls of combining ground and remotely-sensed observations; approaches for integrating 'other ways of knowing', including indigenous ecological and meteorological knowledge, with conventional scientific methods; options for incorporating data-gathering through 'citizen science' participation; best practices for encouraging universally high standards of data stewardship (e.g. FAIR principles, CARE principles for Indigenous Data Governance), thereby treating data as an asset rather than a raw material; avenues for developing frameworks within which to share the burden of gathering and curating data among a broader base of potential end-users; and consideration of how progress might be made towards a full digital twinning of key environmental contexts. We encourage consideration of 'outside-the-box' approaches: our goal is to provide an opportunity for constructive discussion of novel ideas which will help to advance understanding of changing influences and responses in these fascinating landscapes.

## 340 The Changing Arctic Atmosphere

Convenors: Patrick L. Hayes (University of Montreal), Rachel Chang (Dalhousie University), James King (University of Montreal), William Ward (University of New Brunswick)

The Arctic atmosphere is changing rapidly. These changes are observed over various timescales in atmospheric composition, sea-ice extent, interactions with lower latitudes, and atmospheric inputs from land, snow, ice and oceans. Furthermore, understanding the changing Arctic atmosphere during both the summer and winter is an essential part of understanding the global atmospheric system. However, measurements within this harsh environment are especially challenging and sparse measurement coverage, temporally and spatially, means our understanding of this important region of the atmosphere is limited.

This session addresses the radiative, chemical, and transport processes which influence the Arctic atmospheric. Thus, submissions on all aspects of the Arctic atmosphere are welcomed, including new instruments, new measurements, new sites, and new modelling efforts, with an emphasis on new insights into this complex and important atmospheric system. Submissions could cover processes from the ground to the mesopause. Of particular interest is the sensitivity of the Arctic region to changes in inputs/emissions that result in large effects when amplified through feedback mechanisms as well as the impact of an annual polar light/dark cycle, in contrast to a daily cycle, on radiative processes and the energy balance of the Arctic atmosphere.

## 350 General Session - Arctic

Convenor: TBA

This session will include contributions related to Arctic that do not fit into any of the other sessions.

# Theme 4: Biogeochemistry

## 410 Multi-scale impacts of sea ice on Arctic Ocean biogeochemistry

Convenors: Birgit Rogalla (University of British Columbia), Johanna Länger (University of Victoria), Christina Braybrook (University of Calgary), Kristina Brown (Department of Fisheries and Oceans, Canada)

One of the most prominent effects of climate change in the Arctic Ocean is the reduction in sea ice, which has important implications for both ocean dynamics and biogeochemical cycles. Arctic sea ice impacts the biogeochemistry of the surface ocean on multiple spatial scales, for example, it modulates stratification, availability of light, and air-sea gas exchange, as well as the transport and supply of materials from the shelf seas into the central basins. However, linking studies of specific processes within this complex system remains a challenge, limiting a holistic view of the Arctic Ocean response to ongoing change. To address this challenge will require a combination of available techniques and increased communication between scientific communities to improve our understanding of the cascading impacts of sea ice changes to ocean biogeochemistry.

From the smallest interactions to large scale features, this session invites contributions from a variety of perspectives, including direct and remote observations, mechanistic and predictive models, and conceptual representations that advance our understanding of the impacts of continued change to the Arctic sea ice system on ocean biogeochemical cycles. We encourage submissions that help quantify and characterize these impacts, including but not limited to: small-scale process studies, combined observation-modelling studies, laboratory experiments, the sea ice carbon pump, trace metal cycling, and numerical models. We hope this session will facilitate conversations across the sea ice and ocean biogeochemistry community and will encourage combined approaches to these questions.

## 420 General Session - Biogeochemistry

Convenor: TBA

This session will include contributions related to Biogeochemistry that do not fit into any of the other sessions

# Theme 5: Circulation in large lakes and the oceans

## 510 Coastal Oceanography and Inland Waters

Convenors: Guoqi Han (Fisheries and Oceans Canada), Jinyu Sheng (Dalhousie University)

This special session will focus on all aspects of observing and modelling physical and biogeochemical processes in coastal domains, shelf seas, estuaries and inland waters. Topics include but are not limited to coastal physical oceanography, storm surges, tsunamis, estuarine dynamics, hydrology and hydrodynamics of large lakes, mixing and dispersion of materials. Contributions related to both observational and modelling aspects of biogeochemistry in coastal and inland waters are also welcome.

## 520 General Session - Oceans

Convenor: TBA

# Theme 6: Climate change from seasons to centuries

## 610 Climate Variability and Predictability

Convenors: Bin Yu (ECCC), Hai Lin (ECCC)

This session invites contributions that deal with climate variability and predictions on subseasonal, seasonal, interannual and decadal-interdecadal time scales. Contributions are solicited on topics including studies of the Madden-Julian Oscillation (MJO) and tropical waves, El Nino/Southern Oscillation (ENSO), atmospheric circulation patterns, tropical-extratropical interaction and teleconnections, and impacts of these processes on predictability and predictions. Equally welcome are contributions on extended- and long-range weather forecasts, and predictions of climate variability on various time scales, including ensemble and initialization techniques, model development, forecast skill assessment, downscaling and calibration, and end-user value and applications. Results from diagnostic, modelling, model inter-comparison, and theoretical approaches are all welcome."

## 620 Extreme Events in the Coupled Climate System

Convenor: W. Richard Peltier (University of Toronto)

Both in the modern context of continued global warming of the lower atmosphere and in the context of episodes of climate system warming in the distant past, extreme events have accompanied adjustments to the operation of the Earth System. Under modern conditions, extreme precipitation events have become increasingly common and more extreme in their impacts globally through the flooding of human settlements. Similarly, heat waves and their impact upon wild fire frequency and severity exact a mounting toll on both the built and natural environments. These effects and others associated with biological diversity that may be equally extreme in terms of species extinction are hallmarks of a system in transition from a relatively stable and equable Holocene climate that persisted for thousands of years into an anthropocene characterized by significant temperature increase.

During the evolution of Earth out of the last ice-age into the Holocene interglacial, extreme events also accompanied this transition from extreme cold into a state of Holocene warmth. These were of similar import but, interestingly, were much more deeply connected to the global ocean circulation than with the atmosphere and its water cycle. These events included the Dansgaard-Oeschger oscillations and parent Heinrich events of Marine Isotope Stage 3 (MIS3) during a period of maximum continental ice cover. During the deglaciation event that followed, there occurred the Bolling-Allerod warming during which global sea level rose by as much as 30 m on global average. This was followed by the Younger-Dryas cold reversal which began 12,800 years ago and which returned the system to glacial conditions for 1000 years. Immediately following this event, North Africa was green but by approximately 4000 years ago the Sahara was rapidly desertified. Severe impacts were felt on the human settlements that

were developing in the eastern Mediterranean and the Levant as modern agriculture was emerging.

The goal in this symposium will be to organize a comparison of the extreme events that characterized these two periods of warming transition both statistically and mechanistically. The proposed session, which would work best in two back-to-back segments, will cut across all of the themes of the CMOS meeting.

## 630 Actual and future climatology of winter precipitation (solid, mixed and liquid) and hail and their impacts.

Convenors: Dominique Paquin (Ouranos), Sébastien Biner (Ouranos), Alain Mailhot (INRS-ETE)

Solid (snow, hail, sleet) or mixed (rain on snow, ice) precipitation can have significant impacts on Canadian society. Direct impacts, such as transport disruptions during snowstorms, freezing rain episodes disrupting movement or damage to crops during hailstorms are easier to assess. Indirect impacts can sometimes be more subtle, such as those caused by changes in snow density or weight during rain-on-snow events or by reduced snow cover. In order to assess these impacts, current and future, it is important to understand the formation of this precipitation which can see its frequency, intensity, location and duration modified by climate change.

This session focuses on the understanding, current state and anticipated changes of winter precipitation events (solid, mixed, liquid) and hail both in terms of their representation in climate models and from the point of view of their impacts. This is in order to have a better understanding of the current situation as well as the risks that this type of hazard poses to our societies.

We therefore invite people who have studied these phenomena and events to contribute to this session. Presentations on the ability of climate models to represent these phenomena, on the repercussions that particular events may have had, on the anticipated changes of these phenomena on Canadian territory, and on current and future adaptation methods are welcome.

## 640 Space-Based Earth Observation: Providing Critical Information on our Planet

Convenor: Kaley Walker (U. Toronto)
Co-convenors: Matt Arkett (ECCC), Yi Huang (McGill U.), Felicia Kolonjari (ECCC), Paul Kushner (U. Toronto), Thomas Piekutowski (CSA)

Space-based Earth observation provides a unique global perspective on our planet's atmosphere and surface, including the oceans, land, vegetation, ice, and snow. Current and planned satellite missions from Canada and international agencies are providing a wealth of new information about the Earth system that can be used to investigate a wide range of environmental and scientific questions and provide vital data for societal needs. This session encourages contributions from across the full Earth observation value chain, upstream, midstream and downstream. This includes new measurement technologies and techniques, both passive and active; retrieval algorithms; demonstration and calibration of instruments; validation of satellite products; assimilation of data into numerical models; scientific results and discoveries; operational utilization and development of services.

## 650 Collaborative Earth System Modelling in Canada

Convenors: Neil Swart (ECCC), Paul Kushner (UofT), Julie Thériault (UQAM), Kirsten Zickfeld (SFU), Nathan Gillett (ECCC)

Earth System Models (ESMs) are the principal tools used to understand and attribute past climate changes, to make projections of future climate, and near-term environmental predictions. As such, they provide key information for climate-change mitigation and adaptation and the development of societal resilience to the effects of climate change. Development, application, and analysis of these models represent significant scientific and technical challenges, which are difficult for individual organizations to address alone. New technologies, including advanced version control systems, reproducible runtime environments (containers), community analysis packages, and common computing resources are enabling broader collaboration from development to analysis. These tools are helping to break down the technical barriers which have often hampered collaborations between Government and Academic research teams in Canada. This session invites presentations on Earth System Models and modelling applications in Canada, ranging from model descriptions, through to analysis procedures. In particular we invite submissions focused; on community modelling systems that are under active development and application within the Canadian research community, such as CanESM, the UVic ESCM, GEM-NEMO, CanRCM, CRCM, etc.; on systems and approaches designed to enable broader collaboration with these tools; on challenges and opportunities for collaboration between universities, government laboratories, and the private sector; and on the scientific results emerging from such collaborations.

## 660 General Session - Climate

Convenor: TBA

This session will attempt to capture papers on the Climate that do not fit easily into other sessions

# Theme 7: Climate change: risks, impacts, resilience, and responses

## 710 Advances in process-based land surface modelling

Convenors: Joe Melton (ECCC), Elyn Humphreys (Carleton University)

Climate change impacts all aspects of land surface interactions with the atmosphere. These evolving interactions have important feedback effects on both regional and global climate systems. To best understand how to adapt to current and future climate change, we require skillful projections of the land surface response to a warmer climate, increased atmospheric carbon dioxide concentrations, land use change and disturbances, vegetation change, accelerated nutrient cycling, and other perturbations. While process-based land surface models are well suited to address these intricate and emerging global change problems, they will require extensive development and evaluation. This session showcases research relating to process-based land surface model evaluation, application, and development. The diverse perspectives offered from site-level micrometeorological studies, regional analyses, and coupled

land surface-atmosphere interaction studies can offer unique insights into how best to represent these complex systems. We encourage submissions derived from any process-based model, and in particular, those utilizing the Canadian Land Surface Scheme including Biogeochemical Cycles (CLASSIC) terrestrial ecosystem model. CLASSIC is the Canadian community open-source successor to the coupled Canadian Land Surface Scheme (CLASS) and Canadian Terrestrial Ecosystem Model (CTEM) framework with a long history in the Canadian land surface modelling community starting from its early development in 1987.

## 720 Integrating Climate Change Adaptation into Engineering and Environmental Design: Opportunities and Challenges

Convenors: Dr. Elvis Z. Asong (Climalogik Inc.), Dr. Xin Qiu (SLR Consulting), Dr. Andre Erler (Aquanty Inc.)

It is now unequivocal that anthropogenic climate change presents substantial uncertainty and shapes important decisions about the structure of economies, human development, natural resource use, and ways to reduce vulnerability and risks to extreme weather. Risks related to this uncertainty has grown as the 21st century progresses, along with the recognition that these risks must be factored into the design, construction, location, and operation of key cross-sectoral infrastructure and resource planning. But how do managers and professionals plan for uncertain climate change magnitudes and timelines? This challenging question often leads to adoption of a “wait and see” holding pattern, in the hope that climate science can be improved, and uncertainties narrowed before decision-making becomes urgent. However, postponing an honest assessment of climate change risks and assuming a “business-as-usual” approach to planning is a risky proposition. Since it is certain that the global climate is changing, planning that assumes a constant climate from the past, present, and into the future is, unfortunately, flawed. In short, there is no time like the present to begin factoring practical climate change considerations into cross-sectoral decision making, even considering uncertainty in the magnitude of future change. We invite contributions in the areas:

a) Tailoring of climate scenarios information for use in conjunction with sector-specific impacts, vulnerability, and risk models. Particularly, statistical and dynamical downscaling of:

- High-resolution weather forecasts for user applications
- Climate projections for site-specific real-world applications. The focus here is on downscaling of extreme events

b) Multivariate bias-correction of climate projections for use in impacts modelling

c) Novel and practical techniques for extrapolation of historical trends to obtain short-term climate information for projects with design lifetimes <25 years

d) Methods and tools for making vulnerable investments climate resilient. Both bottom-up and top-down impacts, vulnerability, and risk integration approaches and combinations thereof are desirable

e) Approaches for treatment of weather- and climate-related uncertainty and non-stationarity as they impact coping ranges, critical thresholds, vulnerabilities, and success criteria for different projects are welcome

## 730 Producing, Providing and Communicating Useful Climate Information

Convenors: Yannick Rousseau (Ouranos), Diane Chaumont (Ouranos), Isabelle Charron (Ouranos), Elaine Barrow(CCCS), Emilia Diaconescu (CCCS)

Climate services play a central role in the preparation and diffusion of climate datasets that are both scientifically sound and useful to identify vulnerabilities, anticipate the impacts of climate change, and adapt human activities and infrastructure to their environment. Not only do these services provide climate information (e.g., the Canadian Centre for Climate Services created a portal to improve data access), they also form a bridge between hard science (climatologists generating data representing the state of the atmosphere over several decades on a physics standpoint) and application (experts using climate information to guide decisions). As the Climate Services Partnership puts it, the translation and transfer of climate information are key components of this collaborative process that seeks to improve resilience against climate hazards.
Although climate data have greatly improved in terms of coverage, availability and accessibility, challenges remain with respect to processing and communication approaches. The goal of this session is to encourage climate service providers to share their experience, which will allow to identify data-related aspects that need improvement, along with tracks that are worth exploring.

Block A aims to discuss topics related to the production of useful climate data:

- Recent improvements with respect to variables that were less studied or for which there is limited confidence, such as wind, freezing rain and snow;
- Data transformation methods;
- Quality control methods;
- Quantification of uncertainty level and integration into risk and impact assessment.

Block B aims to discuss topics associated with the manner in which climate information is communicated:

- Short- and longer-term vision in the field of climate services;
- Getting the stakeholders involved in the overall process;
- Efficient communication of climate concepts to stakeholders (e.g., terminology, interpretation of results, uncertainty);
- Is large-scale diffusion of usable climate information achievable or desirable?
- Contribution of climate services to science-based decisions.

## 740 Building Climate Resilient Communities

Convenors: Gordon McBean (Western University and ILCR), Paul Kovacs (ICLR and Western University)

When recovering from the pandemic, it is important for Planet Earth to address the Global Agenda 2030 and to bounce forward sustainably and enhance the resilience of Canadian communities. The World Economic Forum's Global Risk Report and Global Agenda 2030 provide a framework for action. The global climate is changing, and Canada is warming at about twice the rate of the planet. To reduce the impacts on Canadians and all societies there is need to address these issues through climate research addressing the impacts, resilience and most effective responses. The pillars of the Sendai Framework for Disaster Risk Reduction provide a framework for synthesis; understanding disaster risk; strengthening disaster risk governance to manage disaster risk; actions for disaster risk reduction for resilience; and enhancing disaster preparedness for effective response including warnings systems for near term through the decades. Communities, including Indigenous communities, have different natural, socio-economic, health and geopolitical systems and will need different strategies. To enable the most effective and continuing implementation, frameworks for measurement and evaluation of action to reduce risks will be examined and recommendations provided on how the frameworks can be used for optimum future benefits. The Session will include presentations across the disciplines and the

climate-weather-environmental, governance and societal issues as the most effectively motivate and providing scientific basis for implementing the building of climate resilient communities.

### 750 General Session - Climate change

Convenor: Geoff Strong

## Theme 8: Dynamics of the atmosphere, oceans, and climate

### 810 Atmosphere, Ocean, and Climate Dynamics

Convenors: Adam Monahan (University of Victoria)
Ron McTaggart-Cowan (ECCC)
Marek Stastna (University of Waterloo)
Michael Waite (University of Waterloo)

This session combines submissions that document studies of the dynamics of the atmosphere, oceans and/or climate system. The scope of the session is deliberately broad in order to include research that spans a broad range of spatial and temporal scales. Studies of the dynamics of mesoscale processes that act on hourly timescales are as welcome in this session as those that document the evolution of planetary-scale structures in a changing climate. Such investigations may include diagnoses and theoretical studies of forecast, climate, and process models, or studies based on reanalysis and other observational datasets; however, any topic that is relevant to atmosphere, ocean, or climate dynamics will fit well into this session

### 820 Computational Methods, Machine Learning, and Model Development

Convenors: Christopher Subich (ECCC), Michael Dunphy (Fisheries and Oceans Canada),
Kris Rowe (Argonne National Laboratory)

This session focuses on recent advances in software engineering, computational physics, scientific computing, and machine learning related to the development of models for the atmosphere, ocean, land surface, and cryosphere. We invite submissions on:

- New and improved numerical schemes---including high-order and adaptive techniques
- The challenges of new computing architectures---including GPU computing, massive parallelism, hardware acceleration, cloud computing, and edge computing
- The problems of big data---including data storage, processing, visualization, and machine learning / artificial intelligence
- The management and development of high-quality scientific software - including language choice, project organization, continuous integration and deployment, as well as best practices for debugging and optimization.

The goal of this session is the rapid dissemination of newly developed methods and techniques, even if they have not yet been deployed inside a large forecasting or analysis system.

## 830 Coastal ocean modelling: processes and applications

Convenors: Laura Bianucci (Institute of Ocean Sciences, Fisheries and Oceans Canada)
Thomas Guyondet (Gulf Fisheries Centre, Fisheries and Oceans Canada)
Andry Ratsimandresy (Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada)
Sebastien Donnet (Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada)

The coastal zone is the region of the ocean that is the most subjected to direct human pressures. For instance, activities such as fishing and aquaculture farming benefit from rich coastal ecosystems and their proximity to the shoreline; the latter is also true for land activities related to transportation, wastewater disposal, etc. Furthermore, the coastal zone is strongly connected to the open ocean and the changes happening offshore. Therefore, direct anthropogenic perturbations along with other pressures exerted by climate change (e.g. warming, acidification, deoxygenation) can lead to negative effects in the coastal ocean, such as pollution, hypoxia, ocean acidification, sea level rise, and loss of ecosystem diversity. Numerical models of the coastal ocean can be used to understand the physical and biogeochemical drivers in different regions, how these processes can change in the future, and what the implications of these changes could be. Furthermore, these models can also be applied to provide useful information for regulators, managers, industries, and coastal users in general. The complexity of coastal regions, both in terms of geography and physical and biogeochemical dynamics, makes these modelling exercises challenging and region-specific. Nevertheless, commonalities can be drawn among different regions and models, such that the modelling community can benefit immensely by sharing experiences and results. This session welcomes contributions about any aspect of coastal ocean models, from specific applications in given regions to more general process-oriented studies, including hydrodynamics-only as well as coupled models (physical-biogeochemical, -ice, -sediments, etc.).

## 840 Mechanisms responsible for the triggering of summertime nocturnal rainfall events over the Great Plains

Convenors: Iaroslav Verevkin (Dalhousie University), Ian Folkins(Dalhousie University)

Warm season precipitation over the Great Plains has a nocturnal maximum which is widely documented but is still difficult to predict. We used TRMM rainfall and GFS forecast data for July-August 2010-2019. The Hovmöller diagram for the TRMM rainfall shows a rainfall feature initiated over the eastern slope of the Rocky Mountains at 21 UTC and propagating eastward with the maximum at 6 UTC over 98-92 W. Despite it may seem like this feature arises from “coherent” rain events that start in the Rocky Mountains and propagate all the way to 92 W, we found that rainfall events initiated over the Rocky Mountains propagate only up to 98 W overnight and the more eastern nocturnal rainfall events are not correlated with the rainfall events initiated over the Rocky Mountains. The rainfall events initiated over the Rocky Mountains and propagating eastward are connected to the positive surface pressure anomaly to the north, the nocturnal rainfall events between 95 W and 92 W are connected to the negative surface pressure anomaly over the Great Plains. The days with rainfall events initiated over the Rocky Mountains have increased upslope wind blowing towards the Rocky Mountains in the late afternoon and evening over the surface which supplies moisture. It was also found that on the west (east) of 101.5 W, the rainfall is mainly connected to the water vapour convergence due to the zonal (meridional) wind. The water vapour convergence due to the zonal wind is strong over the eastern slope of the Rocky Mountains in the afternoon, propagates eastward and fades quickly, the water vapour convergence due to the meridional wind is positive over the broad region of the Great Plains with the maximum overnight.

## 850 The North Atlantic Ocean: Circulation, physical processes, and interactions with biogeochemistry

Convenors: Mathilde Jutras (McGill University), Paul Myers (University of Alberta), Douglas Wallace (Dalhousie University), Noémie Planat (McGill University), Marine Decuypere (McGill University)

The North Atlantic Ocean connects the Arctic Ocean with the Tropics and South Atlantic. More than a conduit, processes within this basin play important driving roles on the world's oceans and on the climate system, on multiple spatial and temporal scales. The North Atlantic sees deep water formation, supplying gases to the deep ocean and causing the transformation of light northward flowing waters into dense southward flowing deep waters. Both of these processes may be sensitive to the input of low salinity waters and thus impact the large scale Meridional Overturning Circulation. The low salinity waters generally enter the basin in narrow and strong boundary currents and the exchange with the less stratified interiors is crucial, yet is likely governed by small scale and temporally rapid processes. The western shelf of the North Atlantic also hosts highly biologically productive areas and the complex interaction between two important boundary currents: the Labrador Current and the Gulf Stream. Our understanding of the mechanisms driving all these processes, their variability and their interactions can still be improved, as well as their relation and influence on biogeochemistry.

Our knowledge of the oceanography of the North Atlantic is growing rapidly with the increasing resolution of climate models and the increasing amount of available observations. This session will present papers that advance this understanding. Papers that link modelling and observations are especially appreciated. Theoretical papers and process studies will also be considered.

This session invites papers on all aspects of the North Atlantic Ocean, including oceanic circulation, physical processes, and interaction between physics and biogeochemistry. Topics could include, but are not restricted to, boundary circulation, connections between the North Atlantic and the Arctic outflow, the subpolar gyre, the AMOC, and the connection with biogeochemistry.

## 860 Developing Ocean Modelling Capacity in Canada

Convenors: Paul Myers (University of Alberta), Youyu Lu (DFO - BIO), Susan Allen (University of British Columbia), Greg Smith (ECCC), David Greenberg (DFO - BIO retired), Frederic Dupont (ECCC), Katja Fennel (Dalhousie University), Neil Swart (ECCC - CCCMA)

Ocean circulation and biogeochemical models are widely used for both research and operational forecasting. However, there are challenges for small research groups to handle the increasing complexity of the model codes, evaluation with various observational datasets, and analysis of the increasing amount of model output data.

This session aims to stimulate discussions on potential coordination and collaboration between Canadian government laboratories and universities in the development, evaluation and analysis of ocean circulation and biogeochemical models for hindcast and forecast at various time scales. Specific topics may include: 1) progress of model research and applications in various regions with different spatial resolutions; 2) new evaluation and analysis results that demonstrate the strength and weakness of the models; 3) improvements in model numerics and parameterization of sub-grid processes; 4) new analysis methods; 5) new forcing and evaluation datasets; 6) model inter-comparison; and 7) data presentation and visualization tools; etc.

## 870 In Memory of Paul LeBlond: Physical Oceanographic Research

Convenors: Susan Allen (University of British Columbia), David Fissel (ASL Environmental Sciences Inc.)

Paul LeBlond (December 30, 1938 - February 8, 2020) was a distinguished scientist and one of Canada's leading physical oceanographers, most notably in his role as a Professor of Oceanography at the University of British Columbia (UBC) from 1964 -2007. His excellence in oceanographic research was reflected in the many honours awarded to him, including: the President's Prize, the J.P. Tully Medal, and as a Fellow of the Canadian Meteorological & Oceanographic Society (CMOS); Honorary Doctorate in Science, Memorial University of Newfoundland and Labrador; Fellow of the Royal Society of Canada; Foreign Member of the Russian Academy of Natural Science; and the Warren Wooster Award, North Pacific Marine Science Organization (PICES).

Paul's research interests were very broad including eddies, coastal oceanography and implications of physical oceanography on fisheries. A focus was ocean waves, ranging from surface waves, to tides, internal waves and tsunamis generated by underwater landslides. This research extended to beach processes and gas bubble dynamics. He was a mentor to many UBC graduate students, including those that he supervised in their research activities and who attended his graduate student lectures, His collaborative research extended to many scientific peers at UBC, and with colleagues from across Canada and internationally.

In this session, colleagues and collaborators of Paul are invited to present the results of recent research studies, which were inspired by, or related to, the influence of Paul.

## 880 General Session - Interdisciplinary

Convenor: TBA

This session will include contributions of an interdisciplinary nature that do not fit into any of the other sessions.

# Theme 9: Hydrology, the cryosphere, and sea-ice forecasting

## 910 Hydrologic Modelling of Floods and Droughts

Convenors: Arelia Schoeneberg, Pacific Climate Impacts Consortium, University of Victoria
Tricia Stadnyk, Canada Research Chair (Hydrologic Modelling), University of Calgary
Jeremy Fyke, Canadian Centre for Climate Services (ECCC)

The magnitude and frequency of floods and droughts is likely to change significantly in a warming climate. To characterize changing hydrologic extremes, and develop responses that ensure resilience to future flood and drought impacts, unique approaches for hydrologic modelling are needed. Classic hydrologic model calibration methods struggle to provide model instances that adequately capture extreme high and low flow conditions, tending instead toward more common mean flow conditions. Similarly, many statistical downscaling and climate model selection approaches are not well-designed to

explore the widest range of future hydrologic uncertainty. Gridded meteorological datasets used to calibrate hydrologic models may be biased, particularly in complex or sparsely-observed landscapes. Most hydrologic models in turn lack adequate representation of critical human management in watersheds, such as climate-change-dependent land use, water demand, and flood and drought mitigation.

Recognizing an acute need for improved hydrologic modelling in support of consequential climate-aware flood and drought risk assessments, we welcome presentations on all topics related to projecting future Canadian hydrologic conditions. This includes, but is not limited to developing hydrologic models with enhanced functionality such as dynamic vegetation, glaciers, and human/hydrology interactions; constructing hydrologically-informed gridded meteorological datasets, GCM selection in support of hydrologic uncertainty quantification, statistical downscaling guided by hydrologic model needs, unique calibration, validation and uncertainty approaches, and uncertainty assessment and regionalization approaches in support of decision making.

We would like to open the dialogue on options for professional designations for hydrologist working in this field and ask authors to share their successes or roadblocks. Recent findings from a study on professional designations for hydrologists, by the Canadian Society for Hydrologic Sciences (CSHS) and Canadian Water Resources Association (CWRA), will be shared in a discussion. We strive to promote equity and diversity in our session and look forward to your submissions.

## 920 General Session - Hydrology

Convenor: TBA