

## **Theme 2: Weather**

### **2.1 High-Impact Weather and Climate**

Convenor: David Sills, Co-Convenor: George Isaac

The forecasting of severe, or high impact, weather, remains a high priority for the Canadian public and many weather information users. Probabilistic forecasts are now being issued by several different methods. Our climate is changing and many believe the frequency of high impact events will increase with time. How accurately can we predict such changes in our climate? How accurately can we predict events like hailstorms, tornadoes, extreme winds and precipitation, hurricanes, etc? What is the right blend of human forecasters, numerical models, and observations? What changes are needed to the current system including how we deliver forecasts? This session will examine these issues through invited and submitted papers on the topic.

### **2.2 Coupled Environmental Prediction**

Convenor: Hal Ritchie

As numerical weather prediction systems become further refined the interactions across the Air-Ice-Ocean interface are becoming increasingly important. This is giving rise to the development of a new generation of fully-integrated environmental prediction systems composed of atmosphere, ice, ocean, and wave modeling and analysis systems. Such systems are in increasing demand as the utility of marine information products (e.g. for emergency response) becomes more widely recognized. This session welcomes contributions on coupled environmental prediction on timescales from hours to seasons, covering the range of coupled processes and interactions at play on regional and global spatial scales, and their application in analysis and forecasting systems. This session is co-sponsored by the Global Ocean Data Assimilation Experiment (GODAE) Ocean View (GOV) Coupled Prediction Task Team (CP-TT).

### **2.3 Monitoring - Renewal and Modernization**

Convenor: Jamie Smith

Observations of known quality are the cornerstone of meteorological, climatological and hydrological services and science. Providing accurate, reliable and sustainable observations in a field where technologies and requirements are constantly changing requires a strategic, modern and integrated approach to monitoring. The MSC's monitoring networks and data management systems are currently undergoing numerous transformations to address these needs. The goal of this session is to describe the current and planned changes to the MSC's monitoring networks and data management system, including modernizations of the radar, upper air, and marine networks. New approaches to network design, data quality, and partnerships will also be discussed.

## **2.4 Weather forecasting applications**

Convenor: Harinder Ahluwalia, Co-Convenor: Steve Ricketts

Weather observations and forecasting are important for Canada's economy, especially considering our varied and sometimes harsh climate. Aviation and roads are obvious examples, while high summer temperatures and winter icing can have significant impacts on energy transmission. Abstracts related to these and other applied areas are invited.

## **2.5 Government and/or Private Sector Provision of Weather Services -- Where is Canada Going? – Panel Discussion**

Convenor: George Isaac

Weather Services in Canada are being offered by the Private Sector and the Meteorological Service of Canada (MSC). Academic institutions also sometimes get involved. The Private Sector is growing and large multinational companies are now providing weather services at no cost to the public. Some government meteorological agencies, in Canada and elsewhere, are now generating revenue providing services to specific clients. Even the monitoring network in Canada is being privatized to some extent by companies and volunteers. So where is Canada going? Is there a plan? Do we need one or will the market place and users decide?

\*\* This will be a panel discussion involving invited experts with lots of time available for audience participation. If the group agrees, a summary will be written up for publication in the CMOS Bulletin.

## **2.6 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: Oceans**

### **3.1 Physical Oceanography**

Convenor: David Straub, Co-Convenors: Louis-Philippe Nadeau, Francis Poulin

Advances in Physical Oceanography benefit from observational data, detailed modelling studies, and theory describing fundamental processes occurring over a large range of spatial and temporal scales. The range of length scales is vast and includes: micro- and fine-structure, sub-mesoscale, mesoscale, and basin-scale flows. In the subpolar regions the dynamics are also intimately coupled to sea ice dynamics. We welcome contributions on these and other related topics and will work with the organizers of the Atmosphere, Ocean and Climate Dynamics session to ensure that there are no scheduling overlaps.

### **3.2 Coastal Oceanography and Inland Waters**

Convenors: Guoqi Han, Jinyu Sheng and Ram Yerubandi

This session will focus on all aspects of monitoring and modelling of physical and biogeochemical processes in coastal domains, shelf seas, estuaries and inland waters. Topics include but are not limited to coastal physical oceanography, tides and storm surges, waves, estuarine circulation, shelf circulation, sea ice, mixing and dispersal of materials, as well as hydrology and hydrodynamics of large lakes. The session welcomes contributions related to both observational and modelling aspects of biogeochemistry in coastal and inland waters.

### **3.3 Collaboration in development, evaluation and analysis of physical and coupled-biogeochemical ocean models**

Convenors: Youyu Lu, Susan Allen, David Greenberg, Frederic Dupont, Nadja Steiner, Paul Myers

This session invites ocean modelling researchers from government, universities and industry who are interested in potential coordination and collaboration in the development, evaluation and analysis of ocean models for hindcast and forecast at various time scales. The model components include ocean physics, sea-ice, and biogeochemistry. Specific topics may include: 1) model code development and improvement; 2) configurations and simulations; 3) model inter-comparison; 4) sources of input data; 5) evaluation datasets; 6) model analysis methods; 7) data presentation and visualization tools; 8) transfer to operations; etc. This session primarily addresses technical issues, but also welcomes presentations on scientific results from ocean modelling studies.

### **3.4 Canada's Three Oceans: Evolving Science in the Arctic, Atlantic and Pacific Oceans**

Convenors: Paul Myers, Ram Yerubandi

This session will focus on all aspects of observing, monitoring and modelling of physical and biogeochemical processes in the three oceans that border Canada, the Arctic, the Atlantic and the Pacific. Topics include but are not limited to water formation, air-sea interactions, shelf-basin exchange, boundary currents, sea ice, abyssal circulation, eddies as well as new technologies to study the ocean and sea-ice.

### **3.5 Strategies for Arctic Ocean Observing**

Convenor: Helen Joseph

The Arctic Ocean of Canada is warming at roughly twice the global average rate, with a dramatic reduction in summer sea ice extent as one of the clearest indicators of this trend. Physical and biological processes are being transformed across the entire region. However, the Arctic Ocean is one of the least well sampled oceans in the world. A coordinated observing approach must therefore be created for the Arctic Ocean and its coasts, to provide baseline data and ensure sustained monitoring.

This session will explore various approaches and strategies to Canadian Arctic Ocean monitoring. Presentations will include the cabled ocean observatory in Cambridge Bay along with related regional studies of the regional meteorology and sea ice, the integrated Beaufort Observatory (iBO) in the Canadian Beaufort Sea, the new observatory planned in association with the Churchill Marine Observatory and new strategies being developed for Baffin Bay. Other strategies for ocean observations that could be showcased include remote sensing techniques by buoys and satellite, and monitoring efforts conducted by northerners. Presentations are also welcomed on strategies to coordinate Arctic Ocean observing activities in Canada.

### **3.6 General Session - Oceans**

Convenor: TBA

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

## **Theme 4: Climate**

### **4.1 Climate Change Resiliency**

Convenor: Jim Young

One of the emerging parts of this topic "resiliency of existing buildings" and what can be done to prepare them for the future. One aspect of resiliency that relies heavily on future weather is energy requirements and use. A key part of the energy analysis is the preparation of a future climate file for use in doing energy assessments for buildings that will last into the changed climate era.

### **4.2 Hydro-meteorological extremes in a changing climate: improved tools for downscaling**

Convenors: Zilefac Elvis Asong, Francis Zwiers, Howard Wheeler, Xuebin Zhang, Yanping Li

The frequency, intensity, and duration of extreme weather and climate events have been increasing over many regions of the globe, and Earth System Models (ESMs) predict further changes in response to enhanced greenhouse gas forcing. The user community of such information, however, often desire high resolution output at finer regional to local scales. We invite contributions that describe improved very high-resolution downscaling methods for seasonal to centennial predictions and projections of weather and climate extremes (both precipitation and temperature related) and uncertainties associated with these methods.

### **4.3 The 1.5-degree Celsius Climate Target: Impacts and Implications for Greenhouse Gas Mitigation**

Convenors: Paul Kushner J, Kirsten Zickfeld, Damon Matthews

The 2015 Paris Agreement calls to "Hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C". The expected impacts of 1.5°C global warming for regions and communities around the world and the implications for greenhouse gas (GHG) mitigation are only beginning to be evaluated. Papers are sought addressing the GHG emissions implications of limiting warming to 1.5-2°C, and the broad anticipated impacts of such near-term warming. This session is linked to the North2Warm activity of the Canadian Sea Ice and Snow Evolution Network (CanSISE) under the NSERC Climate Change and Atmospheric Research Program Network Enhancement Initiative.

### **4.4 Assessment of Canadian Snow and Sea Ice for the Recent Past and the Coming Decades**

Convenors: Paul Kushner J, Chris Derksen, Steve Howell, Reinel Sosprea Alfonso

Studies undertaken during the International Polar Year (IPY, 2007-2008) enabled a comprehensive observation-based assessment of the state of the Canadian cryosphere in that epoch in relation to mean conditions and variability across preceding decades. This session seeks to update the IPY findings to present day and to extrapolate them with climate simulations into the coming decades for snow and sea ice for Canada's North and cold regions, as well as for the pan-Arctic regions. This will contribute to an assessment activity being carried out by the Canadian Sea Ice and Snow Evolution Network (CanSISE) and outside.

#### **4.5 Extreme climatic and weather events**

Convenors: Muhammad Altaf Arain, Hussein Wazneh

Extreme climate and weather events such as floods, droughts, heat waves, freezing rains are a leading cause of disasters for humans, vegetation ecosystems, and wildlife. Numerous studies indicate an increase in the frequency and severity of extreme events. The changing dynamics of extreme events will have severe implications for the environment, ecosystems, economy, and human health in Canada. This session invites contributions focusing on extreme climate and weather events and their atmospheric and biospheric responses and feedbacks.

#### **4.6 Data Assimilation, Ensemble Prediction, and Intrinsic Predictability**

Convenors: WanSuo Duan, Youmin Tang, Mu Mu, Zhijin Li

The past decade has witnessed great advances in data assimilation and ensemble prediction, significantly improving the atmospheric and oceanic prediction skill at various time scales. With great progress in the data assimilation and ensemble prediction, as well as the advance on the theory of nonlinear dynamical systems, we have made considerable achievements in understanding, measuring and utilizing the intrinsic predictability of atmospheric and oceanic variability at various time scales. This session will provide a forum for methodologies, applications and assessments of data assimilation, ensemble prediction and predictability study.

#### **4.7 Climate Variability and Predictability**

Convenors: Hai Lin, Bin Yu

This session invites contributions that deal with climate variability and predictions on sub-seasonal, seasonal, inter-annual and decadal-inter-decadal 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.

#### **4.8 Atmospheric Convection: Physics, Dynamics, and Roles in Climate.**

Convenors: Toni Mitovski , Ian Folkins

The treatment of convection remains a significant source of uncertainty in weather forecasting and climate sensitivity. We invite talks on any aspect of atmospheric convection, and especially its relationship to rainfall variance, forecasting, boundary layer processes, monsoonal circulations, and water vapor and cloud climate feedbacks. These issues may be addressed with convection resolving models, parameterized approaches, climate models, or analysis of datasets.

#### **4.9 General Session - Climate**

Convenor: TBA

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

## **Theme 5: Atmosphere**

### **5.1 GOES-R Readiness in Canada**

Convenor: Dave Bradley, Co-Convenor: Hong Lin

This session is focused on sharing the Environment and Climate Change Canada's activities being undertaken to prepare for the newly launched GOES-R satellites. Contributions related with GOES-R are welcome. Topics of particular interest include: (i) GOES-R data reception and access in Canada (ii) User requirement and preparations (iii) GOES-R product case studies and applications (iv) Geostationary Lightning Mapper validation.

### **5.2 Clouds: Microphysics, Aerosols, and Radiation**

Convenor: David Collins, Co-Convenor: Jiangnan Li

Clouds, microphysical processes, aerosols and radiation each affect Earth's climate and weather and remain a challenge to observe and model, especially interactions that couple them. More complex methods to simulate these processes and interactions are increasingly being used in climate, numerical weather prediction, and air quality models. The development of these more complex parameterizations as well as more comprehensive observational data sets pose substantial challenges to the modelling and observational communities. This session focuses on recent and ongoing studies of topics in cloud physics, including but not limited to: cloud microphysics, radiation, boundary layers and aerosols. This session welcomes contributions addressing the development and application of new theories, observations, analyses, parameterizations, models, or results related to issues in climate, numerical weather prediction and air quality. We also welcome contributions using observational (in-situ, ground-based or satellite-based) data sets to evaluate parameterizations and models.

### **5.3 Recent Advances in Remote Sensing of the Atmosphere**

Convenor: Kenneth Sinclair

Continued development of technology and retrieval techniques is needed to address uncertainties within Earth's climate system. Broadly defined challenges that relate to atmospheric composition, clouds, aerosols, radiative forcing and precipitation are some of these unknowns. Complex interactions and feedbacks between these components compound the uncertainties. Abstracts are requested that present research focused on new approaches or technologies that can address and advance our understanding of these uncertainties on regional to global scales. The method and results can be experimental and from any remote sensing technologies including ground, aircraft, balloon, or satellite platforms. Abstracts on technology development are encouraged and should primarily focus on results or abilities of the instrument, but only lightly on the design.

## **5.4 The Changing Arctic Atmosphere from IPY to YOPP**

Convenor: Kim Strong, Patrick Hayes

The Arctic is changing rapidly. Only a decade has passed between International Polar Year (IPY) (2007-2008) and the Year of Polar Prediction (YOPP) (2017-2019), but even in that short time changes are evident. The atmosphere is reacting to a number of factors, including changing composition, changing sea ice, and changing anthropogenic inputs. Feedback mechanisms can further amplify these responses. The research activities associated with IPY and YOPP have provided a variety of long-term data sets on the Arctic atmosphere, which have been enhanced by laboratory studies and intensive field campaigns. All of these measurements can be used to better understand and predict changes in the Arctic atmosphere. The Canadian Arctic is vast and so the changes are not uniform across the entire region. This session will examine the changes in the Arctic atmosphere, from its southern boundary to the North Pole and all the varied regions in between. This session invites presentations that investigate these changes on different spatial scales from a single molecule or aerosol particle, to the entire Arctic, including regions outside the Arctic that directly impact the Arctic atmosphere. Studies may include a variety of measurement and modeling approaches, such as in situ, remote sensing, and satellite observations, as well as box, regional, and global models of the atmosphere and climate.

## **5.5 General Session - Atmosphere**

Convenor: TBA

The atmosphere is very complicated and there remain many holes in our knowledge. For example, how convection, lake effect storms and extratropical cyclones are initiated and evolve with time. Instrumentation used to characterize our environment is also improving. This session will attempt to capture papers on the atmosphere that do not fit easily into other sessions.

## **Theme 6: Air Quality**

### **6.1 Climate Change, Air Quality and Interconnections to Human Health**

Convenor: Xin Qiu

Climate change will influence many environmental parameters, including air quality, that adversely affect human health both directly and indirectly. Weather and climate play important roles in determining patterns of air quality over multiple scales in time and space, owing to the fact that emissions, transport, dilution, chemical transformation, and eventual deposition of air pollutants all can be influenced by meteorological variables such as temperature, humidity, wind speed and direction, and mixing height. Finally, climate and weather changes will influence the way we heat and cool indoor environments so they will have a pronounced impact not only on energy consumption but also on human exposures to indoor air pollutants.

### **6.2 Future Air Quality**

Convenor: Jim Young

The impacts of climate change on future air quality.

### **6.3 Measurements and modeling of air pollution**

Convenor: Aldona Wiacek

Air quality in developed nations has significantly improved through regulatory action in transportation and electricity sectors, e.g., the Clean Air Regulatory Agenda in Canada (2006), and the Clean Air Act in the US (1970). In 2012, the Canadian Council of Ministers of the Environment has adopted a new national air quality management system which uses new and more stringent Canadian Ambient Air Quality Standards (CAAQS) for O<sub>3</sub> and PM as drivers of action via active air zone management, airshed coordination, industrial emission requirements and mobile source regulation. The CAAQS are being expanded to include SO<sub>2</sub> and NO<sub>2</sub>, at the same time as, e.g., fuel sulphur content regulations in marine transport have been reduced to 0.1% in 2015 within Emission Control Areas, and over all oceans by 2020. It is in this changing regulatory framework that air quality measurement and modeling activities now take place, requiring greater capacity and integration across the measurement and modeling communities. This session aims to bring together researchers with common interests in atmospheric processes related to air quality and welcomes submissions describing measurement and modeling activities of trace gases, isotopes and aerosols from a variety of measurement platforms (e.g., ground-based remote sensing and in situ, satellite, aircraft) and over a range of modeling scales (e.g., regional, global, box modeling), including studies of emission / deposition processes and emission inventories.

### **6.4 General Session – Air Quality**

Convenor: TBA

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

## **Theme 7: Interdisciplinary**

### **7.1 The Year of Polar Prediction**

Convenor: Gregory Smith

There has been growing interest in the polar regions in recent years due to the opportunities and risks associated with anthropogenic climate change. Recognising this, a number of initiatives are underway which focus on improved polar science and predictions, including the Year of Polar Prediction, or YOPP, which will take place between mid-2017 and mid-2019, centred on the year 2018. YOPP is an extended period of coordinated intensive observational and modelling activities, in order to improve prediction capabilities for the Arctic, the Antarctic, and beyond. This session welcomes contributions on plans and activities related to all aspects of YOPP.

### **7.2 Atmosphere, Ocean and Climate Dynamics**

Convenor: Marek Stastna, Co-Convenors: Michael Waite, Adam Monahan, Ron McTaggart-Cowan

This session combines submissions on processes and mechanisms in the atmosphere, the ocean and the climate system under the general theme of dynamics. The scope of the session is deliberately broad in order to include research on any aspect of the earth system from a dynamical perspective. Analyses and theoretical studies of forecast, climate, and process models as well as reanalysis and other observational datasets, especially those difficult to slot into other sessions, are welcome in this session.

### **7.3 Remote Sensing of the Atmosphere and Surface from Space**

Convenor: Kaley Walker, Co-Convenors: Nicholas Grisouard, Doug Degenstein, Stephen Howell, Alexander Trishchenko

Space-based observations provide a unique global perspective on the Earth's atmosphere and surface, including the oceans, land, vegetation, ice, and snow. Current and planned satellite missions from Canada, and international agencies in US, Europe and Japan have provided and will provide a wealth of new information that can be used to investigate a wide range of scientific questions. This session encourages contributions dealing with the many facets of space-based remote sensing, including new measurement technologies and techniques, both passive and active; retrieval algorithms; validation of satellite products; assimilation of data into numerical models; and scientific results and discoveries.

### **7.4 Numerical Methods and Model Development**

Convenor: Christopher Subich, Co-Convenors: Michael Dunphy

This session invites contributions concerning advances in computational physics, scientific computing, and software engineering related to the development of numerical models for the atmosphere, ocean, land surface, and cryosphere. These techniques form the basis of every numerical study done today, and advancements in these fields can apply across the physical sciences included in CMOS's mandate. A session on newly-developed and newly-applied methods allows rapid dissemination of these ideas to the wider community. Sample topics for this session include spatial and temporal discretizations, adaptive refinement techniques, higher-order methods, functional analysis, machine learning, nonlinear optimization, and development methodologies for high-performance computing systems.

## **7.5 Planetary Atmospheres, Oceans and Ice**

Convenor: John Moores

Canadian scientists have substantial participation on planetary missions and data analysis activities exploring the atmospheres of Mars, the Giant Planets, Titan, Venus, Pluto and extrasolar planets. Meanwhile, Canadian signature technologies enable understanding of planetary meteorology and contribute to ongoing proposals for future investigations. This session is intended to provide a forum for the Canadian planetary community dealing with volatiles (atmospheres, oceans and ices) to discuss our activities and share them with the broader Atmospheric, Climatological, Oceanographic and Arctic Science Communities. Investigations of exotic extraterrestrial environments can yield important clues for understanding the responses of our more constrained terrestrial environmental system.

## **7.6 A Transdisciplinary Approach to Future Earth**

Convenor: Gordon McBean

This session would include a variety of presentations with a common focus on how to link across the disciplines and the issues to make integrated projections. These need to include the feedbacks, such as social changes caused by changing oceans and climate, leading to changes in human behaviour that compound or address the issues of sustainable development. How does the natural science community work to be most effective? Issues of communication, integrated environmental prediction and related issues would come together to address these issues.

## **7.7 Boundary-Layer Studies**

Convenor: Peter Taylor, Co-Convenor; Wensong Weng

This session is focused on advances in understanding the dynamical and thermodynamical structure and the turbulence and mixing properties of boundary layers in the atmosphere and ocean. Contributions reporting theoretical, numerical or experimental work are welcome. Topics of particular interest include: (i) Turbulence and mixing characterization in convective, neutral and stably stratified boundary layers. (ii) The parametrization of turbulence and mixing in models ranging from large-eddy simulations of boundary layer flows with subgrid parametrization, regional models with subgrid boundary-layer flow parametrization, and global climate, ocean or lake circulation and weather prediction models. (iii) Boundary-layers over complex terrain.

## **7.8 Harsh Marine Environments**

Convenor: George Isaac, Co-Convenor: Terry Bullock

This session will showcase methods to improve our understanding of, and ability to forecast, clouds, visibility, winds, sea state, currents, sea level, ice and other critical elements in the harsh marine atmosphere and ocean environments. The session will handle all time scales from nowcasting to climate. Work related to the harsh environments on the east and west Canadian coasts as well as the Arctic are encouraged. Papers which highlight impacts of harsh environments either through case studies or longer term averages and/or describe new in-situ or remote sensing instruments for use in marine environments are also welcome.

## **7.9 Artificial Intelligence and Big Data in meteorological and environmental applications**

Convenors: Bertrand Denis and Michel Jean

The past four to five years have seen rapid advances in the field of artificial intelligence coupled with big data. Data Analytics and Predictive Analytics using machine learning algorithms such as Deep learning trained on vast amounts of data are now beginning to fulfill the promises of AI and are rapidly being applied to many fields, including meteorology, with numerous improvements and new developments now possible. Advances in the science and operational sides of meteorology are therefore expected; but also on the client/user side, where a mix of these techniques coupled with new social media data mining can enable better services for improving life and weather sensitive business decisions.

This session will showcase AI and Big Data applications, as well as related technological challenges. We solicit submission of papers on applications supporting decision-making including weather forecasting, air and water quality, health, defense, energy, transport, sales, stock market, leisure, etc. Any presentation or demonstration of AI techniques that would engage discussion with the participants is particularly welcomed.

### **7.10 General Session - Interdisciplinary**

Convenor:

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