



**Proceedings of the
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EASTERN SNOW CONFERENCE

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Proceedings of the Eastern Snow Conference

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FOREWORD

This proceedings volume contains papers presented at the 62nd Eastern Snow Conference (ESC) held 7–10 June 2005 at Wilfred Laurier University in Waterloo, Ontario, Canada. Sessions covering snow modeling, remote sensing, basin-scale studies, blowing snow, changes in the cryosphere, and cold climate technologies were convened.

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. More 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. This year's Western Snow Conference (WSC) (<http://www.westernsnowconference.org/>) participants were invited to join the ESC participants in the option of submitting 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 December 2005 issue of the journal. John Pomeroy (University of Saskatchewan), Kelly Elder (USDA Forest Service), and Andrew Klein (Texas A&M University) edited this special issue of *Hydrological Processes* dedicated to ESC/WSC papers.

We thank the editors at ERDC–CRREL. Over the years this group has contributed considerable time to this publication and has enhanced the quality of these proceedings.

The 2005 meeting of the Eastern Snow Conference and these proceedings were made possible by sponsorship and corporate memberships by the following:

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We look forward to seeing many of you at the 63rd Eastern Snow Conference meeting at the University of Delaware, Newark, Delaware, USA, 8–9 June 2006. This meeting promises an exciting program with anticipated sessions in “The International Polar Year,” “Climate Change,” and “Hydrological and Hydro-Chemical Impacts of Snow and Ice.”

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

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CONTENTS

Foreword.....	iii
Statement of Purpose	vii
Executives for the 62nd Eastern Snow Conference	viii
President’s Page.....	ix

Poster Paper Highlights

The Relation Between Air Temperature and Freeze-Up/Break-Up Dates on Lakes Across Northern Canada <i>F. Lenormand and C.R. Duguay</i>	3
The Impact of Patchy Snow Cover on Snow Water Equivalent Estimates Derived from Passive Microwave Brightness Temperatures Over a Prairie Environment <i>K.R. Turchenek, J.M. Piwowar, and C. Derksen</i>	7
Comparison of MODIS Daily Global Fractional Snow Cover Maps at 0.05- and 0.25-Degree Resolutions <i>G.A. Riggs, N. Digirolamo, and D.K. Hall</i>	21
Changes in the Harding Icefield and the Grewingk-Yalik Glacier Complex <i>D.K. Hall, B.A. Giffen, and J.Y.L. Chien</i>	29
Investigating Relationships Between Land-Cover, Forest Structure, and In-Situ and Airborne Passive Microwave Snow Water Equivalent in a Boreal Forest Environment <i>P. Toose, C. Derksen, A. Walker, and E. LeDrew</i>	41
Are Minor and Trace Elements Useful Indicators of Chemical Weathering Processes and Flow-Routing in Subglacial Hydrological Systems? <i>A.C. Mitchell, G.H. Brown, and R. Fuge</i>	49
High Arctic Ponds, Somerset Island, Nunavut: Spatial and Temporal Variation in Snowcover and Snowmelt <i>K.L. Young and A. Abnizova</i>	69
Hydrologic Recovery of Snow Accumulation and Melt Following Harvesting in Northeastern Ontario <i>J.M. Buttle, C.J. Oswald, and D.T. Woods</i>	83

Snow Modeling

Boundary Layer Growth Over Snow and Soil Patches: Field Observations <i>R.J. Granger, R. Essery, and J.W. Pomeroy</i>	95
Snowmelt Infiltration and Runoff from Forested Hillslopes, Boreal Plain, Alberta <i>T.E. Redding and K.J. Devito</i>	105
Processes of Solar Radiation Transfer Through a Sub-Arctic Shrub Canopy <i>D. Bewley, J.W. Pomeroy, and R.L.H. Essery</i>	109
Uncertainties in Estimating Turbulent Fluxes to Melting Snow in a Mountain Clearing <i>W.D. Helgason and J.W. Pomeroy</i>	129
Estimating the Snow Water Equivalent on the Gatineau Catchment Using Hierarchical Bayesian Modelling <i>O. Seidou, V. Fortin, A. St-Hilaire, A.-C. Favre, S. El Adlouni, B. Bobée</i>	143

Remote Sensing of Snow I

Scaling Associated with Averaging and Resampling of LiDAR-Derived Montane Snow Depth Data <i>S.R. Fassnacht and J.S. Deems</i>	163
Derivation of Topoclimatic Indices for Alpine Snowpack Analysis in Alberta Rocky Mountain Watersheds <i>D.R. Peddle, N.J. Rabe, S.A. Soenen, and D.L. Johnson</i>	173

Glaciers and Glacial Processes

Role of a Supraglacial Snowpack in Mediating the Delivery of Meltwater to the Glacier System: Implication for Glacier Dynamics <i>F. Campbell, P. Nienow, and R. Purves</i>	193
The Current Disequilibrium of North Cascade Glaciers <i>M.S. Pelto</i>	209

Remote Sensing of Snow II

Preliminary Assessment of the Impact of Lakes on Passive Microwave Snow Retrieval Algorithms in the Arctic <i>C. Duguay, J. Green, C. Derksen, M. English, A. Rees, M. Sturm, and A. Walker</i>	223
Assessing Snowpack Water Equivalent Distribution in an Open Tundra Environment Using Various Scales of Passive Microwave Data <i>A. Rees, M. English, C. Derksen, and A. Walker</i>	229

Special Session—Arctic

Shrub Tundra Snowmelt <i>J.W. Pomeroy, D.S. Bewley, R.L.H. Essery, N.R. Hedstrom, T. Link, R.J. Granger, J.E. Sicart, C.R. Ellis, and J.R. Janowicz</i>	237
Snowmelt Runoff Processes in a Headwater Lake Catchment, Subarctic Canadian Shield <i>C. Mielko and M-K Woo</i>	253

Variability and Change in the Cryosphere II

The Influence of the Great Lakes on Snowfall Patterns in the Southern Appalachians <i>B. Perry and C.E. Konrad</i>	269
Snow Cover Changes in Bulgarian Mountainous Regions, 1931–2000 <i>N. Petkova, R. Brown, E. Koleva, and V. Alexandrov</i>	281
The Density of Falling Snow in New England, 1949–2001 <i>Thomas G. Huntington</i>	287

Blowing Snow: Observations and Modeling

Wind Stress Functions for Blowing Snow Initiation and Transport, in Vegetated Grids <i>K.I. Simon, P.A. Taylor, and M. Gordon</i>	301
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Cold Climate Technologies and Experiments

The Fate of Organic Contaminants and Experiments <i>T. Meyer, Y.D. Lei, F. Wania</i>	305
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Sno-Foo Award.....	311
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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.

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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

The 62nd annual meeting of the Eastern Snow Conference (ESC) was held at Wilfred Laurier University in Waterloo, Ontario (7–10 June 2005). Of the 64 people who attended the conference, 17 were students. This year we had a large international presence representing researchers from 10 countries. In total, 42 talks were given and 18 posters were presented at the conference. There were sessions on snow modeling, remote sensing of snow, glaciers and glacial processes, blowing snow, changes in the cryosphere, and cold climate technologies. During the special session on the International Polar Year (IPY) we were treated to keynote addresses by Dr. Barry Goodison and Dr. Mary Albert (both past ESC Presidents), who are, respectively, directing the Canadian and U.S. efforts for the IPY. The quality of the presentations and of the studies being conducted were exceptional and I thank all who shared their data at the meeting.

The success of the 2005 meeting rests with the Executive. I thank Michael English, who, along with Chris Derksen and Miles Ecclestone, made all the local arrangements; our treasurers, Derrill Cowing and Miles Ecclestone, for keeping us in the black; and Claude Duguay (VP and Program Chair) for organizing and running the 62nd meeting. Andrew Klein, our Webmaster, has helped the ESC join the digital age. I also thank our Corporate members (listed in the Foreword) for their continued support of the ESC.

The Campbell Scientific Medal, which is awarded to the best student paper where instrumentation plays a key role, was awarded to Warren Helgason for his work on turbulent heat and mass exchange between the atmosphere and a snowpack. Congratulations, Warren!

The *ESC Proceedings* have been published for 62 years. I find this a remarkable feat for a small organization run by a handful of researchers. Editing the proceedings is one of the most time-consuming jobs and I thank our Editors, Dr. Robert Hellstrom and Susan Frankenstein, for their hard work. This is also the tenth anniversary of ESC's partnership with *Hydrological Processes*, where a number of the papers presented at the conference are published. I thank *Hydrological Processes* for providing ESC participants the opportunity to publish in the journal, and Drs. John Pomeroy and Andrew Klein for handling the *Hydrological Processes* submissions.

I invite you to attend the 63rd meeting of the Eastern Snow Conference, to be held at the University of Delaware in early June 2006. Please visit our Web site (www.easternsnow.org) for up-to-date details of this meeting.

Best Regards,

Susan Taylor
62nd President
Eastern Snow Conference