



Annals of
GLACIOLOGY

Vol 57 No 72



Annals of Glaciology 57(72)

Hydrology of glaciers and ice sheets

VOLUME 57 ISSUE 72 2016

EDITORS

<i>IGS Chief Editors</i>	Jo Jacka J. Graham Cogley	
<i>Annals Editorial Board</i>	Ian Allison Perry Bartelt Sérgio H. Faria Helen A. Fricker	Hester Jiskoot Frank Pattyn Mark Serreze
<i>Issue Chief Editors</i>	Alexander H. Jarosch Ian Hewitt	
<i>Issue Scientific Editors</i>	Guðfinna Aðalgeirsdóttir Gwenn Flowers Helen A. Fricker Joel Harper Matt Hoffman Bryn Hubbard	Tómas Jóhannesson Doug Mair Christian Schoof Thomas Schuler Chris Stokes

INTERNATIONAL GLACIOLOGICAL SOCIETY

<i>President</i>	Doug MacAyeal
<i>Vice-Presidents</i>	Gwenn Flowers Frank Pattyn Shin Sugiyama
<i>Treasurer</i>	Ian Willis
<i>Secretary General</i>	Magnús Már Magnússon
<i>Membership and Accounts Manager</i>	Louise Buckingham

Cover illustration Four glacier rivers, Hverfisfljót, Brunná, Djúpá, and Núpsvötn, southern Iceland, combine in a narrow area, confined by a recent lava flow on one side and a very large sandur plain on the other, to make this weft of braided streams. Photograph by Oddur Sigurðsson.

Annals of Glaciology

Hydrology of glaciers and ice sheets



Published by Cambridge University Press for
the International Glaciological Society
Cambridge, UK

The Annals of Glaciology is a thematic journal published by the IGS 3–4 times a year. All papers are peer-reviewed and edited.

The accuracy of references in the text and lists is the responsibility of the authors, to whom queries should be addressed.

Printed in the UK, by Bell & Bain Ltd., Glasgow.

PREFACE

This thematic issue of the *Annals of Glaciology* concerns the hydrology of glaciers and ice sheets. The ice masses act as vast reservoirs of fresh water, and their hydrology has wide-ranging importance. Many mountain glaciers act as a direct resource of water for habitation, for irrigation, and for hydro-power generation. Hydrological processes are fundamental agents of glacial erosion and landform development, and they provide catastrophic flood risks that demand attention from both regional and national planners. The hydrological systems of glaciers and ice-sheets play a major role in the dynamics of the ice itself, providing strong controls on basal sliding, crevassing, and the mass and thermal balances at the ice surface. Meltwater runoff from ice sheets has potentially profound effects on ocean circulation and marine ecology, as well as its obvious effect on sea level.

Many of these themes are covered by the diverse range of studies in this issue. There are several papers concerning the near surface hydrology of snow, firn, and supraglacial lakes. Subglacial hydrology features heavily, with new measurements of water pressure beneath the Greenland ice sheet, of hydrologically controlled sliding, and estimates of water flow and subglacial lake locations in Antarctica. Suspended sediments in glacial outflows are used both to investigate lithological controls on surging, and to infer the subglacial hydrology of a marine-terminating margin in Greenland. In all, this issue of the *Annals* attracted 26 submissions, of which 15 were accepted for publication. We thank the scientific editors and reviewers for their work in selecting and improving the final papers.

This issue of the *Annals* is loosely associated with an international symposium on Hydrology of Glaciers and Ice Sheets that was convened by the International Glaciological Society (IGS) in June 2015 in Höfn, Hornafjörður, Iceland. The meeting covered a wide range of aspects of glacier and ice-sheet hydrology, including some, but not all, of the studies documented in this issue. The topics at the symposium included supraglacial and firn hydrology, englacial and subglacial hydrology, basal sliding and influence on ice dynamics, erosion and landforms, as well as glacial outburst floods and associated hazards.

The symposium attracted an international audience, with 117 participants as well as eight accompanying persons attending the isolated conference venue at Hótel Vatnajökull, at Lindarbakki, Hornafjörður. Many of the participants stayed at the hotel; others stayed in cabins or camped at nearby Höfn. The program for the week included 68 oral presentations and 35 poster presentations, and included time for fruitful scientific discussion amid the dramatic backdrop of the Vatnajökull ice cap. A midweek afternoon excursion to two nearby outlet glaciers offered the chance to stretch legs and see a newly formed terminus lake. Some participants were also treated to a pre-symposium snowmobile tour of the Vatnajökull ice-cap, and a post-symposium tour of the south coast of Iceland doubled as transport back to Reykjavík for many.

The Höfn symposium was co-sponsored by the University of Iceland, the Institute of Earth Sciences, University of Iceland, the Icelandic Meteorological Office, Landsvirkjun – the National Power Company of Iceland, the Icelandic Road and Coastal Administration, the Iceland Glaciological Society, and the Geoscience Society of Iceland.

**Alexander H. Jarosch
Ian Hewitt**

CONTENTS

Charalampos Charalampidis, Dirk Van As, William T. Colgan, Robert S. Fausto, Michael MacFerrin, Horst Machguth	Thermal tracing of retained meltwater in the lower accumulation area of the Southwestern Greenland ice sheet	1
Michael Kuhn, Kay Helfricht, Martin Ortner, Johannes Landmann, Wolfgang Gurgiser	Liquid water storage in snow and ice in 86 Eastern Alpine basins and its changes from 1970–97 to 1998–2006	11
Łukasz Stachnik, Jacob C. Yde, Marta Kondracka, Dariusz Ignatiuk, Magdalena Grzesik	Glacier naled evolution and relation to the subglacial drainage system based on water chemistry and GPR surveys (Werenskioldbreen, SW Svalbard)	19
S. L. St. Germain, B. J. Moorman	The development of a pulsating supraglacial stream	31
Matti Leppäranta, Elisa Lindgren, Lauri Arvola	Heat balance of supraglacial lakes in the western Dronning Maud Land	39
Bergur Einarsson, Eyjólfur Magnússon, Matthew J. Roberts, Finnur Pálsson, Thorsteinn Thorsteinsson, Tómas Jóhannesson	A spectrum of jökulhlaup dynamics revealed by GPS measurements of glacier surface motion	47
Toby W. Meierbachtol, Joel T. Harper, Neil F. Humphrey, Patrick J. Wright	Mechanical forcing of water pressure in a hydraulically isolated reach beneath Western Greenland's ablation zone	62
Gwenn E. Flowers, Alexander H. Jarosch, Patrick T. A. P. Belliveau, Lucas A. Fuhrman	Short-term velocity variations and sliding sensitivity of a slowly surging glacier	71
Douglas J. Brinkerhoff, Colin R. Meyer, Ed Bueler, Martin Truffer, Timothy C. Bartholomaeus	Inversion of a glacier hydrology model	84
Ian C. Willis, Ed L. Pope, Gwendolyn J.-M.C. Leysinger Vieli, Neil S. Arnold, Sylvan Long	Drainage networks, lakes and water fluxes beneath the Antarctic ice sheet	96
Sebastian Goeller, Daniel Steinhage, Malte Thoma, Klaus Grosfeld	Assessing the subglacial lake coverage of Antarctica	109
Kristin M. Schild, Robert L. Hawley, Blaine F. Morriss	Subglacial hydrology at Rink Isbræ, West Greenland inferred from sediment plume appearance	118
Sverrir Aðalsteinn Jónsson, Ívar Örn Benediktsson, Ólafur Ingólfsson, Anders Schomacker, Helga Lucia Bergsdóttir, William R. Jacobson, Hans Linderson	Submarginal drumlin formation and late Holocene history of Fláajökull, southeast Iceland	128
Jeff W. Crompton, Gwenn E. Flowers	Correlations of suspended sediment size with bedrock lithology and glacier dynamics	142
A. M. MacDonald, A. R. Black, B. É. Ó Dochartaigh, J. Everest, W. G. Darling, V. Flett, D. W. Peach	Using stable isotopes and continuous meltwater river monitoring to investigate the hydrology of a rapidly retreating Icelandic outlet glacier	151