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Ice

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Contents

Cover picture: A ~5 cm section of firn and melt from an ice core (photo by Peter Neff/US National Ice Core Laboratory)

Scanning electron micrograph of the ice crystal used in headings by kind permission of William P. Wergin, Agricultural Research Service, US Department of Agriculture

From the Editor

Dear IGS member

Although this is the last *ICE* of 2012, I am writing this in February 2013. We are a little late in producing it. I would like to report that the final count of IGS members in 2012 culminated at 958. And at the time of writing this we have 743 members paid up for 2013. We are confident we will break the 1000 mark this year. But we need your help – please get your friends and colleagues to renew/join. The membership rate is the same as 2012. So let's all make 2013 an even better year for the IGS.

To sum up 2012, we published 1252 pages of the *Journal of Glaciology*. This is a record number of pages in the *Journal* in any year. We received 185 submissions, down slightly on the previous year (198). But we cannot expect to break the submission record for the seventh year running. In any case, according to our Chief Editor, the quality of the submissions is improving, i.e. administrative rejections right off the bat (i.e. prior to assigning a Scientific Editor and thus sending out to review) are going down.

Right now, the first two issues of the *Journal* are full – all papers now being accepted are being assigned to the third issue. The first issue is complete on the web and it won't be long until the second one will start appearing on the web too. So things are moving smoothly.

The *Journal* impact factor for 2012 was 2.301, slightly down from last year (2.6). But the *Journal* is consistently in the top 100 (out of more than 16 200 titles) for the number of full text downloads at Ingenta: 2353 downloads in November and 1135 downloads in December 2012.

I would also like to tell you that we are fully compliant now with CLOCKSS (Controlled Lots of Copies Keep Stuff Safe) and LOCKSS (Lots of Copies Keep Stuff Safe). This will ensure that all IGS publications will be preserved whatever happens. Should any server where you now access IGS publications go down for any reason you will always be able to access them through one of these two systems. And we have also joined EBSCOhost, which apparently is popular with students.

This brings me to the hot topic of the day. We are looking into the various aspects of 'Open Access' (OA). The IGS staff attended a workshop in London,

organized by ALPSP (the Association of Learned and Professional Society Publishers) earlier this month. It was most interesting and good to get the feeling of what other societies are thinking. I will try and summarize briefly what we found out.

There are in fact three 'models' of OA, Green, Gold and Hybrid.

- **Green Open Access** – this is where we effectively are at the moment. Authors can:
  - Archive the final, post-print version 6 months after its appearance online on the IGS website. In effect, this means papers are locked for 1–5 months. Typically the industry standard is 12–24 months
  - Publisher source and copyright must be acknowledged
  - Post pre-review versions of articles at personal/institutional websites, provided that the publisher and review/acceptance status are indicated clearly

  We retain subscriptions – in other words, it has a minimal effect on our business model

- **Gold Open Access** – everything is open to all readers right away. This is the ideal world, BUT there is a potential serious loss of revenue for the IGS
  - Loss of library subscriptions – we do, however, trust that our members would remain loyal
  - We do not have any other means of subsidizing our publications
  - Possible loss of quality (through economizing on production)

  Copyright will be difficult to manage (i.e. anyone can use any material, pictures or figures for any purpose)
  We would need to compensate for the loss of income, possibly implementing what is referred to as an 'Author Processing Charge' or APC (this includes the production cost (page charges) and cost of publishing)

- **Hybrid Open Access** – issues would include a combination of Green OA and Gold OA papers
  - Individual authors pay to have their papers 'Gold OA' (typical cost in the industry $3000 per paper)
  - We might possibly retain some subscriptions

To finish off this editorial I would like to quote Louise again and say 'The IGS membership reached record levels in 2012. It's now time to break that record!' Your IGS membership for 2013 is now available for renewal at http://www.igsoc.org/membership/renew.html

Magnús Már Magnússon
Secretary General

Recent work

Japan (Honshu)

ALPINE GLACIERS

Identifying active glaciers in Mt Tateyama and Mt Tsurugi in the northern Japanese Alps

So far, Japanese glaciologists and geographers have believed that there are no active glaciers in Japan. The research group of Tateyama Caldera Sabo Museum studied the surface flow velocity and ice thickness of the Gozenzawa perennial snowpatch (length: 700 m; surface area: 0.1 km^2; altitude: 2500–2800 m a.s.l.) in Mt Tateyama (36°34.5′N,137°37′E; 3015 m a.s.l.), the Sannomado perennial snowpatch (length: 1600 m; surface area: 0.13 km^2; altitude: 1700–2400 m a.s.l.) and the Komado perennial snowpatch (length: 1200 m; surface area: 0.17 km^2; altitude: 2000–2300 m a.s.l.) in Mt Tsurugi (36°37.5′N, 137°37′E; 2999 m a.s.l.) in the northern Japanese Alps, Japan, since 2009. The Sannomado and the Komado perennial snowpatches have large ice masses (larger than 30 m thick and about 1000 m long). The research group measured the surface flow velocity and found that both the ice masses had flowed over 30 cm per month in the autumn of 2011. Hence, both the snowpatches are confirmed as active glaciers. The Gozenzawa perennial snowpatch also has a large ice mass (27 m thickness and 400 m long), and it had flowed slightly (less than 10 cm per month) in the autumns of 2010 and 2011. Thus, this snowpatch was also regarded as an active glacier.

Kotaro FUKUI (Tateyama Caldera Sabo Museum, fukui@tatecal.or.jp)

Biological investigation on the Urumqi Glacier No. 1, western China

Studies on cryoconite, microbes, and their effect on surface albedo have been carried out on the Urumqi Glacier No. 1, in western China, by a group from Chiba University, Japan, since 2006. The project is in collaboration with the Tien Shan Glaciological Station, Chinese Academy of Science. The Urumqi Glacier No.1 is one of the well-known glaciers of long-term mass-balance monitoring, but it is also a very interesting glacier in terms of biological communities living on the glacier surface. We found a distinctive microbial community on the glacier: cyanobacteria, which are photosynthetic microbes, dominate the microbial community on the ablation surface and they form a large amount of cryoconite on the surface. The cryoconite substantially reduces the surface albedo and is likely to affect total ablation of the glacier. The dominance of cyanobacteria may be due to abundant deposition of desert sand, which changes the chemical conditions of meltwater to be favourable to cyanobacteria.

Nozomu Takeuchi (Chiba University, ntakeuch@faculty.chiba-u.jp)

Changes in Himalayan glaciers

In order to provide ground-based evidence with respect to ‘Himalayan Glaciergate’, which was inadequate information about changes occurring to Himalayan glaciers, we conducted surveys on three benchmark glaciers in the Nepal Himalaya using carrier-phase differential global positioning system from 2008 to 2010. Surveyed surface elevation was compared with that surveyed in the late 1990s and allowed us to extend the mass-balance records for the recent decade. Results showed the mass-balance trend comparable to the average worldwide. Using an energy-mass-balance model with gridded reanalysis climate data, which were calibrated with in situ meteorological data near the glaciers, we depicted fates of the benchmark glaciers with equilibrium line altitude (ELA). One in arid west Nepal will survive whereas the others in humid east Nepal are doomed to disappear over time. Furthermore, calculated ELA trend suggested that the behaviour of the Asian glaciers should be spatially heterogeneous, caused not only by heterogeneous climate trend (combinations among warming/cooling and drying/wetting) but also by different response of glacier mass balance due to climate regimes.

Koji Fujita (Nagoya University, cozy@nagoya-u.jp)

POLAR GLACIOLOGY

GRENE Arctic Climate Change Research Project

The changes occurring in the Arctic are both substantial and rapid, and the different parts of the Arctic climate system are involved. It has long been argued that the Arctic is the precursor of our changing planet. But beyond the presence of ice-albedo feedback, which seems to accelerate both warming of the ocean and melting of sea ice, there are so many open questions regarding underlying mechanisms of the Arctic. Recognizing this great scientific challenge we start a new Japanese initiative, the ‘Arctic Climate Change

Research Project', within the framework of the GRENE (Green Network of Excellence) Program funded by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT). The project is funded for 5 years starting in 2011 and jointly managed by the National Institute of Polar Research and the Japan Agency for Marine-Earth Science and Technology. Four strategic research targets are set: (1) understanding the mechanism of warming amplification in the Arctic; (2) understanding the Arctic system for global climate and future change; (3) evaluation of the impacts of Arctic change on weather and climate in Japan; (4) protection of sea-ice distribution and Arctic sea routes. Now over 300 scientists from 35 organizations are participating in the project, tackling all aspects of Arctic climate systems. The project seeks and promotes international collaboration with other institutes from various nations, which is essential for Arctic research, while the Japan Consortium for Arctic Environment Research (JCAR) is founded to bolster Arctic research

Among the seven GRENE Arctic projects, one project is devoted to cryospheric research. It is entitled 'The role of Arctic cryosphere in global change' and coordinated by Dr Hiroyuki Enomoto of National Institute of Polar Research. This research project focuses on two targets. One is the effects of land snow and ice cover in the Pan-Arctic region on the Arctic climate. From data gathered in the field and from satellites, we can understand (1) the spatial and temporal distribution of snow cover and (2) glacial fluctuations. To asses ice-albedo feedback we will try to clarify the process of changes in snow and ice cover. From a chemical analysis of snow samples, we will obtain information on air temperature, snowfall events, and the spatial distribution of transported environmental substances. This information is helping to make climate change predictions more accurate. Our second target of research concerns the effects of the mass change of the Greenland Ice Sheet on global climate change. This ice sheet is rapidly shrinking at an increasing rate. About half the reduction in the ice sheet is due to melting and the other half to the discharge of ice; and our goal is to quantify this reduction. We will expand our observational network in Greenland to aid our understanding of the changes in the mass of the ice sheet and the processes responsible for them. We will use a model to incorporate our findings, to make predictions and clarify the effects of reduction in the ice sheet on climate change.

Hiroyuki Enomoto (National Institute of Polar Research; enomoto.hiroyuki@nipr.ac.jp)

Approaching ' the earth system' mechanisms through the past polar environmental changes

In the National Institute of Polar Research (NIPR), a current main project, led by Prof. H. Motoyama, is entitled 'Approaching the earth system mechanisms through the past polar environmental changes'. The aim of this project is to predict $$$ the future of the Earth's environment by knowing the past of Antarctic ice sheet. The project is a collaboration with geology based scientists who investigate growth/retreat history of the ice sheet in East Antarctica based on sediments and rocks near the coast. One of the important research methods to clarify the relationship between elements consisting of ' the Earth system' is the historical reconstruction of the past change of each element, and their chronology. Our recent activity includes Antarctic inland traverses to better understand the polar plateau which contains archive of the climate. Traverse teams have visited area near Dome Fuji and further inland for Glaciological survey. Shallow (~100 m) firn cores were sampled and firn air sampling was conducted at a few locations. Automatic weather stations have been installed. In the 2012/2013 field season, south of Dome Fuji will be investigated for candidate location of a new permanent inland base. Accumulation environment and ice-sheet bed conditions are investigated using ice sounding radars. Another recent topics include survey of ice shelves using steam drill technique. This activity was led by Dr. Shin Sugiyama (Hokkaido University). The field team succeeded to penetrate the ice shelf by a steam drill to investigate environment of the ice shelves. In the next several years, we will investigate glaciological conditions near the coast. The research will include ice core drilling and surveys of Shirase Glacier.

Shuji Fujita (National Institute of Polar Research, sfujita@nipr.ac.jp)

BLOWING AND DRIFTING SNOW

Studies of blowing and drifting snow in Japan's main island of Honshu have been based on knowledge obtained both abroad and in Hokkaido in northernmost Japan. However, the characteristics of winter weather in Honshu are slightly (and sometimes significantly) different from those in Hokkaido and other countries. Honshu experiences particularly heavy winter precipitation, especially in the north-western coastal regions of Tohoku and the Hokuriku District. Moreover, except for in high-elevation mountainous regions, winter temperatures are not very low, generally remaining close to the melting point. Mean winter temperatures in Hokkaido are

much colder than those in Honshu. Thus, aspects of blowing snow differ between Honshu and Hokkaido. The higher temperatures in Honshu increase the threshold for blowing snow through the rapid process of sintering and bond formation between snow grains. Under such conditions, the effect of snowflake collisions on snow surfaces has a significant influence on snow blowing and the development of snowdrifts. Snowflakes tend to decompose when they impact a surface during snowfall, and the decomposed snowflakes begin drifting. The relationship between snowfall and the structure of blowing snow has been studied in the laboratory and the field. In 1997, the Cryospheric Environment Simulator (CES), a large cold laboratory, which incorporated a wind tunnel (1 m x 1 m x 12 m) inside a cold room, was built at the Shinjo Branch of the Snow and Ice Research Center, National Research Institute for Earth Science and Disaster Prevention (NIED, Yamagata Prefecture, northern region in Honshu). Numerous experiments have been conducted in the cold wind tunnel to determine the overall features and dynamics of the saltation layer near the snow surface. An artificial snow machine installed in the CES has enabled examinations of the effects of temperature, snowfall, and snow metamorphism on splash and entrainment processes and the total transport of blowing snow. This cold wind tunnel allows for a wide range of research in the field of blowing snow, including basic studies (e.g., saltation layer structures) and applied research (e.g., snowdrifts around fences and buildings). Recently, particle image velocimetry has been used to investigate the structure of the saltation layer. This technique has the potential to provide detailed insight into the physically significant dynamical processes that control saltating snow.

In snowy regions, snowdrifts form on and around buildings, which can inconvenience residents and cause problems for urban planning. A number of wind, architecture, and civil engineering studies have attempted to determine the mechanisms involved in snowdrift formation based on observations, experiments, and computational fluid dynamics (CFD) with sophisticated numerical techniques developed in wind engineering studies. The aim of these studies has been to facilitate snow removal and manage the use of affected buildings and structures. As mentioned above, temperatures in Honshu are generally warmer than those in Hokkaido to the north. Thus, when studying snowdrift distribution in Honshu, it is important to consider the effects of snowmelt caused by heat exchange on the snow surface. A method combining snowdrift simulation using CFD with a heat balance model is therefore proposed.

CFD techniques are widely used in current research. An important research topic in recent years has been the development of an integrated system composed of a weather forecast model, snowpack model, and blowing snow model. A Snow Disaster Forecasting System (SDFS), constructed by the Snow and Ice Research Center (NIED) has the capability to predict avalanche potential, visibility in blowing snow, and snow conditions on roads. This system has recently been experimentally applied to predict visibility reduction caused by blowing snow on roads in Niigata and Yamagata prefectures, where strong blowing snow occurs frequently in winter. In this system, a simple quasi-one-dimensional blowing snow model is used to estimate the concentration of the suspension layer of blowing snow. Comparison with observations have indicated that the system has the potential to provide useful predictions for decision making, although improved accuracy and usability are still required.

Masaki Nemoto (Snow and Ice Research Center, National Research Institute for Earth Science and Disaster Prevention, mnemoto@bosai.go.jp)

SNOW AVALANCHES

The Sea of Japan side of Honshu is mostly an area of heavy snowfall, because cold air from the Siberian continent absorbs water vapor over the Sea of Japan. In the Niigata and Hokuriku areas, in the center of Honshu, snow melts even in midwinter because of the relatively warm climate. Consequently, wet snow exists and sometimes causes the release of full-depth avalanches even in midwinter. Despite a global warming trend in recent years, both winter 2010/11 and winter 2011/12 were years of heavy snowfall and there were more than 130 victims of snow disasters.

In these areas, studies of the interaction between liquid water and snow are important since there is a lot of wet snow. Yamaguchi and others (2010, 2012) measured and formulated the dependency of snow density and grain size on capillary pressure to clarify the water transport process in the snowpack. Yamanoi and Endo (2002) measured the shear strength of wet snow and formulated the effect of water content on the shear strength. Hirashima and others (2008,2010) implemented their results into the numerical snowpack model and applied them to the prediction of wet snow avalanches.

In addition, non-destructive measurements of water content distribution using a magnetic resonance imaging, artificial avalanche release technique using explosive in wet snow, and development of avalanche dynamics model for

wet snow are under investigation.

Not only the wet snow study, variety of studies are carried out for dry snow avalanche prediction. Particular snowfall species such as graupel and snow crystal without rimes sometimes form weak layer in the snowpack. Therefore, the observations of snowfall species and simulation to reproduce them are carried out. They will be soon implemented into the numerical snowpack model.

At the Snow and Ice Research Center in Shinjo, there is the Cryospheric Environmental Simulator which can make natural identical snow and control environmental condition. Using this facility, changes in the snow crystral geometry and shear strength of round-facet crystals in the small and large temperature gradient condition are conducted. These results are also incorporated in the numerical snowpack model (Hirashima and others 2009, 2011).

Hiroyuki Hirashima (Snow and Ice Research Center, National Research Institute for Earth Science and Disaster Prevention,hirasima@bosai.go.jp)

SNOW AND ICE PHYSICS

Recently, clathrate hydrate crystals are widely investigated. Research on nucleation of both CH_4 and CO_2 clathrate hydrate crystals have been conducted vigorously using the Raman spectrum in relation with memory effects. Nucleation and growth of semi-clathrate hydrate crystals are also studied using an optical microscope. Mobility of guest gas molecule is measured by NMR. In addition, research on air-clathrate hydrate crystals in ice sheets are also studied in connection with chemical impurity.

Further, the following research projects are ongoing:

Transfer of He gas in poly-crystal ice
Morphology of poly-crystal snow grown at low temperature
Orientational analyze of ice crystals using etching technique
Regelation of ice
Friction on ice
Diffusion of water-soluble impurity in ice

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International Glaciological Society

JOURNAL OF GLACIOLOGY

Papers accepted for publication between 1 October and 31 December 2012. The papers are listed in alphabetical order by first author. Some of these papers have already been published.

William F. Budd, Roland C. Warner, T.H. Jacka, Jun Li, Adam Treverrow
Ice flow relations for stress and strain rate components from combined shear and compression laboratory experiments

Brad Danielson, Martin J. Sharp
Development and application of a time-lapse photo analysis method to investigate the link between tidewater glacier flow variations and supra-glacial lake drainage events

Louis Delmas
Influence of snow type and temperature on snow viscosity

H.D. Dugan, M.K. Obryk, P.T. Doran
Lake ice ablation rates from permanently ice-covered Antarctic lakes

Ellyn M. Enderlin, Ian M. Howat
Submarine melt rate estimates for floating termini of Greenland outlet glaciers (2000–2010)

Alec van Herwijnen, Daniel A. Miller
Experimental and numerical investigation of the sintering rate of snow

Andrew J. Hodson, Harriet Paterson, Karen Westwood, Karen Cameron, Johanna Laybourn-Parry
A blue ice ecosystem on the margins of the East Antarctic Ice Sheet

Daisy Huang, Jonah H. Lee
Mechanical properties of snow using indentation tests: size effects

Daniel R. Joswiak, Tandong Yao, Guangjian Wu, Lide Tian, Baiqing Xu
Ice-core evidence of westerly and monsoon moisture contributions in the central Tibetan Plateau

Joseph Kennedy, Erin C. Pettit, Carlos L. di Prinzio
The evolution of ice crystal fabric in ice sheets and its link to climate history

Hannes Konrad, Pascal Bohleber, Dietmar Wagenbach, Christian Vincent, Olaf Eisen
Determining the age distribution of Colle Gnifetti, Monte Rosa, Swiss Alps, by combining ice cores, ground-penetrating radar and a simple flow model

Yves Lejeune, Jean-Maxime Bertrand, Patrick Wagnon, Samuel Morin
A physically based model for the year-round surface energy and mass balance of debris-covered glaciers

Joshua J.S. Marsh, Vanessa L. Boschi, Rachel L. Sleighter, Amanda M. Grannas, Patrick G. Hatcher
Characterization of dissolved organic matter from a Greenland ice core by nanospray ionization Fourier transform ion cyclotron resonance mass spectrometry

L.W. Morland, T. H. Jacka
Deduction of surface accumulation history from ice-core age/depth data

Francisco J. Navarro, Ulf Y. Jonsell, María I. Corcuera, Alba Martín-Español
Decelerated mass loss of Hurd and Johnsons Glaciers, Livingston Island, Antarctic Peninsula

Ben Panzer, Daniel Gomez-Garcia, Carl Leuschen, John D. Paden, Fernando Rodriguez-Morales, Aqsa Patel, Thorsten Markus, Benjamin Holt, Sivaprasad Gogineni
An ultra-wideband, microwave radar for measuring snow thickness on sea ice and mapping near-surface internal layers in polar firn

Fabienne Riche, Maurine Montagnat, Martin Schneebeli
Evolution of crystal orientation in snow during temperature gradient metamorphism

Jason L. Roberts, Roland C. Warner, Adam Treverrow
Inferring ice-flow directions from single ice-sheet surface images using the Radon transform

T. A. Scambos, R. Ross, T. Haran, R. Bauer, D.G. Ainley, K.-W. Seo, M. De Keyser, A. Behar, D.R. MacAyeal
A camera and multi-sensor automated station design for polar physical and biological systems monitoring: AMIGOS

Stefan Schleef, Henning Loewe
X-ray microtomography analysis of isothermal densification of new snow under external mechanical stress

Matthew Sturm, Svetlana Stuefer
Wind-blown flux rates derived from drifts at arctic snow fences

Weston A. Thelen, Kate Allstadt, Silvio de Angelis, Stephen D. Malone, Seth C. Moran, John Vidale
Shallow repeating seismic events under an alpine glacier at Mount Rainier, Washington, USA

Barbara L. Trüssel, Roman J. Motyka, Martin Truffer, Christopher F. Larsen
Rapid thinning of lake-calving Yakutat Glacier and the collapse of the Yakutat Icefield, southeast Alaska, USA

Fabian Walter, Marco Olivieri, John F. Clinton
Calving event detection by observation of seiche effects on the Greenland fiords

Ethan Welty, Timothy C. Bartholomaus, Shad O'Neel, W. Tad Pfeffer
Cameras as clocks

Guoshuai Zhang, Shichang Kang, Koji Fujita, Eva Huintjes, Jianqing Xu, Takeshi Yamazaki, Shigenori Haginoya, Yang Wei, Dieter Scherer, Christoph Schneider, Tandong Yao
Energy and mass balance of the Zhadang glacier surface, central Tibetan Plateau

ANNALS OF GLACIOLOGY 53(61)

The following papers have been selected for publication in Annals of Glaciology *53(61) (thematic issue on Physics, Chemistry and Mechanics of Snow), edited by Barbara Turnbull*

Sergey A. Sokratov, Nikolai A. Kazakov
Dry snow metamorphism expressed by crystal shape

More papers for *Annals* 53(61) will be published in the next issue

Book received

Jouzel J, Lorius C and Raynaud D (2013) *The white planet: the evolution and future of our frozen world.* Princeton University Press, Woodstock, Oxfordshire. 306 pages.
ISBN: 978-0-691-144993 (cloth)

ANNALS OF GLACIOLOGY 54(62)

The following papers have been selected for publication in Annals of Glaciology *54(62) (thematic issue on Seasonal Snow and Ice), edited by Matti Leppäranta*

Helen Dahlke, Steve Lyon
Early melt season snowpack isotopic evolution in the Tarfala valley, northern Sweden

Agnieszka Herman
Numerical modeling of force and contact networks in fragmented sea ice

Wenfeng Huang, Zhijun Li, Xiaoyan Liu, Haiqian Zhao, Shuai Guo, Qing Jia
Effective thermal conductivity of reservoir fresh ice with attention to high temperature

Susanne Ingvander, Helen E. Dahlke, Peter Jansson, Sylviane Surdyk
In-situ snow particle sizes of the Antarctic ice sheet and their relation to physical and remotely sensed snow-surface parameters

Yukiyoshi Iwata, Tomotsugu Yazaki, Shinji Suzuki, Tomoyoshi Hirota
Water and nitrate movements in an agricultural field having different soil frost depths: field experiments and numerical simulation

Chengyu Liu, Wei Gu, Jinlong Chao, Lantao Li, Shuai Yuan, Yingjun Xu
Spatio-temporal characteristics of the sea-ice volume of the Bohai Sea, China, in winter 2009/10

Daiki Nomura, Philipp Assmy, Gernot Nehrke, Mats A. Granskog, Michael Fischer, Gerhard Dieckmann, Agneta Fransson, Yubin HU, Bernhard Schnetger
Characterization of ikaite ($CaCO_3 \bullet 6H_2O$) crystals in first-year Arctic sea ice north of Svalbard

Hiroki Shibata, Koh Izumiyama, Kazutaka Tateyama, Hiroyuki Enomoto, Shuhei Takahashi
Sea ice coverage variability on the northern sea routes, 1980-2011

Thomas Skaugen, Frode Randen
Modeling the spatial distribution of snow water equivalent, taking into account changes in snow-covered area

Jennifer Sobiech, Wolfgang Dierking
Observing lake- and river-ice decay with SAR: advantages and limitations of the unsupervised *k*-means classification approach

Bing Tan, Peng Lu, Zhijun Li, Runling Li
Form drag on pressure ridges and drag coefficient in the northwestern Weddell Sea in winter

Mihaela Triglav- ekada, Matej Gabrovec
Documentation of Triglav glacier using non-metric panoramic images

D. Vikhamar-Schuler, I. Hanssen-Bauer, T.V. Schuler, S.D. Mathiesen, M. Lehning
Use of a multilayer snow model to assess grazing conditions for reindeer

Caixin Wang, Liqiong Shi, Sebastian Gerland, Mats A. Granskog, Angelika H.H. Renner, Zhijun Li, Edmond Hansen, Tõnu Martma
Spring sea ice evolution in Rijpfjorden (80°N), Svalbard, from in-situ measurements and Ice Mass Balance Buoy (IMB) data

G. Zdorovennova, R. Zdorovennov, N. Palshin, A. Terzhevik
Optical properties of the ice cover on Vendyurskoe lake, Russian Karelia (1995–2012)

More papers for *Annals* 54(62) will be listed in the next issue

ANNALS OF GLACIOLOGY 54(63)

The following paper has been selected for publication in Annals of Glaciology *54(63) (thematic issue on Glaciers and ice sheets in a warming climate), edited by Gwenn Flowers*

David Alexander, Tim Davies, James Shulmeister
Basal melting beneath a fast-flowing temperate tidewater glacier

Andrew Bliss, Regine Hock, J. Graham Cogley
A new inventory of mountain glaciers and ice caps for the Antarctic periphery

Roger J. Braithwaite, Sarah C.B. Raper, Romain Candela
Recent changes (1991–2010) in glacier mass balance and air temperature in the European Alps

Seth Campbell, Greg Balco, Claire Todd, Howard Conway, Kathleen Huybers, Christopher Simmons, Michael Vermeulen
Radar-detected englacial stratigraphy in the Pensacola Mountains, Antarctica; implications for recent changes in ice flow and accumulation

Seth Campbell, Samuel Roy, Karl Kreutz, Steven Arcone, Erich Osterberg, Peter Koons
Strain-rate estimates for crevasse formation at an alpine ice divide: Mount Hunter, Alaska, USA

Hermann Engelhardt, Barclay Kamb
Kamb Ice Stream flow history and surge potential

Gabrielle Gascon, Martin J. Sharp, Andrew B.G. Bush
Changes in melt season characteristics on the Devon Ice Cap, Canada, and their association with the Arctic atmospheric circulation

Wanqin Guo, Shiyin Liu, Junfeng Wei, Weijia Bao
The 2008/09 surge of Central Yulinchuan Glacier, northern Tibetan Plateau, monitored by remote sensing

Ute C. Herzfeld, Brian McDonald, Maciej Stachura, Robert Griffin Hale, Phillip A. Chen, Thomas Trantow
Bering Glacier surge 2011: analysis of laser altimeter data

Ute C. Herzfeld, Brian McDonald, Alexander Weltman
Bering Glacier and Bagley Ice Valley surge 2011: crevasse classification as an approach to map deformation stages and surge progression

Martin Heynen, Francesca Pellicciotti, Marco Carenzo
Parameter sensitivity of a distributed enhanced temperature-index melt model

Andreas Linsbauer, Frank Paul, Horst Machguth, Wilfried Haeberli
Comparing three different methods of modelling scenarios of future glacier change in the Swiss Alps

Clément Miège, Richard R. Forster, Jason E. Box, Evan W. Burgess, Joseph R. McConnell, Daniel R. Pasteris, Vandy B. Spikes
Southeast Greenland high accumulation rates derived from firn cores and ground-penetrating radar

Marco Möller, Roman Finkelnburg, Matthias Braun, Dieter Scherer, Christoph Schneider
Variability of the climatic mass balance of Vestfonna ice cap (northeastern Svalbard) in the period 1979–2011

Torbjørn I. Østby, Thomas V. Schuler, Jon Ove Hagen, C.H. Reijmer, Regine Hock
Parameter uncertainty, refreezing and surface energy balance modelling at Austfonna ice cap, Svalbard, over 2004–2008

F. Paul, N.E. Barrand, S. Baumann, E. Berthier, T. Bolch, K. Casey, H. Frey, S.P. Joshi, V. Konovalov, R. Le Bris, N. Mölg, G. Nosenko, C. Nuth, A. Pope, A. Racoviteanu, P. Rastner, B. Raup, K. Scharrer, S. Steffen, S. Winsvold
On the accuracy of glacier outlines derived from remote sensing data

Lene Petersen, Francesca Pellicciotti, Inge Juszak, Marco Carenzo, Benjamin W. Brock
Suitability of a constant air temperature lapse rate over an Alpine glacier: testing the Greuell and Böhm model as an alternative

L. A. Rasmussen
Meteorological controls on glacier mass balance in High Asia

C.A. Reese, K.B. Liu, Lonnie G. Thompson
An ice-core pollen record showing vegetation response to late-glacial and Holocene climate changes at Nevado Sajama, Bolivia

Rafael da Rocha Ribeiro, Edson Ramirez Rodriguez, Jefferson Cardia Simões, Abraham Machaca
Forty-six years of environmental records from the Nevado Illimani lacier group, Bolivia, using digital photogrammetry

Daiki Sakakibara, Shin Sugiyama, Takanobu Sawagaki, Sebastián Marinsek, Pedro Skvarca
Rapid retreat, acceleration and thinning of Glaciar Upsala in the Southern Patagonia Icefield, initiated in 2008

M. Tedesco, C.M. Foreman, J. Anton, N. Steiner, T. Schwartzman
Comparative analysis of morphological, mineralogical and spectral properties of cryoconite in Jakobshavn Isbræ, Greenland, and Canada Glacier, Antarctica

James Turrin, Richard R. Forster, Christopher F. Larsen, Jeanne M. Sauber
The propagation of a surge front on Bering Glacier, Alaska, 2001–2011

Benjamin Wagman, Ginny A. Catania
The impact of subglacial hydrology on the force balance of a physically modeled ice stream

Gifford J. Wong, Robert L. Hawley, Eric R. Lutz, Erich Osterberg
Trace element and physical response to melt percolation in Summit, Greenland snow

Harry Zekollari, Philippe Huybrechts, Johannes Fürst, Oleg Rybak, Olaf Eisen
Calibration of a higher-order 3-D ice flow model of the Morteratsch Glacier complex, Engadin, Switzerland

More papers for *Annals* 54(63) will be listed in the next issue

ANNALS OF GLACIOLOGY 54(64)

The following paper has been selected for publication in Annals of Glaciology *54(64) (thematic issue on The geophysics of the cryosphere and glacier products), edited by Bernd Kulessa*

Adam Booth, Andrew Mercer, Roger A. Clark, Tavi Murray, Peter Jansson, Charlotte Axtell
A comparison of seismic and radar methods to establish the thickness and density of glacier snow-cover

Bryn Hubbard, Terry Malone
Optical televiewer-based logging of the uppermost 630 m of the NEEM deep ice borehole, Greenland

Nanna Karlsson, Dorthe Dahl-Jensen, S. Prasad Gogineni, John D. Paden
Tracing the depth of the Holocene Ice in north Greenland from radio-echo sounding data

Aleksey Marchenko, Eugene Morozov, Sergey Muzylev
Measurements of sea ice bending stiffness by pressure characteristics of flexural-gravity waves

Atsuhiro Muto, Sridhar Anandakrishnan, Richard B. Alley
Subglacial bathymetry and sediment layer distribution beneath the Pine Island Glacier ice shelf, West Antarctica, modeled using aerogravity and autonomous underwater vehicle data

André Nuber, Lasse Rabenstein, Jochen A. Lehmann-Horn, Marian Hertrich, Stefan Hendricks, Andy Mahoney, Hajo Eicken
Water content estimates of a first-year sea-ice pressure ridge keel from surface-nuclear magnetic resonance tomography

David E. Stillman, Joseph A. MacGregor, Robert E. Grimm
Electrical response of ammonium-rich water ice

Andrew Stumpf, Ahmed Ismail
High-resolution seismic reflection profiling: an aid for resolving the Pleistocene stratigraphy of a buried valley in central Illinois, USA

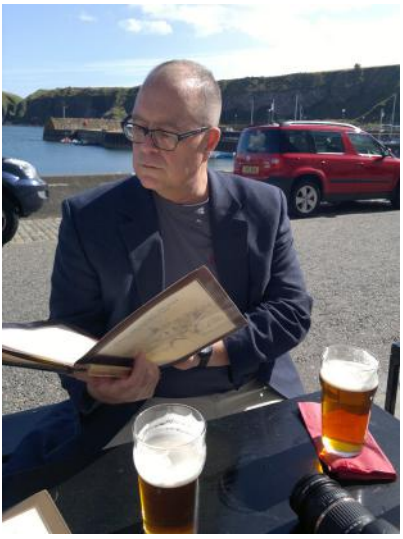
More papers for *Annals* 54(64) will be listed in the next issue

British Branch Meeting 2012

5–6 September 2012
University of Aberdeen, Aberdeen

Scotland has had the rainiest summer on record this year. The 37th annual meeting of the British branch of the IGS, however, commenced with fine weather in the 'granite city' of Aberdeen, Scotland. The meeting was hosted and organized by the Cryosphere and Climate Change group in the School of Geosciences at the University of Aberdeen (thank you Brice, David, Doug, James, Matteo and Rob). A program of 38 oral presentations (a significant portion of which featured student presenters), 18 posters and a 'public debate' co-sponsored by the British Science Festival (also hosted by the University of Aberdeen for the week) made for an engaging visit to the granite city.

Following the public debate on 'The Future of Our Polar Regions' featuring David Vaughan, Peter Nienow and David Macdonald, a wine reception was held in the new campus library (one of the few examples of modern architecture in Aberdeen that does not conflict with its granite uniformity). The first full day of the meeting began with a session on Arctic Glacial Hydrology and Dynamics featuring six student presentations (Tom Cowton, Alison Banwell, Jonny Kingslake, Catriona Butler, Sam Doyle and Christine Dow) and only one presentation of an 'elder' (Richard Hodgkins). The student presentations in this session, and in all that followed (both oral and poster) were over the top. (The high quality of the science and clarity of presentations by students prompted Liz Morris, of the Scott Polar Research Institute, to speculate that parents of the recent past deserve some kind of an award for creating a younger generation that is smarter than those of us who are in their later career stages.) Oral sessions continued with talks on Recent Glacial Change and Basal Processes (mostly involving Arctic-oriented research) and Glacial History (with fascinating talks ranging from local Scottish glacial geology (Clare Boston, Derek Fabel and Danni Pearce) to studies of inverted basal channels in Antarctic ice shelves that conspicuously coincide with grounding-line outflow of subglacial water streams (Anne Le Brocq). Eighteen posters on a variety of subjects (including cryoconite casserole recipes by Michaela Musilova of Bristol University) preceded a Panel Session of the UK Polar Network on Conquering Fieldwork. (At this session, sage advice was given by various 'old hands' to the younger people considering field work: don't put



Doug MacAyeal, IGS President, reviews the prospects for the upcoming IGS BB meeting. After hiking with the Secretary General on a sightseeing trip to Dunnottar Castle the day before the meeting, the two developed a need for re-hydration, which they satisfied in nearby Stonehaven.

The Secretary General where he feels quite at home – in the 'Thief's Hole' at Dunnottar Castle. In the old days, one misplaced reference citation or extra word over the maximum in the abstract would land you in this place. Fortunately, with the on-line submission system, the only hole likely to be encountered nowadays is digital.

Roger Hooke derives great enjoyment from Martyn Tranter's presentation.

The latest Seligman Crystal awardee, David Sugden, displays the Crystal, accompanied by John Glen, who had been awarded the Crystal 40 years before, in 1972.

Richard 'the Enforcer' Hindmarsh chaired an interesting session and mercilessly enforced the time limits imposed on the speakers.

The Sugdens and the IGS President, pictured as the latter, ever the gentleman, presents Britta Sugden with a bouquet of flowers.

As always, the IGS BB meeting attracts participants from different generations. Liz Morris, former IGS President, and Alison Cook enjoying the poster session.

David Sugden's 'Family Tree'. His academic descendants congregated at the meeting to honour their mentor.

British Branch President, Jemma Wadham, addressing the banquet guests to introduce the after-dinner speaker. The banquet was held at the Foyer Restaurant, which doubles as an art gallery – very posh.

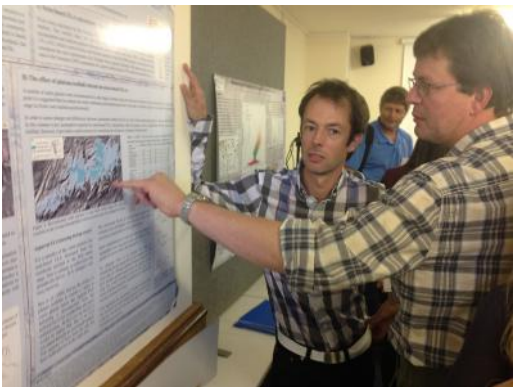
down your rucksack and assume that you'll hike back to it, don't separate yourself from your food, dust destroys tent zips, usually just prior to the mosquito 'mozzy' season...)

The signature event of the first day was the presentation of the Seligman Crystal to Professor David Sugden before the evening's banquet. The presentation featured a moving citation presented by Martyn Tranter, followed by David Sugden's address entitled 'A Geomorphologist in the Glaciological World'. This presentation of the 33rd Seligman Crystal (see additional material in this issue of ICE) was attended by John Glen, the recipient of the 4th Seligman Crystal. John's attendance was a reminder to David that the award does not signify any reason to ease up in one's commitment to glaciological research!

The conference dinner was held immediately after the award presentation at the Foyer Restaurant and Gallery in downtown Aberdeen (a portion of proceeds received by the Foyer paid by meeting participants was donated to local charity). The menu was delicious (excellent wines, local salmon and vegetables, piquant dessert treats), but the main enjoyment came from the various toasts that were held in honor of the Branch meeting, the new Seligman Crystal laureate and the gathering of good friends and colleagues. Following president Jemma Wadham's gracious welcome, Martyn Tranter took the floor with various toasts and stories, culminating in the account of his recent experiences in airport security while attempting to carry formaldehyde-preserved samples in his hand luggage. The evening concluded with various groups exploring the pub culture of Aberdeen in search of its excellent cask-conditioned ales.

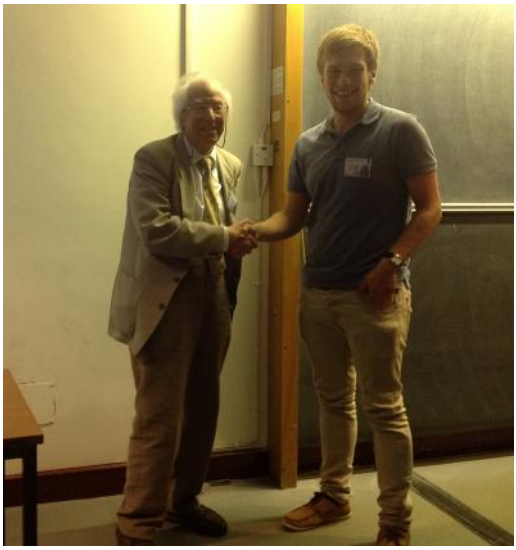
It has become a tradition that the after-dinner speech is given by Martyn Tranter. Invariably it involves anecdotes of glaciological exploits in various parts of the word and includes illuminating accounts of consumption of the type of refreshment displayed behind Martyn.

The second day of the meeting again featured stirring talks and continued poster discussion on a range of subjects including glacial biochemistry, glacial sedimentology, exploration of subglacial Lake Ellsworth, microbes that eat rock, an awe-inspiring session on ice-sheet modeling (this intimidated the session host so much that he threatened that any speakers who took more than their allotted time would have their picture posted on Facebook with Doug and Magnús wearing their Glengarry hats), and geophysical observations of surface and basal features of Antarctica and Svalbard. During the lunch hour, the AGM of the British branch of the IGS was



It may look like a tablet computer, but actually it's a sophisticated camera. Tom Bradwell was about to explain his poster to Derek Fabel when they were rudely interrupted by a large, bearded man waving an iPad about.

For decades John Glen has attended the IGS British Branch meeting and carefully reviewed the contributions made by student participants. Here he is presenting Danni Pearce with the prize for the best oral student presentation ...



...while Jeremy Ely won the prize for the best student poster.

held. The discussion and announcements focused on various aspects of IGS policy and practices that determine its effectiveness in supporting the science of glaciology. The day concluded (in time for departing travel) with the presentation of the John Glen Prize for Best Student Oral and Best Student Poster presentations. This year's winners were Danni Pearce of the University of Worcester for her oral presentation on 'Evidence for a late glacial plateau icefield in the Tweedsmuir Hills, Southern Uplands, Scotland' and Jeremy Ely of the University of Sheffield for his poster presentation on 'Reassessing the validity of the subglacial bedform continuum'. The meeting ended with a round of thanks to Doug Mair and his local organizers for an excellent experience. Next year's British branch meeting will be held in Loughborough.

Doug MacAyeal

Seligman Crystal 2012

Presented to Professor David Sugden
Aberdeen, UK, 5 September 2012

The Society's Council agreed unanimously in 2012 that a Seligman Crystal should be awarded to David Sugden. The Crystal was presented at the British Branch Meeting of the Society. After the presentation ceremony, Professor Sugden gave the following address.

I am humbled but very honoured to receive the Seligman Crystal. There is nothing more precious than to be honoured by one's own community. This is especially so when that community is international, cross-disciplinary, and studying a topic of such importance for humanity as glaciology.

What I would like to do in this lecture is first, to take you back to what it was like to start in glaciology in the 1960s, second, to look at highlights of discoveries made by a series of research students and post docs with whom I have been fortunate to work, and finally, to relate a few key discoveries, even 'eureka moments', of a field scientist in both East and West Antarctica.

I first caught the glacier bug whilst as a 16-year-old I participated in a Brathay survey of Tunsbergdalsbreen in Norway and followed it up with student expeditions to Iceland and Greenland. I marvel at the different attitude to Health & Safety in those days. On the 1962 Oxford University Expedition to East Greenland, organized with Brian John, we dropped supplies and two folding kayaks by parachute to near Syd Kap in inner Scoresby Sund (Fig. 1). We chartered a DC3 from Icelandair and, flying from Mestersvig with no door and no seats, we followed the advice given to us when borrowing the parachutes from the Royal Air Force in Brize Norton, namely, tie the rip cord firmly to the plane. Out went the first load and, one second later, so also did the whole luggage rack to which it was attached! The remaining loads were then attached (at the pilot's request) to his seat!

It was on this expedition that I got news that I had been offered a Department of Science and Industrial Research studentship; the telegram was dropped from an Erzberg mine plane weighted with a slab of butter. This led to a thesis on glacial erosion in the Cairngorm Mountains in Scotland. My supervisor, Marjorie Sweeting, an expert on karst, did suggest that the study of erosion would be impossible to date and thus limiting. Looking back I see that my thesis was classic landscape evolution, following in the mould

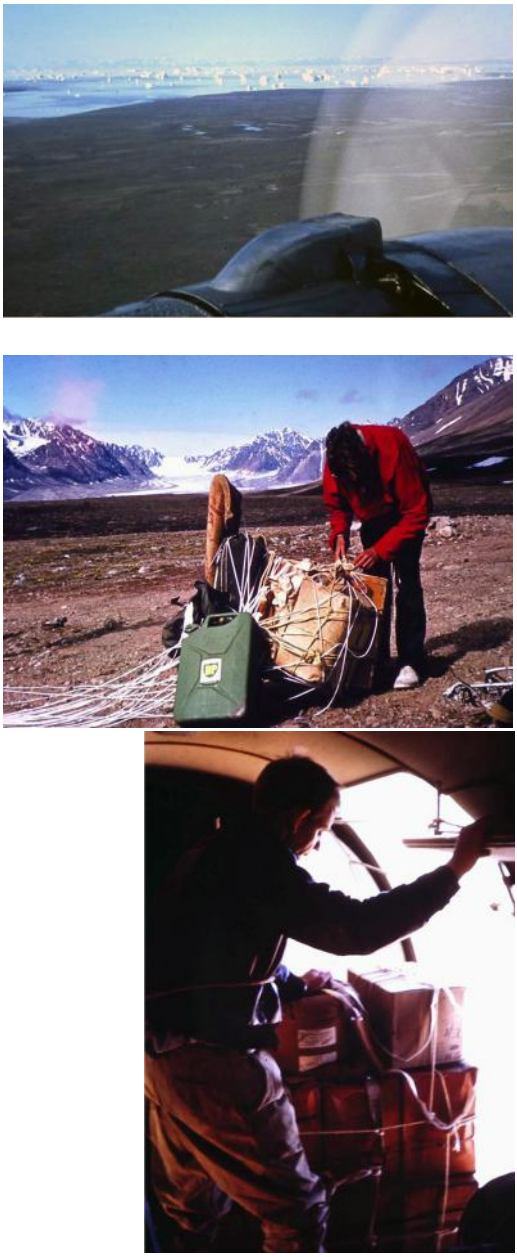


Fig. 1 Dropping freight parachutes from a DC3 in inner Scoresby Sund and Jameson Land on a student expedition to East Greenland in 1962.

Fig. 2 Brian John and I worked with the Whirlwind helicopters of HMS Protector in the South Shetland Islands in 1965/66.

of the geomorphological paradigm of William Morris Davis. There was little on processes or why the landscape of upland tors and clean troughs had been dissected in such a selective manner by glaciers.

In the early years as a lecturer in the University of Aberdeen, I tried to compensate by reading all back issues of the *Journal of Glaciology* to try and understand more about glacial processes. So did Brian John at Durham, and it was John Davey at Edward Arnold who encouraged us to refine and publish our early lecture notes together as *Glaciers and Landscape* in 1976. Others, such as Geoffrey Boulton, were discovering the significance of basal thermal regime in controlling processes of glacial deposition and it was logical to expand this to landscapes, first in Greenland with the aid of air photographs in the Geodetic Institute in Copenhagen, and then, at the encouragement of John Andrews, to the Laurentide Ice sheet, where Molly Mahaffy had developed an early ice-sheet model under his supervision. Most of you in this room will find it difficult to imagine the construction of a computer model in the 1970s. Every evening I would go across campus to the computer centre with my armful of punch cards. The programme ran overnight and for at least a month my results came through with error messages. With the help of my room mates, Giff Miller and Jim Clark, the program eventually worked and it was then possible to compare the pattern of basal thermal regime with the distribution of landscape types and thus begin to relate landscape to process.

Perhaps the best thing about a university post is the joy of working with bright young scientists brimming with optimism and new skills. It is impossible to mention all, but a few examples will make the point. Martin Sharp was one such postgraduate who came to work on surging glaciers in 1978/9. Chalmers Clapperton and I clearly remember four classes he offered to give to our class on glacier processes. These took up a challenge clearly posed by W.S.B.Paterson in *The Physics of Glaciers* (1969) and showed how glacier theory could be tested and refined by well posed field observations. Working with Roland Souchez, Reggie Lorraine and Jean-Louis Tison from Bruxelles, Peter Knight examined the debris and isotopic characteristics of regelation ice exposed at the margin of the Greenland Ice Sheet. We were puzzled by the discovery of refrozen clear ice with an isotopic signature close to average for Greenland, no fractionation, and widely-spaced clots of fine debris, which indicated refreezing en masse in a closed system, perhaps in the interior. In the light of modern hydrological studies, could these be formed by the freezing of surface lake drainage to the base when the discharge does not connect with subglacial drainage routes? It would help explain the puzzling characteristics.

A number of research students and postdocs developed ice-sheet models that helped develop the links between landscape, climate and ice-sheet behaviour. The research students gained invaluable experience, firstly from Bill Budd in Australia and then from Hans Oerlemans, who ran a series of European-wide modelling courses. There are several highlights that changed the scientific questions we ask. Tony Payne showed how topography could introduce sensitive tipping points in the growth of an ice sheet, determining for example whether the ice would remain in the mountains or, exposed to a slightly colder climate, expand to its maximum extent. Nick Hulton showed that the southern westerlies must have moved north during glaciations in order to simulate the known extent of the Patagonian ice sheet; further, both the present ice fields and a large ice sheet could survive in equilibrium with the present-day climate, a theme followed up in Iceland by Andrew Mackintosh. Alun Hubbard introduced longitudinal stress into the models and was able to represent ice-sheet behaviour at the resolution of individual valleys. The importance

of this is that there is a wealth of observational information at such a scale on the beds of the former northern hemisphere, mid-latitude ice sheets that can be used to refine ice-sheet models. Nick Golledge used this approach to show how modelled ice velocities beneath the Younger Dryas ice-sheet in Scotland correlated with a radial pattern of intermediate-sized troughs. A further step is to separate out those erosional forms associated with larger ice sheets, for example the remarkable assemblage of landforms identified by Tom Bradwell caused by a major ice stream flowing from northwestern Scotland to the 'delta' at the edge of the continental shelf.

A modelling approach can also be used to predict the landforms beneath current ice sheets. Stewart Jamieson modelled the extent and basal thermal regime of the Antarctic ice sheet at various stages of its evolution, making it possible, for example, to identify landscapes starting with alpine glaciation and later becoming protected beneath cold-based ice, landscapes associated with the same direction of ice flow during minimum and maximum glacial stages, and those landscapes where ice flow changes direction from stage to stage and may even concentrate deposits. As our understanding of the bed of the Antarctic ice-sheet advances through boreholes and remote sensing, this approach will do much to aid interpretation and the effect of the bed on ice-sheet dynamics.

I have been fortunate to work in the field in Antarctica on some 15 occasions, first with Brian John and Chalmers Clapperton in South Georgia, the South Shetlands and Antarctic Peninsula, and then in the Transantarctic Mountains with George Denton and with others in inner West Antarctica (Fig. 2). Perhaps I can take the opportunity to share two 'eureka moments' associated with the case that the East Antarctic Ice Sheet must have existed in approximately its present state for 14 million years. The first, working with David Marchant, was the discovery of glacier ice in Beacon Valley consisting of regelation ice with striated stones (Fig. 3). This was a surprise since we assumed the ice had come from a local valley head where the mean annual temperature is currently around –30°C; as a result all the ice would be below the pressure-melting point and unable to striate stones. The ice is protected beneath a thin rock debris cover with wedges of tundra polygons filled with volcanic ash, later found to be ~8 million years old. Subsequent analysis of the sediment in the ice revealed erratics from outside the local valley and this implied that ice must have moved up-valley from a thicker Taylor Glacier rather than down-valley from a local source. A few days later Roland Souchez, who was analysing the ice in the core, queried whether

Fig. 3 Beacon Valley in the McMurdo Dry Valleys, Transantarctic Mountains. Here basal ice beneath a thin cover of regolith has survived for more than 8 and probably 13 million years. Taylor Glacier, an outlet of the East Antarctic Ice Sheet, flows into the mouth of the valley.

my orientation of the core could have been the wrong way round. He had found that the foliation in the ice indicated ice flow up-valley, confirming our new interpretation! Others have worked on Beacon Valley subsequently and we now believe this thicker ice dates from ~13 million years ago, the oldest glacier ice yet discovered. Its survival surely suggests that the East Antarctic Ice Sheet and its polar climate have remained essentially intact for the same length of time.

The second revealing discovery came from the great age of meltwater flood debris associated with overriding ice in the Dry Valley area. In the Coombs Hills is an area of corrugated sandstone bedrock with coarse ripples of dolerite, linked to a subglacial suite of meltwater channels and plunge pools (Fig. 4). George Denton and I picked up three dolerite clasts resting on flat

Fig. 4 George Denton stands beside a coarse ripple of meltwater flood debris, Coombs Hills, Transantarctic Mountains.

Fig. 5 The exposure ages (Helium-3) of two cobbles from the meltwater flood debris in the Coombs Hills are remarkably old – 8.9–10.4 million years.

Fig. 6 Exposure ages of erratics on the summits and slopes of the Sarnoff Mountains, Marie Byrd Land, show the ice sheet has thinned by over 800 m in the last 12 000 years.

sandstone bedrock in mid-valley which were part of the bedload of the meltwater event. Analysis of helium-3 in the rocks by Helen Margerison (Quinn) revealed astonishing exposure ages of between 8 and 10 million years (Fig. 5). Allowing for erosion of the clasts puts the ages at ~13–14 million years. So, while the Mediterranean Sea was formed, the isthmus of Panama joined up South and North America and the North Atlantic Ocean widened by almost a third, these brick-sized clasts have remained undisturbed. This reflects the extremely low erosion rates under the present polar climate. Any period of warmth in the last 14 million years would surely have weathered away the clasts. It is truly humbling to stand in such a landscape that is so old.

I would like to tell you of our present research looking at blue-ice moraines in the Heritage Range, in the Ellsworth Mountains block. Earlier work with John Stone showed how in parts of Marie Byrd Land the West Antarctic Ice Sheet has been thinning for at least 12 000 years (Fig. 6). However, work with Mike Bentley and Anne Le Brocq in the Ellsworth Mountains suggests limited thinning of the Weddell Sea sector since the Last Glacial Maximum. Subsequent exposure-age work with Chris Fogwill and Andy Hein in the Shackleton Range shows neither thickening of outlet glaciers at the Last Glacial maximum nor thinning subsequently. This includes major glaciers flowing into the Weddell Sea sector from the East Antarctic Ice Sheet. Perhaps their stability is related to the extreme depth of an offshore trough cut during earlier glaciations. The blue-ice moraines in the Heritage Range are associated with a puzzling mix of exposure ages up to ~400,000 years in age and, working with Andy Hein, John Woodward and Stuart Dunning, in 2012/15 we plan to study the moraine forming processes using radar, ice flow studies, an unmanned small aircraft and exposure ages. If we can understand the mix of ages, we may begin to unravel a rich history of ice-sheet behaviour over half a million years.

There are many people who I want to thank for the award of the Seligman Crystal. First, as the names I have already mentioned illustrate, I have enjoyed remarkable support from the community of the International Glaciological Society. We have a friendly and open approach which encourages ideas and cross-disciplinary collaboration. I particularly thank those who took the trouble to recommend and support me. Second, I owe so much professionally to young colleagues and there are many more significant contributions than I have not had space to mention. It is especially good to see so many young glaciologists in this room. Lastly, my wife Britta has been a staunch glaciology supporter. Though sometimes wishing I had specialised in coral reefs, she handled her business and three small children with aplomb during my too many absences in the field or in the study. It has been quite a journey since that day when she came to hear a lecture about our 1962 Greenland Expedition, which was the occasion when we first met!

David Sugden

Nordic Branch Meeting 2012

25–27 October 2012
Stockholm, Sweden

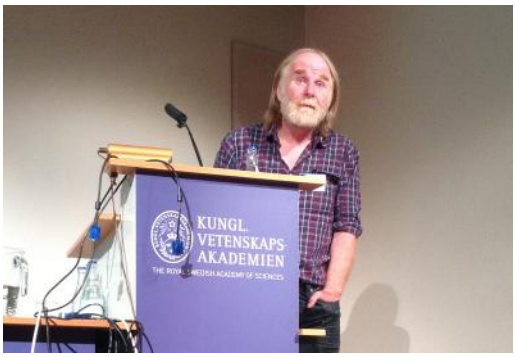
Of the IGS's various branch meetings, that which takes place in late October every year in one of the Nordic countries (Finland, Sweden, Norway, Denmark, Iceland) offers the greatest variety in venue. This year, the Nordic Branch (NB) met in Stockholm, Sweden, following the 2011 meeting in Oslo, Norway, and in anticipation of the 2013 meeting in Helsinki, Finland. For me, the NB meetings (along with the IGS symposium on seasonal snow and ice held in Lahti, Finland, last May) have given me my first travel experiences in Scandinavian countries. This year, I began my trip to Stockholm several days in advance of the NB meeting so that I would have time to see for the first time some of the cultural attractions of the city at a time of year when there are fewer tourists. I spent the day immediately before the start of the NB meeting in a sequence of strategic business meetings with my friend and colleague Magnús Magnússon, Secretary General of the IGS, at various museums and restaurant venues across Stockholm. Between discussing current trends in open-access publication, the ever increasing membership count of the IGS, and the fine points of pickled herring and aquavit, Magnús and I managed to see the National Museum of Antiquities (with an outstanding exhibit on Viking culture), the Vasa Museum (site of the restored 15th century Swedish battleship that capsized almost immediately after being launched), and the majestic Stockholm City Hall (site of the Nobel Banquet).

The NB meeting began on a cool, sunny morning in the Beijersalen (lecture hall) within the Kungliga Vetenskapsakademien (KVA, or Royal Swedish Academy of Sciences) building located next to the campus of Stockholm University. This venue is famous for hosting the committees that select the Nobel Prize winners for Physics and Chemistry, and is adorned with various busts and paintings of eminent Swedish scientists who have led science forward over the centuries. (The KVA was founded by naturalist Carl Linnaeus in 1739, and is only a stone's throw away from Svante Arrhenius road, named after the chemist who did so much to understand what we refer to now as the greenhouse effect, and who's name labels the term in the glaciological flow law involving the way temperature influences rates of deformation.)

This year's meeting was held in the Royal Academy of Sciences in Stockholm where, appropriately, the Nobel Prizes in Physics and Chemistry are decided each year.

We had many colleagues from North America. They had used the opportunity to attend various other project meetings. Here, Jesse Johnson from Montana is talking about using surface velocity observations to infer the parameter in a basal hydrology model.

Following greetings and introduction of the local organizing committee, Caroline Clason and Susanne Ingvander, by Peter Jannson representing Stockholm University, Björn Dahlbäck, head of the co-sponsoring Swedish Polar Research Secretariat, and I (as current president of the IGS) made a few short remarks to kick the meeting off. As part of my remarks, I introduced the *Ymir Awards.* These awards were conceived by the NB to honor the most effective oral and poster presentations made by students—much like the *Glen Prizes* are awarded to students at the British Branch Meeting. *Ymir* is a particularly fitting name for the awards, because according to Norse mythology (see http://en.wikipedia.org/wiki/Ymir) Ymir was one of the beings present at the creation of the Earth, and is said to have an original connection to glaciology by having been born from the 'poisons of an icy river.' After his destruction by other Norse gods who were angry with him, the torn bits of Ymir's flesh gave rise to the world's first graduate students (known as 'dwarves' at the time). The inaugural presentations of the Ymir Awards were made on the last day of the NB meeting to Katrin Lindbäck, from Uppsala University, for the best poster presentation, and to Timo Riikilä from Jyväskylä University, for the best oral presentation. Katrin and Timo were given an official IGS beanie hat and a US National Football League Minnesota Vikings team football (brought from North America as evidence of past Viking presence) as tangible representations of their prestigious honour. (Liss Andreassen and I were asked to decide the award but were hard pressed to differentiate among the extremely well-presented talks and posters of the many students attending the NB meeting. Eventually we had to resort to a few coin tosses to settle the matter.)



When Doug Benn says there is a hole in your ice, he is likely to have been inside it... He gave an interesting explanation for how englacial cave systems originate as surface steams. Plus, he showed wonderful pictures of glaciers near Mt. Everest...

Martina Schäfer gave a presentation on a tour de force modelling study of the ice caps on Svalbard.

The first oral session on 'Glacier Dynamics and Hydrology' was co-chaired by Alun Hubbard, Helen Dahlke and Rickard Pettersson, and began with an inspiring talk by Professor Jesse Johnson from the University of Montana in the USA. Jesse, along with Neil Humphrey and Joel Harper, who were also visiting from the USA, was in Stockholm in order to attend the GAP (Greenland Analogue Project) workshop that had taken place immediately before the NB meeting. Following Jesse's talk came a series of three presentations on the subject of rapid tapping of supraglacial lakes by englacial conduits in Greenland. These amazing presentations presented for the first time a complete image of the kinematics and seismological source geometry of events surrounding rapid lake drainage to the bed of an ice sheet. The talks were made ever so much more lively by the fact that they were presented by three students working with Alun Hubbard: Samuel Doyle, Christine Dow and Glenn Jones – all visiting from the UK and attending the GAP workshop to share the results of their most recent field work with colleagues in the Scandinavian countries. In all, there were 110 participants at the NB meeting, from 18 countries.

The meeting was off to a good start by the time of the first lunch break (including, as always for IGS events, delicious and healthy selections of local cuisine) when it was clear that student participation in the meeting dynamics was going to be highly energetic. Through the rest of the 3 days, over half of the 47 oral and 35 poster presentations would feature students as presenting authors. This stimulated particularly vibrant discussion during the various coffee breaks and meals, because much of the focus of the meeting was on on-going work in the process of being created. The forefront of research was clearly on display during the rest of the oral and poster sessions, which included: 'Geomorphology, Geochronology and

Unbelievable! You walk out of the T-bann (subway) station at the University of Stockholm stop and what do you immediately see??! A granite outcrop that has been erosively moulded and striated by ice! This place calls out to glaciologists!

Glaciochemistry' chaired by Rickard Pettersson, 'Glacier Inventory and Changes' chaired by Doug Benn and Kirsty Langley, 'Remote Sensing' chaired by Kirsty Langley, 'Modelling' chaired by Alexander Jarousch, 'Climate Change and Sea Level' chaired by Stefan Wastegård and 'Mass Balance Observations and Modeling' chaired by Liss Andreassen and Andrew Mercer. What impressed me most about the presentations, besides the high quality of thinking and vigorous application of observational technique on display, was the great geographic range covered by the projects covered by the NB meeting participants. On the local scale, there was the seminal announcement of the new Inventory of Glaciers in Norway produced from years of hard work led

The 'brains' behind the IGS NB 2012 meeting, Liss Marie Andreassen, chair of the NB awards committee and Peter Jansson, chair of the local organizing committee.

And the team that actually made it all work, the dynamic duo of Susanne Ingvander and Caroline Clason. They were, of course, assisted by several enthusiastic Oompaa Loompas.

by Liss Andreassen and her colleagues. In addition to presentations involving ice in Greenland and Antarctica, there were presentations involving research done in the high Himalaya of South Asia featuring adventurers of the likes of Doug Benn and Miriam Jackson. Miriam's presentation about cooperative glaciological research in Bhutan oriented toward assessing water resources for hydroelectric power featured a humorous contrast between conducting such research using helicopter support out of Oslo, Norway, and doing the same work using horses and porters 'off the grid' in Bhutan.

Liss Andreassen with the winners of the Ymir awards, Katrin Lindbäck from Uppsala University for the best poster presentation and Timo Riikilä from Jyvarskyla University for the best oral presentation. They are here seen proudly displaying their prizes, an IGS beanie and a Minnesota Vikings American football.

Attending the NB meeting in Stockholm allowed travellers to spend a day in advance of the meeting visiting some of Stockholm's archaeological and cultural sights such as the fantastic Vasa museum. Seen here are the gun ports where the water flowed in that ultimately led to the sinking of the flagship of the Swedish navy on its maiden voyage after sailing only a few hundred yards.

As always, there was a smörgåsbord of fun to be had at the meeting's ceremonial banquet, where in the past (e.g. in 2011) rock-and-roll concerts and other fun have been known to happen. During the banquet, the usual round of thank-you's and toasts was given (particularly to the local organizing committee mentioned above and their helpers: Hernán De Angelis, Pia Eriksson, Ping Fu, Moa Hamre, Christian Helanow, Jacob Heyman, Peter Jansson, Malin Johansson, Ayaka Okamoto, Ikumi Oyabu, Julien Seguinot, and Carl-Anton Wahlström), the IGS President and Secretary General brandished their hats and Swedish steel (they collect knives from countries that the IGS holds meetings in, and this time they purchased Mora knives made in Sweden), and the 2013 NB meeting venue was announced by Onni Järvinen (to be held in or near Helsinki, Finland). The meeting concluded on Saturday in the Nordenskiöldsalen (a lecture hall named after A.E. Nordenskiöld) in the Geosciences building of the Stockholm University. All in all, the all too brief trip from Chicago to Stockholm to attend the NB meeting was utterly delightful and wonderfully stimulating to the glaciological mind.

Doug MacAyeal

Meetings of other societies

ICE-SHEET MASS BALANCE AND SEA LEVEL (ISMASS) WORKSHOP,

Portland, Oregon, USA, 14 July 2012

The ISMASS 2012 Workshop was held on 14 July 2012 in Portland, Oregon, USA, under the auspices of the XXXII SCAR and Open Science Conference. More than 60 participants from all five continents attended the workshop, which was co-sponsored/supported by the Scientific Committee on Antarctic Research (SCAR), the International Arctic Science Committee (IASC), the World Climate Research Programme (WCRP) Climate and Cryosphere (CliC) Project, the International Council of Scientific Unions (ICSU), the International Glaciological Society (IGS), the International Association of Cryospheric Sciences (IACS) and the Association of Polar Early Career Scientists (APECS). A substantial ICSU grant, complemented by contributions from the other sponsors, allowed funding the participation of many young researchers and eight invited lecturers. The latter were Erik Ivins (JPL, Caltech), Ben Smith (Univ. Washington), Pippa Whitehouse (Durham Univ.), Jay Zwally (NASA), Catherine Ritz (LGGE, Grenoble), Slawek Tulaczyk (Univ. California Santa Cruz), Catia Domingues (ACE CRC) and Robert Nicholls (Univ. Southampton).

The workshop was organized by the ISMASS Interim Steering Committee, comprising Francisco Navarro (appointed by IASC), Frank Pattyn (appointed by SCAR) and Edward Hanna (appointed by WCRP).

Among the main objectives of the workshop were:

1. the assessment of the current knowledge of the contribution of the Antarctic and Greenland Ice Sheets to global and regional sea-level

rise (SLR), with a focus on quantifying the uncertainties, and on understanding and resolving the current discrepancies among the estimates from different observational and modelling methods;

2. the analysis of how model-based predictions of ice-sheet discharge contributions to sea-level changes can be improved, with an emphasis on identifying the main shortcomings of the currently available models and suggesting improvements for the next generation of ice-sheet models.

The workshop was organized as a series of invited lectures on the above topics and closely related ones, followed by three round-tables (Ice-sheet mass balance from remote sensing, and GIA; Modelling of ice-sheet dynamics; Contributions from thermal expansion of oceans, and impacts of SLR), and ended with an open discussion on organizational aspects of the ISMASS expert group.

A review paper and a report are being prepared that will include the main scientific outcomes of the workshop. A summary of the main outcomes, the invited lecture abstracts and videos of the entire sessions can be found at the workshop website, http://www.climate-cryosphere.org/en/events/2012/ISMASS/Results.html

Among the outcomes, it became apparent that recent efforts and inter-comparison experiments have led to an improved convergence of the estimates of ice-sheet mass balance determined using the three satellite geodetic techniques of altimetry, interferometry, and gravimetry, though some discrepancies still remain. A consensus was reached that new post-glacial rebound (PGR) models tested and evaluated against geodetic GPS data, lead to significant downwards revision in PGR and GRACE gravimetric satellite estimates of mass loss. Furthermore, since the 2007 IPCC report, ice sheet models have been improved beyond the commonly used shallow-ice approximation. An advance in the numerical schemes has been accompanied by improved model representation of the complex interactions of the ice-sheet with its bed, atmosphere and ocean. However, there is still much room for improvement, especially regarding linking together all the model components in a 3D prognostic fashion.

Participants found the invited lectures absorbing and stimulating.

Steering Committee member Francisco Navarro.

Among the organizational aspects, it was agreed that ISMASS should continue to focus on ice-sheets and, rather than including glaciers and ice caps in its focus of interest, strengthen the co-operation with the existing groups dealing with them (such as IACS, GLIMS). Similarly, rather than creating focus groups under ISMASS, it was preferred to strengthen the co-operation with, and to serve as a liaison among, the many already existing groups/programmes (IMBIE, IACS, GLIMS, FRISP, SERCE/POLENET, AntClim21, PAIS). It was also agreed, after some debate, that it is not the role of ISMASS to generate updates of cryospheric contributions to SLR in between successive IPCC reports. Other subjects of discussion were the interest of extending the ISMASS expert group to the WCRP, the need to redefine the terms of reference of ISMASS and the need to appoint a new Steering Committee and Chair, a process that is now underway.

Francisco Navarro
Contact info: ismass2012@gmail.com

WGMS WORKSHOP ON MEASUREMENT AND UNCERTAINTY ASSESSMENT OF GLACIER MASS BALANCE

Tarfala, Sweden, 9–11 July 2012

The venue – Tarfala Research Station.

From 9–11 July 2012 the World Glacier Monitoring Service (WGMS), in collaboration with Stockholm University, organized a workshop on measurement and uncertainty assessment of glacier mass balance. The workshop built on the results and experience of earlier workshops in Tarfala in 1998 (Published in *Geogr. Ann. A*) and in Skeikampen, Norway, in 2008 (published in *Ann. Glaciol.*). It was held at the Stockholm University Tarfala Research Station in northern Sweden. The major aims of the workshop were to discuss methods and to identify and quantify related uncertainties of mass balance measurements from the ground, air and space, as well as to provide best practices for the homogenization, validation and recalibration of (long-term) observational series. In view of the increasing number of long-term mass-balance series and the fact that there are several glaciers where the geodetic and glaciological results largely diverge, there is a strong need to address the questions raised. The meeting was attended by experts currently performing and (re-)analysing mass-balance measurements by means of glaciological and geodetic methods.

After a long day of travel (participants arrived from North America, Europe and Asia), the group reached Tarfala Research Station in the early evening and was warmly welcomed by the station staff. The station is located in a sub-Arctic alpine environment in the Tarfala valley at 1130 m a.s.l. in the Kebnekaise Mountains, Swedish Lapland. The valley is surrounded by peaks up to 2000 m a.s.l., including the highest Swedish mountain, Kebnekaise Sydtoppen. The station is fully modern with running water and electric power despite being 25 km from the nearest road. It can be reached by foot or by a scenic helicopter flight from the nearest village, Nikkaluokta, a small Sami village near Kiruna. In close vicinity to the station and in direct view from the station's terrace or comfortable living room, the surrounding glaciers can be admired. This includes renowned Storglaciären with its detailed and long mass-balance series, available since 1945/46.

The first day of the workshop included keynote presentations as input for the subsequent discussions on how to tackle the issues mentioned above. These covered uncertainties and problems

The workshop participants, with Isfallsglaciären in the background.

The audience was attentive.

Are Hallgeir and Chris pointing to the highest summit in Sweden (less high than Galdhøpiggen)?

related to the direct glaciological method, re-analysis of long-term mass-balance series and homogenization methods, and co-registration and bias correction of elevation data. Newly available techniques such as airborne laser scanning as well as statistical tools to assess the quality of mass-balance series were discussed, too.

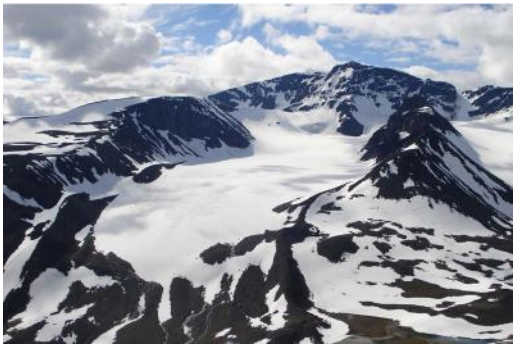
The second day brought an excursion to Storglaciären with on-site discussions of issues discussed the day before. The group safely hiked to Storglaciären (about one hour from the research station) and entered the glacier for an easy walk. The Tarfala staff was mindful of the safety of each participant, and found a compromise on how to tie all members to the rope in the same way. All participants carry out mass-balances measurement on their respective glacier according to certain standards, but apparently everyone uses a unique knot system for the rope. Because there was plenty of snow from last winter, the rope was essential because the glacier was still nearly completely snow-covered, which is rather unusual. In fact, several members of the group unknowingly walked across a large moulin plugged with snow. During the walk, the group got valuable information on the current mass-balance programme and about glacier dynamics, as well as an interpretation of the impressive moraine formations in front of Storglaciären. At the end, an especially motivated sub-group decided to extend the excursion and climb Kebnekaise. Note that there is a north and a south summit, and they even climbed both of them. During the gathering at evening dinner, they reported not only the marvellous view from the top, but also the terrible smell between the two summits, stemming from huge amounts of kerosene that were released by the Norwegian C-130J-30 Hercules plane crash on 15 March 2012. The Tarfala staff is now monitoring the snow and water in the surrounding valleys to evaluate the extent of contamination of the water in the area.

An easy walk on Storglaciären.

The interior of Storglaciären is equally well investigated.

Bernhard and Erich Heucke attended as guests – and undertook the servicing of the Heucke Ice Drill.

The third workshop day was fully dedicated to discussions in groups and in the plenum. As a final outcome of the workshop, a joint publication in a peer-reviewed journal is in preparation and will be made available as soon as ready. It will include a review based on the expertise of the workshop participants working with long-term monitoring mass-balance programmes, supplemented with best practices for assessing the uncertainty of glacier mass-balance series. In the evening, the group once again enjoyed culinary treats (Lappish



View of Storglaciären and Kebnekaise.

The local reindeer ignored the excursion group.

The station dog was glad to have friendly visitors who were clearly taking full advantage of the local hospitality.

food) prepared by the Tarfala staff. The hospitality of the staff and the setting of the venue greatly supported the spirit of intensive and constructive discussions during the workshop. This also included animated conversation in the evenings, stimulated by the diverse specialities that the participants brought along from their home. To calm down afterwards, there was the possibility of taking a hot sauna next to the river until midnight or later!

After a couple of days of excellent weather, Tarfala showed its characteristically glacier friendly weather of low temperature rain and fog in the morning of the departure day. Participants therefore had to hike out from the valley to the road at Nikkaluokta to catch ferry flights.

The workshop was supported by the Wenner-Green Foundation, the Marcus Wallenberg Foundation for International Cooperation in Science, the International Association of Cryospheric Sciences and the International Glaciological Society.

Samuel Nussbaumer, Peter Jansson and Michael Zemp

PS: A detailed workshop report is available from: http://www.wgms.ch/mbw_tarfala.html

Is everything ready for drinks?

The workshop participants and the station staff enjoyed a festive dinner together.

News

Obituary: Mark F. Meier, 1925–2012

In 1981 I was a new graduate student at the University of Washington, recently arrived from New Hampshire to study Alaskan glaciers with Charlie Raymond. Every October a group of glaciologists from various western institutions ranging from the University of Alaska to Caltech in Pasadena would meet at a determinedly informal gathering called 'Northwest Glaciologists'. The venue alternated between the University of British Columbia campus in Vancouver, the UW campus in Seattle and the USGS Project Office – Glaciology, tucked into the 8th floor of an office building in Tacoma, Washington with a commanding view of Mt Rainier. One rainy Thursday in October of that year, I drove down to Tacoma with Charlie and the other graduate students in my group, to attend my first Northwest Glaciologists meeting, and to meet a fabled figure, Mark Meier.

The USGS Tacoma office comprised about 12 people in those days, and was at the very center of US glaciological research, operating not only the best and longest glacier mass balance program in North America but also the long-term study of the retreat of Columbia Glacier, pioneering research and development in ice-penetrating radar, and the earliest applications of satellite remote sensing to snow and ice. Mark was unquestionably the leader of this group, not only in his official capacity as Project Chief but also as guiding spirit; the magnetic center of ideas, direction, and energy.

When we arrived at the Tacoma office on that rainy Thursday, I lingered in the corridors, looking at posters, photographs, and eyeing the names on office doors – other names that I knew, along with Mark's, but had yet to put faces to. In the conference room a few minutes later, Mark appeared, gregarious, welcoming, clearly enjoying his role as social host as much as scientific leader. Mark was accessible even to the newest and least experienced of us, organizing the day's schedule with special attention to the students, and attentive to our presentations. His casual, avuncular bearing was disarming, and his tendency to let his colleagues take the spotlight in the day's talks was disarming, and it was easy, in that time before I knew him well, to suppose that Mark was principally an organizer of people, a host who provided an environment where bright minds could work to best advantage.

Mark Meier, 1986.

That misconception was quickly corrected; by the end of the two-day Northwest Glaciologist's meeting I had a clearer idea of Mark's own powers, and saw that among the bright minds at the Project Office – and among all of my new West-Coast colleagues – Mark was among the very brightest. His contributions, not just in North American glaciology but in the broader international spheres of hydrology and polar science, are of such depth and breadth that it has taken all the subsequent 30 years I have known and worked with Mark Meier to fully understand their scope.

Glaciology is not an old field in North America, and Mark's career spanned a crucial stage, when the study of glaciers moved from a primarily descriptive field, grounded in geology and geography, to a quantitative, process-oriented discipline, grounded in physics and drawing heavily on mathematics and technology. Also during this period, as snow and ice generally came to be fully recognized as an integral part of global hydrology and water resources, programs such as the International Hydrological Decade were established to organize and maintain knowledge of global water resources, including glaciers and ice sheets. Mark played a role here as central as his part in the focused technical investigation of glaciers.

Mark Meier's preparation for a career in modern quantitative glaciology was prescient:

introduced to geology and the mountains by his father, Mark received his undergraduate degree in Electrical Engineering in 1949, followed by an MSc degree in Geology in 1951, both from the University of Iowa. His 1951 thesis was a study of the structure of the Dinwoody Glacier in the Wind River Mountains, combining sophisticated continuum mechanics with geological insight, his thesis work illuminated by an artistic sensibility in his treatment of maps and figures. Following the completion of his MSc, Mark moved on to Caltech in 1951 to study glaciology with the best authority at the time, R. L. Sharp. In addition to his background in geology and electrical engineering, Mark had picked up valuable skills in electronics while in the Navy, including radar technology. Seismic methods were already in use for determining glacier depths, but depth sounding by the propagation of electromagnetic radiation through ice was in its infancy, and his experience in radar would be a factor in its development. His PhD, completed in 1957, involved another field study, on Saskatchewan Glacier in Canada, where Mark again combined geological insight, mathematical expertise and field savvy to produce a highly detailed and complete observational picture of glacier dynamics against which rapidly evolving theory could be tested.

The USGS Project Office – Glaciology was created in 1956 with Mark as Project Chief, renewing the USGS's involvement in glaciers, which had been in decline since the death of F.E. Matthes in 1948. Among its first tasks was the selection of a set of glaciers for long-term study, accessible, logistically manageable, but representative of the thousands of glaciers throughout the mountain ranges of western North America, which, unlike the much more compact European Alps, could only be assessed by statistical inference from a very limited set of observations. This work was coordinated with similar programs in other countries, through the Permanent Service on the Fluctuation of Glaciers, headquartered in Zurich. Mark led the US portion of this program, participating in fundamental issues of experimental design and strategy from selection of glaciers to definitions of standard concepts and terminology in Glacier mass balance. Later, when the World Data Centers for Snow and Ice were formed, the US Data Center (WDC-A Glaciology) was housed at the USGS Tacoma office. (It subsequently was relocated to its current location in Boulder, Colorado.)

Among the glaciers selected for study, the South Cascade glacier, in Washington's North Cascade Range, the Blue Glacier, in Washington's Olympic Range, the Nisqually Glacier on Mt Rainier, and Alaska's Columbia Glacier were

Mark Meier in the field.

Mark's favorites. He and the USGS crew oversaw the construction of huts to support research South Cascade glacier, the site of one of North America's longest glacier mass balance records, and where the world's first radio-echo sounding measurements in temperate ice were conducted; and at Blue Glacier, where Bob Sharp, Mark's PhD advisor at Caltech, had been working since the International Geophysical Year. Sharp, a visionary geoscientist and a seminal figure in North American glaciology, gathered his students at Blue Glacier, and those students gathered their own students, forming a cadre that served as leaders in glaciology for the next half-century: along with Mark Meier, Bob Sharp's glaciological colleagues and descendants also included Ron Shreve, Ed LaChapelle, Barclay Kamb, Charlie Raymond, Sam Colbeck, Bob Bindschadler, Keith Echelemeyer, and Mindy Brugman, among others. Mark Meier's early accomplishments at Blue Glacier were described in a now-classic 1960 *Journal of Geology* paper on the relationship between the glacier's motion and stresses and the structures observed in the ice.

Columbia Glacier, a complex and fast-moving river of ice extending 70 km from the crest of Alaska's Chugach Mountains to the ocean near Valdez, in Prince William Sound, is perhaps the glacier most strongly associated with Mark Meier and one of his oldest and closest colleagues, Austin Post. Post was one of the most astute and well-traveled glaciologists working in Alaska, and following the 1964 Alaskan earthquake he

began an investigation searching for evidence of changes in glaciers caused by the earthquake. In the 1960s, the systematic, long-term behavior of ocean-ending, or 'tidewater' glaciers was known in general terms: long periods of slow advance punctuated by shorter periods of rapid flow, high rates of iceberg calving, and retreat, with much of that knowledge due to Austin Post's efforts. The detailed processes controlling tidewater glacier behavior, however, were obscure. Alaska has more than 50 such glaciers, but Columbia was of special interest in part because its geometry suggested that retreat might be imminent, and also because of its location near the entrance to Valdez Arm, in the northeast corner of Prince William Sound. Ships carrying crude oil from the planned southern terminus of the Trans-Alaska Pipeline would soon be passing through Valdez Arm, and traversing the waters in front of Columbia's terminus, exposed to icebergs calved from the glacier during the retreat. Mark conceived of a plan to study Columbia Glacier in unprecedented detail, and ultimately to make a forecast, predicting when Columbia Glacier's retreat would start, how long the retreat would last, and how the release of icebergs into the tanker shipping lanes in Prince William Sound might threaten shipping operations and tanker safety. Following long and complex negotiations at USGS Headquarters in Reston, Virginia, Mark's ambitious plan was approved, and by the mid-1970s the Columbia Glacier research program was under way. The prediction, issued in 1979, successfully anticipated the onset of the glacier's accelerating flow, increased iceberg calving rate, and dramatic terminus retreat up the valley once occupied by ice as much as 1 km in thickness – now a new fjord, 20 km long and 5 km wide, still choked by icebergs from the glacier's continued retreat, following a pattern whose essential elements were defined 30 years ago by Mark's USGS Tacoma team.

In 1985, Mark left the USGS to move to the University of Colorado at Boulder, where he took the helm of the University's Institute of Arctic and Alpine Research. Mark's experience and reputation in the international scientific community and his engaging, inclusive management style made him an ideal choice to lead INSTAAR. His record of international science leadership, with a particular focus on global hydrology and cold regions research, were ideal assets for the challenges that accompanied INSTAAR's growth during his years as Director, from 1985 to 1994 when the Institute grew to more than three times its size in the early 1980s and broadened both its range of research activities and its role in the teaching mission of the University. Mark's accomplishments by this time can be appreciated by even a partial list of the organizations and working groups he had either headed or participated in: IPCC Lead Author, President of International Association of Hydrological Sciences (IAHS), President of the International Commission on Snow and Ice (ICSI), President and Chair of the Board of Directors of the Arctic Research Commission of the United States (ARCUS), a driving force behind the NSF Arctic System Sciences (ARCSS) initiative, and many more. The awards with which he was honored are equally extensive, and show especially the regard his international colleagues had for him: the Seligman Crystal of the International Glaciological Society, three medals from the Academy of Sciences of the USSR, Fellow of the American Geophysical Union, and Robert E. Horton medalist, also from the AGU.

Far from moving away from active research and into the role of administrator, Mark accomplished some his most significant and far-reaching scientific contributions while he was serving as Director of INSTAAR. These concerned sea level rise, and the role of the world's small glaciers (as opposed to the ice sheets of Greenland and Antarctica) in contributing to sea level rise in a warming climate. Building on a landmark paper he had published in Science in 1984, Mark became the principal authority on global assessments of glacier mass balance, and brought in colleagues such as Mark Dyurgerov and David Bahr to build a team whose expertise and analysis formed the theoretical foundation and knowledge base that forms the core of our knowledge today of the source of a major fraction of present and future sea level rise.

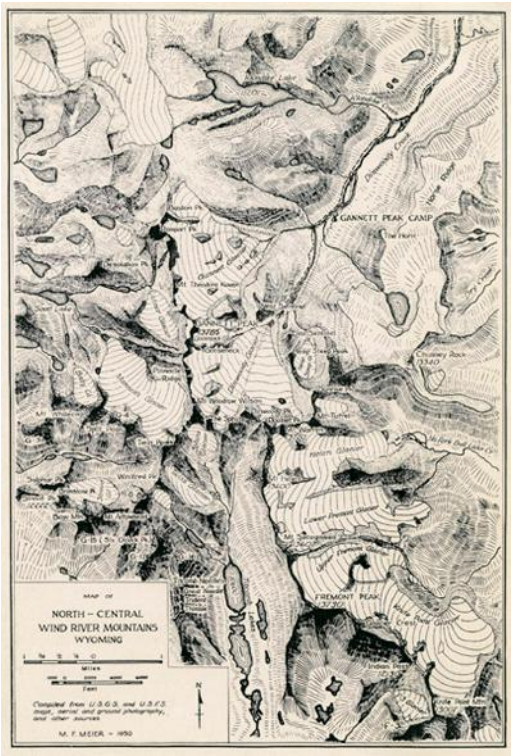
These are the achievements that I have come to appreciate, not only as a student in Seattle but later, when I joined Mark as a Postdoc at INSTAAR and later as a colleague and faculty member. More than a list of committees and awards, however, Mark's contributions and influence emerged gradually in conversations and while working on joint projects, where the discussion of almost any theory, method, instrument, or glacier would lead eventually to some previous key moment where Mark had been present or in which he had a hand. Mark was, in any case, never one to emphasize the highlights of his CV, and his stature in science had to teased out, emerging when necessary and not before.

Mark's life was characterized by interactions with others, and one of the most immediately noticeable of his traits was his sociability, his strong tendency to connect with others, that I had seen first at the Northwest Glaciologist's meeting in Tacoma. His fascination with the weaving projects of his artist wife Barbara, his pride in his children, his tangible delight in his grandchildren, were

likewise an expression of this same awareness of and attention to others, the same tendency to connect. After retiring as INSTAAR's Director, Mark took advantage of the opportunities to spend more time with his family and with his own art as well: painting, drawing, model building, all skills and talents that had been present and active throughout his life – his maps and drawings from his Dinwoody Glacier thesis are wonderful examples – having been nurtured by his own parents, and especially his father, a psychologist with a sophisticated and long-term involvement in art himself.

We have a lot to remember Mark by, more, possibly than for most people who leave us. Not only do we have his research achievements, documented by a prolific record of publication, and other accomplishments in his various scientific capacities, we also have his paintings, drawings, whimsical cartoons illustrating serious scientific points, and even boat models of fantastic craft that never existed in the world outside his own active imagination. And finally, we have our memories, not only of a fine and creative scientist but, for me at least, a welcoming presence, enjoying his role as host and leader, not just to a scientific meeting, but also to a career and lifetime in glaciers.

W.T. Pfeffer
INSTAAR



Mark's Wind River map of 1950.

An obituary for **Austin Post**, Mark Meier's long-term colleague, will appear in the next issue of *ICE*

INTERNATIONAL GLACIOLOGICAL SOCIETY

International Symposium on

Contribution of Glaciers and Ice Sheets to Sea Level:

observations, modelling and prediction

Chamonix, France
26–30 May 2014

Co-sponsored by:
Laboratoire de Glaciologie et Géophysique de l'Environnement

FIRST CIRCULAR
October 2012
http://www.igsoc.org/symposia/2014/chamonix
http://www-lgge.obs.ujf-grenoble.fr/igs2014/

The International Glaciological Society (IGS) will hold an International Symposium on 'Contribution of Glaciers and Ice Sheets to Sea-Level Change: observations, modelling and prediction' in 2014. The symposium will be hosted by the Laboratoire de Glaciologie et Géophysique de l'Environnement. It will be held at the Ecole Nationale de Ski et d'Alpinisme (ENSA), Chamonix, France, from 26–30 May 2014.

THEME

Glaciers, ice-caps and ice-sheets experiencing a warming climate are expected to make an increasing contribution to sea-level rise. Linkages with the other components of the climate system, especially the atmosphere and ocean, are fundamental aspects of the complexity of ice-mass response to changing climate. Observations at the interfaces between atmosphere/cryosphere and ocean/cryosphere have considerably increased our understanding of the complex coupling prevailing between the systems, although strong uncertainties remain. At the same time, ice-flow models have greatly improved over the last few years, but essential processes such as basal hydrology or calving remain strongly parameterized. Strong initiatives to couple ice-flow models to ocean and/or atmosphere models have emerged, but the process of integrating remains challenging. This symposium seeks to address these problems by bringing together experts in cryosphere, climate and oceanography, from both the observation and modelling sides.

TOPICS

Meeting participants are encouraged to present on a wide variety of topics. All these topics can be addressed using observations, forward or inverse modelling, theoretical analysis or the coupling of data and modelling through the use of data assimilation methods. The first six topics are more related to a specific interface and focus on local processes, whereas topics 7 and 8 seek to address the large-scale response of ice mass.

1. *Basal processes*: effect of basal water, link between runoff and surface velocity, hydrological model, friction law linking basal hydrology and water pressure, drumlins and associated sub-glacial landforms
2. *Basal melting* below ice-shelves and at the front of marine terminated glaciers, distribution and amount of melt, accretion of marine ice, coupling of ice sheet and ocean models
3. *Grounding-line dynamics*: marine ice-sheet instability, observed rate of migration, positioning by various techniques, sensitivity of the rate of migration of grounding line to forcing regimes
4. *Calving processes*: calving rate parameterization, damage modelling, numerical implementation in ice-sheet models
5. *Surface mass balance*: snow accumulation and runoff, influence of refreezing in firn, coupling of regional climate and ice-sheet models
6. *Ice body and rheology*: anisotropy, temperature field within ice masses, borehole records, rheology of marine ice, modelling of englacial structure
7. *New generation of ice-sheet models*, their numerical design, impact of mechanics, their coupling with ocean and/or climate
8. *Estimation of the contribution of glaciers and ice-sheets to sea-level change*: initialization (spin-up), forecast estimates of future sea-level rise, ensemble methods, and associated error bars, paleo-reconstruction of past change

Potential participants are encouraged to contact the Scientific and Editorial Steering Committee if they feel additional topics would be appropriate.

PROGRAMME
The symposium will consist of a mixture of oral and poster sessions, with free time planned to allow participants to exchange scientific information in an informal setting. A symposium banquet and a mid-week excursion to the Mont Blanc area glaciers will also form part of the programme.

ABSTRACT AND PAPER PUBLICATION
Participants wishing to present a paper at the symposium are required to submit an abstract. A digest of submitted abstracts will be provided to all participants at the symposium. The Council of the International Glaciological Society has decided to publish a thematic issue of the *Annals of Glaciology* on topics consistent with the Symposium themes. Participants and non-participants alike are encouraged to submit manuscripts for this issue.

SYMPOSIUM ORGANIZATION
Magnús Már Magnússon (International Glaciological Society)

SCIENCE STEERING AND EDITORIAL COMMITTEE
Richard Hindmarsh (BAS, UK) and Frank Pattyn (ULB, Belgium), Co-Chief Editors; scientific editors for the special themed issue of *Annals of Glaciology* will be appointed later.

LOCAL ORGANIZING COMMITTEE
Olivier Gagliardini (Chair), Gaël Durand, Fabien Gillet-Chaulet, Emmanuel Le Meur, Maurine Montagnat, Vincent Peyaud, Armelle Philip, Catherine Ritz, Christian Vincent, Jérôme Weiss

VENUE
The meeting will be held at the ENSA (Ecole Nationale de Ski et d'Alpinisme), Chamonix, France, close to the Mont Blanc area glaciers. Student-type accommodation will be offered.

FURTHER INFORMATION
If you wish to attend the symposium please register your interest online at http://www.igsoc.org/symposia/2014/chamonix/. If you do not have access to the internet you can return the attached form to the IGS Secretary General. Please register your interest as soon as possible as it will help in the planning of the symposium. This will ensure you receive all future communications relating to the symposium.

The Second Circular will give further information about accommodation, the general scientific programme, additional activities, preparation of abstracts and final papers. Members of the International Glaciological Society will automatically receive one, as will all those who have pre-registered. Information will also be updated on the IGS conference website, http://www.igsoc.org/symposia/2014/chamonix/ and the local website, http://www-lgge.obs.ujf-grenoble.fr/igs2014/.

INTERNATIONAL SYMPOSIUM ON
CONTRIBUTION OF GLACIERS AND ICE SHEETS TO SEA-LEVEL CHANGE

Chamonix, France
25–29 May 2014

Family name: _____

Given name(s): _____

Address: _____

_____

_____

Tel: _____ Fax: _____

E-mail: _____

☐ I hope to participate in the Symposium in May 2014

☐ I expect to submit an abstract

My abstract will be most closely related to the following topic(s):

_____

_____

_____

PLEASE RETURN AS SOON AS POSSIBLE TO:

Secretary General, International Glaciological Society
Scott Polar Research Institute
Lensfield Road
Cambridge, CB2 1ER, UK

Tel: +44 (0)1223 355 974
Fax: +44 (0)1223 354 931

E-mail: igsoc@igsoc.org
Web: http://www.igsoc.org

Glaciological diary

** IGS sponsored * IGS co-sponsored

2012

1–5 October 2012
***International Symposium on Ice Core Science**
Giens, France
Website: http://www.ipics2012.org/

13–20 October 2012
Interdisciplinary Climate Change Research Symposium
Colorado Springs, Colorado, USA
Website: http://disccrs.org/a

18 October 2012
Parallel Ice Sheet Model (PISM) Workshop
Seattle, Washington, USA
Contact Andy Aschwanden [aaschwanden@alaska.edu]

19–20 October 2012
Northwest Glaciologists Meeting
University of Washington, Seattle, Washington, USA
Website: http://www.ess.washington.edu/Surface/Glaciology/Glaciology/Home.html

23–26 October 2012
Arctic in Rapid Transition (ART) Science Workshop
Sopot, Poland
Website: http://tinyurl.com/Sopot2012
Contact: Christie Wood [chwood@clarku.edu]

25–27 October 2012
International Glaciology Society Nordic Branch Meeting 2012
Stockholm, Sweden
Contact: Susanne Ingvander[susanne.ingvander@natgeo.su.se]

1–3 November 2012
XI International Scientific Conference: Integrated Researches of Spitzbergen Nature
Murmansk, Russia
Website: http://icc.sklcs.ac.cn/

5–9 November 2012
26th Scientific Conference and First Workshop on Geomatics in Earth Sciences
San Miguel de Tucumán, Tucumán, Argentina
Website: http://www.aaggreunion.org/eng/contents/info

10–12 November 2012
International Conference on the Cryosphere: Changes, Impacts and Adaptation
Sanya, China
Website: http://icc.sklcs.ac.cn/

3–7 December 2012
American Geophysical Union Fall Meeting
San Francisco, California, USA
Website: http://fallmeeting.agu.org/2012/

10–12 December 2012
2012 Ice Sheet System Model (ISSM) Workshop
Irvine, California, USA
Website: http://issm.jpl.nasa.gov/issmworkshops/

2013

6–8 January 2013
SEG/AGU Cryosphere Geophysics Workshop
Boise, Idaho, USA
Website: http://www.seg.org/events/upcoming-seg-meetings/cryo2013
Contact: Hans-Peter Marshall [hpmarshall@boisestate.edu]

14–16 January 2013
Ice2sea North/South glacier workshop
Copenhagen, Denmark
Contact: Nick Barrand [nirr1@bas.ac.uk]

14–17 January 2013
Third International Symposium on Arctic Research (ISAR3): Detecting the change in the Arctic System and searching the global influence
Tokyo, Japan
Contact: Japan Consortium for Arctic Environmental Research [jcar-office@nipr.ac.jp]
Website: http://www.jcar.org/isar-3/

17–20 January 2013
World Snow Forum
Novosibirsk, Russia
Website: http://www.worldsnowforum.org/

20–25 January 2013
Arctic Frontiers: Geopolitics and Marine Production in a Changing Arctic
Tromsø, Norway
Website: http://www.arcticfrontiers.com/

11–13 February
Snow and Ice Research Group (SIRG) New Zealand Annual Workshop 2013 (International Glaciology Society New Zealand Branch Meeting 2013)
University of Otago, New Zealand
Website: http://www.sirg.org.nz/

13–16 February 2013
PAGES Open Sciences Meeting
Goa, India
Website: http://www.pages-osm.org/

14–15 February 2013
17th Alpine Glaciology Meeting
Grenoble, France

18–19 February 2013
Workshop: Passive Microwave Sea Ice Concentration
Copenhagen, Denmark
Website:
http://tinyurl.com/43rdArcticWorkshop

20–21 February 2013
Mountains under Watch 2013: Observing climate change effects in the Alps
Aosta Valley, Italy
Website: http://www.muw2013.it/

21–24 February 2013
Romanian National Symposium 'CRIOSFERA' 2013
Piatra Neamt, Romania
Website: http://http/criosfera2013.weebly.com

25–28 February 2013
Workshop on the Dynamics and Mass Budget of Arctic Glaciers / IASC Network on Arctic Glaciology Annual Meeting
Obergurgl, Austria
Contact Carleen Tijm-Reijmer [c.h.tijm-reijmer@uu.nl]
Website: http://ny.arcticportal.org/workshop.html

7–8 March 2013
Annual Midwest Glaciology Meeting
The Pennsylvania State University, Pennsylvania, USA
Contact Nathan Amador [nsa125@psu.edu]

11–13 March 2013
43rd International Arctic Workshop
Dresden, Germany
Website: http://www.cryosat2013.org/

12–14 March 2013
Third CryoSat User Workshop
Amherst, Massachusetts
Contact Wendy Roth [Wendy.Freeman@Colorado.EDU]

14–15 March 2013
50 Jahre Gletscherforschung: Symposium der Kommission für Erdmessung und Gletscherforschung
Munich, Germany
Website: http://www.glaziologie.de/Symposium2013
(Conducted in German)

18–20 March 2013
Geological Society of America: Northeastern Section 48th Annual Meeting
Bretton Woods, New Hampshire, USA
Website: http://www.cryosat2013.www.geosociety.org/Sections/ne/2013mtg/.org

2–5 April 2013
Snow grain size workshop – measurements and applications
Grenoble, France
Website: http://snowgrain2013.sciencesconf.org/

4–5 April 2013
Conference: Holocene Climate Change
London, UK
Contact Steve Whalley [steve.whalley@geolsoc.org.uk]

7–12 April 2013
European Geosciences Union General Assembly 2013
Vienna, Austria
Website: http://www.egu2013.eu/

13–19 April 2013
Arctic Science Summit Week
Krakow, Poland
Website: http://www.assw2013.us.edu.pl/registration

29 April–2 May 2013
American Meteorological Society: 12th Conference on Polar Meteorology and Oceanography
Seattle, Washington, USA
Website: http://www.ametsoc.org/MEET/fainst/201312polarocean.html

14–17 May 2013
AGU 2013 Meeting of the Americas
Cancun, Mexico
Website: http://moa.agu.org/2013/

30 May–2 June 2013
International Association of Geodesy International Symposium: Reconciling observations and models of elastic and viscoelastic deformation due to ice mass change
Ilulissat, Greenland
Website: http://www.dtu.dk/subsites/iag.aspx

3–7 June 2013
International Workshop: Understanding the response of Greenland's marine terminating glaciers to oceanic and atmospheric forcing
Near Boston, Massachusetts, USA
Website: http://www.usclivar.org/meetings/griso-workshop/

16–18 June 2013
International Conference on Geology and Geophysics
Beijing, China
Website: http://www.engii.org/workshop/icgg2013/

17–19 June 2013
27th international Forum for Research into Ice Shelf Processes (FRISP)
Gregynog Hall, Powys, Wales
Contact Adrian Jenkins [ajen@bas.ac.uk]

18–21 June 2014
4th European Conference on Permafrost – IPA Regional Conference (EUCOP4)
Évora, Portugal
Website: http://www.eucop4.org/

24–28 June 2013
Asia Oceania Geosciences Society (AOGS) 10th Annual Meeting
Brisbane, Australia
Website: http://mpi.ysn.ru/index.php/en/welcome.html

24 June–13 July 2013
Third Forum for Young Permafrost Scientists
Yakutsk, Russia
See forum website

8–12 July 2013
Joint IACS/IAMAS Conference: Air and ice – interaction processes
Davos, Switzerland
Contact: Charles Fierz [fierz@slf.ch]
Website: http://www.daca-13.org/index_EN

22–26 July 2013
Knowledge for the Future: IAHS/IAPSO/IASPEI Joint Meeting
Gothenburg, Sweden
Website: http://iahs-iapso-iaspei2013.com/

28 July–2 August 2013
****International Symposium on Changes in Glaciers and Ice Sheets: observations, modelling and environmental interactions**
Beijing, China
Contact: Secretary General, International Glaciological Society
Website: http://www.igsoc.org:8000/symposia/2013/beijing/

19–31 August 2013
Advanced Climate Dynamics Course 2013: The dynamics of the last deglaciation
Nyksund, Vesterålen Islands, Norway
Website: http://nyksund,%20vester%c3%a5len%20islands,%20norway/

22–24 August 2013
28th Himalayan Karakorum Tibet Workshop and 6th International Symposium on Tibetan Plateau Joint Conference
Tübingen, Germany
Website: http://www.tip.uni-tuebingen.de/index.php/en/hkt-istp-2013-tuebingen

27–31 August 2013
8th IAG International Conference on Geomorphology
Paris, France
Website: http://www.geomorphology-iag-paris2013.com/

4–5 September 2013
****International Glaciology Society British Branch Meeting 2012**
Loughborough, UK
Contact: Richard Hodgkins [r.hodgkins@lboro.ac.uk]

8–12 September 2013
5th Polar and Alpine Microbiology Conference
Big Sky, Montana, USA
Website: http://polaralpinemicrobiology2013.montana.edu/

9–13 September 2013
****International Symposium on Radioglaciology: advances in radio frequency, microwave and digital technologies**
Lawrence, Kansas, USA
Contact: Secretary General, International Glaciological Society
Website: http://www.igsoc.org:8000/symposia/2013/kansas/

9–13 September 2013
***7th International Workshop on Ice Drilling Technology**
University of Wisconsin, Madison, WI, USA
Website: http://icedrill.org/7th-international-workshop-on-ice-drilling-technology/

10–21 September 2013
The annual Karthaus course on Ice Sheets and Glaciers in the Climate System
Karthaus (northern Italy)

22–28 September 2013
International symposium: Physics, chemistry and mechanics of snow
Yuzhno-Sakhalinsk, Russia
Website: http://snowphysics.fegi.ru/en/main.html

29 September–3 October 2013
Earth Cryology: XXI century
Pushchino, Russia
Website: http://cryosol.ru/index/earth_cryology2013/0-45

7–11 October 2013
ISSW International Snow Science Workshop 2013
Grenoble and Chamonix Mont-Blanc, France
Website: http://www.issw2013.com/
Flyer as PDF at http://www.extranet.insight-outside.fr/upload/compte367/File/flyerissw2.pdf

12–19 October 2013
DISCCRS VIII Interdisciplinary Climate Change Research Symposium
Colorado Springs, Colorado, USA
Website: http://disccrs.org/

18–19 October 2013
North West Glaciologists meeting
Vancouver, BC, Canada

2014

10–14 March 2014
****International Symposium on Sea Ice**
Hobart, Australia
Contact: Secretary General, International Glaciological Society

17–20 March 2014
13th International Conference on the Physics and Chemistry of Ice (PCI-2014)
Hanover, New Hampshire, USA
Website: http://engineering.dartmouth.edu/pci-2014

26–30 May 2014
****International Symposium on Observations, Modelling and Prediction of the Cryospheric Contribution to Sea Level Change**
Chamonix, France
Contact: Secretary General, International Glaciological Society

22 August – 3 September 2014
XXXIII SCAR Biennial Meetings and Open Science Conference
Auckland, New Zealand
Contact: Katrina Hall [gateway-antarctica@canterbury.ac.nz]
Website: http://www.scar2014.com/

25–30 August 2014
****International Symposium on the Changing Arctic Cryosphere**
Edmonton, Alberta, Canada
Contact: Secretary General, International Glaciological Society

2015

August 2015
****International Symposium on Contemporary Ice-Sheet Dynamics: ocean interaction, meltwater and non-linear effects**
Cambridge, UK
Contact: Secretary General, International Glaciological Society

2016

June 2016
****International Symposium on the Hydrology of Glaciers and Ice Sheets**
Iceland
Contact: Secretary General, International Glaciological Society

August/September 2016
****International Symposium on Polar Sea Ice, Polar Climate and Polar Change**
Boulder, Colorado, USA
Contact: Secretary General, International Glaciological Society

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