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1 Argentina (and South American Partners)

Argentina is the second country after Chile in terms of ice cover with approximately 15 percent of the total ice in South America. This fact requires a serious commitment to the protection of this natural resource, as ice masses provide drinking water and irrigation. The IANIGLA has helped to elaborate the Argentine law for the protection of glaciers and rockglaciers. After four years, the law on Protection of Glaciers and Periglacial Environment was finally approved by the government in October 2010. As part of this law a national inventory of ice masses and creeping frozen ground and a monitoring program will be made. The IANIGLA is in charge of the coordination between different research institutes in order to elaborate this inventory and will provide policy makers and the private sector related to water management with updated information. A Spanish glossary of periglacial terms has been elaborated by L. Arenson, P. Wainstein and D. Trombotto and a web page on South American Geocryology is in preparation.

Active layer monitorings along the Andean Cordillera with some surface drillings have been continued. At present there are monitoring sites in the provinces of San Juan Mendoza, Neuquén and Chubut between 31° and 42° S. Cryofoms of these sites are being analysed for the mentioned inventory and will be presented at the CTN-P workshop in Potsdam.

Concerning permafrost distribution the Geocryology Unit has started in 2009 a research program to evaluate the present and past distribution of permafrost, in the Andes of North Patagonia (L. Ruiz). After 3 years of BTS measurements a statistical model of mountain permafrost was elaborated. Although not aerially extensive, permafrost conditions were related with high altitude zones that received very little radiation. A streamlet on the tips of a rockglacier at 35° S at the upper basin of the river Malargüe (Mendoza) near the active volcano complex Peteroa will soon be equipped with instruments (P. Grizas).

In 2011 the research group of the Institute of Quaternary Geology (Tucumán) led by Ana Lía Ahumada has intensified fieldwork in the Sierra de Santa Victoria, Cordillera Oriental (Salta and Jujuy). At heights above 4000 ASL active, inactive and fossil rockglaciers were identified in the upper basin of the Rio Bermejo. The research group participated in the Argentine Congress on Geology in Neuquén with

cryological data to be considered for road construction and in terms of sustainable tourism.

The inventory program of soil temperatures (at a depth of 1 m) and air temperatures on the S and N slopes of the volcano Coropuna (15°31'S, 72°39'W, 6377 m ASL) with three monitoring sites between 4600 and 5600 m ASL in search of possible permafrost occurrence has been continued (D. Palacios). The same is true for the south face of the volcano Chachani (16°11' S, 71°31' W, 6057 m ASL), where additional results of a one-year monitoring at 10 m depth at a height of 5331 m are expected.

Researchers from the University of Waterloo, Canada (A. Brenning), the CNRS EDYTEM unit in Chambéry, France (X. Bodin) and the Catholic University of Chile (G. Azócar) continued their field-based monitoring of rockglaciers and periglacial environments in the Andes of Santiago and the upper Elqui valley, partly within a project funded by the Chilean Water Directorate. A rockglacier inventory for the semi-arid Chilean Andes was created within this project and for Chile's national glacier inventory. Thermal imaging and texture filters were furthermore studied as novel rockglacier remote sensing approaches in a collaboration between the University of Waterloo and Universidad Mayor, Santiago.

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2 Austria

Austrian permafrost researchers have been active in the year 2011. Since the foundation of the Austrian Permafrost Working Group in October 2010, the national committee of IPA-Austria consists of A. Kellner-Pirklbauer (Uni. Graz and TU Graz), G.K. Lieb (Uni. Graz), K. Krainer (Uni. Innsbruck), L. Schrott (Uni. Salzburg) and H. Hausmann (Central Institute for Meteorology and Geodynamics/ZAMG Vienna and TU Vienna).

The national permafrost project permAfrost – Austrian Permafrost Research Initiative funded by the Austrian Academy of Sciences, was successfully continued. General information about the project consortium and participating partners was given in the national report of 2010. The permAfrost project is a first step establishing a nationwide permafrost monitoring program in Austria with a running period of three years.

Salzburg
The University of Salzburg group of L. Schrott

continued to conduct permafrost research within the projects permAfrost (WP3000), MOREXPART and permalp.at. permAfrost (WP3000) focuses on permafrost-glacier interactions in the Austrian Alps at the two test sites Kitzsteinhorn and the glacier Goldbergkees (J.-C. Otto).

The MOREXPART project (I. Hartmeyer, M. Keuschnig, L. Schrott), carried out in cooperation with alpS (Centre for Climate Change Adaptation Technologies, Innsbruck), is initiating a new long-term monitoring site for mountain permafrost at the Kitzsteinhorn (3.204 m a.s.l.). In 2011 air flush rotary drilling works were completed (5 boreholes, 20-30m deep). In 2012 all boreholes will be equipped with a new, purpose-built system for borehole temperature measurement developed by GEODATA Inc. In addition 20 shallow boreholes (10-80cm deep) were drilled to measure near-surface rock temperatures. To investigate subsurface thermal changes, two automatically logging ERT-arrays were installed. In 2012 further shallow boreholes will be drilled and a third permanent ERT array will be established (Fig. 1).



Air flush rotary drilling of a 30m deep borehole at the Kitzsteinhorn, Hohe Tauern Range, during early autumn 2011 at about 3000 m a.s.l. Photograph provided by Ingo Hartmeyer.

The permalp.at project (J.-C. Otto, L. Schrott, M. Rosner, M. Rupprechter) is concluded by the end of 2011 including a Web GIS. As one product, a new permafrost distribution map of the Hohe Tauern Range will be published in cooperation with F. Keller (Academia Engiadina, Switzerland).

ZAMG Salzburg (C. Riedl) and ZAMG Vienna (H. Hausmann) – in cooperation with the group of K. Krainer – finished the ÖAW project Permafrost in Austria at Hoher Sonnblick (3106m). At the Sonnblick summit data from 4 boreholes (3 temperature, 1 extensometer) and 35 ground surface temperature sensors were evaluated and seismic tomography (TU-Vienna, H. Hausmann, E. Brückl) was conducted.

The borehole measurements indicate the existence of deep-reaching processes which could affect the long-term stability of the crest. Furthermore, the temporal changes of the rock walls were documented with TLS (S. Seren) and ground surface temperature measurements were continued at the Wintergasse site within the project PERSON (W. Schöner, ZAMG Vienna). The Alpine Space Project PermaNET was also finished. One major result was the 3 dimensional modeling of the permafrost distribution at the Sonnblick summit.

Graz and Leoben

The group of permafrost researcher in the Federal Province of Styria increased in size and consists in 2011 of people from the University of Graz (A. Kellerer-Pirklbauer, G.K. Lieb, O. Sass, M. Rode, G. Winkler, M. Pauritsch), Graz University of Technology (M. Avian, V. Kaufmann, A. Kellerer-Pirklbauer), Joanneum Research, Graz (A. Bauer), and University of Leoben (E. Niesner, B. Kühnast). Two major projects - ALPCHANGE and PermaNET - were officially finalised in 2011.

permAfrost (WP4000) was successfully continued. permAfrost (WP4000) aims to continue and improve research in the field of kinematics, volumetric and thermal monitoring of rock glaciers and permafrost and to understand the inner structure of three rock glaciers in the Hohe Tauern Range (Weissenkar, Hinteres Langtalkar, Dösen). WP4000 consists of four different sub-working packages. M. Avian carried out terrestrial laserscanning (TLS) campaigns at the Hinteres Langtalkar Rock Glacier (almost continuous annual record of TLS data since 2001) and at the rock fall areas Mittlerer and Hoher Burgstall, near Pasterze Glacier. A. Kellerer-Pirklbauer is in charge of the permafrost monitoring network at the three mentioned rock glacier sites as well as several additional permafrost monitoring sites (established during the ALPCHANGE and PermaNET projects) in the Hohe and Niedere Tauern Ranges. During 2011, the existing network was maintained and partly upgraded.

All three mentioned rock glaciers were investigated by geophysical measurements (E. Niesner, B. Kühnast). The field campaign started in August and lasted till September 2010. Multielectrode Geoelectric Tomographie (ERT) with up to 120 electrodes and passive electromagnetic measurements in the Very Low Frequency (VLF) band were applied. The Austrian Army supported the transport of the field equipment by helicopters.

Furthermore within permAfrost (WP4000), V. Kaufmann and his team continued the annual geodetic measurements at the three rock glaciers Weissenkar, Hinteres Langtalkar, Dösen as reported last year. Furthermore, a simple technique for detecting and

measuring fast moving rock glaciers over a wide area based on high-resolution orthoimages provided by geobrowsers, such as Google Maps and Microsoft Bing Maps, was elaborated and tested by V. Kaufmann. Two Bachelor theses (Institute of Navigation, TU Graz) were aimed at applying low-cost GPS receivers for precise measuring of rock glacier flow velocities. Practical experiments were carried out at rock glacier Leibnitzkopf (Schober group, Hohe Tauern range).

A new project entitled Water Resources of Relict Rock Glaciers thematically focusing on ground water storage and discharge dynamics of relict rock glaciers in the Niedere Tauern Range, Styria was initiated in autumn 2010 (G. Winkler, A. Kellerer-Pirklbauer, M. Pauritsch). On the regional scale, this project will elaborate a hydrogeological-focussed rock glacier inventory of the Niedere Tauern Range, Styria (ca. 2500 km²). On a local scale, two rock glaciers will get intensively studied regarding hydrogeological characteristics of the drainage basins, flow and transport characteristics of the alpine aquifer, numerical hydraulic modelling as well as thermal modelling of the rock glacier bodies.

The project proposal ROCKING ALPS (ROCKfall and weathering in the eastern ALPS) is currently in review (O. Sass, M. Rode). In this project it is intended to investigate the governing factors of frost weathering and rockfall in alpine regions by applying 2D-geoelectrics, high-resolution moisture monitoring, rock moisture modeling, infrared photography and detailed rockfall mapping using TLS. Research is already carried out at the three sites Gesäuse, Dachstein and Kitzsteinhorn. At the third study site, research is carried out in close cooperation with the MOREXPERT project mentioned above.

Finally, in the Untertal valley near Schladming, Styria, multi-method geophysical profiling was carried out for investigating permafrost lenses in a rockfall boulder deposit. Several frozen areas were detected at a possibly record-breaking (in Austria) low elevation of c. 900 m a.s.l.. The temperature anomaly (chimney effect) is reflected at the surface by an unique peat bog vegetation.

Innsbruck

The University of Innsbruck group of K. Krainer continued working on two projects funded by the Austrian Academy of Sciences. These are Permafrost in Austria and permAfrost (WP5000). Both projects deal with the study of the impact of changes in the thermal regime of alpine permafrost on melting processes, discharge patterns and water chemistry at test sites in the Ötztal Alps (Lazaunalm, Kaunertal, Hohebenkar, Reichenkar), Samnaungruppe, Stubai Alps and Verwallgruppe by using a combination of

geological/geomorphological, hydrogeological (jointly with TU-Vienna: G. Blöschl), geophysical (jointly with TU-Vienna: E. Brückl, H. Hausmann), geochemical, meteorological and climatological methods.

Three ice-cores drilled at two rock glaciers (Lazaun in the Schnals Valley and Weissbrunn in the Ulten Valley), in South Tyrol, Italy, in September 2010 are studied regarding ice content, chemical composition of the ice (anions, cations, heavy metals), palynology, age, stable isotopes (PermaNET project). Another objective of the K. Krainer group is the ongoing compilation of a rock glacier inventory of Tyrol.

The University of Innsbruck group of J. Stötter continued to carry out research in the permAfrost (C. Klug, M. Spross, J. Stötter) and C4AUSTRIA projects (E. Bollmann, R. Sailer, J. Stötter). Both projects mainly focus on the detection and quantification of permafrost degradation in the Western Austrian Alps using ALS and TLS as well as photogrammetrical analysis. Detailed investigations are carried out on rock glaciers, frozen debris material and rock walls. Expected results are spatio-temporal quantifications of rock glacier melt rates and creep velocities as well as an evaluation of the potential of the applied remote sensing technologies to detect permafrost degradation outside rock glaciers. Furthermore, geophysics, ground temperature monitoring are applied. These activities are done in cooperation with the alpS (see above) project SHIFT.

In 2010 the project MALS (G. Kaser, L. Rieg, R. Sailer, J. Stötter) was initiated. The project aims to detect, evaluate and interpret surface elevation changes of glaciers and rockglaciers in the Ortler Group and the Southern Ötztal Alps (Schnalstal) from repeated ALS campaigns and geophysical techniques.

The University of Innsbruck group at the Institute of Ecology (K. Koinig, E. Ilyashuk, B. Ilyashuk, G. Köck, R. Lackner, R. Psenner) studies the influence of melting permafrost on lakes with a focus on aquatic species and sediment cores. The group obtained a sediment core from a lake affected by a melting rock glacier in summer 2010. The sediment core covers the whole Holocene and it is aimed to compare melting during the current warm period with similar warm periods in the past.

A joint research group consisting of people from the Austrian Academy of Sciences, Innsbruck, and University of Innsbruck, Department of Meteorology and Geophysics and "Alpine Forschungstelle Obergurgl/AFO" (J. Abermann, M. Stocker-Waldhuber, L. Hartl, A. Fischer) monitors flow velocity and surface elevation change at the rock glacier Äusseres Hohebenkar.

Vienna

ZAMG Vienna (W. Schöner, H. Hausmann), ZAMG

Salzburg (C. Riedl), the University of Salzburg (J. Otto) and the Geological Survey of Austria/GBA (R. Supper) are planning a project concerning better understanding the permafrost distribution and reaction on climate change on Sonnblick. The borehole measurements (temperature, seismic tomography, extensometer), geoelectric monitoring, ground surface temperature monitoring (as described further above) shall be continued and permafrost mapping is planned.

GBA (B. Jochum, R. Supper, D. Ottowitz, S. Pfeiler, S. Kauer, A. Römer) carried out permafrost related research applying geoelectrics. From October 2010 until July 2011 a geoelectric monitoring profile was installed in the vicinity of Mölltaler Glacier in 2760 m a.s.l. The used instrument GEOMON4D is a continuous, stand alone, DC resistivity monitoring instrument, a proprietary development by the GBA (Fig. 2). Due to very high electrical resistivities, the measured potential difference usually exceeds the maximum resolution of the input channel. Therefore the instrument was adapted to a constant current source with an automatically adjustable electrical voltage for current input and a high resolution current sensor. The geoelectric profile is measured throughout the project period once a day and the results are sent the next day per email. Starting October 2011 the line was moved next to Kitzsteinhorn in 2940m. These measurements are carried out in cooperation with the University of Salzburg and alpS (M. Keuschnig) which installed temperature probes along the profile and numerous in the surrounding area. The EU FP7 Project SAFELAND and the Austrian Science Fund project TEMPEL funded these measurements.



Permanent geoelectric monitoring profile installed between October 2010 and July 2011 in the vicinity of Mölltaler Glacier at 2760 m a.s.l. The used instrument GEOMON4D is a continuous, stand alone, DC resistivity monitoring instrument developed by the Geological Survey of Austria. Photograph provided by Birgit Jochum.

High latitude permafrost research is currently undertaken at the Vienna University of Technology (A. Bartsch). A. Bartsch is coordinating the DUE Permafrost project and responsible for the management of remote sensing and upscaling tasks in the new FP7 project PAGE21 (lead by AWI Potsdam, Germany). This project is funded by the European Space Agency (ESA) Data User Element (DUE) program, which is a component of the Earth Observation Envelope Program (EOEP). The objective of this project is to establish a monitoring system based on satellite data with focus on the high latitudes. The group around A. Bartsch is responsible for implementation of a surface status (freeze/thaw) algorithm, near surface soil moisture, annual tundra lake monitoring and the data portal. The project is close to completion and will feed into the FP7 project PAGE21.

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3 Canada

The Canadian permafrost community continues to be active in research initiatives to improve characterization of permafrost conditions and to provide information to better understand the impact of climate change and human activity on the northern landscape. A number of projects have been aimed at providing information that can facilitate the development of climate change adaptation strategies to minimize risk to infrastructure and to minimize environmental impacts of northern development.

Collaborative work between the University of Ottawa (A. Lewkowicz and students M. Duguay and C. Miceli) and Geological Survey of Canada (S. Smith) is leading to a better understanding of the ground thermal conditions along the Alaska Highway corridor in the southern Yukon. A key accomplishment in summer 2011 was the re-instrumentation of several boreholes where ground temperatures were last measured over 30 years ago. The ground temperature data collected from these sites will improve the baseline information on current ground thermal conditions and facilitate analysis to better characterize how conditions are changing. This information is essential for planning development in the corridor.

In August 2011, a successful field course was held in the southern Yukon as part of the CRYOEX program. CRYOEX is an exchange program between Canada

and Norway involving University of Ottawa, Carleton University and University of Oslo. The course focused on aspects of permafrost and glaciers and involved a total of 19 professors and graduate students from Norway and Canada.

The Geological Survey of Canada (S. Wolfe and M. Leblanc) is also working collaboratively with territorial governments, academia (M. Allard, Laval, C. Burn Carleton) and Aboriginal Affairs and Northern Development Canada (S. Kokelj) to better characterize the properties of surficial materials along transportation corridors in NWT and at airports and communities in Nunavut. Maps and databases are being generated to assess the terrain sensitivity to a changing climate, providing information to reduce the risk to infrastructure.

The Fifteenth International Specialty Conference on Cold Regions Engineering will be held in Quebec in August, 2012. G. Doré (Laval) is the chair of the conference which is organized by the Canadian Society of Civil Engineering and the American Society for Civil Engineering.

The conference will include a wide variety of topics under the theme “Sustainable infrastructure development in a changing cold environment”. Conference objectives are to foster knowledge exchange and promote technological advancement in areas of cold regions engineering.

A number of interesting research projects are being conducted at the University of Montreal under the leadership of Daniel Fortier. In this report, we highlight some of their work. The U of Montreal team (M. Sliger, MSc Student and I de Grandpré, research coordinator) has been collaboratively working with the Yukon government on groundwater flow in the permafrost environment and its thermal impact on permafrost degradation and road stability. Through collaboration with Guy Doré (Laval) and the contribution of students (J. Malenfant-Lepage, S. Coulombe and L. Langis) work is progressing on the development and assessment of mitigation techniques aimed at controlling permafrost degradation under the embankment at an experimental road test site in the Alaska Highway corridor.

In Nunavik, northern Quebec, the U of Montreal team (students K. Larrivée and K. Grandmont, and C. Lemieux, research coordinator) are working in collaboration with M. Allard and E. L'Hérault (Laval) on the geomorphological and geotechnical mapping of permafrost terrain to identify suitable areas for building new housing to support planning of development.

On Bylot Island, studies focus on the impact of snowmelt water runoff infiltration in the ground and rapid processes of thermo-erosion on permafrost degradation dynamics (E. Godin, PhD student). The impact of these thermo-erosion gullies on drainage of wetlands and ecosystems is being studied by MSc student N. Perrault, in collaboration with E. Levesque (UQTR). Paleoecological, paleoclimatological and paleoenvironmental reconstructions of a Pliocene fossil forest buried in the permafrost are being investigated as an analog to future climate change (A. Guertin-Pasquier, MSc). A new project has been initiated on buried glacier ice bodies in the permafrost, recently exposed by active-layer detachment slides (S. Coulombe, MSc). Associated with an early Pleistocene glaciation, this ice shows great potential as a natural archive of the earth's past climate.

Collaborative studies are being conducted with W. Vincent (Laval) on the northern coast of Ellesmere Island to determine the influence of periglacial mass movements and meltwater on the geochemistry of Ward Hunt Lake and on its benthic biological system (also M. Paquette, D. Sarrazin). Further south, in the Chic-Choc Range (southern Quebec), where the sporadic permafrost thermal regime has been monitored since 1977 on Mt-Jacques Cartier (1268 m a.s.l.), ground surface temperature and snow conditions at a dozen other summits are being studied to refine the permafrost distribution mapping in south-eastern Canada (JT Gray and students G. Davesne and F. Pelletier).

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4 China

Permafrost research in China during the years of 2010 and 2011 continues actively on the following issues: permafrost investigations at representative areas, permafrost ecology and hydrology on the Qinghai-Tibet Plateau (QTP), including that in the Qilian Mountains on the northern edge of the QTP, monitoring and engineering experimental studies of permafrost roadway and railbed along the Qinghai-Tibet Highway (QTH) and Qinghai-Tibet Railways (QTR) from Golmud to Lhasa and along the upgrading Qinghai-Kang (West Sichuan Province) Highway (QKH) from Golmud to Yushu (NH G214), monitoring and modeling studies of permafrost and pipeline engineering in Northeastern China, as well as the study on the extent of permafrost in China during the Last Glaciations Maximum (LGM) and the

Megathermal. In the same time, some new science and engineering research programs have been proposed and are under evaluation, such as the cryospheric change and its impact assessment and adaption, Trans-Tianshan Expressway from Urumqi to Yuli. In particular, the experimental station for highway engineering at Huashixia along the QKH has been relocated to the east of Modoi, and a new research base on permafrost environment and cold regions engineering is being built at Mo'he, the northernmost point in Northeastern China. Altogether, 123 boreholes, 30 active layer process sites, 18 automatic weather stations, and 6 carbon cycle sites have been established and in operation for long-term monitoring (Figure 1 and Table 1).

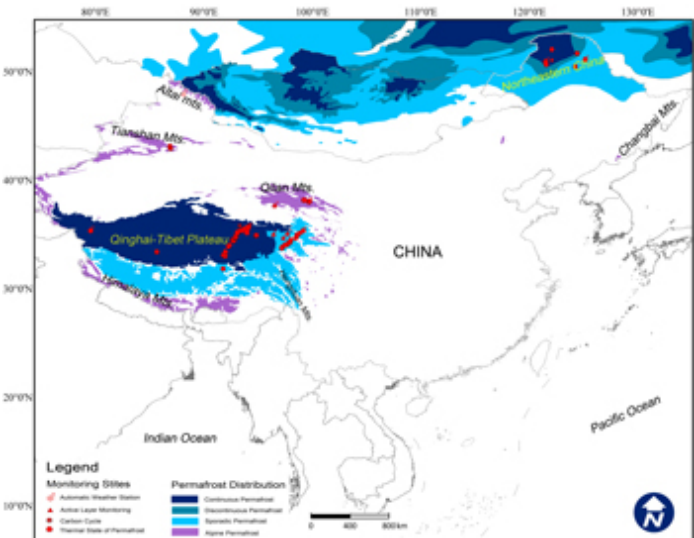


Figure 1. Distribution of permafrost in China and bordering regions, and boreholes for monitoring the thermal state of permafrost.

Monitoring Features	Monitoring Sites						
	Total	Qinghai-Tibet Plateau				Northeastern China (NEC)	Others
Features		QTR/H	SAYR	QLM	QKH		
Thermal State of Permafrost (TSP)	123	35	12	12	10	42	12
Active Layer Processes (ALP)	30	11	7	6	0	3	3
Automatic Weather Station (AWS)	18	7	4	2	1	3	1
Carbon Cycle (CC)	6	6	0	0	0	0	0

Table 1. Summary of TSP, ALP, AWS and CC in permafrost regions in China (incomplete statistics, could be about 100 off as some new holes and boreholes from certain sources were not included, and all sites impacted by engineering activities were excluded. Note: QTR/H --- the Qinghai-Tibet Railway/Highway; SAYR --- the Source Area of the Yellow River; QLM --- the Qilian Mountains; QKH --- Qinghai-Kang (Western Sichuan) Highway; Others include Eastern Tianshan, Southern Altai and Western Kunlun Mountains.

Permafrost Survey on the QTP

The survey on the permafrost extent of about 200,000 km2 (between 78.83°-86.13°E and 35.98°-33.03°N) and with an average elevation of 4,900 m. The surveyed areas include the continuous permafrost on the Qiangtang Plateau in the Interior QTP and the transitional areas in the northwest and southwest. The fieldwork includes total length of drilling and casing of 858 m in permafrost: 51 boreholes for long-term monitoring of permafrost, with depths from 6 to 53 m and at elevations at 4,300 to 5,225 m. Two new sites for the active layer processes were also deployed at Tianshui'hai in the Western Kunlun Mountains and at Gumu in the western Qilian Mountains. Soil samples for physical, chemical and biological properties were obtained from 87 soil profiles and 93 vegetation plots. About 100 ground penetration radar (GPR) profiles were conducted, with a total length of 55 km. Through this survey, understanding on the frozen ground, vegetation and soils have been improved in Western Kunlun Mountains and in the Gaize area. Preliminary analysis indicates that the lower limit of permafrost is at 4,700 m in the Western Kunlun Mountains, whereas it is at 5,000 m in Gaize. Soils are generally very dry (halic), and vegetation is characteristic of alpine deserts or steppes.

Permafrost and ecology on the Qinghai-Tibet Plateau (QTP)

In 2010, 12 boreholes, 4 active layer process stations and 1 automatic weather station were deployed in the sources area of the Yellow River (SAYR) on the north and south slopes of the Bayan Har Mountains along the QKH. Eleven sites for monitoring the active layer processes and three automatic weather stations were established, but the accompanying boreholes were unable to be completed (Figure 2). The preliminary surveys on frozen ground, cryosols and vegetation were completed, and draft map for the distribution of frozen ground was drawn in 2011.

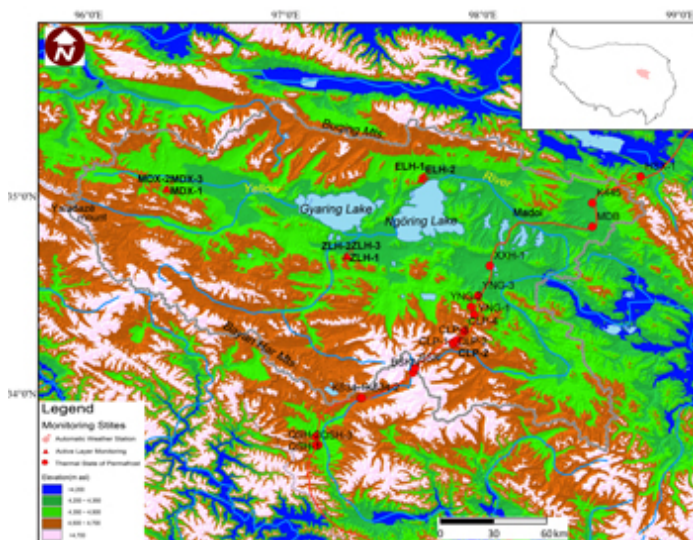


Figure 2. Distribution of permafrost and boreholes for monitoring the thermal state of permafrost in the sources area of the Yellow River (SAYR).

Permafrost and ecology in the Qilian Mountains

The research activities in the Qilian Mountains in 2010 include the assessment of thermal stability of Chaidar-Muli Railway, and investigation and study on the thermal state of permafrost on the southern slopes of the Qilian Mountains.

On 28 July 2010, the program “Thermal stability of permafrost Railbed along the Chaidar-Muli Railway” successfully passed the technical review organized by the Science and Technology Department, Qinghai Province, drawing a full conclusion of the research program since 2007. This program verified the effectiveness of thermosyphons, airducts, block railbed, and grassy protective berms in stabilizing permafrost railbed traversing the wetlands (Figures 3 to 5).

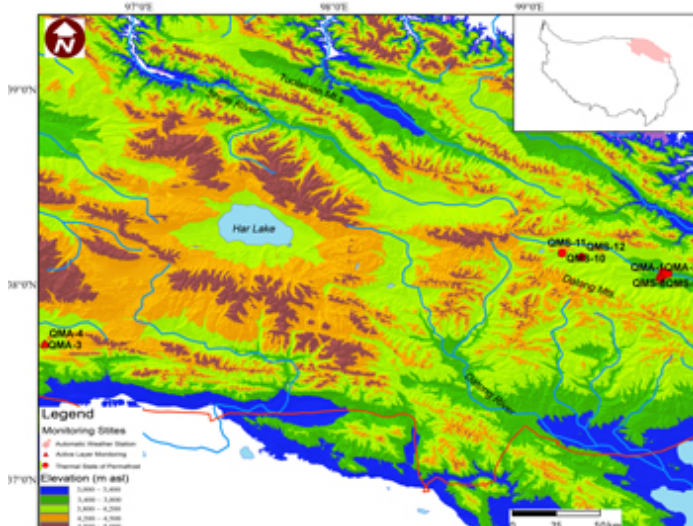


Figure 3. Application of thermosyphons along the Chaidar-Muli Railway



Figure 4. Air-duct ventilated blocky railbed along the Chaidar-Muli Railway



Figure 5. Side protective berm of grass mat along the Chaidar-Muli Railway

The survey on the features of frozen ground and environments were a continuation from 2009, and the areas worked in 2010 and 2011 included the semi-humid area Datong River in the eastern Qilian Mountains, the arid areas in the sources of the Shule River in the northern Qilian Mountains, and the Yashatu in the western Qilian Mountains. The major contents for the research include features of permafrost, influences of local environmental factors on the development of permafrost and vegetation (Figure 6).



Figure 6. Monitoring site for permafrost in the arid

In 2010-2011, four activities were undergoing: 1) Continued monitoring and maintenance of three existing sites; 2) Two automatic weather stations were installed in the sources area of the Datong River and Yashatu; 3) Surveys on vegetation in the watershed of the Datong River in a transition zone from sporadic and continuous permafrost (Figure 7), and; 4) Seven boreholes of 15 m in depth and 1 hole of 100 m in depth were deployed for monitoring the thermal state of permafrost. Preliminary results indicate that the mean annual ground temperature is -2.5°C on the mountain top, and that is close to 0°C in other boreholes.



Figure 7. Sites for vegetation surveys in the Datong River watershed

Permafrost Science and Engineering in the Northeastern China

About 34 new boreholes were added during the last two years for monitoring the thermal state of permafrost, with the deepest 80 m. In the same time, 4 active layer processes, and two automatic weather stations, and two additional AWS and snow-ALP-permafrost monitoring systems were added in studying the permafrost and snow cover processes in the forested areas in the Xing'anling Mountains.

In Gen'he permafrost station, ground temperature and meteorological data since January 2009 were obtained from the existing 8 holes. Along the CRCOP, data from 2007-2011 were obtained. Numerical and empirical analysis on the engineering geology, thermal regimes of pipeline foundations, transitional sections of various causes in particular, and frost hazards were made for the design and construction of the pipeline, which was put into operation in November 2010. The research was published in a Cold Regions Science and Technology special issue (6 May 2010, 64(3)) on China-Russia Crude Oil Pipeline in Permafrost Regions in Northeast China; Chief-edited by G Timco, and Guest-edited by H. Jin, G. Gay, and M. C. Brewer, with 10 papers. However, the oil temperatures were

much higher ($3\text{--}17^{\circ}\text{C}$) than anticipated (-4 to $+6^{\circ}\text{C}$), significant thaw subsidence has resulted in the pipeline foundation soils during the first year of operation from November 2010 to October 2011. In the eight boreholes monitored for the thermal state of the pavement under the runway at the Mo'he Airport, data from 2006 to 2010 were collected, indicating the temperatures were relatively warm but stable.

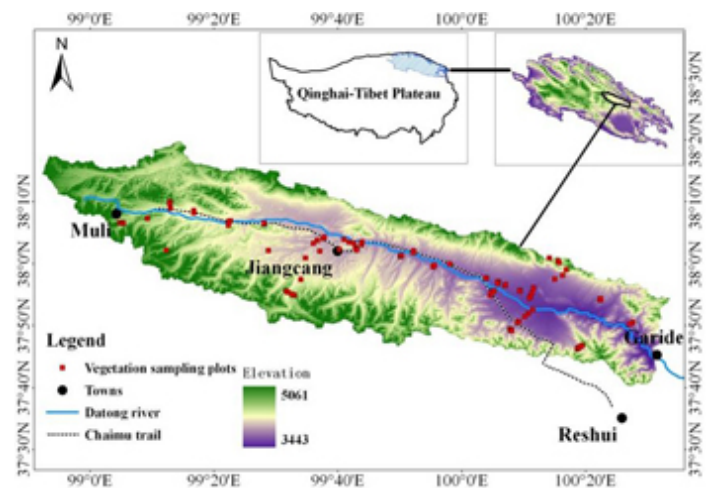
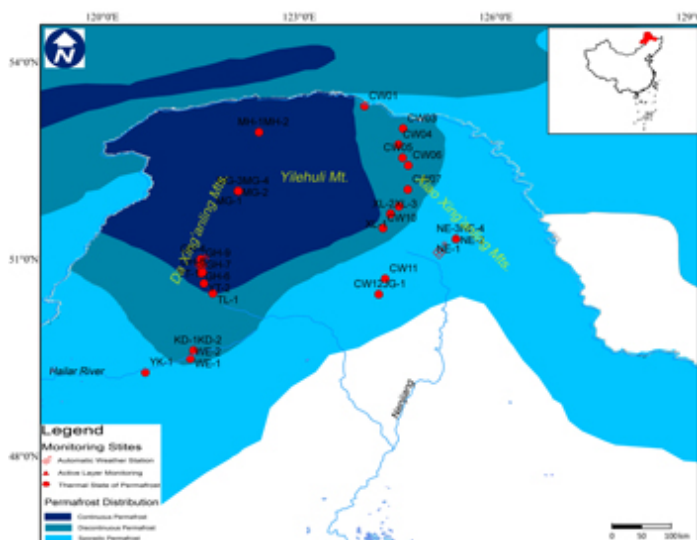


Figure 8. Distribution of permafrost, and boreholes for monitoring the thermal state of permafrost in the Xing'anling Mountains in Northeastern China

Launching and proposing New Programs/Projects

a) There were two new projects launched during 2010-2011: National 973 Program on the Changes in the Cryosphere in the Northern Hemisphere and Their Adaptation, and; Chinese Academy of Science (CAS) Permafrost extent during the Last Glaciations Maximum and Megathermal. Two new programs were also proposed and are now under review: Super 973 on Cryosphere change and its adaptation, which includes five subprojects related to permafrost (thermal state of permafrost, carbon in permafrost regions, Hydrology in cold regions, frost hazard mitigation, and adaptive measures for changing permafrost environments) and; Investigation and mitigation of the proposed Express Highway across the Tianshan Mountains.



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5 Denmark

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6 Finland

The activities of the Finnish permafrost community are going on both in Eurasia and Greenland. The investigations are based on large empirical field studies, long-term monitoring of permafrost and on spatial modelling. Permafrost studies in Finland are covering a wide range of different activities: e.g. bedrock borehole investigations, spatial modelling of vegetation-frost dynamics, climate change impact assessments based permafrost modelling and greenhouse gas emissions from high-latitude wetlands.

Permafrost modelling network at the Finnish Environment Institute (S. Fronek and T. R. Carter) and Department of Geosciences and Geography at the University of Helsinki (M. Luoto) have continued to estimate future changes in the distribution of palsa (permanently frozen peat hummocks) mires in Fennoscandia, and the implications of these changes for greenhouse gas budgets and nature conservation. Recent developments in climate modelling have made it possible to express projections of regional climate change for Europe probabilistically quantifying various aspects of climate modelling uncertainty. These typically involve large ensembles of climate model simulations combined with some statistical analysis. Probability distributions are fitted for projected changes in key climate variables. Fronek and co-authors present an analysis of different sources of impact model uncertainty and combine this with

probabilistic projections of climate change. Climatic envelope models describing the spatial distribution of palsa mires in northern Fennoscandia were calibrated for three baseline periods, multiple modelling techniques and 25 versions sampling the parameter uncertainty of each technique – a total of 600 models. The sensitivity of these models to changes in temperature and precipitation was analysed to construct impact response surfaces. Based on the most robust models, it was estimated as very likely (>90% probability) that the area suitable for palsa is reduced to less than half the baseline area by the period 2030–2049 and as likely (>66% probability) that the entire area becomes unsuitable by 2080–2099 (A1B emission scenario).

The Top-level Research Initiative (TRI) is the largest joint Nordic research and innovation initiative to date. The initiative aims to involve the very best agencies and institutions in the Nordic region, and promote research and innovation of the highest level, in order to make a Nordic contribution towards solving the global climate crisis. The initiative comprises six sub-programmes, two of which will focus on climate change research. Nordic research collaboration is expected to contribute to responding to challenges in the management of climate change in northern regions. Finnish research teams are strongly represented in the new Nordic Centres of Excellence and research projects of the Top-level Research Initiative launched by the Nordic prime ministers. The Finnish teams studying permafrost in the project “Impacts of a changing cryosphere - depicting ecosystem-climate feedbacks from permafrost, snow and ice” (DEFROST)” are headed by Pertti Martikainen (University of Eastern Finland) and Timo Vesala (University of Helsinki).

Pertti Martikainen, Maija Repo, Christina Biasi (University of Eastern Finland) and Matti Seppälä have investigated nitrous oxide emissions on subarctic palsa mires in northern Finland. Additionally, John Woodward (University of Northumbria, UK) and Matti Seppälä continued research in palsa mires, particularly remote sensing (laser scanning) of palsa mires in subarctic Finland. Recent findings on large nitrous oxide (N₂O) emissions from permafrost peatlands have shown that tundra soils can support high N₂O release, which is on the contrary to what was thought previously. However, field data on this topic have been very limited, and the spatial and temporal extent of the phenomenon has not been known. Martikainen and co-authors showed that unvegetated peat surfaces with high N₂O emissions were very common in (sub)Arctic peatlands. Very high N₂O emissions were measured from peat circles in northern Russia,

whereas elevated, sparsely vegetated peat mounds at the same site had significantly lower N₂O release. The N₂O emissions from bare palsa surfaces in Northern Finland were highly variable but reached high rates, similar to those measured from the peat circles. All the vegetated soils studied had negligible N₂O release. In the future, permafrost thawing may change the distribution of wet and dry surfaces in permafrost peatlands, which will affect N₂O emissions.

In northern Finland, field work for Nordic project 'Permafrost observatory in the Nordic Arctic: sensitivity and feedback mechanisms of thawing permafrost' (2009–11) (Finnish participant J. Hjort from the Department of Geography, University of Oulu) 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.

The project 'Spatial modelling of periglacial processes under environmental change' (2008–2011) (J. Hjort and M. Luoto (University of Oulu and University of Helsinki) continued. This project has focused on spatial modelling of periglacial processes based on remote sensing and GIS data. Additionally, Hjort and Luoto have investigated interaction of periglacial processes and ecologic features across altitudinal zones in subarctic landscapes. Moreover, Luoto has continued to investigate dynamics and the main drivers of recent changes in the Arctic vegetation. He has combined vegetation distribution models with periglacial process information in high-latitude landscapes. This project is part of the consortium Impacts of climate change on Arctic environment, ecosystem services and society (CLICHE) funded by the Finnish Research Programme on Climate Change (FICCA), Academy of Finland.

University of Helsinki organized in summer 2011 a graduate school "Global change modelling in high-latitude environments: integrating field sampling with global data". One of the focus areas of the graduate school was permafrost and seasonal frost activity in northern environments in northern Finland and Norway (Figure below).



Permanently frozen peat hummocks (palsas) in subarctic mires in NW Finland, litto. Photography taken during the graduate school excursion "Global change modelling in high-latitude environments: integrating field sampling with global data", August 2011

Geological Survey of Finland (T. Ruskeenieni) investigated recharge of subglacial meltwaters into bedrock within the international Greenland Analogue Project (GAP) initiated by the Finnish (Posiva) and Swedish (SKB) nuclear waste management companies in collaboration with the NWMO from Canada. The research area is in Kangerlussuaq, west Greenland. A new 687 m deep bedrock drillhole extending beneath the ice margin was drilled in 2011. The hole was instrumented with subpermafrost groundwater sampling facility and for monitoring of pressure, temperature and the electrical conductivity of groundwater. Bedrock temperature profiling is provided by fiber optical cable technique (DTS). Moreover, Geological Survey of Finland (P. Lintinen and H. Vanhala) and Mining Geological Company MIREKO continued co-operation in the field of geophysical characterization of permafrost in Northern part of Komi Republic and Nenets Autonomous Region. This study started in 2007 after which three expeditions have been made to lowland permafrost targets and one (2011) to an Alpine permafrost area by Polar Urals.

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7 France

During 2011, the activities of French periglacial communities and permafrost researchers were undertaken in a wide range of approaches (geomorphological field study, physical modelling and numerical approach) and cover several areas (Iceland, Siberia, French Alps).

With Icelandic partners from the Natural Research Centre of Northwestern Iceland (Sauðárkrúkur), Denis Mercier (University of Nantes and UMR 6554 Géolittomer), Etienne Cossart (Paris 1 university and UMR 8586 Prodig), Thierry Feuillet (University of Nantes and UMR 6554 Géolittomer) and Armelle Decaulne (UMR CNRS 6042 Geolab, Clermont-Ferrand) pursued in Northern Iceland their researches on spatial distribution of periglacial forms (patterned ground – polygons, circles) and their environmental characteristics (internal and external controls), as well as on dating large paraglacial mass movements.

Armelle Decaulne also pursues dendrogeomorphic analysis of snow-avalanche activity in Northern Iceland and Western Norway with Icelandic and Norwegian collaborators.

Denis Mercier and colleagues from university of Caen and Unis – Svalbard did a field trip measurement in Kongsfjorden (Spistbergen) in August 2011 to quantify paraglacial shoreline progradation and map offshore deposits with sonar.

Results obtained during recent field campaigns and subsequent analyses were presented at EGU General Assembly in Vienna in April 2011, and at SEDIBUD Workshop held in Zakopane, Poland, in September 2011.

An on-going study of the impact of ice breakup on the erosional process at the head of several fluvial islands has been conducted in the Lena river (Yakutia) by François Costard (UMR IDES, CNRS-Université Paris-sud XI, Orsay) with Emmanuèle Gautier (Laboratoire de Géographie Physique CNRS UMR 8591, Meudon) in cooperation with A. Fedorov and P. Konstantinov from the Permafrost Institute (Yakutsk). In 2008-2011, a 4-years observation program was initiated to quantify the relative influence of fluvial thermal erosion during the ice breakup of the Lena River in Yakutia. Field observations were particularly comprehensive in the relative efficiency the fluvial thermal erosion during the first days of the ice breakup (figure 1). Significant bank retreat mostly takes place after the ice breakup when high-water period induces a direct contact between the water and frozen river banks, thereby inducing thaw. Only a few days are enough to produce erosion rate as high as 30 m.



Figure 1: Pressure ridge due to the accumulation of thawed sand at the head of the Timoshka island after the ice breakup. The accumulation of sediments corresponds to the mechanical effect of the ice push during the breakup. Photo F. Costard.

R. Perrier (PhD student, Paris-Diderot University), E. Cossart (Panthéon-Sorbonne University) and M. Fort (Paris-Diderot University, Sorbonne-Paris-Cité) are carrying on research on alpine permafrost since 2008 (UMR 8386 PRODIG program). Their investigations in both Clarée and Ubaye valleys (southern French Alps) are focusing on mountain permafrost dynamic at different scales. At a regional scale, mapping of permafrost in unconsolidated sediments is going on using various methods (spring water temperature measurements and rockglaciers inventorying). At a closer scale, research concentrates on rockglaciers movement, structure and thermal regime. Their kinematics is recorded by terrestrial geodetic measurements and photogrammetric methods. Together with ground surface temperature monitoring as well as Electrical Resistivity Tomography (ERT) (in cooperation with C. Virmoux and M. Chenet, LGP-CNRS UMR 8591), these data should provide additional information on rockglacier origin and evolution, and contribute to PermaFrance objectives as well.

Research on mountain permafrost in the French Alps continued within the PermaFRANCE network, with support of the PermaNET project. It is conducted by the following labs : Institut de Géographie Alpine in Grenoble, EDYTEM in Chambéry, GIPSA-lab in Grenoble. The deep borehole 2Alpes-3065, drilled in September 2010, was fully equipped in December and February 2011. An innovative DTS (Distributed Temperature Sensing) fiberoptic measurement was first done in February 2011, and confirmed the presence of permafrost down to the bottom of the 100 m deep borehole. First results of the three boreholes in the rockfaces of Aiguille du Midi, and of the two boreholes on the rockglacier 2Alpes-Bellecombes were retrieved. The inventory of rockglaciers was

continued, in collaboration with the RTM, the French service in charge of hazard management in mountain regions.

The final conference of the PermaNET (figure 2) project took place from June 28 to July 1 2011 in Chamonix, with 48 participants. It was organized by the EDYTEM lab and the French project partners. The PermaNET project was financed by the European Territorial Cooperation through the Alpine Space program. It involved 13 partners from 5 countries : France, Italy, Austria, Germany and Switzerland. The objective of the program was i) to build a long term permafrost monitoring network covering the entire Alps, ii) to assess the present knowledge on permafrost occurrence and distribution in the Alps, iii) to develop scenarios on how mountain permafrost will react to climate change and iv) to develop strategies to cope with hazards related to permafrost. The conference included a workshop on methods for permafrost monitoring, a public presentation of the main results and a public conference by Wilfried Haeberli. Three excursions were proposed to the participants. The second day an excursion led all participants to the Aiguille du Midi, the main study site for permafrost in rockfaces, with three horizontal boreholes. The third day, participants had the choice between a cable car excursion to the Punta Hellbronner, where investigations are made on the evolution of high mountain rockfaces, or a hike to the Derochoir, a rock glacier overhanging a torrential basin. An additional one day excursion was proposed on July 1 to the study site Deux-Alpes, where the first deep borehole of the French Alps was drilled in 2010. Among the main achievements of the PermaNET project, presented at the conference, one has to mention :

- * a permafrost evidence database, including 400 observations of permafrost occurrence, and more than 4800 rockglaciers.
- * a permafrost probability map for the entire Alps, calculated on a 30 m grid.
- * a network of around 50 monitoring sites, including 15 boreholes. Most of the boreholes have been declared to the GTN-P by late 2011.
- * a handbook with protocols for permafrost monitoring and detection.
- * a statement of hazards related to permafrost.
- * a documentary film on permafrost and a TV film.

All the project products can be downloaded on the project web page : www.permanet-alpinespace.eu



Figure 2: The 2nd day excursion of the PermaNET final conference, with all participants at the Aiguille du Midi (3842 m a.s.l., Mont Blanc massif), a main study site for Alpine rockwall permafrost. Photo Ph. Deline.

Laboratoire des Sciences du Climat et de l'Environnement studies the impact of glacial-interglacial cycles on the underground flow patterns considering the general issue of nuclear waste storage in the Paris Sedimentary Basin during the last 120 Kyr. A recent study by (D. Régnier, C. Grenier, E. Pons-Branchu, V. Masson-Delmotte, D. Paillard, H. Benabderrahmane) focused on the influence of glacial-interglacial rapid climate variability on NE France permafrost. A compilation of available climate proxies (lake sediments, speleothem growth periods, periglacial structures) and climate simulations shows discrepancies in the reconstructed temperature ranges. Rapid climate variability provides a framework to account for this. A series of high frequency signals were generated using the Greenland ice core NGRIP signal, orbitally-driven transient climate modelling and various reconstruction methods (figure 3). The signals were then constrained to match the NE France available dataset and served to simulate permafrost depth on a 1D vertical column (cf. heat transfer model withinCast3Mcode, <http://www-cast3m.cea.fr>). The resulting stochastic ensemble of simulations provides a novel perspective on permafrost variability for long time scales and its impact on aquifer recharge evolution, especially for the LGM.

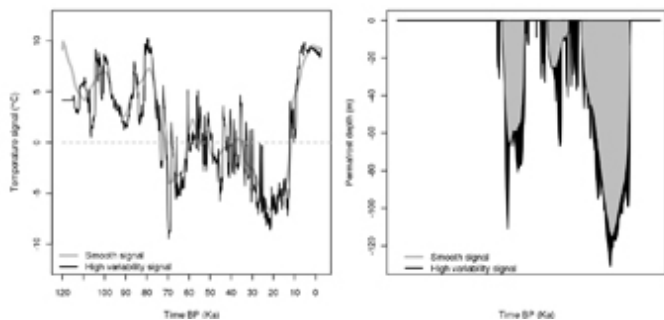


Figure 3 : Examples of two simulations and associated permafrost depth evolution, the first is low frequencies signal (climate simulation output), the second includes rapid variability. Photo Ch. Grenier.

In 2011, A. Rivière and A. Jost (UMR 7619 Sisyphe, University Pierre et Marie Curie Paris VI), in collaboration with J. Gonçalves (UMR 6635 CEREGE, University Paul Cézanne Aix-Marseille III), have been working on the coupled groundwater and heat transport model they develop in order to predict evolving groundwater and permafrost interaction at various time and space scales. They focus in particular on: (i) the pressure response to permafrost formation and dissipation in subpermafrost aquifers at the laboratory scale, (ii) the quantification of groundwater-river exchanges in discontinuous and continuous permafrost areas in a warming context at the catchment scale, (iii) the long-term impact of past permafrost on present-day hydrogeological conditions in large aquifer systems such as the multilayered Paris basin aquifer system on a million years scale.

At the same time, they are carrying out physical modelling experiments on a sandbox in a cold room at UMR 6143 M2C (M. Font-Ertlen, University Caen Basse-Normandie): pressures and temperatures are monitored over freezing and thawing successive cycles, as well as frost heave (figure 4). They also apply geophysical methods to help determining the unfrozen water content (time domain reflectometry, F. Réjiba, UMR 7619 Sisyphe, UPMC; ground penetrating radar, A. Saintenoy, UMR 8148 IDES, University Paris Sud).

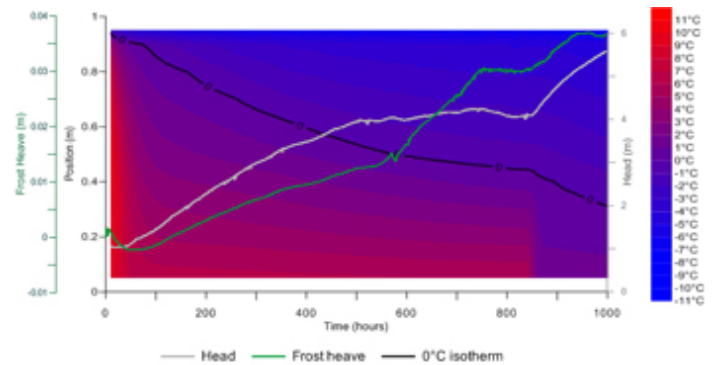


Figure 4: Results from laboratory experiments: subpermafrost hydraulic head response and frost heave measured during freezing. Photo A. Rivière.

At UMR 6143 M2C (Caen), physical modelling experiments have been carried out by B. Hurault in a cold room to characterize the processes that occur during the thawing of experimental permafrost. These experiments provide detailed data on the physical parameters that control permafrost thawing, particularly lithology, ice-contents, ice-layer and thawing-temperatures. About 15 freeze-thaw cycles are registered for each experiment (figure 5). The main conclusions of this study concern the relationship between thaw-settlement, topography and active layer thickness versus the physical parameters used in this study.

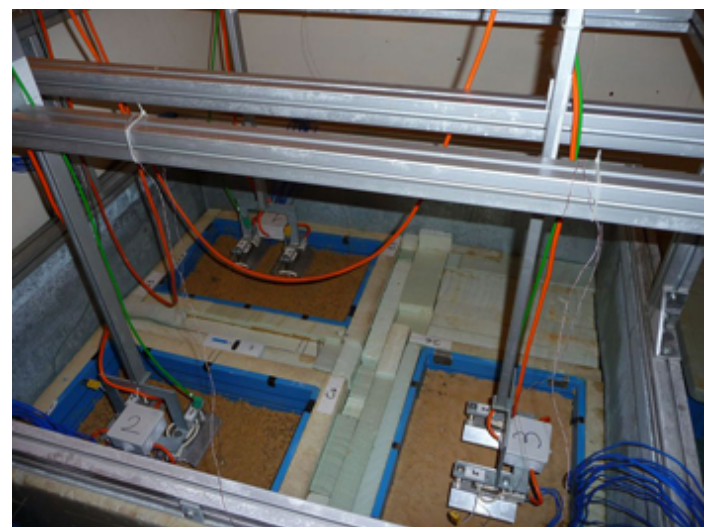


Figure 5: Physical modelling of thermokarst process. Photo B Hurault

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8 Germany

Meeting of the AK Permafrost in Bonn/Rolandseck in Oct. 31 – Nov. 2, 2011.

The meeting of the German working group on permafrost hosted the final colloquium of the bundle

project “Sensitivity of Permafrost to Climate Change” and more than 30 “Alpine and Arctic” talks by young and established scientists. Activities of the AK Permafrost are organized by Lutz Schirrmeister and Michael Krautblatter.

Reports from Potsdam (AWI, GfZ)

Coordinated by the AWI in Potsdam, the EU project “Changing Permafrost in the Arctic and its Global Effects in the 21st Century (PAGE21)” was launched in November 2011. This large-scale collaborative project aims to understand and quantify the vulnerability of permafrost environments to a changing global climate and to investigate the feedback mechanisms associated with increasing greenhouse gas emissions from permafrost zones. This 4 year program involves 18 research groups from various European countries.

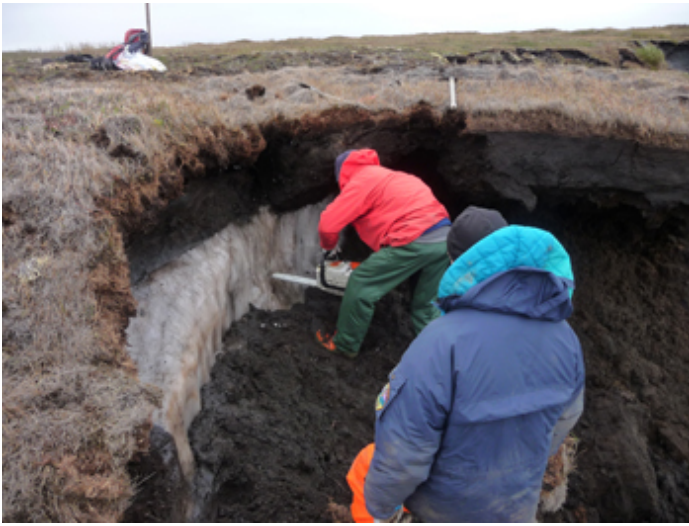
Two new “Helmholtz Young Investigators Groups” dealing with permafrost research will be supported by the German Helmholtz Association for five years. Hugues Lantuit is leading the project “Coastal Permafrost erosion, organic carbon and nutrient release to the Arctic nearshore zone – COPER” at the AWI in Potsdam and Torsten Sachs will be heading the research group “Trace Gas Exchange in the Earth - Atmosphere System on Multiple Scales (TEAM)” at the GfZ in Potsdam.

In June 2011 the first “Airborne Measurements of Methane” (AIRMETH) campaign was completed by scientists from AWI (Jörg Hartmann) and GfZ (Torsten Sachs). A Los Gatos RMT-200 Fast Methane Analyzer was integrated into the research aircraft “Polar 5” to survey various anthropogenic and natural, terrestrial and offshore targets in Germany, the North Sea, and northern Finland. In combination with turbulence data measured at the Polar 5 nose boom, methane fluxes will be calculated for the primary targets - the large northern Finnish wetlands. The campaign served as a test run for AIRMETH-2, for which extensive airborne methane flux measurements over permafrost lowlands between Inuvik and Barrow are planned.



Preparation of POLAR 5 for airborne methane flux measurements

Within the frame of the Russian-German expedition “Lena Delta 2011” multidisciplinary studies in the Lena River Delta and along the coast of the Laptev Sea in NE Siberia were related to the following topics: Measurements of carbon, energy and water fluxes continued on Samoylov Island as on-going collaboration between the Young Investigator group SPARC (Sensitivity of Permafrost in the ARctic) and the University of Hamburg. In addition, an 2-stage expedition to the westernmost Laptev Sea (Cape Mamontov Klyk) and to Muostakh Island in Tiksi Bay had three general foci: 1. coastal erosion via combined field surveying and remote sensing, 2. nearshore subsea permafrost studies using geophysical methods, and 3. regional studies of past climate variability and current conditions using small polygonal ponds and late Holocene polygon ice wedges as records. Simultaneous acquisition of high spatial resolution satellite imagery for both sites shows coastal evolution over large regions, while geoelectric and seismic sounding of the sea bottom at sites where drilling records exist, track subsea permafrost degradation following coastal erosion.



Sampling of late Holocene ice wedge on Muostakh Island (Laptev Sea)

To study the ecological dynamic of polygonal patterned wetlands, field work (Kytalyk 2011) was conducted in the Indigirka lowland around the WWF ecological station at Kytalyk by the German-Russian POLYGON project. Permanent measuring of air, water and ground temperature, soil moisture, water level and conductivity was carried out for six week. In addition a compressive sampling and analytical program was realized concerning flora and fauna living in and around polygons as well as water, soils and frozen ground typical for alas-dominated lowland areas.



Studies of polygon ponds in the Indigirka Lowland

A summer campaign to the El'gygytyn Crater lake, NE Russia, was devoted to extract temperature data from a monitoring site in a 141 m deep permafrost borehole. This site has been instrumented after termination of the ICDP permafrost drilling in December 2008. More studies in the crater were focusing on sediment and geomorphic dynamics in the crater basin. This was done in cooperation with Cologne University, Museum for Natural History,

Berlin, and AARI, St. Petersburg.

A joint Russian-American-German CALM and TSP expedition was organized by the Earth-Cryosphere Institute (ECI) in late summer to Yamal (Western Siberia). The AWI team measured the bio-physical vegetation parameters at the Greening of the Arctic (GOA) sites in Vaskiny Dachi (VD) and Laboravaya and at the VD CALM site. The team also managed field goniometer measurements of reflectance parameters for the evaluation of satellite data.

The Expedition Yukon Coast 2011 took place in July on Herschel Island (NW Canada). The Expedition was part of the long-term cooperation between the AWI and McGill University (W. Pollard, Montréal). The traditional activities of coastal erosion and palaeogeography studies were expanded to other disciplines. The 2011 expedition included the participation of the University of Bonn (M. Krautblatter, C. Teschner). A weather station and a monitoring flume, already tested in 2010, were installed at the outlet of a retrogressive thaw slump to monitor water and sediment discharge over several weeks in the field. Several resistivity profiles were run in the same slump to study the distribution and characteristics of massive ground ice. At a nearby study site, a tundra polygon was outfitted with a weather station measuring air but also soil temperature, as well as an automatic closed chamber gas sampling device to study the release of greenhouse gases to the atmosphere.

News from German universities

Together the AWI Potsdam, two Ph.D. students (Sebastian Zubrzycki and Peter Schreiber) from University of Hamburg conducted a late winter-spring expedition (April to May) to Samoylov Island in the Lena River Delta. Sebastian sampled numerous shallow (1 m) permafrost cores to characterize the quantity and quality of organic carbon in the upper permafrost. Peter focused on an eddy covariance system for measurements of land-atmosphere fluxes of energy, water, CO₂, and CH₄ during late winter and the snowmelt period. Presently, he is analyzing a unique dataset including a two year-round time series of CO₂ fluxes and a long CH₄ flux time covering one early (2011) and one late winter (2010) period. In July, the Ph.D. student Julia Antsibor participated in the LENA 2012 expedition sampling various soils in the Lena River Delta as well as in the upland tundra area around Tiksi to study the heavy metal contents in different tundra landscapes.

At the University of Giessen, Stephan Imbery continued his Ph.D. research in the Chinese Central Tianshan on the contribution of permafrost and snow to the water balance under climate change conditions. In cooperation with CAREERI Lanzhou, a dense network of ground temperature loggers is used to

study the thermal regime of the active layer. Similar studies were carried out in the Kyrgyz Tianshan by Ph.D. student Murataly Duishonakunov in cooperation with the CAIAG Bishkek. Furthermore, the periglacial working group led by Lorenz King installed new temperature loggers at the Kleinmatterhorn (3820 m a.s.l.) and continued the long-term temperature monitoring started in 1998.

At the University of Bayreuth (Department of Ecological Microbiology), 'Palsa peats' and cryoturbated peat soils emitting the greenhouse gas nitrous oxide were assessed in the permafrost zone of Finland and Russia. Cryoturbated peat soils were recently identified as 'hot spots' of N₂O-emissions in arctic tundra. Nitrous oxide is released as an intermediate during denitrification, which is the sequential reduction of nitrate via nitrite and nitrous oxide to molecular nitrogen, part of the N-cycle, and catalyzed by denitrifiers under oxygen limited conditions. K. Palmer and M.A. Horn analyzed the community structure of denitrifiers and their association with nitrous oxide production in such permafrost affected peat soils. N₂O emission and production patterns were related to the community structure of denitrifiers. The soils harbored hitherto unknown denitrifiers, necessitating future research on how such organisms might react to global warming.



Geophysical investigations on the retrogressive thaw slump D (Herschel Island, Arctic Canada) by Hugues Lantuit (AWI Potsdam) and Michael Krautblatter (Uni Bonn).

At the University of Bonn permafrost research is organized in the Group PermaSlope (working group "Permafrost and Slope Failure"). The project "Sensitivity of Rock Permafrost to Climate Change" went to its 3rd and last year with Ph.D. student Sarah Verleysdonk who elaborated a conceptual paper on the Sensitivity Concept in Mountain Permafrost studies (Geografiska Annaler). Ph.D student Daniel Dräbing enhanced laboratory work on the seismic behavior of

20 alpine and arctic metamorphic, sedimentary and volcanic rock samples demonstrating significant P-wave velocity increases in frozen rock that allow for seismic monitoring of permafrost in steep bedrock. His work will be continued as a Ph.D student in the new DACH-funded transnational German-Swiss project "Influence of snow cover on thermal and mechanical behavior of permafrost rocks ("

<http://www.geomorphology.uni-bonn.de/research/ispr>) supervised by M. Krautblatter (Bonn) and M. Phillips (SLF Davos) and Co-Pis. Ph.D student Daniel Funk continued his work on the rock mechanical behavior of thawing rock samples and is a candidate for the submitted proposal "Temporal and spatial subsurface controls of permafrost-affected rock slope failure." Postdoc M. Krautblatter participated in the Yukon Coast 2011 expedition to Herschel Island (Arctic Canada) to investigate retrogressive thaw slumps and went on field trips to the Japanese Southern Alps and the Fujijama guided by A. Ikeda and N. Matsuoka, partly to take samples for quantitative geophysical investigations.

At the University of Würzburg, the local distribution of permafrost and the ground thermal regime in two glacier forefields (Swiss Alps) is investigated in consideration of surface substrate and snow cover by T. Rödder (PhD). Active layer processes are monitored in detail with an automated geoelectrical monitoring system and borehole temperature data. D. Schwindt is finishing his PhD thesis on spatial and temporal permafrost variability regarding ground thermal regime and permafrost-humus interaction in talus slopes below the timberline (Swiss Alps) using geophysical methods and temperature measurements. Two diploma theses use a combined geophysical/photogrammetrical approach. P. Konrad has finished his thesis on geomorphological activity of different subarctic landforms (Sweden). Recent permafrost occurrence was identified as the most influential factor regarding modification of landscape as opposed to slope, exposition, elevation or incoming summer short wave radiation. J. Kästl currently investigates alpine permafrost dynamics in the Swiss Alps.

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9 Italy

In respect to the 2011, an increase in public (Universities, Research Institutes, Regional bureaus) and private (Foundations, Societies) subjects involved

in the lab and field activities can be observed in Italy, as well as the incoming of new enthusiastic researchers with different bias and expertise. So, many activities are in progress in the Italian magma of permafrost and periglacial research, along with initiatives to make more strengthened the cooperation between the different groups.

First of all, it is important to remember that in September 2011 is successfully ended the PermaNET project (Interreg Alpine-Space program) which had involved a lot of Italian partners. The project description and main products are available on the project's website(

<http://www.permanet-alpinespace.eu/>).

Within PermaNET an alpine-wide Permafrost Distribution Map has been settled-up together with an alpine-wide Inventory of the Permafrost Evidences extended to several sectors of the Alps (

<http://www.geo.uzh.ch/microsite/cryodata/>).

The maintenance of the Permafrost Evidences Inventory is managed by ARPA Valle d'Aosta (contact:

e.cremonese@arpa.vda.it). Moreover a PermaNET

documentary film was produced to introduce alpine permafrost, on going studies and monitoring activities in the Alps (

<http://www.fondazionemontagnasicura.org/video-perm>).

Eastern Alps

In the framework of PermaNET project, ARPAAV-Arabba Avalanche Center (A. Cagnati, A. Crepaz) in collaboration with Regione Veneto-Direzione Geologia e Georisorse, Servizio Geologico (A. Galuppo, L. Magnabosco, V. Defendi), continued to monitor the periglacial environment of Piz Boè, in Veneto region, at an altitude of 2900 m a.s.l. An Automatic Weather Station (AWS) was installed for measuring air temperature, relative humidity, snow depth wind velocity and direction, incoming and outgoing radiation (short and longwave) and infrared surface temperature (see Figure); thermistor chain of 16 sensors was placed in a borehole of 30 m. In 2011 it revealed negative temperature below 9 m all over the year. In 2011 GST monitoring network (two dataloggers, one on the rock glacier the other on the bedrock) was improved, adding 19 dataloggers in the area around the rock glacier and near downstream lake (Lech Dlacé). Topographic/theodolite (ARPAAV), and laser scan (CNR IRPI Padova and Torino-A. Pasuto, S. Frigerio, M. Mantovani, M. Baldo) surveys were carried out on the rock glacier, to investigate its displacement, and in the Lech Dlacé, to estimate water volume. During Summer 2011 water samples were collected every week in the shallow lake and in the

inlet spring coming out from the rock glacier, in order to evaluate geochemical and isotopic characterization from the beginning of snowmelt season to the autumn (Institute for the Dynamics of Environmental Processes-CNR, Venice-C. Barbante, J. Gabrieli). The seasonal snowpack as well as summer liquid precipitations are also sampled and analysed. All the samples are analysed for pH, conductivity, major ions, trace elements, heavy metals, rare earth elements (REE) and stable isotopes (δD , $\delta^{18}O$). Water temperature, level and conductivity dataloggers were placed in the lake.

The PhD R. Colucci tutored by M. Guglielmin (Insubria Univ) and Finocchiaro (Univ. Trieste) is continuing and the thermal regime of several ice caves and rock faces is started in the area of M. Canin where it has been established also an AWS to monitor the meteorological conditions of the site.



Piz Boè Automatic Weather Station

Central Alps

The Insubria University Research group (N. Cannone, M. Guglielmin, M. Dalle Fratte, F. Malfasi, A. Valentini, D. Bufalino) on permafrost and periglacial environments still going on the activities in the central Alps as elsewhere. The snow, permafrost and vegetation monitoring site of Foscagno where more than 70 points located within and outside the Foscagno rock glacier between 2300 and 2650 m asl is still going on after 6 years. In order to monitor the characteristics of this spring a new monitoring program of the water discharge has been implemented. Two boreholes within the rock glacier are still going on too as the GPS monitoring of the rock glacier dynamic with the cooperation of Milan University (C. D'Agata).

At Livigno (SO) it is continuing a programme of monitoring CO₂ of fluxes in correspondence of two sites characterised by similar soils and vegetation types but with and without permafrost.

At the same site and on the Foscagno rock glacier a

program to monitor the radon emissions with and without permafrost and with different types of soils and vegetation is also started.

In Trentino, several permafrost investigations undertaken in the framework of the Interreg Alpine-Space project “PermaNET” were completed. The activities were coordinated by the Geological Survey of the Autonomous Province of Trento (G. Zampedri, S. Cocco) with the collaboration of several universities (Pavia: R. Seppi and M. Zumiani; Padova: A. Carton; Trento: M. Dall’Amico and R. Rigon). In particular, a rock glacier inventory including intact and relict landforms was completed, as well as a list of sites to be included in the Permafrost Evidences Database of the whole Alps. Moreover, a local map of permafrost existence index was completed, using the statistical model and the criteria developed within the project. The monitoring activities undertaken within the project were also continued. These include: 1) BTS and GST measurements in several sites of the Ortles-Cevedale, Adamello-Presanella and Dolomiti mountain groups, for which a temperature dataset of two or three full years is now available; 2) borehole temperature measurements at the site of Cavaion (Ortles-Cevedale), where a 50 m deep borehole was drilled in bedrock at ca 2900 m asl, and close to the Alpine hut “Ai Caduti dell’Adamello” (Adamello-Presanella), where two years of data are now available for two 20 m deep boreholes drilled in highly fractured bedrock at ca 3000 m asl. Finally, the surface displacement of two active rock glaciers located in the Adamello-Presanella was investigated for the tenth consecutive year by means of topographic surveys, along with GST measurements carried out for the seventh consecutive year. In addition, one of the two rock glaciers (Maroccaro RG) was surveyed for the third time using terrestrial laser scanning conditions of the site.

area of Mt Ortles

Numerous investigations were carried out within the PRIN 2008 project, under the coordination of the University of Padova (A. Carton) and with the support of the Strategic Project “Geological, morphological and hydrological processes: monitoring, modeling and impact in the North-Eastern Italy” (GEORISKS, Coordinator: R. Genevois). These activities are conducted in collaboration with other universities and institutes (University of Pavia: R. Seppi; University of Padova: L. Carturan, G. Dalla Fontana, T. Zanoner, A. Bondesan; INOGS Trieste: R. Francese). The study areas are located in the Ortles-Cevedale (Val de la Mare) and Dolomiti (Cima Uomo and Pordoi Pass). In the first area, the investigations consist in hydrological observations and extensive GST measurements conducted on several landforms (e.g. active and inactive rock glaciers, scree slopes, till deposits). In the Cima Uomo area, GST measurements and geophysical and topographic surveys are in progress on a rock glacier that is developing from the Little Ice Age moraines of a small cirque glacier. Near the Pordoi Pass (Vauz catchment), investigations were started on periglacial landforms in order to: i) studying the processes involved in the slow movement of the ground and in the development of the landforms of the area, and ii) understanding the role of water circulation inside the slope. GST measurements and geophysical and topographic surveys are in progress.

The universities of Padova (D. Penna, L. Carturan, G. Dalla Fontana and A. Carton), Pavia (R. Seppi) and Venezia (J. Gabrieli) begun hydrological investigations on a small permafrost-dominated catchment in Val de la Mare (Ortles-Cevedale). The investigations aim at understanding the role of permafrost in this kind of catchments and are focused on the streamflow regime using stable isotopes as tracers. The study is carried out in the framework of the IAEA-coordinated research project “Use of environmental isotopes in assessing water resources in snow, glacier, and permafrost dominated areas under changing climatic conditions”. The Museum of Science of Trento (M. Gobbi and V. Lencioni) in cooperation with the Universities of Milano (M. Caccianiga and C. Compostella) and Pavia (R. Seppi), is currently investigating several glacial and periglacial areas of Trentino, in order to compare the arthropod (mainly carabid beetles and spiders) and vegetation assemblages inside and outside periglacial landforms. Two active rock glaciers located in the Ortles-Cevedale and Adamello-Presanella mountain group, and a debris covered glacier (Adamello-Presanella), with a total of about fifty sampling points, were selected. The main ongoing activities are to describe the plant and arthropod colonization patterns, and to test the effect of several



Installation of a thermistor chain on rock face in the

environmental variables (e.g. physical, chemical and organic soil parameters) on the biodiversity and on morphological and physiological species adaptive responses. A total of three master theses were completed (tutors: M. Cacciniga, M. Gobbi and C. Compostella), while one is ongoing.

Specifically in the South Tyrol, the main activities were carried out by the Office for Geology and Building materials testing (V. Mair, K. Lang, D. Tonidandel) from the Autonomous Province of Bolzano. Concerning the financing of the monitoring and studying of permafrost phenomena in 2011 there were some changes. From 2008 to the end of September 2011 the activities were mostly financed by the Alpine Space Interreg IV B project PermaNET. This project was coordinated by the Office for Geology and Building materials testing. Since the 1st of November 2011 a new Interreg IV A Italy-Austria project was launched. The main goals of this project are to maintain and expand the existing monitoring network and to study the chemical and biological properties of high mountain waters influenced by permafrost. The Office for Geology and Building materials testing is assuming the role of the lead partner in this project and is collaborating in the Ortles Ice Core project. This international project on the cryosphere of Mount Ortles, the highest elevation of the Eastern European Alps (3905 m asl), is currently underway with the coordination of the Ohio State University (P. Gabrielli, L. Thompson) and the Hydrographic Office of the Autonomous Province of Bolzano (R. Dinale) (www.ortles.org). Within the project, investigations on permafrost are in progress, with the aim of study the thermal state of the ice-free areas of the massif and its evolution under changing climate conditions. The permafrost investigations are carried out by the Office for Geology and Building materials testing with the collaboration of the University of Pavia (R. Seppi). The ongoing activities include: i) ground surface temperature measurements performed in sites covered by debris using miniature data loggers; ii) temperature measurements of rock faces with different aspects performed with thermistors placed at three depths (10, 30 and 55 cm from the surface); iii) deep temperature measurements of a small ice-cap located on the "Hintergrat" ridge of Mount Ortles, in order to analyze the thermal state of the ice and at the contact between the glacier and the bedrock.

The main activities during 2011 in South Tyrol were in summary: i) data acquisition, maintenance and implementation of regional monitoring network (three boreholes through two active rock glaciers equipped with thermistor chains and TDR cable, two boreholes in rock equipped with thermistor chain and extensometer chain), ii) surface-movement

measurements of a rock glacier using DGPS, iii) installation of six thermistor chains on different rock faces (see Figure) installation of three thermistor chains through two glaciers, on the contact with the bedrock.

Western Alps

In the Valle d'Aosta Region, the monitoring and study of permafrost phenomena are carried out by the following institutions: Aosta Valley Autonomous Region bureaux (Geological Service, Environment Direction, www.regione.vda.it), the Regional Agency for Environmental Protection - ARPA VdA (www.arpa.vda.it), the Fondazione Montagna Sicura - FondMS (www.fondms.org), the University of Turin-DST (www.unito.it/dst/), NATRISK-LNSA (www.natrisk.org), National Research Council (Torino) -CNR-IRPI(<http://www.irpi.to.cnr.it/>), Politecnico di Torino-DITAG

(<http://www.polito.it/ricerca/dipartimenti/ditag>),

Politecnico di Torino-DISTR(

<http://www.polito.it/ricerca/dipartimenti/distr>).

In cooperation with Milano University (C. Smiraglia, C. Milhacea and G. Diolaiuti) the monitoring of the rock faces thermal regime at Punta Helbronner (AO) and at Cima De Piazzzi (3460 m asl; SO, is going on. Unfortunately, at Punta Helbronner is finished the monitoring of the permafrost thermal regime of the 64 m deep borehole in cooperation with the Funivie Monte Bianco because the borehole was destroyed in order to build the new cable car station (M. Guglielmin).

The university of Insubria group (leader M. Guglielmin) continued to cooperate with Arpa Piemonte (L. Paro) within PermaNET Interreg project both to the management of the new network of 5 boreholes drilled last year and to the modelling of permafrost distribution and the calibration of this model through the electrical tomography and BTS measurements realized in several places distributed in all the Piemonte. In particular, Arpa Piemonte i) coordinated and concluded the Wp4 "Permafrost Monitoring Network" activities dedicated to establish the monitoring stations in the whole Alps (with the contribution of all project partners); ii) continued the maintenance of the permafrost monitoring stations in the Alps of Piemonte; iii) completed the draft application of the physical model in order to evaluate the potential distribution of permafrost in Piedmont Alps applying PERMACLIM model (Guglielmin et al., 2003), and carrying out two future scenarios analyzing the IPCC data; iv) continued BTS surveys in different site of the Piedmont Alps in order to evaluate the permafrost distribution (empirical and physical models validation); v) continued to analyze the interrelation

between permafrost data and information regarding slope instability processes, using internal data from regional landslide database (S.I.Fra.P.), regional landslide monitoring network (Re.R.Co.M.F.) and satellite interferometry InSAR; vi) organized a public conference on climate change and its effects on the permafrost and on other components of the environment and the human health (Torino, June 2011); vii) participated with a stand at the 8th National Forum on Earth Sciences "Geoitalia 2011" (Torino, September 2011) in which two posters about Arpa's activities on permafrost studies have been showed; viii) realized one booklet, one book and one video about some studies and results of the permafrost in Piedmont Alps (www.arpa.piemonte.it, for information and download).

The Maritime Alps are considered the southernmost permafrost environment of the Alps. Here, the University of Pisa (A. Ribolini) continued the surface ground temperature of some rock glaciers, and the acquisition of geophysical data (Electrical Resistivity and Ground Penetrating Radar). These activities were financed by the PRIN 2008 project. The monitoring of shallow ground temperature of Vei del Bouc rock glacier (Maritime Alps) is near to 10 years of continuous hourly recording, and the analysis of the fingerprint of the main climatic events occurred in last decade on the active layer of permafrost is running. An Electrical Resistivity Tomography prospection has carried out on a rock glacier in the southern sector of Mt Viso (Val Varaita). The data inversion showed a resistivity distribution coherent with the presence massive ice volumes near the surface, along with ice-rich and unfrozen sediments. This points out that here, as elsewhere in the Maritime Alps (e.g. Schiantala and Marinett rock glaciers), an interaction between former glacier and permafrost must be considered in the data interpretation. On this rock glacier, a 25 MHz Ground Penetrating Radar acquisition was performed (A. Ribolini, M. Spagnolo) in order to compare and contrast electrical resistivity distribution and radargrams.

A 200 MHz Ground Penetrating Radar acquisition (A. Ribolini, M. Bini) was undertaken on the Vei del Bouc rock glacier, where a long record of shallow ground temperature is available.

The campaign of boulders sampling from rock glaciers in the Maritime and Cothian Alps has continued with the aim to date the age of stabilization by means of the cosmogenic radionuclides methods (A. Ribolini, M. Spagnolo). This activity has been carried out within a project financed to the University of Aberdeen (M. Spagnolo, A. Ribolini) by SUERC (Scottish Universities Environmental Research Centre)

Patagonia

In the framework of an international project aimed at the sea-level reconstruction during the Quaternary in the Argentinean Patagonia, the University of Pisa (A. Ribolini) studied several sand wedges intruding the continental series covering beach ridge deposits of the Marine Isotope Stage 5 (125.000 yrs BP) in St Jorge Gulf (see Figure). The grain-size of the material composing the fossil wedges, along with quartz grains characteristics at Scanning Electron Microscope (SEM) analysis, allowed to propose an aeolian sand infilling of the frost cracks. The Optical Stimulated Luminescence age (20500 ± 2000 yrs BP) of the infilling sand and a C14 age (25780 ± 160 yrs BP) of carbonate crust evidenced that two generations of sand wedges have formed during the Last Glacial Maximum (LGM), separated by a phase of loess deposition and/or soil development. This demonstrates that during the LGM the Patagonia coast of St Jorge gulf underwent permafrost condition, with a lowering of MAAT at least of $12-14^{\circ}\text{C}$ compared with today.

Figure. Polygons associated to LGM sand wedges intruded in marine deposits of MIS5. Patagonian coast, Argentina.



Polygons associated to LGM sand wedges intruded in marine deposits of MIS5. Patagonian coast, Argentina

Antarctica

In Antarctica two different expeditions were realized within the framework between the British Antarctic Survey and the Insubria university (M. Guglielmin, N. Cannone). One campaign was organized at Rothera station where the permafrost station (a 30 m deep borehole) is going on and where a season of measurements of CO₂ fluxes on different permafrost conditions was realized. The second campaign was carried out at Signy Island where two different project were realized. The first (L. Paro, R. Gambillara, M. dalle Fratte) was focussed on the geophysical (electric tomography) investigations of several periglacial landforms such as gelifluction lobes, patterned grounds and sorted stripes, moss bank-lobes and on the analyses of the characteristics of the active layer

and permafrost along a transect of deglaciation including all the Holocene. The second project (M. dalle Fratte) was the monitoring of CO₂ fluxes on different permafrost and vegetation conditions. In addition the CALM grid was upgraded with a system to monitor also the snow cover on a part of the grid.

A permafrost session (led by M. Guglielmin and G. Vieira) at the XI ISAES (International Symposium on Antarctic Earth Sciences) was held in Edinburgh between 10 and 15 July with 17 posters and 12 oral presentations. The special issue on Geomorphology on the XXXI SCAR (Scientific Committee of Antarctic research) held in Buenos Aires on August 2010 is now in press.

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10 Japan

The Japanese Cold Climate Geomorphology Colloquium had a memorial symposium in May 2011 to celebrate its 40 years anniversary, entitled 'Research Frontier of Cold Climate Geomorphology'. The symposium was first planned in a special session of the 2011 spring meeting of the Japanese Geographical Society, but the meeting was cancelled due to the Tohoku earthquake and tsunami. The symposium was held separately two months later in Tokyo, including about 70 presentations on glacial, periglacial and mountain geomorphology, as well as mountain geoecology. A special issue including 13 papers from the meeting is planned in Journal of Geography (to be published in April 2012).

The Japanese Permafrost Association had a two-day meeting on 'Dynamics of Frozen Ground' in 2-3 December 2011 in Sapporo. About 30 scientists and students participated and presented their newest results. The meeting highlighted frost mounds (pingo, lithalsa and palsa) in various regions, dynamics of a polar rock glacier, glacierets and permafrost on Japanese high mountains, databases for frozen ground conditions in Japan and overseas, as well as a geopark project.

K. Saito (JAMSTEC) reconstructed the fine-scale frozen ground distribution in East Asia at the LGM, the Holocene Optimum, and the present, using Global Climate Models outputs and a downscale technique, and compared with the observation- and proxy-derived estimates.

K. Harada (Miyagi University) and G. Iwahana (Hokkaido University) started a project named 'Frost

tube in Japan' in November 2011. This project is collaborated with 'Permafrost Outreach Programs' operated by K. Yoshikawa (WERC, INE, UAF). They installed frost tubes at three elementary schools in Hokkaido, Japan, with K. Yoshikawa and Y. Khalilova (IEG, RAS). Seasonal frost depths will be recorded throughout winter at each school.



Installing a frost tube at an elementary school in Hokkaido.

In Svalbard, N. Matsuoka and T. Watanabe (University of Tsukuba) has continued a monitoring campaign on the dynamics of patterned ground (including ice-wedge polygons, mudboils and hummocks) and a polar rock glacier with a variety of methods. A portable terrestrial laser scanner has newly been introduced to map detailed surface relief and produce DEMs of these landforms. Differential GPS and subsurface inclinometers revealed slow advance (less than 2 cm/yr at the surface) of Huset rock glacier, which reflects interannual change in ground temperature.



Huset rock glacier, seen as bulging of talus slopes behind the historic Restaurant Huset (built in 1951), Longyearbyen, Svalbard.

Several field projects are also going on in Japanese mountains (Daisetsu, Fuji and Japanese Alps), Alaska, Siberia and Mongolia.

Compiled by Norikazu Matsuoka (matsuoka@geoenv.tsukuba.ac.jp)

11 Kyrgyzstan

During the summer 2011 scientists of the Kyrgyzstan Geocryology Group (KGG) carried out the following activities in permafrost areas:

Muratally Duishenakunov (PhD student at Kyrgyz National University J. Balasagyn, Bishkek and at ZEU, Giessen University, Germany) continued his studies on “Water resources of Central Asia mountainous regions – their importance to the water balance of semiarid regions”. Automatic temperature loggers in permafrost areas were read out and the data was analyzed from sites installed during the previous summer in the upper Kichi- and Chon-Naryn catchments. Additional temperature loggers were installed in the Basin of Kumtor River.

The Kyrgyz Geocryology Group paid special attention to the Kumtor gold mining sites. Located in the Tian Shan range in permafrost areas at more than 4,000 m above sea level, Kumtor is the second-highest gold mining operation in the world after Yanacocha (Peru), and the largest gold mine operated in Central Asia. It produced more than 7.8 million ounces of gold between 1997 and the end of 2010, and in 2010

Kumtor's gold production was 567,802 ounces. Detailed information may be found in www.centerra.ca/properties/kumtor/.

The geocryology group of Kyrgyzstan visited the base station of the Central Asian Institute of Applied Geosciences (CAIAG) at Lake Merzbacher that is well known for its glacial lake outburst floods (GLOFs). They discussed current glaciological projects with international scientists working on Inylchek glacier. Detailed information on the activities of CAIAG, its structure and staff is given on

<http://www.caiag.kg/index.php?id=363&L=2>.

Members of the Kyrgyz Geocryology Group (KGG) meet at the Lake Merzbacher station of CAIAG.

From left to right: Muratally Duishonakunov (KNU, Bishkek), Sheishenaly E. Usupaev (CAIAG), Bolot Moldebekov (CAIAG Co-Director), Lorenz King (CAIAG advisory board), Ryskul Usulaliev (CAIAG).

12 Mongolia

We organized first international symposium on mountain and arid land permafrost in 2001 (see report on FG25). 22 – 26 August, 2011 we had organized the second international symposium on mountain and arid land permafrost in Ulaanbaatar, MONGOLIA. 25 scientists from Norway, Japan, Romania, USA, China, Russia and Mongolia have participated at the Second international symposium on mountain and arid land permafrost. 14 oral presentations and 7 poster presentations including 4 welcome speeches were presented during the 2 days in the conference hall of the Mongolian Academy of Sciences. A roundtable discussion summarized the symposium, and resulted in three recommendations approved during the closing session (see the symposium report).



Attendees of the second international symposium on

mountain and arid land permafrost in Ulaanbaatar, Mongolia, 22 – 26 August, 2011.

Especially, the Mongolian permafrost and ecological network was recognized as critical for understanding the dynamics of permafrost on a changing planet. At present there are 86 CALM and GTN-P boreholes in Mongolia. All the boreholes have been instrumented to prevent from air temperature convection in them and to protect them against damage by passing people. Some of boreholes have temperature measurements in 1968 – 1987 by Sharkhuu. Initial results of the long-term permafrost monitoring show that the average increase in ALT is 0.5-2.0 cm/year and in MAGT is 0.01-0.03 °C/year under the influence of recent climate warming in Mongolia. Nowadays borehole drillings and field measurements were sponsored by Geography Institute of MAS, Ministry of Nature, Environment and Tourism of Mongolia, Hokkaido University and JAMSTEC, Japan.

Next year (2012) we are planning to drill additional boreholes in Mongolia by supports of Ministry of Nature, Environment and Tourism of Mongolia. As Mongolia lies on southern edge of Siberian permafrost region there are possibility relict permafrost in Mongolia. Therefore we are expecting to drill at relict permafrost within 2012 drilling operation.

According to geographical location Mongolia has a specific weather condition with a cold long winter and less snow cover. This specific weather leads to form the perelotok in some cold year and there is deep seasonal frozen ground until to 5-6 m in some areas with coarse materials. Using this weather specific of Mongolia our senior scientist Dr Lonjid had constructed ice storages in some regions of Mongolia in 1960s – 1980s and in 2010 – 2011 new reconstructed ice storages have been constructed in some towns of Mongolia. Oldest ice storage, constructed in 1968, has a good condition until today.

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13 The Netherlands

Paleopermafrost

The Dutch research community is active in research on the carbon cycle of permafrost and paleo-permafrost research. In paleo-permafrost research the dating and paleo-environment of permafrost phases in Western Europe is the main focus of research. The type locality of the Late Pleniglacial and Late Glacial fluvial to aeolian

succession along the Dinkel river in the eastern Netherlands has been reinvestigated. Optical stimulated luminescence dating (circa 50 samples) has revealed the timing of the environmental changes in this time period. The timing of Late Pleniglacial permafrost existence and permafrost degradation has been established. The major phase of permafrost degradation has been dated between circa 20 and 16 ka during the Late Pleniglacial (PhD Thesis Gent University, C. Dereze). A research project on modeling of paleo-methane emissions from periglacial environments during the Last Glacial has come to an end, and has resulted in a thaw lake expansion model, published in Nature Climate Change (Van Huissteden et al., 2011). A research on the response of paleofluvial systems to cold conditions is continued in China, which- as a side effect- resulted in the detection of mega-cryoturbations (>4 m amplitude) in gravel terrace deposits (collaboration project VU University Amsterdam and Nanjing University).

Carbon exchange from permafrost soils and ecosystems

Research on the carbon cycle and greenhouse gas emission of present-day permafrost environments is conducted by VU University Amsterdam (Prof A.J. Dolman, Dr. J. van Huissteden) and Wageningen University (Dr. M. Heijmans). The research projects in Siberia are conducted in collaboration with Russian counterparts (Russian Academy of Sciences - IBPC, Yakutsk and Krasnojarsk University).

At the Kytalyk reserve near Chokurdagh in the Indigirka lowlands (VU and Wageningen University) research focusses on CO₂ and CH₄ fluxes of tundra ecosystems on continuous permafrost. With three new PhD projects started in 2010 and funded by Dutch science funding organizations NWO and Darwin Center, and participation in the new EU project PAGE21, funding of carbon cycle observations is guaranteed until 2014. This will result in a decade-long time series of CO₂ and CH₄ fluxes, and seven years of research on tundra vegetation ecology. In the new research projects, emphasis is laid on spatial variability of fluxes and the effects of permafrost degradation on the tundra ecosystem and fluxes. Closely linked to this research is a modeling project, aiming to improve hydrological aspects of carbon cycle models, which is part of the EU funded Marie Curie Greencycles Network. Also cooperation is setup with AWI (Dr. Schirrmeister) in the framework of the POLYGON project.

VU University also participates in the Russian Mega-grant programme 'The carbon balance of Central Siberia and the role of the hydrogeochemistry of

the big Siberian rivers in the carbon cycle', led by the Siberian Federal University of Krasnojarsk and the Max Planck Institute for Biogeochemistry in Jena, Germany. The first step in this project is an analysis of the carbon balance of the Yenesei river. A planned river sampling cruise in 2011 had to be cancelled however, due to equipment import problems.

At the "Nymto Park Station" (NPS) in West Siberia in the regional park "Nymto" at 63.7°N, 70.9°E the effect of climate change on the pristine peatland ecosystems and (sub)actual carbon balance of the permafrost boundary zone in Sub-arctic Western Siberia is studied (Yugra State University and Utrecht University, Prof. W. Bleuten).

The Royal Netherlands Institute for Sea Research, NIOZ (Dr. Jens Greinert), is currently chairing the COST Action PERGAMON (ES0902) "Permafrost and gas hydrate related methane release in the Arctic and impact on climate change: European cooperation for long-term monitoring" in which 23 countries with 49 institutes are currently involved. Next to EU countries, Russia, USA, Canada and New Zealand are regular members during the biannual workgroup and management committee meetings. The Action has 6 working groups ranging from atmospheric and remote sensing sciences, to terrestrial studies around methane release from wetlands, to marine studies related to gas hydrate decomposition and permafrost thaw. NIOZ and VU are participating from the Netherlands.

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14 New Zealand

The highlight of the 2010-11 summer for many New Zealand Antarctic Researchers was the far south leg of the latitudinal Gradient Project (www.lgp.aq) which took researchers as far as 86 °S. An account of the K123 expedition is given below. Over the 2011-12 summer Cathy Seybold from USDA, along with Holly Goddard from Waikato University, have been working in the Wright Valley to complete the installation of a ninth soil-climate monitoring site (number 8 was installed last year on the valley wall above Don Juan Pond.) The new station is to be installed on the wall of the Wright Valley near Bull Pass at an altitude of about 800 m. This will complete our climate station network by providing information on the climate on the valley walls in contrast to the valley floor or high alpine areas. The data are available at

<http://www.wcc.nrcs.usda.gov/scan/Antarctica/antarctica>

Malcolm McLeod and Jim Bockheim are continuing the dry valley soil mapping work visiting several sites in the wider dry valley region. Two young Antarctic soil/permafrost workers (Josh Scarrow (Waikato University) and Fiona Shanahan (Lincoln University) have suspended their studies for five months to undertake ship-based work in the Australian Antarctic summer programme for five months. They will be studying relatively unexplored soils in Australian Antarctic ice-free areas.

NZ K123B Beardmore Expedition 2010/11

Errol Balks (field leader and land surveyor, CKL Surveys and Planning), Peter Almond (Soil Scientist, Lincoln University) and Joshua Scarrow (MSc student, Waikato University) undertook soil investigations in the Beardmore glacier region as part of the southernmost expedition of the Latitudinal Gradient Project (LGP). They were supported from the USA CTAM (Central Trans Antarctic Mountains) camp. CTAM was located on the Walcott Nêvé, 2 hours C140 flight south of Scott base at a latitude 84° S and around 1800 m elevation. The CTAM base provided access (via helicopter) to ice free locations throughout the Beardmore Glacier Region.

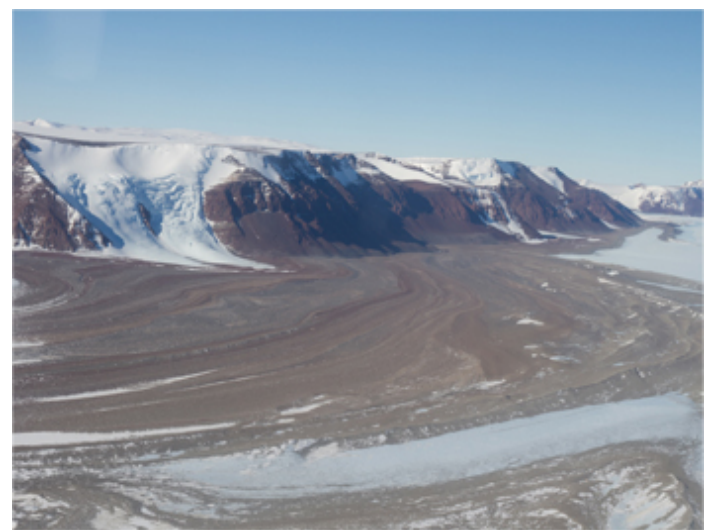


Figure 1: Beardmore Glacier lateral moraine sequence at the foot of the Dominion Range. The contrasting coloured bands are due to the dominant geology of the deposited material; red = dolerite, grey = sedimentary rocks dominant (Photo: Errol Balks).

The team undertook soil-landscape investigation and sampling at three of the largest ice-free areas in the region; Ong Valley, the west side of Dominion Range (Figure 1), and Mount Acheranar. The team spent 6 to 8 days camped at each site (Figure 2), with soil profiles studied and sampled across each area (Figure 3). They found a wide range of soils (mainly on large-scale patterned ground on ice-core moraine),

with older sites having greater depth to the ice-core, dry permafrost, and salt accumulations. Two one-day trips with close helicopter support extended the range of sites across the altitudinal gradient from the Otway Massif on the edge of the polar plateau (2150 m asl) to Mount Kyffin near the Ross ice shelf near the foot of the Beardmore Glacier (210 m asl). The soil data will be used by Landcare Research to extend the accuracy of their Environmental Domains assessment, and provides key information and insights from sites that had generally not been previously visited by soil scientists.



Figure 2: Josh Scarrow (back) and Peter Almond preparing dinner in the kitchen tent which doubled as Josh's sleeping quarters. (Photo: Errol Balks).

Although initially concerned about the number of days the weather would allow work (going on past weather records for the region) the team were pleasantly surprised that there was only one day that work could not be undertaken. There were short-lived snow falls at each camp site, but the temperatures were relatively warm ranging from about minus 17°C to +6°C at the ice shelf below Mt Kyffin. All in all a very successful expedition with great support from Antarctica NZ and the American CTAM camp staff.



Figure 3: Peter Almond closely examining a soil profile at the head of the Ong Valley, Christmas day (as evidenced by him wearing the nice new (clean?) boxers that father xmas brought him.) (Photo: Errol Balks).

Megan Balks

15 Norway

Geology Department, UNIS

The periglacial part of the cryosphere research group in the Geology Department of The University Centre in Svalbard, UNIS was in 2011 coordinated by H.H. Christiansen. She has been on sabbatical during 2011, visiting in spring the Institute of Geology and Geography, University of Copenhagen, Denmark, working with Bo Elberling on comparing the permafrost in NE Greenland to Svalbard. Markus Eckerstorfer continued his Ph.D. study on snow avalanches and meteorological control in Svalbard, working also with the CRYOSLOPE Svalbard (2007-2009) NORKLIMA research project data. In the DEFROST Nordic Centre of Excellence research network, focusing on impacts of a changing cryosphere - depicting ecosystem-climate feedbacks from permafrost, snow and ice, a new Ph.D student Jordan Mertes started in November 2011. He will be studying the ground thermal regime of permafrost landforms within the Nordic area including Greenland. We participated in the CryoEx staff and student exchange project together with the Universities of Oslo, Ottawa and Carleton, and Hanne H. Christiansen, was on sabbatical stay at the University of Carleton, visiting Prof. Chris Burn including a field visit to his key research sites in the Mackenzie Delta in summer and autumn 2011. The new EU 7. Framework research project 'Vulnerability of Arctic permafrost to climate change and implications for global GHG emissions and future climate' PAGE21 started in November 2011. We are a partner in this project and responsible for the work package on physical dynamics of permafrost. A new Ph.D. student Stephanie Härtel, has been hired to start working in 2012 in the PAGE21 project focussing on physical dynamics of permafrost in Svalbard and Zackenberg, NE Greenland.

In the Norwegian US collaboration project on permafrost, SVALASKA, funded by the Norwegian Research Councils POLRES programme, 7 Norwegian researchers and senior students visited the University of Fairbanks Alaska permafrost laboratory research group headed by Vladimir Romanovsky for 10 days in August 2011, seeing both the campus, its surrounding permafrost research sites including the permafrost tunnel, and did a 4 day field tour up the

Dalton Highway visiting the Toolik Field station and reaching the Beaufort Sea at Prudhoe Bay.

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TheCRYOLINKproject

(www.geo.uio.no/english/cryolink/about/) has been continued by B. Etzelmüller, S. Westermann, T. Hipp, H. Farbrot, O. Humlum, K.S. Lilleøren, and K. Gislås, together with K. Isaksen (met.no) and R. Ødegård (HiG), focussed upon 15 shallow permafrost boreholes in southern Norway, and with a permanent geoelectrical monitoring station was established at Juvvasshøe in Jotunheimen. In connection with the CRYOLINK project both a permafrost equilibrium model (K. Gislås) and a fully transient model version (S. Westermann, T.V. Schuler) was implemented for Norway, driven by gridded daily air temperature and precipitation data provided by the Norwegian Meteorological Institute and the Norwegian Water and Energy Directorate. Both models are now operational and will be used for different applications.

The project on mountain meteorology, snow cover, vegetation, ground temperatures and interaction between permafrost and glaciers in southern Norway continues (O. Humlum), and now covers winters with very different meteorological characteristics.

In 2011 the University of Oslo in collaboration with UNIS continued funding for student and faculty member exchange with the University of Ottawa (A. Lewkowicz) and Carleton University (C. Burn) based on a grant provided by SIU (Norwegian Center for International Cooperation in Higher Education). This year a common field course was carried out in Yukon, northern Canada, under the leadership of A. Lewkowicz, C. Burn and L. Copland. 10 Faculty and students participated during the field trip.

In 2011, also the Department (B. Etzelmüller) received funding for a Nordic network funded by Nordforsk. The network facilitate co-operation, PhD courses and student exchange between most Nordic Universities working with permafrost-related research (Stockholm, Copenhagen, Oulu, Helsinki, UNIS), along with the Meteorological Institutes of Denmark and Norway.

Norwegian Geotechnical Institute

Two years of ground surface temperatures have been collected (Regula Frauenfelder) in the Signaldalen valley in the Troms county, Northern Norway. In summer 2008, a large rock-slide had occurred in the Signaldalen. Six temperature devices (Geoprecision M-log5 devices) were installed in rock scree faces close to the release zone and in the nearby soil (UTL devices). The first analyses of the data show MAGST

in the rock-free faces slightly below zero for the year 2009/2010 and slightly above zero for the year 2010/2011. The same can be observed for the near surface soil temperatures. A change detection analysis carried out with a Optech Illris LR laser scanner between summer 2010 and 2011 showed little to no rock fall activity, a fact that was confirmed by the locals living close-by.

Norwegian Meteorological Institute

In 2009-2011 a multidisciplinary study was carried out at the Juvfonne ice patch (1850-2000 m a.s.l., 61.676°N, 8.354°S)[R. Ødegård et al., 2011]. Juvfonne and surrounding terrain is a well-preserved Iron Age hunting station documented by more than 600 registered archaeological artefacts[Nesje et al., in press]. At 10-m depth in Juvfonne the ice temperature is approximately -2 °C based on measurements in one borehole. Radiocarbon dating of organic layers shows ages ranging from 1095 ± 30 BP to 2960 ± 30 BP[Nesje et al., in press]. This gives conclusive evidence that some high altitude ice patches in Jotunheimen have survived since the Bronze Age. This Bronze Age ice is now exposed at or near the surface of perennial ice patches. These finds are consistent with other proxy data from Jotunheimen, and indicates the paleoclimatic significance of high altitude ice patches. The dating of organic material in ice patches can be viewed as a minimum age of near surface permafrost in the area. In this way ice patch studies will offer strongly needed validation of Holocene permafrost modelling [Etzelmüller et al., 2010]. Presently permafrost thicknesses at elevation where we find perennial ice patches (> 1700 m a.s.l.) can be estimated to be more than 100 m. The investigated ice patch Juvfonne covers an altitude range of 1850 to 2000 m a.s.l. and is well within the mountain permafrost zone. Observations of ground thermal regime from previous NFR and EU-funded projects (PACE, CRYOLINK) and BTS data indicate a lower permafrost limit of 1450-1600 m a.s.l. [Hauck et al., 2004; Isaksen, 2001; Isaksen et al., 2002; R Ødegård, 1993; R S Ødegård et al., 1996]. Such potentially old permafrost is now adjusting with current atmospheric and environmental conditions and tends to be in various stages of warming or even thawing [Isaksen et al., 2011].

Publications:

- * Etzelmüller, B., H. H. Christiansen, T. V. Schuler, H. Farbrot, K. Isaksen, R. S. Ødegård, T. Skaugen, and O. Humlum (2010), Modelling of permafrost and seasonal frost in Norway and Iceland – strategies and examples, paper presented at 29th Nordic Geological Winter

Meeting, Geological Society of Norway, Oslo.

- * Hauck, C., K. Isaksen, D. Vonder Mühll, and J. L. Sollid (2004), Geophysical surveys designed to delineate the altitudinal limit of mountain permafrost: an example from Jotunheimen, Norway, *Permafrost and Periglacial Processes*, 15(3), 191-205.
- * Isaksen, K. (2001), Past and present ground thermal regime, distribution and creep of permafrost : case studies in Svalbard, Sweden and Norway.
- * Isaksen, K., C. Hauck, E. Gudevang, R. S. Ødegård, and J. L. Sollid (2002), Mountain permafrost distribution on Dovrefjell and Jotunheimen, southern Norway, based on BTS and DC resistivity tomography data, *Norsk Geografisk Tidsskrift*, 56(2), 122-136.
- * Isaksen, K., R. S. Ødegård, B. Etzelmuller, C. Hilbich, C. Hauck, H. Farbrot, T. Eiken, H. O. Hygen, and T. Hipp (2011), Degrading mountain permafrost in southern Norway - spatial and temporal variability of mean ground temperatures 1999-2009, *Permafrost and Periglacial Processes* DOI: 10.1002/ppp.728.
- * Nesje, A., L. H. Pilø, E. Finstand, B. Solli, V. Wangen, R. S. Ødegård, K. Isaksen, E. Støren, D. I. Bakke, and L. M. Andreasse (in press), Artefacts related to prehistoric reindeer hunting exposed at melting ice patches in southern Norway, and their climatic significance, *The Holocene*.
- * Ødegård, R. (1993), Ground and glacier thermal regimes related to periglacial and glacial processes: Case studies from Svalbard and southern Norway, Dr.Scient. thesis, 44 pp. pp, University of Oslo, Norway., Oslo.
- * Ødegård, R., A. Nesje, K. Isaksen, and T. Eiken (2011), Perennial ice patch studies – preliminary results from a case study in Jotunheimen, southern Norway, paper presented at EGU General Assembly 2011, Vienna.
- * Ødegård, R. S., M. Hoelzle, K. V. Johansen, and J. L. Sollid (1996), Permafrost mapping and prospecting in southern Norway, *Norsk geografisk Tidsskrift*, 50, 41-54.



Participants in the SVALASKA project meeting at the University of Alaska Fairbanks, 10 August 2011, on front row left to right: Hanne H. Christiansen, UNIS/UiO; Santosh K. Panda, UAF; Vladimir Romanovsky, UAF; Markus Eckerstorfer, UNIS & Elchin Jafarov, UAF. Middle row from left to right: Alexander Kholodov, UAF; Reginald Muskett, UAF; Kjersti Gisnås, UiO; Bill Cable, UAF & Ronald Daanen, UAF. Upper row from left to right: Sergey Marchenko, UAF; Stephanie Härtel, UNIS; Tom Rune Lauknes, Norut; Guido Grosse, UAF; Sebastian Westermann, UiO; Kenji Yoshikawa, UAF & Bernd Etzelmuller, UiO.

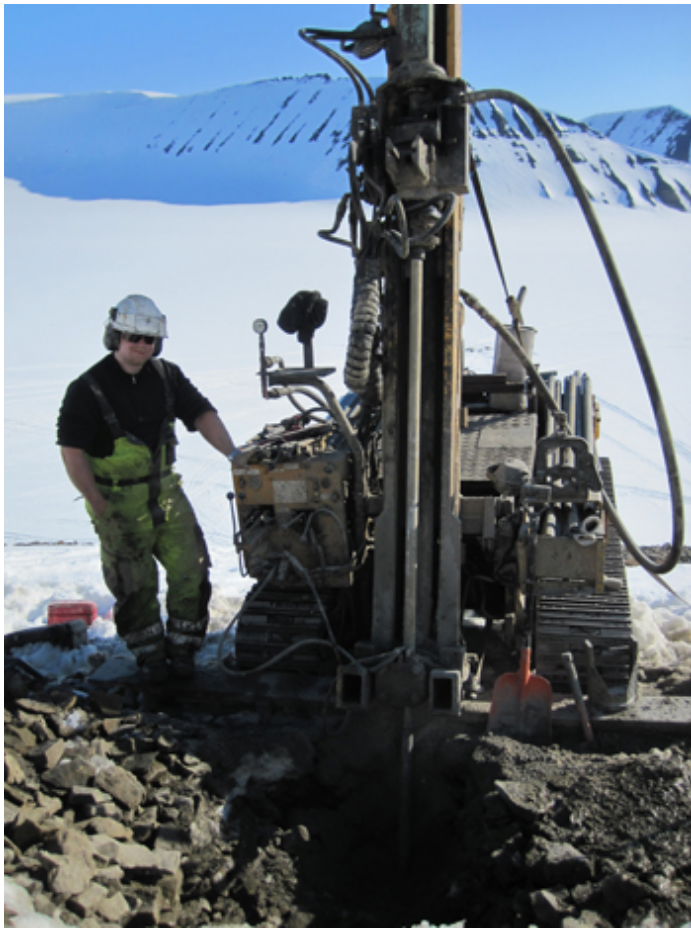
Sintef

In 2009-2011 Lack of efficient methods for geotechnical soundings in cold permafrost has for many years have limited the possibilities of collection of soil parameters without using sampling techniques in arctic regions of Norway; Svalbard. SINTEF Byggforsk has for several years carried out development and research to find suitable and precise methods for collection of frozen soil parameters.

In spring 2011 an internal research project, in combination with M.Sc project of Eirin Husdal, was carried out to develop a sounding procedure for efficient sounding in all types of permafrost soils. The method used in this project is mainly based on the Norwegian Totalsounding method with use of ø 76 mm drillbit, hammer and flushing with air. A geotechnical drill rig was used with the following setup:

- Constant rotation speed: 25-40 rpm
- Constant penetration force: 5-8 kN
- Flushing by air 0,9-1,1 MPa/ ~10 m³/min

Results from the study shows that the method has potential, but need further development and tests to be a method that can give good results in all kind of frozen soils, from saline clays to unsaturated gravel.



Drilling and sounding in permafrost at Svalbard (Photo by Jomar Finseth)

NTNU, UNIS and Sintef

A center for research-based innovation (SFI) has been established at NTNU in Trondheim named Sustainable Arctic Marine and Coastal Technology (SAMCoT). The project is funded by the Norwegian Research Council and the industry over a 5 Year period. There will be a mid-way evaluation with possibilities to prolong the project period with additional 3 years. The research will be performed by NTNU, UNIS, SINTEF and 14 other industrial and scientific partners, with NTNU as responsible leader for the project. One of the areas of work for SAMCoT is Coastal erosion and Permafrost. This activity involves observation of coastal erosion and study of site specific erosion rates in both Svalbard and NW Russia. Measurements and modeling of waves, thermal regime and geotechnical processes will play a major role in the research to understand the major factors for coastal erosion in these areas. Other topics connected to study of permafrost within the program are sustainability of arctic coastal structures, climate change effects on arctic coasts and solutions for landfall of pipelines. Goal for the research will be guidelines and technical solutions for the industry regarding operations and constructions on arctic coasts.

16 Poland

Different aspects of permafrost were investigated in 2011 in three areas: the Tatra Mountains, northern Sweden (the Abisko area) and on Spitsbergen.

The Tatra Mountains are a zone of random occurrence of permafrost. Investigations in the area were carried out by permafrost researchers from the University of Silesia (Sosnowiec) and from the University of Science and Technology (Kraków). The scientists from the University of Silesia studied its structure and ventilation of debris slopes, conducted monitoring of meteorological conditions, snow cover, ground surface temperature, and carried out modeling of the ground surface temperature of the snow cover in a complex topography. In 2011 the University of Science and Technology continued recording (started in 2004) of the ground temperature at the depths of 0, 20 and 50 cm and air temperature at two sites on the northern slopes of Mt. Świnica (1,950 – 2,000 m a.s.l.) and at one site in the Kozia Dolinka valley (1,950 m a.s.l.) in the Tatra Mts. There is also a reference site in Hala Gąsienicowa (1,500 m a.s.l.). The temperature is logged permanently all year round at two-hour intervals. For the season of 2011/2012, an additional site for in-snow temperature studies was established on Hala Gąsienicowa. A set of loggers enable temperature recording at 12 depth points (depending of the snow cover thickness) at 30-minute intervals.

In 2011, W. Dobiński from the Silesian University completed long-term investigations concerning spatial relationships in the interaction between glaciers and permafrost on Spitsbergen, northern Scandinavia and the Tatra Mountains. A synthesis of the main results was published in the form of a monograph (Permafrost in selected areas of the Tatra mountains, the Scandinavian mountains and Spitsbergen in the light of extensive geophysical studies and climatological analyses, Prace naukowe Uniwersytetu Śląskiego w Katowicach nr 2850, Wydawnictwo Uniwersytetu Śląskiego, pp. 172, in Polish).

On Spitsbergen, measurements of the active layer depth of permafrost, its thermal conditions, as well as its dynamics were carried out at the sites included in the CALM project (Site P1 Calypsostranda – the base of the Maria Curie-Skłodowska University (Lublin) (Fig. 1) and Site P2 (A-C) - Kaffiøyra – the station of the Nicolaus Copernicus University (Toruń) (Fig. 2). In both research areas the ground temperature was also measured at standard depths to 1-2 m. In the Kaffiøyra region, such measurements were performed for three

different ecotopes: the beach, the moraine and the tundra. In turn, in Calypsostranda the depth of the active layer (besides the CALM site) was also measured in other 22 sites representing different kinds of active surfaces and expositions. Monitoring of solifluction covers was conducted on five slopes having different exposition and inclination. For this purpose a GPS receiver and a Topcon tachymeter were used. All slopes were also scanned using a Topcon GLS-1500 laser scanner (GSL - Geodetic Laser Scanner).

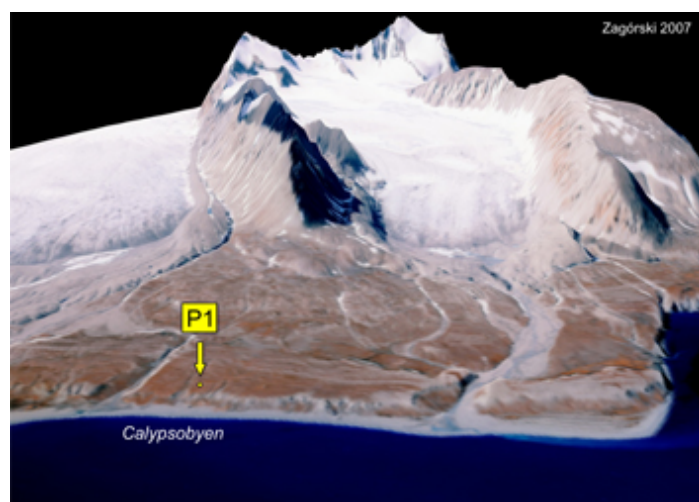


Fig. 1. Area of the Maria Curie-Skłodowska University Research Station and the location of the measurement site P1 (Photo by P. Zagórski)



Fig. 2. Area of the Nicolaus Copernicus University Research Station in Kaffiøyra and location of the measurement sites P2A-C (Photo by A. Arażny)

In addition, in 2011 the permafrost research community from the Adam Mickiewicz University (Poznan) continued investigation of permafrost and periglacial processes in the basic area around Petuniabukta in Billefjorden (Central Spitsbergen, Svalbard). Main efforts were aimed at maintaining two

test areas, “dry” and “wet” (Fig. 3), prepared according to CALM rules, to measure the ground temperature and the thaw depth on raised marine terraces. Further ground temperature measurements were performed in different locations from the valley floor through the outwash plain and glacier marginal zone towards the slopes, where active layer detachments (Fig. 4) were identified and studied in detail. Among other projects considering periglacial processes, studies on aeolian activity and the development of the coast system were undertaken. In a longer time scale a pilot study on weathering of erratic boulders deposited since Pleistocene ice-sheet covers to Little Ice Age advances was introduced and observations of the impact of ground temperature/moisture conditions and periglacial processes on Arctic tundra shrubs growth (Fig. 5) were started as a part of the project “Arctic Shrubs Dendrochronological Potential”. The principal investigators in the above mentioned tasks were Agata Buchwal, Grzegorz Rachlewicz, Krzysztof Rymer, Mateusz Strzelecki and Tomasz Wawrzyniak.



Fig. 3 – Test area for ground temperature and active layer thickness measurements on the raised marine terrace 5 m a.s.l. near the coast of Petuniabukta (photo by K. Rymer)



Fig. 4 – Active layer detachment on the slope of Wordiekammen in Ebba Valley (photo by T. Wawrzyniak)



Fig. 5 – Ground temperature and humidity measurements devices in Ebba Valley on the vegetation growth plot (photo by A. Buchwal)

Besides field research, theoretical and critical studies of permafrost and cryospheric terms and definitions were conducted by W. Dobiński. A clarification and a new usage of selected terms was suggested (Dobinski W., 2011: *Kryosphere – Hydrosphere Relationship*. Nova Science Publishers Inc., New York, pp. 47).

Rajmund Przybylak

based on annual reports sent by W. Dobiński, W. Mościcki, G. Rachlewicz, I. Sobota and P. Zagórski

Publications:

- * Dobiński W., 2011: The concept of cryo-conditioning in landscape evolution – comment to the paper published by Ivar Berthling and Bernd Etzelmüller, *Quaternary Research* 75, 378-384, *Quaternary Research* doi.:

10.1016/j.yqres.2011.06.017 (in press).

- * Dobinski W., 2011: *Kryosphere – Hydrosphere Relationship*. Nova Science Publishers Inc., New York, pp. 47.

17 Portugal

From 2011, IPA-Portugal implemented a national coordinating committee. The members of the committee are: Alexandre Trindade (PYRN-Portugal), António Correia (Univ. Évora), Carla Mora (CEG/IGOT-UL), Gonçalo Vieira (CEG/IGOT-UL - National Representative), João Canário (IPIMAR), Marc Oliva (CEG/IGOT-UL), Mário Neves (CEG/IGOT-UL), Pedro Pina (IST, Technical Univ. Lisbon) and Teresa Barata (Univ. Coimbra).

Research activities on Antarctic permafrost framed within the project Permantar-2 (Permafrost and Climate Change in the Maritime Antarctic) coordinated by the University of Lisbon (CEG/IGOT-UL, PI G. Vieira) took place in Livingston, Deception and King George Islands. Focus was on permafrost and active layer monitoring, snow cover and geomorphodynamics. The collaboration with the University of Wisconsin-Madison allowed to gather new observations on soils from Deception and Livingston islands. Through a collaboration with the Federal University of Viçosa (C. Schaefer), a new shallow borehole has been installed at Tyrrel Plateau, Keller Peninsula (King George Island). PERMANTAR-2 is a collaboration of CEG/IGOT-UL with the Centre of Geophysics of the University of Évora (A. Correia) and Centre of Geophysics of the University of Lisbon (F. Santos), as well as with several foreign institutions: Bulgarian Antarctic Institute, Federal University of Viçosa (Brazil), University of Alcalá de Henares (Spain, Miguel Ramos), University of Buenos Aires (Argentina, A. Caselli) and University of Wisconsin-Madison (USA, James Bockheim). Also in the South Shetlands, the CEG/IGOT-UL team in collaboration with the CGUL run two remote sensing projects on monitoring of snow cover using SAR (SNOWANTAR, PI C. Mora) and on terrain deformation using INSAR (TIDEFINSAR, PI G. Vieira). A new DLR project on both topics is also being implemented by both institutions, in a collaboration that also includes the University of Oslo (A. Kaab).

The CERENA team, at Instituto Superior Técnico, is studying Mars polygonal terrains using Earth analogues to improve the knowledge of the abundant Martian networks. In the summer of 2011, a field campaign in Adventdalen (Svalbard) was conducted

together with CEG/IGOT-UL and UNIS (Norway), to gather polygonal pattern features for comparison with Martian analogues. The field survey, enabled to collect accurate data on the geometry and topology of the polygons, on the characteristics of the vegetation and on the depth of the active layer. Remote sensing derived classifications of vegetation types have been field validated and a detailed geomorphological surveying was conducted. The in-situ measured features are being integrated with two sets of remotely sensed imagery with very high spatial resolution and confronted with those of Mars to evaluate where do Adventdalen polygons stand in relation to quantitatively characterized Martian networks. More information about ongoing activities can be found at <http://planetsci-cerena.weebly.com>.

Research on paleopermafrost and periglacial environments by the CEG/IGOT-UL in the Serra da Estrela (Central Portugal) has restarted. A. Trindade received a FCT funded grant for conducting PhD research on the topic. The focus is on paleoenvironmental interpretation of slope deposits through sedimentological analysis.

The Portuguese IPA group joined at the 3rd Iberian Conference of the IPA in Piornedo, Northwest Spain, where new results of research have been presented. The meeting served also to discuss collaborations with the Spanish colleagues, as well as to plan for the upcoming 4th European Conference on Permafrost that will take place in 2014 in Évora (Portugal). The Organizing Committee met in Piornedo, together with the Spanish IPA members and planned for the conference and especially on the Spanish contribution for the pre and post conference field trips. EUCOP4 was approved in October by the IPA as its Regional Conference for 2014. The event will be jointly organized by the Universities of Lisbon and Évora, in the UNESCO World Heritage town of Évora.

The FCT-CAPES funded Luso-Brazilian Programme for Research on Antarctic Permafrost and Terrestrial Ecosystem Dynamics, a collaboration of the CEG/IGOT-UL (G. Vieira), CGE-UE (A. Correia) and Federal University of Viçosa, Brazil (C. Schaefer) started in 2011. This project aims at coordinating research of both countries on permafrost and active layer in the Antarctic Peninsula and includes student and staff exchange between both countries. A. Trindade, a PhD student from the CEG/IGOT-UL has been in Brazil for 3 months in order to learn new skills on cryosoil geochemistry and micromorphology. PhD student T. Torres and Post-Doc B. Mendonça from Brazil visited Portugal for 5 months in late 2011 for training on active layer and permafrost monitoring and

analysis. In the framework of this project, G. Vieira and C. Mora lectured the intensive course "Introduction to geomorphic dynamics of polar and mountain environments" at the Federal University of Viçosa (Brazil) in October 2011. The course counted with the participation of over 60 MS and PhD students, as well as post-docs from 3 Brazilian universities.



Participants in the course "Introduction to geomorphic dynamics of polar and mountain environments" at the Federal University of Viçosa (Brazil) in October 2011.

Gonçalo Vieira and Pedro Pina

18 Romania

During 2011, the activities of Romanian community of glacial, periglacial and permafrost researchers were undertaken only at universities and cover most of the Romanian Carpathians arch and Romanian-Ukrainian Carpathian sector.

At the Department of Geography, West University of Timișoara, P. Urdea and his team (M. Ardelean, F. Ardelean, A. Onaca) are continuing frost heaving and depth of frost monitoring program in the Muntele Mic area, coupled with thermal photography and infrared cameras, magnetic susceptibility meter and thermal characteristic meter (conductivity, diffusivity) in the investigation of periglacial forms (earth hummocks, solifluctional forms) extended in Făgăraș and Țarcu Mountains. Also, our team and several postgraduate are continuing the program of geophysical investigations - ERT, GPR (Fig. 1) - , ground temperature monitoring by sensors on rock glaciers, scree slopes and rock walls, solifluction lobes, small sorted nets, rocks rivers (Fig. 2) and fossil palsa. In addition, P. Urdea started a series of self-potential investigations in earth hummocks, solifluctional forms and fossil palsa (Fig. 3). Under the coordination of Mircea Ardelean the team of West University of Timișoara started an investigations program of some karstic shaft with perennial snow and ice in Piule-Iorgovanu Mountains, focused on temperature and firn-ice masses evolution (Fig. 4).



Fig. 1. GPR investigations in Ana rock glaciers, Retezat Mts. Fig. 4. (Photo, P. Urdea).



Fig. 4. Instalation of thermal sensor in Albele karstic shaft, Piule-Iorgovanu Mts. (Photo, M. Ardelean).



Fig. 2. Rocks-river dynamics measurements, Cindrel Mts. (Photo, P. Urdea).



Fig. 3. Fossil palsa in the glacial morainic complex Soarbele, Godeanu Mts. (Photo, P. Urdea).

Glacial and periglacial relief and relict permafrost indicators were studied by Timișoara team in Capra_Buha area (Parâng Mountains), Cindrel and Lotrului Mountains (Fig. 5), and by P. Urdea in Cărligata-Buteasa area (Apuseni Mountains).



Fig. 5. Tors in Cristești Mountain, Lotrului Mts. (Photo P. Urdea).

Under the coordination of P. Urdea (Timișoara), P. Chiroiu and R. Putan started their investigations for the Ph thesis on the topic of dendrogeomorphology and dendrochronology of periglacial forms and processes of the alpine belt of South Carpathians and, respectively, geomorphologic and geophysical investigations of periglacial forms and processes on upper part of Capra basin (Făgăraș Mountains). A team of West University of Timișoara lead by M. Voiculescu worked in Southern Carpathians snow-avalanche rhythms during the last decades, combining geomorphic and dendrochronological methods.

Under the coordination of P. Urdea (Timișoara), P. Chiroiu and R. Putan started their investigations for the Ph D theses on the topic of dendrogeomorphology and dendrochronology of periglacial forms and processes of alpine belt of South Carpathians and, respectively, geomorphologic and geophysical investigations of periglacial forms and processes on upper part of Capra basin (Făgăraș Mountains).

In the year of 2011, at the Faculty of Geography, Bucarest University, two PhD theses regarding the permafrost phenomenology (Razvan Popescu) and rock wall denudation (Mirela Vasile) in Southern Carpathians were initiated under the coordination of dr. Alfred Vespremeanu-Stroe. An inventory of the rock glaciers in Southern Carpathians was made based on spatial images. The monitoring of annual ground surface temperature using miniature temperature data loggers and also bottom temperature of snow measurements were conducted on more periglacial landforms of rock glaciers and talus slopes from Retezat (Fig. 6), Parâng and Făgăraș Mountains. Also, the monitoring of two important controlling factors for permafrost maintenance was initiated: liquid precipitations - pluviometry to assessment the local differences in the same massif -

and solar radiation – pyranometry to assessment the differences between computed and field-measured radiation values. Crack extensometers and digital thermometers with data loggers having great capacity of storage for high frequency of sampling were used for a better assessment of rockwalls thermal regime and its effects on weathering (Fig. 7). In-depth thermal measurements were initiated as well, following the profile 2, 15, 20, 40 cm in rock, in order to determine the thermal gradient in different lithologies and areas. The exposure and its influence on the weathering processes is being intensely studied, experimental measurements being conducted in the field in Retezat, Făgăraș and Bucegi Mountains.



Fig. 6. Monitoring of annual ground surface temperature using miniature temperature data loggers and bottom temperature of snow measurements on periglacial landforms of rock glaciers and talus slopes from Retezat (Photo P. Urdea).



Fig. 7. Instalation of crack extensometer in rock walls from Retezat Mountains (Photo R. Popescu).

Studies of perennial ice accumulations in caves continued throughout 2011 in Romania by a

„Babeş-Bolyai” University (Cluj-Napoca) team (A. Perşoiu, B. Onac, I. Perşoiu) . These investigations aimed to 1) decipher the mass balance and dynamics of ice in caves ; 2) explain the relations between climate and the stable isotope composition of ice ; 3) assess the palaeoclimatic potential of pollen grains in ice and 4) disentangle external and internal climate impact on ice dynamics in caves. The vast majority of studies were devoted to Scărișoara Ice Cave (Fig. 8), with some side projects being aimed to Borțig and Focul Viu Ice Caves (Apuseni Mts.).



Fig. 8. Ice sampling for palinological investigations and stable isotope composition on Scărișoara Ice Cave (Photo A. Perşoiu).

On the other hand the studies in Scărișoara Ice Cave formed the bulk of a PhD thesis by Aurel Perşoiu, entitled “Palaeoclimatic significance of perennial ice accumulations in caves: an example from Scărișoara Ice Cave, Romania”, defended in February 2011 at the University of South Florida, Tampa, USA.

The research group of University of „Ștefan cel Mare” University Suceava, lead by M. Mândrescu focused his interest to: 1. detecting new glaciated/periglacial areas and new glacial/periglacial features in the Northern Romanian Carpathians and Romanian-Ukrainian sector ; 2. new studies on the periglacial features and evidence regarding the paleowind direction in Obcinele Bucovinei (“wind

shaped tors”), and 3. studying and mapping the paraglacial and parafluvial features such as antislope scars and rock slope features in the Northern Romanian Carpathians (Fig. 9) and Romanian Ukrainian Carpathians (Fig. 10).



Fig. 9. Antislope scars and rock slope features in The Rodnei Mts. (Photo M.Mândrescu).

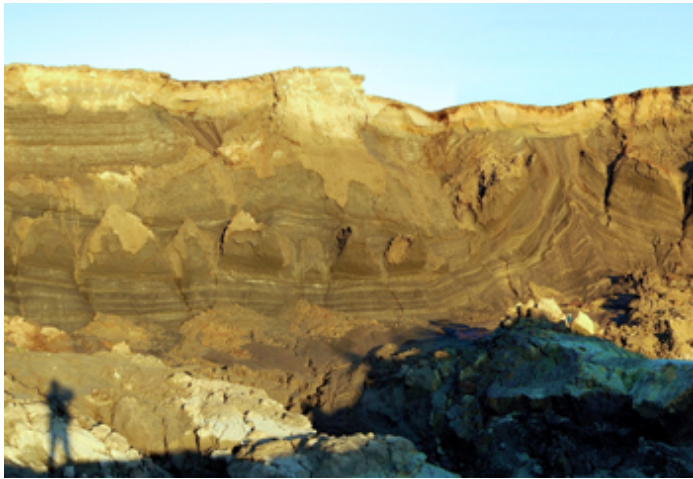


Fig. 10. Antislope scars and rock slope features in Pop Ivan Mountain (Photo M.Mândrescu).

Petru Urdea (urdea@cbg.uvt.ro)

19 Russia

The Russian Committee on the Earth Cryology as the head organization of the 10th International Conference on Permafrost continued to prepare for the main forum of permafrost scientists jointly with other co-organizers of the conference: Tyumen State Oil and Gas University and Government of Yamal-Nenets Autonomous District. The scientists of the Institute of Earth Cryosphere carried out field research on the Yamal peninsula and Polar Ural area in order to determine places of field excursions within the conference framework.



Exposure of massive ice on the Western Yamal, Marre-Sale cape – One of the features to be seen in the TICOP excursions.



The longest polar railway bridge across the Yurebey river, Yamal peninsula – to be seen in one of the TICOP excursions.

The Fourth conference of Russian permafrost scientists and specialists took place on June 7-9, 2011 at the Geology Department of the Lomonosov Moscow State University. The conference was dedicated to a 100th anniversary of V.A. Kudryavtsev – the founder of the first permafrost department at the university. The main organizer of the conference was the Geocryology Department of MSU. There were the following scientific topics presented at the conference: physics-chemistry, thermal physics and mechanics of frozen grounds; geophysical survey in the permafrost zone; lithogeneous geocryology; gas and gas hydrates in the Earth's cryolithosphere; regional and historical geocryology; dynamic geocryology; cryology of planets and biological problems in permafrost zone. The problems of engineering permafrost studies were considered within the following sections: problems of oil and gas fields development in the permafrost regions; engineering geocryology; ecological problems of permafrost; research and design in permafrost

areas. The presentations within the section methodology and education in geocryology were dedicated to training of specialists in the field of permafrost studies. There were 196 scientific presentations introduced on these fields within the conference framework. Preparation of the presentations was carried out by 356 authors representing 118 scientific, scientific-practical and production organizations from various regions of Russia, as well as foreign participants from the USA, Germany, Canada, Sweden, and Japan.

IX International Symposium on the problems of engineering permafrost studies was arranged on September 3-7, 2011 in the city of Mirny. The main organizer of the Symposium was the Melnikov Permafrost Institute. During the work of three sections and a round table there were 59 oral and 28 poster presentations introduced and discussed. Among the works of the Symposium there were 90 presentations published, from which 26 presentations of the foreign scientists from 22 organizations of China, USA, Iran, England, Germany, Denmark, Canada, Poland, and Sweden. The Russian scientists were presented by the employees of 34 different organizations from 19 cities (Moscow, Saint Petersburg, Tyumen, Novosibirsk, Yakutsk, Nizhniy Novgorod, etc.).

In 2011 the Russian scientific organizations and university research groups continued the monitoring research of thermal state of permafrost and stability of cryogeneous geosystems at climate change and industrial disturbances in continental regions and in the Arctic. For a closer collaboration of researchers and development of a common methodological and technical basis of monitoring research in the permafrost zone there are the main representatives of Russian workgroups appointed: Andrey A. Abramov is the official officer in the TSP-group focusing on permafrost temperature; Galina V. Malkova is the official officer in the CALM focusing on the active layer depth measurements. David A. Gilichinskiy is the main coordinator of GTN-P program.

N.Oberman, Komi group of the State Monitoring Regional Center, there is a map of ecological conditions of the reserves is made, the scale is 1:3 500 000 for the Atlas of the Komi Republic. On the map, made on the base of the 20-year monitoring research, the following is shown: the southern border of permafrost in Bolshezemelskaya tundra, as for the year of 1970 and its shift towards the north for 35–40 km as for the year of 2005; cryogenic processes active development areas, the ice content of the annual thermal exchange layer and the temperature at its base.

The design institute Fundamentproekt (Director M.A. Minkin) – the Russian leader in engineering-geocryological research and investigations in the permafrost zone has celebrated its 60th anniversary. Another company is the Scientific-Production Association FundamentStroyAkros (the city of Tyumen) honoring its 20th anniversary arranged the International Conference on Engineering Permafrost Studies. One of the conference topics concerned the main company's activity – the temperature stabilization of the frozen grounds.

The detailed complex of investigations on design and monitoring of transportation systems (automobile and railroad) in the permafrost zone is carried out by the Research Company TransIGEM (prof. V.G. Kondratyev).

The staff members of the Geocryology Department, MSU (A. Brushkov, I. Komarov, L. Roman, L. Khrustalev, and others) took part in updating the main regulatory documents concerned with building the engineering constructions on the frozen grounds (Construction Norms and Rules and State Standards) in the following fields: probability methods of calculating the bearing capacity of permafrost bases, physical and thermal-physical properties of frozen saline and biogenic grounds, strength characteristics of frozen saline and biogenic grounds, classification of grounds (development of the main definitions of classification criteria of frozen saline and peaty grounds, distinguishing the main structures of frozen grounds. Compliance with the European classifications), engineering-ecological research.

Under supervision of professor N.N. Romanovskiy there research was carried out on the dynamics of training ground microrelief in the Yano-Indigirskaya lowland within the framework of the project «POLYGON» with a support of the joint Russian-German grant «Polygons in tundra wetlands: state and dynamics under climate variability in Polar Regions».

In 2011 the Department of Cryolithology and Glaciology, MSU jointly with the G. Washington University (District of Columbia, USA) organized and carried out a summer field international student practice with the following route «Krasnoyarsk – Igarka – Norilsk» (the supervisor of the practice: Dr. V. Grebenets, Prof. N. Shiklomanov, Dr. D. Streletskiy). The Russian and American students investigated the landscape-frozen peculiarities, cryogenic processes, engineering-geocryological problems, geoecological and social-economic-geographic conditions of the

North of Russia, and participated in the researches within the international programs IPA (CALM, TSP). Another area of the summer student practice was the Austrian Alps. In July – August, 2011 the students of this Department jointly with the Bavarian Academy of Sciences (Germany) and Innsbruck University (Austria) organized the international students courses with the studies of glacial and frozen complexes, processes and phenomena near the glacier Fernargtferner at The Ötztal Alps, Austria (supervisor – Associate Professor V. Popovnin, Prof. M. Kun, Prof. L. Braun).

20 South Korea

Korea Polar Research Institute

A new research project starts on June 2011, which is supported by Korea MEST (Ministry of Education, Science and Technology): Establishment of Circum Arctic Permafrost Environment Change Monitoring Network and Future Prediction Techniques (CAPEC Project, PI Dr. Bang Yong Lee) Through this project, we have a plan to establish Arctic monitoring nodes to study environmental changes and develop the state-of-the-art observation techniques for terrestrial permafrost region. This monitoring project includes atmosphere-geosphere-biosphere monitoring system with Ubiquitous Sensor Network (USN) and GPS monitoring. The research aim of this project is (1) Understanding the correlation between carbon dioxide (CO₂) fluxes with soil properties, (2) Estimating the contribution of microbial respiration, and plant photosynthesis and respiration to the CO₂ production from soil (3) Understanding geophysical and mechanical behavior of frozen ground correlated with environmental change. On the basis of KAMP (Korea Arctic Multidisciplinary Program) and CAPEC project, we did Arctic exploration on four different research sites in this summer: Ny-Ålesund, Svalbard Archipelago; Zackenberg, Greenland; Council, Alaska; and Cambridge Bay, Canada.

Ny-Ålesund, Svalbard Archipelago

We collected soil samples to study microbial community and soil organic carbon (SOC) in the area down from Vestre Lovénbreen where different vegetation types were established. We also set plots to study the succession of vegetation in this area. We also have a plan to analyze the spatial distribution of vegetation and microbes along chronosequence of Austre glacier retreat, and the effects of glacier melting water on the both organisms' establishments and soil development.



Korean Research Team (Dr. Yoo Kyung Lee and Dr. Ji Young Jung from KOPRI, Prof. Eun Ju Lee from Seoul National University and students)

Zackenberg, Greenland

In Northeast Greenland, as collaboration with Prof. Anders Michelsen (Univ. of Copenhagen), we visited Zackenberg Research Station (74°30'N / 21°00'W) to collect soil samples at the experimental plots (treatments: summer warming, shaded, added snow, removed snow, and control). We are interested in microbial community and SOC (soil organic carbon) responses to warming. We appreciate Dr. Morten Rasch (Univ. of Aarhus) supporting our visit to Zackenberg Station.



Field trip in Zackenberg Station (Dr. Yoo Kyung Lee and Dr. Ji Young Jung from KOPRI)

Council, Alaska

We managed an automatic carbon dioxide (CO₂) chamber system to monitor CO₂ exchange between surface soil and atmosphere in this area. Chamber system consists of 15 chambers (40 cm × 30 cm), soil

temperature and water content sensors, and solar and wind power generators. Main objective of this study is to investigate roles of vegetation and soil microbes in CO₂ exchange. We also installed an automatic electrical resistivity tomography (ERT) monitoring system from June to September. The ERT monitoring system consists of a fixed array of 42 electrodes with a spacing of 1 m. The electrodes are connected by cable to resistivity meter (Terrameter LS). The array of ERT was dipole-dipole array. We expect ERT monitoring can reveal substantial ground ice degradation as a consequence of variation of air temperature and gas migration. We collected soil samples in order to characterize permafrost soil properties, microbial communities and their correlation. We appreciate Prof. Larry Hinzman (Univ. of Alaska, Fairbanks) supporting our visit to Council site.



CO₂ chamber system established in Council site



Korean Research Team (Dr. Ok-Sun Kim, Dr. Dockyu Kim from KOPRI and Prof. Hee Myung Noh from Seoul National University, ect.) at Council site.

Cambridge Bay, Canada

To pursue the possibility of collaborative research with Canadian partners in the area of long-term monitoring

and assessments of the permafrost, we visited Cambridge Bay on July, 2011. We checked the candidate research area to set up an integrated permafrost monitoring package in Cambridge Bay area. The proposed working package will be the form of monitoring tower type, which will be composed of met observation, CO₂ and/or CH₄ (ambient concentration and/or flux), black carbon measurements, long-term permafrost monitoring bore-hole, soil temperature, radiation (solar, thermal albedo, etc), and so on.



Dr. Young Jun Yoon, Dr. Ok-Sun Kim from KOPRI with Canadian researchers at Cambridge Bay, Canada.

YooKyungLee(yklee@kopri.re.kr)

21 Spain

Spanish research groups working on cryosphere subjects have continued working at different places of Iberian Peninsula, Andean high mountains and Polar Regions. Studies have focused mainly on mountain permafrost degradation, periglacial and nival processes and landforms and their spatial distribution, collaborating with International groups of USA, UK, Portugal, Japan, New Zealand, Argentina, Perú, Brazil, Mexico, France and Switzerland. Several group presented his works on periglacial and permafrost subjects in the III IPA-Iberian Meeting, where it was possible to see the state of the research on periglacial and permafrost made by Spanish groups.

From 21 to 24 June took place the III IPA-Iberian Meeting, organized by the Department of Geography (University of Santiago de Compostela) and coordinate by the Spanish and Portuguese IPA groups, in Piornedo (Galicia, Spain). The Meeting included 4 lectures, 17 oral and 13 poster

presentations in four sessions. At the meeting 35 Spanish and Portuguese scientists participated. Abstracts of presentations have been published in the proceeding “Criosfera, suelos congelados y cambio climático”, edited by the University of Santiago de Compostela. Sessions on “Present day dynamics in periglacial and nival mountain environments”, “Quaternary periglacial environments and chronologies”, Research in Antarctica” and “Permafrost as Planetary cryospheric subsystem” and three lectures by J. Bockheim, A.G. Lewkowicz and C.Thorn took place. The organizers group showed the nival landforms and processes studied in the Sierra de Ancares during one day field trip. We are grateful to M. Valcárcel and P. Carrera by his efforts in organizing, and the invited lecturers by the three very interesting conferences on soils, permafrost and nival processes. Two awards were given to young researchers, one to the best young oral presentation and another one to the best young poster presentation. The first award was for Marc Oliva (UL) and the second one for María González-García (UMA).



Participants in the III Iberian Meeting of IPA in June 2011. The meeting was organised by Marcos Valcarcel (University of Santiago de Compostela) in Ancares (Galicia).

In 2011 has been edited a monographic number on rock glaciers in the Iberian Península (with papers in English and Spanish) of the review Cuadernos de Investigación Geográfica (Geographical Research Papers, nº 37-1, 2011) edited by Prof. J. Arnáez (<http://www.unirioja.es/servicios/sp/ej/cig/cig.shtml>). Seven papers have been published with works on relict rock glaciers in Sierra Nevada (two papers), Cantabrian mountains (two papers), and active rock glaciers in the Pyrenees (three papers).

Several Spanish research groups have been made advances related to periglacial subjects:

PERMAMODEL project, run by the Department of Physics of Alcalá University in collaboration with the Centro de Estudios Geográficos-University of Lisbon,

focuses on the study of the evolution of the thermal active layer in polar permafrost and it is leaded by Dr. Miguel Ramos (Alcalá University). The field experiments are developed in Livingston (62°39'S, 60°21'W), Deception and Penguin (62°43'S, 60°57'W) islands in the maritime Antarctic. These islands have significant areas with ice-free terrain underlain by permafrost and any of them with volcanic activity. The location of these islands close to the mean annual temperature isotherm of -1°C, and their position in the Antarctic Peninsula region, results in a very high sensitivity to climate change. The goal of this project is the monitoring of the temperature gradient of the active layer, as an approach for the calculation of the energy balance of the ground and therefore for the study of climate change, being complementary to the standard meteorological observations. Furthermore, monitoring of the temperature gradient and thermal fluxes of the permafrost in boreholes down to the zero annual amplitude depth, allow the application of inverse modeling techniques for the detection of climate change in decadal, and even centurial, time scales.

Also the Physics and Geology Departments of the Alcalá University are participating in the Mars Science Laboratory NASA mission (MSL) by mean of its join in the experience; Rover Environmental Monitoring Station (REMS) that is lead by the Centro de Astrobiología (CAB-INTA). Mars Science Laboratory is part of NASA's Mars Exploration Program, a long-term effort of roboic exploration of the red planet. Launched on Nov. 26, 2011, 7:02 a.m. PST (10:02 a.m. EST). Mars Science Laboratory is a rover that will assess whether Mars ever was, or is still today, an environment able to support microbial life, basically on the permafrost system. In other words, its mission is to determine the planet's "habitability."

The Research Group on High Mountain Physical Geography of University Complutense of Madrid, leaded by Prof. David Palacios continues researches on climate change and hydrological resources in the Andes, included mountain permafrost and relationship with rock glaciers, recession of glaciers and volcanic activity. During 2011, in collaboration with Dr. Kenji Yoshikawa (University of Alaska), have been made several sounding between 1.5 and 4 m depth in the summits of Chachani (Perú) and Iztaccihualt (México), highest of 5,000 m a.s.l. (Figure 1). It was impossible to use helicopter and so the transport difficulties of the sounding machine were very great (Figure 1A). Present day the group is waiting to collect thermal data registered during the last year. Moreover, the monitoring of the active layer have been continued by 1 meter depth sounding made to several altitudes (between 4,000 and 5,800 m a.s.l.) on the Chachani,

Misti and Coropuna volcanoes of Peru, and Iztaccihualt and Popocatepelt volcanoes of México.

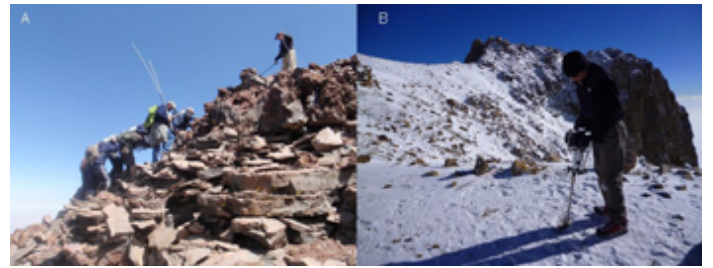


Figure 1. A. Climb with a generator by the steep slopes of the volcano Chachani, at 5300 m altitude, in November 2010. The generator permitted to make a drilling and find a frozen body. B. Kenji Yoshikawa sounding on permafrost in the volcano's summit Iztaccihualt (Mexico) to 5100 high, in November 2011.

The Sierra Nevada and the Eastern Pyrenees have been the main places to study periglacial processes and landforms during 2011 by the University of Barcelona Research Group (2009SGR868), leaded by Prof. Antonio Gómez-Ortiz. The works made in the Sierra Nevada (SE of Iberian Peninsula, 37°N 3°W) have focused on the processes of relict glacier ice and permafrost in the Corral del Veleta (3,120 m a.s.l.). The relict ice was detected in 1999 under a block cover and from 2001 his evolution has been monitored. The origin of relict ice and permafrost conditions could be the historical cold period named Little Ice Age. In the Eastern Pyrenees (NE Iberian Peninsula, 42°N 1°E), have been registered soil thermal data of the alpine belt, where cryonival processes and landforms are dominants. Thermal monitoring of soils (2007-2011) indicates that the medium depth of seasonal frost-thaw is 35 cm depth at the forest belt (La Feixa-La Màtiga, 2150 m) and 40 cm depth above the timberline (Calmquerdós, 2750 m).

Studies in Sierra Nevada, made in collaboration with the universities of Madrid (Complutense), Extremadura and Granada, show the progressive relict ice and permafrost degradation. The thermal data of active layer, the small snow cover during the summertime, the hummock on the debris cover and the frozen body geometry are indicators of the degradation processes. The electric tomography made in 2009 show a internal structure characterised by disconnected frozen bodies to depths -2 m, while in 1999 the top of frozen bodies was located to -1.20 m depth. At this time the frozen bodies was continuous and homogeneous. The thermal data point out a degradation of the top of the permafrost, present day at 1.50 m depth the temperatures change form -2.5°C to 0.7°C between June and September (Figure 2). The results of 2010

and 2011 measurements are unknown because from November 2009 the Corral del Veleta has a snow cover higher than 2 m thick during both summers. So, it is impossible to get data from the monitoring points. It is predictable the absence of degradation during the last two years because all debris cover is frozen and does not permit the penetration of the thermal radiation wave in the active layer.

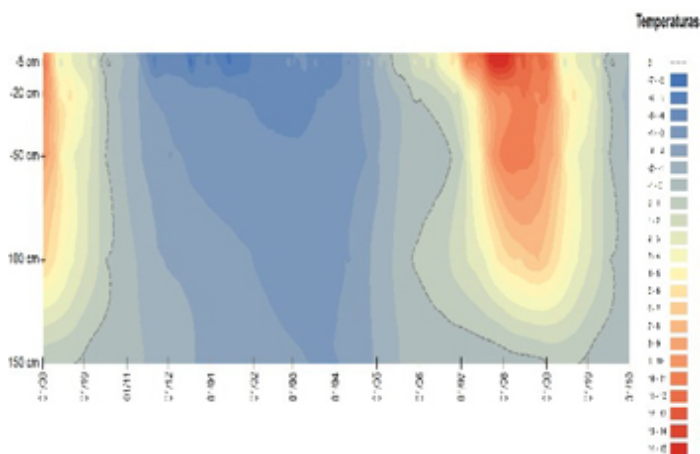


Figure 2. Thermal rhythm of the active layer (Corral del Veleta, Sierra Nevada, 3,120 m a.s.l.).

The PANGAEA Research group (University of Valladolid), continue working on cryosphere in the northern mountains of Iberian Peninsula focused on paleoenvironmental reconstruction of permafrost environments and the active periglacial high mountain environment. Projects supported by National Funds (OAPN 053/2010 and CGL-2010-19729) and the collaboration between five universities (University of Valladolid, University of Extremadura, University of Basque Country, University of Cantabria, Saint Louis University and CES-ALFA Speleological Studies Centre) are dedicated to the study of slope processes related to ice and snow, and the ice existence (glaciers, relict ice, frozen bodies and ice caves) and his dynamic and distribution at the mountains of North Iberian Peninsula (Pyrenees and Cantabrian Mountains). The main objective is to complete the systematic observations through the application of DGPS and Laser-Scanner -on protalus lobe, rock glaciers, debris lobes and cones, ice-patches and ice caves-, soil thermal regimes (soils monitoring and BTS), data analysis of new mountain weather stations and geophysical techniques to relate slope geomorphological activity, thermal conditions and ice conservation and degradation.

This team is working on glacial and periglacial evolution during the Pleistocene and Holocene in the Pyrenees, the changes from glacial to periglacial environments and the present day periglacial processes and mountain permafrost distribution. Have

been applied geomatic techniques, GPR ones and thermal measurements on the LIA forefields of Maladeta, Infierno and Posets massifs for studying the periglacial processes and mountain permafrost. Datalogger and measurements on movements of rock glacier, protalus lobe, debris lobe and slopes look for to get a soil thermal map and a geomorphodynamic map. Partial results show relationship between permafrost and processes above 2700 m a.s.l. Present day, movements on Maladeta rock glacier, Maladeta protalus lobe and debris lobe at several altitudes are known, and they are a complementary knowledge to studies made on Posets and Argualas rock glacier during the last fifteen years. At the same time the PANGAEA research Group is working on present day glaciers (Maladeta, La Paúl-Posets, Infierno, Monte Perdido and Ossue) by GPS control, Laser Scanner and GPR measurements as compliment of study of ice degradation on glaciers and soils.

In the Cantabrian Mountains, by means of soil thermal measurements by dataloggers during the last five years and BTS measurements, have been established the existence of marginal permafrost environments related to relict glacier ice and favourable topoclimate conditions in the Picos de Europa massif. The periglacial processes in the most of Picos de Europa and all the other Cantabrian Mountains are related to the seasonal frozen soils. Slope processes at low altitudes are been studied as possible inferences to past cold period. Geomatic techniques (Laser-Scanner, DGPS, terrestrial photogrammetry) are being used to know the surface movement of debris cones, debris and fines lobes, slides, ploughing blocks, and the relationships with soil thermal regime, snow cover, water availability and surface processes – snow avalanches, rock fall, piping and gelifluction-. During the last two years have been studied the environment of ice caves in the Picos de Europa. An inventory of ice caves show more than 30 caves with perennial ice. Thermal and wet datalogger at different altitudes from 30 to 100 m. depth (Figure 3) have been set up in three ice caves of the Central Massifs. Ice have been analysed and laser scanner applied to know the ice age and cover, characters and dynamic. The next two years could be possible to get results.



Figure 3. Folded ice mass to 100 m depth in the Veronica Cave (Picos de Europa).

The Research Group on Geosciences and Antarctica, led by Jerónimo López-Martínez (University Autónoma of Madrid), is working on the characteristics and recent changes of geomorphological, neotectonic and hydrological processes as well as impacts on the terrain surface and superficial formations within the Northern Antarctic Peninsula region. The GEOPANT-2011 project studies the distribution of the permafrost, its effects on groundwater flows, and also the effects of human activities on soil and terrain surface. The methodology used was developed and applied previously by members of the research team in East Antarctica. The results will allow a comparison of the impacts from these effects and the recovery potential in different Antarctic environments. For all the studies in the different subjects included in this project, recent Radarsat-2 satellite images will be used. The images have already been acquired through the framework of the Canadian Space Agency.

The research group of University of Santiago de Compostela, led by Augusto Pérez-Alberti and Marcos Valcárcel continues working in the Galician Mountains and the Andes. Periglacial Andean environments in Tierra de Fuego and central Andes and nival processes in Ancares are the main researches developed by this research group.

Enrique Serrano

22 Sweden

Stockholm University

At the Department of Physical Geography and Quaternary Geology, Stockholm University, G. Hugelius presented his PhD thesis entitled "Quantity

and quality of soil organic matter in permafrost terrain" in February. Within the project "Permafrost and thermokarst lake dynamics in a subarctic peat plateau, northern Sweden" (B. Sannel), monitoring of ground temperatures in the peat plateau-thermokarst lake complex in Tavvavuoma (68°28' N, 20°54' E, 550 m a.s.l.) has continued. The year-round monitoring of meteorological parameters and ground temperatures started in 2005 and is now performed at ten locations within the peat plateau complex down to a maximum of 6 m depth (Figure below). A Stockholm team (G. Hugelius, J. Palmtag and J. Ramage) carried out fieldwork to assess total storage and landscape partitioning of soil organic carbon on Taymir Peninsula (August 2011), as part of the ESF Cryocarb project.



The monitored peat plateau-thermokarst lake complex in Tavvavuoma, northern Sweden. Lund University

GeoBiosphere Science Centre of Lund University has undergone structural changes. We are now two separate departments – a) Department of Physical Geography and Ecosystem Sciences and b) Department of Geology. Separate or in joint projects we continued and expanded activities in the Abisko area and in Greenland. The "Nordic centre for Studies of Ecosystem Carbon exchange and its interaction with the Climate system".(NECC) has got two monitoring sites in the Stordalen area. 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 intensive and important field activities in the Abisko area, especially in and around the Stordalen bog. For these projects the status and dynamics of the active layer and the permafrost in the bogs are of great importance.

LUCID, is a new Linnaeus programme sponsored by The Swedish Research Council for the period

2008-2018. LUCID is gathering seven disciplines from four faculties for together developing the scientific field “Sustainability Science” and it is coordinated by LUCSUS.

Linnaeus Grants are awarded to exceptionally strong environments performing research of the highest international quality and aiming at innovative research. LUCID aims at creating completely new and unique synergies across natural and social sciences in order to develop new integrated theories and methods for addressing complex sustainability issues. The research will offer theoretical, methodological and practical contributions to the broad and emerging field of sustainability science.

The old “IPA Abisko area active layer transect” is maintained within the CALM system by J. Akerman and Margareta Johansson. We are maintaining 6 of the mires sites along the 100 km east-west transect. Two sites have been abandoned as all permafrost has disappeared. The three mountain sites have been checked occasionally when helicopter transport were available but for these sites there are gaps in the records. The active layer sites have now been monitored since 1978 and annual basic data is presented within the CALM reporting system.

The snow manipulation experiment, where we simulate projected future increases in winter precipitation, is still up and running. After six years the results are visible by eye in spring, summer and autumn. The increased active layer thickness detected at the plots with additional snow is accompanied with surface subsidence, increased moisture and more graminoids compared to the control plots. Five boreholes ranging from 6 to 13 meters have recorded ground temperatures since 2008. Late this summer, the equipment from three of the boreholes was stolen (see figure below). The great advantages of being in an area easy to access now became a disadvantage. New loggers and sensors will be installed in February next year to keep up the monitoring in the boreholes.



Loggers at three of the boreholes in Abisko were stolen in late summer. (Photograph provided by S. Olsson.

23 Switzerland

The Swiss Permafrost Monitoring Network PERMOS celebrated 10 years of operation in 2010. PERMOS was initiated as a research-oriented network in the 1990ies, and officially started with a pilot phase in 2000. It is continuously developing towards an operational monitoring service. The joint funding by the Federal Office for the Environment (FOEN), the Swiss Academy for Sciences (SCNAT) and MeteoSwiss via the Swiss GCOS Office proved successful and substantially supports the network. In 2010, a renewal of the contract for the period 2011–2014 has been signed. The PERMOS Office (at the University of Zurich) coordinates observation and reporting activities, which are undertaken by six partner institutions (ETH Zurich, Universities of Berne, Fribourg, Lausanne and Zurich, WSL Institute for Snow and Avalanche Research SLF).



Excursion to the monitoring site at Gemsstock in the course of the 10th anniversary of PERMOS and view to Urseren Valley with the Tiefen glacier and granite rocks of the Central Swiss Alps in the background

PERMOS 2011 includes three types of observations:

(1) ground temperatures measured at and below the surface at borehole sites, (2) changes in subsurface ice and water content at these sites inferred by geophysical surveys, and (3) velocities of permafrost creep determined by geodetic surveys and/or photogrammetry. In addition, standardized documentation of fast mass movements from permafrost areas (e.g., rock fall) is being established. The three observation elements complement each other, and strategies to deliver a comprehensive picture that cannot be achieved without their joint interpretation are being developed. The observation sites have been carefully evaluated at the end of 2009 based on site characteristics, instrumentation and data quality. As a result so-called PERMOS Reference Sites have been determined. These sites provide the full set of parameters and are considered suitable for long-term operation. In addition, a number of PERMOS Consolidation Sites complement the network.

In addition to the regular field work, collaboration and reporting, major efforts in 2010 and in 2011 were related to integration, processing and storage of the data and the standardization of site instrumentation and strategies. The recently established monitoring activities in neighbouring countries have led to increasing collaboration and exchange with other institutions involved in mountain permafrost research.

The WSL Institute for Snow and Avalanche Research SLF continues to monitor ground temperatures and slope deformation in a growing network of high altitude boreholes (M. Philipps). Seven of these sites are included in PERMOS. On the basis of this valuable data E. Zenklusen Mutter has submitted a dissertation

entitled 'Statistical Analysis of Mountain Permafrost Temperatures'. In addition, terrestrial laserscanning is intensively used to investigate the dynamics of rockwalls, rock glaciers and scree slopes - in combination with airborne laserscanning and photogrammetry. The practical guideline 'Construction on permafrost' published in 2009 has been translated into French and Italian and is in widespread use in the Swiss Alps and neighbouring countries. A new German-Swiss project has just been started in collaboration with the University of Bonn to investigate the thermal and mechanical impacts of snow on frozen rockwalls. SLF is also a project partner in the recently launched Swiss Sinergia project 'The Evolution of Mountain Permafrost in Switzerland' (TEMPS). See www.slf.ch for further details.



Terrestrial laserscanner at Ritzlihorn (Bernese Alps), summer 2010, after a large debris flow damaged infrastructure in the underlying valley (Photo: M. Philipps).

The Institute of Geography of the University of Lausanne (C. Lambiel, C. Scapozza, J.-B. Bosson, L. Ravel) leads several research projects on mountain permafrost. In 2011 ended the project 'Distribution and structure of permafrost in alpine talus slopes'. The use of a multi-method approach (ground temperature monitoring, borehole logging, electrical resistivity tomography, seismic refraction, etc.) offered a precise imagery of the ground stratigraphy within the five talus slopes prospected in the study showing the very heterogeneous permafrost distribution and ice content at the slope scale.

In summer 2011, geophysical prospecting was carried out on a destabilized pebbly rock glacier made of calcareous schists, which is affected by severe slump processes and velocities of about 10 m/year (Tsaté-Moiry rock glacier, Valais Alps) revealing once again the extreme discontinuity of mountain permafrost. Attempts are currently made to integrate

this discontinuity in a model with a machine learning approach in order to improve the accuracy of permafrost extension maps in mountain areas.

Researches at the University of Lausanne also concern the glacier-permafrost interactions. In 2011 a project was launched to study the internal structure as well as past and current evolution of small debris covered glacier and their associated glacier forefields, in which large quantities of ground ice can be found. Related to this, the evolution of the Gentianes ice-cored moraine is studied with terrestrial laser scanning since 2007. A new project launched in summer 2011 aims at studying the evolution of recently deglaciated rock walls and/or affected by permafrost conditions with TLS and rock temperatures measurements in the Mont Fort area (Verbier).

More generally, efforts are continuing in mountain permafrost monitoring on various sites of the Valais Alps. DGPS measurements are repeated annually on 8 rock glaciers, bi-annually on 6 of them and seasonally on 2 of them, in order to follow their velocity variations. Ground temperatures are recorded in 13 boreholes, whereas ground surface temperature monitoring is carried out on about 120 sites. First measurements began in 1998. Finally, electrical resistivity monitoring is led on 2 sites since 2007. A part of these measurements are included in the PERMOS network.

Following a variety of seismic refraction, GPR and geoelectric campaigns, 7 boreholes have been located and drilled by the Institute for Geotechnical Engineering and the Institute of Geophysics ETH Zurich to depths ranging from 25 m to 28 m in the degrading Furggwanhorn rock glacier in the Turtmann valley (S. Springman, T. Buchli, H. Maurer). The hydrological regime has led to the development of thermokarst and depressions at the root, which are combining with surface deformations at more than 3 m/a. A multi-method deformation monitoring campaign utilizing terrestrial lidar, radar interferometry and DGPS is being conducted to determine surface movements and to combine these with data of shear at depth from borehole inclinometers. A meteorological station has been installed and thermistor chains have been placed in each borehole. Active layer investigations are being conducted by monitoring fluxes and further geophysical and hydrological campaigns are planned for next summer. A series of laboratory experiments are underway and combine with pressuremeter tests that were conducted in two of the boreholes to determine stress strain response in the rock glacier body. This characterisation will contribute parameters for the thermo-hydro-mechanical modelling phases to follow.

At the University of Zurich, Department of Geography, strategy and method for modelling permafrost distribution over entire mountain regions was developed and applied to the European Alps. A corresponding map showing permafrost distribution for the entire Alps with a resolution of approximately 30m is now available online. The legend and interpretation key communicate the uncertainties of the sparse data basis and the statistical modelling approach and allow to further refine the estimate shown on the map based field information (Böckli, Nötzli, Brenning, Gruber). A global permafrost map with a resolution of 1km has been elaborated and is also available online. It shows the importance of heterogeneity (such as topography or non-continuous permafrost) globally as well as the difficulties involved in validating or calibrating any global permafrost model (Gruber). Both maps are available online at www.geo.uzh.ch/microsite/cryodata/.

Based on 40 footprints that each contains ten iButton temperature loggers within 10m x 10m, mean annual ground surface temperature, the date of snow melt, and the date of snow-pack ripening have been calculated. The small-scale replication allowed to also investigate the often considerable variability that exists over short distances and that makes the comparison of grid-based models with point measurements difficult (Gubler, Fiddes, Schmid, Gruber).

The wireless sensor networks on Matterhorn and Jungfraujoch allowed demonstrating that temperatures at depth in heterogeneous and fractured bedrock can be markedly lower than assumed based on measurements and models in near-vertical and homogeneous rock. Furthermore, the measurement of cleft-dilatation on Matterhorn allowed distinguishing two modes of movement for permafrost rock mass with ice-filled clefts. One type points to ordinary thermo-mechanical forcing whereas the other shows an effect of ice temperature or melt (Hasler, Beutel, Gruber).

Dedicated hardware for the low-power operation of inexpensive single-frequency GPS for continuously monitoring the movement of slopes has been developed. The devices either log raw data or transmit wirelessly. First test show daily GPS solutions in post-processing to result in a positional accuracy of about +/- 1mm and resolve short bursts of rock glacier movement during snow melt and precipitation. In total, about 20 locations have been equipped for continuous GPS monitoring (Wirz, Buchli, Limpach, Su, Beutel, Raetzo, Gruber).

Based on a pilot campaign, the feasibility and utility of outdoor acoustic emission sensing for monitoring rock

damage during freezing has been demonstrated. Based on this, a measurement system for continuous operation in high-elevation rock walls has been developed, tested and installed. It contains the sensing and processing hardware, methods for fixing the sensors at depth, for installing temperature and liquid water probes in rock at depth, and for sealing boreholes appropriately. These measurements will provide a means to scale theoretical and laboratory insight on frost weathering and ice segregation to real conditions (Girard, Weber, Hunziker, Beutel, Amitrano, Gruber).

The measurements of rock and cleft temperature and dilatation as well as the continuous GPS and the acoustic emission monitoring are made in customized wireless sensor networks. This technology has moved from an experimental to an operational phase with continuous and highly reliable measurements. For the computer engineering community, this resulted in a new focus on the investigation of data quality issues, post-processing and online data cleaning mechanisms (Buchli, Keller, Lim, Beutel).

The open-source model GEOtop has been further tested and consolidated for simulating the coupled heat and water transfer in frozen soil and rock in mountain topography. The introduction of scripting interface now allows to conduct large parameter studies with high-performance computing (Endrizzi, Gruber). In order to apply such simulations to large mountain ranges, a method for sub-grid computation based on a lumped model is in development (Fiddes, Gruber).

During 2010, the University of Zurich (I. Gärtner-Roer) also quantified rockglacier kinematics by in situ measurements (tachymeter) at several PERMOS sites (Murtèl (keysite), Muragl, Turtmann Valley (keysite)). Additional rockglaciers were surveyed within the project "Monitoring and process analysis of permafrost creep and failure in changing temperature regimes", which is part of the German DFG-bundel "Sensitivity of Mountain Permafrost of Climate Change (SPCC)" running 2008-2011. An additional series was started on the destabilized Furggwang rockglacier, which is intensely investigated (7 boreholes with temperature and inclinometer measurements, geophysics, hydrology) by the ETHZ (S. Springman). In 2011 the kinematic measurements continue on the PERMOS and project sites mentioned already in 2010. In addition, data compilation with the "Airborne Digital Sensor" (ADS, Leica Geosystems) was started within PERMOS and will be evaluated within the SNF project TEMPS. Together with Norwegian colleagues (B. Etzelmüller, K. Lilleøren, A. Kääb; University of Oslo) a rockglacier study was performed on Iceland by

combining field mapping and analysis of aerial images and PALSAR data.

2011 started the SNF (Swiss National Foundation) Sinergia project TEMPS "The Evolution of Mountain Permafrost in Switzerland" whose lead is located at the University of Fribourg (C. Hauck). The 3-year project regroups researchers from the Universities of Lausanne, Fribourg and Zurich, the ETH Zurich and the WSL Institute for Snow and Avalanche Research SLF and consists of 4 strongly collaborating and inter-related subprojects, which focus specifically on the determination of the current state, and on the dominant processes influencing the future evolution of permafrost in the Swiss Alps, namely TEMPS-A "Regional Climate Model analysis for Alpine permafrost research" (Schär, Kotlarski, Salzmann, Rajczak), TEMPS-B "Ground ice and water content estimation and integrative analysis of mountain permafrost monitoring elements (Delaloye, Hilbich, Lambiel, Noetzli, Staub), TEMPS-C "From kinematics to dynamics: geomorphic and physical controls of permafrost creep derived from airborne digital sensors and terrestrial surveys" (Gärtner-Roer, Phillips, Schaepman) and TEMPS-D "Subsurface modelling of the sensitivity of mountain permafrost to climatic changes (Hauck, Hoelzle, Marmy). Based on process and modelling studies, the project seeks to understand the permafrost system in general and in an integrative way, and on different spatial and temporal scales. In 2010 and 2011 has continued the GRAPE "Ground-Atmosphere Modelling of Permafrost Evolution" subproject (Hauck, Hoelzle, Salzmann, Schneider, Scherler, Pellet, Rosset), part of the project cluster "Sensitivity of Mountain Permafrost to Climate Change" (SPCC). GRAPE has aimed on the one hand at bridging the gap between the analysis of global causes (RCM modelling) to the analysis of local impacts (mountain permafrost degradation) involving the scale transfer from RCM simulations (ENSEMBLES) to the quantification of freeze and thaw processes within the subsurface, and on the other hand at combining the refined model tools to include (a) atmospheric drivers, (b) improved assessment of current ground ice characteristics, (c) improved process analysis concerning permafrost degradation and aggradation and (d) analysis of possible future impact scenarios based on validated model simulations using geophysical, meteorological and borehole temperature monitoring data.

2011 saw also the finalization of the PhD thesis of S. Morard dedicated to the analysis of the effect and the efficiency of the air circulation for cooling deepest layer of a porous debris accumulation (talus slopes, relict rock glaciers) and also for preserving and/or

generating an extrazonal permafrost at locations where the MAAT is largely above freezing conditions ($>4^{\circ}\text{C}$). In addition the climate, ventilation and ice formation of the Diablotins ice cave has been investigated for the last two years (Morard, Bochud, Delaloye). Whereas the cave was almost not frozen around 1990, the ice has aggraded since that time and still prevents nowadays the continuation of the exploration in one of the deepest karstic cave system in the area.



The Diablotins ice cave in the Swiss Prealps : subliming ice stalactites by aspiration of cold air inside the cave in winter time (top); ice flooding (bottom) (photos: R. Delaloye)

The creep rate of Alpine rock glaciers and periglacial mountain slopes has continued to be surveyed by DGPS as well as by satellite SAR interferometry at the University of Fribourg (Barboux, Delaloye). A particular emphasis has been put for the last years on surveying rapidly moving, sometimes completely destabilized rock glaciers in the Valais Alps (western Switzerland) as for instance the Grabengufer rock glacier, which moved up to 180 m between 2009 and 2011.



The unstable front of the destabilized Grabengufer rock glacier in winter 2010 (photo: R. Delaloye)

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Monitoring the thermal state of permafrost by automated time-lapse Capacitive Resistivity Imaging

At the University of Sussex Permafrost Laboratory, geophysical experiments are being set up as part of the Natural Environmental Research Council (NERC) Technology Proof of Concept Programme. The aim of the experiments is to test the technical feasibility of undertaking time-lapse tomographic measurements using permanent, in-situ capacitive sensors to remotely monitor permafrost temperatures. The sensors are placed on the rock surface, as distinct from galvanic sensors drilled into the rock and subject to ice-induced disturbance or variable electrical contact. Results from capacitive sensors will be compared with those from galvanic electrodes used for time-lapse Electrical Resistivity Tomography (ERT) in blocks of soft and hard limestone subject to one-sided and two-sided freezing. It is hoped that this will lead to significant improvements in monitoring capability, both for permafrost simulation experiments in the laboratory and for practical applications in the field (e.g. monitoring of thaw-sensitive alpine permafrost in Europe). The research is funded by a NERC grant to Oliver Kuras, Paul Wilkinson, Phil Meldrum, Ed Haslam and Simon Holyoake (British Geological Survey), Julian Murton (University of Sussex) and Michael Krautblatter (University of Bonn), and is being carried out by this interdisciplinary team, which also includes Tim Cane, Phil Watson and Barry Jackson (University of Sussex).

The interactions of past permafrost and glaciers was a major theme of a Glaciotectonics Workshop that took place from 11th to 15th September 2011 at Sheringham, North Norfolk, UK. The complex polydeformed glacial and pre-glacial sediments exposed in the coastal sections of North Norfolk provided an ideal location and natural laboratory that brought expertise in glacial geology, structural geology, permafrost stratigraphy and state-of-the-art imaging of sediment microstructures. The workshop comprised a fertile mixture of talks and field visits. A prominent theme proposed by Richard Waller (Keele), Emrys Phillips, Jonathan Lee (British Geological Survey), David Vaughan-Hirsch (University of Southampton) and Julian Murton was the identification of geological evidence for coupling between a Middle Pleistocene ice sheet and permafrost beneath its margin, in the form of sand intraclasts within a glaciotectionic *mélange* (Figures 1 and 2; Waller et al., 2011) and rafts of chalk bedrock measuring tens of metres in length (Figure 3). The workshop was sponsored by the Quaternary Research Association, the Glacial Landsystems Working Group and the Subglacial Permafrost Task Force of the International Permafrost Association. It was organized by Emrys Phillips, Jonathan Lee and Hannah Evans (British Geological Survey), who have also edited a field guide on the topic:

Phillips E, Lee JR, Evans HM. 2011. Glaciotectonics - FieldGuide. *Quaternary Research Association* . (available from:

http://qra.org.uk/publications/field_guides)

Waller RI, Phillips E, Murton JB, Lee JR, Whiteman, CA. (2011). Sand intraclasts as evidence of subglacial deformation of Middle Pleistocene permafrost, north NorfolkUK. *Quaternary Science Reviews* 30: 3481–3500.



Fig. 1 Sand intraclasts within a glaciotectionic *mélange*

(the Bacton Green Till Member), West Runton, North Norfolk, UK. The intraclasts range from a few tens of centimetres to >10 m in length and have sharp contacts with the surrounding till. Preservation of primary stratification within the intraclasts is attributed to deformation at temperatures slightly below the pressure-melting point, when pore ice cemented the intraclasts as rigid bodies. At the same time deformation was concentrated into the surrounding finer-grained till because of its significant liquid water content and ductile rheology.



Fig. 2 A geological conundrum: the big question mark. This sand intraclast within the glaciotectionic *mélange* at West Runton invited participants of the Glaciotectonics Workshop to identify its origin and palaeoenvironmental significance. Please send your answers to Richard Waller.

Periglacial and Glacial Engineering Geology Working Party

The Working Party on Periglacial and Glacial Engineering Geology—part of the Engineering Group of the Geological Society of London—has submitted a book proposal to the society. The book's aim is to provide an essential reference handbook for professionals working in relict periglacial and glacial ground conditions, as well as a valuable textbook for students and others. The Steering Group of the Working Party comprises John Charman (Chair), Chris Martin (Secretary), Dave Giles, Julian Murton, Kevin Privett and Mike Winter. For further information, contact Chris Martin (Christopher.Martin@uk.bp.com).

Julian Murton (j.b.murton@sussex.ac.uk)



Fig. 3 Two stacked rafts of white chalk bedrock (note flint bands within them) separated by and overlain by unconsolidated sand and gravel of the Wroxham Crag Formation, Overstrand, North Norfolk, UK. The detachment of the chalk rafts is inferred to have occurred near the ice-sheet margin or proglacially, when permafrost was present in the chalk and overlying crag deposits.

25 United States of America

TICOP Proceedings.

The USPA is involved in editing papers for the Tenth International Conference on Permafrost (TICOP). Ken Hinkel is serving as Editor to coordinate the review of the 86 English-language papers that were submitted in October 2011. Of these, the first author is American on 33 (38%) papers. The 17 Associate Editors, representing discipline subtopics, have requested two reviews for each paper. All TICOP paper reviews are due near the end of November, and a subset of Associate Editors met before AGU to discuss issues related to publication of the Proceedings. The final version of all submitted papers is due on 1 February 2012.

The *2011 Fall Meeting of the American Geophysical Union* took place in San Francisco, California, December 5–9. Over 20 oral and 26 poster sessions included permafrost related presentations, which were distributed over ten AGU sections and focus groups.



During the 2011 Fall AGU in San Francisco, former Vice President of the US, Al Gore, hosted researchers in his home to discuss global climate change. (Left to Right) Walt Meier, University of Colorado; Marla Meehl, National Center for Atmospheric Research (NCAR); Jerry Meehl, NCAR; the Honorable Al Gore; Doug MacAyeal, University of Chicago; Eric Steig, University of Washington; and Larry Hinzman, University of Alaska Fairbanks. Photo by Dan Myers.

The *USPA Annual Meeting* was also held during the 2011 AGU Fall Meeting. The reception and the following agenda attracted a national and international crowd. Oliver Frauenfeld succeeded Torre Jorgenson as the USPA President. Thomas Douglas was appointed to Treasurer, Michael Lilly as President-Elect, and Mike Waldrop as a board member at-large. This year the meeting was also accessible live on the web through WebEx. Many of the attendees were early career permafrost researchers, which were informed about several travel grant opportunities to attend TICOP in Salekhard.

The *USPA membership* increased its student representation from 15 to 18 graduate and undergraduate fellows since 2010. As a whole, USPA had 104 paying members as of early December 2011, which is up from 95 in 2010.

USPA education and outreach activities were supported by the organization's educational funds; the Permafrost Young Researcher's Network (USPA-PYRN) Educational Fund, the University of Alaska Educational Fund (USPA-UAF) and the Permafrost and Engineering Educational program (PEEP). USPA continued to offer travel support to early career permafrost researchers attending the AGU Fall Meeting. The travel grants, which were supported by the PYRN and UAF Educational funds,

were awarded to Benjamin Abbot, Amanda Barker, Katrina Bennett, Elchin Jafarov, Miriam Jones, and Susan Natali. The winners received their check during the USPA Annual Meeting in San Francisco. The PEEP Educational Fund received its first application to its K-12 education program, which aim to provide support to science teachers in permafrost engineering education. The goal of this program is to introduce the importance of permafrost engineering issues to high school teachers and students.

USPA Past-President James "Jim" Rooney was given the prestigious 2011 Harold Peyton Award from the American Society of Civil Engineers (ASCE). He has had an exemplary 47-year career of cold regions practice and publications in geotechnical studies, planning, engineering, design, construction of civil engineering facilities in cold climates, and for his dedication to advancing engineering practice through ASCE Technical Council on Cold Regions Engineering committee activities. Jim is joining several other USPA members who were past winners of the award for outstanding contributions to cold region engineering.



Jim Rooney (center) with ASCE 2011 President Kathy Caldwell and ASCE Executive Director Pat Natale.

Vladimir Romanovsky, professor of geophysics, was the recipient of the 2011 Usibelli Award for Research from the University of Alaska Fairbanks. Romanovsky is among the world leaders in permafrost research. He is consistently sought out as an expert in who can explain complicated concepts to both the public and media and is a frequent collaborator with colleagues in a variety of disciplines. As part of his research work during the last five years, Romanovsky has mentored 22 students and nine postdoctoral researchers and has been listed on more the \$10 million in research grants, many of them with an interdisciplinary focus. He also teaches both graduate and undergraduate courses and incorporates his interdisciplinary philosophy into his teaching and service work.



Professor Vladimir Romanovsky is the recipient of the 2011 Usibelli Award for Research. Romanovsky is a specialist in permafrost with UAF's Geophysical Institute and the Department of Geology and Geophysics. UAF photo by Todd Paris.

In April 2011, *Fritz Nelson* received the Francois Emile Matthes Award for Lifetime Achievement in Cryospheric Science from the Association of American Geographers.

The Graduate School, Rutgers University, awarded *Jerry Brown* its Lifetime Achievement Award in a ceremony on March 4, 2011, on the Cook Campus, New Brunswick, NJ. The citation stated "In recognition of his distinguished contributions to the study of Arctic regions and their soils". Fritz Nelson, a former faculty member, attended the festivities. Jerry's professor and mentor at Rutgers, John Tedrow, was unable to attend

The American Society of Civil Engineers, ASCE, sponsored the first "Arctic Technology Conference", which was organized by the same professional societies that do the yearly "Offshore Technology Conference". The ATE conference attracted more than 1000 attendees. ASCE, through the Technical Council

on Cold Region Engineering (TCCRE), has several published monographs and books ranging from the “Quarterly Journal on Cold Regions Engineering” to “Cold Regions Pavement Design”. There are currently 12 monographs in the works. ASCE has currently about 4000 members with interests in cold region engineering. In addition to awarding Jim Rooney the Peyton Award, ASCE honored Don Hayley with the 2011 Canadian American Amity Award.

The ARCSS/Thermokarst project. Breck Bowden reports that the ARCSS/TK (<http://thermokarst.psu.edu/>) was established in 2008 with funding from the U.S. National Science Foundation. The intent of this project is to use a systems approach to address hypotheses about how upland thermo-erosional features influence the structure and function of the foothill and mountainous landscape in the vicinity of the Brooks Range in arctic Alaska. The project involves about 30 collaborating researchers from 11 institutions in the US and Canada. We found that the common thermo-erosional features in the Toolik region are glacial thaw slumps, retrogressive thaw slumps, thermo-erosional gullies, and active layer detachment slides. These features expose soil carbon and nutrients to microbial activity which significantly increases emissions of important trace gases (e.g., carbon dioxide and methane) to the atmosphere and increases export of sediment and nutrients to streams and lakes. When these features form, the original tussock tundra vegetation (*Eriophorum vaginatum*) is replaced over a period of several decades by a shrub-dominated community (*Salix* spp.). Thus, these thermo-erosional features have important long-term impacts on the arctic landscape and human communities. The ARCSS/TK project has engaged in a number of outreach activities including a series of seminars on the environmental and human consequences of permafrost degradation. Videos of the seminars have been archived by the Association of Polar Early Career Scientists at <http://www.apecs.is/>.



Thaw slump and sediment plume on the Wulik River (2010). Photograph provided by WB Bowden.

The Cold Regions Research and Engineering Laboratory, CRREL, through Kevin Bjella, Anna Wagner and Jon Zufelt reports that Phase I of the New CRREL Permafrost Tunnel in Fox, Alaska, is currently being completed. In March of 2011, 28.3 m of the proposed 300 m of new passageways, a refrigeration system, and portal structure were completed. The new excavation is 4.5 m x 4.5 m (w x h) and is planned to connect to the existing Permafrost Tunnel allowing for new studies of warm fine-grain permafrost, and broadening research from the Old Tunnel. Finishing of the tunnel walls to provide research grade surfaces for mapping and sampling is being conducted. The portal structure was completed this summer with retaining walls, vegetation seeding, and final grading. Geotechnical studies were also completed in the spring and summer at Thule, Greenland. Ground penetrating radar provided good imaging of over 5 m of ice-rich glacio-fluvial sediments, overlying a dipping shale bedrock sequence of the Thule Supergroup. The GPR results correlated very well with core samples and air-rotary drilling. Epigenetic wedges and thick segregated ice was encountered in the drilling, but was not visible in the GPR.

The construction of a permafrost soil warming prototype was completed at the Fairbanks Permafrost Experiment Station (Farmers Loop Road). This joint project with the Department of Energy's Oak Ridge National Laboratory seeks to understand the physical, biological, and chemical changes in permafrost soils when they are heated to 4 °C above ambient conditions, as an analog for climate change. Low energy heaters are inserted to a depth of 4 meters with the lowest meter heated. The 30-meter diameter plot and control area are instrumented with thermistors and the heaters are controlled by a power management system. The heaters were recently turned on and the

soil will be heated for the next 18 months.



The experimental warming plot near Fairbanks. Photograph provided by Jon Zufelt.

CRREL also had a 50 year anniversary alumni gathering in 2011 (see photo provided by Jerry



CRREL 50th Anniversary, 2011, Alumni Photo

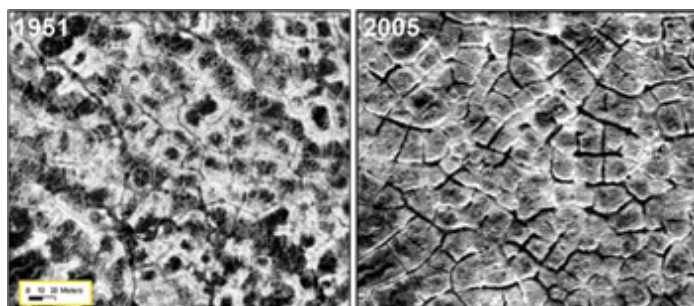
1-Peter Smalldge 2-Doc Simon 3-Steven Lotterhand 4-Bill Harrison 5-Nancy Libson 6-Mary Albert 7-Helen Lobacz 8-Bill Quinn 9-Gerry Frankenstein 10-Carolyn Merry 11-Ed Chamberlain 12-Bob Redfield 13-Tom Jenkins 14-Laura Binkman 15-Ed Link 16-Maureen Kessler 17-Jim Clark 18-Joe Roberto 19-Slave Ackley 20-Peter Hoekstra 21-George Ashken 22-Gary Trachter 23-Jim Morse 24-Bob Bag 25-Larry Gatto 26-Peter Keene 27-Greg Fellers 28-Roy Bates 29-Slave Denhartog 30-Mark Ueda 31-John Rand 32-Bob Eason 33-Roger Berger 34-Slave Flanders 35-Judy Betts 36-Charlie Clark 37-Wayne Tobason 38-Tony Gove 39-Jerry Danner 40-Caryl Collins 41-Jerry Brown 42-Arlene Gauthier 43-Slave Fisk 44-Sukhor (Sue) Smith 45-Paul Belmann 46-MAJ Derrick Michalsky 47-Dew Smith

Brown).

CRREL alumni gathering. Photograph provided by Jerry Brown.

Southwest Research Institute® (SwRI®) reports on a wide variety of investigations they have undertaken of Kobuk Valley National Park with either NASA Mars Fundamental Research or SwRI Earth Observation Systems for Climate Change Impact Assessments internal research initiative funding. At both the 42nd Lunar and Planetary Science Conference and the 5th International Conference on Mars Polar Science, Cynthia Dinwiddie reported on ground-penetrating radar, capacitively coupled resistivity, and borehole surveys of the Great Kobuk Sand Dunes that were conducted in March 2010. The frozen active layer was very clearly imaged throughout the dune field, and the presence of near-surface unfrozen water beneath the active layer was confirmed with borehole data. Staff also collected in situ meteorological, particle flux, and

subsurface ground temperature data at the dunes for a period of 15 days. These data and their interpretation will be presented in a paper (now in draft) to be submitted to the journal *Sedimentology*. At the Great Kobuk Sand Dunes, Don Hooper observed and documented the late-winter state of niveo-aeolian deposits, denivation forms, and debris flows on lee slopes. Results may have implications for analogous deposits and processes on Mars, and will be presented at the 2011 American Geophysical Union (AGU) Fall Meeting and in an article in preparation for the 5th Mars Polar Science special issue of the journal *Icarus*. Stuart Stothoff led development of a slope stability risk assessment tool for permafrost terrain, and will present results at the 2011 AGU Fall Meeting and the 2012 10th International Conference on Permafrost. Marius Necsoiu has spearheaded remote sensing analyses of processes and landforms in Kobuk Valley National Park, culminating in a 2.5 m ALOS PRISM based digital surface model of land topography for a portion of the Kobuk lowlands; a time-series of ALOS-PALSAR soil moisture retrievals (manuscript in review at *IEEE Geoscience and Remote Sensing Letters*); and development of high-resolution orthorectification and co registration and active-contouring change-detection techniques for analysis of thermokarst thaw lake surface-area change. The earliest historical aerial photographs have been successfully co-registered with modern satellite imagery, enabling analyses that span the entire period of record (1951 to present). One significant outcome of this work was the observation that vast areas of low-centered polygonal ponds present in Kobuk Valley in 1951 have rapidly transitioned to high-centered, dry polygonal peat plateaus surrounded by water-filled trenches where massive wedge ice has degraded. These results will be presented in a paper (now in draft) to be submitted to the journal *Permafrost and Periglacial Processes*.



Kobuk Valley polygonal ground. The 26 August 1951 illustrates an example of low-center polygon ponds. Fifty-four years later (18 August 2005 image), the polygon troughs have deepened and are now wetter than the high-standing centers of the polygonal peat plateaus. Image credits: U.S. Navy KBV (1951) and Quickbird panchromatic image 101001000474C60A

(2005).



Southwest Research Institute's field team at Great Kobuk Sand Dunes in March 2010. L to R: Donald Hooper (SwRI), Kevin Bjella (CRREL), David Stillman (SwRI), Cynthia Dinwiddie (SwRI), Ronald McGilnnis (SwRI). Photograph provided by Seth Kantner

University of Virginia, through Gerald “J.J.” Frost and Howard Epstein, undertook a field study in northwest Siberia that focused on interactions between cryogenic disturbance and proliferation of tall alder shrubs in patterned-ground. Major findings were that (1) differential frost-heave maintains mineral-dominated microsites that strongly facilitate recruitment of boreal shrubs in warmer parts of the Low Arctic; and (2) shrub expansion causes sharp declines in active layer temperature and breaks down microsite thermal gradients that are required to sustain differential frost-heave. Thus, shrubland development has important implications for permafrost because canopy shading and the formation of an organic mat strongly buffers the active layer from climate change. Shrubification also diminishes cryogenic disturbance regime, by eliminating the potential for differential frost-heave. This work would not have been possible without cooperation from Russian colleagues at the Earth Cryosphere Institute and Moscow State University. As luck would have it, the field site is within a stone’s-throw of Salekhard, venue for the Tenth International Conference on Permafrost (TICOP), so J.J. and Howie plan to revisit the field site after the conference next year.



University of Virginia's team in northwest Siberia

Alaska Ecoscience and others. A study on ice-wedge degradation funded by NSF was initiated in 2011 and included fieldwork at four main sites: Prudhoe Bay, Jago River, Itkillik River (see photo), and Eielson. The research focuses on feedbacks controlling the degradation and stabilization of ice wedges through varying phases of water impoundment and vegetation recovery. Fieldwork included measurements of surface microtopography with ground-based LIDAR, sampling of soil stratigraphy and ground ice (photo of Itkillik yedoma), installation of micro-climate data loggers, and vegetation sampling (photo of vegetation sampling in collapsing trough). Members of the team include Yuri Shur, Torre Jorgenson, Misha Kanevskiy, and Kim Wickland. The U.S. Fish and Wildlife Service collaborated at the Jago site and the work included several students.



Photograph provided by Torre Jorgenson



Photograph provided by Torre Jorgenson

Monitoring of permafrost characteristics and degradation associated with coastal ecosystems on the Yukon-Kuskokwim Delta (see photo) was initiated in 1994 and continued in 2011. The monitoring includes a network of topographic transects, vegetation and soil plots, sediment and salinity stations, soil temperature and water-level recorders, and permafrost exposures (see photo). A time-series of airphotos and newly acquire high-resolution satellite imagery have been georectified to quantify rates of permafrost degradation. Team members include Torre Jorgenson, John Terenzi, and Craig Ely.



Photograph provided by Torre Jorgenson

The *Geophysical Institute Permafrost Laboratory* research team in collaboration with Russian colleagues continued the development of the observation borehole network for the thermal state of permafrost monitoring in Alaska, Russia, and Central Asia as part of the Arctic Observing Network project. The work included data collection and maintenance of existing boreholes, instrumentation of new or recovered boreholes, and gathering of historical data. Additionally, during the 2011 summer field work, thermal conductivity and moisture of active layer soils have been determined at the 5 selected sites in northern Yakutia. Results of measurements have been submitted to the AON Cooperative Arctic Data and Information Service portal. Russian-US TSP project web portal was established as a part of GI Permafrost Laboratory web site. Detailed description of each observation point, links to the collected data as well as information about ongoing research are posted on this web portal (http://www.permafrost.gi.alaska.edu/sites_map).



Photograph provided by Torre Jorgenson

Reginald Musket continued research investigations of energy and mass changes associated with changes in permafrost across the Northern Hemisphere. This investigation applies methods and techniques from satellite geodesy with multi-satellite and sensor systems. Surface energy changes are derived using the Moderate Resolution Imaging Spectroradiometer (MODIS) for land-surface temperature change, Advanced Microwave Scanning Radiometer –E (AMSR-E) for soil moisture and snow water equivalent changes, Special Scanning Microwave / Imager (SSM/I) and Scanning Multi-Channel Microwave Radiometer (SMMR) for snow water equivalent, Atmospheric InfraRed Sounder (AIRS) (includes the Atmospheric Microwave Sounding Unit) for atmospheric and near-surface carbon dioxide changes, the Gravity Recovery and Climate

Experiment (GRACE) for near-surface water equivalent mass changes (groundwater and total water storage change), the Ice Cloud and land Elevation Satellite Geoscience Laser Altimeter System (ICESat GLAS) for land and water surface elevation changes and the Global Positioning System (GPS) with the International Terrestrial Reference Frame Network for land-surface elevation changes and isostatic glacial changes.

Guido Grosse continued fieldwork on the northern Seward Peninsula, Alaska, in June 2011 on thermokarst lake dynamics (together with B. Jones). Recently drained lake basins were visited and several lake and permafrost temperature monitoring stations were maintained or installed. Results from ending NASA and NSF projects on thermokarst lake and carbon cycling dynamics are in the write-up stage and several publications have already appeared in various peer-reviewed journal. A small Arctic LCC project has resulted in a dataset of potential future lake drainage on the Alaska Arctic Coastal Plain (together with B. Jones). New funding for permafrost and thermokarst related research in 2011 and beyond became available through the U.S. Fish and Wildlife Service and National Park Service (lake and permafrost dynamics in the Western Alaska LCC region and two Arctic National Parks; together with V. Romanovsky), NSF Arctic Observatory Network (Towards a circumarctic lakes observation network – CALON; starting on the Alaska Northslope; together with K. Hinkel, C. Arp, B. Jones, and others), and NASA Carbon Cycle Sciences (Lake methane emissions from thermokarst lakes in North America; together with K. Walter Anthony and others).



Photograph provided by Guido Grosse

The George Washington University: The 2011 Circumpolar Active Layer Monitoring (CALM) project field activities were conducted in Alaska and Russia. The Alaska field team consisted of Dima Streletskiy (GWU), Anna Klene (University of Montana), Fritz

Nelson (University of Delaware) and three GWU students (K. Nyland, J. Butler, C. Cohen). Annual active-layer, ground temperature observations were conducted at a series of CALM sites representative of the diverse climatic and landscape conditions on the North Slope of Alaska and the Seward Peninsula. Ground subsidence monitoring by means of differential GPS was conducted at several sites. Anna Klene installed new temp/RH loggers and conducted a series of interviews in Barrow as a part of ongoing project focusing on changes in ground thermal regime in traditional Inupiat ice-cellars. The GWU CALM project has facilitated annual observations at 86 Russian sites. All data are available at CALM webpage at www.udel.edu/Geography/calm. Preparations are underway for the joint CALM/TSP workshop to be organized within the framework of the Tenth International Conference on Permafrost.

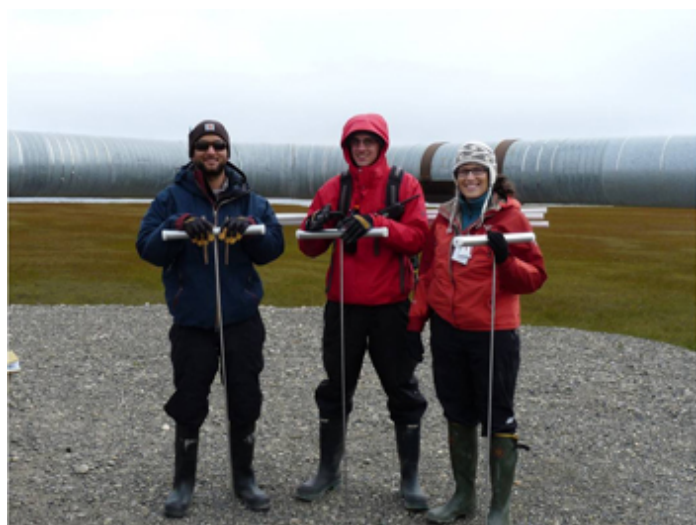
Dima Streletskiy together with Valery Grebenets (Moscow State University) and Nikolay Shiklomanov organized International Permafrost Class on Permafrost in summer of 2011 in Central Siberia along the Yenisei River. Three GWU and 12 MSU students participated in the class. Students were introduced to methods of permafrost investigations in natural and technogenically modified landscapes, including site evaluations, temperature and active-layer monitoring and coring. The emphasis was made on relations between permafrost and other components of Arctic natural system. Socio-economic problems of development in permafrost regions were extensively covered throughout the course.

The George Washington University junior Kelsey Nyland was awarded the Rice Fellowship to study North American past cryogenic weathering and relict permafrost-related features. The research is utilizing the Coefficient of Cryogenic Contrast (CCC) analysis to quantitatively evaluate characteristics of paleo-permafrost using mineralogical properties of the substrate.

We have continued to develop methodology for quantitative evaluation of socio-economic impacts of permafrost degradation. Over the last year we have broadened this research by including political, economic, and demographic issues related to development of Russian permafrost regions. Three master thesis related to those issues are currently under preparation at GWU Geography department. An interdisciplinary Arctic research group was formed at the Institute for European, Russian and Eurasian Studies within the GW Elliot School of International affairs to facilitate the research of complex interactions between climatic, political, and economic drivers of changes in Russian urban permafrost-affected communities.

D. Streletskiy was instrumental in organizing

permafrost-related sessions for the 2011 and 2012 Annual meetings of the Association of American Geographers.



GW undergraduates Clayton Cohen (left), Jacob Butler (center) and Kelsey Nyland (right) are all geared up to do CALM thaw depth measurements on the Prudhoe Bay Oil Field.



The George Washington University Faculty and Students in the Permafrost Tunnel in Igarka, Russia. Top Row left to right: Nikolay (Kolia) Shiklomanov, Colin Reiser, Kelsey Nyland. Bottom Row: Genevieve Parente and Dmitry (Dima) Streletskiy.

Cooperative Extension Service, University of Alaska. Recently, it was learned by Professor Rich Seifert of the University of Alaska Cooperative Extension Service that the resources and publications of the former Permafrost Foundation of Alaska had been transferred to the Cold Climate Housing Research Center (CCHRC) in Fairbanks, for safekeeping and archival storage. The Permafrost Foundation has been disbanded and their website (www.permafrost.org) has also disappeared from the Internet. When Seifert discovered that the two unique Permafrost Foundation

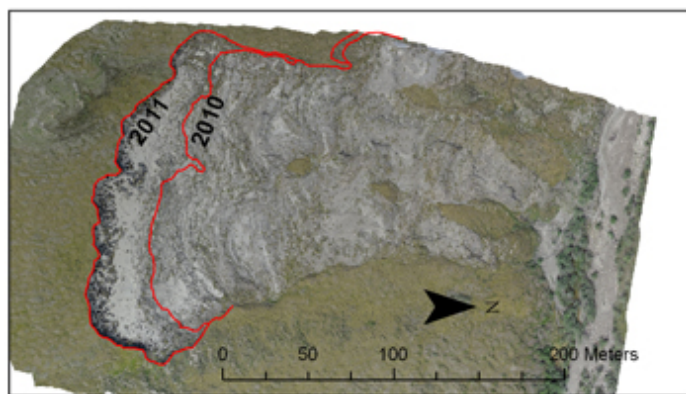
manuals were no longer available either on the internet, he inquired as to whether CCHRC was intending to place them on their website. They weren't planning on it, so Seifert placed them, with CCHRC permission on his UAF Extension website and they are here:

http://www.uaf.edu/ces/energy/housing_energy/resour and here:

http://www.uaf.edu/ces/energy/housing_energy/resour This makes these manuals written by emeritus professors Terry McFadden and Tom Kinney available on the web again through the public service arm of the University of Alaska Fairbanks. The manuals are also available through this web site:

<http://www.uspermafrost.org/education/PEEP/ptf-man>, which is the US Permafrost education web site.

The National Park Service, Fairbanks, AK, through Dave Swanson, has begun implementation of a permafrost monitoring program in the 5 NPS units in northern and northwestern Alaska. Recently completed mapping using 1-m resolution IKONOS satellite imagery (years 2006-2008) located 848 active-layer detachments and 276 retrogressive thaw slumps (RTS) across the Noatak National Preserve (2.7 million ha). Three-dimensional photo-monitoring of 18 RTS in 2010 and 2011 revealed rapid growth of individual slumps. Slumps grew by escarpment retreat of over 20 m between 2010 and 2011 in 7 of the slumps.



Orthophotograph of a retrogressive thaw slump in the Noatak National Preserve that grew by scarp retreat of up to 40 m between 2010 and 2011.

Water and Environmental Research Center University of Alaska, through Kenji Yoshikawa, has involved 195 communities in the permafrost/seasonal frost outreach network, which now include almost all of the Alaskan permafrost-occupied communities as well as Little Diomed, St. Lawrence Islands, and seasonal frost in Southeast Alaska and Aleutians. For the ten whaling communities, temperature sensors were installed in the native meat storages Sigluaques (ice cellar). The

results will be published in a ground temperature book in 2012 and distributed to the communities. As part of this program, permafrost lectures are developed for K-12 students that will include TunnelMan series and the frost tube protocol (http://ine.uaf.edu/werc/projects/permafrost/frost_tube) Yoshikawa and a group from the Universidad Complutense Madrid (including D. Palacios), the Universidad Nacional Autónoma de México (UNAM) drilled in a Mexican volcano (Iztaccíhuatl) at 5000 masl. Yoshikawa also traveled to the Peruvian Andes (Nevado Chachani; 5350m) with the Universidad Complutense Madrid and Instituto Geológico Minero y Metalúrgico (INGEMMET), Peru.



Kenji Yoshikawa is explaining the frost tube for high school kids at Hollis, Southeast Alaska.



Kenji Yoshikawa drilling at Iztaccíhuatl, Mexico, at 5000 masl.

The Next-Generation Ecosystem Experiments (NGEE) is funded by the US Department of Energy to address the question “How does permafrost thaw and degradation, and the associated changes in landscape evolution, hydrology, soil biogeochemistry and plant community dynamics, affect feedbacks to the climate system?” This project will use observations and models to quantify the response of physical, ecological, and biogeochemical processes to climatic change across molecular to landscape scales. Field and lab research will focus on interactions that drive

ecosystem-climate feedbacks through greenhouse gas fluxes and changes in surface energy balance. These feedbacks will arise due to gradual thawing of permafrost and thickening of the seasonal active layer. Feedbacks will also occur as a result of the threshold-dominated processes of permafrost degradation and thermokarst formation and through the many processes that are influenced as a result of these landscape-scale dynamics. This project will consider how components of complex systems are linked and the interplay in space and time that determines system behavior. Fundamental knowledge gained in these investigations will be used to improve representation of ecosystem dynamics, subsurface biogeochemistry, and land-atmosphere processes in regional and global models, and will reduce uncertainty and improve prediction of climate change in high-latitude ecosystems. The research scope of NGEE Phase 1 is designed to address our overarching science question through a series of integrated field observations, lab experiments, and modeling activities. Permafrost degradation and its impact on water, nitrogen, carbon, and energy-related processes will be investigated across a hierarchy of scales, including the pore/core, plot, and landscape scales. Field research will be conducted in Alaska on the North Slope (Barrow) and Seward Peninsula (Council). Phase 1 modeling efforts will focus on application of existing models to evaluate their predictive capability across a range of spatial scales, from single-column to plot to landscape scales. Model results will be compared with laboratory experiments and field observations at the Barrow and Council sites. We will simulate permafrost degradation in a warming Arctic using the land surface component of a major climate prediction model as well as several high-resolution process-resolving models of subsurface physical and biological dynamics. These integrated experimental and modeling efforts will (1) quantify how permafrost degradation influences surface and subsurface hydrology, (2) resolve biogeochemical mechanisms that control rates of CO₂ and CH₄ flux, (3) characterize the role of nitrogen availability in shrub expansion and plant productivity, (4) identify mechanisms underlying changes in ecosystem net energy budgets due to vegetation dynamics, and (5) quantify prediction capabilities associated with existing models.

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