



**Proceedings of the  
65th ANNUAL**

# **EASTERN SNOW CONFERENCE**

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## FOREWORD

This proceedings volume contains papers presented at the 65<sup>th</sup> Eastern Snow Conference (ESC) held 28–30 May 2008 at the Lake Morey Inn, Fairlee, Vermont. Sessions covering human interactions with snow; snow and snowpack processes; ice: rivers, lakes and sheets; permafrost and glaciers; remote sensing and modeling of snow; snow microstructure; and snow and ice measurements were convened. We had an excellent turnout at this year's meeting with nearly 100 attendees.

The ESC is a joint United States and Canadian forum for discussing recent work on operational, applied, and scientific issues related to snow and ice. It also retains an increasing interest as a symposium where novel approaches to cryospheric science of international significance are presented. The ESC has published an annual series of proceedings since 1952. Typical topics include studies of snow and ice as materials, snow removal, meteorological forecasting, river ice control, snow hydrology, snow chemistry, glaciology, remote sensing of snow and ice, and snow ecology. Membership in the ESC is open to all interested individuals and corporations. Additional copies of the current proceedings and all back issues can be obtained from the Secretary. Additional information about the Eastern Snow Conference may be found at <http://www.easternsnow.org/>.

We continue with an optional review process and authors may submit extended abstracts or full papers to the proceedings. Participants in the Western Snow Conference (WSC) (<http://www.westernsnowconference.org/>) were invited to join the ESC participants in the option to submit papers relevant to winter hydrology to the international journal, *Hydrological Processes*. These papers went through a formal journal review, revision, and referee process and many appear both in these proceedings and in the July 2008 issue of the journal. John Pomeroy (University of Saskatchewan), Kelly Elder (U.S. Forest Service, Ft. Collins, Colorado), and Andrew Klein (Texas A&M University) edited this special issue of *Hydrological Processes* dedicated to ESC/WSC papers.

We thank members of the publications team, Information Technology Laboratory, at the Engineering Research and Development Center, Cold Regions Research and Engineering Laboratory (ERDC-CRREL). Over the years this group has contributed considerable time to this publication and has enhanced the quality of these proceedings. We especially thank Gioia Cattabriga for her effort on behalf of these proceedings.

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We look forward to seeing many of you at the 66<sup>th</sup> Eastern Snow Conference meeting to be held 9–11 June 2009 at Niagara on the Lake, Ontario, Canada. This year's meeting theme is "The changing cryosphere: tracking and understanding changes in snow and ice."

Robert Hellström and Susan Frankenstein  
ESC Proceedings Editors  
Bridgewater State College and ERDC-CRREL



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## STATEMENT OF PURPOSE

The Eastern Snow Conference (ESC) is a joint Canadian/U.S. organization founded in the 1940s, originally with members primarily from eastern North America. Our current members are scientists, snow surveyors, engineers, technicians, professors, students, and operational and maintenance professionals from North America, the United Kingdom, Japan, and Germany. There is a western counterpart to the ESC, the Western Snow Conference (WSC), which also is a joint Canadian/U.S. organization. Every fifth year the ESC and the WSC hold joint meetings.

The Eastern Snow Conference is a forum that brings the research and operations communities together to discuss recent work on scientific, applied, and operational issues related to snow and ice. The location of the conference alternates yearly between the United States and Canada, and attendees present their work by either giving a talk or presenting a poster. Most resulting papers are reviewed, edited, and published in our yearly *Proceedings of the Eastern Snow Conference*. In recent years, the ESC meetings have included sessions on snow physics, winter survival of animals, snow and ice loads on structures, river ice, remote sensing of snow and ice, and glacier processes. Volumes of the *Proceedings* can be found in libraries throughout North America and Europe, and the papers are also available through the National Technical Information Service (NTIS) in the United States and CISTI in Canada.

\* \* \* \* \*

Le Colloque sur la neige-région est (ESC) est une organisation américain-canadienne fondée dans les années '40 et dont les membres provenaient à l'origine surtout de l'est de l'Amérique-du-Nord. Actuellement, les membres, qu'ils soient chercheurs, techniciens en enneigement, ingénieurs, techniciens, professeurs, étudiants, et spécialistes des services d'exploitation et d'entretien, viennent non seulement d'Amérique-du-Nord, mais aussi du Royaume Uni, du Japon, et d'Allemagne. Le Colloque sur la neige-region ouest (WSC), aussi une organisation américain-canadienne, est l'homologue de l'ESC pour l'ouest nord-américain. Tous les cinq ans, l'ESC et la WSC organisent des réunions en commun.

Le Colloque sur la neige-region est un forum qui rassemble chercheurs et responsables des services d'exploitation pour discuter des travaux récents sur les problèmes scientifiques, opérationnels, ou autres dus à la neige et à la glace. Le site de cette réunion annuelle alterne entre les États Unis et le Canada. Les participants y présentent les résultats de leurs travaux par des communications orales ou au moyen d'affiches. Ces communications, une fois revues et éditées, sont publiées dans les *Annales de l'ESC*. Dans les années récentes, les réunions de l'ESC ont inclus des sessions sur la physique de la neige, la survie hivernale de la faune, les forces exercées par la neige et la glace sur les structures et les bâtiments, la glace de rivière, la télédétection de la neige et de la glace, et les processus glaciaires. Les *Annales de l'ESC* sont accessibles dans la plupart des bibliothèques scientifiques d'Amérique-du-Nord et d'Europe. Des copies d'articles peuvent être obtenues du National Technical Information Service (NTIS) aux États Unis et son équivalent au Canada, le CISTI.



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## THE PRESIDENT'S PAGE

The spring season is a busy period for conferences in the geophysical science community. In recent years, the executives of the Eastern Snow Conference have worked hard to raise the scientific profile of the ESC annual meeting, and the very strong attendance (approximately 85 attendees) at our 65<sup>th</sup> annual meeting in Fairlee, Vermont illustrated the progress we've made. The annual meeting of the ESC is now a notable venue for presenting new research results on the cryosphere in general and snow cover in particular. The 2007 ESC meeting was part of a joint congress of the Canadian Meteorological and Oceanographic Society, Canadian Geophysical Union, and American Meteorological Society. While these large meetings are important for maintaining the profile of the ESC, it was rewarding to see such a strong and full technical program for the standalone meeting this year. Thank you to all the presenters and attendees for making the 65<sup>th</sup> annual ESC meeting a resounding success.

The local arrangements committee selected a scenic and relaxing venue. Thanks to Rae Melloh, Susan Frankenstein, Janet Hardy, Sally Shoop, and Renee Melendy for facilitating a very well-organized meeting. Steven Fassnacht (Vice President and program chair) coordinated an efficient program of 36 oral presentations and 35 posters, including keynote presentations from former ESC Presidents Bert Davis and Mary Albert. Bert led off the conference with a forward-looking discussion of remote sensing contributions to snow hydrology in an era now characterized by a lack of stationarity. Mary provided an insightful and entertaining overview of the Norwegian–U.S. Scientific Traverse of East Antarctica at the ESC banquet.

Student participation is an important component of the ESC annual meeting and a full slate of student awards was presented this year. Congratulations to Christopher Karmosky (Penn State University) for winning the inaugural David Hewitt Award for best student poster, Nicholas Kinar (University of Saskatchewan), recipient of the Campbell Scientific Award, and Christopher Fuhrmann (University of North Carolina) winner of the Wiesnet Medal for best student paper.

We are pleased to note some new developments with the ESC Proceedings. With the 2008 publication, we will move to digital distribution, so you should be reading this along with a DVD instead of the traditional bound copy. Susan Frankenstein and Rob Hellström continue to provide exceptional leadership in producing the ESC Proceedings each year. The entire back catalogue of Proceedings will also be available online at the ESC website ([www.easternsnow.org](http://www.easternsnow.org)). Thanks to Andrew Klein and Miles Ecclestone for coordinating this effort. We continue to produce an annual special issue of *Hydrological Processes*. Andrew Klein and John Pomeroy continue in their role as Guest Editors—thanks to Andrew and John for maintaining the research profile of the ESC.

The ongoing success of the ESC is dependant on extensive behind-the-scenes efforts by our volunteer executives. Notable thanks are due to Miles Ecclestone and Derrill Cowing, our Canadian and American secretary-treasurers. Miles and Derrill ensure the financial stability of the ESC, and always contribute significantly to the organization of the annual meeting.

I'd like to invite you to the 2009 Eastern Snow Conference to be held in Niagara-on-the-Lake, Ontario in the heart of wine country on the Niagara Peninsula (technical program chair—Richard Kelly, University of Waterloo). With the full program this year, we anticipate moving to an extended meeting format of three days. Please continue to check the ESC website for further information.

Best regards, and thank you for your continued support of the Eastern Snow Conference.

Chris Derksen  
65<sup>th</sup> President, Eastern Snow Conference