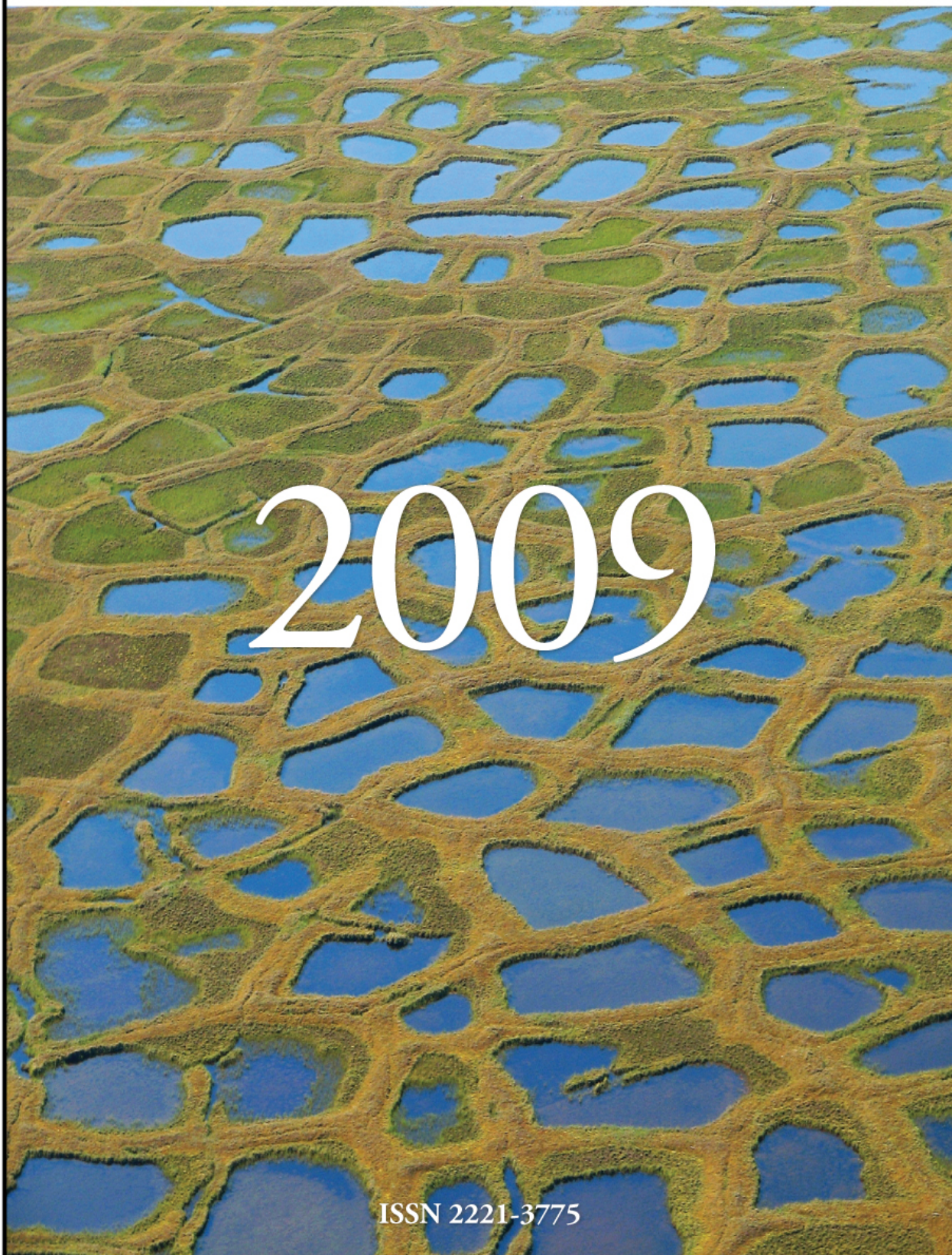


COUNTRY REPORTS



Reports from the Adhering Bodies of the International Permafrost Association



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1 Argentina (and South American Partners)

A.-L. Ahumada, G. Ibáñez Palacios and S. Páez (Fundación Miguel Lillo, Tucumán) continue their research of cryogenic environments and rockglaciers of the Sierra de Aconquija (Province of Tucumán) and Sierra de Santa Victoria (Provinces of Salta and Jujuy). They have registered 256 active and 67 inactive rockglaciers at Aconquija and located their limit of activity at 4300 m a.s.l. approximately. The research group has also started investigations at the Nevados de Cachi (Province of Jujuy). A.-L. Ahumada was invited to hold a lecture on global warming at the Academy of Science in Buenos Aires. Together with other experts (e.g. D. Trombotto), she worked as advisor for the elaboration of an Argentine Law for the protection of glaciers and rock glaciers.

A. Brenning and X. Bodin (University of Waterloo, Canada) continued the geodetic monitoring of rock glaciers and thermokarst-affected massive ice in the Andes of Santiago/Chile in 2008/09. In addition to differential GPS measurements initiated in 2004, they used terrestrial laser scanning (TLS) on rockglaciers for the first time in the Andes. Additionally, ground surface temperatures are being monitored at a wide range of locations for statistical analysis.



Peteroa Volcano, Argentina / Chile (Photograph provided by Dario Trombotto)

L. Ruiz (IANIGLA) has successfully applied the BTS method to detect permafrost in the Valley of Silence near Lake Caradoc in the north-west of the province of Chubut. He thereby recovered the input information necessary for a model simulation of permafrost extent in the vicinity of the Lake District in the Humid Andes. The identified mountain permafrost was characterized as a type of low altitude patchy (island) permafrost

(>1700 m a.s.l.) with surface radiation values typically lower than 14 Mj/m²/d. M. Castro (Universidad Nacional de Cuyo, Mendoza) has registered 95 rockglaciers in the Cordillera del Tigre (Province of Mendoza).

In 2009, D. Trombotto (IANIGLA) and P. Penas (CNEA, Buenos Aires) with the support of the ICES (Malargüe) made an inspection flight over the active volcano Peteroa for a thermal analysis of the caldera which is ice covered and features exposures with permafrost and subterranean glacier ice.

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2 Austria

Permafrost research in Austria in 2009 was carried out by an increasing number of experienced and younger scientists. The University of Innsbruck group of K. Krainer in cooperation with the Vienna University of Technology (E. Brückl, H. Hausmann), the Central Institute for Meteorology and Geodynamics in Salzburg/ZAMG Salzburg (M. Staudinger, C. Riedl) and the Geological Survey of Austria (A. Römer) continued working on the project Permafrost in Austria. At the study area Krummgampental, Kaunertal (Ötztal Alps) permafrost mapping was continued on unconsolidated sediments (rock glacier, moraines, talus slopes) using a 12 channel seismic recording system with continuous recording modus. Interpretations of velocity-depth functions from 1D-diving wave tomography, 2D seismic refraction analyses and BTS-temperatures were evaluated for permafrost detection. A structural investigation was conducted with GPR (low frequency antennas/15&35MHz). At the study area Sonnblick the observation of P- and S-wave velocity field variations and seismic tomography using 15 borehole geophones was applied.

ZAMG Salzburg also continued working on PermaNET (<http://www.permanet-alpinespace.eu>). For 2009 a laser scan of the north face of Sonnblick was carried out which will be repeated in the following years. For the 3D modelling of the permafrost distribution on Sonnblick long term climate data, present borehole temperature data (20 m) and ground surface measurements were collected and corrected. ZAMG Vienna (W. Schöner) continued working on the project PERSON as another part of the larger permafrost



Collection of ground surface temperature data and marking the sensor location in the Sonnblick north face at 3100 m a.s.l. (Photograph provided by Gerhard Schauer) The University of Salzburg group (L. Schrott, J.-Ch. Otto, B. Ebohon) continued working on [permaalp.at](http://www.permaalp.at) (<http://www.permaalp.at>; including a Web GIS). At several test sites (Glorer Hütte, Kitzsteinhorn, Gradental, Obersulzbachtal) new data have been gathered by field geophysics (ERT, GPR), ground temperature dataloggers and BTS-measurements.

The University of Innsbruck group of J. Stötter carries out permafrost research within PermaNET, ALS-X (Combination and Evaluation of Airborne Laserscanning and TerraSAR-X Data in Glaciology and Hydrology) and C4AUSTRIA (Climate Change Consequences for the Cryosphere) projects. All projects apply airborne laser scanning/ALS data and relevant tools. Preliminary results show that the high spatial resolution and the precision of the ALS data facilitate the quantification of permafrost degradation.

The Graz group consisting of the University of Graz (A. Kellerer-Pirklbauer, G.K. Lieb), Graz University of Technology (M. Avian, V. Kaufmann), and Joanneum Research (A. Bauer), continued working on ALPCHANGE (extended to November 2009; <http://www.alpchange.at>) and PermaNET spatially focussing on study areas in the Hohe Tauern and Niedere Tauern Ranges in Austria. In 2006, comprehensive permafrost monitoring networks were installed at six study areas within ALPCHANGE (see previous Frozen Ground issues). All these monitoring activities were continued and extended within PermaNET in 2009. Local scale activities were exemplarily the continuation of the annual geodetic measurements on the Dösen, Hinteres Langtalkar and Weissenkar rock glaciers, field mapping, 2D-geoelectric measurements (in cooperation with J. Götz, University of Salzburg) and BTS measurements at different sites. The resurveying by terrestrial laser scanning/TLS of the front of the Hinteres Langtalkar rock glacier (since 2000) as well as most of its lower

two-third as seen from a higher elevated scanner position (first time this year) was carried out by the new TLS system Riegl LMS-Z620. Airborne laser scanning/ALS was carried out in September 2009 at the Pasterze area and the Central Schober Mountains. Finally, within a bilateral project A. Kellerer-Pirklbauer and M. Avian joined colleagues from the Universidad Complutense, Madrid, Spain (D. Palacios, L. M. Tanarro, J. Marcos) for joint fieldwork in the Sierra de



Gredos and Sierra Nevada.

Joint fieldwork of Austrian permafrost researcher (A. Kellerer-Pirklbauer, M. Avian) with Spanish colleagues (D. Palacios, L. M. Tanarro) at the southern most active rock glacier and permafrost site of Europe, at Corral de Veleta in the Sierra Nevada, Spain.

(Photograph provided by Andreas Kellerer-Pirklbauer) Finally we want to report on a new project that should be approved by the end of 2009. **PERMAFROST – Austrian Permafrost Research Initiative** is a joint project by four different Austrian permafrost research groups (Graz, Salzburg, 2 x Innsbruck) and a first step in order to establish a permafrost monitoring program in Austria. This project will be funded by the Austrian Academy of Sciences.

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3 Canada

The Canadian permafrost community has been busy this past year with IPY projects and other activities including organization of the Sixth Canadian Permafrost Conference. This report presents some highlights of ongoing research and other activities.

Thermal State of Permafrost (TSP-Canada) – A Canadian Contribution to the International Polar Year – S. Smith, A. Lewkowicz and C. Burn

This collaborative project led by S. Smith (Geological Survey of Canada), A. Lewkowicz (University of Ottawa) and C. Burn (Carleton University) has made significant progress on its objectives to establish new permafrost monitoring sites to address gaps in the existing long-term monitoring network. As reported last year over 80 new boreholes were added. In 2009 additional sites were established in Nunavut communities, along an elevation transect at Eureka and in the Yukon with the most recent borehole drilled at Mt. McIntyre. Permafrost thermal data have been collected for the IPY period (2007-2009) from most new sites as well as the long-term sites. These data are currently being compiled to produce a 'snapshot' of ground thermal conditions that will provide an improved baseline against which to measure change. The Canadian snapshot database will contribute to the larger international database. The Canadian team will be active in preparation of a special issue of Permafrost and Periglacial Processes that will present initial IPY results. Canadians and their international colleagues met in October 2009 in Ottawa to develop the special issue. The snapshot database and the special journal issue will be disseminated at the IPY early science conference in June 2010.

Permafrost and Climate Change, Herschel Island – C. Burn

A long-term study of permafrost response to climate change on Herschel Island, Yukon Territory has recently been completed. Research results contribute to the IPY project and were presented in a recent paper published in the Journal of Geophysical Research by C. Burn and Y. Zhang of Carleton University. Using a recent ground temperature profile, climate records and modelling, Burn and Zhang determined that mean annual temperatures at the top of permafrost and 20 m depth increased by 2.6 and 1.9°C respectively over the last century. An interesting aspect of the Herschel Island study is that the scientists were able to reconstruct climate conditions 100 years ago from the records kept by the missionaries and whalers who lived there at the turn of the 20th century. The whalers, especially H.H. Bodfish, described snow conditions at Herschel, and they are much the same as today over much of the windswept island, i.e. a very thin layer of snow throughout winter. The missionaries, especially I.O. Stringer, kept weather records on behalf of Canada's Dominion Observatory. These data enabled a precise documentation of the change in conditions that has

occurred in the 20th century in Canada's western Arctic.

Special Issue of Permafrost and Periglacial Processes on the Mackenzie Delta – C. Burn and S. Kokelj, editors

A special issue of Permafrost and Periglacial Processes, edited by C. Burn (Carleton) and S. Kokelj (Department of Indian and Northern Affairs), containing a collection of papers on permafrost in the Mackenzie Delta and adjacent regions was released in June 2009. Topics investigated include cryostratigraphy and its relationship to Quaternary history, trends in active layer thickness and ground temperatures across treeline, the development of retrogressive thaw slumps and their influence on lake water quality, and the potential impact of climatically induced thermokarst on terrain stability. Much of the research presented is very relevant to planned infrastructure projects including the proposed Mackenzie Gas Project.

Highlights of the PPP issue include maps of ground temperatures in the Mackenzie Delta area. This is the first regional comparison of ground temperature conditions over a period of about 40 years. Included were conditions over the region collected in the last three years and contrasted with data presented by J.R. Mackay from the 1970s. The PPP issue also contains the longest record of active layer thickness variation published so far, with data collected at Illisarvik, 1983-2008. This record, summarizing changes at 12 sites on a hillslope transect shows clear thickening of the active layer at a tundra site during that period.

Enhancement of the Permafrost Monitoring Network in the Mackenzie Corridor – S. Smith

Through support received from the Northern Energy Development Initiative, the Geological Survey of Canada (GSC) undertook to address gaps in its permafrost thermal monitoring network in the Mackenzie Corridor and to collect baseline environmental information that is essential for planning northern energy development and the assessment of associated environmental impacts. Over 50 new monitoring sites were established throughout the corridor between 2005 and 2008. Collaboration with the Department of Indian and Northern Affairs (Kokelj) facilitated the installation of temperature cables in the Mackenzie Delta region. Permafrost thermal data have now been collected from all new installations with a two year record available for most sites. The initial data have been presented in GSC publications including a database product published as GSC Open File 6041 that includes thermal and geotechnical data for new field sites established in the central and southern

Mackenzie Valley. An important achievement was the collection of new information on ground thermal conditions in areas (such as the region north of Norman Wells) where very little recent information existed. Data from the new sites and the existing long-term monitoring sites have facilitated an updated characterization of ground thermal conditions throughout the corridor providing a baseline against which change can be measured. Data are being generated that are essential for planning development within the region. In addition the enhanced network will be an important contribution to environmental monitoring and management programs associated with future development projects in the region.

2008 Roger Brown Award Recipient, Margo Burgess

Margo Burgess of the Geological Survey of Canada was presented with the Roger J.E. Brown Award at the 2008 Annual Canadian Geotechnical Society Meeting. The Roger Brown Award is presented by the Cold Regions Geotechnology Division of the Canadian Geotechnical Society and honours excellence in the field of permafrost science and engineering. Margo was recognized for her achievements as a geoscientist over her 30 year career at the Geological Survey of Canada. Highlights of her work include the monitoring of the response of the ground thermal regime and terrain stability to natural and anthropogenic disturbances and the compilation of permafrost and geotechnical databases. She has published extensively, with many publications on the performance of the Norman Wells pipeline including its response to geotechnical issues such as uplift buckling of pipelines, and creep of thawing warm permafrost slopes. The results of her research related to the Norman Wells pipeline have been important not only to the ongoing maintenance and management of the existing pipeline but have also been utilized in the design of the proposed Mackenzie Gas Project and the associated environmental assessment process.

Margo has also been active in the IPA as a member of its Standing Committee on Data, Information and Communication. She also served as a member and secretary of the Canadian National Committee to the International Permafrost Association from 1999 to 2009.

Margo has also contributed her permafrost expertise to international assessments. In 2000, she co-authored the permafrost contribution to Chapter 2 of the Intergovernmental Panel on Climate Change's Third Assessment report. In 2004, she was an expert reviewer for the Arctic Climate Impact Assessment.

The Canadian permafrost community is proud to have Margo as a colleague and congratulate her for receiving this honour.

Sixth Canadian Permafrost Conference, September 2010

The CNC-IPA together with the Canadian Geotechnical Society will be hosting a joint Canadian Permafrost Conference and annual Geotechnical Conference in Calgary, September 12-15, 2010. This will be the Sixth Canadian Permafrost Conference and is open to all permafrost-related contributions. The conference website is geo2010.ca.

J. Oswell (Naviq Consulting Inc. and Chair, CNC-IPA) has been invited to present the R.M. Hardy Address at the Conference. The R.M. Hardy Keynote Address was established in 1986 to honour this great Canadian teacher and engineer. The address is presented by a well-known, senior CGS member from the area or city where the annual Canadian Geotechnical Conference is held. The topic is usually on a problem or issue of national or local interest. Jim will make a presentation

CanCOP 6

The 6th Canadian Conference on Permafrost
September 12-16, 2010
Calgary, Alberta, Canada

The Canadian National Committee of the International Permafrost Association (CNC-IPA) invite you to the 6th Canadian Conference on Permafrost. The Conference will be held concurrently with the 63rd Canadian Geotechnical Conference at the Hyatt Regency Hotel in Calgary, Alberta, Canada from September 12-16, 2010.

Permafrost Sessions

Mackenzie Delta and Coastal Dynamics - Climate Change and Permafrost - Sumps and Contaminants in Permafrost - Periglacial Processes - Permafrost Geophysics - Slope Stability - Permafrost and Glaciers - Frozen Core Dams and Mining - Infrastructure - General Permafrost Science

www.geo2010.ca

on geotechnical aspects of pipelines in permafrost. *Proceedings of Canadian Permafrost Conferences Available On-line*

The proceedings of the five Canadian Permafrost Conferences (1962-1990) are available for searching and viewing at <http://www.aina.ucalgary.ca/cpc>.

PDF files of the proceedings can be viewed sequentially, and a database containing 187 records describing the papers and other items that appeared in the proceedings can be searched for words in titles and abstracts, broad or detailed subject and geographic categories, authors, and conference numbers. All in this database are also available in the international Arctic & Antarctic Regions database, the main Arctic Science and Technology Information System (ASTIS) database, and relevant ASTIS subset databases.

This initiative was supported by the Canadian National Committee for the International Permafrost Association. The Geological Survey of Canada (Natural Resources Canada) provided support for the digitization of the conference proceedings and funded ASTIS (Arctic Institute of North America, University of Calgary) to index the papers and create the website.

Don Hayley to Present Canadian Geotechnical Society Cross Canada Lecture in Spring, 2010

The Canadian Geotechnical Society has invited Don Hayley, of EBA Engineering Consultants and former member of the Executive Council of IPA, to present a series of lectures to the membership of the Canadian Geotechnical Society. This lecture tour is a semi-annual program and the lecturer is a notable engineer or geo-scientist of international repute in their respective field. Specific dates for the tour and locations have yet to be finalized.

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4 China

Climate warming and enhanced anthropogenic activities have caused, are causing, and will continue to cause degradation of frozen ground in China, resulting in the destabilization of existing cold-regions infrastructures. These problems have been embodied in the field by increasing damage or failure of engineering structures, by frequent outbreaks of construction-induced frost hazards, and by increasing challenges for frozen-ground engineers and scientists. The most urgent issues are probably the retrofitting of existing infrastructures to adapt to changing climate and rising expectations in the level of design of future

infrastructures to adapt to changing or changed frozen-ground conditions and upgraded construction standards.

In 2009, permafrost activities in China mainly included projects and programs funded and conducted by the Ministry of Science and Technology (MoST) and National Science Foundation, as well as continuing studies on the Qinghai-Tibet Railway, Highway and Expressway, and the China-Russia Oil Pipeline in Northeastern China.

MoST Permafrost Project of the State Key Laboratory of Frozen Soils Engineering (SKLFSE)

Headed by Professor Wei Ma, this research team will regard the complex climate, frozen-ground, and engineered system as an integrated and interactive system in order to study the physical, mechanical, and chemical processes in frozen-ground foundations and cold regions environments, and their internal interdependence and mutual impacts; to explore the interactions of permafrost and environment, and the complex resultant moisture, thermal and mechanical coupling processes; and to develop and improve the prediction theories and methods on the long-term stability of frozen-ground foundations. Research on the interactions of frozen-ground environments and cold-regions infrastructure can provide more reliable scientific information for the detection of changes and impacts in cold-regions environments, the mitigation of frost hazards, and the control over safety, reliability and long-term stability of state key engineering projects. This project will advance the research on frozen-ground engineering, and help sustain the research in geocryology and cold-regions engineering.

One of the major objectives in this project is to understand and forecast the changes in elevational permafrost. Based on current and future data on the evolution of permafrost, seasonally frozen ground and the active layer processes, the project aims at better understanding the responses of permafrost and active layer to climate change, its interaction with environmental variables, such as vegetation, snow cover, and slopes as well as forecasting changes and their hydrological, ecological, environmental and socio-economical implications.

The study is to be implemented along a planned Qinghai-Tibet Permafrost Ecology Transect (QTPET) which is now under construction. The QTPET is to start from Nagqü, Tibet south of the Tanggula Mountains to the Hei'he Watershed on the northern flank of the Qilian Mountains (total area of about 1200×600 km). It

includes the Sources Area of the 3 Rivers (Yangtze, Yellow and Lancang/Mekong) (SA3R), and the areas along the Qinghai-Tibet engineering corridors from Golmud to Nagqū and from Xi'ning to Yushu, Qidam Basin, and the middle part of the Qilian Mountains. It also includes the Tanggula, Kunlun, Qilian, Bayan Har, Anyemaqên mountain ranges, which are characterized by strong local variations in the zonation of frozen ground, soils, flora and fauna. The northwestern Qingshui'he-Budongquan transect along the Highway S308 extends until the Altyn Tag, a path characterized by declining impacts from monsoonal climate, steep heat-moisture gradients, and dramatic changes in frozen ground conditions and cold regions ecology. The existing Tianshuihai-Akeseqin Permafrost Station along the Highway G219, which was established in 2007 by a joint effort of the University of Heidelberg and the SKLFSE, will be enlarged and extended both in the direction of Yecheng and Ritu near Bangong Co Lake. Akeseqin, with an average elevation of 5000 m a.s.l. and a very harsh environment (very windy year-round and dry (20-27 mm/a)), is believed to be the bottleneck for species migration from southeast to high and west Asia. Long-term (>10-15 years) ecological profiles are also being set up along the SA3R until the Middle Qilian Mountains. There are also several stations built and planned along the Qilian Mountains to form a northwestern profile for permafrost ecology.

These research activities and field monitoring networks may result in about 10 new permafrost, active layer and ecology stations (PALES), with their center being located at the Yushu-Madoi in the SA3R.

MoST QTP Permafrost Survey Project

With Professor Lin Zhao as the chief scientist and the Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences as the host, the MoST Basic Research Project "Baseline Survey of Permafrost in the representative areas on the Qinghai-Tibet Plateau" was officially initiated on 24 May 2009. This 5-year, \$2.5-M project aims at collecting and analyzing the existing data on continuous and discontinuous permafrost zones along the main road systems (mainly the Qinghai-Tibet Railway and Highway [QTR/H, or G109], Qinghai-Kang Highway [QKH, or G214] and Xinjiang-Tibet Highway [XTH, or G219]). It will also perform comprehensive investigations of permafrost conditions along two discrete, longitudinal and altitudinal (Madoi-Qūmalêb-Budongquan-Hoh'Xil-Tianshuihai/Akeseqin) transects, and comprehensive mapping of five representative areas. Using geophysical sounding,

drilling and hand-dug pits, mapping will delineate the present boundaries of permafrost zones, determine the thickness of the active layer, and include data on soils, vegetation, climate and geomorphology. It will also aim at improving the existing observation and monitoring systems, at acquiring basic data of permafrost and cold regions environments, at GIS/RS-assisted mapping of permafrost distribution, and at assessing the status quo of permafrost.

After three months of preparation, the field campaign of this year started on 12 September and was completed on 20 October. The field team consisted of about 40 people and came from the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI, Lanzhou, Gansu), the Northwest Institute of Plateau Biology (NIPB, Xi'ning, Qinghai), the Institute of Mountain Hazards and Environments (IMHE, Chengdu, Sichuan), and the Lanzhou University. In addition, the project also invited Professor Chien-lu Ping from the College of Agriculture and Natural Resources, University of Alaska Fairbanks, USA and Dr. Tanya O'Neill from the Department of Earth and Ocean Sciences at the University of Waikato, New Zealand to participate in the fieldwork, who provided training for soil investigations for about 10 days.

This field project selected Wenquan along the QKH as the first test/representative area to survey the boundaries continuity (areal extent), and lower limit of permafrost, permafrost active layer thickness, soils, vegetation, climate and geomorphology. It was the first joint action for surveying methods, which will help to standardize surveying methods and records.

Qinghai-Tibet Expressway Experimental Research Project

With the gradual implementation of the State Expressway Networks Planning in China, more fast-track, high-grade highways will reach the regions affected by frozen ground. About 30% of the expressways will be in seasonally frozen ground areas, and an additional 2% will cross permafrost terrains. In particular, the Qinghai-Tibet Expressway (QTE) will spread across extensive permafrost areas. Significant increases to the roadway widths are expected as well as increased heat accumulation due to construction standards associated with such constructions. This will lead in turn to more intensive interactions between the engineered infrastructure, the underlying permafrost, and the surrounding environment. New solutions need to be sought to ensure their long-term stability and to comply with safety standards

In order to provide scientific basis and engineering solutions for the construction of the highway, many research projects have been started. About \$1 million from the SKLFSE budget is invested on the Qinghai-Tibet Expressway experiment and demonstration. The experimental section was based on the experiences from the QTH and QTR, and took into considerations the requirements and standards for the construction of state expressways, and applied nine different experimental engineering setups to control the structural configurations of the centerline, shoulders, side protective slope, and slope toe/drainage ditches from the perspective of heat convection, conduction and radiation. The experiment began on 1 September, and the road construction and equipment installation were completed by 30 September.

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5 Denmark

The Danish contribution for 2009 concentrates on on-going permafrost research presented on the NUUK CLIMATE DAYS 25.-27. August 2009 being a scientific activity related to COP15 – UN climate change conference in Copenhagen. It attracted 145 participants from 16 nations with contributions related to “Changes in the Greenland Cryosphere”.

Mr K. Kleist, prime minister of Greenland, welcomed the Conference. Key note talk was given by Director K. Erb (US National Science Foundation): “Greenland research: Key to global climate research”. A permafrost overview was presented by Professor V. Romanovsky (University of Alaska Fairbanks – UAF): “State and fate of permafrost in the northern hemisphere”. Local climate monitoring was covered by Dr K. H. Svendsen (ASIAQ): “Greenland Survey, ASIAQ, a potential partner in climate change investigations” and by Professor S. Rysgaard (Greenland Climate Research Centre) with examples of long term climate monitoring programs from the research stations at Zackenberg and Nuuk .

On-going permafrost projects covered a half day seminar on “Permafrost and terrestrial hydrology changes” chaired by Professor V. Romanovsky. A series of contributions were presented related to the US NSF supported permafrost project ARC-0612533: “Recent and future permafrost variability, retreat and degradation in Greenland and Alaska – An integrated approach” carried out in co-operation between

University of Alaska Fairbanks, Danish Meteorological Institute (DMI), Greenland Survey (ASIAQ) and the Technical University of Denmark (DTU-BYG and ARTEK).

Initially, Dr M. Stendel with coworkers from DMI: J. Hesselbjerg Christensen and G. Adalsgeirsdottir and from UAF: R. Daanen, S. Marchenko and V. Romanovsky presented: “The fate of permafrost in Greenland and Alaska: Results from high-resolution transient climate simulations”. T. Ingeman-Nielsen and N. Foged (ARTEK / DTU-BYG) continued with “Permafrost temperature reanalysis and model projections for Ilulissat, West Greenland”. Afterwards N. Foged with coworkers T. Ingeman-Nielsen and I. Brandt (ASIAQ / DTU-BYG) and K. H. Svendsen (ASIAQ) presented: “Permafrost Risk Zonation in West Greenland” which aims to present recommendations for adaption to the climate change based on risk mapping vulnerability in towns and their surroundings with suggested technical solutions for foundations, roads and other infrastructures. This part of the seminar was closed by PhD-student I. Brandt and co-authors on “Evidence of sporadic permafrost at the Qinggorput infrastructural development site in Nuuk, West Greenland”.

The permafrost session continued with a contribution on “Permafrost and Ecosystem Carbon Stocks in northeast Greenland” given by primary authors K. M. Iversen from ASIAQ , M. P. Tamstorf from NERI, University of Aarhus and B. U. Hansen from IGG, University of Copenhagen together with co-authors from IGG, University of Copenhagen; C. Sigsgaard, B. Elberling and T. Friborg.

Dr D. Yang (CLIC Project Office and University of Alaska Fairbanks) with coauthors K. Steffen (CIRES, University of Colorado), T. Worby (Australian Antarctic Division and ACE CRC) and V. Ryabinin (World Climate Research Programme) gave an Update on Climate and Cryosphere (CLIC) Project and its relation to the International Polar Year 2007 - 2008. Furthermore, D. Yang together with B. Ye (CAREERI, Lanzhou, China) and D. Kane (UAF) presented “Permafrost impact on streamflow regime over the large northern watersheds”.

In 2009 Greenland Climate Research Centre in Nuuk has been established in Nuuk and is headed by Professor S. Rysgaard.

The Arctic Technology Centre ARTEK situated at Sanaartornermik Ilinniarfik in Sisimiut and at DTU-BYG in Lyngby has continued its research, innovation and education in Arctic Engineering. Until now 20 students have finalized with a degree in Arctic Engineering and

the number of new students has reached 16 to 18 per year. A. Stuhr Jørgensen finalized in March his PhD-study "Assessment of three mitigation techniques for permafrost protection" and is now developing the research and education in road engineering in Danmark as well as Greenland. I. Brandt finalized a Master in Arctic Engineering on geophysical investigations for permafrost at the Thule Airbase and is now industrial PHD-student (ASIAQ and DTU-BYG) on "Integrated Geoscience Study of Extend and Effects of Permafrost Change in Greenland".

The Danish IPA adhering body SAFT – Society of Arctic Research and Technology – has continued its cross-disciplinary outreach activities and support to MSc and PhD-students in Greenland and the Arctic. SAFT maintains through Secretary S. Hanson (sha@spacecenter.dk) contact with Permafrost Young Research Network (PYRN).

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6 Finland

Long-time IPA's Finnish representative Professor Matti Seppälä (Department of Geography, University of Helsinki) retired in the end of September 2009. Professor Seppälä has studied periglacial landforms and processes on both hemispheres and over four decades. Nevertheless, he has promised to continue his scientific journey in future. On the behalf of the permafrost community, I wish you Matti very pleasant and active retirement!

In northern Finland, field work for Nordic project 'Permafrost observatory in the Nordic Arctic: sensitivity and feedback mechanisms of thawing permafrost' (2009–10) (Finnish participant J. Hjort from the Department of Geography, University of Helsinki) was conducted in Vaisjeaggi palsa mire close to the Kevo research station. The main objectives of this project are to establish a permafrost monitoring network based on existing Nordic research stations and key research sites for assessing the effects of climate change on the permafrost environment and secondly to provide comparable data and new insight from these sites on the sensitivity and feedback mechanisms of thawing permafrost. In addition, the project 'Spatial modelling of periglacial processes under environmental change' (2008–2010) (J. Hjort and M. Luoto and M. Marmion both from the University of Oulu, Department of Geography) continued.

Geological Survey of Finland (P. Lintinen, H. Vanhala

and J. Jokinen) and Mining Geological Company MIREKO continued co-operation in a field of geophysical characterisation of permafrost and talik structures in Northern part of Komi Republic. In late summer 2009, geophysical electrical and electromagnetic measurements were conducted at Korotaiha river area in Nets Autonomous Region in Russia where average permafrost thickness is about 200 m. The geophysical techniques tested were (1) a multi-electrode resistivity sounding system, (2) a transient electromagnetic (TEM) resistivity sounding system and (3) an electromagnetic VLF-R resistivity meter.

An international Permafrost-project coordinated by the Geological Survey of Finland (T. Ruskeeniemi and L. Ahonen) investigated the impacts of permafrost on the geochemistry and flow conditions of deep groundwaters in metamorphic bedrock terrain. The main targets were to identify the physico-chemical processes active in low-porosity, hard rocks and to increase understanding of their interaction. The focus was on the phenomena, which might have influence on the stability of the repository. Investigations were carried out in 2000-2008 within three sites in Arctic Canada (depth of permafrost = 350–540 m): Lupin gold mine, Ulu Au prospect and High Lake Zn-Cu prospect.

The research project 'Global change impacts on sub-arctic palsa mires and greenhouse gas feedbacks to the climate system' (PALSALARM) is carried out by the Finnish Environment Institute (S. Fronzek and T.R. Carter) and the Universities of Copenhagen, Lund and Oulu (M. Luoto). The PALSALARM consortium organized a scientific symposium on palsa mires in Abisko, Sweden, from 28–30 October 2008. The symposium was structured in three themes:

- * Theme 1: Spatial distributions of palsa mires and permafrost and its current status
- * Theme 2: GHG feedbacks of palsa mires
- * Theme 3: Palsa mire ecosystem and paleoecological studies

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7 France

A. Decaulne, CNRS UMR6042 Geolab, Clermont-Ferrand, France, pursues researches coupling geomorphic dynamics occurring on slopes (mostly snow avalanches and debris flows) and dendrogeomorphology in Iceland, in collaboration with

P. Sæmundsson (Natural Research Centre of Northwestern Iceland, Sauðárkrúkur) and Ó. Eggertsson (Iceland Forest Service, Research Branch, Mogilsá). Field work was done on this topic during the summer 2009 in Northern Iceland. For comparison, two other sites were investigated in Nordfjord, Norway, in collaboration with A. A. Beylich and K. Laute (Geological Survey of Norway, Trondheim). Results obtained during the recent studies were presented during the 7th International Conference on Geomorphology IAG/AIG, held in Melbourne in July 2009, and during the Working group SEDIBUD Workshop held in Kingston, Canada, in October 2009.

Research is also carried out on a glacier system of Svalbard since 2006. The objective of Hydro-sensor-FLOWS project (IPY#16) is to investigate the hydrology of the Austrelovenbre Glacier basin (Brogger peninsula) by continuous monitoring the space and time dynamics over a 4-years period (2007-2010). The project is coordinated by M. Griselin (UMR Thema) and C. Marlin (UMR IDES) in association with GEODE (Pau) and FEMTO (Besançon). The main objective is to improve our understanding of the system reactivity to contemporary climatic fluctuations. Different methods are used to study the glacier and its hydrology and its dynamics: image loggers (satellites and automatic cameras on the ground), loggers recording climatic data, air temperature at 20 locations on the basin and hydro-geochemical data.

Stream water is sampled for chemical and isotopic analyses. At the end of the Fall 2009 field trip, the team has obtained the hydro-glacio-climatologic data for a third complete hydrological year (October-October). The rain flood events recorded in Autumn 2008 gave information concerning the rain influence in the hydrological processes, while, until that time, the team had recorded only high runoff linked to high air temperature. Summer 2008 has been in the mean 1969-1998 (i.e. colder than 2007). Summer 2009 is different with large summer periods of high air temperatures and several big events of rain. The ablation-accumulation measurements will give accurately the yearly variation in height of the glacier: that will be our second glaciological mass balance. The team noticed that, during Autumn 2008, following the flood event of mid-September, it had to re-do the mass balance measurements at the very end of September. It was totally different that the one made by the beginning of September. The GPR investigation combined with DEM provided a first mapping of the bedrock elevation. The mapping of the glacier basement by GPR is carried out by scientists of FEMTO and AWI Comparing the DEM of 1964, 1995 and 2007, the team has obtained the 3D difference in

glacier volume. Since 1964, the Austrelovenbre glacier lost a third of its volume, and 20% since 1995, showing an acceleration in the melting process.

The CLIMAFLU project (2008-2011), endorsed by the ANR program is an international cooperation between France and Russia, led by F. Costard (IDES, CNRS-Université Paris-sud XI), E. Gautier (Laboratoire de Géographie Physique CNRS UMR 8591) and A. Fedorov (Permafrost Institute, RAS, Yakutsk). Investigations of the effect of climate warming on the fluvial dynamics of the Lena river (Yakutia) is the topic of that project. F. Costard (UMR 8148, IDES, CNRS-Université Paris-sud XI) with E. Gautier and D. Brunstein (Laboratoire de Géographie Physique CNRS UMR 8591) carried out investigations on the Lena flood plain at the latitude of Yakutsk. Two expeditions took place in 2009, one in May to study the breakup phase and the second one in July after the flood season. The objective was to set up several data loggers over several islands in order to measure the thermal regime of the permafrost. This study is expected to allow a quantitative analysis of the evolution of islands in a floodplain under a periglacial environment.

C. Grenier, E. Mouche, D. Régnier from LSCE (Laboratoire des Sciences du Climat et de l'Environnement – UMR1572) have been developing activities in numerical modeling for permafrost issues over the last years with the purpose of studying the impact of glaciation cycles on underground flow patterns. The application field typically corresponds to a 500 m depth and 50 x 50 km zone around the French underground research laboratory (operated by ANDRA, the French nuclear waste storage agency) at Bures in the eastern part of the Paris Sedimentary Basin. In the present phase, a 3D coupled Thermo-Hydro (TH) module is being developed by D. Régnier (PhD student) within the Cast3M code (www-cast3m.cea.fr), validated against analytical solutions and benchmarked against literature cases. The model involves a Mixed Hybrid Finite Element numerical scheme and includes heat conduction, heat advection, phase change, coupled water flow. It will soon be applied to study permafrost evolution with coupled TH phenomena for various systems at various scales (underground flows in sedimentary layers under thermal stress, river taliks, thermokarst lakes). Other recent activities deal with 1D column modeling of permafrost evolution for climate reconstruction purposes (e.g. Bures, France; Ohrid Lake, Albania).

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8 Germany

At the University of Bonn, the research project SORP (Sensitivity of Rock Permafrost to regional climate change), which is part of the DFG-bundle SPCC, is centered on rock permafrost monitoring and permafrost induced rock wall instabilities. S. Verleysdonk started her Ph.D. thesis within the project with field sites in the German (Zugspitze) and Swiss Alps (Turtmann Valley and Piz Corvatsch). S. Bledow and D. Funk installed extensometer measurements at the Zugspitze and are carrying out shear tests on thawing cleft material as well as stability modeling based on empirical data. Further research focused on the relationship between summer snow cover and rock permafrost detected by refraction seismics (D. Dräbing, Turtmann Valley). M. Krautblatter discussed patterns of multiannual aggradation of permafrost in rock walls with and without hydraulic interconnectivity as well as temperature-calibrated imaging of seasonal changes in permafrost rock walls by quantitative electrical resistivity tomography at the Zugspitze (Krautblatter et al., acc.). Within the sub-project "Monitoring and process analysis of permafrost creep and failure in changing temperature regimes" (I. Gärtner), kinematics of several rockglaciers in the Valais and Grisons were quantified combining terrestrial and remote sensing methods. Together with ground surface temperature monitoring as well as geophysical soundings these data aid in investigating rockglacier dynamics.

At the University of Würzburg, the permafrost research group led by C. Kneisel continued investigations on permafrost characterization using surface and subsurface temperature monitoring and geophysical mapping techniques in different (sub-)alpine and subarctic environments in Switzerland and northern Sweden.

Research on sites with sporadic permafrost below the timberline (Engadin and Appenzell, Swiss Alps), with focus on permafrost-humus interaction, thermal regime and the influence on temporal and spatial permafrost variability are continued by D. Schwindt within his Ph.D thesis. T. Rödder has started his Ph.D. project investigating the sensitivity of alpine permafrost in unconsolidated sediments and its spatio-temporal variability in a changing climate at the Murtel/Corvatsch site. This research project is part of the DFG-bundle project SPCC (<http://www.spcc-project.de>). Recently, A. Bast finished his diploma-thesis on small scale distribution of permafrost within the glacier forefield Muragl (Swiss

Alps) regarding multiple geomorphological parameters. C. Kneisel and several undergraduate and graduate students undertook additional 2D geophysical surveys for investigating the spatial distribution and characteristics of permafrost on different periglacial landforms (e.g. solifluction /gelifluction slopes) in a subarctic mountain environment in the Abisko region, northern Sweden. Furthermore, permafrost conditions at an isolated lowland palsa were investigated (active-layer and near- and subsurface temperature measurements, permafrost depth detection).

At the University of Jena, C. Hilbich is currently conducting a geophysical monitoring network at 6 different permafrost sites in the Swiss Alps with permanent electrical resistivity tomography (ERT) and refraction seismic tomography (RST) profiles within the SPCC project and in close co-operation with the Swiss PERMOS network. The applicability of both ERT and RST monitoring for the detection and quantification of ground ice degradation was investigated on short time scales by the application of appraisal analysis.

At the University of Giessen, O. Wild analyzed two data sets of near-surface ground temperatures at Stockhorn-Plateau, 3410 meters a.s.l. (Valais, Switzerland). The long-term temperature monitoring at Kleinmatterhorn (3820 meters a.s.l.) started in 1998 by L. King will be continued after recalibration of the temperature-loggers.

AWI (Potsdam) conducts research in the Canadian Arctic continuously since 2005. At Polar Bear Pass (Bathurst Island), field work focuses on the hydrology and energy balance of a High Arctic Wetland in cooperation with Prof. K. Young from York University. On Herschel Island and the Yukon Coastal Plain, AWI works together with McGill University (Montreal) studying coastal erosion and paleoenvironmental dynamics on the East-Beringian edge using lake sediments and ground ice. The 12th Russian-German-Expedition Lena Delta 2009 with 35 participants took place from June to August. The overall aims are to continue ongoing research on carbon, water and energy cycling, coastal erosion, land-sea interaction and paleoclimatic reconstruction, carried out on the polygonal tundra, on Yedoma surfaces and thermokarst depressions, within the channel network and on a N-S-transect. The 141 m permafrost core from Elgygytgyn Crater ICDP deep drilling in Chukotka has successfully arrived in the lab. Now it is being subsampled for multidisciplinary studies between Germany, Russia, and the US. Revealing the stable oxygen isotope record from Elgygytgyn lacustrine diatoms is ongoing in the

AWI-Potsdam lab. Periglacial surface structures were studied during the field campaign „Svalbard Permafrost Landforms as Analogues for Mars“ on Spitsbergen in July 2009. The data will be used as ground truth for high-resolution stereo images acquired by the high-resolution camera HRSC-AX. The AWI-project “Sensitivity of Permafrost in the Arctic” were continued to characterize the spatial heterogeneity of the permafrost energy budget near Ny-Alesund, in spring and summer 2009. High resolution stable isotope records ($\delta^{18}O$, d -excess) in ice wedges from Alaska (Barrow) and Northeast-Siberia (Dmitrii Laptev Strait) enable to reconstruct regional climate changes during the late Glacial and the Late Holocene and highlight the potential of ground ice as climate archive. As a final result of a joint German-Russian-Switzerland INTAS Project, the $^{36}Cl/Cl$ dating method was successfully applied to syngenetic ice wedges from six sites in northern Yakutian middle and late Pleistocene ice-rich deposits. A Data User Element Program (DUE PERMAFROST) was launched in spring 2009 by the European Space Agency (ESA) as a platform to users and service providers to integrate earth observation service focussed on permafrost monitoring. <http://www.ipf.tuwien.ac.at/permafrost/>. The German Helmholtz Association and the Russian Foundation for Basic Research are supporting a Joint Russian-German Young Researcher Group focused on the sensitivity of the Siberian permafrost coast to change that includes the AWI (Potsdam) and the Institute for Coastal Research (Geesthacht), along with three Russian partner institutes.

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9 Italy

The activities of the Italian permafrost communities are going on both in the Alps and in Antarctica. In Antarctica, within the project “Permafrost and Climate Change II”, M. Guglielmin (Uninsubria), N. Cannone (Univ. Ferrara), S. Favero-Longo and F. Baio (Sogetec) participated to a campaign at Rothera and Signy Stations in cooperation and with the logistical support of the British Antarctic Survey. In this campaign a new 30 m deep borehole was instrumented and included in the ANTPAS and TSP networks. Analyses of the effects of vegetation on the active layer thermal regime and on CO_2 fluxes were carried out. Additionally, the permafrost monitoring stations and the ice-wedge monitoring stations in Victoria Land were inspected and maintained.

The research on weathering processes in cryotic

Antarctic environment continued through a cooperation between University of Ferrara (N. Cannone), University of Turin (S. Favero-Longo, R. Piervittori) and Insubria University (M. Guglielmin) enhancing the role of bioweathering in the formation of weathering features like tafoni.

The more important project that involved almost all the Italian permafrost community in the Alps is the PERMANet project (Interreg Alpine-Space program, started in June 2008) where ARPA Vda, ARPA Piemonte with Insubria University (M. Guglielmin), the Province of Trento with University of Pavia, (R. Seppi), the University of Padova, (A. Carton) and the University of Trento (M. Dall’Amico and R. Rigon); Regione Veneto, the Province of Bolzano with Innsbruck University are working under the leadership of the Bolzano Province (V. Mair).

A large range of coordinated goals are planned within Permanet. The Regional Agency for Environmental Protection (ARPA VdA) and Fondazione Montagna Sicura (FMS) are mainly focussed on the maintenance and upgrading of permafrost monitoring network (from surface boreholes in high-mountain steep rock walls to shallow and deep boreholes in gentle morphologies) and on the relationships between permafrost degradation and rock falls especially around the Mont Blanc Massif. Arpa Piemonte is mainly focussed on the installation of a permafrost monitoring network and for this reason has selected 5 sites in different climatic areas between 2400 and 3100 m a.s.l., where after geophysical investigations and BTS measurements, four 30 m deep, one 100 m deep and one 5 m deep boreholes were drilled and instrumented. The Province of Trento is focussed both on the creation of a permafrost monitoring network and on the permafrost modelling. For the first aim, preliminary BTS and ground surface temperature measurements were conducted on three potential different sites for the drilling of a 50 m deep borehole, that is planned for the late summer 2009. Also two existing boreholes near the Alpine Hut “Ai Caduti dell’Adamello” in the Adamello-Presanella Group are monitored to understand the relationships between permafrost degradation and observed slope movement. Modelling activities are also performed to model the permafrost distribution in the province. A freezing-soil module has been developed inside the open source hydrological model GEOtop (www.geotop.org) by M. Dall’Amico and R. Rigon and allows to perform long term temperature simulations including phase change effects. Regione Veneto has planned to carry out one deep borehole in bedrock and one within a dolomitic rock glacier. The Bolzano Province is leading the

entire project and has planned to do different boreholes both in bedrock (one 150 m long subhorizontal borehole) and within rock glaciers.

In addition, University of Turin (M. Freppaz et al) is still pursuing its research on soil characteristics at low elevation permafrost sites and soil development within patterned ground. ARPAVDA (U. Morra Di Cella, E. Cremonesi) and University of Turin started a research project on the influence of snow properties (e.g. snow depth, density, temperature, resistivity, etc.) on the soil thermal regime and the snowpack evolution in permafrost areas. The cooperation between the universities of Pavia (R. Seppi) and Padova (A. Carton), for the research on Adamello Presanella and Ortles Cevedale mountain regions is also being continued. It consisted mainly in the continuation of near-surface ground temperature monitoring and in topographic measurements conducted for the 8th consecutive year on two active rock glaciers. One new PhD student (L. Carturan, University of Padova) focused on the climatic sensitivity of the cryosphere in the Ortles-Cevedale area. The research on the relationships between vegetation and permafrost and carbon fluxes also continue in Upper Valtellina (N. Cannone and M. Guglielmin) where a new site for monitoring of thermal and moisture conditions within the active layer and related CO₂ emissions has been installed. In Upper Valtellina the latter investigators pursue the measurements of active layer thermal regime, snow spatial variability and vegetation phenology and variability started since 2006. The Insubria university (E. Binaghi and M. Guglielmin) started a research project on the use of neural network approaches for permafrost distribution modelling.

The University of Pisa (A. Ribolini) continued his research in the Maritime Alps with ground surface temperature monitoring and geophysical (electrical tomography and radar) investigations on active and inactive rock glaciers and other periglacial landforms.

Finally, L. Paro (Arpa Piemonte) is finalizing his PhD on the development and the paleoclimate meaning of block streams in the area of Val Susa (Piemonte, Western Alps).

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10 Japan

In the Japanese archipelago, a permafrost study on the Fuji volcano (3776 m a.s.l., MAAT= -6°C), which was started last year, was re-designed because of an

unexpected high ground temperature that was monitored in two 3-m deep boreholes at the summit area (A. Ikeda, G. Iwahana, T. Sueyoshi, K. Harada, R. Nishii and H. Arai).

In the southern Japanese Alps, an automatic camera has visually recorded movements of surface stones, data which were combined with records of frost heave, soil temperature and moisture to explore the detailed dynamics of solifluction features (N. Matsuoka). Radiocarbon dating of relict rock glaciers around Mt. Ainodake (MAAT= -2°C) indicated the advance of the rock glaciers from the Last Glacial Maximum to the Late Glacial (A. Ikeda and R. Nishii).

Several overseas projects are also going on. In Svalbard, a monitoring campaign is being continued in order to understand the dynamics of ice- and soil-wedge polygons, mudboils and a polar rock glacier with a variety of methods (N. Matsuoka, T. Watanabe), in collaboration with UNIS (H.H. Christiansen) and the University of Oslo (O. Humlum). Detailed (2D and 3D) geophysical sounding was used to detect subsurface frost wedge structures under non-sorted polygons and to illustrate temporal variation in the subsurface moisture regime (T. Watanabe).

In Alaska, a project named '2004 Forest Fire Impacts to Hydrological Cycles, Permafrost and Eco Systems in Central Alaska' is being pursued since 2005 in order to monitor permafrost conditions after severe wildfire (K. Harada, K. Narita, K. Saito). In August 2009, the following observations were carried out at the Kougarak site near Nome, Alaska: thaw depths, surface roughness compared with satellite data and ground temperatures (since 2007). Vegetation surveys were also made in order to characterize the recovery after wildfire at burned sites. Continuous data of thaw depth and ground temperature could be obtained during these investigations and will help to understand the effect of wildfire on permafrost condition and vegetation recovery.

In Siberia, the RIGC (Research Institute for Global Change) in JAMSTEC (Japan Agency for Marine-Earth Science and Technology) and the Melnikov Permafrost Institute, Siberian Branch of Russian Academy of Science, have started to improve distributed soil moisture and temperature monitoring in the active layer around Yakutsk region since the spring of 2009 in order to better characterize increased soil moisture and altered active layer thermal properties, which are likely due to widespread warming of the surface layer of permafrost in this region. An

educational activity, a field science short course 'Taiga forest ecosystem on permafrost –Role of permafrost zone in a global change–' for graduate students and young scientists was conducted in the Spasskaya Pad Research Station of the Institute for Biological Problems of Cryolithozone in Yakutsk, Russia from the 1st to the 7th of August 2009. This summer field course was provided by the Global COE Program of Hokkaido University 'Establishment of Center for Integrated Field Environmental Science' (<http://www.ees.hokudai.ac.jp/gcoe/>).

The Japanese Permafrost Association was formally founded as the national organization corresponding to IPA in September 2008, aiming at promoting collaborative research, exchanging information on permafrost monitoring and organizing scientific meetings. In the 2008–09 period, meetings on permafrost and periglacial research were held twice (November 2008 and February 2009) in Sapporo. About 20 scientists and students participated to each meeting.

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11 Kazakhstan

The Kazakhstan Alpine Geocryological Laboratory and the Permafrost Institute, Siberian Branch of the Russian Academy of Sciences are in the process of elaborating a map on "Geocryological Hazards in Kazakhstan" (scale 1:5000000). Natural and technogenic geocryological processes and phenomena are divided into three categories on a scale of "danger": low danger, average danger and high danger.

A finding from this publication is that anthropological changes to the environment often induce the activation or the intensifying of geocryological processes and subsequent hazards. The occurrence of these features is generally strongly driven by local geographical characteristics. In mountainous areas, the degree of danger in some areas is determined not by the frequency of geocryological processes and phenomena, but by the dimension of the most significant ones, namely, glacial mud-flows, rock-glaciers down movement and cryogenic rockslides. All mountainous regions of Kazakhstan are also characterized by high seismic activity which adds to the likeliness of occurrence of major natural hazards.

The geothermal monitoring of seasonal frozen ground and permafrost in Zailiyskiy Alatau (Northern Tien Shan) is being continued. New results show that since the 2000-2001 period, temperatures have been further decreasing throughout the permafrost profile. The long winter and cool summer of 2008-2009 have caused the lowest depth of seasonal frozen layer (about 4 m) observed over the past 32 years of observations.

Other new results from different settings in the mountains of Northern Tien Shan confirmed that the depth and intensity of freezing depends not only on the severity and snowiness of the cold period, but also on the temperature of the ground before freezing and the relationship between the onset of freezing and the timing of the snow cover.

Evidence of crevasses in a rock glacier in the Uzynbulak river valley (Dzhungarskiy Alatau) was observed by the Kazakh researchers in 2009. The fast motion of the rock glacier is explained by powerful seismic collapse in the upper part of the valley it is located in. Sudden rock collapse on the rock glacier has caused a sharp increase in the plasticity of the frozen matrix and led to the increase of the motion speed. As a result, the rock glacier has moved downwards along the Uzynbulak river valley by more than 2 km.

Data on morphology, genesis, dynamics and evolution of rock-glaciers from Asia, America, Greenland and Antarctica was summarized in the journal «Cryosphere of the Earth» (#2, #3, 2008).

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12 Mongolia

The joint Japanese and Mongolian project of the Northern Hemisphere Cryosphere Program of RIGC, sponsored by JAMASTEC continues into its seventh year in Nalaikh and Terelj areas near Ulaanbaatar. In addition, within the framework of this project M. Ishikawa, Saruulzaya from Hokkaido University and Jambaljav, Dashtseren, Jargaltulga, Javhlan from Institute of Geography, MAS started to monitor ground temperatures in more than 30 shallow (5-10 m deep) boreholes with and without permafrost, located mainly in Altai and southern Hangai regions, Western Mongolia. Last year the boreholes were drilled by the Institute of Geography, MAS. This year JAMASTEC provided full funds for field work and HOBO U12 data loggers for equipping the boreholes.

For now 13 years, monitoring of permafrost temperatures and active layer thickness has been continued successfully in more than 40 (shallow to deep) boreholes in permafrost in Mongolia within the framework of the International CALM and GTN-P programs through collaboration between N. Sharkhuu and scientists from University of Alaska, Fairbanks and University of Delaware. In addition, within the framework of the above NHCP/RIGC project N. Sharkhuu started collaboration in monitoring of permafrost in some selected boreholes, located in the Northern Mongolia.

Within the framework of PIRE (Partnerships for International Research and Education) - Ecological and Evolutionary Effects of Climate Change and Anthropogenic Influences in Mongolia project, implemented by the University of Pennsylvania and National University of Mongolia, sponsored by National Science Foundation of the U.S., Prof. Alain and graduate student Sh. Anarmaa from the University of Pennsylvania have started monitoring changes in soil carbon respiration, soil temperature and moisture content in experimentally warmed chambers, which simulate global warming, and control plots at 12 observation sites, underlain by discontinuous permafrost, in the eastern Hovsgol area, Northern Mongolia. In addition, research on quantifying above- and below-ground carbon stocks is planned to be carried out. This project will continue for next four years. N. Sharkhuu conducts monitoring of permafrost temperature and active layer thickness in nine boreholes in this area as he did in the last seven years.

K. Yoshikawa, University of Alaska Fairbanks and N. Sharkhuu conducted borehole drilling (down to 33 m) at a 20 m high Mongot pingo top in Tes valley, Northern Mongolia. The purpose of this drilling was to understand pingo ice formation using isotope analysis, to monitor permafrost temperature, active layer and artesian water pressure by data loggers. This pingo was also drilled in 1968 and water was encountered under pressure at 32 m. The initial flow resulted in a 70 cm high artesian fountain which flow was carefully monitored for 120 hours by N. Sharkhuu. New data from the drilling enables to estimate some change in dynamics of the pingo evolution during last 40 years.

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13 The Netherlands

Carbon and water exchange at the water-atmosphere interface in Siberia

Research in the taiga and tundra ecosystems in eastern Siberia is performed in cooperative projects of the Institute for Biological Problems Cryolithozone (IBPC) of the Siberian Division of the Russian Academy of Sciences in Yakutsk and the Vrije Universiteit (VU) in Amsterdam (Department of Hydrology and Geo-Environmental Sciences).

In a larch/birch forest near Yakutsk (Spasskaya Pad Field Station) and on a tundra site near Chokhurdakh in the Indigirka lowlands (Kytalyk reserve) flux measurements have been made with eddy correlation towers. The aim is to estimate the annual exchange rates and their interannual variability, and to determine the sensitivity to environmental factors of the fluxes.

The 2006-2009 campaigns have been funded by NWO (Dutch Organization of Scientific Research), VU and RFBR (Russian Foundation for Basic Research). Participating Dutch institutes are VU Amsterdam, Utrecht University (Paleoecology) and Wageningen University (Vegetation Ecology). This resulted in joint fieldwork at the tundra site in the summers of 2007-2009, including a methane flux measurement campaign on tundra and floodplain environments and thermokarst lakes, vegetation ecological experiments and sampling of lake bottom sediments for paleo-ecological research. Also a site was established for longer term monitoring of active layer thickness. In the summer of 2008, for the first time eddy covariance measurements using a cavity ringdown laser system were successfully set up and operated at the tundra site; its operation continued in the summer of 2009. Contact scientist: K. van Huissteden (ko.van.huissteden@falw.vu.nl).

The Willem Barentsz Polar legacy

When Willem Barentsz discovered Spitsbergen in 1596 he could never have imagined that more than 400 years later dozens of Dutch scientists go over there for all kinds of research and there would even be a Dutch Arctic Station. Nowadays Dutch researchers explore a variety of research topics from polar Archaeology till polar Zooplankton. A lot of these polar researchers are now working together in the Willem Barentsz Polar Institute (WBPI), an institute for Arctic and Antarctic research, although Willem Barentsz never went to the Antarctic.

The WBPI wants to be a clear Dutch identity in the international field, enhance the co-operation between Dutch polar researchers and contribute to polar education and outreach activities. The WBPI wants to

give a positive boost to new initiatives from the Netherlands in the polar areas. It hopes to create an organisation that is a clear contact point of Dutch research in polar areas for the international field.

The first WBPI symposium was held in Groningen, 22th October 2009, followed by a day from the Netherlands Polar Network for early career scientist (NLPN) that is supported by the WBPI. The WBPI encourages students to do international polar courses and is willing to help (international) students to find suitable courses and master projects in the Netherlands.

More information can be found on the website: www.wbpolar.nl.

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14 New Zealand

This year we are celebrating 50 years since the first soil/permafrost scientific expedition in the Ross Sea Region of Antarctica. It was undertaken by Prof. John D. McCraw and Dr Graeme G. Claridge. They set off from Scott Base on the Massey Ferguson tractors that Sir Edmund Hillary took to the South Pole in 1957/58 and drove to New Harbour, from which they travelled on foot for several weeks exploring the Taylor Valley and adjacent areas. Graeme Claridge went on to become an expert on Antarctic soil chemistry and, with Iain Campbell, authored the most authoritative book available on the soils of Antarctica. Both McCraw and Claridge are fit and well - (permafrost and cryosol research must be good for you) and we will be holding a celebration to mark their original journey in November this year.

Looking forward in time, Meridian Energy, in Alliance with Antarctica New Zealand and with support from the US National Science Foundation (NSF), are constructing a three turbine 'proof of concept' wind farm on Crater Hill, Ross Island, Antarctica. Following commissioning in February 2010, the wind farm will supply power to and link the electrical grids of New Zealand's Scott Base and neighbouring US McMurdo Station offsetting fuel use. Sub-zero temperatures, absence of batching plant, aggregate and large quantities of fresh water have meant that it is not possible to construct a typical concrete gravity pad wind turbine foundation. Instead, the project has utilised a pre-fabricated foundation comprising eight 13-tonne concrete blocks buried in the permafrost. The blocks are fixed to an eight-legged steel 'spider' with a flange that bolts to the wind turbine tower. Each concrete block is also fitted with two 12m long ground

anchor bolts drilled and grouted in as an additional precaution for extreme weather events.

Most New Zealand Antarctic researchers are currently involved in a funding bidding round that will largely determine the fate of NZ Antarctic permafrost research for the next six years. There is only a small pool of funds and a great deal of competition from many science areas so it is a challenging time for many.

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15 Norway

TSP Norway IPY project activities

The Permafrost Observatory project: A contribution to the Thermal State of Permafrost in Norway and Svalbard (TSP Norway) was continued. The first full year data from all the TSP boreholes have now been downloaded from different landforms in Svalbard and northern Norway. A few new boreholes have been drilled and instrumented to complete the Nordenskiöld Island Permafrost Observatory in Svalbard.

NORPERM, the Norwegian online permafrost database, was launched spring 2009, and contains TSP Norway data and other permafrost data from Norway and Svalbard. The project can be followed on www.tspnorway.com. A. Kholodov from University of Fairbanks Alaska and the TSP Alaska project visited UNIS in April 2009 to discuss the NORPERM database for future US permafrost database developments.

TSP Norway partners play an important role together with other permafrost partners in Norway in organising the Third European Conference on Permafrost (EUCOP) in Svalbard in June 2010, which will be an important event to present the first TSP Norway IPY results. Registration has now opened at the conference website: www.eucop2010.no.

Geology Department, UNIS

Permafrost and periglacial studies were done by H. H. Christiansen, H. Juliussen, L. Kristensen, U. Neumann and M. Eckersdorfer, partly within the TSP Norway project, but within the CRYOSLOPE Svalbard research project (www.skred-svalbard.no). L. Kristensen submitted her PhD thesis on the glacier surges in permafrost environments. M. Eckerstorfer

started a PhD study on snow avalanches and meteorological control in Svalbard, cooperating closely with the CRYOSLOPE Svalbard project.

The department participated in the Nordic Council funded Nordic collaboration research project 'Permafrost Observatory in the Nordic arctic: sensitivity and feedback mechanisms of permafrost change' led by B. Elberling, University of Copenhagen, Denmark. In summer 2009 sediment cores from marginal permafrost areas, palsas in northern Sweden (Tavvavoma site), Finland (Kevo site) and Norway (Neiden and Karlebotn areas) were collected and thermistor strings established in shallow boreholes.

The intensive graduate course AG-330 Permafrost and Periglacial Environments were run for the third time in April 2009 with 20 students.

Physical Geography, Department of Geosciences, University of Oslo

Within the CRYOLINK project B. Etzelmüller, H. Farbrot, O. Humlum and T. Hipp, together with K. Isaksen (met.no) and R. Ødegård (HiG) gathered the first years data series from 15 boreholes in southern Norway. In addition, geophysical soundings were carried out at all sites. A permanent geoelectrical monitoring station was established at Juvvasshøe in Jotunheimen. During September, new active layer monitoring stations were established, utilising high-resolution thermistors and automatic loggers. Both equilibrium type and transient heat flow models are developed within the project.

The project on mountain meteorology, snow cover, vegetation, ground temperatures and interaction between permafrost and glaciers in southern Norway continues (O.Humlum). M.Ferbarlein's MSc project on palsas came to a successful end in 2009.

University of Oslo in collaboration with UNIS received funding for student and faculty member exchange with the University of Ottawa (A. Lewkowicz) and Carleton University (C. Burn) from SIU (Norwegian Center for International Cooperation in Higher Education). The project (CryoEX) facilitates exchange of faculty members and students.

Department of Geography, NTNU

At the Department of Geography ground surface temperature monitoring has been carried out by I. Berthling along a steep climatic gradient of the inner fjord/western mountain areas in Southern Norway. This is now part of the ESF SedyMONT project led by

A. Beylich (NGU/NTNU) and funded by the Norwegian Research Council. Ground surface temperature monitoring of steep rockwalls in Innerdalen, Western Central Norway is undertaken by J. Wasrud and I. Berthling. Within the watershed of Vekve in Oppdal, Central Norway, monitoring of ground temperatures and thaw consolidation processes takes place (I. Berthling, G. Vatne, A. Beylich, W. Larsen, L. R. Libach).

Norwegian Meteorological Institute, Norwegian Geological Survey and other research Institutions

The Norwegian Geotechnical Institute (R. Frauenfelder) is active in Northern Norway, studying temperatures and dynamics of a rock glacier in Nordmannvikdalen, in collaboration with University of Oslo (J. Tolgensbakk). In Signadalen landslide activity is analysed, in collaboration with the Norwegian Meteorological Institute (K. Isaksen).

The project PYRN-TSP (Permafrost Young Researchers Network's Contribution to the Thermal State of Permafrost Project in the Nordic Countries) established in September 2008 a 58.5 m deep borehole at Iškoras in Karasjok, Finnmark, Northern Norway. The first data from the borehole was collected in January 2009 and later in summer 2009. A high precision datalogger and a 25 m thermistor chain were installed summer 2009. Data shows active layer depths of more than 8 m and -0.4 °C at 50 m depth. (K. Isaksen, M. Johansson, H. Farbrot, B. Etzelmüller, H. Christiansen).

PACE borehole data from Juvvasshøe and Janssonhaugen were collected. A new official weather station was established by the Norwegian Meteorological Institute at Juvvasshøe in June 2009. Data is available at yr.no (<http://www.yr.no/place/Norway/Oppland/Lom/Juvvas>)

In the Troms and Møre and Romsdal area of northern and southern Norway respectively, temperature data collection are continued in a permafrost and climate monitoring project on unstable rock slopes in Norway. The project was established in 2001. (K. Isaksen, L.H. Blikra, H. Farbrot, T. Eiken and J.L. Sollid).

On Dovrefjell, southern Norway, collection of temperature data was continued from 11 boreholes (9 m deep) along an altitudinal transect across the mountain permafrost transition zone. These boreholes were drilled and instrumented in October 2001. The objective of the study is to model the trend and variability of mean annual ground temperature (MAGT) and to evaluate the influence of the snow cover on

shallow electromagnetic sounding , shallow seismic sounding and ground penetrating radar.

In the summer of 2009, a large range of interdisciplinary studies of periglacial phenomena were carried out in the region of stations/bases of Polish universities. The results of investigations will be published and presented at international conferences.

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17 Portugal

The year 2009 has been important for Portuguese permafrost research and contributed to the consolidation of research, funding and critical mass. Activities focused on three main subjects: i) Antarctic permafrost and active layer dynamics, led by the Centre for Geographical Studies, University of Lisbon (CEG-UL); ii) Chemistry of Arctic permafrost by IPIMAR; iii) Earth-Mars analogues by CERENA - Instituto Superior Técnico, UTL.

The CEG-UL is leading the FCT-funded project PERMANTAR in Livingston (LI) and Deception (DI) Islands (Antarctic Peninsula region), which also involves the Centre of Geophysics of the University of Lisbon and Centre of Geophysics of Évora. The project includes also the universities of Alcalá (Spain) and Buenos Aires (Argentina), and the Bulgarian Antarctic Institute. PERMANTAR collaborates closely with the Spanish project PERMAMODEL-IPY. Main activities focused on the installation and upgrading of permafrost and periglacial processes monitoring sites: i) a new 8 m borehole in LI, ii) three new 4-5m boreholes (collaboration with the Russian Academy of Sciences) in DI, iii) new CALM-S sites in DI and LI, iv) a meteorological station in LI, v) solifluction, thermokarst and rockglaciers monitoring sites, vi) time-lapse cameras, vii) year-round monitoring with resistivimeter with datalogger in DI, viii) electrical resistivity tomography surveying in LI, and ix) n-factor monitoring sites in DI. Master theses on Antarctic permafrost have been presented by A. Trindade and R. Melo (<http://www.antecc.org>). Education and outreach activities have been organized, including talks in schools, public lectures and a permafrost film "Permafrost! Polar science at 62°S" for classroom activities. It will be freely available in DVD to schools and open-access in the Internet. The CEG-UL team continued the scientific coordination of the grant program New Generation of Polar Scientists funded by Caixa Carbono Zero (CGD). This program involves full-time funding of two students on permafrost research in a total of six grants in polar science.

IPIMAR's research on permafrost was conducted in Umuijaq, Northern Québec. The main objectives are studying carbon and contaminant chemistry in thermokarst lakes and their hydrological impact on rivers, sea and snow pack. Measurements of biogas fluxes and sampling of water, ice, snow and sediments for analysis were conducted. Umuijaq is an area of carbon-poor permafrost which contrasts with the results obtained in 2008 in a carbon-rich permafrost area. This study contributes to a better understanding of the impacts of permafrost thaw on the carbon and trace element contaminants cycles.

CERENA continued researching automated mapping and characterization of polygonal networks on Mars. Research focused on the detailed analysis of the NASA Phoenix landing region (around 68° N), which are extensive plains largely occupied by small-scale polygonal terrains. These were difficult to perceive in previous imagery but are now unveiled by the HiRISE camera onboard Mars Reconnaissance Orbiter (30 cm/pixel). The huge number of small polygons (diameter around 4 m) demonstrates the necessity of using automated approaches allowing for a detailed mapping of these extensive networks. This will contribute to gather data to help probe into the most widely accepted genetical models, namely thermal contraction of permafrost.

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18 Romania

Activities of the Periglacial Romanian Research Group during 2009 focused on (1) geophysical investigations on glacial and periglacial deposits, (2) climate change through meteorological and climatological data in Carpathian Mountains, (3) paleoenvironmental reconstruction of glacial and periglacial environments in Romanian mountain area, connected especially to relict rock glaciers.

At the Department of Geography, West University of Timișoara, P. Urdea and his team (M. Torok-Oance, M. Ardelean, F. Ardelean, A. Onaca) are continuing the application of 2D electrical resistivity tomography, with measurements on rock glaciers, scree slopes and solifluction lobes in Făgăraș Mountains, the highest Romanian mountains. Also, the Bâlea area (central part of Făgăraș Mountains) is being used by P. Urdea and A. Onaca to introduce undergraduate students to glacial and periglacial geomorphology through a 7

days final second year field trip. A new area in the Southern Carpathians has been mapped and studied geomorphologically, the periglacial forms seem to have been active during the Little Ice Age, a cooling being proven by dendroclimatological and dendroecological analyses, carried out by I. Popa (Forest Research Station Câmpulung Moldovenesc).

In order to investigate the coupling between several periglacial processes and climate - in the context of the global warming, a project on collecting meteorological data series from the periglacial belt was launched by the collaboration between two teams from University of Bucharest, headed by A. Vespremeanu-Stroe, and from West University of Timișoara, headed by P. Urdea. The studies of temperature regime of the ground (solifluctional forms, rock glaciers, earth hummocks) and free face-rock walls are carried out year-round at a network of permanent sites established at high altitude in the Eastern and Southern Carpathians, with a focus on the Retezat and Făgăraș Mountains. Over 100 data loggers for temperatures and humidity have been installed. The investigators undertook Basal Temperatures of Snow (BTS) measurements, geodetic measurements (with Sokkia 610 topographic station) monitored the Pietrele and Valea Rea rockglacier movements and the water temperatures of the springs situated on the front of 7 rock glaciers in Retezat Mountains. Also, the team led by A. Vespremeanu-Stroe has been conducting morphometric analyses of the shape of Carpathian relict rock glaciers.

A. Munteanu (Bucharest University) and E. Marinescu (Craiova University) defended their PhD thesis on the geomorphology of Piatra Craiului Mountains and, respectively, Gilort basin (Southern Carpathians), with special chapters dedicated to glacial and periglacial forms and processes.

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19 Russia

In 2009, the research of Russian geocryologists has focused on the exploration of the spatial and temporal characteristics of the cryosphere, on the inhomogeneous reaction of the cryosphere to global and regional climate change, and on the geoecological and the engineering-cryolithological peculiarities of the northern regions. A series of basic research projects are carried out on the following issues: "Cryosphere as life support and biodiversity conservation

environment", "Evolution of cryosphere in conditions of varying climate", "Permafrost of the Arctic seas and the continental margins of the Western sector of Eurasia: assessment of the contemporary state, characteristics of the dynamics, geocryological history, transformation of frozen and cryotic rocks, hydrocarbon emanation", "Permafrost and Arctic shelf in conditions of the varying climate, ecosystem stability and gas-hydrates, processes of organic matter disposal" (ECI SB RAS).

Mass settling of the permafrost table at the depth of zero annual amplitude has been observed and verified by drilling and seismic investigations (microseismics) in the western Siberian forest-tundra. Over a period of 25-30 years, the pre-tundra light forest has moved approximately 30-40 km northward (ECI SB RAS).

Researchers at Moscow State University demonstrated that the change in a number of permafrost characteristics under climate warming conditions is determined by the aggregation of features and components of the landscape changing under climate warming. Changes of the permafrost characteristics of the aggradational type (decrease and stabilization of the permafrost temperature, diminishing of the seasonal thawing layer, ice enrichment of permafrost upper horizons) are observed in certain landscape conditions against the background of degradational trends (increase of the permafrost temperature, extension of the talik's area) (MSU, Geographical Department).

Monitoring of permafrost parameters (rock temperature and active layer depth) have been continued at the steady-state-stations in the framework of Russian and International IPY projects: Thermal state of permafrost, Arctic monitoring of active layer, Dynamics of the Arctic coasts, Change of vegetation cover. At the anthropologically-disturbed sites of Nadym and Urengoy steady-state-stations the network with long series of observations on ground temperature has been renewed (ECI SB RAS).

Results on changes in ground temperature, active layer thickness, daylight surface settlement, variations in CO₂ emissions have been obtained at the field steady-state-station and monitoring sites on the permafrost territory of Yakutia over a period of 10-15 years. The degree of reaction of permafrost landscapes to various anthropogenic disturbances (logging, plowing area, fires, etc.) in a changing climate have also been a focus of these investigations (IMZ SB RAS).

A series of observations on ground temperature on the

accumulative surfaces of the Yenisei Gulf (with new temperature loggers) are being pursued. New data on the two-stage structure of the Ice Complex in the Dixon village and on the development of thermokarst processes on the Sibiryakova Island have been obtained (ECI SB RAS, VNIIOkeangeologiya, MSU).

The works on the geotechnical monitoring of the railroad bed and embankment of the Obskaya-Bovanenkovo railway are in progress. This is the most northern railway in the world and it will go as far as the gas fields of Yamal Peninsula in the north of Western Siberia. A forecast on the evolution of cryogenic hazard processes has been elaborated, with detailed sections on recommendations for engineering protection of the embankment and the surrounding area as well as suggestions on improvement of the embankment construction for the sustainable exploitation of the railway (PNIIS).

Researchers at Fundamentproject conducted a large range of research projects with the objective to create special GIS geocryological maps: A 1:1 000 000 scale geocryological map of European North of Russia, an album of the landscape, soil, vegetation maps and maps of cryogenic processes activity for the Eastern part of Yamal Peninsula (1:100 000 scale) and an album of maps along the prospective path of the Murmansk-Volkhov gas-pipeline (Fundamentproject).

Using GIS technology, a series of digital permafrost maps of various scales including its characteristics (ice content of surface sediments, ground temperature, active layer thickness and freezing layers as well as moisture content) have been compiled for the natural environment of Yakutia (IMZ SB RAS).

Based on the results of engineering-geological surveys, a series of special electronic maps on the projected route of the Polunochnoye-Salekhard railroad along the foothills of the eastern slope of the Northern and Polar Urals has also been created (PNIIS).

At the Geology Department of Moscow State University, two methods have been developed: 1) A method of determining of the long-term strength, the durability and the rate of deformation of frozen ground in order to evaluate its bearing capacity for the construction foundation and 2) a method for the determination of the minimum values of thawing ground strength taking into account the changes in the physical and mechanical properties and in the pore pressure observed during thawing (MSU, Geology Department).

A series of experimental methods for the strengthening of the foundations of large constructions have been conducted in the Norilsk region. These setups include (in addition to the conventional cooling from underground or the use of seasonal cooling devices in the perimeter of constructions) static pressing down of piles to the bearing horizons, partial cementation of thawed gravel-pebbly or sandy soils, installation of buried subsidiary beams in the grid as well as widening of the upper part of the pile etc. (MSU, Geographical Department).

The international student field courses on permafrost in the North of Western Siberia were carried out this year again. In 2009, the student field courses were organized on board of the ship "Sovetskaya Arktika" by the Geographical department of Lomonosov MSU, IKZ and LIN SB RAS and VNIIOkeangeologiya. Research took place at the Yenisei River, the Yenisei Bay, the Kara Sea and the Gydan Bay.

The following publications have been released by Russian researchers in 2009:

- * The sixth part of the book "Fundamentals of permafrost" - "Geocryological forecast and ecological problems of geocryology" has been prepared by a group of scientists, edited by L.S. Garagulya and E.D. Ershov (MSU, Geological Department).
- * A unique Monograph on parametric drilling and core sampling through permafrost strata including a complete set of laboratory research was released under the name "Structure and properties of the frozen ground in the southern part of the Bovanenkovo gas-condensate field. Advice on the prevention of problems linked to cryogenic structures and gas blasts encountered during permafrost drilling and well operations" (MSU, Geological Department).
- * The monograph "Cryogenic metamorphism of rocks and underground waters " by S.M. Fotiev has been prepared for publication. For the first time, the conditions and results of the cryogenic metamorphism of rocks and underground waters during the Late Cenozoic have been examined. The geocryological interpretation of the unique Baikal paleoclimatic sequence has been used to do so (ECI SB RAS).
- * The monograph "Cryology of Mars and other planets of Solar System" has also been prepared for publication (Geology Dept., MSU).

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20 Spain

Several Spanish research teams are working on permafrost and periglacial processes in Spanish mountains, Antarctica and Andes, continuing previous work. Activities in 2009 focused on: Periglacial processes and environments in the Iberian Peninsula (Galician Mountains, Sierra Nevada, Cantabrian Mountains, Pyrenees and Central System); Permafrost and periglacial processes in Maritime Antarctic; and Martian permafrost.

Projects on Maritime Antarctic are focused on "Active layer Monitoring and Modelling", from University of Alcalá, led by M. Ramos, and on "Geomorphic dynamic, permafrost mapping and periglacial environment", led by J. López-Martínez (Universidad Autónoma de Madrid). Studies in Cantabrian Mountains have been carried out by the University of León Group, led by J.M. Redondo, and the University of Valladolid, led by E. Serrano, working especially in the Palentine Mountains and Picos de Europa massif. The University of Santiago de Compostela group, headed by A. Pérez-Alberti and M. Valcárcel, is working on nival and periglacial processes in the Galician Mountains, and on Crionival landforms in Southern Andes (Tierra de Fuego). In the Pyrenees two groups work on periglacial environments, one from the University of Zaragoza, led by Dr. J. Chueca, focusing on nival and thermal regimes and one from the University of Valladolid, headed by E. Serrano looking at permafrost and present day periglacial processes. The University of Barcelona group, led by A. Gómez-Ortiz, works in Sierra Nevada, where a Doctoral Thesis titled "Holocene Palaeoenvironmental reconstruction of The Sierra Nevada from sedimentary records" has been presented by M. Oliva.

The Universities of Salamanca and Complutense of Madrid Group, led by R. Cruz and J. Pedraza are working on Quaternary periglacial landforms on Central System. The research team of the Universidad Complutense de Madrid, headed by D. Palacios, works in the Andean volcanoes, and a Doctoral Thesis titled "Climatic Change impact on glaciers of Nevado Coropiuana volcanic complex (Central Andes, South Perú)" has been presented by J. Úbeda. Finally, the Astro Biological Center (CAB) and the University of Alcalá work further on Martian permafrost.

From 21 to 24 June, 2009, the Second Iberian Congress of IPA took place in Sigüenza (Spain), organised by the University of Alcalá and coordinated by M. Ramos. This is a joint meeting between the Spanish and Portuguese Permafrost communities, a

continuation of IPA-Spain ones, started in 1993. The congress topic was "Periglacial environments, permafrost and climatic variability" with three main sessions: A) "Present-day dynamic in mountain periglacial environments", B) "Iberian results during the International Polar Year (IPY)", and C) "Permafrost like planetary cryospheric subsystem". The meeting welcomed forty five participants, included three lectures (F. Nelson, H.W. Hubberten and G. Vieira). Twenty six oral presentations and eighteen posters were presented. Nineteen oral presentations and thirteen posters make the Spanish contribution. The Iberian IPA Congress did finish with a fieldtrip in the Iberian Range Highlands. The next meeting, the Third Iberian Congress of IPA, will be organized by University of Santiago de Compostela (Spain) in Galice, June 2011, and coordinated by M. Valcárcel.

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21 Sweden

At the University of Lund, The GeoBiosphere Science Centre continued/expanded activities in the Abisko area. The "Nordic centre for Studies of Ecosystem Carbon exchange and its interaction with the Climate system"(NECC) has got two monitoring sites in the area. A new installation for calibration of remote sensing data has been established at the Abisko-Jokka delta (Eklund / Schubert). The CARBOMONT project-"Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas" and the ELSA project "Exchange processes between the land surface and the atmosphere" have activities in the Abisko area, especially in and around the Stordalen bog.

The old "IPA Abisko area active layer transect" is being maintained. J. Åkerman and M. Johansson are still maintaining 10 of the originally 12 CALM sites along the 100 km east-west transect.

The new boreholes - 6 and 16 meter deep drilled close to the old boreholes established in the 1980s by J. Åkerman continue to deliver data. Preliminary results show that the permafrost thickness is shrinking from below as well as from above. The snow manipulation experiment at a peat mire 6 km east of Abisko, northernmost Sweden is still running and the monitoring programme has this year been extended. At the manipulation site, projected future changes in snow depth are simulated and the impacts on permafrost and vegetation are being monitored. This summer, monitoring of greenhouse gases (CO₂, CH₄, N₂O) was initiated by J. Bosjö (a new PhD student)."

The Arctic Council of Ministers has requested a report on the current status of various aspects of the Arctic's Cryosphere. The major sections are the Greenland Ice Sheet, Arctic Sea Ice and the Terrestrial Cryosphere, which consists of the chapters Snow, Permafrost, Glaciers and Ice Caps, Hydrology. Sweden together with Canada is coordinating the terrestrial Cryosphere component and Sweden (T. Callaghan and M. Johansson) is leading the snow and permafrost chapters. The project will finish by the end of 2010.

A new project entitled "The Greenland Analogue Project" on Greenland's west coast, east of Kangerlussuaq, has been initiated (L. Claesson Liljedahl and J.-O. Näslund). GAP is a multilateral project, which is funded by the Swedish, Finnish and Canadian Nuclear Fuel and Waste Management Companies (SKB, Posiva and NWMO). GAP involves researchers from universities and geological surveys in Sweden, Finland, Denmark, Canada, the United States and the United Kingdom. The project includes a subproject on groundwater chemistry/flow and permafrost in the bedrock by bedrock drilling. Two boreholes (220 and 340 meters) were drilled close to the ice sheet this summer. The boreholes are monitored for temperature, pressure and conductivity, and preliminary results indicate that the permafrost goes deeper than 300 meters at a distance of ca 500 meters from the ice sheet. The results from the bedrock drilling will be used in the planning of a deep bedrock drilling (ca 500-700 meters) close to the ice margin and in under the ice sheet, which will be drilled in order to study the groundwater flow, chemistry and permafrost conditions.

During the year we lost Dr. Richard Åhman, a well known Nordic Palsa specialist and Dr. Bo Malmström who worked with frost mounds and other periglacial forms in Sweden and Norway.

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22 Switzerland

PERMOS, the PERmafrost MONitoring Switzerland, has been further consolidated: In addition to the coordination office, a scientific committee was constituted and met three times. Besides elaboration of data policy, defining governance structures and ensuring quality, it conducted the re-evaluation of the "B"-ranked sites in fall 2009. Standards for the two types of sites, "Thermal Sites" and "Dynamic / Kinematic Sites" are being implemented step by step.

As one part of the process, a questionnaire was published on www.permos.ch to receive information from the larger public, when rock fall were observed. Existing rock fall inventories form the base and are complemented by feedback from the questionnaire. In June, the Annual PERMOS meeting was held in Neuchâtel and included an excursion to the Jura permafrost site Creux du Van.

At the WSL Institute for Snow and Avalanche Research SLF (www.slf.ch), new practical guidelines for the construction of infrastructure in mountain permafrost were developed in collaboration with various partners; with a special emphasis on site selection and structure design with special technical solutions. The SLF permafrost monitoring network now includes new instrumented boreholes under recently built mountain infrastructure such as pylons, buildings and defense structures. Temperature trends from older boreholes located in complex mountain topography in the Swiss Alps are being analyzed using specially developed Generalized Linear Models. At sites where reference data are available, 3D-laserscanning techniques are being tested to monitor creep, subsidence and erosion rates in different types of mountain permafrost terrain. Electrical Resistivity Tomography (ERT) surveys continued to be made on the Gemsstock ridge (with the University of Bonn). ERT monitoring were carried out (with the University of Fribourg within PERMOS) to observe the rapidly thawing ground ice at the Flüela Pass site, where one of the first Swiss permafrost investigations was carried out in the 1970's.

The Institute of Geography of the University of Lausanne (www.unil.ch/igul) concentrated its researches on two main topics: study of permafrost extension and characteristics in various alpine landforms and study of permafrost creep. Between September 2008 and 2009, nine new boreholes were drilled on three different talus slopes in the Valais Alps, within the permafrost belt: Petit Mont Rouge (Arolla), Les Attelas (Verbier, including borehole logging) and Les Lapires (Nendaz). Lapires is a joint project with the University of Fribourg. Geophysical surveys (ER and seismic tomography) were carried out with the University of Zurich. Automatic cameras were installed at all sites to observe references to internal air circulation in the scree slopes. Electromagnetic geophysics surveys (EM 31, IP and VLF-R) to map permafrost extent were applied in the Ticino Canton (Southern Swiss Alps). Investigations about relative and semi-absolute dating of alpine periglacial landforms using the Schmidt Hammer were carried out in several sites of the northern and southern Swiss

Alps. Movement, deformation and internal structure of creeping permafrost landforms (rock glaciers, frozen moraine) were studied using d-GPS, Terrestrial Laser Scanning (with the Institute of Geomatics and Risk Analysis of the University of Lausanne) and ERT.

At the University of Zurich (www.geo.uzh.ch/en/units/physical-geography-3g), a number of long-term projects involving modeling, measuring, and monitoring in mountain permafrost are being continued. Three new permafrost-related PhD projects have recently started: one concerning uncertainty and validation of physics-based permafrost models, one concerning statistical modeling of permafrost over the Alpine arc combined with local 2D/3D modeling, and one concerning sub-grid computation of permafrost and other cryosphere phenomena in mountains for application on continental scales. The Permasense wireless sensor networks on Matterhorn and Jungfrauoch are measuring and transmitting information on temperature, electric conductivity and crack dilatation. Additionally, the thaw of ice-filled clefts in bedrock is further investigated using laboratory experiments (with the Université de Caen, France. A collaboration with the SLF Davos, the Federal Institute for the Environment (FOEN), the Bavarian State Ministry for the Environment, and the Central Institute for Meteorology and Geodynamics (ZAMG) in Austria has started in the scope of the PermaNET project (Alpine Space, Interreg III). Field sites were instrumented with temperature sensors and a database of alpine-wide permafrost evidences has been set up, which serves for the design and validation of statistical modeling. The occurrence of rock avalanches from glacierized and perennially frozen rock walls in the Central European Alps is investigated in a multi-scale approach. Detailed finite element stability modeling and analyses of high-resolution time-lapse DTMs are combined with regional-scale statistical analyses of detachment zones to evaluate the controlling factors for periglacial rock mass failures (in collaboration with University of Oslo and the ETH Zurich). Terrestrial survey were restarted on the rock glaciers Murtèl and Muragl (Grisons) to quantify permafrost creep rates on an seasonal to annual basis.

At the University of Fribourg, the Department of Geosciences (www.unifr.ch/geoscience/geographie/en/index3.php) established three new “permafrost” faculties in September 2008 (Reynald Delaloye, Martin Hoelzle, Christian Hauck) building a new scientific group called “Alpine Cryosphere & Geomorphology”. The research focus includes mountain permafrost monitoring and modelling, using a variety of geophysical, geodetic and

geomorphological methods, as well as subsurface modeling and coupling procedures to Regional Climate Models. Currently 3 PhD students and 2 PostDocs work on various topics ranging from ground-atmosphere modeling, effect of snow cover, geophysical monitoring to kinematics of rock glaciers and unstable permafrost slopes.

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Vonder-Mühl

23 United Kingdom

A symposium to celebrate Professor Charles Harris' career was held on 25th September at the UMR CNRS 6143 "M2C"/ University of Caen, in Caen, France. Details of this happy and successful event are given in Frozen Ground #33.

Work has continued in establishing a chronology for the relict periglacial landscape of East Anglia. Through their application of cutting-edge luminescence dating methods Stephen Hitchens and Mark Bateman (Sheffield) have been able to discern from single samples multiple activation ages of both stripes and periglacial polygons, indicating polycyclic development of these features during Marine Isotope Stages 4–2. Stephen's untimely death in September is a great loss to the UK periglacial community and he will be sorely missed.

Glacier-permafrost interactions associated with a Pleistocene ice sheet overriding permafrost ~430,000 years ago in Norfolk, Eastern England, were studied by an interdisciplinary team led by R. Waller (University of Keele) and comprising C. Whiteman (University of Brighton), E. Phillips and J. Lee (British Geological Survey) and J. Murton (University of Sussex). The structural attributes of stratified sand intraclasts within silty and clayey tills constrain the thermal conditions of glaciotectonic deformation. Analogous deformation structures in metamorphic rocks and glacially deformed permafrost in Arctic Canada support the hypothesis that the Norfolk structures did not form in an unfrozen deforming bed, as long thought, but in warm and ductile permafrost.

Ancient plant DNA preserved in permafrost soils was the focus of a UK-Danish-Russian field trip to Duvanny Yar on the lower Kolyma River, Yakutia, NE Siberia (See Figure). This Beringian type site preserves a record of terrestrial silt-sand (Yedomas) deposition during Marine Isotope Stages 3 and 2 (~50,000–10,000 years ago). Frozen cores of sandy

silt were collected in a ~35-m high vertical transect through the Yedoma deposits by J. Haile (Universities of Copenhagen & Oxford), M. Edwards (University of Southampton) and J. Murton for DNA analysis, radiocarbon and optical dating, and sedimentological analyses.

The new Permafrost Laboratory at the University of Sussex is now in operation as a result of collaboration between Geography and Engineering at Sussex. A pilot experiment has been running since April to test the hardware and monitoring system, with a systematic experiment on rock fracture in mountain rockwalls planned.

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The 2009 Fall Meeting of the American Geophysical Union took place in San Francisco, California, December 14–18. Larry Hinzman, IARC Director and former U.S. Permafrost Association (USPA) board member, was invited to present the prestigious Nye Lecture on “Arctic Hydrology and the role of feedbacks in the climate system.” Approximately 200 talks and posters dealt with frozen ground, presented across virtually all AGU sections and focus groups. Presentations covered climate feedbacks and interactions, remote sensing and modeling techniques, geomorphology, environmental change, and many other topics. The USPA also held its annual meeting on 17 December during the 2009 AGU Fall Meeting. J. Rooney replaced Y. Shur as President. Coordinated by the new Permafrost Young Researchers Network (PYRN)-USPA liaison A. Liljedahl, the USPA established a USPA-PYRN Educational Fund to provide long-term support for early career permafrost researchers. The effort is managed by a PYRN-USPA committee who provide advice to the USPA Board of Directors. 2009 USPA-PYRN initiatives included five partial travel grants to the 2009 AGU Fall Meeting, and a social networking and professional development event during AGU. Activities are announced through the website <http://pyrn.ways.org>.

The 2009 Annual Meeting of the Association of American Geographers took place March 22–27 in Las Vegas. The AAG’s Cryosphere Specialty Group (CrSG) sponsored 14 sessions, including two sessions specifically on frozen ground, as well as sessions on cryospheric remote sensing, IPY, glaciers, water resources, and Arctic hydroclimatology. The annual CrSG awards were presented: H. J. Walker, Boyd Professor Emeritus at Louisiana State University, was

recognized with the 2009 Francois Emile Matthews Award. The R. S. Tarr Illustrated Student Paper Award went to V. Chu of UCLA, for her presentation on “Rapid response of sediment plumes to Greenland ice-sheet surface melt.”

T. Krzewinski reports ASCE’s 14th International Specialty Conference on Cold Regions Engineering was held in Duluth, Minnesota, 30 August–3 September 2009: 70 papers were presented and published in conference proceedings. Awards were presented with D. Miller receiving the Harold R. Peyton Award, D. Kane the Can-Am Award, and T. Vinson as the Eb Rice Lecturer. Speakers included Representative Oberstar and President-Elect B. Leonard of ASCE. TCCRE Committee meetings were held at the conference. A number of meetings are planned: ISCORD 2010, from 1–5 June in Yakutia, Russia. ASCE will propose to host ISCORD 2013 in Anchorage, AK. ASCE’s 15th International Specialty Conference on Cold Regions Engineering will be in 2011 in Quebec, joint with CSCE, organized by G. Doré. ASCE/TCCRE will cosponsor CSCE “Circum Polar Engineering Conference 2012,” to be held in Yellowknife in September. TCCRE Committee meetings will be held in Las Vegas, in conjunction with AGU and USPA meetings in San Francisco in December of 2009, and in May 2010 in Seattle. TCCRE provided members for the Standards Committee, charged with updating the Standard on Frost Protected Shallow Foundations (FPSF). Recent rewrites were by Krzewinski and E. Clarke, and changes are being accepted by committee polling at this time. TCCRE has been representing ASCE in supporting a PBS Documentary “Building Alaska,” to be released shortly. Krzewinski is leading ASCE efforts with B. Connor (UAF), K. Korri (ADOT), and T. Brooks (Alaska Railroad). Recently shown as a part of the Anchorage Film Festival, the film will air on PBS in late 2009.

T. Zhang and the permafrost group at the National Snow and Ice Data Center at the University of Colorado in Boulder (O.W. Frauenfeld, K. Schaefer, B. Sheffield, R. Jin, M. Parsons, R. Armstrong, L. Liu, Z. Fan, J. Wahr, and R.G. Barry) continue work on many aspects of frozen ground. Frauenfeld has accepted an appointment in the Geography Department at Texas A&M University, but continues to collaborate with Zhang on investigating changes in permafrost temperatures, active layer thickness, and depth of seasonally frozen ground using soil temperature data from 400+ stations across Russia. With Q. Wu (CAREERI), Zhang is also studying permafrost changes over the Qinghai-Tibetan Plateau. With

support from NSF and IARC/NSF, daily snow depth and soil temperature acquisition from the Russian high latitudes is in progress. Using InSAR data, surface deformation over permafrost is detected on the North Slope of Alaska (Liu, Zhang, and Wahr). The NSIDC Frozen Soil Algorithm is being further developed, validated, and calibrated using surface soil temperature data from Russia, China, and U.S. (Zhang, Jin, and Armstrong). Under NASA, NSF, and IARC/NSF funding, permafrost samples from 7 boreholes to 2.9 m were taken in Fairbanks and the North Slope of Alaska in summer 2009 for carbon studies (Zhang, Schaefer, and Liu) with USGS-Boulder. A NASA-funded modeling project studies permafrost carbon in the Arctic (Schaefer and Zhang). A one-dimensional model of water and heat transport in boreal soils with freezing and thawing was developed to simulate soil response to climate change (Fan and Zhang). Zhang and Parsons continue to describe global permafrost distributions and statistics using the IPA permafrost map and other available data. With NASA support, "All About Frozen Ground" () was developed and is available as a public resource (Sheffield and Zhang).

K. Yoshikawa reports on the Permafrost/Active Layer Outreach Program, which builds on work begun in 2005 to establish long-term permafrost and active layer monitoring sites adjacent to schools in Alaska and other countries including tropical high mountains such as Kilimanjaro, Tanzania. Monitoring stations are located at the over 150 Alaskan schools/communities. The sites collect permafrost temperature data and active layer depth. Data gathered from these stations are shared with other schools and made available to the public through: . This project involves more than 10,000 students and 500 teachers across Alaska. Specialists in outreach education are developing a classroom lesson Permafrost/Active Layer in Alaska that will be included in a "Tunnel Man" movie series. Activities and teaching materials in the Permafrost Handbook encourage students to collaborate and communicate new ideas. Parsons received the AGU Charles S. Falkenberg Award, presented jointly by AGU and the Earth Science Information Partnership (ESIP). The award honors Parsons as "a scientist under 45 years of age who has contributed to the quality of life, economic opportunities, and stewardship of the planet through the use of Earth science information and to the public awareness of the importance of understanding our planet.

W. Eisner (University of Cincinnati), with collaborators C. Cuomo (University of Georgia) and K. Hinkel, reports on "Connecting Indigenous Knowledge to Landscape Process Research, Arctic Coastal Plain of

Alaska." The classification of 260 records from the Iñupiaq Knowledge GIS is reported in "Advancing Landscape Process Research through the Incorporation of Iñupiaq Knowledge" (Eisner et al. in press at Arctic). The entire data suite (GIS layers, videotaped interviews, and related archived data) will be part of a web-based GIS, to be included in a website of resources, research, and information related to indigenous and local community knowledge in northern Alaska, and collaborations between scientists and indigenous communities more generally. They presented their GIS data to the Barrow community in the form of a day-long workshop in June 2009, which generated lively feedback from the 40 attendees, including over 20 Iñupiaq elders.

K. Hinkel (University of Cincinnati), J. Lenters (University of Nebraska), Y. Sheng (UCLA), and their students continued surveying lakes on the North Slope of Alaska. 2009 summer work was concentrated near Atkasuk, ~100 km inland from Barrow. Research components included (1) surveying lake shores with DGPS to determine shoreline changes between mid-June and mid-August, and correlating changes with measured drop in water depth and lake volume; (2) mapping lake bathymetry and collecting summer temperature profiles from lakes; and (3) modeling the energy and water balance of instrumented "focus" lakes near Barrow and Atkasuk. Graduate student B. Winston has been analyzing archived satellite images to verify that some lakes consistently experience ice melt-out earlier than surrounding lakes, and that lake ice melt-out occurs later in a wide Arctic littoral zone due to lower temperatures and cloudy/foggy conditions in late spring.

The permafrost group at the University of Delaware (UD) has undergone significant changes during the past year. K. Shiklomanov has accepted a professorial appointment in the Geography Department at George Washington University (GWU) in Washington DC. In August 2009 the Circumpolar Active Layer Monitoring (CALM) program received a five-year award from the U.S. National Science Foundation, and will be a component of the Arctic Observing Network. This new CALM III will be administered jointly through GWU and UD, with Shiklomanov acting as project director and Nelson as co-principal investigator. UD doctoral students D. Streletskiy and M. Demitroff are making good progress, with dissertation research focused on active-layer studies in northern Alaska and fossil periglacial features in the Mid-Atlantic region, respectively. New graduate students who will be involved in CALM III include C. Marquez (GWU) and A. Campbell (UD). The 2009 field parties in northern and western Alaska included Shiklomanov, Nelson, A.

Klene (University of Montana), C. Seybold (U.S. Natural Resources Conservation Service), Streletskiy, Marquez, Campbell, and L. Polyakova (Moscow State University).

T. Osterkamp reports on his project “Physical and Ecological Changes Associated with Warming Permafrost and Thermokarst in Interior Alaska,” in collaboration with M.T. Jorgenson, E.A.G. Schuur, Y.L. Shur, M.Z. Kanevskiy, J.G. Vogel, and V.E. Tumskoy. They are currently summarizing their observations and measurements of physical and ecological changes at a tundra site near Healy, AK. Air temperatures decreased (1985–1999) while permafrost warmed and thawed, creating thermokarst terrain probably as a result of increased snow depths. Thermokarst-induced changes in relief alter the near-surface hydrology and ecological processes, especially on vegetation.

K. Bjella, on behalf of the Cold Regions Research and Engineering Lab, reports on studies at the Permafrost Tunnel in Fox, AK, including electrical resistivity and GPR studies by the Southwest Research Institute, tunnel roof support load and creep analysis by CRREL, ice wedge isotope analysis by UNLV and D. Lawson. The University of Alaska, Institute of Northern Engineering is conducting a study at the Fairbanks Permafrost Research Station, aka Farmers Loop Road Site, for lateral loading of pipe piles. Bjella also reports on the installation of a 12 m thermistor cable at Thule, Greenland, to investigate the state of the permafrost and the effect on infrastructure. B. Astley and Bjella conducted an Army-funded demonstration on Fort Wainwright of permafrost delineation techniques (DC resistivity, capacitively-coupled resistivity, ground-penetrating radar, electromagnetics, and frost probing) to be used in future site selection and geotechnical surveys on military installations underlain by permafrost.

N. Mölders and D. PaiMazumder (University of Alaska Fairbanks) examined how the design and density of a permafrost network may affect regional climatology calculated therewith. Biases most likely occur in mountainous regions. Mölders and Kramm wrote a review book chapter on the status of treating permafrost in climate, numerical weather prediction, and chemistry transport models, and how to improve the permafrost representation in these models.

V. Romanovsky reports for the growing UAF permafrost group at the Geophysical Institute/International Arctic Research Center (K. Yoshikawa, S. Marchenko, R. Daanen, G. Grosse, A. Kholodov, and R. Muskett). They continue work on projects including permafrost and active layer

dynamics within Alaska, instrumentation of boreholes, acquisition of subsurface temperatures from circum-arctic permafrost regions (Thermal State of Permafrost, TSP), and the modeling of permafrost in various regions: Alaska, Siberia, and Greenland. Permafrost spatial dynamics, implemented by Marchenko for an Alaskan permafrost domain, use a high-resolution spatial data set (2x2 km) and Scenarios Network for Alaska Planning (SNAP) data for climate forcing (<http://www.snap.uaf.edu>) derived from five GCMs: ECHAM5, GFLD21, MIROC, HADLEY, and CCCMA using the A1B emissions scenario. G. Grosse continued fieldwork within NASA and NSF projects in the northern lowlands of the Seward Peninsula, AK, with K. Walter Anthony (UAF), L. Plug (Dalhousie University), M. Edwards (University of Southampton), L. Slater (Rutgers), and N. Bigelow (UAF), and together with B. Jones (UAF/USGS) and K. Peterson (UAA) along a transect of the Colville River (Alaska North Slope). Additional field work took place in eastern Siberia with S. Zimov (Northeast Science Station Cherskii). B. Jones completed remote sensing analyses of thermokarst lake dynamics on the Seward Peninsula, AK, and M.S. student M. Tillapaugh is completing her thesis on remote sensing of thermokarst lakes dynamics in the Kolyma lowland (Siberia). R. Daanen continues simulating permafrost conditions in Greenland and Alaska (NSF-funded). Results from 25 km resolution Greenland permafrost simulations are used to project degradation from infrastructure development; similar simulations for Alaska are available online. He continues EPSCoR-funded work on debris glacier-like features in the Brooks Range. A new DOE study has started, forecasting soil freezing rates in northern Alaska, and new outreach efforts were established with the Watershed School of Fairbanks, teaching fifth graders about the permafrost life cycle. Part of TSP, the GI permafrost group collaborated with Russian, Kazakh, and Mongolian colleagues to update their national Permafrost Monitoring Networks, resulting in many new and improved sites. R. Muskett continued work on space geodesy and remote sensing of the northern hemisphere (MODIS, ICESat, GRACE, and AMSR-E) with an emphasis on water equivalent mass changes of Eurasian and North American watersheds as related to permafrost changes.

H. Pollack of the University of Michigan reports on the publication of his new book titled “A World Without Ice.” The book is a tale of climate change and people, told through the prism of ice. Published by Penguin and with a foreword by Al Gore, the book describes the role of ice in the development of Earth’s landscape, climate, and human civilization, and the reciprocal impact of people on the planet’s ice. It describes the

delicate geological balance between ice and climate, and why the rapid disappearance of ice portends serious consequences in our not-so-distant future. For more information, see www.worldwithoutice.com.

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