ISSN 1929-7726 (Online / En ligne)

CMOS BULLETIN SCMO

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

December / decembre 2018 Vol. 46 No. 6

Story Inside: ***Canada's Top Ten Weather Stories of 2018 /***
Les dix événements météorologiques les plus marquants au Canada en 2018**. p 12.**
Photo source: https://pixabay.com/en/users/piro4d-2707530/


Nothing says it
LIKE A PICTURE.

CMOS Bulletin SCMO
Volume 46 No. 6
December 2018 - decembre 2018

CMOS Bulletin SCMO

"at the service of its members / au service de ses membres"

Editor / Rédactrice: Sarah Knight
Director of Publications /
Directeur des publications: Douw Steyn

Canadian Meteorological and Oceanographic Society / Société canadienne de météorologie et d'océanographie
E-mail: bulletin@cmos.ca
Courriel: bulletin@scmo.ca

CMOS Office / Bureau de la SCMO

P.O. Box 3211, Station D
Ottawa, Ontario, Canada, K1P 6H7
Homepage: http://www.cmos.ca
Page d'accueil: http://www.scmo.ca

Gordon Griffith, Ing., P. Eng., FEC
Executive Director - Directeur général
Tel/Tél.: 613-990-0300
E-mail/Courriel: cmos@cmos.ca

Ms. Qing Liao
Office Manager - Chef de bureau
Tel/Tél.: 613-990-0196
E-mail/Courriel: accounts@cmos.ca

CMOS exists for the advancement of meteorology and oceanography in Canada.

Le but de la SCMO est de promouvoir l'avancement de la météorologie et l'océanographie au Canada.

Words from the President

Anthropogenic Climate Change and Environmental Sustainability

To complete our review of the stewardship themes I identified at the time of the Halifax congress, it's time to highlight environmental stewardship and sustainability, particularly in the area of anthropogenic climate change. The last two months have witnessed the increasingly urgent messages of climate science and the risk humanity faces in the absence of climate action, in the lead up to the COP24 climate talks in Katowice, Poland.

The scientific backdrop for this meeting was provided by the October 2018 Special Report of the Intergovernmental Panel on Climate Change entitled Global Warming of 1.5°, which concluded:

- That human activities have caused approximately 1.0°C of global warming above pre-industrial levels, and that global warming is likely to reach 1.5°C, or another 50% of global warming, in the coming one to three decades.
- That Northern nations like Canada experience warming greater than the global mean, including two to three times higher in the Arctic.
- That human-induced warming has already caused detectable impacts on ecosystems, on human systems, and on human well being. These impacts include hot extremes in most inhabited regions, and increased frequency and intensity of both heavy rainfall events and drought in several regions.

The report also outlines the benefits of avoiding the limit of 2.0°C of global warming (double the current level of warming we have experienced): reducing risks of droughts and heavy rainfall events, sea level rise, species loss and extinction; and moderating negative impacts on agriculture and health. To stay under this limit requires ambitious and rapid transformations in many domains, from energy systems, to land use, regional planning, infrastructure, transportation, and industry, all in the support of deep carbon emissions reductions.

To start our modest response in face of these enormous challenges, in November, CMOS's Scientific Committee and Council endorsed the Global Warming of 1.5° Report. I encourage you to read the text of the endorsement, which highlights the Canadian perspective on the Special Report and recognizes Canadian contributions to it. As I stated at the November Council meeting, I believe that such endorsements are of concrete value. The primary role of CMOS should be to advocate for and support the kind of high quality, peer reviewed science represented by this report. Such support can never be taken for granted, as we witnessed in the controversy regarding international endorsement of the report at COP24.

Of course, the challenges we face cannot be limited to statements of support but must also be accompanied by action. That's why we are seeking to account for and reduce CMOS's environmental impact, within sustainability frameworks like the Global Reporting Initiative. This also gives us a chance to improve our practice as a professional society. For example, at the December 2018 meeting of Council, we decided for the first time to allow members to attend and vote on CMOS business via electronic (WebEx) access to the CMOS Annual General Meeting, starting at the IUGG General Assembly in 2019. This will allow our membership to participate in CMOS's business without undertaking unnecessary travel. Please let us know (myself, at president@cmos.ca; our Executive Director, Gordon Griffith, at exec-dir@cmos.ca; or Sarah Knight, CMOS Bulletin editor, at bulletin@cmos.ca) your thoughts and your interest in helping with our effort to reduce CMOS's environmental impact.

As we face tough and challenging news, let us not lose perspective on what we have to be grateful for in the CMOS community. I wish all of you all the best for the New Year.

Sincerely,

Paul Kushner

CMOS President and Professor, Department of Physics, University of Toronto
Email: president@cmos.ca
Tel: 416-946-3683

Mot du président

Les changements climatiques anthropiques et la pérennité de l'environnement

Pour terminer la revue des thèmes relatifs à la gestion que j'ai présentés lors du congrès d'Halifax, il est temps de mettre l'accent sur la gestion et la pérennité de l'environnement, notamment dans le domaine des changements climatiques d'origine humaine. Au cours des deux derniers mois, nous avons pris connaissance de résultats de plus en plus alarmants issus des sciences du climat ainsi que de messages sur les risques auxquels l'humanité sera confrontée en l'absence de mesures relatives au climat, et ce, dans la perspective des négociations sur le climat de la COP24 à Katowice, en Pologne.

En toile de fond de cette rencontre, le rapport spécial d'octobre 2018 qu'a produit le Groupe d'experts intergouvernemental sur l'évolution du climat sous le titre « Réchauffement planétaire de 1,5 °C » et qui conclut que :

- les activités humaines ont causé une augmentation d'environ 1,0 °C de la température de la planète par rapport aux niveaux préindustriels et que le réchauffement de la planète atteindra probablement 1,5 °C, c'est-à-dire une hausse atteignant la moitié du réchauffement déjà connu, mais au cours des 10 à 30 prochaines années;
- les pays nordiques, comme le Canada, connaissent un réchauffement supérieur à la moyenne mondiale, et notamment deux à trois fois plus élevé dans l'Arctique;
- ce réchauffement d'origine humaine a déjà produit des effets détectables sur les écosystèmes, sur les systèmes humains et sur le bien-être humain. Ces impacts comprennent des extrêmes de température maximale dans la plupart des régions habitées, ainsi qu'une augmentation de la fréquence et de l'intensité des pluies abondantes et des sécheresses dans plusieurs régions.

Le rapport souligne également les avantages de ne pas atteindre 2,0 °C d'augmentation de la température (le double du niveau actuel de réchauffement) : la réduction des risques de sécheresse et de pluies abondantes, de l'élévation du niveau de la mer, du déclin et de la disparition des espèces, ainsi que l'atténuation des incidences négatives sur l'agriculture et la santé. Pour rester sous cette limite, il faut une transformation ambitieuse et rapide de nombreux domaines, des réseaux énergétiques à l'aménagement du territoire, en passant par les infrastructures, les transports et les industries, le tout dans le but de réduire considérablement les émissions de carbone.

Pour apporter notre modeste contribution à cet enjeu de taille, le comité scientifique et le conseil d'administration de la SCMO ont approuvé, en novembre, le Rapport spécial sur le réchauffement planétaire de 1,5 °C. Je vous encourage à lire la position de la SCMO, qui souligne la perspective canadienne du rapport spécial et les contributions canadiennes à celui-ci. Comme je l'ai mentionné lors de la réunion du conseil d'administration de novembre, je pense que cet appui revêt une importance concrète. La fonction première de la SCMO devrait être de promouvoir et d'appuyer le type de science de haute qualité, évaluée par des pairs, que représente le rapport du GIEC. Un tel soutien ne peut jamais être tenu pour acquis, comme le montre la controverse concernant l'approbation internationale du rapport à la COP24 (en anglais).

Bien entendu, les enjeux qui nous préoccupent ne peuvent se régler uniquement par des déclarations de soutien, celles-ci doivent également s'accompagner d'actions concrètes. C'est pourquoi nous nous efforcerons de tenir compte de l'impact environnemental de la SCMO et de réduire celui-ci, grâce à des cadres de développement durable comme la Global Reporting Initiative (site en anglais). Cette approche nous permet en outre d'améliorer nos pratiques en tant que société professionnelle. Par exemple, lors de la réunion du conseil d'administration de décembre 2018, nous avons décidé de permettre aux membres d'assister à l'Assemblée générale annuelle de la SCMO et de voter relativement aux affaires de la Société par le biais d'un accès électronique (WebEx), et ce, pour la première fois, dès l'Assemblée générale de l'UGGI en 2019. Cette mesure permettra à nos membres de participer aux activités de la SCMO sans avoir à se déplacer. Veuillez nous faire part de vos réflexions et de votre désir de nous aider à réduire l'impact environnemental de la SCMO, à l'une des adresses suivantes : president@cmos.ca (moi), exec-dir@cmos.ca (directeur général, Gordon Griffith) ou bulletin@cmos.ca (rédactrice en chef du bulletin de la SCMO, Sarah Knight).

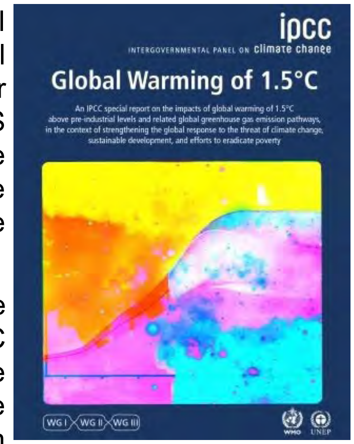
Tandis que nous prenons connaissance de nouvelles préoccupantes, ne perdons pas de vue l'apport positif des membres de la SCMO. Je vous souhaite à tous une bonne année.

Paul Kushner

Président de la SCMO et Professeur, Département de physique, Université de Toronto
Email : president@cmos.ca;
Tél. : 416 946-3683

Position Statement

CMOS Statement on the IPCC Special Report on Global Warming of 1.5°C



The Canadian Meteorological and Oceanographic Society (CMOS) is the national society dedicated to advancing atmospheric, oceanic, and related environmental sciences in Canada. CMOS has more than 800 members from Canada's major research centres, universities, private corporations and government institutes. CMOS is uniquely positioned to provide expert advice to Canadians on the science of climate change. Many of its members are internationally recognized scientific experts who are extensively involved in comprehensive assessments of the current state of knowledge with respect to this complex issue.

This position statement is intended to summarize and reflect CMOS's views on the IPCC Special Report entitled 'Global Warming of 1.5°', which was approved by IPCC in October 2018. The report was prepared in response to the invitation by the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) articulated in its decision to adopt the Paris Agreement in December 2015. Under the Paris Agreement, 195 nations committed to "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels". While several studies had explored the avoided impacts and emission reduction implications of limiting warming to 2°C, little was known about the 1.5°C limit.

The special report assesses the available scientific, technical and socio-economic literature relevant to global warming of 1.5°C. It presents findings about the current state of the climate system relative to 1.5°C, the impacts that would be avoided by limiting warming to 1.5°C compared to 2°C, the greenhouse gas emission pathways and systems transitions required to keep warming below 1.5°C, and implications for sustainable development and poverty eradication.

Where do we stand now?

Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels in 2017. This means that anthropogenic global warming caused by greenhouse gases and other forms of pollution has brought us to within 0.5°C of the 1.5°C limit. At the current warming rate, global warming is likely to reach 1.5°C between 2030 and 2052, with a best estimate of 2040. Current global warming will persist from centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise. However, past emissions alone are unlikely to cause global warming of 1.5°C.

The observed warming is not evenly distributed. In particular, land regions like Canada have experienced warming greater than the global mean, including two to three times higher in the Arctic.

Why stay at the 1.5°C global warming limit?

Human-induced warming has already caused detectable changes in the climate system with impacts on ecosystems, as well as human systems and well-being. Many of these impacts and associated risks will be exacerbated at the 1.5°C limit. Projected climate changes at 1.5°C include an increase in hot extremes in most inhabited regions, and increased frequency and intensity of both heavy rainfall events and drought in several regions.

Climate model simulations show stark differences in impacts and associated risks between 1.5°C and 2°C. If we avoid the 2°C limit and stay below the 1.5°C limit, we expect to see a wide range of benefits, including:

- Reduced risks from droughts and heavy rainfall events;
- 10 cm less global mean sea level rise by 2100, with up to 10 million fewer people exposed to sea level rise-related risks;
- Reduced impacts on biodiversity and ecosystems, including species loss and extinction;
- Reduced increase in ocean temperature and ocean acidity and reduced decrease in ocean oxygen levels, implying reduced risks to marine biodiversity, fisheries and ecosystems and their services to humans;

- Substantially lower probability of a sea-ice-free Arctic Ocean in the summer;
- Higher probability of saving some coral reefs;
- Lower risks for heat-related and ozone-related mortality;
- Smaller net reductions in yields of maize, rice, wheat and potentially other cereal crops, and in the nutritional quality of rice and wheat;
- Up to 50% fewer people around the world exposed to a climate change-induced increase in water stress.

What can we do to stay below the 1.5°C global warming limit?

Limiting global warming requires staying within a carbon emissions budget. The current global emission rate of carbon dioxide (CO_2) is about 40 billion metric tonnes per year (more precisely, 42 $GtCO_2$ per year). The report estimates that we only have 10-15 years of emissions at the current rates before we burn through this budget. In order to avoid exceeding the 1.5°C limit, net CO_2 emissions must be cut by about half by 2030, reaching effectively zero (accounting for anthropogenic CO_2 removals) around 2050. Furthermore, emissions of methane and black carbon need to be cut.

Achieving these reductions – which is known as mitigation – requires rapid and far-reaching transitions in energy systems, land use, urban planning, infrastructure (including transport and buildings), and industry. The scale of these systems transitions is unprecedented, and implies deep emissions reductions in all sectors. It will open up a wide range of choices for how to invest in different mitigation options.

The report argues that staying within the 1.5°C limit requires, along with emissions reductions, carbon dioxide removal (CDR) from the atmosphere through human interventions such as afforestation. Large-scale CDR is highly challenging and potentially unsustainable, and will have to be increasingly relied on if emissions reductions are delayed.

The benefits of limiting warming to 1.5°C for sustainable development

Limiting warming to 1.5°C benefits efforts towards sustainable development and poverty eradication, for example through benefits towards food production, availability of clean water and human health. Limiting warming to 1.5°C can have benefits for sustainable development and poverty eradication if adaptation and mitigation measures are carefully chosen. For instance, widespread bioenergy plantations to mitigate global warming can compete for land with food production, potentially affecting food security.

The Canadian picture and the view of CMOS

The impacts of climate change will be felt differently around the world. For Canada, the impacts are determined by its location in the northern middle to high latitudes and its long coastlines bordering the Atlantic, Arctic and Pacific oceans. Because warming is amplified at high northern latitudes, parts of Canada have experienced twice the warming observed globally, with many detectable impacts on ecosystems and human systems. Along with other countries, Canada would see significant benefits from limiting warming to 1.5°C. If we avoid the 2°C limit and stay below the 1.5°C limit, we expect to see a wide range of benefits, including fewer and less intense heat waves, less intense heavy rainfall events, fewer wildfires, reduced sea level rise, lower probability of a sea ice-free Arctic in the summer, with reduced associated risks for Arctic ecosystems and communities, reduced risk of climate-induced degradation and loss of high latitude tundra and boreal forest, and a smaller permafrost area subject to thaw.

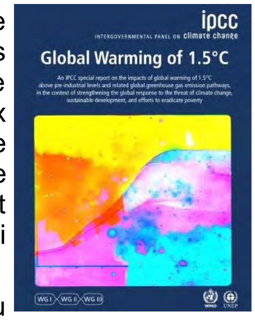
The report suggests that Canada's emission reduction targets are insufficient to limit warming to 1.5°C and will need to be strengthened if Canada is to do its fair share in reducing global carbon emissions.

Beyond our borders, it is, in the view of CMOS, important for Canada, as an internationally engaged nation, to be fully aware of the stakes and take action on carbon emissions reductions to limit global warming to 1.5°C and avoiding the risks associated with the 2°C limit. This needs to apply to CMOS's own practice as a professional organization, which is a topic we will be focusing on in the coming year.

CMOS strongly endorses this IPCC Special Report, and furthermore recognizes and appreciates the time investment of the Canadian researchers who contributed their expertise to lead it; it provides critical scientific input to climate policy at the highest international level.

Position de la SCMO

Position de la SCMO relativement au rapport spécial du GIEC sur le réchauffement planétaire



La Société canadienne de météorologie et d'océanographie (SCMO) est la société nationale vouée à l'avancement des sciences atmosphériques, océaniques et environnementales connexes au Canada. La SCMO compte plus de 800 membres, travaillant au sein de centres de recherche majeurs, d'universités, d'entreprises privées et d'organismes gouvernementaux canadiens. Elle reste la mieux placée pour fournir aux Canadiens des avis d'experts en matière de sciences des changements climatiques. Bon nombre de ses membres jouissent d'une reconnaissance internationale dans leur domaine d'expertise scientifique et participent activement aux évaluations approfondies établissant l'état actuel des connaissances, en ce qui concerne cet enjeu complexe.

Cette prise de position vise à résumer et à refléter le point de vue de la SCMO relativement au rapport spécial du GIEC intitulé « Réchauffement planétaire de 1,5 °C », et approuvé par le GIEC en octobre 2018. Le rapport a été rédigé suivant l'invitation qu'a formulée la Conférence des Parties à la Convention-cadre des Nations Unies sur les changements climatiques (CCNUCC) dans sa décision d'adopter l'Accord de Paris en décembre 2015. Dans le cadre de cet accord, 195 pays s'engagent « [à contenir] l'élévation de la température moyenne de la planète nettement en dessous de 2 °C par rapport aux niveaux préindustriels et [à poursuivre] l'action menée pour limiter l'élévation de la température à 1,5 °C par rapport aux niveaux préindustriels ». Bien que plusieurs études aient exploré les impacts évités et les répercussions de la réduction des émissions relativement à la limite du réchauffement à 2 °C, peu de résultats concernaient la limite de 1,5 °C.

Le rapport spécial évalue la littérature scientifique, technique et socio-économique existante sur le réchauffement climatique de 1,5 °C. Il présente des conclusions sur l'état actuel du système climatique par rapport à la limite de 1,5 °C, les impacts qui seraient évités en limitant le réchauffement à cette valeur plutôt qu'à 2 °C, les scénarios d'émission de gaz à effet de serre et la transition des systèmes qui s'avéreraient nécessaires au maintien sous 1,5 °C du réchauffement, ainsi que l'incidence sur le développement durable et l'élimination de la pauvreté.

Où en sommes-nous?

Les activités humaines auraient causé un réchauffement planétaire d'environ 1,0 °C par rapport aux niveaux préindustriels en 2017. Ce qui signifie que le réchauffement planétaire anthropique, que génèrent les gaz à effet de serre et d'autres formes de pollution, nous place à 0,5 °C de la limite de 1,5 °C. Au taux actuel, le réchauffement de la planète atteindra probablement 1,5 °C entre 2030 et 2052, et vraisemblablement autour de 2040. Le réchauffement planétaire actuel persistera durant des siècles et des millénaires. Il continuera d'influer à long terme sur le système climatique, y compris la hausse du niveau de la mer. Toutefois, il reste peu probable que les émissions passées entraînent à elles seules un réchauffement planétaire de 1,5 °C.

Le réchauffement observé n'est pas réparti uniformément. Notamment, dans les régions terrestres, comme au Canada, où le réchauffement s'avère plus important que la moyenne mondiale, y compris deux à trois fois plus élevé dans l'Arctique.

Pourquoi s'en tenir à la limite de réchauffement planétaire de 1,5 °C?

Le réchauffement d'origine anthropique a déjà généré des changements détectables dans le système climatique, et touché les écosystèmes ainsi que les systèmes et le bien-être humains. Bon nombre de ces répercussions et des risques connexes seront exacerbés une fois atteinte la limite de 1,5 °C. Les changements climatiques prévus à la suite d'une hausse de 1,5 °C comprennent une augmentation des extrêmes chauds dans la plupart des régions habitées, et une augmentation de la fréquence et de l'intensité des épisodes de pluies abondantes et de sécheresses dans plusieurs régions.

Les simulations des modèles de climat montrent des différences marquées dans les impacts et les risques connexes entre les hausses de 1,5 °C et de 2 °C. Si nous évitons une hausse de 2 °C et restons en dessous de la limite de 1,5 °C, nous verrons vraisemblablement un large éventail d'avantages, dont les suivants :

- Une réduction des risques liés aux sécheresses et aux pluies abondantes;
- Une hausse du niveau moyen de la mer réduite de 10 cm d'ici 2100, et jusqu'à 10 millions de personnes en moins exposées aux risques liés à l'élévation du niveau de la mer;
- Des impacts moindres sur la biodiversité et les écosystèmes, y compris la réduction et l'extinction d'espèces;
- Une réduction de l'augmentation de la température et de l'acidité de l'océan ainsi que de la baisse du niveau d'oxygène marin, ce qui amoindrit les risques menaçant la biodiversité, les pêcheries et les écosystèmes marins et leurs services aux humains;
- Une probabilité considérablement réduite de trouver l'océan Arctique libre de glace de mer estivale;
- Une probabilité accrue de sauver certains récifs coralliens;

- Une réduction des risques de mortalité liés à la chaleur et à l'ozone;
- Des réductions nettes moindres du rendement du maïs, du riz, du blé et éventuellement d'autres céréales, ainsi que de la qualité nutritionnelle du riz et du blé;

Jusqu'à 50 % de personnes dans le monde qui ne seraient pas exposées à une augmentation du stress hydrique émanant des changements climatiques.

Que faire pour rester en deçà de la limite de réchauffement planétaire de 1,5 °C?

Pour limiter le réchauffement climatique, il faut respecter un budget d'émission de carbone. Le taux d'émission mondial actuel de dioxyde de carbone (CO_2) s'élève à environ 40 milliards de tonnes métriques par an (plus précisément, 42 Gt de CO_2 par an). Le rapport estime qu'à ce rythme nous n'avons plus que 10 à 15 années d'émission avant de fracasser ce budget. Afin d'éviter de dépasser la limite de 1,5 °C, les émissions nettes de CO_2 devront diminuer de moitié d'ici 2030, et atteindre zéro (avec prise en compte de l'absorption d'origine anthropique de CO_2) vers 2050. Les émissions de méthane et de carbone noir doivent aussi diminuer.

L'atteinte de ces objectifs, ou « atténuation », nécessite des transitions rapides et étendues relativement aux systèmes énergétiques, à l'utilisation des sols, à l'urbanisme, aux infrastructures (y compris les transports et les bâtiments) et aux industries. L'ampleur de ces transitions est sans précédent et implique de fortes réductions d'émissions dans tous les secteurs. Cette approche ouvrira un large éventail d'options quant à la façon d'investir dans différentes mesures d'atténuation.

Le rapport soutient que pour rester sous la limite de 1,5 °C, il faut, en plus des réductions d'émissions, éliminer de l'atmosphère le dioxyde de carbone, et ce, par des mesures d'origine humaine, comme le boisement. L'élimination à grande échelle du dioxyde de carbone reste très difficile et potentiellement non viable. Mais il faudra y recourir de plus en plus si les réductions d'émission accusent un retard.

Les avantages de limiter le réchauffement à 1,5 °C et le développement durable

Limiter le réchauffement à 1,5 °C profite au développement durable et à l'éradication de la pauvreté, par exemple en favorisant la production alimentaire, la disponibilité d'eau propre et la santé des humains. Limiter le réchauffement à 1,5 °C profitera au développement durable et à l'éradication de la pauvreté, si les mesures d'adaptation et d'atténuation sont judicieusement choisies. Par exemple, la production à grande échelle de biomasse agroalimentaire visant à atténuer le réchauffement climatique pourrait accaparer les terres nécessaires à la production d'aliments, cette concurrence menacerait potentiellement la sécurité alimentaire.

La situation au Canada et le point de vue de la SCMO

L'incidence mondiale des changements climatiques se manifestera différemment d'une région à l'autre. Au Canada, les impacts sont déterminés par notre emplacement dans les latitudes nordiques modérées à hautes et nos longues côtes qui touchent les océans Atlantique, Arctique et Pacifique. Le réchauffement est amplifié dans les hautes latitudes du Nord, certaines régions du Canada connaissent donc un réchauffement deux fois plus important que celui observé à l'échelle mondiale. Il s'accompagne aussi de nombreux impacts détectables sur les écosystèmes et les systèmes humains. Comme d'autres pays, le Canada profiterait considérablement d'un réchauffement limité à 1,5 °C. Si nous écartons la limite de 2 °C pour rester sous 1,5 °C, nous pourrions tirer parti d'un large éventail d'avantages, notamment des canicules moins nombreuses et moins intenses, moins d'épisodes de pluies abondantes, moins d'incendies de forêt, une hausse réduite du niveau de la mer, et une probabilité moindre de voir l'océan Arctique libre de glace estivale. Ce qui entraînerait une diminution des risques connexes pour les communautés et les écosystèmes arctiques, une réduction du risque de dégradation causée par l'évolution du climat, une perte réduite de la toundra et des forêts boréales des hautes latitudes, ainsi qu'une réduction de l'étendue du pergélisol soumise au dégel.

Le rapport laisse entendre que les cibles de réduction des émissions du Canada ne suffiront pas pour limiter le réchauffement à 1,5 °C. Celles-ci devront être renforcées si le Canada souhaite participer équitablement à la réduction des émissions mondiales de carbone.

De l'avis de la SCMO, il importe pour le Canada, en tant que nation engagée à l'échelle internationale, d'être pleinement conscient des enjeux au-delà de nos frontières, et de prendre des mesures pour réduire les émissions de carbone, afin de limiter le réchauffement planétaire à 1,5 °C et ainsi éviter les risques associés à la limite de 2 °C. En tant qu'organisation professionnelle, la SCMO doit appliquer ces principes à son propre fonctionnement, un sujet sur lequel nous nous pencherons au cours de la prochaine année.

La SCMO appuie fermement ce rapport spécial du GIEC et reconnaît et apprécie le temps qu'ont investi les chercheurs canadiens qui se sont appuyés sur leur expertise pour en diriger la rédaction. Le rapport constitue un apport scientifique essentiel aux stratégies relatives au climat, et ce, au niveau international le plus élevé.

A Look at Ontario's Climate of the Future with the Ontario Climate Data Portal (OCDP)

Huaiping Zhu[1], Ziwang Deng[1], Jinliang Liu[2], Xin Qiu[3], Xiaoyu Chen[1], Xiaolan Zhou[1]

[1]LAMPS, Department of Mathematics and Statistics, York University, Toronto, ON; [2] Department of Earth and Space Science and Engineering, York University, Toronto, ON; [3] NOVUS Environmental, Guelph, ON

Climate change is undeniable, and scientists around the world agree that in the coming decades the effects of a warming planet are only going to become more and more felt. What does climate change mean for Ontario? The development of the Ontario Climate Data Portal (OCDP) is intended to easily answer that question through the display of an array of possible scenarios. With an extensive and robust backdrop of climate model inputs, the OCDP provides maps, graphs and other interactive displays for Ontario based on the various greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC).

WHY THE OCDP?

A wide range of climate projection data generated with various methods can be found in the public domain; however, users usually face a challenge on which data to choose and some do not even have the resources or expertise to collate the information into a form that meets their needs. To make the practitioners' practices easier in applying climate data to their risk assessments and to promote consistency and comparability among climate risk assessments in Ontario, the Laboratory of Mathematical Parallel Systems (LAMPS) Climate Change Research Group at York University has developed a super ensemble of Ontario-specific high resolution (10km x 10km) regional climate data and disseminated these data on the Ontario Climate Data Portal (OCDP).

HOW THE OCDP WORKS

This super ensemble is based on collectively 209 members from both global climate models (GCMs) and regional climate models (RCMs), including 47 members generated by dynamical downscaling from the North American Coordinated Regional Climate Downscaling Experiment (NA-CORDEX), University of Toronto and University of Regina, and 162 members generated by statistical downscaling from LAMPS and the Pacific Climate Impacts Consortium (PCIC). This ensemble accounts for all emission scenarios defined by the various greenhouse gas concentration trajectories adopted by the IPCC, referred to as Representative Concentration Pathways (RCPs). This includes 40(19.1%), 64(30.6%), 15(7.2%) and 90(43.1%) members under RCP 2.6, 4.5, 6.0 and 8.5, respectively. One major product of the OCDP is a set of probabilistic projections for both long term averages of the basic variables and extreme climate indices for 2050s (2040-2069) and 2080s (2070-2099) at provincial, regional, municipal and grid scales. All data have passed quality control and bias correction using latest sophisticated techniques.

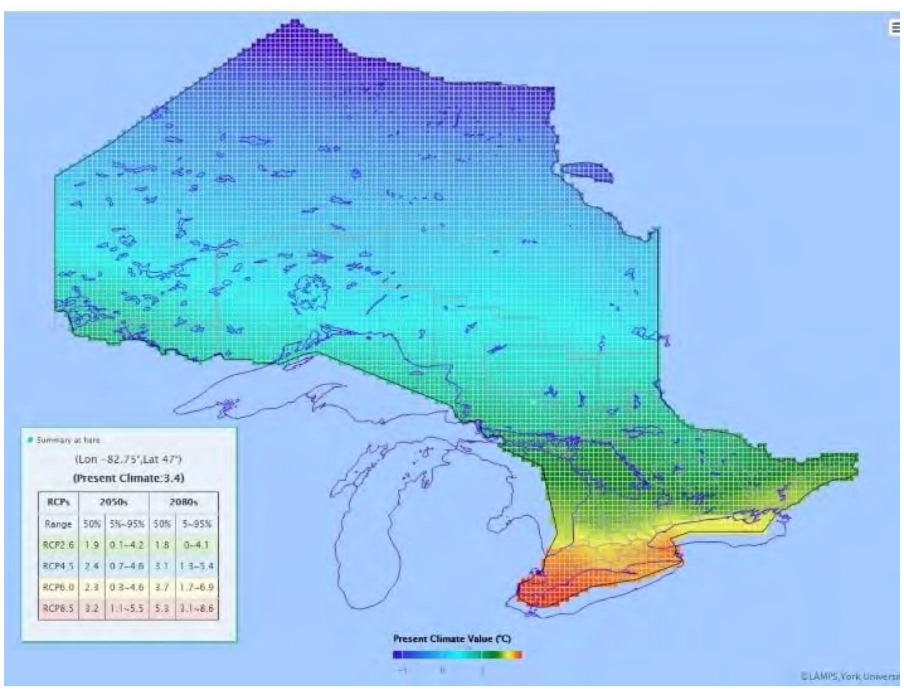


Figure 1. Here, the OCDP visualizes the current climactic conditions in the map, and listed in the table are the anticipated future climatic conditions under all IPCC RCPs (for at any selected location). The values in the table shown here are for a location close to the Aubrey Falls Provincial Park northwest of Sudbury, which could see as much as 5.5°C temperature rise by 2050s, and an 8.6°C temperature rise by 2080s under the IPCC's business as usual (RPC 8.5) scenario.

WHO IS THE OCDP FOR AND WHAT CAN IT DO FOR YOU?

The OCDP was developed for users with all knowledge levels, and it consists of four main sections: maps, time-series, datasets and documents. In the maps section, we provided a provincial summary at the top of the page followed by interactive visualization of spatial distribution of climate change information for each variable's annual, seasonal and monthly mean for both the historical period and projected changes in 2050s and 2080s relative to the reference period, along with the confidential interval (5~95%). As an example, figure 1 shows annual mean temperature and the changes under the four RCPs. The projected temporal variation of the variables were plotted as time series of annual anomaly (relative to the reference period (1986-2005) for provincial averages and decadal variations for each of the 50 regions and 150 municipals of Ontario from 1981 to 2099; all these interactive time-series figures are posted in the time-series section. For those who would like to carry out their own further analyses, over 10 terabytes (TB) of climate data behind the data section could be quickly download from either our cloud storages or database. Sample codes in several widely used data analysis languages (Python, R and Matlab) are provided to read the downloaded files. In the documents section, we provided practitioners some ready-to-use factsheets based on the data for their decision making; also in this section are some project reports users can use as template for their own studies.

As an open source about Ontario-specific high resolution regional climate data in support of climate change adaptation in Ontario, the OCDP has attracted great interests of many users. According to the performance analysis by Google Analytics, users are mainly from, but not limited to, Ontario; traffic to the portal has jumped significantly since its official launch in June 2018, more than 7000 users have visited and downloaded data from the OCDP. Data from the OCDP have been used in various sectors for various purposes, including government policy development. We will continue to improve the OCDP to better serve our users.

About the Author

Dr. Huaiping Zhu is a Professor and York Research Chair in Applied Mathematics, and the Director of the Laboratory of Mathematical Parallel Systems (LAMPS) at York University.

In addition to his expertise on dynamical systems, mathematical theories, models, and methodologies/tools for applications in biology, specifically prevention and control of mosquito-borne diseases, his Climate Change Research Group in LAMPS has carried out tremendous work in climate change modeling and impact studies in the past decade, resulting in the user-friendly OCDP and the large volume of climate data on it to support climate adaptation in Ontario.

Acknowledgements

The authors would like to thank the Ontario Ministry of the Environment, Conservation and Parks (MECP) for its financial support to this project, although the content of this paper is solely the responsibility of the authors and does not necessarily represent the official views of the MECP.

Corresponding author: huaiping@mathstat.yorku.ca

Canada's Top Ten Weather Stories of 2018

David Phillips, Environment and Climate Change Canada

Canada is not as cold as it once was, with every region and all seasons warmer than ever before. While Canada is still the snowiest country, less snow is falling in our southern regions. Our mountain snowpack and glaciers are disappearing rapidly, and frost-free days are increasing. Our growing seasons are longer, but so are the length and intensity of our wildfire seasons. In the Great Lakes, the past decade has featured both record high and low water levels. When it rains, it often rains harder and longer, with higher incidents of flash flooding, especially in our cities. Storms seem to be getting bigger and moving more slowly, leaving more damage in their wakes.

Scientists from Environment and Climate Change Canada have concluded that the risk of western fires since 2015 has increased two to six times due to human-induced warming and that, in the Arctic, extreme sea-ice minima in recent years would have been extremely unlikely in the absence of human influences. In fact, scientists have made a clear link between climate change and extreme weather events that include heat waves, wildfires, flooding, and sea ice disappearance.

Weather changes in Canada are happening abruptly not subtly, rapidly not gradually. As Canadians continue to experience more and more extreme weather, intense month-long heat waves, suffocating smoke and haze from wildfires, and extreme flooding will simply be the norm mere decades from now. Events that were once rare or unusual for our grandparents are now more commonplace, while we all become more vulnerable due to extreme weather. As the Top Ten Weather Stories of 2018 bear out, Canadians must become more resilient—not only for what lies ahead but also for the variations in climate, which are already here.

This year featured extreme and impactful weather events that caused costly damage across the country. Historic river flooding occurred in British Columbia and New Brunswick, while the Greater Toronto Area experienced flooding almost every time it received a heavy rainfall. In the North, significant losses of sea ice cover and reductions in ice thickness continued; however, year-to-year variability in ice extent presented significant challenges to Arctic communities and for marine navigation. Paulatuk, Kugluktuk, Cambridge Bay, and other villages were unable to receive some or all of their ship-based annual resupply resulting in shortages of some goods and much higher costs to residents, businesses, and government. Like last year, this year was hot and dry for long periods in the Prairies, which led to serious hardships for growers and ranchers. However, this year, once the harvest got underway, early winter cold and snow set in for nearly six weeks. In July, uncontrollable fires raged across British Columbia; in August, Ontario. Firefighters in British Columbia began this year like the one before, bailing and bagging to help residents with record spring floods before moving on to fight nearly three times the average number of fires in a province-wide state of emergency. Month-long infernos fouled the air with unprecedented levels of smoke and haze, impacting millions of Canadians from coast to coast.

When it comes to tornadoes, it's never possible to get an exact count. In 2018, there were 49 confirmed and possible tornadoes, which was fewer than normal. All were weak except for a killer in Alonsa, Manitoba, on August 3rd, which caused the first tornadic death in Canada in seven years and a family of strong tornadoes that pummeled parts of eastern Ontario and western Quebec on the last day of summer. And what a summer it was, with relentless heat from Victoria to St. John's. Ottawa had its second-warmest Canada Day dating back almost to Confederation. Montréal had its warmest July on record with deadly consequences. Hundreds of daily records fell in the West, including Calgary's all-time hottest day ever. For some cities, it was back-to-back opposites, with April the coldest on record followed by the warmest May ever. If you ask most Canadians, they'll tell you that the long, hot summer was either a hummer or a bummer, but it was the never-ending winter that irked them the most. The cold grabbed hold early in the season and wouldn't let go until May.

For the 12 month period—from December 2017 to November 2018—every season came out warmer than normal, an average 0.4 °C above normal. Despite a cold La Niña at the start of the year, 2018 soon turned warmer than normal for the 22nd consecutive year. According to the United Nations World Meteorological Organization, 2018 was the 40th consecutive year globally with above-normal temperatures and the fourth-warmest year since observations began 135 years ago. The 20 warmest years on record have been in the past 22 years, with the top four in the past four years.

1. Record wildfires and smoky skies

Across Canada, the wildfire season started slowly, owing to the long, lingering winter that in some regions lasted into May. Despite the late start, national statistics showed that there were more fires than ever last year, and the total area burned was double the longer term averages.

In British Columbia, spring flooding led to increased vegetation, which dried out in the hot dry summer, turning it to kindling. For the second year running, British Columbia faced a province-wide state of emergency. Nearly 2,000 wildfires ignited across the province. Though the season started late, it made up for lost time. By August 8, there were 460 simultaneous wildfires—more than any single day in 2017—with 25 of notable size.

May was one of the hottest and driest on record, across British Columbia's interior and south coast. A damp June eased the wildfire concern temporarily, but, by July, things were ramping up. Lightning on July 18 ignited forests in the Okanagan. Gusty winds and intense heat created fast-moving and aggressive fires that prompted evacuations and a state of emergency. As air temperatures soared and humidity dropped, fires spread quickly, becoming uncontrollable, going wherever winds took them. Firefighters from across Canada, the United States, Mexico, Australia, and New Zealand were joined by the military to battle back the blazes.

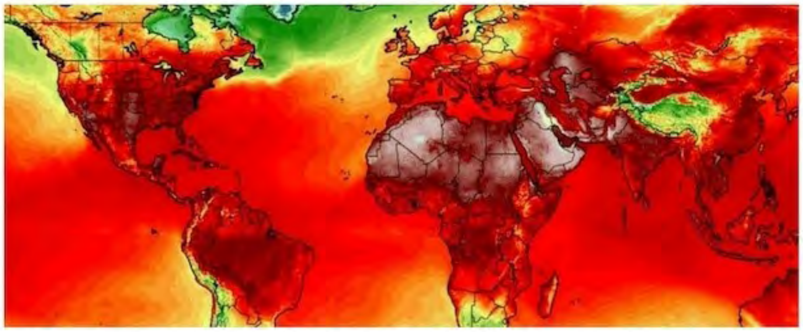
By August, more than 10 million Canadians, from Victoria to the shores of Lake Superior, were breathing in the smoke from Western fires. Across the West, air-quality alerts became a fact of life for weeks, the smoke-polluted air endangering the health of the elderly, very young, and anyone living with respiratory disease. Downwind of the fires, residents in several western cities gasped and wheezed for a record number of hours as if sitting by a smouldering campfire. Alberta's cities were especially dark and dirty, with Calgary recording 478 hours of smoke and haze (normal summer count is 12 hours) with one bout, between August 14 and 20, lasting 141 consecutive hours. Edmonton experienced 230 hours of smoke and haze, more than double its previous smokiest summer. Beautiful British Columbia didn't look so beautiful, and, in Prairie Big Sky Country, you couldn't see the sky for much of the summer.

2. Canada affected by global summer heat wave

Across the globe, summer 2018 was the third warmest on record. Torrid heat stretched from Japan to Great Britain to California, and Canada was also affected. May brought an early summer that persisted relentlessly through August, even longer in the East. For millions in the southern part of Canada, it was the third-warmest summer on record. On some days, heat warnings prevailed, from Vancouver Island to Newfoundland, with some regions hitting a humidex in the mid-40s. It's rare for a heat-humid wave to grip so much of the country for so long, but two semi-permanent blocking highs persisted on either side of the country throughout the summer—a Bermuda High parked over the Atlantic Ocean and a California High stalled over the Pacific Coast. The result was a dome that blocked in the hot summer air and kept wetter weather out.

Millions in the East sweated it out through a sweltering heat wave that hit in time for the Canada Day long weekend, lasting from late June to the end of the first week of July—the longest and most intense heat spell in years. In Ottawa, it was the second-warmest Canada Day ever, with records going back to the 1880s. Further, the humidex reached a high of 47, the highest ever recorded in the nation's capital. Across the Ottawa River, in Gatineau, the humidex reached a record 48. It was likely the worst combination of heat and humidity ever experienced in the National Capital Region. Understandably, attendance at afternoon celebrations on Parliament Hill dropped from an expected 20,000 to 6,000. In Montréal, Urgences-santé experienced a 30 per cent increase in emergency calls. Across Quebec, 93 people died from heat-related complications.

July and August combined were the hottest on record in Atlantic Canada, and the humidity only added to the discomfort. In July, cities in all four Atlantic Provinces recorded highest-ever average temperature, including Halifax, which had more than two straight weeks with maximum temperatures of 25 °C, shattering the previous record set in 1876. In Saskatchewan, three cities broke all-time high temperature records—Regina set an August record with a high of 41.3 °C on August 11, with records dating back to 1883. On the same day, Moose Jaw's temperature rose to a record 42.3 °C—two degrees away from Canada's warmest high ever recorded. But it was Calgary's new all-time record on August 10 that made national headlines as the temperature hit 36.5 °C, with records dating back to 1881.



Satellite image of global summer heatwave, July 2018.

BC wildfire. Source: gov.bc.ca

Top Ten Number 3. Hot and dry to snow-filled skies blunt the Prairie harvest

Prairie growers and ranchers faced enormous challenges during a tough growing season. With the frost line two-metres deep in places, the long, cold spring kept farmers off their fields until mid-May. Then came drought through the southern and central Prairies where, between April and August, they received less than 60 per cent of the average rainfall. In some places, rainfall totals were the lowest in at least 40 years. For some producers, it was the third dry year in a row. In Regina, back-to-back drought years in 2017 and 2018 were the driest on record spanning 135 years.

When sweltering heat arrived in July and August, crops shrivelled. Cattle producers and dairy farmers faced dwindling stocks of feed grain and rising prices, forcing some to sell off their cattle and dairy cows prematurely. In Val Marie, Saskatchewan, rainfall in the growing season was a paltry 72 mm—less than a third of normal. At a farm near Val Marie, the hay yield was 32 bales per acre, compared to 210 last year, and amounted to less than a third of what would be needed for winter.

The seasons jumped from summer to winter as temperatures plunged and rain changed to snow when a cold-air mass out of the Yukon and the Northwest Territories invaded the Prairies in the second week of September and didn't budge until mid-October. September frost is normal, but six weeks of cold and snow is unprecedented. A vast majority of the crops, upwards of $4 billion worth, was still on the fields and was flattened by record snows that made it impossible to combine. Farmers watched their crop quality being downgraded day by cold day until it bottomed out at feed grade. The miserable harvest weather was nowhere worse than in Alberta. Undoubtedly, Edmonton had its most miserable September on record. Afternoon temperatures averaged a record 6.6 °C colder than normal and a record 38.4 cm of snow fell compared to a normal of 1 cm. October was Calgary's turn for weather misery. During the first two days of the month, a total of 38 cm of snow fell at the airport, breaking the record for any October day in 138 years.

Top Ten Number 4. Powerful May winds cost $1 billion

On May 4, a fast-moving squall line of thunderstorms raced across southwestern Ontario around noon, went through the Greater Toronto Area around 4:00 p.m., and sped into Montréal and Québec City by evening. Hurricane-force gusts produced record wind speeds for May: 126 km/h in Hamilton; 122 in Kitchener-Waterloo; 119 in Toronto; and 117 in Montréal. Power lines were toppled, leading to widespread power outages. In Quebec, 285,000 customers lost power, while in Ontario, where winds severed 350 hydro poles, 300,000 customers were impacted. With such fierce winds, fences, signs, shingles, siding, patio furniture, and bus shelters took flight. Straight-line winds speared tree branches into vehicles and homes, caused high-rise buildings to sway, and construction cranes to crumple. At some intersections, traffic lights crashed to the street. In Toronto and surrounding areas, GO train service was stopped. Along the shores of eastern Lake Ontario, strong winds and high waves destroyed docks. In Quebec, waves breached break walls and eroded the coastline. Tragically, three workers were killed during the storm. According to the Insurance Bureau of Canada, it was the country's costliest storm in five years with total losses estimated near $1 billion.

Top Ten Number 5. Ottawa-Gatineau tornadoes on summer's last day

On September 21, the last day of summer, meteorologists in Ontario and Quebec were busy tallying the season's severe-weather statistics. It had been a relatively quiet storm season with five tornadoes in Ontario and two in Quebec, which were below the normal of 12 and 7 respectively. At the same time, they were keeping an eye on the possible collision of a warm, humid air mass and a sharp cold front. Things were aligning to produce late afternoon thunderstorms in eastern Ontario and western Quebec.

At 4:17 p.m., a tornado watch that had been issued for much of Renfrew and Lanark counties near Ottawa became a warning. Just before 5:00 p.m., a tornado struck Kinburn-Dunrobin, skipped across the Ottawa River and touched down in the lower Pontiac (Luskville) region of western Quebec, before striking the Mont-Bleu neighbourhood of Gatineau. Less than an hour later, another line of thunderstorms crossed the Ottawa Valley creating another tornado that struck Ottawa from Arlington Woods (Nepean) to Greenboro (Gloucester).

The Dunrobin-Gatineau tornado was classified as EF-3, with maximum winds up to 265 km/h, ranking it as the strongest tornado to hit eastern Ontario since 1903. More noteworthy, it was the strongest storm to strike anywhere in Canada during September in 120 years. The Dunrobin-Gatineau tornado lasted 40 minutes and tore a path almost 40 kilometres long. The Arlington Woods tornado was classified as EF-2, with maximum winds up to 220 km/h. The tornado outbreak also included four other EF-1 tornadoes (between 138 km/h and 177 km/h); one at Calabogie in Ontario; and three in Quebec (Val-des-Bois, near the Baskatong Reservoir, and 25 km north of Otter Lake). In the aftermath of the tornadoes, 430,000 people were left without power.

Top Ten Number 6. Spring flooding throughout southern British Columbia

For the second consecutive year in British Columbia, widespread spring flooding threatened communities across the province's south, especially along the Okanagan, Kettle, and Fraser Rivers. It was a snowy winter, and, by spring, the snowpack across the province was the deepest observed in nearly 40 years of recordkeeping, ranging from 160 to 260 per cent more than normal, with a depth over 10 metres on some mountain peaks. When late-spring brought record high temperatures, a shock melt hit the region. Snowpack from alpine peaks to valleys melted all at once, overwhelming river systems and causing prolonged flooding.

Under a stationary ridge of high pressure, hot, dry air ranging from 5 °C to 10 °C above the seasonal average for early May pushed northward, promoting a steady, around-the-clock snow melt. Days later, scattered showers and thunderstorms worsened the situation. Water rose in rivers to levels not seen in more than half a century, causing devastating floods and forcing thousands of residents to evacuate their homes. A total of 300 members of the Canadian Armed Forces, 200 firefighters, and hundreds of volunteers spent an exhausting week bailing, bagging, and battling rising waters. Nearly 5,000 residents were evacuated and another 7,000 were put on standby alert as states of emergency were declared across the interior. Two days of heavy rain pushed rivers to levels higher than those recorded during devastating floods 70 years ago. The charred forests, devoid of vegetation from last summer's wildland fires, were especially vulnerable to flash flooding, mudslides, and debris flows. Back-to-back bad flood and wildfire years are not yet a trend but a worry because each can increase the risk of the other.

Top Ten Number 7. Flash flooding of the Saint John River

Flooding along the Saint John River is a rite of spring in New Brunswick—sandbagging duties are to be expected. But nothing was expected about this year's flooding. Even the most seasoned flood experts were taken by surprise. The snowpack had been deep but not record-breaking. There were early warm days but no record heat. Heavy rains fell but nothing out of the norm. None of the flood triggers were remarkable in and of themselves, but together they combined to create a flood that breached the banks of the Saint John River for over two weeks.

In early April, Edmunston was covered with 50 cm to 80 cm of snow. Over a 48 hour period, temperatures in the province soared to 29 °C, turning the Saint John basin from slush to sweat. Then, heavy rainstorms began to roll though, with rain falling on 31 of the following 32 days, totalling 152 mm. The result was a fast two-metre rise above flood levels on the Saint John River. The hotter it became, the faster the snow melted and the higher the floodwaters rose. Down river of Fredericton, water levels exceeded 2008 levels and historic 1973 levels, making 2018 the largest, most impactful flood in modern New Brunswick history. Throughout the province, rivers filled with raw sewage, motor oil, propane tanks, and drowned animals. Water levels were so high that the famous Reversing Falls stopped reversing. Adding to this were several days of high wind that created significant waves and related erosion. The Trans-Canada Highway between Fredericton and Moncton was closed along with over 150 roads, bridges, and culverts across the province. The Canadian Army and Coast Guard came in to assist with flood relief efforts.

Ottawa/Gatineau tornado touching down. Source: ottawacitizen.com

A flooded street in Fredericton, NB, April 2018. Source: globalnews.ca

Top Ten Number 8. Toronto's August deluge

Late in the evening of August 7, a compact storm blossomed near York University, in suburban Toronto, before crawling southward to unload its moisture on the city centre. A downtown weather station recorded 58 mm of rain while Toronto City Centre Airport received 72 mm. Incredibly, Toronto Pearson International Airport, in Mississauga, and Buttonville Airport, in Richmond Hill, got less than 6 mm of rain; other weather stations didn't record a drop. Downtown, the flash flood swamped roads and underpasses, submerging cars and forcing drivers and passengers to scramble to safety. Water poured into underground buildings, even trapping two men in an underground elevator. Power had been lost in their office building during the flood and, as water rapidly rose in the elevator, police scrambled to swim to their rescue. When the men were finally released, only 30 cm of air space remained in the elevator. Water flooded parking garages and subway platforms, wreaking havoc on city transportation. Over the summer, there were other instances where moderate rains led to flooding, signalling a larger issue for urban areas: As cities grow and more surfaces become impermeable, the risk of urban flooding increases.

Top Ten Number 9. Record cold start to a long winter

Across Canada, winter 2017 to 2018 began in November, deepened in December, paused in January, and came roaring back in February for a further two-month residency. Six months of winter proved to be a tough haul for even the heartiest of Canada's cold-weather enthusiasts. It started when a dreaded polar vortex weakened, unleashing a dam of frigid air and brutal wind chills. Then, right on cue, December 21, winter's first day, brought record-breaking Arctic air in over the North Pole and down through Canada. Between Christmas and New Year's, extreme cold records were shattered, and 2018 dawned with extreme cold weather warnings for a swath of Canada the size of Europe. From Calgary to Cape Breton Island, outdoor New Year's celebrations were brought inside, and most January 1 polar bear dips were frozen out.

With a lot of winter still to come, by late January, southern Quebec had already reached its average winter number of -20 °C or below days. Edmonton set a record of 127 days in a row with sub-freezing temperatures. In front of the Parliament buildings, Ottawa's "Hockey on the Hill" had to be moved indoors when the cold became too dangerous. Winter's long, deep freeze had impacts across the country, including delays to rural mail delivery, garbage and recycling collection, and train and air travel, owing to frozen equipment. There were overflows at city shelters as Canada's vulnerable homeless population sought shelter from the cold.

Top Ten Number 10. A cruel, cold, and stormy April

Known as the cruellest month, April lived up to its reputation across much of Canada in 2018. Nationally, it was the coldest April in 16 years, and, for millions in Ontario and Quebec, it hadn't been that cold for 71 years. Some dubbed it "Apriluary" as farmers and golfers waited out frozen ground.

On April 4, a powerful Colorado storm tracked across southern Ontario and Quebec, coating surfaces with freezing rain, dumping heavy rain or snow or both, and buffeting the region with jet-stream strong winds. For almost 20 hours, freezing rain poured down on Montréal and Gaspé. A storm surge in Québec City led to the St. Lawrence River breaching its banks and flooding roads. Then, on April 15, a Texas storm packing twice as much punch rolled into the region bringing days of ice pellets and freezing rain. In just three days, southwestern Ontario was pounded with a half a month's rainfall.

Toronto endured 21 hours of ice pellets, 9 hours of freezing rain, and 24 hours of rain. The gooey mix totalled 7 cm to 12 cm in places. Across southern and eastern Ontario, strong winds blew sheets of snow and ice from buildings, smashing windows both on Parliament Hill, in Ottawa, and in downtown Toronto. The CN Tower closed after ice fell and pierced the dome below, forcing the cancellation of a Blue Jays game. Power losses from both storms numbered 500,000 in Ontario and 100,000 in Quebec, with some customers hit with outages twice in less than two weeks.

Regional highlights

Canada

- Another warm year—barely
- Record-low sea ice (maximum concentration)
- And more low sea ice (minimum concentration)

Atlantic Canada

- Christmas Day (2017) power outage in Nova Scotia
- Covered bridge lost in flood
- Easter blizzard
- Summer snow in Newfoundland
- Rare June frost
- Storms Chris, Beryl, and Michael
- More power outages
- Lobsters not yet aboard
- Record fall snowfall in Happy Valley
- Newfoundland's greatest blast on earth
- 350,000 Maritimers in the dark

Quebec

- January flooding follows record cold
- Icy surfaces across southern Quebec
- February flooding and power outages
- One/two/three punch March storms
- Three storms in cruel April
- Putting the "gust" in August

Ontario

- January's mixed bag of weather
- Thawing, raining, and flooding in February
- April/May weather whiplash
- Ontario's first tornado
- Northern Ontario's trio of June storms
- Ottawa too dry for too long and too wet all at once
- Menacing Ontario wildfires
- Trees down, trees down
- Rain equates to flooding in Toronto
- Leftovers of Tropical Storm Gordon
- September's last tornadoes
- Pre-winter teaser

Prairie provinces

- Million dollar blizzard
- An abundance of snow in Calgary
- Sudden melting and ice jamming trigger Alberta flooding
- Manitoba wildfire season early and over
- Stormy weather challenges cattle and people
- May's snow and cold gives way to June's heat in Churchill
- Weather adds three hours to football game
- Mid-Prairie storms
- Saskatchewan tornadoes—a year's worth in two days
- Million dollar hailers in western Prairies
- Calgary's early August hailer
- North America's strongest, and a killer, tornado
- Edmonton's record September snowfall
- Calgary's October snow-mageddon
- Forgotten fall returns
- Rime icing turns lights and water off in Saskatchewan

British Columbia

- Boxing Day ice storm in Fraser Valley
- January storm blasts coastal British Columbia
- January liquid sunshine
- Winter's worst moment comes in February
- July heat and record dryness
- Winter starts at end of summer
- Weather stopped ferries but not runners

North

- Arctic winter heat wave
- Arctic ice causes shipping problems
- Let it freeze
- Hours and hours of blizzards
- Yukon heat
- Record summer wet in Yellowknife
- Quiet wildfire season in the Northwest Territories
- Record winds whip Nunavut capital

Catastrophes and The Insurance Industry

Laura Twidle, Director of Catastrophic Loss Analysis, Catastrophe Indices & Quantification Inc.

Catastrophes not only disrupt communities and people's lives, but they also have a major financial toll. In Canada, insured losses due to natural disasters have increased steadily over the past decade, and it is becoming more common for annual insured losses due to catastrophes to exceed $1B. The majority of catastrophic events the past two years have not been a result of the traditional damaging hail in the Prairies, but from larger-scale events in eastern Canada. Water is becoming a bigger player as the industry continues to increase exposure to the peril.

What is an insurance catastrophe?

Whether the frequency of extreme events is increasing or not, insured catastrophic losses have increased over the last decade (Figure 1). A catastrophic event (CAT) is an event that affects multiple policies and causes more than $25 million of insured damage. Catastrophe Indices & Quantification Inc. (CatIQ) is Canada's insured loss index provider, which means that CatIQ produces insured loss estimates on CATs. A majority of the Canadian property & casualty insurance market submits CAT data to CatIQ, which is then aggregated to produce the industry-wide total by province and line of business (personal, commercial, auto). Data in this article comes from the CatIQ database (2008-present) unless otherwise stated.

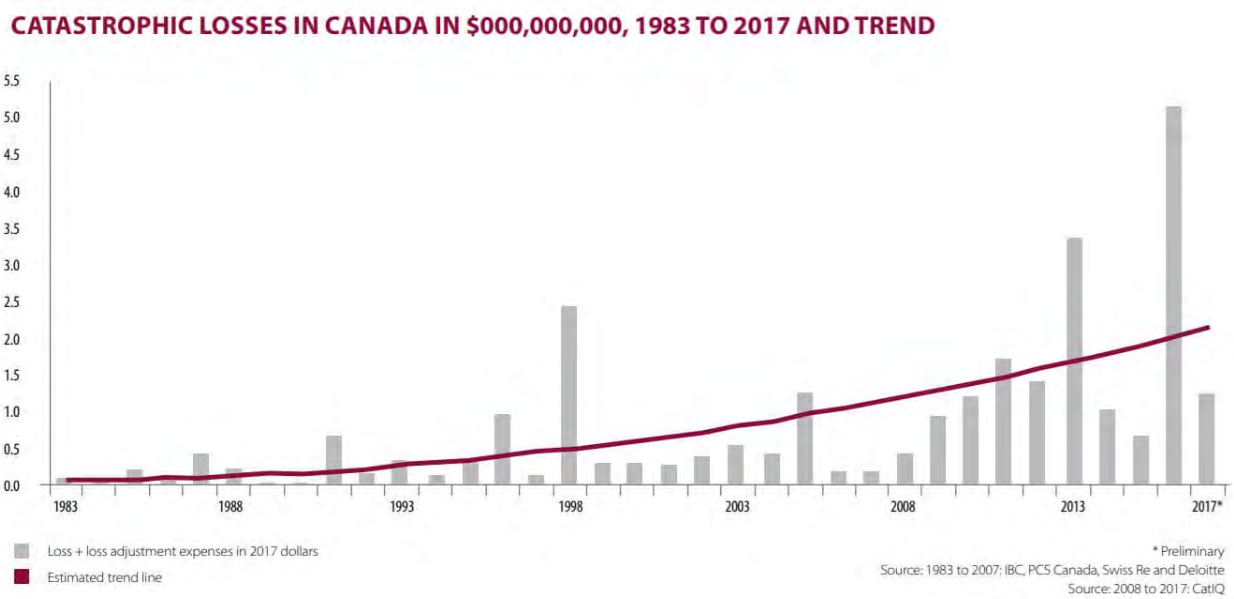


Figure 1: CAT losses in Canada from 1983-2017 in 2017 dollars. From the IBC 2018 Fact Book.

CATs can be a result of different perils at varying magnitudes. However, since property must be damaged, the most important factor is usually location. For instance, a thunderstorm which produces softball-sized hail in a rural area would not cause as much damage than if the stones pelted a populated centre.

In the summer of 2018, there were 6 thunderstorm related CATs, and five Notable Events (~$10-25M in insured damage). On the last day of summer, severe thunderstorms rolled across southern Ontario and Quebec, some of which produced devastating tornadoes to the Ottawa and Gatineau region. The tornadoes, downbursts and hail totaled more than $295M of insured losses. Much of the damage was confined to the areas impacted by the tornadoes due to severity of the winds (Figure 2). In contrast, southern Ontario and Quebec experienced a different type of wind-related storm in early May, where prolonged gusty winds downed trees onto property and tore shingles off homes. A peak wind gust of 126 km/h was reported at the Hamilton International Airport and resulted in more than $500M of insured losses; becoming the costliest CAT in Ontario since the Toronto floods in July 2013.

The costliest catastrophe in Canada's history remains the Fort McMurray Wildfire of May 2016; and holds Canada's record for the largest mass evacuation, where over 80,000 people were forced to flee their homes. Insured losses from Fort McMurray have been estimated at ~$3.8B, after the fire destroyed over 2,000 structures.

Insured losses not only come from physical damage; mass evacuation on its own can lead to a CAT and was the case for the City of Williams Lake, BC in July 2017. Multiple wildfires neared the city and threatened to cut off highways, so an evacuation order was issued for more than 20,000 residents. After a 12-day evacuation, including power outages, additional living expenses and business interruption, there was enough insured loss incurred to reach the CAT threshold.


Figure 2: Downed tree on a car from tornado in Greenboro, Ottawa (Credit: Savanah Ashton)

The summer is known as “CAT season” due to the high frequency of thunderstorms and wildfires. Not only is the summer active in general, but the summer perils are also the most insured perils; home policies generally cover wind, fire and hail, but where does water fit in?

Water is probably the most misunderstood coverage on a home policy. Water damage related to burst pipes, broken taps, bad connections, and hot water tank failures are included in most policies (A Guide to Residential Water Damage and Flood Insurance). However, additional coverage would likely be needed if the sewer backs up, and is available to most who want the coverage. On the other hand, additional overland flood coverage is not available to everyone and, if it is offered, may not be affordable. Typically, overland flooding occurs in the spring, when temperatures warm, the snowpack melts, ice jams occur, and precipitation transitions to rain (and falls onto a frozen or saturated surface).

This past spring, the Saint John River spilled its banks flooding Fredericton, Saint John and many communities in between, but this did not result in an insurance CAT… why? Locally, this was considered a disaster, however the flood insurance gap was large (a combination of not being offered and low take-up rate). Many homeowners without overland flood insurance would have to pay for the damage themselves. If a homeowner has never experienced a flood, they might not recognize that a risk exists. If they do not recognize the risk, how can it be expected that they will take the necessary measures through seeking insurance or taking mitigative measures? A survey of 2,300 Canadians living in flood zones, conducted by Partners For Action in May 2017, found that only 6% were aware of the risk. Now that the industry is increasing its exposure to water, there is the potential for more CATs to occur outside the traditional “CAT season”; 77% of the market now offers overland flood coverage (https://www.canadianunderwriter.ca/insurance/many-canadians-actually-understand-water-damage-coverage-1004149526/).

Next to flooding, the winter and spring also bring conditions suitable for ice storms. This past April, southern Ontario and Quebec experienced snow, ice pellets, and prolonged freezing rain. The weight of the ice caused trees to fall on homes and vehicles. To add salt to the wound, strong winds and flooding rains quickly followed causing further damage. The insured losses from the event resulted in more than $190M.

CAT Stats

In April of 2018, CatIQ declared 100 CATs in just over decade (Press Release), and as of Dec 2018, 108 CATs have cost the insurance industry more than $18B. Thunderstorms may make up 60% of the total number of events over this period (Figure 3), but they only make up half of the overall losses. The most significant insured loss events in Canada’s history are actually not thunderstorm related, and include the Fort McMurray Wildfire (~$3.8B), the 2013 Calgary flooding (~$1.7M), and the 1998 ice storm (~$2B) (2018 IBC Fact Book). It is important to note that the dollar figures mentioned here are only insured losses, and the total economic loss would be much higher.

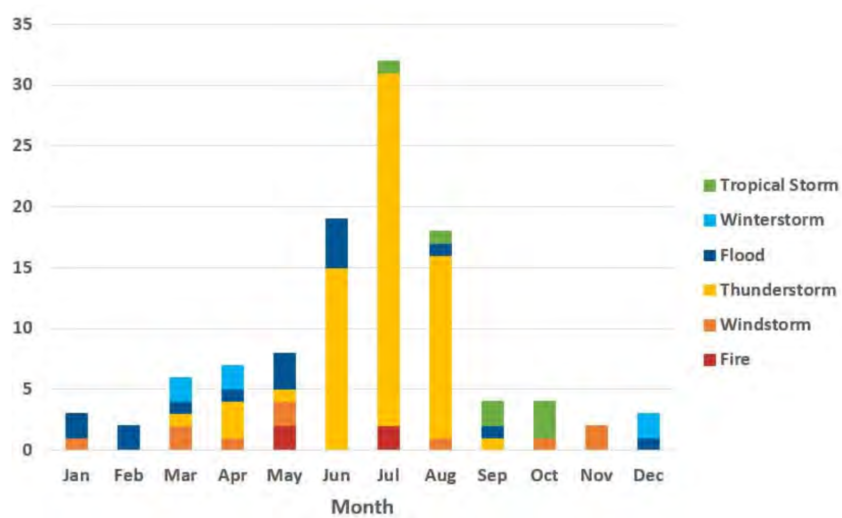


Figure 3: CAT types by month 2008 to present.

Article: Catastrophes and The Insurance Industry

In the past two years, there has been a reversal where Ontario insured losses have surpassed Alberta's. Since 2008, Alberta has made up more than half of the CAT losses across Canada; though for the year of 2017, Ontario surpassed Alberta by 10% and, thus far in 2018, Ontario has made up 70% of insured losses.

CatIQ Connect – Canada's Catastrophe Conference

Many communities and organizations across Canada are working towards mitigating and adapting to extreme weather risk. The annual Canadian catastrophe conference, CatIQ Connect, brings together all sectors to discuss and foster collaboration before disasters. The conference draws more than 200 delegates, where themes are along the lines of preparedness and resiliency, adaptation, new research, and tools. The upcoming event will be held from Feb 4-6, 2019 at the Metro Toronto Convention Centre.

About the Author

Laura is a meteorologist and the Director of Catastrophic Loss Analysis at Catastrophe Indices and Quantification Inc. (CatIQ).

Laura forecasts weather-related disasters across Canada, reports on insurance catastrophes and analyzes loss data. Laura also organizes and sits on the steering committee for the annual Canadian catastrophe conference, CatIQ Connect.

Before joining CatIQ, Laura worked as an operational meteorologist at Wood Group, formerly Amec Foster Wheeler.

Environment and Climate Change Canada / Environnement et Changement climatique Canada

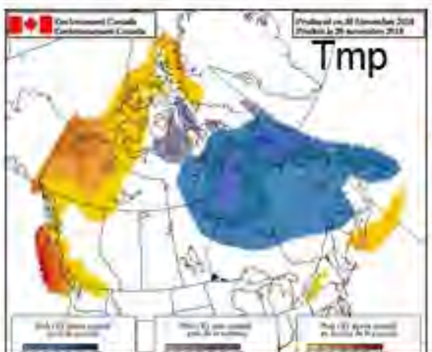
Canada

Seasonal Outlook for the winter 2018/19 (DJF) based on the official CanSIPS forecast issued on the 30th Nov. 2018

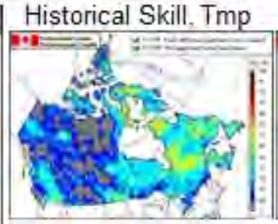
Marko Markovic , Bill Merryfield and Kevin Gauthier

Temperature: Equal probability chances are expected across southern Canada. Over the southern Canada the winter forecast was inconclusive with an exception of southern BC where we expect ~40% probability for an above normal winter. Same result, with higher probabilities, is expected over NW Canada. Below normal winter is most probable in northern ON, northern and central QC, NL and over the Hudson Bay region.

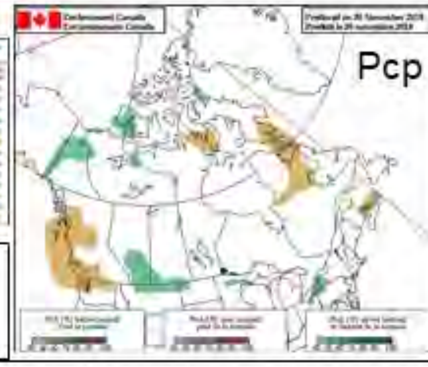
Elevated chance of below normal precipitation over the coastal and southern BC? There is 40-50% probability for this outcome in southern and central BC, possibly as a result of an El Nino phenomena developing in the equatorial Pacific. Below normal precip. is also most likely over northern parts of NB, NS and QC with a low probability of 40-50%. Above normal precipitation is likely at 40-50% over the southwestern Prairies.



Historical Skill, Tmp



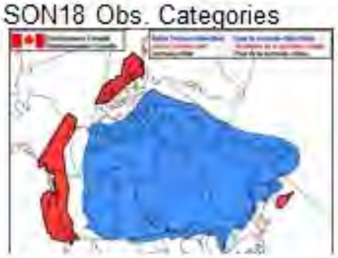
Historical Skill, Pcp



CanSIPS DJF18/19 forecasted Indices:
Nino3.4 = 1.00 (weak El Nino)
PDO = 0.1 (weak positive phase)

What will influence the next season? It is highly likely that a weak El Nino will occur in the equatorial Pacific this winter. ECCC predicts this event to persist into the following spring. According to the longer lead seasonal forecast issued by International Research Institute (IRI), there is a probability of ~90% that a weak El Nino will prevail this winter and of ~80% to continue in spring. **PDO** index is expected to remain near neutral this winter, with a very limited influence to the coastal areas. **PNA** index will remain positive for the first part of December after which the skill is low. Historically, positive PNA is related to below normal temperatures over NE Canada. According to the ECCC seasonal forecast, weak El Nino will probably have no major impact over Canada this winter except to increase the chance of warm temperatures in the coastal west. Earlier than normal ice formation in Hudson Bay seen in current observations could potentially exert an abnormal cooling in the vicinity during early winter.

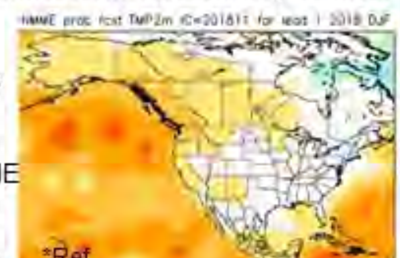
SON18 Obs. Categories



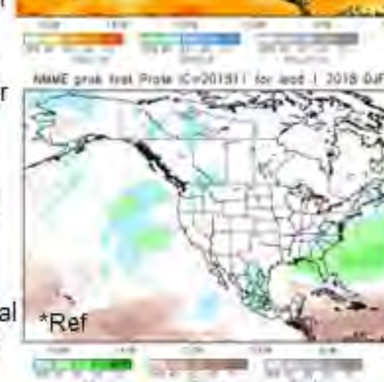
SON18 CanSIPS Catgs.

Verification SON18, Based on 89 observational days
Percent Correct, Temperature: All stations: 9%. The CanSIPS forecast did not predict the very cold weather in much of Canada in October and November 2018.

Seasonal forecast by other centers: Temperature: There is a difference between NMME (longer lead forecast) and CanSIPS. According to the NMME (North American Multi Model Ensemble) (lead 1 month), probability of above normal temperatures (>40%) is expected in western and central parts of Canada and over NS. Eastern ON, QC and the region over the Great Lakes have equal chances for temperature outcome this winter. According to NMME, only northern QC, a region in the vicinity of the northeastern Hudson Bay is most likely to have below normal winter.



Precipitation: There is agreement between CanSIPS and a longer lead forecast from NMME (lower figure), over the southern AB for a 40% probability chance for an above normal precip. Difference between the two systems is seen over the Maritime regions where NMME is predicting the opposite precip. probabilities with respect to CanSIPS. Similarly to CanSIPS, NMME is predicting equal probability chances over most of Canada this winter.



*Ref: http://www.cpc.ncep.noaa.gov/products/NMME/

Environment and Climate Change Canada / Environnement et Changement climatique Canada

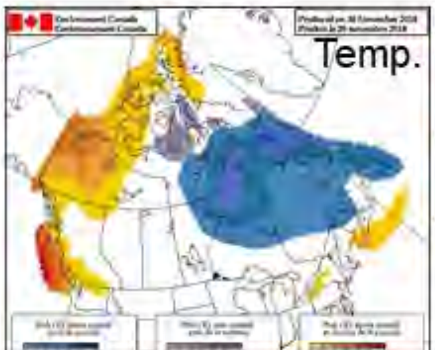
Canada

Prévision saisonnière pour l'hiver 2018/19 (DJF) par le système SPISCan, produite le 30 novembre 2018

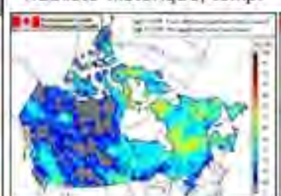
Marko Markovic , Bill Merryfield and Marielle Alarie

Température: Chances égales d'être au-dessus/près/sous la normale sur le sud du Canada. La prévision pour l'hiver est non concluante sur le sud du pays. À l'exception du sud-ouest de la CB où l'on prévoit, avec une probabilité d'env. 40%, des températures au-dessus des normales. Scénario similaire sur l'ouest de l'Arctique, où cette probabilité est plus élevée. Conditions en-dessous des normales sur le nord de l'ON, le nord et le centre du QC, TNL et la Baie d'Hudson.

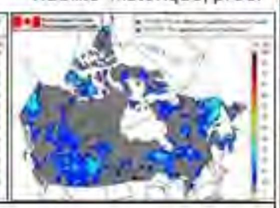
Des précipitations sous la normale sur la côte et le sud de la CB? La probabilité d'observer du temps sec sur plusieurs régions de la CB est de 40-50%; possiblement causé par le phénomène El Nino dans le Pacifique équatorial. Des précipitations sous la normale sont aussi prévues sur une partie des Maritimes, le nord du QC, avec une faible probabilité de 40-50%. Plus de précipitation que la normale pourait être observées sur le sud-ouest des Prairies.

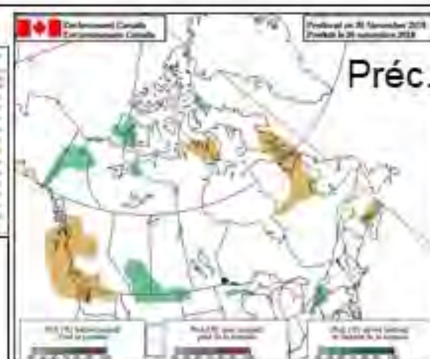


Habileté historique, temp.



Habilité historique, préc.





Indices climatiques prévus par SPIS Can, DJF18/19 :
Nino3.4 = 1.00 (faible El Nino)
PDO = 0.1 (faible phase positive)

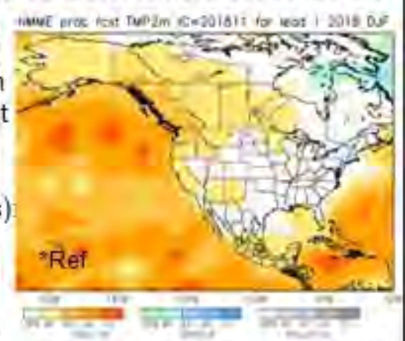
Qu'est-ce qui influencera le climat cette saison? Il est fort probable qu'un faible El Nino se produira cet hiver dans le Pacifique équatorial. ECCC prévoit que cet événement persistera jusqu'au printemps. Selon la prévision saisonnière à plus long terme de l'International Research Institute (IRI), il y a une probabilité d'env. 90% que cet El Nino prévaudra cet hiver, probabilité diminuant à 80% au printemps. L'indice **ODP** (PDO en ang.) devrait rester quasi neutre cet hiver, avec une influence limitée sur les zones côtières. L'indice **PNA** restera positif en début décembre; par la suite, le signal sera faible. Historiquement, un PNA positif est relié à des températures sous les normales sur le nord-est du Canada. Selon ECCC, le faible El Nino n'aura pas d'impact majeur sur le Canada cet hiver, à l'exception de croître la possibilité d'observer du temps doux sur la côte-ouest. Finalement, plus tôt qu'à l'habitude, la formation de glace sur la Baie d'Hudson pourrait exercer un refroidissement anormal à proximité au début de l'hiver.

SON18 Catégories obs.

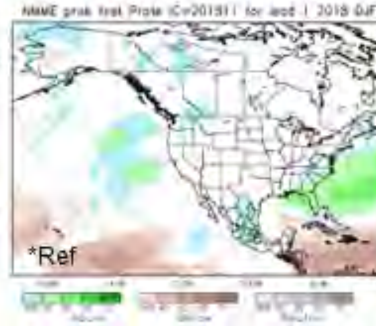
SON18 SPISCan Catgs.

Vérification SON18, basée sur **89 jours** d'observation
Pourcentage correct, temp.: toutes les stations: 9%.
SPISCan n'a pas prévu le temps froid observé sur presque tout le Canada en octobre et novembre 2018

Prévisions saisonnières des autres centres: **Température**: Il y a une différence entre le NMME, qui a une longue échéance de 1 mois, et SPISCan. Selon le NMME (North American Multi Model Ensemble) la probabilité d'observer des températures au-dessus des normales sur l'ouest et le centre du Canada, ainsi que sur la NE, est prévue > 40%. Sur l'est de l'ON, le QC et la région des Grands-Lacs ont une chance égale pour les anomalies de température. Selon le NMME, seulement l'extrême nord du QC et le nord-est de la Baie d'Hudson devraient observer du temps froid.



Précipitations: Il y a un accord entre SPISCan et et la prévision avec l'échéance plus longue du NMME (figure en bas): le sud de l'AB, devrait observer plus de précipitation que la normale, avec une prob. de 40%. La différence entre les deux systèmes est observée sur les Maritimes où le NMME prévoit l'opposé de SPISCan. Ailleurs sur le Canada, on observe une bonne similarité entre SPISCan et le NMME poue cet hiver.



*Ref: http://www.cpc.ncep.noaa.gov/products/NMME/

Terry J. Gillespie, 1941-2018

Photo Credit: L. Gillespie

Dr. Terry Gillespie, Professor Emeritus University of Guelph, passed away suddenly on December 2, 2018 following a brief illness. Terry was a well-known educator and researcher, who specialized in micrometeorology. He was a long-standing member of CMOS and was awarded the Dr. Andrew Thomson Prize in Applied Meteorology in 2006.

Terry received his B.Sc. Degree in Physics from the University of British Columbia in 1962, followed by his M.A. in Meteorology from the University of Toronto. He worked as a weather forecaster for the Meteorological Service at Dorval and Goose Bay airports before completing his Ph.D. in 1968 at the University of Guelph. He was the first Ph.D. student graduating from the new Agrometeorology program at Guelph, and was hired immediately after as an Assistant Professor. From 1968 to 2005, he taught 10 different meteorology courses at the University of Guelph, educating hundreds of undergraduate students. He was an exceptional teacher, receiving many awards including the 3-M Canada Teaching Fellow (1988).

After retirement, as Professor Emeritus, he continued helping educate students and was a volunteer instructor for the Weather Course for the Canadian Power Squadron. Terry supervised over 25 graduate students, many of whom have gone on to be leading meteorologists and scientists in government, industry and academia. Terry authored over 80 publications and contributed to numerous conferences. He is famous for his work on meteorological aspects of plant diseases and atmospheric chemistry, especially related to the interactions with plants and agriculture; as well as meteorological aspects of landscape architecture. He also made many international contributions to teaching and research in Africa, Asia, and South America. Terry served on many scientific committees, such as the Ontario Climate Advisory Committee, was Chair of the Department of Land Resource Science at the University of Guelph from 1996 to 2001, and was a Fellow of the Canadian Society of Agricultural and Forest Meteorology.

In retirement, he was a supporter of the Guelph Youth Music Centre and the Guelph New Horizons Band and learned to play the saxophone.

Terry was an important contributor to our meteorology community in Canada, and he will be truly missed. Our condolences to his wife Lorraine, children Carmen and Adam, grandchildren, and extended family. A tree will be planted in memory of Terry J. Gillespie in the Wall-Custance Memorial Forest, University of Guelph Arboretum. Dedication service, Sunday, September 15, 2019 at 2:30 pm.

Brian Amiro

Terry getting 2005 Andrew Thomson prize from Susan Woodbury in May 2006.

William (Bill) Andrew Gault, 1939-2018

William (Bill) Andrew Gault was born in Ottawa on May 25, 1939 and received his B.Sc. from Carleton University in 1961. In 1967 he completed a thesis entitled “A Study of the Twilight Airglow Emissions of Sodium, Lithium, And Potassium”. His career was dedicated to the development of new instruments for the observation of the aurora and airglow, including a basic scanning Michelson interferometer, used for the observation of the spectrum of the daytime (in winter darkness).

He later designed a system based on the Fabry-Perot interferometer, which had better suppression of the scattered sunlight, obtaining unique results. In 1984, he worked with a team to develop WINDII (WIND Imaging Interferometer), an instrument to measure winds from the newly approved NASA Upper Atmosphere Research Satellite (UARS). With the WINDII experience, Bill designed a ground-based wind instrument called ERWIN (E Region WINd interferometer) which measured ground-based winds from Resolute in Nunavut for a number of years and later from Eureka, one of the most Northern points in Canada. Bill retired in 2003, having left his mark on the upper atmospheric community in terms of sophisticated measurements of winds and other parameters of the upper atmosphere.

Bill was an inherently quiet and honest person who would undertake tasks on his own, then offering thorough and ingenious solutions. Early on the morning of November 19th, 2018, after a long bout with cancer, Bill passed away peacefully, leaving behind his wife Danielle, son Ian, daughters Stephanie Schaller and Kathleen Baggio, grandchildren, great-grandchildren, and other family members. The family will remember his patience, kindness and empathy. In leaving the science community in 2018 he has also left his mark with the many colleagues he acquired along the way with his insights and his quiet, thoughtful and caring manner.

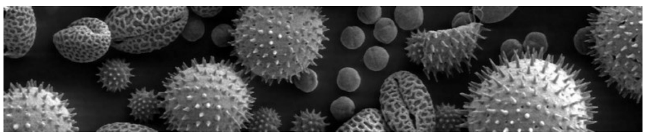
Gordon G. Shepherd

In case you missed it...

From CMOS Bulletin Volume 46, Number 5:

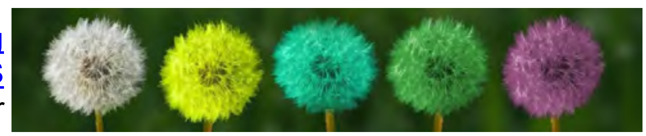
Using Back Trajectories to Trace the Origins of Fine Particulate Matter (PM2.5) / Origine des particules fines (PM2.5) : méthodologie des rétrotrajectoires
by Jean-Philippe Gilbert, Richard Leduc, and Nathalie Barrette

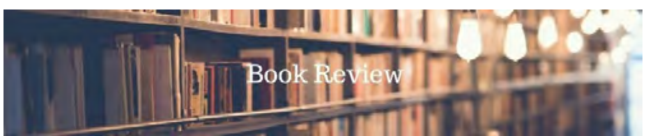
The IFMS: Uniting Meteorologists Around the World
An Interview with Harinder Ahluwalia



Pollen, Chemistry and Clouds
by Ellen Gute

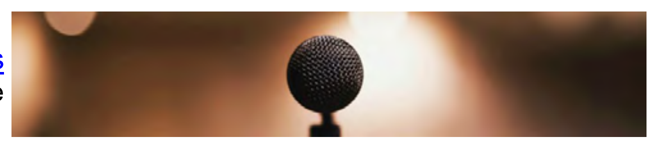
Message from the President for October 2018: Standing Together - Effective Advocacy for CMOS
by Paul Kushner





Book Review: Ice : Nature and Culture
Book by Klaus Dodds, Review by Bob Jones

Members Updates
Meeting Notifications, Books for Review, and more



These articles, and more, in the online CMOS BULLETIN.

http://bulletin.cmos.ca (english)

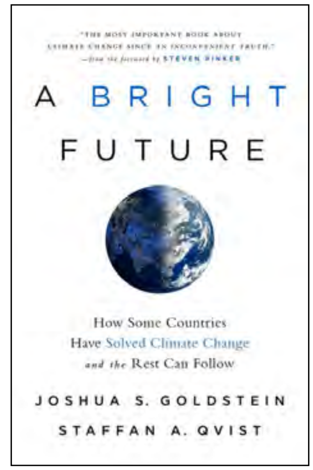
http://bulletin.scmo.ca (français)

Subscribe here to receive your bi-monthly e-update.

http://bulletin.cmos.ca
http://bulletin.scmo.ca

CMOS News

Four New Books Available for Review



A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow, 2019. By Joshua S. Goldstein and Staffan A. Qvist, Hachette Book Group, ISBNs 978-I-5417-241O-5 (hardcover), 978-1-5417-2409-9 (e-book), 288 pages, $34.00. (2018-9)

Trends and Changes in Hydroclimatic Variables: Links to Climate Variability and Change, 2019. Edited by Ramesh Teegavarapu, Elsevier Inc., ISBN 978-0-12-810985-4, 400 pages, US$127 (2017-10)

Tropical Extremes: Natural Variabilities and Trends, 2019. Edited by V. Venugopal, Jai Sukhatme, Raghu Murtugudde, Remy Roca, Elsevier Inc. ISBN 978-0-12.809248-4, 333 pages, US$110 (2018-11)

World Seas, An Environmental Evaluation. VOLUME III: Ecological Issues and Environmental Impacts, Second Edition, 2019. Edited by Charles Sheppard, Elsevier Inc. ISBN 978-0-12-805052-1, 633 pages, US$250. (2018-12)

Other recent titles still available for review by a CMOS member:

Synoptic Analysis and Forecasting, An Introductory Toolkit, 2017. By Shawn Milrad, Elsevier, ISBN 9780128092477, 246 pages, US$125.00 (2018-1)

Ice Caves, 2017. Edited by Aurel Persoiu, Elsevier, ISBN 9780128117392, 752 pages, $225.00 (2018-2)

Rainbows: Nature and Culture, 2018. By Daniel MacCannell, The University of Chicago Press and Reaktion Books Ltd, ISBN 9781780239200, 208 pages, US$24.95 (2018-4)

Verner Suomi: The Life and Work of the Founder of Satellite Meteorology, 2018. By John M. Lewis, The University of Chicago Press and the American Meteorological Society, ISBN 9781944970222, paperback,168 pages, US$30.00. (2018-5)

The Deep Pull: A Major Advance in the Science of Ocean Tides.
By Walter Hayduk, FriesenPress, ISBN 9781525518706 (hardcover) $35.49, 9781525518713 (softcover) $27.49, 9781525517820 (eBook) $11.99, 251 pages. (2018-7)

Climate in the Age of Empire: Weather Observers in Colonial Canada, 2018. By Victoria C. Slonosky, American Meteorological Society, ISBN 978-1-944970-20-8, US$35, 311 pages. (2018-8)

Never reviewed a book before? No problem! Check out some of these past reviews for ideas: Ice: Nature and Culture; Weather in the Courtroom; Convenient Mistruths: A Novel of Intrigue, Danger and Global Warming.

If you a review a book it is yours to keep! Contact the Editor to get involved.

Jim Drummond Awarded the Martin Bergmann Medal for Excellence in Arctic Leadership or Science by the Royal Canadian Geographical Society

For his exceptional contributions to Arctic research, science and leadership, the Society is awarding James Drummond the 2018 Martin Bergmann Medal.

His contributions in furthering Arctic research include his establishment of PEARL (Polar Environment Atmospheric Research), the globally-recognized Arctic flagship observatory that has contributed to a significant body of research. His enthusiasm for Arctic research has animated the CANDAC/PEARL Outreach Program that supports thousands of students, teachers, senior officials, and members of the diplomatic community. Dr. Drummond is a highly sought-after and active contributor in the national and international scientific community, including his work on multiple high-level committees.

From all of us at CMOS, Congratulations Jim!

Source: rcgs.org; Photo source: thechronicleherald.ca

Other News

The Northern Science Award

Polar Knowledge Canada would like to announce that nominations are now open for the 2019 Northern Science Award.

The Northern Science Award is presented annually to an individual or a group who have made a significant contribution to meritorious knowledge and understanding of the Canadian North. In the spirit of the last International Polar Year (2007-2008) the Northern Science Award recognizes the transformation of knowledge into action.

This year marks the 34th anniversary of the award, which comprises the Centenary Medal, which was created to commemorate the 100th Anniversary of the first International Polar Year, 1882-1883, along with a cash prize.

The deadline for nominations is January 31st 2019. For more information, visit the website of Polar Knowledge Canada at: https://www.canada.ca/en/polar-knowledge/fundingforresearchers/awards.html or contact: Polar Knowledge Canada, info@polar.gc.ca

BAMOS Special Issue – Commemorating the 30th Anniversary of AMOS

AMOS
Australian Meteorological & Oceanographic Society

BAMOS is pleased to present a very Special Issue documenting the events of the thirtieth anniversary of AMOS celebrated through 2017. A year on, this publication provides reflections on the establishment of AMOS and highlights some of the scientific developments over this time.

Thank you to John McBride for his contributions as a guest editor of this edition. We hope you enjoy this issue.

Read online/download at Joomag

Have a read and let us know what you think at bamos@amos.org.au.

DATA, MODELS AND ANALYSIS

The Highest Impact Articles in *Atmosphere-Ocean*

Available from CMOS for $40 CDN (taxes included) + shipping.
Contact exec-dir@cmos.ca or accounts@cmos.ca

CMOS SCMO

Edited by
GUOQI HAN, HAI LIN and DOUW STEYN

ROUTLEDGE

Council / Conseil d'administration

President / Président
Paul Kushner
Department of Physics, University of Toronto, Toronto, ON
Tel.: 416-946-3683; E-mail/Courriel: president@cmos.ca

Vice-President / Vice-président
Kimberly Strong
E-mail/Courriel: vice-president@cmos.ca

Past-President / Président Sortant
Wayne Richardson
Tel.: 613-729-6757; Cel.: 613-851-7071; E-mail/Courriel: past-president@cmos.ca

Treasurer / Trésorier
Amir Shabbar
E-mail/Courriel: treasurer@cmos.ca

Corresponding Secretary / Secrétaire-correspondante
Alanna MacKenzie
E-mail/Courriel: corsec@cmos.ca

Recording Secretary / Secrétaire d'assemblée
Fred Conway
E-mail/Courriel: recsec@cmos.ca

Councillors-at-large / Conseillers
1) Iain Russell
Director, Meteorological R&D, Pelmorex Media Inc.
Tel.: 905-829-1159 x1405; E-mail/Courriel: irussell@pelmorex.com

2) Robert Sica
University of Western Ontario, London, ON
Tel.: 519-661-3521; E-mail/Courriel: bobsica@purplecrowlidar.ca

3) Nadja Steiner
Department of Fisheries and Oceans, CCCma, Environment Canada
E-mail/Courriel: nadja.steiner@canada.ca

4) Felicia Kolonjari
Ph.D. student
E-mail/Courriel: Felicia.kolonjari@gmail.com

CMOS Bulletin SCMO @ bulletin.cmos.ca

The CMOS Bulletin has moved on-line to http://bulletin.cmos.ca. Please continue to send articles, notes, workshop reports and news items to bulletin@cmos.ca. We will be accepting, reviewing, and publishing content on an on-going basis.

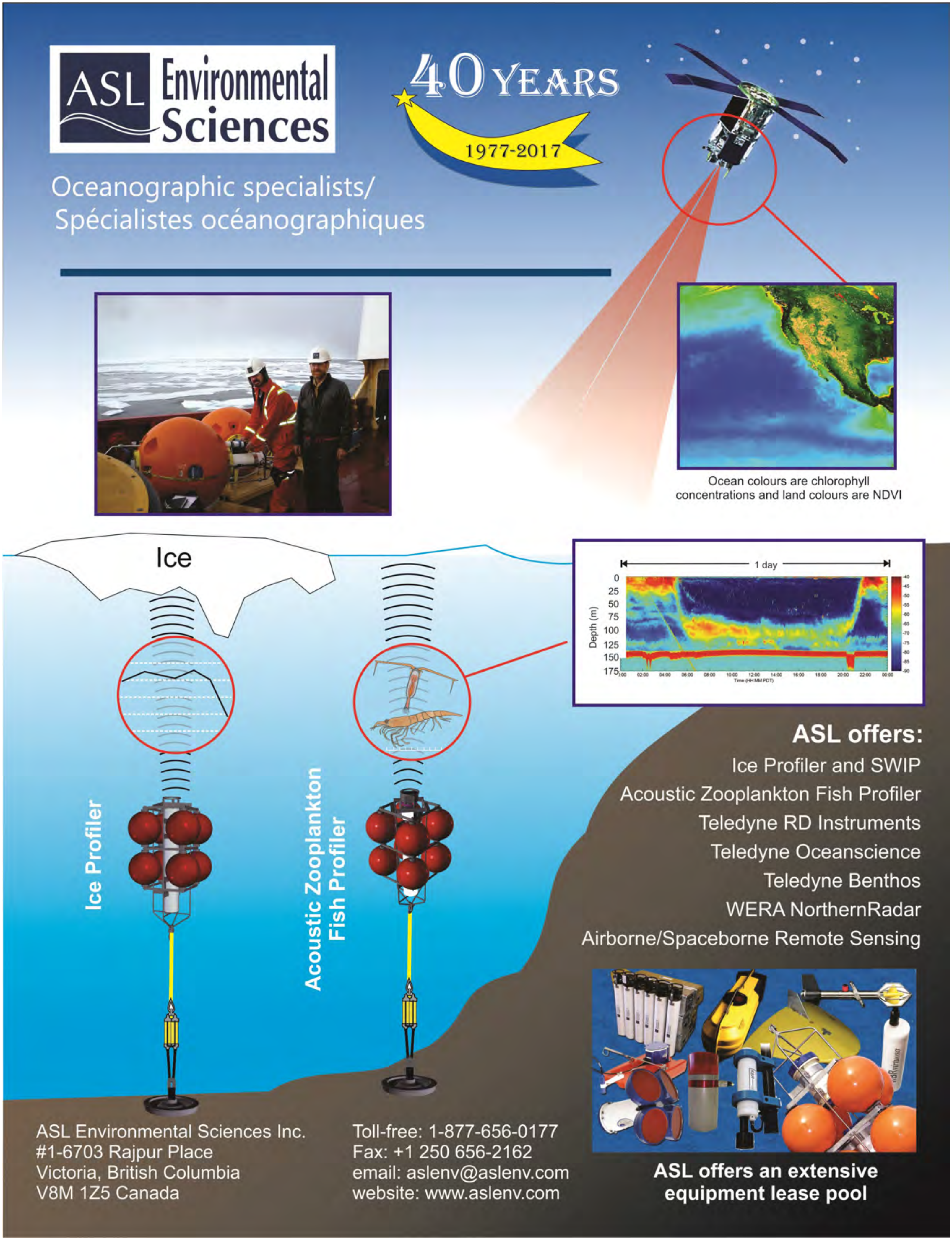
This publication is produced under the authority of the Canadian Meteorological and Oceanographic Society. Except where explicitly stated, opinions expressed in this publication are those of the authors and are not necessarily endorsed by the Society.

CMOS Bulletin SCMO @ bulletin.scmo.ca

Le *Bulletin de la SCMO* se trouve maintenant en ligne à http://bulletin.scmo.ca/. N'hésitez pas à soumettre notes, rapports d'atelier et nouvelles à l'adresse bulletin@scmo.ca. Nous accepterons, réviserons et publierons vos contenus sur une base continue.

Cette publication est produite sous la responsabilité de la Société canadienne de météorologie et d'océanographie. À moins d'avis contraire, les opinions exprimées sont celles des auteurs et ne reflètent pas nécessairement celles de la Société.

Thank you to Bob Jones and Paul-André Bolduc, for their continued editorial assistance and guidance.



ASL Environmental Sciences
40 YEARS
1977-2017
Oceanographic specialists/
Spécialistes océanographiques
Ocean colours are chlorophyll concentrations and land colours are NDVI
Ice
1 day
Depth (m)
Ice Profiler
Acoustic Zooplankton Fish Profiler
ASL offers:
Ice Profiler and SWIP
Acoustic Zooplankton Fish Profiler
Teledyne RD Instruments
Teledyne Oceanscience
Teledyne Benthos
WERA NorthernRadar
Airborne/Spaceborne Remote Sensing
ASL offers an extensive equipment lease pool
ASL Environmental Sciences Inc.
#1-6703 Rajpur Place
Victoria, British Columbia
V8M 1Z5 Canada
Toll-free: 1-877-656-0177
Fax: +1 250 656-2162
email: aslenv@aslenv.com
website: www.aslenv.com