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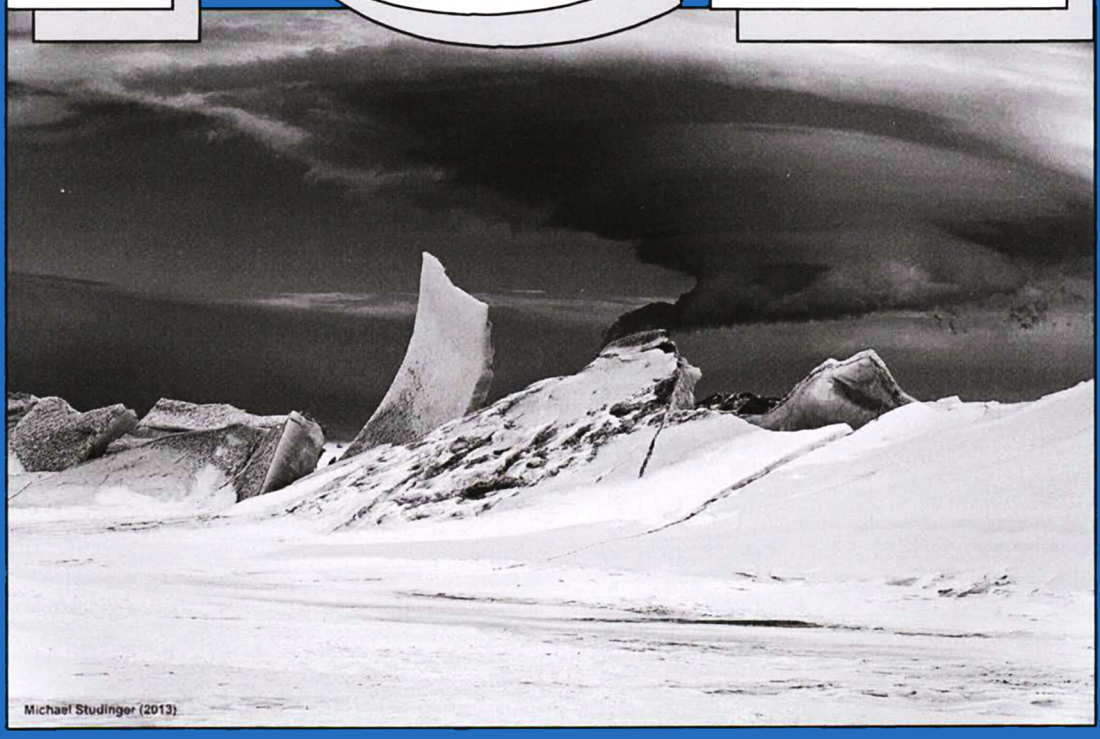
ICE



NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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Ice

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Contents

Cover picture: Pressure ridges on the sea ice near Scott Base, Antarctica. Photograph by Michael Studinger.

From the Editor

Dear IGS member

This is the time of year when we decide on next year's membership and subscription rates and pricing policy. Throughout the year, Council, the President and Treasurer, the Publications Committee and the IGS office have been actively involved in discussions.

The proportion of members opting for online only membership has been steadily increasing since it was first introduced, and is currently (for 2014) at 60%. Taking into consideration this clear movement of the preferences of readers of our publications away from print and towards online, and in accordance with the wishes expressed by Council at its most recent meeting in Chamonix, from 2015 onwards IGS membership will include online access to, but not print versions of, the Journal of Glaciology and ICE. There will not be a 'print and online' membership category.

As the online IGS membership rate has been unchanged since its inception, we feel it is time to increase it slightly in tune with the inflation rate over the past year here in the UK, i.e. 2.7%.

Please visit our membership web page (http://www.igsoc.org/membership) for further details about prices.

From time to time, I am asked whether there is any need at all for us to do anything to the manuscripts accepted for publication in our journals. Why not just publish the papers exactly as the authors supply them? In light of this question, I thought it might be helpful to summarize exactly what it is we do in the IGS Publications Office.

We pride ourselves at the IGS that we publish, in the *Journal* and *Annals* papers, correspondence and reviews of the highest scientific quality. We strive to ensure that the high-quality science is presented at its very best, both on the web and in print. We take authors' manuscripts through various stages of production to achieve a published work that is as consistent, complete and clear as possible, making it accessible to a wide readership.

Once a paper has been accepted, the Chief Editor asks the author to send final files to the IGS office. We are able to process both Word and LaTeX text files, and can accept figure files in various formats. We always aim to work closely with our authors to ensure any potential problems with graphics or text files are resolved early on in the process, to avoid delays in publication and ensure the best possible outcome from the initial source files provided.

Once authors send their final files to us, the initial stage in the process is reference checking. We use our extensive database of glaciological references (at present comprising approximately 110 000 references) to check that all references are complete and correct, and highlight any inconsistencies for the attention of the author at proof checking.

Once reference checking is complete, the files are then prepared for copy editing. Manuscripts are edited meticulously for sense and grammar, and the IGS house style is applied. We also check the references against the reference citations to ensure completeness, and likewise ensure that figure and table captions are consistent with the figures and tables themselves, and indeed with the text. Our aim is to ensure that the content is as clear, complete and consistent as possible. Again, any inconsistencies or queries noted by the copy editors are highlighted for the attention of the author.

The figures are sized and styled in the IGS office, and both figure and text files are then prepared for typesetting. Our typesetter produces a first proof, ensuring that the text, figures and tables are laid out logically and coherently. We then send the first proof to the author for checking and, once proof corrections are returned, the paper enters the last stages of production before publication: a rigorous proof-reading stage and then final correction and page make-up. If necessary, we are happy to provide second proofs to authors, particularly if revised figures or changes to layout have been required.

We operate a system of continuous online publication: papers are uploaded online in pdf format as soon as they are finalized. We endeavour to work closely with our authors throughout the production process and we regularly accommodate authors' requests regarding specific publication dates, particularly if the timing is to correspond with press coverage. We are also happy to promote (via the IGS website, Facebook and Twitter) press releases that authors or their institutions produce to coincide with publication.

We have a small production team here at the IGS, the greatest benefits of which are that we get to know many of our authors well and each paper is overseen by only a small number of people, ensuring consistency throughout the process. Ultimately, our aim is to provide a smooth and efficient service for all the scientists and researchers who publish with us, to ensure that their work is presented at its best.

To finish off, I note that the penultimate issue of the *Journal* for 2014, issue 223, is now published. The last issue is well on its way to completion and we are now assigning papers to the first issue of 2015. We are working hard to complete the last 2014 issue of the *Annals* and work is progressing nicely on *Annals* issues for 2015. So we continue to work hard on getting your papers out there as soon as possible.

Magnús Már Magnússon
Secretary General

Recent work

Finland

TERRESTRIAL SNOW

Satellite remote sensing of snow

Jouni Pulliainen, Juha Lemmetyinen, Kari Luojus, Lenna Leppänen, Matias Takala (FMI)

The FMI Arctic research unit is responsible for several multi-national research initiatives aiming at the exploitation of Earth Observation data in monitoring aspects of the Earth's cryosphere. Below are described some of the activities conducted in recent years, where the unit has led a research consortium.

ESA DUE GlobSnow

The efforts of the European Space Agency (ESA) funded GlobSnow project has resulted in two hemispherical-scale records of snow parameters intended for climate research purposes. The datasets contain satellite-retrieved information on snow extent (SE) and snow water equivalent (SWE) extending more than 15 and 30 years respectively. The dataset on snow extent is based on optical data of Envisat AATSR and ERS-2 ATSR-2 sensors covering the Northern Hemisphere between 1995 and 2012. The record on snow water equivalent is produced using a combination of passive microwave radiometer and ground-based weather station data. Recent efforts within the GlobSnow project include the further development of the optical SE retrieval methodology for NPP Suomi VIIRS data and preparation for Sentinel-3 OLCI and SLSTR utilization. Additionally, the combination of the optical SE and the passive microwave SWE products is been investigated within the GlobSnow project. The project is being coordinated by the Finnish Meteorological Institute (FMI).

EUMETSAT H-SAF

The aim of the EUMETSAT H-SAF (Hydro Satellite Application Facility) project is to develop and operate near-real-time products that will benefit hydrology research and provide data for the operation of hydropower plants. Within H-SAF, FMI participates in snow, validation and hydrovalidation clusters, the other clusters involving precipitation and soil moisture. The current phase of the project is CDOP2 (Continuous Operation and Development 2), which will end in February 2017. Currently operational snow products are H10 (Snow Detection) and H13 (Snow water equivalent by MW radiometry). Preoperational products are H11 (Snow status (dry/wet) by MW radiometry) and H12 (Effective snow cover by VIS/IR radiometry). Products H10, H12 and H13 are developed in co-operation with the Turkish State Meteorological Service (TSMS) in such a way that FMI is responsible for flat areas and TSMS for mountainous areas. FMI alone is responsible for the H11 product. All snow products are validated on a yearly basis against relevant ground truth data. Hydrological validation is performed by assimilating snow product results with the hydrological model VIC (Variable Infiltration Capacity). FMI validates products over Finland.

ESA CoReH2O

Between 2009 and 2013 several research studies related to the development of the proposed ESA CoReH2O (Cold Regions Hydrology High-Resolution Observatory) satellite mission were conducted. CoReH2O was a candidate 7th Earth Explorer Core mission by the European Space Agency (ESA). The studies consisted both of science studies addressing aspects such as the theoretical basis of forward models and the synergistic use of CoReH2O with other satellite systems, as well as experimental campaigns. A significant contribution of FMI was related to the lead of the main experimental campaign designed to provide reference data for CoReH2O algorithm development. The NoSREx (Nordic Snow Radar Experiment) campaign was conducted between 2009 and 2013 at the FMI Arctic Research Centre in Sodankylä, Finland. The campaign aimed to provide season-long time-series of microwave backscatter observations form snow covered terrain; both stationary tower-based and airborne instruments (the ESA SnowScat and SnowSAR experimental sensors) were applied. Backscatter (radar) measurements of snow cover were complemented by microwave emission (radiometer) observations and state-of-the-art in situ observations of snow, soil and atmospheric properties. The experimental dataset, distributed thought the campaign portal of ESA provides a unique tool for future development of remote sensing applications for snow cover.

ESA SMOS+ Permafrost

The Finnish Meteorological Institute, Arctic Research completed a 1 year ESA funded Support to Science Element study 'SMOS+ Innovation Permafrost' in co-operation with Gamma Remote

Sensing, Switzerland. The main objective of the study was to develop methods and algorithms for detection and monitoring of soil freezing and thawing processes using ESA SMOS mission (Soil Moisture and Ocean Salinity) passive microwave data (L-band – 1.4 GHz). These methods and associated algorithms were demonstrated with SMOS satellite data over the Northern Hemisphere and with tower-based reference radiometer data in Sodankylä Arctic Research Centre. To support interpretation of experimental data, a radiative transfer model was developed to simulate passive microwave signatures of snow covered terrain at L-band. The model allows simulation of microwave emission from a layered snowpack covering soil consisting of layers at different stages of freezing.
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Observations and modelling of snow, ice, and soil frost in Finnish Lapland
Jouni Pulliainen, Leena Leppänen, Matias Takala, Juha Lemmetyinen, Kari Luojus (FMI)
FMI's Arctic Research Center in Sodankylä, northern Finland comprises an extensive snow, ice and soil frost measurement site. The measurements, both automatic and manual, are conducted in several locations including forest, bog, lake and fell environments. Additional data is acquired via visiting instruments (such as SnowScat scatterometer by European Space Agency 2009–13) and during special measurement campaigns. In the main snow measurement site are located an intensive observation area (IOA), two microwave instruments, an optical spectroradiometer installed into a mast and numerous automatic (e.g. snow height and temperature, soil temperature and moisture, radiation) and manual reference (e.g. grain size, SWE, density, temperature and specific surface area) measurements. Information gathered is actively used for both optical and microwave remote sensing data validation, calibration, algorithm development and modelling purposes. Another site, located on a nearby wetland, hosts an L-band microwave radiometer specifically utilized in soil frost and soil moisture related research (the ESA Elbara-II instrument). Regular manual in situ snowpack, ice and soil frost measurements are made on a weekly basis at several sites. In addition, four snow courses and snow surface elemental/organic carbon measurements are carried out. Recent research related to Sodankylä measurements include physical modelling of the snowpack with the SNOWPACK model, comparison of manual measurements and microwave measurements for snow grain size and snow water equivalent determination, and investigation of the effects of snowpack characteristics, illumination conditions and forest environment on snow reflectance and, further, on optical remote sensing. The Arctic Research Centre is also one of the WMO's SPICE (solid precipitation intercomparison experiment 2012–14) test sites.
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Impacts of climate change on snow cover and properties
Onni Järvinen and Matti Leppäranta (UH)
Global warming is already changing important physical and biological systems of the Arctic. The impacts of these changes on the Arctic's communities and livelihoods are large and projected to grow in the future. There is even a risk that rapid change in climate will cause a destabilization of ecosystems. Our research team has focused on the impacts of climate change on snow properties and snow cover. Snow cover is a natural part of the Arctic landscape for most of the year. It is an important form of fresh water storage, it forms an insulating cover on land and frozen inland waters, it has high reflectance of sunlight and it is an essential element in Arctic ecosystems. For human activities snow poses technical problems but snow is also part of good quality of life and a major resource for tourism. We aim to (1) classify snow zones and their evolution in Lapland on the basis of snow structure and properties, (2) construct rheological models of snow cover and (3) evaluate the sensitivity of the snow zones to climate change.
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Snow conditions and reindeer winter mortality and calf production
Sirpa Rasmus and Heli Siitari (UJ)
Semi-domesticated reindeer in northern Finland live in an environment where continuously changing weather conditions significantly affect populations. Reindeer herds forage for food beneath the snow for 6–8 months a year. Deep snow cover and late snow melt can cause high winter mortality and low calf production. Also the structural properties of snow are important: for example, extensive ground ice can even cause population crashes. Warming winters will alter the amount and structure of snow, as well as the length of the snow season. Use of snow structure models can give valuable information for reindeer management, especially when estimating the possible effects of climate change, and snow properties in different environments, like forested and open areas. In our project we combine meteorological observations, reindeer herders' experiences and snow structure simulations by a model SNOWPACK to study the relevance of snow properties on reindeer herding. The final aim of our

project is to build time series of snow conditions (amount, duration, structure) for five districts both in the past (1981–2010) and also in the future by using the regional climate scenario outputs and snow structure modelling during the years 2071–2100. Together with herders we will discuss the potential for adaptation in reindeer herding.
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Snow effects on observed gravity
Jaakko Mäkinen and Jouni Peltoniemi (FGI). Collaboration with Russia and India.
FGI maintains a program of monitoring local snow mass around the Finnish Antarctic Research Station Aboa in western Dronning Maud Land (DML). Snow surface heights within 2.5 km of Aboa are observed using real-time kinematic GPS methods, and the density of the top layer sampled. The main purpose of the program is to determine the variation in the gravity effect of the local snow, in order to correct the time series of absolute gravity measurements at Aboa. The measurements are repeated when the gravity station is occupied, lastly during the 2011/12 austral summer. In addition, a snow stake line extending 5 km from Aboa is observed annually. A central factor driving the interannual variation in the local snow appears to be wind accumulation/ablation. Similar local observations were performed in 2011/12 at Novolazarevskaya (DML) and Maitri (DML). Local snow mass is also monitored around the gravity laboratory of the Metsähovi Research Station of the FGI in Kirkkonummi, Finland. The main purpose is again to obtain corrections to observed gravity, especially to the time series of the superconducting gravimeter in the laboratory. Both the thickness of the snow layer and the snow water equivalent (SWE) is observed manually in a dense grid around the station. Special attention is paid to the lateral inhomogeneity generated by small-scale topography and vegetation effects. In winter 2013 FGI started mapping the snow surface by photogrammetry from a drone. In December 2013 continuous automatic point measurements of SWE were begun. They are based on the attenuation of the natural gamma radiation of the soil.
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ATMOSPHERIC SNOW

Radar observations of snow fall
Annakaisa von Lerber (FMI)
Radar observations of falling snow are compared with with ground measurements. The focus is on modelling melting layer microphysical and electromagnetical characteristics with respect to C-band weather radar, but the model assumptions have also been tested at, for example, the Ka-band. The studies have also addressed the attenuation of radar signal caused by the melting layer and its dependence on the originating melting crystal habit. A 5 year long measurement campaign is going on comparing the performance of different instruments, like disdrometers and gauges, measuring solid precipitation and gathering ground validation data for the NASA and JAXA GPM (Global Precipitation Measurement) satellite. The work is carried out in co-operation with UH.
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ICE PHYSICS AND CHEMISTRY

Numerical simulation and measurement of friction, fracture and crushing of ice
Lasse Makkonen, Maria Tikanmäki, Kari Kolari, Juha Kuutti (VTT)
A general theory on the origins and modelling of sliding friction was developed and utilized in an ice friction model. A comprehensive thermodynamic model of friction of ice was developed. The model was implemented in a numerical model of crushing of ice. Adhesional failure was modelled by the FEM-method and the results were applied in developing the new ice adhesion measurement system at VTT. A re-meshing technique was introduced by which it is possible to numerically model a continuous fracture process. Simulation of ice crushing experiments with the new model has been successful and provides good results both qualitatively and quantitatively. It was shown that the 60-year-old equation that related surface tension to surface energy is incompatible with the mathematical structure of thermodynamics. Surface tension on a solid was therefore re-defined. An analytical solution was found for the solid fraction in solidification of a supercooled liquid. For the water/ice system it is always 70%.
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Discrete particle model for simulations of fracture and calving phenomena
Jan Åström and Thomas Zwinger (CSC), Timo Riikilä, Tuomas Tallinen and Jussi Timonen (UJ), John C. Moore (UL)
Within the SVALI Nordic Centre of Excellence project, a new model that describes ice as a material of discrete point masses connected by elastic beams and dampers has been developed and tested under certain scenarios representing two-dimensional calving and surging. Current activities aim to improve the computationally highly demanding code's performance and extend the simulations to three dimensions.
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Ice core chemistry of Holtedahlfonna, Svalbard
Emilie Beaudon and John C. Moore (UL)
We completed the major ion chemical analysis of a core dating back to AD 1700 from a fairly maritime environment on western Spitsbergen. Comparison with the well-studied Lomonosovfonna ice core reveals that a good climate record is preserved (at least at decadal resolution) despite seasonal melt. The ammonia and MSA records show that there has been rather different meteorological states across Spitsbergen with the eastern side affected by strong inversion layer over sea ice while the western open-water side allows deeper atmospheric mixing, and trapping less pollutants.
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SURFACE ALBEDO AND ENERGY BALANCE

Remote sensing of sea ice albedo
Terhikki Manninen, Aku Riihelä, and Vesa Laine (FMI)
FMI has investigated a new technique for estimating sea-ice albedo that can overcome these limitations. It turned out that a microwave-based method of estimation is capable of providing daily observations without gaps. Microwave observations are not limited by solar angle, cloud cover or the need for atmospheric correction. The higher temporal resolution of this coverage allows changes in surface albedo to be linked to short-term atmospheric and ocean processes, leading to a better understanding of seasonal cycles. Two studies have been made about estimating the optical broadband black-sky Arctic sea ice albedo using AMSR-E passive microwave radiometer data. The objective of the first study was to develop the remote sensing method and it was validated against CLARA-A1-SAL (AVHRR) data set. In the second study the method was employed to estimate detailed weekly and daily albedo progress over the whole Arctic sea ice area from June to September for the period of 2003–11. The microwave method can overcome limitations of optical methods for albedo measurements. A substantial recent development is that the 28-year global surface albedo dataset CLARA-A1-SAL, developed at FMI, has now been released to the scientific community by the CM SAF project of EUMETSAT. The dataset has been validated against in situ observations and shown to have good accuracy and applicability over Arctic snow and sea ice. First applications of the dataset are now emerging, including a study on the albedo trends of the Arctic sea ice zone and another on the accuracy of current treatments of sea ice albedo in CMIP5 climate models.
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Snow grain size and albedo in Antarctica: measurements and modeling
Roberta Pirazzini, Petri Räisänen, Timo Vihma, Milla Johansson, Esa-Matti Tastula (FMI)
Snow grain macro-photos collected near the Finnish Antarctic Station Aboa during summer 2009–10 have been analysed to investigate the link between snow grain metamorphism and surface albedo. Snow grain macro-photos were taken twice a day for a 1 month period from four snowpack layers (at the surface and at the depths of 5, 10 and 20 cm). A cave inside the snowpack was used as a cold and dark 'laboratory'. The dataset also includes vertical profiles of snow temperature and density (twice a day), surface broadband albedo, surface spectral reflectance during clear and overcast days, and ancillary meteorological data. With such an extensive and complete dataset, we studied the snow grain metric that best reflects the grain scattering properties at various wavelengths, establishing a direct relationship between measured grain dimensions and optically-equivalent grain size. For this purpose, we analyzed the 2D macro-photos with an image processing software that allows the determination of the size distribution of many dimensional quantities. A statistical approach was applied to estimate the representativeness error in the snow grain observations. The distributions of the obtained grain size metrics and the snow density profiles were utilized in the radiative transfer model DISORT to simulate the surface spectral albedo. The comparison of the model results with the observed spectral albedo allowed the identification of the snow grain dimensions that best explain the albedo at each wavelength. The impact of the snow grain shape in the model simulations was addressed utilizing spherical and droxtal grain representations.
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Absorbing aerosols and fate of the Indian glaciers
Onni Järvinen (UH), Matti Leppäranta (UH) and Antti-Pekka Hyvärinen (FMI)
Aerosols in southern Asia are highly absorbing because of their high black carbon (BC) content and the occasional presence of large amounts of desert dust. This causes a reduction of solar radiation at the surface accompanied by substantial atmospheric heating. The current and future trends of aerosol concentrations in this region are very unclear: while measurements conducted in megacities show a decrease in aerosol concentrations over the few recent years, regional-scale measurements seem to be indicative of an increasing trend. Future aerosol concentrations in the southern Asia, in turn, depend crucially on emission control strategies in household, industrial and transport sectors. The primary goal

of this project is to quantify how the amount and properties of absorbing aerosols are affecting the mass balance of glaciers in the Himalayas. We aim to understand this relationship first in a single small glacier on a mechanistic level and then upscale this knowledge to different glaciers in the Himalayas. A study combining atmospheric and glaciological research in the Himalayan region is quite unique. Previous glaciological studies have focused on observing glacier changes through direct or satellite observations. Atmospheric studies include remote sensing from satellites and simulations of heating rates. Several short-term expeditions (first expedition in May 2014) will be made to the Pindari Glacier, central Himalaya, during the study. On the glacier, different aerosol and glacier characteristics will be studied. An ice core drill will be used to gather information from the deeper parts (2–10 m) of the active surface layer. A weather station will be installed during the first expedition. Also, snow stations will be installed that will record the temperature changes in the snowpack and snow accumulation events. The data from the snow stations will be retrieved during the annual expeditions.
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Surface albedo and absorbing aerosols
Outi Meinander, Gerrit de Leeuw, Aki Virkkula, Heikki Lihavainen, Petri Räisänen (FMI)
Recent research has addressed black carbon (BC) in snow, spectral and broadband UV and visible albedo of snow in Sodankylä, north of the Arctic Circle, and development of albedo parameterizations for climate models. Special effort has been put into research on the effects of light-absorbing impurities on the spectral reflectance (300–2500 nm) and density of seasonal snow in Sodankylä. To separate natural variability from the anthropogenic effects of black carbon, the Soot on the Snow (SoS-2013) experiment was carried out in Sodankylä. The purpose was to study the effects of deposition of BC, Icelandic volcanic sand and glaciogenic silt on the surface albedo, snow properties and melt of the seasonal snow. The BC in snow has been analysed using three different methods in Sweden (the thermal–optical method), the USA (spectrometer), and Finland (SP2). The measured BC concentrations in Sodankylä snow in 2009–11 data varied from 9 to 106 ppb, detected by the thermal–optical method. The high concentrations of carbon were due to air masses originating from the Kola Peninsula, Russia, where mining and refining industries are located. The work has been carried out within the Academy of Finland project Arctic Absorbing Aerosols and Albedo of Snowand the Nordic Centre of Excellence Cryosphere–Atmosphere Interactions in a Changing Arctic Climate.
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Surface energy balance over Antarctic Peninsula ice shelves
Ilona Välisuo and Timo Vihma (FMI)
Ice shelves in the Antarctic Peninsula have significantly disintegrated during recent decades. To better understand the atmospheric contribution in the process, we have analysed the interannual variations in radiative and turbulent surface fluxes and weather conditions over the Larsen C Ice Shelf (LCIS) and Wilkins Ice Shelf (WIS) in the Antarctic Peninsula in 1989–2010. Three atmospheric reanalyses were applied: ERA-Interim by ECMWF, Climate Forecast System Reanalysis (CFSR) by NCEP and JRA-25/JCDAS by the Japan Meteorological Agency. In addition, in situ observations from an automatic weather station on LCIS were applied, mainly for validation of the reanalyses. In LCIS from December through August and in WIS from March through August, the variations of surface net flux were partly explained by the combined effects of atmospheric pressure, wind and cloud fraction. The explained variance was much higher in LCIS (up to 80%) than in WIS (26–27%). Summer melting on LCIS varied between 11 and 58 cm w.e. The mean amount of melt days per summer on LCIS was 69. The high values of melting in summer 2001–02 presented in previous studies on the basis of simple calculations were not supported by our study. Instead, our calculations based on ERA-Interim yielded strongest melting in summer 1992–93 on both ice shelves. On WIS the summer melting ranged between 10 and 23 cm w.e., and the peak values coincided with the largest disintegrations of the ice shelf.
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ICE SHEET AND GLACIER DYNAMICS

General development of Elmer/Ice model
Thomas Zwinger (CSC)
The CSC owns the Finite Element code Elmer, published under open source and underpinning the ice sheet simulation code Elmer/Ice which has been deployed in large numbers of projects. The package is continuously in development by an international consortium and is also backed up by refinements in Elmer (new algorithms, porting to new HPC platforms). Elmer/Ice was used by nine papers cited in the IPCC AR5. The source code as well as a comprehensive online documentation is accessible via the recently created web portal http://elmerice.elmerfem.org. Elmer/Ice courses were held in 2011 and 2013 during SVALI (Nordic Centre of Excellence 'Stability and Variations of Arctic Land Ice') summer schools on Earth System Models and Ice Models, as well as an advanced course in fall 2013 (also supported by SVALI).
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Dynamic evolution of Scharffenbergbotnen blue ice area since the Late Glacial Maximum
John C. Moore and Martina Schäfer (UL) and Thomas Zwinger (CSC). Collaboration with UK.
We investigated the dynamics of ice flow in the Scharffenbergbotnen valley, Dronning Maud Land, East Antarctic Ice Sheet, specifically its blue ice area (BIA) within a Finnish Academy project. We used Elmer/Ice to investigate the flow dynamics to aid interpretation of horizontal ice cores. Simulations indicate that a pronounced fabric within the ice is the most likely explanation of the current flow field. In addition to ice flow simulations, we investigated the impact of local katabatic wind fields on the ablation over the whole valley, finding that the local geometry focuses strong winds towards the BIA. This study was carried out with the newly implemented variational multi-scale (VMS) stabilization scheme for turbulent flows from Elmer within the master thesis of T. Malm at Aalto University.
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Evolution of the Greenland ice sheet
Thomas Zwinger (CSC). Collaboration with Japan and France.
Two versions of the evolution of the Greenland Ice Sheet (GRIS) have been produced using Elmer/Ice one within the US initiative seaRISE and the other within the EU FP 7 project ice2sea. Both runs (which led to high-impact papers) used sophisticated new meshing techniques for horizontal adaption in order to resolve local features such as ice streams down to a resolution of 500 m. The models were driven by input from climate models and we obtained projections for different scenarios. A further study, led by the University of Bristol, investigated the impact of increasing surface melt on the mass balance of GRIS.
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Dynamics and prognostics of Pine Island Glacier
Thomas Zwinger (CSC). Collaboration with France.
Elmer/Ice and two other ice sheet models were used to investigate the future behavior of Pine Island Glacier (PIG), West Antarctica. Several numerical experiments with different perturbations lead to the conclusion that the retreat of PIG is governed by the marine ice sheet instability which, being governed by the bathymetry, will continue for another further 40 km, leading to a significant contribution to global sea level rise from this glacier. This work was largely funded by the EU FP 7 project ice2sea.
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Numerical simulations of Gurenhekou Glacier on the Tibetan Plateau
John C. Moore (UL) and Thomas Zwinger (CSC). Collaboration with China.
We investigated the impact of climate change on Gurenhekou Glacier located in the southern Tibetan Plateau, a glacier representative of tens of thousands of mountain glaciers in the region. We deployed Elmer/Ice to simulate the evolution of the glacier until 2057. Different ways of parameterizing the climate forcing based on measurements from nearby weather stations, a surface mass balance measurement campaign and an energy balance model were used. We show that ice dynamics play a minor role compared with climate forcing in future evolution of most glaciers in the region. Using observed mass balance relations and a high-resolution climate model we extend the results to statistically simulate the evolution of 67022 separate glaciers in high-mountain Asia to 2050.
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Simulation of the Dome A system, East Antarctic ice sheet
John C. Moore (UL) and Thomas Zwinger (CSC). Collaboration with China, Germanyand UK.
The age of ice at Dome A is of interest both because of a deep ice core to be drilled by Chinese teams and also because of the presence of basal accretion ice layers in many parts of the subglacial alpine valleys. We show that, in addition to geothermal heat flux, the ice fabric is a critical determinant of the age and thermal state of the basal ice layers. A comparison between steady-state simulations using Elmer/Ice with several prescribed fabrics and high quality radar data of both the bedrock and englacial isochrone layers was made. The results may suggest a dynamic region, consistent with intermittent ice accretion but somewhat contrasting with ice sheet models of great stability.
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Numerical simulations of ice-caps and glaciers in Svalbard
Martina Schäfer (UL and FMI), John C. Moore, Rupert Gladstone and Yongmei Gong (UL), Ilona Välisuo (FMI), Thomas Zwinger (CSC). Collaboration with France, Germany, Switzerand, Norway, Sweden, and Denmark.
The dynamic regime of Svalbard's Nordaustlandet ice caps is dominated by fast-flowing outlet glaciers. The motion of these fast outlet glaciers occurs largely through basal sliding. Up to now, most of the sliding laws used in ice flow models were based on uniform parameters with a condition on temperature to identify regions of basal sliding. We deploy inverse methods to

infer a spatially varying field of sliding parameters from surface ice-velocity observations within Elmer/Ice and BISICLES, and explore the role of different heat sources (friction heating, strain heating and latent heat through percolation of melt water) on the development of sliding. We focus on Franklinbreen on Vestfonna and Basin 3 on Austfonna, fast flowing outlet glaciers that have been observed to accelerate since 1995. Model intercomparison (Elmer/Ice and BISICLES) has been done to investigate the sensitivity of Austfonna transient behaviour to model physics and basal boundary conditions. Separately, the sensitivity of coupling Elmer/Ice to an external climate mass-balance model for future simulations on a century scale is studied on Vestfonna. Midtre Lovénbreen, a small alpine-type valley glacier in northwest Spitsbergen, has been modelled with Elmer/Ice in order to study the interactions between the atmosphere and glacier. The study aims to reconstruct the mass balance from the simulations and validate this modelled mass balance against observations. This work is largely funded by the Nordic Centre of Excellence SVALI and the European Science Foundation Project SvalGlac.
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Subglacial hydrological model
Thomas Zwinger and Peter Råback (CSC). Collaboration with France.
The flow of glaciers and ice-streams is strongly influenced by the presence of water at the interface between ice and bedrock. In this project, a hydrological model evaluating the subglacial water pressure is developed with the final aim of estimating the sliding velocities of glaciers. The global model fully couples the subglacial hydrology and the ice dynamics through a water-dependent friction law. The hydrological part of the model follows a double continuum approach which relies on the use of porous layers to compute water heads in inefficient and efficient drainage systems. This method has the advantage of a relatively low computational cost that would allow its application to large ice bodies such as Greenland or Antarctic ice-streams.
E-mail: thomas.zwinger@csc.fi

SEA ICE

Satellite remote sensing of sea ice
Juha Karvonen, Marko Mäkynen, Markku Similä, Bin Cheng, Eero Rinne, Jari Haapala (FMI)
The estimation of ice concentration using C-band SAR imagery has been studied. Studies using HH polarization and dual-polarized SAR imagery HH/HV polarization combination have been made and reported. The results have been promising and operational tests will be performed during the ice season 2013/14. Ice thickness retrieval based on SAR imagery and ice modeling has been studied over different geographic areas. From SAR imagery it is possible to extract information on the ice deformation and ice drift; this information jointly with ice thickness distribution from an ice model can be used to redistribute the modelled sea ice over the area. Such studies have been made for example for the Baltic Sea, Gulf of St Lawrence, Caspian Sea and Bohai Sea. A new ice drift estimation algorithm based on multitemporal SAR imagery and phase correlation has been developed and reported. This algorithm is in operation use as part of the MyOcean OSITAC. In addition to SAR, sea ice thickness algorithms have been developed for passive microwave and altimeter instruments too. For the passive microwave, we have been active in developing and validating thickness products from the SMOS mission. A reprocessing of altimeter time series from Envisat RA-2 is ongoing to produce a low-resolution Arctic sea ice thickness product for the years 2002–12.
E-mail: juha.karvonen@fmi.fi

Sea ice studies using coastal radar
Juha Karvonen and Jari Haapala (FMI)
The detection of fine-resolution ice drift using multitemporal coastal radar image analysis has been studied and reported. Basically the methodology is similar to detecting ice drift from SAR data. However in the case of coastal radar data automatically identified ice objects can be tracked in time, because the temporal sampling of the data is adequate for this purpose.
E-mail: juha.karvonen@fmi.fi

Relationship of sea ice conditions and ice loads on ships
Mikko Lensu and Jari Haapala (FMI). Collaboration with South Africa.
FMI is participating in a project studying the relationship of sea ice conditions and the loads that ice induces in a ship navigating in ice. A FMI model, remote sensing and in-situ data is compared to ship measurements from the icebreaker *Agulhas* in Antarctic waters. FMI researchers participated the *Agulhas* Antarctic cruise in 2013/14 as well as the test runs of the ship in the Baltic 2 years earlier.

Sea ice and snow thermodynamics
Bin Cheng, Marko Mäkynen, Markku Similä, Laura Rontu, Timo Vihma (FMI)
Sea ice and snow thermodynamics have been studied in the Arctic and the Baltic Sea. The thermodynamic sea-ice model HIGHTSI has been applied in the Kara Sea using different snow parameterization schemes. The precipitation

forcing based on numerical weather prediction models caught up the synoptic-scale snowfall events, but the magnitude was liable to errors. The modelled ice thickness was compared with in situ measurements and the modelled snow thickness was compared with AMSR-E snow thickness. The ice growth was modelled reasonably well applying HIGHTSI either with a simple parameterization for snow thickness or with the HIRLAM or ECMWF model precipitation as input. For the latter, however, an adjustment of snow accumulation in early winter was necessary to avoid excessive accumulation and consequent underestimation of ice thickness. Applying effective snow heat conductivity improved the modelled ice thickness. Snow and ice mass balance buoys (SIMB) developed by the Scottish Association for Marine Science were deployed in the Baltic Sea for the first time in winter 2012/13. The buoys have been used to monitor the snow and ice temperature in real time and the thickness of snow and ice can be derived on the basis of temperature profile within air–snow–ice–water. The data have been used study the thermal interactions between air and snow, snow and ice, and ice and ocean and to improve a high-resolution thermodynamic snow and ice model (HIGHTSI). A number of SIMBs have been deployed in an Arctic lake, the Arctic Ocean and the Antarctic Weddell Sea for snow and ice mass balance research.
E-mail: bin.cheng@fmi.fi

Modelling of Antarctic sea ice
Petteri Uotila and Timo Vihma (FMI). Collaboration with Australia, Japan and UK.
The sea-ice concentration budget of a fully coupled climate model is computed to assess its realism in simulating the autumn–winter evolution of Antarctic sea-ice. The budget consists of the local change, advection and divergence, and the residual component, which represents the net effect of thermodynamics and ridging. Although the model simulates the evolution of the sea-ice area reasonably well, its sea ice concentration budget significantly deviates from the observed one. The modelled sea-ice budget components deviate from observed close to the Antarctic coast, where the modelled ice motion is more convergent, and near the ice edge, where the modelled ice is advected faster than observed due to inconsistencies between ice velocities. In the central ice pack the agreement between the model and observations is better. Based on this, we propose that efforts to simulate the observed Antarctic sea-ice trends should focus on improving the realism of modelled ice drift.
E-mail: petteri.uotila@fmi.fi

Coastal zone of the Gulf of Finland in winter
Ioanna Merkouriardi and Matti Leppäranta (UH)
The Gulf of Finland is located in the seasonal sea ice zone (SSIZ), where sea ice forms in the wintertime and melts in late spring. Sea ice has a great influence in the physical and ecological characteristics of the water body and also produces an important economic impact due to its major importance for the marine transportation and foreign trade. The sea freezes, and the evolution of the ice and the water body progress in an interactive manner. At the climatological edge of the SSIZ, there is also a high interannual variability in the ice conditions. Using data from the last ~100 years we study the interannual variability and trends of the hydrographic characteristics, heat content, freezing and break-up days and ice thickness in the coastal zone. Moreover, we examine the influence of the sea ice on the physics of the water body: hydrography, circulation, and atmosphere–ocean interaction. In addition to that, there is ongoing research in the estuaries of the River Kymijoki. The purpose of this project is to examine the physical, chemical and optical properties of the estuaries with respect to the coastal sea ice conditions.
E-mail: Ioanna.Merkouriardi@helsinki.fi

LAKE ICE

Ice conditions and under-ice dynamics at Lake Kilpisjärvi, Finnish Lapland
Elisa Lindgren (UH)
Lake Kilpisjärvi is a seasonally ice-covered tundra lake located in northwest Finnish Lapland 473 m above sea level and only 60 km from the shore of the north Atlantic Ocean. The ice season is the longest in Finland with an annual duration of 200–250 days. A 2 week field study was performed between May–June 2013, during an exceptionally fast melting season when the ice was already snow-free. The objective was to learn more about the radiatively driven convection that has been recognized as the strongest driver for under-ice mixing in snow-free conditions. The properties of the ice cover and the water column were measured with several instruments including CTDs, thermistor chains, current meters, PAR-sensors and an autonomous underwater vehicle. Additionally, an ice sample was collected to analyze the crystalline structure from thin sections. The unusually warm weather resulted in ice thickness decreasing at the mean rate of 4.5 cm d^{-1} with internal deterioration producing candled ice. Due to weak winds the ice cover remained almost unbroken until an early ice break-up on 3 June. The on-going research will provide new information about the dynamics of polar lakes at

the end of an ice-covered season.
E-mail: elisa.lindgren@helsinki.fi

Lake ice thermodynamics in Finnish Lapland
Bin Cheng, Timo Vihma, Laura Rontu, Anna Kontu and Jouni Pulliainen (FMI). Collaboration with Canada and China.
The seasonal evolution of snow and ice on Lake Orajärvi, northern Finland, has been investigated for three consecutive winter seasons. Material consisting of numerical weather prediction model (HIRLAM) output, weather station observations, manual snow and ice observations, high spatial resolution snow and ice temperatures from ice mass balance buoys (SIMB), and MODIS lake ice surface temperature observations was gathered. A snow/ice model (HIGHTSI) was applied to simulate the evolution of the snow and ice surface energy balance, temperature profiles and thickness. The weather conditions in early winter were found to be critical in determining the seasonal evolution of the thickness of lake ice and snow. The contribution of snow to ice transformation was vital for the total lake ice thickness. On the seasonal time scale, the ice bottom growth was 50–70% of the total ice growth. The development of HIRLAM by increasing its horizontal and vertical resolution and including a lake parameterization scheme improved the atmospheric forcing for HIGHTSI, especially the relative humidity and solar radiation. Challenges remain in accurate simulation of snowfall events and total precipitation.
E-mail: bin.cheng@fmi.fi

ABBREVIATIONS

AU: Aalto University
CSC: CSC-IT Center for Science
FGI: Finnish Geodetic Institute
FMI: Finnish Meteorological Institute
UH: University of Helsinki
UJ: University of Jyväskylä
UL: University of Lapland
VTT: VTT Technical Research Centre of Finland

Timo Vihma

International Glaciological Society

JOURNAL OF GLACIOLOGY

Papers accepted for publication between 1 May and 31 August 2014. The papers are listed in alphabetical order by first author. Some of these papers have already been published.

G. Aðalgeirsdóttir, A. Aschwanden, C. Khroulev, F. Boberg, R. Mottram, P. Lucas-Picher, J.H. Christensen
Role of model initialization for projections of 21st century Greenland ice sheet mass loss

E. Babcock, J. Bradford
Quantifying the basal conditions of a mountain glacier using a targeted full-waveform inversion: Bench Glacier, Alaska

David B. Bahr, W. Tad Pfeffer, Georg Kaser
Glacier volume estimation as an ill-posed inversion

Ed Bueler
An exact solution for a steady, flow-line marine ice sheet

Wing S. Chan, Merlin L. Mah, Donald E. Voigt, Joan J. Fitzpatrick, Joseph J. Talghader
Crystal orientation measurements using transmission and backscattering

J. L. Davis, J. De Juan, M. Nettles, P. Elosegui, M. L. Andersen
Evidence for non-tidal diurnal velocity variations of Helheim Glacier, East Greenland

Damiano della Lunga, Wolfgang Müller, Sune Olander Rasmussen, Anders Svensson
Location of cation impurities in NGRIP deep ice revealed by cryo-cell UV-laser-ablation ICPMS

Christine F. Dow, Jeffrey L. Kavanaugh, Johnny W. Sanders, Kurt M. Cuffey
A test of common assumptions used to infer subglacial water flow through overdeepenings

Christine F. Dow, B. Kulessa, I.C. Rutt, S.H. Doyle, A. Hubbard
Upper bounds on subglacial channel development for interior regions of the Greenland ice sheet

E.M. Enderlin, G.S. Hamilton
Estimates of iceberg submarine melting from high-resolution digital elevation models: application to Sermilik Fjord, East Greenland

Helen Amanda Fricker, Sasha P. Carter, Robin E. Bell, Ted Scambos
Active lakes of Recovery Ice Stream, East Antarctica: a bedrock-controlled subglacial hydrological system

Shuji Fujita, Motohiro Hirabayashi, Kumiko Goto-Azuma, Remi Dallmayr, Kazuhide Satow, Jiancheng Zheng, Dorthe Dahl-Jensen
Densification of layered firn of the ice sheet at NEEM, Greenland

Jeannette Gabbi, Marco Carenzo, Francesca Pellicciotti, Andreas Bauder, Martin Funk
A comparison of empirical and physically based glacier surface melt models for long-term simulations of glacier response

Gabrielle Gascon, Martin J. Sharp, David O. Burgess, Peter Bezeau, Andrew B.G. Bush, Samuel Morin, Matthieu Lafaysse
How well is firn densification represented by a physically based multilayer model? Model evaluation for Devon Ice Cap, Nunavut, Canada

Nicholas R. Golledge, Oliver J. Marsh, Wolfgang Rack, David Braaten, R. Selwyn Jones
Basal conditions of two Transantarctic Mountains outlet glaciers from observation-constrained diagnostic modelling

Kay Helfricht, Johannes Schöber, Katrin Schneider, Rudolf Sailer, Michael Kuhn
Interannual persistence of the seasonal snow cover in a glacierized catchment

Ute C. Herzfeld, Brian Mcdonald, Bruce F. Wallin, William Krabill, Serdar Manizade, John Sonntag, Helmut Mayer, William Alex Yearsley, Phillip A. Chen, Alexander Weltman
Elevation changes and dynamic provinces of Jakobshavn Isbræ, Greenland, derived using generalized spatial surface roughness from ICESat GLAS and ATM data

Tristram D.L. Irvine-Fynn, Enoc Sanz-Ablanedo, Nick Rutter, Mark W. Smith, Jim H. Chandler
Measuring glacier surface roughness using plot-scale, close-range digital photogrammetry

Takao Kameda, Yasuhiro Harada, Shuhei Takahashi
Characteristics of white spotted wet snow observed on saturated wet snow

Arne Keller, Kolumban Hutter
Conceptual thoughts on continuum damage mechanics for shallow ice shelves

K. Langley, K. Tinto, A. Block, R. Bell, J. Kohler, T. Scambos
Onset of fast ice flow in Recovery Ice Stream, East Antarctica: a comparison of potential causes

Jan T.M. Lenaerts, Joel Brown, Michiel R. van den Broeke, Kenichi Matsuoka, Reinhard Drews, Denis Callens, Morgane Philippe, Irina V. Gorodetskaya, Erik Van Meijgaard, C.H. Reijmer, Frank Pattyn, Nicole P.M. Van Lipzig
High variability of climate and surface mass balance induced by Antarctic ice rises

Quentin Libois, Ghislain Picard, Marie Dumont, Laurent Arnaud, Claude Sergent, Evelyne Pougatch,Marcel Sudul, David Vial
Experimental determination of the absorption enhancement parameter of snow

Andrew K. Melkonian, Michael J. Willis, Matthew E. Pritchard
Satellite-derived volume loss rates and glacier speeds for the Juneau Icefield, Alaska

Frank Paul, Nico Mölg
Hasty retreat of glaciers in northern Patagonia from 1985 to 2011

Erin C. Pettit, Erin N. Whorton, Edwin D. Waddington, Ronald S. Sletten
Influence of debris-rich basal ice on flow of a polar glacier

Stacey E. Porter, Ellen Mosley-Thompson
Exploring seasonal accumulation bias in a west central Greenland ice core with observed and reanalyzed data

Delphine Six, Christian Vincent
Sensitivity of mass balance and equilibrium-line altitude to climate change in the French Alps

Matteo Spagnolo, Edward C. King, David W. Ashmore, Brice R. Rea, Jeremy C. Ely, Chris D. Clark
Looking through drumlins: testing the application of ground penetrating radar

Tian Lide, Zong Jibiao, Yao Tandong, Ma Linglong, Pu Jianchen, Zhu Dayun
Direct measurement of glacier thinning on the southern Tibetan Plateau (Gurenhekou, Kangwure, Naimona'Nyi Glaciers)

James Turrin, Richard Forster, Jeanne M. Sauber, Dorothy K. Hall, Ronald Bruhn
Effects of bedrock lithology and subglacial till on the motion of Ruth Glacier, Alaska, deduced from five pulses from 1973 to 2012

Tsutomu Uchida, Keita Yasuda, Yuya Oto, Renkai Shen, Ryo Ohmura
Natural supersaturation conditions needed for nucleation of air clathrate hydrates in deep ice sheets

C.J. van der Veen, L.A. Stearns, J. Johnson, B. Csathó
Flow dynamics of Byrd Glacier, East Antarctica

J. M. van Wessem, C.H. Reijmer, M. Morlighem, J. Mouginot, E. Rignot, B. Medley, I. Joughin, B.Wouters, M.A. Depoorter, J.L. Bamber, J.T.M. Lenaerts, W.J. van de Berg, M.R. van den Broeke, E. van Meijgaard
Improved representation of East Antarctic surface mass balance in a regional atmospheric climate model

Robert G. Way, Trevor J. Bell, Nicholas E. Barrand
An inventory and topographic analysis of glaciers in the Torngat Mountains of northern Labrador, Canada

Ken Whitehead, Brian Moorman, Pablo A. Wainstein
Measuring daily surface elevation and velocity variations across a polythermal Arctic glacier using ground-based photogrammetry

J. Paul Winberry, Sridhar Anandakrishnan, Richard B. Alley, Douglas A. Wiens, Martin J. Pratt
Tidal pacing, skipped slips, and the slow-down of the Whillans Ice Stream, Antarctica

Wu Yuwei, He Jianqiao, Guo Zhongming, Chen Anan
Limitations in identifying the equilibrium-line altitude from the optical remote-sensing derived snowline in the Tien-Shan Mountains

Yuande Yang, Bo Sun, Zemin Wang, Minghu Ding, Cheinway Hwang, Songtao Ai, Lianzhong Wang, Yujun Du, Dongchen E
GPS-derived velocity and strain fields around Dome Argus, Antarctica

Jacob C. Yde, Mette Kusk Gillespie, Ronny Lølund, Henry Ruud, Sebastian H. Mernild, Simon de Villiers, N. Tvis Knudsen, Jeppe K. Malmros
Volume measurements of Mittivakkat Gletscher, southeast Greenland

V. Zagorodnov, S. Tyler, D. Holland, A. Stern, L. Thompson, C. Sladek, S. Kobs, J.P. Nicolas
New technique for access-borehole drilling in shelf glaciers using lightweight drills

Harry Zekollari, Johannes Jakob Fürst, Philippe Huybrechts
Modelling the evolution of Vadret da Morteratsch (Switzerland) since the Little Ice Age and into the future

A. Zirizzotti, L. Cafarella, S. Urbini, J.A. Baskaradas
Electromagnetic ice absorption rate at Dome C, Antarctica

ANNALS OF GLACIOLOGY 55(65)

The following papers have been selected for publication in Annals of Glaciology *55(65) (thematic issue on Advancing clean technologies for exploration of glacial aquatic ecosystems), edited by Peter Doran*

V.V. Lukin, N.I. Vasiliev
Technological aspects of the final phase of the 5G borehole drilling and Lake Vostok unsealing

Martin J. Siegert, Keith Makinson, David Blake, Matt Mowlem, Neil Ross
An assessment of deep hot-water drilling as a means to undertake direct measurement and sampling of Antarctic subglacial lakes: experience and lessons learned from the Lake Ellsworth field season 2012-13

Annals 55(65) is now complete

ANNALS OF GLACIOLOGY 55(68)

The following papers have been selected for publication in Annals of Glaciology *55(68) (thematic issue on Ice drilling technology), edited by Frank Wilhelms*

Pinlu Cao, Cheng Yang, Zhichuan Zheng, Rusheng Wang, Nan Zhang, Chunpeng Liu, Zhengyi Hu, Pavel Talalay
Low-load diamond drill bits for subglacial bedrock sampling

Jay A. Johnson, Alexander J. Shturmakov, Tanner W. Kuhl, Nicolai B. Mortensen, Chris J. Gibson
Next generation of an intermediate depth drill

Tanner W. Kuhl, Jay A. Johnson, Alexander J. Shturmakov, Joshua J. Goetz, Chris J. Gibson, Donald A. Lebar
A new large diameter ice cord drill: the blue ice drill

Adrian B. McCallum
A brief introduction to cone penetration testing (CPT) in frozen geomaterials

J. Schwander, S. Marending, T.F. Stocker, H. Fischer
RADIX: a minimal-resources rapid-access drilling system

Alexander J. Shturmakov, Donald A. Lebar, Charles R. Bentley
DISC drill and replicate coring system: a new era in deep ice drilling engineering

Joseph M. Souney, Mark S. Twickler, Geoffrey M. Hargreaves, Brian M. Bencivengo, Matthew J. Kippenhan, Jay A. Johnson, Eric D. Cravens, Peter D. Neff, Richard M. Nunn, Anais J. Orsi, Trevor J. Popp, John F. Rhoades, Bruce H. Vaughn, Donald E. Voigt, Gifford J. Wong, Kendrick C. Taylor
Core handling and processing for the WAIS Divide ice-core project

Huiwen Xu, Lili Han, Pinlu Cao, Mingyi Guo, Junjie Han, Dahui Yu, Pavel Talalay
Low-molecular-weight, fatty-acid esters as potential low-temperature drilling fluids for ice coring

Nan Zhang, Chunlei An, Xiaopeng Fan, Guitao Shi, Chuanjin Li, Jingfeng Liu, Zhengyi Hu, Pavel Talalay, Youhong Sun, Yuansheng Li
Chinese First Deep Ice-Core Drilling Project DK-1 at Dome A (2011–2013): progress and performance

More papers for *Annals* 55(68) will be listed in the next issue

ANNALS OF GLACIOLOGY 56(69)

The following papers have been selected for publication in Annals of Glaciology *56(69) (thematic issue on Sea ice in a changing environment), edited by Petra Heil*

Jennifer K. Hutchings, Petra Heil, Olivier Lecomte, Roger Stevens, Adam Steer, Jan L. Lieser
Comparing methods of measuring sea ice density in the East Antarctic

Jennifer K. Hutchings, Donald K. Perovich
Preconditioning of the 2007 sea-ice melt in the eastern Beaufort Sea, Arctic Ocean

Stefan Kern, Gunnar Spreen
Uncertainties in Antarctic sea-ice thickness retrieval from ICESat

Nina Maaß, Lars Kaleschke, Xiangshan Tian-Kunze, Rasmus T. Tonboe
Snow thickness retrieval from L-band brightness temperatures: a model comparison

Michael H. Meylan, Lucas J. Yiew, Luke G. Bennetts, Ben J. French, Giles A. Thomas
Surge motion of an ice floe in waves: comparison of a theoretical and an experimental model

Phil Reid, Sharon Stammerjohn, Rob Massom, Ted Scambos, Jan Lieser
The record 2013 Southern Hemisphere sea-ice extent maximum

Ian Simmonds
Comparing and contrasting the behaviour of Arctic and Antarctic sea ice over the 35-year period 1979–2013

Adrienne White, Luke Copland, Derek Mueller, Wesley Van Wychen
Assessment of historical changes (1959-2012) and the causes of recent break-ups of the Petersen ice shelf, Nunavut, Canada

S. Willmes, G. Heinemann
Pan-Arctic lead detection from MODIS thermal infrared imagery

Pat Wongpan, Patricia J. Langhorne, David E. Dempsey, Lisa Hahn-Woernle, Zhifa Sun
Simulation of the crystal growth of platelet sea ice with diffusive heat and mass transfer

Qinghua Yang, Svetlana N. Losa, Martin Losch, Jiping Liu, Zhanhai Zhang, Lars Nerger, Hu Yang
Assimilating summer sea-ice concentration into a coupled ice--ocean model using a LSEIK filter

Xi Zhao, Haoyue Su, Alfred Stein, Xiaoping Pang
Comparison between AMSR-E ASI sea-ice concentration product, MODIS and pseudo-ship observations of the Antarctic sea-ice edge

More papers for Annals 56(69) will be listed in the next issue

ANNALS OF GLACIOLOGY 56(70)

The following paper has been selected for publication in Annals of Glaciology *56(70) (thematic issue on Contribution of Glaciers and Ice Sheets to Sea Level Change), edited by Richard Hindmarsh and Frank Pattyn*

C. Vincent, E. Thibert, M. Harter, A. Soruco, A. Gilbert
Volume and frequency of ice avalanches from the Taconnaz hanging glacier (French Alps)

More papers for Annals 56(70) will be listed in the next issue

The Sea Ice Meeting

A report on the IGS symposium on 'Sea Ice in a Changing Environment'

Hobart, Tasmania, Australia, 10–14 March 2014

An international contingent of sea ice scientists converged on Hobart in March for the 4th International Sea Ice Symposium of the International Glaciological Society, hosted by the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC).

The symposium, on the theme Sea Ice in a Changing Environment, ran for five days, but the full programme stretched over 11 days and included seven workshops and the inaugural Public Open Science Day (see below). Over 210 delegates, including 173 from 16 overseas countries, attended the meeting, with strong representation from Belgium, Germany, Japan, New Zealand and the USA.

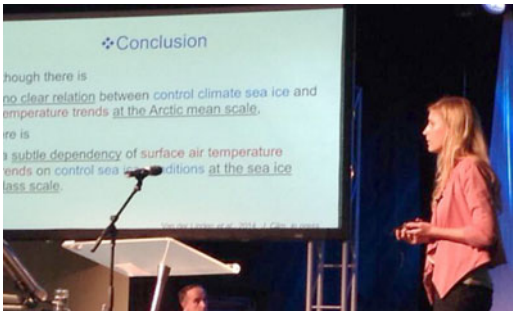
A total of 155 oral presentations, including 10 keynote lectures, and over 120 posters contributed to the 14 symposium topics. The latter were strongly multidisciplinary and covered a wide range of highly topical issues. These included large-scale change and variability in both polar regions; advances in sea ice analysis using remote sensing, modelling and palaeo records; advances in instrumentation and observation methods; sea ice and ecosystems modelling; and interactions between sea ice and ice sheets, ice shelves, icebergs, the ocean and atmosphere and the biosphere.

Scientific highlights showcased during the symposium included new findings on the 2013 Antarctic sea ice extent maximum and the strong regionalization of Antarctic sea-ice processes, Arctic sea ice decrease, linkages between Antarctic sea ice and ice shelf health, bipolar control mechanisms of algal assemblages, and advances in numerical modelling, remote sensing, instrumentation and methods. The affiliated workshops allowed specialized task and working groups to present and discuss new developments and future directions with their participants.

Tony Worby presented a special plenary session on the use of remote sensing in sea-ice analysis celebrating the work of Seymour Laxon and Katharine Giles, lost to the glaciology community in 2013

A strong field of student and young scientist contributions were judged for best poster and oral presentations by a panel led by Professor Emeritus

The auditorium was spacious and comfortable and the audience was attentive.



Elena van der Linden from the Royal Meteorological Institute of the Netherlands gave a clear explanation of the relationship between local atmospheric temperature and sea ice concentration.

Willy Weeks with the winners of the various student presentation awards.

Willy Weeks. Professor Weeks, who is acknowledged as the leading living sea-ice scientist, also entertained delegates with a very personal account of sea-ice research over the last 50 years (the 'good old days').

In tune with the topic of this symposium, the International Glaciological Society will publish a thematic issue of the Annals of Glaciology (Volume 56(69)), including about 50 peer-reviewed manuscripts received from both symposium participants and non-participants.

Feedback from symposium participants on the quality and relevance of presentations and the symposium set up has been very positive. Delegates also enjoyed their welcome by the Tasmanian Governor, the Honourable Peter Underwood, one evening at Government House, and the time allocated to enjoy Tasmania's unique outdoor and cultural scene during Wednesday afternoon excursions.

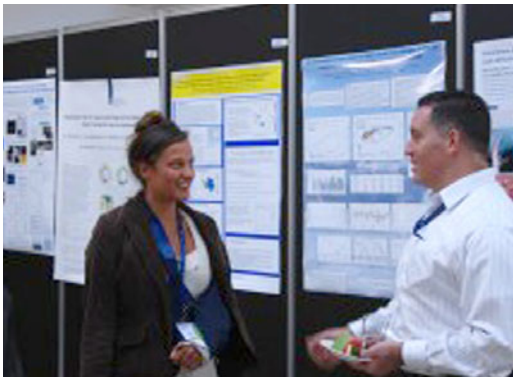
The symposium would not have been possible without the generous support and sponsorship offered by a number of organizations, both local and world-wide. These included the ACE CRC, the World Climate Research Programme's Climate and Cryosphere (CliC) project (Norway), the Office of Naval Research – Global (USA), the Tasmanian Government Department of Economic Development, Tourism and the Arts, the International

Participants were invited to a reception at Government House on Tuesday evening.

The Tromsø contingent was in Hobart in force having organized the previous sea ice symposium in 2010 and with the T-shirt (modelled here by Mats Granskog) to prove it.

The CEO of the ACE CRC, Tony Press, Eric Wolff and Mana Inou enjoying the Governor's hospitality

The main lobby outside the lecture theatres where the refreshments were served and the poster sessions took place.

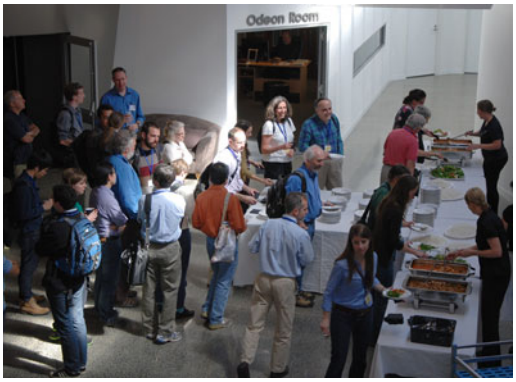


Natalie Radojcic and Marvin (Blake) McBride enjoying the poster session.

Association for Cryospheric Sciences, Institute for Marine and Antarctic Studies (IMAS – at the University of Tasmania), the University of Manitoba (Canada), Business Events Tasmania, and the National Snow and Ice Data Center (USA). This sponsorship included support for young scientists to attend the conference. The Local Organiszing Committee is grateful to the sponsors and other supporters for enabling this world-class event to be hosted by the ACE CRC in Hobart.

Last but not least, the organizing committee is grateful for the help and enthusiasm of many volunteers from the ACE CRC, IMAS and the Australian Antarctic Division. Without the extraordinary help of these people, the symposium and associated events could not have taken place.

Petra Heil and Rob Massom
On behalf of the symposium Local Organizing Committee.



The food was excellent throughout the symposium.

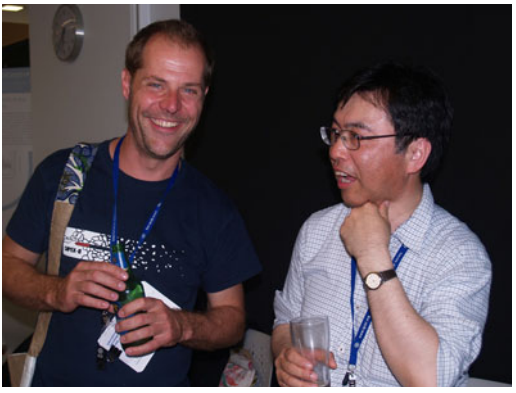
Coffee breaks were a good time to catch up with your colleagues and friends – here Mark Hemer, Mike Meylan and Alex Babanin.

Petra Heil and Jan Lieser of the LOC with some of their crew of helpers and support staff – the symposium couldn't have gone on without their input! L to R: Merel Bedford, Mana Inoue, Molly Jia, Wenneke ten Hout, Jan Lieser, Petra Heil, Amelia Fowles, Miranda Harman and Eva Cougnon.

Hajo Eicken was so anxious to get to the Icebreaker that (like several others) he arrived with his luggage still on his back...

As is their wont, the Council of Elders lost no timing in kitting themselves out in appropriate hats, this time of kangaroo leather.

... but the Icebreaker refreshments were certainly worth the effort.



Klaus Meiners and Takenobu Toyota exchanging notes over a beer at the Icebreaker

Willy Weeks gave an entertaining and informative talk as the after-dinner speaker at the IGS banquet.

Gauthier Carnat, Célia Julia Sapart and Véronique Schoemann at the symposium banquet on Thursday evening.

Inaugural Public Open Science Day of the ACE CRC

The new waterfront building of the University of Tasmania, home to the Institute for Marine and Antarctic Studies (IMAS) and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), opened its doors to its first major public event on Sunday 9 March 2014.

School students and the general public were invited to attend the Public Open Science Day on the theme of sea ice and the polar system. The event was organized by the Local Organizing Committee of the International Symposium on Sea Ice in a Changing Environment and the ACE CRC (see above). The enthusiastic public response engendered a great deal of energy in those fortunate enough to participate in showcasing the unique contribution of Hobart's highly-diverse research community to Antarctic and Southern Ocean science.

Three keynote speakers provided the audience with an introduction to the wonders and challenges of sea ice physics and ecosystems and connections between Tasmanian/Australian weather patterns and the Antarctic and Southern Ocean. The speakers, Professor Andy Mahoney (USA), Professor Hauke Flores (Germany) and Tasmania's own Dr Mike Pook, captivated the audience with entertaining and informative talks, and many questions were asked of all three speakers after both sessions. One speaker even used icy poles to help demonstrate brine flow through sea ice. Such was the success of these lectures that the IMAS lecture theatre was filled to capacity in both sessions.

Other popular activities included five science stations adjacent to the lecture theatre, giving visitors first-hand experience of Antarctic ice, viscosity (an analogue to gravity drainage of the

Public lectures during the open day were well attended. (photo ACE CRC)

Children get tangled in the food web game run by Australian Antarctic Division krill scientist Rob King (left) during the Public Open Science Day.... (Photo ACE CRC)

... while IMAS PhD student Mana Inoue shows off an Antarctic ice core. (Photo ACE CRC)

ACE CRC research scientist Jessica Melbourne-Thomas with some enthusiastic children dressed up like expeditioners. (Photo ACE CRC)

ice sheet), and ocean waves (simulated in a tank). Emerging technologies were also demonstrated, much to the delight of the many budding 'tech heads' present. The science stations were ably manned by students and young scientists, who provided background information, explained the science and answered questions.

A selection of superb photography provided a display of the polar landscape, wildlife, microorganisms and work environment. In a side lecture, the crowd was treated to a demonstration of the power of satellite remote sensing, in this case in support of sea ice science and ship operations south of Tasmania. The old favourite 'dress up like an Antarctic expeditioner' (kits courtesy of the Australian Antarctic Division) entertained young and old alike. Another great success was a demonstration of the Antarctic food web. Finally, school-aged attendants participated in a prize draw, with the winners invited to a special session at the sea-ice symposium.

With an estimated 2000–3000 visitors, lots of smiley faces and a wonderful bunch of contributors and helpers (thank you everyone!), this Public Open Science Day was a spectacular success and a wonderful lead-in to the international sea ice conference. Visitor feedback was overwhelmingly positive and enthusiastic, with many expressing an interest in more such events.

Petra Heil and Rob Massom
On behalf of all involved in the Open Science Day event

Excursion to Mona

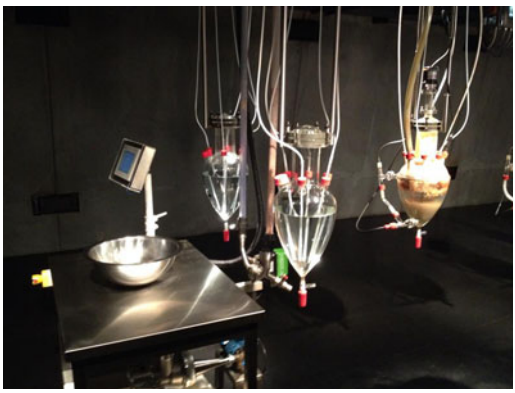
There is a brave new world in Hobart, specifically a brave new world of art, which is embodied in the Museum of Old and New Art, a.k.a. MONA. As is customary with IGS symposia, Wednesday afternoon of the long, engaging week of oral and poster presentations was devoted to less formal activity and a chance to relax and get to know fellow delegates. I took the trip (by ferry boat from the docks at the Hobart waterfront) to the MONA to visit what is undoubtedly Australia's most 'out back' exhibition of mostly modern art.

The museum, funded privately by a successful Australian gambling professional, is filled with some of the most far-out material I've ever seen. Possibly the most sensuously grand piece was a multi-stage kinetic sculpture (below) that featured a digestion process that, when fed twice a day, produced bio-degraded 'droppings' that possess many of the same features (including olfactory) of human-made waste products.

While no subject was off limits as themes for the art displayed in the MONA, there were some art forms that were very creative and attractive to a glaciologist. The most impressive expression of nature in the gallery was a piece that is in a state of constant creation: a machine drawn pencil sketch (below) that is controlled entirely by wind vanes on the outside of the building. For those who like numerical modelling, there was also a digital whispering gallery driven entirely by random number generators.

All told, the Wednesday adventure to MONA for about 30 participants of the Symposium turned out to be an exciting experience that provided both a challenging aesthetic experience and a good break from the excellent science of the week.

Doug MacAyeal



Excursion to Mount Field

Another field-excursion went to Mount Field National Park. Founded in 1916, this is Tasmania's oldest national park and lies an hour's drive north-west of Hobart. The park is known for its temperate rainforest and its stunning waterfalls. Our group of more than 50 IGS participants visited the Russell, Horseshoe and Lady Barron falls, stopping often to watch wildlife and look at tree-ferns. On the way back to Hobart, the group stopped at the Two Meter Tall farmhouse micro-brewery to taste some Tasmanian beers and ciders and had an Australian BBQ featuring some local game.

The rain forest was full of fascinating fungi.

Rob Massom and Hayley Chen pose beside one of the beautiful waterfalls.

Excursion to Mount Wellington

About 30 keen participants took up the outdoor challenge of descending Mt Wellington (1268m) by bike. During a bus tour from Hobart's wharf area to the top of the mountain, some commentary and great views of the mountain itself were enjoyed. From the top magnificent 360° views from the Derwent Valley down to the Southern Ocean and across to the Tasman Peninsula were on offer. The inlets, bays and hills of beautiful Hobart made a stunning panorama. Bikes and safety gear were issued by our guides on top of the mountain in a rather windy and hence chilly location, so every one was keen to get moving. On our downhill descent from the mountain, the subalpine landscape was gradually replaced by a magnificent forest. Several VERY short stops allowed regrouping and to take in the varying views. The winding mountain road took us past the Chalet and the Springs to the foothills, where we moved on an off-road section. Riding on some winding, twisting ups and downs, some of us looked forward to the comfort of the next IGS sessions. We entered suburbia near the Cascade Brewery and Gardens, close to the conference centre. We then cycled past the historic Female Factory and through South Hobart and Battery Point with their Georgian and Federation architecture.

A group of intrepid cyclists pose against the stunning panorama of Hobart laid out below.

Excursion to Bonorong Wildlife Park and historic Richmond

Tasmania is an ark for many wildlife species that have disappeared on mainland Australia. Bonorong, a sanctuary for Tasmanian wildlife about 40min north of Hobart, operates Tasmania's only 24-hour wildlife rescue service, receiving about 5000 rescue calls per year, from which they recruit temporary residents for the park and foster them out to a network of 850 wildlife carers. Our group was given a personalized tour by Bonorong director Greg Irons, the 2012 Young Australian of the year (TAS), where we found out that across Australia there are 23 million feral cat kills every day. On the bright side, the tour met some of the animals and learned about their story of survival. Close contact was made with a wombat and koala before viewing the Tasmanian devils. Since the onset of facial tumour disease, about 85% of the Tassie devil population has gone in the past 17 years. The tour was entertaining, inspiring and interesting and was followed by independent exploration of the park.

The tour moved then on to historic Richmond, with fine examples of Tasmania's stark convict heritage and beautiful historic buildings. The town was established in the 1820s, when it was an important military staging post and convict station linking Hobart with Port Arthur. It nestles in the Coal River valley, and is famous for its Georgian architecture. We enjoyed a stroll to the oldest bridge in Australia, built in 1823, wandered past the gaol, churches and many other historic buildings. The tour ended with a stopover at the the Coal Valley vineyard, which also offered panoramic views over the vines to to the Coal River estuary below, with Pittwater and Barilla Bay.

Petra Heil

Close encounter with a wombat...

... and an Eastern Grey kangaroo.

Tasmanian devils have extraordinary and rather alarming faces.

A group of symposium participants at the oldest bridge in Australia

INTERNATIONAL GLACIOLOGICAL SOCIETY

International Symposium on

Contemporary ice-sheet dynamics:
ocean interaction, meltwater and non-linear effects

IGS2015
ICE SHEET DYNAMICS

Cambridge, UK, 17–22 August 2015

Co-sponsored by:
British Antarctic Survey

FIRST CIRCULAR
July 2014
http://www.igsoc.org/symposia/2015/cambridge

The International Glaciological Society (IGS) will hold an International Symposium on 'Contemporary ice-sheet dynamics: ocean interaction, meltwater and non-linear effects' in 2015, in Cambridge, UK, from 17–22 August 2015.

THEME

Over the last 15 years remarkable progress has been made in understanding the processes affecting Earth's great ice sheets. At both poles, observations increasingly show the sensitivity of grounded ice to changes in the ocean, prompting a gathering pace in research into how ice sheets change in response to variations in ocean climate.

The processes controlling grounded ice's response to ocean changes are an intimately interrelated sequence. The open ocean delivers heat into the coastal seas, coastal seas transfer it to ice fronts via proglacial fjords and to the ice shelf cavities, processes at the ice–ocean interface melt the ice and affect behaviour in the inland ice streams, and the ice stream dynamics finally transmit changes across the drainage basins from which they are nourished. In this way, the ocean is intimately linked to ice-stream and drainage-basin changes; every process along this sequence is important, and changes to any of these stages can affect the whole system.

The meeting will bring together researchers from the oceanographic and glaciological communities who use observational and modelling tools in the study of ice-sheet stability, surface mass balance and its influence on glacier dynamics, ice stream–ice shelf interaction, ice-sheet basal properties, sub-glacial hydrology, tidewater glaciers and ocean interactions, ice shelf mass balance, ice shelf stability, iceberg calving, oceanographic circulation and processes within sub-ice shelf cavities, circulation and ocean heat transfer through fjord systems, continental shelf processes that modify oceanographic conditions and processes beneath ice shelves, and teleconnections that influence shelf seas. By bringing all these communities together, the aim of the meeting is to establish an integrated understanding of this interrelated sequence of processes that ultimately link open-ocean variations with changes in the inland ice sheet, and to provide an overview of the current state of knowledge in this rapidly-moving field of research.

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

TOPICS

Following on from the discussion above, topic areas will cover the sequence of environments and disciplines from the open ocean to the inland ice sheet, and include observations and modelling of:

1. **Transport of ocean heat across the continental shelf break** (oceanographic mechanisms that allow heat onto the continental shelf, influence of teleconnections, shelf break ocean dynamics)
2. **Continental shelf ocean processes** (processes influencing shelf conditions, circulation in proglacial fjords, impacts on the ice shelf cavity and tidewater glacier calving fronts, air-sea exchange, sea-ice formation, coastal polynyas)
3. **Sub-ice-shelf processes and environment** (ice shelf basal mass balance, ice-ocean boundary layer, sub-ice shelf heat transport)
4. **Tidewater glacier and ice-shelf stability** (iceberg calving processes, impact of sub-glacial drainage on ice front processes, ice-shelf disintegration, structure of ice shelves)
5. **Ice sheet-stream-shelf glaciology** (impact of ice shelves on ice streams, grounding line dynamics, upstream propagation of grounding line changes, ice stream dynamics, ice stream basal conditions, sub-ice stream hydrology, ice sheet and ice stream mass balance)
6. **Dynamics and stability of ice sheets** (evidence of past ice sheet instability from proxies, observed state of the great ice sheets, non-linear dynamical processes)
7. **Integrated understanding of the processes linking oceans and ice sheets, and changes therein** (external drivers and internal instabilities, interactions between these, model predictions of future behaviour and implications thereof, overall effect of ocean and atmosphere on changes in the great ice sheets)

Potential participants are encouraged to contact the Chief Editor if they feel additional topics would be appropriate.

PROGRAMME

A mixture of oral and poster sessions, interlaced with ample free time, forms the general framework of the symposium, which is intended to facilitate the exchange of scientific information between participants in an informal manner. Additional activities will include the customary Icebreaker and Symposium Banquet.

ABSTRACT AND PAPER PUBLICATION

Participants intending to present at the symposium are required to submit an abstract in due time. The Council of the International Glaciological Society will publish a related thematic issue of the *Annals of Glaciology*. Participants and non-participants of the symposium alike are encouraged to submit manuscripts for this volume.

SYMPOSIUM ORGANIZATION
Magnús Már Magnússon (International Glaciological Society)

SCIENCE STEERING AND EDITORIAL COMMITTEE
Chief Editor: Tony Payne

LOCAL ORGANIZING COMMITTEE
Chair: Andy Smith

VENUE
The symposium will be held in Cambridge, UK. Cambridge has a strong glaciological heritage, which continues today. The British Antarctic Survey has been based in Cambridge since 1975; the Scott Polar Research Institute, part of the University of Cambridge, was founded in 1920 and houses a unique polar museum; Cambridge is also home to the International Glaciological Society.

The venue for the symposium will be Churchill College, University of Cambridge. Churchill College is the largest College campus in Cambridge, set in a 42 acre site on the edge of the city centre. It is one of the newer colleges of the University, receiving its Royal Charter in 1960 with a Foundation that specifies a focus on science, mathematics and technology. Accommodation has been reserved for conference participants in Churchill College.

The Symposium Banquet will be held in the Great Hall of Homerton College, University of Cambridge. The Great Hall was built in 1889 and retains an atmosphere of history, grandeur and academia.

SYMPOSIUM EXCURSIONS
To be determined.

FURTHER INFORMATION
If you wish to attend the symposium please register your interest online at http://www.igsoc.org/symposia/2015/cambridge/.

The Second Circular will give further information about accommodation, the general scientific programme, additional activities, preparation of abstracts and final papers. Members of the International Glaciological Society will automatically receive a Second Circular, as will all those who register their interest online. All information regarding this symposium will be updated on the IGS conference website, http://www.igsoc.org/symposia/2015/cambridge/, and a local symposium website.

INTERNATIONAL GLACIOLOGICAL SOCIETY

International Symposium on

Glaciology in High-Mountain Asia

IGS 2015 KATHMANDU

Kathmandu, Nepal
1–6 March 2015

Co-sponsored by:

- International Centre for Integrated Mountain Development (ICIMOD)
- LabEx OSUG@2020 (ANR10 LABX56)
- Institut de Recherche pour le Développement (IRD)
- Laboratoire d'Étude des Transferts en Hydrologie et Environnement (LTHE)
- Université Joseph Fourier Grenoble 1
- International Association of Cryospheric Sciences
- Department of Hydrology and Meteorology, Government of Nepal
- Kathmandu University
- Tribhuvan University

SECOND CIRCULAR
July 2014
http://www.igsoc.org/symposia/2015/kathmandu
http://www.icimod.org/igs2015/

The International Glaciological Society will hold an International Symposium on 'Glaciology in high-mountain Asia' in 2015. The symposium will be held in Kathmandu, Nepal, from 1–6 March 2015.

THEME

The high mountains of Asia are estimated to contain one of the greatest concentrations of glacier ice outside the polar regions, and are the headwaters of rivers which support agriculture and livelihoods of over one billion people. Changes in snow, ice, and permafrost due to climatic changes will impact water resources, ecosystems and hydroelectric power generation, and will aggravate natural hazards. To understand these impacts, the symposium will provide a forum to discuss advances in measurements, modeling, and interpretation of glaciological and cryospheric changes in high mountain Asia.

As the field of glaciology intersects with both atmospheric and hydrologic sciences, the symposium will also focus on linkages between atmospheric processes and cryospheric change and the downstream impacts in the region. The meeting seeks to bring together scientists from the region and around the world and provide an overview of the state of science with respect to the glaciers, snowpacks and permafrost of the Himalayan, Hindu Kush, Karakoram, Tien Shan, Pamir and Tibetan Plateau regions.

TOPICS

Symposium topics should be focused on studies in high mountain Asia, and include the following:

1. **Past, present, and future glacier change** (reconstructions, observations, projections)
2. **Observations and models of glacier dynamics** (including glacier response times, and thickness and volume of ice)
3. **Glacier and snow melt processes** (debris cover, supraglacial lakes, black carbon, etc.)
4. **Hydrology of glacierized catchments**
5. **High-altitude meteorology, climate downscaling and climatic change** (ice core records, etc.)
6. **Glacial hazards** (GLOFs, avalanches, mass movements)
7. **Permafrost studies** (measurement, modelling, distribution)
8. **Impacts of cryospheric change** (local and regional water resources, ecosystems, etc.)

REGISTRATION FEES
All fees are in US dollars, $

– Participant (current IGS member):	$425
– Participant (non-member):	$625
– Student or retired (current IGS member):	$250
– Student or retired (non-member):	$325
– Accompanying person (18+):	$100
– Accompanying person (<18):	$50
– Late registration surcharge (after 1 February 2015):	+$100
– Early-bird discount (before 15 December 2014):	-$50

The fees include the icebreaker, the symposium banquet, lunch (Mon–Fri) daily morning/afternoon coffee and the mid-week excursion. The fees for non-members include online membership of the IGS for 2015.

Please register for the symposium through the IGS website. If you cannot do this, contact the IGS office directly. If payment by credit card is not possible, contact the IGS office to arrange for a bank transfer. T**he 'Early-bird' deadline for registration is 15 December 2014. After 15 December the registration fee will be as indicated in the table above. A late registration surcharge of $100 will be added after 1 February 2015.**

ACCOMPANYING PERSONS: The accompanying person's registration fee includes the icebreaker, mid-week excursion and symposium banquet. It does not include tea/coffee, lunch **nor attendance at symposium sessions**.

STUDENT SUPPORT: Students who are listed as presenting authors are encouraged to apply for financial support at the time of abstract submission. Only presenting authors will be supported, and support levels will depend on the number of applications received.

VENUE

The symposium will take place at the historic Yak and Yeti Hotel in Kathmandu, Nepal (yakandyeti.com). The hotel is centrally located, with access to shops, restaurants, and a wide variety of accommodation options. Transport to the hotel from Tribhuvan International Airport takes approximately 30 minutes, and most hotels offer airport pickup and dropoff. There is also a pre-paid taxi service desk available before leaving the airport.

LOCATION

The Kathmandu Valley has a rich cultural and religious history and is home to seven UNESCO World Heritage Sites. At 1400 m elevation, Kathmandu is surrounded by the foothills of the Nepalese Himalaya, and is typically dry and mild in March. Traffic is more or less on the left, road signs and rules are virtually non-existent, and pedestrians must be decisive.

ACCOMMODATION

A block of 50 rooms has been reserved at the Yak and Yeti, at an approximate cost of $120/night, including breakfast, wifi and airport pickup and dropoff. To get the special symposium room rate, contact Shital Baniya, Sales Manager at the hotel. Tel: +977 1 4248999 (reception); Mob: +977 984168394; E-mail: sales@yakandyeti.com.np

As one of the top tourist destinations in Asia, Kathmandu is full of accommodation options to fit any budget, many of them being located in nearby Thamel. Other alternatives are given on the local website (www.icimod.org/IGS2015)

MIDWEEK EXCURSION
A half-day midweek excursion will be organized on Wednesday afternoon. There will be a choice of (1) a cultural walking tour of Bhaktapur or (2) hiking in the Nagarjun Forest. Bhaktapur is located 45 minutes east of Kathmandu and contains a stunning mix of history and culture in a car-free central walking zone. The walk is approximately 2.5 hours. Nagarjun Forest, located only 20 minutes north of the conference venue, is one of the Kathmandu Valley's best kept secrets. The hike will take participants on a strenuous 3-hour (5 km) trip to the summit, with a vertical gain of over 500 m.

REGISTRATION AND RECEPTION
There will be a Welcome reception/dinner at the Yak and Yeti Hotel at 19:30 on Sunday 1 March, sponsored by ICIMOD. Registration will start at 17:00 at the same location. It will also be possible to register on Monday morning

BANQUET
The banquet will be held on Thursday evening. More information will become available on the symposium homepage.

POST-SYMPOSIUM EXCURSION
An excursion to the Annapurna Sanctuary is proposed. The trek, covering approximately 8 days, will take participants up to 4300 m in one of the world's premier trekking locations. A local trekking agency will organize all transportation and logistics, and more details will be announced on the symposium homepage.

ABSRACT AND PAPER PUBLICATION
Participants wishing to present a paper at the symposium are required to submit an abstract, and there will be both oral and poster presentations. A programme and collection of submitted abstracts will be provided for all participants at the symposium. The Council of the International Glaciological Society has decided to publish a thematic issue of the *Annals of Glaciology* on topics consistent with the symposium themes. Submissions to this issue will not be contingent on presentation at the symposium, and material presented at the symposium is not necessarily affirmed as being suitable for consideration for this issue of the *Annals*. Participants are encouraged, however, to submit manuscripts for this *Annals* volume. The deadline for receiving *Annals* papers is 5 January 2015.

SYMPOSIUM ORGANIZATION
Magnús Már Magnússon (International Glaciological Society)

SCIENTIFIC STEERING AND EDITORIAL COMMITTEE
Graham Cogley (Chief Editor); Surendra Adhikari; Etienne Berthier; Bodo Bookhagen; Tobias Bolch; D.P.Dobhal; Koji Fujita; Stephan Gruber; Walter Immerzeel; Shichang Kang; Jeffrey Kargel; Francesca Pellicciotti; Joseph Shea; Patrick Wagnon

LOCAL ORGANIZING COMMITTEE
Joseph Shea (Chair); Dorothea Stumm; Patrick Wagnon; Pradeep Mool; Rijan Kayastha; Arun Shrestha; Prerna Thapa, Lochan Devkota

Photos by E. Soteras, E. Miles and J. Shea

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Joseph Shea
Local Organizing Committee
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FURTHER INFORMATION

If you wish to attend the symposium please log onto the IGS website at www.igsoc.org/symposia/2015/kathmandu/registration and register your details and interest in attending. This will ensure you receive any relevant information and updates. Formal registration will open 15 October 2014

IMPORTANT DATES

International Symposium on Glaciology in High-Mountain Asia

Abstract submission deadline:	27 October 2014
Student travel support application:	27 October 2014
Notification of acceptance:	15 November 2014
Early registration deadline:	15 December 2014
Deadline for full refund:	12 January 2015
Deadline for partial refund:	14 February 2015
Venue hotel booking deadline:	5 January 2015
Late fee payable from:	1 February 2015
Welcome/Reception Dinner (sponsored by ICIMOD):	1 March 2015
Symposium starts:	2 March 2015

Annals of Glaciology volume 57, issue 71

Paper submission deadline:	5 January 2015
Final revised papers deadline:	15 April 2015

News

Report from the Third International Summer School in Glaciology

McCarthy, Alaska, USA, 6–16 August 2014

Hosted by the University of Alaska Fairbanks (UAF), the third International Summer School in Glaciology brought together a dynamic group of students and instructors to discuss glaciology theory and techniques in the heart of the Wrangle Mountains in southwestern Alaska. The majority of participants set off from Fairbanks on 6 August and after a 10 hour journey of pipeline views, gas station brews, salmon jumping and rear-wheel bumping, we all arrived in the small town of McCarthy, Alaska.

We were an international group of students, with approximately half studying in the USA and the remainder travelling from the UK, Canada, Norway, Germany, Switzerland and as far as New Zealand, Australia and India! Equally diverse were the research interests of the students, with thesis projects spanning geographically from pole to pole and academically from computer modelling to fieldwork-intensive case studies. Joining us as glaciology instructors were Regine Hock (UAF and summer school coordinator), Jon Ove Hagen (University of Oslo), Martin Truffer (UAF), Ed Bueler (UAF), Andy Aschwanden (UAF), Nick Barrand (University of Birmingham) and Mike Loso (Alaska Pacific University Anchorage). The instructors did a great job satisfying our broad spectrum of interests and over the 10-day course we studied glacier mass balance and surface energy balance, continuum mechanics, ice dynamics, tidewater glaciers, ice sheet modeling, inverse methods, glacier geomorphology, subglacial hydrology, thermodynamics and remote sensing methods. With a lineup like that, we were grateful for the endless supply of caffeine from our gracious hosts at the Wrangle Mountain Centre! Our morning lectures were hosted in Porphyry Place, a beautiful log cabin and former home of the late Edward LaChapelle, the highly regarded avalanche researcher, glaciologist, ski mountaineer and author.

In the afternoons we would spend 2 hours gaining hands-on experience through exercises developed around the morning lecture content. After refuelling once more on caffeine, we would shift to our group assignments in which teams of two or three students would work on a project developed by one of the course instructors. The projects were wonderfully diverse and ranged from modelling experiments to working with remote sensing or field measurements. As an example, one team was able to work with data collected by a drone (i.e. not an undergraduate student) over the nearby Kennicott Glacier. The drone, most unfortunately, met a sad demise as it attempted a renegade survey of its own over the moraines of the Kennicott, and we graduate students vicariously learned the dangers of disobedience in the field. The efforts of our group projects culminated in a mini-conference on the last day of the field school at whichh students presented their findings. The group projects were a great opportunity to benefit from the specific expertise of our assigned mentors and it was amazing to see how much we had accomplished in such a short time. Who knew the secrets to Matlab and Python programming lay in the remote reaches of Alaska?

Kennicott Glacier. Photo: Noel Fitzpatrick

Regine Hock and Shaun Eaves working on group projects. Photo: Florian Ziemen

Admiring a moulin on Root Glacier.
Photo: Laura Thomson

A new addition to the summer school was a session on science communication facilitated by Lindsay Bartholomew, science curator at the Frost Museum of Science in Miami, Florida, USA. Lindsay did a great job helping us rekindle our scientific sense of wonder and curiosity, and taught us how to encourage this in others through sharing our own research in an accessible, exploratory and engaging way. It was unquestionably a valuable addition to our training as future scientists and will hopefully become a regular component of glaciology programmes in the future. Lindsay maintained a compelling blog about the summer school throughout our time in McCarthy and it can be viewed at:
http://www.miamisci.org/lindsayinthearctic/

The highly anticipated field excursions were led by part-time resident of McCarthy Mike Loso. On our first excursion, Mike led us from the trailhead in the town of Kennicott to the lateral moraines of the Kennicott Glacier and then onto the Root glacier, which coalesces with the debris-covered Kennicott approximately 5 km upstream from the terminus. We crossed the Root Glacier, admiring great examples of thrust faults, moulins and medial moraines. We even witnessed a large colony of glacier mice, which became a noted highlight throughout the course. From the western margin of the Root glacier we admired the impressive Donahoe Falls, then slid down the debris-ridden margin to explore an ice cave that forms where the waters from Donahoe Falls cut under the ice. As we scrambled back onto the glacier, the mantra of graduate students everywhere, 'two steps forward, one step back', rang all too true, but we all found our way back up onto the Root Glacier (albeit with varying levels of gracefulness). At the end of the day we devoured a delicious pasta dinner and enjoyed an entertaining public lecture on Tidewater Glaciers from Martin Truffer in the Kennicott recreation hall. On our second excursion we explored the proglacial area of the Kennicott glacier where a large lake has formed in recent years. From here we had excellent views of the regional geomorphology and were able to take in lateral moraines and trim lines dating back to the Little Ice Age, as well as several rock glaciers that flow into the Kennicott valley.

Two of our evenings were spent enjoying talks from guest lecturers. On the first evening of the field school Mark Vail, a 30-year resident of McCarthy, shared with us the fascinating history of

Instructors and participants of the third International Summer School in Glaciology on Root Glacier.
Photo: Andy Aschwanden

Students investigating an ice cave beneath Root Glacier near Donahoe Falls.
Photo: Laura Thomson

Glaciologists refueling in the old McCarthy Hardware Store, now used by the Wrangle Mountain Centre. Photo: Noel Fitzpatrick

the community and the nearby ghost town of Kennicott. Kennicott was developed upon the prosperous copper ore deposits of the region during the early 1900s. Any lingering misgivings about our own drive from Fairbanks were quelled as we heard stories of the men who built (and rebuilt) the Copper River and Northwestern Railway across river gorges and mountain ranges, and often within mere metres of unpredictable glaciers. We also enjoyed a lecture from Vladimir Alexeev (UAF), who shared with us his work on global climate modelling, with a specific emphasis on changes occurring in the Arctic. This lecture provided a helpful context for many of us working in the Arctic and brought to our attention the broader impacts of these changing conditions, beyond the response of glaciers.

For fun (which is not to say that continuum mechanics isn't fun), we spent our evenings enjoying the wilderness of Alaska in its many forms. Given our international crowd, we decided to initiate a football match on a pock-marked pitch, with the New World taking on the Old World… and then immediately regretting the decision (it appears that you can't teach a New World old tricks). We also participated in Friday-night softball with the McCarthy locals (many with beards to rival the most field hardened glaciologists), open mic night in the McCarthy Saloon, and undertook our own attempts at music making in the old McCarthy Hardware Store, which serves as the main gathering space for the Wrangle Mountain Centre. On our final night together we were treated to a decadent meal in the dining room of the McCarthy saloon, and here the wine and conversation flowed like Jakobshavn Isbræ in the summer of 2012. The winners of the photo and video contest were selected by the crowd applause-ometer and the winners were awarded the coveted paraphernalia generously donated by the IGS (thank you!). Students and instructors alike spent the remainder of the evening around the campfire where Glacier Jeopardy ensued and the student poster contest culminated (in a rather fiery display). We left as a new generation of glaciologists, indoctrinated in the lexicon of the Glossary of Mass Balance and Related Terms, and very thankful for the camaraderie and efforts of our peers and mentors alike!

Winners of the photo and video contest, modelling their IGS prizes (Top, left to right: Noel Fitzpatrick, David Lilien, Caitlyn Florentine, Laura Thomson, Jenna Zechmann. Bottom: Aurora Roth). Photo: Regine Hock

The International Summer School in Glaciology would not be possible without support from the National Science Foundation (NSF), the Glaciology Exchange Program GlacioEx, the International Association of Cryospheric Sciences (IASC), and the International Glaciological Society (IGS).

(Disclaimer: No drones were harmed in the writing of this article).

Laura Thomson
Geography, University of Ottawa

Glaciological diary

** IGS sponsored * IGS co-sponsored

2014

4–5 August 2014
Intercomparison of Snow Grain Size Measurements Workshop (follow-up to March Workshop in Davos)
Reading, UK
Contact:
Martin Schneebeli [schneebeli@slf.ch]

6–8 August 2014
Workshop on Microstructure in Snow Microwave Radiative Transfer (MICROSNOW workshop)
Reading, UK
Contact:
Melody Sandells [m.j.sandells@reading.ac.uk]
Website: http://www.esa-da.org/content/microstructure-snow-microwave-radiative-transfer-microsnow-workshop

6–8 August 2014
Workshop: Geophysical Methods for Permafrost Characterization and Monitoring
Fairbanks, Alaska, USA
Contact: Fred Day-Lewis [daylewis@usgs.gov]

6–16 August 2014
***Third International Summer School in Glaciology**
McCarthy, Alaska, USA
Website: http://glaciers.gi.alaska.edu/courses/summer-school/2014

11–15 August 2014
22nd IAHR International Symposium on Ice
Singapore
Website: http://www.iahr-ice2014.org/

16–21 August 2014
World Weather Open Science Conference Montréal, Canada
Cryosphere sessions:
Cryosphere and stable atmospheric boundary layers
Ocean and cryosphere observations and their assimilation
Website: http://wwosc2014.org/

16–31 August 2014
Advanced climate dynamics course: The Dynamics of the Greenland Ice Sheet
Arctic Station, Disko Island, West Greenland
Website: http://www.uib.no/en/rs/acdc/54141/acdc-2014

17–22 August 2014
International Workshop on Ice Caves (IWIC)
Idaho Falls, Idaho, USA
Website: http://www.iwic-vi.org/

22–24 August 2014
***100 Years Glacier-Climate Studies at Claridenfirn: worldwide longest glacier mass balance series 1914-2014**
Zürich, Switzerland
Contact:
Martin Lüthi [martin.luethi@geo.uzh.ch]
Website:
http://snow-ice-permafrost.ch/en/clariden100/

22 August 2014
Workshop: Antarctic Near-Shore and Terrestrial Observing System Proposal
Auckland, New Zealand (prior to the start of XXXIII SCAR meetings)
For more information, download the workshop leaflet at http://www.scar.org/events/ANTOS_Workshop_NZ_Aug14.pdf

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

8–9 September 2014
***International Glaciological Society British Branch Meeting**
Bristol Glaciology Centre, University of Bristol, UK
Contact:
Martin J Siegert [M.J.Siegert@bristol.ac.uk]
Website: http://bristolglacio.wix.com/igsantmeetbristol

9–20 September 2014
Karthaus course: Ice sheets and glaciers in the climate system
Karthaus, Italy
Contact: J. Oerlemans [J.Oerlemans@uu.nl]
Website: http://www.projects.science.uu.nl/iceclimate/karthaus/

11–12 September 2014
*The UK Antarctic Research Symposium
Bristol Glaciology Centre, University of Bristol, UK
Contact:
Martin J Siegert [M.J.Siegert@bristol.ac.uk]
Website: http://bristolglacio.wix.com/igsantmeetbristol

18–21 September 2014
International Symposium on The Future of the Glaciers: From the past to the next 100 years
Celebrating 100 years of the Bulletin of the Italian Glaciological Committee
Turin, Italy
Website: http://www.glaciologia.it/

16–17 September 2014
Workshop: Novel Mission Concepts for Snow and Cryosphere Research
Noordwijk, Netherlands
Website: http://www.congrexprojects.com/2014-events/14c19/introduction

18–19 September 2014
International Sea Ice Concentration and Thickness Evaluation and Inter-comparison Workshop
Hamburg, Germany
Website: http://www.climate-cryosphere.org/meetings/seaice-conc-2014

18–21 September 2014
International Symposium on The Future of the Glaciers: From the past to the next 100 years
Celebrating 100 years of the Bulletin of the Italian Glaciological Committee
Turin, Italy
Website: http://www.glaciologia.it/

26 September 2014
Sea ice and Climate Modeling Forum Workshop on large-scale sea-ice simulations
Reading, UK
Website: http://www.climate-cryosphere.org/activities/groups/seaicemodeling

29 September–3 October 2014
International Snow Science Workshop (ISSW)
Banff, Alberta, Canada
Website: http://issw2014.com/

13–15 October 2014
Workshop – Chemical atmosphere-snow-sea ice interactions: taking the next big step in field, lab and modelling
Darmstadt, Germany
Website: http://www.antarctica.ac.uk/about_bas/events/ca

13–16 October 2014
Workshop – Past as Prologue: Holocene climate as context for future climate change
Timberline Lodge, Mount Hood, Oregon, USA
Website:
http://people.oregonstate.edu/~marcotts

13–17 October 2014
Climate Symposium
Darmstadt, Germany
Session: Cryosphere in a Warming World
Website: http://www.theclimatesymposium.com/

17–18 October 2014
Northwest Glaciologists Meeting
Fairbanks, Alaska, USA
Website: http://glaciers.gi.alaska.edu/events/northwest2014

19–22 October 2014
Geological Society of America Annual Meeting
Vancouver, Canada
Session: Slope Stability and Permafrost (T96).
Convener: Stephan Gruber [Stephan.Gruber@carleton.ca]
Website: http://community.geosociety.org/gsa2014/home/

21–24 October 2014
ART Science Workshop: Integrating spatial and temporal scales in the changing Arctic System – towards future research priorities (ISTAS)
Brest, France
Contact:
Kirstin Werner [werner.192@osu.edu]

27–28 October 2014
SVALI Elmer/Ice course
Held in connection with the IGS Nordic Branch Meeting in Iceland
Reykjavík, Iceland
Website: elmerice.elmerfem.org/

30 October–1 November 2014
***International Glaciological Society Nordic Branch Meeting**
Mýrdalsjökull , Iceland
Contact: Eyjólfur Magnússon [eyjolfm@hi.is] and Alexander H. Jarosch [alex@hi.is]

3–4 November 2014
Workshop: NSF DataViz Hackathon for Polar CyberInfrastructure
New York, NY, USA
Contact: Workshop Committee [nsfdatavis@gmail.com]

18–21 November 2014
GEORISK 2014: Improving geophysical risk assessment, forecasting and management
(IUGG Commission on Geophysical Risk and Sustainability)
Madrid, Spain
Website: www.georisk2014.com

8–12 December 2014
Arctic Change 2014
Ottawa, Canada
Website: http://www.nrsc.gov.in/isprs/2014tc8symposium.html

9–12 December 2014
Midterm symposium of the International Society of Photogrammetry and Remote Sensing, Commission VIII (Remote sensing applications and policies):
Operational Remote Sensing Applications: Opportunities, Progress and Challenges
Hyderabad, India
Website: http://www.nrsc.gov.in/isprs/2014tc8symposium.html

2015

2–6 March 2015
****International Symposium on Himalayan glaciology**
Kathmandu, Nepal
Contact: Secretary General, International Glaciological Society
Website: http://www.igsoc.org:8000/symposia/2015/kathmandu/

23–26 March 2015
Workshop on the Dynamics and Mass Budget of Arctic Glaciers/IASC Network on Arctic Glaciology Annual Meeting
Obergurgl, Austria
Website: http://www.iasc.info/nag/

23–27 March 2015
Workshop: Dynamics of Atmosphere–Ice–Ocean Interactions in the High Latitudes
Rosendal, Norway
Website: http://highlatdynamics.b.uib.no/www.iasc.info/nag/

21–25 April 2015
Annual Meeting of the Association of American Geographers
Chicago, Illinois, USA
Website: http://www.aag.org/cs/annualmeeting

23–30 April 2015
Arctic Science Summit Week, ASSW 2015
Toyama, Japan
23–25 April: ASSW Business Meetings
27–30 April: ISAR-4 and ICARP III Symposium
Website: http://www.assw2015.org/

21–27 June 2015
****International Symposium on the Hydrology of Glaciers and Ice Sheets**
Iceland
Contact: Secretary General, International Glaciological Society
Website: http://www.igsoc.org:8000/symposia/2015/iceland

22 June–2 July 2015
26th Union of Geodesy and Geophysics (IUGG) General Assembly
Prague, Czech Republic
Website: http://www.iugg2015prague.com/

22–25 July 2015
PALSEA2 2015 Workshop: Data-Model Integration and Comparison
Tokyo, Japan
Contact Glenn Milne [gamilne@uottawa.ca]

17–22 August 2015
****International Symposium on Contemporary Ice-Sheet Dynamics: ocean interaction, meltwater and non-linear effects**
Cambridge, UK
Contact: Secretary General, International Glaciological Society
Website: http://www.igsoc.org:8000/symposia/2015/cambridge/

2016

20–24 June 2016
Eleventh International Conference on Permafrost (ICOP 2016)
Potsdam, Germany
Website: http://icop2016.org

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

2018

15-27 June 2018
SCAR/IASC Conference
Davos, Switzerland
Contact: SCAR Secretariat [info@scar.org]

New members

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International Glaciological Society

Secretary General M.M. Magnússon

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	*C. Ritz	2011–2014	2011
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	*J. Stroeve	2012–2015	2012
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	*Y. Zaika	2013–2016	2013
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	L. Stearns	2014	2014
	F. Pattyn	2014	2014

*First term of service on the Council

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Nominations	E. Brun (Chairman)
Publications	C.L. Hulbe (Chairman)

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1967	H. Bader	1989	W.F. Weeks	2003	K. Hutter
1969	J.F. Nye	1990	C.R. Bentley	2005	R.B. Alley
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1972	B.L. Hansen	1992	H. Röthlisberger	2009	P.A. Mayewski
1974	S. Evans	1993	L. Lliboutry	2011	A. Iken
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1977	W.B. Kamb	1996	W.F. Budd	2013	P. Duval
1982	M. de Quervain	1997	S.J. Johnsen		
1983	W.O. Field	1998	C. Lorius		
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1985	M.F. Meier	2000	S.C. Colbeck		
1986	G. de Q. Robin	2001	G.S. Boulton		

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1993	H. Richardson	2010	T.H. Jacka
1997	D.R. MacAyeal	2012	W.S.B. Paterson
1998	G.K.C. Clarke	2013	J.W. Glen
1999	J.A. Heap	2013	A. Weidick
2003	C.S.L. Ommanney		

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International Glaciological Society

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ICE

Editor: M.M. Magnússon (Secretary General)

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