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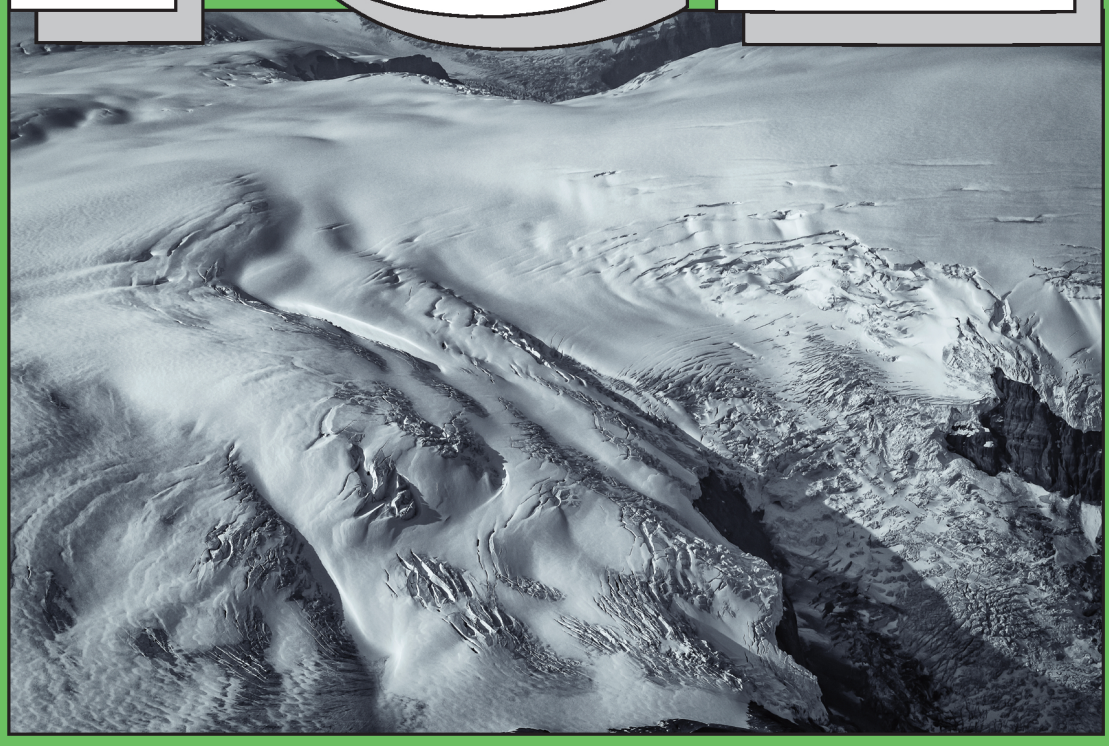
ICE



NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

ISSN 0019–1043

Ice

News Bulletin of the International Glaciological Society

Numbers 176 and 177 1st and 2nd issues 2018

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Cover picture: The Columbia icefield (Canada) seen from a small light aircraft. Photo by David Rippin.

From the Editor

Dear IGS member

Welcome to the first issue of ICE for 2018. Yet again it contains a lot of interesting articles and information which we trust you will enjoy.

As of the IGS Annual General Meeting held during the IGS British Branch meeting on 14 September 2018 we re-elected Gwenn Flowers as one of our Vice Presidents. Ian Willis has retired as our Treasurer, a position he has held for over 12 years. Our new Treasurer is Amber Leeson. The new 'Elected Council Members' are Regine Hock, Christina Hulbe, Andrey Glazovsky, Kang Shichang (re-elected) and Shelley MacDonell.

It is with great sadness, but also with deep gratitude for his service to our society, that the IGS reports the death of J. Graham Cogley, Professor Emeritus in the Department of Geography, Trent University, Canada. Graham died on 4 October 2018 in Peterborough, Ontario, Canada. Graham was a long-standing member of the IGS, having joined in 1970. Since May 2016 Graham had been IGS Chief Editor of the *Journal of Glaciology* and *Annals of Glaciology*.

Sadly two other prominent IGS members have died in October: Hans Weertman and Keiji Higuchi. Full obituaries will be published in *ICE* and online on our website.

As some of you may be aware we have been having problems with our payment portal. If you wish to renew or join, please contact ouise at igsoc@igsoc.org for alternative payment options.

Shortly you will receive exciting information about our new portal through which you will be able to join the IGS, renew your memberships and book onto our many and varied events. You will receive an invitation to join this new way of interacting with the IGS within the next few months so please keep a look out for it in your inboxes.

So, to finish off this issue's editorial, I would like once agian to encourage all of you to renew your membership and, if you are not a member, please join. I also encourage you to submit your paper to the highly respected and prestigious *Journal of Glaciology* or to the *Annals of Glaciology*. In doing so you are supporting the glaciological community, i.e. yourselves.

Magnús Már Magnússon
Secretary General

Core values of the IGS

The International Glaciological Society was founded in 1936 to provide a focus for individuals interested in practical and scientific aspects of snow and ice.

Our objectives

The International Glaciological Society's objectives, enshrined in its Constitution, are to:

- stimulate interest in and encourage research into the scientific and technical problems of snow and ice in all countries;
- facilitate and increase the flow of glaciological ideas and information;
- publish:
    - the *Journal of Glaciology*,
    - the *Annals of Glaciology*,
    - *ICE*, the News Bulletin of the International Glaciological Society, and
    - other appropriate publications, such as books and monographs;
- sponsor lectures, field meetings and symposia;
- promote and mentor the next generation of scientists.

Our core values

The International Glaciological Society and its members are committed to:

- diversity and respect for the individual, regardless of, for example, gender, sexual orientation, race, ethnic origin, nationality, religion or age;
- integrity by being open, responsible, transparent, accountable, honest, ethical and genuine;
- maintenance of a safe, friendly and inclusive environment at IGS forums and business for all participants;
- excellence, innovation and improvement;
- the encouragement of teamwork and collaboration;
- minimization of negative impacts on the environment.

Our scientific code of conduct

The International Glaciological Society and its members are committed to:

- respecting and promoting the Society's core values;
- excellence in ice and snow related research and its publication and communication, which is free of undisclosed conflicts of interest, plagiarism, fabrication or falsification;
- a peer publication review process that is fair, unbiased and aimed at improving and enhancing the research and resulting publication.
- striving to ensure that glaciological research and underlying data are freely available, through forms of open access publication and use of accessible data depositories

International Glaciological Society

JOURNAL OF GLACIOLOGY

Papers accepted for publication between 1 January and 30 September 2018. The papers are listed in alphabetical order by first author. Some of these papers have already been published.

Karen Alley, Ted Scambos, Robert Anderson, Harihar Rajaram, Allen Pope, Terry Haran
Continent-wide estimates of Antarctic strain rates from Landsat 8-derived velocity grids

Sven Avak, Margit Schwikowski, Anja Eichler
Impact and implications of meltwater percolation on trace element records observed in a high-Alpine ice core

Eviatar Bach, Valentina Radic, Christian Schoof
How sensitive are mountain glaciers to climate change? Insights from a block model

Elizabeth Bagshaw, Nanna Karlsson, Lai Bun Lok, Ben Lishman, Lindsay Clare, Keith Nicholls, Stephen Burrow, Jemma Wadham, Olaf Eisen, Hugh Corr, Paul Brennan, Dorthe Dahl-Jensen
Prototype wireless sensors for monitoring sub-surface processes in snow and firn

Ruben Basantes Serrano, Antoine Rabatel, Christian Vincent, Pascal Sirguey
An optimized method to calculate the geodetic mass balance of mountain glaciers

Sandra Brügger, Erika Gobet, Federica Schanz, Oliver Heiri, Christoph Schwoerer, Michael Sigl, Margit Schwikowski, Willy Tinner
A quantitative comparison of microfossil extraction methods from ice cores

Charlie Bunce, Rachel Carr, Peter Nienow, Neil Ross, Rebecca Killick
Ice front change of marine-terminating outlet glaciers in northwest and southeast Greenland during the 21st century

Achille Capelli, Ingrid Reiweger, Jürg Schweizer
Acoustic emission signatures prior to snow failure

Zhao Chen, Peter Bromirski, Peter Gerstoft, Ralph Stephen, Douglas Wiens, Richard Aster, Andrew Nyblade
Ocean-excited plate waves in the Ross and Pine Island Glacier ice shelves

John Erich Christian, Michelle Koutnik, Gerard Roe
Committed retreat: controls on glacier disequilibrium in a warming climate

Gabriela Collao-Barrios, Fabien Gillet-Chaulet, Vincent Favier, Gino Casassa, Etienne Berthier, Inés Dussaillant, Jeremie Mouginot, Eric Rignot
Ice-flow modelling to constrain the surface mass balance and ice discharge of San Rafael Glacier, Northern Patagonia Icefield

Anna Crawford, Greg Crocker, Derek Mueller, Luc Desjardins, Ronald Saper, Tom Carrieres
The Canadian Ice Island Drift, Deterioration and Detection (CI2D3) database

Anna Dal Farra, Susan Kaspari, James Beach, Thomas Bucheli, Michael Schaepman, Margit Schwikowski
Spectral signatures of submicron scale light absorbing impurities in snow and ice using hyperspectral microscopy

Suresh Das, Milap Chand Sharma
Glacier changes between 1971 and 2016 in the Jankar Chhu watershed, Lahaul Himalaya, India

Eva de Andrés, Jaime Otero, Francisco José Navarro, Agnieszka Promińska, Javier Lapazaran, Waldemar Walczowski
A two-dimensional glacier-fjord coupled model applied to estimate submarine melt rates and front position changes of Hansbreen, Svalbard

Basile de Fleurian, Mauro Werder, Sebastian Beyer, Douglas Brinkerhoff, Ian Delaney, Christine Dow, Jacob Downs, Olivier Gagliardini, Matthew Hoffman, Roger Hooke, Julien Seguinot, Aleah Sommers
SHMIP, the Subglacial Hydrology Model Intercomparison Project

Zhiheng Du, Cunde Xiao, Minghu Ding, Chuanjin Li
Identification of multiple natural and anthropogenic sources of dust in snow from Zhongshan station to Dome A, East Antarctica

Zbynek Engel, Kamil Laska, Daniel Nývlt, Zdeněk Stachoň
Surface mass balance of small glaciers on James Ross Island, north-eastern Antarctic Peninsula, during 2009–2015

Darri Eythorsson, Sigurdur Gardarsson, Andri Gunnarsson, Birgir Hrafnkelsson
Statistical summer mass-balance forecast model with application to Brúarjökull glacier, south east Iceland

Francesca Falcini, David Manish Rippin, Maarten Krabbendam, Katherine Selby
Quantifying bed roughness beneath contemporary and palaeo-ice streams

Sindre Fritzner, Rune Graversen, Keguang Wang, Kai Christensen
Comparison between a multi-variate nudging method and the ensemble Kalman filter for sea-ice data assimilation

Olivier Gagliardini, Mauro Werder
Influence of increasing surface melt over decadal timescales on land terminating, Greenland-type outlet glaciers

Joseph Graly, Kathy Licht, Christine Kassab, Broxton Bird, Michael Kaplan
Warm-based basal sediment entrainment and far-field Pleistocene origin evidenced in central Transantarctic blue ice through stable isotopes and internal structures

Marianne Haseloff, Olga Sergienko
The effect of buttressing on grounding line dynamics

Jolana Hruba, Gunther Kletetschka
Environmental record of layers of bubbles in natural pond ice

Jennifer Hutchings, Andrew Roberts, Cathleen Geiger, Jacqueline Richter-Menge
Erratum: Spatial and temporal characterisation of sea ice deformation

Xu Ji, Erkan Oterkus
Physical mechanism of ice-structure interaction

Stephen Jimenez, Ravindra Duddu
On the evaluation of the stress intensity factor in calving models using linear elastic fracture mechanics

Leonora King
Comparing two methods of remotely estimating moulin discharge on the Greenland Ice Sheet

Uta Krebs-Kanzow, Paul Gierz, Gerrit Lohmann
Estimating Greenland surface melt is hampered by dampened temperature variability

Astrid Lambrecht, Christoph Mayer, Anja Wendt, Dana Floricioiu, Christof Völksen
Elevation change of Fedchenko Glacier, Pamir Mountains, from GNSS field measurements and TanDEM-X elevation models, with a focus on the upper glacier

Zhaoguo Li, Yinhuan Ao, Shihua Lyu, Jiahe Lang, Lijuan Wen, Victor Stepanenko, Xianhong Meng, Lin Zhao
Investigation of the ice surface albedo in the Tibetan Plateau lakes based on the field observation and MODIS products

Stefan Lippl, Saurabh Vijay, Matthias Braun
Automatic delineation of debris-covered glaciers using InSAR coherence derived from X-, C-, and L-band radar data: a case study of Yazgyl Glacier

David McClung, Chris Borstad
Probabilistic size effect law for mode II fracture from critical lengths in snow slab avalanche weak layers

Toby Meierbachtol, Joel Harper, Neil Humphrey
Short duration water pressure transients in Western Greenland's subglacial drainage system

Brent Minchew, G.Hilmar Gudmundsson, Alex Gardner, Fernando Paolo, Helen Fricker
Modeling the dynamic response of outlet glaciers to observed ice-shelf thinning in the Bellingshausen Sea Sector, West Antarctica

Brent Minchew, Colin Meyer, Alexander Robel, Gudmundur Hilmar Gudmundsson, Mark Simons
Processes controlling the downstream evolution of ice rheology in glacier shear margins: case study on Rutford Ice Stream, West Antarctica

Masahiro Minowa, Evgeny Podolskiy, Shin Sugiyama, Daiki Sakakibara, Pedro Skvarca
Glacier calving observed with time-lapse imagery and tsunami waves at Glaciar Perito Moreno, Patagonia

Leslie Morland
Asymptotic analysis of flow near a glacier terminus

Colleen Mortimer, Martin Sharp, Wesley Van Wychen
Influence of recent warming and ice dynamics on glacier surface elevations in the Canadian High Arctic, 1995–2014

Lisbeth Nielsen, Christine Hvidberg, Guðfinna Aðalgeirsdottir, Vasileios Gkinis, Roman Nuterman
The effect of a Holocene climatic optimum on the evolution of the Greenland ice sheet during the last 10kyr

Atsumu Ohmura, Maxi Bottcher
Climate on the equilibrium line altitudes of glaciers: theoretical background behind Ahlmann's P/T Diagram

Simon Ommanney, Laura Thomson
Corrigendum: Crusoe Glacier tongue, Axel Heiberg Island, Nunavut

Gordon Oswald, Soroush Rezvanbehbahani, Leigh Stearns
Radar evidence of ponded subglacial water in Greenland

Tino Pieczonka, Tobias Bolch, Melanie Kröhnert, Juliane Peters, Shiyin Liu
Glacier branch lines and glacier ice thickness estimation for debris-covered glaciers in the Central Tien Shan

Ankit Pramanik, Ward Van Pelt, Jack Kohler, Thomas Schuler
Simulating climatic mass balance, seasonal snow development and associated freshwater runoff in the Kongsfjord basin, Svalbard (1980–2016)

Alexandra Pulwicki, Gwenn Flowers, Valentina Radić, Derek Bingham
Estimating winter balance and its uncertainty from direct measurements of snow depth and density on alpine glaciers

Rebecca Pyne, Elizabeth Keller, Silvia Canessa, Nancy Bertler, Alex Pyne, Darcy Mandeno, Paul Vallelonga, Helle Kjær, Stefanie Semper, Ed Hutchinson, W. Troy Baisden
A novel approach to process brittle ice for continuous flow analysis of stable water isotopes

Carl Renshaw, Aleksey Marchenko, Erland Schulson, Evgeny Karulin
Effect of compressive loading on first-year sea ice permeability

Daiki Sakakibara, Shin Sugiyama
Ice front and flow speed variations of marine-terminating outlet glaciers along the coast of Prudhoe Land, northwestern Greenland

Pablo Sánchez Gámez, Francisco José Navarro
Ice discharge error estimates using different cross-sectional area approaches: a case study for the Canadian High Arctic, 2016-2017

Colin Sayers
Increasing contribution of grain boundary compliance to polycrystalline ice elasticity as temperature increases

Anne Solgaard, Alexandra Messerli, Thomas Schellenberger, Christine Hvidberg, Aslak Grinsted, Miriam Jackson, Thomas Zwinger, Nanna Karlsson, Dorthe Dahl-Jensen
Basal conditions at Engabreen, Norway, inferred from surface measurements and inverse modelling

Chris Stokes, Liss Andreassen, Matthew Champion, Geoffrey Corner
Widespread and accelerating glacier retreat on the Lyngen Peninsula, northern Norway, since their 'Little Ice Age' maximum

Victor Tsai, Xiaozhou Ruan
A simple physics-based improvement to the Positive Degree Day model

Muhammad Usman, Masato Furuya
Inter-annual modulation of seasonal glacial velocity variations in the Eastern Karakoram detected by ALOS-1/2 data

Alessandra Viani, Thomas Condom, Christian Vincent, Antoine Rabatel, Baldassare Bacchi, Jean Sicart, Jesus Revuelto, Delphine Six, Isabella Zin
Glacier-wide summer surface mass balance calculation: hydrological balance applied to the Argentière and Mer de Glace drainage basins (Mont Blanc)

Christian Vincent, Marie Dumont, Delphine Six, Fanny Brun, Ghislain Picard, Laurent Arnaud
Why do the dark and white ogives of Forbes bands have similar surface mass balances?

Xin Wang, Chengde Yang, Yanlin Zhang, Kaiguo Chai, Shiyin Liu, Yongjian Ding, Yong Zhang, Yongshun Han
Monitoring and simulation of hydrothermal conditions indicating the deteriorating stability of a perennially frozen moraine dam in the Himalayas

Yetang Wang, Shugui Hou, Huai Baojuan, wenling An, Hongxi Pang, Yaping Liu
Glacier anomaly over the Western Kunlun Mountains, northwestern Tibetan Plateau, since the 1970s

Andrew Williamson, Ian Willis, Neil Arnold, Alison Banwell
Controls on rapid supraglacial lake drainage in West Greenland: an Exploratory Data Analysis approach

Adrienne White, Luke Copland
Area change of glaciers across Northern Ellesmere Island, Nunavut, between ~1999 and ~2015

Pat Wongpan, David Prior, Pat Langhorne, Katherine Lilly, Inga Smith
Using electron backscatter diffraction to measure full crystallographic orientation in Antarctic land-fast sea ice

Tun Jan Young, Dustin Schroeder, Poul Christoffersen, Lai Bun Lok, Keith Nicholls, Paul Brennan, Samuel Doyle, Bryn Hubbard, Alun Hubbard
Resolving the internal and basal geometry of ice masses using imaging phase-sensitive radar

Jenna Zechmann, Adam Booth, Martin Truffer, Alessio Gusmeroli, Jason Amundson, Christopher Larsen
Active seismic studies in valley glacier settings: strategies and limitations

Harry Zekollari, Philippe Huybrecht
Statistical modelling of the surface mass balance variability of the Morteratsch glacier, Switzerland: strong control of early melting season meteorological conditions

Hongbo Zhang, Fan Zhang, Guoqing Zhang, Ma Yamoing, Kun Yang, Ming Ye
Daily air temperature estimation on glacier surfaces in the Tibetan Plateau using MODIS LST data

Hui Zhang, Li Zhongqin, Zhou Ping, Fan Zhu, Wang Lin
Mass balance observations and reconstruction for Haxilegen Glacier No.51, eastern Tien Shan, from 1999 to 2015

Zhen Zhang, Shiyin Liu, Yong Zhang, Junfeng Wei, Zongli JIang, Kunpeng Wu
Glacier variations at Aru Co in western Tibet from 1971 to 2016 derived from Remote Sensing data

Meilin Zhu, Yao TanDong, Wei Yang, Xu Qing, Guangjian Wu, Xiaojun Wang, Ying Xie
Reconstruction of the mass balance of Muztag Ata No. 15 glacier, eastern Pamir, and its climatic drivers

ANNALS OF GLACIOLOGY 59(76)

The following papers have been selected for publication in Annals of Glaciology *59(76) (thematic issue on Polar ice, polar climate, polar change), edited by Mark Serreze*

Wiebke Aldenhoff, Céline Heuzé, Leif Erisson
Comparison of ice/water classification in Fram Strait from C- and L-band SAR imagery

Ekaterina Cherniavskaia, Ivan Sudakov, Kenneth Golden, Courtenay Strong, Leonid Timokhov
Observed winter salinity fields in the surface layer of the Arctic Ocean and statistical approaches to predicting large-scale anomalies and patterns

Kyle Duncan, Sinead Farrell, Laurence Connor, Jacqueline Richter-Menge, Jenny Hutchings, Rose Dominguez
High-resolution airborne observations of sea ice pressure ridge sail height

Grant Macdonald, Alison Banwell, Douglas MacAyeal
Seasonal evolution of supraglacial lakes on a floating ice tongue, Petermann Glacier, Greenland

Dmitrii Murashkin, Gunnar Spreen, Marcus Huntemann, Wolfgang Dierking
Method for detection of leads from Sentinel-1 SAR images

Sohey Nihashi, Nathan Kurtz, Thorsten Markus, Kay Ohshima, Kazutaka Tateyama, Takenobu Toyota
Estimation of sea-ice thickness and volume in the Sea of Okhotsk based on ICESat data

Marta Wenta, Agnieszka Herman
The influence of spatial distribution of leads and ice floes on the atmospheric boundary layer over fragmented sea ice.

Yuande Yang, Hao Ke, Zemin Wang, Fei Li, Minghu Ding, Bo Sun, Bo Jin, Lianzhong Wang, Songtao Ai
Decadal GPS-derived ice surface velocity along the transect from Zhongshan Station to and around Dome Argus, East Antarctica, 2005–2016

Annals 59(76) is now complete

ANNALS OF GLACIOLOGY 59(77)

The following papers have been selected for publication in Annals of Glaciology *59(77) (thematic issue on Cryosphere and Biosphere), edited by Alex Anesio, Andrew J. Hodson and Martyn Tranter*

Roberto Sergio Azzoni, Ilario Tagliaferri, Andrea Franzetti, Christoph Meyer, Astrid Lambrecht, Chiara Compostella, Marco Caccianiga, Umberto Filippo Minora, Carlo Alberto Garzonio, Eraldo Meraldi, Claudio Smiraglia, Guglielmina Diolaiuti, Roberto Ambrosini
Bacterial diversity in snow from mid-latitude mountain areas: Alps, Eastern Anatolia, Karakoram and Himalaya

Lin Feng, Yanqing An, Jianzhong Xu, Shichang Kang
Characteristics and sources of dissolved organic matter in a glacier in the northern Tibetan Plateau: differences between different snow categories

Shigeki Murakami, Yukari Takeuchi
Difference in snowmelt processes between an opening and three Japanese cedar stands

Francesca Pittino, Maurizio Maglio, Isabella Gandolfi, Roberto Sergio Azzoni, Guglielmina Diolaiuti, Roberto Ambrosini, Andrea Franzetti
Bacterial communities of cryoconite holes of a temperate alpine glacier show both seasonal trends and year-to-year variability

Shipika Sundriyal, Tanuj Shukla, Lukasz Stachnik, Manish Mehta
Carbonate and silicate weathering in glacial environments and its relation to atmospheric CO_2 cycling in the Himalayas

Nozomu Takeuchi, Ryutaro Sakaki, Jun Uetake, Naoko Nagatsuka, Rigen Shimada, Masashi Niwano, Teruo Aoki
Temporal variations of cryoconite holes and cryoconite coverage on the ablation ice surface of Qaanaaq Glacier in northwest Greenland

Yukari Takeuchi, Kouichi Nishimura, Abani Patra
Observations and numerical simulations of the braking effect of forests on large-scale avalanches

Jeffery A. Thompson, Lora Koenig
Land surface phenology in Greenland and links to cryospheric change

More papers for *Annals* 59(77) will be listed in the next issue

ANNALS OF GLACIOLOGY 60(78)

The following papers have been selected for publication in Annals of Glaciology *60(78) (thematic issue on Timescales, Processes and Glacier Dynamics), edited by Jesse Johnson and Cornelis van der Veen*

John Fegyveresi, Richard Alley, Donald Voigt, Joan Fitzpatrick, Lawrence Wilen
A case study of ice-core bubbles as strain indicators

Sharon van Geffen, Johannes Oerlemans
A critical evaluation of the applicability of seven conceivable surge theories to Variegated Glacier

Aniket Gupta, Rijan Kayastha
Developing a glacio-hydrological model for high Himalayan catchment

More papers for *Annals* 60(78) will be listed in the next issue

ANNALS OF GLACIOLOGY 60(79)

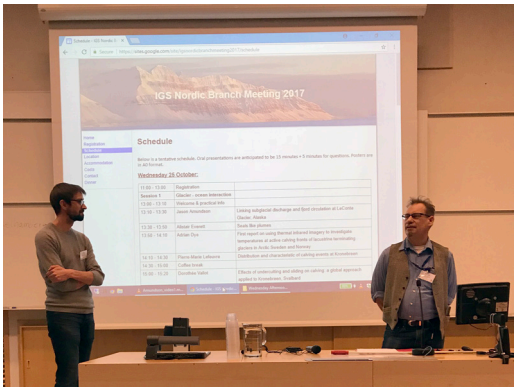
The following paper has been selected for publication in Annals of Glaciology *60(79) (thematic issue on Progress in Cryoseismology), edited by Fabien Walter*

Fabian Lindner, Gabi Laske, Fabian Walter, Adrian Doran
Crevasse-induced Rayleigh-wave azimuthal anisotropy on Glacier de la Plaine Morte, Switzerland

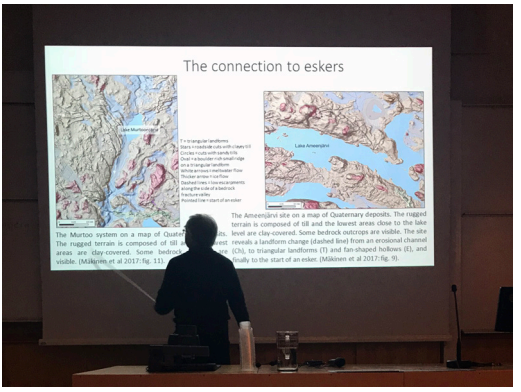
More papers for *Annals* 60(79) will be listed in the next issue

Nordic Branch Meeting 2017

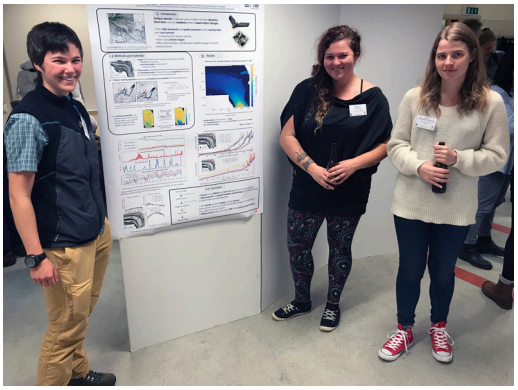
Uppsala University, Uppsala, Sweden, 25–27 October 2017

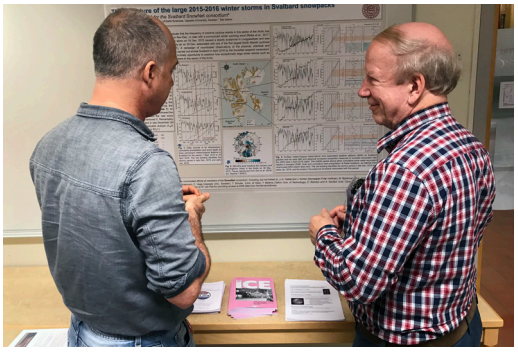


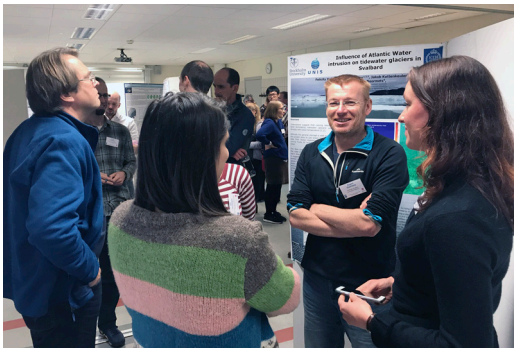
The meeting started with a welcome from our local hosts, Ward van Pelt, Rickard Pettersson and Veijo Pohjola.



Presenters included (above left) Nathan Maier, (below left) Dorothée Vallot, (top right) Anja Diez, (middle right) Kari Kajuutti and (bottom right) Louise Steffensen.



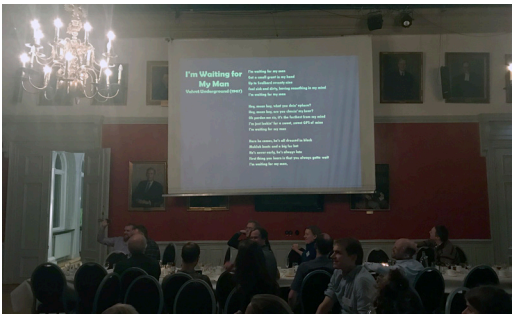




Much networking took place at the poster session, which was as convivial as always.

Jason Box reports:
On 26 October, 2017, at the campus of the University of Uppsala, Sweden, IGS Nordic Branch participants gathered for a pleasant and memorable evening of socializing and professional networking. Participants were treated to:

- a little history of the University of Uppsala: founded in 1477, it predates any in Denmark by a year
- a delicious traditional Swedish meal including reindeer and schnapps
- an evening that ended with the energetic sounds and glaciologically augmented lyrics of the 'The Real van Pelts', who played edgy rocking covers of Clash and original numbers.
- a sing-song from the various nations represented, for example, a scintillating version of 'Home on the Range' by four US participants.



A PowerPoint presentation allowed everyone to join in with 'The Real Van Pelts'. Here are some of the lyrics of their songs:

I'm Waiting for My Man
Velvet Underground (1967)

I'm waiting for my man
Got a small grant in my hand
Up to Svalbard seventy nine
Feel sick and dirty, having something in my mind
I'm waiting for my man

Hey, dumb boy, what you doin' up here?
Hey, dumb boy, you chasin' my bear?
Oh pardon me sir, it's the furthest from my mind
I'm just lookin' for a sweet, sweet GPS of mine
I'm waiting for my man

Here he comes, he's all dressed in black
Mukluk boots and a big fur hat
He's never early, he's always late
First thing you learn is that you always gotta wait
I'm waiting for my man

Postdoc Blues
John K. Samson (2017)

So your presentation went terrible
All wrong dongles, sweat stains and stares
Leave the TV on with the sound down low in your underwear

Don't despair you'll get it right tomorrow night
In Thunder Bay, maybe
Don't delay, your day is short
You can't afford to wait

I believe in you and your PowerPoints
I know why you can't stay away
Out on Highway 1 with the rental car and a lot to say

Don't despair you'll get it right tomorrow night
In Nipigon, maybe
Don't delay, our day is short
You can't afford to wait

So take that overhead out of your folder and read it
And recommit yourself to the healing of the world
And to the welfare of all creatures upon it
Pursue of practice that will strengthen your heart

I Fought the Law
Bobby Fuller (1964, The Clash 1979)

My Ice Sheet model is a huula baloola
I fought the law and the law won
I fought the law and the law won

It gives me the creeps when I programmed none
I fought the law and the law won
I fought the law and the law won

My field equations are so bad to me
They say I am ill posed
When I try to invert to infinity
I fought Glen´s law and the law won
I fought Glen´s law and the

Repeat…

Best student oral presentation of the meeting went to Paul Weber. Here, Paul receives his award (and the coveted IGS beanie) from the judges, Liss M. Andreassen and Tómas Jóhannesson. The best student poster award went to Xiaoran Guo, who had unfortunately left before the presentation.

And here is Paul (top) in full flow! Other presenters included (left) Gong Cheng and (above) Miriam Jackson.

The first conference of the Chilean Society for the Cryosphere

Valdivia, Chile, 8–9 March 2019

Two of the pillars of the foundation of glaciology in Chile, Cedomir Marangunic and Gino Casassa, describe challenges facing Chilean glaciological research today.

The first meeting of the Chilean Society for the Cryosphere (SOCHICRI) was held in Valdivia, Chile on 8–9 March at the Faculty of Science of Austral University. The idea was to bring together a diverse range of researchers from around the country to present, share and discuss their current research and issues. The idea ended up being too popular, and with 85 people registered, registration had to close earlier than expected!

Nicole Schaffer describes the results of using snow fences to augment water supply in the semi-arid Chilean Andes.

Participants came from all over the country, with some driving more than 1650 km to be there.

The oral presentations were organized in four sessions (Climatology/Energy Balance, Mass Balance and Remote Sensing, General Glaciology, and Glacier Hydrology) and covered a wide range of issues from glacier biology to climatological processes to glacier mass balance. A poster session was held on Thursday afternoon and the first day closed with some beers and snacks at the local bar/brewery 'El Growler'.

Lurking below the surface were concerns about the official definition of glaciers in Chile that is used by the public sector and how this may impact the Environmental Impact Assessment process, an issue increasingly relevant in this part of the world. Additionally, concerns about the elaboration and trajectory of the glacier protection and preservation law, the 'Ley de Glaciares', whose first draft was developed more then 10 years ago and which has been stuck in the lower house of Parliament for 2 years now. A thought-provoking presentation regarding socio-environmental conflicts related to Chilean glaciers delivered by Alexis Segovia provided fodder for an interesting discussion regarding the role of scientists within the resolution of these conflicts.

The second day closed with a discussion about the goals and the mission of this new society and

James McPhee outlines future challenges for snow science in Chile.

Alexis Segovia explains the political milestones related to Chilean glaciers from 2002 to date.

the most appropriate legal figure to achieve these goals. A transitional committee, with representatives from different institutions that are currently studying the cryosphere was named and included: Pablo Iribarren, Alvaro Gonzalez, Marius Schaefer (Austral University), Shelley MacDonell (CEAZA), Francisco Fernandoy (Andrés Bello University), Alfonso Fernández (University of Concepción), Marcelo Somos (University of La Frontera), Gino Casassa (University of Magallanes), Ayón García (University of Atacama).

Future meeting points for researchers studying the Chilean Cryosphere include the XV Chilean Geological Congress to be held at the University of Concepción in November this year, and the next meeting of the SOCHICRI which is programmed to be held in La Serena in the beginning of next year.

With the level of healthy debate and the participation of many young voices in the development of a Chilean Society for the Cryosphere, the future can only be bright for future advances in glaciology and related disciplines in this Andean country.

For more information see: http://www.sochicri.cl.

Shelley MacDonell

Lively discussions in the poster session.

Healthy debates over the future of Chilean glaciology were held on Thursday night.

Report from the Alaska Summer School

McCarthy, Alaska, USA, 5–15 June 2018

In early June, 28 glaciology students convened at the University of Alaska Fairbanks (UAF) for the fifth biennial International Summer School in Glaciology. We had travelled from as near as our homes just down the street, in Canada and in the contiguous United States, and from as far as Nepal, India, New Zealand, Europe and Peru. However, our journey merely began in Fairbanks, and early in the morning of 5 June we drove together in vans to the small village of McCarthy, Alaska, making several stops along the way to admire the regional scenery and geological and cultural history. We would return to Fairbanks in 10 days, minds full of new knowledge and memories from the rigorous course and beautiful setting.

The summer school was truly defined and enhanced by its unique and remote location. McCarthy is an early 1900s boomtown near the abandoned copper-mining town of Kennecott, and the area is now a hub of the Wrangell–St Elias National Park. McCarthy can be accessed only by plane or by a footbridge at the end of a 60-mile dirt road, and it has no centralized utilities. Residents and visitors cart in water from the nearby Kennicott Glacier and produce electricity with solar panels and generators. We students camped in a clearing about a 7-minute walk from 'downtown' McCarthy. We were generously hosted by the Wrangell Mountains Center (WMC), an organization dedicated to 'connecting people with wildlands through art, science, and education in the Wrangell Mountains'. WMC director Nate, summer intern Carson and kitchen and garden manager Sophie welcomed us with open arms and made sure we were warm and comfortable in the historic Old Hardware Store building, where we ate and worked, and in Porphyry Place, the former home of glaciologist Edward LaChapelle, where our lectures were held. Sophie also ensured that we were well fed with delicious breakfasts, lunches, snacks and dinners, and kept us energized and ready to learn with countless pots of coffee.

2018 International Summer School of Glaciology participants on Root Glacier. Photo: Mark Fahnestock and timer.

The view from Tent City, where students and several instructors camped out during the summer school. Photo: Sophie Goliber.

Our days started with 4 hours of lectures on glaciology topics including, but not limited to, continuum mechanics, glacier hydrology, remote sensing, modeling and geomorphology. The lectures were followed by lunch, 2 hours of problem sets with guidance from the instructors, and 2 or more hours of group project time. Our project topics ranged from modeling subglacial drainage to investigating glacier surge behavior using satellite-derived velocity fields, and from correcting and analyzing lidar data from Kennicott Glacier to examining glacier mass balance from photogrammetry or weather station data. Each two-student group presented their project results at a public mini-conference on our last full day

Summer school students work on remote sensing problem sets under the tutelage of instructors Kelly Brunt and Mark Fahnestock. Photo: Regine Hock.

Summer school participants let a McCarthy resident cross the footbridge. Photo: Regine Hock.

in McCarthy, and we were all inspired and impressed by the fruits of our dozens of hours of labor. The summer school also offered several evening public lectures that were well attended by the community. On our second evening in town, Mark Vail, who has lived in McCarthy for several decades, painted for us a vivid picture of the history of McCarthy and Kennecott and the nearby glaciers. The next night, course instructor Andy Aschwanden told a full Porphyry Place about the current state of the Greenland Ice Sheet and how we can expect it to react to a warming climate. The discussions that ensued between us (the glaciology students and instructors) and McCarthy locals and tourists helped us hone our science communication skills and connect with people with a variety of backgrounds and experiences.

For many of the students, the highlights of the summer school were the two excursions. The first outing, an all-day, round-trip hike across Root Glacier to the end of Blackburn Mountain, where Root Glacier merges with Kennicott Glacier, was several students' first experience traversing a glacier. It was incredible for everyone to see features such as clear blue surface ponds, deep moulins, medial moraines and (small) crevasses

Lecture in Porphyry Place. Photo: Regine Hock.

First-time glacier-trekkers on Root Glacier. Photo: Regine Hock.

Summer school participants making music on Blackburn Mountain. Photo: Regine Hock.

firsthand. A few brave students even jumped in the melt ponds – in some cases only to rush back out again! Our second excursion was a half-day hike along the terminus of Kennicott Glacier, led by National Parks Service geologist Mike Loso. This trip allowed us to clearly see the effects of climate change on the glacier and the geomorphology of the larger McCarthy area. Most notably, a sizeable lake has formed over the last several years between the current terminus and a past moraine, indicating that the glacier has experienced both retreat and melt. The locals of McCarthy have started to capitalize on the opportunities that this new lake offers, including a new location for kayaking, but they have yet to name it!

Instructor Martin Truffer's daughters, Sonja and Emilie, who joined us in McCarthy, ensured that we upheld the summer school tradition of a Saturday night soccer game. But this year's game strayed from tradition in a few ways. Tracking down a soccer ball proved harder than we imagined, and the game was saved just in time thanks to summer school student Tushar Khurana asking McCarthy residents at the weekly McCarthy softball game if we could borrow a soccer ball. Also, rather than forming teams of students from the 'Old World' and students from the 'New World,' as done in previous years, we divided ourselves based on shirt color. We can still hear the sideline chants of 'NEUTRAL! NEUTRAL!' or 'RGB! RGB!' Both teams played fearlessly, and an unfortunate, but mostly harmless, ball-to-face incident led to the winning photo of the summer school photo contest. Finally, the game-ending goal was scored by course organizer Regine Hock's innovative method of picking up the goal and moving it in front of the rolling soccer ball! We even brought sports to the local pub, where student Anna Serdetchnaia won the headstand contest at Open Mic Night, and to school itself, through a lively game of Assassin, which involved would-be 'assassins' chasing 'targets' and trying to 'kill' them with an expertly placed name tag sticker. When we weren't running around, we were eating ice cream from the McCarthy general store, sitting around the campfire, flightseeing the beautiful Wrangell–St Elias National Park, kayaking, hiking, learning to play student Jade Cooley's mouth harp (footage of which made up the winning video of the video contest), and swimming in a frigid lake under the midnight sun.

Excursion to the terminus of Kennicott Glacier. Photo: Regine Hock.

Our last night in McCarthy was filled with delicious food and happy memories as we cheered on the entries to the student photo and video contests and crowned the champions of Assassin at the school-end banquet. The winning videographer (Jade Cooley), photographer (Whyjay Zheng), and photo subjects (Maria Zeitz, Alexander Hager and Eric Johnson) all received warm International Glaciological Society hats! Many of us finished off the night at Open Mic Night, and somehow we all managed to tear down our tents, stuff everything into our bags and trek back across the footbridge to the UAF vans by 8:00 the next morning. After arriving in

From left: Students Federico Covi and Steven Bernsen and instructor Kelly Brunt making music outside the Old Hardware Store. Photo: Regine Hock.

Student winners of the video and photo contests. From left: Jade Cooley (winning videographer), Whyjay Zheng (winning photographer), and Maria Zeitz, Eric Johnson, and Alex Hager (winning photo subjects). Photo: Regine Hock.

Fairbanks, we returned home in waves, with some leaving even before the end of the pizza party at Regine's lovely home, others leaving early the next morning, and still others leaving days or weeks later after doing research or traveling in Alaska. Each of us made it home with a full mind, new friends and a wealth of memories to share.

We would like to extend our deepest appreciation to the hosts and sponsors of the summer school: the Geophysical Institute at UAF, the WMC, the International Glaciological Society, NASA, the International Association of Cryospheric Sciences, the International Arctic Science Committee, the International Union of Geodesy and Geophysics, the *Frontiers in Earth Sciences* journal, and the Norwegian–North American Exchange Program RemoteEx. We are also very grateful to our wonderful instructors – Regine Hock, Andy Aschwanden, Ed Bueler, Mark Fahnestock, and Martin Truffer from UAF; Kelly Brunt from the University of Maryland/NASA Goddard Space Flight Center; Matthew Hoffman from the Los Alamos National Laboratory; Erin Whorton from the US Geological Survey Tacoma; and Mike Loso – for making our time in McCarthy so special.

Allison Chartrand (Ohio State University)
Maya Becker (University of California San Diego)

The winning photo of the summer school student photography contest. An unfortunate soccer ball collision with Maria Zeitz's face (foreground right) left her eyeglasses broken. Alex Hager (foreground left) came up with an innovative fix while other students offered encouragement and skepticism. Photo: Whyjay Zheng.

News

Annual General Meeting 2017

14 December, Newbury Room, Hilton New Orleans Riverside, New Orleans, Louisiana, USA

The President, Douglas R. MacAyeal, was in the Chair.

26 persons, from 9 countries, attended, of whom 25 were members.

1. The previous AGM's minutes
The Minutes of the last Annual General Meeting, published in the 2nd issue of *ICE,* 2016, No. 171, p. 6–12, were approved on a motion by J. Zwally, seconded by B. Molnia and signed by the President.

2. The President's report
The President gave the following report for 2016/17:

Ladies and gentlemen, members of the IGS and dear colleagues
I took office 6 and a half years ago succeeding Eric Brun to be the 14th President of the IGS since its founder, Gerald Seligman, retired from the post in 1963. As I started my term in 2011, the IGS operated with a mood of contentment, because, except for the long-established *Journal of Geophysical Research* (JGR) published by the American Geophysical Union (AGU), which had co-evolved with the IGS since the 1950s, there was little competition from other organizations.

The European Geosciences Union (EGU) established *The Cryosphere* (TC) in 2007. While it only published 65 papers that year, by 2011, when I began as President, TC had earned the respect of the glaciological community, and published 1133 pages that year. This number was virtually the same as that of the IGS's *Journal of Glaciology*, which was 1176 in 2011. Despite the fact that the IGS still published 828 pages more than TC when you factored in the four *Annals of Glaciology* issues published in 2011, it was clear that the community was shifting away from the traditional publication model the IGS had sustained since 1947. The EGU's open-access model and its reduced cost was clearly pressing the IGS to change its publication model.

Over the next 4 years, the main concern I had as President was to navigate the IGS through the existential challenge coming from TC. The principal question was, 'How do we stay relevant in the community, especially in terms of our flagship and auxiliary publications, the *Journal* and *Annals*?' Fortunately, IGS members Christina Hulbe and Eric Wolff, together with the rest of the IGS publication committee, provided a clear path to navigate. They said that the IGS should embrace an open-access publication model and should also modernize its production process (production = the processing of accepted manuscripts to yield a published paper volume) by considering alternatives to the process that had been successfully operating in the past. Above all, they argued, the IGS should remain mindful of its core values and sense of mission as it navigates through these changes.

After an extended period of debate, argument and consideration of multiple approaches, the IGS council decided at its meeting in Cambridge in 2015 to partner with Cambridge University Press (CUP) and to render all IGS publications beyond the end of 2015 fully open access (Gold). (The entire archive of previously published volumes of the *Journal* and *Annals* were also to become openly available, but subject to the copyright agreements that were originally made between the IGS and authors at the time of publication in the past.) The transition to OA publishing under CUP was difficult, and required a great deal of work. Jo Jacka, the renowned Chief Editor of the IGS, who served in his post for more than 13 years, provided a constant compass needle pointing toward the values and qualities that IGS publications must continue to strive for. Magnús Magnússon, the secretary general of the IGS for the last 14 and a half years, proved more than able to establish the partnership with CUP and oversee the down-sizing of the IGS home office. While the big shift in IGS publication model occurred on my watch as President, it was largely these people, Christina, Eric, Jo, Magnús, plus others including Council members and various other volunteers, who were the visionaries as well as the behind-the-scenes workers who accomplished the shift.

Currently, 2 years out from the IGS re-inventing itself as an efficient, modern open-access publisher, we appear to be holding our own. Indeed, our intention is to provide services and opportunities in such a fashion as will allow us to climb back into the pre-eminent place we previously held among publishers that serve the glaciological community. Our statistics for the current year show that submissions to the *Journal* and *Annals* are staying constant even despite the

new competition from TC and *Frontiers in Earth Sciences-Cryospheric Sciences*. Our *Journal* and *Annals* are both climbing in various metrics of impact, with the most recent accolade being the fact that the *Journal*'s impact factor now exceeds that of the JGR (3.6 for us, 3.4 for JGR in 2016). Additionally, this year, the *Journal* and *Annals* are the two journals of all journals publishing in glaciology to have seen significant impact factor increase from 2015 (+53% and +73% for the *Journal* and *Annals*, compared to –10% and +9% for TC and JGR).

We are now on a good path, but we are not out of the woods, and I do not think that the IGS should ever be complacent about its ability to compete with the many high-quality journals that the glaciological community can choose between. Constant innovation and adaptation must be part of the IGS organizational activity.

Where does the IGS stand now? The IGS is now in 'safe harbour' relative to the difficult restructuring of its publication processes. We have a vibrant new Chief Editorship in the form of five co-CEs who oversee the scientific elements of all IGS publication. Thank you to Graham Cogley (managing co-CE), Hester Jiskoot, Sergio Faria, Perry Bartelt and Frank Pattyn for organizing and leading a fine group of scientific editors. Our publishing partner, CUP, has facilitated a highly modernized method of on-line access to the *Journal* and *Annals*, including the entire archive of past papers (now freely available on line, for all intents and purposes, fully open-access). Our home office has downsized to one full-time employee, who is helped by a part-time worker and several occasional workers. Our physical footprint has reduced from a large office and storage space that was relatively isolated from the Cambridge, UK, academic environment (not being physically connected to either SPRI or BAS) and moved into an office at BAS.

I am furthermore happy to announce that the IGS has awarded the Richardson Medal to Dr Julie Palais, the long-standing manager of glaciological programs at the US National Science Foundation. While her career serving glaciological science through maintenance of a strong, focussed program in the USA is exemplary, her work to facilitate the various international programs leading to ice-core drilling and analysis is specifically singled out as meriting recognition by the IGS.

What has predictably not gone as well as we had hoped is what appears to be a drop off in the number of members of the IGS. With the free availability of the *Journal* and *Annals* to members and non-members alike, some people in the community have chosen not to renew their membership, and some people who have not previously been members have questioned the need to become a member. The situation is not a crisis for the IGS; however, what it means is that the IGS loses two important elements that are supported by membership: we have a reduced income and we have a smaller cadre of members who volunteer to perform the important services that the IGS delivers to the community. Traditionally, the IGS provides charitable support and co-sponsorship to a wide range of community activities. For example, in 2017, the IGS co-sponsored the Summer Training Workshop on Cryoseismology held in Fort Collins, Colorado, USA as well as the Communicating Science Workshop held in Boulder, Colorado. The IGS plans to continue to support summer schools and other training activities in the years to come. The financial scale of the IGS support cannot be maintained unless there is income from member dues (as well as from author publication charges, but dues are how the IGS has the greatest potential to raise income used in the service of the community). The IGS is responding to the drop in membership in 2016 by reducing its membership dues for 2017. Clearly, this is a gamble, but we hope that reducing dues to roughly the same level as those of other entities such as AGU and EGU will encourage membership numbers to rise.

Where to in the future? There were many good ideas for how the IGS could develop or modernize that came up during my term as President which I regrettably was unable to see fully materialize. Foremost on my mind was to ensure that awards and recognition bestowed on individuals in the community by the IGS were equable in terms of diversity. When I started my term as President, the three main awards given by the IGS (the Seligman Crystal, the Richardson Medal and Honorary Membership) had so far only gone to individuals of one sex (with the exception of its namesake for the Richardson Medal). Hard work by the Awards Committee and the individual members who take on the onerous task of preparing nomination cases, led to one Seligman Crystal, two Richardson Medals and one Honorary Membership being awarded to four females. This is a slow start, in my opinion, but I am encouraged by the fact that the Awards Committee is now activating itself to engage with this issue, under the able leadership of Lora Koenig.

Governance is another long-standing area where the IGS should probably seek reform. In the past, IGS Council members would regularly engage in face-to-face meetings to undertake both the mundane business decisions and the forward-thinking planning of the IGS. It has become increasingly difficult during my term to hold Council meetings where members attending

have also attended sufficient numbers of previous Council meetings to allow them to have a sense of the issues the Council has under consideration. This will be a problem for the new officers and Council of the IGS to solve in the coming years.

I close my report with a few personal remarks. First, I thank you, the members of the IGS, for having allowed me to serve as your President for the two terms in which I served. I have enjoyed the experience far more than the psychic burden I have experienced worrying about the IGS's operations and future existence. As I look back on my 40 years as a glaciologist, I regard having been the IGS President as possibly my best contribution to the world. I am, and shall always be, honoured and uplifted to have been your President.

Douglas R. MacAyeal
President

The Secretary General invited attendees to ask questions or to comment on the Presidents report.

R. Hock commented that it is worth publicising that the IGS has substantially lowered its membership fees with the aim of increasing membership. B. Molnia asked if there was a strategy in place to recruit more members. The SG commented that the Membership Manager has started using more 'user-friendly' communications and hopefully that will make members more aware of what it is like to be an IGS member. The President also replied that our publishing partner, Cambridge University Press, does now provide us with details of what papers are most heavily viewed and cited. The President has gone to the relevant authors that have the most 'views' and thanked them for publishing with the IGS. Such posts have generated several hundreds of 'likes' and thus increased the IGS's profile. This interaction with IGS authors is something that the IGS should be more proactive in doing in the future.

J. Zwally asked about using more modern website techniques to attract attention from those that visit the IGS site. The SG replied that the IGS is in the process of updating its membership database and as part of that we will be creating a new webpage for the IGS. Suggestions like the above are most welcome and the SG asked members to please communicate their suggestions to the IGS office.

The President also mentioned that IGS members get 10% reduction in the Author Processing Charges (APCs) and that should encourage people to join the IGS. There has been a discussion as to whether this discount should be used in some other way, as if an author's institution pays APCs, then the discount goes to the institution not the member. For example, perhaps a fund could be instigated that could be deployed in a charitable way to support the goals of the Society.

T. Scambos proposed, and J. Shea seconded, that the President's report be accepted. This was carried unanimously.

3. The Treasurer's report
The IGS Treasure, I.C. Willis, presented his report with the audited Financial Statements for the year ended 31 December 2016.

Fellow members, ladies and gentlemen

The Society's accounts underwent an independent examination rather than a full audit this year. Throughout my report, I will refer to the Society's unaudited accounts for 2016, referring to the relevant page numbers.

The Society's finances are summarized by considering the changes from 1 January 2016 to 31 December 2016, as shown on page 12 of the accounts. In the table, the Restricted Fund is money associated specifically with the Seligman Crystal and the Richardson Medal. The Unrestricted Funds is everything else.

Restricted Funds: decreased by £831 from £6065 to £5234 as a net result of the interest on investments (£122) and the manufacture of Richardson Medals (£953).

Unrestricted Funds: decreased by £58 378 from £526 376 to £467 998 showing that the income to IGS largely from i) membership, ii) its contribution of author processing charges and library income from Cambridge University Press, and iii) symposia attendance, was somewhat less than the expenditure associated with running the IGS office and paying the salaries necessary to manage the IGS affairs.

Total: The Society had its net resources before revaluation drop by £67 469 resulting in the negative movement in the Society's funds of £59 209 in 2016, compared to profits of £35 697 in 2015, £97 204 in 2014, £8477 in 2013, £28 092 in 2012, and losses between 2008 and 2011.

This is somewhat disappointing as it is the first net loss for 5 years, and comes in the year in which the Society made big changes to its operations, downsizing its office and going into partnership with CUP for the publication of the *Journal* and *Annals*. I reported last year that the Society had a cumulative deficit of £36 311 running since 2007 and that I hoped to close that entirely this year. Unfortunately, we have now increased that cumulative deficit to £95 520. As a result of office downsizing, our expenditure is now of the order

of ~£310 000 and our total assets are ~£473 000. In this respect, the Society is not in a bad place, but clearly it cannot continue to support the losses of the magnitude it has incurred this year into the future.

In more detail, income is itemised in notes 2–5, and expenditure is listed in notes 6–8 on pages 17–20 of the accounts.

Income:

Note 2. Donations were £20 in 2016 compared to £92 in 2015. There were no Grants received in 2016.

Note 3. Income from interest on investments increased slightly in 2016 compared to 2015: up £852 from £9891 to £10 743. Income from this source has been rising steadily for the last few years, showing that our choice to invest in a particular 'higher interest' but still 'low risk' investment account has been a good one. The particular account to invest in is reviewed each year.

Note 4. Incomes associated with the *Journal*, *ICE* & Books and with *Annals* were down massively compared to 2015, of course, as a result of entering into the CUP partnership. These figures should be judged together with the CUP Royalty figure. Thus, in 2015 the Society received £228 642 from the direct handling of the *Journal*, *ICE* & Books, whereas this was only £12 407 in 2016 and (see Note 5 here) comprised the sale of *ICE* to libraries and members (still managed directly by the Society), the sale of paper copies of the *Journal* to members (still handled by the Society), and vestigial income from the processing/sale of the *Journal* before fully handing over to CUP). Similarly, the Society received £120 116 from the handling of *Annals* in 2015 but just £1909 in 2016. This (again, see Note 5) was also associated with vestigial processing/sale of the *Annals* before CUP took over completely.

The CUP Royalty was £111 639 (this is not split by *Journal*/*Annals* but I will ask for this to be itemized in future).

Thus, if we look at the difference between the total *Journal*, *ICE* & Books and *Annals* income in 2015 (£348 758) and the same plus the CUP Royalty in 2016 (£125 955), the discrepancy is £222 803. A reduction in this source of revenue is to be expected, of course, since CUP are now keeping a proportion of the article processing charges and income from hard copy sales to libraries, in return for producing the Society's key publications. Some of this disparity is due to slightly fewer *Annals* papers being processed in 2016 compared to 2015. More importantly, some of the difference is because since 2016 CUP have been collecting an article processing charge for both the *Journal* and *Annals*, whereas in 2015 the Society levied a page charge. This has resulted in less revenue per *Journal* and *Annals* volume in 2016 than previously.

Returning to Note 4, income from Meetings/Symposia was down by £33 336 from £85 500 in 2015 to £52 134 in 2016. This reflects the fact that three symposia occurred in 2015 (Kathmandu, Iceland and Cambridge) but just one in 2016 (La Jolla). The La Jolla meeting was very successful in terms of income generated cf the three meetings in 2015 (but see comments re expenditure below – Note 6).

Income from membership was down by £12 803 from £64 440 to £51 637. If this is a result of the move to Open Access and is the beginning of a trend, then this is worrying.

Expenditure:

Note 6. A summary of all expenditure shows that outgoings associated with running Meetings & Symposia were up by £11 194 from £113 743 in 2015 to £124 937 in 2016. This is despite the fact that only one Symposium was run in 2016 (La Jolla) but three (Kathmandu, Iceland and Cambridge) the year before. This increase is partly because two grants totalling £7450 were awarded in 2016 to support the Alaskan and the Argentinian Glaciological Summer Schools (see Note 7) whereas no grants were awarded in 2015. It is also partly the way the invoicing of the La Jolla meeting was organized compared to the 2015 meetings, with a bigger proportion of the income and expenditure coming through the IGS bank accounts (see my comment above re La Jolla income – Note 4).

Looking at the income and expenditure solely for Meetings & Symposia (comparing Notes 4 and 6) and ignoring the grants of £7450, we see that in 2015 the three meetings ran at a loss of £28 243 in 2015 (an average loss of £9414 per meeting) but the La Jolla meeting in 2016 had a deficit of £65 353! This is not a reflection on the local organizing committees and their local internal budgeting, but is due to the direct and support costs associated with running the IGS office which are assigned to Symposia/Meeting activity. I mentioned this in my report from last year, that the Society's symposia are running at a loss when the IGS office costs are factored in. Comparing the last 2 years suggests that there are considerable economies of scale to be made when the IGS can run three symposia rather than just one. It would also be beneficial if the IGS in combination with local organizing committees could obtain additional grant income from sponsors to offset the direct and support costs associated with IGS office activity.

Note 8. Direct costs are down substantially in 2016 compared to 2015 as a result of the *Journal* and *Annals* going fully online open access and many former IGS activities now being undertaken by CUP. This is reflected in the reduced printing costs from 2015 to 2016 (IGS still prints *ICE* and circulars but not the *Journal*/*Annals*), distribution costs (again, IGS still posts *ICE* and circulars), online submission fees (IGS still manages this for symposia but not for papers); with the biggest reductions seen in the wages and salaries and associated national insurance and pension contribution costs. Proof reading/editorial costs have also dropped to zero, of course, as a result of these costs now being shouldered by CUP.

Many support costs are also down as a result of the CUP collaboration, notably telephone, stationery & postage, computer and web hosting, and wages and salaries and the associated national insurance and pension contribution costs. Office rent is comparable, although the IGS moved part way through the year to a smaller unit within the British Antarctic Survey. There may be savings on this item in subsequent years as a result.

Travel and subsistence costs (largely the 'out of Cambridge' costs of our Secretary General) have undergone a modest reduction of £2861 from £17 455 in 2015 to £14 594 in 2016, in part a result of the Society hosting two fewer symposia in 2016 vs 2015.

Termination costs was a substantial item on last year's accounts; one member of the original valued production staff continued to work throughout January 2016 just after the transition to CUP and this is reflected in the modest termination cost of £2797 for 2016.

The Independent Examination fee was less in 2016 than 2015 (a saving of £1000), largely a result of the simpler accounting as the IGS has streamlined its activities with its partnership with CUP.

Professional fees were high in 2015 (associated with consultations about contract termination and the partnership agreement with CUP) and these were substantially reduced, therefore, in 2016.

Summary

The Society's finances are in reasonably good shape but the recent 4-year trend of turning in a profit has been reversed this year. We ran a significant deficit in 2016 (~11% of funds) compared to surpluses in 2015 (~7% of funds), 2014 (~20% of funds), 2013 (~2% of funds), and 2012 (~7% of funds), and various deficits between 2008 and 2011 (ranging from ~1% to ~27% of funds). Despite this, our funds now exceed our annual expenditure, which is a healthy place to be in.

The Society will need to continue to monitor its income largely from CUP, membership fees, and symposia registration, and its outgoings associated with running symposia and running the IGS office.

It is increasingly important for the IGS to hold on to and attract new authors and have them submit articles to the *Journal* and to *Annals*. The more papers published, the greater the contribution the IGS receives from CUP. This is the main single revenue stream to the Society. It is also increasingly important for the Society to hold on to and attract new members, as membership fees are also a valuable source of income to the Society. It will need to think of innovative ways of making the Society more attractive, especially now that a major reason for joining (copies of the *Journal*) is no longer an incentive because of Open Access. It is difficult to see how individual Symposia registration fees can be increased as these are already relatively high compared to, e.g., the EGU and AGU. But obtaining external grants to sponsor certain aspects of IGS Symposia, which therefore benefit the Society, would be advantageous.

On the output side, the Society must monitor its expenditure associated with running symposia and with generally running the IGS. There are economies of scale to be made when the Society runs more than one symposium per year and it would be advantageous if the Society could run two or three per year rather than just one if possible. Salary costs (including NI and pension contributions) are by far the most expensive item of expenditure (totalling £117,299 in 2016, 38% of all expenditure). The Society should continue to ensure that salary inflation and travel and subsistence rates are sustainable.

Ian C. Willis, Treasurer
4 July 2016

The President invited members to discuss the Treasurer's report.

F. Navarro proposed, and B. Molnia seconded, that the Treasurer's report be accepted. This was carried unanimously.

4. Election of auditors for 2017 accounts

The Secretary General proposed the IGS remain with our current auditors, Messrs Peters Elworthy and Moore, as they had been doing our accounts for several decades they knew the innards of the IGS very well..

On a motion from the Secretary General, B. Parizek proposed and T. Bartholomaus seconded, that Messrs Peters Elworthy and Moore of Cambridge be elected 'Independent Inspectors or Auditors', whichever is appropriate for the 2017 accounts. This was carried unanimously.

5. Elections to Council

After circulation to members of the Society the Council's suggested list of nominees for 2017–20, no further nominations were received, and the following members were therefore elected unanimously.

President:	Francisco J. Navarro
Vice-Presidents:	Hilmar Gudmundsson
	Julienne Stroeve
Elective Members:	Koji Fujita
	Adam Treverrow
	Nanna Karlsson

These appointments were unanimously approved by the AGM on a motion from J Zwally and seconded by B Molnia.

The President raised the question of whether the Council should take steps to further involve the membership in the nominating process and to encourage members to be more pro-active in putting forward nominations for officers and Council members. He then thanked the outgoing Council members and welcomed the newly elected members.

The outgoing President, D.R. MacAyeal now handed the chairmanship of the IGS AGM over to the newly elected President, F. Navarro.

6. Other business

J. Zwally commented that we all, as IGS members should actively encourage authors to submit to the IGS publications. In his experience IGS publications provide authors and reviewers with a considerable amount of detail relating to the processing of paper submissions. We should continue with and hopefully increase the number of profiled papers and we should try and actively interact with the press and encourage them to look towards IGS publications for news stories. We should try and have more press releases as those increase the profile of our publications, in particular the *Journal of Glaciology*.

T. Scambos encouraged the diversity of the IGS publications and that with a new website we should show innovation and emphasize what sets us apart from other publications. One such thing could possibly be the publication of data papers. He also advocated that we should try and encourage the community to think in terms of being a member of the IGS and also as such being an author that publishes in IGS publications. The IGS community provides authors with thorough reviews and in that provides a valuable benefit to authors in helping them develop skills as a scientific authors without having everything on display which, in some cases can have a detrimental effect on early career authors. The IGS needs to harness the massive community of young scientists that is emerging as is seen in their attendance at the AGU fall meeting and make sure they are part of the IGS in the future.

L. Stevens suggested that the IGS should set up a mentoring program. There are organizations that have been very successful in doing this and it would encourage young scientists to join and to participate in the workings of the IGS. R. Hock responded that this could be one of the first tasks of the proposed 'Young Glaciologists' committee that Council is proposing to establish. M. Truffer commented that the IGS needs to put much more emphasis on things like mentoring, diversity, sexual harassment, equality etc. Those are issues that the professional community has and the IGS has to engage in them. T. Bartholomaus said that one of his favourite things with the IGS is the people and the affinity that we have for each other. What the IGS is 'selling' is the community and the support we can provide to each other and the feeling that we are doing this together. He welcomed that the membership costs have decreased but raised the question whether it would be possible to reduce them even further. We need to make it a 'no-brainer' for graduate students to join. Lower membership rates and mentoring would definitely encourage young scientists to join. Lower prices for younger members would get them into the IGS and once they become established they can hopefully afford to pay a higher rate. A. Banwell also pointed out that quite often younger scientists do not have a 'fund' they can charge their membership to and are thus forced to pay it out of their own pocket.

B. Molnia suggested that the new website should include a section where members can communicate with each other and interact with the general membership at large. And *ICE* could possibly be expanded to include such a forum. A discussion about the upcoming new website for the IGS ensued and the point was made that maintaining a website is very time-consuming and at the same time it is very important there be a person responsible for it. The SG expanded on this saying that the new website would be hosted outside the University of Cambridge and that would make it easier to allow other people to come in and maintain certain sections of the site that are relevant to them. An example of this would be different IGS branches and the various committees that operate within the IGS.

Members commented that the upcoming 'Code of Conduct' is very important and it was suggested that the membership as a whole should be asked to ratify it so everyone would be aware of it. The SG explained the procedure that was used to develop the Code. It was suggested that the previously

mentioned mentorship program should be linked to the Code and it be known that IGS members, possibly through a small focus group, are there to help colleagues, in particular younger ones, who may have issues and complaints. Such a focus group would have to be 'elastic' in such a way that when dealing with an issue, those advising would be independent and not in any way related to the 'progression' of the person in question.

The question was raised whether reports made to Council about the various activities of the Society should be made public. In particular some statistics relating to workings of the Society such as the publication, e.g. number of submissions, acceptance rate, publication times, etc. The SG commented that those reports are confidential and that if the report authors were aware that the full report would be made public, certain things that are important for Council members be aware of might possibly be left out of the reports. But it would be an idea to have edited versions of the reports made available to members.

T. Bartholomaus asked if the IGS should be offering advice on the risk management of fieldwork. The meeting responded this would be outside the scope of the IGS and such advice could potentially invite litigation and the infrastructure to maintain such an advisory panel would be substantial. There are organizations, such as the British Antarctic Survey, the Alfred Wegener Institute and several universities, that have a large section that deals with risk managements relating to fieldwork and the IGS should not and cannot take part in such a venture. There is also the issue that the various universities and indeed the different countries have different rules. It might, however, be a possibility to have a discussion forum where people could ask questions and comment on what is involved in running a field campaign. There would have to be a big headline disclaimer for such a forum however.

No other items were raised.

The President asked for a motion to adjourn the AGM.

The AGM was adjourned on a motion from D.R. MacAyeal and seconded by J. Zwally at 20:09 PDT.

Polar Science Communication: Answers from the Experts

'Make a connection'
'Know your goal'
'Always know your audience'
'Lead the interview'

At the IGS Symposium on 'Polar Ice, Polar Climate, and Polar Change' in Boulder, CO, USA, a panel discussion on science communication added to the scientific program. Immediately prior to the Symposium, 32 polar scientists participated in a workshop on 'Communicating Science for Polar Researchers' located at the National Snow and Ice Data Center**.** On this panel, two recent, early-career trainees from the workshop (Michaela King, Christian Wild) were paired with two experienced science communication experts (Waleed Abdalati, Twila Moon) to share their expertise with the audience. After brief introductions, the panel answered questions in a conversation with the audience. Rather than a full transcript, here are some bulleted highlights from the event to share the panel's insights with a wider audience.

Panelist introductions

Waleed Abdalati

- Range of communication activities. Communicates to general public to explain earth science through radio, TV, print, and more
- Audiences include: Senate and Congress, Astronauts, and Social Media
- Key Points for Communication
  - Understand Context of Conversation
  - Be clear about your message
  - Understand what resonates → make a connection
  - Develop a network [of people who need to hear/communicate science] and make yourself available to provide information to these people

Twila Moon

- Communicating science since graduate school
- Audience has changed throughout her career – started in education/outreach, then the media, and now she communicates with policy makers

Michalea King

- Interested in science communication out of necessity – concerned with the ongoing misrepresentation of science
- Eager to work with secondary school teachers

Christian Wild

- During recent fieldwork expedition in Antarctica at Darwin Glacier carried out outreach and blogged from the field
- Interested in science communication for personal reasons to share science with the general public and taxpayers who support scientific opportunities

What is the best way to get across the idea of uncertainty?

- This is a really hard question to address, because people don't always care
- Relate to stock market and temperature records
- Categories of uncertainty from IPCC – 'absolutely sure, somewhat certain, etc.'
- Think about what 'uncertainty' means to the audience
- Emphasize what we know, not what we don't know

How do you reach a skeptical audience?

- Waleed had to visit Senator who wanted to cut Earth Science funding
  - Started the conversation from common ground – the value of knowing what's coming in the future, irrespective of cause
  - Built trust and then moved toward more difficult topics
- Take time to unpack why the person holds their position. What value is driving their beliefs? But don't expect your values to necessarily change the opinions of those with other values
- The six Americas: The different background of people and how they may be predisposed to listen, or fundamentally disagree
- You probably can't reach hardcore skeptics, but you can reach people who are on the fence, or at least convince them to take action
- Build gradually off of someone's foundation so they be more receptive to your message
- Why should people care? Bring polar science home to them. Broadly: make it real and relatable

How do you establish your credibility and motivations? For example, to be asked to weigh in on certain issues to the media?

- Depends on your audience – for example, journalists often value academic credentials
- Start up phase – Try to be active on social media such as Twitter and up to date on website
- Make sure you audience doesn't think you're serving your own self-interest by walking them through the risks/issues you face as a scientist
- Walk people through your reasoning – use a narrative instead of coming off as definitive
- The way you talk is important – use personal stories to connect, and don't hesitate to be excited and passionate
- BE HUMAN!!!
- Just be credible to build credibility

How do you address the following argument: There is uncertainty in the future, and what we will know could change our current conclusions? (Basically, why should we believe science?)

- Resources: climate voices, climate network, studies on how to talk to skeptics
- Rephrase it as an opportunity to learn more and to be leaders in the climate fight
- Vision of the future and how we can change/ get there
- Avoid talking about the situation as a disaster – it's not as exciting as 'moving toward a bright new future'
- Deficit model – sometimes scientists think throwing more information at people will win them over, but it's more important how you present the information than the amount of information itself
- More information is not always better – you can use analogy or tell it in a different way, and often a simple message is most effective and useful
- Actually, scientists are very skeptical – we test and retest

How do you convey your message without getting misquoted?

- Choose your words carefully
- Think about sound bites *before* you agree to talk to the media or communicate your science
- Clear, simple statements
- Resource: Compass (science communication nonprofit) – message box, opportunity to sort out messages
- Small mistakes are sometimes fine – make sure the big ideas are correct
- The media cycle moves fast
- Have a specific goal for the interview and come back to it often – lead the interview
- Don't answer questions that are way off base
- Media are interested in novelty, relevance, proximity and humor, because that's what's of interest to their consumers (the public)

Any specifics about communicating Polar Science vs All Science?

- Don't dramatize
- Polar regions are abstract to most people – use visual language (e.g. 'air conditioning for the planet'), analogies, and make them see and picture what we're talking about
- We are protagonists, even heroes
- Don't use jargon

People don't consume long articles, how do we get them to delve deeper?

- Tell them a story to keep them listening and reading
- Start with something interesting
- Weave a story throughout your work
- Start with a hook and not general background

Suggestions for commenting on other scientists' work or big events?

- Larsen C was a great, recent example of being in contact for events
- Embrace what you know and stretch the width of your knowledge
- Stay up to date on other research – you're more of an expert than the average person and possess the skill set to more easily become an expert on a branch of science related to your specialization
- Don't fear saying you can't comment
- Ask for time to prepare your response, and don't be afraid to take the time you need to answer the question or provide comment

Suggestions for communicating to people near your field site (particularly when locals may see scientists as 'people with charts and graphs')?

- Give them an opportunity to share their knowledge with you. Ask open ended questions like 'Have you noticed something different?'
- Tie it back to what they experience and what they will understand
- They might think you're there to tell them something in/about a place that they already understand (and perhaps that they understand differently from you). Sometimes, you just need to let it go
- Build a relationship with the middleman – it might be hard and take time
- Reframe in a way that they aren't wrong, but that you're trying to learn more and prepare for the future. Work within their worldview
- Start by listening
- Remember that it takes time to build trust
- Say 'Yes and' instead of 'No' or 'Yes but'

What are some of your favorite tips for science communication

- Spend more time listening
- Its hard to recycle science communication – always know your audience
- Use the improv method of 'Yes, and...' instead of 'Yes, but...' or 'No' to avoid alienating your audience
- Do things you're excited about – don't make science communication something you dislike doing
- Have a small detail from/about the audience to tailor your message to
- Know your goal and have a realistic goal
- Understand that people have different values and that you won't change their values

Upcoming projects…

- TV show on Citizen Science – Waleed (side note: Hosting a TV show is weird!)
- AGU abstracts – plain language summaries
- Practice small forms of outreach: tell your Uber driver about your work

These notes and write-up were contributed by **Lynn Kaluzienski, Jessica Scheik and Allen Pope**. *The workshop was funded by the NSF Office of Polar Programs (Award #1720574) and the NASA Cryosphere Program (Award #NNX17AK61G); international participants were supported by the International Arctic Science Committee (IASC) and the Scientific Committee on Antarctic Research (SCAR).*

Obituary: Alan Stewart Thorndike, 1946–2018

Alan Stewart Thorndike, glaciologist, died in Easton, Maryland, USA on 8 January 2018, aged 72, after a short illness with an aggressive pneumonia. Alan will be remembered as a kind and generous man with a powerful intellect, a scholar, man of action and athlete, in spite of suffering from Parkinson's disease for three decades.

Alan, one of five children born to Alan Mouton Thorndike and Mary Louise Van Dyke Thorndike, grew up in Bellport, NY, USA, on the south side of Long Island. There he developed what became a lifelong passion for sailing. Adventurous and not always one to follow the rules (he often acted as if 'small craft advisories' applied only to those in dinghies), Alan sailed Long Island Sound, Puget Sound and Barkley Sound, the Strait of San Juan de Fuca, Haro Strait and the Strait of Georgia, the waters surrounding the San Juan Islands, and the rivers and creeks of Chesapeake Bay. Believing that boats should be made from wood and willing to put in the work to care for them, Alan captained various boats, a self-made 8 ft dinghy, a 19 ft sloop, a 41 ft ketch and finally the *Peregrina*, a 30 ft sloop built in 1962, which he restored and sailed in his retirement years.

Alan left Bellport to attend the Northfield Mount Hermon School in Massachusetts and went on to Wesleyan University in Connecticut. There he studied mathematics, physics and geology and took a BA degree in 1967. After college he travelled to the Pacific Northwest where he earned his PhD in geophysics from the University of Washington. At the age of 29 he was Chief Scientist on the ice for the Arctic Ice Dynamics Joint Experiment (AIDJEX), his work being crucial to the scientific effort and planning.

I first met Alan in 1965 when he was a graduate student on the Juneau Icefield, Alaska, attending one of the summer courses organized there by Professor Maynard Miller. I was one of the lecturers. The lectures were given in a hut at the top of the Vaughan Lewis Icefall and below it was a very conspicuous example of the 'pressure waves' that I was lecturing about. Alan and I decided to go down and look at them more closely. I think there were three in the party. I had only a little experience of climbing, and none of ice and snow climbing, while he was much younger and already very competent. On our way down I slipped on a steep snow surface and was held on a short rope by Alan, who very efficiently

helped me climb back. For that moment he held my life in his hands.

Much later we met again in Seattle as members of the modelling group of AIDJEX. The movement of the sea ice was monitored by data-buoys using the NavSat system and Alan was in charge of this. However, perhaps his most lasting contribution to the theory of sea-ice movement was an improvement in the theoretical model. The condition of the sea ice in each elementary area was to be characterized by its average thickness. Alan pointed out that, instead, in each elementary area there was a distribution of thicknesses and to capture the mechanical properties it is this whole distribution that must be used in the model. He was saying that a function, the thickness, ought to be replaced by what mathematicians call a functional, the whole distribution of thicknesses. In practice, only a few bins in the distribution might be enough, the fraction of open water, and the fractions of first-year, second-year and third-year ice. The conceptual advance of the 'Thickness distribution' and the 'Thickness distribution equation' describing its changes continue to be fundamental components of advanced sea-ice models.

There was a distribution of velocities in the sea-ice and, by mapping it to velocity space, Alan produced caustic patterns that evolved in ways not entirely understood by mathematicians. He interested his mathematician friend Clifford Cooley in these ideas and and the three of us happily worked together on the classification of the caustic patterns. The result was a list of the possible ways in which the caustics can evolve, which was correctly described by the great mathematician Vladimir Arnold in the preface to his book on the subject as 'semi-successful', 'semi' because we had overlooked two of the possibilities. Nonetheless we regarded the remark, coming from such a man, as a great compliment. Alan and I formed a firm and long-lasting friendship and played recorders together in a quartet. He was a joy to be with, working or otherwise. Later, in the field, he found himself directing the evacuation of the main Big Bear camp when it unluckily cracked apart in October 1975.

Alan was a passionate and inspiring teacher with an impressively wide range. He joined the faculty of the University of Puget Sound (UPS) in Tacoma, Washington in !983 and served there until his retirement in 2012. Alan was proud of his contributions as a teacher, often enriched by his skilled craftmanship in wood and metal. He loved to recreate famous physics experiments, such as the Zeeman effect, with students in his lab. He taught classes across disciplines, including courses on the origins of life and climate modelling. Many of the students he taught and mentored have gone on to complete doctorates in physics, astronomy or geophysics. And Alan's touch is still apparent on the campus. For example, he designed the multi-story Foucault pendulum that hangs in UPS's Harned Hall and built the Penrose tiling that lies beneath it. With his colleague Jim Evans, he organized an international Max Planck Symposium, held at UPS to mark the 100th anniversary of the quantum with the papers subsequently published by Springer. Alan's outstanding contributions to the university were officially recognized when he was named the second University Professor of Natural Sciences.

An achievement of which he was particularly proud was the working model he built of the Antikythera Mechanism. The ancient Greek prototype, which survives only in fragments, was a gearwork machine (about the size of a shoebox) that replicated the motions of the Sun, Moon and the planets, told time in two different calendars and predicted eclipses. It was built probably in the 2nd century BC, lost in a shipwreck around 60 BC, and recovered by sponge divers in 1901. It has been the subject of an intense international research effort in recent decades. With Jim Evans and Christian Carman, Alan formed a research team that discovered the way that the nonuniform motion of the Sun was displayed on the mechanism and showed the way that the retrograde motions of the planets and cyclic changes in the Moon's orbit were probably produced by the epicyclic gear wheels.

Alan's talents extended far beyond the sciences and the classroom. He ran cross-country and track and completed several marathons. In Washington State he won 24-hour time trial bicycle races (once logging 391 miles). Because his balance was poor in the last 4 years of his life in Oxford, Maryland, he rode a recumbent three-wheeler, his goal being 100 miles a week. He built clocks and a device to measure the tides in Oxford's Town Creek. He was a master woodworker, who built a harpsichord and beautiful furniture for his family, bowls and boxes for friends and toys for his grandchildren.

In writing this tribute I have quoted extensively, by kind permission, from the fine appreciation of his father written by his son John. I have also been greatly helped by Jim Evans at the University of Puget Sound and Jamie Morison at the Polar Science Center of the University of Washington.

John F. Nye

Obituary: Terence J. Hughes, 1938–2018

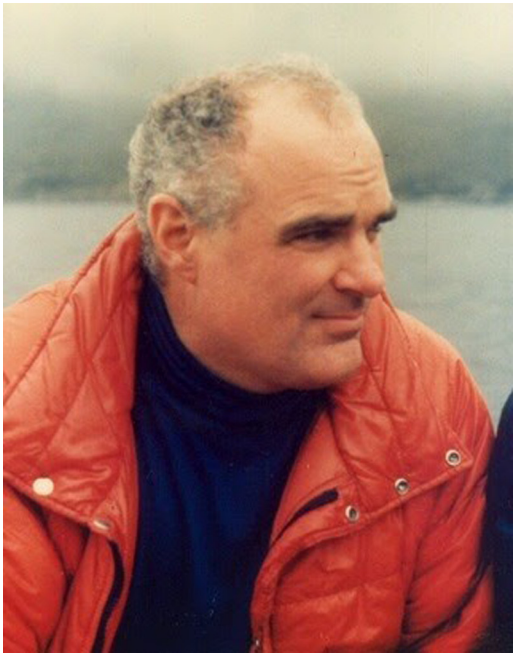
Terence Joseph (Terry) Hughes, glaciologist and Professor Emeritus of Earth Sciences and Climate Change at the University of Maine, passed away on 10 March 2018, at 80. He died at his home in Fort Pierre, South Dakota, USA, with his wife Beverly (Barr) Hughes by his side, from inoperable pancreatic cancer, first diagnosed in 2010, which then spread to his liver.

Terry was born on 15 February 1938, in nearby Pierre, South Dakota, to Judge Leo James Hughes and Mary Susan (Schiltz) Hughes. Raised on the Hughes cattle ranch south of Forth Pierre, Terry graduated from Fort Pierre High School in 1956, then attended the South Dakota School of Mines and Technology, where he majored in metallurgy and turned out for football. Being strong but not overly fast (he noted), he played lineman (in the guard position). They never won a game, he also mentioned, and were even defeated by the local high school team – but he loved it. From childhood he played football for 15 years, of which he said (recently): 'Those were the days'. He graduated in metallurgy in 1960.

Subsequently Terry enrolled as a graduate student at Northwestern University, where he earned an MS (1962) and a PhD (1968), both in materials science, under John O. Brittain, professor of mechanical metallurgy. He carried out thermal expansion and X-ray diffraction studies from –200 to +1400°C on Ni–Al alloys having the cesium chloride structure from 46–60% Ni. This work was the beginning of Terry's career-long interest in thermal expansion as a driver of large-scale convection in crystalline materials, particularly in the Earth's mantle, and potentially, he hypothesized, in the Antarctic ice sheet. While never quite accepted by the glaciological community for Antarctic ice, thermal convection in nitrogen-rich ice, it turns out, is thought to be a major process shaping the landscape of Pluto (Mckinnon and others, *Nature*, 2016).

Terry also took time to travel around the world, alone, during 1966/67, mostly overland through Asia, Europe, Africa and the Americas. He wrote an account of his travels.

When Terry defended his PhD thesis, Dr Johannes Weertman (Seligman Crystal laureate and the Walter P. Murphy Professor Emeritus of Materials Science and Engineering at Northwestern University immediately prior to his death in October 2018; obituary to appear in *ICE* 178) –



who had become well-known in glaciology for theoretical work, including on glacier sliding and the deformation of floating ice shelves during the late 1950s and early 1960s, and who was a member of Terry's thesis committee – recommended he specialize in the study of ice as a material.

Terry did so. In 1968, at the invitation of then Director Colin Bull, he accepted a position as a glaciologist at the Institute of Polar Studies (now Byrd Polar Research Center) at Ohio State University (OSU). There he also joined the faculty of the Civil Engineering Department in 1970, and met his future wife, Beverly Ann Barr. They were married in 1974. After serving on a committee to establish an atmospheric sciences program at OSU, he accepted a 6-month appointment in 1974 as a Senior Postdoctoral Fellow in the Advanced Study Program at the National Center for Atmospheric Research (NCAR). The 6 months in Boulder, Colorado, also served as Terry and Bev's honeymoon.

At OSU Terry also met Dr Gerald (Gerry) Holdsworth, who was then working on his PhD at the Institute of Polar Studies. Gerry obtained funding from the National Geographic Society

Terry on his third birthday. This photo was supplied for use in his obituary by Terry himself.

and the Arctic Institute of North America to re-survey the elevation of Mt Logan (St Elias Range, Yukon Territory, Canada), an enormous massif with 11 summits above 5000 m. The Alaska–Canada Boundary Survey had surveyed it as 6050 m, making it the second highest mountain in North America. Gerry had argued that the measurement could be too low by as much as 150 m because of refraction errors over long distances, so Mt Logan might be ~15 m higher than the 6187 m (as then surveyed) summit of Denali in the Alaska Range, officially the highest mountain in North America. He proposed a new survey in which refraction errors would be eliminated by having one surveying party at the summit making a simultaneous sighting with another party at a known survey marker near the base. Terry had climbed Mt Kilimanjaro (5895 m) in East Africa, so Gerry – knowing he was likely to be tolerant of the high elevations on Mt Logan – invited Terry to join him as a second member of the summit survey team. Terry accepted. Two graduate students occupied the base survey station.

In May 1968 pilot Phil Upton landed Gerry and Terry above the snowline in King Trench, a tributary of Quintino Sella Glacier (which flows into Bagley Ice Valley). Aware of Terry's strength, Gerry piled the tent and surveying equipment, including a brass theodolite, on his back for the climb and began calling him 'horse'. From King Col they continued up the slopes toward Mt Logan's upper reaches. Terry described the climb as up to ~45°, long but not difficult.

The surveying team near the base had a direct line of sight to Mt Logan's north peak (5559 m), so that was what Gerry picked for their surveying site. From the north peak he would also be able to sight the main summit at a distance of about 10 km.

When they reached the north summit, Gerry set up his tripod and theodolite. The wind was blowing in strong gusts that shook the tripod, so he could not get a good sighting to the base camp. The two at the base camp were to set off smoke bombs when they saw Gerry and Terry on the north summit, so they could locate the base camp, but they saw no smoke. Terry noted that Gerry, who is normally mild-mannered, responded to those conditions with a lengthy and creative blast of profanity that greatly impressed Terry. Meanwhile, Terry piled rocks around the legs of the tripod, which reduced the problem of wind vibrations. Gerry was then able to obtain theodolite readings to the other summits on Mt Logan, including the highest summit, and he took readings to other points below that could be sighted as well from their base camp.

After descending, Gerry and Terry learned the base camp party had, in fact, seen them on the north summit and had set off their smoke bombs, although the smoke had not been visible from high above. The base team obtained theodolite sightings on their north summit location, which enabled Gerry to calculate that Mt Logan was somewhat lower (not higher) than 6050 m. Needless to say, Terry noted, this new lower elevation was not accepted for Canadian maps until Gerry surveyed a second, more-rigorous height in 1974, with Henry Brecher and Ferdi Taxboeck. Henry, a professional surveyor based at (then) OSU Institute of Polar Studies, collaborated with Terry during later glaciological field projects.

Followup: in May 1992, a Geological Survey of Canada expedition climbed Mt Logan and used GPS to fix the summit elevation at 5959 m a.s.l. The official GPS-measured height of Denali, in the Alaska Range, is 6190 m a.s.l. The latter has thus retained its status as the highest mountain (and the only peak higher than 6000 m) in North America.

The year 1968 was also significant, from Terry's point of view, in that glacial geologist John H. Mercer (of the OSU Institute of Polar Studies) published 'Antarctic Ice and Sangamon Sea Level', in which he argued that the West Antarctic Ice Sheet (WAIS) was inherently unstable because it was mostly grounded far below sea level. The present WAIS, Mercer argued, has most likely re-formed since an apparent collapse about 120 000 years ago,

which – he hypothesized – accounted for the 4–6 m sea-level rise dated to that time. Mercer coined the phrase 'marine ice sheet' to describe WAIS, a phrase subsequently used to describe other ice sheets of the late-Wisconsin glacial maximum that were grounded well below sea level.

That same year, glacial geologist George Denton (of the University of Maine, UM) and geochronologist Richard Armstrong (then of Yale University) presented evidence that a former marine ice sheet – i.e. an expanded West Antarctic Ice Sheet – had occupied the Ross Sea Embayment of Antarctica, and had invaded the now ice-free Dry Valleys in the TransAntarctic Mountains west of McMurdo Station, where most US Antarctic research was centered. Other glacial geologists published evidence for marine ice sheets during the late-Wisconsin glacial maximum in the Barents Sea and covering the Queen Elizabeth Islands (the Innuition ice sheet).

Marine ice sheets became a major focus of Terry's research. During 1972–75 he published, as reports, four Ice Stream Cooperative Antarctic Project (ISCAP) bulletins in which he proposed a comprehensive research program to address the question 'Is the West Antarctic Ice Sheet Disintegrating?' Terry interpreted the concave WAIS profiles, as shown on the American Geographical Society's 1970 Map of Antarctica, as implying the WAIS interior was being drawn down by its large ice streams, thus building on Mercer's hypothesis.

In early 1974, Terry carried out his first field study funded by a National Science Foundation (NSF) Antarctic research grant. It was a study of ice flow and calving dynamics into a crater, where the 12 August 1970 eruption on Deception Island had blown the terminus off a glacier. He and his companions drilled three 10 m holes into the newly-created calving face, to measure shear along vertical planes near the ice front that resulted, he hypothesized, in calving. It was dangerous work; fortunately no one was killed or injured. Terry described it as the first serious field study of the mechanics of calving which, at the time, was a neglected area of glaciology. This effort marked the beginnings of his career-long collaboration, in Antarctica and Greenland, with surveyor Henry Brecher.

After Terry wrote his third ISCAP bulletin (at NCAR, during the last half of 1974), he accepted a joint faculty appointment in the Institute for Quaternary Studies (now the Climate Change Institute) and the Dept. of Geological Sciences (now the School of Earth and Climate Sciences) at UM.

During this time frame, he published his ISCAP bulletins as a series of three papers in the *Journal of Geophysical Research* (1973) and *Reviews of Geophysics and Space Physics* (1975, 1977). Terry's publications on the WAIS ice streams almost certainly helped generate the scientific interest that resulted in funding by NSF – after completion of the 1973–78 Ross Ice Shelf Geophysical and Glaciological Survey (RIGGS) – of the Siple Coast Project and subsequent field studies of the ice streams of the Marie Byrd Land sector of WAIS, which later included Pine Island and Thwaites Glaciers in the Amundsen Sea sector. Although not funded to participate in those studies, Terry can be credited with drawing attention to the instability and potential disintegration of WAIS.

Arriving at UM in January 1975, Terry joined Professor George H. Denton, glacial geologist, who was principal investigator of the ice-sheet and glacier reconstruction component of a multi-university project called CLIMAP (Climate: Long-range Investigation, Mapping, and Prediction), which was funded by NSF as a component of the International Decade of Ocean Exploration. The UM component of CLIMAP was to reconstruct the large ice sheets that covered much of the Earth's surface during the late-Wisconsin glacial maximum ~18 000 a BP.

Glacial geologic evidence was used to define the former ice-sheet margins. Lacking information about surface topography, Terry used the relation between large-scale basal shear stress, ice surface slopes and ice thicknesses to write the differential equations for the ice sheet profiles along flow lines, using basal shear stress profiles for frozen- and melted-bed flow lines derived from the present Antarctic and Greenland ice sheets. Mathematician David H. Schilling, on leave from the University of Wisconsin Center Barron County, also joined the project and developed a finite difference numerical method and program to solve Terry's equations. Craig S. Lingle, then a new graduate student (Terry's first) with a BS in electrical engineering (and earth science secondary teaching certificate) from the University of Washington, also joined the project in fall 1975. After David Schilling returned to Wisconsin, Craig used his finite difference program to reconstruct the late-Wisconsin ice sheets along flow lines, mapped the results and calculated the ice-sheet volumes and other properties (using planimetry).

At Terry's invitation, Dr Robert H. (Bob) Thomas (1937–2015) moved from the University of Nebraska, where RIGGS was based, to UM. There, he became Douglas R. MacAyeal's MS thesis advisor when Doug became an MS graduate student at UM after graduating in physics from Brown University. Doug then participated in RIGGS and developed the first finite-element model of a large ice mass (the Ross Ice Shelf). The relationships between Bob, Terry and George Denton eventually became less than cordial, however, and Bob moved on to NASA.

The UM CLIMAP work also involved simulating the hypothesized collapse of the marine

WAIS during the late Sangamon Interglacial, between 138 ± 7 ka BP and 118 ± 7 ka BP, when eustatic sea level was about 5–7 m higher than at present (as emphasized by John Mercer). A numerical solution of the ice-sheet equations that simulated this WAIS disintegration was developed and applied by James L. Fastook (now professor of computer science at UM; then he had just completed his PhD in physics there), following earlier work by Bob Thomas on WAIS ice streams grounded below sea level.

This effort also involved reconstructing the global distribution of 'small' glaciers and ice caps during the late-Wisconsin glacial maximum – which, of course, were much larger than at present. This work was carried out by Dr John T. Hollin (1930–2016) in collaboration with David Schilling.

The CLIMAP late-Wisconsin ice sheet reconstruction was presented by Terry – not without controversy – at the International Symposium on the Dynamics of Large Ice Masses, convened in 1978 by the International Glaciological Society in Ottawa, Canada. Subsequently, George Denton secured an agreement with Wiley Interscience to publish this work as a book, *The Last Great Ice Sheets* (edited by Denton & Hughes, 1981; the chapters have many co-authors). As of 2018, this comprehensive work has been cited more than 1000 times (according to Google Scholar).

In 1981, Terry also published 'The weak underbelly of the West Antarctic ice sheet', concluding that WAIS was most vulnerable to irreversible retreat and collapse via the fast-flowing Thwaites and Pine Island glaciers in the Amundsen Sea sector. At the time, this idea was so controversial he had to publish it as an extended letter to the editor of the *Journal of Glaciology*. (As such, it did not need the approval of peer reviewers.) Some 33 years later Eric Rignot and his colleagues published measurements (*Geophysical Research Letters*, 2014), using spaceborne SAR interferometry, showing strong grounding-line retreat during 1992–2011 for Pine Island, Thwaites and other Amundsen Sea glaciers. Simultaneously, Ian Joughin and his colleagues published a numerical modeling study (in *Science*, 2014) showing that the Thwaites Glacier basin may, indeed, be en route to collapse, with time-scale estimates and sea-level implications. As of 2018, Terry's letter to the editor has been cited 129 times. He was prominently featured in a 2014 *Newsweek* article ('Is it too late to save our cities from sea-level rise?')

Following his ground-breaking studies of the West Antarctic Ice Sheet's stability and the glaciological processes that shaped the sequence of events in the history of the last glacial cycle, Terry devoted himself to glaciology for the decades of the 1990s and 2000s up until his retirement from UM in 2010. Throughout these decades, as through all his professional life as a glaciologist, Terry enjoyed creating and discussing novel ways to understand large-scale ice-sheet flow. A prolific author, Terry wrote *Ice Sheets* (1998), which Oxford University Press sent to him for final corrections – then they published it before Terry had a chance to return it with the corrections. (Later, he published a corrected updated version.) Often his papers had dramatic titles, such as 'Deluge II and the continent of doom: rising sea level and collapsing Antarctic ice' (*Boreas*, 1987), 'Calving bays' (*Quaternary Science Reviews*, 2002), 'The Jakobshavns effect' (*Geophysical Research Letters*, 1986), 'On the pulling power of ice streams' (*Journal of Glaciology*, 1992), and 'Did the West Antarctic Ice Sheet create the East Antarctic Ice Sheet?' (*Annals of Glaciology*, 1982). In all his works, Terry exhibited an unusual and idiosyncratic approach to mechanical analysis. Most of his arguments were based on intricately constructed geometrical figures and vector diagrams, with reasoning based on the balances gleaned from their analysis. His last publication, 'Holistic Ice Sheet Modeling: A First-Order Approach' (*Nova*, 2012) exemplifies his unique personal approach to glaciology.

Probably the best way to sum up Terry's professional contributions as a glaciologist is to note the series of questions about ice sheets he posed in the conclusion of his final published work (Holistic Ice Sheet Modeling, *Nova*, 2012):

'What are its most energetic parts?
'What factors force motion in these parts?
'Which of these factors vary over time?
'What physical processes case the time variation?
'Can these processes be quantified theoretically?
'What experiments will test these theories?

'To prove something, you have to draw fast and shoot straight. That's what I've tried to do.'

Throughout Terry's life, and especially in his later years, he was an activist for right-to-life. This led his wife, Beverly, and him to shelter pregnant or sexually abused women in their house throughout the period of time Terry was a professor at UM. Terry is survived by Beverly, his two sons and seven grandchildren.

Terry leaves behind many presently active or retired professional glaciologists that he trained when they were graduate students or postdoctoral scholars, including: Jim Fastook, Jesse Johnson, Craig Lingle, Douglas MacAyeal, Maury Pelto, Tad Pfeffer and Coen Hofstede.

Jim Fastook, Jesse Johnson, Craig Lingle & Doug MacAyeal

New Zealand Chapter, 2017 Highlights

Kia ora from Aotearoa/New Zealand, we have had busy year down here in the Southern Hemisphere, and below is a short summary of some key activities and successes in 2017.

We started off the year with the International Symposium on the Cryosphere in a Changing Climate, held in Wellington. It was fantastic that so many IGS members made the journey south. The symposium was packed full of exciting new research and overall a great success. Check out ICE (vol 174) for a detailed account of the symposium and field trips.
https://www.igsoc.org/ice/2017/173/ice173_col.pdf

Glacier Monitoring
Although New Zealand has over 3100 glaciers only two have ongoing mass balance programmes. 2017 saw the Brewster Glacier programme, led by Brian Anderson (Victoria University of Wellington, VUW) and Nicolas Cullen (Otago University, OU), enter its 13th year, while the Rolleston Glacier programme, led by Tim Kerr (Aqualinc) and Heather Purdie (University of Canterbury, UC) entered its 7th consecutive year. Thanks to all our colleagues and postgraduate students who give their time to help with these important field programmes.

Some exciting news from our two iconic west coast glaciers: ongoing monitoring of Franz Josef Glacier/Kā Roimata o Hine Hukatere (Brian Anderson) and Fox Glacier/Te Moeka o Tuawe (Heather Purdie & Brian Anderson) indicates that Franz has been slowly advancing since December 2016 and, while the advance is small so far, the glacier continues to thicken upstream. In a similar vein, Fox is starting to thicken upstream, although this signal has not yet stimulated any action at the terminus. We will be monitoring activity at both these glaciers very closely over the coming summer.

Sabine Baumann (Technical University of Munich) has been working with a number of our members to update the New Zealand Glacier Inventory, with results presented at AGU in December. This database, originally created by Trevor Chinn, is a great resource and will be well utilized in future research projects.

The National Institute of Water and Atmospheric Research (NIWA) end-of-summer-snowline programme is now into its 40th consecutive year. This is another extremely valuable glacier monitoring programme and database, and we hope that it continues for another 40 years!

Funding successes:
Dan Price (UC) has been awarded a Marsden Fast-Start for research on Antarctic sea-ice thickness. David Prior (OU), Huw Horgan (VUW), Christina Hulbe (OU) and colleagues had Marsden success for research exploring new flow laws for ice sheets. Andrew Mackintosh (VUW), Brian Anderson (VUW) and colleagues have been awarded Marsden funding to explore whether a previous collapse of the Antarctic Ice Sheet caused abrupt climate change in the Southern Hemisphere.

Check-out the Royal Society website for full details of these new projects
https://royalsociety.org.nz/what-we-do/funds-and-opportunities/marsden/awarded-grants/marsden-awards-2017/

2017 saw two more projects funded by The Deep South National Science Challenge. Inga Smith (OU) and colleagues were awarded funding for their project on the impact of freshwater icebergs and ice shelf melt in the New Zealand Earth System Model,
http://www.deepsouthchallenge.co.nz/melting-ice-nzesm,
and Andrew Mackintosh (VUW), Nicolas Cullen (OU) and colleges also secured funding to undertake research on the impact of climate change to NZ's frozen water resources. This last project is a truly collaborative effort, bringing together nine NZ snow and ice researchers from a range of NZ institutions!
http://www.deepsouthchallenge.co.nz/snow-ice-and-glaciers-our-changing-climate

Publications
There have been a number of excellent publications by members of the New Zealand chapter in 2017, too many to list here. However, details of these publications can be found at https://sirg.org.nz/about/bibliography/

Finally, the 2018 annual workshop will be held on 7–9 February at Mount Hutt Retreat, Canterbury. The annual workshops place emphasis on student presentation/participation and so we look forward to hearing about lots of new projects!

That is all from the New Zealand Chapter for now

Hei konā mai

Heather Purdie
(IGS National Correspondent)

INTERNATIONAL GLACIOLOGICAL SOCIETY

International Symposium on

Five Decades of Radioglaciology

Stanford University
Stanford, California, USA
8–12 July 2019

Co-sponsored by:
- Department of Geophysics, Stanford University
- School of Earth, Energy, and Environmental Sciences, Stanford University

SECOND CIRCULAR
September 2018
http://www.igsoc.org/symposia/ 2019/stanford

The International Glaciological Society will hold an International Symposium on 'Five Decades of Radioglaciology' in 2019. The symposium will be held at Stanford University in Stanford, California, USA on 8 –12 July 2019. The main symposium will take place from Tuesday morning, 9 July, until the afternoon of Friday 12 July. On Monday 8 July there will be a pre-symposium short-course on ice penetrating radar science and engineering for early-career researchers. Also on Monday 8 July, side meetings will also be scheduled for collaborative radar sounding projects including BedMap3 and the SCAR AntArchitecture project.

THEME

Radio-echo sounding is a powerful geophysical technique for directly characterizing the subsurface conditions of terrestrial and planetary ice masses at the local, regional and global scales. As a result, a wide array of orbital, airborne, towed and in situ instruments, platforms and data analysis approaches for radar sounding have been developed, applied or proposed. Terrestrially, airborne radar-sounding data have been used in physical glaciology to observe ice thickness, basal topography and englacial layers for more than five decades. More recently, radar-sounding data have also been exploited to estimate the extent and configuration of subglacial water, the ice-sheet surface, the geometry of subglacial bedforms, the spatial variation of basal melt, englacial temperature, and the transition between frozen and thawed bed. Planetary radar sounders have been used or are planned to observe the subsurface and near-surface conditions of Mars, Earth's Moon, comets and the icy moons of Jupiter. These instruments provide critical subsurface context for surface-sensing, particle, and potential-field instruments in planetary exploration payloads. This symposium will discuss advances in radar-sounding systems, mission concepts, signal processing, data analysis, modeling and scientific interpretation.

SUGGESTED TOPICS

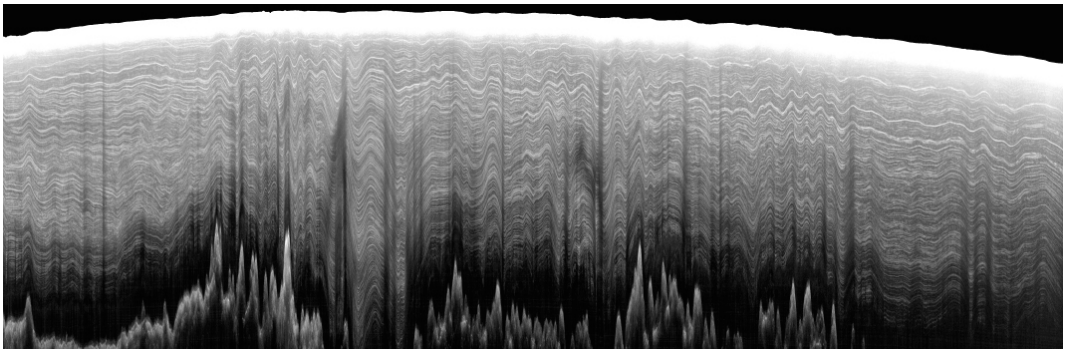
We seek papers and presentations that advance the understanding radar sounding and its use in physical glaciology. Key focus areas include (but are not limited to):

1. **Radar systems:** development, performance and platforms
2. **Data:** intercomparison, validation and release
3. **Radar processing:** propagation, inversion and automation
4. **Englacial structure:** layers, deformation and accretion bodies
5. **Attenuation:** near-surface properties, temperature and chemistry
6. **Bed conditions:** topography, roughness, thermal state and hydrology
7. **Interpretation:** comparing observations with modeling and theory
8. **Planetary radioglaciology:** radar investigations of planetary cryospheres

ABSTRACT AND PAPER PUBLICATION

Participants wishing to present a paper (oral or poster) at the Symposium must submit an abstract by 11 March 2019. Abstracts need to be submitted via the IGS website. Accepted abstracts will be posted on the Symposium website.

The Council of the International Glaciological Society will publish a thematic issue of the Annals of Glaciology on topics consistent with the symposium themes. Submissions to this issue will not be contingent on presentation at the Symposium, and material presented at the symposium is not necessarily affirmed as being suitable for consideration for this issue of the Annals. Participants are encouraged, however, to submit manuscripts for this Annals volume. The deadline for submission of Annals papers is 1 August 2019



REGISTRATION FEES
All fees are in US dollars, $
Early registration until 24 April 2019

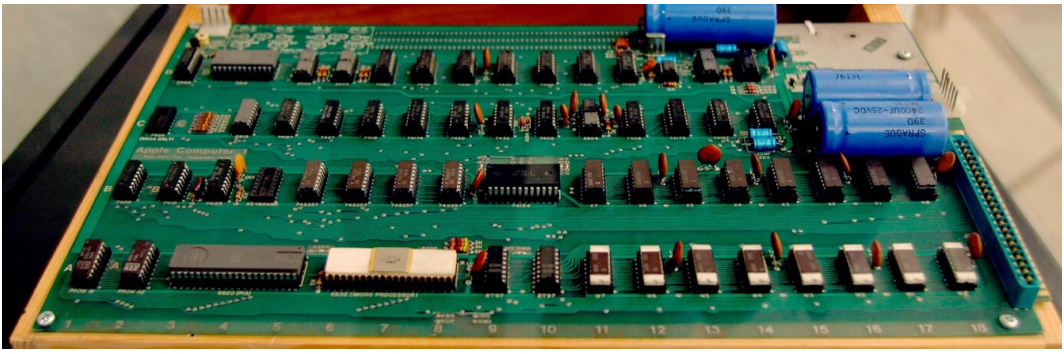
– Participant (IGS member):	$650
– Participant (not IGS member):	$750
– Student or retired (IGS member):	$475
– Student or retired (not IGS member):	$500
– Accompanying person (21+):	$300
– Accompanying person (12–20):	$225
– Accompanying person (<12):	Free
– Delegate registration after 24 April 2019:	add $50
– Delegate registration after 15 May 2019:	add further $100

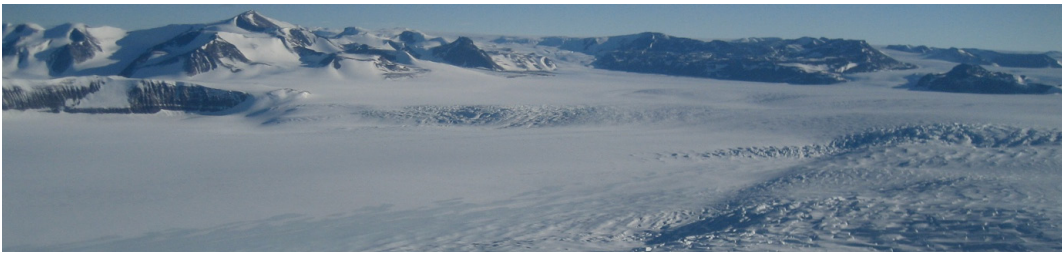
All prices will be charged in UK£ equivalent at the exchange rate valid near the date of transaction.

The fees include the Icebreaker, the mid-conference excursion, the Banquet and morning/afternoon refreshments Tuesday through Friday. Please register for the symposium through the IGS website. If you cannot do this, contact the IGS office directly at igsoc@igsoc.org. If payment by credit card is not possible, contact the IGS office to arrange for a bank transfer.

Please check whether you will require a visa to enter the USA. If you need an invitation letter, please contact the IGS office at igsoc@igsoc.org. The sooner you do this the more likely it is that your visa will be processed in time.

ACCOMPANYING PERSONS
The accompanying person's registration fee includes the Icebreaker, the midweek excursion and the Symposium Banquet. **It does not include attendance at the presentation sessions.**





STUDENT AND EARLY-CAREER SUPPORT
We anticipate being able provide travel, housing, and registration support for a number of early-career researchers (graduate students, postdocs, recent hires in permanent positions) on a competitive basis. An announcement will be made when the early-career support budget is confirmed, and travel support applications will be posted at that time.

PROGRAM
True to tradition, the symposium will include oral and poster sessions interlaced with ample free time to facilitate the interactions of the participants. Additional activities include an opening Icebreaker, a Banquet dinner and an excursion during the mid-symposium afternoon break.

VENUE
The symposium will be held in the Mackenzie Room of the Stanford Engineering Quad and the poster session will be held on the patio of the Mitchel Earth Sciences Building.

LOCATION
Stanford University is one of the world's leading research universities and is located in the San Francisco Bay area. Stanford and the adjacent city of Palo Alto are less than an hour from the city San Francisco, less than an hour to beaches in Santa Cruz and Half Moon Bay, less than two hours from the wine regions of Napa and Sonoma, and less than four hours to parks in Yosemite or Lake Tahoe. With June weather averaging highs of 78°F and lows 52°F (26 and 11°C), 0.08in (0.2 cm) of precipitation and numerous pedestrian and bike paths in along the bay and in the hills, the greater Palo Alto area is ideal for hiking, biking and other outdoor activities. The 8000 acre campus is a few blocks away from the suburban garage where Hewlett and Packard created their audio oscillator, cited as 'the birthplace of Silicon Valley' in the national register of historic places. The region is also home to the headquarters of Apple, Google, Facebook, Netflix, Cisco, Adobe,

Intel, Tesla, Uber and numerous other companies and startups pushing the frontiers of scientific and technological innovation.

ACCOMMODATION

A number of rooms in the Stanford Munger Graduate Residence and the Stanford Guest House on the Stanford Campus have been reserved to provide more affordable/convenient accommodation than many local hotels. You must make the actual booking yourself by calling the front desk at +1 650-926-2800 or by booking online at https://ussg.webhotel.microsdc.us/ and quoting Group Code IGS19. To guarantee your room, please provide them with your credit card details at least 90 days prior to arrival. The following on campus options are available for the IGS for arrivals starting 7 July through departures until 13 July:

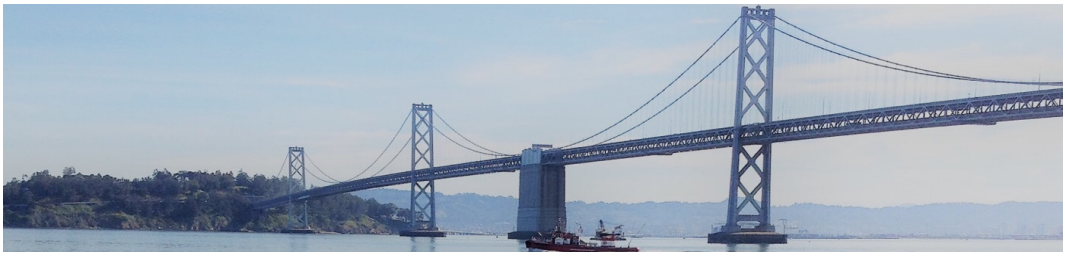
- **Stanford Guest House:** Small hotel on the campus of the Stanford Linear Accelerator (a 2.5mile/4 km walk or bus ride from the conference). Standard rooms (one Queen bed): ~$165 per night, Deluxe rooms (two Queen beds): ~$205 per night (rates include continental breakfast).
- **Munger Graduate Residence:** On-campus apartment accommodation (less than a mile from the conference). All guests have private bathrooms but share common areas (lounge and kitchen) in the apartment with other guests: ~$166.75 per person per night.

ICEBREAKER
The Icebreaker will be held on Monday, 8 July, 5:00–8:00 pm on the patio of the Mitchell Earth Sciences Building. Refreshments and heavy hors d'oeuvres will be available. Delegates can also use this opportunity to complete their registration and collect their conference bag materials.

BANQUET
The Banquet will be held on Thursday evening on a cruise boat in San Francisco Bay. Bus transportation to and from the dock in San Francisco will be provided.

MID-CONFERENCE EXCURSION
Wednesday afternoon buses will be available to transport delegates to visit the Computer History Museum and NASA Ames Research Center. This excursion will give delegates a chance to consider the impact that technological advances developed right here in the heart of Silicon Valley have had on our ability to collect and analyze radioglaciological data.

MID-CONFERENCE FUN RUN/WALK
Friday morning at 8:00 am we will give you a chance to wake up early and shake off the midweek banquet with a scenic 6 km run/walk to the 'Stanford Dish', a 46m radio telescope built in 1961. A longer 10 km route will give you the opportunity to see more of Stanford's campus. Access to water at the trail and showers on campus after the run will be provided.



SYMPOSIUM ORGANIZATION
Magnús Már Magnússon (International Glaciological Society)

SCIENCE STEERING AND EDITORIAL COMMITTEE
Dustin Schroeder (Stanford; Chair), Rob Bingham (Edinburgh), Don Blankenship (UTIG), Knut Christiansen (Washington), Olaf Eisen (AWI), Gwen Flowers (SFU), Nanna Karlsson (GEUS), Ala Khazendar (JPL), Jonathan Kingslake (Columbia), Michelle Koutnick (Washington), John Paden (CReSIS), Jeremie Mouginot (Grenoble), Martin Siegert (Imperial)

LOCAL ORGANIZING COMMITTEE
Dustin Schroeder (Stanford; Chair), Davide Castelletti (Stanford), Winnie Chu (Stanford), Thomas Jordan (Stanford), Elisa Mantelli (Stanford), Liliane Pereira (Stanford), Matthew Siegfried (Stanford)

FURTHER INFORMATION
Please register your interest online if you wish to attend the symposium at http://www.igsoc.org/symposia/2019/stanford.

IMPORTANT DATES

Five Decades of Radioglaciology

Opening of online abstract submission:	1 February 2019
Opening of online registration:	1 March 2019
Abstract submission deadline:	11 March 2019
Notification of abstract acceptance:	25 March 2019
Early registration deadline:	24 April 2019
Deadline for full refund:	30 April 2019
Deadline for refund on a sliding scale:	15 May 2019
Late registration surcharge starts:	16 May 2019
Symposium starts:	8 July 2019

Annals of Glaciology volume 61, issue 81

Paper submission deadline:	1 August 2019
Final revised papers deadline:	1 October 2019

The Call for Papers for the *Annals of Glaciology* is posted on https://www.igsoc.org/annals/call4papers.html. Accepted papers will be published as soon as authors have returned their proofs and all corrections have been made.

Hard copy publication is scheduled for late 2019/early 2020.

INTERNATIONAL GLACIOLOGICAL SOCIETY

International Symposium on

Sea Ice at the Interface

Winnipeg, Manitoba, Canada
18–23 August 2019

Co-sponsored by:
University of Manitoba

FIRST CIRCULAR
April 2018
http://www.igsoc.org/symposia/2019/winnipeg

The International Glaciological Society (IGS) will hold the next **International Symposium on Sea Ice** in Winnipeg, Manitoba, Canada, 18–23 August 2019. Registration will begin on 9 April 2019.

THEME

Sea Ice at the Interface. Sea ice plays a critically important yet highly dynamic role in global climate, polar marine ecosystems, globalization and indigenous cultures. Ongoing dramatic changes to the sea-icescape and freshwater–marine coupling, particularly involving ice sheets, glaciers, ice shelves, sea-ice loss and continental runoff, have major implications for climate within and beyond the polar regions, environmental and ecological integrity, and regional and global socioeconomic development. This symposium presents a timely opportunity to show recent advances in our knowledge and technological capabilities in sea-ice related research. In addition, the symposium will encourage holistic discussions amongst scientists, stakeholders and policy makers regarding the most recent changes, long-term trends and variability in the sea-ice environment in both hemispheres, and how best to engage and communicate with the general public.

SUGGESTED TOPICS

We seek papers and presentations on any timely topics related to the sea-ice environment. Key focus areas include (but are not limited to):

1. **Role of sea ice in the regional and global climate**: Large-scale change and variability in sea ice and climate, including: regional to hemispheric response, teleconnections, attribution of change (including large-scale atmospheric and oceanic circulation changes and feedback mechanisms), shape and structure of the polar vortex and extreme events.
2. **Paleoclimate studies**: Sea-ice historical records and observations; reconstructions from ice-core records, deep-sea sediments, various tracers and proxies; reconstructions from archaeological studies and local and traditional knowledge.
3. **Remote sensing and autonomous observations of sea ice and its various interfaces:** Advances in instrumentation and observation methods, including: non-destructive observations, autonomous observatories (including autonomous underwater and aerial platforms), new remote sensing modelling and retrieval techniques, new remote sensing systems.
4. **Coupling sea-ice modelling with observations**: Sea-ice and coupled model verification, advances in numerical parameterizations, current gaps, translating observations into models, CMIP5 and CMIP6 ensemble synthesis. The modelling is not limited to GCM/ESM, but also includes regional and process models.
5. **Sea-ice forecasting on daily to seasonal to decadal time-scales**: Statistical and modelling approaches; best practices to evaluate forecasts; new data products to improve sea-ice forecasting.
6. **Sea ice and snow thermodynamic processes, microstructure and optics**: New observations of sea-ice growth and decay processes and of the characteristics of the sea-ice matrix, including the contribution of snow to sea-ice formation and decay (e.g. snow-ice, superimposed ice and melt-pond formation), micro-physical properties and sea-ice optical properties.

7. **Sea-ice dynamic process and forcing mechanisms**: Ice kinematics, dynamics and mechanics, linkage to floe-size distribution, ice concentration, type and age, and dynamical effects on the sea-ice matrix; forcing of ice motion by both the ocean and atmosphere.
8. **The ocean–sea-ice–atmosphere interface:** Exchange of climatically relevant gases, boundary-layer processes, waves, tides, drag coefficients, synoptic scale forcing.
9. **The changing marginal ice zone:** Processes at the outer sea-ice–ocean boundary, numerical and experimental advances in wave–ice interaction, wave attenuation and floe-size modification.
10. **Glacier–sea-ice coupling:** Coupled land–ice/sea–ice processes including polynyas, basal melt and refreeze, water-mass modification, freshwater balance, oceanic heat content and ice melange linkage to ice-shelf stability; climate coupling of the marine and land-ice environments.
11. **Freshwater-marine coupling in polar regions:** Role of increasing freshwater delivery to polar marine systems including: continental runoff, hydroelectric regulation, increasing precipitation, increasing melt and timing of melt relative to associated marine processes
12. **Biogeochemical processes of sea ice at various interfaces:** Sea-ice brine and bubble composition and dynamics; fluxes and cycling of gases, nutrients and trace elements; sea-ice biogeochemical modelling.
13. **Contaminants in sea-ice environments:** Source, fate, effects and mitigation of contaminants (including mercury, POPs and oil-related contaminants) in sea-ice environments and implications for the ecosystems and food safety.
14. **Sea-ice ecosystems:** Observations, models and process studies examining sea ice as a habitat over the full range of trophic levels; effects of change and variability on ecosystem function, structure and coupled relationships; diversity and function revealed by genomic approaches.
15. **Detection and monitoring of marine ice hazards:** Icebergs, shipping, oil spills in ice-covered waters.
16. **Inuit and indigenous sea-ice knowledge and use:** Inuit and indigenous knowledge of sea ice and associated processes; indigenous travel over sea ice; community-based monitoring programs; integration of various knowledge-based systems.
17. **Opportunities, adaptation, and mitigation:** Marine shipping and resource development in the polar oceans; geopolitics; adaptation and mitigation; information systems, safety, security and preparedness.

We will also accept proposals for sessions that are not listed above prior to the call for abstracts. Contact: Feiyue.Wang@umanitoba.ca

PROGRAM

The symposium will include oral and poster sessions, and will provide a friendly and intellectually stimulating environment to facilitate face-to-face interactions and networking. Additional activities will include an opening reception, a banquet dinner and a mid-symposium afternoon excursion.

For the adventurous, a post-symposium 4-day excursion to Churchill, Manitoba, will be available for a maximum of 20–30 people, on a first-come basis (cost to be determined). Located on the shore of the sub-Arctic Hudson Bay, Churchill is a world-class tourist destination for viewing polar bears, beluga whales and the aurora borealis. This trip will include a visit to the town of Churchill, the new Churchill Marine Observatory research facility, the Churchill Northern Studies Centre, and a beluga tour at the mouth of the Churchill River. Learn more about this destination: http://www.everythingchurchill.com.

ABSTRACT AND PAPER PUBLICATION
Participants who wish to present a paper (oral or poster) at the Symposium will be required to submit an abstract. The Council of the International Glaciological Society will publish a thematic issue of the *Annals of Glaciology* on topics consistent with the Symposium themes. Participants are encouraged to submit manuscripts for this *Annals* volume. A call for abstracts will be issued in the Second Circular.

SIDE MEETINGS
The Local Organizing Committee welcomes requests from groups and organizations for meeting spaces to host side meetings prior to or after the symposium. Send all requests to Lucette.Barber@umanitoba.ca

VENUE
We look forward to welcoming the international glaciology and sea-ice communities to Winnipeg, Manitoba. The University of Manitoba and the Province have a long history in Arctic, sea ice and Indigenous studies and activities. The meeting will take place in the historic Fort Garry Hotel in the heart of downtown Winnipeg, adjacent to the Winnipeg Forks and Exchange District. This venue is ideally situated within walking distance of the Canadian Human Rights Museum, the VIA Rail train station and numerous eating venues, markets and shops. https://www.fortgarryhotel.com/winnipeg-conference-centre/meeting-spaces https://www.exchangedistrict.org

SYMPOSIUM ORGANIZATION
Magnús Már Magnússon (International Glaciological Society).

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Glaciological diary

** IGS sponsored * IGS co-sponsored

2018

2–4 May 2018
International Conference on Geology and Earth Sciences
Rome, Italy
Website: http://http//geoscience.madridge.com/

7–9 May 2018
5th Polar Prediction Workshops
Montreal, Canada
Contact Amélie Bouchat <amelie.bouchat@mail.mcgill.ca>

10–19 May 2018
2nd SCAR Summer School on Polar Geodesy
Ladozhskoe Ozero, Russia
Website: https://www.polarforschung.de/2nd-scar-summer-school-on-polar-geodesy/

14–17 May 2018
1st Tvärminne Polar Microbes Symposium
Helsinki, Finland
Contact: Eeva Eronen-Rasimus <eeva.eronen-rasimus@ymparisto.fi>
Website:
https://www.arcus.org/sites/all/modules/civicrm/extern/url.php?u=6970&qid=857595

20–24 May 2018
Japan Geophysical Union Meeting
Tokyo, Japan
Website: http://www.jpgu.org/meeting_e2018/

29 May–9 June 2018
Arctic Field Summer School 2018: Arctic Coastal Environments in Rapid Transition
Utqiaġvik (Barrow), Alaska, USA
For US-based graduate students only
Contact Tohru Saito <(tsaito@alaska.edu>

3–8 June 2018
****International Symposium on Timescales, Processes, and Ice Sheets Changes**
Buffalo, NY, USA
Contacts: Secretary General, IGS
Beáta Csathó; University at Buffalo, NY, USA <bcsatho@buffalo.edu>

4–9 June 2018
28th IAHR Symposium on Ice
Vladivostok, Russia
Contact: Tatiana Uvarova <searay@yandex.ru>

5–9 June 2018
75th Eastern Snow Conference
College Park, Maryland, USA
Website: http://www.easternsnow.org/

5–15 June 2018
University of Alaska, Fairbanks: Fifth International Summer School in Glaciology
McCarthy, Alaska, USA
Website: https://glaciers.gi.alaska.edu/courses/summer-school/2018

11–12 June 2018
Ice Sheet System Model Sea-Level Workshop
University of Hawaii, Manoa, Hawaii, USA
Website: https://issm.jpl.nasa.gov/issmworkshop2018/

15–26 June 2018
POLAR2018 – the SCAR and IASC/ASSW Conference
15–18 June SCAR and IASC/ASSW Business & Satellite Meetings
19–23 June SCAR/IASC Open Science Conference
24–26 June SCAR Delegates Meeting & 2018 Arctic Observing Summit
Davos, Switzerland
Website: http://www.polar2018.org/
Contact: Anja Schilling Hoyle, conference manager <polar2018@slf.ch>

23–24 June 2018
Permafrost Young Researcher Network Workshop
Chamonix, France
EUCOP website: https://eucop2018.sciencesconf.org/

23 June–1 July 2018
5th European Conference on Permafrost (EUCOP)
Chamonix, France
Website: https://eucop2018.sciencesconf.org/

16 July 2018
NSGG Postgraduate Research Symposium 2018
Leeds, UK

7–11 August 2018
CANQUA/AMQUA 2018: Crossing borders in the Quaternary
Joint meeting of the Canadian and American Quaternary Associations
Ottawa, Canada
Session S8. The Relict Permafrost Environment. Conveners: Trevor Porter, Denis Lacelle <denis.lacelle@gmail.com>, Duane Froese
Website: https://www.quaternary2018.com/

13–17 August 2018
CESM (Community Earth System Model) Polar Modeling Workshop
Boulder, Colorado, USA
Website: http://www.cesm.ucar.edu/events/workshops/2018PMWS/

13–18 August 2018
Training school: Glaciers, moraines and climate: identifying, dating and extracting paleoclimate data from evidence of past glacier change
Inchnadamph, Scotland, UK
Website: https://www.polartrec.com/events/43314

3–6 September 2018
32nd Forum for Research into Ice Shelf Processes (FRISP) Workshop
Centre Paul-Langevin, Aussois, France
Website: https://jbs.locean-ipsl.upmc.fr/FRISP2018.html

3–7 September 2018
UArctic Congress 2018
Oulu, Finland
Website: https://congress.uarctic.org/

4–5 September 2018
****International Glaciological Society British Branch Meeting**
University of Exeter, Exeter, UK
Contact: Anna Le Brocq <a.lebrocq@exeter.ac.uk>

7–8 September 2018
Northwest Glaciologists Meeting
Fairbanks, Alaska, USA
Contact: Martin Truffer <mtruffer2@alaska.edu>

10–12 September 2018
2018 UK Antarctic Science Conference
Durham, UK
Website: https://www.dur.ac.uk/uk-antarctic-science/

10–14 September 2018
15th International Circumpolar Remote Sensing Symposium (ICRSS)
Potsdam, Germany
Website: https://alaska.usgs.gov/science/geography/CRSS2018/

11–22 September 2018
Karthaus course: Ice Sheets and Glaciers in the Climate System
Karthaus, Italy
Contact: Johannes Oerlemans <j.oerlemans@uu.nl>
Website: https://www.arcus.org/events/arctic-calendar/28029

16–19 September 2018
WAIS Workshop
Stony Point, New York, USA
Contact: Betsy Sheffield <betsys@nsidc.org>

16–20 September 2018
Thwaites Glacier Program meeting
Stony Point, New York, USA
Contact: Betsy Sheffield <betsys@nsidc.org>

24–29 September 2018
Symposium: 25 years of Progress in Radar Altimetry
Ponta Delgada, São Miguel Island, Azores (Portugal)
Contact: Jérôme Benveniste <jerome.benveniste@esa.int>

24–29 September 2018
Symposium: Polar Regions and Cryosphere in the Context of Global Warming
Sochi, Russia
Website: https://www.arcus.org/events/arctic-calendar/28131

7–12 October 2018
22nd International Snow Science Workshop
Innsbruck, Austria
Website: http://issw2018.com/en/

9–11 October 2018
2nd Arctic Biodiversity Congress
Rovaniemi, Finland
Website: https://www.arcticbiodiversity.is/congress
Contact: CAFF <caff@caff.is

17–19 October 2018
2018 Polar CORDEX meeting
Warsaw, Poland
Website: http://www.climate-cryosphere.org/activities/targeted/polar-cordex/meetingswww.arcticbiodiversity.is/congress
Contact: Marzena Osuch <marz@igf.edu.pl>

24–26 October 2018
****International Glaciological Society Nordic Branch Meeting**
The Arctic Centre, Rovaniemi, Finland
Website: https://www.arcticcentre.org/events/Nordic-International-Glaciology-Society-(IGS)-meeting/
Contact: Rupert Gladstone <rupertgladstone1972@gmail.com>

25–26 October 2018
International Symposium on Remote Sensing and Global Change: The Antarctic, Arctic and Tibetan Plateau
Wuhan, China
Circular: https://www.igsoc.org/symposia/Flyers_etc/2018internationalsymposiumfirstcircular.pdf

30–31 October 2018
Workshop: Towards a better harmonization of snow observations, modeling and data assimilation in Europe
Budapest, Hungary
Website: http://harmosnow.eu/snowconference

10–14 December 2018
ArcticNet Annual Scientific Meeting 2018
Ottawa, Ontario, Canada
Contact: Catherine Girard <catherine.girard.15@ulaval.ca>, Sophie Dufour-Beauséjour <sophie.dufour-beausejour@ete.inrs.ca>, Gwyneth MacMillan <gwyneth.anne.macmillan@umontreal.ca>
Website:

2019

14–16 January 2019
Year of Polar Prediction (YOPP) Arctic Science Workshop
Helsinki, Finland
Contact: YOPP International Coordination Office <office@polarprediction.net>

20–24 January 2019
Workshop on the Dynamics and Mass Budget of Arctic Glaciers & the IASC Network on Arctic Glaciology Annual Meeting
Geilo, Norway
Website: https://nag.iasc.info/workshop

22–24 January 2019
Arctic Frontiers Science 2019: Smart Arctic
Tromsø, Norway
Website: http://www.arcticfrontiers.com/

7–8 February 2019
Cryospheric Science with ICESat-2 (CSI): Software Carpentry Workshop
Seattle, Washington, USA
Contact: email-icesat@uw.edu
Website: https://software-carpentry.org/

11–15 February 2019
International Advanced Training Course on Snow and Avalanche 2019: 'Practice Meets Science'
Davos, Switzerland
Website: http://www.slf.ch/more/training

20–22 February 2019
***New Zealand Snow and Ice Research Group (SIRG: the New Zealand branch of IGS) Annual Workshop**
Kurow, New Zealand
Website: https://sirg.org.nz/

3–5 April 2019
***International Symposium on Mitigation Measures against Snow Avalanches and Other Rapid Gravity Mass Flows**
Siglufjörður, Iceland
Website: http://snow2019.is/

15–18 April 2019
Permafrost conference 2019: Solving the puzzles from the cryosphere
Pushchino, Russia
Website: http://cryosol.ru/en/cryoconference2019en.html

12 –17 May 2019
****International Symposium on Erosion and Sedimentation**
Madison, Wisconsin, USA
Contacts: Secretary General, IGS
Neal Iverson <niverson@iastate.edu>

17–21 June 2019
Cryospheric Science with ICESat-2 (CSI): Hackweek 2019
Seattle, Washington, USA
Contact: email-icesat@uw.edu
Website: https://icesat-2hackweek.github.io/

8–12 July 2019
****International symposium on Five Decades of Radioglaciology**
Stanford, California, USA
Contacts: Secretary General, IGS
Dustin Schroeder <Dustin.M.Schroeder@stanford.edu>

9–16 July 2019
International Association of Cryospheric Sciences meeting
at International Union of Geodesy and Geophysics General Assembly
Montréal, Québec, Canada
Contact: Andrew Mackintosh <Andrew.Mackintosh@vuw.ac.nz>

25–31 July 2019
20th Congress of the International Union for Quaternary Research (INQUA) 2019
Dublin, Ireland
Session: Quaternary glaciations: Processes, Sediments and Landforms. Conveners: Lorna Linch <L.Linch@brighton.ac.uk>, Danni Pearce, Jan Piotrowski, Dave Evans

18–22 August 2019
18th International Conference on Cold Regions Engineering and 8th Canadian Permafrost Conference
Québec, Québec, Canada
Website: http://https//www.agora-inscription.ca/iccre-cpc2019

18–26 August 2019
****International Symposium on Sea Ice**
Winnipeg, Manitoba, Canada
Contacts:
Secretary General, IGS
David Barber University of Manitoba <David.Barber@umanitoba.ca>

4–5 September 2019
***International Glaciological Society British Branch Meeting**
Northumbria University, Newcastle, UK
Contact: Nick Rutter <nick.rutter@northumbria.ac.uk>

4–6 September 2019
ARCTIC FUTURES 2050: Science for Policy in a Changing Arctic
Study for Environmental Arctic Change (SEARCH)
Washington, DC, USA
Webpage: https//www.arcus.org/sites/all/modules/civicrm/extern/url.php?u=10456&qid=1589603

2020

Late August/early September 2020
****International Symposium on Ice Stream Dynamics**
Durham, UK
Contacts: Secretary General, IGS
Chris Stokes <c.r.stokes@durham.ac.uk>

2021

Summer 2021
****International Symposium on Interactions of Ice Sheets and Glaciers with the Ocean**
La Jolla, California, USA
Contacts: Secretary General, IGS
Helen Amanda Fricker <hafricker@ucsd.edu>

September 2021
****International Symposium on Southern Hemisphere Glaciers under Pressure: subglacial lakes, subaquatic environments, calving glaciers and climate**
Valdivia, Chile
Contacts: Secretary General, IGS
Andrés Rivera, Centro de Estudios Cientificos, arivera@cecs.cl

2022

June 2022
****International Symposium on Maritime Glaciers**
Juneau, Alaska, USA
Contacts: Secretary General, IGS
Jason Amundson <jmamundson@alaska.edu>

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International Glaciological Society

Secretary General M.M. Magnússon

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Immediate Past President	D.R. MacAyeal	2011–2017	2010
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	*N. Karlsson	2017–2020	2017
	*Kang Schichang	2015–2018	2015
	*A. Mackintosh	2015–2018	2015
	*D. Notz	2016–2019	2016
	*A. Pope	2016–2019	2016
	*C. Tijm-Reijmer	2015–2018	2015
	*A. Treverrow	2017–2020	2017
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	L. Koenig		

*First term of service on the Council

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Nominations	D.R. MacAyeal (Chairman)
Publications	G. Flowers (Chairman)

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1963	G. Seligman	1989	H. Oeschger	2001	G.K.C. Clarke
1967	H. Bader	1989	W.F. Weeks	2003	K. Hutter
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1972	B.L. Hansen	1992	H. Röthlisberger	2009	P.A. Mayewski
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1976	W. Dansgaard	1995	A.J. Gow	2012	D.E. Sugden
1977	W.B. Kamb	1996	W.F. Budd	2013	P. Duval
1982	M. de Quervain	1997	S.J. Johnsen		
1983	W.O. Field	1998	C. Lorius		
1983	J. Weertman	1999	C.F. Raymond		
1985	M.F. Meier	2000	S.C. Colbeck		
1986	G. de Q. Robin	2001	G.S. Boulton		

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G.K.C. Clarke	J.W. Glen
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2003	C.S.L. Ommanney	2016	E.M. Morris
2010	T.H. Jacka	2017	J.M. Palais

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International Glaciological Society

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ICE

Editor: M.M. Magnússon (Secretary General)

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