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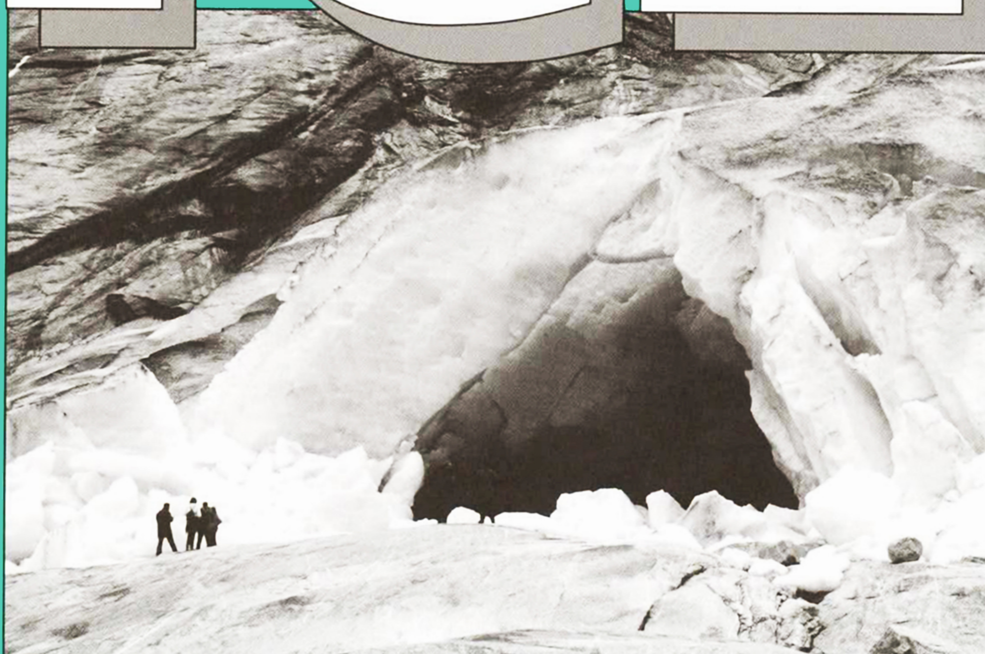

NEWS BULLETIN
OF THE INTERNATIONAL
GLACIOLOGICAL
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CONTENTS

COVER PICTURE: The glacier front and subglacial river tunnel of Nigardsbreen, an outlet glacier from Jostedalsbreen ice cap, Western Norway, is a very scenic and popular (but also dangerous) tourist spot. The photograph was taken on the Geilo post-symposium tour. Photograph by M. M. Magnússon.

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

By the time this reaches you, the last issue of Volume 50 of the *Journal of Glaciology* should be on its way to you.

We are also in the final stages of getting issues 172 and 173 to the printers. I am pleased that issue 173 is composed entirely of papers that have been accepted in 2005.

As we have been putting great emphasize on the publication of the Journal, ICE has suffered. Now that the Journal is catching up we are hoping to be able to publish ICE at a more regular pace. We are of course dependant upon receiving material from you so I would like to encourage everybody to contact their local correspondent and submit material which you think might be of interest to the glaciological community.

Now that we are catching up with our publication schedule, we are turning our attention to other "backlogs", namely papers "forgotten" in the review process, either with the authors themselves or with reviewers. For example, there are authors out there who were sent reviews of their papers in 2003 but from whom we have not yet received a revised manuscript or a response.

I would like to emphasize how important it is that authors providing final copy comply with the instructions, in particular those relating to figures and tables. Our new production system works very efficiently and accurately if authors supply us with materials in the most appropriate formats (namely Word or TeX for text and tables; tiff or eps for figures). The column "Notes from the production team" will be keeping you up to date on what you can do to help us keep the production flowing quickly and smoothly.

Magnús Már Magnússson
Secretary General

RECENT WORK

USA (Western)

(For abbreviations used see page 13)

ORGANIZATIONS AND DATA CENTRES

CliC Scientific Coordinating Committee
R.G. Barry (NSIDC, WDCC, CIRES)
Efforts are underway to establish a Scientific Coordinating Committee (SCC) for Climate and Cryosphere (CliC) related activities in the United States. The international project for CliC was initiated in March 2000 by the World Climate Research Program and will run through 2015. The International CliC Project Office supported by Norway is located in Tromso (http://clic.npolar.no). The web site provides the CliC Science and Coordination Plan and initial implementation strategy. National committees for CliC have been established over the 18 months in Canada, China, Japan and Russia to coordinate national goals and plans. An ad hoc group met in Washington, DC in January 2004 to consider the potential roles of a US CliC SCC and mechanisms for establishing and supporting it to hold (minimally) one or two meetings annually. WCRP CliC has recently signed MoUs of cooperation with the SEARCH program and the International Permafrost Association. To date, sponsors of a US CliC SCC have not been identified, but efforts to resolve this are continuing. For more information contact rbarry@kryos.colorado.edu.

Antarctic Glaciological Data Center
T.A. Scambos, R. Bauer, J. Bohlander, B. Raup,
T. Haran (NSIDC)
The Antarctic Glaciological Data Centre is a data-management project at National Snow and Ice Data Centre that seeks snow, firn, ice, and climate-related data for the Antarctic. The data centre also maintains large archives of ice velocity and 10-meter temperature data, and keeps a satellite-image record of changes in the Antarctic coast, available upon request. We encourage all Antarctic researchers to contribute and share data, which may be found at: http://nsidc.org/agdc/

REALLY OLD ICE

Snowball Earth
S.G. Warren, R. Brandt, T. Grenfell (UWA);
C. McKay (AMES)
There is mounting geological evidence that the oceans froze all the way to the Equator on at least two occasions in the Neoproterozoic, 550–700 million years b.p. We have computed the expected ice thickness on the tropical oceans and its implication for survival of surface life (Warren et al., 2002: *J. Geophys. Res. (Oceans), 107, C10, 3167* doi:10.1029/2001JC001123).

ANTARCTICA

Snow megadunes
T.A. Scambos (NSIDC); M. Fahnestock (UNH);
M. Albert (CRREL); C. Shuman (UMD)
Pilots flying over Antarctica in the 1960s first noticed snow “megadunes”, large ripple-like structures covering much of the East Antarctic plateau. Our ground-based study is a broad investigation of the potential significance of these stripe-like snow accumulation dunes, meters tall but kilometres in spacing. These have firn structures and characteristics indicative of extensive reworking of snow in the presence of low accumulation and continuous wind action. It is suspected that snow chemistry is greatly affected, and the wide extent of the dune pattern (~500,000 km^2) makes it likely that some ice cores have intercepted dune-processed firn. More at: http://www-nsidc.colorado.edu/antarctica/megadunes/

Antarctic Peninsula ice shelves
T.A. Scambos (INSTAAR); C. Hulbe (PSU);
D.R. MacAyeal (UC); M. Fahnestock (UNH)
Our study of ice shelves focuses on break-up processes and feeder glacier responses related to climate change in the Antarctic Peninsula, and the possibility that other regions could experience similar break-ups if Antarctic climate warmed.

Vostok Lake Phenomenon Geographical Study
Igor Zotikov (Fulbright Scholar from Russia at
CIRES/NSIDC)
The huge, deep subglacial fresh-water Lake Vostok is located under 3700 meters of ice in central East Antarctica, below Vostok station. Its study has planetary and biological applications. Permanent bottom melting under the ice sheet was studied in 1962–1967, and radio-echo sounding (1970–78) discovered subglacial lakes below this ice sheet. Deep core drilling at Vostok Station (1970–1996) ended close to the ice/lake interface. Biological applications, and the first ecologically clean entry of Lake Vostok are planned for 2001–2007.

Ocean tide modeling and related ice shelf and ice plain studies

L. Padman, (ESR); S. Erofeeva, (OSU); H. A. Fricker (UCSD); M. A. King (NEW); I. Joughin, (UWA)

We are developing several ocean tide models for the Antarctic region, and using these models in applications including: detiding of ERS and GLAS altimetry for ice shelf thickness trends; detiding of SAR for interferometric determination of ice shelf velocities; understanding "stick-slip" motion on the Whillans Ice Plain; ocean tide load contribution to bedrock GPS tidal signals; and basal melt rate calculations. Models fall into two categories; dynamics-based (constrained solely by shallow water wave equations, open-ocean boundary conditions, and astronomical forcing), and inverse models which assimilate tidal data (heights from satellite altimetry, ice-shelf GPS, and ocean pressure and coastal tide gauges; and ocean velocity data from moored current meters and vessel-mounted acoustic Doppler current profilers). Models include 1/4º x 1/12º circumpolar models ("CATS" and "CADA"), and regional solutions at higher resolution for the Ross Sea (including the RIS) and the Antarctic Peninsula region. More information may be found at http://www.esr.org/antarctic/tides_content.html

Glaciers of Taylor Valley, Antarctica

A.J. Fountain, T. Nylen, R. Johnston, A. Ebnet, J. Ebnet, C. Delany (PSU)

We are studying the climate and glaciers of Taylor Valley with the ultimate purpose of estimating stream flow and it effect on the ecosystem of this dry polar desert. We monitor the mass balance of four glaciers in the valley, two of which we measure the balance of the entire glacier. For those glaciers, the annual mass balance ranges +/- 10 cm w.eq. and shows no trend over the past decade. We have developed a temperature-index model to estimate summer melt-water runoff from the glaciers (A. Ebnet). This application differs from similar work in that runoff often occurs when air temperatures are below freezing. Little melting occurs on flat surfaces of the glaciers because heat loss to the winds and sublimation typically dominates the ablation. Melt-water is produced at subfreezing temperatures in two ways: (1) depressions in the ice create their own microclimate partly by shielding the surface from winds and increasing the ice temperature at ice walls favorably oriented to the sun (R. Johnston); (2) a solid-state greenhouse effect occurs whereby more heat is gained in the subsurface of the ice via solar radiation than lost through conduction; melting occurs below the surface. J. Ebnet is investigating subsurface melting using a model developed by Glen Liston. We are also investigating the use of synthetic aperture radar for detecting glacier melt water (C. Delany). Results show that melt-water can be detected but confounding effects exist, including change in surface roughness via the development of sun cups and perhaps cryoconite holes in the subsurface. Thomas Nylen has examined the climate of the dry valleys and identified katabatic winds as a major factor governing valley temperatures. The winds increase summer temperatures above the melting point and can increase winter temperatures by 3°C. The average seasonal temperature of the valleys is directly related to katabatic frequency.
http://www.glaciers.pdx.edu

Mechanics of dry-land calving ice cliffs

E.C. Pettit, B. Hallet, M.R. Koutnik,, E. Whorton (UWA); A. Fountain , T. Nylen, P. Sniffen (PSU)

This project is comprehensive study of land-based polar ice cliffs. Through field measurements and modeling we will identify the physics underlying the formation of ice cliffs at the margin of Taylor glacier in the McMurdo dry valleys. Preliminary modeling results suggest that the horizontal velocity peaks one-third the distance up the cliff face and that the highest shear strain rates are at its base. We hypothesize that the displacement field of the glacier is more important than the local ablation pattern in maintaining ice cliffs, and the timing of calving events is controlled by temperature fluctuations causing transient stress fields to develop in the " thermal skin" of the cliffs. The study comprises three components: field work, numerical modeling, and remote sensing. The first of two field seasons will happen the austral summer of 2004–05. At three sites, we install instruments to measure the ice deformation and temperature fields near the cliff face using a combination of strain gages, tilt sensors, thermistors, and a GPS surface strain network. An ablation stake network will augment existing energy balance data, and a small seismic network will monitor local "ice quakes" associated with ice cracking at the terminus and calving events. The instruments will be left over one winter to identify the effect of the seasonal cycles of temperature and solar radiation. These data will be combined with time-lapse photography to document ice-cliff evolution. Ultimately, the field data will be used to test and validate a computer model which will then enable us to explore the sensitivity of ice cliff evolution to diverse glacier characteristics, including basal sliding rate, ice temperature, and angle of incident solar radiation.

Flow history of Kamb Ice Stream

G. Catania, H. Conway, C.F. Raymond (UWA); T.A. Scambos (INSTAAR)

We investigated several curvilinear features parallel to ice flow in the lower reach of Kamb ice stream using a combination of ground-based ice-penetrating radar and GPS observations and geophysical models. Several of these features are buried shear margins marking past positions of the ice stream at different times. Other features are more complex and likely represent zones of increased basal melt, as internal layers here are strongly down-warped. Adjacent to these down-warped layers are large areas containing numerous diffractors near the bed. We believe that this pattern is best explained through floatation of the area. More at: www.geophys.washington.edu/Surface/Glaciology/PROJECTS/Scars/welcome.html

Glacial History of Ridge AB

H. Conway, G. Catania, H.-P. Marshall, C.F. Raymond (UWA)

Ground-based radar-detected internal layers across the ridge are highly disturbed, indicating large strains in the past. Some of the observed folding is related to bed topography, but often it is not; apparently some folding has been inherited from processes that occurred upstream. The lower end of the Ridge contains peculiar mid-depth hyperbole, similar to those we have mapped in the flat-ice terrain in the lower reach of Kamb Ice Stream; we suspect that this region was floating in the recent past. We have not found evidence of lateral expansion of Mercer Ice Stream (at least in the recent past) into the Ridge, as was suggested by Shabtaie and Bentley (1988). However, we did find evidence that Van der Veen Ice Stream was wider in the past. Available evidence suggests that this paleomargin was abandoned ~3k years ago. More at: http://www.geophys.washington.edu/Surface/Glaciology/PROJECTS/RidgeAB/ridgeab.html

A flow-band model of the transition from inland to ice-stream flow

S. Price, H. Conway, E.D Waddington (UWA);
R.A. Bindschadler, (GSFC)

We have developed a new, higher order, thermo-mechanical ice flow model for the purpose of investigating the link between stresses in the ice, frictional melting at the bed, and how these relate to the transition from inland to streaming ice flow in West Antarctica. The heat and momentum balance equations are solved in orthogonal, curvilinear coordinates using the finite volume method. The model output has been validated by comparisons with various analytical solutions and with the work from previous authors. As a first practical application, we are using it to help constrain the flow and thickness history of Siple Dome, West Antarctica. More at "recent results" within: http://students.washington.edu/sfp/.

Glacial history and basal temperature using ice-sounding radar and ice-core data

J. MacGregor, D.P. Winebrenner, H. Conway,
J. Sylvester (UWA)

We are developing age/depth relationships for inter-ice stream ridges on the Siple Coast for which ice core data are lacking, by using ice-sounding radar (1–5 MHz frequency) to observed isolated englacial radar layers which correspond to radar-detected layers that have been dated using the Siple Dome core). We establish layer correspondences by first developing a depth sequence of isolated layers at Siple Dome, translating that sequence (with uncertainties) to other ridges via ice flow and accumulation modeling to yield depth bands in which isolated layers on the latter ridges may be expected, and then detecting any actual isolated radar layers. A statistical model for radar layer occurrence in 'quiet' bands in echograms provides estimates of the confidence of correspondence. We take corresponding radar layers to be corresponding isochrones, and thus infer a refined age/depth relation on ridges remote from Siple Dome, even for cases where no contiguous layer tracing between ridges is possible. Our present efforts focus on Englehardt Ridge, within which new signal processing has revealed several new, isolated radar layers. Separately, we are using radar observation of the depth-averaged radar attenuation through Siple Dome (Winebrenner et al., Ann. Glac. 37, 2003) together with physico-chemical modelling of ice attenuation vs. temperature and impurity burdens, to investigate 'radar thermometry', i.e., the use of sounding radar over smooth beds to estimate basal temperature. Modelling and observations indicate that observation of the (depth-averaged) e-folding length for radar attenuation in Siple Dome to within 3% can be used to diagnose basal temperature to within 1K.

Thickness history of Siple Dome

E.D. Waddington, H. Conway, S.F. Price, E.J. Steig (UWA); R.B. Alley (PEN); E.J. Brook (OSU);
K.C. Taylor (DRI); J.W.C. White (CU)

Ice thickness in West Antarctica at the last glacial maximum (LGM) is key to understanding ice streams and interpreting ice cores, yet it is poorly known. Although trim lines, moraine limits and exposure-age dating provide geologic constraints on ice thickness near the Transantarctic Mountains and in Marie Byrd Land, lack of exposed bedrock hampers traditional geologic methods in a central region comprising ~$2x10^6$ km^2. We have inferred ice-sheet thickness changes in the central Ross Embayment by using a transient 1-D kinematic ice-flow model to find combinations of accumulation and ice-sheet thickness histories that match the depth-age relation and the measured layer-thickness pattern in the Siple Dome ice core. When we rejected unreasonable accumulation histories, the remaining history pairs indicated thinning of 200 to 400 m since the LGM. Using a transient higher-order thermo-mechanical flow-band model driven by an acceptable accumulation history, we are able to match the observed internal-layer pattern reasonably well with a thickness change of approximately 300−400 meters. Comparison of stable isotopes from Siple Dome with other ice cores also suggests limited thinning. Our estimated thickness changes are smaller than those in some previous reconstructions based on whole ice-sheet flow models constrained by geologic evidence from the Transantarctic Mountains and marine data from the Ross Sea floor.

Ross-Amundsen Divide – a good place for an ice core

H. Conway, E.D. Waddington, E.C. Pettit, G. Catania,
K. Matsuoka (UWA); Felix Ng (MIT); T.A. Neumann (UVM); D.L. Morse (UTIG)

Geophysical measurements (ice penetrating radar and GPS) have been carried out to identify a suitable deep ice core site in the Western Divide region between the Ross Sea Embayment and the Amundsen Sea in West Antarctica. We have tracked ice thickness and continuous radar-detected internal layers from the Byrd up to the Divide sites. Ice thickness near the divide is 3460m and the deepest continuous layer ("old faithful") is 2270m below the surface. Old faithful corresponds to measurements of *"off-scale acidity ... due to excessive*

volcanism" in the Byrd core (Hammer et al. 1994) and dates to 17.5 ka BP. We are using the derived age-depth relationship to estimate flow and accumulation histories at potential core sites. Repeat measurements of a network of survey poles using GPS methods were completed during the 2003–04 season. The measurements will be used to produce a map of surface topography and surface velocities, necessary for realistic ice flow modelling. More at:
http://www.geophys.washington.edu/Surface/Glaciology/PROJECTS/Iwais/iwais.html

Glaciological characteristics of the Ross/Amundsen Sea ice-flow divide deduced by new analyses of ice-penetrating radar data

K. Matsuoka, C.F. Raymond (UWA); D.L. Morse (UTIG)

The West Antarctic highland separating ice flow towards Ross and Amundsen Sea Embayments has been affected by varying glaciological conditions through the Quaternary. Support Office of Aerogeophysics Research at University of Texas gathered airborne radar data along longitudinal and transverse tracks in the flow-divide region. We are now using these data to examine the spatial pattern of radio-echo intensity returned from within the ice. The goal is to detect anomalous zones in temperature and other properties that complement more traditional analysis of the geometry of radar-detected internal layers for determining the flow history.

Clouds and sea ice in the Earth's radiation budget

M. Fitzpatrick, S.G. Warren, R. Brandt (UWA)

The Antarctic sea ice zone is the cloudiest region on Earth. Both clouds and sea ice have high albedo. We are working to determine their relative importance in the planetary albedo of the Southern Ocean. Pyranometer observations on the research ship *Aurora Australis* were used, together with visual observations of ice type and measurements of ice albedo, to infer optical depths of clouds over both sea ice and open water (Fitzpatrick et al., 2004: *J. Climate, 17,* 266–275). The distribution of optical depths can be used to compute radiative properties of clouds for any sun angle over any surface type. They will be used together with climatologies of cloud cover and sea-ice albedo in a study of the solar-radiation budget of the Antarctic sea-ice zone.

Ice crystals in the Antarctic atmosphere

V. Walden, (UID); S.G. Warren, E. Tuttle (UWA)

During the winter of 1992 at South Pole Station, falling snow crystals were collected daily on a gridded slide, which was then photographed under a microscope. The images of 14,000 crystals were measured. Statistics of ice crystal types and aspect ratios were computed (Walden et al, 2003: *J. Appl. Meteor.,* **42**, 1391–1405).

Bacterial activity in South Polar snow

S.G. Warren, S. Hudson (UWA)

A published claim of bacteria undergoing metabolic activity in surface snow at the South Pole was questioned, because of the lack of liquid water: even at the highest temperatures ever recorded the thickness of the quasi-liquid layer on ice crystals would be far smaller than the width of a bacterial cell (Warren and Hudson, 2003: *Applied and Environmental Microbiology*, **69**, 6430–6431).

Sulfate in Antarctic snow

S. Harder, S.G. Warren, R. Charlson (UWA)

To aid in interpretation of ice-core records of sulfate, samples were taken of falling snow and surface snow through a year at South Pole Station, to distinguish dry deposition and wet deposition (Harder et al., 2000: *J. Geophys. Res. (atmospheric chemistry)*, *105,* 22,825–22,832,6).

Surface albedo of the Antarctic sea-ice zone

R. Brandt, S.G. Warren, T. Grenfell (UWA); A. Worby (AAD)

Albedo was measured for a variety of ice types on three ship voyages between Australia and Antarctica. Hourly visible observations of ice type and snow thickness are available from the ASPeCt dataset from icebreaking ships of many nations, about 20,000 observations total. Ice concentration is available from satellite microwave measurements. These three sources of data were combined to produce a seasonal and regional climatology of surface albedo for the ocean around Antarctica (Massom et al., 2001: *Reviews of Geophysics*, *39,*413–445).

GLACIER MECHANICS

Icelandic Glaciers

Throstur Thorsteinsson (UWA, SI); K. Matsuoka, E. D. Waddington (UWA); I. Howat, S. Tulaczyk (UCSC); H. Bjornsson (SI)

A closely spaced Ice-Penetrating Radar survey on a 4 by 4 km area on northwest Mýrdalsjökull revealed significant bed topography, with ice thickness ranging from 100 − 350 m. There was also a strong internal reflector, most likely from a volcanic eruption at Katla in 1918. Strong, heterogeneous radar echoes, presumably scattered from water-related features, were observed over the whole area. Velocity measurements showed that the speed ranged between 30 and 54 m a^{-1}, which could be solely due to internal deformation. At Breiðamerkurjökull, samples of pro-glacial sediments were collected, and ice-flow velocity was measured across a shear margin, separating a fast eastern stream from a slower western stream. There was no obvious stratification in the sediments sampled. The strain rate at the shear margin was extremely high, and we plan to explore the influence of fabric and texture.

Passive seismic experiment, Columbia Glacier, Alaska

W.T Pfeffer, S. O'Neel, D.E. McNamara (INSTAAR)

During June 2004, we deployed an array of 11 seismometers on rock positions surrounding the lowest 15 km of Columbia Glacier, Alaska. Ten stations are high frequency sensors, and the eleventh is a broadband sensor. Complete azimuthal coverage of the lower glacier should allow precise timing and relatively accurate locations of seismic events (calving, crevassing, basal sliding) in the terminus region. A time-lapse camera shooting four times daily also records surface area changes at the terminus. Surface velocities may also be calculated from the photographs, and a GPS receiver was deployed ~8 km upstream from the terminus. We hope to study both temporal and spatial variations in calving and fracturing when the data is recovered in October and again in spring 2005. Columbia Glacier continues its rapid retreat. Although the rate of terminus retreat has recently slowed (due to a prominent constriction in the channel), the calving flux continues to greatly exceed the mass-balance flux, and the geometry is changing as rapid thinning occurs over the entire glacier.

Sliding and erosion at Bench Glacier, Alaska

R.S. Anderson, S.P. Anderson (CU, UCSC), K.R. MacGregor (UCSC, MC); C.A. Riihimaki (UCSC, BMC); M.G. Loso (UCSC); M. Kessler (CU, UCSC); Shad O'Neel (CU); E.D. Waddington (UWA)

We documented the meteorological forcing, the sliding response and erosional output of 7 km long, 1 km wide Bench Glacier, near Valdez Alaska, during the melt seasons of 1999, 2000, and 2002. Our modelling goal was to simulate the long-term evolution of glaciated valley profiles (MacGregor et al., 2000, *Geology,* 28,1031). This research catalyzed development of numerical models linking subglacial hydrology and sliding dynamics (Anderson et al., *JGR-Earth Surface*,109(F3), doi: 10.1029/2004JF000120). More elaborate models (Kessler and Anderson, *GRL*, 31, L18503, doi: 10.1029/2004GL020622), which include distributed cavities that can grow by sliding, and evolving conduits, reproduce not only the annual up-glacier propagating wave of sliding seen on Bench Glacier, but annual outburst floods from side-glacier lakes exemplified by Hidden Creek Lake at Kennicott Glacier.

Linking subglacial hydrology to sliding velocity at the glacier scale

J. Harper (UMT); N. Humphrey (UWY); W.T. Pfeffer (CU)

Our understanding of the relationship between subglacial hydrologic conditions and sliding processes offers a limited ability to predict sliding velocity. This project is focused on collecting and analyzing a data set from Bench Glacier, Alaska, that spans unique time and space scales so as to offer new insight into this problem. A network of 47 boreholes at locations spanning the entire length of the glacier has been instrumented to collect water-pressure observations at frequent time intervals for a period of 3 years. These data are supported by: 1) subglacial measurements of water conductivity and turbidity; 2) GPS measurements of surface velocity and elevation; 3) optical surveys of velocity and uplift of a dense network of stakes; 4) vertical strain measured along boreholes; 5) borehole slug and pump tests; 6) dye-tracer experiments; and, 7) direct observation of englacial and subglacial water flow via borehole video camera. Results are being used to elucidate the seasonal evolution of the subglacial drainage system and the linkages between hydrology and glacier sliding.

Outburst floods from Hidden Creek Lake at Kennicott Glacier, Alaska

S.P. Anderson (CU, UCSC); J.S. Walder (USGS CVO); A.G. Fountain (PSU); R.S. Anderson (CU, UCSC); D.C. Trabant (USGS); E.R. Kraal (UCSC); M. Cunico (PSU)

Outburst floods are rarely monitored as they occur. We made detailed observations during outburst floods from Hidden Creek Lake, a ~30 x 10^6 m^3 ice-marginal lake dammed by Kennicott Glacier, Wrangell Mountains, Alaska, in the summers of 1999 and 2000. The data collection included lake level; discharge into the lake; ice-dam deformation; water level in boreholes in the ice dam; water level in a down-glacier ice-marginal basin; and water discharge, chemistry and sediment concentration in the Kennicott River (see Anderson et al. 2004, *JGR-Earth Surface* 108(F1), doi: doi:10.1029/2002JF000004, and Anderson et al. 2004, *Chem. Geol*.202(3-4): 297-312.). Observations in 1999 began about a day prior to the outburst, while in 2000 observations began about three weeks prior to the outburst. Water balance showed that the lake did not leak prior to the onset of drainage in the outburst. Passage of lake water through the glacier during the outburst disrupted the chemistry of the Kennicott River, produced backfilling in a previously dry ice-marginal basin, and resulted in uplift and an increase in surface speeds measured on Kennicott Glacier. All of these phenomena are consistent with increasing subglacial water pressure during passage of the flood wave.

http://www.glaciers.pdx.edu/kennicott/default.html

Mt. St. Helens Glacier

J.S. Walder (USGS, CVO)

Following the end of the 1981-1986 episode of lava-dome growth at Mount St. Helens, an unusual glacier grew rapidly within the crater of the volcano. The glacier, fed primarily by rock- and snow avalanches from the crater walls, has a maximum thickness of about 220 m and until recently formed a crescent that wrapped around the old lava dome on both east and west sides. A new lava dome began growing in the south of the crater in late September 2004 and has by now (8 November 2004) nearly filled the gap between the old dome and crater wall, thereby splitting the glacier in half. Glacier ice has been bulged upward and outward to create an apron of highly fractured ice around the new dome. Firn and ice on the outer flank of the apron have been warped upward almost vertically. Growth of the new lava dome has caused negligible meltwater runoff, and there has been a notable absence of ice-surface cauldrons in the crater glacier. The lack of melting is probably due to an insulating layer of water-saturated fragmental material (landslide debris and pumice) between the glacier and intruding hot rock.

Studies of Eliot Glacier, Oregon, USA

A. Fountain, K. Jackson (PSU); R. Schlicting (CHS); F. Granshaw (PCC)

Eliot Glacier is near Portland, Oregon. R. Schlicting is examining the thermal properties of the rock-debris layer that covers the lower ablation zone of the glacier. The goal of this work is to determine the spatial and temporal variation in the insulating properties of the

debris layer and the resulting processes that control ice melt. To examine how the glacier has changed over time and estimate the rate of debris flux to the surface, K. Jackson is measuring the ice speed and ablation rate of the glacier. A map of surface elevation of the ablation zone will be compared to maps made in previous years, most notably by S. Lundstrom.
www.glaciers.pdx.edu

GLACIERS AND CLIMATE

Glacier Change in the American West

A. Fountain, D. Percy, H. Basagic (PSU); F. Granshaw (PCC)

We are developing a GIS database of glacier change in the American West (exclusive of Alaska). We are compiling glacier inventories using historic maps, aerial and ground-based photographs, and satellite imagery. We have currently complied a 1:100K scale coverage of glaciers that is available at www.glaciers.us. This work was in collaboration with Richie Williams of the US Geological Survey. During the summer of 2004 we will compile a 1:24K scale coverage, which will be made available as well. At the same time, we are compiling temporal data on glacier change. Our immediate goal is to compile the temporal coverage for the various National Parks with whom we are currently collaborating. Much of this collaboration is with Dan Fagre, US Geological Survey at Glacier National Park. H. Basagic is currently working on the glaciers of the Sierra Nevada.

Modelling mass balance with upper-air meteorological data

L.A. Rasmussen, H. Conway. (UWA)

A simple model using once-daily upper air values in the NCEP-NCAR Reanalysis database estimates winter, summer, and net balance at two glaciers in southern Alaska, one in western Canada, and one in Washington ($0.42 \leq r^2 \leq 0.79$) substantially better than any of several seasonally-averaged, large-scale climate indices commonly used. It has about the same range of r^2 values over the three balance components for each of nine glaciers in Norway and two in Sweden. It takes precipitation to be proportional to the product of relative humidity and the wind component in a particular critical direction, both at 850hPa, and allocates it between rain and snow depending on whether the temperature at the altitude of the terminus is above or below +2^{o}C. It takes ablation to be proportional to the excess of temperature above 0^{o}C at the altitude of the equilibrium line. The model parameters (critical direction, constants of proportionality) are determined empirically from the time series of balance measurements. More at:
http://www.geophys.washington.edu/Surface/Glaciology/PROJECTS/BLUE_GLAC/SCG

Upper-air conditions over Patagonia

L.A. Rasmussen, H. Conway, C. F. Raymond (UWA); E. Rignot (JPL)

Precipitation over the Patagonia icefields in the past 40 years is inferred from upper-air conditions archived in the NCEP-NCAR Reanalysis database. At any site, it is assumed to be proportional to the product of the relative humidity and the westerly component of the wind, both at 850hPa at the 50^o S, 75^o W Reanalysis grid-point; it is assumed to be snow if the temperature at the altitude of the site is below +2^{o}C, otherwise rain. Because of the scarcity of precipitation measurements in the region, the constant of proportionality cannot be determined, so inferences are limited to describing relative changes. Warming has been about 0.5^{o}C over the 40 years, both winter and summer, with the effects that it has (1) shifted from snow to rain about 5% of the precipitation, the total amount of which has changed little, and (2) increased annual melt in the ablation areas by about 0.5m w.e. The icefields have been losing mass since at least 1870, so this 40-year trend represents only an acceleration of the longer-term trend of adjusting to climate change since the Little Ice Age. More at:
http://www.geophys.washington.edu/Surface/Glaciology/PROJECTS/Patagonia/patagonia.html

Volume changes of the Patagonia icefields, South America

E. Rignot (JPL, CECS); G. Casassa, A. Rivera (CECS); C.F. Raymond, H. Conway (UWA).

We are investigating changes in volume of the Patagonia icefields in response to climate warming in the last century. Satellite remote sensing (ERS-1/2, Radarsat-1, SIR-C) is used to map ice velocity and changes over time; airborne remote sensing (NASA/CECS P3 campaign of 2002; NASA AIRSAR campaign of 2004) is used to map the changing topography of the glaciers; and field campaigns are employed to characterize ice thickness (2.5 MHz radio echo sounding), snow accumulation (ice accumulation radar, snow probe), thickness change (GPS surveys), and velocity change (GPS surveys) to determine the mass loss of the glaciers, their fluxes to the ocean and the variability of these parameters through time. Comparison of field data with numerical climate models is used to determine the snow input to the icefields in the last century and detect short and long-term trends. This research is funded by NASA Cryospheric Sciences Program.

Melt regime of the floating tongue of Petermann Glacier, in northwestern Greenland

E. Rignot (JPL); K. Steffen (CU)

In collaboration with the British Antarctic Survey and the University of Colorado in Boulder, we study the melt regime (bottom and surface) of the floating tongue of Petermann glacier, a major outlet glacier in northwestern Greenland. The remote sensing part of the program includes airborne laser altimetry (NASA Wallops) and radio echo sounding (University of Kansas) surveys of the glacier; as well as satellite radar interferometry imaging using ERS-1/2 and Radarsat-1. These data are used to refine the bottom melt budget of the glacier and determine the spatial distribution in bottom melting. The results indicate pronounced channelization of bottom melting along cavities parallel to flow lines. Field surveys using the phase radar sounder of BAS confirm high melt rates and also a pronounced spatial variability in melt rates. GPR surveys of the glacier have confirmed the existence of those melt channels and provided details on their shape and distribution. Climate data and ablation data collected at the surface are used to infer the energy balance and surface ablation regime of the glacier over several years during the entire year to fill an important gap in our knowledge of climate in north Greenland. This project is funded by NSF Arctic and NASA Cryospheric Science programs.

Altitude variation of mass balance in Scandinavia

L. A. Rasmussen (UWA)

At ten glaciers in Norway and two in Sweden, vertical profiles of net balance are strongly linear and nearly parallel from year to year. Separate quadratic functions fit each year's observed balance profiles little better than a family of parallel lines does. At one of the altitudes on each glacier where net balance is routinely reported, it correlates very well ($r \geq 0.97$) with the glacier-total net balance. The glacier-total net balance correlates much better from glacier to glacier than does the slope of individual linear functions. A remarkable consequence of the high correlations from glacier to glacier and between one site on a glacier and the glacier-total net balance is that observations at one site on one glacier provide a good estimate of glacier-total net balance at nearby glaciers. More at:
http://www.geophys.washington.edu/Surface/Glaciology/PROJECTS/Scandinavia/scandinavia.html

Climate Change on the Tibetan Plateau

O.W. Frauenfeld, T. Zhang, M.C. Serreze (CIRES, NSIDC)

The Tibetan Plateau is characterized by the most complex terrain of the globe. The Plateau plays a significant role in generating the Asian monsoon, and is a key region for climate change detection. Surface records indicate significant warming over recent decades, however reanalysis data do not confirm this warming trend. We hypothesize that this discrepancy is due to the extensive land-use changes that have occurred on the Tibetan Plateau in recent decades.

INSTRUMENTS AND METHODS

Enhanced Polar DEMs

T.A. Scambos, T. Haran (NSIDC)

Calibrated satellite images may be used in conjunction with existing elevation data to create detailed elevation models of ice sheets, revealing features as small as 1-2 km across with meter-level vertical accuracy. The images permit detailed investigations of accumulation and temperature variations around small topographic features.

Ice Borehole Camera

F. Carsey, H. Engelhardt, A. Lane, A. Behar (JPL)

A simple camera system for acquisition of side-looking and down-looking images in hot-water drilled boreholes has had its second Antarctic deployment on Amery Ice Shelf with the Australian Antarctic Division, and a third deployment is planned in the coming field season with BAS at Rutford Ice Stream. (See Carsey et al., 2002. *J. Glac.*, **48**(163), 622-628.)

Glaciology Field Technology Development

F. Carsey, H. Engelhardt (JPL)

A thermal drill suited to shallow (300 m or less), real-time profiling of ice mass properties is under development for ultimate deployment on the polar caps of Mars. The drill melts ice and immediately removes the meltwater to the surface for analysis, in our case, in IR absorption, electrochemical, and electrophoretic cells. Vertical sampling can be obtained either through simple continuous pumping or by melting and removal of finite volumes (depth intervals) for finer resolution. Field demonstration is planned.

Autonomous Field Survey Systems

F. Carsey, A. Behar (JPL)

Long-range autonomous surface vehicles are in development for use in planetary and earth science applications. Initial deployments have been of a simple wind-blown "tumbleweed" rover capable of developing topographical information along a random-walk route; solar powered systems with route finding are planned. More at:
http://robotics.jpl.nasa.gov/~behar/JPLTumbleweed.html

Borehole optical stratigraphy measures layering and strain in polar firn

R.L. Hawley, E.D. Waddington, D.P. Winebrenner (UWA); E.M. Morris (BAS)

We have developed borehole optical stratigraphy (bos), a technique for acquiring and analyzing video logs of boreholes in polar firn. In principle, the instruments and methods can be used in any glacier borehole, but our current field locations are Siple Dome, Antarctica, and 2 locations in Greenland, Summit and Raven camps. A bos log produces a profile of visible brightness versus depth. Using bos, we have identified and counted annual layers in a Siple Dome borehole, and we are currently measuring vertical strain at Summit and Raven, by tracking individual features as they move through the firn column. In that experiment, we hope to resolve small changes in firn densification through an annual cycle, by making bos logs on a monthly basis throughout the winter. In a related project we will study cores at nicl to determine which physical properties give rise to the light and dark features. Grain size and density are the most probable candidates, and test logs at summit show a striking correlation between brightness and density as measured by a neutron-scattering probe at shallow depths.

Spatial and temporal accumulation patterns from deep radar layers

E.D. Waddington, M.R. Koutnik (UWA);
T.A Neumann (UW, UVM)

We have developed a geophysical-inverse procedure to extract robust estimates of spatial patterns of accumulation-rate from radar layers whose depths have been impacted significantly by gradients in ice thickness and accumulation-rate. Our Forward Model is a 2.5D flow-band model that calculates ice velocities, particle paths, and layer shapes. Our Inverse procedure finds model parameters comprising the accumulation pattern, ice flux into one end of the flow band, geothermal flux, Glen flow-law softness parameter A_0, and layer age. Data sets comprise ice-surface topography, layer geometry, and point-measurements of accumulation rate, and ice-flow velocity (if any). Prior estimates of layer age, input ice flux, geothermal flux, and ice softness can constrain the inversion. We avoid over-fitting the data by ensuring that the non-dimensional mismatches to the data approximate samples from a normal distribution with zero mean and unit variance. Using a steady-state version, we have extracted accumulation rate along a flow line on the north flank of Taylor Dome. We are now developing the transient procedure, to extract histories of accumulation rate, ice-thickness, and ice-divide migration across the Ross-Amundsen divide in West Antarctica, since the LGM.

Effects of firn ventilation on geochemistry of polar snow

T.A Neumann (UWA, UVM); E.D. Waddington (UWA)

We have investigated the effects of airflow through snow (ventilation) on geochemical concentrations in polar firn. The primary component of this work is our model for water-vapor motion in firn, which allows for vapor exchange with the atmosphere and sublimation or condensation within the firn. We use this model to investigate how stable isotopes, irreversibly deposited species (those which are not re-entrained after deposition, such as sulfate), and reversibly deposited species (which are volatile and can cycle between the atmosphere and firn, such as H_2O_2) are affected by ventilation. Our models suggest that both reversibly deposited species and irreversibly deposited species are relatively insensitive to ventilation-driven water-vapor motion, but that stable isotopes can be significantly affected. Unlike other stable-isotope models, we allow disequilibrium between pore-space vapor and the surrounding snow grains. We also calculate the isotopic effects of sublimation and condensation. Results suggest that isotopic change in the upper few meters is more rapid than can be explained by the Whillans and Grootes (1985) model, that isotopic equilibration with atmospheric vapor is important in low accumulation rate regions, and that ventilation enhances isotopic exchange by creating regions of relatively rapid sublimation and condensation in the firn.

http://www.uvm.edu/~tneumann/p_minus_e/

Remote sensing of snow.

S.G. Warren, R. Brandt, T. Grenfell, S. Hudson (UWA); M. Fily, D. Six (LGGE)

The dry-snow zones of Antarctica and Greenland can be used as calibration targets for visible and ultraviolet sensors on satellites. This was done for AVHRR (Masonis et al., 2001: *Int. J. Remote Sensing*, *22*, 1495-1520). Surface measurements of bidirectional reflectance of snow in support of this were made at South Pole (Warren et al., 1998: *J. Geophys. Res. (Planets), 103,* 25,789–25,807) and are now underway at Dome C.

PERMAFROST

Frozen Ground Data Center

T. Zhang, M. Parsons (CU)

The Frozen Ground Data Centre (FGDC) at the National Snow and Ice Data Centre is a cooperative project of the World Data Centre for Glaciology at Boulder, the International Arctic Research Centre (IARC), and the International Permafrost Association (IPA). The FGDC identifies, archives, documents, and distributes data related to permafrost and seasonally frozen ground. The FGDC currently holds over 100 data sets and information products, and contains detailed metadata records describing over 100 additional data sets available at other Global Geocryological Data nodes around the world. The data centre provides access to these data through an online search and order system and through availability in the Global Change Master Directory.

Permafrost and seasonally frozen-ground studies

T. Zhang, R.L. Armstrong, C. Oelke, O. Frauenfeld, R.G. Barry, D. Gilichinsky, J. Smith (CU)

We developed a combined frozen soil algorithm to detect near-surface freeze/thaw cycles in the contiguous United States, using a passive microwave remote sensing algorithm over snow-free surfaces, and a one-dimensional numerical heat transfer model with phase change over snow-covered surfaces. Using the algorithm, we investigated the seasonal variation in the timing and duration, number of days, and areal extent of near-surface frozen soils in the United States between July 1997 and June 1999. We also modelled the soil thermal regime of the Arctic terrestrial drainage basin at 25 x 25 km resolution, using a one-dimensional heat transfer model with phase change. In this study, we analyzed a 22-year time series (1980–2001) of soil temperatures to depths of 14 m, and created annual soil temperature profiles for the entire Arctic, for regions of continuous, discontinuous, and isolated permafrost, and for areas of seasonally frozen ground. Long-term changes in the active layer and in freeze/thaw depths in the Russian arctic were investigated, and we found that active layer depth is most strongly related to snow depth, but is also affected by air temperature. Several studies were undertaken on permafrost dynamics and their hydrological implication over the Russian arctic drainage basin.

Interactions between trends and periodical components in air and soil temperature time-series over the permafrost-occupied regions of the Asian territory of Russia

S.M. Chudinova (NSIDC, IPhBPSS); R.G. Barry, T. Zhang, (NSIDC); V.A. Sorokovikov, D.A. Gilichinsky (IPhBPSS)

We used Singular Spectrum Analysis (SSA) to detect both long- and short-term rhythms in ST between 1960 and 1990 over five permafrost-occupied regions in Russia, and to determine the correspondence of soil temperature (ST) with surface air temperature (SAT) over the same time period. The trends and periodic components in the summer SAT time series corresponded to the summer and annual ST time series only over the West Siberia Plain. In the eastern and western Central Siberian Plateau and in Transbaikalia, ST rhythms reconstructed in the annual time series for all depths investigated coincide best with winter seasonal ST, even though ST in summer corresponds well with the 5 to 7 year rhythms in the summer SAT time series. However, a number of rhythms in winter SAT and ST were not coincident for the West Siberian Plain, the eastern Central Siberian Plateau, and the territory east of the Lena River. Although we found increasing summer soil temperatures in the West Siberia Plain, we believe that this increase does not threaten the region's discontinuous permafrost. The annual ST increase was observed down to 160 cm only, and the permafrost table in this region is located at 100–200 m, and is overlain by deep layers of peat, which protect it against warming. A significant increase in annual ST is tracked down to 320 cm for the Central Siberian Plateau and Transbaikalia. Taking into account the total increase in SAT during entire 20th century over these territories, the maximum effect on permafrost should be expected here. The least soil warming between 1960 and 1990 for the territory east of the Lena River, occupied by low-temperature continuous permafrost. The proportion of trend-explained variance in annual ST there is considerably lower than in the other study regions, and the observed rise in ST was less than that found in the other regions. SAT in this region during the last temperature cycle did not exceed previous cyclic highs. We conclude that current warming will not result in degradation of permafrost in the region east of the Lena River.

Changes in the freeze–thaw cycle and permafrost dynamics, and their hydrological implications over the Russian Arctic

T. Zhang, R. Barry, O.W. Frauenfeld (NSIDC)

Seasonal freezing and thawing processes in cold regions play a major role in the Arctic hydrological system and in ecosystem diversity and productivity. Permafrost changes and seasonally frozen ground dynamics are also important indicators of climate change. We rescued long-term soil temperature records from Russian stations and derived active layer and seasonal freeze depths. Our analyses indicate that active layer depths have been steadily increasing over recent decades, with even greater decreases in seasonal freeze depth. In general, the seasonally frozen ground regions of the Russian high latitudes are more susceptible to climate change than the Russian permafrost regions.

ARCTIC AND SEA ICE

Book called "Sea Ice"

W. F. Weeks (w-f-weeks@comcast.net) Portland, Oregon

The above titled book, which is nearing completion, is a series of fairly detailed monographs on different aspects of the geophysics of sea ice. Currently 11 of the estimated 15 to 16 chapters are in initial draft form and are being reviewed. It is hoped to go to press by 2006.

Trends and extreme recent minima in Arctic sea-ice cover

M. Serreze, T.A. Scambos, F. Fetterer, J. Stroeve (NSIDC)

Over the past several decades, the Arctic sea ice cover has exhibited significant reductions in areal extent, primarily during late summer and autumn. Ongoing studies are examining the causes of this trend, with a particular focus on extreme recent minima such as seen in September of 2002 and 2003. These studies use ice concentration data set derived from passive microwave imagery, and fields from various atmospheric reanalysis efforts.

Assimilation of observed sea-ice motion vectors in sea-ice models

T. Arbetter, W.N. Meier, J. Maslanik (NSIDC)

Sea ice motion vectors can be derived on a daily basis from remotely-sensed passive microwave satellite observations and enhanced with drift-buoy observations. These motions are of a resolution (25km) much finer than the large-scale atmospheric analyses (1–2.5 degrees) typically used to force sea ice models. In the course of a model simulation, the observed ice motion vectors are blended with modelled ice motion via optimal interpolation to create a corrected solution that remains consistent with the model's momentum balance.

Snow on Arctic sea ice

S.G. Warren, I. Rigor, N. Untersteiner (UWA);
V. Radionov, N. Bryazgin, Ye. Aleksandrov (AARI); R. Colony (UAF)

Measurements of snow depth were made at Soviet drifting stations continuously from 1954 to 1991. They were analyzed to produce a monthly regional climatology (Warren et al, 1999: *J. Climate, 12*, 1814–1829).

Passive-microwave sea-ice concentration algorithm inter-comparison

W.N. Meier (NSIDC)

Several passive microwave sea ice concentration algorithms have been developed over the years. In this study, visible/infrared imagery from AVHRR was used to evaluate the performance of four commonly-used algorithms (NASA Team, Bootstrap, NASA Team 2, and Cal/Val) in the Barents Sea, Greenland Sea, and Baffin Bay. The year-long study, encompassing melt, freeze-up, and mid-winter conditions, indicates that Bootstrap and NASA Team 2 have the lowest biases and RMS errors overall. However, there is considerable day-to-day variability in the results depending on the local conditions. A major factor in the uncertainty of historical passive microwave sea ice concentrations from SSM/I can be attributed to the low spatial resolution of the sensor (25 km gridded). The advent of AMSR-E, with its higher spatial resolution and the use of the Bootstrap and NASA Team 2 algorithms for standard products should provide a substantial improvement in passive microwave sea ice concentration estimates.

Fluorometric profiling of Chlorophyll-A concentration in Arctic sea ice

D.P. Winebrenner, C. Krembs (UWA)

The phytoplankton chlorophyll concentration due to phytoplankton in aquatic systems can be estimated by means of direct water sampling and chemical analysis or by measuring the fluorescence of a water sample at appropriate excitation and emission wavelengths. Fluorometric estimation permits much finer sampling in space and time, and thus greatly facilitates studies of ecosystem dynamics. Such dynamics are of great interest in sea ice, but logistical difficulties greatly impede their study. We are developing fluorometric estimation and profiling of chlorophyll content in sea ice to address this problem, eventually using autonomous sensors. Scattering and absorption are much stronger in sea ice than in seawater (even turbid seawater), at both the excitation and emission wavelengths of chlorophyll. We find theoretically, however, that because scattering in sea near the ice/water interface is very highly forward scattering, fluorometer systems that employ short path lengths can used effectively in sea ice, with little or no change in calibration. Laboratory and initial field observations (acquired near Barrow, AK during 2003 and 2004) confirm this. These findings indicate that fluorometry can enable studies of seasonal dynamics of sea ice phytoplankton populations with depth resolutions on the order of millimetres and temporal resolutions of days to hours.

SEA-LEVEL CHANGE

Contribution to sea-level rise from fast-flowing glaciers in Greenland and Antarctica

Eric Rignot (JPL)

Using satellite radar interferometry from ERS-1/2 and Radarsat-1, combined with other data (laser altimetry from airborne surveys or ICESat, radio-echo sounding from airborne surveys or BEDMAP), we estimate the mass discharge of the largest glaciers draining the Greenland and Antarctic ice sheets and compare the results with the latest maps of snow accumulation and ice sheet topography to determine the ice sheet mass balance. To examine the impact of short-term fluctuations in velocity of these glaciers, glacier velocities of key glaciers (Pine Island, Thwaites, Totten, Lambert in Antarctica; Petermann, 79north, southeast Greenland and northwest Greenland) are investigated over several years using Radarsat-1. This project is funded by NASA Cryospheric Science Program.

ICE AND SNOW PROPERTIES

Grain growth and deformation in fine-grained ice

S.M. McDaniel (UWA, LANL), E.D. Waddington (UWA); K.A. Bennett (DOEBES); W.B. Durham (LLNL)

Recent laboratory research on fine-grain (2-10 micron) ice I_h suggests that ice may not always deform with a stress exponent of n=3. While dislocation creep is active during most deformation of ice sheets, glaciers, and planetary ices, other deformation mechanisms may also be active, and even dominant, at the same time. Recrystallization may reduce the average grain size. These smaller grains may deform predominantly by grain boundary sliding (GBS) and diffusion, a process labeled Grain-Size Sensitive creep (GSS). We conducted a two-pronged research program: 1) static annealing of fine-grain ice and 2) laboratory deformation of fine-grain ice. Our findings indicate that fine-grain ice grows in accordance with the law proposed by Tony Gow (1969). During deformation of ice at low deviatoric stress (< 0.1 MPa – conditions found in natural ice bodies) we found a combination of GSS and dislocation creep (and possibly other regimes) at temperatures (222–226 K) where GSS creep was expected to be clearly dominant. GBS does not produce a lattice preferred orientation (LPO) or grain growth), yet using neutron diffraction, we found a clear LPO. Improved understanding of the interactions among grain growth, grain-boundary migration, recrystallization, and deformation mechanisms, should improve future models of ice-sheet and glacier flow.

Robust estimation of ice-sheet fabric from thin sections

Throstur Thorsteinsson (UWA, SI);
E.D. Waddington (UWA) L. Wilen (OU);
G. Lamorey (DRI)

We have developed a new method that allows robust estimation of the probability-density distribution of crystal orientations in the underlying in-situ crystal populations, based on c-axis directions measured in thin sections from ice cores. Robust estimates retain only structures that are required by the data, given both measurement errors and statistics of limited sample sizes. Crystal-orientation distributions at different depths and sites can now be quantitatively compared, even when the number of measured crystals differs significantly. Further comparison of fabric strength, in terms of so-called cone angles, either inferred from measured sonic velocities in boreholes, or calculated from crystal fabric distributions, allows us to compare fabric-evolution model results with in-situ fabric data.

Radiative properties of ice crystals

T. Grenfell, S.G. Warren (UWA); S. Neshyba (UPS)

Models of radiative transfer in snow and ice clouds often represent all shapes of ice crystals as "equivalent spheres". A choice of equivalent spheres that preserves the surface-to-volume ratio is being examined for its accuracy as a function of crystal size and wavelength for various shapes. Results for hexagonal prisms have been published (Grenfell and Warren, 1999: *J. Geophys. Res., 104,* 31697–31709*;* Neshyba et al., 2003: *J. Geophys. Res, 108,* D15, 4448, doi:10.1029/2002JD003302.5). Computations for hollow crystals are underway.

Multi-resolution snow products for the hydrologic sciences
J. Dozier, J. Frew, J. C. Shi, UCSB; T. H. Painter (NSIDC)
Because most hydrologic applications require regular, frequent measurements, the instruments that provide the bulk of the data used have been AVHRR and MODIS in the optical part of the spectrum, with spatial resolutions of 1.1 km and 250 m at nadir, and the passive microwave sensors, with spatial resolutions of tens of kilometres. Because snow-covered area can vary at a spatial scale finer than that of the resolution of the remote sensing instrument, this subpixel heterogeneity introduces artefacts into the measurements. In areas of patchy snow cover, sensors measure radiation reflected or emitted from a mixture of snow, rock, soil, and vegetation. We are developing a new set of products – snow-covered area, albedo, and snow water equivalence - that fuse optical (MODIS, AVHRR) and microwave data (SSMR, SSM/I, AMSR-E) and that incorporate spatial heterogeneity into the analysis.

Radiative impacts of desert dust deposits in alpine snow
T. H. Painter (NSIDC); C. Landry (CSAS)
Albedo reduction by desert dust deposits in alpine snow in the mountains of the Western US remain unstudied despite frequent and regionally extensive dust deposition events. This project will investigate the radiative effects and frequency/magnitude of absorbing dust deposits to alpine snow surfaces in the San Juan Mountains of Colorado. Dust entrained from the Colorado Plateau is frequently deposited in snowfields of the San Juan Mountains of Colorado. Dust layers decrease the snow albedo and accelerate regional melt when the overlying snow layers melt to expose the dirty layers.

Forecasting direct-action avalanches during storms
H. Conway, Pam Hayes (UWA); H.-P. Marshall (CU)
We are developing a simplified model of the evolution of snow-slope stability during storms. The model (SNOSS) keeps track of the evolving gravitational stress imposed by the new snow and the strength of sub-surface layers. Avalanching is predicted when the stress from the overburden exceeds the strength of a buried weak layer; there is a competition between the rate of loading from new snowfall and the rate of strengthening of buried layers. SNOSS is particularly suited to operational applications because the required input data (hourly measurements of precipitation, air temperature and new snow density) are often routinely measured. Model development and verification is being done using data from Snoqualmie Pass in the Washington Cascades, USA, and Milford Road, New Zealand. Comparison of model results and observations indicate that the timing of direct-action avalanches is often predicted to within a few hours.

ABBREVIATIONS

(AAD)	Australian Antarctic Division
(AARI)	Arctic and Antarctic Research Institute, St. Petersburg
(AMES)	NASA Ames Research Center
(BMC)	Bryn Mawr College
(CECS)	Centro Estudios Cientificos, Valdivia, Chile
(CHS)	Cleveland High School, Portland OR
(CIRES)	Cooperative Institute for Research in Environmental Sciences
(CSAS)	Center for Snow and Avalanche Studies, CO
(CU)	University of Colorado, Boulder
(CVO)	USGS Cascade Volcano Observatory
(DOEBES)	U.S. Dept. of Energy Office of Basic Energy Science
(DRI)	Desert Research Institute, University of Nevada
(ESR)	Earth and Space Research, Corvallis OR
(GSFC)	NASA Goddard Space Flight Center
(INSTAAR)	Institute of Arctic and Alpine Research, University of Colorado
(IPhBPSS)	Institute of Physicochemical and Biological Problems in Soil Science, Pushchino, Russia
(LANL)	Los Alamos National Laboratory
(LLNL)	Lawrence Livermore National Lab
(JPL)	Jet Propulsion Lab, California institute of Technology
(LGGE)	Laboratoire de Glaciologie et Géophysique de l'Environnement
(MC)	Macalester College
(MIT)	Massachussets Institute of Technology
(NEW)	University of Newcastle upon Tyne, UK
(NSIDC)	National Snow and Ice Data Center
(PEN)	Pennsylvania State University
(PCC)	Portland Community College
(OSU)	Oregon State University
(OU)	Ohio University
(SI)	Science Institute, University of Iceland
(UAF)	University of Alaska Fairbanks
(UC)	University of Chicago
(UCSB)	University of California, Santa Barbara
(UCSD)	University of California, San Diego
(UID)	University of Idaho
(USGS)	U.S. Geological Survey
(UMD)	University of Maryland
(UNH)	University of New Hampshire
(UMT)	University of Montana
(UPS)	University of Puget Sound
(UTIG)	University of Texas Institute for Geophysics
(UWA)	University of Washington
(UWY)	University of Wyoming
(WDCC)	World Data Centre C for Glaciology

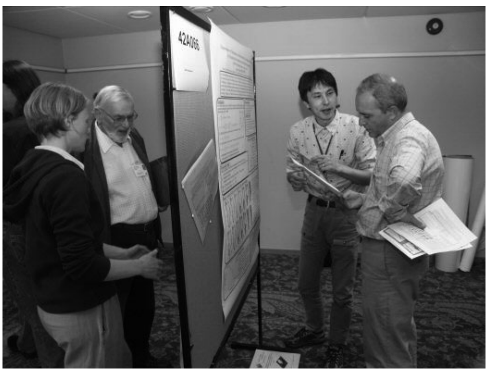
INTERNATIONAL GLACIOLOGICAL SOCIETY

A REPORT FROM THE GEILO SYMPOSIUM

23–27 August 2004, Bardøla Hotel, Geilo, Norway

There are two principal reasons for attending IGS symposia. One reason, of course, is to learn about the latest exciting scientific discoveries of our peers and colleagues. The other reason, perhaps less obvious, is to renew acquaintances and establish new friendships in a relaxed international setting. Last summer's International Symposium on Arctic Glaciology, held in the Norwegian mountain town of Geilo, was a winner on both counts.

For some participants, the social program began on the platform of Oslo Central Station where glaciologists gathered for the scenic four hour train journey to Geilo. The first official social event of the week, however, was the traditional icebreaker held on Sunday evening. Oddly enough for a group of glaciologists, the event was moved indoors because of cool temperatures! The icebreaker was memorable both for the food and for an announcement by our conference chairman, Jon Ove Hagen, regarding the number of free drinks participants were allowed. Jon Ove's beer and wine announcements became a regular feature of dinners during the week and, depending on the day, were met with either cheers or good-natured jeers!



Most evenings, groups of glaciologists lingered in the dining room after dinner. After sunset, which in summer in Norway is quite late, it was time to move upstairs to the hotel's bar. Someone must have heard the stories of late-night dancing at the Ice Cores and Climate Symposium in Kangerlussuaq a few years ago, because the hotel provided a dance band *every* night. Bill Krabill and his wife surely won the award for best looking couple on the dance floor. Actually, they were the only couple, but I am confident they would have still been winners had the competition been more intense. Other than dancing, the Olympics were usually showing on the bar's television but unless the Norwegian beach volleyball team was in action, most glaciologists preferred to hold their own competitions on the füssball and pool tables. If the IGS ever decides to award a Seligman Crystal for füssball, Andreas Ahlstrøm will be its inaugural winner! By the end of the week, most challengers were insisting that he play one-handed, facing backwards, wearing a blindfold. Sadly, that still was not enough to beat him.

The mid-symposium excursion happened to fall on the only cloudy, wet day of the week. Despite the conditions, nearly everyone piled on the train for the short ride up to Finse (1222 m). On arrival, some participants decided that a hike through mist and rain to Hardangerjøkulen might be better substituted with an afternoon in front of the fire at the Finse hotel's bar. Those that completed the hike, though, were rewarded with fine views (albeit of clouds), muddy clothes, and the spectacle of about a hundred glaciologists slipping and sliding their way across the sloping terminus of Midtdalsbreen!

The conference banquet was a fitting event to end the week. Jon Ove's announcement of the evening's beer and wine allowance was greeted with an enthusiastic cheer at the start of dinner. Between courses, our Secretary General, Magnús Magnússon, proposed that a participant from each nation represented at the meeting give a traditional toast from their home country. Thankfully Jon Ove's drink allowance managed to sustain a surprising number and variety of toasts. Chad Dick was somehow able to give three toasts, one each

for Scotland, Australia and New Zealand – immigration authorities from these countries are reportedly now examining his status! The toast of the night, though, probably gave Magnús more than he bargained for. Veijo Pohjola rose to give a Swedish toast, but instead of a simple “skål!” he, and the sizeable contingent of Swedes in the room, burst into song!

Jon Ove Hagen and the local organizing committee deserve our thanks for putting together a great meeting. A key factor in the social success of the symposium was the choice of venue. The Hotel Bardøla had everything a mountain resort hotel should have – warm hospitality, comfortable accommodation, a great atmosphere, and truly fabulous food. And, of course, a füssball table.

University of Maine Gordon Hamilton

A REPORT FROM THE GEILO POST SYMPOSIUM TOUR

Our three-day post symposium excursion was packed with adventure, scenic views, informative glaciology, interesting discussions, and lots of fun. Expertly led by Jon Ove Hagen and Nils Haakensen, the 11 of us representing 7 countries began with a ride on the Flaamsbanen, possibly the world’s only train with spiral tunnels cut into the walls of the steep valley it descends, and certainly the only one that lets everyone off for 10 minutes to be serenaded by melancholy mountain nymphs. In true Norwegian tradition, we

decided to get out of the warm and dry train and hike the last leg of the trip in the rain. The path led us through a beautiful, glacier-carved valley down to sea-level, with some of us taking a several kilometre off-piste excursion to visit some alleged potholes. After only minor injuries, we eventually found them, scoured deeply into the valley walls with any one of them large enough to hold the entire symposium inside. It was on this side-trip that we learned that Norwegian kilometres are not quite the same length as SI kilometres, as we had to jog the last several such kilometres not to miss the last ferry of the day that already had our baggage on board.

The ferry took us through a spectacular fiord, with steep cliffs covered by dozens of waterfalls plunging into the ocean, all thankfully visible from the warm and dry bar on board. After disembarking, we were surprised to learn that for the next two days we would be transported around the country inside a luxury bus, such that each person had 10 seats to themselves! So there was plenty of space for mingling and engaging in various conversations, and the fact that most of us were from different countries led to great opportunities for understanding cultural differences and similarities. For example, our first stop on the bus was the Norwegian Glacier Museum, which I think we unanimously agreed was the ugliest building in Norway, despite the interesting exhibits inside. Afterwards we spent a pleasant evening in the Hotel Mundal, stepping back in time 100 years and being treated to the scenic vista of yet another fiord from the steps of the hotel.

Over the next two days, though the weather was somewhat cloudy and rainy, we were able to see and visit Norwegian glaciers of all shapes and sizes. Many of these were fed from the Jostedalsbreen ice cap, the largest in Norway. There was plenty of time for small hikes and picture taking, while our guides shared their extensive knowledge of the history, research, and lore of most of these. Along the way we stumbled across a lichenometry field camp in the Jotunheimen where we got an impromptu lecture on the history of the local glaciers from John Matthews, visited permafrost terrain in perhaps the coldest and windiest place in Norway, walked on a glacier formed purely from avalanches from a hanging glacier above it, and toured the beautiful museum at Nigardsbreen, which got its name apparently during a little ice age advance when nine ("Ni") farms ("gards") were over-run by the glacier. By the end of the trip, it was clear to all of us that we had just experienced the best possible glacier tour of Norway (especially considering the excursion was cheaper than the symposium!), with the only complaint being that we could not continue it for another week. Thanks again to our guides!

Countries participating: US, Norway, England, Iceland, Canada, Japan, Switzerland

University of Alaska Matt Nolan

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JOURNAL OF GLACIOLOGY

Papers accepted for publication between 1 December 2004 and 30 June 2005. The papers are listed in alphabetical order by first author. Some of these papers have already been published.

Andreas P. Ahlstrom, Johan J. Mohr, Niels Reeh, Erik Lintz Christensen, Roger LeB. Hooke
Impact of enhanced surface melting on basal water pressure beneath the Greenland Ice Sheet margin assuming channelized drainage

Steven A. Arcone, Vandy B. Spikes, Gordon S. Hamilton
Stratigraphic variation in polar firn caused by differential accumulation and ice flow: interpretation of a 400-MHz short-pulse radar profile from West Antarctica

Min Song, Ian Baker, David M. Cole
The effect of particles on dynamic recrystallization and fabric development of granular ice during creep

S. Barwick, D. Besson, P. Gorham, D. Saltzberg
South Polar in situ radio frequency ice attenuation

Robert G. Bingham, Peter W. Nienow, Martin J. Sharp and Sarah Boon
Subglacial processes at a High Arctic polythermal valley glacier

Ed Bueler, Craig S. Lingle, Jed A. Kallen-Brown, David N. Covey, Latrice N. Bowman
Exact solutions and verification of numerical models for isothermal ice sheets

David O. Burgess, Martin J. Sharp, Douglas W.F. Mair, Julian A. Dowdeswell, Toby J.Benham
Flow dynamics and ice-berg calving rates of the Devon ice cap, Nunavut, Canada

G.A. Catania, H. Conway, C.F. Raymond, T.A. Scambos
Surface morphology and internal layer stratigraphy in the downstream end of Kamb Ice Stream, West Antarctica

Trevor Chinn, Clive Heydenrych and Jim Salinger
Is the ELA a practical substitute for mass-balance measurements? Findings from New Zealand's Southern Alps

Min Song, David M. Cole, Ian Baker
Creep of ganular ice with and without dispersed particles

Sarah B Das, Richard B Alley
Characterization and formation of melt-layers in polar snow: observations and experiments from West Antarctica

Ian S. Evans
Global variatinos of local asymmetry in glacier altitude: separation of north-south and east-west components

Arthur M. Greene
A time constand for hemispheric glacier mass balance

Daniela Jansen, Henner Sandhager, Wolfgang Rack
Model experiments on large tabular iceberg evolution

Kenneth C. Jezek, H.X. Liu, R. H. Thomas, S. Gogineni, W. Krabill
Structure of Eastern Antarctic Peninsula ice shelves and ice tongues from syhthetic aperture radar imagery

Jerome B. Johnson, Mark A. Hopkins
Identifying microstructural deformation mechanisms using discrete element modeling

Charles A. Knight
An exploratory study of ice cube spikes

Bernd Kulessa, Bryn Hubbard, Mike Williamson, Giles H. Brown
Hydrogeological analysis of slug tests in glacier boreholes

Eric M. Leonard, Peter Staab, Stephen G. Weaver
Kinematics of Spruce Creek Rock Glacier, Colorada

M.C. Morel Fourcade, J.-M. Barnola, J. Susini, R. Baker, G. Durand, M. de Angelis, P. Duval
Application of micro X-ray flourescence to chemical mapping of polar ice

Thomas A. Neumann, Edwin D. Waddington, Eric J. Steig, Pieter M. Grootes
Non-climate influences on stable isotopes at Taylor Mouth, Antarctica

Charles Raymond, Thomas Neumann, Eric Rignot, Keith Echelmeyer, Andres Rivera, Gino Casassa
Retreat of Tyndall Glacier, Patagonia, over the past half century

D. Steiner, A. Walter, H.J. Zumbuhl
The application of a nonlinear backpropagation neural network to study the mass balance of the Great Aletsch Glacier

Anahita A. Tikku, Robin E. Bell, Michael Studinger, Garry K.C. Clarke, Ignatzio Tabbaco, Fausto Ferraccioli
Influx of meltwater to subglacial Lake Concordia, East Antarctica

HP Jacobson and ED Waddington
Recumbant folding of divide arches in response to unsteady ice-divide migration

C.L. DiPrinzio, L.A. Wilen, R.B. Alley, J.J. Fitzpatrick, M.K. Spencer, A.J. Gow
Fabric and texture at Siple Dome, Antarctica

Eric W. Wolff, Eliza Cook, Piers R.F. Barnes, Robert Mulvaney
Signal variability in replicate ice cores

V. Zagorodnov, LG Thompson, P Ginot, V Mikhalenko
Instruments and Methods: Intermediate depth ice coring of high altitude and polar glaciers with a light-weight drilling system

ANNALS OF GLACIOLOGY, VOLUME 41

The following papers from the SCAR28 International Symposium on ITASE and ISMASS held in Bremen, Germany, 27–28 July 2004, have been accepted for publication in *Annals of Glaciology* Vol. 41, edited by Gordon S. Hamilton**:**

Arcone, S.A., V.B. Spikes, G.S. Hamilton
Phase structure of radar stratigraphic horizons within Antarctic firn

Benassai, S., S. Becagli, R.Gragnani, O. Magand, M. Proposito, I. Fattori, R.Traversi, R. Udisti
Sea spray deposition in Antarctic coastal and plateau areas from ITASE traverses

Bertler, N., P.J. Barrett, P.A.Mayewski, S.B. Sneed, T.R.Naish, U. Orgenstern
Solar forcing recorded by aerosol concentrations in coastal Antarctic glacier ice, McMurdo Dry Valleys

Dixon, D., P.A. Mayewski, S.D. Kaspari, K.J. Kreutz, G.S. Hamilton, K. Maasch, S.B. Sneed, M.J. Handley
A 200-year sulfate record from sixteen Antarctic ice cores and associations with Southern Ocean sea ice extent

Eisen, O., W. Rack, U. Nixdorf, F. Wilhelms
Characteristics of accumulation rate in the vicinity of the EPICA deep-drilling site in Dronning Maud Land, Antarctica

Gallee, H., V. Peynaud, I. Goodwin
Simulation of the net snow accumulation along the Wilkes Land transect, Antarctica, with a regional climate model

Hamilton, G.S., V.B. Spikes, L.A. Stearns
Spatial patterns in mass balance of the Siple Coast and Amundsen Sea Basin, West Antarctica

Jacobel, R. & B. Welch
A time marker at 17.5 KYBP detected throughout West Antarctica

Kaspari, S.D., P.A. Mayewski, D.A. Dixon, S.B. Sneed, M.J. Handley
Sources and transport pathways of marine aerosol species into West Antarctica

Lange, M.A., N. Blindow, K. Grosfeld, T. Kleiner, C.-O. Mohrholz, M. Nicolaus, C. Oelke, B. Paschke, H. Sandhäger, M. Thoma
Numerical model studies of Antarctic ice sheet-ice shelf-ocean systems and ice caps

Mayewski, P.A., K.A. Maasch, Y. Yan, S. Kang, E.A. Meyerson, S.B. Sneed, S.D. Kaspari, D.A. Dixon, E.C. Osterberg, V.I. Morgan, T. van Ommen, M.A.J. Curran
Solar forcing of the polar atmosphere data, mechanism, and implications

Patterson, N.G., N.A.N. Bertler, T.R. Naish, U. Morgenstern
ENSO variability in the deuterium excess record of a coastal Antarctic ice core from the McMurdo Dry Valleys, Victoria Land

Rivera, A., G. Casassa, R.H. Thomas, E. Rignot, R. Zamora, D. Antúnez, C. Acuña, F. Ordenes
Glacier wastage on southern Adelaide Island and its impact on snow runway operations

Schneider, D.P., E.J. Steig, T. Van Ommen
High resolution ice core stable isotopic records from Antarctica: towards interannual climate reconstruction

Stearns, L.A. and G.S. Hamilton
A new velocity map for Byrd Glacier, East Antarctica from sequential ASTER satellite imagery

Steig, E.J., P.A. Mayewski, D.A. Dixon, S.D. Kaspari, M.M. Frey, D.P. Schneider, S. A. Arcone, G.S. Hamilton, V.B. Spikes, M. Albert, D. Meese, A.J. Gow, C.A. Shuman, J.W.C. White, S.B. Sneed, J. Flaherty, M. Wumkes
High-resolution ice cores from US ITASE (West Antarctica): development and validation of chronologies and determination of precision and accuracy

Turner, J., T. Lachlan-Cope, S. Colwell, G.J. Marshall
A positive trend in western Antarctic peninsula precipitation over the last 50 years reflecting regional and Antarctic-wide atmospheric circulation changes

Van de Berg, W.J., M.R. van den Broeke, C.H. Reijmer, E. van Meijgaard
Characteristics of the Antarctic surface mass balance (1958-2002) using a regional atmospheric climate model

Van den Broeke, M., C. Reijmer, D. van As, R. van de Wal, J. Oerlemans
Seasonal cycle of the Antarctic surface energy balance using data of Automatic Weather Stations

Welch, B. and R. Jacobel
Bedrock topography and wind erosion sites in East Antarctica, observations from the 2002 US–ITASE traverse

Yan, Y., P.A. Mayewski, S. Kang, E.A. Meyerson
An ice core proxy for Antarctic circumpolar zonal wind intensity

ANNALS OF GLACIOLOGY, VOLUME 42

The following papers from the International Symposium on Arctic Glaciology held at Geilo, Norway 23–27 August 2004 have been accepted for publication in *Annals of Glaciology* Vol. 42, edited by J.A. Dowdeswell and I.C. Willis**:**

Guðfinna Aðalgeirsdóttir, Helgi Björnsson, Finnur Pálsson and Eyjólfur Magnússon
Analyses of a surging outlet glacier of Vatnajökull ice cap, Iceland

Liss M. Andreassen, Hallgeir Elvehøy, Bjarne Kjøllmoen, Rune V. Engeset and Nils Haakensen
Glacier mass balance and length variation in Norway

Hernán De Angelis and Johan Kleman
Paleo-ice streams in the northern Keewatin sector of the Laurentide ice-sheet

I. Baker, D. Iliescu, R. Obbard, H. Chang, B. Bostick and C.P. Daghlian
Microstructural characterization of ice cores

Jonathan Bamber, William Krabill, Vivienne Raper and Julian Dowdeswell
Interpretation of elevation changes on Svalbard glaciers and ice caps from airborne lidar data

H. Björnsson, S. Gudmundsson and F. Pálsson
Katabatic winds on Vatnajökull ice cap, Iceland and their impact during warmer climate

J. E. Box
Greenland ice sheet surface mass balance variability: 1991–2003

Roger J. Braithwaite
Mass balance characteristics of Arctic glaciers

Ola Brandt, Helgi Björnsson and Yngvar Gjessing
Mass balance rates derived by mapping internal tephra layers in Mýrdalsjökull and Vatnajökul ice caps, Iceland

Ian A. Brown, Per Klingbjer and Andy Dean
The effect of mass balance changes on SAR backscatter: a case study from two Arctic glaciers

Keith A. Brugger, Kurt A. Refsnider and Matthew F. Whitehill
Variation in glacier length and ice volume of Rabots Glaciär in response to climate change, 1910–2003

Guy.H.K. Calluy, H. Björnsson, J.W. Greuell and J. Oerlemans
Estimating the mass balance of Vatnajökull from NOAA-AVHRR imagery

David Chandler, Richard Waller and William Adam
Basal ice motion and deformation at the ice sheet margin, West Greenland

Mattias de Woul and Regine Hock
Static mass balance sensitivity of Arctic glaciers and ice caps using a degree-day approach

Rune V. Engeset, Thomas Schuler and Miriam Jackson
Jökulhlaup at Blåmannsisen, northern Norway: the first event and future risk

D. Fritzsche, R. Schütt, H. Meyer, H. Miller,
F. Wilhelms, and L.M. Savatyugin.
Late Holocene ice core record from Akademii Nauk ice cap, Severnaya Zemlya, Russian Arctic

Thomas Geist, Hallgeir Elvehøy, Miriam Jackson and Johann Stötter
Airborne laser scanning technology as a tool for evaluating volume changes – case study Engabreen, Norway

Mariusz Grabiec
Attempt of estimation of the snow accumulation on the glaciers of Svalbard on the basis of standard observation at weather stations

Wouter Greuell and Johannes Oerlemans
Assessment of the surface mass balance along the k-transect (Greenland ice sheet) from satellite-derived albedos

Ralf Greve
Relation of measured basal temperatures and the spatial distribution of the geothermal heat flux for the Greenland ice sheet

Jon Ove Hagen, Trond Eiken, Jack Kohler and Kjetil Melvold
Geometry changes on Svalbard glaciers - mass balance or dynamic response?

Richard Hodgkins, Richard Cooper, Jemma Wadham and Martyn Tranter
Topographic Controls on the Spatial Distribution of Winter Accumulation at a High-Arctic Glacier (Finsterwalderbreen, Svalbard)

Andy Hodson, Jack Kohler and Moana Brinkhaus
Water and energy balance of a maritime High Arctic glacier: multi-year observations from Midre Lovenbreen, Svalbard

Per Holmlund , Peter Jansson and Rickard Pettersson
A re-analysis of the 58 year mass balance record of Storglaciären, Sweden

Elisabeth Isaksson, Teija Kekonen, John Moore and Robert Mulvaney
The methanesulphonic acid (MSA) record in a Svalbard ice core

Miriam Jackson, Ian A. Brown and Hallgeir Elvehøy
Velocity measurements on Engabreen

Christian Jaedicke and Peter Gauer
The influence of drifting snow on the location of glaciers on western Spitsbergen

J. Jania, Yu. Macheret, F. Navarro, A. Glazovsky,
E. Vasilenko, J. Lapazaran, P. Glowacki, K. Migala,
A. Balut and B.A. Piwowar
Temporal changes in the radiophysical properties of a polythermal glacier in Spitsbergen

Peter Jansson and Hans W. Linderholm
Constraints on latitudinal climate forcing of mass balances of Scandinavian glaciers from combined glacier and tree-ring studies

Andreas Kääb, Bernard Lefauconnier and Kjetil Melvold
Flow field of Kronebreen, Svalbard, using repeated Landsat7 and ASTER data

Roy M. Koerner
Mass balance of glaciers in the Queen Elizabeth Islands, Nunavut, Canada

Yuriy M. Kononov, Maria D. Ananicheva and Ian C. Willis
The millennium dynamics of Polar Ural glaciers by high resolution reconstruction of glacier mass balance

M.O.Leibman, S.M.Arkhipov, D.D.Perednya,
A.S.Savvichev B.G.Vanshtein and H.-W.Hubberten
Geochemical properties of the water-snow-ice complexes in the area of Shokalsky glacier, Novaya Zemlya archipelago

Christoph Mayer and Thomas Schuler
Breaching of an ice-dam at Qorlortossup tasia, South Greenland

K.M. McKinzey, J.F. Orwin and T. Bradwell
A revised chronology of key Vatnajökull outlet glaciers during the little ice age

Atsushi MIYAMOTO, Hitoshi SHOJI, Akira HORI, Takeo HONDOH, Henrik B. Clausen and Okitsugu WATANABE
Ice fabrics evolution processes under various deformation conditions revealed by X-ray crystallographic analyses

F. Navarro, A. F. Glazovsky, Yu. Ya. Macheret,
E.V. Vasilenko, M.I. Corcuera and M.L. Cuadrado
Structure, dynamics and ice volume changes of Aldegondabreen (Spitsbergen) during 1936–1990

Anna Nelson, Ian Willis and Colm O'Cofaigh
Evidence for subglacial sediment deformation and sliding beneath the surge-type glacier, Brúarjökull, Iceland

Matt Nolan, Bernhard Rabus and Larry Hinzman
Volume change of McCall Glacier, Arctic Alaska, from 1956 to 2003

Anne-Marie Nuttall, Richard Hodgkins and Adrian Fox
Long-term dynamics of Finsterwalderbreen, a Svalbard surge-type glacier.

J. Oerlemans and F.M. Nick
A minimal model of a calving glacier

Frank Paul and Andreas Kääb
Challenges for glacier inventorying from multispectral satellite data in the Canadian Arctic: Cumberland Peninsula, Baffin Island

Vivienne Raper, Jonathan Bamber and William Krabill
Interpretation of the anomalous growth of Austfonna, Svalbard, a large Arctic ice cap

L. A. Rasmussen and H. Conway
Influence of upper-air conditions on glaciers in Scandinavia

Niels Reeh, David A. Fisher, Roy M. Koerner and Henrik B. Clausen
An empirical firn-densification model comprising ice lenses

Kunio Rikiishi, Hideaki Ohtake and Yurika Katagiri
The role of atmospheric circulation in the growth of sea ice fields in marginal seas around the Arctic Ocean

Kunio Rikiishi and Shinya Takatsuji
Interannual variation in the sea ice extent in the Sea of Okhotsk with special reference to its negative correlation with the sea ice extent in the Bering Sea

David Rippin, Ian Willis and Neil Arnold
Annual and seasonal patterns of velocity and strain across the tongue of the polythermal glacier Midre Lovenbreen, Svalbard

Cecilie Rolstad and Johannes Oerlemans
The residual method for determination of the turbulent exchange coefficient applied on automatic weather station data from Iceland, Switzerland, and West Greenland

Fuyuki Saito and Ayako Abe-Ouchi
Dependence of simulation and sensitivity of Greenland ice sheet to numerical procedures for ice sheet dynamics

Thomas Schuler, Regine Hock, Miriam Jackson, Hallgeir Elvehøy, Matthias Braun, Ian Brown and Jon-Ove Hagen
Distributed mass balance and climate sensitivity modelling of Engabreen, Norway

T. Schuler, K. Melvold and J.O. Hagen
Assessing the future evolution of meltwater intrusions into a mine below Gruvefonna, Svalbard

I.K. Seierstad, J. Olsen, B.M. Vinther and S.J. Johnsen
The timespan of the Bølling-Allerød period in the GRIP ice core

Abha Sood
Fresh water discharge from Greenland using regional climate simulations

Leigh Stearns, Gordon Hamilton and Niels Reeh
A 35-year record of ice dynamics on a large East Greenland outlet glacier: Daugård-Jensen Gletscher

Daniel Steinhage, Olaf Eisen and Henrik Brink Clausen
Regional and temporal variation of accumulation around North-GRIP derived from ground based ice-penetrating radar

Graham Stuart, Tavi Murray, Alex Brisbourne, Peter Styles and Sam Toon
Seismic emissions from a surging glacier: Bakaninbreen, Svalbard

R. Thomas, E. Frederick, W. Krabill, S. Manizade, C. Martin and A..Mason
Elevation changes on the Greenland ice sheet from comparison of aircraft and ICESAT laser altimeter data

IGS BRITISH BRANCH ANNUAL MEETING 2005

The 30th annual meeting of the British Branch of the International Glaciological Society will be held at Northumbria University, Newcastle upon Tyne on **Wednesday 14th and Thursday 15th September 2005.** Papers on all aspects of the cryosphere are invited for oral and poster presentation.

A conference of the Environmental and Industrial Geophysics Group (EIGG) of the Geological Society will then be held at the same venue on **Friday 16th September 2005** on the *'Geophysics of glacial and frozen materials'*.

This day conference aims to bring together the leading UK near-surface geophysical and glaciological communities (and of course all other interested scientists and practitioners worldwide!). Characterizing the properties of and processes in glacial and frozen materials unites scientists and practitioners from many different disciplines. Both 'deeper-earth' and 'near-surface' geophysical methods have lead to exciting discoveries and advances in the past, and promise to do so increasingly in the future. This conference will emphasise past, present and future geophysical applications in characterising the properties of and processes in glacial and frozen materials.

If you have any queries regarding either conference please don't hesitate to John Woodward. If your query is related to the EIGG meeting you may also wish to contact Bernd Kulessa who is convening this day meeting (**b.kulessa@qub.ac.uk** or 02890 974746). Please inform any interested colleagues or new postgraduates of the dates of the Northumbria meeting (and ask them to e-mail us to receive future postings).

We look forward to seeing you at Northumbria.

Dr John Woodward
Division of Geography
Northumbria University

Dr Bernd Kulessa
School of Civil Engineering
Queen's University Belfast

IGS NORDIC BRANCH ANNUAL MEETING 2005

The annual meeting of the Nordic Branch of the International Glaciological Society will be held at the Geocenter Copenhagen, Denmark, from Thursday to Saturday, 3–5 November, 2005.

The IGS Nordic Branch Meeting will provide a informal venue for Nordic based glaciologists and glaciology students to present their latest results and projects and aims to stimulate discussion and networking among the participants. Students and young researchers are especially encouraged to present their work.

If you might be interested in participating, send an e-mail to Andreas Ahlstrøm (aa@oersted.dtu.dk) to receive further information on the meeting program and suggestions for accommodation. This information will also appear on our web site

http://server.oersted.dtu.dk/igsnb/

INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL SYMPOSIUM ON EARTH AND PLANETARY ICE–VOLCANO INTERACTIONS

Reykjavík, Iceland
19–23 June 2006

Earth & Planetary
Ice-volcano interactions

Reykjavík, Iceland June 19 - 23, 2006

CO-SPONSORED BY

Icelandic Glaciological Society
Science Institute, University of Iceland
Icelandic Meteorological Office
Landsvirkjun
The National Energy Authority
Nordic Volcanological Center
The Icelandic Road Authority

FIRST CIRCULAR

April 2005

Registered Charity

The International Glaciological Society will hold an International Symposium on Earth and Planetary Ice–Volcano Interactions in 2006. The symposium will be held in Reykjavík, Iceland, with registration on 18 June and sessions from 19 to 23 June 2006.

THEME

Ice-covered volcanoes pose many interesting challenges to scientists. Numerous interesting phenomena arise from the thermal interaction between hot volcanic materials and ice, here on Earth and elsewhere in the Solar System; examples include the triggering of jökulhlaups, the effect of internal layers of volcanic origin on radar signals, and the relationship between older subglacially erupted volcanoes and the glaciers in which they formed. Furthermore, ice–volcano interactions may cause major hazards such as lahars, jökulhlaups, and explosive eruptions. An improved understanding of these topics can only be advanced through multidisciplinary research, drawing together such diverse fields as remote sensing, fieldwork, and modeling. This symposium provides a forum for researchers from a variety of backgrounds to discuss the science of interactions of volcanoes and ice.

TOPICS

The suggested topics include:

1. Effects of ice cover on volcanic systems:
    a. Extraction of heat from magma to meltwater: subglacial and supraglacial melting
    b. The effect of glacier overburden and water pressure on volcanic activity, seismic activity and subglacial geothermal systems
    c. Older subglacially formed volcanoes as evidence for past ice cover thickness and extent
2. Effects of geothermal and volcanic systems on glaciers and ice caps:
    a. Mass balance (subglacial melting, the effect of tephra on albedo)
    b. The effect of subglacial geothermal activity and eruptions on glacier flow
    c. Effects on the atmosphere and the ocean
    d. Subglacial lake studies
3. Geophysical exploration of ice-covered volcanoes:
    a. Looking through the ice (radio echo soundings, etc.)
    b. Detection of subglacial geothermal activity (surface depressions; chemicals in meltwater)
4. Information from internal acid layers and tephra layers:
    a. On volcanic activity
    b. On mass balance
5. Volcano–glacier hazards:
    a. Monitoring of ice-covered volcanoes and geothermal areas (inflation of volcanoes, seismicity, meltwater chemistry, thermal activity, lake levels)
    b. Jökulhlaups, lahars
6. Extraterrestrial ice–volcano interaction

SESSIONS

Oral presentations will be held on four full days and one half-day. There will be ample opportunity for poster displays.

PUBLICATION

Selected papers from the symposium will be published by the Society in the *Annals of Glaciology*. All papers (including those based on posters) will be refereed and edited according to the Society's regular standards before being accepted for publication.

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.

SYMPOSIUM ORGANIZATION

Magnús Már Magnússon (International Glaciological Society)

SCIENCE STEERING AND EDITORIAL COMMITTEE

Garry K.C. Clarke, Chief Scientific Editor; John Smellie, Assistant Chief Scientific Editor

LOCAL ARRANGEMENTS COMMITTEE

Þröstur Þorsteinsson (Chairman), Helgi Björnsson, Bryndís Brandsdóttir, Magnús T Guðmundsson, Hreinn Haraldsson, Tómas Jóhannesson, Matthew Roberts., Freysteinn Sigmundsson, Óli Grétar Blöndal Sveinsson, Þorsteinn Þorsteinsson

WCRP CLIMATE AND CRYOSPHERE (CliC), IUGG – COMMISSION FOR CRYOSPHERIC SCIENCES (IUGG – CCS) and INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL SYMPOSIUM ON CRYOSPHERIC INDICATORS OF GLOBAL CLIMATE CHANGE

Cambridge, UK
21–25 August 2006

FIRST CIRCULAR
March 2005

Registered Charity

The International Glaciological Society will hold an International Symposium on Cryospheric Indicators of Global Climate Change in 2006. The symposium will be held in Cambridge, England, with registration on 20 August, and sessions from 21–25 August.

THEME

The cryosphere, consisting of snow cover, sea-, lake- and river-ice, glaciers, ice caps and ice sheets, and frozen ground including permafrost, is a fundamentally important part of the global climate system. Many components of the cryosphere respond sensitively and very visibly to climate changes. Cryospheric changes provide important information about past climatic conditions in regions where other climate observations are sparse, and they have significant implications for global sea level, regional water resources and both terrestrial and aquatic ecosystems. Feedbacks between the cryosphere and other components of the climate system play a key role in how the climate system evolves over time. In situ observations, remote sensing, the analysis of proxy records and numerical modelling all contribute to understanding the dynamics of cryospheric change and cryosphere/climate interactions. Building on the foundation laid by the 1st CliC International Science Conference, held in Beijing in April 2005, this symposium will promote discussion of the evidence for changes in all components of the global cryosphere, their interdependence and causes, our current ability to model these changes, and what they tell us about changing global climate.

TOPICS

The suggested topics include:

1. Observed historical changes in the cryosphere.
2. Processes that lead to changes in the cryosphere and how these make interpretation difficult.
3. Actual records of climate in cryospheric regions, and their relation to changes in the cryosphere, including statistical/model interpretation.
4. Extension of climate records back in time, using observations of cryospheric changes.
5. Synthesis of records by geographical region, and ultimately globally.
6. Linkage of historical cryospheric records to palaeo-records of climate.
7. Modelling of all of the above. How well do models capture the observed changes?

SESSIONS

Oral presentations will be held on three and a half days. There will be ample opportunity for poster displays.

WORKSHOPS

Two half days will be dedicated to workshops

PUBLICATION

Selected papers from the symposium will be published by the Society in the *Annals of Glaciology*. All papers (including those based on posters) will be refereed and edited according to the Society's regular standards before being accepted for publication.

ACCOMMODATION

The Local Organizing committee has made a block booking for accommodation at Downing College. We can only guarantee accommodation in Downing if you commit to it 180 days prior to the start of the symposium (22 February, 2006). Further 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. 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.

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NEWS

International Commission on Snow and Ice (ICSI) superseded by IUGG/Commission for Cryospheric Sciences

At the XXIV International Union of Geodesy and Geophysics (IUGG) General Scientific Assembly in Perugia, the formation of the International Association of Cryospheric Sciences (IACS) is planned from the current Union Commission for the Cryospheric Sciences (IUGG/CCS). The IACS will become the eighth association of the IUGG.

The IUGG/CCS is and IACS will be a non-governmental organisation within the International Council for Science (ICSU)/IUGG structure. The organisation is open to all with an interest to further the cryospheric sciences and is without formal individual membership.

For decades several attempts have been made by the International Commission on Snow and Ice (ICSI) to promote all Cryospheric Sciences and to elevate the study of the Cryosphere to a more prominent position within the IUGG, from a Commission within the International Association of Hydrological Sciences (IAHS) to a separate Association under IUGG. In the last year we have met strong support and encouragement from the IUGG itself as well as from its Associations, particularly from IAHS to achieve this goal. This enabled the bureau of ICSI to put forward a proposal to the IUGG board during its Boulder meeting in 2004 for why the formation of a new Association for the Cryospheric Sciences should be formed. This work was lead by the now Past-President Gerry Jones and the current President Georg Kaser with much help from the entire CCS bureau as well as from the secretary of the IUGG, Jo Ann Jocelyn and the NSIDC director Roger Barry. The result of our efforts resulted in a strong vote within the IUGG governing body to consider a new Association by 2007, in conjunction with the IUGG Assembly in Perugia. In the mean time it was decided that a new commission called the Union Commission for the Cryospheric Sciences should be formed. This is the IUGG/CCS which has now formally replaced ICSI, which in turn therefore no longer exists. The IUGG/CCS is organized directly under IUGG and is not a part of the IAHS. To further the close and natural contacts that exist between the Cryospheric Sciences and the IAHS a new commission has formed under IAHS called the Commission for Snow and Ice Hydrology (ICSIH). Close contacts will of course remain between IUGG/CCS and its former mother organization IAHS, including its other Commissions, as well as with other Associations.

IUGG/CCS has the following goals:

– to promote studies of cryospheric systems of the Earth and other bodies of the solar system and of the interplanetary medium;
– to encourage research in the above subjects by members of the cryospheric community, national and international institutions and programmes, and individual countries through collaboration and international co-ordination;
– to provide an opportunity on an international basis for discussion and publication of the results of the above research;
– to promote education and public awareness on the cryosphere;
– to facilitate the standardisation of measurement or collection of data on cryospheric systems and of the analysis, archiving and publication of such data.

For information on IUGG/CCS/IACS, its activities, and contact information to commission officers please visit the IUGG/CCS web-site: www.glaciology.su.se/ICSI. IUGG/CCS, through its commitment to further the Cryospheric sciences, wishes close contacts with the Cryospheric community in order to best serve the community.

BOOKS RECEIVED

Ute C. Hertzfeld. 2004. *Atlas of Antarctica: topographic maps from geostatic analysis of satellite radar altimeter data.* Springer - Verlag Berlin Heidelberg New York. xvi+364 pp. 169 illus. 5 tables. With CD -ROM(ISBN 3-540-43457-7 (hardcover), £115.50, (US$ 159, EUR€ 149.95, SFR 254))

Roger LeB. Hooke. 2005. *Principles of Glacier mechanics.* Second edition. Cambridge University Press. xviii+429 pp. (ISBN 0-521-54416-5 (paperback), £35 (US$ 65); 0-521-83609-3 (hardcover), £75 (US$ 120))

John D. Castello and Scott O. Rogers. 2005. *Life in ancient ice.* Princeton University Press. 336 pp. 71 illus. 27 tables. (ISBN 0-691-07475-5 (hardcover) £45)

Matti Leppäranta. 2005. *The drift of sea ice.* xiii+266 pp. (ISBN 3-540-40881-9 (hardcover), £77. (€ 99.95, SFr 169, US$ 119)).

Colin J. Burrows. 2005. *Julius Haast in the Southern Alps*. Canterbury University Press. 215 pp. (ISBN 1-877257-08-7 (hardcover) NZ$49.95)

GLACIOLOGICAL DIARY

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2005

2–11 August 2005
IAMAS General Assembly. Beijing, China
Web: http://www.iamas.org/

Workshop on Glacier Mass Balance and its Coupling to Atmospheric Circulation
Principal Convener: Prof. Peter Jansson, University of Stockholm, Sweden; Secretary of ICSI. E-mail: peter.jansson@natgeo.su.se

Workshop on Mountain Snow and Ice Cover
Principal Convener: Paul Foehn, Swiss Federal Institute for Snow and Avalanche Research SLF, E-mail: foehn@slf.ch

Workshop on Modelling Forest Snow Processes
Principal Convener: Richard Essery, Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth
E-mail: rie@aber.ac.uk

23–27 August 2005
* Conference on Glacial Sedimentary Processes and Products, Aberystwyth, UK
Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth SY23 3DB, UK
Email: Michael Hambrey mjh@aber.ac.uk,
Neil Glasser nfg@aber.ac.uk,
Bryn Hubbard byh@aber.ac.uk

1–10 September 2005
The 11th International Conference and Field Trip on Landslides (CFL), Norway
E-mail: icfl05@ivt.ntnu.no
Web: www.ivt.ntnu.no/ICFL05

5–9 September 2005
** International Symposium on High-elevation Glaciers and Climate Records, Lanzhou, People's Republic of China
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

14–15 September 2005
* IGS British Branch Annual Meeting 2005
Division of Geography, Northumbria University
Web: http://northumbria.ac.uk/sd/academic/sas/gem/bbgis/

16 September 2005
Environmental and Industrial Geophysics Group, The Geological Society
GEOPHYSICS OF GLACIAL AND FROZEN MATERIALS
Division of Geography, Northumbria University
web: http://northumbria.ac.uk/sd/academic/sas/gem/bbgis/

13–24 September 2005
5th Karthaus Summer Shool on Ice Sheets and Glaciers in the Climate System. Karthaus, northern Italy.
Contact: Johannes Oerlemans
E-mail: j.oerlemans@phys.uu.nl
Web: http://www.phys.uu.nl/%7Ewwwimau/education/summer school/

24–29 September 2005
Polar Regions and Quaternary Climate Euro-Conference – toward an Integrative View of Climate in Antarctica and Circum-Antarctic Regions. An ESF Research Conference held at Acquafredda di Maratea (near Naples), Italy.
Contact: Ms. Anne-Sophie Gablin
E-mail: asgablin@esf.org
web: http://www.esf.org/esf_genericpage.php?section=10&language=0&genericpage=2183&shortcut=1

1–5 October 2005
Open Science Conference: Global Change in Mountain Regions.
Perth, Scotland, UK
Web: http://www.mountain.conf.uhi.ac.uk/

10–14 October 2005
Third International Conference on the Oceanography of the Ross Sea, Antarctica, Venice, Italy
Jane Frankenfield Zanin, CNR-ISMAR (Istituto di Scienze Marine), San Polo 1364, 30125 Venezia, Italy
Email: jane.frankenfield@ve.ismar.cnr.it

17–18 October 2005
Evolution of the Antarctic ice sheet: new understanding and new challenges
A Discussion Meeting organised by the Royal Society.
The meeting will be held at Society's London offices at Carlton House Terrace
Web: http://www.royalsoc.ac.uk/event.asp?id=1834&month=10,2005

3–5 November 2005
* IGS Nordic Branch Annual Meeting 2005
Geocenter Copenhagen, Denmark
Contact: Andreas Ahlstrøm
E-mail: aa@oersted.dtu.dk
Web: http://server.oersted.dtu.dk/igsnb/

5–9 December 2005
** International Symposium on Sea Ice, New Zealand
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

5–9 December 2005
AGU Fall meeting – Several cryospheric sessions are planned
American Geophysical Union, San Francisco, CA, USA
E-mail: fm-help@agu.org (subject: 2005 Fall Meeting)
Web: http://www.agu.org/meetings/fm05/

2006

6–10 February 2006
GLIMS workshop
Twizel, New Zealand
Contact: Shulamit Gordon, s.gordon@antarcticanz.govt.nz AND Jeff Kargel Kargel@hwr.arizona.edu)

19–23 June 2006
** International Symposium on Earth and Planetary Ice-Volcano interactions. Reykjavík, Iceland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

7–9 August 2006
Asian Permafrost Conference
Lanzhou, China
Web: http://www.casnw.net/permafrost/

21–25 August 2006
* International Symposium on Cryospheric Indicators of Global Climate Change
A joint CliC/IGS/ICSI Symposium
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

4–8 September 2006
* III International Symposium on Avalanches and Related subjects.
The contribution of theory and practice to avalanche safety
Kirovsk, Murmansk region, Russia
Contact: Pavel Chernous at PChernous@apatit.com

2007

2–13 July 2007
24th General Assembly of the International Union of Geodesy and Geophysics, titled Earth Our Changing Planet, in Perugia, Italy.
Web: http://www.iugg2007perugia.it/

2008

23–27 June 2008
9th International Conference on Permafrost Celebrating the 25th Anniversary of the formation of the International Permafrost Association
University of Alaska Fairbanks, Fairbanks, Alaska, USA
Web: http://www.nicop.org/

NOTES FROM THE PRODUCTION TEAM

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We hope you like the new look Journal and Annals. To further improve their appearance, we'd like to standardize the fonts used in figure labelling. If possible, please send us your figures with the legends in Optima, the font we use in the text. If you don't have Optima, please use another sans serif font, for example Futura or Arial.

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Special Issue of Geografiska Annaler, Series A:

Late-glacial glacier events in southernmost South America and their global significance
Guest Editor: David Sugden

All articles from this special issue of Geografiska Annaler, Series A: Physical Geography (Volume 87, Issue 2) are now available FREE online for 60 days or until 30th September 2005.

Visit www.blackwell-synergy.com/toc/geoa/87/2 to view the table of contents and access the full content of all articles from this issue.

ABOUT THIS ISSUE
The research published in this special issue reports on findings from a project led by The University of Edinburgh studying climate change in the Patagonia region and carried out over some 14 years. The research concludes that during climate oscillations at the end of the Last Ice Age, glaciers in Patagonia got larger when those in the Northern Hemisphere were shrinking and vice versa. This is the first firm dating evidence from a land mass in such a southerly latitude to reveal the existence of the bipolar seesaw. The study also shows that the peak of the Last Glacial Maximum, the onset of deglaciation and the start of the Holocene are in phase with global trends. The implication is that Patagonian glaciers respond to global climate change on an orbital time scale in response to wholesale global reorganisation of the atmosphere and oceans. However, during the transition from an Ice Age mode to an interglacial mode the global system is sufficiently sensitive to be affected by the bipolar seesaw. Such behaviour is of clear relevance to a world where human activity could be pushing the Earth's system towards such sensitivity.

LINKS
Full details of the project and photographs are available at http://www.geos.ed.ac.uk/homes/des.

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ICE

Editor: M.M. Magnússon (Secretary General)

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