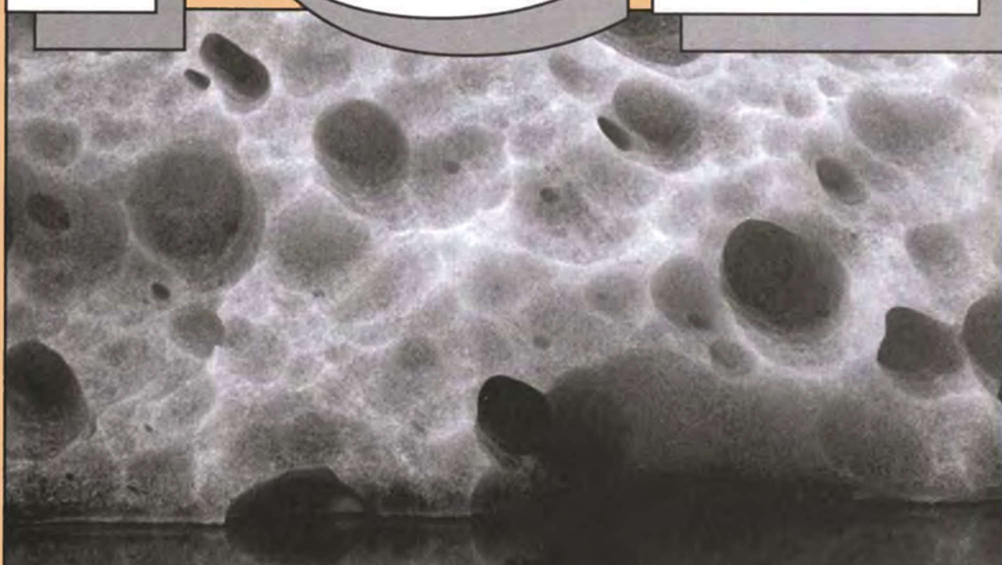
Number 145

3rd Issue 2007

ICE



NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

ISSN 0019–1043

Ice

News Bulletin of the International Glaciological Society

Number 145 — 3rd Issue 2007

Contents

Cover picture: Iceberg (detail), Columbia Bay, 2005. From *The Opening of a New Landscape: Columbia Glacier at Mid-Retreat* by W. Tad Pfeffer, published by the American Geophysical Union

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

This is the last ICE issue for 2007 although it reaches you in the fifth month of 2008 (yes, we are still behind with ICE but are hoping to have caught up by the end of 2008)!

2007 brought a record number of submissions to the *Journal of Glaciology*, 145 in all. That is a 19% increase from last year's record of 122 and a 41% increase over the 1993–2006 average. This shows that our authors really appreciate the speed with which the *Journal* is published now. We finished publishing volume 53 online in December 2007 and the first issue of 54(2008) was published at the beginning of February 2008 and should be out in hardcopy by the end of March.

And talking about hardcopy, we have been in negotiations with various printing companies and with our present printers. This is an indirect result of our ALPSP award; everyone wants to be 'The Printer' of an award-winning publication. We were the focus of considerable attention and by the time you read this will have been able to negotiate a very favourable deal with a printer. As a result, our printing cost will be considerably reduced, a saving we are hoping to pass on to our members.

Another change that will hopefully be in place by the time you read this is the online submission system for the *Journal*, to be followed very shortly by the *Annals*. We have signed a contract with EJPress, and the submission website is, at the time of writing this, being tested. We hope that this will make things easier for our authors. But we are also aware that online submission does not suit everyone so we have built in a facility that will enable the IGS office staff to receive your submission in the more conventional way and we will be able to do the online submitting on your behalf.

We are also investigating the feasibility of publishing ICE online. At first it will be an interactive PDF but we are hoping to convert ICE to a proper online publication in due course.

One aspect of the IGS operation has been a concern for a while. It is the membership itself, or rather the decline in membership. One reason for this has been the outdated methodology in the way we manage the membership, send out reminders and collect the fees. We are hoping to move to a membership system that would automate all of this and also enable members to pay their membership online. But we also need you, our members, to embark on a membership drive to bring our membership back up to pre-2000 levels. Membership of the International Glaciological Society is extremely good value for money at present but we are thinking of various other ways to make it even more attractive. So please pester any colleagues you know are not members of the IGS, to join. And tell your students about the IGS and encourage them to join. Students can join at an extremely good rate. I can recall Charlie Raymond encouraging his students to join and we all did. And I believe all of us are still members, more than 25 years later.

Magnús Már Magnússson
Secretary General

Recent work

New Zealand

New Zealand recently became the newest regional branch of the International Glaciological Society (website www.sirg.org.nz).

Snow and ice research in New Zealand covers all topics from sea ice and avalanches to glaciology and hydrology. Important groups are based at the major universities (Otago, Canterbury, Victoria, Massey, Lincoln and Auckland) as well as the national (Crown) research institutions including the National Institute for Water and Atmospheric Research (NIWA), Institute of Geological and Nuclear Sciences (GNS Science) and Industrial Research Limited (IRL).

The last New Zealand area report was in 2001. Since then, many new snow and ice specialists have been appointed (e.g. Wolfgang Rack, Canterbury University, Nicolas Cullen, John Orwin, University of Otago, Martin Brook, Massey University, Andrew Mackintosh, Nancy Bertler and Brian Anderson, Victoria University of Wellington, Jordy Hendrix and Martyn Clark, NIWA). Short-term studies of glacier climate, mass balance, dynamics and hydrology have been undertaken and a full glacier mass balance programme has begun on Brewster Glacier since 2004 (Otago and Victoria Universities and NIWA) and a partial mass balance programme is in its eighth year on Franz Josef Glacier (Canterbury and Victoria Universities). These field programmes have been boosted by numerical modelling of ice flow and glacier mass balance (Victoria University and NIWA). Nancy Bertler (Victoria University of Wellington) has led the development of an ice core laboratory at GNS Science, a first for New Zealand. Ongoing work includes process studies on cold-based glaciers in the McMurdo Dry Valleys, Antarctica (Sean Fitzsimons, Shelley MacDonell and others, Otago University) and a national survey of end of summer snowlines in New Zealand (Trevor Chinn, Andrew Willsman, Jim Salinger and Blair Fitzharris). A group from Otago and Victoria Universities, IRL and NIWA has conducted winter and summer studies of the influence of the ocean, conditioned by proximity to an ice shelf, on the formation of sea ice. It is also worth noting that the ANDRILL project (http://www.andrill.org/) is co-led by New Zealand. Drilling in 2006 and 2007 has recovered >2 km of sediment cores from the continental margin in the Ross Sea, enhancing our understanding of Antarctic Ice sheets during the last 20 million years.

The abstracts below provide a sample of recent activity but they do not cover the full range of topics. They are mostly from our annual Snow and Ice Research Group meeting (4–6 February 2008). Further reports from New Zealand will hopefully correct this bias and include more Antarctic glaciology and sea ice research.

Andrew Mackintosh
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NEW ZEALAND GLACIOLOGY AND ASSOCIATED TOPICS

Gradients of mass balance sensitivity and volume changes in the Southern Alps, New Zealand

Brian Anderson and Andrew Mackintosh ARC-Geog; brian.anderson@vuw.ac.nz

Maritime glaciers have the greatest sensitivity to climatic changes, because they occur in high-precipitation environments. This high sensitivity, combined with short response times compared to ice sheets, means that maritime glaciers will make a significant contribution to sea-level rise in the coming decades, as the climate warms. Calculations of glacier sensitivity and volume change are common for individual glaciers, but have rarely been undertaken on a regional basis. Here, we use an energy balance model on a regional scale to calculate the mass balance sensitivity of the ice mass in the central portion of the Southern Alps of New Zealand. Using a 30-year dataset of gridded climatology, the changes in mass balance and glacier volume in this area are calculated. The model is tuned against mass balance measurements on a few glaciers and evaluated against annual snowline measurements on many glaciers over the 30-year period.

Response of Mueller and Tasman glaciers to climate change

Andrew Mackintosh UWell-Geog, Jörg Schaefer UColum-LDEO, Bjørn Andersen UOslo, David Barrell GNS, George Denton UME-ESCC, Robert Finkel LLNL, Mike Kaplan UColum-LDEO, Aaron Putnam UME-ESCC and Rosanne Schwartz UColum-LDEO; Andrew.Mackintosh@vuw.ac.nz, schaefer@ldeo.columbia.edu

We explore the forcing mechanisms that drive advance and retreat of Mueller and Tasman Glaciers in the M. Cook region of New Zealand during the Holocene and in particular, the last few

centuries. The motivation for our work is a new moraine chronology based on high-precision terrestrial cosmogenic nucleide (^{10}Be) measurements. The ages show that Mueller Glacier probably reached its Holocene maximum ~6000 years ago. Less extensive advances occurred ~3100–2800, ~1800–1700, ~600–450, ~300–200 and ~170–150 years ago. The Tasman moraine sequence comprises fewer preserved moraine loops, but advances have been dated to ~6100–5800 and ~1700–1500 years ago.

The responses of debris-covered, lake-terminating glaciers to climate change may be complicated. On temperate glaciers, most ablation occurs directly by melt, but changing surface debris cover and/or iceberg calving in lakes can significantly alter a glacier's balance. Using the case study of Tasman and Mueller Glacier retreat since the 19th Century, we argue that these processes are important but do not mask the overarching climate signal. Surface debris acts to increase glacier response time during retreat, thus delaying the 'climatic' reaction, while lake formation enhances retreat once a critical point of surface lowering is exceeded.

Modelling of Brewster and Franz Josef Glaciers by Brian Anderson indicates that the mass balance of high-precipitation glaciers is sensitive to small atmospheric temperature changes. We hypothesise that the Tasman and Mueller moraines, which clearly document changing terminus length, are also dominantly indicators of past temperature. Simple response-time calculations show that these glaciers may 'view' climate a little differently. We speculate that the Mueller and Tasman Glaciers respond in decades during cold intervals when they have a cleaner ice surface and centuries during warmer times, when significant debris mantles develop. Differences in timing of moraine formation of these two glaciers may be a function of their response times.

Controls on spatial and temporal variation in glacier accumulation, Southern Alps, New Zealand

Heather Purdie, Andrew Mackintosh,
Brian Anderson, VUW and Wendy Lawson
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Glacier mass balance, the difference between snow and ice accumulation and ablation on a glacier, is an important signal of climate change. Variations in glacier mass balance are derived, in part by field measurements, and also through the application of computer modelling. On temperate maritime glaciers where high rates of precipitation make accumulation measurement difficult, accumulation processes are poorly understood. In such areas, accumulation calculations may be sensitive to the assumptions made in models, in particular, relationships between elevation, temperature and precipitation. In New Zealand, few direct measurements of snow accumulation have been made, modelling of glacier mass balance and ice-core studies are just beginning, and both require empirical data and an improved understanding of snow accumulation processes for their development and interpretation.

In this study, I will attempt to quantify glacier accumulation rates at high temporal and spatial resolution on the Tasman, Brewster, and Franz Josef glaciers. The influence of elevation, topography, and ice flow on derived accumulation rates will be investigated. Variations in glacier accumulation rates are commonly interpreted as climate signals therefore it is important to identify and extract spatial signals prior to temporal analysis. Furthermore, temporal changes in snow accumulation will be related to local and synoptic-scale climate variability. It is hoped that our improved understanding of the fundamental processes affecting accumulation variability will improve our understanding of past climate (through ice cores) and strengthen model predications of longer-term glacier behaviour in relation to changing climate. Specifically, this study will attempt to:

1. Identify how elevation, topography and ice flow influence measurements of glacier accumulation rates
2. Consider spatial and temporal variability in accumulation in relation to regional climate patterns, in particular, varying synoptic storm types
3. Analyse an ice core previously collected at Tasman Glacier and ascertain whether, given the spatial and temporal variability in accumulation, it provides a regional signal of glacier-climate variations.

Modelling of summer ablation on the Brewster Glacier, New Zealand

S.D. Gillett, N.J. Cullen, R.J.W. Hodson,
UOtago-Geog; J. Thomson, B. Anderson and
A. Mackintosh, UWell-Geog

Ablation modelling is becoming an essential tool in glacier research in New Zealand. This is because there is a need to forecast run-off from glacierised areas and forecast the response of the mass balance of glaciers to climate change. Thus far there has been no direct comparison in New Zealand between the two main forms of ablation modelling, the energy balance model and degree-day (temperature-index) model. As part of an existing glacier mass balance programme on the Brewster Glacier, Southern Alps, an automatic weather station was installed on the glacier at about 1780 m.a.s.l. in December 2007. Continuous micrometeorological measurements collected over the 2007 and 2008 summer period will be used as input into an energy balance model and a degree-day model and compared with measured ablation at the AWS site. Comparison of the relative accuracy of the two ablation models will increase understanding and also reduce the uncertainty concerning ablation modelling on glaciers in the Southern Alps of New Zealand.

Mass balances of glaciers in the Southern Alps of New Zealand

Dorothea Stumm, Sean Fitzsimons,
Nicolas Cullen, UOtago-Geog; Martin Hoelzle,
Horst Machguth, UZur-GGG; Brian Anderson
and Andrew Mackintosh UWell-Geog

The mass balances of four glaciers in the Southern Alps of New Zealand are investigated. Different types of glaciers are examined, ranging from maritime to continental glaciers. Since 1977, a yearly end-of-summer snowline (EOSS) survey has been conducted by taking oblique photographs of 50 index glaciers from a light aircraft. In the past, these records have been used as a proxy for the mass balance.

In 2004, a field-based mass-balance programme was established on Brewster Glacier, and since 2005, mass balance measurements are made with the glaciological method on Glenmary, Rolleston and Park Pass Glacier. For these four glaciers, the mass balance is modelled with an energy-balance model that is forced by nearby climate information. After calibrating the model with the direct mass balance measurements, the mass balance will be calculated for the past 30 years and validated with the aerial photographs from the EOSS survey. The climate sensitivity of the glaciers is evaluated by modelling the mass balance with varying temperature and precipitation data.

The mass-balance model has been applied previously in the European Alps and this project provides a test of the model for the Southern Alps of New Zealand. The modelled and validated mass balance data provides a good tool to evaluate the EOSS as mass balance surrogate. Past mass balances will be reconstructed, and scenario based model predictions are used to estimate future melt and accumulation for the investigated glacier.

Investigation of spatial and temporal albedo variations and implications for ablation on the lower Brewster Glacier, South Westland, New Zealand

R.J.W. Hodson, N.J. Cullen, S.D. Gillett,
UOtago-Geog; B. Anderson, J. Thompson and
A. Mackintosh, ARC-Geog

Understanding and modelling of snow and ice melt processes on glaciers is of considerable interest to the global scientific community. At both local and global scales glacial mass balance models are useful tools for assessing the effect of climate variability on glacier mass balance and associated downstream river flow regimes. However, most models do not consider spatial or temporal variations in surface albedo and ablation. Recent research on the Brewster Glacier has highlighted the existence of significant spatial variations in ablation magnitudes (George, 2004).

This BSc (Hons) dissertation being carried out during the 2007–2008 summer melt season aims to contribute to the ongoing Brewster mass balance programme by improving the understanding of physical controls on ablation variations. To achieve this, two automated on-ice albedo sites have been installed. Sampling of albedo and surface parameters across a high-resolution network of stakes within the ablation zone is being conducted. This work focuses on albedo variations under clear sky conditions. The objectives of this research are to: 1) directly measure spatial and temporal ablation and albedo variations within the ablation zone; 2) test an albedo parameterisation model developed in Sweden by Brock (2000); 3) assess the accuracy of ice albedo values calculated with a distributed energy balance model by Anderson, Mackintosh and others (submitted).

Recent ice volume changes (1976-2005) for the big glaciers of the Southern Alps, New Zealand

T. Chinn APP, A. Willsman NIWA-Dun,
J. Salinger NIWA-Auc, and B.B Fitzharris
UOtago-Geog; t.chinn@xtra.co.nz

This paper presents the findings of ice lost to both surface lowering (downwasting) and proglacial lake growth, using topographic maps and longitudinal profile surveys made in April 2007, on the 12 largest glaciers of Mt Cook National Park. The profile work, arranged by A. Willsman of NIWA, was carried out by helicopter and GPS.

The NIWA EOSS programme has found that, despite global warming, mass balance for most glaciers of the Southern Alps is near zero, but with substantial ice loss from down-wasting and calving into lakes at terminal areas of the largest valley glaciers. This follows a period of warming and persistent and accelerating glacier wastage from the termination of the 'Little Ice Age' (1850–1890) to the mid 1970s. The largest debris-covered valley glaciers are still responding to this warming and have maintained their 'Little Ice Age' areas for all but the last three decades. The relatively thick ice of the lower reaches of these glaciers was largely relict and insulated beneath thick protective mantles of debris. Ice loss was by slow surface lowering alone, with little or no terminus retreat.

The loss of ice volume from larger glaciers due to calving into the growing glacial lakes was 0.63 km^3 and tongue down-wasting, 5.37 km^3. This is large compared with those from the mass balance changes. The mass balance and overall ice losses are described in companion papers by Fitzharris and others and Salinger and others.

Overall ice volume trends and variation in ice volume in the Southern Alps 1976–2005

J. Salinger NIWA-Auc, T. Chinn APP, A. Willsman NIWA-Dun, B.B Fitzharris UOtago-Geog; j.salinger@niwa.co.nz

New Zealand has a long and continuing record of annual end-of-summer-snowline (EOSS) measurements for a set of 46 index glaciers of the Southern Alps from 1977 to present. Two methods are used to determine changes in glacier mass since 1977 one using mass balance gradient, described in a companion paper by Fitzharris and others., and the other using topographic changes, described in the companion paper by Chinn and others.

Years and seasons of considerable negative mass balance are marked by either, above average temperature anomalies, and/or reduced precipitation in the Southern Alps and increased east or north easterly circulation. Temperature and circulation appear to be the most important factors. Years and seasons with positive mass balances have below average temperature anomalies and above average or average precipitation. Generally these are associated with periods of stronger westerly or southwesterly circulation over New Zealand. The Southern Oscillation Index encapsulates all these features and is a useful climate index associated with variability. The large glaciers are still reacting to regional warming of about 1°C since the Little Ice Age, are extensively covered by a debris mantle in their lower reaches and are calving into proglacial lakes.

The overall results show a significant decrease in ice volume of the Southern Alps from 1976–2005, despite only a slightly negative mass balance averaged over this period. Ice volume over the monitoring period, as derived from $EOSS_{Alps}$ and estimates of mass balance, shows little cumulative change, with a loss from this source of only 0.49 km^3 from an estimated starting total volume of 54.60 km^3. This is only 8% of the total ice volume loss of for this period. The bulk of the ice volume loss (5.37 km^3) comes from calving into proglacial lakes and tongue down-wasting of 12 large glaciers. The overall rate equates to rate of loss of –0.2 km^3/a, which is probably slower than earlier in the 20th century. For example, Ruddell (1995) estimates the total ice volume of the Southern Alps to be about 100 km^3 at about 1880, and at about 170 km^3 at 1850 (Heolzle and others, 2007). The rate of ice loss between the 19th century and 1977 is estimated at between –0.5 km^3/a and –0.8 km^3/a.

Changes in ice volume of glaciers of the Southern Alps since 1977

B.B. Fitzharris UOtago-Geog, J. Salinger NIWA-Auc, T. Chinn APP, A. Willsman NIWA-Dun; bbf@geography.otago.ac.nz

Methods for estimating changes in ice volume of the Southern Alps with global warming are briefly reviewed. New Zealand has a long and continuing record of annual end-of-summer-snowline (EOSS) measurements for a set of 46 index glaciers of the Southern Alps from 1977 to present. The EOSS values give an immediate, annual signal of mass change. There are also area-elevation curves available for each of the index glaciers. Estimates of the mean mass balance gradient can be used to convert changes in EOSS to changes in ice volume. Two gradient values, one for the accumulation area, and one for the ablation area are used. Ice volume changes since 1977 are calculated for each index glacier and extended to all small to medium-sized glaciers of the Southern Alps using the New Zealand glacier inventory. Results show that over the last 30 years there has been a small loss of ice volume for these of 0.49 km^3. However, the method is not appropriate for calculating loss of ice volume from our largest glaciers. They have complications that arise from calving into growing glacial lakes and down-wasting beneath a debris cover at their tongues. Estimates of ice losses for these require a different method. Ice losses are much larger, as described in companion papers by Chinn and others and Salinger and others.

Landscape change at the terminus of Tasman Glacier, Aoraki/Mt Cook National Park

Delia Strong UOtago-Geog, Sean Fitzsimons UOtago-Geog and Pascal Sirguey GLIMS-NZ

Landscape change in the Aoraki/Mount Cook National Park is occurring rapidly, as valley glaciers appear to have entered a phase of accelerating retreat. Using remotely sensed images and historical maps, spatial and temporal changes in the behaviour and position of the terminus of the Tasman Glacier are examined. A chronology of change since early European settlement has been developed from historical maps, vertical aerial photographs and Advanced Spaceborne Thermal Emission and reflection Radiometer (ASTER) images. While there are inherent difficulties in rectifiying historical maps and vertical aerial photographs for quantitative assesment of landscape change, the seven year dataset of ASTER images provides an opportunity to quantify changes in geomorphology and the rate of terminus retreat. For example preliminary results show a 37%

increase in the area of Tasman Lake from 2000 to 2006. Based on the ASTER images, feature tracking is assessed as a tool for determining short term fluctuations in glacier velocity. The application of satellite imagery to mapping debris covered glaciers is known to be problematic and this study attempts to assess the value of ASTER images in the context of mapping and quantifying landscape change at a low gradient, debris covered valley glacier in New Zealand.

Snow and ice research information to the world through Google Earth

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The recent explosion of open source virtual globe systems such as Google Earth, Microsoft Virtual Earth and NASA World Wind provide an ideal platform for sharing geographical research information with the world. Three examples of using the Google Earth platform to share snow and ice geographical information with the world are presented.

The first example presents maps of the estimated daily snow cover in the Lake Pukaki region from output of the SnowSim-Pukaki snow storage model. This example uses time stamps, allowing for viewing of a specific day's snow cover, or animating a sequence to see how the snow cover changes.

The second example provides avalanche hazard area information for the Aoraki/Mt Cook region. The hazard areas were derived from an operational hazard report. Geographical information system processing based on the hazard report was used to prepare the hazard maps prior to publishing to a Google Earth format.

The third example compares snow and ice photographs with the Google Earth view as seen from the location that the photo was taken from. This provides a simple but powerful method of placing an image in its correct spatial and/or temporal context.

The three examples demonstrate the potential for public access to research in a user-friendly format, enabling improved community outreach.

Investigating permafrost distribution in the Mount Cook region for improved modelling of glacial related slope instability hazards

Simon Allen, Ian Owens, UCan-Geog and
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During the extremely hot and dry summer of 2003 in the European Alps, the occurrence of numerous rockfall events from high elevation steep bedrock exposed visible ice within the associated detachment zones (Gruber and others, 2004), confirming qualitatively what had earlier been demonstrated in both theory and laboratory based experiments regarding permafrost degradation, climate warming, and related slope instabilities. Numerous large rock avalanche events have been documented in high mountain regions of the earth, often with catastrophic consequences owing to process interactions and chain events involving mass movements of ice, debris or glacial lake water. Although geological and geometric conditions of bedrock are the most significant factors for the stability of steep slopes, permafrost and its degradation represent a highly sensitive, rapidly changing factor of crucial relevance to alpine slope stability. The thawing of ice-filled rock joints and associated destabilisation in response to climate warming can primarily be attributed to direct loss of ice/rock adhesion and elevated internal water pressure due to the phase change from ice to water (Gruber and Haeberli, 2007).

Although permafrost processes have been discussed in relation to rock glacier distribution in New Zealand, there has been no scientific consideration in New Zealand given to the likely wider distribution of permafrost within bedrock slopes, and in particular, on steep slopes which dominate at higher elevations throughout the Mount Cook region. Recent large rock avalanches, including the spectacular summit failure of Mount Cook (McSaveney, 2002) have awoken interest in the understanding of permafrost and slope stability interactions in the region. Here we present the first results from permafrost distribution modelling for the MCR, based upon local application and calibration of topo-climatic relationships established in the European Alps. Initial validation of the estimated permafrost distribution is discussed on the basis of a rock glacier inventory and remote sensing based vegetation mapping. An extensive field campaign to record rock wall temperature data throughout the region is outlined, and these data are expected to significantly improve the validation of systematic permafrost distribution modelling in the region. Ultimately, this improved knowledge of permafrost distribution will be coupled with analyses of recent glacial terrain changes, topographic and geological analyses, to assess current and future slope instability hazards in the region.

Modelling the spatial variability of snow water equivalent - guidance from field data

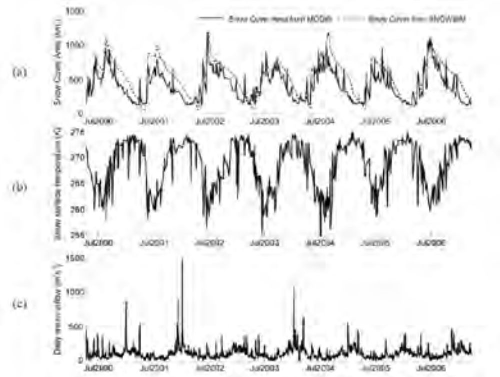
Martyn Clark, Jordy Hendrikx, Ross Woods,
NIWA-CC, Andrew Slater UCol-CIRES,
Einar Örn Hreinsson, Tim Kerr, Ian Owens,
UCant and Nicolas Cullen, UOtago

This talk reports on the use of field data on the spatial variability of snow water equivalent to guide the design of distributed snow models. Diagnosis of field data from the Jollie catchment in the New Zealand Southern Alps shows that there are numerous factors that control snow distribution and many of these display variability at different scales. At the hillslope scale (less than ~100 m), spatial variability in snow depth is caused by drifting and avalanching, whereas at the watershed scale (100–10 000 m) spatial variability in snow depth is caused by variability in freezing levels and melt energy. Similar conclusions can be gleaned from previous studies. The spatial variability in hillslope-scale processes can be represented in models as a continuous function (e.g. as a probability distribution) but several problems are encountered when using continuous functions to describe the spatial variability in watershed-scale processes. Fortunately, the variability at the hillslope scale is separable from variability at the watershed scale, and it is possible to identify an 'ideal' modelling scale that distinguishes hillslope-scale and watershed-scale processes. Based on these results, we suggest a general strategy for configuring snowmelt-runoff models in mountainous river basins. Watershed-scale variability in freezing levels and melt energy should be explicitly resolved by disaggregating the river basin into multiple model elements (grid cells or sub-basins) that are ~3–4 km across, and using multiple elevation bands of ~100–200 m in height within each model element. At the sub-grid scale (i.e., within each elevation band) the aggregate impact of hillslope-scale variability should be implicitly modeled using probability distributions. In this approach the within-element variability is clearly separated from the variability between model elements.

Analysis of relationships between time series of snow-cover parameters and tributary inflow in the lakes of the upper Waitaki Catchment

Pascal Sirguey, Renaud Mathieu GLIMS-NZ, UOtago-SS, and Yves Arnaud IRD-LGGE; sirpa271@student.otago.ac.nz

Time series of snow cover distribution and surface temperature have been retrieved from MODIS images over the period 2000–7 in the Ohau, Pukaki and Tekapo catchments. The analysis of these time series along with the daily tributary inflows observed in the corresponding lakes offers promising perspectives towards a better understanding of the relationships between these parameters. We investigated the use of signal processing tools such as wavelet analysis to explore the dynamic of these signals and identify possible relationships.



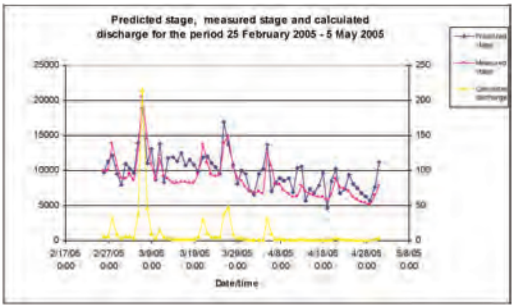
Examples of times series used for the analysis: (a) comparison between the snow cover area retrieved from MODIS in the Pukaki catchment and the Snow cover area estimated in the SNOWSIM-Pukaki model; (b) mean surface temperature of 23 selected sites of perennial snow in the Mount Cook region; (c) daily mean tributary inflow of lake Pukaki (data courtesy of Meridian Energy).

The hydrological system and climate of Brewster Glacier, Aotearoa New Zealand in the context of regional and global climate change

Alex Winter-Billington, Andrew Mackintosh, Brian Anderson, VUW-Geog, and Tim Kerr UCant; winteralex@student.vuw.ac.nz

Temporal and spatial variability in stream discharge is conrolled by variations in local climate, and this in turn is intimately related to both regional and global atmospheric circulation and climate change. In non-glacierised catchments, the relationship between atmospheric variables and streamflow can be readily ascertained and the stream hydrograph predicted fairly certainly with weather forecasts. The relationship is more complicated in glacierised catchments. This study attempts to quantify the relationship between Brewster Glacier proglacial discharge and both local (measured) atmospheric variables and broader atmospheric circulation patterns with sufficient accuracy and specificity that prediction of discharge can be made using local weather forecasts and atmospheric circulation indices. It is found that temperature and rainfall are consistently the most influential variables in predicting discharge production, that wind speed contributes significantly during autumn while humidity does so in summer, and atmospheric pressure contributes very little. A multiple regression equation can predict 64% of variation in the proglacial stream hydrograph, but only 46% of discharge calculated with a ratings curve, and around 90% of the total discharge volume. A qualitative relationship is established between discharge at Brewster

Glacier proglacial stream and Aotearoa New Zealand atmospheric circulation indices. An estimation of future discharge from Brewster proglacial stream is made in accordance with regional climate change scenarios.



Snow and groundwater recharge in Canterbury, New Zealand

Paul A. White, GNS-Tau; p.white@gns.cri.nz

Recharge to groundwater associated with two snowfalls on the Canterbury Plains is assessed at five groundwater recharge monitoring sites.

Snow and rainfall from a snow storm on and around 19 September 2005, following dry antecedent conditions on the Canterbury Plains, produced up to 77.5 mm of ground-level precipitation at groundwater recharge sites. Recharge to groundwater at three of the five groundwater recharge sites is associated with the snow storm. The largest measured groundwater recharge was 24 mm at Winchmore; no recharge was measured at Lincoln and Hororata.

Snowfall was widespread in Canterbury on 11 and 12 June 2006 after a period of relatively wet conditions in Canterbury. Up to 65 cm of snow was recorded on the Canterbury Plains with the largest snowfall at Winchmore. Precipitation (including rainfall, presumably, and snow melt) during the storm event at five groundwater recharge sites was at most 59.1 mm.

Groundwater recharge began soon after (3–4 hours) the onset of precipitation in the storm. Groundwater recharge and precipitation for the period 11–30 June 2006 (including snow and rainfall) is large:

- Christchurch Airport 65.5 mm groundwater recharge from 100.5 mm precipitation
- Lincoln 39.7 mm groundwater recharge from 119 mm precipitation
- Dunsandel 148 mm groundwater recharge from 172 mm precipitation
- Hororata 136.2 mm groundwater recharge from 136 mm precipitation
- Winchmore 58 mm groundwater recharge from 102.5 mm precipitation.

Snowfall, and rainfall in large storm events, is significant to total groundwater recharge in Canterbury and is therefore important for Canterbury water resources. For example, groundwater recharge for the period 11–30 June 2006 is:

- greater than total groundwater recharge for the 2005 calendar year at Lincoln and Hororata
- equivalent to approximately 200 million m^3 of water on the Canterbury Plains in the catchment of Te Waihoa/Lake Ellesmere, which is 53–99% of the range in estimated annual groundwater use in the catchment of Te Waihoa/Lake Ellesmere.

ANTARCTIC GLACIOLOGY

Glacial history of the Darwin-Hatherton glacial system in the central Transantarctic Mountains; field mapping and sampling for cosmogenic dating

Bryan Storey, Mette Riger-Kusk, and David Hood, UCan-GA; bryan.storey@canterbury.ac.nz

In order to accurately predict the response of the Antarctic ice sheet to future climate change, we need a well-constrained understanding of its current behaviour, and of the way it has responded to past climate change. Although we now have a relatively detailed understanding of behaviour and recent change of some of the fast-flowing components of the Antarctic cryosphere, we know relatively little about the way in which the outlet glaciers that drain the East Antarctic Ice Sheet through the Transantarctic Mountains have behaved in the recent past, or the processes that control their behaviour and response.

The key aims of this research project is to accurately evaluate the amount and rate of recent change of the outlet Darwin–Hatherton glacial system that drains the East Antarctic Ice Sheet (EAIS) through the Transantarctic Mountains into the Ross Ice Shelf at 79°55′ S. This glacier system is a significant site for understanding change, because it is one of the few locations in the central Transantarctic Mountains where well-preserved glacial moraines provide geomorphological evidence for the recent (Holocene) behaviour of the ice sheet. Bockheim and others. (1989) mapped five separate glacial drift sequences (Hatherton, Britannia I, Britannia II, Danum and Isca).

This presentation will report on recent field work undertaken in December 2007 in the Lake Wellman area on the margin of the Hatherton Glacier. The aerial extent of the glacial drift deposits indicate that in the past, ice was over 800 metres thicker than it is today. Although numerous recessional moraines are present, the boundaries between the different drift sequences are not always obvious. There has been extensive reworking of older drift sequences. Extensive sampling of glacial erratics was undertaken for cosmogenic dating.

An ASTER Digital Elevation Model (DEM) for the Darwin–Hatherton Glacial System, Antarctica

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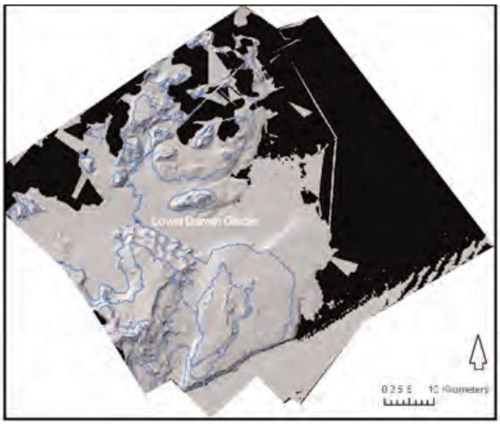
The Darwin–Hatherton glacial system is an outlet glacial system in the Transantarctic Mountains, Antarctica, which drains ice from the East Antarctic Ice Sheet into the Ross Ice Shelf. This research provides remotely sensed data that can be used in modelling research for the Darwin-Hatherton glacial system, which in turn can be used in mass balance research for the West Antarctic Ice Sheet.



DEM of the lower Darwin Glacier at 45 m resolution. Averaged from five individual ASTER DEMs. Hill-shade version with 500m interval topographic contours.

Two improved digital elevation models (DEM) are produced to cover the lower Darwin Glacier and to cover the upper Darwin and Hatherton Glaciers. The new improved DEMs are generated from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite data, with a resolution of 45 m. To produce the two final DEMs, multiple DEMs are firstly adjusted to remove systematic errors and are then stacked and averaged to increase the accuracy and produce the final two DEMs. For the lower Darwin Glacier, 5 DEMs were averaged and in the upper Darwin and Hatherton Glaciers, 6 DEMs were averaged. The accuracy is quantified by a remaining error of +9 m for the lower Darwin Glacier DEM and + 37 m for the upper Darwin and Hatherton Glaciers DEM. This is a significant improvement from the existing 200 m resolution Radarsat Antarctic mapping project (RAMPv2) DEM which has a remaining error of +138 m over the lower Darwin Glacier and +152 m over the upper Darwin and Hatherton Glaciers. The accuracy is assessed by comparing the ASTER and RAMPv2 DEMs to highly accurate ice, cloud and land elevation satellite (ICESat) laser altimetry data.

Precise surface elevation mapping of polar ice sheets using differential SAR interferometry

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The surface elevation at the margins of the Antarctic ice sheet is largely unknown at the required accuracy to detect short-term changes. This is partly because the resolution of conventional radar altimeters, especially on the sloping coastal areas, is too coarse. The Geoscience Laser Altimeter System (GLAS) onboard IceSat performs well with respect to vertical accuracy, but the satellite orbit allows only incomplete coverage. The derivation of accurate digital elevation models (DEM) using interferometric Synthetic Aperture Radar (INSAR) requires at least one pair of coherent interferograms, a precondition often not met. Other limitations for INSAR are, besides lack of ground control points, inaccuracies in the data processing and atmospheric conditions. In general, INSAR is especially useful to measure horizontal and vertical displacement because of the high sensitivity to ice motion.

In our study we try to fill the gaps between IceSat elevation profiles. We investigated the potential and accuracy of mid 1990s ERS-1/2 SAR data to derive DEMs by including large amounts of IceSat data, acquired after 2002, as ground control. Our main study area was Dronning Maud Land in East Antarctica, where we had a large amount of SAR data available.

The result of our study is a high resolution DEM with varying vertical and horizontal accuracy, which mostly outperforms currently available DEMs of that region. Taking all the uncertainties into account, we investigated the possibility that remaining errors and differences in quality are related to snow surface and volume properties, or are more likely a consequence of a real elevation change between the acquisition of SAR and IceSat data. Applying the proposed method to data in the western Ross Sea region, we also show an example of a preliminary DEM near Scott Base.

Implementation of the GLIMMER ice sheet model in the UVic ESCM

Jeremy Fyke, VUW, UVictoria, Lionel Carter VUW, Andrew Weaver UVictoria, and Andrew Mackintosh VUW; fykejere@student.vuw.ac.nz

The successful coupling of an updated, modular, standardised ice sheet model to an earth system model of intermediate complexity (EMIC) will allow for past and future behaviour of large-scale ice sheets to be studied over a wide range of timescales. This work will ultimately focus on simulations of Antarctic Ice Sheets and their interaction with the ocean and climate. The coupling of the GLIMMER ice sheet model to the UVic ESCM is ongoing. The UVic ESCM is an established modular EMIC. It has been extensively used to study aspects of past, present and future climate over timescales of decades to millennia. GLIMMER is (at the core) a 3D finite difference thermomechanical ice sheet model, with significant add-ons developed to enable efficient coupling to global climate models. It is also used for standalone studies of ice sheet dynamics, using prescribed boundary conditions. Coupling and debugging of the UVic ESCM/GLIMMER model will be followed by initialisation and validation tests and simulations of the coupled system to present and future climate change forcing. Future development of the model system will likely include the addition of ice sheet/shelf/ocean interactions and simulation of ice stream processes in large ice sheets.

Sources of dust in Dronning Maud Land, Antarctica, during the last Glacial and the deglaciation derived by rare earth element measurements in the EPICA-DML ice core

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Mineral dust measured in ice cores from Antarctica provides unique information about climate variability in the past more than 800 000 years. Higher dust load in the atmosphere during glacial times is attributed to higher aridity in the source and higher storminess during colder climate. For the interpretation of the dust ice core record it is of importance to know the provenance of the dust. Up to now, dust provenance in Greenland and Antarctic ice cores were determined using isotopic measurements of strontium, neodymium and lead. These methods need a large volume of ice (300g to 2–3 kg). Since drilling ice cores in Antarctica needs a huge effort in time, money and logistics, analysis have to performed on as small samples volume as possible. A new method is presented using rare earth elements (REE) fingerprints measured by inductively coupled plasma mass spectroscopy (ICP-MS) to define dust provenances in ice cores using less than 10 ml of sample volume.

Within the European Project on ice coring in Antarctica (EPICA) two deep ice cores were drilled, one of them in Dronning Maud Land (DML), an area of relatively high accumulation (recent accumulation rate: 64 kg/(m?year)). A quasi-continuous REE record in ice from a depth interval of 500–1100 m is presented. This corresponds to the last Glacial and the following deglaciation. A comparison with REE fingerprints in the potential source areas reveals South America as the source for glacial dust. During warmer climate other sources become more important.

Relict ice in the Dry Valleys, Antarctica

Warren W. Dickinson ARC, Ronald S. Sletten QRC and Birgit Hagedorn QRC

The 8 Ma relict ice in Beacon Valley, Antarctica has been the topic of much debate since Sugden and others reported it in 1995. However, the occurrence of relict ground ice, is not unique to Beacon Valley, and it is found in a variety of forms within 1 m of the surface in many parts of the Dry Valleys. This ice is important because it not only drives the development of Dry Valley landscapes but also contains a paleoenvironmental record. Furthermore, it is our best analogue for understanding the presence of ice on Mars. In this paper we compare the properties and occurrences of ground ice from the Beacon, Pearse, Victoria and Wright Valleys and Table Mountain. We also show several methods of core sampling frozen sediments and ice.

The origins of relict ground ice are complex and may overlap. Ablation models suggest this ice should be younger than 10 000 years, yet it persists under very old surfaces. In appearance, it ranges from clear massive ice, to debris-rich ice, to pore-filling ice in sediments and soils. Our studies suggest that the ice can result from *in situ* processes or from stranded remnants of past glaciers and lakes. Highly deformed debris-rich ice may result from accumulated strain of multiple advances and retreats of cold-based glaciers or from rock glaciers and gelifluction processes. Although we cannot provide absolute dates for the ice, their relative ages also give insight to their origins.

To improve our understanding of the Antarctic climate system, it is crucial to understand climatic signatures that may be present in these features. Although these features probably may not yield high resolution climate data, their data provide a terrestrial history that will complement marine and ice core data.

The dynamic response of the Warszawa Icecap, Antarctica to past and future climate change

Alun Hubbard UWales-IGES, Anne le Brocq, Regina Hock, Steve Palmer, Andy Shepherd, Mattiaus Braun, Dave Hildes, Andy Wright; abh@aber.ac.uk

In 2002 a glaciological field-campaign was initiated on King George Island, South Shetlands with the aim of providing detailed geophysical, geodetic and meteorological measurements to constrain a modeling investigation of the response and sensitivity of its local ice-mass to recent past and forecast future climate scenarios. Ongoing measurements of surface velocity, mass-balance, englacial and basal radar reflectors along with remotely sensed imagery provide boundary conditions for a 3D higher-order, thermomechanical flow model of the Warszawa icecap at 100 m resolution. The model is coupled to climate through a temperature-index melt and accumulation algorithm incorporating direct net radiation and snow-drifting effects which yield the time-dependent surface mass-balance boundary condition. Feedbacks between surface-melt and basal decoupling are also incorporated through the transfer of longitudinal stresses and a basal dynamics parameterisation. An ensemble of spin-up experiments were run to validate the model against contemporary observables and to determine the primary influences on the present ice geometry. These experiments reveal the icecap to be ultra-sensitive to climate, rapidly responding to perturbations in temperature, precipitation, basal dynamics and ice calving. Prevailing wind-direction and aspect also exert control through their primary effect on mass accumulation and ablation. A further set of time-dependent experiments forced by palaeo-climate records/proxies to replicate post-Little-Ice-Age history through to the end of this century under the best and worst-case IPCC temperature trajectories reveals that the icefield was relatively stable until the mid-1950s, after which its retreat has steadily accelerated. Given continuation of the recent rapid warming observed across the region, the Warszawa icefield will dwindle to less than 5% of its present volume by the end of this century though more conservative estimates of climate forcing, offset by enhanced precipitation, are arguably more likely and result in significantly less depreciation in ice cover. Hypsometric up-scaling of these results across the sub-Antarctic yields a net volume loss of between 143 GTonnes under a stabilisation of the 2000–2005 climate to 986 GTonnes with an assumed 4°C warming by the end of this century.

ANTARCTIC SEA AND LAKE ICE RESEARCH

Platelet ice growth during winter: McMurdo Sound, Antarctica

Greg Leonard, Pat Langhorne, Craig Purdie, Ross Vennell, Russell Frew, David Dempsey, UOtago, Tim Haskell IRL, Mike Williams, Craig Stevens, NIWA, Natalie Robinson NIWA, VUW, Mark McGuinness, Jonathan Crooks VUW

Platelet ice is the name given to ice crystals that nucleate in t he ocean and grow either at depth or loosely attached to the ice-water interface. Linked to the proximity of ice shelves, it is known to form in supercooled sea water.

This project began in 2002 and has conducted observations on and below the landfast sea ice of McMurdo Sound during the austral winter of 2003. A key finding is that the presence of platelet ice in the sea ice cover is conclusively linked to the time history of the appearance of ice crystals in the water column, monitored using the strength of the backscattered signal from an acoustic Doppler current profiler as a proxy. Generally, these crystals appeared from early winter as water near the ice-water interface became supercooled. This supercooling appears to be related to a simultaneous, abrupt change in the structure of the upper water column, from one that behaved dynamically and contained both the warmest and coolest measured temperatures, to one in which the water was essentially isothermal near its surface freezing temperature. Near-surface ocean temperature was affected by tidal mixing and by an increase in the thickness and density of the surface mixed layer, which was created by salt rejection during ice growth. These processes allowed cold water, trapped by buoyancy in a band at the base of the mixed layer in early winter, to gain access to the ice-water interface by midwinter. This band of cold water probably had its origin beneath the McMurdo Ice Shelf.

Given the link between ice crystals in the water column and the crystal structure of the sea ice, the mechanism of crystal inclusion in the sea ice cover has been modelled. As young sea ice freezes brine is rejected at the ice–water interface, stirring the water beneath. The influence of this stirring on the upward precipitation of tiny ice crystals in the water column has been modelled. It is found that brine rejection has a significant influence only when the ice is growing very rapidly.

For logistical reasons winter measurements were conducted at a single site. The team is now comparing sites where the abundance of platelet ice varies widely. Further, the experimental programme will be extended into a second winter field season in 2009.

Formation and structure of refrozen cracks in sea ice

Chris Petrich, UOtago, UAF-GI, Pat Langhorne UOtago, Tim Haskell IRL

This study characterises the healing process and structure of undeformed, linear, parallel-sided, flooded cracks in land-fast sea ice. Field investigations and refreezing experiments were performed in McMurdo Sound, Ross Sea, Antarctica, between 1998 and 2002. Data from a two-dimensional thermistor array are used to show that the ice-water interface of freezing cracks is arch-shaped due to bidirectional heat flow to the surrounding ice cover and to the atmosphere. Ice growing laterally into the crack is found to desalinate over a prolonged period of time, until the isotherms are approximately horizontal. Superposition of heat flow to the atmosphere and to the host sea ice sheand otherslows the refreezing progress to be modeled analytically. Close to the ice–air interface, the salinity is higher at the sides of wide refrozen cracks than it is at the center. However, deeper down and in narrower cracks in general, the salinity is higher at the center than at the sides. A finite volume, computational fluid dynamics (CFD) model reproduces the generally arch-shaped alignment of brine pockets. This pattern is attributed to convection in the mushy layer. Crystals are found to grow upstream into the crack because of a salinity gradient in the buoyant convective flow.

Preferred crystal orientation in freshwater ice
Marc Mueller-Stoffels, UOtago, UAF-GI,
Pat Langhorne UOtago
Crystal orientations in lake ice have been subject of considerable attention due to their influence on albedo and stability during melt season. It has been reported in the literature that ice sheets on freshwater bodies develop preferred crystal orientations. In some ice sheets c-axis vertical crystals become dominant, in others, c-axis horizontal dominate. However, the reason for these differences is unclear, and it has been suggested that the preferred orientation depends either on the thermal characteristics of the water body or on whether the ice is seeded. Experiments have been conducted which confirm that in seeded fresh water ice sheets the favoured c-axis orientation is horizontal, regardless of the bulk temperature gradient in the water column. However, these experiments also suggest that the temperature gradient close to the interface is influenced by seeding. We propose that the partial melting of seeds prior to freezing of seeded ice sheets creates conditions favourable to the growth of c-axis horizontal crystals. Alternatively, unseeded ice sheets, grown under the same conditions, develop a preference for c-axis vertical crystals.

Modelling the salinity of growing sea ice
Chris Petrich UAF-GI, UOtago, Pat Langhorne UOtago**,** Hajo Eicken UAF-GI
Desalination of sea ice under quiescent conditions has been modelled with a two-dimensional continuum computational fluid dynamics (CFD) model and with an explicit analytical model. The governing equations of the CFD model are solved with the finite volume method. The analytical model assumes gravity-driven convection as the only desalination process. Both models predict that the quasi-steady, stable salinity profile of sea ice can be parameterised by the growth rate, independent of the oceanic heat flux. The relationship approximates a power law for growth rates above 1 cm per day, which is consistent with field data. The results are consistent with an earlier desalination model. Sensitivity studies of CFD simulations show that the modelled stable salinity appears to depend little on the permeability at high porosities. However, increased permeability at high porosities reduces the appearance of scatter in the salinity distribution. Simulations with anisotropic permeability suggest that the stable salinity depends on the geometric mean of the lateral and vertical permeability components. Assuming a critical porosity, below which no fluid motion is possible, is not necessary to produce a stable salinity profile.

ABBREVIATIONS

APP	Alpine and Polar Processes, Lake Hawea, New Zealand
ARC	Antarctica Research Centre, Victoria University, Wellington, New Zealand
ARC-Geog	Antarctic Research Centre and School of Geography, Environment and Earth Sciences, Victoria University, Wellington, New Zealand
AWI	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
GLIMS-NZ	Global Land Ice Measurements from Space (GLIMS) New Zealand Office
GNS-Dun	GNS Science, Dunedin, New Zealand
GNS-Tau	GNS Science, Taupo, New Zealand
IDEP	Institute for the Dynamics of Environmental Processes – CNR, Venice, Italy
IRD-LGGE	Institut de Recherche pour le Développement, Laboratoire de Glaciologie et Géophysique de l'Environnement, Saint Martin d'Hères, France
IRL	Industrial Research Ltd
LLNL	Lawrence Livermore National Laboratory, Livermore, California, USA
NIWA-Auc	National Institute of Water and Atmospheric Research, Auckland, New Zealand
NIWA-CC	National Institute of Water and Atmospheric Research, Christchurch, New Zealand
NIWA-Dun	National Institute of Water and Atmospheric Research, Dunedin, New Zealand
QRC	Quaternary Research Center, Earth and Space Sciences, University of Washington, Seattle, Washington, USA
UAF-GI	Geophysical Institute, University of Alaska, Fairbanks, Alaska, USA
UCan-GA	Gateway Antarctica, University of Canterbury, Christchurch, New Zealand

UCan-Geog	Department of Geography, University of Canterbury, Christchurch, New Zealand
UCant	University of Canterbury, Canterbury, New Zealand
UCol-CIRES	Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, USA.
UColum-LDEO	Lamont-Doherty Earth Observatory of Columbia University, New York, USA
UME-ESCC	Department of Earth Sciences and Climate Change Institute, University of Maine, Orono, Maine, USA.
UOslo	University of Oslo, Oslo, Norway.
UOtago	University of Otago, Otago, New Zealand
UOtago-Geog	Department of Geography, University of Otago, Otago, New Zealand
UOtago-SS	School of Surveying, University of Otago, Dunedin, New Zealand.
UVictoria	University of Victoria, Victoria, British Columbia, Canada
UWales-IGES	Centre for Glaciology, University of Wales, Aberystwyth, UK
UWell-Geog	School of Geography, Environment and Earth Science, Victoria University of Wellington, Wellington, New Zealand
UZur-GGG	Department of Geography, Glaciology and Geomorphodynamics Group, University of Zurich, Zurich, Switzerland
VUW	Victoria University of Wellington, Wellington, New Zealand
VUW-Geog	School of Geography, Environment and Earth Sciences, Victoria University of Wellington, Wellington, New Zealand

International Glaciological Society

ANNUAL GENERAL MEETING 2007

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

6 September 2007, main symposium lecture theatre,
Presidium of the Russian Academy of Sciences, Moscow, Russia

The President, Professor Atsumu Ohmura, was in the Chair.
66 persons from 17 countries were present, of whom 24 were IGS members.

1. Minutes of the last Annual General Meeting
The Minutes of the last Annual General Meeting, published in *ICE*, 2006, No 142, p. 9–12, were approved on a motion by T. Neumann, seconded by D.R. MacAyeal and signed by the President.

2. President's Report
The President gave the following report for 2006–2007:

Ladies and gentlemen,
The International Glaciological Society has completed its 71st year. It is my pleasure to report on a very happy year since the Cambridge conference. The article contributions for the *Journal of Glaciology*, the society's core production, are increasing. We published *Annals* vol. 45, on Earth and Planetary Ice–Volcano Interactions, within 1 year after the symposium. In comparison with symposia organised by other academic societies and associations, it is rare to see proceedings published within a year. The main reason for the increasing publication activity is to a great due to the speeding up in the editing process and early electronic posting of the accepted articles, not forgetting the prestige of the *Journal*. These aspects are no doubt grasped by potential authors. It is nice to see the production team at the society's office in Cambridge in good spirits and full of enthusiasm. The high rate of publication activity is important for all scientists and also for the interest of the Society. Publication can, however, be speeded up even more. There are two processes that are still slow. These are return of the reviews and proof reading and return of the revised articles. This means **us**. An electronic review process will be introduced shortly. We are, however, being very careful not to increase the burden of reviewers by using poorly programmed review software. This new path will not eliminate the conventional review method. The new and traditional reviewing systems will be used in parallel.
The Society organised a conference on the Cryospheric Indicators of Global Climate Change and co-sponsored 13 symposia at the 24th IUGG General Assembly in Perugia, which will be published as *Annals of Glaciology*. The Moscow symposium again represents an increasing level of activity for the Society.
Reading the articles published in recent journals, one sees a vast increase in our knowledge of glaciology. In contrast with the progress taking place in a number of areas in our field, we lack fundamental knowledge in glaciology, for example the volume of glacier ice, both regional and global. The lack of precise knowledge of the ice volume constantly plagued IPCC while estimating the ultimate potential rise in sea-level. It is even more difficult to perceive what is happening with regard to ice volume change right now in the warming climate. There are two main reasons for this problem. One is the fact that we did not complete the World Glaciology Inventory and the other is our incapability to engage seriously in mass-balance monitoring. The table presents the present best estimate of glacier surface area and ice volume, together with the degree of completion of the inventory. Two countries, the former Soviet Union and China, despite having a large number of glaciers, have completed their inventories. The present difficulty in estimating the global ice volume is due to a great extent to the incompleteness of the inventory in the USA and Canada. The reason for the difficulty in making progress with the glacier inventory is clear. It is not easy for young scientists to construct a brilliant career while engaged in inventory work. However, our science has reached the stage of requiring a huge database to make further progress. In many other branches of science it is also difficult to make such a database and even more to keep it up to date. This is the case in astronomy, seismology,

molecular biology and climatology, to mention just a few. Glaciology is not alone in experiencing this problem. Large-scale data-gathering demands an enormous amount of work that requires professional experience and a careful and dedicated attitude but is usually not rewarded. We cannot blame young scientists for avoiding this sort of work. Nobody has a right to ask them to sacrifice their careers for the information that all others need. I am wondering whether this is not ideal work for retired scientists to engage in as volunteers. At a rough estimate, ten people could complete the glacier inventory at a comfortable pace based on the original detailed method in about 3 years. Using satellite data the work will no doubt be accelerated. If we don't take any action, this area will forever remain an unknown region of knowledge.

In the table, figures in bold indicate completed regions for which the data are available at NSIDC and WGMS; figures in italics also indicate completed regions, but not all data are available at the data centres; while the figures in ordinary type are those for incomplete or untouched regions. Satellite-based inventories should give priority to these regions.

Region and country	No. of glaciers inventoried	Area in 1989 WGMS publication	Area in WGI km^2	Best area estimation km^2	Completion in decimal	No. of glaciers to deal with
South America						
Tierra del Fuego, PIF	244	21200	1221.7	21200	0.058	3990
Argentina north of 47.5′ S	2350	1385	863.11	1385	0.623	1421
Chile north of 46′ S	**1050**	**743**	**756.8**	**756.8**	**1.000**	**0**
Bolivia	**1697**	**566**	**509.5**	**509.5**	**1.000**	**0**
Peru	1679	1780	1131.1	1780	0.635	963
Equador	*114*	*120*	*110.8*	*110.8*	***1.000***	***0***
Columbia	106	111	18.61	111	0.168	526
Venezuela	**7**	**3**	**2.51**	**2.51**	**1.000**	**0**
Central and North America						
Mexico		11		11	0.000	
USA (with Alaska)	2592	75283	12658	75283	0.168	12824
Canada	15054	200806	36405	200806	0.181	67982
Africa	**60**	**10**	**10.85**	**10.85**	**1.000**	**0**
Europe						
Iceland		*11260*	*11200*	*11200*	*1.000*	*0*
Svalbard	**895**	**36612**	**33666**	**33666**	**1.000**	**0**
Scandinavia with Jan Mayen	**2410**	**3174**	**3058**	**3058**	**1.000**	**0**
Alps	**5426**	**2909**	**3059.71**	**3059.71**	**1.000**	**0**
Pyrenees	**108**	**12**	**11.43**	**11.43**	**1.000**	**0**
Former USSR and Asia						
Former USSR	**20908**	**77223**	**82128**	**82128**	**1.000**	**0**
Afganistan, Iran, Turkey	60	4000	472	4000	0.118	4559
Pakistan, India	303	40000	1898.4	40000	0.047	6081
Nepal, Bhutan	226	7500	2983	7500	0.398	342
China	**46377**	*56481*	*11049*	*59425*	*1.000*	*0*
Indonesia		7		7	0.000	
Oceania						
New Zealand	**3149**	**860**	**1157.9**	**1157.9**	**1.000**	**0**
Subantarctic islands		7000		7000	0.000	
Total	**105365**	**549056**	**204371.4**	**554179.5**	**0.369**	**180346**

The Secretary General invited members to discuss the President's report.

J. Schweitzer proposed, and D. Issler seconded, that the President's report be accepted. This was carried unanimously.

3. Treasurer's Report

The Secretary General, on behalf of the treasurer, Dr I.C. Willis, presented the following report with the Financial Statements for the year ended 31 December 2006.

The state of the Society's finances is best summarised by considering the changes from 1 January 2006 to 31 December 2006, as shown on page 7 of the accounts. In the table, the Accumulated Fund refers largely to costs associated with running the *Journal*, the Designated Fund refers to costs associated with running symposia and the *Annals*, and the Restricted Fund is money earmarked specifically for costs associated with the Seligman Crystal.

Restricted Fund: increased very slightly from £7907 to £7945 as a consequence of accrued interest of £265

Designated Fund: decreased slightly by £1,946 from £176,134 to £174,188 largely because of an increase in production and printing costs associated with the publication of *Annals* 43–44.

Accumulated Fund: increased by £31,707 from £354,912 to £386,619 mostly because of a decrease in printing costs of the *Journal* and *Annals* and a small profit of £2846 in the value of investments due to an adjustment to market value (note 8, page 15).

Total: the Society made a net profit of £26,799 in 2006 compared to a net loss of £18,229 in 2005.

In more detail, income is itemised in note 2, page 12 and expenditure listed in notes 3 & 4, page 13 of the auditors report.

Income:
Income from membership dues was unchanged and *Journal* sales were up by £15,753. Sales of *Journal* reprints by authors not paying page charges continued to fall, this year by £165. Page charge income rose by £28,675 compare to £25,533 last year so we managed to continue the trend. (N.B. (1) authors paying page charges receive 100 reprints automatically for no extra charge. N.B. (2) Discounts and refunds at bottom of page 12 refer to 10% discount given to agents selling *Journal* and *Annals* to libraries.)

Expenditure:
A large expenditure is associated with **printing and publishing** the *Journal* and *Annals* but we managed a decrease of £12,269 compared to an increase of £107,739 last year. This reflects a stabilisation of production; we have caught up with both the *Journal* and the *Annals*. Other major expenditure comes from the costs of **supporting** the *Journal* and *Annals*. The IGS office published four *Journal* issues and three *Annals* volumes and worked on two more *Journal* issues and two *Annals* volumes. Salaries and NI contributions appear to have risen slightly by £5,233 cf. 2005, in line with inflation, and telephone, postage and stationery costs appear to have increased by £3,873. Computer costs increased by £8,481 to reflect the intention to gradually update the IT equipment and we have also entered into a maintenance contract.

Journal* and *Annals
In 2006, the Society published 807 pages in the *Journal of Glaciology* and 1319 pages in the *Annals of Glaciology*. In 2005 the figures were 808 for the *Journal* and 1019 for the *Annals*.

This continues to reflect the reorganisation of the production procedures, which have considerably improved the efficiency of the production process so that the Society has been able to catch up on its backlog of printing as well as reducing the time lag between submission and publication. This continues to be a major priority for the IGS office. As of this week we have already published about 600 pages of the *Journal* this year and we are expecting to send out the last issue of 2007 by the end of November. In addition we have already published almost 1200 pages of the *Annals* and are planning to publish another 300 pages this year.

Summary
The Society's finances are in fairly good shape but we shouldn't be complacent. We ran at a profit this year (~3.5% of total funds) compared with a slight loss last year (~3% of total funds). It is important for us to maintain our inputs as well as operating carefully and efficiently to minimise our costs.

On the **inputs** side, we are particularly grateful to all those authors who have been both able and willing to support the Society by the payment of page charges. If you can, please build page charges into your grants in order to support the Society. Also, I would also make a plea to members of the Society to do all in their power to increase the membership. Although we are continuing to receive new members these are now beginning to fall behind those who are retiring or moving to other fields. Our target is a base of at least 1000 and there is still some way to go. Please encourage your colleagues and students to join. I believe they will find it is extremely good value for money. Also, please ensure that libraries in any institutions over which you have influence either maintain their subscriptions or take one out.

On the **outputs** side, I believe that we continue to increase the efficiency of the IGS office and the IGS staff deserve our help, encouragement and support for what they are doing on our behalf. Under Magnús's management, we have now caught up with the publication of the *Journal of Glaciology* and the *Annals of Glaciology*.

Ian C. Willis, Treasurer

T. Neumann asked what the membership of the IGS was to which the SG responded that it was difficult to estimate as the IGS office was behind in processing some membership renewals/applications but an estimate based on the average membership for the last 3 years suggests about 700 members. This number is down from what the membership was at its maximum in 2001, 835. This emphasises that the IGS must concentrate on increasing its membership in the near future and do so by giving members value for money.

J. Schweitzer asked how income is balanced against expenditure. SG replied that during the past year, the IGS had an excess of £26,799, as is reflected in the Treasure's report.

T. Neumann proposed, and J. Schweitzer seconded, that the Treasurer's report be accepted. This was carried unanimously.

4. Election of auditors for 2007 accounts.
On a motion from the Secretary General, D.R. MacAyeal proposed, and D. Issler seconded, that Messrs Peters Elworthy and Moore of Cambridge be elected auditors for the 2007 accounts. This was carried unanimously.

5. Elections to Council.
After circulation to members of the Society of the Council's suggested list of nominees for 2007–2010, no further nominations were received, and the following members were therefore elected unanimously.

Elective Members (4):	Ninglian Wang (China)
	Olivier Gagliardini (France)
	Francisco Navarro (Spain)
	Christine Hvidberg (Demark)

These appointments were unanimously approved by the AGM.

6. Other business
No other business was motioned

The AGM was adjourned on a motion from P. Bartelt, seconded by D.R. MacAyeal.

JOURNAL OF GLACIOLOGY

Papers accepted for publication between 1 November 2007 and 31 January 2008. The papers are listed in alphabetical order by first author. Some of these papers have already been published.

Helgard Anschutz, Daniel Steinhage, Olaf Eisen, Hans Oerter, Lutz Eberlein
Temporal variation of accumulation patterns in western and central Dronning Maud Land, Antarctica

Liss M. Andreassen, Michiel R. van den Broeke, Rianne Giesen, Johannes Oerlemans
A 5-year record of surface energy and mass balance from the ablation zone of Storbreen, Norway

Jeremy N. Bassis, Helen A. Fricker, Richard Coleman, Jean-Bernard Minster
An investigation into the forces that drive ice-shelf rift propagation on the Amery Ice Shelf, East Antarctica

Genady P Cherepanov, Ivan E Esparragoza
A fracture-entrainment model for snow avalanches

Thorben Dunse, Olaf Eisen, Veit Helm, Wolfgant Rack, Daniel Steinhage, Victoria Parry
Characteristics and small-scale variability of GPR signals and their relation to snow accumulation in Greenland's percolation zone

T.J. Fudge, Neil F. Humphrey, Joel T. Harper, W. Tad Pfeffer
Diurnal fluctuations in borehole water levels: configuration of the drainage system beneath Bench Glacier, Alaska, USA

N.F. Glasser, T.A. Scambos
A structural glaciological analysis of the 2002 Larsen B ice-shelf collapse

Syosaku Kanamori, Carl S. Benson, Martin Truffer, Sumito Matoba, Daniel J. Solie, Takayuki Shiraiwa
Seasonality of snow accumulation at Mount Wrangell, Alaska, USA

Susan Kaspari, Roger LeB. Hooke, Paul Andrew Mayewski, Shichang Kang, Shugui Hou, Dahe Qin
Snow accumulation rate on Mt. Everest: synchroneity with sites across the Tibetan Plateau on 50–100 year timescales

Douglas R. MacAyeal, Marianne H. Okal, Jonathan E. Thom, Kelly M. Brunt, Young-Jin Kim, Andrew K. Bliss
Tabular iceberg collisions within the coastal regime

Frank Pattyn
Investigating the stability of subglacial lakes with a full Stokes ice-sheet model

Vasilii V. Petrenko, Jeffrey P. Severinghaus, Edward J. Brook, Jens Mühle, Melissa Headly, Christina M. Harth, Hinrich Schaefer, Niels Reeh, Ray F. Weiss, Dave Lowe, Andrew M. Smith
A novel method for obtaining very large ancient air samples from ablating glacial ice for analyses of methane radiocarbon

S.F. Price, A.J. Payne, G.A. Catania, T.A. Neumann
Seasonal acceleration of inland ice via longitudinal coupling to marginal ice

Antoine Rabatel, Jean-Pierre Dedieu, Emmanuel Thibert, Anne Letréguilly, Christian Vincent
25 years (1981–2005) of equilibrium-line altitude and mass-balance reconstruction on Glacier Blanc, French Alps, using remote-sensing methods and meteorological data

Makoto Suwa
Termination V in the Vostok (Antarctica) ice core

Robert Thomas, Curt Davis, Earl Frederick, William Krabill, Yonghong Li, Serdar Manizade, Chreston Martin
A comparison of Greenland ice-sheet volume changes derived from altimetry measurements

Jacob C. Yde, Mette Riger-Kusk, Hanne H. Christiansen, N. Tvis Knudsen, Ole Humlum
Hydrochemical characteristics of bulk meltwater from an entire ablation season, Longyearbreen, Svalbard

H.J. Zwally, Per Gloersen
Arctic sea ice surviving the summer melt: interannual variability and decreasing trend

ANNALS OF GLACIOLOGY, VOLUME 47

The following selected papers from the 6th International Workshop on Ice Drilling Technology, held at the National Conservation Training Center, Shepherdstown, West Virginia, USA, 17–23 September 2006, have been accepted for publication in Annals of Glaciology *Vol. 47, edited by Frank Wilhelms and Joan J Fitzpatrick*

Henry Rufli, Jakob Schwander
A floating station structure

Herbert T. Ueda
Byrd Station Drilling 1966–1969

More papers for Annals 47 will be listed in the next issue of ICE

ANNALS OF GLACIOLOGY, VOLUME 48

The following selected papers from the Cryospheric Section of the IUGG General Assembly, held in the city of Perugia, Italy, 2–14 July 2007 have been accepted for publication in Annals of Glaciology *Vol. 48, edited by T.H. Jacka. The papers are listed in alphabetical order by main author.*

Christina Bell, Douglas Mair, David Burgess, Martin Sharp, Michael Demuth, Fiona Cawkwell, Robert Bingham, Jemma Wadham
Spatial and temporal variability in the snowpack of a High Arctic ice cap: implications for mass-change measurements

Marco Belò, Christoph Mayer, Claudio Smiraglia, Andrea Tamburini
The recent evolution of Liligo Glacier, Karakoram, Pakistan, and its present quiescent phase

Ewa Berdnorz, Joanna Wibig
Snow depth in eastern Europe in relation to circulation patterns

Susanne L. Buchardt, Dorthe Dahl-Jensen
At what depth is the Eemian layer expected to be found at NEEM?

David N. Collins
Climatic warming, glacier recession and runoff from Alpine basins after the Little Ice Age maximum

V.M. Kotlyakov, G.B. Osipova, D.G. Tsvetkov
Monitoring surging glaciers of the Pamirs, central Asia, from space

C. Mihalcea, C. Mayer, G. Diolaiuti, C. D'Agata, C. Smiraglia, A. Lambrecht, E. Vuillermoz, G. Tartari
Spatial distribution of debris thickness and melting from remote-sensing and meteorological data, at debris-covered Baltoro Glacier, Karakoram, Pakistan

Rudolf Sailer, Wolfgang Fellin, Reinhard Fromm, Phillipp Jörg, Lambert Rammer, Peter Sampl, Andreas Schaffhauser
Snow avalanche mass-balance calculation and simulation-model verification

Simon Schneiderbauer, Thomas Tschachler, Johann Fischbacher, Walter Hinterberger, Peter Fischer
Computational fluid dynamic (CFD) simulation of snowdrift in alpine environments, including a local weather model, for operational avalanche warning

H. C. Steen-Larsen, D. Dahl-Jensen
Modelling binge-purge oscillations of the Laurentide ice sheet using a plastic ice sheet

Wen Jiahong, Wang Yafeng, Liu Jiying, Kenneth C. Jezek, Philippe Huybrechts, Beata M. Csatho, Katy L. Farness, Sun Bo
Mass budget of the grounded ice in the Lambert Glacier–Amery Ice Shelf system

Xiao Cunde, Li Yuansheng, Ian Allison, Hou Shugui, Gabrielle Dreyfus, Jean-Marc Barnola, Ren Jiawen, Bian Lingen, Zhang Shenkai, Takao Kameda
Surface characteristics at Dome A, Antarctica: first measurements and a guide to future ice-coring sites

Zhang Shengkai, E Dongchen, Wang Zemin, Li Yuansheng, Jin Bo, Zhou Chunxia
Ice velocity from static GPS observations along the transect from Zhongshan Station to Dome A, East Antarctica

Annals 48 is now complete and has been published

ANNALS OF GLACIOLOGY, VOLUME 49

The following papers from the International Symposium on Snow Science, held at the Russian Academy of Sciences, Moscow, Russia, 3–7 September 2007, have been accepted for publication in Annals of Glaciology *Vol. 49, edited by Martin Schneebeli and Jerome B. Johnson*

A. N. Bozhinskiy
Modelling of snow avalanche dynamics: influence of model parameters

Ruzica Dadic, Javier G. Corripio, Paolo Burlando
Mass balance estimates for Haut Glacier d'Arolla from 2000-2006 using DEMs and distributed mass balance modeling

Luca Egli
Spatial variability of new snow amounts derived from a dense network of Alpine automatic stations

Thierry Faug, Benoit Chanut, Mohamed Naaim, Bertrand Perrin
Avalanches overflowing a dam: dead zone, granular bore and run-out shortening

Frédéric Flin, Jean-Bruno Brzoska
The temperature gradient metamorphism of snow: vapour diffusion model and application to tomographic images

Emanuela Bianchi Janettia, Elisa Gorni, Betty Sovilla, Daniele Bocchiolab
Regional snow depth estimates for avalanche calculations using a 2D model with snow entrainment

Tobias Jonas, Flavia Geiger, Hannes Jenny
Mortality rates of the Alpine chamois: the influence of snow-meteorological factors

V.S. Kulibaba, M.E. Eglit
Numerical modeling of an avalanche impact against an obstacle with account of snow compressibility.

J. Ignacio López-Moreno, J. Latron
Spatial heterogeneity in snow water equivalent induced by forest canopy in a mixed beech–fir stand

T. A. Neumann, M. R. Albert, R. Lomonaco, C. Engel, Z. Courville, F. Perron
Experimental determination of snow sublimation rate and stable-isotopic exchange

A. Prokop, M. Schirmer, M. Rub, M. Lehning, M. Stocker
A comparison of measurement methods: terrestrial laser scanning, tachymetry and snow probing for the determination of the spatial snow depth distribution on slopes.

PK Satyawali, AK Singh, SK Dewali, Praveen Kumar, Vinod Kumar
Time dependence of snow microstructure and associated effective thermal conductivity

Olga V. Sergienko, Douglas R. MacAyeal, Jonathan E. Thom
Reconstruction of snow/firn thermal properties from observed temperature variation: application to iceberg C16 (Ross Sea, Antarctica), 2004 - 2007.

Jurgita Simaityte, Daniele Bocchiola, Juozas Augutis, Renzo Rosso
Use of a snowmelt model for weekly flood forecast for a major reservoir in Lithuania

Yukari Takeuchi, Yasoichi Endo, Shigeki Murakami
High correlation between winter precipitation and air temperature in heavy-snowfall areas in Japan

More papers for Annals 49 will be listed in the next issue of ICE

Snow and Ice (Sneg i Led)

ABSTRACT. During the recent International Symposium on Snow Science hosted by the Russian Academy of Sciences, the Secretary General of the International Glaciological Society had an opportunity to interview the famous, and very elderly writer Leo Tol-Schneee to learn about the sequel to his novel *War and Peace.* The sequel, *Snow and Ice*, is a novel that treats the love and argumentation of a large family of international scientists bent on understanding the role of snow in the making of the human condition. Advance preview of this blockbuster novel will be featured in Annals of Glaciology, Volume 49.

PRESENT AT INTERVIEW:

IGS Secretary General: Magnús $\sum_{i=1}^{\infty}$ *Magnús* $\prod_{k=1}^{i}$ *son*

World-renowned Russian author: Leo Tol-Schneee (formerly Leo Tolstoy)

Magnús $\sum_{i=1}^{\infty}$ *Magnús* $\prod_{k=1}^{i}$ *son:*

Leo, it's a delight and honour to have you attend the International Glaciological Society's ?rst ever international symposium in Moscow, Russia. Indeed, you are perhaps the most important author of Russian literature known to the international community, and it is extremely unusual for a small, scholarly organization such as the IGS to attract the attention of celebr ities of your ilk. I wonder what it was that attracted you to attend this conference.

Leo Tol-Schnee:

Well Magnús, it's only fitting that I be here at a symposium on the science of snow, because the history of Russia, and indeed my writing career, which has been based on this history, has depended in very important ways on snow. Gosh, even the upcoming winter Olympic Games to be held in 2014 in Sochi Russia inspires a vigorous analysis of snow hazards that Russian scientists are handling very creatively.

But before I get into that, I want to commend you, Magnús, and the local arrangements committee, especially Profs. Kotlyakov, Sokratov and Bozhinskii (and 8 others) for creating such a fine experience. Indeed, when I arrived at my hotel room overlooking the statue of Yuri Gagarin (the world's first cosmonaut), and had a chance to look at my registration package, I found that the organizing committee had given each attendee of the conference a beautifully bound book containing some of the most influential and insightful papers on snow (and other topics of glaciological interest) published by Russian scientists. This beautiful blue volume, edited by Prof. Kotlyakov, inspired me to add several new volumes to my new project, my novel *Snow and Ice*.

But getting to your question: My first novel, War and Peace, told the story of, among other things, the great retreat of Napoleon's La Grande Armée from Moscow in the winter of 1813, which was perhaps the most monumental turning point in the history of Europe. During this retreat, Russia's winter snow played an important role; however, as my novel points out to greater historical relevance, it was Napoleon's arrival in Moscow (which had been left undefended by General Kutuzov in 1812), and the incredibly rich life of this ancient city, that proved to be Napoleon's undoing. This fact inspired the major point of my new novel, *Snow and Ice*: Now, almost 200 years after Napoleon's arrival in Moscow and the undoing of his army by Russia's great winter snows, snow has become the peaceful central theme that brings the world again to Moscow; but this time to enjoy this great city to a maximum degree–with retreat from Moscow only done reluctantly carrying a heavy load of good memories.

M $\sum_{i=1}^{\infty}$ *M* $\prod_{k=1}^{i}$*:*

What sort of good memories are you referring to?

LT:

Well, first of all. The honor of being in the Russian Academy of Sciences, seeing the venerable Moscow State University across the river; meeting the various scientists from the Institute of Geography, etc. For a long time, I've wanted to see snow scientists from around the world come together here, because, you know, the distances in Russia are so great, and snow scientists from elsewhere have had a hard time in the past meeting their Russian counterparts. After this meeting, however, I see that scientists from all sides are finally getting a chance to connect faces with names. More importantly, however, we had a great deal of fun during the week of the conference. Gosh, so much fun, I'd liken it to a ride in a troika on a sleigh

The grandeur in the Metro in Moscow is incredible

The main spire of the majestic Moscow State University is a major landmark

across the Northern Steppe with a full bottle of vodka and a gang of merry friends! First of all, I had a chance to show lots of the international community all about the city of Moscow. Lots of the first-time travellers to Moscow got a huge kick out of riding the city subway to the Kremlin and back. Scientists generally don't have an eye for style or efficiency (think about it? we novelists just write it down: you guys and gals, you narod, can't simply write down what you want to say about snow and ice without having to go through all sorts of reviews, typesetting and house editing for efficient use of journal space: tit efficient use of journal space! How could I have written War and Peace under such constraints!).

Like I say, the subway ride to the Kremlin was an eye opener, because first, the trains came every 30 seconds (not every 30 minutes like in other parts of the world), and second, the people, especially our fine Moscow women (genchina, in our language), are dressed like supermodels. In fact, one of the reasons, Magnús, that we Moscow Russians are so good-looking is that we share a common Viking ancestry with you people of Iceland (recall that Moscow was founded by Prince Yuri Dolgoruki whose ancestors had a lot of contact with Vikings who were founding colonies all throughout the world during the Medieval Warm Period). But most of all, the Moscow Russians have become a vibrant, style-conscious people who love fine clothing and to show off their excellent taste on the streets. It's not uncommon here in Moscow to see genchina in high-heeled shoes walking down cobble stone streets showing off some of the extraordinary gymnastic athleticism known to Russia when they get a heel stuck in a crack and become unshod.

The Kremlin, of course, was a treat to behold for visitors and Russians alike. Because here was over 800 years of settlement history concentrated in one overwhelming sight: the Orthodox cathedrals, the giant bell, the giant cannon, the domes of St. Basil's, Red Square and the Tomb of Lenin, the museums and the Kremlin Diamond Fund; all this spoke of the ancient and lasting heritage of the people who settled here on the banks of the Moskva River. Besides the Kremlin, there were wonderful trips to the Novodevichy Convent (to see, among other sights, the graves of many great figures in Russian History) and to the Tretyakov Gallery. Possibly the most fun was had during the casual strolls through the Old Arbatskaya

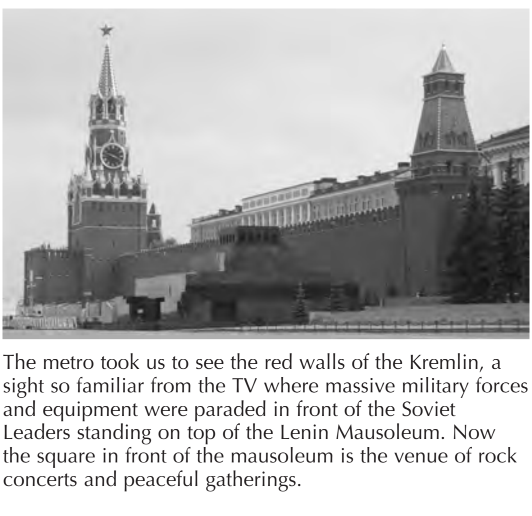
We had a fantastic banquet in one of the many grand ballrooms within the Russian Academy of Sciences

The symposium was an excellent opportunity to meet with colleagues in relaxed surrounding over a nice glass of vodka and some local delicatessen

Interesting tropical surroundings where we enjoyed the daily refreshments

After a busy IGS Council meeting the participants retired a n d to a lovely Ukrainian restaurant

Within easy view from the symposium venue we could see the statue of the first human in space, Yuri Gagarin



The metro took us to see the red walls of the Kremlin, a sight so familiar from the TV where massive military forces and equipment were paraded in front of the Soviet Leaders standing on top of the Lenin Mausoleum. Now the square in front of the mausoleum is the venue of rock concerts and peaceful gatherings.

Kitay Gorod, and fine dining experiences featuring food from central Asian countries that have magnificent cuisines (I liked Georgian shashlik especially).

$M \sum_{i=1}^{\infty} M \prod_{k=1}^{i}:$

How did the conference end? Was it worth it?

LT:

Ne mozhet byt'!, my gosh, Magnús, the conference ended with a traditional Russian 'bang'. A banquet where the vodka flowed like water and the food was as plentiful as it was tasty (I particularly liked the way many of the American visitors enjoyed tasting pickles, rye bread and salty fish for the first time, a true Russian tradition). Of course it was worth it. The science alone was extremely educating, and has given me important ideas for the writing project on snow I want to present at the next IGS conference on the subject, in Manali, India (2009). But the best part was learning how to make toasts in languages of 19 different countries (there were attendees from 19 countries at the banquet held in the Russian Academy of Sciences building): How many opportunities can you have to hear shouts of Nastrovia! (Russian drinking toast) followed by shouts of Here's mud in your eye! (Canadian drinking toast).

$M \sum_{i=1}^{\infty} M \prod_{k=1}^{i}:$

Thank you Leo, we'll look forward to seeing you next April (2009) at the IGS symposium on Snow and Avalanches to be held in Manali, India.

ΔΘûg Mac∀ΣΛl

REPORT ON THE IGS NORDIC BRANCH ANNUAL MEETING 2007

The 2007 Nordic IGS meeting was attended by about 70 people in Uppsala on 25–27 October 2007. That the meeting was tremendously enjoyable was due to the sterling efforts of Rikard Pettersen, Ulf Johnsel and Veijo Pohjola. It is remarkable how far a registration fee of 250 SEK goes to advancing the girth of the participants and, no matter how long some of the lectures seemed to be, there was the soon-to-be-realized hope of more chocolate cake, beer and fruit (for the health-conscious glaciologist) to steady the ship. This is no doubt why the esteemed Secretary General continues to enthusiastically participate in these meetings. And indeed this meeting was not punctuated by the sound of loud snoring that one usually associates with Magnús. Or perhaps it was because there was a large group of Icelanders at the meeting – and it was in my humble opinion Tómas Jóhannesson who provided the highpoint of the scientific content of the meeting with his description of drilling through the Katla ice caldera to the subglacial lake. There was a 'modest' jökulhlaup that collapsed the 2 km wide caldera camp site 2 months after the season ended that would have ended the research (and other more valuable items) prematurely had it occurred slightly earlier.

The more realistic highlight of the meeting was certainly the glaciology beat combo Johnny Clash – featuring Veijo Pohjola on vocals and guitar, Mattias Karlsson on rhythm guitar, Jack 'Sledgehammer Sam' Kohler on bass, Matti Pohjola on cornet, Henrik Åkman on drums and Jim Hedfors on acoustic guitar. They turned out a variety of Clash/Cash/Undertones mixes tunes and lyrics. The encore featured VG singing the popular Bollywood hit 'Chaiyya Chaiyya' to extemporized musical backing. This was a great relief after the tortuous performance art drummed up by Magnús where every nationality represented at the meeting had to perform a drinking song – as there were 17 nationalities, the impact on sobriety can be imagined.

As far as the talks were concerned, many were given by students as that is the main aim of the meeting – introducing students to the demands of public presentations, usually in non-native English. Many of the talks were on traditional mass balance surveys of glaciers, but there were also talks on remote sensing, Antarctic blue ice areas, paleo-ice streams and finite element modelling of glaciers. The broadening of glaciology was represented by talks on the interlinking of the physical and biological cryospheres via cryoconites. Several talks featured video clips, raising the bar on entertaining powerpoint shows. The entertainment probably climaxed with simultaneous performance translation by Peter Keupers Munneke of himself in Dutch on video into English (both at top volume level). The IPY Kinnvika and Glaciodyn projects were well-represented in talks and also by the showing of the 1957 Swedish documentary on the Kinnvika station activities – which certainly shows how much better supported IGY activities were than the IPY funding levels are 50 years later. A depressing reflection on the political will to do research on the polar areas despite, or perhaps even because of, the high impact climate change science that we produce. However the meeting, the youngsters and the science being done were both encouraging for Nordic glaciology in the future. The next meeting will be organized by Finnish members at an exciting, exotic and cheap location possibly far away from Nordic taxes.

John Moore

Sledgehammer Sam, alias Jack Kohler, on bass, Henrik on drums, Matthias on rhythm guitar, Jim Hedfors on acoustic guitar, Matti Pohjola on cornet and Veijo Pohjola on vocal/guitar

Notes from the production team

The production process on papers accepted for publication in the *Journal* and *Annals of Glaciology* is now quite speedy, but in each issue we are experiencing hold-ups at the author proof-correction stage because some authors are in the field or away when we email them their proofs. If you would let us know your anticipated movements and contact details over the immediate weeks and months following acceptance of your paper (or, if you are unavailable for a time, those of one of your co-authors), we can make sure we send your proofs to the correct address at a convenient time and that we can publish your work as quickly as possible.

Another thing that would help us accelerate the administration of articles would be that you always include your IGS-assigned manuscript number in emails and written correspondence. It is always useful too if the manuscript number is somewhere within the names of all the electronic files (text and figures) of revised and finally accepted papers. Thanks a lot.

Craig Baxter
IGS Production

IMPACT AND PRESTIGE

The impact factor explained

We hear a lot these days about 'impact factors', which are used to rate the success of institutes, scientists and journals. Although the impact factor calculated by Thomson/ISI is well-known, it's also understood that it is a very crude measure of scientific impact. IGS members may be interested, then in a new, alternative, calculation that has recently become available. This is called the SCImago Journal Rank (SJR), and it is freely available at http://www.scimagojr.com/index.php. The main difference is that the Thomson/ISI impact factor is simply the number of citations by journals in the system in year n of papers published in years ($n-2$) and ($n-1$). The SJR has a more complicated iterative algorithm that takes into account the prestige of the citing journal. It's tricky to understand exactly how this is done, but the good news is that it's in the *Journal of Glaciology*'s favour. I took a bunch of journals that I use, and which might be used by IGS authors, and listed the 2006 impact factors and SJRs. I was disappointed to find that the *Journal*, with a 2006 impact factor of 1.446, did very badly (actually bottom of my self-chosen list). However, in the SJR, the *Journal* pulled up above journals such as *Quaternary Research*, *The Holocene*, and even JGR!

I imagine there are two reasons for this: (1) it illustrates that the *Journal* does indeed tend to be cited in prestigious papers and journals and (2) the *Journal of Glaciology* tends to have peak citations more than 2 years after publication, which disadvantages it in the impact factor, especially because in the past we made the mistake of publishing some issues in the year after the date on the cover, thus further reducing the period in which citations might count. As far as I can tell, the SJR uses a 3-year window, and I think it also use citations in that period to papers published in any previous year, thus really boosting our late citations.

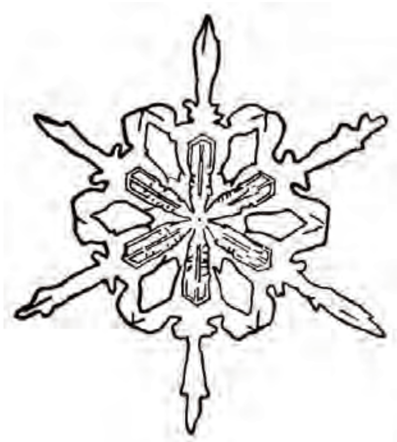
So, the good news is that, on this count, the *Journal of Glaciology* becomes a much more prestigious journal. The bad news is that the *Annals* is not in the listing on the SCImago website, so this does not solve the problems the Secretary General told you about in the editorial of *ICE* 144.

Well, my study was only a bit of fun, and I'm afraid we won't easily persuade the funding agencies that do use impact factor to abandon it. However, if you want to publish in a prestigious journal, then the *Journal of Glaciology* is not a bad choice!

Eric Wolff
IGS vice-president

INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL SYMPOSIUM ON DYNAMICS IN GLACIOLOGY



Limerick, Ireland
17–22 August 2008

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SECOND CIRCULAR

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INTERNATIONAL GLACIOLOGICAL SOCIETY
PRESIDENT: A. Ohmura
VICE PRESIDENTS: E. Brun, E. Wolff, I Allison
IMMEDIATE PAST PRESIDENT: E.M. Morris

SYMPOSIUM ON RADIOGLACIOLOGY AND ITS APPLICATIONS

The International Glaciological Society will hold an International Symposium on Dynamics in Glaciology in 2008. The symposium will be held in Limerick, Ireland, from 17–22 August.

SYMPOSIUM ORGANIZATION

Magnús Már Magnússon (International Glaciological Society).

LOCAL ARRANGEMENTS COMMITTEE

Andrew Fowler (Chairman), Stephen O'Brien, Alan Hegarty, Marguerite Robinson, Peg Hanrahan, Jenny Wright.

SCIENCE STEERING AND EDITORIAL COMMITTEE

Andrew Fowler (Chief Scientific Editor), Chris Clark, Garry Clarke, Richard Hindmarsh, Tavi Murray, Felix Ng, Christian Schoof.

INFORMATION ABOUT THE SYMPOSIUM MAY BE OBTAINED FROM:

International Glaciological Society, Scott Polar Research Institute, Lensfield Rd, Cambridge CB2 1ER, UK. Tel: +[44] (0)1223 355 974; Fax: +[44] (0)1223 336 543; Email: igsoc@igsoc.org
IGS website: http://www.igsoc.org/symposia/
Local website: http://www.macsi.ie/igs/

PARTICIPATION

This circular includes instructions for registration and for arranging accommodation both through the travel agency website. A registration form (available at the symposium website) is also included, though online registration is strongly encouraged. The registration and accompanying payment are due 31 May 2008. There is a surcharge for late registration. The participant's registration fee includes organization costs, a set of abstracts, the icebreaker, coffee breaks and lunch, a traditional barbeque, the mid-week excursion and the banquet.

Registration fees	€
Participant (IGS member)	385
Participant (not IGS member)	465
Student or retired IGS member	175
Accompanying person	185/140
Late registration surcharge (after 31 May 08)	100

Symposium study tour:
Bookings will be made through the local website. Details will be posted as they become available.

Registration refunds will be made according to date of notification. Cancellations made before 31 May 2008 will receive a full refund. Cancellations between 31 May and 9 August 2008 will receive a 50% refund. After 9 August it will not be possible to make any refund.

THEME

Mathematical and computational modelling have formed an integral part of the development of glaciology since its development as a quantitative science. Early examples of this are the development of the theory of kinematic (surface) waves on glaciers, the theory of glacier sliding over hard beds, and the theory of subglacial drainage. As the theory of such phenomena develops, new observations and insights motivate the construction of new and better theoretical models. Recent examples include the dynamics of ice motion over subglacial till, the formation of subglacial landforms, and the ice dynamic behaviour which causes Heinrich events.

This conference will focus on the interplay between novel glaciological observations, and the models which are necessary to explain such observations. It will focus on the study of phenomena in glaciology which are dynamic in nature, involving variation in time and/or space. The purpose of the meeting is to bring together field scientists and experimentalists who have intriguing observations to report with theoreticians and modellers who have been studying such phenomena. A particular encouragement will be to enable a workshop atmosphere in which open problems and observations will be discussed.

TOPICS

The suggested topics include:

1. Surging glaciers. Are the different types of surging glacier (Variegated/Trapridge type) amenable to a unified theoretical description? Can theories predict surging behaviour quantitatively?
2. Ice streams. Are ice streams due to thermal runaway? Hydraulic runaway? Are they topographically controlled?
3. Jökulhlaups. Is the Nye theory satisfactory? When can we expect sheet floods of the 1996 Grímsvötn type to occur?
4. Ice sheets and climate change. Can the Milankovitch mechanism cause the initiation of ice ages? Can climate change cause marine ice sheet collapse? Is the current behaviour of the Greenland Ice Sheet climatically controlled?
5. Glacial geomorphology. How are drumlins and eskers formed? What causes mega-scale glacial lineations?

6. Subglacial hydrology. Are the Röthlisberger/linked cavity/canal theories of drainage satisfactory? What sort of theory is appropriate under an ice sheet?
7. Extraterrestrial ice. How can we explain the troughs on the Martian ice caps, or the wrinkled crust of Europa?
8. Paleoglaciology. Do we understand Heinrich events? What caused Dansgaard–Oeschger events? Can we explain Snowball Earth?

SESSIONS

Oral presentations will be held on four full days and one half-day. There will be ample opportunity for poster displays. Poster boards measuring 900 mm wide by 1800 mm high (A0 portrait size) will be supplied for the poster presentations.

ABSTRACTS

(1) SUBMISSION OF ABSTRACTS

Participants who want to contribute to the Symposium should submit an abstract of their proposed presentation. This abstract must contain sufficient detail for its scientific merit and relevance to the symposium theme to be judged by the Editorial Board. A website will be available from 1 February 2008 where authors can upload their abstract and all the relevant contact information. The abstract itself should not exceed 400 words. References and illustrations should not be included.

Those unable to submit their abstract via the internet can submit electronic files on a CD or diskette to the IGS office where a member of staff will upload them onto the website.

LAST DATE FOR RECEIPT OF ABSTRACTS: 12 MARCH 2008

(2) SELECTION OF ABSTRACTS

Each abstract will be assessed on its scientific quality and relevance to the Symposium theme. Authors whose abstracts are accepted will be invited to make either an oral or poster presentation at the Symposium. First or corresponding authors will be advised by 15 April 2008 of the acceptance or otherwise; other authors will not be informed separately. Authors who have not received notification by that date should contact the IGS office in Cambridge in case their abstract was not received. The abstracts will be compiled into a paper or CD format, and may be published on the Internet.

(3 DISTRIBUTION OF ABSTRACTS

A set of the accepted abstracts will be provided to participants upon registration on 17 August 2008.

THEMATIC PUBLICATION

The Council of the IGS has decided to change the editorial policy of the *Annals of Glaciology*. The *Annals* will be published as a thematic journal whose themes will be chosen by the IGS Council on a regular basis. Such themes may run parallel to the themes of symposia or may be independent. Thus the Council has decided to publish an *Annals* issue whose theme will be 'Dynamics in Glaciology'. Submissions are open to anyone. All papers should be submitted through the IGS online submission system and will be refereed and edited according to the Society's regular standards before being accepted for publication. Those submitting abstracts to the symposium will be asked to indicate whether they intend to submit a paper for publication in the *Annals*, so that reviewers may be sought in advance. Papers submitted for consideration for the *Annals* cannot be submitted to another publication as well.

The page charge policy for publishing in the *Annals of Glaciology* has not been decided yet but that information will be made available as soon as possible.

EXCURSIONS

MID WEEK FIELD TRIP

The excursion will take us past the drumlin fields of mid-Clare towards the Burren, Ireland's premier karst region of exposed limestone pavement, hosting a variety of alpine flora, as well as numerous ring forts and dolmens.

A packed lunch will be provided and dinner is included in a traditional Irish Pub in Doolin, County Clare.

BANQUET to be held on Thursday evening, 20 August at the Clarion Hotel, Steamboat Quay, Limerick. The Clarion Hotel is the tallest hotel in Ireland and is situated on the river Shannon waterfront. The banqueting suite boasts stunning views of the city and river (http://www.clarionlimerick.com).

SYMPOSIUM STUDY TOUR – THREE DAYS – WEST OF IRELAND

The tour will set off from Limerick on the morning of Saturday 23rd, passing through a drumlin field near Gort, and stopping at arguably one of the best drumlin sections in the country situated in Barna, just outside Galway. We then drive through the spectacular scenery of Connemara, and travel up to Sligo, before returning to Limerick/Shannon on Monday afternoon. En route we will visit a number of glacial and sedimentary features, including drumlins, fjords, classic glacial mountains, marine deltas, eskers and end moraines, as well as the famous Clew Bay drumlin field. Overnight stops will be in Letterfrack and Sligo.

Further details and costs will be available shortly on the symposium website.

ACCOMPANYING PERSONS PROGRAMME

The accompanying person registration fee (€185 for 18 and over, €140 for under 18) includes the icebreaker, traditional barbeque, the mid-week excursion and the banquet. Short excursions around the Limerick/Shannon area will be offered, at additional cost. These might include trips to Bunratty Castle, Craggaunowen and Killaloe. See the symposium website for further details or email marguerite.robinson@ul.ie.

TRAVEL, ACCOMMODATION AND OTHER LOCAL INFORMATION

Ireland is not a full member of the Schengen Treaty. Thus you will require a passport to enter the country. Some nationalities will require a visa. Information about which nationalities need a visa, where and how to apply (including forms) is to be found at http://foreignaffairs.gov.ie/home/index.aspx?id=8605

LOCATION AND WEATHER

There are several restaurants and bars on the university campus and many more within walking distance. The campus is also home to one of the top fitness centres in the country. Facilities include a 50m swimming pool, cardio-fitness centre, indoor/outdoor running tracks, basketball and tennis courts. The centre is open to the public and details can be found at www.universityarena.com. The university campus is a ten minute taxi ride from the city centre and regular buses link the two (see www.buseireann.ie/site/your_journey/printed_timetable_pdfs/city/308.pdf). The city has many restaurants, bars, shops and historical sites. More information on Limerick city can be found on the websites www.limerick.ie/VisitingLimerick and www.limericktourist.ie.

Weather in August is usually dry and sunny with an average temperature of 15–17°C. However, the weather is changeable and rain is always a possibility.

VENUE

The symposium is to be held by the Department of Mathematics and Statistics, University of Limerick. See http://www.ul.ie and http://www.macsi.ie.

Getting to the University

Easy access to the university is by Shannon International Airport, located 25km from the university campus. Several US carriers service the airport and regular flights also operate to and from the UK and many other European destinations. Alternatively, participants can transfer through Dublin airport which operates connecting flights to Shannon daily. Regular trains also run between Dublin and Limerick city.

More details can be found on the airport's website www.shannonairport.com and the Irish rail service's website www.irishrail.ie.

The university is approximately a 30 minute taxi ride from Shannon airport. Taxis cost €45 and can be booked in the arrivals hall. Alternatively, Bus Eireann operates regular buses from Shannon to Limerick bus/train station which is then a short taxi ride from the university campus. Details can be found at www.buseireann.ie.

Accommodation information

Accommodation is available on-campus. The university campus, set in 300 acres of beautiful riverside parkland, provides a relaxed, convenient, scenic and self contained environment for delegates during their stay. The accommodation is provided in en-suite apartments situated within close walking distance of all meeting and social conference facilities on campus. The accommodation consists of terrace-style apartments. Each apartment has four or six bedrooms and a shared, comfortable living room and kitchen with cable television and card phones. Each bedroom has a double bed, desk and bathroom. Bed linen and towels are supplied and there is a daily cleaning service. Continental breakfast is delivered into the apartments for guests each day. The village has free adjacent parking. Certain apartments can be reserved for visitors requiring disabled access. Delegates are welcomed at the reception on their arrival. Rooms can be booked at a cost of €55 per person per night on the agent's website, www.iccbookings.com/ConferenceBookingsUL/index.html. Double rooms are available and will be booked as two singles at a reduced rate. Alternatively, participants may choose to stay off-campus. There are several hotels in the city (see www.limericktourist.com/directory/accommodation/hotels). However, the Castletroy Park Hotel, located adjacent to the university campus, is recommended. The Local Organizing Committee has reserved a limited number of rooms, which will be held until 10 July 2008. The rates are as follows:

17 August 2008 for 5 nights
Conference rates, B&B per night:
Single €120.00 Double €145.00

Guests book directly with the hotel quoting conference reference ISDG. The rooms will be held until 10 July and at that time the unbooked rooms will be released back to the hotel. Guests can still book after that time but must pay the normal hotel rates.

Internet access

Wireless internet access will be available in the poster presentation area in addition to various locations throughout the university. Details of laptop configuration for the university's wireless network will be provided on arrival. For participants selecting to stay on-campus there will be wired Internet access in all bedrooms.

For additional information contact:

marguerite.robinson@ul.ie jenny.wright@ul.ie

IMPORTANT DATES

Abstracts due	12 March 2008
Notification of acceptance	15 April 2008
Preregistration deadline	31 May 2008
Papers due	15 June 2008
Deadline for full refund	29 June 2008
Deadline for refund	01 August 2008
Registration	17 August 2008
Conference starts	18 August 2008
Final revised papers	28 September 2008

REGISTRATION

Registration will be through the IGS main office. See form overleaf.

INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL SYMPOSIUM ON DYNAMICS IN GLACIOLOGY

Limerick, Ireland, 17–22 August 2008

REGISTRATION FORM

Family Name: ______________________________

First Name: ______________________________

Address: ______________________________

____

Tel: ____________ Fax: ____________ E-mail: ____________

Accompanied by: Name: ______________________ Age (if under 21) ____

Name: ______________________ Age (if under 21) ____

REGISTRATION FEES	**€**	**£**	**US$**
Participant (member of the IGS)	385	288	572
Participant (not a member of the IGS)	465	347	691
Student or retired IGS member	175	131	260
Accompanying person (aged 18 or over/under 18)	185/140	138/105	275/208
Late registration surcharge (after 27 May)	100	75	149
TOTAL REGISTRATION FEES	____	____	____

ACCOMMODATION

Accommodation bookings should be done by individual attendees through the local links as indicated above.

Payment of registration fee may be made by cheque to: INTERNATIONAL GLACIOLOGICAL SOCIETY or preferably by Access/Eurocard/MasterCard or VISA/Delta

Card No.																	Expires				

			Security code (the last three digits on the signature strip on the back of the card)

Name of card holder as shown on card: ______________________________

Signature: ______________________________

Payment may also be made by a direct bank transfer to: Bank of Scotland, 38 St Andrew Square, Edinburgh, EH2 2YR, UK.

£ Sterling Account name: International Glaciological Society. Sort Code 80-11-00 Account no: 06065959
IBAN number: GB90 BOFS 8011 0006 0659 59 SWIFT/BIC code: BOFSGB21012

€ Euro Account name: International Glaciological Society. Sort Code 12-20-10 Account no: 40571001
IBAN number: GB90 GB85 BOFS 1220 1040 5710 01 SWIFT/BIC code: BOFSGB21EUL

$ US Account name: International Glaciological Society. Sort Code 80-20-13 Account no: 40571USD01
IBAN number: GB98 BOFS 8020 1340 5711 01 SWIFT/BIC code: BOFSGB2SXXX

Please note that we need the full amount.
ANY BANK OR TRANSFER CHARGES MUST BE BORNE BY THE PAYEE AND INCLUDED IN THE BANK TRANSFER. It is usually possible to indicate this on the bank transfer form by ticking a box. Please inquire at your bank).
If payment made after 31 May 2008, add €100 for each person

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

INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL WORKSHOP ON WORLD GLACIER INVENTORY

Lanzhou, China
20–24 September 2008

CO-SPONSORED BY:

Cold and Arid Regions Environmental and Engineering Research Institute
Chinese Academy of Sciences (CAREERI, CAS)
World Glacier Monitoring Service (WGMS)
World Glacier Inventory (WGI)
Institute of Tibetan Plateau Research
Chinese Academy of Sciences (ITP, CAS)
Global Land Ice Measurements from Space (GLIMS)
National Natural Science Foundation of China (NSFC)
Chinese Academy of Science

FIRST CIRCULAR

January 2008

Registered Charity

The International Glaciological Society will hold an international workshop on World Glacier Inventory in 2008. The workshop will be held in Lanzhou, People's Republic of China, during 20–24 (Saturday to Wednesday) September.

THEME

An effort to create an inventory of important features of glaciers on a global scale was launched as part of the International Hydrological Decade (1965–1974). The main motivation was to obtain information on distribution of surface area and ice volume of glaciers. Initially it was aimed at all glaciers outside the existing two ice sheets, Greenland and Antarctica. It was also planned to repeat a similar effort every 50 years to detect changes in glaciers. To date about 37% of the estimated total glacier surface is inventoried and made available through the World Glacier Monitoring Service (WGMS) in Zürich and National Snow and Ice Data Center (NSIDC) in Boulder. In the meantime, it was realized that the original inventory method was too time consuming, and some areas even lacked the information necessary for the inventory. In the early 1980s a simplified inventory method was developed mainly based on satellite images. This is outlined in Global Land Ice Measurements from Space (GLIMS) which covers 34% of the estimated glacier surface outside Greenland and Antarctica.

During the 40 years after launching the World Glacier Inventory and 25 years after introducing the simplified inventory method, both efforts made substantial progress and contributed tremendously to our knowledge in glaciology and related sciences. They are, however, not complete. The original and detailed inventory was completed by only 11 countries and one region. Viewed globally, some 63% of the estimated total surface area remains untouched. Some completed national inventories are not forwarded entirely to the world data centres. The satellite-based inventories also left 66% uncovered, although some areas are covered by both methods. Combining both inventories, 45% is dealt with, leaving 55% of glacier surfaces inaccessible. Curiously, 26% of glacier surfaces is inventoried by both methods. This situation offers a chance to compare simplified methods with the original method, in order to estimate the quality of the satellite-based and semi-automatic inventory methods. Further, original and simplified methods were successfully applied beyond the regions of the original concept, namely to Greenland and Antarctica, albeit for limited areas.

A number of scientific works have been already accomplished by using inventoried data. Glacier inventory is often used to calculate changes in hydrological basin discharge. The combination with GCMs provided scenarios on future changes of the sea-level. These works have not, to date been discussed among related communities. Glaciers in certain geographic regions are inventoried but the resulting files were not always forwarded to data centres. Although not in the original plan, some areas in Greenland and Antarctica were inventoried, but data were not sent to the world data centres. All these problems make the estimation of the ice volume, a primary goal of the inventory effort, difficult. In the meantime the cryosphere itself is rapidly changing. It is of the utmost importance to complete the global inventory as soon as possible. The proposed workshop is not an occasion to present the inventoried contents. The workshop is intended to review and discuss what has been accomplished on a global scale, and to consider how WGI data have been and will be applied and what remains to be done to complete the WGI.

TOPICS

The suggested topics include:

1. Overview of the present status of glacier inventories based on the original (WGI) and simplified (GLIMS) methods.
2. Experiences of completion of national inventories: Ex-Soviet Union, China and Iceland (These are big owners of glaciers who completed the national inventories).
3. GLIMS and GlobGlacier status: Developments in methodology for an automatic inventory; other glaciological remote sensing projects at NASA, ESA and other space agencies.
4. Comparison of satellite-based inventories with original WGI.
5. Present data availability at two main centres, NSIDC in Boulder and WGMS in Zürich.
6. Applications of WGI and GLIMS for glacier ice volume calculation, global sea-level change, hydrological cycle and water resources, energy planning and disaster monitoring; new ideas for other applications.
7. Strategy for completion of the World Glacier Inventory and GLIMS.

ABSTRACT AND PAPER PUBLICATION

Participants wishing to present a paper at the workshop are required to submit an abstract. A pre-print of submitted abstracts will be provided for all participants at the workshop. Selected papers will be refereed, edited and published by the International Glaciological Society.

ACCOMMODATION

Details will be given in the Second Circular.

FURTHER INFORMATION

If you wish to attend the symposium please return the attached form as soon as possible. The Second Circular will give further information about accommodation, the general programme, and preparation of abstracts and final papers as well as a registration form. Copies of the Second Circular will be sent to those who return the attached reply form. Members of the International Glaciological Society will automatically receive one.

WORKSHOP ORGANIZATION

Atsumu Ohmura (IGS) (Chair), Qin Dahe (CAS), Roger Barry (WGI, GLIMS), Wilfried Haeberli (WGMS)

SCIENCE STEERING AND EDITORIAL COMMITTEE

Atsumu Ohmura, Simon Ommanney, Roger Braithwaite, Bruce Raup, Wilfried Haeberli, Qin Dahe, Ding Yongjian, Liu Shiyin, Wang Ninglian

LOCAL ARRANGEMENTS COMMITTEE

Qin Dahe (Chair), Yao Tandong, Liu Shiyin, Ren Jiawen, Ding Yongjian, Wang Ninglian, Kang Ersi

WORKSHOP STUDY TOURS

There may be two choices for the workshop study tours: (1) tour to the Hailuogou glacier (29°36', 101º54'), a temperate glacier on the east slope of Mt Minya Konka in the western Sichuan Province. A permanent observational station near the glacier has run over 20 years. To the north of the mountain, the famous Tibetan town Kangding is located; (2) tour to the No. 12 glacier (39°26', 96°33'), a cold glacier in the northwest Qilian Mountains in the Gansu Province. The Dunhuang Mogao Grottos, a renowned historic site dating back to 366 AD, is within 100 miles to the west of the glacier.

INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL WORKSHOP ON WORLD GLACIER INVENTORY

Lanzhou, China, 20–24 September 2008

Family Name: ______________________________

First Name(s): ______________________________

Address: ______________________________

____

____

____

Tel: ____________________ Fax: ____________________

E-mail: ______________________________

I hope to participate in the Workshop in September 2008 ☐

I expect to submit an abstract ☐

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

____

____

____

I am interested in an accompanying person's programme ☐

I am interested in the workshop study tours ☐

PLEASE RETURN AS SOON AS POSSIBLE TO:

Secretary General, International Glaciological Society,
Scott Polar Research Institute, Lensfield Road, Cambridge, CB2 1ER, UK
Internat.: Tel: +44 (0)1223 355 974 Fax: +44 (0)1223 354 931
E-mail: igsoc@igsoc.org Web: http://www.igsoc.org

News

Obituary: Erkki Palosuo, 1912–2007

The grand old man of ice research in Finland, Professor Erkki Palosuo passed away after a sudden stroke on 11 August 2007. This sad news was unexpected since, in spite of his respectable age, he was in excellent physical and mental health. This was witnessed by more than 50 of his descendants on the occasion of his 95th birthday two months earlier.

Erkki Palosuo (until 1933 Brander) was born in Kitee, Karelia, eastern Finland on 28 June 1912 and passed away in the same town. He graduated from the high school *Joensuu lyceum* in 1931. Then he commenced his studies at the University of Helsinki but moved to the Military Academy in 1937, graduating in 1939. The Winter War broke out in December 1939, and Erkki Palosuo was based in Helsinki flying Blackburn Ripon reconnaissance planes. When the war broke out again in 1941 Erkki served as a wing commander in a squadron equipped with Tupolev SB-2 bombers captured from the Soviet air force. Erkki and his crew destroyed two Soviet SC-type submarines in the summer of 1942 on the Gulf of Finland. When Finland changed sides in the war in 1944 Erkki continued to lead flight operations, this time against the Germans, and made reconnaissance flights in Lapland and the Bay of Bothnia using a Bristol Blenheim aircraft. His eventual rank in the Finnish Air Force was that of major and he was decorated with many medals.

Reliable information not only on the enemy, but also on sea ice, was critical at that time. The winters of 1940 and 1942 were exceptionally cold and the whole Baltic Sea became ice-covered. Foreign trade, e.g. transport of food supplies from Germany, as well as navy operations, was severely limited by sea-ice conditions. On the other hand, thick, landfast sea ice could also be used in army operations, as shown by the attack of Soviet tanks over the Gulf of Vyborg in February 1940 and by the Finnish invasion of the island of Suursaari in March 1942. In his search for information on sea-ice conditions, Erkki Palosuo thus was already an expert in sea-ice charting and ice-type classification, as well as forecasting of ice conditions, prior to his scientific career. After the war he returned to his studies at the University of Helsinki. In 1947 he obtained a masters degree in meteorology, and in the following year he resigned from the Finnish Armed Forces and began work in the Ice Service of the Finnish Institute of Marine Research. He went on with his doctoral studies under the supervision of Professor Risto Jurva and presented his doctoral thesis, entitled *A treatise on severe ice conditions in the Central Baltic,* in 1953. This work focused on the drift ice in the central and southern part of the Baltic Sea and was largely based on the material Erkki had collected in his wartime ice reconnaissance flights. It was a very important work, and is still the only publication to thoroughly analyse the morphology and drift of the ice fields in those parts of the Baltic. An analysis of the Baltic Sea ice climatology was also included. As a whole, the thesis was a new step from cartographic work to the geophysics of sea ice in the Baltic Sea.

Erkki Palosuo on the Nordaustlandet expedition (Palosuo family archives, photographer not known)

Erkki Palosuo became the leading scientist in the Baltic Sea ice community, developing the ice charting methodology and opening new lines in sea-ice basic research. He was able to join the international sea-ice science network and became a well-known character. He performed investigations on the stability of landfast ice in the Baltic Sea with case studies and statistical analyses. He then commenced ice-structure analyses, and a particular, basin-invariant finding was the transition of ice structure from sea-ice type to fresh-water ice type in 1961. Based on ice samples from the estuary of Tornionjoki, Bay of Bothnia, Baltic Sea he was able to show that the transition takes place at the water salinity of about 1 ppm.

In the 1960s Erkki started to work on sea-ice ridges in the Baltic Sea and collected a database of large ridges. The observations still constitute the main dataset of large ridges in the Baltic Sea. This work was connected to winter shipping, as ridges are the most difficult obstacles in the Baltic Sea. The winter navigation expanded to more and more difficult ice conditions, and finally in 1970 all-year sea traffic had been opened to all the main harbours in Finland. Erkki's role in the development of ice-mapping methods and ice-risk evaluation was remarkable. Aerial reconnaissance became a routine tool, flights performed at times by Palosuo himself, and they remained so until the operational use of high-resolution remote sensing satellite imaging in the 1980s.

For most of his science career, 1948–73, Erkki Palosuo worked in the Ice Service of the Finnish Institute of Marine Research. However, he expanded his research to other sections of cryospheric science and even to physical oceanography. He took part in the Nordaustlandet expedition in International Geophysical Year 1957/8, performing crystal structure analyses of the ice of the Austfonna glacier. He returned to the glacier once, in 1966. He also took part in the cruise of SS *Manhattan* through the North-west passage in 1969. In Finland he went into lake-ice investigations, where Professor Heikki Simojoki had been the geophysics pioneer in Finland. Erkki Palosuo's work dealt with the snow-ice formation and crystal structure of lake ice. Through these expansions from sea ice research, he became the leading scientist in cryospheric research in Finland. His most notable achievements in physical oceanography were being the first to map the wintertime hydrography in the frozen basins of the Baltic Sea and investigation of the hydrography and circulation of the Gulf of Bothnia. The winter work was based on Finnish icebreakers, the only platform available at that time for the oceanographic research of ice-covered waters.

In 1973 Erkki Palosuo was appointed Professor of the Department of Geophysics in the University of Helsinki. He gave courses in snow and ice geophysics and physical oceanography. The cryosphere remained his research topic. His main field was, as before, sea ice, and he played an active role in the development of the Finnish–Swedish collaboration in the Baltic Sea winter problems. A rapid growth of sea-ice research in Finland and Sweden due to the expanded winter shipping followed. He did more sea-ice ridge studies, and started large-scale mapping of Baltic Sea ice ridges with an airborne laser profilometer. He added the seasonal snow cover to his topics, also pioneering in Finland the study of friction between snow and ski.

Erkki Palosuo retired from the University of Helsinki at the end of 1977 but did not retire from science: he went back to the research of the high Arctic and took part in the Swedish expedition Ymer-80, in the summer of 1980, to the Barents Sea and Svalbard–Franz Joseph Land sector of the Central Arctic Basin. His research there concerned sea-ice structure and salinity, sea-ice ridges and occurrence of icebergs. In the 1980s Erkki Palosuo completed the analysis of his Arctic data from the Austfonna glacier and Ymer-80 expeditions, and continued with the physics of skiing in collaboration with the Department of Physics in the University of Helsinki. His last scientific publication was a historical review (with three co-authors) 'Snow and ice geophysics in Finland during the 1900s', in volume 37 of *Geophysica*, 2001.

In 1974 Erkki Palosuo became a member of Societas Scientiarum Fennica (Finnish Society of Sciences), the oldest science academy in Finland. He served the Geophysical Society of Finland as treasurer from 1950–65 and as the chairman in 1968, and was awarded the Palmén medal of the Society in 1983. He was chairman of the Finnish Geographical Society in 1972 and was a member of the International Glaciological Society since 1950, Finnish correspondent in 1960–79, and Fellow of the Arctic Institute of North America. Two geographical sites bear his name: Palosuo Bay in Svalbard and Palosuo Islands in Antarctica.

When Erkki Palosuo retired in 1977 there was a generation gap in Finnish ice research, as there were no scientists actively working in the field who were even close to his age, experience or skills. Fortunately, Erkki continued to work on various projects for decades after his retirement and thus further educated us younger scientists interested in ice problems. Thus his expertise and vision were, after all, effectively communicated to new generations of ice researchers. We hope that some of his good humour, endless enthusiasm and kindness have rubbed off as well. Nowadays, ice research in Finland is thriving, so that we can confidently say that Erkki Palosuo's heritage remains and keeps bearing fruit.

Matti Leppäranta[1] and Lasse Makkonen[2]
[1] Department of Physics, University of Helsinki
[2] VTT Technical Research Centre of Finland

Recent meetings (of other organizations)

Workshop: Glaciers in Watershed and Global Hydrology

More than 60 researchers from 20 countries gathered in the beautiful Austrian village of Obergurgl to attend the workshop 'Glaciers in watershed and global hydrology' from 27–31 August 2007. The aim of the workshop was to bridge the intellectual gap at the glacier terminus – where glaciology traditionally ends and hydrology traditionally begins. Fittingly, those in attendance were from both disciplines and all shared an interest in the downstream effects of glaciers.

The workshop comprised three days of presentations (33 oral and 14 poster) focused on (1) incorporation of glaciers in runoff-models, (2) effects of climate change on glacier runoff and the hydrology of glacierized catchments and (3) glaciers as information repositories for hydrological modelling. A selection of papers from the workshop will be published in a special issue of Hydrological Processes later in 2008.

A half-day hiking excursion in the local mountains provided an intermission during the workshop, and an enthusiastic lecture by Ludwig Braun on the scientific history of Vernagtferner was one evening's memorable entertainment. Other evenings were spent in conversation at the bar and in the dining room of the distinctive Universitätszentrum in Obergurgl, where most conference participants were accommodated. All appreciated the fine cuisine served at the centre, which included nightly offerings of traditional Austrian dishes.

On top of Schwarzkögele (Photo: Markus Weber)

Entering the impressive 250 m long ice cave at the margin of Vernagtferner. (Photo: R. Hock)

(Scientific?) discussions in the Universitätszentrum bar. (Photo: R. Hock)

Excursion guide Ludwig Braun protects participants from dehydration with traditional beverages after the glacier hike. (Photo: R. Hock)

The rapid decline of glaciers and associated runoff changes came to life for more than 25 participants who attended the two-day excursion to the glacier Vernagtferner in the nearby Vent valley and toured the impressive gauging and meteorological station. Those who stayed overnight at the Vernagt mountain hut were rewarded with blue sky and sunshine, proving the miserable weather forecast wrong. The full-day hike across the glacier, through a spectacular 250 m ice cave and to nearby Schwarzkögele (>3000 m a.s.l.) was clearly a highlight of the workshop.

The workshop was sponsored by the International Commission on Snow and Ice Hydrology (ICSIH) of IAHS and the Union Commission for the Cryospheric Sciences (UCCS). Financial support by UNESCO-IHP, the University of Innsbruck and the IUGG enabled us to cover organisational costs and to support five early-career scientists from Brazil, India, Nepal and Pakistan with travel grants.

Regine Hock, Tómas Jóhannesson, Gwenn Flowers and Georg Kaser
Conveners

Glaciological diary

**** IGS sponsored** *** IGS co-sponsored**

2008

7–9 January
International Workshop on Snow, Ice, Glacier and Avalanches
Mumbai, India
See http://www.csre.iitb.ac.in/csreworkshop/index.html
Contact: Dr. G.Venkatraman; e-mail: gv@iitb.ac.in

28 January–2 February
Workshop on the dynamics and mass budget of Arctic glaciers
GLACIODYN (IPY) meeting,
Obergurgl, Austria
Convenors: J. Oerlemans, email: j.oerlemans@phys.uu.nl; and C.H. Reijmer, email: c.reijmer@phys.uu.nl
See: http://www.phys.uu.nl/~wwwimau/research/ice_climate/iasc_wag/activities.html

10–11 March
International Symposium on Mitigative Measures against Snow Avalanches
Egilsstadir, Iceland
See: http://www.orion.is/snow2008/organizer.html

10–11 March
Workshop on the Microstructure and Properties of Firn
Dartmouth College, Hanover, NH, USA
See http://engineering.dartmouth.edu/firn/

18–19 March
IP3 Users Workshop: 'Prediction of Water Resources in Mountain and Northern Canada: What is needed, what can be done'
Canmore, Alberta, Canada
See http://www.usask.ca/ip3/download/canmore2008/canmore_agenda.pdf

26–28 March
Workshop on mass balance measurements and modelling
Skeikampen, Norway.
Convenor: Glacier section at Norwegian Water Resources and Energy Directorate (NVE).
See http://www.nve.no/mbworkshop

27–29 March
GSA Northeastern: Antarctic Climate Evolution
Buffalo, NY, USA
See http://www.geosociety.org/sectdiv/northe/08mtg/techprog.htm

1–4 April
Second International Conference – 'Arctic Palaeoclimate and its Extremes (APEX) – Recent Advances'
Department of Geography, DurhamUniversity, Durham, UK
See http://www.apex.geo.su.se/meetings/apex2008.html
Conference contact: Niamh McElherron; c.mcelherron@durham.ac.uk

5–8 May
Science of Solar System Ices (ScSSI)
A cross-disciplinary workshop
Oxnard, California, USA
See http://www.lpi.usra.edu/meetings/scssi2008/

10–14 May
CGU-CGRG Joint Meeting: 'Canadian Geophysical Sciences: Present and Future'
Banff Park Lodge, Banff, Canada
See http://ucalgary.ca/~cguconf/

25–29 May
42nd Annual Congress of the Canadian Meteorological and Oceanographic Society (CMOS)
Special session on 'Avalanche Science and Forecasting'
Kelowna, BC, Canada
See http://cmos2008.ca/en/

26–30 May
Interpraevent 2008 – 11th International Symposium
Dornbirn Exibition Centre, Dornbirn, Austria
See: http://www.interpraevent2008.at/

9–13 June
****International Symposium on Radio-glaciology and its Applications, Madrid, Spain**
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
See: http://www.igsoc.org/symposia

15–20 June
The 27th International Conference on Mathematical Geophysics
Longyearbyen, Spitsbergen
See http://www.fys.uio.no/cmg2008/

16–18 June
GLIMS workshop on glacier mapping using remote sensing methods
Boulder, Colorado, USA
See http://glims.org/

24–26 June
Antarctic Peninsula Climate Change (APCC-5): Climate, Ice, Oceans, and Life
University of California, Irvine, California, USA
Contact: Eric Rignot, erignot@uci.edu

29 June–3 July
9th International Conference on Permafrost
Celebrating the 25th Anniversary of the formation of the International Permafrost Association
University of Alaska Fairbanks, Fairbanks, AK, USA
See: http://www.nicop.orgn

3–11 July
XXI Congress of the International Society for Photogrammetry and Remote Sensing Special Session on Observation and Monitoring of Polar Regions (SS-12)
Beijing, China
See http://www.isprs2008-beijing.org/

8–11 July
SCAR/IASC 2008 Open Science Conference
St Petersburg, Russia
See: http://www.ipy.org/index.php?/ipy/detail/scar_open_science_conference

13–18 July
Goldschmidt2008 – Session 16d: Biogeochemistry of weathering in glacial environments: local, regional, global and extraterrestrial consequences
Vancouver, Canada
Contact: Martyn Tranter; m.tranter@bristol.ac.uk

6–14 August
International Geological Congress (IGC)
Oslo, Norway
See http://www.33igc.org/coco/

11–14 August
Joint 17th Conference on Applied Climatology and 13th Conference on
Mountain Meteorology
Whistler, British Columbia, Canada
See http://www.ametsoc.org/MEET/fainst/200813montmet17AP.html

17–22 August
****International Symposium on Dynamics in Glaciology**
Limerick, Ireland
Contact: Secretary General, International Glaciological Society,
See
http://www.igsoc.org/symposia/2008/ireland/

2–3 September
Observations and causes of sea-level changes over millennial to decadal timescales
The Geological Society, London, UK
See www.geolsoc.org.uk/gsl/events/listings/page3053.html

8–9 September
***IGS British Branch annual meeting**
School of the Environment & Society, Swansea University, UK
Contact: Timothy D. James; igsbb2008@swansea.ac.uk
See http://www.swansea.ac.uk/geography/Research/igsbb2008/

9–20 September
Karthaus 2008 summer course on 'Glaciers and Ice Sheets in the Climate System'
Karthaus, northern Italy
See http://www.phys.uu.nl/~wwwimau/education/summer_school/

20–24 September 2008
****International Workshop on World Glacier Inventory**
Cold & Arid Regions Environmental & Engineering Research Institute
Lanzhou, China
Contact: Professor Shiyin Liu; liusy@lzb.ac.cn

4–6 November
First International Symposium on the Arctic Research (ISAR-1): Drastic Change under the Global Warming
Tokyo, Japan
See http://www.jamstec.go.jp/iorgc/sympo/isar1/index.html

10–13 November
Quaternary Climate: from Pole to Pole
EPICA Open Science Conference
Venice, Italy
See http://www.epica2008.eu/

2009

6–10 April 2009
****International Symposium on Snow and Avalanches**
Manali, India
Contact: Secretary General, International Glaciological Society
See
http://www.igsoc.org/symposia/2009/manali/index.html

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Editor: M.M. Magnússon (Secretary General)

This news bulletin is issued to members of the International Glaciological Society and is published three times a year. Contributions should be sent to your National Correspondent or to the Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, England.

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