

U.S. PERMAFROST ACTIVITIES 2003

Two oral sessions and one poster session on permafrost were presented at the Fall meeting of the American Geophysical Union in San Francisco the week of December 8, 2003. The U.S. Permafrost Association held its annual meeting at the AGU. Results of this year's election are posted on the Association's web site (www.uspermafrost.org). During the past year membership in the USPA increased to 170 individual, corporate and institutional members. U.S. participation in the 8th ICOP included 48 attendees, 40 papers published in the proceedings, and nine extended abstracts. The USPA was unanimously elected by the American Geological Institute's (AGI) Member Society Council as its 42nd Member Society (www.agiweb.org).

A program focused upon the freshwater cycle of the Arctic Basin was funded by the U.S. National Science Foundation under the SEARCH program. Projects under this "Freshwater Initiative" address the goals of the Arctic-CHAMP program (<http://arcticchamp.sr.unh.edu/index.shtml>):

- Assess and better understand the stocks and fluxes within the arctic hydrologic cycle;
- Document natural variability in and changes to the arctic water cycle;
- Understand the sources of natural variability and causes of arctic water cycle change and assess their direct impacts on biological and biogeochemical systems; and
- Develop predictive simulations of the response of the earth system and human society to feedbacks arising from natural variability and progressive changes to the arctic hydrological cycle.

The American Society of Civil Engineers (ASCE) Technical Council on Cold Regions Engineering (TCCRE) met in Las Vegas in March. Dan Smith (University of Alberta) presented plans for the 12th International Conference on Cold Regions Engineering in Edmonton, Alberta, May 16–19, 2004. The 13th International Conference on Cold Regions Engineering is being planned for Bangor, Maine, in June or July 2006. About 10 members of TCCRE participated in the 8th ICOP. ASCE President Patricia Galloway is planning to visit Finland and Russia in June 2004. TCCRE is providing input on ASCE's involvement in cold regions engineering for a presentation to the Association of Finnish Civil Engineers during the visit. TCCRE members are

contributing to the following conferences: Winter Cities in Anchorage (February 2004); EWRI World Water Congress (Anchorage, May 2005), ISCORD2004/Symposium, and the 13th International IAHR St. Petersburg Ice Symposium (June 2004). TCCRE committees continue to produce the *Journal of Cold Regions Engineering*, Cold Regions Monographs, and programs for sessions at ASCE national meetings.

The 135-acre, CRREL Farmer's Loop Road permafrost site, Fairbanks, Alaska was dedicated as one of the National Geotechnical Experimentation Sites (NGES) at a ribbon-cutting ceremony on September 23, 2003. The NGES Geo Council serves as a forum for exchanging ideas and information among geo-engineering associations and professions, construction organisations, and government agencies. Engineering research has been conducted on the site since the late 1940s and included experimental permafrost foundations, the measurement



Ribbon-cutting group (from left to right): James Wuebben, Joe Roberto, Rick Morrison, James Houston, Karen Henry, Jean Benoît, Peter Smeallie. (Photograph by Marie Darling).

of frost heave forces on piles, long-term influence of vegetation on permafrost stability, experimental road surfaces, insulation of roads and thawing of permafrost by passive solar means, and bioremediation. With the addition of the CRREL site the NGES Program now has seven sites available to the geo-community to advance the state-of-the-art in the areas of in-situ field testing, field instrumentation, prediction of soil behavior, and foundation prototype testing.

Tingjun Zhang and Roger G. Barry, National Snow and Ice Data Center (NSIDC), University of Colorado, report a number of current projects and activities:

- Historical soil temperature changes in the Russian Arctic and Subarctic;
- Inter-decadal variations of freeze and thaw depths in Russia;
- Response of river runoff to permafrost thawing in the Russian Arctic drainage basin;
- Numerical simulation of talik formation under thaw lakes and talik freeze-up following thaw lake drainage;
- Detecting near-surface soil freeze/thaw cycle using a frozen ground algorithm; and
- The Frozen Ground Data Center <http://nsidc.org/fgdc>

Larry Hinzman and Doug Kane, University of Alaska–Fairbanks, report that numerous studies related to permafrost hydrology have been initiated or continued at the University of Alaska–Fairbanks Water and Environmental Research Center. These include studies on the impacts of water removal from tundra ponds, assessing the changes in water resource use on the Seward Peninsula for the last century, and assessment of wildfire in tundra watersheds (<http://www.uaf.edu/water/projects>). Several WERC researchers are also involved in the Freshwater Initiative (see above item), as well as continuing hydrological studies and observations started in 1984 in the Kuparuk River watershed, Northern Alaska.

Ken Hinkel, University of Cincinnati and Frederick Nelson and Nikolai Shiklomanov, University of Delaware, report on several related activities. The first five-year phase of the Circumpolar Arctic Layer Monitoring (CALM) program was completed, and plans for the second, five-year phase were initiated. Summer 2003 observations continued at many of the 125 circumpolar sites in Northern Alaska. Average grid thaw depths were about the same as in 2002 and, in general, average thaw depths were 10–20 cm below peak averages experienced in 1998. Thickness of the organic layer was determined by Jim Bockheim, University of Wisconsin, on the seven Alaskan CALM grids. Soil temperature and drift thickness have been monitored since 1997 along the 3.2-km long and 4-m high snow fence. Ground subsidence beneath the drift crest appears to be ongoing, most of the vegetation is dead, and ponding has become more pronounced. In August, about 70 air and soil temperature loggers were serviced in and around Barrow; these are used to monitor the urban heat island (UHI) effect in the 150 km² study area. There is a direct correlation between the UHI magnitude and fossil fuel consumption. Anna Klene is completing her doctoral dissertation on the UHI project.

Wendy Eisner, Kenneth Hinkel, and Richard Beck, University of Cincinnati, and James Bockheim, University of Wisconsin, are investigating research on paleoenvironments, geomorphic processes, and carbon stocks of drained thaw-lake basins on the Alaskan Arctic Coastal Plain. In 2003, fieldwork included thaw-lake basins, sites not impacted by the thaw-lake cycle, and ancient backshore beach dune complex. Paleosol sequences were sampled to help elucidate the erosional/depositional history of the Atkasuk region. Interviews with Inupiat community elders offered invaluable observations on landscape and climate change, as well as accounts of their cultural traditions and personal history.

During 2003, the Permafrost Lab of the Geophysical Institute UAF continued observations of the active layer depth, moisture and temperature and the permafrost temperature dynamics at the numerous permafrost observatories within the Alaskan Arctic and Sub-Arctic. A new active layer/near-surface permafrost observatory was established on the Banks Island in the Canadian Arctic (under Walker's Biocomplexity project). The IARC-funded permafrost observatory at Barrow was equipped with additional snow depth sensors. Establishment of a new permafrost observatory in the Cooper River basin was initiated. This site is very interesting because the old (Late Pleistocene) permafrost is almost continuous at this relatively southern location. At the same time, the temperature of permafrost at this site is very close to the melting point of ice and is continuing to rise. Ph.D. dissertation "Permafrost Dynamics in 20th and 21st Centuries Along the East-Siberian and Alaskan Transects" by Tatiana Sazonova was completed.

Tom Osterkamp reported at the 8th ICOP that permafrost temperatures along a north-south transect from Prudhoe Bay to Gulkana have generally warmed since the late 1980s, initially in response to thicker snow covers and continues into 2003. The warming north of the Brooks Range (2 to 4 °C) is comparable in magnitude to the century long warming there. Thin discontinuous permafrost is thawing at the base at a rate of 0.04 m per year at one site.

Gary Clow, U. S. Geological Survey, completed logging the 21 NPRA deep borehole array, downloaded data loggers from the soil temperature, active-layer network, added soil moisture sensors to nearly all the stations, and installed three new stations (two in NPRA and one in ANWR) as its contribution to the Global Terrestrial network for permafrost (GTN-P).

Walter Oechel and Kristen Freeman, San Diego State University, continue measurements of mass (CO₂ and H₂O) and energy fluxes at Barrow, Atkasuk, and Ivotuk,

Alaska. All three sites are validation sites of CO₂ flux for MODIS product over the Arctic region. A portable eddy covariance tower was deployed to measure mass and energy fluxes at three locations along a transect between Barrow and Atqasuk. Soil respiration using automatic soil respiration chambers and soil CO₂ concentration were measured at both the Barrow and Atqasuk sites.

Patrick J. Webber, Craig E. Tweedie, and Robert D. Hollister, Michigan State University, report on recent activities at the Arctic Ecology Laboratory at Michigan State University (www.cevl.msu.edu/ael/) that includes organisation activities for CEON (see p. 41), continuation of ITEX research and vegetation mapping at Barrow, and an undergraduate trip in December 2003 to Patagonia and Antarctica on a new MSU study abroad field course.

Donald (Skip) Walker, University of Alaska, and a team including 19 scientists and students from the U.S. and Canada completed its second field season investigating the effects of climate on frost-boil ecosystems. The project, funded under the NSF Biocomplexity in the Environment (BE) initiative, has as its main objective to determine how the decreased activity of vegetation in colder climates affects frost heave processes, and the size and spacing of frost boils, across all five arctic bioclimate subzones. This summer three Canadian research sites were established at Green Cabin in Aulavik National Park, Banks Island, and Mould Bay, Prince Patrick Island. Key factors being studied are the role of cryoturbation in sequestering soil carbon, and how biogeochemical cycling of carbon and nitrogen is affected by cryoturbation.

Nicole Mölders and John E. Walsh, Geophysical Institute and the International Arctic Research Center, University Alaska–Fairbanks, are modeling the impact of permafrost and snow on the thermal and hydrologic regimes of the Arctic. The soil frost and snow modules of the hydro-thermodynamic soil vegetation scheme (HTSVS) were implemented and tested within the offline version of the Common Land Model (CLM) of the NCAR Community Climate System Model (CCSM). As the project evolves, we will address changes in permafrost and associated hydrologic impacts in the context of greenhouse-gas-induced climatic change.

Ron Sletten and Bernard Hallet, University of Washington, established two physical and chemical monitoring sites at Thule, Greenland. This project is part of the NSF-funded biocomplexity project on

carbon and nutrient cycling led by Jeff Welker, Colorado State University and includes Josh Schimel, University of California–Santa Barbara. The UW group also conducted the final field season in the Dry Valleys, Antarctica, on a project investigating surface ages and turnover due to contraction cracks; data includes continuous records of contraction crack dynamics (hourly data) and soil temperature at varying depths up to 20 m over the past five years.

Torre Jorgenson and Erik Pullman ABR, Inc., and Yuri Shur, University of Alaska, completed their third field season in the eastern NPRA, northcentral Alaska, studying lake basin development, floodplain development, and ice-wedge degradation as part of environmental baseline studies funded by Conoco Phillips Alaska, Inc. The work focuses on quantifying ground ice, sediment, and carbon stratigraphy within geomorphic units across the landscape. Ken Karle, Hydrologic Mapping and Modeling, Inc., Yuri Shur, and Torre Jorgenson initiated a pilot-scale project to evaluate remote sensing techniques for monitoring permafrost changes in central Alaska for the National Park Service.

Ted Vinson, Oregon State University, continues to promote the use of probabilistic methods in cold regions engineering design, which now incorporates global climate change considerations. He is currently working on a Federal Highway Administration project to produce an interactive instructional CD (or DVD) on Geotechnical Considerations and Road Foundation Engineering Practice in Cold Regions.

Tom Douglas, Cold Regions Research and Engineering Laboratory, Mark Conrad and Katharine Woods, Lawrence Berkeley Laboratory and Shirish Patil, University of Alaska Fairbanks are investigating permafrost cores to better understand the stable isotopic regime of methane hydrates. The core samples are from the 425-m deep Hot Ice #1 borehole drilled by Anadarko Petroleum Corporation, Maurer Technology, and the U.S. Department of Energy during March and April of 2003. The borehole penetrated permafrost at about 380 m. Preliminary isotopic results show increasing inputs of CO₂ derived from hydrocarbons/hydrates with depth, and may yield insight into methane hydrate formation within the permafrost.

Hannele Zubeck, University of Alaska Anchorage, continues research on foundations in permafrost, and includes field testing on removable piles in support of Hot Ice #1—the arctic tundra platform that holds the drilling rig and operations for Anadarko Petroleum Corporation's methane hydrate production.

Larry Bryne, Alaska Department of Natural Re-

sources, and associates continue the investigation as to when the tundra is 'sufficiently hard' to allow off road travel for the purpose of seismic exploration, oil field development and maintenance in the North Slope oil fields around Prudhoe Bay. The criterion which DNR follows for opening the tundra is 6 inches of snow and 12 inches of ground frost. Over the past 30 years the exploration season has decreased by over 100 days because the tundra has been slower to harden in the winter. Last December, DNR allowed Conoco Phillips Alaska (CPA) to construct a mile section of 'demonstration' ice road to assess these techniques.

David Esch, with Geo Engineers Inc., Anchorage, is currently involved in the Alaska Department of Transportation study of life-cycle costs of the airports in the Yukon-Kuskokwim Delta region. This includes the analysis of present construction methods and providing recommendations for the most suitable and economical methods of constructing and maintaining airfield embankments on the discontinuous permafrost of the region, and which are underlain primarily by ice-rich organic silts, and lack suitable sources of gravels for the construction of embankments.

Vladimir Aizen, University of Idaho, and an interna-

tional team recovered two, 175-m surface to bottom ice-cores from the Belukha Plateau at the Siberian Altai in August 2003. The cores may record a 2,000-year climatic and environmental record. A 21-m shallow snow/firn core was recovered from the Bomi glaciated area in southern Tibet in October 2003. Several automatic weather stations are located at 4800 and 5800 m asl.

H. Jesse Walker, Louisiana State University, reports that the Colville River delta information has a new URL: <http://louisdl.louislibraries.org>. The "Colville Delta" collection has 53 texts, 24 tables/graphs, 50 maps, 1145 photographs and 870 aerial photographs ranging in dates from 1947 to 1992. The materials can be searched under 894 subject titles.

Details of the above reports and additional reports of U.S. permafrost activities are posted on the USPA web site.

The report *Climate Change, Permafrost and Infrastructure* was published in 2003 and is available from the U.S. Arctic Research Commission (www.arctic.gov).

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