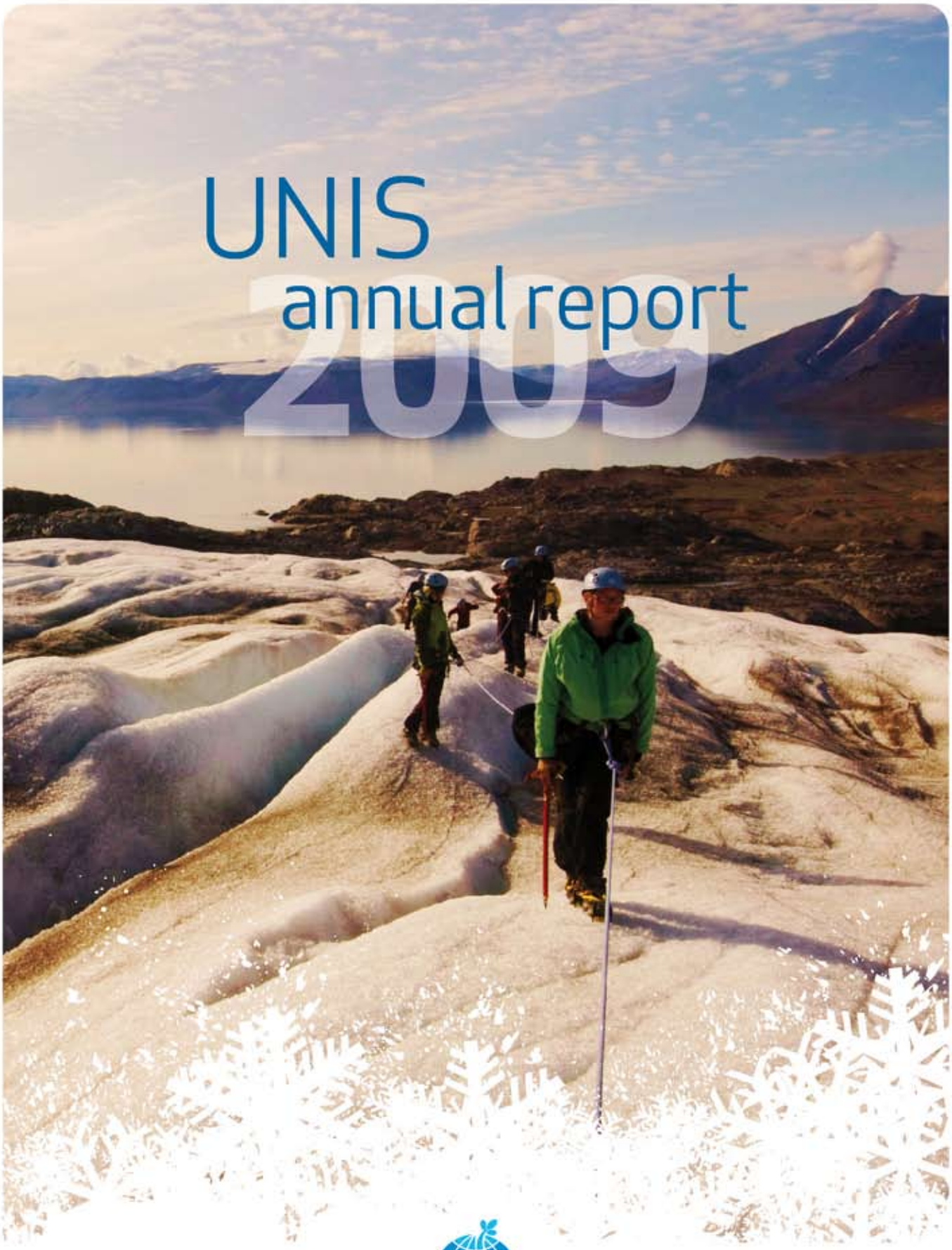


UNIS annual report 2009

UNIS

The University Centre in Svalbard

Front cover: AG-210 students on excursion on the Nordenskiöld glacier in Billefjorden, August 2009.

Photo: Endre Før Gjermundsen

contents

from the director

When the University Centre in Svalbard first opened its doors in 1993 the big question was: Is it possible to establish an institution for research and higher education in a coal mining community at 78° north? Can we get good scientists to move up here? Will we be able to achieve a sufficient level of quality? The skeptics were many.

Seventeen years later UNIS is considered a success. Our mission is to offer education and perform research based on Svalbard's location in the High Arctic and the advantages this represents. UNIS is the Arctic extension of the Norwegian mainland universities while at the same time having an international profile. And the word gets around. 400 students from 30 countries will take part in the UNIS experience in 2010.

In the beginning UNIS was conceived as an Arctic college. Lower level courses dominated the catalogue. In 2001 UNIS received funding for the first PhD position. In 2010 we have approximately 25 Ph.D.s and Post docs at UNIS. We are clearly developing in the direction of a graduate school.

It is our ambition to perform high quality research and innovation addressing issues of global significance. We want to contribute to a better understanding of Arctic life, nature and processes and to a higher competence in sustainable exploitation of the regional resources. We take pride in educating the Arctic experts of tomorrow.

The long term goal of UNIS, according to our strategic plan, is to become a leading international centre for Arctic studies. The Norwegian government has confirmed this ambition and we are well on our way. Still in a coal mining community at 78° north.

Longyearbyen April 2010

Gunnar Sand
Managing director of UNIS

report of the board of directors 2009

The year 2009 was marked by restructuring. Cost-saving measures were implemented in a host of areas and reductions were made to both the course portfolio and staffing levels. These measured have worked, and UNIS ends the year with a surplus of NOK 1.7 million and strengthened shareholder capital. Student production has decreased somewhat, but the portfolio of externally funded research projects continues to increase. The decline in the number of applications relates particularly to Norwegian students.

The University Centre in Svalbard AS (UNIS) was established as a state-owned limited corporation on November 29, 2002, replacing the original institution established in 1994 by the Norwegian University of Science and Technology (NTNU) and the Universities of Oslo, Bergen and Tromsø. The relationship with the founding institutions is taken care of through representation on the Board of Directors and teaching committees, as well as direct relations with the research communities. As a continuation, equivalent relationships are being developed with the universities in Stavanger and Ås, but without board representation.

The institution's objective is to provide tuition and engage in research based on Svalbard's geographic location in the High Arctic and the special advantages this offers. The educational provision shall act as a supplement to the tuition offered at the universities in mainland Norway and culminate with examinations at Bachelor, Master or Ph.D. level. The educational provisions at UNIS shall have an international profile, and all tuition is given in English.

Education
In 2009, UNIS offered four fields of study: Arctic Biology, Arctic Geology, Arctic Geophysics and Arctic Technology. A total of 40 courses were offered, of which 22 were at Master's or Ph.D. level. These courses include the compulsory courses on safety and Svalbard history, and the summer course IPY Field School. A total of 353 students from 29 different countries took courses and 40 Master's students worked on their theses. This equates to 119 student-labour years.

The proportion of Norwegian students admitted to courses at UNIS in 2009 was 35 percent, of which 41 students were from NTNU, 28 from UiO, 28 from UiB and a total of 27 from UiT, UMB and UiS. Thirteen percent of the course students came from other Nordic countries (Denmark, Sweden, Iceland and Finland), while 16 percent were from Germany, seven percent from the United Kingdom and six percent from the Netherlands. The proportion of Russian students is stable and this year accounts for four percent. Grants from the Ministry of Foreign Affairs (UD) and the Norwegian Centre for International Co-operation in Higher Education (SIU) have contributed to the development through scholarship programmes for Russian, American (five percent) and Canadian (two percent) students.

The application figures for our courses in 2009 were generally good, and several courses attracted twice as many applications as available study places. However, owing to financial reasons, UNIS reduced its course portfolio in the autumn semester and this has particularly affected Norwegian students' interest in UNIS.

UNIS has commenced quality assurance work to ensure we live up to the requirements of the Norwegian Agency for Quality Assurance in Education (NOKUT), even though we are not an accredited institution. The quality assurance system covers all processes of significance for educational quality.

According to NOKUT, there are three central relations: quality as perceived by the students, in accordance with recognised academic objectives and that the educational provisions are broadly speaking relevant in today's society. UNIS has established a forum for quality assurance – the UNIS Research and Education Committee – to deal with routines for evaluation of education, documentation of the institution's work with the learning environment and routines for quality assurance of new educational provisions.

Research
The research activity in 2009 has been good, which can in part be attributed to external financial contributions and good collaboration with external institutions. Below are examples of central projects for each department.

Winter ecology is an important research field for the marine biological group at UNIS. In 2009, the group completed comprehensive field work within the ArcWin project (Arctic Wintertime), during which pelagic samples taken through an entire winter season. Field work during the Polar Night is a logistical challenge, and involves scientists taking samples from under the ice in the Billefjorden using snowmobiles and ice drills. The data is used to better understand the vertical migration of zooplankton, its lifecycle and strategies for storing energy. The project also affects changes in the population composition over time.

A research group at the Department of Arctic Geophysics, the Air-Chryosphere-Sea Interaction Observation and Modelling Group (ACSO), is exploiting the geographical location in the Arctic to conduct field research during the part of the year when climate changes are expected to be clearest, namely winter and spring. The scientists study the most critical processes related to climate change, such as deep water formation, albedo and freezing in the chryosphere, and atmospheric turbulence. The group will join forces through new projects aimed at one of the most challenging questions of Arctic research, namely the link between calving of glaciers in the Arctic and Antarctic.

In the autumn of 2009, the Longyearbyen CO_2 lab project drilled its fourth well to a depth of 970 m, after a major upgrade of the drilling rig and equipment. The drilling was successful. The most exciting aspect with the future in mind is the reservoir interval from 700-950 m. A reservoir of porous sandstone has been identified and injectivity proven through water tests. It remains to be seen what size the storage capacity in the reservoir is until the final conclusion about the CO_2 reservoir can be drawn. This work is continuing into the new year. This project is managed by the UNIS Arctic Geology department.

Within Arctic Technology, scientists from UNIS in collaboration with partners from NTNU and SINTEF are working to acquire more and better knowledge about ice drift in the Barents Sea in relation to design loads on onshore and offshore constructions. This research is relevant for future field constructions in the Norwegian and Russian sectors, and the group is part of a broader network of Norwegian and Russian industrial companies and knowledge environments. This discipline is attractive to the business community, and UNIS has had two industry-financed Ph.D. positions.

In 2009, scientists at UNIS published 63 articles in international refereed journals, of which 29 were at the highest level. In addition, there were 10 chapters in books. Corresponding figures for 2008 were 52 articles, of which 24 were at the highest level and nine chapters in books.

Dissemination
Work concerning information has been a top priority in 2009. Nearly 200 Norwegian and international media reports have focussed on UNIS, including reports on Chinese TV and in the Spanish newspaper El Pais, as well as a visit by Aljazeera. NRK TV has had more than 10 reports from UNIS in the past year.

Each year we receive visits from many delegations for Norwegian and international authorities and other public and private actors. The visit by the United Nations Secretary-General Ban Ki-moon was a highlight in 2009. The Svalbard Seminars had the highest visitor numbers since the 1990s. An open day was arranged in collaboration with the Svalbard Museum and Jørn Hurum, in which all grads at the school participated. Other lectures open to the public have also been well attended. UNIS is also a partner in both Studietur Nord and Svalbardkurset. Our website is updated regularly.

Future areas of priority will be regular production of news items for the website and updating of the website content, as well as increased production of articles for the website Forskning.no. The Board of Directors is extremely satisfied with the dissemination activities.

The library at UNIS experienced a significant drop in both the number of visitors (down 26 %) and loans (down 13 %). This decline is believed to be linked with the reduction of staff in the library.

Social responsibility
Right from the start, UNIS has been clear that the institution shall be a resource for the local community. This applies to the staff, students and the knowledge we possess. The staff shall live and work in Longyearbyen and contribute to the development of both the institution and the community. Neither staff nor students may start their own clubs or societies, but instead engage themselves in the community's social and cultural life. In 2009, UNIS switched to permanent positions, which means UNIS will become an even more stable institution for the local community. In addition, permanent positions will also secure stable quality in research and education.

Forty-seven percent of goods and services were purchased locally in Longyearbyen, according to the annual accounts for 2009.

In the latest version of the strategic plan, UNIS has expanded the mission statement from being a resource for Longyearbyen to being a resource for the communities of Svalbard, including Barentsburg. The relationship with the Russians is developing through a desire to collaborate with Russian scientists and a growing number of Russian students and staff at UNIS.

UNIS collaborates with the travel and tourism industry in Svalbard and Finnmark University College about the training of guides, with Bydrift Longyearbyen about the development of environmentally-friendly solutions for power production, with Store Norske and Leonhard Nilsen about Carbon capture and storage (CCS) and environmental analyses, and with Avinor about environmental analytical services. Several Master's and Ph.D. theses are directed towards issues of relevance to Longyearbyen, Svea and Barentsburg.

Staff
As of December 31, 2009, the scientific staff at UNIS comprised eight professors, 11 associate professors, five post docs, 18 Ph.D. students, three project positions and 29 with professor/adjunct associate professor attachments. The technical and administrative staff comprised 12 and 16 labour years respectively. Women accounted for 58 percent of the technical and administrative positions, 29 percent of the scientific positions and 43 percent of the students. Five of the eight members of the Board of Directors were women. The Board of Directors is not aware of discrimination of any form taking place at UNIS.

The following positions are externally funded: one professor (Statkraft), four post docs (three funded by the Research Council of Norway and one by ConocoPhillips), five Ph.D. (three funded by the Research Council of Norway and one each by Total and Statoil) and five professor/adjunct associate professorships (two by Akvaplan-niva and one each by ARS/NAROM, NERSC and NGU). In addition, three professor/adjunct associate professorships are part-financed by the Norwegian Polar Institute, and one vacant scientific position has external funding from Store Norske. The Board of Directors would like to thank these institutions for their contribution to UNIS.

Health, Safety and Environment
Absence due to sickness at UNIS in 2009 was 2.56 percent. The institution has an agreement with Longyearbyen Hospital concerning occupational health services and is certified as an IA enterprise. In 2009, one staff member injured a finger in an occupational accident. Apart from this incident, there were no other injuries or reports of serious occupational accidents or calamities of significance.

UNIS is unaware of contamination of the wider environment to any significant degree as a result of the institution's operations. UNIS is working continually to limit the environmental impact of its activities.

Economic development
Funds for operation and investment at UNIS are appropriated in the budget of the Ministry of Education and Research. In 2009, appropriations to UNIS from the Ministry totalled NOK 83,713,000, of which NOK 64,115,000 constituted base funding and NOK 19,598,000 rent for the science park and KHO. Income over and above the appropriations from the Ministry of NOK 40.5 million comprises NOK 28.2 million from external project income for research and NOK 12.3 million in income from consultancy services and rentals. Compared with last year, the income from consultancy services is double. UNIS has also experienced an increase in external funding for research from 8 percent of its gross income in 2001 to 23 percent in 2009. The Board of Directors is extremely satisfied with the increase in external income.

The annual accounts for 2009 show an operating surplus of NOK 2,861,825. After financial costs, this surplus is NOK 1,709,573. This figure was transferred to other equity.

The company's total assets at year-end 2009 were NOK 74,156,599, comprising NOK 46,791,442 of institutional buildings and NOK 9,769,474 of shareholder capital and other equity.

In 2009, a salary of NOK 948,773 was paid to the Managing Director. The Chairperson of the Board of Directors received a fee of NOK 55,000, the Deputy Chairperson NOK 33,000 and the other members of the Board of Directors each received a fee of NOK 22,000.

The institution's accounts were audited by PriceWaterhouse Coopers A/S.

Infrastructure and housing
At year-end 2009, UNIS owned a total of 50 apartments. In addition, UNIS rents 10 studio apartments for Ph.D. students and a further 16 for guest lecturers. The access to rented studio apartments for Ph.D. students has halved since 2008, when we received notice as a tenant. The owner wished to sell all the studio apartments and we were forced to use some of the guest studio apartments to replace the lost studio apartments. UNIS has developed a joint living solution for Ph.D. students and guest lecturers in collaboration with Barlindhaug Utbygging AS. The new complex will be completed in late 2010/early 2011 and has a total of 52 small studio apartments, all of which are less than 30 m² in size. UNIS has contracted rental for all the units.

At year-end 2009, UNIS' combined housing loans total NOK 35.8 million. Interest and instalments on the loan as well as inventory for the apartments must be financed from the operational budget.

The Student Welfare Organisation in Tromsø offers a total of 144 studio apartments to students. It is decisive for UNIS that the students have satisfactory living conditions, and the Board of Directors emphasises continuing the good co-operation with the Student Welfare Organisation in Tromsø.

Shareholder equity and financial risk
In 2009, UNIS sold two of the oldest apartments, as both needed total refurbishment and were also too small to house families. The income from these sales was used in its entirety on down payment of the housing loan and, together with instalment payments, contributed to reducing the loan sum by NOK 5.1 million or 13 % compared with year-end 2008. Combined with this year's surplus, this has contributed to increasing the shareholder equity ratio by 4 % to 13.17 % at 31.12.09. Strengthening of the shareholder equity is still necessary in order to strengthen the solidarity in the company. The conditions for the loan raised in the autumn of 2008 included a requirement from the bank that the shareholder equity ratio shall be 20 % of the account balance. The bank has dropped this requirement for 2008 and 2009.

The cash flow statement shows a liquidity payment from the operation of NOK 2.4 million. This positive liquidity development may be attributed in full to the fact that at year-end UNIS manages more funds that are paid in advance to UNIS by externally financed projects. The liquidity reserves at year-end account for NOK 13 million of funding belonging to external projects. In the past two years, the working capital (current assets minus short-term debt) has gone from positive to negative.

Measures implemented in 2009 contributed to improving the liquidity. A major challenge in the years ahead will be to obtain income over and above the ordinary appropriations from the Ministry of Education and Research in order to handle the liquidity requirements resulting from the loan related to the purchase of apartments and requirements for renewing equipment.

Internal financial control
UNIS has established simple and good systems for financial follow-ups and reporting. In the light of proposals for appropriation frameworks from the Ministry in October, preparations are being made for a thorough budgeting process for all departments linked to this activity. Detailed budgets are prepared for each individual course. The course responsible attests an expense voucher as indicated by the Head of Finances in the Department of Administration. Research funds are allocated to the departments, which are responsible for allocating these to the individual scientist. The course directors and individual scientists receive continuous updates comparing the accounts against the budget.

Financial reporting to the Board of Directors comparing the accounts with the adopted budget is a regular item on the agenda for board meetings and includes reviewing each discrepancy.

Risk and internal control associated with fieldwork, excursions and laboratory activities
One of the main aims of UNIS is take advantage of its location in a high Arctic area for extensive excursions including fieldwork to gather samples and data. UNIS has specialist laboratory functions to analyse these samples.

Fieldwork in the Arctic can involve danger to the health and lives of the participants as well as damage to the environment. Consequently, UNIS has established a comprehensive set of rules and regulations to ensure fieldwork is carried out in a safe manner.

The UNIS Board visits the CO2 drill site in Adventdalen in November 2009.
Back: Berit Kjeldstad, Geir Anton Johansen, Tore Vorren (Chairman); Hanne Christiansen (staff representative); Viva Mørk Kvello, Frank Eggenfellner (staff representative); Rita Sande Rød (student representative). Front: Gunnar Sand (director) and Annik Myhre.

Photo: Alvar Braathen

All students and staff must undergo compulsory safety training. Field and laboratory work is subject to quality assurance by risk assessments and is covered by strict reporting routines, including eventual undesirable incidents.

Safety instructions and control routines at UNIS include the formulation of objectives from the Svalbard Environmental Protection Act, which states that in the event of conflict between the activity and the environment priority must be given to environmental considerations. UNIS strives to carry out its activities with as little negative impact on the natural environment as possible.

Board of Directors and Annual General Meeting
The UNIS Board of Directors held five meetings in 2008, two of which were in Longyearbyen and one was a teleconference. Sixty-nine matters were officially discussed. The Annual General Meeting was held in Oslo on April 29, 2009.

Continued operation
The institution's annual accounts are presented on the assumption of continued operation. The reasoning for the assumption is in the budget for 2010, which outlines the measures that have been implemented.

The path forward
In November 2009, the Board of Directors adopted a new strategic plan for UNIS, which includes targeting the strengthening of the relationships with the Norwegian universities and developing further the international relationships. Safety, quality of education and environmentally-friendly behaviour are all high on the agenda, as is the institution's task as an active community participant in Longyearbyen and Svalbard as a whole.

UNIS' strategic action plan has been a limiting factor. Investment in apartments and field equipment, which are essential expenses for UNIS in Svalbard, must in the main be covered by the operating budget, which means that an increasing proportion of the base funding is used for other purposes than our community assignment. Moreover, UNIS has had strong growth in externally funded projects and Ph.D. and post doc positions, both of which demand significant contributions.

In 2009, UNIS has taken measures to systemise its strained budget and has emerged from the process in a stronger position. An assumption for further development of UNIS will be that any additional expenses associated with field-based research and education in Svalbard are covered.

UNIS delivers good results in all aspects in which universities are measured and it has shown a great ability to handle challenges at a high level. UNIS is acting in a sustainable and responsible manner in relation to the environment and has become a significant participant in and resource for the local community.
As the Board of Directors sees it, UNIS has every opportunity to achieve its overall goal of becoming a leading international centre for Arctic studies, and the Board of Directors looks forward with the Ministry to realise the institution's potential.

The Board of Directors would like to thank all staff at UNIS for their good contributions in what has been a challenging year!

Bergen 15. mars 2010

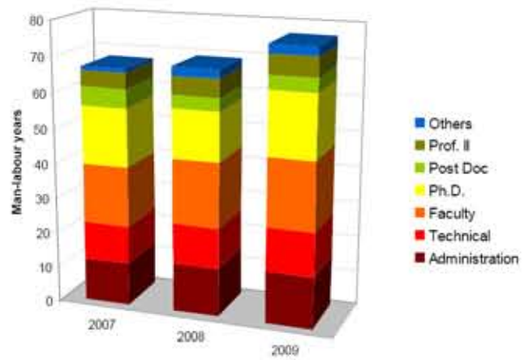
Tore Vorren | Styreleder
Berit Kjeldstad | Nestleder
Annik M. Myhre
Geir Anton Johansen
Viva Mørk Kvello
Hanne Christiansen
Frank Eggenfellner
for Rita Sande Rød
Elin Tronvoll | Vararepresentant
Gunnar Sand | Director

The UN Secretary-General Ban Ki-Moon visited UNIS in September and met with some of the UNIS student population.

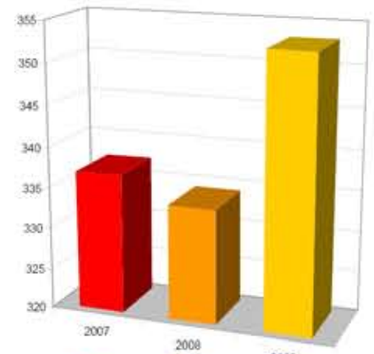
Photo: Maximilian Janson

statistics

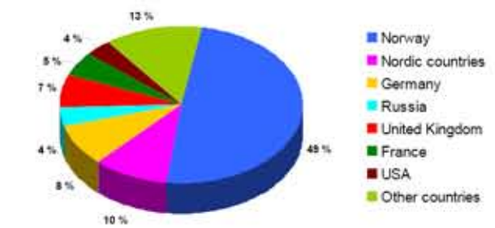
Work force in man-labour years according to category at UNIS 2007-2009



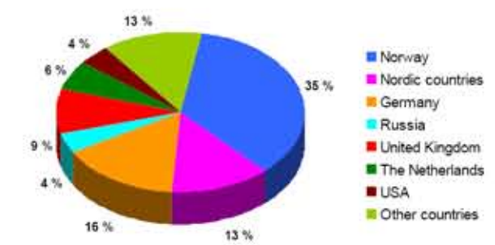
Number of students completing UNIS courses 2007-2009



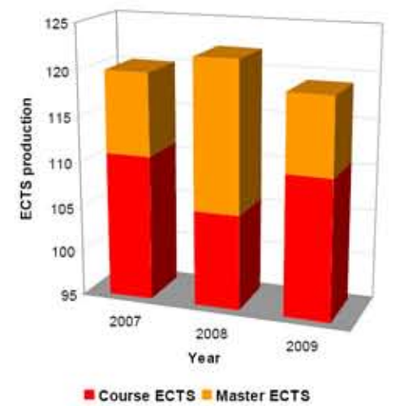
UNIS students' nationality 2008



UNIS students' nationality 2009



Production in student-labour years (1 year = 60 ECTS credits)



Note: In accordance with mainland universities practice, UNIS now registers ECTS by 1) course production and 2) master students attendance at UNIS

resultatregnskap 2009

	2009	2008
Driftstilskudd fra KD	83 713 000	78 719 000
Avsatt til investeringstilskudd	-1 156 553	-2 316 325
Årets driftstilskudd fra KD	82 556 447	76 402 675
Eksterne prosjektinntekter	28 194 934	26 279 700
Øvrige inntekter	12 354 966	5 750 807
Brutto driftsinntekter	123 106 347	108 433 182
Direkte prosjektkostnader	25 512 756	23 630 656
Netto driftsinntekter	97 593 591	84 802 526
Lønn og sosiale kostnader	41 881 386	39 788 631
Felt- og toktkostnader	8 582 871	6 328 478
Kostnader lokaler	24 985 249	23 895 917
Øvrige driftskostnader	17 041 043	16 531 161
Avskrivninger	2 241 216	1 195 361
Sum driftskostnader	94 731 766	87 739 548
Driftsresultat	2 861 825	-2 937 022
Finansinntekter og finanskostnader		
Finansinntekter	693 701	1 377 884
Finanskostnader	1 845 953	1 890 603
Netto finansposter	-1 152 252	-512 719
Årsresultat	1 709 573	-3 449 741
Disponeringer:		
Til/fra annen egenkapital	1 709 573	-3 449 741

balanse pr. 31.12.2009

	2009	2008
EIENDELER		
Anleggsmidler:		
Bygninger	46 791 442	50 492 658
Andeler Svalbardhallen	1	1
Sum anleggsmidler	46 791 443	50 492 659
Omløpsmidler:		
Varebeholdning	2 603 278	2 202 766
Debitorer	3 823 504	6 789 100
Andre kortsiktige fordringer	2 600 226	7 605 655
Betalingsmidler	18 338 148	15 791 367
Sum omløpsmidler	27 365 156	32 388 888
SUM EIENDELER	74 156 599	82 881 547
GJELD OG EGENKAPITAL		
Innskutt egenkapital	2 054 025	2 054 025
Opptjent egenkapital	7 715 449	6 005 876
Sum egenkapital	9 769 474	8 059 901
Avsetninger for forpliktelse		
Utsatt innt.føring tilskudd Nordlysstasjonen	0	50 000
Sum avsetninger for forpliktelser	0	50 000
Langsiktig gjeld:		
Boliglån SparebankEN	35 845 474	40 976 690
Sum langsiktig gjeld	35 845 474	40 976 690
Kortsiktig gjeld:		
Leverandørgjeld	6 401 194	10 395 482
Skyldige off.trekk og avgifter	3 801 100	6 331 702
Annen kortsiktig gjeld	18 339 357	17 067 772
Sum kortsiktig gjeld	28 541 652	33 794 956
SUM GJELD OG EGENKAPITAL	74 156 599	82 881 547

August 2009: AB-202 students having a lecture on the sea ice in connection with the course cruise.

Photo: Frank Eggenfellner

arctic biology

By Ole Jørgen Lønne

The department conducts research in arctic biology and ecology and provides a full one-year curriculum of undergraduate studies and eight Ph.D./Master's level courses. The department pursue the strategy to has two research groups, one in marine arctic ecology and one in terrestrial arctic ecology. The two strategies is, however, linked in several areas.

Terrestrial Ecology Research Group

By the end of the year, the terrestrial group consisted of three associate professors (one on leave) and two Ph.D. students with research interests focussing on the flora and terrestrial invertebrate fauna. The Ph.D. students, María Luisa Ávila Jiménez and Eike Müller, are in their third year investigating the dispersal to and colonisation of Svalbard by the flora and terrestrial invertebrate fauna; Ávila Jiménez on the project "High Arctic invertebrate biogeography: dispersal, establishment and survival" and Müller on "Plant dispersal and establishment in the Arctic."

Svalbard Environmental Fund funding enabled the first microarthropod samples to be collected from Edgeøya on the east coast of Svalbard. These samples revealed several species of Collembola and enchytraeid worm not previously observed from the better known west coast. A return trip is planned for 2010 to more fully describe the invertebrate fauna of this region previously unvisited by soil fauna researchers. First results indicate an east coast invertebrate community distinctive from the west coast. Funding from the Norwegian Research Councils' NorRuss call was awarded for the AVIFauna project (avian spread of invertebrates in the Arctic) and for an invertebrate workshop with participants from throughout Europe. Both are planned to commence in 2011. The local distribution of the endemic aphid, Acyrthosiphon svalbadicum, was studied in Kongsfjorden via two trips in to Ny-Ålesund in 2009. Snow depth is thought to control local aphid occurrence on a widely distributed host plant via moderating the length of the subsequent summer period. Snow depths were measured in April and presence or absence of the aphid established in August. Return trips are planned for March and July 2010 to corroborate initial results.

The SPIDER (Svalbard Pictorial Invertebrate Database and Educational Resource) was launched this year (**www.svalbardinsects.net**) funded by the Svalbard Environmental Fund. The site is now available in English and Norwegian and will be continually updated and revised based on user feedback. Target audiences include the local school and tourist organisations.

Projects investigating the invertebrate fauna of high Arctic bird nests was completed and published. This was in collaboration with bird researchers at the Norwegian Polar Institute (NPI) and the Norwegian Institute for Nature Research (NINA). Data was presented by associate professor Steve Coulson and Ávila Jiménez at the Nordic Soil Zoology workshop in Tartu, Estonia. Ávila Jiménez spent two periods completing laboratory work at the British Antarctic Survey (B.A.S.) in Cambridge, UK, where samples of Collembola sampled from throughout Svalbard and the wider holarctic are being analyzed using molecular techniques to identify population relationships and dispersal routes.

July 2009: Silverweed (Potentilla pulchella) is a quite common plant in Svalbard and got sampled this summer for DNA barcoding in Canada.

Photo: Kristine Westergaard

In addition Ávila Jiménez participated on a research cruise to the Antarctic peninsula on board the B.A.S. research vessel, RRS James Clark Ross. Masters projects studying reindeer reproductive behaviour and tourist interactions with polar bears were successfully completed.

During 2009, the department has widened its scope by the inclusion of fungal research. In collaboration with the University of Oslo, plant-fungi interactions (mycorrhizal communities) and its colonization dynamic have been studied, and the diversity of fungi was recognized through next generation sequencing. This research will be developed further in the years to come. Funding from Svalbard Environmental Protection Fund has also initiated classical morphological investigations of the fungal flora in Western Spitsbergen. Fungal experts on Tricholoma, Galerina and Inocybe followed us during fieldwork 2009, and new fungal groups will be investigated in 2010. This knowledge is strongly needed, both for the local community, and to build up a reference data base for the molecular identification (DNA-barcodes) of fungi.

Also the **svalbardflora.net** project got further funding through the Svalbard Environmental Protection Fund. This web site had been visited by more than 125.000 by the end of the year, and Alsos has been asked by the Conservation of Arctic Flora and Fauna (CAFF) to develop this web site further to cover the circum Arctic.

The project "Svalbard seeds in Svalbard Global Seed Vault" also got further funding from the Svalbard Environmental Protection Fund, and the germinability of 88 species were tested in the phytotron at UNIS. All except 12 species germinated, so the Svalbard Global Seed Vault may serve as an ex situ conservation for the majority of flora in Svalbard.

A project meeting for the EU project "Eco-Change" was arranged in June and gathered around 40 scientists from all over Europe. The aim of the project is to "provide data, scenarios and associated confidence limits so that policy markers and land managers can use them for anticipating societal problems and for designing sustainable conservation strategies by accounting the most likely global change effects on biodiversity and ecosystems". Svalbard is central in this project as it is an easily accessible area to test methods and study effect of past climate changes. New field work done in 2009 included sampling soil samples for DNA analyses to find which plant species were growing in Svalbard during the Holocene warm period 8000-4000 BP.

Samples of all vascular plants in Svalbard were collected in field or from herbarium and sent off to the Canadian Centre for Barcoding. Thus, we have now a complete genetic reference library which can be used for taxonomical, biodiversity and ecological research.

Marine Ecological Research Group

In 2009 one professor, two associate professors, two post doctoral research fellows and four Ph.D. students pursued research in Arctic Marine Biology. Last year concluded the official part of The International Polar Year (IPY), and much of our field related activities was arranged through ongoing IPY projects. The two post docs and three of the Ph.D. students continued their work on the large externally funded projects; "Climate effects on planktonic food quality and trophic transfer in the Arctic Marginal Ice zones" (CLEOPATRA), "The Arctic sea in wintertime: ecosystem structuring due to environmental variability during the polar night" (ArcWin), and the Statoil funded "Ice Edge" programme.

Winter ecology was a main research field in the department in 2009, and saw the end of an extensive field campaign as part of the ArcWin project, where pelagic samples were collected at regular intervals for a whole winter season. This extensive sampling campaign is a direct follow up from a work that was published early 2009 on hitherto unknown processes among the zooplankton community during the polar night. Field campaigns during the polar night is logistically challenging, conducted by snow mobiles and sampling through the ice during winter. We use Billefjorden as our field location, and the sampling has been very successful. The data are promising and will be used to answer questions regarding the seasonal and diel vertical migrations of zooplankton, their life cycle and energy storage strategies, and the possible predator-prey interactions in the system. ArcWin has also seen good progress on the benthos ecology component of the project, and published a paper dealing with changes in the decapod fauna in Isfjorden during the last 100 years. In general, little evidence for any changes in terms of species composition was reported, but there seems to have been a shift at the community level especially during the last 50 years.

The CLEOPATRA-project is funded by the Research Council of Norway (Norklima program) and is IPY accredited. The project runs over four years (2007-2010), and investigate how increased light intensities, due to reduced ice concentrations and ice extent, affect timing, quantity and quality of primary and secondary production in the Arctic marginal ice zone (MIZ). The MIZ is the key productive area of Arctic shelf seas. The ongoing warming of Arctic regions will lead to a northward retreat of the MIZ and to an earlier opening of huge areas in spring. This may result in a temporal mismatch between the phytoplankton spring bloom and zooplankton reproduction. Less ice will also reduce the ice algae production that may be an important food source for spawning zooplankton prior to the spring phytoplankton bloom. Quantity and quality of primary production in seasonally ice-covered seas is primarily regulated by light and nutrients. Excess light, however, is potentially detrimental for algae and can reduce algal food quality. A decrease in the relative amount of essential polyunsaturated fatty acids (PUFAs) in algae due to excess light may affect the reproductive success and growth of zooplankton, and thereby the transport of energy to higher trophic levels, such as fish, birds, and mammals.

June 2009: All modes of transportation are used when UNIS staff go on a field campaign to Billefjorden as part of the ArcWin project.

Photo: Janne Søreide

The project concluded most of the field and experimental work in 2008, so 2009 was predominantly a year dedicated to data analyses and writing up the results. During the Arctic Frontiers conference in Tromsø in January 2009, two invited talks were given presenting the main results from the project.

GRADUATES 2009:

MASTER DEGREE:

Máret Johansdatter Heatta: The mating system of Svalbard reindeer (Rangifer tarandus platyrhynchus)

Gro Vestues: The mating system of Svalbard reindeer. Effects of male age and antler size on harem size, behaviour during the rutting season and reproductive effort

Margrete Nilsdatter Skaktavl Keyser: Polar bears and humans in Svalbard. A survey among tourists in Longyearbyen

Elke Morgner: The effect of vegetation type and snow depth on annual CO2 efflux in a high arctic tundra region

Mona M. Fuhrmann: The adaptive significance of chromatophores in the sympagic Amphipod Apherusa glacialis

Anika Beiersdorf: Foraging trip duration in relation to body mass: are little auks heavier following longer or shorter trips?

Aino-Maaria Luukkonen: The use of space and food resources by purple sandpipers (Calidris maritima) in a high Arctic estuary in relation to tidal dynamics

Hanne Halkinrud Thoen: Pigmentation in the Arctic deep-sea amphipods Eurythenes gryllus and Anonyx sp.

Kim Klein: Phenological and vegetative response of the evergreen shrub Empetrum nigrum ssp. nigrum and ssp. hermaphroditum to simulated global warming

Allan Buras: Ecological investigations on Euphrasia wettsteinii in Colesdalen, Svalbard

Mats P. Björkman: Seasonal and annual carbon dioxide effluxes from Arctic ecosystems

Leif Einar Støvern: Exclusive vegetation patterns below extremely acidic, abandoned mine-waste piles near Longyearbyen in Svalbard, Norway

Sara Bystedt: Large-Scale Distribution and Colonisation of Plants and Soil Invertebrates in Svalbard – Assessing the Nunatak Hypothesis

April 2009: UNIS scientists doing fieldwork for the ICEBOUND project on top of the mountain "Munken" in Northwestern Spitsbergen.

Photo: Endre Før Gjermundsen

arctic geology

By Hanne H. Christiansen

In 2009, research in the Arctic Geology Department covered seven scientific subjects in Earth Science; marine geology, Quaternary geology, glaciology, glacial geomorphology, permafrost and periglacial geomorphology, sedimentology, and structural geology. The research vision of the department focuses on Svalbard, its fjords and adjacent shelf that together offer an excellent opportunity to study a wide range of landforms, processes, sediments and structures related to the development of the Barents Shelf and infill of sedimentary basins. As an area of terrestrial outcrop on the Barents Shelf, Svalbard provides excellent access to a vast range of basin settings, from the low-latitude infill of the Devonian basins, to the present glacial and periglacial erosion and infill of valleys and fjords.

By the end of 2009, the staff consisted of six full-time faculty, professors Benn, Braathen and Christiansen, and associate professors Hormes, Jensen and Noormets. The department also has six adjunct professors, Helland-Hansen, Humlum, Ingólfsson, Thiede, Olausson and Osmundsen, and Jørn Hurum started as a new adjunct associate professor. In addition, we have one post doc, Juliussen, four UNIS based Ph.D. students, Bælum, Gjermundsen, Sund and Eckerstorfer, ten external Ph.D. students, and one research assistant, Neumann, who finished his contract in the end of 2009. In 2009 the department appointed a seventh full-time staff member, former adjunct professor Olaussen in Petroleum Geology to start 1 January 2010. This position if the first industry funded staff position in our department. In May 2009 all associate professors and professors got permanent positions, leaving the 3 year contract employment system.

One Ph.D. student Lene Kristensen defended her thesis in December, while seven master students have graduated from our department in 2009. This is by far the largest number of students graduating from our department in one year. From 2009 we have started the dual operation of most of our master/Ph.D. level courses, due to reduction in the course funding at UNIS. In 2009 we have run four bachelor and seven master/Ph.D. level courses. The total student production was 1845 ECTS in 2009, and thus was stable compared to 2008 (1820 ECTS) despite the decrease in the number of courses offered. This is mainly due to more students applying for our courses filling most courses in 2009. We had waiting lists for several of our courses in 2009. The former and recent staff in our department published 35 peer reviewed papers in 2009, which is a significant increase since 2008, when this number was 18. Several of the papers are multi-authored within the department.

The International and Interdisciplinary IPY Polar Field School with 24 highly selected undergraduate students was coordinated by our and the UNIS study administration departments in 2009, and in close cooperation with APECS (Association of Early Carrier Scientists) and University of the Arctic. Several members of our department staff used new IPY results to train the next generation arctic researchers in the geology and geography of Svalbard. 300 students applied for this course.

Alvar Braathen focused on three projects in 2009; Longyearbyen CO2 lab, Basin development in the Billefjorden Trough, and a metamorphic core complex in the Devonian basin. The "Palaeokarst in Billefjorden" project is currently creating a 3D reservoir-analogue model from superbly-exposed kilometer-scale stratiform and cross-cutting collapse-breccias, and backed by a high-resolution digital elevation model from helicopter laser scanning. The work is conducted within a large network of collaborating institutions and researchers, including Braathen and UNIS Ph.D. student Karoline Bælum.

The "Core complex" study visited Germaniahalvøya of NE Spitsbergen. This area reveals a major basement horst in the shape of an antiform bound by shear and fault zones. Overlying Devonian clastic deposits rest on the tectonic contact. The structural style and kinematics, combined with a metamorphic gradient in the basement horst, supports the hypothesis of a metamorphic core complex of late/post Caledonian age. The overall picture in large mimics the tectonic scenario developed for Norway and West Greenland. The current study is performed by Braathen (UNIS), Osmundsen (NGU and UNIS) and Maher (Univ. of Nebraska, USA), and will likely be expanded with a new field campaign in 2011.

The Longyearbyen CO2 lab project continued its high-profile activity aimed on identifying potential reservoirs near Longyearbyen. The longer perspective is to develop one or more of the reservoir(s) into a CO2 injection laboratory, with the ultimate aim to utilize it as a permanent CO2 storage site. During 2007 and 2008, three wells were drilled to 403 m, 505 m and 860 m, respectively. The forth well, Dh4, was finalized in November 2009 at 970 m depth, and was successful in that it drilled through and cored significant sandstone in the target reservoir and that good injectivity of water (current substitute for CO2) was

found. Continuous works with drill cores and outcrop data have resulted in comprehensive compilations, and the cores have been carefully examined with respect to petrophysical properties. As the project grows in size from year to year, the UNIS team involved increases. In 2009, UNIS researchers have been Braathen, Jensen and Olaussen, Ph.D. student Karoline Bælum, and many students at undergraduate and graduate level. Further, Fred Hansen, UNIS head of safety, has been involved in quality assurance of technical operations, and UNIS director Sand and vice director Flå with management tasks.

Anne Hormes and Ph.D. student Endre F. Gjermundsen sustained their research into the ice sheet reconstruction in Northwest Spitsbergen and Atomfjellet as part of the Icebound project. Cosmogenic nuclide dating results of exposed bedrock and erratic boulders of 16 samples are available from fieldwork in 2008 and 2009. 15 more results are awaited in February 2010. Attempts by Gjermundsen of recognition of glacial trimlines from 3D models show promising results. Gjermundsen presented his first results at the international Karthaus-2009 summer school "Glaciers and ice sheets in the climate system".

Anne Hormes started to be involved in a prequel study in collaboration with the Sysselmannen/Governor of Svalbard and the Norwegian Institute for Cultural Heritage/Norsk Institutt for Kulturminneforskning (NIKU). Fieldwork was performed at Fredheim and Hiorthhamn in order to define a follow-up project concerned about geohazards for cultural heritage on Svalbard. Two students of AG-210 were involved in studying solifluction processes and GIS use for geohazard mapping for their term projects. The project has a great potential to involve future UNIS students in an applied research field.

External Ph.D. student Trine M. Holm from University in Innsbruck is a Marie Curie fellow within the European training network NSINK. She measured biological and physical properties in Kongressvatnet and took lake sediment cores from Lakes Hajeren and Blokkvatnet. Since we took two long cores from Kongressvatnet in 2008 we have now much data available for Holm's Ph.D. project in collaboration with University of Tromsø, the Tandem Laboratory at Uppsala University and the Alfred-Wegener Institute for Polar and Marine Research, like magnetic susceptibility, p-wave velocity and amplitude, X-ray pictures, first radiocarbon dating on macrofossils. Master student Willem van der Bilt (Utrecht University and UNIS) have already used data from short cores taken from Kongressvatnet for his Master thesis entitled 'Post Little Ice Age environmental change documented in lake sediments from Kongressvatnet, Spitsbergen'. He presented the results of his Master thesis at the Annual Arctic Workshop at Bates College in Maine, USA. Holm uses all these data in comparison to her diatom studies to reconstruct the palaeoenvironment of these lakes with regard to changes in climate and nitrogen deposition. She presented the results of her studies on the NSINK workshop in at in May, and at the XIX Nordic Diatomist's Meeting in April in Porvoo, Finland.

In 2009, Riko Noormets continued his research into the geomorphology and sedimentary processes of glacially influenced continental margins in the Arctic as well as in the West Antarctica. He participated on two international research cruises in 2009 - one on RRV James Clark Ross with colleagues from Cambridge, Durham and Loughborough Universities UK; INSTAAR, Colorado, USA and GEOTOP-UQAM, Montreal, Canada to the West Greenland margin, including the Disko Bay and Umanak fjord systems where the aim was to collect evidence on the extent and dynamics of Jakobshavns Isbrae during the last glacial cycle; and the other one on I/B ODEN with colleagues from the Stockholm University, Sweden and Lamont-Doherty Earth Observatory, Columbia University, USA to the Yermak Plateau in the Arctic Ocean.

On the teaching side, Noormets designed a course in Arctic Marine Geology (AG-211) and ran it twice in 2009 with full student numbers. He organized two marine geological/geophysical cruises to the fjords and continental margin of the West Svalbard as part of the course. In addition to his teaching at UNIS, Noormets advised B.Sc., M.Sc. and Ph.D. students at the Universities of Brown, Tromsø and Cambridge.

In June 2009, Doug Benn attended the Conference on High Mountain Glaciers at the Norwegian Polar Institute in Tromsø, acting as rapporteur for the Glaciology Working Group. He contributed to the final report arising from the meeting, on the impact of climate change on the world's mountain glaciers, due to be published by UNEP in 2010. In August, he participated in the Svalbard Science Forum Joint Co-operation Initiative Workshop on Pan-Svalbard Co-operation. This meeting gathered together glaciologists and upper atmosphere scientists from several research-active nations in Svalbard, to develop new ways of sharing data and working together. Participants visited UNIS, the Polish Research Station at Hornsund, Barentsburg, and Ny-Ålesund, travelling from place to place (and enjoying excellent hospitality) on the Polish training vessel Horyzont. Benn played a lead role in preparing the glaciology parts of the final report, which can be found on the Svalbard Science Forum web pages (http://www.svalbardscienceforum.no).

Doug Benn continued his productive research collaboration with Polish scientists at the Hornsund Polish Research Station. He and external UNIS Ph.D. students Jason Gulley and Alison Banwell conducted fieldwork on Hansbreen and Werenskioldbreen in September in collaboration with Prof. Jacek Jania and Dr. Mariusz Grabiec (University of Silesia), investigating subglacial drainage channels using a combination of direct exploration and ice-penetrating radar. The data gathered during the field campaign is being used to test new models of subglacial channel formation. Jason Gulley and Alison Banwell also commenced a two-year study of the drainage system of Rieperbreen, investigating the relationship between channel morphology and flow characteristics.

Glaciological fieldwork was also carried out on Midtre Lowenbreen by Doug Benn and Dr. Sven Lukas (University of London), who were based at the AWI station at Ny-Ålesund. The research employed electrical resistivity techniques to investigate the subsurface structure of ice-cored moraines, and their implications for moraine-forming processes in Ice Age Scotland.

In November and December, Doug Benn carried out a research expedition to the Mount Everest region, Nepal, with external UNIS students Sarah Thompson, Jason Gulley, Alison Banwell, as part of a long-term study of the impact of climate change on debris-covered glaciers in the region. As well as mapping newly discovered ice caves, the team made a detailed survey of a rapidly growing moraine-dammed lake, which they predict could develop into a major hazard for communities downstream. They are working with local agencies and the International Centre for Integrated Mountain Development (ICIMOD) to monitor the evolution of the lake, and develop hazard management strategies.

The Ph.D. work by Monica Sund on "Dynamics of calving and surging glaciers" a part of the GLACIODYN project continued. During 2009 field measurements were carried out on several glaciers. On Kronebreen calving and velocity measurements were collected from terrestric photogrammetry. During winter 2008-09 the glacier system Nathorstbreen had started to advance and the predicted surge was followed through the year by use of cameras. The surge appears to be the largest surge in Svalbard during the last ~70 years. Also the development of the Comfortlessbreen surge was monitored. Global Navigation Satellite System measurements continued on Kroppbreen, and also measurements on other glaciers were conducted in collaboration with the University of Oslo. Aerial and satellite images were used to gain further information of the development of the glaciers. Information on the project could be found on Sunds's homepage at www.unis.no (Staff – Arctic Geology – Monica Sund).

The permafrost and periglacial geomorphology research group in 2009 consisted of Hanne Christiansen, Markus Eckerstorfer, Håvard Juliussen, Lene Kristensen, Ulrich Neumann, Ole Humlum, Bo Elberling and Tatsuya Watanabe. As part of the activities in the 'Permafrost Observatory Project: A Contribution to the Thermal State of Permafrost in Norway and Svalbard' (TSP NORWAY) IPY project the first Norwegian Permafrost database, NORPERM (www.ngu/no/norperm), was launched in 2009, and we immediately started using this for education and research. 2009 also provided us with the very first year of temperature data from all the boreholes established mainly in 2008, and international IPY collaboration on the results started. Tatsuya Watanabe started as external Ph.D. student in 2009 studying mudboil dynamics in Adventdalen. Master student Stephanie Härtel worked on her ice-wedge reconstruction thesis studying different sites in Adventdalen. Master student Stephan Vogel started studying the cornices above Nybyen with respect to their dynamics and meteorological control. Master student Dominik Langhamer finished his thesis on active layer dynamics in Svalbard and NE Greenland.

Collaboration with Norut in Tromsø was started in the PERMA-SAR project studying the potential for the SAR technique to record permafrost landform changes on a seasonal and interannual basis. Nordic collaboration on obtaining permafrost cores and establishing thermal monitoring in shallow boreholes in palsas in the Nordic area was started in 2009 in the PERMA-NOR Nordic funded collaboration project. We worked in the Neiden and Karlebotn areas in Finnmark as the Norwegian part. Field data was collected in the Nordnes unstable rock slope area as part of the collaboration with the 'Rockslide in Troms' intermunicipality geohazard research and monitoring project, for determining the potential influence of permafrost on the unstable rock slope processes.

In 2009, the "Climate change effects on high arctic mountain slope processes and their impact on traffic in Svalbard" (CRYOSLOPE Svalbard) NORKLIMA research project, studying climate change effects on high arctic mountain slope processes had its third and final year. Ulrich Neumann and Markus Eckerstorfer conducted over 60 fieldwork days on snow mobiles and skies without any accidents, collecting avalanche information. First data analyses were started right after the spring season resulting in one conference paper, two conference presentation and three submitted papers into scientific journals. First outcomes show, that almost 50 % of all observed snow avalanches were cornice falls, followed by slab avalanches 30 %. Over 70 % of all snow avalanches were of a direct action type, releasing right after a snowstorm. Thus, 9 intensive snow avalanche cycles were observed between the 2006-2009 fieldwork period, all following a low pressure reaching the area around Longyearbyen. Markus Eckerstorfer, who worked had been a volunteer in the project in 2008, started his Ph.D. study in 2009 focusing on snow pack factors and meteorological control of snow avalanches in the maritime high arctic landscape around Longyearbyen. During his 4 years project he will use CRYOSLOPE Svalbard results, continue some of the established field operations and update the project webpage **www.skred-svalbard.no**.

June 2009: The International Polar Field School students got a closer look at a curious walrus in Grønfjorden, just outside Barentsburg.

Photo: Elise Strømseng

GRADUATES 2009:

PH.D. DEGREE:

Lene Kristensen: Glacier surges and landforms in a permafrost environment at the tidewater glacier Paulabreen, inner Van Mijenfjorden, Svalbard.

MASTER DEGREE:

Dominik Langhamer: Influence of summer meteorology and local ground conditions on thaw progression for two Circumpolar Active Layer Monitoring (CALM) sites: a comparison between northeast Greenland and central Svalbard

Willem van der Bilt: Post Little Ice Age environmental change documented in lake sediments from Kongressvatnet, Spitsbergen

Tine Larsen: Mediumfjellet thrust stack - fracture models predicting reservoir quality

Stig Atle Kvien Stene: Facies and architecture of the Battfjellet Formation, northern Nathhorst land, Spitsbergen

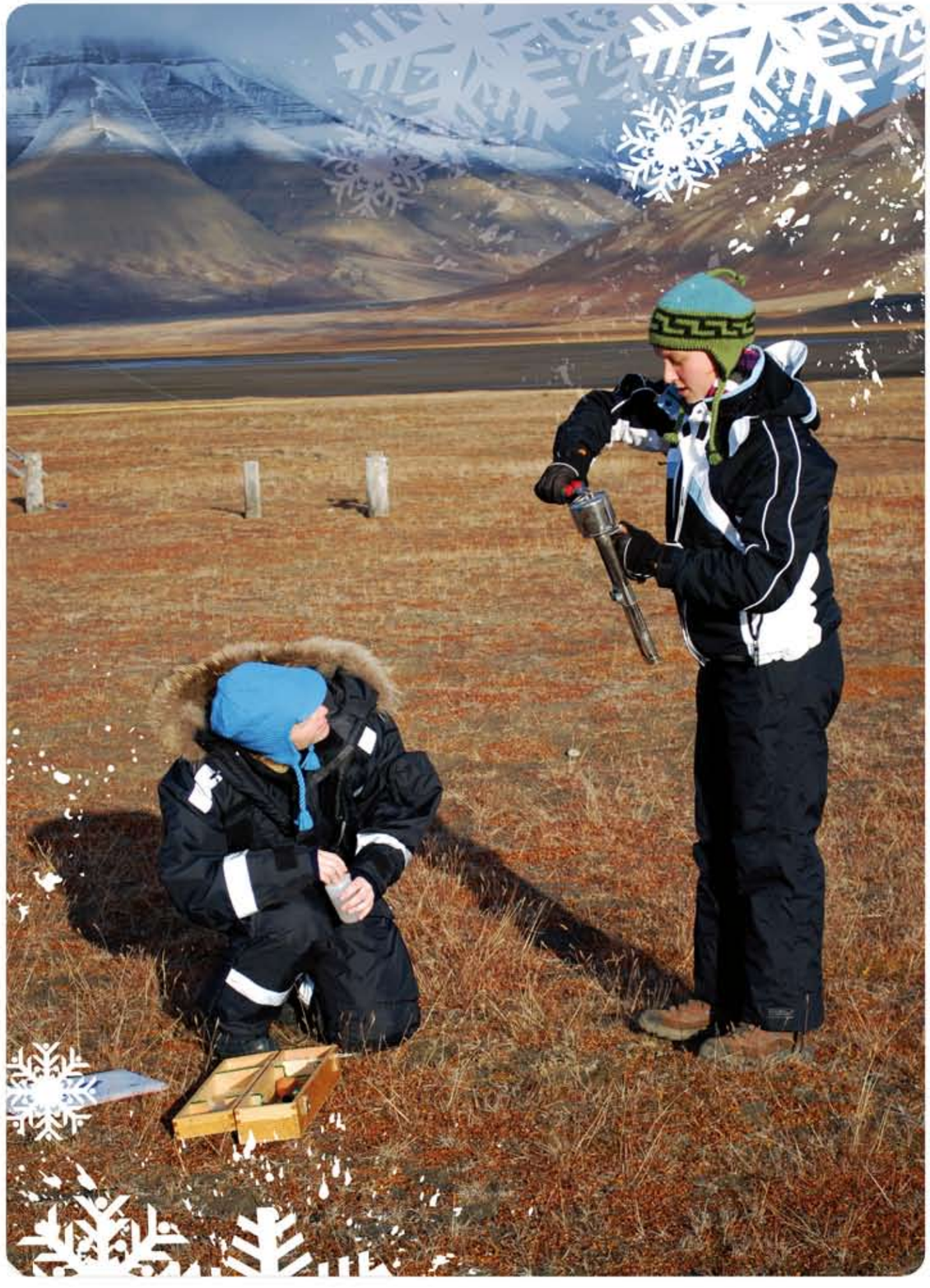
Maria Temminghoff: Characterization of the englacial drainage system in Scott Turnerbreen, Svalbard, by speleological mapping and ground-penetrating radar.

Sanna Kallio: Hydrological system of Rieperbreen

Espen Rødland Mikkelsen: Feasibility study of monitoring of CO_2 by time-lapse seismic

Sigrid Elvenes: Landskap og prosesser på Vesterålsbanken

Andreas Hetland Olsen: Facies and architecture of the Battfjellet Formation, northern Nathhorst land, Spitsbergen



September 2009: AGF-213 students doing field experiments in Adventdalen.

Photo: Tor de Lange

arctic geophysics

By Carl Egede Bøggild

The department has in total of six full time faculty positions, and has established research within oceanography, cryosphere, meteorology, middle and upper polar atmosphere. The department also consists of six adjunct professors, as well as one post doc (oceanography) and four Ph.D. students (upper polar atmosphere, middle polar atmosphere, oceanography and meteorology).

Teaching was conducted at both the undergraduate and graduate level, with six courses in each level. An important part of all courses is the field work, which allows the students to actively carry out research in the field. During 2009 the department has carried out several ship cruises and a glacier course with teaching of field methods. The data collected are then typically used in course reports, giving the students valuable experience in analyzing and presenting scientific data in a coherent manner.

Middle/Upper Atmosphere Research Group

In 2009 the middle/upper atmosphere group in the Arctic Geophysics department has experienced exceptional success. There were several observational campaigns at KHO, SPEAR, and EISCAT, and all facilities operated nominally. Secondly, the Research Council of Norway (RCN) had an international expert panel evaluate the quality of the scientific research in the middle/upper atmosphere group. Their findings were exceptional: "There is high international impact of their work", and "the quality of its research strongly motivates a continuous support to the group". Based on scientific merits and the worldwide importance of this type of research the expert panel also recommended that the group should be given a small growth in funding for post docs and Ph.D. students. In a situation where UNIS has severe financial challenges, the middle/upper atmosphere group was also extremely successful at obtaining external funding from RCN. First, a grant was awarded to operate the SPEAR facility for three years, and Lisa Baddeley was hired as a post doc from July 2009. A second big grant was awarded in October 2009 to upgrade the optical instrumentation at KHO. This project is called InfraSpace, and it will run for three years. The group also got two smaller grants to promote collaboration with Russian groups in Barentsburg (i.e. PGI and AARI).

Consequently, in the last 15 months the middle/upper atmosphere group has secured close to 17 MNOK of external funding from RCN.

Physical Oceanography Research Group

In physical oceanography, main focus has been on research related to ongoing Norwegian IPY projects. Associate professor Frank Nilsen is PI in the two largest Norwegian IPY projects, IPY iAOOS-Norway and IPY BIAC. New instruments and subsurface moorings were deployed around Svalbard in September-October 2007 and repeated in September 2008. The retrieved data from 2009 is used to study the dynamic of the West Spitsbergen Current and its effect on the water mass and sea ice distribution in the Arctic Ocean (iAOOS), and to study ice production and deep-water formation in the Barents Sea and its effect on the thermohaline circulation (BIAC). These projects also fund post doc Ragnheid Skogseth in physical oceanography. During 2009, Frank Nilsen and Ragnheid Skogseth had their sabbatical at the Polar Science Center, Applied Physical Laboratory, University of Washington, Seattle. Master student Eli Anne Ersdal, who defended her master thesis "On the tidal forcing of the Storfjorden polynya" in August 2009, and UNIS Ph.D. student Sigurd Henrik Teigen who is working on the water mass transformation in the West Spitsbergen Current, had long and productive research stays at the Polar Science Center in Seattle.

Two science contributions from the physical oceanography group in 2009 are highlighted here. Based on the IPY-BIAC data, our study indicates that supercooled water is generally present during polynya events with moderate wind and large net surface heat loss along the Arctic continental shelf (Skogseth et al., 2009). This opens for a new debate on the freezing point temperature. Furthermore, a chapter on sea ice and oceanography was published in a sea ice textbook based on data and experience from the two above-mentioned IPY project.

Meteorology Research Group

One of the focus areas in meteorology is air-ice-sea interaction. A study site is the shoreline of Isfjorden. The measurements from this site will contribute to a better understanding of the exchange processes between the sea and the air, with and without sea ice, something which is crucial for improving weather and climate models in the Arctic.

The project "Climate change effects on high arctic mountain slope processes and their impact on traffic in Svalbard" (CRYOSLOPE Svalbard), is a 3-year project (2007-2009) funded by the Norwegian research council (Norklima). The meteorology group's focus is on meteorological monitoring and surface exchange processes with the aim to better understand the connection between avalanches and weather.

The meteorology group also works with what controls the climate on a local scale with varying topography and surfaces such as tundra, snow, ice etc.

Cryosphere Research Group

In the field of snow- and ice processes research process studies has been carried out to determine the way aerosols cause darkening and hence increased melts rates of glacier ice. In 2009 field campaigns were carried out on glaciers in Grønfjorden as well as Longyearbreen. The main aim was to quantify the mass of aerosols and solar reflectivity on the melting glacier surface and its variability on the melting surface. Preliminary analysis show promising results that are being worked up for publication. The PRODEX project is funded by ESA and is in collaboration with the Norwegian Computing Center and University of Sheffield.

A research project in collaboration with several international research institutions focuses on the fresh water discharge from the Greenland ice sheet. The research project FreshLink, funded by the Danish Research Councils and the Danish Ministry of Climate, focuses on that linkage between fresh water discharge from the ice sheet and marine circulation in the fjord. Presently research institutions from Norway, Denmark, Greenland and United States are involved. In 2009 field campaigns have been carried out both in the autumn by use of ski equipped aircraft landing directly on the glacier snow surface. During the summer campaign a transect of samples and measurements were carried out to quantify the impact of aerosol accumulation on the melting ice surface.

Glaciodyn is a RCN funded research project focused at investigating the role of ice dynamics in the response of Arctic glaciers and ice caps to global warming, to improve prediction of future changes and their impact on freshwater fluxes to the ocean and thus global sea level. Predicting glacier response to climate change requires accurate parameterisation of surface and dynamic processes, and robust and versatile methods for modeling their evolution and interaction. In this connection detailed process studies has been carried out to determine micro structures in the snow pack. Such micro structures are controlling where the melt water refreezes and forms ice lenses inside the snow pack.

For the first time a full assessment was made on the state of the Greenland ice sheet in a changing climate has been documented in a comprehensive report with participation of AGF as one of the lead authors. As such, this report is the first in a series of reports presenting the results of the SWIPA project. The SWIPA project was established by the Arctic Council in April 2008 as a follow-up to the 2005 Arctic Climate Impact Assessment (ACIA).

Its goal is to assess current scientific information on changes in the Arctic cryosphere, including the impacts due to changes in the cryosphere that have potentially far reaching implications for both the Arctic and the Earth as a whole.

GRADUATES 2009:

PH.D. DEGREE:

Robert S. Fausto: Improving Surface Boundary Conditions for Large-Scale Ice Sheet Models of Greenland

MASTER DEGREE:

Nial Peters: Development and calibration of a DSLR system for auroral studies

Vigdis Lonar Barth: Identification and tracking of extreme electron densities by EISCAT Svalbard radar and SuperDARN

Karina Elizabeth Bravo Ibáñez: Observations of polar cap patch substructures by EISCAT Svalbard Radar

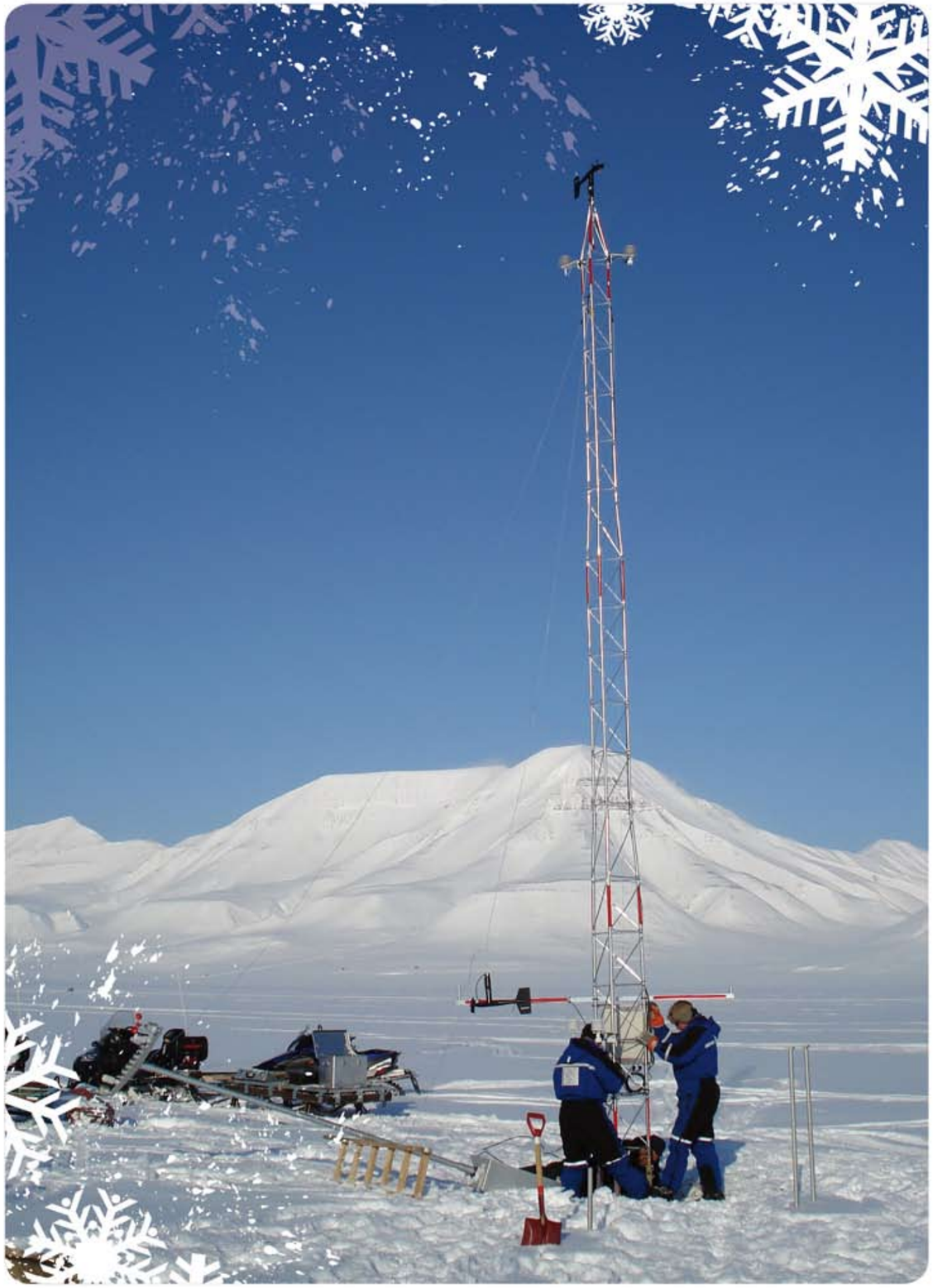
Borgar Aamaas: Elemental carbon in Svalbard snow from local sources and its impact on surface albedo

Eli Anne Ersdal: On the tidal forcing of the Storfjorden polynya

Juho Pekka Vehviläinen: Snow modelling on Tellbreen, Svalbard with SNOWPACK snow physical model during winter and spring 2009

Miina Manninen: Structure of the atmospheric boundary layer in Isfjorden, Svalbard, in early spring 2009

Eeva Mäkiranta: Observations of atmospheric boundary layer over sea ice in a Svalbard fjord



April 2009: UNIS technicians set up the new weather station nearby the old Aurora station in Adventdalen.

Photo: Stefan Claes

April 2009: Arctic technology staff on fieldwork in Van Mijenfjorden, just outside Svea.

Photo: Lucie Strub-Klein

arctic technology

By Aleksey Marchenko

The Arctic Technology Department offers educational and research opportunities in Arctic Engineering and Arctic Environmental Technology & Chemistry. Arctic Engineering concentrates on engineering problems related to the Arctic Environment: living and building on frozen ground that may be subject to landslides and avalanches (Geotechnics), Arctic offshore oil and gas exploitation (Ice Mechanics, Geotechnics). Arctic Environmental Technology and Chemistry concentrates on current and potential pollution problems and environmental impacts.

The technological and analytical challenges deriving from increased human activity in the northern marine and atmospheric environments, including Svalbard, continue to be our main focus. Climate change related topics are a high priority in education and research.

Arctic Engineering

The key topics within Arctic Engineering are permafrost and ice. We perform field studies, mathematical modeling and numerical simulations of thermo-mechanical response in relation to onshore, coastal and offshore infrastructure. The main sites of our investigations are Longyearbyen, the Van Mijenfjorden, Svea and North-West Barents Sea. These research directions also include climate change related aspects. In this context, UNIS Arctic engineering scientists monitor ground temperatures when the permafrost is influenced by human activities and investigate how the temperature changes influences the strength and stiffness of the soil material.

In addition we seek improved solutions for foundations, road structures and routes, i.e. generally try to find ways to minimize the problems the frozen ground poses to engineering activities when establishing infrastructure in cold regions. Students in frozen ground engineering may involve themselves into engineering problems related to frozen ground and the utilization of this ground for infrastructure like foundations for building, roads, quays, pipelines, transmission lines etc.

Recent activities are development and monitoring of environmental friendly quays and constructions for preventing coastal erosion, monitoring the actual condition of different foundations of buildings, collecting information from fragmentary site investigations, judging threats from snow avalanches and slow or faster soil movements in the form of landslides and investigating the conditions of the dikes holding the water supplies for Longyearbyen. Typical foundation conditions for buildings in Longyearbyen have been reported in the 2009 M.Sc. thesis by Marie Nokken: "Foundation behaviour in Longyearbyen, Svalbard".

One part of the frozen ground engineering problems is to map the ice features in ground that may pose future problems for the foundation behaviour (buildings, roads, airfields etc.). The course AT-329 focuses on the use of Ground Penetrating Radar for this purpose and student projects are often pointed towards practical problems in the Longyearbyen or Svea communities. In addition M.Sc. theses are dealing with GPR and resistivity measurement methods, like Margrete Åsmul 2009 thesis: "On the applicability of using ground penetrating radar for disclosing ice features in coarse permafrost ground".

The development of community related infrastructure in Longyearbyen and Svea poses important scientific and engineering tests for our staff and students. The ice coverage in the Van Mijenfjorden is usually stable through the season, allowing us to perform seasonal studies on sea ice without risks. Several unique medium- as well as large scale experiments were been performed on the ice close to Svea, over the past years during a set of international co-operation projects. These experiments brought together a unique combination of real sea ice measurements and load determinants. Hydrological and ice conditions on the Van Mijenfjorden and Tempelfjorden were monitored and in-situ ice stresses were investigated. The main focus within this topic was to investigate how environmental variables (meteorological and hydrological) determine sea water hydrology, ice conditions and strength of land fast ice: in open sea, near shoreline, near glacier fronts and near industrial objects (coal quay Kapp Amsterdam). In the Barents Sea we performed our annual field studies and measurements of sea ice ridges, icebergs, sea currents, temperature and salinity of the water in ice adjacent layers and inside ridge keels. We also deployed three ice tracking buoys on the iceberg and drifting ice in the Western Barents Sea to monitor their motion with high spatial and temporal resolution. In parallel measurements of sea currents velocities were performed from the drifting ice in the same region. Field data were used for the modeling of the ice and icebergs drift in the Barents Sea. Ice samples collected during field works were tested for the strength properties and structure in the UNIS cold laboratory. Laboratory experiments were used also to study the friction between ice and rough steel surfaces and to study freeze bonds formation between submerged ice blocks. This activity is a part of a combined scientific and educational program were students participate in state-of-the-science research activities as part of their project work.

Researcher Nataly Marchenko is working for the collection and analyzing of ice pilot experience from sealers for the construction of data base of incidents with ships in ice conditions in the Russian Arctic. The work is supported by PetroArctic project. She also administrates two RCN projects supporting scientific exchange of students (Ph.D. and M.Sc. level) as well as scientific personnel between Russian and Norwegian Academic institutions involved in research in the European High North.

Several Ph.D. projects are related to the research of ice influence on shore line and elements of quay structure in Van Mijenfjorden. Ph.D. student Fabrice Caline is studying the design of environmentally friendly shore protection structures. The project is supported by the coal mining company Store Norske (SNSG), the Research Council of Norway (RCN) and recently obtained the European Eureka innovation label. Field work for this Ph.D. project was finished in 2008 and in 2009 Caline delivered his Ph.D. thesis for the consideration by the evaluation committee.

The Ph.D. project of Sebastien Barrault is focused on mechanical deformations of land fast ice due to temperature variations and tides. Experiments were also performed in the UNIS ice tank. Membrane sensors were frozen in the ice for continuous measurements of internal stresses in the ice. This project, supported by Total Norge, finished in the end of 2009. In parallel to the project, M.Sc. Mikhail Naumov together with Russian colleagues from the Fiber Optics Research Center of the RAS (Moscow) has performed laboratory experiments on the measurements of thermal expansion of saline ice with optical fiber sensors. The experiments demonstrated negative coefficient of thermal expansion for saline ice.

The Ph.D. project of Lucie Strub-Klein is related to the study of physico-mechanical properties of sea ice ridges. Samples from several ice ridges in the Barents Sea, Fram Strait and grounded ice ridge in Van Mijenfjorden were tested for the uniaxial compressive strength. Porosity of these ice ridges was reconstructed by the drilling profiles. Thermistors strings were used to measure long term evolution of temperature profiles in ice ridges in Van Mijenfjorden. The project is supported by Petro-Arctic program.

The UNIS Ph.D. project of Luis Delmas is focused on the study of geotechnical and climate related mechanisms leading to increased snow avalanches releases under the special Arctic conditions. The effect of permafrost on the temperature gradient in the snow pack is studied in the field around Longyearbyen.

The Ph.D. project of Aleksey Shestov is supported by SIU and UNIS and is focused on field studies and mathematical modeling of sea ice growth and ice influence on seabed and quay constructions. Field work carried out in 2009 included measurements of sea currents and temperature in ice adjacent layers and inside ridge keels in the Barents Sea and in Van Mijenfjorden with using of Acoustic Doppler Velocimeter ADV SonTek and Sea-Bird temperature and pressure recorders. In-situ measurements of ice stresses were performed below the coal quay Kapp Amsterdam. Numerical simulations of thermodynamic consolidation of sea ice ridges and ridge keels destruction under the interaction with seabed were performed for extreme weather conditions in the Baydaratskaya Bay, Kara Sea.

Environmental Technology and Chemistry

Key topics of interest include: The fate of oil spills in an Arctic environment and possible countermeasure and mitigation strategies as well as development of sustainable remediation techniques; levels and spreading of persistent organic pollutants and their behaviour in the Arctic environment (Polychlorinated biphenyls, current-use pesticides and organochlorine pesticides in Arctic biota, sea water, ice, snow, lake sediment and tissues); and spreading and effects of pollution from local mining industry. Oil spills in the waters around Svalbard, can be expected to behave significantly differently than oil spills in warmer waters, like the North Sea. The differences in spreading, evaporative loss, emulsification, dispersion and other factors add up to important modifications in operational oil spill contingency planning. There is a range of potential sources of oil spills in and around Svalbard, including fishing boats and freighters, tourist vessels, and leakage or seepage from oil storage on land.

The department is involved in the EU-initiative (7th Frame work programme) on fate and behaviour of persistent organic pollutants (POPs) in the Arctic under changing climate conditions (ArcRisk). The initiative started in May 2009 with an integrated UNIS Ph.D. position in the research project. The Ph.D. student, Pernilla Carlsson, started her research during spring 2009. Carlsson will investigate selective up-take processes for persistent organic pollutants (POPs) into the Arctic food web ultimately causing exposure of indigenous people of the Arctic. How the up-take of pollutants is influences by potential climate change will be an integrated part of her work. The study is integrated into a large research network including collaboration with the University of Lancaster, University of Tromsø, Environment Canada, Masaryk University Brno (Czech Republic) and IVI (Sweden).

A new associate professor, Mark Hermanson, began to work in August 2009. Dr. Hermanson (from the University of Pennsylvania, Philadelphia, USA) will focus his research on transport and fate of organic pollutants in Arctic environments. Publications in 2010, resulting largely from work at the end of 2009, will include transport and fate of current use and legacy pesticides, brominated flame retardants, and other persistent contaminants to Svalbard ice cores. Dr. Hermanson is undertaking an initiative to identify particle-borne contaminants reaching Svalbard, especially the brominated flame retardants, some of which are found in very high concentrations in Svalbard ice cores.

The analytical laboratory available for environmental chemistry has instruments capable of extraction and analysis of trace organic contaminants in environmental samples from the Arctic environment including water (including ice & snow), tissues, sediments, and atmospheric gas and particulates. The contaminants include common organochlorine contaminants including polychlorinated biphenyls and pesticides. Dr. Hermanson introduced a several-fold expansion of sample extraction and clean-up capability by moving most of his lab to UNIS from the University of Pennsylvania. The instruments available include gas chromatographs with various detectors, including electron capture, flame ionization, and mass spectrometry (ion trap). The laboratory is currently actively in use for graduate courses (AT-321 and AT-324), the undergraduate course (AT-209) as well as for research purposes.

As a part of her Ph.D. project, Monika Trümper in 2009 performed combined laboratory and field experiments on photochemical transformation processes of persistent organic pollutants on ice and snow surfaces under Arctic conditions. In addition, the Environmental Technology group has conducted comprehensive experimental work within two research project financed through the RCN for the investigation of pharmaceutical residues in sewage treatment processes under different Climate conditions and the environmental behaviour of perfluorinated flame retardants in off-shore fire fighting foams (AFFF), respectively.

Another topic of interest is the environmental control of acids and metals being released (known as acid mine drainage) from mine waste rock dumps and the impact of metals as these accumulate in soil, disperse within the hydrological system or taken up by plants. A Ph.D. study by Jørgen Hollesen (University of Copenhagen) on self incineration processes in waste dumps from coal mining activities is now underway with close co-operation with Russian (Barentsburg) and SNSK (Svea) co-operation partners.

Project co-operation 2009

The department continued in 2009 with two RCN projects supporting scientific exchange of students (Ph.D. and M.Sc. level) as well as scientific personnel between Russian and Norwegian institutions involved in research in the European High North. The projects "NorthPOP" and "Safe loading and transport of hydrocarbons from the Barents sea" are currently co-ordinated through the department. In co-operation with Carl E. Bøggild, the Environmental Technology group is involved in the FreshLink initiative, to establish freshwater inflow budgets into East Greenland Fjord system. The department is also involved in the project "Marine Safety Management in the High North" together with total 18 participating companies including the RCN, represented by the MarOff program. In 2009, two new RCN funded research projects associated to the NorthPOP project have been funded: "ArcticInterCal on intercalibration of quantification methods for the determination of POP traces in Arctic environmental samples" and "SvalPOP: investigation of the role of particles in the transformation and environmental stability of POPs in the Arctic atmosphere". In addition, the department is involved in a new RCN funded project on "Environmental Waste management in the Arctic" (EWMA) co-ordinated by the University of Tromsø. The research site in Svea has been followed up by SINTEF Rock and Soil Mechanics and by UNIS/NTNU M.Sc. project work by Rolf Anders Aasland ("Vurdering av brudd i fylling, Barryneset; Svea"). Based on the results so far the technique developed has been adopted by SNSK for remedy work at Kapp Amsterdam in Svea.

GRADUATES 2009:

MASTER DEGREE:

Anton Kulyakhtin: Iceberg drift and towing modeling in Barents Sea

Bente Helene Stafne: Analysis of basic and acidic pharmaceuticals in the Arctic environment by LPME and UPLC-MS/MS

Irene Andreassen: New emerging persistent organic pollutants in selected Arctic biota

Kristian Forsberg: Development of a new analytical method for the analysis of selected serotonin re-uptake inhibitors in large volume sea water samples

Margrete Åsmul: On the applicability of using ground penetrating radar for disclosing ice features in coarse permafrost ground

Marie Nokken: Foundation behaviour in Longyearbyen, Svalbard

Silje Eriksen Holmen: Trends and variability in transport of persistent organic pollutants to the Arctic and possible relation to climate change

Christian Ulrich: Weiterentwicklung und Anwendung eines massiv parallelen Smoothed Particle Hydrodynamics Simulationsverfahrens

student council

By Matilda Hallerstig (SC leader autumn 2009) and Benjamin Merkel (SC leader spring 2010).

The Student Council works together with the UNIS board, UNIS leader group and the student welfare organization to create as good student environment as possible. It also arranges social activities like Friday Gathering and movie nights, and administrates two cabins, hiking and safety equipment and more for students to use free of charge. Because Longyearbyen is a small community it is also important to promote student participation in public events like "Ta Sjansen" and activities organized by the local sports club Svalbard Turn.

Because the student group is relatively small, a large percentage of the students are involved in the Student Council and related activities. This makes it easier for the individual student to make his/her voice heard. A challenge for the Student Council is the high turnover time of 1-2 semesters among the students. This requires a dynamic structure where the service offered by the Student Council can change according to the demands of the students. For continuity it is also important to have a good communication between old and new students.

During autumn 2009 the Student Council started to work together with SiTø and UNIS to improve housing conditions for students. Also student surveys were undertaken to get a picture of student opinions about different aspects of the student life. These surveys give students a chance to contribute anonymously with positive and negative critic to the work of UNIS and the Student Council and are a valuable tool to make conditions for students even better. Over all, the surveys showed that students are positive both to UNIS studies and to the Svalbard student life in general.

In the same semester the Student Council started to get involved in the UNIS Research and Education Committee to assure quality in all courses that UNIS provides. The Student Council is also involved through representatives on the UNIS board and in UNIS the leader group to speak about opinions and concerns regarding students and UNIS as an institution.

September 2009: UNIS students capture the scenery on Nordenskiöld mountain.

Photo: Benjamin Merkel

scientific publications 2009

Scientific publications (FRIDA level 1 and 2) published with UNIS as author address in journals accepted by the Norwegian Association of Higher Education Institutions (UHR). A more thorough UNIS publication list (incl. conference papers, etc.) is available in the FRIDA database system:
http://wo.uio.no/as/WebObjects/frida

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Sea-ice fauna. I: pp. 303-322

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Kovacs, Kit; Haug, T.; Lydersen, C.
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Sakshaug, E.; **Johnsen, Geir**; Kristiansen, Svein; Quillfeldt, C.v.; Rey, F.; Slagstad, D.; Thingstad, F.
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Sakshaug, E.; **Johnsen, Geir**; Volent, Z.
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August 2009: UNIS field camp at Rudmosepynten, Billefjorden.

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