

CMOS-CGU Congress 2016 Sessions

THEME 1: PLENARY

Eight presentations on topics in meteorology, oceanography and earth sciences from invited plenary speakers

THEME 2: ATMOSPHERE

Clouds: Microphysics, Aerosols, and Radiation

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, or results related to issues in climate, numerical weather prediction and air quality. We welcome contributions using observational (in-situ, ground-based or satellite-based) data sets to evaluate parameterizations and models.

Renewable Energy

This interdisciplinary session will present renewable energy and sustainable energy papers addressing the complex interactions of atmospheric behavior on renewable energy and energy production (i.e. wind and solar). The session will provide a broad overview of renewable energy resource studies such as:

1. Solar radiation observations, data resource, and impact of climate change on the solar resource
2. Wind speed measurements, reference stations, and regional global models in renewable energy
3. Impact of extreme weather conditions, climate change on renewable energy and production loss.
4. Wind and Solar resource assessment, modelling and forecasting
5. Applications of wind speed, solar radiation, and energy production forecasting.
6. Sustainable energy and efficient ways in which to reduce greenhouse gas emissions

Fog or Low Visibility in Atlantic Canada

Fog or low visibility has many significant impacts in Atlantic Canada. Fishing, servicing of offshore oil and gas platforms, aviation at airports, road transportation, commercial shipping, and recreational boating are all affected. Surveillance activities, search and rescue activities, and naval operations are also

impacted by low visibility and ceiling conditions. Yet few research-grade quantitative measurements are made and there is an incomplete knowledge of forecast accuracy. Good climatologies are also generally not available. Fog monitoring, especially offshore, is especially difficult. Satellite or remote sensing techniques appear to be viable yet more research is required. Before improved forecasts of low visibility are made, the physical mechanisms of fog formation and dissipation should be understood. Techniques to verify visibility forecasts need to be established. In order to be useful for certain clients, aviation for example, forecasts have to be quantitative and not simply indicators of fog/no fog. This presents some additional challenges because visibility in liquid fog depends on knowing/forecasting droplet concentrations, sizes and cloud liquid water content, or some surrogates of those parameters. Visibility also changes if snow or rain is falling and if ice particles are present suspended in the air. This session will present papers highlighting the progress being made on these problems, including a better understanding of fog or low visibility, new climatologies, improving our monitoring capability, discussion of new forecasting techniques, and some new projects which are addressing these issues.

Aviation Meteorology and Climatology

This session is intended for meteorological and climatological research related to aviation. It includes establishing baselines from historical observations, civilian and military aircraft operations, risks associated with flying under a changing climate, weather forecasting and observations at airports, search and rescues, NAV CANADA programs and others. This session brings individuals with different expertise from various sectors (government, academia, consulting, airline) to exchange ideas on this theme. It is of particular interest to those who are in the Aviation Special Interest Group (SIG).

Environment Canada and the Toronto 2015 Pan Am and Parapan American Games (TO2015 Games)

Environment Canada and the Toronto 2015 Pan Am and Parapan American Games (TO2015 Games). The collaboration between Science and Technology and the Meteorological Service of Canada to showcase Environment Canada science and operational capabilities through the provision of enhanced weather monitoring, world-class research, and venue specific weather alerts to ensure the safety and protection of athletes, staff, essential federal services, volunteers and spectators. The proposal is to have an introductory 30 minute presentation by Dr. David Sills

1. David Sills - Science in support of the TO2015 Games. The following four presentations will be 12 minutes each (with 3 for questions)
2. John MacPhee - Planning, deployment, commissioning, and decommissioning of the mesonet.
3. Martin Elie - Datalogger programing Design, coding, implementation and issues
4. Joan Klaassen - Data analysis and inter-comparison from the mesonet compact stations.
5. The Ontario Storm Prediction Centre - Forecast and alerting in support of the TO2015 Games.

General Atmosphere

General Atmospheric Science and Meteorology.

THEME 3: Climate

Climate Variability and Predictability

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.

Regional climate modelling and diagnostics

2016 will commemorate the 25th anniversary of the inception of regional climate modelling in Canada. High-resolution Regional Climate Models (RCMs) are increasingly being used for studying regional climate processes and for the generation of climate information at the regional scales. Contributions are invited on various topics related to RCM, such as development, outstanding issues, evaluation of performance and added value, diagnostics, design of simulations ensembles, applications to climate-change scenarios and impact studies, assessment of uncertainties, and participation to model Intercomparison projects such as the COordinated Regional Downscaling EXperiment (CORDEX).

Climate Services and Monitoring

This is a general session inviting speakers on the topics of climate services and climate monitoring. Topics range from the provision of basic historical climate/weather data services and analyses to more complex climate information such as engineering data sets like IDF and building code climatology, homogenized data for trend analysis and extreme weather impacts and analysis. Of relevance are the users of climate data and services and how climate information is used in decision making in short and long term applications (or "real-time/non real-time"). Climate monitoring/vigilance includes the various monitoring networks and analysis of data, including mapping on scales from days to weeks to months and communicating the impacts and risks of climate variability in the short and long term.

Agroclimatic Extremes- past, present and future

This session focuses on understanding how extreme weather & climatic events (including disasters) affect the agriculture sector. The objective of this session is to expand our knowledge of how we can use past, present and future events to better identify and assess risks, adapt and reduce the impacts and costs associated with extreme events. Some aspects of extreme events, such as abnormal timing of precipitation or abnormal onset of frost are unique to agriculture. For example, it is documented that between 2008 and 2012, federal-provincial disaster relief payouts for climate-related extreme events totaled more than \$785 million. Additionally, more than \$16.7 billion in crop insurance was paid out during the same period. This session will focus on:

1. Defining. How do we quantify and define extreme weather and climate in agriculture? Do appropriate extreme weather and climatic indices exist for agriculture?
2. Monitoring and assessing. What is the baseline? How do we monitor and assess extreme weather and climate in agriculture? What is the trend? Are extreme weather and climatic events occurring with unprecedented frequency, duration and magnitude?
3. Forecasting. Are the extreme weather and climatic indices predictable with a sufficient lead time and skill to allow affected users and decision-makers to make informed choices?
4. Modeling. To what extent are extreme weather and climatic events represented in the Global Climate Models?
5. Communicating. Are extreme weather and climatic events communicated in ways that allow effective and timely use in decision support tools? and
6. Gaps. What are the uncertainties and gaps in our understanding and knowledge of extreme weather and climate that are preventing us from moving forward?

Researchers and practitioners from the following sciences and fields are encouraged to submit papers: hydrology, climatology, geography, forestry, insurance, transportation, energy, actuary and media. In addition to the aspects outlined above, paper topics on how to integrate climate extremes in biophysical ecosystem models, and gap analysis which identifies future research work on impacts of extreme weather on resources sectors, and forecasts of opportunity that show sufficient skill in climate extremes representation are also welcome.

Progress in Developing Uncertainty Estimates for Gridded Climate Data

High spatial resolution gridded climate and weather products such as PRISM, DayMet, ANUSPLIN, TopoWx as well as those developed as needed within specific research contexts are widely applied in the natural sciences. They are used for development of downscaling products, forcing for process models, or simply for directly informing engineers, resource managers and other practitioners about climate in locations distant from observing stations. Lower resolution gridded climate data such as HadCRUT4 and the 20th Century Reanalysis are also critical for assessment of regional and global climate change and variability. These data sets are subject to considerable uncertainty in regions with complex topography and sparse observational networks. Uncertainty is compounded for precipitation, which has very high and typically complicated spatial variability especially at shorter timescales such as daily and monthly totals. Among the available datasets, some attempts have been made to quantify uncertainty to accompany the gridded data, but many products are still provided without such estimates. This

session aims to further explore the development of supporting data to better enable users to propagate error in their application. We seek submissions ranging from the theoretical backing of spatial uncertainty, to describing methods for developing uncertainty estimates, to progress in refining existing estimates. Presentations discussing the analyses of uncertainty in lower resolution global observational or model ensemble data products are also desired. This session will help inform the attendees of the state of uncertainty analysis in gridded climate products and potentially help to establish more standard practice in their delivery. Any such developments will help end-users make better informed choices when deciding among products for application in a region of interest.

Climate-carbon cycle interactions

The marine and terrestrial carbon cycles are key determinants of the future level of atmospheric CO₂ and hence of future climate change. The global carbon cycle is expected to change in response both to elevated atmospheric CO₂ and to changes in climate, and uncertainties in its response are of a similar magnitude as uncertainties in the physical climate system for predictions of climate change in the 21st century and beyond. Interactive terrestrial and ocean carbon cycles have now been incorporated in most state-of-the-art global climate models, offering powerful tools to investigate climate-carbon cycle interactions. Recent developments include the implementation of coupled carbon-nitrogen cycles, permafrost and wetland carbon emissions. Research with these models has highlighted the proportional relationship between global warming and cumulative CO₂ emissions, the irreversibility of CO₂-induced climate change on centennial timescales, and the resulting policy implications. We invite submissions on all aspects of the global carbon cycle and its interactions with climate change.

Climate Extremes: Drivers and Mechanisms, Today and in the Future

There is a justifiably strong sense that weather and climate extremes are becoming more frequent, and that the main reason is human-induced climate change.⁴² (Trenberth et al., *Nature Climate Change*, 2015). In the context of recent climate events and projected future climate changes, this session solicits papers in the area of extreme climatic events, their mechanisms and drivers, our ability to attribute them to human influence, and their risk of occurrence under ongoing climate change. We are interested in hearing about your research on climatic extremes from droughts, to storms and floods, to heat waves, to sudden sea ice loss and other cryospheric changes, using tools from statistical climatology, climate dynamics, Earth System Modeling, and Regional Climate Modeling. The session will feature invited talks by Kevin Trenberth of the U.S. National Center for Atmospheric Research and another speaker (TBD). We also seek contributed papers from across the CMOS community including the research networks within the NSERC Climate Change and Atmospheric Research Networks (e.g. Cansise.ca and www.CNRCWP.uqam.ca).

General Climate

General Climate

THEME 4: CRYOSPHERE

THEME 5: OCEAN

Oceanographic HF Radar: Acquisition to Assimilation

High-frequency radar (HFR) is a technology which relies on the scattering of radio-frequency radiation from the ocean surface in the high-frequency range (3 to 30 MHz). The scattering is used to measure surface currents, sea state, wind, and even to track marine traffic and icebergs. While the technology was partly pioneered in the 1980s by Canadian researchers, the adoption of commercial systems has only recently taken hold in Canada with installations in the Strait of Georgia and northern BC coast, Placentia Bay, the St Lawrence estuary, and the Scotian Shelf. Our reliance on HFR will only grow from here. For example, Ocean Networks Canada plans to expand the Strait of Georgia network, and to install additional instruments further north on the British Columbia coast. The intent of this session is to bring together those who have an interest in HFR data and instrumentation. We encourage presentations demonstrating the use of HFR for all purposes including (but not limited to!) oceanographic studies (including validation), tsunami detection, surface trajectory prediction, instrument and algorithm development, search and response, sea state estimation, assimilation into ocean circulation models, and ship and iceberg tracking.

Physical Oceanography

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.

Monitoring marine ecosystems and climate

Marine ecosystem monitoring is essential to support sustainable management of marine resources and adaptive responses to climate change and other ecosystem pressures. Ocean monitoring programs provide essential observations for detecting and understanding the causes of long-term change in the physical and chemical environment and the structure and function of marine communities. This session will provide a forum for scientists from DFO and other institutions to disseminate the results of marine

ecosystem and climate monitoring and exchange ideas about how to enhance the role of ocean monitoring in the future. The Atlantic Zone Monitoring Program (AZMP) was implemented in 1998 by the Department of Fisheries and Oceans (DFO) with the aim of increasing the Departmentâ€™s capacity to understand, describe, and forecast the state of the marine ecosystem. Information gathered by the AZMP informs a wide variety of research and management objectives within DFO, including oceanographic research programs, fisheries stock assessments, climate change risk assessments and the designation of marine protected areas. The session will use the experience of AZMP as a starting point for discussion of past practice and future directions but the session welcomes contributions from other programs. Talks addressing the use of observational data to inform decision making; integration of monitoring observations and modeling studies; assessment and mitigation of information gaps; advances in data management practice; and the use of sustained federal monitoring programs as a backbone providing context and platforms for process studies are especially welcomed.

Acoustics in oceanography and marine sciences

Acoustic techniques are the primary means of long distance communication and remote sensing underwater. Consequently, acoustics is key to revealing the underwater world. The focus of this session is to highlight the contributions of underwater active and passive acoustics to all aspects of oceanography and marine sciences. Areas of interest include, but are not limited to: sonar and passive acoustics, bio-acoustics, passive acoustic monitoring, fisheries acoustics, geophysical applications, acoustic communication, defense applications, ambient and ocean noise, anthropogenic noise, long-range propagation, tomography, high-frequency scattering, imaging, and quantitative inversion.

Modelling Tracers in the Ocean

Coupling biological or chemical models to physical ocean circulation models has led to rapid advancement in our scientific understanding and predictive powers in a broad range of fields. This session invites papers on all aspects of configuring such models: including

- 1) best practices for advection, mixing or sinking,
- 2) how to formulate appropriate air-sea or benthic exchanges,
- 3) ensuring boundary conditions are consistent between the physics and the tracers and
- 4) how to make the models faster.

Coastal Oceanography and Inland waters

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, storm surges, tsunamis, estuarine dynamics, hydrology and

hydrodynamics of large lakes, mixing and dispersion of materials. We also invite contributions related to both observational and modelling aspects of biogeochemistry in coastal and inland waters.

General Ocean

General Ocean

Collaboration in development, evaluation and analysis of ocean models

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. Specific topics include:

- 1) optimal design of model domain and grid;
- 2) sources of model input data;
- 3) set up and tests of model parameters;
- 4) improvement in model numerics;
- 5) interface with sea-ice, atmosphere and hydrology modules;
- 6) particle tracking and tracer modules;
- 7) visualization tools;
- 8) model validation and datasets;
- 9) coordinated experiments and inter-comparison;
- 10) model analysis and scientific issues;
- 11) strategy for code version control, sharing and transfer to operations; etc.

This session primarily addresses technical issues, but also welcomes inspiring ideas of ocean modelling studies. While the focus will be on the NEMO and FVCOM models used for the Canadian CONCEPTS, MEOPAR, VITALS, GEOTRACES and World Class Oil Tanker Safety projects, we also welcome experience sharing and insight developed from other state-of-the-art ocean models.

The emerging Arctic Ocean and ocean-atmosphere interactions

Whereas sea ice has been declining in recent decades in the Arctic, it remains a critical factor in simulations and forecasts related to the Arctic atmosphere, oceans, and biological systems. Predicting the future state of sea ice is important for our understanding of climate change and weather. In this session, we will explore the latest developments in our understanding of atmosphere-ice-ocean interactions, to improve understanding and modelling of sea ice in scales ranging from regional-basin scales to the global earth-system. The session will include topics such as, but not limited to, sea ice albedo, surface energy exchange in the sea ice zone, the role of snow on sea ice, sea ice dynamics, the role of ocean waves, wave-ice interactions, interactions between sea ice dynamics and thermodynamics, and the impact of sea ice formation and melt on ocean structure. It will also include remote sensing of

sea ice and sea ice modelling and prediction, at local scales, the marginal ice zone, regional and global scales. In particular, surface waves now have a greater role in the contemporary Arctic Ocean than in previous decades. Indeed, in summer, the entire Arctic Ocean may soon resemble a large marginal ice zone (MIZ), where waves propagate through the ice over large scales, while attenuating and scattering, fracturing ice into ever changing floe size and thickness distributions. Storms and winds may increase. New opportunities and new problems may arise: navigation and maritime activities may become possible, but waves, storm surges and coastal erosion may increase. Air–sea interactions may enter a new regime, with momentum, energy, heat, gas, and moisture fluxes being modulated by the waves, and impacting upper-ocean mixing. We invite presentations on modelling, in situ measurements, remote sensing and related dynamics of the emerging Arctic Ocean

THEME 6: SOLID EARTH

Lithospheric Structure of Eastern North America

Eastern North America records ca. 3 Ga of Earth history, ranging from the Archean Superior Province, via the Proterozoic Grenville Province, to the Paleozoic Appalachians. The accretion of these terranes took place through a dramatic series of tectonic events, involving rifting, major orogenies with associated convergent faulting, and the impingement of the Great Meteor hotspot track. These tectonic events must necessarily have affected the lithosphere as well as the crust, and the availability of new data sets from Canada and the U.S. open up the possibility of relating crustal tectonic events to the structure and fabric of lithospheric domains, and so answering major questions about the vertical coherence of tectonic provinces and the formation of stable cratonic lithosphere. This session is intended for lithospheric studies of eastern North America and surrounding areas, as well as studies addressing related issues in crustal tectonics and geophysical imaging.

Geophysical signatures of active subsurface processes

Our environment and society are increasingly being shaped by natural and anthropogenic processes with potential to affect long-term land-use and the sustainable development of our natural resources. While many of these processes have effects on the earth's surface, others are occurring at depth. Geophysical methods are uniquely poised to monitor these changes and help the scientific community gain a better understanding of the dynamics involved, thereby enabling better prediction of long term outcomes and potential impacts on the environment and society. This session will focus on geophysical signatures and time-lapse monitoring of active subsurface processes. The long time-constants of many processes and the expenses of deploying instrumentation bring unique challenges for the scientific community. Experiments must be designed in order to provide accurate measurements over extended periods of time and often under severe climatic conditions. Long-term reliability of instrumentation and potential perturbation of the natural system by the measurement apparatus must be carefully considered. This session will provide researchers with an opportunity to showcase experiments and

monitoring programs that are aimed at understanding active subsurface processes and their measurement. We invite submissions that make use of geophysical imaging and measurement of in-situ physical parameters. Such work may include subjects such as monitoring of seepage in dams, solute and contaminant transport, thawing of permafrost, and CO₂ sequestration within saline aquifers or through mineral carbonation.

Solid Earth General Session

This session focuses on the physics and chemistry of the solid Earth and the liquid core of the Earth, including geomagnetism, paleomagnetism, marine geology/geophysics, tectonophysics, hydrogeophysics, engineering geophysics, chemistry and physics of minerals, and related instrumentation and techniques. We invite oral and poster contributions that focus on scientific results and/or their applications to exploring these issues that do not fit any approved specialist sessions.

THEME 7: HYDROLOGY

Oil Sands Reclamation

Oil sands extraction creates enormous challenges for managing tailings and overburden, water resources and ecosystem processes on the Western Boreal Plain (WBP). The flat and gently rolling boreal forest, dominated by peatlands covering over 50% of the land area, is transformed into a landscape with more exaggerated topography and barren soils that require reclamation. Industry recognizes the need to integrate landscape reclamation to include hydrologic response areas (HRAs) that control water storage and movement to achieve multiple objectives including managing site runoff, water quality and ecosystem development. A better understanding is needed of how soil capping and hillslope reclamation control down-gradient hydrological and ecosystem processes, particularly wetlands, and of wetland reclamation itself. We invite presentations on hydrological and biogeochemical processes in and around the oil sands extraction areas, which improve our understanding of the viability of landscape reclamation in the WBP.

Hot and Hotter: Temperature as an indicator of environmental change and a tracer of hydrologic processes

Temperature is both an important environmental variable and a powerful tracer of hydrologic processes. For example, surface water temperature is a critical determinant of aquatic ecosystem health, while ground temperature determines permafrost distribution, influences subsurface biogeochemical reactions, and retains thermal signatures from past climates. Subsurface temperature can be used as a hydrologic tracer via a proper understanding of the interplay between energy transport and water flow. For example, streambed temperatures can both affect stream habitat and be employed

to determine rates of groundwater-surface interactions. Additionally, deeper temperature-depth profiles in wells can be investigated to study the interactions of subsurface temperature, multi-decadal climate change, and vertical groundwater flow. This session will feature studies that employ temperature to investigate hydrological processes, both as a tracer and an environmental variable. Possible topics include groundwater-surface water interactions, novel techniques for measurement and analysis of temperature, advances in numerical modeling approaches, climate change impacts on temperatures in hydrologic systems, and subsurface temperature changes (permafrost thaw) in cold regions.

Applications of L-Band Microwave Remote Sensing in hydrological monitoring

Passive and active microwave L-Band remote sensing has numerous applications for the monitoring of soil moisture, soil/freeze thaw processes, and the cryosphere. Over the last few years, several satellite missions collecting data in these frequencies have been launched including the Soil Moisture and Ocean Salinity (SMOS), Aquarius, the Soil Moisture Active Passive (SMAP) and Advanced Land Observing Satellite (ALOS-2) PALSAR, offering a great number of applications for the use of these data in the hydrological and atmospheric sciences. Furthermore, numerous aircraft and ground-based field campaigns have recently been conducted for improved physical understanding of the properties and applications of retrievals from sensors operating in the L-band frequency. In this session we welcome presentations on the applications of L-band microwave remote sensing for the monitoring, modelling and enhanced understanding of the hydrosphere and its interactions on climate processes.

Cold Regions Hydrology and Hydrometeorology

This session welcomes scientific submissions that discuss recent and projected changes to cold regions hydrology and land surface processes and developments in predictive capability of the hydrology and hydrometeorology of regions that are affected by snowfall, snow cover, frozen ground, river/lake ice or glaciers. Of particular interest is work outlining field and/or remote sensing studies of hydrological and hydrometeorological processes, the use of models in diagnosis and prediction of hydroclimatic change, the representation of cold region processes in land surface schemes, and regional climate model applications. As there is abundant evidence that the extremes of precipitation and streamflow will intensify with global change, this session also encourages submissions that investigate the characteristics and behaviours of these particular events in the context of cold regions hydrology and hydrometeorology and their predictability at various scales.

Advances in Hydroecology in Canada

The Hydrology Section of the Canadian Geophysical Union approved the formation of a Hydroecology Committee in May 2015. The objective of the newly formed Hydroecology Committee is to promote and advance the understanding of the linkages between hydrology and ecology in wetland, lake, and river systems across Canada. The goal of this session organized by the Chairs of the Hydroecology Committee is to convene scientists who are investigating the role of hydrology in influencing ecological processes

and integrity in ecosystems across Canada. Topics of interest include, but not limited to: anthropogenic effects, such as climate change and flow regulation, on low flow and flood events with implications for riverine and riparian/delta floodplain environments; development of hydroecological model and monitoring approaches; application of new methods in hydroecology including environmental flow development; assessment of spatial and temporal trends in hydroecological variables.

General Hydrology

This is a General Session for Hydrology that invites contributions from all aspects of hydrology.

Use of Remote Sensing for Floodplain Characterization

This session invites contributions that deal with the use of remote sensing in flood plain and flooding characterizations. Papers related to the new Canadian RADARSAT-2 satellite and the future RADARSAT-3 Constellation mission are particularly welcome. Contributions are solicited on topics including wetland mapping, InSAR water level monitoring in wetlands, SAR and InSAR river ice monitoring, water bodies mapping, floodplain mapping in urban areas.

Urban Water In Canada

The proportion of the Canadian population living in urban areas has grown steadily since the early 1900s and the expansion of urban land area has followed suit. In urban and urbanizing watersheds, rivers and streams exhibit flashy stormflow and degraded water quality that ultimately affect aquatic ecosystem health in downstream receiving waters. Many public and private institutions are increasingly aware of the opportunities and challenges associated with preserving the environmental integrity of our watersheds and waterways and science-based urban water research is growing accordingly. We invite papers that explore how the interactions of hydrological, biogeochemical and ecological processes with the built environment underlie spatiotemporal patterns in water quantity and quality in urban and urbanizing watersheds in Canada. Research that evaluates individual and cumulative drivers of changes in water quantity and quality, for example, changes in land use and land cover, conservation measures, and low impact development, as well as utilizing a combination of field-, laboratory- and modelling-based approaches is of particular interest for this session.

Historical and Projected Changes in Hydroclimatological Extremes: Investigating the Roles of Teleconnection Signals and Climate Change

The intensity and frequency of hydroclimatological extremes such as floods, droughts, and intense rainfall, which pose serious threats to societies and ecosystems, are likely to rise because of climate

change. Hydrological modelling and statistical prediction of these extremes are challenging because of their nonstationary variations. Understanding the anthropogenic and natural causes of hydroclimatological extremes helps to improve current prediction models. This session seeks presentations on the latest advances in physical understanding, hydrological modelling and statistical analysis of nonstationary extremes, analysis of past trends and variability, future projections, effects of teleconnection signals such as ENSO, PDO and AO/NAO, comparison of statistical and dynamical model forecasts, and case studies involving analysis of extremes for infrastructure design. Submissions on the application of statistical techniques (e.g. extreme value theory, probabilistic extreme analysis, and regional frequency analysis) and evaluation of uncertainties are also encouraged.

THEME 8: GEODESY

Integrated Geodetic & Geophysical Monitoring of Earth Systems

Improvements to geodetic methodologies have enabled better understanding of the Earth's systems, including improved modeling and forecasting of changes that may affect society. Satellite-based geodesy (e.g., GPS, GRACE, InSAR) and repeated terrestrial geophysical observations (e.g., magnetotellurics & absolute gravimetry) provide complementary data sets that further enhance and enrich scientific investigations of time-variable processes. Submissions that apply multiple geodetic and geophysical tools and/or data sets to investigate dynamic processes are sought by this special session. Studies at all spatial scales are welcomed including those (for example) from broad-scale glacio-isostatic adjustment, to regional-scale earthquake deformation and hazard studies at both active margins and continental interiors, to variations in total water storage within a basin, to localized monitoring of surficial doming near CO₂ sequestration injection sites. Similarly we also encourage contributions that employ multiple techniques to investigate processes on any time scale (including), from long-term secular deformation, to transient geodetic signals that have durations of several weeks (such as Episodic Tremor and Slip), to atmospheric loading and ionospheric studies, and to high-rate applications such as ~GPS seismology™ studying surface coseismic displacements and surface waveforms. Especially encouraged are contributions using geodetic and geophysical data to study interactions between atmosphere, hydrosphere, cryosphere, geosphere, pedosphere, biosphere, and magnetosphere systems.

Geodesy and Geodynamics

This General Geodesy session is open to all other aspects of geodesy. In particular, contributions related to three-dimensional georeferencing and GNSS/INS/imaging for navigation, mapping and GIS applications are welcome. This session is open to papers within the broad depth of geodetic sciences and applications to geodynamics. This session encourages submission of papers dealing with the state-of-the-art in geodetic measurements involving ground and space techniques individually (e.g., GNSS, VLBI, gravity) or in combinations (towards GGOS), and interpretation and application of the geodetic

signal into investigations towards Earth rotation and polar motion, precise orbit determination, analysis and prediction of processes involving the oceans, atmosphere and internal processes in the solid Earth

Geoid Modelling and Vertical Systems

This session deals with all aspects related to geoid modelling and vertical systems, being regional or global. Those aspects include among other topics, improvements in geoid modelling, downward continuation, terrain effects, use of different types of gravity anomalies, used of terrestrial and / or space data, gravimetry, gradiometry, and other methods. Gravimetric space missions. Other related topics are also welcome.

THEME 9: BIOGEOSCIENCES

Greenhouse Gas Exchange from Restored or Reclaimed Ecosystems

This session will explore the magnitude of and controls on greenhouse gas exchange between land, water, and atmosphere in environments undergoing or previously subject to ecological restoration or reclamation efforts. Restoration or reclamation efforts often seek to return key ecosystem functions to the landscape of which the net exchange of greenhouse gases is a particular relevant example in context of climate change. We invite papers concerned with the creation or fate of climate-relevant gases in disturbed ecosystems that have been considered for or are undergoing work that removes or compensates for the disturbance. Consideration of greenhouse gas exchange from microbial to global scales and using a variety of methods (e.g. laboratory incubations, mesocosms, chamber measurements, eddy covariance, numerical modeling) are welcome.

Use of Remote Sensing in Arctic Studies

This session invites contributions that deal with arctic environment studies. Contributions are solicited on topics including studies of the use of remote sensing in arctic studies for example for permafrost mapping, land cover mapping, sea ice mapping, tundra ecosystem monitoring. Equally welcome are contributions on permafrost monitoring using climatic data and on effects of permafrost thawing. Papers related to the new Canadian RADARSAT-2 satellite and the future RADARSAT-3 Constellation mission are particularly welcome.

Use of Remote Sensing for Floodplain Characterization

This session invites contributions that deal with the use of remote sensing in flood plain and flooding characterizations. Papers related to the new Canadian RADARSAT-2 satellite and the future RADARSAT-3 Constellation mission are particularly welcome. Contributions are solicited on topics including wetland

mapping, InSAR water level monitoring in wetlands, SAR and InSAR river ice monitoring, water bodies mapping, floodplain mapping in urban areas.

Aquatic Transport of Nutrients and Carbon from Agricultural Landscapes

Eutrophication is a critical problem globally that affects both inland and marine waters. It is well recognized that the timing, magnitude, and speciation of diffuse nutrient inputs from watersheds to receiving waters exert strong controls over both total algal biomass and algal community dynamics. Despite this, there are still major knowledge gaps regarding the effects of seasonality, storm events, land use, and management practices on the particulate and aqueous speciation and bioavailability of key nutrients such as carbon, nitrogen, phosphorus and silicon. The aim of this session is to bring together researchers working on aquatic nutrient and carbon transport from agricultural landscapes. While we are interested in all scales, including individual parcels of land, headwater catchments, and large rivers, we are especially interested in work which examines nutrient and carbon transport across multiple scales.

Impacts of long-term variations and extreme events on winter biogeochemical processes

Winter is a key period for biogeochemical, hydrological and ecological processes across Canada. During colder months, snowpacks contribute to hydrological and biogeochemical budgets, insulate soils and biota and mediate climatic processes through their physical structure and albedo. As a result, winter processes are uniquely vulnerable to changes in temperature, as the effects can be direct or indirect, through changes in duration and depth of snow cover, the form of precipitation or the timing of spring melt. The frequency and intensity of extreme winter events, including rain-on-snow events or ice storms may be affected by climate change, resulting in unforeseen changes to biogeochemical cycling. Furthermore, in many regions, the greatest observed increases in temperature have been during the winter. While Canada has a rich legacy of cold season research, we are only beginning to understand the implications of these changing drivers on biogeochemical processes. We invite contributions focusing on winter biogeochemical processes, with particular emphasis on changes to winter processes due to extreme events or long-term variations. We welcome papers with broad disciplinary perspectives and will consider papers presenting field, laboratory and/or modelling data. Examples might include impacts of freeze-thaw or rain-on-snow events, interactions between winter hydrology, ecology and biogeochemistry, under-snowpack or under-ice processes or changes in the shoulder seasons (fall freeze-up and the vernal transition) that impact winter processes.

General Biogeosciences

This session will highlight the diversity of research investigating the underlying processes, measurement, and modelling of ecosystem form and function. Presentations discussing all aspects of ecosystem form

and function from recent advances in understanding the fundamental mechanisms underlying processes shaping landscapes to novel methods for modelling them and approaches for monitoring them via both field and remote techniques are encouraged. Sample topics include integrating measurements, modelling, and remote sensing to describe biogeoscience processes in both natural and managed ecosystems; characterizing measurement and modelling uncertainty in complex and heterogeneous landscapes; scaling linked water/nutrient/sediment exchange processes; determining the impacts of changing climate conditions on water/nutrient/sediment exchange processes across ecosystems; identifying and evaluating the effects of drought and other extreme weather phenomena on ecosystem form and function; developing novel and improved sensor systems and measurement techniques; and, diagnosing the effects of biota on driving change in landscape form or hydro-biogeochemical functioning.

THEME 10: EARTH SURFACE

Land surface modelling for GCMs and ESMs

The importance of land surface processes and feedbacks in the global climate system has long been recognized, and decades of research have gone into the development of land surface schemes for global climate models (GCMs) and earth system models (ESMs). The development of such land surface schemes involves particular challenges, in that they must include physical processes operating at sub-diurnal time scales and at local spatial scales, but must also be capable of being applied at century-long time scales and global spatial scales. Thus, for example, although testing of the models with field data is of key importance in validating the physical realism of their parameterizations, this must also be complemented with regional-scale validation, usually using remote sensing observations. Ongoing research must also address the perennial problem of representing sub-grid scale heterogeneity in vegetation, soils, surface water and ground or surface ice, as well as the new frontiers of adding biogeochemical cycles, vegetation dynamics and the effects of surface disturbances. In Canada, 2016 will mark thirty years of development work on CLASS, the Canadian Land Surface Scheme, and nearly fifteen years of work on CTEM, the Canadian Terrestrial Ecosystem Model. This model development work has involved dozens of researchers in Canadian government and university centres, and numerous collaborations with researchers internationally. This session invites presentations on current work in CLASS and CTEM development, as well as work on the development of other land surface schemes designed for climate and weather models.

Modelling Earth Surface Processes

Research in the general area of Earth surface processes has evolved over the past two decades to become a much more hypothesis-driven science. Now, researchers often combine field and/or laboratory data with some kind of model to either aid in data interpretation or improve our theoretical understanding of Earth surface processes. We encourage submissions that demonstrate the novel

application of physical, numerical and/or conceptual models to the study of the erosion, deposition, and formation of landforms and sediments over a wide range of temporal and spatial scales. Areas of particular interest include the development and testing of landscape evolution models, the use of physically based models to interpret the cause of landform changes observed in the field, and the use of physical models to study landscape dynamics in the laboratory. Presentations describing recent advances in our theoretical understanding of Earth surface processes are also encouraged.

Advances in Earth Surface Processes

Earth Surface Processes are an important subdiscipline of geosciences. It addresses, past, present and future challenges within geosciences and includes the influence of human activities on the Earth's surface. We invite oral and poster contributions that focus on scientific results and/or their applications to exploring earth surface processes at regional, national and international scales and would be suitable for work that does not fit any approved specialist sessions.

THEME 11: INTERDISCIPLINARY

Hydro-Climatic Extremes and Variability

Since human activities and ecosystem health are dependent on adequate, reliable water supplies, hydro-climatic extremes and variability pose a serious threat to society and the environment. Phenomena ranging from longer-term droughts and excessive moisture conditions, to short-duration extreme precipitation events and associated floods are among Canada's costliest natural disasters impacting a wide range of sectors including agriculture, forestry, industry, municipalities, recreation, health and society, and aquatic ecosystems. Recently, there has been a considerable increase in the damages and risks associated with extremes in water, weather, and climate. Explanations for these advanced trends range from development policies that have allowed urban growth on the flood plains of many rivers, to poor water management practices in semi-arid regions. In addition, there is growing scientific consensus that these increasing impacts are clear evidence of changes in the frequency and intensity of severe events associated with climate change. Over the past several years, knowledge of extreme events and their impacts have increased due to advanced statistical analyses of past observed climate data, and improved re-analyses products and climate/hydrologic model outputs. In addition, individual case-studies of particularly extreme hydro-climatic events have advanced our understanding of impacts associated with these extremes. This scientific session focuses on the occurrence, causes, impacts, and adaptation strategies to hydro-climatic extremes and variability around the globe with an emphasis on Canada. Papers are invited that explore all aspects of climatologic and hydrologic extremes and variability including observational and/or modelling studies of: Past occurrence including trends and variability in frequency and magnitude, Projected future changes and associated impacts on hydrology and water resources systems, Adaptation strategies, Methodologies for improving monitoring and prediction, and Related topics.

Unmanned air vehicles in the earth, meteorological and oceanographic sciences

The use of unmanned air vehicles (UAVs) is increasing in a wide range of civilian applications and the earth, meteorological and oceanographic sciences are no exception. In addition to savings on fuel and personnel costs, UAVs have the advantages of safe low altitude flying and high manoeuvrability. The session will focus on all aspects of this emerging technology, from platform design to mission planning and data interpretation. Abstracts are invited that feature UAVs of different types and sizes (quadrotors, helicopters, fixed-wing, optionally piloted, etc.), equipped with various sensors (day time video cameras, night time infrared cameras, hyperspectral sensors, magnetometers, 3D imaging systems, etc.). Case histories on UAV missions are particularly welcome, including but not limited to, management of open-pit mines, geological mapping, ecosystem monitoring, species inventory, digital terrain analysis, precision agriculture, weather forecast, etc. The session aims at bringing together people from a wide range of disciplines from natural hazard management to soil sciences.

Imaging in the earth, meteorological and oceanographic sciences

Imaging is providing an interesting new perspective for several applications in the earth, meteorological and oceanographic sciences. This session will feature different imaging techniques, including X-ray computed tomography, 3D laser imaging and radar, and different imaging sensors such as LiDARs, triangulation-based laser cameras, and bathymetric laser systems. The session will cover applications at different scales from micron-scale (e.g. detailed imaging of the surface and interior of geomaterials) to meter-scale (e.g. imaging road cuts and outcrops), panoramic-scale (e.g. imaging transportation corridors and mountain slopes) and planetary scale (e.g. remote sensing of the atmosphere and oceans from satellites). Abstracts are invited on instrumentation and calibration, mapping, image processing and analytics, and case histories.

Atmosphere, Ocean, and Climate Dynamics

This session combines submissions on processes and mechanisms in atmosphere, ocean and climate 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 and of reanalysis and other observational datasets serve to increase our understanding of dynamical processes that drive circulations across time and spatial scales. Other sessions exist for addressing operational issues, numerical modelling, and the acquisition and use of observations. However, dynamical studies of the atmosphere, ocean, and climate systems are often difficult to slot into particular sessions. Combining such studies into a single session could be of great benefit to the CMOS community in general. Note to congress organizers: We would like to request that our session be scheduled between May 29 and 31 since the co-organizer who will be attending the

meeting is also serving as Associate Dean during this time period and will need to return to Waterloo for University meetings later in the week.

Military Meteorology and Oceanography

The basis of military weather and oceanographic services is to provide advice on the impact of the physical environment on military capabilities, to ensure the safety and effectiveness of military resources. This session will present information on current projects in this domain.

Extraordinary Pacific Ocean and Atmospheric Variations During 2013-2015

In 2013, large scale atmospheric features in the northwestern hemisphere evolved such that the Aleutian Low over the northeast Pacific during the winter of 2013-14 was abnormally weak. Surface conditions included weak geostrophic winds and no major storms, resulting in reduced Ekman pumping out of the Gulf of Alaska and minimal mixed layer dynamics in the upper ocean. As a result, by early 2014 the surface waters in the northeast Pacific were extraordinarily warm and low in nutrients. Coined the "Blob" by Nick Bond of the University of Washington, the associated oceanographic conditions and atmospheric response to the warm surface waters affected weather from Alaska to California, and through modifications to the Jet Stream, weather across much of North America throughout much of 2014 and 2015. By mid-2015, an El Nino had developed, bringing the Tropics into play. This session invites talks and posters assessing all aspects of the ocean and atmosphere phenomena possibly contributing to and resulting from the extraordinary variations in ocean-atmosphere structures during the 2013-2015 period.

Coupled modelling and the Year of Polar Prediction

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 is particularly relevant for the upcoming Year of Polar Prediction (YOPP), a period of intensive observing, modelling, verification, user-engagement and education activities planned for mid-2017 to mid-2019, to enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, including ice-ocean forecasting. YOPP is a major initiative of WMO's world Weather Research Polar Prediction Project (WWRP-PPP). 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. Contributions on observations, modelling and verification related to YOPP are especially

invited. This session is co-sponsored by the Global Ocean Data Assimilation Experiment (GODAE) Ocean View (GOV) Coupled Prediction Task Team (CP-TT) and WWRP-PPP.

Sensitivity and Uncertainty Analysis of Earth and Environmental Systems Models

Proper characterization of uncertainty remains a major challenge, and is inherent to many aspects of modelling such as structural development, hypothesis testing and parameter estimation, and the adequate characterization of forcing data and initial and boundary conditions. To address this challenge, methods for a) uncertainty analysis (UA) that seek to quantify uncertainty (and how it propagates through a system/model), and b) the closely-related methods for sensitivity analysis (SA) that evaluate the role and significance of uncertain factors (in the functioning of systems/models), have proved to be very helpful. This session invites contributions on both theory and/or application of SA/UA methods applicable to all Earth and Environmental models (e.g. climatological or hydrological models). Contributions addressing any or all aspects of sensitivity/uncertainty, including those related to structural development, hypothesis testing, parameter estimation and model calibration, forcing data, and initial and boundary conditions are invited. Particular topics of interest include (but are not limited to):

- 1) Novel methods for effective characterization of sensitivity and uncertainty
- 2) Implications of SA/UA for model calibration and validation
- 3) Impact of input data uncertainty on model performance
- 4) Single- versus Multi-criteria SA/UA
- 5) Metric specification for model evaluation
- 6) Improving the computational efficiency of SA/UA (efficient sampling, surrogate modelling, parallel computing, model pre-emption, etc.)

Prediction and Communications of Weather-Related Health Services

This is a general session inviting speakers on the topics of Prediction of Weather-Related Health Services. Prediction encompasses elements of modeling, forecasting and case studies associated with the provision of health services. Weather-related Health services are associated with air quality, extreme temperatures, UV, vector-borne diseases and others. Papers related to innovative communications approaches, the development of indices to enhance public usability and evaluation of weather-related health services will also be entertained.

Engaging with the Private Sector

While CMOS continues to grow and find relevance in society, the important transfer of knowledge and science into the private sector becomes an important vehicle to operationalise or support Canadian science. This Special Session of the CMOS Congress is intended to showcase members and companies of

the CMOS Private Sector. Contributors are invited to make their pitch about their companies, on the relevance of their work and science as it relates to CMOS in meteorology, oceanography with scientific applications that results in a commercial product or service.