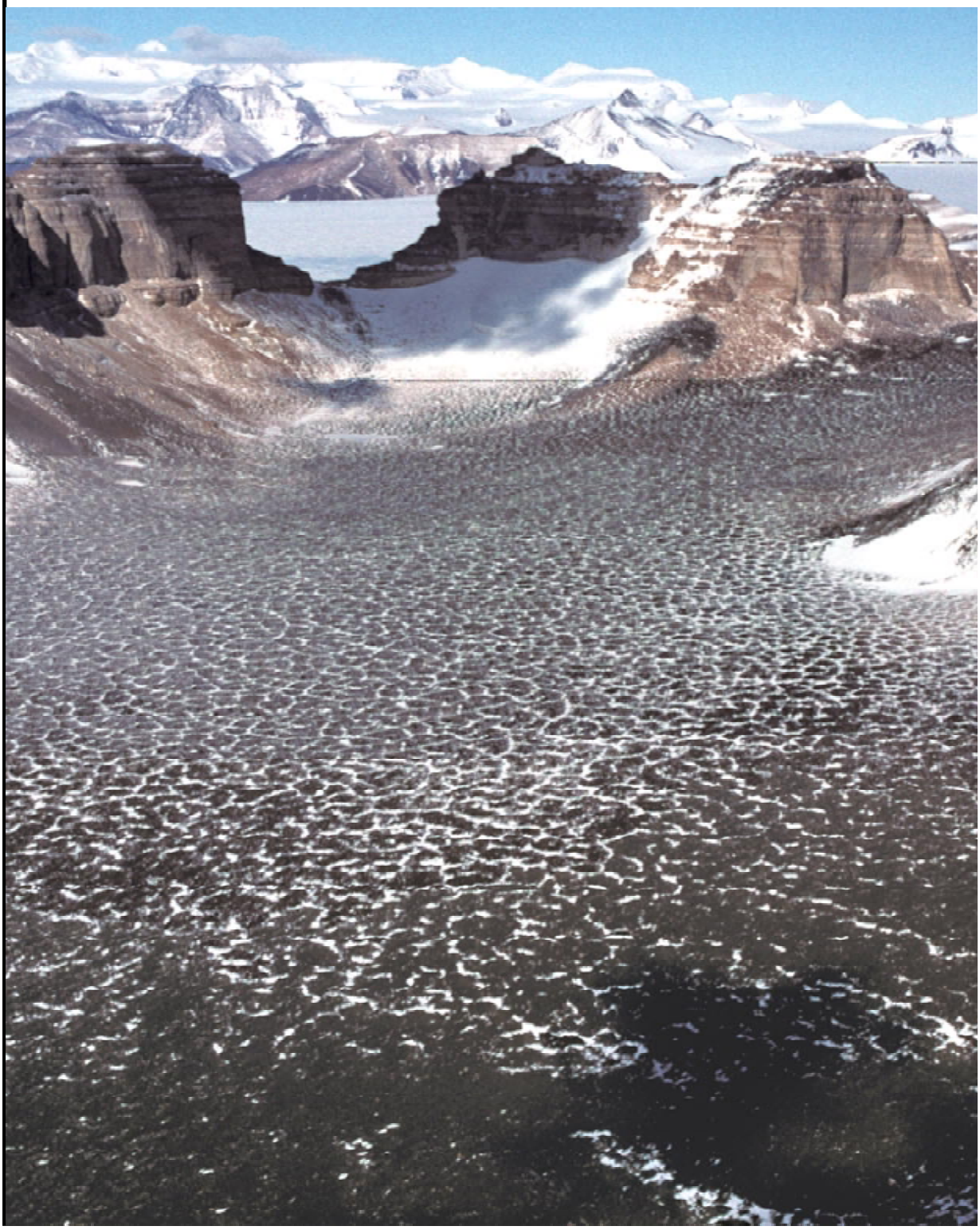
FROZEN GROUND

The News Bulletin of the International Permafrost Association Number 28, December 2004



INTERNATIONAL PERMAFROST ASSOCIATION

The International Permafrost Association, founded in 1983, has as its objectives to foster the dissemination of knowledge concerning permafrost and to promote cooperation among persons and national or international organisations engaged in scientific investigation and engineering work on permafrost. Membership is through adhering national or multinational organisations or as individuals in countries where no Adhering Body exists. The IPA is governed by its officers and a Council consisting of representatives from 24 Adhering Bodies having interests in some aspect of theoretical, basic and applied frozen ground research, including permafrost, seasonal frost, artificial freezing and periglacial phenomena. Committees, Working Groups, and Task Forces organise and coordinate research activities and special projects.

The IPA became an Affiliated Organisation of the International Union of Geological Sciences (IUGS) in July 1989. Beginning in 1995 the IPA and the International Geographical Union (IGU) developed an Agreement of Cooperation, thus making IPA an affiliate of the IGU. The Association's primary responsibilities are convening International Permafrost Conferences, undertaking special projects such as preparing databases, maps, bibliographies, and glossaries, and coordinating international field programmes and networks. Conferences were held in West Lafayette, Indiana, U.S.A., 1963; in Yakutsk, Siberia, 1973; in Edmonton, Canada, 1978; in Fairbanks, Alaska, 1983; in Trondheim, Norway, 1988; in Beijing, China, 1993; in Yellowknife, Canada, 1998, and in Zurich, Switzerland, 2003. The ninth conference will be in Fairbanks, Alaska, in 2008. Field excursions are an integral part of each Conference, and are organised by the host country.

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Cover: Picturesque polygonal patterned ground in Farnell Valley (elevation 1500 m, S77.88°, E160.67°) as it enters Beacon Valley, Quartermain Mountains, Antarctica. Contraction cracks are pervasive in the McMurdo Dry Valleys formed in ice-bonded soils and massive "ground ice "(the term 'subsurface ice' is under discussion as possibly a more appropriate term for Antarctica). The polygons are outlined by snow-infilled troughs that highlight the contraction cracks. Ferrar Glacier and the Royal Society Range are seen in the background. Photograph taken January 23, 1999, by Ron Sletten, University of Washington. See the Southern Hemisphere and Antarctic Working Group reports for more information on IPA activities in the Southern Hemisphere.

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The IPA is a non-governmental association of national organisations representing 24 countries or groups of countries. The success of the bulletin depends upon the willingness of IPA participants to supply information for publication. News items from any IPA participant or others are very welcome, as are interesting photographs. To submit news items or photos please contact:

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Full text available as PDF file on IPA web site (http://www.geo.uio.no/IPA/).

This issue of *Frozen Ground* was compiled and edited by Jerry Brown and Hanne Christiansen. Angélique Prick (Norway) provided editorial assistance. Donna Valliere prepared the camera copy.

Executive Committee Report

The past year has been a busy one for the IPA. Major permafrost conferences were held in Tyumen, Russia, in celebration of the 60th anniversary of the Tyumen Region, and in Lanzhou, China, on permafrost engineering. IPA participated in the Arctic Science Summit Week (ASSW) and the Arctic Climate Impact Assessment (ACIA) meetings in Reykjavik, Iceland; the Scientific Committee on Antarctic Research (SCAR) Science Conference in Bremen, Germany; the 30th International Geographical Congress in Glasgow, Scotland; and the 32nd International Geological Congress in Florence, Italy, among other meetings, including the European Geosciences Union, American Geophysical Union, American Society of Civil Engineers, and the Canadian Geotechnical Society. Members of the Executive Committee met in Moscow and Tyumen in May and again in December in San Francisco.

The IPA and the International Geographical Union renewed its Agreement of Cooperation during the Glasgow Congress. The agreement provides for cooperation with the new IGU Commission on Cold Region Environments and the exchange of IPA and Commission newsletters. As a result of the agreement IPA remains an affiliated member of the IGU. A new Memorandum of Understanding was developed and signed between IPA and the Climate and Cryosphere (CliC) programme of the World Climate Research Programme. Both agreements are consistent with the 2003 IPA Council resolution to increase international cooperation. Several other cooperative activities are under discussion including those related to the Global Carbon Project (GCP), the newly designated IUGG Commission for the Cryospheric Sciences (CCS), and renewed cooperation with the International Quaternary Association (INQUA).

During the past year considerable effort was devoted to developing a project to commemorate the 125th anniversary of the International Polar Year. The project "Thermal State of Permafrost (TSP)" proposes to obtain a "snapshot" of permafrost temperatures throughout Planet Earth during the period 2007–2008. A planning proposal was submitted to our parent organisation, the International Union of Geological Sciences (IUGS). The TSP project compliments the existing Global Terrestrial Network for Permafrost (GTN-P).

All ten Working Groups, five of which were newly designated in 2003, initiated activities for the 2003–2008 period. This year marked the culmination of planning for a joint SCAR-IPA activity in the Antarctic with the formation of a SCAR Expert Group (see Antarctic WG report for details).The new WG on Glacier and Permafrost Hazards in High Mountains, a joint activity with the International Commission on Snow and Ice (ICSI), organised an EGU session and planned future international activities. The Cryosol WG, a joint activity with the International Union of Soil Science, held several meetings and was responsible for publication this year of the 726-page book *Cryosols: Permafrost-affected Soils*. The Permafrost and Climate WG participated in a jointly organised CliC workshop in Fairbanks on Spatial Modelling. The PACE 21 Field Workshop took place in Svalbard. The Coastal and Offshore WG participated in the 5th International Workshop on Arctic Coastal Dynamics at McGill University; ACD is a joint project with the International Arctic Science Committee and the IGBP LOICZ. Several co-chairs of Working Parties participated in the ACIA Conference in Reykjavik.

The final report of the 8th ICOP was completed by the Swiss Organising Committee, and contains the conference report of the IPA International Advisory Committee. The three-member task force on proposed organisational changes submitted its report to the Executive Committee. Based on these findings the Executive Committee prepared recommendations to the Council for modifications in nominations, elections and membership categories. The Executive Committee prepared a draft Long Range Plan (2005–2013). The Council will meet in Potsdam in June 2005 to consider these recommendations and the Plan.

Planning for future IPA conferences is underway in the U.S, Germany, Russia, and China: Ninth International Conference on Permafrost (NICOP), Fairbanks, Alaska, in June 2008; the Second European Conference on Permafrost, Potsdam, in June 2005, the Fourth International Conference on Cryopedology, Arkhangelsk in August 2005, and the proposed Regional Permafrost Conference in Lanzhou, in September 2006. Representatives of IPA will participate in the CLiC Science Conference and ASSW in China in April 2005, in several permafrost conferences in Russia in 2005, in the Second International Conference on Arctic Research Planning (ICARP II) in Copenhagen, Denmark, in November 2005, in the 18th World Congress of Soil Science in Philadelphia, U.S.A., in July 2006, and in the XVII INQUA Congress in Australia in August 2007. The 33rd International Geological Congress will be held in Oslo, Norway, in August 2008 with excursions to the Arctic. IPA proposes to work closely with the IGC/IUGS organisers and to link NICOP and current projects to the IGC programme.

The IPA Secretariat, based at the University Centre in Svalbard (UNIS), has received funding from the Norwegian Research Council to provide administrative support for IPA activities. We extend our appreciation to Ole Humlum, University of Olso, for designing and maintaining the new IPA web site. This issue of *Frozen Ground* starts with a series of short lead articles that presents current progress and prospects for selective future activities.

Global and Regional Activities

The Thermal State of Permafrost: An IPA Contribution to the International Polar Year and Year of Planet Earth

Jerry Brown, International Permafrost Association, Woods Hole, MA, USA (jerrybrown@igc.org)

The 125th Anniversary of the International Polar Year (1882–83 to 2007–08) offers an unique opportunity for the International Permafrost Association (IPA) to conduct a well-designed, global and coordinated, multi-national programme of permafrost observations. The anniversary also marks the 50th anniversary of the International Geophysical Year (IGY 1957–58) during which time many contemporary geocryologists were active or beginning their careers. Ideally a new generation of geocryologists will emerge from the proposed permafrost-related IPY activities. The Ninth International Conference on Permafrost (NICOP) will be held at the University of Alaska Fairbanks in June 2008, marking the 25th anniversary of the Fourth ICOP and the formation of the IPA in Fairbanks in 1983. The Conference also provides the opportunity to celebrate the 125th anniversary of the IPY.

The IPA has proposed the project *Thermal State of Permafrost (TSP)* to measure temperatures in existing and new boreholes over a fixed time period in order to provide a "snapshot" of permafrost temperatures in both time and space. There exists no global database that defines the thermal state of permafrost within a specific time period. Reported or unpublished temperature measurements were obtained at various depths and periods over the past five or more decades, yet we know these temperatures have changed and at different rates for different regions. Although this project is focused on the IPY commemoration, its results have much broader significance and application as the concerns for a warming Earth impact on many societal concerns in the high latitudes and high mountains of Planet Earth. A legacy of this IPY TSP programme will be the development of the International Network of Permafrost Observatories (INPO).

As is known, permafrost conditions range from very cold (temperatures of –10°C and lower) and very thick (more than 500 metres and as much as 1400 metres) in the Arctic, to warm (within one or two degrees from the melting point) and thin (several metres or less in thickness) in the Subarctic. In the continuous permafrost zone, permafrost occupies the entire area (except beneath large rivers and deep lakes). In the discontinuous permafrost zone including the sporadic zone, anywhere from 10 to 90 percent of the surface is underlain by permafrost. Permafrost results in unique landscape features, such as patterned ground, and its thawing results in subsidence, thaw lakes, slope failures, and changes in surface and subsurface hydrology.

The permafrost temperature regime (at the depth of 10 to 200 metres) is a sensitive indicator of the decade-to-century climatic variability and long-term changes in the surface energy balance. The range of the interannual temperature variations ("noise") decreases significantly with depth, while decadal and longer time-scale variations (the "signal") penetrate to greater depths into permafrost with less attenuation. As a result, the "signal to noise" ratio increases rapidly with depth and the ground acts as a natural low-pass filter of the climatic signal, making temperature-depth profiles in permafrost useful for studying past temperature changes at the ground surface.

The objectives of the *Thermal State of Permafrost (TSP)* are to:

- Obtain a set of standardized temperature measurements in all permafrost regions of Planet Earth (snapshot)
- Produce a global data set and maps of contemporary permafrost ground temperatures
- Update GTN-P borehole and active layer inventories and increase the number of sites
- Refine measurement strategies and protocols
- Provide data to verify models and reanalysis approaches for past, present and future permafrost and active layer temperatures and scenarios
- Report initial results at 2008 conferences (including modelling and mapping)

The acquired temperature data set will serve as a baseline in the future to establish the rate of change of near-surface permafrost temperatures, to assess changes in permafrost boundaries, and to validate models, climatic scenarios, and temperature reanalyses approaches. The actual TSP Borehole Campaign is proposed to take place over a 12- to 18-month period during 2007–08. Once established, the IPA/TSP network of monitoring boreholes will provide the potential for long-term measurements of geothermal response of permafrost to changes in climate and ground cover. Data will be incorporated into the WMO/FAO/IPA Global Terrestrial Network-Permafrost (GTN-P). The GTN-P presently consists of more than 450 candidate boreholes including the PACE network (Permafrost and Climate in Europe) and an additional 125 sites in the Circumpolar Active Layer Monitoring (CALM) network (www. gtnp.org).

The initial TSP planning activities (2005–2006) focus on identification of accessible boreholes, preparations for the actual measurement campaign, and the compilation of metadata and available data. To accomplish this we propose

a series of consultations and regional meetings and workshops in Europe, Asia and Russia amongst our permafrost colleagues. We have already identified a majority of boreholes in North America and the Nordic region. However, what is lacking is a comprehensive and representative set of accessible boreholes, particularly in Russia and China.

Based on the workshop sponsored by the International Arctic Research Center in Fairbanks (2000) and subsequent activities, approximately 200 Russian boreholes were identified and metadata provided to GTN-P. Additional efforts are required to identify a spatially representative set of Russian boreholes.

The second major region involves China and adjacent countries. Although these regions are not within the 60°N latitude for IPY, they are of considerable interest and importance from a permafrost standpoint. In China the main region is the Qinghai-Xizang (Tibet) Plateau where the new railway crossing the Plateau is nearing completion. Our Chinese colleagues have for a long time considered the Plateau as the "Third Pole of Planet Earth." A second area is Northeast China where future pipeline routes may encounter permafrost problems. The warm permafrost in these regions is close to thawing and a good baseline is needed now. The main boreholes in Mongolia and Kazakhstan have been identified.

IPA and China are planning a regional permafrost conference including a mapping workshop in Lanzhou for early September 2006 that will include site visits to the Plateau. The 2006 conference will provide the opportunities to meet with representatives from Mongolia, Kazakhstan, Russia, and China and to visit many of the sites. The IPA has a permafrost-mapping project underway for Central Asia and borehole locations and data will be integrated into it. The TSP project is also coordinated with the Global Climate Observing System's (GCOS) regional program for Asia, with an IPA participant (S. Marchenko) responsible for a project related to runoff and permafrost degradation.

A limited number of boreholes are also available in the Antarctic and some new ones are planned over the next several years. The IPA Working Group on Antarctic Permafrost and Periglacial Environments, in close collaboration with the recently approved SCAR Permafrost Expert Group, will assist in the TSP project and provide information and coordination with national programmes.

The planning objectives of TSP will be pursued informally and at the following meetings:

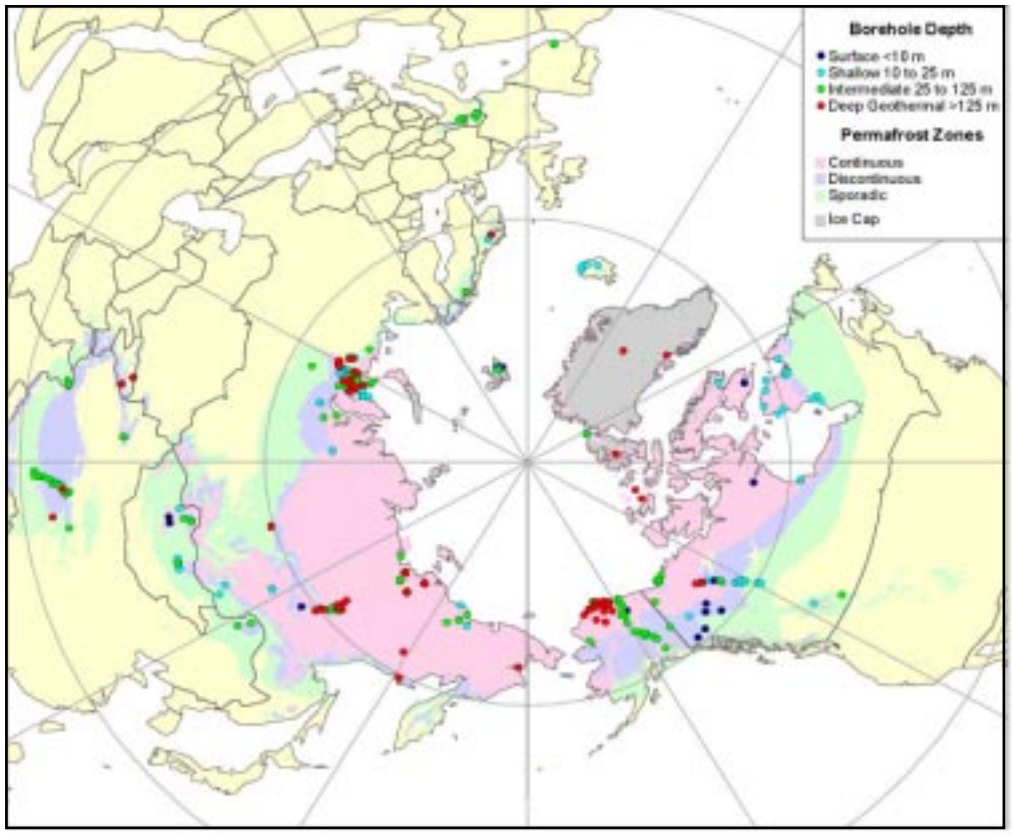
- Climate and Cryosphere (CliC) Science Conference in Beijing, April 2005
- Pushchino conference (late May) and the Geocryology Conference, June 2005
- Second European Conference on Permafrost, Potsdam, June 2005
- Fourth International Conference on Cryopedology, Arkhangelsk, August 2005
- Second International Conference on Arctic Research Planning (ICARP II) Copenhagen, Denmark, in November 2005
- Regional Permafrost Conference, Lanzhou, September 2006.

As part of the site selection and design of the actual borehole campaign we will plan to identify several "regional transects" across the major permafrost zones in North America, Europe (PACE), and Eurasia. Data from these TSP transects will be utilized to assess changes in south-north permafrost boundaries. Results from the recent workshop (October 2004) on Spatial Modelling and Remote Sensing of Permafrost held at the International Arctic Research Center in Fairbanks, will assist in the planning and implementation of the TSP project. Other IPA working groups and data activities will assist in implementation of the pre-TSP campaign, the actual campaign activities, and final reporting and data archiving. We will be working closely with our parent organization; the International Union of Geological Sciences (IUGS) and its Year of Planet Earth project, Geoindicators initiative and the Commission on Management and Application of Geoscience Information (CGI). Since both the NICOP in Fairbanks and the 33rd International Geological Congress in Oslo will take place in the summer of 2008, we will plan to present initial TSP results at both conferences. This will contribute to the IPA celebration of the 125th IPY anniversary along with other planned permafrost research activities.

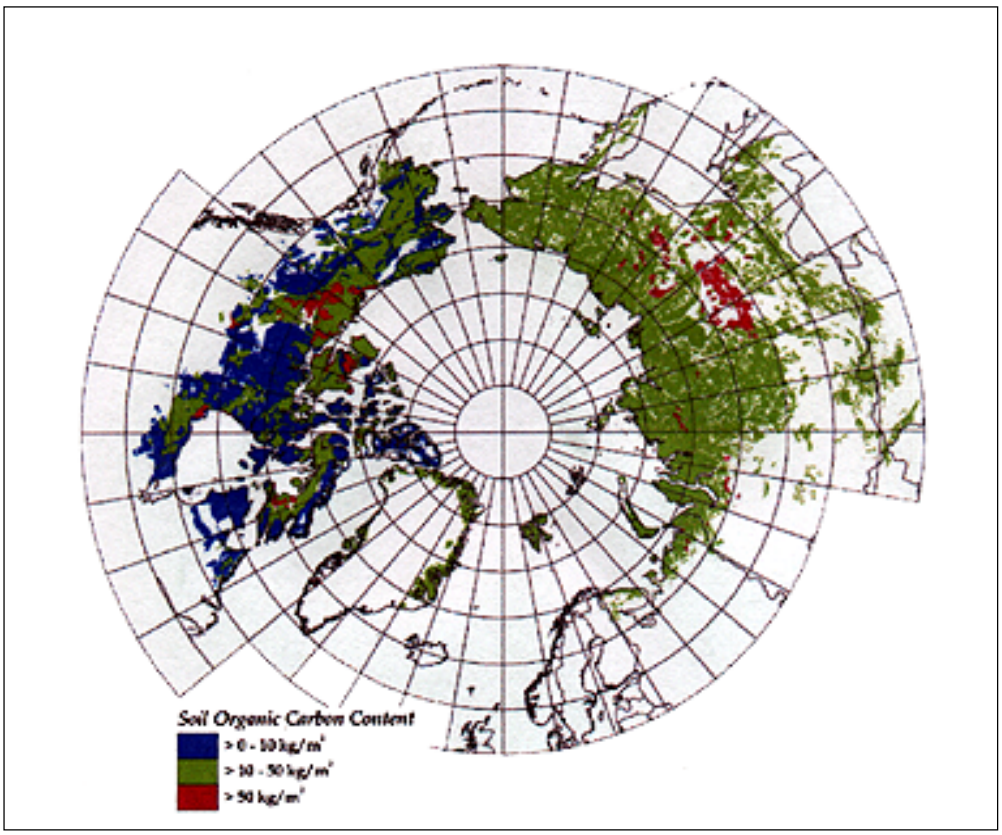
The IUGS has provided modest initial support for organizing TSP. Other private and public funding in cooperation with on-going and new national and international projects will be required to support all phases of the TSP project. We anticipate that the TSP project will be identified in 2005 as an official IPY project.

National planning representatives include:[1] Vladimir Romanovsky (U.S.A.), Sharon Smith (Canada), Alexander Vasiliev (Russia), Cheng Guodong (China), Charles Harris (for PACE participants and countries); and Mauro Guglielmin (Italy) for the Antarctic. Additional representatives to be designated.

[1] See Members and Working Parties addreses (p. 55–56).



Location of TSP candidate boreholes presently identified in the GTN-P (www.gtnp.org).



Organic carbon content of Cryosols in the northern circumpolar region.

ORGANIC CARBON IN CRYOSOLIC SOILS IN THE NORTHERN CIRCUMPOLAR REGION[1]

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Soils are the largest source of organic carbon in terrestrial ecosystems. The abundance and composition of this carbon (organic matter) play an important role in soil and ecosystem processes. Estimates of the amount of soil organic carbon worldwide range from 1115 to 2200 Pg. However, since this carbon is very dynamic, it can be changed markedly both by human activities such as land use, deforestation and biomass burning, and by natural forces such as wildfires and climate change.

Cryosols, also called Gelisols, are permafrost-affected soils that occur in the circumpolar regions. In northern ecosystems these Cryosols not only contain by far the largest amounts of organic carbon when compared to other terrestrial ecosystem components, but also sequester carbon. In addition, these northern areas are predicted to be the areas most affected by climate change. The Northern and Mid Latitudes Soil Database (NMLSD)[2] which was developed by the Cryosol Working Group of the International Permafrost Association (IPA) and the International Union of Soil Science (IUSS), has been used to determine the organic carbon stocks in Cryosolic soils.

Cryosols cover approximately 7770×10^3 km^2 of the northern circumpolar area, with approximately 54% of these soils occurring in Eurasia and 46% occurring in North America. Although most of these soils occur in the continuous permafrost zone (78%), they also cover significant areas in the discontinuous (14%), sporadic (6%) and isolated (2%) permafrost zones.

ORGANIC CARBON CONTENT

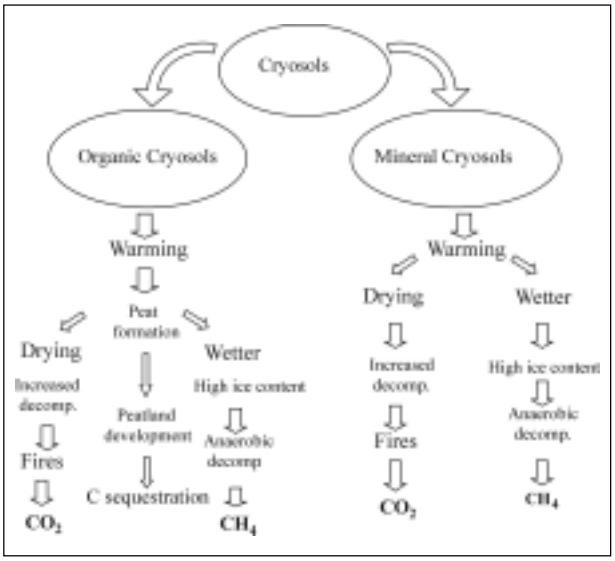
The organic carbon content of Cryosols in these northern circumpolar regions varies from 26 to 137 kg m^{-2} (for the 0–100 cm depth). The distribution of soil organic carbon contents is illustrated on the map (p. 5). The soil organic carbon masses of these Cryosols are approximately 119 Gt at the 0–30 cm depth and 268 Gt at the 0–100 cm depth. The Eurasian portion of this area contains the greatest soil organic carbon mass (64% of the total at 0–30 cm and 60% at 0–100 cm). The 268 Gt organic carbon is approximately 16% of the world's soil organic carbon.

The carbon estimates presented here relate only to a maximum depth of one metre; most peat deposits in the northern circumpolar region are greater than one metre deep. In addition, some mineral Cryosols also contain significant amounts of soil organic carbon below the one metre depth. This suggests that the amount of organic carbon in these soils is likely much higher than has been estimated for these northern regions. Therefore, soil organic carbon should be determined to the base of the organic-rich mineral layer underlying the peat deposit (for Organic Cryosols) or, in mineral soils, to a depth of at least two metres. If this were done, the amount (mass) of soil organic carbon at high latitudes would increase, possibly as much as twofold.

CRYOSOLS AND CLIMATE CHANGE

Although climate change will affect all soils, Cryosols will be one of the most affected groups of soils due to climate warming because of increased thaw or localized disappearance of permafrost. In the southern portion of the permafrost regions the temperature of the frozen layer in these soils is no more than a few degrees below 0° C. As a result, a slight amount of disturbance or increase in soil temperature could lead to a positive thermal regime. This in turn would cause thawing of the soil organic matter, triggering a higher rate of decomposition and release of carbon in the forms of CO_2 or CH_4. In Canada, perennially frozen soils cover approximately 35% (2530×10^3 km^2) of the soil area and contain about 39% (103 Gt) of the soil organic carbon mass. Studies suggest that 48% of the total soil organic carbon in Cryosols in Canada will be severely to extremely severely affected by climate warming, which will likely cause the release of a large portion of this carbon into the atmosphere.

The schematic diagram illustrates the pathways of expected changes in organic and mineral cryosols as a



Change in carbon balance in Cryosols due to climate warming.

[1] Report modified from the one published in the CliC Newsletter " Ice and Climate," March 2004.

[2] Cryosol Working Group. 2001. Northern and Mid Latitudes Soil Database, Version 1. National Soil Database, Research Branch, Agriculture and Agri-Food Canada, Ottawa, Canada.

result of climate warming. Carbon in cryosols that are affected by drying will probably be released as CO_2 as a result of increased decomposition and wildfires. Carbon in the wet cryosols, which will become wetter as the ice-rich permafrost thaws, will probably be released as methane. Methane is 21 times more effective as a greenhouse gas than CO_2. This global degradation of cryosols may trigger a very strong feedback mechanism that might further increase climate warming. Another possibility, however, is that there also may be increased peat development (carbon sequestration) because of higher temperatures and elevated CO_2 levels.

Conclusion

IPA has recently refocused its interest on carbon stocks in the cryosphere. Some of the specific objectives of this approach are to update the inventory of carbon pools in northern soils using available soil, peat, and permafrost data and spatially distributed GIS techniques, to investigate the quality and dynamics of soil organic matter along regional and climatic gradients, to monitor soil carbon pools associated with established monitoring sites such as the Circumpolar Active Layer Monitoring (CALM) network and other sites, and to assess the feedbacks from high latitude soils to global warming. As indicated, estimates of organic carbon in northern circumpolar Cryosols have been made for a depth of only one metre. Future research should focus on determining the amount of organic carbon stored in the underlying layers (0–5 m) of permafrost soils. A better understanding of the dynamics of carbon in these soils, including the dynamics of carbon stored in the near-surface permafrost, is also needed. With the knowledge gained from such studies, we should have a better understanding of the role of soil carbon in the cryosphere.

As proposed in the IPA Council resolutions in Zurich, these activities would be coordinated with the Global Carbon Project (GCP) of the Earth System Science Partnership (ESSP)[3] and the Climate and Cryosphere (CliC) programme of the World Climate Research Programme (WCRP).

[3] Global Climate Project (2003) Science Framework and Implementation. Earth System Science Partnership (IGBP, IHDP, WCRP, DIVERSITAS) Report No.1, Global Carbon Project Report No.1. 69pp, Canberra.

Permafrost Science in the Southern Hemisphere[1]

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Southern Hemisphere high-latitude environments possess large and ecologically important and sensitive areas of permafrost and seasonally frozen terrain, but a number of historical factors have led to the poor international recognition of Southern Hemisphere permafrost as part of the global cryosphere. First, insights from regional studies are often poorly accessible internationally when they are published in a language other than English and/or published in local or non-permafrost journals. Second, Southern Hemisphere research communities have been, and to a greater or lesser extent still are, isolated from Northern Hemisphere-based research programmes and debates. This is closely related to the more restricted human and financial resources available in countries south of the equator, often leading to limited involvement and representation in international activities. As regards the Antarctic, historically, few dedicated permafrost studies have been undertaken by national programmes through SCAR, but these are gaining new momentum. Finally, while NH permafrost research has been stimulated by applied problems related to natural resources exploitation, SH permafrost is generally found in sparsely populated areas.

Many of the distinctive attributes of permafrost in the Southern Hemisphere are related to the latter's land-sea distribution. Land masses occupy about 22% of the SH from the equator to 30°S, dropping off to less than 1% between 40 and 65°S and rapidly increasing again to 100% towards the Antarctic continent. Consequently, permafrost is found in the high alpine zones of low-latitude mountains of the Andes, extending into Patagonia and New Zealand, with evidence for Late Quaternary periglacial conditions in Southern Africa and Tasmania. Mid-latitudinal periglacial conditions are restricted to the islands of the sub- and maritime Antarctic. Continuous permafrost exists in all ice-free areas of the Antarctic continent.

Andes, Patagonia and New Zealand Alps

The Andes contains the largest SH permafrost environment outside the Antarctic. Recognition of Andean permafrost is largely based on the distribution of associated landforms, especially rock glaciers, rather than direct monitoring or modelling approaches. The spatial distribution and nature of permafrost is still poorly known. Simple relations with mean annual air temperatures do not hold as moisture variations prevent simple correlations between MAAT and ground thermal conditions. The high topographic complexity of mountain terrain further compli-

[1] Report modified from the one published in the CliC Newsletter Newsletter " Ice and Climate" March 2004.

cates the distribution patterns, exacerbated by a lack of climate stations. As in the Andes, the spatial distribution of mountain permafrost in the New Zealand Alps is largely known through the spatial distribution of rock glaciers and debris-covered glaciers.

Responses to current climate change of permafrost conditions in the Andes and New Zealand Alps, and its landscape consequences, are virtually unknown. The key challenge is to understand the relationships between the permafrost properties (distribution, thermal conditions, ice content and active layer thickness) and climate parameters through employment of monitoring and modelling approaches. Implementation of the GTN-P network will however have to deal with the realities facing SH permafrost science in general, as outlined above.

Past distributions of permafrost

The Quaternary distribution of permafrost and periglacial environments has dominated cold regions studies on all Southern Hemisphere continents and has yielded a wealth of evidence in the form of landforms. Discussions on the paleoenvironmental interpretation of these landforms are notoriously vague. The key issue is the poor understanding of the mechanisms responsible for their formation and the climatic boundary conditions required for these processes to operate in the regions where they occur. Modern analogue studies combining field-based process analysis with climate monitoring may lead to a better understanding of the physical links between periglacial process activity and climate interactions, especially where undertaken in 'new' environments, such as the Antarctic.

Diurnal frost environments

Seasonal and diurnal frost environments receive relatively little attention in the permafrost community. However, low-latitude mountains with low seasonal, but high diurnal variation in radiation inputs, are dominated by diurnal frost cycles. Their importance is established for the Bolivian and Peruvian Andes, Southern African mountains, New Zealand Alps and the sub-Antarctic islands. The potentially high (365/a) frequency of freeze-thaw events makes needle ice growth a highly effective ground disturbance factor resulting in break up and heave of vegetation, and high rates of sediment movement. In the highlands of Lesotho and high plains of South America these impacts on vegetation manifest themselves through disruption of grazing lands and accelerating erosion rates, adversely affecting the livelihoods for rural mountain communities.

Marginal maritime frost environments, such as the Sub-Antarctic, appear particularly sensitive to current climate change. The very small seasonal and diurnal temperature ranges result in conditions for frost action under the current warming and has, for example, resulted in rapid degradation of the summit permafrost on Marion Island.

Thus, while perhaps a marginal component of the global cryosphere, recent research highlights the distinctive attributes of the diurnal frost environments of low-latitude mountains and the maritime mid-latitudes. Its close interactions and importance for both ecosystems and the livelihood of rural mountain communities makes it an important area for further research.

Antarctic region

The Antarctic experiences an extremely varied range of climate conditions. Compared with the Arctic little is know about the distribution, thickness, properties and age of permafrost with most data coming from the Dry Valleys Drilling Project and, some long-term, cryosols studies. Active–layer dynamics are very different as interior permafrost areas have surface layers with very low moisture content (<3%), leading to fundamental terminological issues. Active layer thickness varies from 40–150 cm on Antarctic islands to 15–20 cm along the polar plateau, hosting a range of cryogenic processes. In contrast to the maritime islands, active layer processes such as solifluction and cryoturbation are largely absent in the Transantarctic Mountains. However, poor understanding of the climate-permafrost interactions provides for a very limited basis on which climate change signals and responses can be identified. The extreme age of areas such as the Dry Valleys, but also inland mountain ranges, further highlights important issues for long-term soils development under conditions of extreme cold and aridity and the relevance of such areas for planetary permafrost studies.

The science issues pertaining to Antarctic permafrost and soils are now being taken forward by the IPA Working Group on Antarctic Permafrost and Periglacial Environments and the SCAR Expert Group on Permafrost and Periglacial Environments. Jim Bockheim organised the first international workshop on Antarctic permafrost and soils, in Madison, Wisconsin, U.S.A., November 14–18, 2004, resulting in the first step towards a set of internationally coordinated research activities. The following specialist subgroups (chairs in braces) were formed: i) database development and management (Beata Csatho, Cheryl Hallam), ii) permafrost group (terminology, database, modelling, mapping) (Ron Sletten), iii) soils and geomorphology (attributes, protocols, mapping) (Jim Bockheim), iv) CALM-S and GTN-P monitoring (Mauro Guglielmin). The IPY provides a logical framework to develop these activities.

Conclusion

It is of fundamental scientific interest to develop a global understanding of permafrost science. This is made the more pertinent given the concerns of warming impacts on the global cryosphere, of which the GTN-P network is one expression. Southern Hemisphere permafrost envir-

onments are fundamentally different from those in the North and raise a large number of pertinent questions. A number of historical reasons have led to a low profile of permafrost studies from these regions in the international permafrost science. One obstacle has been a low accessibility for international scientists to the Antarctic region in particular. The newly formed working groups on Antarctic permafrost within the IPA and SCAR aim to identify and address some of the scientific gaps and related issues for this continent. Other mechanisms should be developed to stimulate permafrost science at the low- and midlatitudes, including those associated with the climate and cryosphere (CliC) programme.

Permafrost Hazards in Mountains

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Climate change has significant impact on ground temperatures in cold mountains. Questions arise if and to what extent these changes influence the intensity and probability of potentially hazardous processes in regions with mountain permafrost. Buildings and utilities may be damaged by permafrost-induced debris flows or rockfalls. Construction activities are affected by thaw or instability in frozen material. These human activities influence the ground thermal regime at their base by altering the heat fluxes. Problems related to permafrost have become a significant cost factor for the maintenance or construction of high-mountain infrastructure.

Increasing rockfall activity and a number of large rock avalanche disasters are examples of mountain hazards. In the case of the September 20, 2002, rock-ice avalanche at Kolka-Karmadon in the Russian Caucasus, a combined rock-ice avalanche of approximately 10 million m^3 triggered the disastrous shear-off of an entire glacier tongue. The resulting avalanche and mudflow killed more than 120 people. The 10–15 million m^3 rock avalanche of September 18, 2004, in the Italian Alps may have been related to permafrost conditions or their changes.

Frozen Debris

Rock glaciers and other forms of creeping mountain permafrost may be the source of a number of hazards. Rock glaciers represent an efficient long-term debris transport system. They are able to displace debris volumes in the order of 10^3 to 10^4 m^3 per millennium into steep flanks or channels, where they contribute materials to the formation of potential debris flows. The advance of rock glaciers leads to frequent rock falls along the steep front of the rock glacier. If rock glaciers become unstable, slides enhance the rock fall activity or debris flow formation.

Ground warming as recently observed, for instance in the European Alps, is able to increase potential hazards. Increasing creep rates are currently observed for a number of rock glaciers in the European Alps. Presumably this acceleration is due to the rise of ground temperatures and subsequent decrease in ground-ice viscosity.

Ice-rich permafrost influences the hydrology and the mechanics of debris slopes. Ground water concentration above the permafrost table is able to trigger active layer detachments or debris flows. Thawing permafrost in debris slopes might lead to complex hydrological interactions including water storage in unfrozen caverns, and enhanced melt water release. Ground ice cements debris slopes. In the case of thaw, slope stability is decreased. On the other hand, ice-cemented debris prevents retrogressive erosion caused by debris flows.

In cold mountainous regions, ground thermal conditions in moraines are often a crucial factor in the damming of moraine lakes. Permafrost or near-permafrost conditions support the long-term preservation of dead ice bodies, that upon melting leave underground cavities. In these cold mountain regions, glaciers and permafrost often coexist in close spatio-temporal proximity. For instance, permafrost may be able to penetrate into recently deglaciated glacier forefields, to alter the thermal, hydrological and dynamic conditions of thick glacial deposits, and thus to influence related hazards. Such effects are of increasing interest in the light of the current worldwide glacier retreat.

Frozen Rock Walls

A second class of permafrost hazards concerns frozen rock walls. Permafrost in rock faces leads to ice-filled discontinuities, and influences the rock hydrology and the hydrostatic pressure. Steep temperature gradients in the surface zones cause the transport and refreezing of free water and subsequent growth of ice lenses. The resulting increase in pressure is able to destabilize the rock locally.

With a rise in temperature, frozen rock joints reach minimal stability at temperatures between –1.5°C and 0°C, i.e. even before thaw. In parallel, the hydrostatic pressure within the rock wall might change. As a consequence, enhanced rockfall activity and rock avalanches are expected, in particular, within the lower boundary of permafrost distribution.

Complex thermo-mechanically conditions are found in partially glacierized, alpine rock faces. Through advection of temperate firn the base of steep glaciers might be temperate or comparably warm. At the same time, enhanced heat flux at the front of such glaciers leads to cold frontal sections stabilizing the glacier front. Though

Starting zone of the rock face of the devastating September 2002 ice-rock avalanche at Kolka-Karmadon, Caucasus. Photograph by I. Galushkin.

little is understood, it is clear that changes in the surface temperatures can cause highly complicated feedback mechanisms and chain reactions both for rock and glacier stability. In that context, the retreat of steep glaciers and the connected uncovering of rock might have even more drastic and rapid consequences than a rise in the mean annual surface temperature itself. Beside the thermally-governed impacts, retreat of steep glaciers leads to mechanical changes in the underlying and surrounding rock wall. Indeed, increasing rockfall activity and a number of large rock avalanche disasters might have been influenced by thermo-mechanical changes; e.g. the rock-ice avalanche at Kolka-Karmadon and the Italian Alps avalanche close to the Ortler Mountain. The latter avalanche started from a south-facing rock wall at an elevation of around 3500 m asl, i.e. the roughly estimated zone of warm permafrost in this region.

Challenges

Present atmospheric warming affects terrestrial systems particularly where ground or glacier ice is present. Changes in the equilibrium of glaciers and permafrost thermal regimes are shifting hazard zones beyond historical knowledge. The lower boundary of permafrost distribution in the Swiss Alps, for instance, is estimated to rise presently at a vertical rate of 1–2 m per year.

Estimates of hazard potential based on empirical data from the past will not be directly applicable under these new extreme conditions. Empirical knowledge has to be complimented by improved process understanding. The impacts of environmental change on hazard potentials need to be continually monitored. A rapid transfer of this information is critical for the successful mitigation of hazards in highly sensitive high-mountain environments. New techniques for hazard assessments based on remote sensing and numerical modelling have to be fully exploited, and knowledge has to be transferred to affected regions in the underdeveloped countries where hazard potential are present.

High-magnitude, low-frequency events and their relation to changes in permafrost conditions represent a special challenge in risk assessment. Scientific efforts are necessary for understanding the complex spatio-temporal, thermo-mechanical processes in glacierized and frozen alpine rock walls, and large debris bodies under permafrost conditions. These are among the challenges the new ICSI/IPA Working Group on Glacier and Permafrost Hazards in High Mountains are addressing (see GAPHAZ WG report).

The International Union of Geological Sciences has together with the UNESCO Earth Science Division and the joint UNESCO-IUGS International Geoscience Programme initiated the programme Planet Earth–Earth Sciences for Society (www.esgs.org), a component of the International Year of Planet Earth. One of the nine scientific elements of the initative is the theme "Geohazards." GAPHAZ plans to establish collaboraton with the Planet Earth programme.

WORKING GROUPS AND STANDING COMMITTEE REPORTS

(in alphabetical order)

During its meeting in Zurich on July 25, 2003, the IPA Council reviewed and approved proposed activities for 10 Working Groups (WG) and the Standing Committee on Data, Information and Communications. Five WGs are new, two of which were previously Task Forces (Mapping and Isotopes). Four WGs continue for a second 5-year term, and one was granted an extension of one year to formulate a new programme with the IGU (Periglacial). Several WGs are joint with other international organizations (Cryosol with IUSS; Coastal with IASC, and the Glacier and Permafrost WG with ICSI). Others such as Astrobiology and Antarctic WGs are developing joint sponsorship. No new Task Forces were requested; however the Council established a Task Force to review IPA organizational issues. Membership on the WGs is open to all those interested in contributing; simply contact the Co-chairs. Members of the IPA Executive Committee serve as liaison with WGs.

1. ANTARCTIC PERMAFROST AND PERIGLACIAL ENVIRONMENTS (NEW)

Co-chairs

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Statement of Goals

- Coordination/communication amongst researchers within IPA.
- Develop an Antarctic permafrost map.
- Develop monitoring/observation protocols (CALM, GTN-P, periglacial processes) and stimulate their implementation.
- Improve mobility and access to the Antarctic by permafrost researchers by means of common research activities in the Antarctic region.
- Data management of existing and new data (central data base).
- Interaction and collaboration with related IPA WGs (cryosols, astrobiology, planetary and others), SCAR (RiSCC, PAG), CliC.

The Antarctic Permafrost workshop held during the 8th ICOP formulated the importance of permafrost studies by recognizing its presence in all ice-free areas on the continent; the existence of periglacial conditions throughout the Antarctic region, and its importance in relation to Antarctic ecosystems, climate change response, hydrology, weathering, human impacts and other aspects of the Antarctic environment. Discussion identified a number of issues that led to the proposal for this new working group. These are:

i) the lack of spatial information on permafrost form, temperature, moisture content, thickness, geochemistry and age;

ii) the need to extend the network of sites monitoring active layer and near-surface permafrost temperatures;

iii) the lack of spatial information on periglacial landforms and process monitoring;

iv) the need for an understanding of environmental conditions explaining the spatial distribution of permafrost, its properties and related processes.

A further aim is to stimulate coordination and communication amongst researchers and to improve mobility and access through common research activities in the Antarctic region.

An important issue is the visible presence of Antarctic permafrost science within national programmes of SCAR. One step forward has been for the IPA to develop a closer relationship with SCAR. A letter drafted in 2001 led to the formation of a Permafrost Action Group (PAG) in the Standing Scientific Group on Geosciences (SSGG) of SCAR. Its chair, Wayne Pollard, participated in the Antarctic workshop during the ICOP 2003 and co-organized a permafrost paper and poster session during the *SCAR Open Science Conference* in Bremen, July 2004. The sessions hosted seven presentations each. The paper session was attended by about forty participants, many from outside the IPA community, with titles covering active layer conditions and vegetation interactions in continental Antarctica, surface and sub-surface ice in the Dry Valleys, sub-Antarctic island frost environments, and permafrost–freshwater and meltwater chemical analysis from the maritime Antarctic islands. The poster session included discussions on soils properties and mapping, active layer observations from the continent and maritime islands, as well as permafrost development on the Antarctic Peninsula.

Discussions led to a proposal for the PAG to be continued as the *Expert Group on Permafrost and Periglacial Environments* (EGPPE) of the SCAR Standing Scientific Group on Geosciences. The aims of this group will be similar to that of the IPA working group and be chaired by the same group of persons. An initial lifetime of four years is proposed. It is envisaged that the EGPPE will extend the interactions between the IPA and SCAR life sciences, geosciences and physical sciences, improve the visibility of permafrost science in the Antarctic and stimulate proposals and funding within national Antarctic programmes.

Participants in the Antarctic Permafrost and Soils Workshop. Photograph by John Kimble.

Antarctic Permafrost and Soils Workshop

During November 15–18, 2004, approximately 40 scientists from 14 countries assembled in Madison, Wisconsin, for a workshop on "Antarctic Permafrost and Soils." Sponsored by the National Science Foundation, Office of Polar Programs, Antarctic Section, the primary goals of the workshop was to initiate discussion for the production of permafrost and soil maps of the Southern Circumpolar Region. The workshop also reviewed the use of satellite products, digital raster graphics, aerial photography, Lidar data, and digital elevation models for the design and organization of a database for Antarctic soils, permafrost, and ground-ice conditions. The need for development of a permafrost monitoring network for Antarctica, including drilling and equipping boreholes for long-term measurement of permafrost temperatures was addressed. The format of the workshop included plenary addresses, country reports on existing Antarctic databases, approximately 30 oral and poster presentations, breakout sessions, a group discussion on future research needs and priorities, and preparation of a final report. (www.soils.wisc.edu/antarcticConf)

2. Coastal and Offshore Permafrost

Co-chairs
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Statement of Goals

- To encourage interactions of investigators on the subjects of onshore, transitional and offshore permafrost and hydrates.
- Complete the first phase of Arctic Coastal Dynamics and plan and implement a follow up programme including maintaining a network of circumarctic key sites.

A major contribution to the Coastal and Offshore Permafrost (COP) WG is provided through the joint activities of the IPA/IASC project Arctic Coastal Dynamics (ACD). As reported in *Frozen Ground* 27 (p. 41) the IASC-sponsored 4th ACD workshop was held in St. Petersburg, Russia, November 10–13, 2003, and the results were published in *Reports on Polar and Marine Research* 482, (229 pp). During the 4th ACD workshop, the sixty participants from seven countries presented 63 papers. Five thematic groups met and prepared reports on 1) development of a circumarctic GIS, 2) onshore-offshore permafrost transition, 3) transport and fate of eroded material, 4) planning of Arctic Coastal Biodiversity research, and 5) environmental forcing. The circum-arctic segmentation of the coastline and the compilation of the parameters required for the quantitative assessment of the sediment and organic carbon input to the Arctic Ocean through coastal erosion was facilitated during the workshop and at meetings of the GIS members (R. Ødegård, F. Steenhuisen and V. Rachold) in Bremerhaven and Potsdam. Relevant climate forcing and environmental data was compiled by Dave Atkinson for each of the eight regional seas and transferred to GIS-format as individual layers. The coastal permafrost group (chaired by Hans-W. Hubberten and M. Allard), identified the need for a better understanding of the geomorphological, cryological and thermal changes that take place in permafrost during the transition from onshore (terrestrial) to offshore (sub-littoral) conditions. A methodology for the detailed study of coastal transects was elaborated. The suggestions of the group are being considered for the coastal permafrost drilling transect to be performed in the western Laptev Sea by a Russian-German team of the Permafrost Institute (Yakutsk) and the Alfred Wegener Institute (Potsdam) in spring 2005.

The Arctic Coastal Biodiversity group subsequently developed a workshop proposal that was submitted to IASC and funded to develop a Science and Implementation Plan. Close links will be maintained with ACD.

The 5th ACD Workshop was held at McGill University (Montreal, Canada), October 13–17, 2004, with workshop chairs: Wayne Pollard, McGill University, Montreal, Canada and Volker Rachold, Alfred Wegener Institute, Potsdam, Germany (www.acd2004.mcgill.ca). Approximately 40 participants from Canada, Germany, The Netherlands, Norway, Russia, and the United States attended. In addition to the Russian ACD Steering Committee Members and two IASC-sponsored Young Scientists, six other Russians were financed through grants of the Canadian Department of Foreign Affairs and International Trade (DFAIT) and the Canadian International Development Agency (CIDA). During the first day of the workshop, ca. 15 overviews talks and ca. 30 posters were presented. Based on the material presented, four thematic working groups were identified: 1) definition and understanding of the processes involved in the transition from onshore to offshore permafrost, 2) impact of coastal erosion on human populations in the Arctic, 3) analysis of environmental forcing variables and 4) compilation of the circum-Arctic web-deliverable coastal GeoInformation System. The working group discussions concentrated mainly on ACD products (Internet Map Server to be established at AWI Bremerhaven), publications (Arctic Coastal Book and EOS article), and future proposals (IPY coastal programme, new INTAS projects). During the last day of the workshop, Michel Allard (Laval University, Quebec, Canada) invited the group to Quebec City for a guided tour aboard the Canadian icebreaker "Amundsen."

The workshop report including the extended abstracts will be published in *Reports on Polar and Marine Research.*

A special issue of the international peer-reviewed journal *Geo-Marine Letters* edited by V. Rachold, F. Are, D. Atkinson, G. Cherkashov and S. Solomon is in press and provides a collection of COP and ACD relevant papers. These included the following topics:

- sediment and organic carbon flux from coastal erosion;
- coastal classification and GIS development;
- coastal processes in response to environmental forcing;
- spatial and temporal variations of coastal change;
- the role of sea-ice and glacier ice in shaping the Arctic coasts;
- offshore permafrost;
- impacts of human activity on coastal processes;
- coastal modelling.

The printed version of the special issue is anticipated for spring 2005, the online publication will be available by the end of 2004.

The ACD programme was accepted as an Arctic regional project of the International Geosphere-Biosphere Programme–Land-Ocean-Interactions in the Coastal Zone (IGBP-LOICZ). An ACD report appeared in early 2004 in the IGBP-LOICZ Newsletter No. 29 (December 2003).

As part of Tyumen conference special sessions were held on: Frozen Ground of Arctic Shelves chaired by M. Grigoriev and Hans-W. Hubberten; and Arctic Coastal Dynamics, and Coastal and Offshore Permafrost chaired by A. Vasiliev and V. Rachold.

The COP WG participated in the SEDIFLUX workshop (see Other News), and contributed to the session "Coastline changes: interrelation of climate and geologic processes" at the 32nd International Geological Congress (32IGC) in Florence, Italy.

A COP-related session "The role of permafrost coasts in the Arctic System" (co-chaired by V. Rachold and V. Romanovsky) was organized for the AGU Fall Meeting in San Francisco.

A coastal working group (chaired by V. Rachold) was approved for the 2nd International Conference on Arctic

Participants of the 5th Arctic Coastal Dynamics (ACD) Workshop, McGill University, Montreal, Canada. Photograph by Volker Rachold.

Planning (ICARP II) to be held in Copenhagen (November 2005). The group is developing a science plan to address critical questions of Arctic coastal research for the next 5-10 years. Coastal and offshore permafrost dynamics will play a central role in the feedback mechanisms to the global system through potential greenhouse gas emissions to the atmosphere and organic carbon input to the Arctic Ocean. The first working group meeting was organized at the Alfred Wegener Institute (Potsdam), September 12–15, 2004 (www.icarp.dk/index.html).

The modelling of the long-term evolution of permafrost and the gas hydrate stability zone (GHSZ) in rifts of the East Siberian shelf during transgression-regression cycles and climate fluctuations (e.g. Romanovskii *et al.* in press) is supported by a stipend of the Russian-German Otto-Schmidt-Laboratory, and involves young scientists, students, and graduate students. The modelling shows that anticline-like structures are formed on the inner part of the Arctic shelf and submarine taliks on the outer part of the shelf. Different geothermal heat flux values have to be considered for rift faults and the undisturbed lithosphere blocks. The anticline-like structures may function as "traps" for gases and sites of gas hydrate concentration. The submarine taliks, on the other hand, may be places of gas emission during transgressions.

Field investigations on periglacial processes in the transition zone between marine and terrestrial conditions have been undertaken by a Russian team (A. Kholodov and V. Tumskoy) with funding by the Russian Foundation of Basic Research (Grant 03-05-64351). Specific processes include freezing and thawing, and sedimentation and deposition in thermokarst lakes, lagoons and depressions. To decipher the complex and poorly understand processes involved in the transformation of the chemical composition (including carbon content) and the structure and texture of the newly formed deposits, lacustrine, thermokarst lake, thermokarst lagoon and marine deposits are being studied. During spring 2004 samples were collected from different deposits in boreholes drilled in the southeast Laptev Sea region. The field investigations and sampling were continued in summer 2004 on the New Siberian Islands and lowlands by V. Tumskoy.

Annual field measurements at the ACD key sites in the western Laptev, Kara, Barents, East Siberian Seas, and at several sites in the Alaska were performed in 2004 and will be continued in 2005.

The INTAS project "Arctic coastal dynamics of Eurasia: classification, modern state and prediction of its development based on GIS technology" was successfully completed. The INTAS project "Arctic coasts of Eurasia: dynamics, sediment budget and carbon flux in connection with permafrost degradation" has one additional year. Development of follow-up projects is in progress.

Under the new U.S. National Science Foundation Arctic programme the Study of the Northern Alaska Coastal System (SNACS), a three-year project entitled "Collaborative Proposal: Flux and Transformation of Organic Carbon Across the Eroding Coastline of Northern Alaska" was funded with T. Jorgenson and C.L. Ping as lead investigators.

3. CRYOSOL

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Statement of Goals

- Establish interactions between geocryology and soil science.
- Develop a Circumpolar Soil Carbon Database to improve our understanding of soil carbon distribution and dynamics in permafrost-affected soils.
- Develop an Arctic and Antarctic soil database to enhance the classification and distribution of permafrost soils.
- Evaluate soil carbon dynamics, sink and sources in cold environments (at high latitudes and altitudes).
- Investigate the effect of global change on the genesis and properties of soils with permafrost.
- Organize the IV International Conference on Cryopedology and participate in the 18th World Congress of Soil Science.

The major activities of this year were participation in the WRB-CWG Trans-Ural Polar Tour and working group meetings in Russia (Tyumen and Petrozavodsk).

The CWG meeting in Tyumen was held during the International conference "Cryosphere of Oil- and Gas-bearing Provinces" in May 2004. Participants were S. Goryachkin, E.-M. Pfeiffer, J. Brown, D. Fedorov-Davydov, D. Gilichinsky, S. Gubin, D. Konyushkov, S.

Participants of the WRB/CWG Trans-Ural Polar Tour in the Ural Mountains, July 2004. Photograph by Galina Mazhitova.

Maksimovich, and N. Mergelov. Members were pleased to recognize the publication of the WG monograph *Cryosols. Permafrost-affected Soil* edited by John Kimble and published by Springer Publishing House. G. Mazhitova provided information on the forthcoming Trans-Ural field tour organization. S. Goryachkin lead the discussion on the IV International Conference on Cryopedology. It was agreed to change the venue from Apatity to Arkhangelsk as a result of the recent death of Prof. V. Nikonov, the key cryopedologist in Apatity. The conference programme was approved including field excursions. In August 2004, Goryachkin organized a special expedition to Arkhangelsk to prepare for the conference and the field excursion. A number of samples were taken for the laboratory analyses in Moscow and in Hamburg, in preparation for the field excursion guidebook. See web site for conference details (http://www.igras.geonet.ru/cwg/).

Discussions on the study of carbon pools and dynamics in high latitudes were stimulated by a proposal by Peter Kuhry, University of Stockholm. The proposal is to organize a new project on carbon in soils and permafrost. There was general support by the WG members to further develop carbon studies within the framework of the WG. Organisational details are under discussion with the Executive Committee and await additional information and plans from the new Global Carbon Project, and other IPA activities related to modelling, climate and permafrost properties and mapping.

The Working Group "World Reference Base for Soil Resources" (WRB) of the International Union of Soil Science (IUSS) asked the Organizing Committee of the "Soil Classification–2004" Conference (Petrozavodsk, Russia, August 3–8, 2004) for a pre-conference tour to familiarize the group members with Cryosols (permafrost-affected soils). The Organizing Committee requested Russian members of the Cryosol Working Group to organize the WRB/CWG Trans-Ural Polar tour that was held on July 26–August 1, 2004.

Responsible organizers were Galina Mazhitova and Elena Lapteva (Komi Science Center, Ural Division of the Russian Academy of Sciences). They were assisted by Goryachkin, Konushkov, and Marius Drewnik (Poland). Twenty three persons from Austria, Belgium, Germany, Hungary, Italy, Latvia, The Netherlands, Poland, Russia, South Africa and U.S.A. participated in the tour.

The tour covered the area between 66 and 68°N and between 64 and 67°E including East European Subarctic, the polar segment of the Ural Mountains and southernmost Yamal Peninsula in West Siberia. Different Cryosols and Gelic soils were demonstrated to participants, and classification improvements were discussed. Soil chemical analyses for 11 pedons were conducted under international standards.

The tour showed in particular that introduction of the Turbic qualifier is necessary for Cambisol soil reference group, which means that strongly cryoturbated soils with deep position of permafrost table or even without permafrost within a two-metre depth should be recognised in the system. Relative speed of soil profile renovation by cryoturbations and by soil-forming processes, including horizon-forming ones, is poorly known and impedes understanding of soil genesis. Russian and international methods of soil analyses in some cases provide noncomparable results, especially with regard to soil texture and cation exchange capacity (CEC). Use of particle size distribution and CEC data obtained under Russian standards cannot provide even rough correlation with WRB, at least for permafrost-affected soils. In particular, distinguishing between Dystric and Eutric soils may be very confusing. CEC is highly method-dependent index that calls for its more accurate interpretation given the important role it plays in most soil classification systems. The above WRB/CWG report was prepared by Galina Mazhitova.

The co-chairs met in Petrozavodsk, Russia, during the International Conference on Soil. They agreed, in addition to the Arkhangelsk conference, to organize a small symposium on Cryosol problems in the Potsdam conference.

The goals of the Cryosol Working Group were edited and updated by the CWG co-chairs. Cochair Pfeiffer and a number of WG members attended the Workshop on Antarctic Permafrost and Soils. Pfeiffer also attended the SCAR Conference in Bremen to discuss plans for the new SCAR expert group (see Antarctic WG report for details).

4. Glacier and Permafrost Hazards in High Mountains (New)

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Statement of Goals

- Improve the international scientific communication on glacier and permafrost hazards.
- Compile a state-of-knowledge related to glacier and permafrost hazards in mountains.
- Work towards a greater transfer of information and improved communication between the scientific and governmental communities.
- Signpost sources of advice to international and national agencies, responsible authorities and private companies.
- Act as a focal point for information for international media during relevant crises.

The WG is a joint initiative between IPA and the Inter-

national Commission on Snow and Ice (ICSI). It was formally approved by IPA on July 25, 2003, and by ICSI on November 4, 2003.

The working group (acronym: **G**lacier **A**nd **P**ermafrost **HAZ**ards in mountains, GAPHAZ) has set up a web-page (www.geo. unizh. ch/gaphaz) and a mailing list (cf. GAPHAZ web-page). GAPHAZ conducted a first scientific session on glacier and permafrost hazards within the European Geosciences Union (EGU) General Assembly 2004 (Session CR17, April 30, 2004). Seven speakers presented at the oral session: J. Reynolds (invited) gave a comprehensive and lively overview on glacier hazards and related risk assessment; C. Huggel proposed a methodology for assessment of glacial hazards; M. Chiarle presented consequences of the summer 2003 in the Italian Alps; A. Zischg reported about a study on permafrost degradation and related debris flow hazards; A. Kääb gave an update about the current hazard development at Macugnaga/ Monte Rosa; C. Kneisel presented geophysical studies related to potential starting conditions of periglacial debris flows; and J. Noetzli discussed the potential relation between summer 2003 rock falls and permafrost. About 80 persons joined the interesting and stimulating presentations. The corresponding poster session hosted six posters: M. Pelfini (2) about the collapse of an ice-cored moraine and an integrative study on debris flows; I. Roer about recent changes in rock glacier kinematics; W. Haeberli about combined glacier/permafrost hazards; J. Reynolds about hazards related to surging glaciers in Pakistan; and S. Gruber about thermal variations within rock walls and corresponding slope instability. The posters initiated fruitful discussions and knowledge exchange. Further information and the abstracts can be found at www.copernicus. org (go to EGU).

For the EGU 2005 to be held in Vienna, Austria, April 25–29, 2005, a session is planned entitled "Global change: new challenges for assessing glacier and permafrost hazards". A session on permafrost hazards and a working group meeting is also planned for the 2nd European Permafrost Conference in Potsdam.

In addition to the scientific session, the first GAPHAZ technical meeting was held at EGU 2004, joined by 21 scientists. A protocol of the technical meeting can be found in the internal section of the GAPHAZ web-page. The most important outcomes can be summarized as follows:

- GAPHAZ plans a publication for the end of the working group duration.
- GAPHAZ will work towards setting up a set of state-of-the-art principles for dealing with glacier and permafrost hazards in mountains. Furthermore, it is planned to compile a list of the most important scientific gaps related to glacier and permafrost hazards in mountains.
- A next major GAPHAZ session will be envisaged for AGU 2005; participation at other conferences is planned.
- GAPHAZ will try to incorporate members from developing countries in order to improve knowledge exchange.
- GAPHAZ will help to launch courses on glacier and permafrost hazards in the countries affected.

Since GAPHAZ is a joint IPA-ICSI activity it aims also at distributing ICSI news to the IPA community. Complete ICSI information can be found on www.glaciology. su.se/ ICSI. ICSI recently became the IUGG Commission for the Cryospheric Sciences (CCS) through a decision of the IUGG Executive Committee. This is the first step toward the establishment of the International Association for the Cryospheric Sciences (IACS) within IUGG, which the IUGG Executive Committee will recommend to the IUGG Council in 2005. The Council would then vote on the recommendation in Perugia, Italy, at the IUGG General Assembly in 2007. The current ICSI/CCS President, Gerry Jones (Canada) completed his term of office in 2004. Georg Kaser (Austria), the current President-Elect assumes the Presidency of ICSI/CCS for 2005 to 2009. The Secretary of ICSI/CCS (2003–2007) is Peter Jansson (Sweden). Jerry Brown (IPA President) and Georg Kaser (the incoming ICSI/CCS President) are in contact with respect to further IPA-CCS collaboration.

5. Isotopes and Geochemistry of Permafrost (New)

Co-chairs
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Statement of Goals

- Promote the application of isotope and geochemical methods in permafrost research.
- Identify and bring together individuals and groups active in these investigations.
- Facilitate the communication with other individuals, programmes, and archives that are involved in isotopes and geochemical investigations in polar regions.

The Working Group met during the SCAR Conference in Bremen on July 26, 2004, with the participation of: J. Bockheim, J. Brown, Hans-W Hubberten, H. Meyer, E.M. Pfeiffer, R. Sletten, B. Stenni. The achievements of the WG were the establishment of a web page (www.awi-potsdam.de/www-pot/geo/isochem-wg.html) and an email-list server (isochem-wg@awi-potsdam.de), which are maintained by AWI Potsdam and used for the distribution of information among the members of the WG. Presently, the WG consists of 31 members. However, the activity of the working group was considered as less than optimal, especially considering the response to the proposed ques-

tions and activities for the WG activities. For this purpose, it was discussed, whether the scope of the working group should be broadened (in order to attract more people willing to participate actively), or narrowed (in order to select key questions, which can be addressed by smaller groups, e.g. oxygen and hydrogen isotopes in ice wedges). It was agreed to keep the general activities as broad as they are presently, but to facilitate cooperation of smaller groups. One key activity of the WG is to understand processes that influence the isotopic and geochemical composition of permafrost as an archive of scientific interest. It was considered as one of the main tasks of the WG to write an overview paper, provisionally named "Isotopes and Geochemistry of Permafrost—An overview". Individuals or groups interested in contributing to this overview should contact Ron Sletten or Hanno Meyer.

A routine sampling and analytical protocol for stable oxygen and hydrogen isotope in precipitation at the remote Arctic regions will be developed. The latter should be designed to compliment existing programmes (e.g. Global Network for Isotopes in Precipitation) and to be used as a basis for interpreting isotopes in various types of ground ice. Additionally, a circum-Arctic network for the sampling of precipitation according to the protocol was proposed. The first stations of this network have already been installed in Yakutsk (five years) and Tiksi (one year); stations in Barrow and Tyumen are planned. Individuals or groups sampling Arctic precipitation on a regular basis are invited to join this network and should contact WG co-chairs.

Field work within the scope of the WG took place in:

- Alaska in spring 2004 where scientists from AWI Potsdam (Meyer) studied permafrost tunnels in Barrow and Fairbanks.
- in central Yakutia (AWI, Diekmann, Meyer),
- in 2003 near Cape Mamontov Klyk, Eastern Laptev Sea (Schirrmeister, Grigoriev), with Russian partners from the Permafrost Institute Yakutsk (Kunitsky), Moscow State University (Dereviagin) and the AARI in St. Petersburg (Bolshiyanov), and
- in the periglacial surroundings of impact crater lake El'gygytgyn, Chukotka (AWI, Schwamborn; AARI, Fedorov).

The next meeting of the WG will be at the 2nd European Conference on Permafrost in Potsdam. Informal meetings with the Russian community will be held before Potsdam in Pushshino and Moscow during May and June 2005 conferences.

6. Mapping and Modelling of Mountain Permafrost (New)

Co-chairs

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Statement of Goals

- Main goal is to further develop systematic strategies for mapping and modelling mountain permafrost.

Subgoals are

- Develop an international set of accepted legends at different map scales to be used for mountain permafrost maps.
- Promote mountain permafrost mapping in Central Asia.
- Encourage further development of 2D, 3D and 4D (including time) models of permafrost in mountain regions.

The tasks are organized in two subgroups:

- The mountain permafrost modelling subgroup will promote mountain permafrost modelling in both time and different spatial scales chaired by Rune S. Ødegård.
- The regional mapping subgroup will focus on permafrost mapping in Central Asia chaired by S.S. Marchenko and D. S. Drozdov.

Models for the calculation of mountain permafrost distribution are available and they have become valuable tools for research and application. Research to improve these models has continued, in particular in Scandinavia and in the Alps. However, the need for physical-based models that simulate ground temperatures are required as a high priority to address the effects of ongoing climate change that is probably causing strong instabilities in high mountain rock walls and steep debris slopes. Models are required that are able to investigate transient effects and actual temperatures.

Projects in the Alps are focused on the following: a) models of the surface energy-balance in complex topography (the upper boundary condition); b) models of heat transfer in the snow pack; c) models of 3-dimensional heat transfer in the ground including non-conductive heat fluxes; and d) models that are able to simulate debris transport by creep in a regional scale. Realistic simulation of transient ground temperatures and mountain permafrost requires a coupling of energy balance models within complex topography and models for 3-dimensional ground heat transfer and heat conduction within different materials, such as snow, bedrock and debris. In addition, model validation is absolutely necessary and should be performed with observed data at different locations such as the PACE-boreholes sites. Other surface and borehole monitoring, mapping, modelling and slope processes activities are underway in Iceland and Norway. A regional-scale permafrost map based on meteorological observations over northern Norway has been refined and validated at these localities.

Progress was made on compiling and reviewing a com-

mon legend for the Central Eurasia permafrost map. A composite digital map was compiled by Marchenko based on existing IPA and Chinese maps and models for the four countries (Kazakhstan, Mongolia, Russian and China). Planning is underway to meet in Beijing at the CliC April conference, and in Russia and Germany in May and June.

Several members of the WG met during the 5th Arctic Coastal Dynamics Workshop in October 2004 (R. Ødegård and D. Drozdov). Marchenko attended two regional meetings of GCOS in Almaty, Kazakhstan and Yerevan, Armenia, and demonstrated mapping and modelling approaches on the role of permafrost and ground ice in the fresh water supply in the arid regions of Central Asia. The next meeting is planned at the 2nd European Permafrost Conference in Potsdam.

7. Periglacial Landforms, Processes and Climate

IPA Co-chairs
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Statement of Goals

- To facilitate analysis of climate change induced changes in periglacial environments and their distribution.
- To promote knowledge about the impact of these changes on periglacial land systems and human activities.

At the 2003 Council meeting, a one-year extension of the Periglacial Processes and Environments WG was approved in order to make it possible for the WG to consult with the International Geographical Union (IGU) on the organisation of new joint activity related to cold climate surficial processes. After consulting with the chair of the IGU Commission on Climate Change and Periglacial Processes (CCCPP) and other members of the international scientific community, the two co-chairs recommended (June 2004) that the IPA should continue to sponsor a specific Working Group addressing periglacial processes and their coupling to climate, and methodologies to investigate and monitor such geomorphic processes. By mail ballot, the Council approved the new WG and its goals (see above). The new WG will contribute toward a better understanding of the periglacial geomorphic effects of climatic variations, past, present and future.

The recent decades have witnessed an increasingly awareness of a series of modes of variability within the global climate system which operate over a range of temporal and spatial scales. Our understanding of the nature of these modes of variability, their inter-relationships and links to global climate change, and their associated geomorphic effects in periglacial environments have progressed greatly in recent years, and new interpretations continue to emerge. As well as identifying various modes of variability within the present-day climate, many geomorphic and geological studies also focused on elucidating their longer term histories, often using evidence from a range of environmental archives such as tree rings, ice cores and geomorphic phenomena. Climate oscillations occur across several time scales, ranging from intra-seasonal changes to decadal and interdecadal variability such as is evident in the North Atlantic Oscillation (NAO). At longer time scales, there are such important phenomena as the Dansgaard-Oeschger Cycles, Bond Cycles and Heinrich events, which occur at century to millennial scales.

The primary aims of the WG are reflected by the organization of the three subgroups:

1. Temporal variability (Ole Humlum)
   - Review current understanding of the geomorphic effects in periglacial regions of different modes of climatic variability operating at different time scales (e.g. annual and century scale)
   - Consider their importance to the development of modern and past periglacial geomorphological research ideas
   - Investigate if certain periglacial phenomena may represent useful proxies for past and present climate change
2. Spatial variability (Achim Beylich)
   - Investigate climatic impacts on geomorphic processes and sediment transfer in different periglacial environments
   - Compare periglacial sediment transfer with sediment transfer in other climates
3. Field technology (Norikazu Matsuoka)
   - Promote standardized field techniques for periglacial processes
   - Develop a global monitoring network for periglacial processes
   - Incorporate new techniques and update the existing handbook on periglacial processes

Outcomes from the three subgroups constitute the basis for developing a database on registered periglacial phenomena (distribution, type, dimension), periglacial process rates, meteorological variables, ground conditions, etc., and which is a future major task of the WG.

The new IPA WG will collaborate closely with the new IGU *Commission on Cold Region Environments* and the IPA and SCAR activities on Antarctic Permafrost and Periglacial Environments in order to ensure a stronger involvement and representation in international programmes concerned with permafrost, periglacial, coastal and mountain processes and global change.

The initial membership and activities of the new WG included presenting the plans at the PACE 21 Field Workshop in Longyearbyen, Svalbard (September 8–13, 2004). The initial membership is about 20 persons from 10 countries. Preceding the workshop, two model experimental sites

for monitoring frost weathering and ice-wedge cracking were established near Longyearbyen, and the monitoring technologies were discussed during the workshop excursions.

Over the past several years the multi-authored field manual was prepared and can be downloaded from the IPA web site. This field manual continues to receive new contributions and updates. A special issue of the journal *Permafrost and Periglacial Processes* 14(4) entitled: *Monitoring Periglacial Processes: New Methodology and Technology*, was published in 2004, containing papers on a variety of new methodologies and techniques for monitoring periglacial processes. The two co-chairs were guest editors of this special volume.

During 2004 the following periglacial meetings were held:

- Permafrost and Periglacial Processes: a day in honour of Hugh French: Association Québécoise pour l'Étude du Quaternaire (AQQUA) and Canadian Geomorphology Research Group (CGRG), May 2004.
- SEDIFLUX (Sedimentary Source-to-Sink Fluxes in Cold Environments) First Workshop, Saudårkrokur, Iceland, June 2004 (see separate report).
- International Geographical Union (IGU) Congress in Glasgow, August 2004.
- PACE 21 Field Workshop in Longyearbyen, Svalbard, September 2004.

During the year, liaison with the International Geographical Union (IGU) Commission on Climate Change and Periglacial Processes (CCPP) continued. The IGU newsletter was available via e-mail. The CCPP chaired by Prof. Jef Vandenberghe with Dr. Julian Murton as secretary was the last one in a series of IGU commissions that have undertaken activities on periglacial research in IGU starting in 1949. The Commission had its final meeting at the IGU Congress in Glasgow (August 2004). The proposal for a new IGU commission entitled 'Cold Region Environments' was discussed during the past year and was approved by the IGU. The new commission is co-chaired by Martin Gude (Germany) and Christer Jonasson (Sweden). The joint IPA-IGU Agreement of Cooperation was signed by the two Presidents during the Congress and covers the new Commission's activites and the exchange of newsletters (see separate report).

8. Permafrost and Climate

Co-chairs
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Statement of Goals

- Overall goal is to investigate the interactions between permafrost and climate; past, present and future.

Specific goals include

- Propose cartographic and conceptual bases for representing changes in permafrost distribution.
- Undertake an international approach to inter-comparison of active layer and permafrost models.
- Coordinate active layer and borehole monitoring programmes under GTN-P.
- Identify critical processes and measurements in heat and mass transfer.

During the Permafrost Conference in Tyumen in May 2004 a permafrost modelling group met to discuss the possibility of establishing a permafrost model-comparison experiment. Until recently there has been little effort to develop an explicit hierarchy of permafrost models, to evaluate their performance using standardized validation tools and data sets, to rank the performance of various models in different applications and to explicitly link modelling results with observations. This situation has made it difficult to incorporate generated data sets and modelling products into the larger global-change research enterprise. To address these problems, a workshop on geographic modelling and remote sensing of permafrost was held in Fairbanks in October 2004. The workshop was attended by 40 scientists from Canada, China, Denmark, France, Germany, Japan, Kazakhstan, Mongolia, Norway, Russia and the U.S.A.. The workshop was funded and co-sponsored through a collaborative project of the U.S. National Science Foundation at the University of Delaware (N. Shiklomanov, O. Anisimov, F. Nelson), the University of Alaska (V. Romanovsky), the University of Colorado (T. Zhang), the International Arctic Research Center, NASA, the WCRP Climate and Cryosphere programme, and the IPA.

At the present time, two distinct groups of scientists are involved in spatial modelling of permafrost. One group represents the permafrost scientists who realized the necessity to generalize the results obtained from site-specific permafrost modelling activities (scaling-up approach). Another group predominantly consists of climate modellers (both on global and regional scales) who have recognised that permafrost could play a much more important role in the arctic climate than previously assumed. Therefore, the first and most important objective of the workshop was to bring these two groups together and establish a common language for a dialog that will be extremely beneficial to both groups. The second objective was to explain to each other the basic structure and performance of the existing models and to compare different approaches for the development of permafrost spatial model. The third objective was to discuss the data needs and availability for the models that were represented. The fourth objective was to examine the potential of using the remote sensing techniques in permafrost research and the possibility of combining the remote sensing and permafrost

modelling in the investigation of the spatial and temporal variability of permafrost. Workshop abstracts are available and a summary report of the workshop discussions and recommendations is in preparation.

Interaction between climate and permafrost is the focus of the Northern Eurasian Earth Sciences Partnership Initiative (NEESPI; see *Frozen Ground* 27, p. 40). This initiative was launched in 2001 jointly by NASA in the U.S.A. and the Russian Academy of Sciences. One of the decisions of the scooping meeting in St. Petersburg (February 2004) was to promote closer cooperation of the NEESPI with the permafrost scientific community, with particular emphasis on modelling the impacts of changing climate on permafrost and potential feedback to climate system through release of greenhouse gases. An important step in implementation of this decision was a special NEESPI session at the AGU meeting in December 2004, where members of the WG and permafrost modelling community presented recent results. Another session entitled "Changes in Frozen Ground: Environmental and Climatic Impacts," contained 26 papers about permafrost. The session, organized by T. Zhang, O. Frauenfeld, R. Barry, and F. Nelson, was the subject of a press conference held at the AGU meeting.

Activities under the Global Terrestrial Network for Permafrost (GTN-P) continue to grow and evolve. The Thermal State of Permafrost (TSP) component of GTN-P was proposed as a constituent programme of the International Polar Year (IPY) efforts. Work to date on the GTN-P was summarized in a presentation by Sharon Smith (Geological Survey of Canada) at the Arctic Climate Impact Assessment meeting in Iceland in November 2004. Another GTN-P component, the Circumpolar Active Layer Monitoring (CALM) programme received a second five-year grant from the U.S. National Science Foundation to the University of Delaware to support research and operations in Eurasia and Alaska. CALM currently incorporates more than 125 observation sites. The new phase of the programme provides support for field observations in Russia, Kazakhstan, Mongolia, and Alaska.

The Working Group has been closely involved with several national and international programmes addressing the environmental impacts of global warming. The following outlines some of the initiatives in which Working Group members have been engaged over the past year.

The Intergovernmental Panel on Climate Change (IPCC) has begun work on its Fourth Assessment Report (FAR). Unlike earlier IPCC reports, FAR focuses more on the socio-economic aspects of climatic change than on the environmental processes associated with it. T. Zhang (University of Colorado) is responsible for a section entitled "Changes in Frozen Ground." A chapter on "Polar Regions" includes a discussion of permafrost-climate interactions. The Convening Lead Authors are O. Anisimov (State Hydrological Institute), and D. Vaughan (British Antarctic Survey). The first authors' meeting took place in Vienna September 21–24, 2004. Given the overall socio-economical focus of the ongoing report, it is expected that work focused on geocryological hazards in permafrost regions will be well represented in the chapter.

Another effort involving research on geocryological hazards is a contribution made in the Final Report of the Arctic Climate Impact Assessment (ACIA). Chapter 16 of this report is devoted to the Arctic infrastructure and its susceptibility to changing climate. WG Co-chair Anisimov contributed material on permafrost to this chapter. The 139-page Summary report "Impacts of a Warming Arctic: Arctic Climate Impact Assessment" is available at www.amap.no/acia/ (see Permafrost Engineering report).

Climate change and its effects on permafrost environments are one of the concerns of the new IGU Commission on Cold Region Environments (see report in Other News). The Commission's charge mentions cooperative work with the IPA Permafrost and Climate Working Group explicitly, and specifies that the Commission will focus on human-impact studies.

Preparatory work for the second International Conference for Arctic Research Planning (ICARP II) is underway. Several permafrost scientists are involved in ICARP II's Theme 7, "Cryosphere and Hydrologic Processes and Systems," led by Terry Prowse (University of Victoria) (www.dpc.dk/icarp).

Permafrost continues to become more visible in the larger arena of climate-change science. Working Group members have been instrumental in this regards, and have made many presentations before academic conferences, policy forums, and government bodies. Results of assessment of the potential geocryological hazards and threats to infrastructure associated with the anthropogenic climatic warming were presented by Oleg Anisimov on the annual meeting of the European Geophysical Union (Nice, April 25–30, 2004) and at the Summit of Governors of the Northern Countries organized by the International Northern Forum in Yakutsk, July 22–26, 2004. The meeting in Yakutsk was attended by the top-level representatives of the international decision-making and business community, who expressed concern about the potential hazards to environment and infrastructure that may result from thawing and warming of permafrost.

The U.S. Arctic Research Commission recently issued the printed version of its Permafrost Task Force report, *Climate Change, Permafrost, and Impacts on Civil Infrastructure* (www. arctic.gov/publications.htm) and printed copies from (usarc@ acsalaska.net). The report's lead authors are F. Nelson and L. Brigham. Synopses of the report from engineering and policy perspectives will appear in late 2004 in the *Journal of Cold Regions Engineering* and *EOS—Transactions of the American Geophysical Union*, respectively.

9. PERMAFROST ASTROBIOLOGY (NEW)

Co-chairs
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Statement of Goals

- Develop cooperation between earth and biological sciences on the interaction of knowledge for the spatial and temporal limits of the deep cold biosphere on and beyond the Earth, and in the search for extraterrestrial life.
- Bring together scientists and spacecraft engineers for planning future Martian missions, relevant to astrobiology.
- Foster studies on terrestrial permafrost as analogue for extraterrestrial areas of potential sites for water and life, and conduct field campaigns focused on aseptic sampling of ancient permafrost/ground ice in search of preserved microorganisms and biosignatures.
- Explore terrestrial permafrost, ground ice and ice-covered areas for field calibration of space techniques employing geocryological/glaciological experience for interpretation of the space-related remote sensing and satellite imagery and data in the analysis of periglacial planetary features.

A new project has been initiated to understand the limit that radiation places on long-term survival in frozen soils. Toward this goal we will measure the levels of alpha, beta, and gamma radiation from U, Th and K decay in permafrost and the effects of this radiation on microbes in the permafrost over timescales of millions of years. The project is a collaboration between NASA Ames (C. McKay), Soil Cryology Laboratory, Russian Academy of Sciences (D. Gilichinsky), Oklahoma State University (R. Kalchgruber), DLR (G. Horneck) and St. Petersburg State Polytechnic University (A. Pavlov). The radiation environment in permafrost is measured with downhole loggers for gamma radiation and with microdosimetres placed in retrieved permafrost samples for alpha and beta radiation. Comparison with bacteria present in permafrost and survivorship studies in permafrost samples under artificial irradiation should help elucidate the role radiation plays in long-term preservation of microorganisms in permafrost.

In May the special session "From Siberia to Mars" leaded by G. Horneck and D. Gilichinsky took place in Tyumen (Russia) during the International Conference "Cryosphere of Oil-and-Gas Bearing Provinces." In October the sites in the Russian permafrost areas that are interesting for Astrobiology were discussed in a workshop "Astrobiology Expeditions" held in St. Petersburg (Russia) with the Director of NASA Astrobiology Institute Bruce Runnega. In November five poster presentations were made by Moscow State University students at the 4th European Conference on Exo/Astrobiology (Open University, Milton Keyns, U.K.).

Both Co-chairs participated in the Antarctic workshop in Madison, Wisconsin.

The following papers, related to Permafrost Astrobiology were published:

Rivkina, E., K. Laurinavichius, J. McGrath, J. Tiedje, V. Shcherbakova, D. Gilichinsky. "Microbial Life in Permafrost" in *Advances in Space Research*.

Shcherbakova, V., Rivkina, E., K. Laurinavichius, S. Pecheritsina, D. Gilichinsky "Physiological Characteristics of Bacteria isolated from Water Brines within Permafrost" in *International Journal of Astrobiology*.

Dirk Wagner reports on a new project in the DFG (German Research Foundation) Priority Programme "Mars and the Terrestrial Planets" at the Alfred Wegener Institute for Polar and Marine Research/Research Unit Potsdam (Potsdam). It addresses questions related to tolerance limits of microorganisms in extreme environments such as terrestrial permafrost and what can be learned from these studies for the search of life in comparable extraterrestrial permafrost habitats such as on Mars. In order to examine these questions, lithoautotrophic methanogens derived from Siberian permafrost in addition to known species will be used as keystone organisms to investigate their potential to survive adverse living conditions (www.awi-potsdam.de/www-pot/geo/dfgmars.html). The tolerances of these organisms in pure cultures as well as in their natural environment will be tested with regard to different stress factors. The borders of growth influenced by desiccation, temperature extremes, radiation, starvation and increased salt concentrations will be analyzed for the different physiological groups. The comparative system studies will serve to understand the modern Mars cryosphere and other extraterrestrial permafrost habitats, and aid in the search and understanding of extraterrestrial life.

10. PERMAFROST ENGINEERING

Co-chairs
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Statement of Goals

- Document impact of climate change on infrastructure including observations, monitoring and case studies.
- Evaluate potential participation in deep drilling project related to oil and gas exploration.
- Consider developing hydrology and geophysics subgroups or Task Forces.
- Work with Organizing Committee to develop permafrost engineering sessions at the Ninth ICOP.

Co-chair Instanes was lead author of the Infrastructure Chapter 16 of the Arctic Climate Impact Assessment report "Impacts of a Warming Arctic". The 139-page summary report is available at (www.amap.no/acia/). A summary of the Chapter 16 results and identification of gaps were

presented at the November conference in Iceland. Some conclusions are:

- Projected climate change is possible to be a factor in engineering projects if its effects go beyond those anticipated in the existing conservative approach. Therefore, engineering design should take into account projected climate change where appropriate and where the potential effects represent an important component of the geothermal design.
- Permafrost engineers must address the problem of preserving infrastructure under projected future climate conditions. One solution is to construct new buildings as existing ones are damaged and abandoned. In areas of warm, discontinuous permafrost, it is very difficult to find economic solutions to address the impacts of climate change on foundations or structures. These areas, together with the coastal zone, present the greatest challenges in a changing climate.
- The sensitivity of permafrost soil strength to projected climate change can be mapped using a simple strength sensitivity index, as proposed in this report. A risk-based procedure for analyzing structures based on their sensitivity to the potential consequences of climate change is a reasonable approach to incorporating climate change concerns into the design process.

The following ACIA key findings are related to the Engineering WG activities:

- Many coastal communities and facilities face increasing exposure to storms.
- Severe coastal erosion will be a growing problem as rising sea level and a reduction in sea ice allow higher waves and storm surges to reach the shore.
- Along some arctic coastlines, thawing permafrost weakens coastal lands, adding to their vulnerability.
- In some cases, communities and industrial facilities in coastal zones are already threatened or being forced to relocate, while others face increasing risks and costs.
- Thawing ground will disrupt transportation, buildings, and other infrastructure.
- Transportation and industry activities on land, including oil and gas extraction and forestry, will increasingly be disrupted by the shortening of the periods during which ice roads and tundra are frozen sufficiently to permit travel.
- As frozen ground thaws, many existing buildings, roads, pipelines, airports, and industrial facilities are likely to be destabilized, requiring substantial rebuilding, maintenance, and investment.
- Future development will require new design elements to account for ongoing warming that will add to construction and maintenance costs.

Working Group members including Co-chair Vinson attended the 6th International Symposium on Permafrost Engineering in Lanzhou, China, in September. Vinson also participated in the preparation of the U.S. Arctic Research Commission report (see Permafrost and Climate report).

Closer coordination is being undertaken with Technical Committee TC8: Frost Geotechnics of the ISSMGE.

Standing Committee on Data, Information and Communications

Co-chairs
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Sharon Smith, Canada (ssmith@nrcan.gsc.ca)

Statement of Goals

- Implement IPA strategies for data recovery, archiving and development of data and information products including GGD and CAPS Version 3.0 for 2008.
- Communicate information within and external to the permafrost communities (e.g., IPA, GTN-P, and Frozen Ground web sites, *Frozen Ground*, CAPS CDs).
- Prepare subject index to 8th ICOP proceedings and extended abstracts, and develop plans for cumulative indexes and CD of previous ICOP proceedings.

The IPA web site is now located at the University of Oslo and is being maintained by Ole Humlum (www. geo.uio.no/IPA/). On behalf of the IPA we extend our appreciation to the Geodata Institute, Southampton University, and its staff for the years of dedicated service in the development and maintenance of the original IPA web site.

The subject index for the Eighth ICOP proceedings was compiled by Antoni G. Lewkowicz, University of Ottawa, Canada. It is posted on the IPA web site.

Over the past year, the web site for the Global Terrestrial Network for Permafrost (GTN-P) (www.gtnp.org) was developed further and now contains a component that provides access to summary historical thermal data for some boreholes in addition to borehole metadata (site descriptions). Borehole metadata was compiled for approximately 70% of the boreholes that have been identified for inclusion in the GTN-P. Summary historical data (including maximum, minimum and mean temperature where available) was provided for several Canadian sites and a number of sites in Alaska, Europe and Asia. Additional data will be added as it is received from investigators. Investigators may submit mean monthly temperature data (or lower frequency data) to Sharon Smith. Higher frequency data may be archived with NSIDC. Data will be updated on an annual basis. The GTN-P data service will service the IPY Thermal State of Permafrost activities. GTN-P presentations and posters were presented at several conferences including the ACIA. A new CALM web site was developed at the University of Delaware.

The Geological Survey of Canada continues to release data sets from its permafrost monitoring programme. A

CD compilation of summary thermal data for Norman Wells Pipeline monitoring sites was released this year. The relational database includes data collected between 1985 and 2001 for monitoring sites both on and off the pipeline right-of-way along with detailed site descriptions. Also included is information on thaw depth and thaw settlement over the monitoring period (see S.L. Smith et al., CD Rom 2004. GSC Open File 4635). The web site for the Canadian Permafrost Monitoring Network (www.canpfnetwork.com) has been updated. The site now provides access to summary historical ground temperature data for several Canadian boreholes and to active layer data for monitoring sites in the Mackenzie Valley.

The Global Geocryological Data system (GGD) was developed starting in the late 1980s as an internationally-distributed system linking investigators and data centers around the world. The Frozen Ground Data Center (FGDC) at the World Data Center (WDC) for Glaciology in Boulder facilitates the operation of the GGD by collecting and distributing information (metadata) that describes permafrost and frozen ground related data. Many GGD products are available directly through the FGDC; some are held by other institutions.

In 1998, the WDC compiled the first Circumpolar Active-layer Permafrost System (CAPS) data collection on CD-ROM. CAPS included 56 data sets and an additional 89 metadata descriptions for products held elsewhere by investigators and institutions around the world. In late 2002, the FGDC published the contents of CAPS online at the FGDC web site (www.nsidc.org/fgdc), and began updating and adding to the CAPS collection to create CAPS Version 2.0 for distribution at the Eighth ICOP. Part of the effort of updating CAPS was to contact the investigators and institutions holding the 89 GGD products not contained on CAPS. Unfortunately, 45 of the 89 products were not readily accessible and may no longer be available. These 45 products are still listed on the CAPS2 CD set, but we have elected not to list them in our online database since we cannot afford to provide support to users seeking these products.

The potential loss of these data highlights the need for continued ongoing support of data management for the international permafrost community. During the five-year interval between the first and second CAPS, there was little financial support for the management of the data contained on CAPS. Although the publication of CAPS 2.0 data and online access was a welcomed milestone, there is little ongoing support to manage these data and maintain linkages to the many GGD products held elsewhere. It is likely that more of these data will be lost by the time of the Ninth ICOP in 2008.

The SCDIC is maintaining close contact with the Climate and Cryosphere (CliC) programme of the World Climate Research Programme. Co-chair Barry is also co-chair of the CliC Scientific Steering Group. The CliC science plan will be presented at the First CliC Science Conference in Beijing, April 11–15, 2005 (www.clic2005.org). The plan consists of four main topics; CPA1 on terrestrial cryosphere includes research related to hydrology, permafrost and carbon stocks. The CliC Data and Information Service (DISC) is incorporating GGD/CAPS metadata into its data activity (clic.npolar.no/disc/disc.php).

In the past several years two Russian glossaries have come to our attention. *Geocryological Glossary* compiled by the Research Institute for Engineering Site Investigations and *Permafrost Hydrotechnic Engineering* edited by Kagan and Krivonogova of the Hydrotechnic Institute of B. E. Vedneev, St. Petersburg.

International Advisory Committee for the International Conference on Permafrost

Chair
Kaare Flaate, Norway (kflaate@online.no)

Statement of Goals

- Provide continuity in maintaining Conference policies and to assist in other matters as requested by the hosting member.

The IAC completed its responsibilities for the Eighth International Conference on Permafrost by issuing its report on the conference in January 2004 and later commenting on drafts of the final report by the Conference Organizing Committee.

The IAC commended the Organizing Committee for its report and noted that many of its recommendations will be very useful in planning future conferences. The report is available on the IPA web. A CD of the proceeding volumes was produced and was made available to registered participants.

The IAC looks forward to working with the organizers of the Ninth ICOP.

Kaare Flaate, Chair (Norway)
Felix Are (Russia)
Jerry Brown (U.S.A.)
Branko Ladanyi (Canada)
Antoni Lewkowicz (Canada).

News from Members

Members are encouraged to submit periodic updates of activities for posting on the IPA Web site.

Argentina (and South American Partners)

The book *Los fenómenos periglaciales. Identificación, determinación y aplicación* by Dario Trombotto and Ana Lía Ahumada is in the process of being published by the Fundación Miguel Lillo. This book synthesizes the current information about periglacial processes on the basis of the research carried out in Argentina and other parts of South America.

Under the direction of Ana Lía Ahumada, the Northwest Argentina working group of the Institute for Quaternary Geology of the "Fundación Miguel Lillo" continues working on a high basins inventory of eastern Sierra de Aconquija. A special emphasis is on the water (ice) content of rock glaciers and on hazard assessment in these high mountain areas sensitive to climatic change.

Further monitoring of the rock glacier Morenas Coloradas in the Central Mendoza Andes (Dario Trombotto, IANIGLA, Mendoza) indicated in summer 2004 a temperature of 2.5°C at 5 m depth at Balcón I (3560 m asl), i.e. where top of the permafrost permafrost occurred until 1999. Another increase in active layer thickness, although less pronounced (15 cm), could also be observed at Balcón II (3770 m asl). Active layer thickening is accompanied by a reactivation of ancient thermokarst.

Bolivia: The Bolivian (J. Argollo)–Argentinian (R. Villalba) research project "Cryogenic processes as a major forcing of upper-treeline limit of *Polylepis* in the Bolivian Altiplano" is aimed at climate variations reconstruction using proxy data from high regions across the Western Americas. Tree-ring data have been collected for the past four years in the southern Bolivian Altiplano. *Polylepis tarapacana* (queñoa) is a good indicator of interannual precipitation changes and some queñoa cross-sections have been collected between 4500 and 4750 m asl on old volcanoes (five in Bolivia and one in Argentina). Landscape features linked to inactive cryologic processes are common in the area. At the Uturunco volcano (21°S, 67°W), the upper limit of the queñoa woodlands appears to be controlled by rock streams (Andean kurums) that were probably active during the Little Ice Age. These features are better developed on the S-SW slopes than on N-facing slopes; queñoas can therefore reach higher elevations on these slopes. Cross-sections from *Polylepis* trees killed by this downslope movement of rock and ice have been used for dating the activation of these cryogenic processes using dendrochronological techniques.

Bernard Francou and his team (Institute of Research for Development, France) have established a glacier monitoring network that includes glaciers of the Cordillera Real, Zongo and Chacaltaya (Bolivia, 16°S). A summary of the research on the Cerro Caquella rock glacier is ready for publication.

Brazil: The Antarctic working group of Proantar-Brazil (F. Simas and C. Schaefer), a new group in the AASP, continued working on permafrost investigations and chemical processes on King George Island, Antarctica. A summary of their work was published in the proceedings of the 2004 SCAR meeting in Bremen.

Chile: Rock glaciers in the semiarid Andes of Chile are being studied by geomorphologists from the Humboldt University Berlin. On the basis of random sampling and aerial photographs, Alexander Brenning established a regression model correlating relief parameters to rock glacier and glacier distribution in the Santiago and Mendoza Andes. A rock glacier was discovered in the Santiago Andes just 10 km east of the Chilean capital—a striking proof of the need for further permafrost investigation in Chile. First results were presented at the EGU Conference in Nice. Further research on the Punta Negra rock glacier (Santiago Andes) by Tobias Wittkopf includes monitoring ground temperatures between 2500 and 4000 m asl in order to better understand soil-snow-atmosphere heat exchanges (Andreas Lamm).

Ecuador and Perú: A large-scale monitoring programme (B. Francou, IRD) in these countries (together with Bolivia, see above) includes mass balance (energy balance), ENSO events and hydrological balance on several tropical glaciers at the Cordillera Blanca, Yanamarey and Artezonraju in Peru (9°S) and in the Ecuadorian Andes (Antizana and Carihauyrazo, appr. 0°). A workshop on this topic was carried out in July in Huaraz. Despite smaller retreat rates during cold events (La Niña), tropical glaciers retreat has been accelerating since the late 1970s in an area extending from Ecuador to Bolivia.

Finally, I would like to express my gratitude to the colleagues from different South American countries, Switzerland, Germany and France for their support of the Argentine IPA representation.

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Belgium

Frozen ground research at the University of Ghent (I. Heyse and G. Ghysels) mainly focuses on the study of relict periglacial phenomena. During the Pleistocene, Belgium was situated in the ice-free cold-climatic zone surrounding the Fennoscandinavian Ice Sheet. Evidence for these very cold conditions is provided by relict cryogenic features, including frost-wedge pseudomorphs.

Gunther Ghysels is doing a PhD on frost-wedge pseudomorphs in Flanders (Belgium).

Frost-wedge pseudomorphs are widespread and occur at different stratigraphic levels, suggesting widespread and

Pleistocene thermal-contraction-cracking polygons, Sint-Niklaas, Flanders, Belgium (51°08′N/04°11′E). Photograph by I. Heyse and G. Ghysels.

periodical thermal contraction cracking during the Pleistocene. This research aims at better understanding the variety and types of frost-wedge pseudomorphs in Flanders, their spatial distribution, age and chronology, their palaeoenvironmental significance and the relation between phases of wedge formation/degradation and climate/climatic changes as recorded in ice-core and marine records. OSL-dating is now being applied to the wedge fillings, adjacent and overlying materials to obtain a more precise and accurate absolute chronology for frost-wedge formation and degradation. Completion of this study and presentation of the final results are planned for 2005.

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CANADA

One of the noteworthy events in Canada in 2004 was the special session held in honour of Professor Hugh French, as part of the joint Canadian Geomorphology Research Group/Association Québecoise pour l'Etude du Quaternaire meeting. Hugh officially retired from the University of Ottawa in 2003 after a 36-year career in the Department of Geography and the Department of Earth Sciences. Among the awards that Hugh received during his career were the Roger J.E. Brown Award of the Canadian Geotechnical Society in 1989 for outstanding contributions to permafrost science and engineering, and the Canadian Association of Geographers Award for Scholarly Distinction in 1995. Hugh is now Professor Emeritus, but continues to teach courses including a periglacial field course in the Gaspésie (eastern Canada).

The day-long special session on May 15, 2004, in Quebec City honoured Hugh's distinguished career as professor, permafrost scientist, founder and editor of the journal of Permafrost and Periglacial Processes (PPP), and member and past President of the IPA Executive. Over 30 permafrost researchers attended from Canada and abroad (Japan, Norway, Belgium, U.K., U.S.A.). The introduction to the meeting was made by Albert Pissart, Professor Emeritus at Liège, who worked with Hugh on Banks Island in the 1970s and later was Associate Editor on PPP; Jerry Brown; and Antoni Lewkowicz, Hugh's former graduate student and Associate Editor of PPP. The latter and two other former graduate students, Wayne Pollard (McGill) and Julian Murton (Sussex) gave papers. Many of the more than 20 papers from the special session will be published in 2005 in the first issue of volume 16 of PPP as a lasting tribute to Hugh French's influence on the field of permafrost science. The special session and special volume were organized by Antoni Lewkowicz.

On November 15–16 in Calgary, another special event took place—the two-day Permafrost and Arctic Geotechnology Symposium, "Our Canadian Legacy." The symposium, organized by the Cold Regions Geotechnology Division of the Canadian Geotechnical Society, featured more than a dozen Canadian permafrost pioneers and specialists either summarizing their areas of expertise and/or sharing interesting and challenging case histories.

Symposium attendance far exceeded expectations, clearly demonstrating the renewed interest in permafrost engineering issues associated with resource developments in Canada's North. A highlight was the presence of Dr. J. Ross Mackay, who introduced Dr. Chris Burn, who spoke on climate change in the Mackenzie Valley. The programme and list of presentations can be found at http://members. shaw.ca/cgssymposium

In another notable event, Dan Riseborough (GSC/NRCan) received the Senate Medal for Outstanding Achievement at the doctoral level and the Governor General's Medal for the top student of all 2004 graduating classes. The awards were in recognition of his outstanding dissertation presented at Carleton University in September 2004 entitled "Exploring the Parameters of a Simple Model of the Permafrost-Climate Relationship"

Researchers from the University of Calgary, lead by Matthew Tait of Geomatics Engineering and Brian Moorman of Geography, and Geology and Geophysics, are undertaking a project to investigate methods for measuring the small scale subsidence associated with hydrocarbon extraction beneath permafrost in the Mackenzie Delta. The subsidence bowl for an individual field has been modelled to be several square kilometres in spatial extent with subsidence in the centimetre per year range. Currently, DGPS and interferometric SAR in conjunction with active layer heave modelling are being tested against traditional surveying techniques.

A study of how permafrost and hydrological systems react to rapid glacier retreat is being undertaken on Bylot Island in the Eastern Canadian Arctic by researchers at the University of Calgary (lead by B. Moorman). Recent glacial retreat has been identified to have a major influence on the

hydrological system of surrounding permafrost. Ongoing research includes hydrological routing, massive ice preservation, slope stability and the thermal regime of permafrost.

Mapping and studies of the properties of the lithalsas from southern Alaska across the Yukon Territory into British Columbia has been completed (S. Harris, Univ. of Calgary). Work on the layers within the active layer was presented in June 2004 at the Tyumen permafrost conference. Field work is continuing on evidence for a similar layering in bedrock containing permafrost at Plateau Mountain. The monitoring of ground temperatures in permafrost is continuing in the Yukon.

A federal interdepartmental initiative, led by the Department of Indian Affairs and Northern Development (DIAND) and noted in last year's Frozen Ground report, was approved by Cabinet for 3-year funding of $75 million. The science supported by this funding will be focused on addressing biophysical research gaps related to northern energy development in the Mackenzie Valley and Delta, and the associated government regulatory preparedness. Over $9 million will be dedicated to geoscience studies (mostly in NRCan and also in DIAND), will include permafrost monitoring, slope stability investigations, and coastal and nearshore studies. Energy, northern and pipeline related permafrost studies by the federal government in the western arctic (onshore, coastal and offshore) also continue to be funded by the Federal Panel on Energy Research and Development (PERD).

The application and environmental impact studies for the Mackenzie Gas Project were officially filed in October 2004 by Imperial Oil Resources Ventures Limited, the Mackenzie Valley Aboriginal Pipeline Limited Partnership, ConocoPhillips Canada Limited, ExxonMobil Canada Properties and Shell Canada Limited. The project will involve the development of three onshore natural gas fields in the Mackenzie Delta, and the transport of natural gas via buried pipelines through the continuous and discontinuous permafrost regions of the Mackenzie valley to northwestern Alberta. A streamlined regulatory review process has begun and a Joint Environmental Assessment (EA) Review Panel has been established. Many members of the Canadian permafrost community are or will be involved in various aspects of the project and its approval, from engineering design and environmental investigations for the proponents, to reviewing the environmental impact assessment.

GSC (Geological Survey of Canada) and its partners were involved in several coastal and nearshore permafrost investigations. The application of remote sensing to coastal permafrost distribution in the Mackenzie Delta region was a primary focus (S. Solomon). Radar satellite and ground penetrating radar were used successfully to delineate areas of bottomfast ice in the nearshore region. The University of Calgary (B. Moorman) provided the expertise in GPR. Bottomfast ice distribution is a critical control on the

Group at Laval University honouring Hugh French. Photograph by Antoni Lewkowicz.

distribution of seasonal frozen ground and permafrost in water depths shallower than 2 m.

The GSC (D. Forbes, G. Manson and S. Solomon) carried out coastal stability surveys at sites throughout the western Canadian Arctic. The surveys support aspects of the joint IPA-IASC Arctic Coastal Dynamics project by providing information of coastal environments ranging from submergent and exposed to emergent and protected. This project includes partners from the departments of Fisheries and Oceans and the Geodetic Survey of Canada who are determining rates of sea level rise and vertical ground motion, respectively. Rates of ground motion are also being monitored using GPS at sites in the Mackenzie Delta. These locations will provide information on differential rates of subsidence in the delta prior to the development of oil and gas fields there. Changes in the rate of sea level rise and subsidence influence flooding frequency and therefore coastal permafrost stability.

The web site for the Canadian Permafrost Monitoring Network was updated (www.canpfnetwork.com) (S. Smith). The site now provides access to summary historical ground temperature data for several Canadian boreholes and to active layer data for monitoring sites in the Mackenzie Valley. A CD compilation of summary thermal data for Norman Wells Pipeline monitoring sites was released this year. (For more information on both these items, see the report of the Standing Committee on Data Information and Communication).

A study concerned with massive ground ice in coarse-grained deposits and its implications for granular resource inventories is being conducted in the Mackenzie Delta area by researchers from McGill University (W. Pollard) and the Canadian Department of Indian Affairs and Northern Development (DIAND) (B. Gowan). Supported by PERD and DIAND, this study addresses questions concerning the nature, origin, distribution, and significance of massive ground ice in deposits identified as potential sand and gravel sources. In 2003–04 fieldwork included a series of resistivity and GPR surveys at sites on Richards Island

and along the East Channel of the Mackenzie River. Samples of ice and ice-rich sediments were taken for physical and chemical analyses. Results will facilitate characterisation of sensitivity of these sediments to natural or anthropogenic disturbance, as well as providing information about massive ice occurrence in coarse sediments. This research forms the basis of MSc research of Greg De Pascale (McGill University).

The Canadian daily snow depth database that was released on the *Canadian Snow CD* in 2000 has been updated to the end of the 2002/2003 snow season. The database includes daily snow depths observed at close to 2000 climate stations in Canada, monthly depth statistics (mean depth, median depth, snow cover duration) as well as climate normals for the 1971–2000 period. The updated dataset files (partitioned by province) can be downloaded from the Canadian Cryospheric Information Network (www.ccin.ca) (R. Brown, Meteorological Service of Canada).

An Introduction to Frozen Ground Engineering, Second Edition by O.B. Andersland and B. Ladanyi, was published in 2004 jointly by ASCE and John Wiley & Sons, New York, 363 p.

S. Solomon (NRCan/GSC) and D. Atkinson (formerly NRCan, now with the International Arctic Research Center at the University of Alaska) completed their contributions to the Cryosphere chapter of the Arctic Climate Impact Assessment (ACIA). They provided information on coastal permafrost and the sea level rise. B. Ladanyi (Ecole Polytechnique) contributed to the Chapter on Infrastructure, Buildings, Support Systems, and Industrial Facilities.

A two-day workshop on "Permafrost Geophysics: Exploration and Engineering Challenges" in regions of continuous and discontinuous permafrost is being organized for April 2005 in Calgary. The workshop, sponsored by the Association of Professional Engineers, Geologists and Geophysicists of Alberta, will involve tutorials on the current knowledge from ultra-near surface to deep oil and gas exploration. Short presentations on case studies and a panel discussion focusing on cross-disciplinary approach to permafrost investigations are planned.

For many decades numerous scientific field parties operating in the Canadian Arctic have received critical logistics support from the Federal government's Polar Continental Shelf Project (PCSP) of NRCan. We wish to give PCSP the long overdue recognition for the significant contribution it has made to permafrost research in the Canadian Arctic, not only for Canadians but also numerous colleagues in the international community.

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CHINA

Permafrost monitoring has been carried out continuously on the Tibetan Plateau since 1988; the year of the establishment of the Cryosphere Research Station on the Qinghai-Xizang Plateau. Eleven active-layer monitoring sites, and 18 permafrost-temperature monitoring boreholes along the Qinghai-Xizang Highway (QXHW) cover almost all types of vegetation cover and permafrost found on the plateau. The active layer monitoring sites observe air temperature and humidity at the height of 1.5 m, of soil temperature and moisture at 10 to 15 different depths from the ground surface to the base of active layer, and of soil heat fluxes at 3 depths (2, 5 and 10 cm). The depths of the 18 boreholes range from 20 to 130 m. Starting in 2000, four meteorological stations were established along the QXHW in order to measure air temperature, humidity, wind speed at 2, 5 and 10 m above the ground, solar radiation, net radiation, snow depth, and precipitation. Two fluxes monitoring sites were installed in 2004 in order to monitor the heat, moisture and carbon dioxide fluxes at 3 m above the ground surface.

Five international symposia have been held during the last ten years in order to share and exchange our experience and knowledge in permafrost engineering: in Chita (Russia), 1993; in Harbin (China), 1996; in Chita, 1998; in Lanzhou, 2000, and in Yakutsk (Russia), 2002. Since the first symposium, the participation at these bilateral symposia have increased significantly, evolving into international meetings attended by scholars and engineers from many countries. These symposia have substantially enhanced the development of permafrost science, engineering and technology and the multidisciplinary collaboration within this field.

The 6th International Symposium on Permafrost Engineering was held September 5–7, 2004, in Lanzhou, China. The following summary of the symposium was prepared by Huijun Jin and Guodong Cheng.

The 6th International Symposium on Permafrost Engineering was successfully held under the auspices of the Glaciology and Geocryology Branch of the Chinese Geographical Society, the IPA Chinese Adhering Body. It was co-organized by the State Key Laboratory of Frozen Soils Engineering (SKLFSE), the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), the Chinese Academy of Sciences (CAS), the Qinghai-Tibet Railway Company (QTRC), the PRC Ministry of Railway, the First Railway Survey and Design Institute (FRSDI), and the United Institute of Permafrost Research and Natural Resources Development, Siberian Branch (Russian Academy of Sciences). Fifty-eight technical papers were published in the Symposium Proceedings, as a supplement of the *Journal of Glaciology and Geocryology* (Vol. 26).

About 150 scientists and engineers from seven countries attended the symposium. Seventeen Chinese engineers and scientists and 17 scholars from six other countries participated in a field trip along the Qinghai-Tibet Highway/Railway during September 8–13, and in a seminar in Lhasa on September 14. During this seminar, the

Participants at the 6th International Symposium on Permafrost Engineering in Lanzhou, China. Photograph provided by Huijun Jin.

latest progress on permafrost engineering and the survey, design and construction of the Qinghai-Tibet Railway (QTR) were presented and discussed with some of the major railway designers, regulators and administrators.

Permafrost conditions occupy 22% of China land territory. About 70% of the Qinghai-Tibet Plateau is underlain by high-elevation permafrost. The QTR from Golmud to Lhasa is due for completion in 2007. It will traverse 632 km of the plateau permafrost. The Qinghai-Tibet Highway is generally parallel and about 1 to 2 km away from the railway. Chinese engineers are facing unprecedented engineering and environmental challenges; therefore, permafrost engineering has recently become the main research focus for cold regions scientists and engineers. Moreover, many foreign scientists and engineers have been invited or volunteered to become involved in the resolution of permafrost problems that are developing along the QTR.

Qinghai-Tibet Railway bridge embankment. Photograph provided by Huijun Jin.

Many promising achievements have been obtained during the past three years in the QTR construction practice. These include the adoption of techniques such as rock-stone ventilation roadbeds and side slopes, air-duct ventilated roadbeds, and thermosyphons for cooling the underlying permafrost, and the utilization of insulation boards. The techniques adopted are being tested under real conditions. However, there are still numerous engineering and environmental problems waiting for solutions. In this respect, the Lhasa symposium helped considerably in the development of applications. It aimed at soliciting comments and recommendations for the improvement of the design and construction. During the numerous discussions on design, maintenance and environmental engineering issues, international experts were encouraged to share their experience in order to assure that the QTR utilized the best standards in terms of quality and safety, within limited construction costs. Some experts pointed out that actively cooling the roadbed could be achieved by removing snow from the embankments and toe areas, or using light-coloured embankments and side slope surfaces, awnings for shading the solar radiation, and hairpin or tilted thermosyphons. Some new ideas on using "natural cold reserves" were proposed to protect the QTR permafrost roadbed from thawing.

Some of the major questions from the post-conference field trip that participants were concerned with: field explorations for the design, construction and operations; general understanding of design criteria; construction in building of the QTR; active, passive, reactive and proactive protection of the permafrost foundation underlying the railbed; interactions between the natural and engineering environments; and drainage of excess water. The major concerns from the QTR builders, authorities and adminis-

trators dealt with: long-term effects of rock-stone ventilation, convection roadbed and coarse stone protection; applicability of insulation materials; thermosyphons; impacts of climatic warming on the QTR; slope stability and hazards mitigation along railways in permafrost areas; and advice for a long-term QTR monitoring system. The participants were impressed by the innovative designs and quality of workmanship on the QTR.

Professor Valentin Kondratev invited colleagues to join the permafrost engineering conference to be held in Chita in 2005 where emphasis will be on linear infrastructures in permafrost areas. President Guodong Cheng invited participants to join the International Regional Permafrost Conference in 2006 in Lanzhou, China. It is co-sponsored by the IPA and organized jointly by the Chinese Society of Glaciology and Geocryology, the Chinese Academy Sciences, SKLFSE, CAREERI and CAS. A post-conference field excursion to the construction sites in the permafrost areas along the Qinghai-Tibet Railway/Highway will be organized (contact Prof. Lai Yuanming: ymlai@ ns.lzb.ac. cn).

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FRANCE

The research group CNRS UMR 6042 (GEOLAB Laboratory, Clermont-Ferrand) continues its periglacial investigations within various research projects. The last field season of a four-year programme led by Denis Mercier and supported by the French Polar Institute took place in Northwest Spitsbergen. It is aimed at paraglacial dynamics including relationships between geomorphic processes and vegetation colonization.

In Iceland, the scientific cooperation between Armelle Decaulne and Thorsteinn Saemundsson (Natural Research Centre of Northwestern Iceland, Saudårkrokur) consisted of a joint investigation of snow-avalanche and debris-flow processes (geomorphic impact, triggering factors, slope deposit stratigraphy, relative dating using lichenometry and vegetation cover) and in a study of associated natural hazards in fjords and valleys in north and northwest Iceland. They co-organized with Achim Beylich (Geological Survey of Norway) the First SEDIFLUX Science meeting. The Second SEDIFLUX Science Meeting is organized by Samuel Etienne (setienne@seteun.net) in Clermont-Ferrand in January 2005 (see Other News).

Results from previous field seasons in Alexander Island (Antarctic Peninsula) and in the Falkland Islands are being processes by Marie-Françoise André, Kevin Hall and Joselito Arocena with a particular focus on past and present alveolar weathering, thermally-driven processes, and stone runs.

At the CNRS UMR M2C 6143 (Caen University), various research programmes are dedicated to morphodynamics in periglacial environments. In order to constrain the evolution of fault scarps and steep slopes in areas that have experienced periglacial erosion during the Quaternary, a physical modelling experiment was carried out in a cold room. Boundary conditions were assessed with reference to field data obtained along the La Hague Fault Scarp (North Cotentin, Normandy). Data from 41 freeze-thaw cycles point out that scarp degradation mainly results from three interactive processes: (i) cryoexpulsion that modifies the soil rheology, ii) combined effects of frost creep and gelifluction which lead to slow and gradual downslope displacements of the active layer, and iii) debris flows that induce rapid mass movements when the active layer is water saturated. One of the most surprising results of this physical modelling is the importance of rapid water-induced mass displacement during thawing. This appears to be a very efficient process in scarp erosion and degradation.

A new programme funded by the INSU/CNRS (Programme National "Relief de la Terre" 2004) is dealing with the role of debris flows on slope degradation in periglacial environments. A research programme of the University of Sussex (Julian Murton) funded by the U.K. Natural Environmental Research Council on "Bedrock fracture by ice segregation" has been active in Caen since 2003. A new programme of the Cardiff group (C. Harris) started in 2004 on the topic of physical modelling of mass-movement processes on permafrost slopes: both full-scale (Caen refrigerated tanks) and small-scale physical modelling (Cardiff Geotechnical Centrifuge) are developed to investigate mass movement processes in clay-rich soils at steep gradients.

Martian permafrost structures were investigated at the Laboratory IDES (UMR 8148, Orsay). The frozen ground of Mars is likely to contain water ice that may be studied by either geomorphic or geophysical approaches. The Gamma-Ray Spectrometer on board the Mars Odyssey spacecraft gave new data about the distribution of hydrogen, and thus ground ice, in the first metre of the planet. We interpret these data in connection with the geomorphic features observed at the same latitudes where ground ice is present (N. Mangold). This work provides a tool for studying recent features associated with the presence of very superficial ice. Investigation of the geophysical properties of Martian frozen ground by radar experiment is currently the topic of preliminary research prior to the first result of the radar MARSIS onboard Mars Express. Radar data will allow the identification of ground ice and possibly of ground water at depth of the order of several hundreds of metres. Current research concerning radar are in progress at the Laboratory IDES. It is focusing on the propagation wave of the radar response in a one cubic metre permafrost mass in a cold room. The propagation of a 0°C interface have been detected with a GPR and validated with thermocouples (P. Tucholka, A. Saintenoy, F. Costard).

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GERMANY

The 2nd European Conference on Permafrost (EUCOP II) organized by the AWI and the ESF PACE 21 project will be held June 12–16, 2005, in Potsdam, Germany. The scientific steering committee is chaired by Charles Harris, and the local organizing committee by Hans-W. Hubberten. Permafrost scientists from Europe and other countries are invited to attend the conference and present results in the wide field of permafrost research and engineering (www.awi-potsdam.de/EUCOP).

The Alfred Wegener Institute for Polar and Marine Research (AWI-Potsdam) carried out a multidisciplinary study of the coastal region of Cape Mamontov Klyk (Western Laptev Sea) in summer 2003 (L. Schirrmeister, M. Grigoriev). The main topic of the new Russian-German project "Process studies of permafrost dynamics in the Laptev Sea" is transition processes from terrestrial to submarine permafrost. A joint Russian/German expedition focused on geocryological and sedimentological investigations, periglacial morphology, palaeosols, modern periglacial surface conditions, coastal dynamics, and hydrological and palaeontological studies. Other topics included palaeoenvironmental reconstruction, interpretation of remote sensing data, methane budget calculations and permafrost transformation. The 7th expedition to the Lena River Delta (May–July 2004, D. Wagner) focused on trace gas flux measurements and the microbial community involved in the carbon turnover during the thawing of the active layer. Micrometeorological eddy covariance measurements providing turbulent flux data (heat, water, CO_2, and CH_4) in the atmospheric boundary layer were carried out for the spring-summer period.

Late Quaternary environment and palaeoclimate in central Yakutia are investigated by the AWI (B. Diekmann) and the Aachen University (F. Lehmkuhl) with partners from the Permafrost Institute Yakutsk (V.V. Kunitzki, V. Spector) and the Yakutsk State University (L. Pestryakova, A. Prokopiev). Fieldwork in 2002 and 2003 in the Verkhoyansk Mountains and in 2004 in the alass region northeast of Yakutsk studied the development of periglacial and glacial landscapes, lacustrine systems, as well as permafrost complexes and ground ice features. During the summers 2003 and 2004 joint expeditions of palaeolimnologists of AWI (T. Kumke) and Yakutsk State University (L. Pestryakova) investigated 47 lakes in the Central Yakutian lowlands in order to establish a calibration dataset for diatoms and chironomids for quantitative reconstructions of the Yakutia palaeoenvironments.

In Spring 2003, scientists from the AWI-Potsdam (H. Meyer) sampled permafrost tunnels in Fairbanks and Barrow with the support of the University of Alaska Fairbanks (K. Yoshikawa and J. Brown). The objective was to apply in Alaska the experience acquired on complex Late Quaternary permafrost deposits in Siberia. Stable isotope analysis of ice wedges was the main research topic. Hydrological studies were carried out during the summer on the North Slope of Alaska within a collaboration between the Water and Environmental Research Center (UAF, L. Hinzman) and AWI (J. Boike). The modelling of small-scale hydrological processes was supported by several other field measurements.

The Institute for Geography at the Giessen University (L. King) continues monitoring ground temperature in the periglacial belt of the Matter Valley, Swiss Alps. Shallow ground temperatures measured in two test areas since 2002 indicates that discontinuous permafrost occurrence corresponds with coarse-textured surface deposits. The influence of coarse cover layers on ground thermal regime even exceeds that of snow cover thickness and duration (S. Philippi, T. Herz). In summer 2004, 65 temperature sensors were installed between the ground surface to a depth of 100 cm near the existing PACE borehole sites at the Stockhorn Plateau site, in order to demonstrate the influence of topographical effects on the ground thermal regime.

M. Gude (Jena) continues investigating permafrost thermal regime and geotechnical stability at the Zugspitze. In cooperation with the local cable-car company, permafrost was observed in foundations and mitigation measures have been evaluated. The interdisciplinary research programme SCREECOS (Scree Ecosystems) continues analysing low altitude sporadic permafrost in highland scree slopes in Germany, Czech Republic and France (M. Gude). The influence of permafrost on biomass productivity in Siberian boreal forests was evaluated in terms of its contribution to a global carbon budget model (EU-project SIBERIA II, C. Schmullius, Jena).

At the Institute for Meteorology and Climate Research, University of Karlsruhe, a physically-based approach was developed to assess the ground-ice content from seismic and geoelectric data sets (C. Hauck). Geophysical permafrost monitoring continues at Schilthorn, Swiss Alps, in collaboration with the University of Zurich (I. Völksch, M. Scherler, M. Hoelzle, C. Hauck) and is aimed at determining the spatial variability of energy exchange processes between atmosphere and permafrost on a 1- to 100-m scale. A permafrost map of the German Alps developed in collaboration with the Freiburg University roughly estimates the distribution of probable and possible permafrost (S. Blasius, C. Hauck, C. Schneider).

At the University of Marburg, Department of Geography, H. Brückner and G. Schellmann are working on beach ridges in Andréeland (Svalbard). On the basis of the observed sequences they propose a scenario for late Pleistocene and Holocene landscape evolution.

At the Department of Physical Geography, University of Regensburg, H. Strunk continues his research in the Ob region of western Siberia, together with L. Agafonov, Ural Branch of the Russian Academy of Sciences,

Yekaterinburg. The research topic is the reconstruction of the thermokarst history of the last 500 years (M. Krabisch). The study is based on dendrochronological analysis of living trees (*Pinus sibirica*).

The Department of Physical Geography, University of Würzburg (C. Kneisel) assesses changes in active layer and permafrost thickness by geoelectrical techniques in the discontinuous permafrost zone of the Swiss Alps. In collaboration with A. Kääb (Zurich) permafrost creep within the Muragl glacier forefield is evaluated using a combined geomorphological, geophysical and photogrammetrical approach. New geophysical and geomorphological permafrost investigations began in a subarctic alpine environment in northern Sweden.

The International Geographical Union established a new Commission on Cold Region Environments, chaired by M. Gude (Jena); see Other News for details.

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ICELAND

A permafrost monitoring and mapping programme was started in collaboration between the University of Oslo (B. Etzelmüller, O. Humlum), the JFS Geological Services, Iceland (Á. Guümundsson) and the University of Iceland (H. Björnsson). Four shallow boreholes (between 8 and 24 m) were drilled in central and eastern Iceland, all at around 900 m asl. In addition, a ground surface temperature monitoring programme was established in northern (Trollaskagi) and eastern Iceland (Vopnafjurdur). Studies on permafrost and slope dynamics within the framework of moving rock glaciers, ice-cored moraines and other slope deposits continued using digital photogrammetry on multitemporal air photos (B. Wangensteen, Á. Guümundsson, A. Kääb, T. Eiken, H. Farbrot, B. Etzelmüller).

Drilling borehole in Iceland. Photograph by Ole Humlum.

ITALY

Two new working groups started in 2002 within the Italian Association of Geomorphology (AIGEO): one lead by Mauro Guglielmin (Insubria University) about permafrost distribution and slope stability in the Italian mountains, and one about relict periglacial and permafrost features in Italy (mainly in the Apennines and Ligurian Alps).

Adriano Ribolini and other scientists from Pisa University continue geophysical and geomorphological research on rock glaciers in the Maritime Alps. At Genova University, Cristiano Queirolo presented in 2004 a PhD on relict block streams at Mount Beigua (close to Genova). At Pavia University, Roberto Seppi is working on a PhD about the rock glaciers of the Adamello area. Nicoletta Cannone (Milano Bicocca) continues her research on the relationships between vegetation and the disturbance induced by permafrost creep on the slopes and rock glaciers of the Central Italian Alps.

Mauro Guglielmin continues monitoring permafrost temperature at the PACE borehole of Stelvio (3000 m asl) and at the Foscagno rock glacier (2500 m asl). His two projects funded by the Italian Institute of Mountain Research (IMONT) will allow the completion of geophysical investigations at the Foscagno Rock Glacier and in the surroundings of the Val Pola landslide. Three new boreholes (between 16 and 21 m deep) were drilled at different elevations along the Foscagno Rock Glacier and a 24 m deep borehole was drilled close to the Val Pola landslide in order to monitor permafrost in this valley slope that presents a high geological hazard.

Mapping and modelling permafrost distribution in the Aosta Valley started in 2003. This project supported by ARPA Valle d'Aosta and Insubria University (M. Guglielmin) includes the installation of a new CALM site and a new borehole (100 m deep) in permafrost at the end of 2004 in the Cervinia area, and the monitoring of rockwall temperature at around 3900 m asl on the Matterhorn.

Italian research activity in Antarctica continues through the project "Permafrost and Climate Change" lead by M. Guglielmin, in cooperation with seven universities and within the agreements with the British Antarctic Survey (J. Cynan Ellis-Evans, R. Worland), Waikato University (M. Balks), the Alfred Wegener Institute (Hans-W. Hubberten, D. Wagner) and the Istituto Antartico Argentino (J. Strelin).

The established permafrost monitoring network includes five instrumented boreholes in Victoria Land and one borehole on James Ross Island. Shallow boreholes are planned on Signy Island (Maritime Antarctica). Monitoring of the two Victoria Land CALM sites continued. Ongoing research on granite weathering in Northern Victoria Land is now pursued with a particular focus on biological processes and thermal stress by the Milan University (A. Strini), Milano-Bicocca (N. Cannone) and Insubria University (M. Guglielmin). Studies on ground ice distribution, permafrost hydrology, frost blisters and icing blisters have been carried out in collaboration with H. French and A. Lewkowicz (Ottawa University) in Victoria Land. R. Raffi (Rome University) continues her research on ice wedges distribution in Victoria Land.

Relationships between vegetation, active layer and climate change are investigated within the RiSCC framework (Regional Sensitivity to Climate Change in Antarctic Terrestrial and Limnetic Ecosystems) framework by N. Cannone. Over 30 participants from 14 countries took part to the 5th RiSCC workshop held on July 2-8, 2003 at Insubria University with the support of the Programma Nazionale di Ricerca in Antartide (PNRA), the Società Italiana di Ecologia (SITE), the Società Italiana di Botanica (SBI) and the Stelvio National Park.

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JAPAN

In Russia, an ongoing research project on rock glacier flow and thermal regime in central Kamchatka (Y. Sawada, T. Sone, K. Yamagata and K. Fukui) provided ground temperature data and a three-year database on small rock glaciers movement on the basis of a triangulation survey. A research group from Hokkaido University continues monitoring ground surface and active layer energy and water balance near Yakutsk (G. Iwahana *et al*.).

In Mongolia, a group of researchers from the Japanese Institute of Observational Research for Global Change (M. Ishikawa) and the Institute of Geography in Mongolia (N. Sharkhuu, D. Battogtokh) continue the study of land-surface energy exchange and frozen ground hydrothermal parameters in the southern boundaries of the Eurasian permafrost zone. Intensive observations over a period of two years provided a distinct hydrothermal characterisation of the dry active layer, contrasting energy exchange processes between permafrost and non-permafrost slopes, and methodologies for monitoring frozen ground hydrology. Moreover, a geomorphological field campaign was carried out in the Mongolian Altai mountains (M. Ishikawa, T. Kadota, N. Sharkhuu, G. Davaa, D. Battogtokh). Numerous permafrost-related landforms including rock glaciers, pingo, solifluction lobes, frost-cracks and polygons were investigated in a deglaciated valley. Miniature temperature loggers were installed at representative sites.

In eastern Tibet, during this third year of the five-year project "Permafrost hydrology in the source area of Yellow River" carried out by a joint group from the Geological Survey of Japan, University of Tsukuba and ETH Zurich (N. Matsuoka, A. Ikeda, T. Sueyoshi, T. Ishii), a long-term observatory was established at Madoi (4273 m asl), aimed at measuring air and soil temperatures (down to 8 m deep), soil moisture and soil thermal properties, precipitation and snow depth. Miniature temperature loggers provided year-round ground surface temperatures at eight localities with different altitudes (3200-4700 m asl). These data combined with seismic sounding results suggest that a large part of the plateau around Madoi (4000-4300 m asl) lies in a marginal permafrost environment and experiences rapid permafrost degradation.

In central Hokkaido (Japan), researchers from Hokkaido University have been monitoring changes in ground ice for four years in a low-altitude block slope where intensive cooling in winter controls the ground-ice growth in the subsequent spring and summer (Y. Sawada). At the beginning of winter 2004, a micrometeorological station was installed in a representative permafrost site in the Daisetsu Mountains (G. Iwahana *et al*.).

In the Southern Hemisphere, long-term monitoring of air and ground temperatures began in February 2004 at two sites in a coastal area of Dronning Maud Land, Antarctica, during the 45th Japanese Antarctic Research Expedition (H. Miura *et al*.). Thermal probes installed down to 2 m deep will indicate the active layer thickness and long-term temperature variations in the upper part of permafrost. During the Argentinean Antarctic expedition of the summer 2003-2004, T. Sone and K. Fukui studied permafrost temperature and rock glaciers on James Ross Island (Antarctic Peninsula). A geodesic survey was conducted on a rock glacier near Ushuaia, Terra del Fuego, Argentina in November 2003 (T. Sone and J. Strelin).

In the Swiss Alps, periglacial processes (frost weathering, solifluction and permafrost creep) have been monitored for the last ten years. The 2004 fieldwork focused on paraglacial slope failures along U-shaped valleys, which possibly followed glacier retreat or permafrost degradation since the last glacial period (N. Matsuoka, A. Ikeda, M. Abe).

Field work in the Alaska Range covers the period 2003–2005 in order to compare rock glacier dynamics in mid-latitude and in sub-polar mountains (A. Ikeda and K. Yoshikawa).

In Longyearbyen (Svalbard), a new international project was started in order to establish a model experimental site for periglacial processes (N. Matsuoka, H. Christiansen and O. Humlum); see also the WG report on Periglacial Landforms, Processes and Climate.

The journal *Seppyo* (*Journal of the Japanese Society of Snow and Ice*) published in 2004 a special issue on 'Frozen Ground' (Vol. 66-2), including a glossary and thirteen papers (one in English and seven Japanese papers with English abstracts) about experimental frost heave, frozen ground engineering and permafrost investigations in Siberia, Mongolia, China and Japan.

The following PhD theses were completed in 2004:

Ikeda, A. 2004 (University of Tsukuba): Rock glacier dynamics near the lower limit of mountain permafrost in the Swiss Alps;

Iwahana, G. (Hokkaido University): Influence of forest disturbance on the ecosystem energy and water balance in the continuous permafrost zone, Eastern Siberia;

Sawada, Y. (Hokkaido University): Extra-zonal permafrost on block slope in Shikaribetsu Mountains, Central Hokkaido, Japan.

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KAZAKHSTAN

The Kazakhstan Alpine Permafrost Laboratory (KAPL) continues its study of cryogenic processes and slope evolution in the Northern Tien Shan Mountains, and continues monitoring temperatures of permafrost and seasonally frozen rocks.

In the Zailiyskiy Alatau Mountains, no significant temperature change was noticed in permafrost at an elevation of 3300–3400 m asl during the last decade. Climate change in the Northern Tien Shan Mountains at various high-altitude zones did not have any noticeable impact on temperature regime of the seasonally frozen rock or on the depth of seasonal freezing.

In the late spring 2004, several rockslides occurred on the loess slopes in the low mountain area of the Zailiyskiy Alatau. These rockslides caused casualties and destroyed several construction sites. It is very likely that these rockslides were affected by the unusual type of seasonal freezing, i.e. by slope cryogenic processes.

A geocryological map (scale 1:25000) of the Malaya Almatinka river basin (Northern Tien Shan) was compiled using GIS. The book *Mountain Permafrost: from the Equator to Polar Latitudes* by A.P. Gorbunov was published in 2003 in Russian.

Intense glaciers retreat has been observed in the Tien Shan and the Pamir-Alai during the last 50 years. Over this period, in the Northern Tien Shan, the glaciated area was reduced by 30 percent and the periglacial zone consequently encountered some modifications: thermokarst and mudflow became more active on recent moraines. The (KAPL) developed a high interest in these landforms and processes. In the near future, it is planned to monitor rock glacier movement in the Bolshaya Almatinka river basin (Zailiyskiy Alatau Range, Northern Tien Shan).

New information is available about Tashrabat, the oldest building on permafrost in the mountains of Central Asia. It was built in the early 11th century, used for 300 years and recently reconstructed. This massive stone building is located in Kyrgyzstan, in the Atbashi Range near the Tashrabat Pass at 3200 m asl (40°52′ N; 75°16′ E). The perennial frozen state of the "cultural" ground layer, and the ground subsidence at the eastern wall after thawing of the frozen coarse detrital ground was observed in late 1970 during archeological excavations.

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MONGOLIA

The Institute of Geography reports the publication of several maps. Ya. Jambaljav and D. Byambademberel compiled and published the permafrost map of the Ulaanbaatar area (scale 1:100 000), using air photographs, remote sensing and land surface data. This map shows the distribution of mountain permafrost, the presence of permafrost in river valleys and in depressions, and the distribution of seasonally frozen ground. D. Tumurbaatar, Ya. Jambaljav, D. Byambademberel, D. Battogtokh, D. Solongo published a map of seasonal freezing and thawing of frozen ground in Mongolia at a scale 1:1 500 000. D. Tumurbaatar published a book on seasonally frozen ground and permafrost in Mongolia, and is based on data and material he collected for more than 30 years.

N. Sharkhuu reported continued collaboration on several international projects:

• The primary goal of the Hövsgöl GEF (Global Environment Facility) project is to study the impacts of nomadic pasture use and climate change on watershed ecosystems, biodiversity and permafrost of the taiga (boreal) forest and steppe of northern Mongolia. During the last two and one-half years, the distribution, temperature and composition of permafrost and the depth of active layers have been studied and mapped by a joint team from Mongolia, Norway and Alaska using 16 shallow (5–10 m deep) boreholes, geophysical (resistivity) and geothermal (surface and ground temperature) measurements at different landscape sites. In October 2004 HOBO data loggers were installed in eight (5–10 m deep) boreholes, installed 10 UTL-1 data loggers under different soil surfaces and six UTL-1 data loggers on surfaces of specially prepared plots, established 15 snow benchmarks on different landscape sites in the Dalbay and Borsog valleys, installed 10 icing benchmarks along the Borsog river channel, and 12 frost-heave benchmarks near boreholes in the Dalbay and Borsog valleys. Ground temperatures in 25 boreholes, located in Hövsgöl project and surrounding areas, were measured.

• The Japanese and Mongolian ERONIAR project continued for the third year in Nalaikh and Terelj areas near Ulaanbaatar with M. Ishikawa. Monthly observations were made in a seven-metre deep borehole at the Nalaikh site.

• Continued observations at the 30 CALM sites and other GTN-P boreholes.

• Within the framework of project on Central Asian permafrost mapping, data loggers are located at sites of differing on altitudes and aspects in the Altai, Hövsgöl, Khangai and Khentei mountain regions.

With financial supports from Koyoto University and the Mongolian petroleum authority, monthly leveling measurements for the last two years were performed to study the dynamics of frost heave and thaw settlement of ground in five areas near Ulaanbaatar. Similar measurements were begun at sites in the Hovsgol Lake basin and the Darkhad depression.

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THE NETHERLANDS

The Vrije Universiteit in Amsterdam and the Wageningen University are investigating the carbon and water

exchange of taiga and tundra ecosystems in eastern Siberia, and in collaboration with the Institute for Biological Problems Cryolithozone of the Siberian Division of the Russian Academy of Sciences in Yakutsk. Measurements are taken using eddy correlation systems and soil flux chambers in a larch / birch forest near Yakutsk (Spasskaya Pad Field Station) and on a tundra site near Chokhurdakh in the Indigyrka lowlands (Kytalyk Reserve). In 2004, this research embedded in the EU TCOS project (Terrestrial Carbon Observation System) has been extended with flux chamber measurements of methane fluxes and survey of active layer thickness and temperature. The objective is to estimate the annual exchange rates and to determine the sensitivity of the fluxes to environmental factors. The methane flux measurements will also be used in modelling their link with the last glacial climate and past permafrost changes. The first modelling results were published in *Quaternary Science Reviews* 23 (J. van Huissteden).

Joint research between the Vrije Universiteit in Amsterdam (Jef Vandenberghe), the State Hydrological Institute and the Institute of Limnology at St. Petersburg continued with the support of the Russian-Dutch research cooperation programme. Different methods of relating changes in vegetation and permafrost to climate changes were compared and applied to the post-glacial environments of western and eastern Europe; a related database will be available by internet. Changes in river patterns of northwest Russia that could be expected from potential changes in environmental and climatic conditions were calculated according to methods previously applied for Holocene variability.

In May 2004, the new interdisciplinary research project "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 (CASUS)" was established between the Utrecht University (W. Bleuten, The Netherlands), the University of Kuopio (Finland), the Ural State University (Russia), the Tomsk State University (Russia) and the Institute of Soil Science and Agro-chemistry (RAS Novosibirsk). CASUS focuses on the annual carbon balance of sub-arctic peatland areas of Western Siberia; initially estimated in three key areas by ground flux measurements in the main mire types and in surface water. The point trace gas fluxes of mires will be validated with measurements of net primary production and recent carbon accumulation. GIS combined with land unit classification using multispectral satellite images will allow the evaluation of area fluxes, which in turn will be compared with the interpretation of hyper-spectral satellite images in terms of carbon gas concentrations in the lower atmosphere. The effects of climate change as predicted by IPCC scenarios on the carbon balance of sub-arctic peatland of Western Siberia will be evaluated. In August, the Siberian partners organized a field expedition for selecting sites in the continuous permafrost zone; extensive methane flux was almost absent. This confirms the hypothesis on the loss of trapped methane in the region of degrading permafrost. The thawing at the top of the permafrost explains the rapid changes in hydrological conditions leading to the appearance and disappearance of lakes, which in turn complicates the interpolation procedures concerning trace gas fluxes over large areas.

A new international website was opened for scientific discussions concerning vegetation-pattern, hydrology, hydrochemistry, microbiology, biogeochemistry (including Carbon and Nutrient cycling) and climate (change) of northern pristine peatland areas (http://www.peatresearch.com). We kindly invite colleagues to join this network by sending an email with their name, logo and link-address to: w.borren@geog.uu.nl

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NORWAY

In Jotunheimen, southern Norway, temperature data from the Juvvasshøe PACE borehole (established in 1999) were collected (K. Isaksen). On Dovrefjell, southern Norway, data collection continued from 11 boreholes in a transect across the permafrost transition zone. These boreholes were drilled and instrumented in October 2001 (K. Isaksen, R.S. Ødegård, T. Eiken and J.L. Sollid). The monitoring programme on Dovrefjell was extended with six new sites to measure ground surface temperatures (R.S. Ødegård and K. Isaksen). In the Møre and Romsdal area of southern Norway and in the Troms and Finnmark areas of northern Norway air- and ground temperatures data were collected (K. Isaksen, L.H. Blikra, T. Eiken and J.L. Sollid). In the mountains of Troms two new 30-m deep boreholes were drilled and instrumented in August 2004 for future collection of temperature data (K. Isaksen and L. H. Blikra). In Svalbard data from the Jansssonhaugen PACE borehole (established in 1998) were collected (K. Isaksen) and the first data from a new 2-m deep borehole on Janssonhaugen (established October 2003) were analysed and compared with the PACE borehole data from the same site. Collection of the temperature data from all these Norwegian boreholes is organized in a long-range monitoring programme. The data are stored at the Norwegian Meteorological Institute, Oslo, by Ketil Isaksen. The borehole thermal monitoring is carried out in cooperation between the Norwegian Meteorological Institute (K. Isaksen), the University of Oslo (T. Eiken, J.L. Sollid, R.S. Ødegård) and the Norwegian Geological Survey (L.H. Blikra).

In Svalbard, Hanne H. Christiansen (University Centre in Svalbard, UNIS) and Ole Humlum (University of Oslo) continued their monitoring programme on mountain meteorology, snow cover and ground temperatures around Longyearbyen. The meteorological station at Jansson-

haugen has been collecting hourly data since May 2000, while a station at the mountain plateau Gruvefjellet (477 m asl) has been in operation since August 2002. At the Gruvefjellet station snow cover thickness, geomorphic activity and active layer temperatures are also monitored. The main research activity of Hanne H. Christiansen in 2004 was the collection of the first full year dataset on ice-wedge dynamics using a multi-technique approach. This demonstrated significant winter activity. Collaboration with Norikazu Matsuoka (University of Tsukuba, Japan) was started extending the field measurements of ice-wedge dynamics. Late Holocene loess deposits with syngenetic ice-wedges have been studied for palaeoenvironmental reconstruction in cooperation with Anne Hormes (Uppsala University). Thaw progression is monitored in the UNISCALM site. Here a 10-m liquid-filled borehole has been instrumented for thermal monitoring. The effect of snow and snowdrift on slopes as avalanches are being monitored for enabling better linking between meteorology and avalanche activity. Geophysical measurements of pingos were carried out in Adventdalen by Neil Ross and Charles Harris (Cardiff University) together with H.H. Christiansen. All of these activities were demonstrated during the PACE21 workshop in Longyearbyen, Svalbard in September (see Other News).

In southern Norway, a programme on mountain meteorology, snow cover and ground temperatures was initiated in 2004 in a transect from the humid west coast (Sognefjorden-Ålesund) to the more continental regions at the Swedish border to the east (Femunden-Trysil), making use of a new type of automatic digital camera and dataloggers (O. Humlum, H. Juliussen both University of Oslo). This programme also attempts to map past conditions, making use of existing long-meteorological records, old photographs, written documentation and geomorphic evidence. By this approach, environmental changes back to the final Late Weichselian deglaciation will be investigated (O. Humlum).

In central and eastern Norway (Gaustatoppen, Sølen and Elgå Mountains), the University of Oslo continues for the fourth year its ground surface temperature monitoring and its permafrost mapping programme (E. Heggem, H. Juliussen, B. Etzelmüller, O. Humlum). In northern Norway (Lakselv area, Finnmark), BTS measurements, ground surface temperature monitoring and DC resistivity tomography were started in order to systematically map permafrost limits in the Gaissane Mountains (H. Farbrot, B. Etzelmüller). A regional-scale permafrost map based on meteorological observations over northern Norway was refined and validated at these localities.

In western Norway (Sognefjellet, Fannaråken), a small project on the relationship between small glaciers and permafrost includes ice and ground temperature monitoring and velocities measurements (B. Etzelmüller, J.O. Hagen, H. Uldahl). In Mongolia, a second year of ground surface and ground temperatures were recovered this summer from the Hövsgöl area (E. Heggem).

Late Holocene ice-wedge in loess deposit Adventdalen Photograph by Hanne H. Christiansen.

Scientists from the Department of Earth Science of the University of Bergen in collaboration with Russian colleagues are investigating the Quaternary history of the Pechora Lowland, Polar Urals and the West Siberian Plain in northern Russia. The emphasis is on glacial history (J. Svendsen), including huge ice-dammed lakes (J. Mangerud), that had a considerable influence on permafrost distribution. Numerous lakes were formed by delayed melting of buried glacial ice (M. Henriksen). Glacial ice has survived up to the present day also in the European part of northern Russia (V. Astakhov, J. Svendsen).

At the Geological Survey of Norway Achim Beylich continues his process research on mass transfers, denudation, sediment budgets and relief development in subarctic and arctic environments in Iceland and Lapland. Research on weathering and chemical denudation is carried out in cooperation with the Department of Earth Sciences, Uppsala University, Sweden (E. Kolstrup, L.B. Pedersen and others). Research on denudation and interactions between geomorphological processes and vegetation cover is in collaboration with the Botanical Institute of Göteborg University, Sweden (U. Molau *et al.*), the Natural Research Centre of Northwestern Iceland in Saudårkrókur (Sæmundsson), the Kevo Subarctic Research Institute, Finland (S. Neuvonen), and the Institute of Geography of the University of Halle-Wittenberg, Germany (K.-H. Schmidt). Sedimentation in small arctic lakes of Swedish Lapland is investigated in co-operation with the Department of Geology of the University of Helsinki, Finland. Beylich is the coordinator of the ESF Network SEDIFLUX (see Other News).

Angélique Prick (University of Liège, Belgium) continues monitoring rock temperature and weathering rates in the Longyearbyen area, Svalbard. She started in 2004 a rock temperature monitoring programme across Troms

(northern Norway) in collaboration with H.H. Christiansen (UNIS), O. Humlum (University of Oslo) and D. Chaput (School of Geography and the Environment, University of Oxford).

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POLAND

Polish research carried out on Spitsbergen (Svalbard) and in the upper parts of the High Tatra Mountains in 2004 focused on permafrost, contemporary morphogenetic processes and periglacial relief, and constitutes a part to the research programmes dedicated to the impact of climate change on the abiotic components of the environment.

Research on Spitsbergen was conducted in the region of Polish Polar Station in Hornsund on Oscar II Land (close to the station of Nicholas Copernicus University of Toruñ) and in Billefjorden (Petuniabukta), i.e. where former research has been conducted by the Adam Mickiewicz University of Pozña. The projects dealt with thermal air currents and dynamics of active layer- permafrost layer, geomorphological processes and matter circulation in the periglacial and glacial geoecosystems. Research in the High Tatra Mountains aimed at reconstructing climatic changes and geomorphological processes above tree line, from the Little Ice Age to the present day, as well as at documenting the presence of permafrost at elevations around 2000 m asl.

The Workshop "Glaciology, geomorphology and sedimentology of the Spitsbergen polar environment" was organized on Spitsbergen in July 2004 by the Arctic Commission of the Committee on Polar Research of the Polish Academy of Sciences and the Polish Geomorphologists Association. Participants attending from Poland, France, Slovenia and the Czech Republic discussed cryosphere issues in the Recherchefjord area (Bellsund, Calypsostranda, i.e. the location of the station of the Maria Curie-Sködowska University in Lublin), in the Kaffioyra coastal plain (station of the Nicholas Copernicus University of Toruñ) and in the Magdalenefiord region (NW Spitsbergen). This workshop led to the publication of a special guidebook, available also in an electronic format, which is based on the results of many years of research in Spitsbergen.

Several scientific conferences dealing with periglacial topics were held in 2004 in Poland. In June 2004, the 53rd Congress of the Polish Geographical Society was organized by the Maria Curie-Sködowska University in Lublin. Some papers in the session "Geomorphological problems of various morphoclimatic zones" presented research results from Spitsbergen on topics such as active layer dynamics and hydrological and geomorphological processes in marginal glaciers zones. In September 2004, the XXX International Polar Symposium, which is also the annual meeting of the Polar Club of the Polish Geographical Society, was organized in Gdynia by the Department of Meteorology and Nautical Oceanography of the Gdynia Maritime Academy. Latest results in Polish Arctic and Antarctic research were presented. Conference Proceedings were published with abstracts of presentations; some of these papers will be published in English in the journal *Polish Polar Research* (www.polish.polar. pan.pl).

Following the suggestion of the Committee on Polar Research of the Polish Academy of Sciences, the research project "Structure, evolution and dynamics of lithosphere, cryosphere and biosphere in the Antarctic and the European Arctic" will be carried out in 2004–2007, leading the Polish polar research that will arise in the context of the International Polar Year 2007–2008. One of its main topics is the response of glaciers and permafrost to global change.

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RUSSIA

The International Conference "Cryosphere of Oil-and-Gas-Bearing Provinces" was held in Tyumen, May 23–27, 2004, in honor of the 60th anniversary of Tyumen district. Scientists and engineers from Canada, Germany, Israel, Japan, Kazakhstan, Mongolia, Norway, Switzerland, Ukraine, United Kingdom, and U.S.A. participated. For the Russian permafrost community, this conference was an extremely important event as it produced major international discussions about the scientific, engineering, social and environmental issues in northern regions' development.

Participants in Tyumen press conference representing the IPA Executive Committee and National Members, and officials of Tyumen State Oil and Gas University and the Russian Academy of Sciences Photograph provided by the conference organizers.

The Conference resolutions, discussed and approved during the meeting of the Earth Cryology Council reflect the scope of these topics. A draft agreement between representatives of visiting universities, members of the IPA Executive Committee, and officials of the Tyumen State Oil and Gas University provides the basis for future exchanges. A group

Participants in the Nadym field trip on site at one of the gas production facilities. Photograph provided by the conference organizers.

of Japanese, North American, and Russian participants accompanied by Academician V.P. Melwnikov visited Nadym and the gas field deposits at Yubileinoe, Yamsoveiskoe and Medvezh'e. The field trip was followed by a day-long session entitled "From Science to Practice," and the preparation of a resolution of cooperation among representatives of the Earth's Cryology Council, the International Permafrost Association, the Department of Strategic Development «Gazprom» and the «Nadyumgazprom» Gas Enterprise. This included endorsements for the development of the regional observational network using common methods such as those used by GTN-P.

In 2004, Russian permafrost specialists carried out fieldwork, theoretical and experimental research and were partners in a number of international projects (CALM, INTAS, NATO, Russian-German collaboration, among others).

One of the main study topics was permafrost evolution in response to climate change and human activity in different regions. Despite contemporary climate warming, several sites showed decreasing active layer thickness. The varia-

Resolutions of the International Conference on Cryosphere of Oil- and Gas-Bearing Provinces, Tyumen, Russia

Recognizing the importance of economic development of northern regions and significant scientific and engineering accomplishments and educational potential demonstrated during the International Conference on Cryosphere of Oil- and Gas-Bearing Provinces held in Tyumen 23–27 May 2004; and recognizing the IPA Resolutions approved at the Eighth International Conference on Permafrost in Zurich, Switzerland, July 25, 2003, to plan and participate in international programmes and to coordinate activities related to permafrost responses to climate changes, participants in the Conference resolve to:

1. Utilize and expand the Global Terrestrial Network-Permafrost (GTN-P) for the proposed International Polar Year (IPY) Programme on the "Thermal State of Permafrost" (TSP) by increasing the number and spatial coverage of existing and new boreholes in Russia.

2. Utilize the material and human resources of the Tyumen State Oil & Gas University (TSOGU) and its long-term environmental and permafrost observatories in the Arctic and Sub-Arctic of West Siberia for the IPY-TSP and GNT-P studies. Encourage academic and scientific cooperation between TSOGU and national universities from the countries affiliated with the IPA.

3. Continue and resume observations and data analysis of the soil temperature measurements at established meteorological stations in Russia, Kazakhstan, Mongolia, and China.

4. Initiate, support and encourage IPA members to participate in an exploratory geophysical and coring programme to assess permafrost and gas hydrate stability zones on the Arctic continental shelves.

5. Continue to support investigation of extreme geocryological environments and processes on Earth in order to explore the possibility of extraterrestrial life.

6. Encourage permafrost engineering research related to oil and gas development in cold regions.

7. Participate in planning of projects and conferences of the Climate and Cryosphere (CliC) programme of the World Climate Research Programme (WCRP) and other international programmes including the International Polar Year (IPY).

8. Promote investigations among applied specialists and government organizations to assess the risks caused by climate change, and in so doing evaluate the actual influence of global warming on the stability of structures and the consequences on design criteria.

9. Devote additional attention to the investigations of the permafrost interaction with surface and ground waters.

tions in seasonal thaw depth appear to be poorly correlated with air temperature (Department of Cryolithology and Glaciology, Moscow State University). Both permafrost degradation was observed close to the southern limit of permafrost as well as its formation. A monitoring site was installed in the Shaksha Lake region in order to investigate the thermal regime of such recently formed permafrost (Chita Institute of Natural Resources, Ecology and Geocryology, Siberian Branch of the Russian Academy of Sciences–SB RAS).

Specialists from the Institute of Environmental Geoscience RAS, in cooperation with the Department of Geocryology at MSU, carried out theoretical investigations and modelled permafrost evolution in the context of climate change, with an emphasis on the possible consequences for construction. This work achieved new advances in the study of the early stages of themokarst formation and methods for geocryological prognosis.

The analysis of impacts of climate change in Yakutia was studied considering separately natural and human factors. Ground temperatures and the depth of the permafrost table were forecasted. The studied territory is divided into five zones with different responses of permafrost to climate warming (Department of Geocryology, MSU). Four stages in the development of permafrost from the early Pleistocene until the Holocene were recognised for northeastern Eurasia (Ershov and Maksimova). Data on permafrost characteristics on the southern part of Novaya Zemlya was extended within the database for the radioactive waste disposal sites.

New data were obtained on the mechanisms and kinetics of hydrate and ice forming in methane-saturated ground under gas pressure. Quantitative characteristics were obtained that could be used as evidence for the stability and self-conservation of gas hydrates in dispersed ground at negative temperature (E.M. Chuvilin and others, MSU).

Exogenic processes in the Lena River valley during the Holocene were modelled, and their connections with climate change was established. The results are relevant for paleoclimatic reconstructions and for the forecasting of disastrous floods. Permafrost landscapes mapping techniques (using GIS) were improved. Digital maps were prepared for different regions of Yakutia; they show the ice content of surface deposits, the ground temperature, the active layer thickness and moisture content (Permafrost Institute, SB RAS).

V. Tumskoy (Department of Cryolithology and Glaciology, MSU) reported the widespread occurrence of large massive ice bodies in the Late Pleistocene deposits on the Faddeevsky and the New Siberia Islands and provided genetic interpretations. Members of the Department conducted numerous field observations in order to establish the main causes of structures deformation in the cryolithozone. A set of recommendations on engineering solutions for buildings foundation in the northern regions was prepared, in the perspective of the permafrost conditions disturbances occurring during construction."

The development of permafrost under consolidation was investigated theoretically at the Earth Cryosphere Institute (SB RAS). The heat transfer induced by ice movement can double the effective thermal conductivity of the modelled material. The quantity and quality of material removed by coastal erosion into the sea were determined for the western sector of the Russian Arctic. The approximate estimates were accomplished using geoecological information for coasts along shallow water regions. Rates of seashore recession were established in cooperation with the Arctic Coastal Dynamics (ACD) project (A.A. Vasilyev).

Quantitative estimates were forecasted according to two different climate change scenarios in order to determine the erosion rates of the ice-rich coastlines along the eastern Russian Arctic seas for the first half of the 21st century (Permafrost Institute, SB RAS).

Geotechnical surveys were conducted for engineering investigations of permafrost along the Barents Sea coastline. These included large-scale mapping, determination of physico-mechanical properties of the frozen or cooled salt-rich ground, ecological conditions and other permafrost engineering studies. A complex of medium and small-scale maps was prepared for development of the Timan-Pechora oil and gas field, the Yamal fields and the "Eastern Siberia-Pacific Ocean" pipelines (Industrial and Research Institute for Construction Engineering).

The Institute "Fundamentproject" provided engineering solutions to the foundations and the monitoring of structures for the Bovanenkovo and Harasaway gas fields (Yamal Peninsula) and for the "Yamal-central regions of Russia" pipeline. These include: refrigeration facilities and heat screens; "orthotropic" overlapping slabs; reinforcing ground surface by geogrids; and the use of large span grillages with increased bearing capacity.

S.A. Koudryavtsev completed investigations on computations of design and construction on frost heaving soils (Petersburg State University for Communication Means).

The regularities of permafrost morphology, temperatures, and cryogenic processes and phenomena were generalized along the southern transect "Altai —Pamir" (Kazakhstan High-mountain Geocryological Laboratory of the Permafrost Institute SB RAS).

The 6th International Symposium on Permafrost Engineering held in Lanzhou (China) in September 2004 was co-organized with the Permafrost Institute (SB RAS) and other Russian institutions (see details in the China report).

In 2004, Russian permafrost researchers took part in the following international meetings:

The XIII Glaciological Workshop. Arctic and Antarctic Institute, St. Petersburg

The XI International Scientific Conference for Students and Post-graduate Students

"Lomonosov 2004", Section of Geography, Moscow State University

2nd International Workshop on Circumpolar Vegetation Classification and Mapping, Tromsø, Norway

7th International Workshop on Cold Regions Development, Sapporo, Japan

International Congress on High Technologies, Paris

5th International Workshop on Arctic Coastal Dynamics, Montreal

The following monographs were published in Russian in 2004:

Alekseev V.R. *Engineering Geocryology, Glaciology, Ice Technology*. Yakutsk, Permafrost Institute SB RAS, 390 p.

Anisimova. Methods of hydrochemistry in the permafrost science (manual). Yakutsk, Permafrost Institute SB RAS, 78 p.

Shesternev, D.M. *Cryogenic Processes of Zabaikalie*. Published in Yakutsk, PI SB RAS, 255 p.

Gavriliev, R.I. *Thermal Properties of Environmental Components in Cryolithozone (Reference Manual)*. Yakutsk, Permafrost Institute, SB RAS, 153 p.

Cheverev V.G. *The Nature of the Soils Cryogenic Properties*. Moscow, Scientific World.

Development of the Earth Cryosphere. Geography, Society, Environment (this seven-volume monograph is dedicated to the 250th anniversary of MSU). Volume 1. *Structure, Dynamics, Evolution of Natural Systems*. V.N. Konishchev, Rogov, V.V., Grebenets, V.I., Tumel, N.V., Volodicheva, N.A., Voitkovsky, K.F., Popovnin, V.V., Petrakov, D.A., Oleinikov, A.D., Shpolyanskaya, N.A., Rozenbaum, G.E. (Department of Cryolithology and Glaciology, MSU).

Slagoda E.A., *Cryolithogenic Deposits of the Laptev Sea Coastal Plain: Lithology and Micromorphology*.

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SPAIN

The *Bulletin of the Royal Spanish Society of Natural History* (issue # 99) recently published 16 papers related to permafrost and periglacial research carried out on the Iberian Peninsula. The presented topics include nivation dynamics, permafrost mapping, the relationship between climate and periglacial activity, rock glaciers, periglacial features, the consequences of the Little Ice Age, and ecosystem restoration in periglacial environments. These papers refer to projects carried out in the Pyrenees, Sierra de Guadarrama, Sierra de la Estrella, Sierra Nevada, Mexico and the Antarctic. This bulletin presents also an in-depth analysis of recent developments in permafrost and periglacial research on the Iberian Peninsula.

Ongoing research continued in many areas. Researchers from the Universidad de Zaragoza recently achieved important progress in permafrost prospecting on the north face of Peña Telera (Pyrenees) using geoelectric surveying and BTS. A research group from the Universidad de Leon is working on the origin and morphology of currently in-

Rock glacier at Peña Lago in the Cantabrian mountains, Spain. Photograph provided by Javier Santos.

active rock glaciers in the Cantabrian Range have set up an experimental station to measure the intensity of periglacial activity in areas surrounding glaciers. The Universidad Complutense de Madrid continues monitoring geomorphological processes related to snow cover in Sierra de Guadarrama. A multidisciplinary team led by the Universidad de Barcelona is currently monitoring cold climate processes in the cirque area of Corral del Veleta, Sierra Nevada, with a particular interest for the active-layer thermal characteristics, active rock glaciers dynamics and the geomorphological impact of snow cover. Temperature monitoring continues in the boreholes drilled and instrumented for the PACE project.

Outside the Iberian Peninsula, the GIFA group from the Universidad de Alcalá de Henares is monitoring the temporal evolution of the thermal gradient in the active layer on Livingston Island (South Shetlands, Antarctic). Temperatures in two boreholes are presently being monitored: one 2.3 m deep at Incinerador, with sensors at 5, 15, 40, 90, 150 and 230 cm, and one at Sofia, 1.1 m deep with sensors at 5, 15, 40 and 90 cm. Air temperature is continuously recorded at three different altitudes (15, 115 and 275 m asl). All these sensors have been recording data without interruption since 2000.

The team at the Universidad Complutense de Madrid was involved in a research project on the Popocatepetl volcano in Mexico.The project focused on the impact of volcanic activity on permafrost distribution and the subsequent consequences on geomorphological dynamics on active volcanoes, with a special emphasis on lahars generation. A one-metre deep observational network was established at elevations between 4100 and 4900 m on the Popocatepetl and on a neighboring inactive volcano Ixtachihualt. Sensors were installed in the boreholes at 15 and 100 cm depth. Complete information about the project is available (www.ucm.es/info/agr/lahar). The same team is conducting similar research in the Andes on other volcanoes includ-

ing Parinacota (Chile, Bolivia), Misti and Chachani (Peru).

The group from the University of Valladolid continues its work in the Pyrenees (Posets and Monte Perdido) by monitoring present-day periglacial processes and mapping permafrost distribution. Recently, similar investigations were initiated in Picos de Europa (Cantabrian Range) and Picos de Urbian (Iberian Range), both in northern Spain.

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In Antarctica, the Universities of Valladolid and Autónoma de Madrid are working on periglacial processes, and the interactions of permafrost, landforms, soils, and fresh water. Field work in 2003 and 2004 was on Byers Peninsuala (Livingston Island) and Elephant Island, South Shetland Island. The work is coordinated with the SCAR activities (PAG and RISCC), the IPA Antarctic Working Group, and GTN-P/CALM.

Spain and Portugal have proposed to the IPA that a new membership be established that combines the two countries into a new Iberian member. We await the Council decision in June 2005.

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SWEDEN

Over the past 20 years, the Department of Physical Geography, Lund University, acted informally as the Adhering Body to IPA, and was assisted in recent years by the Abisko Research Station (ANS) and the Swedish Academy of Sciences. In May 2004 the South Swedish Geographical Society (SSGS) formally agreed to act as the National Adhering Body to the IPA, and to provide the annual contribution to IPA and travel costs to IPA meetings for the Council member. The SSGS is a long-standing permanent NGO with board members from the public, the regional administration and Lund University. Under the South Swedish Geographical Society a small national committee "for permafrost and periglacial studies" with participants from the Swedish Academy of Sciences /ANS, and the major universities will be formed. A major Nordic geographical conference in May 2005 (www.ngm.cc/) will be the venue for the first meeting of the new committee. The national committee will elect the Swedish Council member and through its chairman/secretary will conduct the IPA business. The SSGS produces the Swedish Geographical Yearbook (Svensk Geografisk Årsbok). The next issue has the theme "Effects of Climatic Change in Nature and Society" with Jonas Akerman as editor.

Torbjörn Johansson, Jonas Åkerman and Torben R. Christensen (GeoBiosphere Science Centre, Lund University) and Patrick Crill (Stockholm University) report the following for the Abisko site in northern Sweden. During 2004 the CALM grid at Stordalen and surrounding mire has been intensively surveyed using real time kinematic (RTK) GPS technique with an accuracy of +/- 2 cm in height (+/- 2 ppm, distance related noise) and +/- 1 cm in x and y wise (+/- 1 ppm). A total of approximately 10,000 points were surveyed over the whole mire (ca. 16 ha). We have now created opportunities to follow the permafrost degradation and thermokarst features change on the site at a centimetre scale (point). The general resolution is approximately 10 meters. The microtopography data is used in a carbon flux perspective to quantify "hot spots" on the mire. During the summer months vegetation mapping within the CALM grid has been completed. Implications of already observed changes for CH_4 emissions for thawing permafrost at the landscape scale were published. A PhD studentship on permafrost dynamics and its implications for biodiversity and ecosystem functioning has been announced and will commence in January 2005.

Peter Kuhry, at the University of Stockholm (peter.kuhry@natgeo.su.se) since 2003, reports on his previous work at the Arctic Centre in Rovaniemi (Finland) where he coordinated several EU and Finnish research projects in Northeast European Russia, mostly in the Usa River Basin. A series of published papers dealt with the long-term (Holocene) history of permafrost dynamics in the area, regional climate modelling and permafrost simulation, GIS-based river discharge modelling and fluvial morphology in a permafrost environment, regional permafrost mapping and changes in permafrost conditions for the period of recent warming, GIS-based regional soil mapping including the distribution of cryosols as well as soil carbon allocation, measurement of carbon fluxes in a permafrost environment, GIS-based modelling of the arctic treeline in relation to climate and ground conditions, and the distribution of infrastructure in relation to present and future permafrost conditions. Kuhry's present efforts are focusing on the distribution at the regional and landscape levels of soil organic matter quantity and quality in permafrost soils and sensitivity to climate change. Britta Sannel started her PhD studies in August 2004 on the topic of temporal and spatial dynamics of peat plateau/thermokarst complexes,which includes plant macrofossil studies, remote sensing and ground monitoring of peat plateau areas in Scandinavia, Canada and Russia.

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SWITZERLAND

The "**Per**mafrost **Mo**nitoring **S**witzerland (PERMOS)" is operated by the eight Swiss university institutes involved in permafrost research and financially supported by the Swiss Academy of Sciences (SAS), the Federal Office for

Water and Geology (FOWG) and the Swiss Agency for Environment, Forests and Landscape (SAEFL). The pilot phase of PERMOS was extended until the end of 2005 and will be incorporated later on into the official federal environmental monitoring. The biannual report 2000-2002 was published in 2004 and can be downloaded from (www.permos.ch).

The Swiss permafrost community met in February 2004 in Davos. Several presentations about ongoing projects and fruitful discussions made this two-day event a big success. The following activities are reported by several institutes:

At the Swiss Federal Institute for Snow and Avalanche Research (SLF), Martina Lütschg is finishing her PhD thesis entitled "A model and field analysis of the mutual influence of snow cover and alpine permafrost" in which the SNOWPACK model is used to simulate the effects of different snow cover characteristics and ground types on permafrost distribution and, based on field data, laboratory measurements and various climate change scenarios.

The stability of the snow cover in permafrost and non-permafrost sites was analyzed by Marcia Phillips and Jürg Schweizer, using data from extensive snowpack stability tests obtained during two winters in Davos and long-term SLF avalanche statistics.

Armin Rist is analyzing new data about water in the active layer of a scree slope. In parallel, a laboratory experiment simulates the effects of water on the ground thermal regime and on slope stability. Slope stability tests were carried out in the field in collaboration with Sarah M. Springman (ETH Zurich) in summer 2004.

Three new boreholes have been added to the SLF monitoring network, making a total of 15 instrumented boreholes in alpine permafrost. Marcia Phillips continues to monitor the performance of snow-supporting structures in creeping permafrost terrain.

The Glaciology and Geomorphodynamics Group (University of Zurich) investigates the influence of ground-surface characteristics on the active layer thermal regime, in a coarse, bouldery matrix, in order to better understand the non-conductive processes. The analyses are based on data from shallow boreholes as well as from single thermistors and wind sensors placed in the active layer (S. Hanson, M. Oswald, M. Hoelzle).

Rock wall temperature data are used as a validation for the new programme TEBAL, which was developed from the former energy balance programme PERMEBAL to obtain spatial information about temperatures in rock walls. A particular emphasis was placed on investigating permafrost thawing and alpine rock walls destabilization that occurred during the hot summer of 2003. Moreover, hyperspectral remote sensing data are used for characterizing accurately surface parameters such as albedo (S. Gruber, D. Schläpfer, M. Hoelzle).

The summer 2003 rock falls and several older documented events were investigated in the perspective of permafrost degradation in steep rock walls. GIS-based models were developed to simulate these events (J. Noetzli, W. Haeberli, M.Hoelzle). Airborne GPR measurements of the spatial snow depth distribution in the Corvatsch-Furtschellas area were compared to ground measurements and with simulation results from the model TEBAL (A. Hasler, S. Gruber, R. Purves, M. Hoelzle).

In the context of the necessary assessment of the possible impacts of the predicted climatic change on mountain permafrost, the most promising tools for obtaining information about future atmospheric conditions are the Regional Climate Models (RCM). In order to use RCM data in permafrost modelling, a methodology is being established for downscaling the gridded output of RCMs, which will have a spatial resolution of 56 km (N. Salzmann, F. Paul, M. Hoelzle).

In order to better understand the intra-regional variability in rock glacier distribution, several numerical modelling approaches were applied in a study region in the eastern Swiss Alps. Among others, a dynamic model was created that allows a 4D simulation of talus-derived, rock glacier occurrence. The modelling of their spatio-temporal development and distribution shows very promising results (R. Frauenfelder, W. Haeberli, M. Hoelzle, B. Schneider, University of Basel, and B. Etzelmüller, University of Oslo).

A combined study on the development of transverse ridges on rock glaciers including high precision field surveys and physical laboratory experiments revealed that these forms are advected downstreams with a speed that approximates the overall rock glacier surface velocity. Surface speeds turned out to exhibit local maxima on top of individual ridges. In a field study on the advance mechanisms of rock glaciers a novel measurement approach allowed the determination of the ice content and the vertical velocity profile near the front. Photogrammetric measurements of speed and thickness of selected rock glaciers were continued within the PERMOS monitoring network and pointed out an increase in surface speed for most of the observed individuals (A. Kääb).

An initial explorative study of permafrost distribution in the Kazbek massif (North Ossetia, eastern Caucasus) was initiated within a project of the Swiss Agency for Development and Cooperation (SDC) in response to the catastrophic Kolka-Karmadon rock/ice avalanche that occurred on September 20, 2002 on Dzhimarai-khokh Peak (4780 m asl) (S. Zgraggen-Oswald, R. Frauenfelder, C. Huggel, A. Kääb, W. Haeberli).

The Institutes of Geography of the University of Lausanne (C. Lambiel, E. Reynard) and Fribourg (R. Delaloye) have been collaborating closely in alpine permafrost research in Switzerland for the last years. Reynald Delaloye presented a PhD thesis about mountain permafrost in peripheral areas. Thermal regime and permafrost occurrence in talus slopes are studied in low elevation sites (J.

Dorthe, S. Morard) and in the alpine discontinuous permafrost belt (K. Pieraci). In order to learn more about the influence of air circulation on thermal regime, a shallow borehole (about 20 m) will be drilled and instrumented in autumn 2004, for the first time in a low altitude talus slope (at 1550 m asl in the Combe de Dreveneuse, Valais Prealps).

Surface displacements are monitored at some alpine permafrost features (active and inactive rock glaciers, frozen deposits in Little Ice Age glacier forefields, talus slopes) using GPS (E. Perruchoud) and photogrammetry (J.-P. Dousse, in collaboration with A. Kääb and R. Lugon, at K. Bösch, Institute Sion). GPS surveys have been carried out at six sites since 2000. Global accelerations were observed between 2000 and 2003. Surface velocities seemed to keep increasing between 2003 and 2004. The photogrammetry study of the Rechy rock glacier (Valais) has been carried out since 1986 on the basis of high resolution aerial photographs taken every four to five years.

Permafrost thermal monitoring is conducuted in two boreholes (Lapires and Gentianes). Using the building site of a snow supporting structure, a new shallow borehole (20 m) was drilled in bedrock in summer 2004 (Pointe du Tsaté, 3070 m asl). BTS and GST (ground surface temperature) monitoring have gone on at 15 sites since 1996 (for the longest BTS series) and 1997 (for GST). Some of these measurements are included in PERMOS. One of the most interesting results came from an inactive rock glacier (Alpage de Mille, Valais Alps), where the nine-years BTS series indicated a winter ascending air circulation throughout the whole rock glacier. Assessing the thermal effect of such a process is a challenging perspective for further research.

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A meeting of the International Geographical Union (IGU) Commission on Climatic Changes and Periglacial Environments was held on August 19, 2004 during the IGU Congress in Glasgow, Scotland. The meeting was organized by Julian Murton and attended by some 30 participants, including speakers from the U.S.A., South Africa, Russia, Finland, Ukraine, Germany, Belgium and the U.K.. The theme of the meeting was "Climatic Impacts on Periglacial Environments." It began with an excellent keynote lecture by Fritz Nelson (University of Delaware, U.S.A.) on climatic warming and its impacts in high-latitude permafrost regions. This was the last meeting of the IGU 'periglacial' commission, which has promoted periglacial research for the past 55 years. Jef Vandenberghe (Chair of this commission; Vrije Universiteit, Amsterdam) thanked the participants and welcomed Martin Gude and Christer Jonasson as co-chairs of the newly-approved IGU commission on Cold Regions Environments (Other News)

A new series of physical modelling experiments, led by Charles Harris and funded by the Natural Environmental Research Council (NERC), is currently being set up at the CNRS Centre de Géomorpologie, Caen, France. The experiments will simulate and monitor solifluction processes and rates in a cold active layer compared with seasonally frozen ground in non-permafrost terrain. This work involves collaboration between the universities of Cardiff (C. Harris), Dundee (M. Davies), Sussex (J. Murton) and Caen (M. Font, J-C. Ozouf).

Another large-scale laboratory modelling study in the Caen cold rooms, also funded by the NERC, concerns bedrock fracture by ice segregation. The study, led by Julian Murton, is currently determining behaviour of porous bedrock (a variety of sandstones and limestones) to one-sided freezing (seasonal frost) and two-sided freezing (permafrost). The overall objective is to acquire data for testing a numerical model of rock fracture by growth of segregated ice. Collaborators on this research are from the universities of Sussex (J. Murton), Caen (J-C. Ozouf, J-P. Coutard), and Alaska at Fairbanks (R. Peterson).

Field investigations of contemporary frost action are being undertaken on the mountains of northern England by the University of Durham. Jeff Warburton has developed a simple time series model to predict the ground thermal regime of a sorted stripe field from air temperature data.

The initial results have been useful in developing a second field programme in the Northern Lake District that will refine the thermal regime model and look more closely at the temperature interactions between fine and coarse stripes. Continuous recording of fine stripe heave using a non-contact sensor will provide data to examine the relationship between frost action and soil thermal conditions.

A second study in the Lake District by Jeff Warburton and collaborator Richard Johnson (University of Central Lancashire) is also underway to investigate the post-wildfire effects of frost on the breakdown of bare, crusted soils. This NERC funded project will use laboratory simulation experiments to determine rates of crust breakdown under different freeze-thaw conditions.

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United States of America

The Fall meeting of the American Geophysical Union was held in San Francisco, California, December 13–17. A number of oral and poster sessions on all aspects of the cryosphere were convened under the auspices of the Cryosphere Committee. Included were sessions on the role of permafrost coasts in the Arctic system; changes in frozen ground, environmental and climatic impacts; paleoecological approaches to Late Quaternary climate change; and Arctic freshwater cycles.

The U.S. Permafrost Association held its annual Board

and Members meetings during the AGU Meetings. President Tart and incoming President Vladimir Romanovsky chaired the business meeting. Plans for the Ninth International Conference on Permafrost (NICOP) in June 2008 were reviewed including the formation of the U.S. National Committee for NICOP. The annual elections resulted in the new members of the Board of Directors: F.E. Nelson (President-Elect), David Norton (Member) and Jon Zufelt (Secretary). During the year the USPA was represented at several meetings of the American Geological Institute (AGI). USPA is one of the 43 Member Society Council of the AGI (www.agiweb.org). USPA cosponsored the Alaska Section's American Water Resources Association conference in Fairbanks in April.

F.E. Nelson provided the following report on the Association of American Geographers (AAG). The AAG held its national meeting March 15–19 in Philadelphia, Pennsylvania., marking its Centennial Anniversary in the city of its original convention. With more than 7500 members, the AAG is one of the largest national geographical organizations in the world with members from 62 countries. The AAG is organized around a series of 54 Specialty Groups representing core areas of geographical research. The group of most interest in permafrost is the Cryosphere Specialty Group, formed in the mid-1990s by H. Jesse Walker. Other AAG subdivisions with topical interests overlapping those of IPA include the Climate, Geomorphology, Mountain, Biogeography, and Water Resources Specialty Groups.

The Cryosphere Specialty Group sponsored seven sessions associated with the theme "Celebrating a Century of Physical Geography" (CCPG), and involved 60 contributing authors. They were co-sponsored by the Geomorphology, Climate, and Biogeography Specialty Groups, and the Archives and Association History Committee. Many of the papers delivered in the CCPG sessions will be published in several special issues of the journal *Physical Geography* edited by Dorothy Sack. CCPG also sponsored an evening reception attended by more than 300 people.

The AAG Centennial Meeting also featured several sessions addressing contemporary cold-regions topics under the title "Cryosphere in the 21st Century." Organized by Alan Frei (Hunter College), these sessions incorporated presentations on permafrost, periglacial geomorphology, glaciology, sea ice, cold climates, and snow cover. The AAG's 2005 annual meeting will be held April 5-9, in Denver, Colorado. More than 50 presentations on various aspects of the cryosphere are scheduled (www.aag.org).

Rupert (Bucky) Tart provided the following report on recent activities of the American Society of Civil Engineers. The Technical Council on Cold Regions (TCCRE) accomplished the following this year:

- Completed and published a new 492-page monograph titled "Thermal Analysis, Construction and Monitoring Methods for Frozen Ground".
- Co-hosted the 12th International Conference on Cold Regions Engineering (ICCRE) held in Edmonton, Alberta, on May 16–19, 2004, in cooperation with the Canadian Society of Civil Engineers.
- Three TCCRE members (Tom Krzewinski, Bucky Tart and Hanalee Zubeck) accompanied ASCE president Pat Galloway on a visit to Finland on June 26–30, 2004. They assisted by making presentations to Finnish engineers at various meetings.
- TCCRE members arranged sessions and gave presentations at the Winter Cities Conference held in Anchorage on February 18-20, 2004.
- Three TCCRE awards were presented at the Edmonton Cold Regions Conference, including the Eb Rice Memorial Lecture award to Dr. Robert Carlson of UAF, the Can-AM CE Amity award to Mr. James C. McDougall of North 60 Engineering in Calgary, and the Harold R. Peyton award to Dr. Dan Smith of the University of Alberta.
- TCCRE EXCOM and the various TCCRE committees met once during the year, just prior to the 12th ICCRE at Edmonton, Alberta and again in Duluth on October 30 to develop next year's budget.

TCCRE is continuing to work on organizing the upcoming 13th International Conference on Cold Regions Engineering at Bangor, Maine in 2006, planning and preparation of several new Cold Regions Monographs, and planning and editing papers for the Journal of Cold Regions Engineering. Dave Esch is the incoming Chairman of the TCCRE and Bucky Tart is the new Vice Chairman.

Fritz Nelson and Kolia Shiklomanov report that the University of Delaware Permafrost Group (UDPG) continues its research on active-layer processes in northern Alaska. Two new grants were approved by the U.S. National Science Foundation; the CALM grant to extend support for Eurasian and Alaskan sites for an additional five years, and a collaborative grant with Tingjun Zhang (University of Colorado), Vlad Romanovsky (University of Alaska), and Oleg Anisimov (State Hydrological Institute, St. Petersburg) to compare and evaluate modelling strategies for mapping permafrost under climate-change scenarios. Anna Klene moved to the University of Montana's geography programme and continues her work in northern Alaska. Cathy Seybold (Natural Resources Conservation Service, USDA) has taken over management of instrumental arrays from Ron Paetzold. Dmitri Streletskiy, a master's student in geocryology at Moscow State University spent two semesters and the 2004 field season with UDPG. Mary Lemcke completed her MS thesis on sediment-filled wedges in central Delaware. Andrea Wedo

is conducting a quantitative study of the sediments in a large boulder field in east-central Pennsylvania. Michael Walegur maintains a network of climate instruments at high elevation for a transect from Maine to North Carolina. Kim Gregg completed a thesis on the paleoclimatic implications of blockfield distribution in the Appalachian. Mark Demitroff, who works collaboratively on paleoperiglacial problems in southern New Jersey with Hugh French, has joined us as a graduate student. Silvia Cruzatt, is installing CALM-type instrumental arrays at high elevation in the Peruvian Andes. Fritz Nelson delivered the *Blackwell Geomorphology and Society* address at the AAG conference and a plenary lecture at the 30th Congress in Glasgow, Scotland.

Larry Hinzman reports that the faculty and staff of the University of Alaska Water and Environmental Research Center continued studies in various aspects of permafrost hydrology. Daniel White is leading an investigation to document the long-term changes in water resource use on the Seward Peninsula. A component of this project is to model the current permafrost distribution as well as that in 1900 and 2100 and determine the consequent impacts on the hydrology. Kenji Yoshikawa continues his studies on periglacial processes including aufeis development, pingo formation and polygon networks. Horacio Toniolo and Debasmita Misra have initiated studies on sediment transport during thermokarst formation. Douglas Kane is continuing the long-term study of permafrost hydrology in the Kuparuk watershed. We also continue studies to examine the impact of wildfires on permafrost regime and the effects of thermokarsting on the local hydrology.

Vladimir Romanovsky (Geophysical Institute, UAF) reports that the Permafrost Laboratory continued to collect data on the active layer and permafrost temperatures at more than 60 locations within Alaska and in the Canadian Arctic. During the last year, two new permafrost observatories were established. One in Gakona area where air, active layer and permafrost (down to 30 metres) temperatures and soil moisture (down to 5 metres) are measured at hourly resolution. Another site was established near Mould Bay on Prince Patrick Island, Canada, as part of Walker's Biocomplexity project. We also continued the modelling of permafrost dynamics, both at site-specific and spatially distributed levels. Modelling of permafrost dynamics at four different sites on Seward Peninsula was undertaken. The modelling results explained the differences in permafrost evolution at the locations were permafrost presently exists and where it is absent. Spatially distributed model of permafrost dynamics was established for northern Alaska (north from 64°N) for the time period between 1900 and 2100.

Tom Osterkamp reports that permafrost temperatures have been measured in boreholes along a north-south transect of Alaska for a quarter century. These measurements show a recent and strong warming at all the sites except one. In cooperation with Janet Jorgenson, U.S. Fish and Wildlife Service, additional measurements of permafrost temperatures were made over a two decade period (1985–2004) in the Arctic National Wildlife Refuge (ANWR). Interpretation of these measurements indicates that the century-long warming documented for the central and western Arctic has also occurred in the region near Barter Island and in this area north of the Brooks Range.

Gary Clow and Frank Urban (U.S. Geological Survey) continued to expand the Department of the Interior's network of active-layer monitoring stations in northern Alaska under the GTN-P programme. A major upgrade to the network to improve its long-term reliability was completed during August 2004. Three additional stations were also installed, bringing the total number of DOI active-layer monitoring stations in northern Alaska to 14; ten in the NPRA while the remaining four are in the ANWR. Improvements to DOI's GTN-P deep borehole array in the NPRA was also initiated in anticipation of the TSP campaign. The use of coiled tubing technology to drill new deep boreholes in permafrost is being investigated.

Tim Collett, U.S. Geological Survey (USGS), reports that under the U.S. Methane Hydrate Research and Development Act of 2000, the U.S. Department of Energy (DOE) funds laboratory and field research on both Arctic and marine gas hydrates. Among the current Arctic studies, British Petroleum Exploration Alaska and DOE have undertaken a project to characterize, quantify, and determine the commercial viability of gas hydrates and associated free gas resources in the Prudhoe Bay, Kuparuk River, and Milne Point field areas in northern Alaska. The University of Alaska in Fairbanks, the University of Arizona in Tucson, and U.S. Geological Survey are also participating in the Alaska British Petroleum project. Also in northern Alaska the Bureau of Land Management, the Alaska Division of Geological and Geophysical Surveys, and the USGS are assessing and characterizing the resource potential of selected gas-hydrate/free-gas accumulations on public lands. Information from this study will then be used to assess and characterize the gas hydrate potential in the NPRA, ANWR, and the State lands. The goal of this joint work is to assess the economically recoverable resource potential of gas hydrates and associated free gas accumulations in northern Alaska by 2007.

D.A. Walker (UAF) reports that a team of 24 people from Fairbanks and other organizations worked at Inuvik and Mould Bay, Prince Patrick Island, during the period July 12–27, 2004, as part of the NSF project "Biocomplexity associated with biogeochemical cycles in arctic frost-boil ecosystems. The main objective of the research is to

Trench across non-sorted stripes exposing buried organic matter, Thule, Greenland. Photograph by Ron Sletten,

investigate frost-boil ecosystems along a climate gradient from the coldest parts of the Arctic to the northern boreal forest. This year the project established three new 10-×10-m grids: one near Inuvik in a lichen-woodland and two at Mould Bay. Patterned-ground formation includes the development of contraction cracks, differential frost heave, and the development of a vegetation mat. The strength of these processes varies across the climate gradient and interact to form small non-sorted polygons, sorted and non-sorted circles, and large well-vegetated mounds.

Ron Sletten, Bernard Hallet, Birgit Hagedorn (University of Washington) undertook the third year of the multidisciplinary NSF study in the vicinity of the Thule Air Base, Greenland. The project "Biocomplexity of carbon cycling in the High Arctic" is conducted with Jeff Welker (University of Alaska, Anchorage), Heidi Seltzer and Patrick Sullivan (Colorado State University), and Josh Schimel (the University of California, Santa Barbara). The primary goals are to investigate physical, chemical, and biological interactions and feedback on carbon flux, weathering, and ecosystem dynamics. Study sites are established along a vegetation-density transect from sea level to the ice cap. We have continuous monitoring of meteorology, soil temperature to 1.4 m, soil water content utilizing true TDR, river stage, and snow depth. In summer 2004, we used a backhoe to excavate a 30-m long, 1.5-m wide, approximately 1-m deep trench (below the frost table) across a series of non-sorted stripes to study cryoturbation and its role in burying carbon (see photo). Jennifer Horwath, PhD student, is assessing the below ground carbon content to below the base of the active layer (approx 1 m). Preliminary results indicate that current estimates of organic carbon in High Arctic systems may be underestimated since previous estimates did not account for organics moved to depth via cryoturbation. Heather Heuser, also a PhD student, is studying the history of the Thule area by analyzing ^{18}O in diatoms from lake cores.

The University of Washington group continued work in Antarctic focusing on the contraction crack dynamics and renewal rates in polygon-covered surfaces in the Dry Valleys. In a recent paper (Ng, et al.) the age of sublimation till overlying buried ice in Beacon Valley suggests that till formed during ice sublimation occurred in the past several hundred thousand years; this is inconsistent with other reports of this ice being over 8 million years old. For further information see (http://depts.washington.edu/icylands).

Ron Paetzold (retired, USDA Natural Resources Conservation Service) reports that there are seven active CALM soil climate stations in Antarctica: Scott Base, Marble Point, Bull Pass, Victoria Valley, Mt. Fleming, Minna Bluff, and Granite Harbour. Routine maintenance was performed on and data retrieved from these stations in January 2004. CDs with the processed data for these stations are available.

Nicole Mölders and her group at the Geophysical Institute evaluated the frozen soil/permafrost module of the Hydro-Thermodynamic Soil-Vegetation Scheme (HTSVS), which is applied in several weather prediction models and has been implemented in the Community Climate System Model (CCSM). They compared simulated and observed soil temperatures for various sites in the Baltic region (from the WINTEX/NOPEX campaign) and Alaska to detect and remove model shortcomings. Narapusetty, a graduate student is currently working on the development of an improved numerical scheme for the frozen soil/permafrost module to better capture the discontinuities in soil variables and parameters along the freezing line.

Leslie A. Viereck, Boreal Ecology Cooperative Research Unit, Fairbanks, with the help of the Bonanza Creek Long Term Ecological research (LTER) contiues to maintain three of the interior Alaska CALM sites; Pearl Creek (since 1965), Wickersham fire site (since 1971), and the FP5C site. A Wickersham fire poster on the effect of wildfire and fireline construction on the annual depth of thaw in a blackspruce/permafrost site in interior Alaska (a 33-year record) showed contrary to our original prediction that a shallow active layer did not return to the site by a gradual freezing back from the lower depth, but rather by the formation of a layer of seasonal frost that eventually remained frozen throughout the entire year.

Craig Tweedle of the Arctic Ecology Laboratory, Michigan State University in collaboration with Nuna Technologies indicates significant developments on the

Barrow Area Information Database and Internet Map Server (BAID-IMS, (ims.arcticscience.org/) and the Circumarctic Environmental Observatories Network Internet Map Server (CEON-IMS, (www.ceonims.org/). Each application has the same basic GIS functions, which allow users to query and search site-based information, select and buffer features (points, lines, polygons), measure distance, change units (feet, metres, miles, and kilometers), identify features, change scale (by zooming in or zooming out) and print. BAID-IMS covers a total area of the application of approximately 280,000 km^2. The CEON-IMS application extends from 45 degrees north and includes circum-arctic thematic data such as bathymetry and topography, land cover and permafrost, some satellite-derived products. For example, users can link to more than 3500 WMO stations reporting real time weather data and long-term climatic averages north of 45 degrees north.

Tingjun Zhang reports on a number of frozen ground activities at the National Snow and Ice Data Center/WDC for Glaciology, University of Colorado at Boulder. The NSF-funded project with Zhang, Roger Barry, David Gilichinsky continues to recover, collect, digitize, and archive historical soil temperatures for up to 400 stations from the Former Soviet Union. Based on in-situ measurements, thawing index, and numerical modelling, Zhang investigated the spatial and temporal variability of active layer thickness over the Russian Arctic drainage basin. Zhang and Armstrong for the NASA/NOAA GEWEX American Prediction Program (GAPP) investigated the spatial and temporal variations of seasonally frozen ground in the contiguous United States. Using passive microwave remote sensing data and numerical modelling, they developed the NSIDC Frozen Soil Algorithm to detect near-surface (<10 cm) soil freeze-thaw cycles in the Northern Hemisphere. Zhang and Barry continue the IARC-funded Permafrost Data Assembly project. This activity is producing value-added products such as gridded soil temperature, active layer thickness, permafrost distribution, snow thickness and air temperature for the region north of 50°N. Zhang with Nikolai Shiklomanov (University of Delaware) are involved in a permafrost modelling comparison at selected locations and regions. Dr. Svetlana Chudinova, Pushchino, was a NSF-NATO Postdoctoral Fellow at NSIDC working on the effects of 20^{th} century climate change on the soil temperature regimes in the regions of perennially and seasonally-frozen ground of Russia.

Torre Jorgenson, ABR, Fairbanks, compiled for the Nature Conservancy a new ecosystems map of northern Alaska. It and more detailed US reports are posted on the USPA web site (www.uspermafrost.org). Please sign up to receive information on the 2008 conference.

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Other News

New Zealand

New Zealand permafrost research in the Antarctic includes the following activities.

The Latitudinal Gradient Project (LGP) "is a framework within which interdisciplinary and international collaborations can be supported logistically towards the common goals of: i) understanding the complex ecosystems that exist along the Antarctic Victoria Land coast; and ii) determining the effects of environmental change on these ecosystems." (www.lgp.aq/). Five sites along the Victoria Land coast, covering a latitudinal range from 72° to 83° S, are studied in detail in the fields of: limnology and oceanography; marine and terrestrial ecology; physiology and genetics; soil science and microbiology; meteorology and climate modelling; glaciology and geomorphology; sediment- and ice-core palaeoclimatology. The information gained from the different sites along the coast will increase our understanding of polar ecosystems and help create a predictive knowledge of the future effects of environmental change on these ecosystems. The LGP's success is dependent on the interdisciplinary aspects of the project and the interaction of researchers at each site, forming a complete picture of the ecosystems studied.

The LGP began in the 2003/04 summer with a field camp established at Cape Hallet where researchers from New Zealand, U.S.A. and Italy worked with New Zealand and Italian logistic support. A group led by Jackie Aislabie, of Landcare Research, and Megan Balks from Earth Sciences at the University of Waikato investigated the soils and permafrost, in a much warmer, wetter environment than that experienced further south in the Ross Sea Region of Antarctica. Work undertaken included soil description and characterisation, installation of soil moisture and temperature monitoring equipment and installation of dipwells to monitor summer water tables perched on the permafrost. Work at Cape Hallet is planned to continue for the 2004/05 and 2005/06 summers then the focus of the LGP is planned to move south to the Darwin Glacier area.

In the 2004/05 summer Malcolm McLeod from Landcare Research, along with Megan Balks and Jim Bockheim, plans to commence field work on a soil mapping project in the Wright Valley. The ultimate goal is to produce interpretive maps of the vulnerability of soils and permafrost to human activities in the region that will contribute to decisions relating to environmental management in the area.

Jackie Aislabie's research group, in collaboration with USDA, now have a network of seven soil-climate monitoring stations in the Ross Sea Region. Data is downloaded annually and contributed to the CALM project. The stations form a transect along the Antarctic coast (Minna Bluff, Scott Base, Marble Point, and Granite Harbour), with a further transect running inland from Marble Point to the Wright Valley and Mt. Fleming. Stations supported by Ron Sletten of the U.S.A. in Victoria and Beacon Valleys also contribute to the available data set. In the 2005/06 summer we hope to add temperature measurement to 20 m at the Marble Point and Bull Pass sites with the support of Mauro Guglielmin from Italy.

Cape Hallet Camp, January 2004. Photograph provided by Megan Balks.

New Zealand has announced its interest in becoming a member of the IPA. The IPA Council plans to act on the request at its June meeting in Potsdam.

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Portugal

Present-day periglacial processes and relict features are currently being studied in the Serra da Estrela, Central Portugal, by researchers from the University of Lisbon. The main emphasis is placed on monitoring ground temperatures, studying the local mountain climates and investigating the relationships between glacial and periglacial relict landforms and deposits, especially these indicating a former occurrence of permafrost.

An ongoing collaboration between the Universities of Lisbon and of Alcalá de Henares (project coordinator, Spain) studies the active layer and permafrost temperatures on Livingston Island (South Shetlands, Antarctic). A new project aimed at drilling boreholes has been submitted for evaluation; this project focuses on monitoring and modelling the permafrost evolution and distribution on Livingston and Deception Islands, in collaboration with researchers from the University of Zurich.

A committee for the preparation of the International Polar Year is being developed.

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ROMANIA

The year 2004 witnessed important advances in glacial, periglacial and permafrost research in the Romanian Carpathians. The Department of Geography at West University, Timisoara, contributed considerably to this progress. Under the leadership of Petru Urdea, a team composed of Florin Vuia, Mircea Ardelean, Mircea Voiculescu and Marcel Török-Oance developed the project "Present-day geomorphological processes in the alpine domain of the Southern Carpathians in the context of global change (2002–2004), as a part of a larger research project financed by the National Council for Scientific Research in Superior Education (CNCSIS). One of the project objectives is to obtain a realistic overview of recent geomorphological processes in the alpine domain of the Transylvanian Alps with a typology of their occurrence under the perspective of global change. Current geomorphological studies focus primarily on past and present dynamics in periglacial areas. For example, P. Urdea studied the Last Glacial Maximum permafrost extent in the mountains of central Romania (Bihor, Cerna) on the basis of some mapped relict features (block stream and block fields, polygonal soils, stone circle, etc.).

The Timisoara research team recently received financial support from the CNCSIS for another research project, led by Mircea Voiculescu and entitled "Geographical risks in the alpine belt of the Southern Carpathians. GIS-technique applications and mapping of hazards areas". Another project deals with "Recent geomorphological processes in the alpine domain of the Southern Carpathians in the perspective of global change;" digital terrain models of the Fagaras Mountains, Parâng Mountains and Muntele Mic have been developed for that project. A new member of the Timisoara research team, Lucian Dragut, has just completed his PhD (Cluj-Napoca University), this thesis includes a chapter about ancient glacial and periglacial features.

At Pitesti University, Smaranda Toma has started working on a PhD dedicated to the glacial and periglacial geomorphology of the Buda Basin (southern slope of the Fagaras Mountains).

Several conferences were held in Romania in order to support these new advances in geomorphological research. During the 5th International Conference on Geographic Research in the Carpathian-Danube Area (Timisoara, May 17–19, 2002), a round table was organized on the "Trends in morphodynamic processes in the Carpathians alpine areas". The First International Workshop on Ice Caves took place from February 29 to March 3, 2004, in Capus, Romania. The Speleological Institute Emil Racovic of Cluj-Napoca and the Universita degli Studi di Milano (Italy) organized this meeting attended by over 30 scientists coming from 11 countries.

In September 23–26, 2004, on Bâlea Cascad (Fagaras Mountains), an International Workshop on Alpine Geomorphology and Mountain Hazards was organized by the Department of Geography of West University with the support of the Carpatho-Balkan Geomorphology Commission. Scientists from Romania, Germany, Italy, Hungary, Poland, and Slovakia took part.

Glacial and periglacial features and relict permafrost indicators were studied by the Timisoara team in Muntele Mic, by Petru Urdea in the Bihor Mountains, by Petru Urdea and Dorel Gureanu in the Cernei Mountains, by Florin Vuia in the Parâng Mountains, by Mircea Ardelean in the Piule-Iorgovanu Mountains, by Andreea Andra and Alexandru Nedelea (Bucharest University) in the Topolog and Capra Basin (Fagaras Mountains), and by Marcel Mândrescu (University of Suceava) in the Rodnei and Climani Mountains (Eastern Carpathians).

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NEW IGU COMMISSION ON COLD REGIONS

During the International Geographical Congress in Glasgow in August, the International Geographical Union (IGU) renewed its focus on periglacial topics by approving the new Commission on Cold Region Environments. The Commission was proposed by Jef Vandenberghe, who previously lead former commissions on periglacial topics. On this occasion, a formal Agreement of Cooperation was signed between the presidents of IGU and IPA that extended the joint activities and related cooperation. The Commission's scope includes activities of the new IPA Working Groups on Periglacial Landforms, Processes and Climate, and Permafrost and Climate.

The Commission builds on the work of the former periglacial commissions, but will have a broader scope. Cold-climate regions face increased impacts and responses to environmental sensitivity, the consequences of which are not purely physical. Hence, these issues require the incorporation of social, economic and environmental aspects. The themes stress the need for interdisciplinary efforts to assess an integrated understanding of cold region geo-ecosystems, including land use and climate change issues. A second focus will be on the improvement of combining process and geo-archive information in arctic and alpine environments as well as in former periglacial environments. Within this geographical-oriented commission, an integration of many aspects of the physical environment with the social and economic realms, such as sustainable development, will be emphasized.

Commission activities concentrate on the organisation and co-sponsoring of topical workshops and conference sessions, as well as contributing geographical expertise to organisations dealing with cold region issues. In order to disseminate information, a homepage will be launched, and a newsletter will be distributed among all interested. To subscribe to the newsletter or to contribute to the

Discussion of new Commission. Clockwise: Anne Buttimer (IGU President), Jerry Brown, Ron Abler (IGU Secretary General), Christer Jonasson, Martin Gude, and Achim Beylich. Photograph by H.J. Walker.

Commission's work, contact the chair Martin Gude (Jena, Germany (martin.gude@uni-jena.de) or the co-chair Christer Jonasson (Abisko, Sweden (christer.jonasson@ans.kiruna.se)

The new IGU Commission consists of a steering committee with one member each from 11 members countries. Dario Trombotto (Argentina), Nancy Doubleday (Canada), Xiaoping Yang (China), Martin Gude (Germany), Norikazu Matsuoka (Japan), Jef Vandenberghe (Netherlands), Ole Humlum (Norway), Tatiana Vlassova (Russia), Christer Jonasson (Sweden), Julian Murton (U.K.), and Frederick E. Nelson (U.S.A.). Several additional national members may be added.

PACE21: Permafrost and Climate in the 21st Century

The PACE21 Network, funded by the European Science Foundation, promotes collaborative and interdisciplinary research on permafrost in a changing global climate. The programme focuses on: permafrost thermal regime; observation systems and process measurements; permafrost-climate interaction, including permafrost relationships with global climate models and modelling; measuring and modelling geomorphological processes in the field and laboratory, permafrost characterisation and mapping, including new geophysical approaches, modelling thermal processes in the atmosphere-permafrost boundary layer, modelling changing spatial distribution and character of permafrost, mapping and modelling geo-environmental impacts and associated hazards in warming permafrost environments, developing risk-based assessment procedures for engineering and land-use planning in sensitive permafrost terrain.

PACE21
EUROPEAN SCIENCE FOUNDATION

The second PACE21 workshop, this time a field workshop on Permafrost Geomorphological Systems in a Changing Global Climate, was held September 8–13 at the University Centre in Svalbard (UNIS). The PACE21 network is supported by the European Science Foundation. The workshop organizers of this workshop were Hanne H. Christiansen, Ole Humlum, Johan-Ludvig Sollid and Charles Harris. The workshop was attended by 37 delegates, 35 from Europe and two from Japan. It was particularly pleasing that half the delegates were Masters or PhD students, while the conference was also graced by the presence of the distinguished senior permafrost scientists, Harald Svensson (Denmark) and Johan Ludvig Sollid (Norway). The format was two days of oral presentations and a poster session, held at UNIS, and then three days of field excursions in the Longyearbyen area.

An abstract volume covering the oral presentations of the workshop, edited by Charles Harris and Hanne H. Christiansen was published for the meeting. Copies may be obtained from Hanne H. Christiansen at UNIS, Svalbard, or from the IPA web.

The field days enjoyed cold but generally dry conditions and provided excellent opportunities to discuss experimental monitoring programmes and the geomorphological evolution of the area. On September 10 the excursion theme was lowland permafrost in Adventdalen, where we observed the UNISCALM site, ice wedge polygons, ice wedge dynamics, permafrost thermal monitoring at the Aurora Station, thermal monitoring at a coal mine, overview of the Janssonhaugen area, PACE borehole, overview of the Adventdalen pingos. The leaders were Hanne H. Christiansen, Ole Humlum, Ketil Isaksen and Neil Ross.

On September 11 the excursion was introduced to rock weathering and permafrost conditions in and around Longyearbyen. The excursion visited monitored rock faces and weathering experiments, scree slopes, old wooden piles displaced by mass movement, debris flow and avalanche protection measures, and discussed engineering strategies

PACE21 Workshop delegates in Longyearbyen September 2004. Photograph by Hanne H. Christiansen.

in permafrost. An optional extra on Sunday, enjoyed by half the group, was a flight over Adventdalen, Sassendalen, and across the calving glacier Tunabreen, then returning to Adventdalen via Gipsdalen and DeGeerdalen. Aerial panoramas included rock glaciers, scree slopes, ice wedge polygons, sorted stripes, pingos as well as extensive outwash fans, glacial moraines, and of course the glaciers themselves. Excursion leaders were Angélique Prick, Hanne H. Christiansen, Ole Humlum and Anja Fleig.

On September 12 the theme was glacier–permafrost interaction, Larsbreen and Longyearbyen. Participants walked across the margins of polythermal glaciers, observed ice-cored moraines, rock glaciers, avalanche processes, and slope processes, and enjoyed superb views across the glaciers and Longyearbyen from the plateau surface. The leaders were Rune S. Ødegård and Ole Humlum.

Professor Johan-Ludvig Sollid kindly provided additional copies of the ICOP 2003 Field Guide of the Svalbard excursion for all delegates. The leaders of each field day are to be congratulated on their clear and interesting explanations, and for stimulating a lively discussion. Thanks to all.

Photographs from the plane ride are available on the PACE21 web pages: www.earth.cf.ac.uk/research/geoenvironment/pace/31.PACE21_Programme.htm.

A Special Volume of The Norwegian Journal of Geography (Norsk Geografisk Tidskrift) will publish papers from the workshop, and it is planned to include this with the conference materials provided at the next PACE21 meeting, which will be at the 2nd European Permafrost Conference in Potsdam.

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CLIMATE AND CRYOSPHERE

The World Climate Research Programme (WCRP) project "Climate and Cryosphere" (CliC) held the first session of its Scientific Steering Group at the Australian Antarctic Division, in Hobart, Tasmania, Australia, on October 25–29, 2004. CliC (see www.clic.npolar.no) is a core project of the WCRP, and is as well cosponsored by the Scientific Committee on Antarctic Research. The main goal of the session was to consider actions and arrangements that would turn the project from its planning phase to implementation including optimal ways of building the project activities on initiatives associated with the International Polar Year 2007/2008. CliC is charged with coordination of the WCRP-IPY activities.

Due to the wide scope of the project, its implementation will be coordinated by the four CliC Project Areas (CPAs). The CPA1 called "The terrestrial cryosphere and hydrometeorology of cold regions" is of primary interest for the frozen ground specialists. A fundamental charge to CPA1 is to improve estimates and quantify the uncertainty in the estimates of water and energy balance and flux components in cold regions. Improved estimates should be produced of the amount and form of carbon and ground ice stored in the ground and their release rates to the atmosphere or surface and ground water in a warming climate.

Fulfilling its terrestrial objectives, CliC will work in close contact and partnership with the International Permafrost Association (IPA), the Earth System Science Partnership (ESSP) Global Carbon Project, the Northern Eurasian Earth System Partnership Initiative (NEESPI), and several other projects and programmes. Through the Integrated Global Observing Strategy Theme on Cryosphere, it will strengthen the in-situ and remote sensing observing sys-

tems for terrestrial elements of the cryosphere with particular attention to solid precipitation, snow water equivalent, soil moisture and temperature, and glacier mass balance. Transects and "Super Study Sites" are planned in different environments for intensive measurements, scaling, process parameterization, modelling and remote sensing validation.

One of the project foci is the role of cryosphere in the water resource management, especially for mountain regions, including improved derivation of fresh water resources from glaciers and ground ice, melting snow-pack, fresh water ice and rain on snow. Coordination of the many research and operational initiatives in this area, such as the Arctic Hydrological Cycle Observing System, Community-wide Hydrological Analysis and Monitoring Programme, Northern Research Basins, and several others should generate a tangible input to the ESSP Global Water System Project.

A Memorandum of Understanding was signed in 2004 between CliC and IPA outlining the scope and principles of mutual cooperation. IPA President Brown took part in the Science Steering Group session as an invited expert. Permafrost scientists and experts are cordially invited to take part in the CliC First Science Conference entitled "Cryosphere—The 'Frozen' Frontier of Climate Science: Theory, Observations, and Practical Applications" in Beijing, China, April 11–15, 2005 (www.clic2005.org).

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SEDIFLUX: Sedimentary Source-to-Sink-Fluxes in Cold Environments

Climate change will cause major changes in the Earth surface systems and the most dramatic changes are expected to occur in the cold climate environments of the Earth. Geomorphological processes, operating at the Earth's surface, transferring sediments and changing landforms are dependent on climate, vegetation cover and human impacts and will be significantly affected by climate change. More reliable modelling of sediment transfer processes operating under present-day climatic settings is needed to determine the consequences of predicted climate change. In Europe the wide range of high latitude and high altitude environments provides great potential to investigate climate-process relationships and to model the effects of climate change by using space for time substitution.

The ESF Network SEDIFLUX (2004–2006) brings together senior scientists, young scientists and research teams from different fields. The large number of projects run by the ESF Network participants demonstrates the high level of research activity of scientists working on sediment fluxes in different cold environments. The Network forms a framework for an integrated and multidisciplinary investigation of the research topic and will be a catalyst for strengthening and extending contacts and exchange.

The Steering Committee of SEDIFLUX consists of scientists from seven countries: Achim Beylich (Co-ordinator of SEDIFLUX), Norway; Samuel Etienne, France; Bernd Etzelmüller, Norway; Vyacheslav V. Gordeev, Russia; Jukka Käyhkö, Finland; Volker Rachold, Germany; Andrew Russell, U.K.; Karl-Heinz Schmidt, Germany; Torsteinn Sæmundsson, Iceland; Fiona S. Tweed, U.K.; Jeff Warburton, U.K.

Network activities include four Science Meetings in Saudårkrókur, Iceland, Clermont-Ferrand, France (January 20–22, 2005, Durham, U.K. (December 2005), and a final Science Meeting in Trondheim, Norway, October 2006. Steering Committee meetings are attached to these Science Meetings. A session "Hydrology and sediment fluxes in permafrost regions," is co-organized by SEDIFLUX at the 2nd European Permafrost Conference in Potsdam. Journal publications, publication of abstract volumes, publication of a SEDIFLUX Handbook, development of a SEDIFLUX database, and the dissemination of Network activities and outputs by using electronic media are other planned activities (web pages, newsletters, forum, etc.).

A monitoring and operational data collection and standardized methods will provide a baseline for the development of reliable models and for future research in the changing cold environments. Apart from further collaborations and collaborative research activities, project and programme applications both at national and at the European levels will be discussed and initiated. For further information see www.esf.org/SEDIFLUX or contact the SEDIFLUX coordinator Achim Beylich (Achim. Beylich@ngu.no).

Northern Research Basins

The 15th International Symposium and Workshop, August 29–September 2, 2005, will be held in Luleå and Kvikkjokk, Sweden. The theme is "Links between human activities and high latitude hydrological systems."

The theme for the 15th NRB will take a step back from the global scale of the last few meetings, and will concentrate on the regional and local importance of change in the Arctic to hydrological processes. This theme will stress the increased demands placed on the water systems of cold regions over the last 30 years whether it be energy production (e.g., the oil and hydropower industries), new industries (e.g., eco-tourism) or social change within Arctic communities (e.g., urbanisation and development). The change in focus will open the NRB community to new disciplines such as ecology and social sciences.

The NRB community was established in 1975 as part of the International Hydrological Programme (IHP).

The Regional Working Group on Northern Research Basins was set up to foster research of river basins in northern latitudes. Unlike other snow and ice conferences, NRB is

intended specifically for Arctic environments, thus full membership is open to countries with territory north of the Arctic Circle. Founder members were Canada, Denmark (Greenland), Finland, Norway, Sweden, the U.S.A. and the U.S.S.R.. Iceland joined in 1992 and Russia has since taken over the role of the U.S.S.R.. In addition, countries with polar research programmes are eligible for associate membership; current associate members are Germany, Switzerland, the U.K. and Japan. Symposia are held every two years and alternate between North America and Europe.

Direct enquiries to: (NRB.2005@tvrl.lth.se) or (annette.davies@tvrl.lth.se) and NRB web (http://aqua.tvrl.lth.se/nrb_2005.html).

PERMAFROST: EUROPEAN GEOSCIENCES UNION (EGU)

In September 2002 the European Geosciences Union (EGU) was established from the former European Geophysical Society (EGS) and European Union of Geosciences (EUG). In this re-organised society there exists an independent Cryological Section (CR) with four subsections: i) snow, ii) permafrost iii) glaciers and ice sheets and iv) sea ice. After an initial open permafrost session at the 2003 joint EGS-EUG-AGU General Assembly, four permafrost sessions were held at the 1st General Assembly of the EGU, which took place April 25–30, 2004, in Nice, France. These included a permafrost open session (Conveners: Hoelzle, Etzelmüller), sessions about glacier and permafrost hazards (Kääb, Etzelmüller, Reynolds), periglacial morphology (Vandenberghe, Humlum) and geophysical prospecting in periglacial environments (Hauck, Kneisel). A total of 67 permafrost-related contributions were presented.

The next General Assembly will take place April 25–29, 2005, in Vienna, Austria. Information about the conference and the sessions can be found at www.copernicus.org/EGU/ga/egu05/. We would like to encourage colleagues to propose new/additional sessions for future EGU meetings. Further information can be obtained from the Secretariat for Permafrost, Cryological Section, EGU.

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GLOBAL CARBON PROJECT (GCP)

The newly formed Global Carbon Project is a shared partnership project between the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP), and the International Programme of Biodiversity Science (DIVERSITA). This partnership constitutes the Earth Systems Science Partnership (ESSP). The scientific goals of the GCP are to develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them. Major questions are:

Patterns and Variability: What are the current geographical and temporal distributions of the major pools and fluxes in the global carbon cycle?

Processes and Interactions: What are the control and feedback mechanisms that determine the dynamics of the carbon cycle?

Carbon Management: What are the dynamics of the carbon-climate-human system into the future, and what points of intervention and windows of opportunity exist for human societies to manage this system?

The GCP Science and Implementation Plan is available as ESSP Report No. 1. For further information see www.globalcarbonproject.org.

PUBLICATIONS

New Book Available: Cryosols: Permafrost-Affected Soils, Edited by: John M. Kimble (ISBN: 3-540-20751-1) 2004, 729 pp.

This book represents the culmination of over ten years of labour and cooperation amongst members of the IPA and IUSS Cryosol Working Groups. The 37 chapters and introductions with 52 authors are divided into six sections: history of polar soil research, geographic distribution of Cryosols, soil properties and processes, ecological processes, classification, and management and use of these soils. Price is $219 USD plus handling (www.springeronline. com)

Proceedings Volume: Sixth International Symposium on Permafrost, September 5–7, 2004.

This 324-page volume is a Supplement to the *Journal of Glaciology and Geocryology*, Volume 26, 2004. Contact the Journal editor for ordering information (edjgg@lzb.ac.cn).

Revised Editon: Geocryological Map of Russia and its Neighbouring Republics; English Language Version.

The recently published Second Edition is available for $450 USD (plus postage). Purchasers of the First Edition can buy the Second Edition upgrade for a special price of US $60 (plus postage) (map@freezingground.org).

PLANNING CALENDAR

The following meetings share common interests with the IPA Membership and Working Parties. The list is not all inclusive, but is intended to help avoid overlaps in scheduling future IPA and other international meetings, particularly starting in 2005. Please send corrections and additions to the IPA contact (ole.humlum@geo.uio.no). Readers are referred to web sites or individual email contacts for more information. Additional meetings and information can be found on the IASC Survey of Arctic Meetings (SAM) web (www.iasc.no).

2005

January 20–22, International Conference on Periglacial Geomorphology, Clermont-Ferrand, France (setienne@seteun.net)

February 22–24, Third International Symposium on the Arctic Research and Seventh Ny-Alesund Scientific Seminar. Tokyo, Japan (www-arctic.nipr.ac.jp/symposium2005/)

February 21–23, Remote Sensing of Snow and Glaciers—Important Water Resources of the Future Workshop, Bern, Switzerland (http://dude.uibk.ac.at/lissig/Conferences/Berne2005/index.html)

March 5–10, PAGES-DEKLIM Conference: The Climate of the Next Millenia in the Perspective of Abrupt Climate Change during the late Pleistocene, Mainz, Germany (www.pages.unibe.ch/calendar/2005/deklim.html)

March 20–27, 8th High Mountain Remote Sensing Cartography Symposium, La Paz, Bilivia (www.kfunigraz.ac.at/geowww/fernerkundung/site/fge–start/symposium/symposium.htm)

April 2–5, Climate and Cryosphere Sessions, Association of American Geographers, Denver, Colorado (www.aag.org)

April 3–9, VIIth IAHS Assembly, Symposium on Contribution from Glaciers and Snow Cover to Runoff from Mountains in Different Climates and Workshop on Andean Glaciology, Foz do Iguaçu, Brazil (www.cig.ensmp.fr/~iahs/)

April 11–15, First CLiC Conference, Cryosphere, the 'frozen' frontier of climate science, Beijing, China (www.clic.npolar.no/meetings/first/)

April 12–13, Third Scientific Conference "Geocryological Problems of Transbailalia (GPT-2005)," Chita, Siberia, Russia (v_kondratiev@mail.ru)

April 17–24, Arctic Science Summit Week, Kunming, Yunnan Province, China (www.iasc.no)

April 25–29, European Geosciences Union, Vienna, Austria (www.copernicus.org/EGU/ga/egu05/index.htm)

May 23–27, Third International Congress on Environmental Change in Central Asia, Ulanbaator, Mongolia (www.num.edu.mn/MOLARE/frames/international_congress_frame.html)

May 25–29, International Conference: Priorities in Earth Cryosphere Research, Pushchino, Russia (gilichin@issp.serpukhov.su)

May 31–June 3, Third Russian Conference on Geocryology, Moscow State University, Moscow, Russia (www.geol.msu.ru/deps/cryology/fe.htm

June 12–16, EUCOP II, 2nd European Permafrost Conference, Potsdam, Germany (http://www.awi-potsdam.de/EUCOP/)

June 19–24, 15th International Offshore and Polar Engineering Conference & Exhibition, Seoul, Korea (www.isope.org)

August 1–8, IV International Conference on Cryopedology, Arkhangelsk, Russia (http://igras.geonet.ru/cwg/)

August 10–12, PAGES 2nd Open Science Meeting (www.pages2005.org)

August 8–11, 2005, Earth System Processes 2, Calgary, Alberta, Canada (www.geosociety.org/meetings/esp2)

August 29–September 2, Northern Research Basins, 15th International Symposium and Workshop, Luleå and Kvikkjikk, Sweden (http://aqua.tvrl.lth.se/nrb_2005. html)

September 1–10, 11th International Conference and Field Trip on Landslides (ICFL), Tromsø and Trondheim, Norway (www.ivt.ntnu.no/ICFL05)

September 5–9, International Symposium on High-Elevation Glaciers and Climate Records, Lanzhou, China (www.igsoc.org)

September 7–11, Sixth International Conference Geomorphology, Zaragosa, Spain (http://wzar.unizar.es/actos/SEG/)

November 10–13, ICARP II - 2nd International Conference on Arctic Research Planning, Copenhagen, Denmark (www.icarp.dk/Index.html)

December 5–9, American Geophysical Union Fall Meeting, San Francisco, California, U.S.A. (meetinginfo@agu.org); U.S. Permafrost Association annual meeting (www.uspermafrost.org)

2006

April, European Geosciences Union (www.copernicus.org/EGS/egsga/futurega.htm)

May, Pushchino, Russia (gilichin@issp.serpukhov.su)

May 8–12, 21st Polar Libraries Colloquy, Rome, Italy (biblioteca.pnra@enea.pnra.it)

June 12–16, International Symposium on Terrestrial and Extraterrestrial Glacier Volcano/Geothermal Interactions, Reykjavík, Iceland, www.igsoc.org/symposia/2006/iceland/

July 9–15, 18th World Congress of Soil Science (WCSS), Philadelphia, PA (www.iuss.org/)

July 23–26, 13th International Conference on Cold Regions Engineering, Current Practices in Cold Regions Engineering, Bangor, Maine, Philip Dunn (Philip_Dunn@umit.maine.edu)

August 21–25, International Symposium on Cryospheric Indicators of Global Climate Change—A joint CliC/IGS/ICSI Symposium, Cambridge, England, www.igsoc.org/symposia/2006/cambridge/

September (early), Regional International Permafrost Conference, Lanzou, China and and Field Excursion to Qinghai-Tibet Railroad, Lai Yuanming (ymlai@ns.lzb.ac. cn)

December 11–15, American Geophysical Union Fall Meeting, San Francisco, California (meetinginfo@agu. org); U.S. Permafrost Association annual meeting (www.uspermafrost.org)

2007

April, European Geosciences Union (www.copernicus.org/EGS/egsga/futurega.htm).

July, 24th IUGG General Assembly, Perugia, Italy (www.iugg.org/)

July 29–August 6, XVII INQUA Congress, Cairns, Australia (johnd@geog.uwa.edu.au)

December 10–14, American Geophysical Union Fall Meeting, San Francisco, California, U.S.A. (meetinginfo@agu.org); U.S. Permafrost Association annual meeting (www. uspermafrost.org)

2008

June 23–27, Ninth International Conference on Permafrost, Fairbanks, Alaska (www.nicop.org)

August 5–14, 33rd International Geological Congress, Olso, Norway (iugs.secretariat@ngu.no)

August 15–20, 31st Congress of the International Geographical Union, Tunis (www.igu-net.org)

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IPA-RELATED WEB SITES

(See Working Parties reports for additional web sites)

International Permafrost Association (www.geo.uio.no/IPA/)

Global Terrestrial Network for Permafrost (www/gtnp.org)

Circumpolar Active Layer Monitoring (CALM) (go to for temporary link)
(www.udel.edu/Geography/research_cryo.htm)

Arctic Coastal Dynamics (www.awi-potsdam.de/acd)

Permafrost and Climate in the 21st Century (PACE21)
(www.earth.cf.ac.uk/research/geoenvironment/pace/31.PACE21_Program.htm)

National Snow and Ice Data Center (NSIDC) (http://nsidc.org/fgdc)
Frozen Ground Data Center (http://nsidc.org/fgdc)

Associated International Organizations

International Union of Geological Sciences (IUGS) (www.iugs.org)
International Geographical Union (IGU) (www.igu-net.org)
International Union of Soil Science (IUSS) (www.iuss.org)
Scientific Committee on Antarctic Research (SCAR) (www.scar.org)
International Arctic Science Committee (IASC) (www.iasc.no)
Climate and Cryosphere (CliC) (www.clic.npolar.no)
Global Climate Observing System (GCOS) (www.wmo.ch/web/gcos/)
Commission for the Cryospheric Sciences (CCS) (www.glaciology.su.se/ICSI)

Upcoming Permafrost Conferences

EUCOP II
2nd European Conference
on Permafrost
Potsdam, Germany, 12–16 June 2005

www.AWI-Potsdam.de/EUCOP

IX International Conference on Permafrost
June 23-27
2008
University of Alaska Fairbanks

www.nicop.org

Cryosol Working Group
international union of soil science & international permafrost assotiation

IV International Conference on Cryopedology
CRYOSOLS: GENESIS, ECOLOGY AND MANAGEMENT
Arkhangelsk , Russia , August 1-8, 2005
http://igras.geonet.ru/cwg/

May 25–28, 2005, International Conference: Priorities in Earth Cryosphere Research, Puschino, Russia (gilchin@issp.serpukhov.su). Visa application deadline January 31, 2005; Abstract deadline February 15, 2005; copy to Elena Spirina (lena@issp.serpukhov. su).

May 31–June 3, 2005, Third Russian Conference on Geocryology, Moscow State University, Moscow, Russia (www.geol.msu.ru/deps/cryology/fe.htm)

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