Elements

Volume 31, Number 1 January 2013

THE NEWSLETTER OF THE CANADIAN GEOPHYSICAL UNION

IN THIS ISSUE

LE BULLETIN DE L'UNION GÉOPHYSIQUE CANADIENNE

President's Column

Happy New Year, CGU members! 2012 was an active and exciting year for CGU. We held our first joint congress with the Canadian Water Resources Association in Banff in May, which was a great success. We are currently busy planning our 2013 meeting, which will be held in Saskatoon with CMOS and CWRA from May 26-30; many thanks to Rod Blais for all his hard work in putting together a high-caliber scientific program. This 3-way meeting will be another first for us. As always, we welcome member feedback and ideas to keep our annual meetings vibrant and of the highest scientific caliber.

I am happy to report that CGU has hired an Executive Director, Dr. Gordon Young, to help move CGU's objectives forward and grow our organization. Many of you know Gordon well, as he is a dedicated and long-standing CGU member. Welcome, Gordon, and we look forward to working with you!

Another change in our organization is that Ed Krebes, the long-serving editor of the Elements newsletter, has retired from this role. Gordon Young is taking on the Editorial role for this issue, and we will continue to discuss the format that Elements should take in the future – again, thoughts and ideas welcome. Many thanks to Ed for his outstanding leadership and service for CGU as the Elements Editor!

In the coming months, you will be hearing from us on an amended set of bylaws for CGU. There are new federal regulations on governance of not-for-profit societies in Canada that have been mandated by Corporations Canada. In order for CGU to continue to exist (beyond 2014) we must comply with these new regulations, so obviously we are treating this as a high priority. We will be presenting the amended bylaws for ratification by the membership at our annual meeting at the beginning of June.

Wishing you all a successful start to 2013, and I look forward to meeting with you in Saskatoon.

Gail Atkinson

Message from the Executive Director

Just a short message to express my surprise and delight when, last September, I received a message from Gail Atkinson inviting me to take on the newly created post of Executive Director of CGU. I regarded the invitation as a great honour and a privilege to be able to assist in running the premier earth sciences not-for-profit organization in Canada. I accepted enthusiastically!

The duties and responsibilities associated with the post are quite extensive and it will take me some time to come up to speed with all that is required. I am fairly familiar with the types of duties to be performed from my experience as Secretary of the then NRC Associate Committee on Hydrology in the 1980s and as Secretary General of the International Association of Hydrological Sciences in the 1990s, but having been away from the Canadian scene for a good many years I have lost much of my immediate contact with earth sciences research in the Canadian context.

I very much look forward to re-establishing contact with the research community, within universities, government-based institutions and within the private sector. I anticipate much contact through email and at the up-coming CGU-CMOS-CWRA meeting in Saskatoon in May. I hope to be able to do my small part in promoting and facilitating your collective research efforts!

Gordon Young

J. Tuzo Wilson Medal – Call for Nominations

The Executive of the CGU solicits nominations for the J. Tuzo Wilson Medal – 2013. The Union makes this award annually to recognize outstanding contributions to Canadian geophysics. Factors taken into account in the selection process include excellence in scientific and/or technological research, instrument development, industrial applications and/or teaching.

If you would like to nominate a candidate, please contact Dr. Cherie J. Westbrook, Chair of the CGU Awards Committee, University of Saskatchewan (Email: cherie.westbrook@usask.ca). At a minimum, the nomination should be supported by letters of recommendation from colleagues, a brief biographical sketch and a Curriculum Vitae. **Nominations should be submitted by January 31, 2013**. Additional details concerning the nomination process can be obtained from the Chair of the CGU Awards Committee.

L'exécutif de l'UGC vous invite à suggérer des candidats pour la médaille J. Tuzo Wilson – 2013. L'Union décerne la médaille chaque année "en reconnaissance d'une contribution remarquable à la géophysique canadienne". En choisissant parmi les candidats, on considére les accomplissements en recherches scientifique ou technologiques, aux développements d'instruments, aux applications industrielles et/ou à l'enseignement.

Si vous désirez suggérer un candidat pour cette médaille, s.v.p. contacter Dr. Cherie J. Westbrook, Président du Comité des Prix d'Excellence, Université de la Saskatchewan (Email: cherie.westbrook@usask.ca). Les nominations doivent être supportées de lettres de recommandation de collègues, d'un bref sommaire biographique et d'un Curriculum Vitae. **Les nominations doivent être soumises avant le 31 janvier, 2013**. Des détails additionnels concernant le processus de nomination peuvent être obtenus en communiquant avec le Président du Comité des Prix d'Excellence de l'UGC.

Past Wilson Medalists

1978	J. Tuzo Wilson
1979	Roy O. Lindseth
1980	Larry W. Morley
1981	George D. Garland
1982	Jack A. Jacobs
1983	D. Ian Gough
1984	Ted Irving
1985	Harold O. Seigel
1986	Michael Rochester
1987	David Strangway
1988	Ernie Kanasewich
1989	Leonard S. Collett
1990	Gordon F. West
1991	Thomas Krogh
1992	R. Don Russell
1993	Alan E. Beck
1994	Michael J. Berry
1995	Charlotte Keen
1996	Petr Vaníček
1997	Chris Beaumont
1998	Ron M. Clowes
1999	David Dunlop
2000	Don Gray
2001	Roy Hyndman
2002	Doug Smylie
2003	Garry K.C. Clarke
2004	W.R. (Dick) Peltier
2005	Ted Evans
2006	Alan Jones

2007	Herb Dragert	2010	Nigel Edwards
2008	Ming-ko (Hok) Woo	2011	Fred Cook
2009	Garth van der Kamp	2012	Doug Oldenburg

CGU Young Scientist Award – Call for Nominations

The Executive of the CGU solicits nominations for the CGU Young Scientist Award – 2013. The CGU Young Scientist Awards recognize outstanding research contributions by young scientists who are members of the CGU. Both the quality and impact of research are considered. To be eligible for the award, the recipient must be within 10 years of obtaining their first Ph.D. or equivalent degree. The awards are made by the CGU Executive on the recommendations of a special committee struck for this purpose. The selection committee seeks formal written nominations from the membership, plus letters of support and a current curriculum vitae. Nominations for the CGU Young Scientist Awards may be submitted by CGU members at any time.

If you would like to nominate a candidate, please contact Dr. Cherie J. Westbrook, Chair of the CGU Awards Committee, University of Saskatchewan (Email: cherie.westbrook@usask.ca). The nomination should be supported by three letters of recommendation from colleagues. **Nominations should be submitted by January 31, 2013**. Additional details concerning the nomination process can be obtained from the Chair of the CGU Awards Committee.

L'exécutif de l'UGC vous invite à suggérer des candidats pour le prix pour Jeune Scientifique de l'UGC – 2013. Les Prix pour Jeunes Scientifiques de l'UGC reconnaissent les contributions exceptionnelles de jeunes scientifiques qui sont membres de l'UGC. La qualité et l'impact de la recherche sont considérés. Pour être éligible pour le prix, le scientifique doit avoir obtenu son premier Ph.D. ou degré équivalent au cours des dix dernières années. Les prix sont accordés par l'Exécutif de l'UGC sur recommendations d'un comité spécial à cette fin. Le comité de sélection sollicite des nominations formelles par écrit des membres de l'UGC, accompagnées de lettres d'appui et d'un curriculum vitae à jour. Des nominations pour les Prix pour Jeunes Scientifiques de l'UGC peuvent être soumis en tout temps par les membres de l'UGC.

Si vous désirez suggérer un candidat pour cette médaille, s.v.p. contacter Dr. Cherie J. Westbrook, Président du Comité des Prix d'Excellence, Université de la Saskatchewan (Email: cherie.westbrook@usask.ca). Les nominations doivent être supportées de trois lettres de recommandation de collègues. **Les nominations doivent être soumises avant le 31 janvier, 2013**. Des détails additionnels concernant le processus de nomination peuvent être obtenus en communiquant avec le Président du Comité des Prix d'Excellence de l'UGC.

Past Winners

2005	Shawn J. Marshall, J. Michael Waddington
2006	No winner
2007	No winner
2008	Brian Branfireun, Scott Lamoureux
2009	Gwenn Flowers, Stephane Mazzotti
2010	Sean Carey
2011	Michael Riedel
2012	Brian Menounos

CGU Meritorious Service Award – Call for Nominations

The Executive of the CGU solicits nominations for the CGU Meritorious Service Award – 2013. The CGU Meritorious Service Award recognizes extraordinary and unselfish contributions to the operation and management of the Canadian Geophysical Union by a member of the CGU. All members of the CGU are eligible for this award, although the award is not normally given to someone who has received another major award (e.g. the J. Tuzo Wilson Medal). Nominations for the CGU Meritorious Service Award may be submitted by CGU members at any time. The award is made by the CGU Executive based on recommendations from the CGU Awards Committee, and is based on lifetime contributions to CGU activities.

If you would like to nominate a candidate, please contact Dr. Cherie J. Westbrook, Chair of the CGU Awards Committee, University of Saskatchewan (Email: cherie.westbrook@usask.ca). The nomination should be supported by three letters of recommendation from colleagues. Nominations should be submitted by January 31, 2013. Additional details concerning the nomination process can be obtained from the Chair of the CGU Awards Committee.

L'exécutif de l'UGC vous invite à suggérer des candidats pour le Prix pour Service Méritoire de l'UGC – 2013. Le Prix pour Service Méritoire de l'UGC reconnait les contributions extraordinaires et désintéressées à l'opération et à l'administration de l'Union Géophysique Canadienne par un membre de l'UGC. Tous les membres de l'UGC sont éligibles pour ce prix, sauf que normalement, ce prix n'est pas donné à quelqu'un qui a recu un autre prix important tel que la Médaille Tuzo Wilson. Des nominations pour le Prix pour Service Méritoire de l'UGC peuvent être soumises en tout temps par les membres de l'UGC. Le Prix est accordé par l'Exécutif de l'UGC sur recommendations du Comité des Prix de l'UGC, pour l'ensemble des contributions d'un membre aux activités de l'UGC.

Si vous désirez suggérer un candidat pour cette médaille, s.v.p. contacter Dr. Cherie J. Westbrook, Président du Comité des Prix d'Excellence, Université de la Saskatchewan (Email: cherie.westbrook@usask.ca). Les nominations doivent être supportées de trois lettres de recommandation de collègues. Les nominations doivent être soumises avant le 31 janvier, 2013. Des détails additionnels concernant le processus de nomination peuvent être obtenus en communiquant avec le Président du Comité des Prix d'Excellence de l'UGC.

Past Winners

2004	Ron Kurtz
2005	Ted Glenn
2006	J.A. Rod Blais
2007	Ed Krebes
2008	Patrick Wu
2009	Garry Jarvis
2010	Zoli Hajnal
2011	Masaki Hayashi
2012	Kathy Young

The Stan Paterson Scholarship in Canadian Glaciology

1) Background

The Stan Paterson Scholarship in Canadian Glaciology honours Dr. Stan Paterson, a preeminent Canadian Glaciologist who has worked extensively on glaciers in the Canadian High Arctic and Rocky Mountains and is author of the classic textbook *The Physics of Glaciers*, now in its fourth edition. The scholarship is made possible by an endowment from Stan Paterson.

2) Award

The Stan Paterson Scholarship in Canadian Glaciology is a $2500 scholarship awarded at the annual spring meeting of the Canadian Geophysical Union.

3) Eligibility

Eligible students are those studying glaciology with confirmed admission to, or current enrolment in, a research-based graduate degree program (Master or PhD) at a Canadian University. Glaciology is broadly defined as the scientific study of all aspects of, and processes related to, Earth's cryosphere. Field research, if applicable, may be undertaken elsewhere in the world.

4) Application Process

The application comprises an official academic transcript, proposal, current Curriculum Vitae, and two letters of appraisal from academic referees. The application package for the Stan Paterson Scholarship in Canadian Glaciology is expected to parallel the applications for the NSERC CGS/PGS program. Applicants to the NSERC CGS/PGS program may submit the same materials for their application for this award.

i) Official Transcript - An official transcript from the institution at which formal course work was last completed is required. The university-sealed transcript envelope should accompany the other application materials.

ii) Proposal - The applicant must provide a maximum one page research proposal briefly outlining the background/rationale, approach and outcomes/expected outcomes, and significance of their postgraduate research program in glaciology. In addition to the one page proposal, an additional page is permitted for bibliographic references.

iii) Curriculum Vitae - The applicant must provide a current CV in an NSERC PGS format (see Form 200), that includes: Current Address; Citizenship; Academic Background (degree, discipline, institution, start date, (anticipated) completion date); Academic, research and other relevant work experience; List of scholarships and other awards; Theses completed or in progress and a summary of the most recently completed or in progress thesis. No justification for a location of tenure is required, however the applicant must be registered in a full-time program at a Canadian University.

iv) Letters of Appraisal. Provide letters of appraisal from two academic referees (one, if applicable, from the current master's or doctoral supervisor). As per the NSERC Form 200 Appendix 1, the referee is asked to comment on the applicant's research ability/potential and on the applicant's communication, interpersonal and leadership abilities. The letter should be limited to one page, be signed, and delivered with the application package in a sealed envelope with a signature over the backflap.

5) Criteria for Assessment

Applicants for the Stan Paterson Scholarship in Canadian Glaciology are evaluated and selected according to criteria that parallel those of the NSERC PGS program in the following categories:

i) Academic excellence

- Academic record
- Scholarships and awards held

ii) Research ability or potential

- Quality of contributions to research and development
- Significance, feasibility, and merit of proposed research
- Ability to think critically
- Ability to apply skills and knowledge
- Judgment
- Originality
- Initiative and autonomy
- Enthusiasm for research
- Determination and ability to complete projects within an appropriate period of time

iii) Communication, interpersonal and leadership abilities

- The ability or potential to communicate scientific concepts clearly and logically in written and oral formats. For example, this could include:
    - quality of the application's presentation;
    - participation in preparing publications; and
    - awards for oral presentations or papers.

- Professional and relevant extracurricular interactions and collaborations. For example, this could include:
    - mentoring;
    - teaching;
    - supervisory experience;
    - project management;
    - chairing committees;
    - organizing conferences and meetings; and
    - elected positions held.

The adjudication committee will assess the above criteria with the following weighting scheme:

30%	Academic Excellence
50%	Research Ability and Potential
20%	Communication, interpersonal and leadership abilities

Excellence is an essential requirement for this award. If, in the judgment of the adjudication committee, this requirement is not met by any of the candidates the award will not be given.

6) Deadline for Application, Adjudication, and Notification

The deadline for submission is February 28, 2013. Complete application packages (Sealed transcript, proposal, CV, two sealed letters of reference) are to be sent to:

Dr Cherie J. Westbrook,
Chair CGU Awards Committee
Department of Geography & Planning
University of Saskatchewan
117 Science Place
Saskatoon, SK, S7N 5C8

Phone: (306) 966-1818
Fax: (306) 966-1428
e-mail:cherie.westbrook@usask.ca

The applications will be adjudicated by an awards committee appointed by the Canadian Geophysical Union. The winner of the Stan Paterson Scholarship in Canadian Glaciology will be notified sufficiently in advance so that they may make arrangements to attend the annual spring meeting of the Canadian Geophysical Union to receive their award in person if they were not already planning to do so.

2013 JOINT SCIENTIFIC CONGRESS OF THE CMOS, CGU AND CWRA

Bridging Environmental Science, Policy and Resource Management

Call for Abstracts for the 2013 Joint Scientific Congress of CMOS, CGU, and CWRA, 26-30 May 2013, Saskatoon, SK

(la version française suit)

Dear colleagues,
The 2013 Joint Scientific Congress of the CMOS, CGU, and CWRA will be held at TCU Place in Saskatoon, SK, 26-30 May 2013. Preliminary programs, registration, hotel, and general information are posted on the 2013 Congress Web site at http://www.cmos.ca/congress2013/index.htm. The theme of this congress is *Bridging Environmental Science, Policy and Resource Management*, and presentations are encouraged for all areas of interest of CMOS (Canadian Meteorological and Oceanographic Society), CGU (Canadian Geophysical Union), and CWRA (Canadian Water Resources Association). The collaboration of these three societies reflects the growing interdisciplinary aspect of all our sciences, and the need to consider novel collective approaches in a world that is changing rapidly due to the combined impacts of global climate variability, evolving global economies, population growth, and overall impacts on or by our atmosphere, water resources, and the solid earth; hence the theme of this congress.
Both oral and poster presentations are encouraged on these topics, and on all areas of interest of the three societies.
Please submit abstracts electronically to the link found on the Congress website (http://www.cmos.ca/congress2013/index.htm) between 13 January and the submission deadline of 16 February 2013. You will be requested to indicate your choice of area of interest and session (details available later), and to specify your preference for either an oral or a poster presentation. A non-refundable abstract fee of CAD $50 (payable by credit card) will be charged at the time of submission. Your abstract will be evaluated by the Science Program Committee, and every effort will be made to respect your preference of session and type of presentation. You will be notified by the end of March 2013 as to the status of your presentation.
We strongly encourage student members of CMOS, CGU, or CWRA to submit papers on their research. Student presenters may apply for a Student Travel Bursary from one of these societies upon submitting their abstract (travel bursary applications will be provided during or after submitting your abstract submission). Student members may later be asked to submit an extended abstract (up to 2 pages) to be considered for a student presentation award.
For additional information, please contact one of the science program chairs: Geoff Strong (geoff.strong@shaw.ca representing CMOS), Rod Blais (blais@ucalgary.ca for CGU), or Bob Halliday (rhalliday@sasktel.net for CWRA). If you are an exhibitor, an educator, a member of the media, or anyone else with an interest in the meeting, please visit the Congress website (http://www.cmos.ca/congress2013/index.htm) for contacts and further information.

Congrès Scientifique Conjoint 2013 de la SCMO, de L'UGC et de L'ACRH 26-30 May 2013, Saskatoon

Intégration des sciences de l'environnement, de la politique et de la gestion des ressources.

Demande de résumés pour le congrès scientifique conjoint 2013 de la SCMO, de l'UGC et de l'ACRH, du 26 au 30 mai 2013, à Saskatoon, en Saskatchewan.

Chers collègues,
Le congrès scientifique conjoint 2013 de la SCMO, de l'UGC et de l'ACRH se tiendra à la TCU Place à Saskatoon, en Saskatchewan, du 26 au 30 mai 2013. Les renseignements préliminaires sur les programmes, l'inscription, l'hôtel et les informations générales sont affichés sur le site Internet du congrès 2013 au http://www.cmos.ca/congress2013/index.htm. Le thème de ce congrès est : *Intégration des sciences de l'environnement, de la politique et de la gestion des ressources,* et les offres de présentations sont encouragées pour tous les domaines d'intérêt de la SCMO (Société canadienne de météorologie et d'océanographie), de l'UGC (Union géophysique canadienne) et de l'ACRH (Association canadienne des ressources hydriques). La collaboration de ces trois sociétés reflète l'aspect interdisciplinaire croissant de toutes nos sciences et la nécessité de considérer de nouvelles approches collectives dans un monde qui change rapidement à cause des répercussions combinées des variations du climat global, des économies mondiales en évolution, de la croissance de la population et des répercussions générales sur notre atmosphère ou de notre atmosphère, nos ressources hydriques, et la croûte terrestre; d'où le thème de ce congrès. Les présentations orales et par affiches sont encouragées sur ces sujets ainsi que sur tous les domaines d'intérêt des trois sociétés.
Veuillez soumettre les résumés électroniquement au lien

qui se trouve sur le site Internet du congrès (http://www.cmos.ca/congress2013/index.htm) entre le 13 janvier et la date limite de soumission, le 16 février 2013. Vous devrez indiquer votre choix de domaine d'intérêt et de séance (détails disponibles plus tard) et spécifier votre préférence pour une présentation orale ou par affiche. Des frais de présentation non remboursables de 50 $ CAN (payables par carte de crédit) seront demandés au moment de la soumission. Votre présentation sera évaluée par le comité du programme de sciences, et nous ferons tout notre possible pour respecter votre préférence de séance et de type de présentation. Vous serez avisé de la décision prise quant à votre présentation avant la fin du mois de mars 2013.

Nous encourageons fortement les membres étudiants de la SCMO, de l'UGC ou de l'ACRH à soumettre des résumés de leurs recherches. Les présentateurs étudiants peuvent faire une demande de bourse de voyage pour étudiant à l'une de ces sociétés lors de la soumission de leur résumé (des formulaires de demande pour une bourse apparaîtront pendant ou après la soumission de votre résumé). Les membres étudiants peuvent aussi avoir à fournir par la suite une résumé plus longue (jusqu'à 2 pages) pour un éventuel prix de présentation étudiante. Pour de plus amples renseignements, veuillez communiquer avec l'un des présidents du programme de sciences : Geoff Strong (geoff.strong@shaw.ca représentant la SCMO), Rod Blais (blais@ucalgary.ca pour l'UGC) ou Bob Halliday (rhalliday@sasktel.net pour l'ACRH). Si vous êtes un exposant, un enseignant, un membre des médias ou une personne intéressée au congrès, veuillez visiter le site Internet du congrès (http://www.cmos.ca/congress2013/index.htm) pour les coordonnées et d'autres renseignements.

CMOS-CGU-CWRA Joint Assembly, 26-30 May 2013, Saskatoon

Abstract Submission Template (English)

Title of your presentation in bold lower case letters and no more than two lines

I.M. Presenter[1] & A. Coauthor[2]
[1]Department of Geoscience, University of Calgary, Calgary, Alberta, T2N 1N4
Phone: 403-220-5028 Fax: 403-284-0074, Email: impresenter@ucalgary.ca
[2]Département de biologie, Université Laval, Sainte-Foy, Québec, G1V 0A6
Téléphone: 418-656-1111 Fax: 418-656-1112, courriel: acoauthor@ulaval.ca

The abstract should not exceed 250 words. It may include both text and figures, but the full abstract submission (title, author's names, affiliations, and contact information, abstract, biographies) must fit within one standard letter size page (8.5" x 11") with a 1" border all around.

I. M. Presenter: PhD (Alberta); Associate Professor, University of Calgary
A. Coauthor: PhD (Montreal); Assistant Professor, Université Laval

Oral presentation

HW5 – Hydrology and the Urban Biophysical Environment

Congrès Scientifique Conjoint 2013 de la SCMO, de L'UGC et de L'ACRH 26-30 May 2013, Saskatoon

Le format de soumission d'un résumé en Français

Titre de votre présentation en lettres bold minuscules et pas plus de deux lignes

I.M. Presenter[1] & A. Coauthor[2]
[1]Department of Geoscience, University of Calgary, Calgary, Alberta, T2N 1N4
Phone: 403-220-5028 Fax: 403-284-0074, Email: dfkelly@ucalgary.ca
[2]Département de biologie, Université Laval, Sainte-Foy, Québec, G1V 0A6
Téléphone: 418-656-1111 Fax: 418-656-1112, courriel: jtremblay@ulaval.ca

Le résumé ne doit pas dépasser 250 mots. Il peut inclure à la fois le texte et des figures, mais la soumission complète du résumé (le titre, le(s) nom(s) des auteurs, informations pour contact, le résumé et les biographies) doit être contenu sur une page de format régulier (8.5" x 11") avec une marge de 1" tout autour.

I. M. Presenter: PhD (Alberta); Associate Professor, University of Calgary
A. Coauthor: PhD (Montréal); Assistant Professor, Université Laval

Présentation orale

HW5 – Hydrology and the Urban Biophysical Environment

Report on the CWRA-CGU Joint Annual Meeting, Banff, June 5-8, 2012

Rod Blais

The 38th Annual Meeting of the Canadian Geophysical Union (CGU) was held jointly with the National Conference of the Canadian Water Resources Association (CWRA) at the Banff Centre, Banff, AB, on June 5-8, 2012. Four other technical societies joined the 2012 CWRA-CGU Meeting:

- Canadian National Committee on Irrigation and Drainage (CANCID)
- Canadian Society for Hydrological Sciences (CSHS)
- Canadian Geomorphology Research Group (CGRG)
- North American Stream Hydrographers (NASH)

The theme of the meeting was '**Earth, Wind & Water – Elements of Life**'. Over 550 participants took part in this meeting including some 350 registrants, 130 students for the four days and miscellaneous one-day registrants and exhibitors. One interesting observation is that out of these full registrants, respectively 143 and 48 were not members of either CWRA, CGU or any of the associated societies.

A number of workshops were held before and on the third day of the conference. On June 5th, three workshops on 'Assessment of the Hydrologic Impacts of Climate Change', the 14th Canadian Geoid Workshop on 'Geoid-based Vertical Datums - North American and International Initiatives' and 'Alberta Wetlands: from Classification to Policy'. On June 7th in the afternoon, six workshops were held on 'Cross-Generational Mentoring in the CWRA', 'Canada Wide Water Strategy', 'Aboriginal Awareness, Water Rights and Challenges ', 'Guided Walk along the Bow River', 'Filling the Gaps: Are we ready for a quantum leap in hydrometric data availability? ' and 'More Value from the Same Water: Maximizing Water's Sustainable Contribution to the Canadian Economy'.

Four Invited Plenary Speakers highlighted the technical program:

- **Terry Prowse** on 'The bio-geo-physical role of changing freshwater ice'
- **Eric Berman** on 'HAZUS-MH – A tool for estimating losses from earthquakes, floods and hurricane winds'
- **Pascal Audet** on ' The role of water in subduction zones'
- **Jeffrey McDonnell** on 'The importance of boundary conditions on water flow and residence time at the hillslope scale'

The CGU-GEODESY (CGU-GS) had 5 sessions:

- Regional and Global Geoid-Based Vertical Datums I, II & III
- Geodetic Sciences and their Applications to Geodynamics
- Advanced Geocomputations and Applications

The CGU-HYDROLOGY (CGU-HS) had 10 single and sponsored 9 joint sessions:

- Predictions in Ungauged Basins
- Hydrologic Impacts of a Changing Climate I, II, III & IV
- Hydro-Ecological Responses to Natural Resources Development
- Geophysical and Geodetic Applications in Hydrological Sciences
- Hydrologic and Water Quality Monitoring and Modeling in Transboundary Lake Systems
- Biogeomorphology: Interactions between Riparian Ecosystems, Aquatic Ecosystems and Stream Channels I, II
- Glacial and Proglacial Environments (joint with CGRG)
- Tracing and Fingerprinting Sediment Sources and Transfers in Watersheds (joint with CGRG)
- Fluvial Responses to Environmental Change I, II (joint with CGRG and CWRA)
- Hydrology and the Urban Biophysical Environment I, II & III (joint with CWRA)
- Long-Term Watershed Monitoring – From Science to Water Management I & II (joint with CWRA)

The annual Woo Lecture was given by B.L. McGlynn on 'Climate and watershed structure influences on hydrologic connectivity and stream network propagation of watershed signatures'.

The CGU-SOLID EARTH (CGU-SE) had 5 sessions:

- HAZUS Canada: Measure Earthquake and Flood Risk I, II
- Geophysical Applications in CO_2 Storage
- Lithographic Imaging, Tectonics and Dynamics
- Earth Deep Interior

The CGU-BIOGEOSCIENCES (CGU-BG) had 2 single and sponsored 2 joint sessions:

- Carbon, Energy and Energy Cycling in Vegetation Ecosystems

- Application of Remote Sensing and Geographic Information Systems in Solving Environmental Issues
- Managing and Rehabilitating Rivers and their Corridors: New Approaches I & II (joint with CWRA)

The CWRA had 15 single and sponsored 10 joint sessions:

- Water Economics
- Peatlands and Plants
- Water Policy & Governance I & II
- Modelling Tools and Applications
- Water Quality and Habitat Indicators
- Municipal and Industrial Water Demand
- Managing Hydrologic Regimes in Canada
- Hydrotechnical Advancements and Adaptations
- Adaptation Learning for Managing Extreme Events
- Water in First Nation, Metis and Innuit Communities of Canada I, II
- Adaptation Learning for Watershed Management Decision-Makers
- Developments in Environmental Flows Science, Management and Policy I, II
- Hydrometric Procedures and Standards (joint with CGU-HS)
- Hydrometric Data Access and Sharing (joint with CGU-HS)
- Groundwater-Surface Water Interactions I, II (joint with CGU-HS)
- Hydrometric Network Planning and Supporting Initiatives (joint with CGU-HS)
- Quality Assurance and Uncertainty of Hydrometric Records (joint with CGU-HS)
- Agricultural Water Management and Related Issues I, II, III & IV (joint with CANCID)

The CGRG had 3 sessions:

- Hypothesis-Driven Science: Linking Field Observations to Earth Surface Processes
- Advances in Fluvial Geomorphology
- Advances in Glacial Geomorphology

The CSHS had 2 sessions:

- Hydrological Modelling Innovation in Canada I & II

All together, the conference had 63 oral and 3 poster sessions, out of which 21 joint sessions involving the four Sections of CGU, CWRA and the associated societies CANCID, CSHS, CGRG and NASH. This was undoubtedly one of the most successful scientific meetings from a general perspective in recent years. Well-deserved thanks are due to Gail Atkinson and Monica Wagner, CGU and CWRA Co-Chairs of LAC, respectively, Shaun Toner, CWRA Co-Chair for the Technical Program, and all the other members of LAC and SPC (listed in the Program Book and the website) for their hard work and cooperation in these endeavors. Special recognition needs to be included for Sean Douglas, our conference webmaster, A.Z.K. Abdel-Razek for the Conference Program handout and Margaret-Anne Stroh for all the arrangements. Finally, our generous sponsors also deserve our most sincere thanks for their contributions. Any further comments and/or suggestions are always welcome.

Mitacs – Inspiring Innovation

Mitacs supports national innovation by coordinating collaborative industry-university research projects with human capital development at their core. Since 1999, Mitacs has been promoting academic-industrial R&D while supporting the development of future innovation leaders. Mitacs has developed a proactive and successful approach to supporting innovation, both directly through collaborative R&D and indirectly through long-term development of skilled human capital.
In particular, Mitacs:

- Helps companies identify their innovation needs and matches them with academic expertise;
- Fosters cutting edge research tied to commercial outcomes;
- Builds international research networks, creating innovation leaders in Canada and abroad; and,
- Provides professional and entrepreneurship skills training for graduate students, so they have the tools to meet emerging innovation needs.

Look for a Mitacs presentation at the upcoming CGU conference in Saskatoon and for more information see www.mitacs.ca.

International Workshop on Seasonal to Decadal Prediction
Toulouse, France, May 13-16, 2013

The Working Group on Seasonal to Interannual Prediction (WGSIP) and the Working Group on Climate Modelling (WGCM) are organizing a Workshop on Seasonal to Decadal (s2d) Prediction under the sponsorship of Météo-France, CNRS, CERFACS, WCRP and BNP-Paribas.

Presentations on all aspects of Seasonal to Decadal Prediction are of interest. Please view the Workshop website at

http://www.meteo.fr/cic/meetings/2013/s2d/

Both oral and poster presentations will be part of the Workshop.

HYDROLOGY SECTION NEWS

Prepared by Sean Carey, President, CGU-Hydrology Section

The CGU Hydrology Section (CGU-HS) had an active 2012, starting off with two student meetings held jointly with the Biogeosciences section at the University of Saskatchewan and McMaster University. Furthermore, the CGU-HS had an exceptionally busy role in this year's annual meeting, which was held jointly with the CWRA in Banff, Alberta.

2012 saw the publication of 11 papers in a special issue of Hydrological Processes, highlighting the contributions of CGU-HS members from the 2011 meeting. Currently another special issue is in progress to be published in summer 2013 and we hope to continue this tradition in the future.

At the 2012 annual general meeting, the CGU-HS voted to expand the executive to include one graduate student member. This position will be filled at the 2013 annual general meeting after a call for nominations. In addition, the CGU-HS announced that it had limited funds to support special projects and new initiatives and welcomes innovative ideas for education and outreach from the membership.

The CGU-HS executive would like to remind students of the deadlines for this year's Don Gray Scholarship, Don Gray Best Student Paper in Hydrology Award and the Campbell Scientific Award for Best Student Poster in hydrology. Deadlines will be announced in February 2013 on the CGU-HS website www.cgu-hs.ca. We are looking forward to seeing everyone in Saskatoon.

GEODESY SECTION NEWS

Prepared by Joe Henton, President, CGU Geodesy Section

On behalf of the Geodesy Section I would like to wish you all a Happy New Year. We are all looking forward to the 2013 Joint Scientific Congress of the CMOS, CGU & CWRA to be held in Saskatoon, May 26-30, 2013. Thank you to all that have put together session and workshop proposals for what certainly will be an exciting meeting. We also wish to thank Marc Véronneau who is representing the Geodesy Section on the Scientific Program Committee for this meeting.

Over the past couple of CGU meetings we have seen a number of impressive contributions from our colleagues related to start-of-the-art refinements for GPS analyses using Precise Point Positioning (PPP) technologies. As such we would like to point out that the International Association of Geodesy (IAG), Natural Resources Canada (NRCan) and York University will be jointly hosting a PPP workshop entitled "PPP: Reaching Full Potential". The meeting will be held in Ottawa, June 12-14, 2013. Please contact Sunil Bisnath (sbisnath@yorku.ca) for additional details.

Finally the executive would like to reiterate that the CGU-GS may be able to provide financial support for new initiatives that provide recognition and/or benefit to our members (e.g., ideas suggested during the 2012 Annual General Meeting included establishing an award for distinguished scientists in the field of geodesy and support for student-focused activities and workshops). Please forward your ideas on how to develop a more vibrant Geodesy Section. We look forward to seeing you in Saskatoon next spring.

BIOGEOSCIENCES SECTION NEWS

Prepared by Brett Eaton, President, CGU-Biogeoscience Section

The Biogeosciences Section (BGS) was active in two conferences in the past year; BGS jointly held the Eastern Student conference with the Hydrology Section, and was involved with three sessions at the 2012 Joint Meeting with CWRA in Banff, Alberta from, June 5-8. At the Joint Meeting, the section elected/selected the following executive members:

- Dr. Brett Eaton (President, University of British Columbia)
- Dr. Merrin Macrae (Vice President, University of Waterloo)
- Dr. Altaf Arain (Treasurer, McMaster University)
- Dr. Carl Mitchell (Secretary, University of Toronto)
- Dr. Mark Johnson (Member at Large, University of British Columbia)
- Dr. Tim Duval (Member at Large, University of Toronto)
- Dr. Edward Johnson (Past Vice President, University of Calgary)

In 2012, the Section focused developing plans to increase membership in the BGS section and improve the visibility of research in the Biogeosciences at CGU meetings. One approach is to target key session themes each year, which are to the focus of the annual meetings. For 2013, we are actively encouraging members to submit session proposals related to Biometeorology, since the 2013 CGU meeting will be held jointly with CMOS. At future meetings, we will focus on Biogeomorphology and Ecohydrology. The BGS group also plans to initiate a "Mentorship Dinner" program in which students can sign up to go out to dinner with member/mentor, and facilitates mentorship, collaboration opportunities and networking.

SOLID EARTH SECTION NEWS

Prepared by Sam Butler, President and Phil McCausland, Secretary

From all of us in the Solid Earth Section, welcome to 2013! As we head into the new year, it is a good time to reflect on 2012 and look to the upcoming year's activities.

At the 2012 Banff CGU-CWRA "Elements" meeting, Solid Earth geophysical sciences continued to have a strong presence, with a total of 38 presentations contributed in five sessions. The Section presented its Best Student Paper Award to Robert Gray of the University of Toronto for his presentation entitled "Influence of sediment deposition on lithospheric tectonics." We also saw a successful competition for a signature logo for the Section, voted on at the Annual meeting. The logo shown above was designed by Christine Gagnon. By year's end, Section membership had grown to 52 regular and 18 student CGU members, marking a new high point in the three years that the Section has been in existence.

For 2013, the Solid Earth Section is organizing seven sessions and two workshops for the upcoming joint CMOS-CGU-CWRA meeting in Saskatoon. We will also increase the dollar value of the annual Best Student Paper Award to $750 and have an election of a new Executive at the Annual meeting. The Section is also seeking to support regional graduate student geophysical conferences by offering limited sponsorship funding. For more information and updates on the Section throughout the year, please visit the Solid Earth Section website at: http://www.cgu-ugc.ca/SESection/index.htm

Best wishes for a fantastic 2013!

CGU 2012 Best Student Paper Award Winners

A number of awards were presented in recognition of outstanding performance in scientific research and presentation by students. Each of the awards comes with a monetary prize. The awards were announced and presented at the Awards Banquet at the recent 2012 CGU-CWRA Joint Meeting in Banff. To be considered for an award, the student must be the first author and presenter of the paper (visit http://www.cgu-ugc.ca for details).

The papers or extended abstract of some of the award winners were presented in the July 2012 edition of Elements; a further two papers are presented below. They are:

CGU Best Student Paper (all fields of geophysics – oral presentations):

Winner: Colin McCarter (University of Waterloo): The hydrology of the Bois-des-Bel peatland 10 years post-restoration: a tale of two scales. Co-author: J. Price

Geodesy Section Award for Best Student Paper in Geodetic Research & Education (oral presentation):

Winner: Rebekka Steffen (University of Calgary): Effects of changes in frictional strength on the fault behaviour in northeastern Canada. Co-authors: P.Wu, H. Steffen, D.W. Eaton.

The Hydrology of the Bois-des-Bel Peatland 10 Years Post-Restoration: A Tale of Two Scales

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Abstract

Understanding ecohydrological processes in restored and natural peatlands is integral in determining the potential success of restoration and the hydrological trajectory of a restored ecosystem. This study reports on the ecohydrological functions of the Bois-des-Bel peatland in 2010; ten years after restoration measures were implemented by comparing the Restored site to Unrestored (abandoned in 1980) and Natural sections of the peatland. Since restoration, a complete cover of *Sphagnum* moss (primarily *S. rubellum*) has regenerated at the Restored site, while no *Sphagnum* regeneration occurred at the Unrestored site. The Restored and Unrestored sites had similar average water tables of -40.3 ± 10.6 cm and -41.3 ± 8.5 cm, respectively, while the Natural site had an average water table of -33.1 ± 4.3 cm. In addition to a less variable water table, average volumetric moisture content at the Natural site within the upper 5 cm of the *Sphagnum* was 20 - 25 % compared to 10 - 15 % at the Restored site. Although Bois-des-Bel has a healthy regenerated *Sphagnum* surface, the water table does not yet fluctuate within the regenerated moss layer, staying almost entirely within the cutover peat beneath the moss layer. This limits the accessibility of water to the uppermost portion of the moss layer where the *Sphagnum* has physiological water supply requirements. The presence of a complete moss layer is one measure of success, but the divergent hydrological conditions indicate that the ecohydrological function has not yet fully returned.

Introduction

Peatlands depend on a combination of large scale (water table, evapotranspiration, runoff, etc.) and small scale processes (capillary flow, soil water retention, etc.) to survive and sequester carbon (Gorham, 1991; Waddington, 2008; Waddington *et al.*, 2001). The removal of *Sphagnum* and peat through peat harvesting disrupts the hydrology that supports carbon sequestration; turning a carbon sink into a source (Gorham, 1991). Restoration measures applied to Bois-des-Bel (BdB) in 2000 allowed for the reintroduction and success of bog vegetation (*Sphagnum rubellum* & *Eriophorum vaginatum*) (PERG, unpublished data). Lucchese et al., (2010) plotted the change in moss thickness between 2000 and 2008 to calibrate the Clymo (1984) peat growth model and project the future change in thickness. Based on specific yield of the new (2008) moss layer and hypothetical water deficits, they estimated it would take 17 years for the water table to be contained in the new moss layer, which they suggested would represent conditions required for successful restoration (Lucchese *et al.*, 2010). In situ moisture dynamics were not measured. As of 2010, gross ecosystem respiration still exceeded production (Strack, unpublished data); hence it is evident that the hydrological conditions in the moss had not yet recovered their ecohydrological function.

Although water table is important in peatlands, it is the ability of the newly regenerated *Sphagnum* to transmit water from the water table to the capitula that is paramount for the *Sphagnum's* survival and consequently, the success of the restoration (Hayward and Clymo, 1983). Although *Sphagnum* forms denser capitula during restoration (Waddington *et al.*, 2011), it is dependent on a dense network of stems, branches, and leaves to provide the necessary capillary forces to supply the capitula with water from below (Hayward and Clymo, 1982; Silvola and Aaltonen, 1984; Thompson and Waddington, 2008).

It is speculated that there is a hydrological disconnect at BdB between the cutover peat and the regenerated *Sphagnum* moss layer that limits the movement of water from the cutover peat to the *Sphagnum* moss. Furthermore, it is unknown whether it is the larger scale hydrology that is limiting the water movement to the regenerated *Sphagnum* or the newly restored moss layer is limiting itself. Therefore, the objectives of this study are to 1) determine how the large scale hydrology of BdB has changed since the initial assessment of Shantz & Price (2006); and 2) identify the hydrological connectivity between the cutover peat and regenerated *Sphagnum* moss layer (small scale processes).

Study Site

BdB is located 10 km northwest of Riviére-du-Loup, Quebec (47°57'47" N, 69°26'23" W, 28 masl), with an average temperature and precipitation of 14.6°C and 366.2 mm, respectively, from May – August (Environment Canada, 2012). The ombrotrophic peatland is approximately 220 ha with ~2.2 m of peat thickness in the Natural site and 1.8 m in the Harvested site (Restored and Unrestored) (Lavoie *et al.*, 2001). Since restoration (2000) a complete ~15-20 cm of *Sphagnum* moss, chiefly *S. rubellum*, has covered the Restored site; the Natural site is also dominated by *S. rubellum* (PERG, unpublished data). The Unrestored and Restored sites are located adjacent to each other with a buffer of ~30 m, whereas the Natural site is ~2 km away in the same peatland.

Methods

Field monitoring at the BdB peatland occurred from Julian Day (JD) 145 - 225 in 2010. Meteorological, water tables (Leveloggers), and volumetric soil moisture data were averaged every thirty minutes (60 minutes for volumetric soil moisture) between JD 145 - 295. Manual water table measurements were made twice weekly. For the comparison to early post-restoration results (2000-2002) reported by Shantz & Price (2006), only twice-weekly manual well measurements were used to determine average

water table in addition to runoff, ET, and precipitation from JD 145 - 245.

Micrometeorological stations were installed and instrumented with net radiometers, tipping bucket rain gauges, temperature/relative humidity probes, and two thermocouples measuring soil temperature at 1 and 5 cm to calculate ground heat flux using Fourier's Law. The Priestley - Taylor combination approach (Priestley and Taylor, 1972) was used in conjunction with soil lysimeters (four per site) to calibrate coefficient of evaporability (alpha) as outlined by Price & Maloney (1994) to obtain unique evapotranspiration (ET) values for all three sites (Unrestored – 1.72, Restored – 1.44, Natural – 1.63). Weirs were installed at both the Restored and Unrestored sites using a bucket and stopwatch to derive a stage-discharge relationship for each site. Two perpendicular transects of wells (2.54 cm diameter PVC pipes) were measured at all sites. Averages of all manual well measurements were used to compare to Shantz & Price (2006)

Volumetric soil moisture (θ) content was measured using time domain reflectometry (TDR) with uniquely derived calibrations for each peat type (Topp *et al.*, 1980). Two pits per micrometeorological station (both Restored and Natural) were dug in areas with 20 cm of *Sphagnum* regeneration (Restored site only) and four TDR probes per pit were installed horizontally at depths below the *Sphagnum* surface of 2.5, 7.5, 17.5, and 27.5 cm. The pits were backfilled with peat and covered with the intact *Sphagnum* moss. Leveloggers were installed near all TDR sites to better determine θ/water table relationships in ~20 cm of moss.

Sphagnum/cutover peat bulk density (ρ_b) and specific yield (S_y) were determined for the upper 20 cm in 2.5 cm depth increments at Restored and Natural sites. The samples were dried at 105°C for 48 hours and weighed to determine bulk density (Boelter 1969).

Results

Evapotranspiration was largest at the Natural site (329 mm) followed by the Unrestored site (290 mm) and lastly the Restored site (242 mm). Like previous work by Shantz & Price (2006), the runoff at the Restored site was less than the Unrestored site (Table 1). The water tables from the manual measurements (JD 147 – 245) in the Natural site (-33.1 ± 4.3 cm) are higher than both the Restored and Unrestored sites, -40.3 ± 10.6 cm and -41.3 ± 8.5 cm, respectively (Table 1). The water table at the Restored site fluctuates almost entirely within the cutover peat (i.e. > ~20 cm below the surface) and not the regenerated moss layer.

Because both sets of TDR probes at the individual sites were very similar, only one depth profile per site is reported here. The Restored site is dryer than the Natural site in the regenerated *Sphagnum* (Probes 2.5, 7.5, and 17.5 cm) (Figure 1). θ at 2.5 and 7.5 cm at the Restored site are nearly identical, unlike at the Natural site which has a ~10 % in θ difference between equivalent depths. θ at 17.5 cm at the Restored site is more similar to that at 2.5 cm at the Natural site. At the Restored site there are limited responses

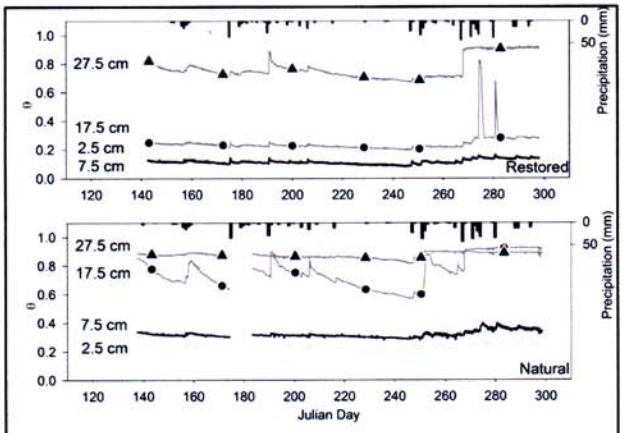

Figure 1 Volumetric soil moisture content for the Restored and Natural sites @ depths 2.5 cm (grey), 7.5 cm (black), 17.5 cm (dark grey, circles), and 27.5 cm (dark grey, triangles) between JD 145-295

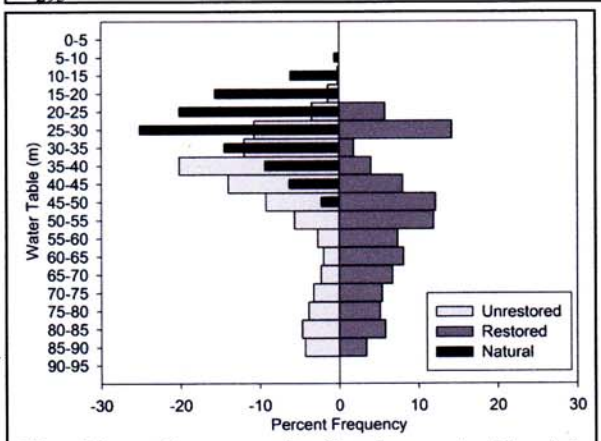

Figure 2 Percent frequency graphs of Levelogger water tables at all sites. μ±σ: Restored -52.2 ±18.4 cm, Natural -31.8 ±8.3 cm, and Unrestored -46.1 ±18 cm. Measurements between JD 145-295

Year	2000		2001		2002		2010		
Site	Res	Unr	Res	Unr	Res	Unr	Res	Unr	Nat
Precipitation (mm)	220		254		210		201		
Evaporation (mm)	248	334	374	501	253	257	242	290	329
Runoff (mm)	15	18	13	43	2	17	7	37	N/A
Average Water Table ± (σ) (cm)	-30.0 ±9.5	-45.5 ±6.0	-30.4 ±10.5	-40.4 ±6.0	-37.2 ±14.3	-44.3 ±6.6	-40.3 ±10.6	-41.3 ±8.5	-33.1 ±4.3

Table 1 Comparison of 2010 data to first 3 years post restoration. Water table n= 476, 201, and 248 for the Restored (Res), Unrestored (Unr), and Natural (Nat) sites, respectively. Measurements were taken from JD 147-245 (runoff JD 181-245)

to precipitation events at 17.5 cm, whereas there is a strong response at the Natural site. Although the water table at the Restored site does occasionally enter the regenerated moss layer (~20 cm) (Figure 2), only short spikes to saturation are seen in the 17.5 cm probe (~ JD 270-280), these spikes are followed by rapid desaturation.

Bulk density is lower in the new moss at the Restored site compared to the Natural site, both increasing slightly with depth. At the Restored site bulk density jumps from 0.05 g/cm^3 to ~0.15 g/cm^3 at depths below 17.5 cm (Figure 3), where there is cutover peat. Although both sites had similar specific yields at the surface (0.26 and 0.29 g/cm^3), it was much greater at the Restored site (0.36-0.41 g/cm^3 vs. 0.23-0.10 g/cm^3) in the underlying moss layers (Figure 3).

Discussion

There are no apparent differences between the first 3 years post restoration and the 2010 field season in the large scale hydrology (Table 1). Initially after restoration the decreased ET from the Restored site was beneficial due to higher soil moisture contents and less stress on the mosses (Petrone *et al.*, 2004a; Petrone *et al.*, 2004b; Price *et al.*, 1998; Waddington *et al.*, 2011); however, these data suggest that the lower ET is not indicative of natural peatlands, probably due to lower soil moisture contents of the *Sphagnum* at the Restored site (Figure 1). The runoff generated at BdB in 2010 maintains the same relationship between the Unrestored and Restored sites as reported by Shantz & Price (2006) (Table 1). The large scale data indicates that the hydrology has not evolved since restoration and is still divergent from the Natural site.

Although the Restored site's water table appears similar to those reported by Shantz & Price (2006), the ~15-20 cm of moss growth indicates that there has been an approximate rise in water table equal to that of the moss growth but still predominantly within the cutover peat (Figure 2). The water table rarely fluctuates within the regenerated moss layer (only in autumn) and desaturates quickly due to high specific yields within the regenerated *Sphagnum*. This rise in water table is a positive indication that BdB is progressing towards a natural system but more time is needed until the water table will fluctuate predominantly within the regenerated moss layer. This may coincide with the partial collapse and decomposition of basal moss layers, which would increase its water retention (decrease specific yield) and perhaps cause structural changes in the overlying moss resulting in more similar water content and evaporation rates to the Natural site.

The 2.5 and 7.5 cm depths at the Restored site are close to the residual water contents of the regenerated *Sphagnum* at BdB reported by Waddington et al., (2011). These water contents indicate that the mosses at the restored site are potentially under moisture stress compared to the same mosses in a natural peatland. The current loose structure (low bulk-density) of regenerated *Sphagnum* limits its water retention (see low θ at 17.5 cm in Figure 1) hence its ability to draw water through capillary forces from the relatively saturated cutover peat (Figure 1 - 27.5 cm depth). These results confirm the conclusions of Waddington et al., (2011) that further lateral infilling of the regenerated *Sphagnum* is required to maintain sufficiently

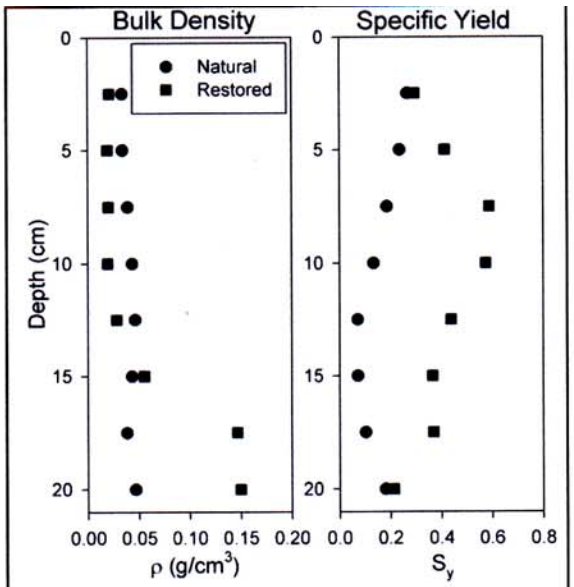

Figure 1 Bulk density and Specific yield (0-20 cm) of the Restored and Natural sites. n=1

high moisture contents that are indicative of a natural peatland. The regenerated *Sphagnum*'s inability to draw water from the cutover peat illustrates the limited connectivity between the regenerated *Sphagnum* and cutover peat.

Conclusions

Notwithstanding a modest rise in water table, the large scale hydrology of the site still behaves similarly as during the first 3 years post-restoration, with the water table predominantly controlled by the cutover peat, and not the regenerated *Sphagnum* moss layer. For this to be rectified there needs to be further decomposition of the new *Sphagnum* layer closest to the cutover peat. The further decomposition and lateral infilling (Waddington *et al.*, 2011) of the *Sphagnum* will increase its water retention (hence water content) sufficiently to hold water close to the uppermost growing part of the plant (capitula), but not as strongly as the current cutover peat, which renders the water inaccessible to the loosely structured overlying moss. The improved hydraulic linkage between the regenerated *Sphagnum* and cutover peat will increase the water availability for *Sphagnum*'s biological processes. Until the regenerated *Sphagnum* layer is better able to regulate its soil moisture and the water table fluctuates predominantly within the regenerated *Sphagnum* layer, Bois-des-Bel will not sequester sufficient carbon to signal its functional restoration.

References

Environment Canada. 2012. 'Canadian Climate Normals 1971-2000: St Arsene'. http://www.climate.weatheroffice.gc.ca/climate_normals/ 09/04/2012

Clymo RS. 1984. 'The Limits to Peat Bog Growth', Philosophical Transactions of the Royal Society B: Biological Sciences. 303, 605-654

Gorham E. 1991. 'Northern Peatlands : Role in the Carbon Cycle and Probable Responses to Climatic Warming', Ecological Applications. 1, 182-195

Hayward PM, Clymo RS. 1982. 'Profiles of Water Content and Pore Size in Sphagnum and Peat, and their Relation to Peat Bog Ecology', Proceedings of the Royal Society B: Biological Sciences. 215, 299-325

Hayward PM, Clymo RS. 1983. 'The Growth of Sphagnum: Experiments on, and Simulation of, Some Effects of Light Flux and Water-Table Depth', The Journal of Ecology. 71, 845

Lavoie C, Zimmermann C, Pellerin S. 2001. 'peatland restoration in southern Quebec (Canada): A paleoecological perspective', Ecoscience. 8, 247-258

Lucchese M, Waddington JM, Poulin M, Pouliot R, Rochefort L, Strack M. 2010. 'Organic matter accumulation in a restored peatland: Evaluating restoration success', Ecological Engineering. 36, 482-488

PERG. unpublished data. 'Dominate Species of Bois-des-Bel Peatland 2010.

Petrone RM, Price JS, Carey SK, Waddington JM. 2004a. 'Statistical characterization of the spatial variability of soil moisture in a cutover peatland', Hydrological Processes. 52, 41- 52

Petrone RM, Price JS, Waddington JM, Waldow HV. 2004b. 'Surface moisture and energy exchange from a restored', Journal of Hydrology. 295, 198-210

Price J, Rochefort L, Quinty F. 1998. 'Energy and moisture considerations on cutover peatlands : surface microtopography , mulch cover and Sphagnum regeneration', Ecological Engineering. 10, 293 - 312

Priestley CHB, Taylor R. 1972. 'On the Assessment of Surface Heat Flux and Evaporation Using Large-Scale Parameters', Monthly Weather Review. 100, 81-92

Silvola J, Aaltonen H. 1984. 'Water content and photosynthesis in the peat mosses *Sphagnum fuscum* and *S. angustifolium*', Annalses Botanici Fennici. 21, 1-6

Strack M. unpublished data. 'Carbon Dynamics of Bois-des-Bel, 2010',

Thompson DK, Waddington JM. 2008. 'Sphagnum under pressure : towards an ecohydrological approach to examining Sphagnum productivity', Ecohydrology. 1, 299- 308

Topp GC, Davis JL, Annan AP. 1980. 'Electromagnetic determination of soil water content: measurements in coaxial transmission lines', Water Resources Research. 16, 574-582

Waddington JM. 2008. 'Dissolved organic carbon export from a cutover and restored peatland', Hydrological Processes. 22, 2215- 2224

Waddington JM, Lucchese MC, Duval TP. 2011. '*Sphagnum* moss moisture retention following the re-vegetation of degraded peatlands', Ecohydrology. 4, 359-366

Waddington JM, Rotenberg PA, Warren FJ. 2001. 'Peat CO 2 production in a natural and cutover peatland : Implications for restoration', Biogeochemistry. 54, 115-130

Effects of changes in frictional strength on the fault behaviour in northeastern Canada

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Introduction

In most regions, the stress in a region is defined by the tectonic background stress and the lithostatic stress. The superposition of these two is one factor in controlling the movement along faults. In deglaciated regions, an additional stress is found: the rebound stress. This stress is related to the rebounding of the crust and mantle after deglaciation.

The process of rebounding, called glacial isostatic adjustment (GIA), is observed in northeastern Canada, where a GIA signal of up to 12 mm/a is found by GPS measurements (Wu et al., 2010). Several models have been developed to analyse the viscosity, rheology and structure of the mantle. Wu (1996, 1997) used these models to find the GIA stress behaviour during and after glaciation in northeastern Canada. The GIA stress is the superposition of rebound, tectonic background and lithostatic stress. It has rotated after the end of deglaciation until today, and is consistent with the tectonic background stress now. However, these models do not include faults, and are not able to represent local stress changes. A recent study by Steffen et al. (2012) showed that the local stress field due to the fault systems in the northeastern Hudson Bay is rotated by up to 90° to the regional stress direction of NE-SW of eastern Canada, which is mainly due to the ridge-push of the mid-Atlantic. Therefore, it is necessary to include faults into GIA models to identify local stress directions.

Fig. 1 shows the stress behaviour for a thrust regime due to glaciation and deglaciation, and their impacts on the Mohr circle. The Mohr circle is a way to represent different stress settings and their effects on fault stability. In a thrust regime, the maximum stress is the horizontal stress, and the vertical stress is the minimum. A point in the crust is therefore affected by σ_1 in the horizontal, and σ_3 in the vertical. The point is close to failure, which is indicated by a relative small distance between the Mohr circle and the line of failure. During the glaciation process, the horizontal stress is increased due to flexure in the lithosphere, and the vertical stress is increasing both due to flexure in the lithosphere and the vertical applied load of the ice sheet. Therefore, the Mohr circle is moving in the positive direction along the normal stress axis, and away from the line of failure, thus suppressing any fault movement. As soon as the ice is melting, the load is decreased, but the flexure in the lithosphere due to the glaciation remains. Decreasing of the load reduces the vertical stress only, leaving a high horizontal stress. Therefore, the radius of the Mohr circle is increasing and the midpoint of the circle is moving in the negative direction along the normal stress axis. The circle touches or crosses the line of failure, and the fault will start to move, releasing the stress in earthquakes.

The goal of this study is to show the aforementioned stress settings in a GIA model, including a lithosphere and mantle. This has to be done by advancing current GIA models by including a fault into these models.

Methodology

Several methods have been developed to model the process of GIA (see Steffen & Wu, 2011; for an overview). In this study, the finite-element method based on Wu (2004) is used. A flat two-dimensional earth model is developed, which consists of six layers (Fig. 2), but can be divided in three different parts. The first part is the lithosphere composed of a 20 km thick crustal layer, and a lithospheric mantle of 100 km. The lithosphere behaves elastic. The upper mantle builds up the second part, divided into two layers with thicknesses of 330 km and 220 km. In contrast to the lithosphere, the upper mantle is a visco-elastic layer. The lower mantle, the third part of the earth model, behaves also visco-elastic. The sides of the earth model are fixed in the horizontal direction. To account for gravity in the model, so-called Winkler foundations are used, which are applied along density contrasts. These foundations represent the buoyancy forces, holding the model in equilibrium. The earth models of this study include a fault surface without density contrast.

On top of the earth model, a parabolic ice model (Fig. 2) is applied which simulates the last glacial cycle in North America. The ice sheet has a maximum thickness of 3,500 m at glacial maximum, and a width of 3,000 km. Both parameters are similar to realistic ice sheets by Peltier (2004) and Lambeck et al. (1998). The volume of the ice sheet increases for 100,000 years, and decreases in the following 10,000 years.

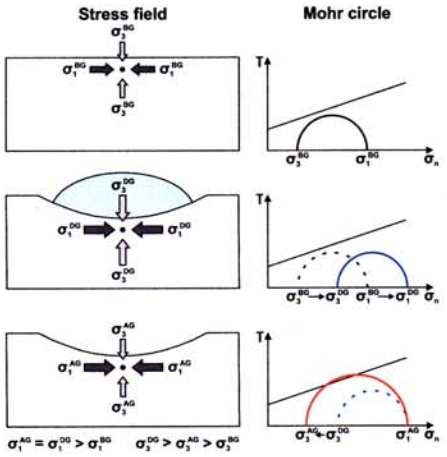

Figure 1: Schematic sketch of fault stability before, during and after glaciation for a thrusting regime. The upper row shows the state of stress and Mohr circle before glaciation (BG), the middle row represents the stresses for maximum glaciation (DG: during glaciation), and the lower row indicates the stress behaviour at the end of deglaciation and during uplifting (AG: after glaciation). The horizontal stress is σ_1, the vertical stress is σ_3, σ_n represents the normal stress and τ the shear stress.

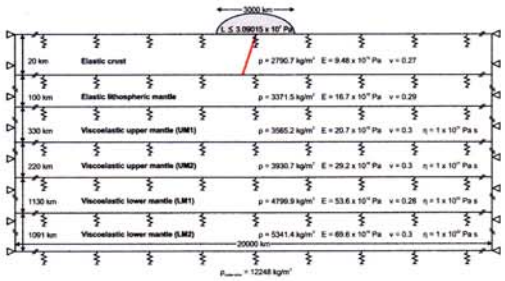

Figure 2: Sketch showing the structure of the used model. Springs represent foundations, triangles represent the fixed degree of freedom, and the red line shows the fault in the crustal layer. The ice load is shown on top of the earth model with a grey colour.

Results

Several fault factors are tested in the models, e. g. friction coefficient, location, and fault angle. In the following, we will concentrate on the vertical displacement behaviour along the fault for a varying friction coefficient only. The fault is located at the centre of the ice sheet, which is expected to observe the highest fault offset due to GIA, as the maximum load was applied in that area. The fault has a dipping of 45°.

The stress used as input for the fault model is a GIA stress, therefore, consisting of tectonic background, lithostatic and rebound stress induced by the GIA process. The movement along the faults is only driven by the changes of horizontal compared to vertical stress. Additional extension or shortening of the model is not applied.

Fig. 3 shows the vertical displacement along the fault after the end of deglaciation for friction coefficient of 0.6. Results for other friction coefficients are summarized in Table 1. The area shown represents only a small part of the model. The length of the fault is 28.5 km up to a depth of 20 km. The displacement due to GIA is not shown, as it has values of up to 280 m in that area. A thrusting movement is observed for all four friction coefficients. The slip rate varies between 2.8 and 3.5 m, with the highest values for a friction of 0.2, and the lowest value for a friction of 0.8 (Table 1).

Table 1 compares the dependence of the friction coefficient on the fault offsets for different locations of the fault. The fault at 750 km is located in the middle between centre and border of ice sheet. 200 km to the east of the ice sheet border a third fault is implemented. The fourth fault is included in the forebulge area. Only one fault is activated at each time. The fault offset is decreasing from the centre of the ice sheet to the boundary area. In contrast, in the forebulge area a higher fault offset is found compared to the third fault area. The vertical GIA displacement is also higher for the area beneath the ice sheet and in the forebulge area compared to the position close to the boundary of the ice sheet, which is close to the axis of tilting. For a friction coefficient of 0.2 a smaller offset of up to 0.8 m is found. The highest fault offsets are observed for friction coefficients of 0.4 and 0.6. In general, a thrusting mechanism is found for all faults, related to the background stress, which is a thrust regime.

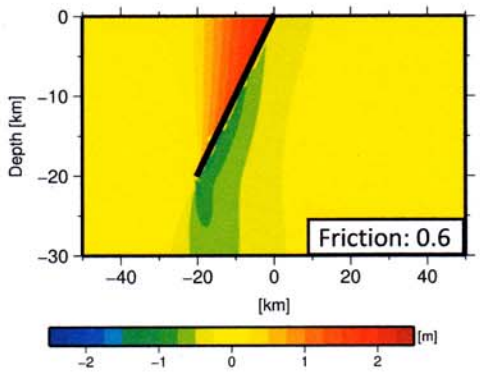

Figure 3: Vertical displacement behaviour for a fault located at the centre of the ice sheet for a friction coefficient of 0.6. The fault offset is indicated in Table 1.

Table 1: Fault offsets depending on friction coefficients and location of the fault.

Location	Friction coefficient			
	0.2	0.4	0.6	0.8
0 km	3.5 m	3.4 m	3.1 m	2.8 m
750 km	2.3 m	2.6 m	2.6 m	2.5 m
1700 km	1.2 m	1.5 m	2 m	2.1 m
2200 km	1.6 m	2.4 m	2.6 m	2.5 m

Discussion

The amount of fault offset for different locations is mostly depending on the flexure and deformation in that area. The fault at the ice sheet centre shows the highest displacement due to GIA and is depressed at most. Moving to the ice sheet boundary, the area is not much depressed anymore. Further away from the ice sheet, in the forebulge area, the opposite case is happening, as the crust is uplifted during glaciation and is now depressing since the ice is gone. Therefore, the flexural effects are higher than for locations close to the boundary of the ice sheet.

The thrusting mechanism found for all fault locations and friction coefficients agrees with observations of earthquake data in eastern Canada and Scandinavia (e. g. Steffen & Wu, 2011, Steffen et al., 2012). The amount of fault slip rate obtained from the models is similar to offsets in eastern Canada. The largest earthquake in northeastern Canada happened in Ungava Peninsula 1989 and an offset of up to 1.8 m was found (Adams et al., 1991). This fault is assumed to be post-glacial. The Ungava Peninsula is not at the centre of the former ice sheet. However, fault offsets in Scandinavia of up to 10 m are found, which are higher than the estimated offsets from this study. As the fault in our models is located in a homogeneous crust without density contrasts, the stress is not accumulated at the fault and is continuous along the boundary as well. For a fault that separates two different materials, stress will be different on both sides, leading to a larger movement along the fault. In nature, faults are mostly represented by two different materials on both sides.

Conclusion

In this study faults have been implemented into current GIA models to test the effect of different friction coefficients and location of the faults in relation to the ice sheet. As it was observed in a previous study that such GIA models show no agreement with observed stress directions, the implementation of a fault has been inevitable.

Preliminary results from new GIA models including a fault, suggest fault offsets of at least 2 m depending on the location of the fault related to the former ice sheet, and the friction coefficient. These offsets fit to observed ones in Ungava Peninsula in northeastern Canada. In future studies, several parameter will be tested to account for more realistic fault offsets found in Scandinavia and northeastern Canada, e. g. different time steps, realistic ice sheets, density contrast along the faults, fault angle, and mantle viscosity.

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References

Adams, J., Wetmiller, R.J., Hasegawa, H.S., Drysdale, J. (1991): The first surface faulting from a historical intraplate earthquake in North America, *Nature*, **352**, 617-619, doi:10.1038/352617a0.

Hibbitt, D., Karlsson, B., Sorensen, P. (2011): Getting Started with ABAQUS - Version (6.11), Hibbitt, Karlsson & Sorensen, Inc.

Lambeck K., Smither, C., Johnston, P. (1998): Sea-level change, glacial rebound and mantle viscosity for northern Europe, *Geophys. J. Int.*, **134**, 102 - 144, doi:10.1046/j.1365-246x.1998.00541.x.

Peltier, W.R. (2004): Global Glacial Isostasy and the Surface of the Ice-Age Earth: The ICE-5G (VM2) Model and GRACE, *Annu. Rev. Earth Planet. Sci.*, **32**, 111-149, doi:10.1146/annurev.earth.32.082503.144359.

Steffen, H., Wu, P. (2011): Glacial isostatic adjustment in Fennoscandia - A review of data and modeling, *J. Geodyn.*, **52**(3-4), 169-204, doi:10.1016/j.jog.2011.03.002.

Steffen, R., Eaton, D.W., Wu, P. (2012): Moment tensors, state of stress and their relation to post-glacial rebound in northeastern Canada, *Geophys. J. Int.*, doi:10.1111/j.1365-246X.2012.05452.x.

Wu, P. (1996): Changes in orientation of near-surface stress field as constraints to mantle viscosity and horizontal stress differences in Eastern Canada, *Geophys. Res. Letters*, doi:10.1029/96GL02149.

Wu, P. (1997): Effect of viscosity structure on fault potential and stress orientations in eastern Canada, *Geophys. J. Int.*, doi:10.1111/j.1365-246X.1997.tb05653.x.

Wu, P. (2004): Using commercial Finite element packages for the study of earth deformations, sea levels and the state of stress, *Geophys. J. Int.*, **158**(2), 401 - 408, doi:10.1111/j.1365-246X.2004.02338.x.

Wu, P., Steffen, H., Wang, H. (2010): Optimal locations for GPS measurements in North America and northern Europe for constraining Glacial Isostatic Adjustment, *Geophys. J. Int.*, **181**, 653-664, doi:10.1111/j.1365-246X.2010.04545.x.

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