

**Proceedings of the
66th ANNUAL**

EASTERN SNOW CONFERENCE

9–11 June 2009

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Proceedings of the Eastern Snow Conference

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FOREWORD

This proceedings volume contains papers presented at the 66th Eastern Snow Conference (ESC) held 9–11 June 2009 at the White Oaks Conference Resort, Niagara-on-the-Lake, Ontario, Canada. Sessions covering glaciers; trends in snow cover extent and accumulation; remote sensing of snow; sea ice; winter storms and observations; snow and ice measurements; snow and ice models were convened. We had an excellent turn-out at this year's meeting with nearly 70 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 journal. John Pomeroy (University of Saskatchewan), Kelly Elder (USFS, Ft. Collins) and Andrew Klein (Texas A&M University) edit this special issue of *Hydrological Processes* dedicated to ESC/WSC papers.

We thank members of the Technical Communication Branch, Information Management Division, 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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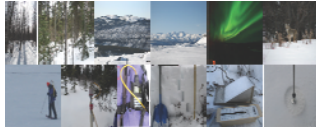
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We look forward to seeing many of you at the 67th Eastern Snow Conference meeting to be held 8–10 June 2010 at Jiminy Peak Mountain Resort, Hancock, MA. This year’s meeting theme is “The Changing Cryosphere: Tracking and Understanding Changes in Snow 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-région 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-région 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

This year we had another excellent Eastern Snow Conference. The 66th annual meeting was held at Niagara-on-the-Lake, Ontario, Canada on the theme “*The changing cryosphere: tracking and understanding changes in snow and ice.*” Our 67 attendees from both sides of the border and across the pond stayed on site at the White Oaks Resort. Thank you to all the presenters and attendees for making the meeting a huge success.

Vice President and program chair Richard Kelly put together a very diverse program. There were 29 high quality oral presentations in seven non-concurrent sessions and an ongoing interactive poster session that featured 28 excellent posters. Thanks to Richard Kelly, Gordon Young, and Mike English of the local arrangements committee for selecting a great venue. This year we had a mid-conference tour during the late afternoon of the first day of talks. This ensured that most attendees toured the organic Featherstone Winery on the bench of the Niagara wine-growing region. The ESC attendees asked the winery owners a barrage of questions that were answered very knowledgeably, while savouring their products. After the tour, the banquet was held at the conference hotel. This year's banquet talk was given by Professor (emeritus) Ken Hewitt from Wilfrid Laurier University and was entitled “*Abode of snow; a critical look at glacier change and the Himalayan Cryosphere*”. The presentation illustrated the unusual nature of western Himalayan glacier dynamics in high mountain environments.

Student participation is a crucial component of the ESC and is acknowledged with three awards: the Wiesnet Award is given to the best student paper, the Campbell Scientific (Canada) award is given to students registered at a Canadian higher education who demonstrate innovative technical expertise in data collection, and the David Hewitt Miller Award is presented for the best student poster presentation. This year the Wiesnet Award was presented to Si Chen (Dartmouth College) and the David Hewitt Miller Award to Iliyana Dobrova (Texas A&M University). On a lighter note, the Annual Sno-Foo is presented to a distinguished snow scientist who, in striving for excellence in snow research, contributes to an event of notable humour. This year's winner was Rob Hellström (Bridgewater State College).

This year you will be reading this on a DVD, or after the 2010 meeting, online via the ESC website (www.easternsnow.org). 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. Thanks to Andrew Klein and Miles Ecclestone for coordinating this effort. We continue to produce an annual special issue of Hydrological Processes that further highlights 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, who 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 2010 Eastern Snow Conference to be held in at the Jiminy Peak Mountain Resort, Hancock, Massachusetts from June 8th through 10th. The conference has not been held in Massachusetts since 1973. With Mauri Pelto (program chair - Nichols College) and the local arrangements committee's efforts, most of us will be exploring new ESC territory. This year's general theme is “*Here today gone tomorrow, the Eastern North America Cryosphere,*” with a special poster session entitled “*IPY and Beyond.*” Students are encouraged to enter the ESC Student Paper Competitions. Please continue to check the ESC website for further information.

I wish you a safe and successful field season. Thank you for your supporting the Eastern Snow Conference

Steven R. Fassnacht
66th President
Eastern Snow Conference