WELCOME!

Cryosphere changes in the Alaska region in the last decade have been dramatic. Widespread glacier retreat, reduction of summer sea ice, decreased snow season, thawing permafrost, and thinner and less durable freshwater ice are amongst the clearest signs of worldwide climate change. Everyone who lives, works, or does business in Alaska will need to adapt to changes in the cryosphere. Knowledge about the current and future state of the frozen part of the State is crucial for managing the future Arctic Ocean, hydroelectric resources, evaluating flood hazards, assessing the condition of winter pathways, and adapting to the profound ecophysical changes expected for the various regions of Alaska. Several scientists in Alaska devote their time to studying cryosphere processes. In this Newsletter we highlight projects and discoveries led by Alaskan scientists engaged in cryosphere research with the hope to create a tool that allows efficient communication between scientists and stakeholders.

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### 1 Changing Arctic Lakes and the Circumarctic Lakes Observation Network (CALON)

A shift has been observed in many thermokarst lakes over the last decades from lakes that once froze to their bed by the end of winter (bedfast ice), toward conditions where liquid water is now present at the lake bed year round, according to a new paper by researchers at the University of Alaska Fairbanks (UAF), U.S. Geological Survey (USGS), and the Bureau of Land Management (BLM), focused on northern Alaska. This form of lake change has important implications for heat storage, permafrost thaw, methane release, winter water supply, and over wintering aquatic habitat. A long-term trend towards thinner lake ice in relation to more snowfall and warmer temperatures in the early winter is likely the cause of this observed pattern.

In a coordinated effort to better understand this and many other Arctic lake dynamics at landscape scales, the National Science Foundation (NSF)-funded Circumarctic Lakes Observation Network was initiated by scientists from UAF, USGS, and three other universities. This effort seeks to link remote sensing to nested monitoring systems at 57 individual lakes arrayed across mountain-to-coast transects on the North Slope.

Two teams—one working from Toolik Lake Long Term Ecological Research (LTER) station to the Teshekpuk Lake Observatory, and the other from Barrow to Reindeer Lake—initiated field work for this project in April 2012, traveling by snowmachine over 2000 km. Along these exciting and remote traverses, researchers drilled many holes to equip lakes with sensor networks, measure snow and ice thickness, and collect water and sediment samples. The team also recently repeated surveys on this same series of lakes in mid to late August and successfully completed the first full field season for the CALON project.

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### 2 Monitoring Outburst Floods from Mendenhall Glacier

An unexpected outburst flood from Mendenhall Glacier in July 2011 threatened houses and other infrastructure in Juneau. It was later determined that the outburst flood originated from Suicide Basin, a small basin on the margin of Mendenhall Glacier containing stagnant ice. Researchers Jason Amundson and Eran Hood at the University of Alaska Southeast (UAS), along with undergraduate Jamie Pierce, began working with city officials to monitor the glacier and assess the potential for future outburst floods.

By installing a pressure sensor into a marginal lake within Suicide Basin, the researchers were able to document a smaller outburst flood that occurred in July 2012. Data from the sensor has provided critical information regarding basin volume as well as filling and draining rates. Starting in the summer of 2013, the marginal lake will be monitored remotely, providing an early warning system for residents of Mendenhall Valley.

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Floodwaters from the Mendenhall Glacier Lake outburst flood in July 2011 caused discharge on the Mendenhall River to increase from 2,800 cubic feet per second (cfs) to more than 16,000 cfs and raised the level of Mendenhall Lake by 5.5 feet. The outburst from Suicide Basin released about 37 million cubic meters of water, which is enough to fill almost 15000 Olympic sized swimming pools. (Eran Hood)
Rapidly Moving Debris Lobes Along the Dalton Highway Trigger UAF-DOT Collaboration

Frozen debris lobes have been observed in the Brooks Range since the early days of the pipeline route survey and construction. However, these lobes were considered inactive by most researchers and engineers at that time. Recently, UAF researchers started observing dramatic changes in some of these features, found on mountain slopes with permafrost along the Dalton Highway. Tumbling trees, split tree trunks, large cracks, seeping water, mudflows, and slabs of frozen soil bulldozing over trees in front of the lobes provide a sure indication of renewed activity, potentially linked to permafrost thaw within the slopes.

Seed funding from NSF EPScOR (Experimental Program to Stimulate Competitive Research) allowed Ronnie Daanen and Guido Grosse of UAF to conduct initial surveys and remote sensing studies, and results were indeed surprising: the frozen debris lobes advanced downslope at up to 3 m per year, and a single one at up to 10 m per year. A particular frozen debris lobe was found to be very close to the Dalton Highway, and early projections from 2009 indicated a rendezvous within 25 years, a number that has since been corrected downward as the lobe appears to accelerate further. Since that time, the Alaska Department of Transportation & Public Facilities has become interested in these features as well. Though still outside the right of way, the moving debris lobe close to the road—measuring 30 m in height, 100 m in width, and several hundred meters in length—will, no doubt, pose a hazard to the road system in the coming years.

DOT has pledged additional support, now also involving the UAF Institute of Northern Engineering (INE) slope stability specialist M. Darrow and a DOT survey and drill crew. Seismic surveys, as well as coring, were conducted in the summer and fall of 2012. A remote sensing study, using Interferometric synthetic aperture radar (InSAR) satellite studies for detecting surface deformation and optical high-resolution satellite data to monitor the lobe advance, is currently being completed as well.

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Sea Ice Thickness Dataset for Improved Ice Prediction Collected in Spring 2012

As part of the Arctic Sea Ice Outlook and the University of Alaska Fairbanks SIZONet project, a comprehensive dataset on the thickness and properties of sea ice in the Chukchi and Beaufort Seas was compiled in a collaborative effort between NASA’s IceBridge Program, the Naval Research Lab, the energy industry (Fugro N.V.), a Canadian research group at the University of Alberta, and UAF. The data were collected in March and April of 2012 and were made available within a month after collection, as a quick-release product for informing seasonal ice prediction models.

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The data, predictions, and related information can be accessed at the Sea Ice Outlook website:
http://www.arcus.org/search/seaiceoutlook/ice-thickness-data

Results and additional information can be accessed in the open access journal, Natural Hazards and Earth System Sciences:
http://tinyurl.com/debris-lobes
Flood Hazards Assessed at the Valdez Glacier Stream

Glaciers occupy and serve to regulate runoff events in many alpine catchments throughout Alaska, by acting as a storage unit for precipitation and meltwater, while also providing stream flow during dry periods. Recent mass balance studies of south-central and southeast Alaska glaciers indicate that many glaciers in these regions have been decreasing in volume over the past 60 years, in response to a warming climate.

Alaska communities and infrastructure located in valleys below these glaciers are susceptible to flooding resulting from glacial lake outbursts and extended periods of glacier melting. These events have the potential for disrupting the livelihoods of Alaskans and impacting the State’s economic activity.

In spring of 2012, scientists from the Alaska Division of Geological & Geophysical Surveys (DGGS) and the University of Alaska Fairbanks began collecting detailed simultaneous measurements of glacier mass balance and basin hydrology in the Valdez Glacier catchment. The goal of this work is to develop more accurate predictions of the glacier-related flood hazard potential for the community of Valdez and other stakeholders. Methods developed as part of the Valdez study will serve as a template for future projects aimed at assessing potential hazards to communities downstream from glacier watersheds. Work on this project will continue through the fall of 2013 and is principally supported through DGGS’s Climate Change Hazards Program.

For more information: Gabriel Wolken, Alaska DGGS: gabriel.wolken@alaska.gov; Anthony Arendt, UAF: arendta@gi.alaska.edu; Jennifer Davies, UAF: jlydavis@gmail.com; Anna Liljedahl, UAF: akliljedahl@alaska.edu; and Alessio Gusmeroli, UAF: alessio@iarc.uaf.edu

SnowSTAR 2012: Alaskan North Slope Snow LiDAR Campaign

Between April 8 and 21, 2012, sixteen scientists from the Cold Regions Research and Engineering Laboratory (CRREL), UAF, the National Snow and Ice Data Center (NSIDC), and Colorado State University (CSU) worked in and around Toolik Lake, just north of the Brooks Range, measuring the snow pack using a variety of techniques.

An important goal of this campaign was the application of Light Detection and Ranging (LiDAR) equipment when surveying snow. Mounted on an aircraft looking downward, LiDAR can create a swath map of the snow surface with precision to nearly centimeters. If a second map of the exact same area is acquired when there is no snow, the two surfaces can be differenced to produce a detailed snow depth map. The development of this technique could revolutionize the survey of snow in Alaska.

For more information: Matthew Sturm, Cold Regions Research and Engineering Laboratory (CRREL): Matthew.Sturm@usace.army.mil & Simon Filhol, UAF: svfilhol@alaska.edu

Five dispatches were produced during the project and are posted on the Scientific American website: http://tinyurl.com/aknorth

Measuring snow depth on Alaska’s North Slope. (Drew Slater)

Traversing the Valdez Glacier for snow and ice surveys. (Alessio Gusmeroli)
Permafrost Dynamics Provide Linkages to Multidisciplinary Science in Barrow

Several researchers from UAF are partnering with colleagues at the Department of Energy (DOE) National Laboratories (Oak Ridge National Laboratory (ORNL), Lawrence Berkeley National Laboratory (LBNL), Brookhaven National Laboratory (BNL), and Los Alamos National Laboratory (LANL)) as part of the Next-Generation Ecosystem Experiments program (NGEE Arctic), supported by the Office of Biological and Environmental Research in the DOE Office of Science. The overall goal of this project is the improvement of climate model predictions through advanced understanding of coupled processes in Arctic terrestrial ecosystems.

In the last 18 months, dozens of NGEE researchers have visited the Barrow Environmental Observatory to study various components of the Arctic ecosystem. These components include permafrost, meteorology, soil moisture, snow, water chemistry, biogeochemistry, geomechanics, geophysics, microbiology, hydrology, and plant ecology. The NGEE project will continue for the next three years, with further plans for a six-year continuation. This highly productive program has facilitated many new partnerships and has pulled the tools and models of the national laboratories into collaborations with university researchers, helping the advancement of Arctic science.

For more information: Alessio Gusmeroli, UAF: alessio@iarc.uaf.edu & Larry Hinzman, UAF: lhinzman@iarc.uaf.edu

Statewide Downscaled Snow Product Underway

In order to meet the need for high-resolution snow projections, a set of regionally and seasonally specific algorithms in order to relate the long-term average fraction of snowy days in a month to the long-term monthly temperature is being developed by researchers at the International Arctic Research Center (IARC) and the Scenarios Network for Alaska and Arctic Planning (SNAP). These algorithms can then be applied to gridded decadal average temperature to estimate future snow likelihoods.

The percent or fraction of snow-days is simply the ratio of the number of days in a month with snow to the number of days with any type of precipitation. This correlates strongly with the ratio of snow-water-equivalent to total precipitation, but it allows us to use stations where the measured amounts of snow or precipitation—though not their occurrence—might be in doubt. Data used include regions developed for the Precipitation Frequency Atlas (Perica et al., 2012). Final testing on the algorithms continues, and researchers expect a manuscript and data product to be available soon.

For more information: Stephanie Mcafee, UAF: smcafee4@alaska.edu; John Walsh, UAF: jwalsh@iarc.uaf.edu; and Scott Rupp, UAF: tsrupp@alaska.edu

Is some cryosphere news missing?
Contribute to the next issue of Changing Ice by e-mailing your story, idea, or other suggestions to alessio@iarc.uaf.edu
Digital Sea Ice Atlas and Climate Model Evaluation Development

The Alaska Center for Climate Assessment and Policy (ACCAP), the Alaska Ocean Observing System (AOOS), the National Weather Service (NWS) Anchorage, the National Snow and Ice Data Center (NSIDC), and National Oceanic and Atmospheric Administration Pacific Marine Environmental Laboratory (NOAA PMEL) are working together to produce a digital sea ice atlas by 2013. This atlas will consist of digitally-stored sea ice concentration data on a grid that covers all Alaska coastal waters to a distance of ~500 km from shore, with a spatial resolution of 25 km. The time resolution is monthly for the period of 1850~1950, and weekly for the period from the early 1950s to 2010, with an allowance for subsequent updates.

A user interface will allow depictions of variations and trends in ice coverage, breakup date, freeze-up date, and open water season length at user-specified locations along the Alaska coastline. A coarser-resolution digital database for the entire Arctic is also scheduled for completion in mid-2013. In addition, as part of a larger CMIP5 GCM (Coupled Model Intercomparison Project Phase 5 Global Climate Model) evaluation and downscaling project, SNAP is evaluating the performance of sea-ice model components.

This project will result in the ranking of models by their performance from 1979-2010. The ranking can provide a basis for narrowing uncertainty in projections of rates of sea-ice loss and in increases in open-water season length at specific locations in the coastal waters of Alaska and other Arctic subregions. For more information: John Walsh, UAF: jwalsh@iarc.uaf.edu & Tracy Rogers, UAF: tsrogers@alaska.edu

Exxon-Mobil Transfers More than 100 New Boreholes to the Geophysical Institute Permafrost Laboratory

The UAF Geophysical Institute Permafrost Lab (GIPL) maintains the international Thermal State of Permafrost project and monitors more than 50 boreholes in the State of Alaska. Together with boreholes from other projects—such as those the USGS maintains in the National Petroleum Reserve Alaska (NPR-A) or those of the community school-based Permafrost Project outreach—borehole temperature data is being used in order to monitor and project permafrost temperatures in the state.

The transfer of existing boreholes from Exxon-Mobil along a section of the Dalton and Alaska Highways between the Brooks Range and the Canadian border adds many valuable study sites within the discontinuous permafrost zone to the existing network. Funds for instrumentation and maintenance of some of these additional boreholes can be leveraged from existing projects over the coming two years, while the UAF Vice Chancellor for Research has supported the new sites by paying the site permit fee requested from BLM for the same period. The GIPL is hoping to get future support from NSF and BLM or other sources in order to equip and maintain most of the additional boreholes and to waive the permitting fees for these additional sites in the future. For more information: Guido Grosse, UAF: ggrosse@gi.alaska.edu & Vladimir Romanovsky, UAF: veromanovsky@alaska.edu

One of the Conoco-Phillips boreholes transferred to UAF. Photo from August 2012. (S. Panda)
Glaciologists from Around the World Travel to Alaska for IGS Symposium

More than 260 glaciologists from around the world gathered at UAF June 24-29, 2012 for the annual symposium of the International Glaciological Society (IGS), hosted by the Geophysical Institute. More than 80 oral presentations and almost 200 poster presentations were given on the symposium’s theme—"Glaciers and ice sheets in a warming climate.”

Many presentations confirmed that glaciers around the world are retreating and thinning, with direct implications for sea-level rise and streamflow. In addition to professional exchanges, the symposium also provided ample opportunity for social interactions outside of the lecture hall. For example, a banquet was held on the Riverboat Discovery on the Chena River, as well as a barbecue at the Museum of the North. Half way through the conference, participants were offered the choice between different afternoon excursions in the vicinity of Fairbanks, including Chena Hot Springs, the Cold Regions Research and Engineering Laboratory (CRREL) permafrost tunnel, traditional gold panning, and a visit to the rocket launch facility at the Poker Flats Research Range.

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Top: The IGS conference was a success thanks to Chair of the Local Organizing Committee, Regine Hock (left) and other supporters, Elizabeth Lily (middle), and Gwenn Flowers (right). (Andy Aschwanden)

Middle: There were some lively discussions during the two IGS poster sessions. (Andy Aschwanden)

Bottom: A participant asks a question after an interesting presentation. (Andy Aschwanden)
Snow, Ice and Permafrost Hazards in Alaska: Research Needs and Opportunities

On June 13, 2011, ACCAP partnered with scientists at UAF’s Geophysical Institute and the Alaska Division of Geological and Geophysical Surveys (DGGS) to co-sponsor a workshop entitled “Snow, Ice and Permafrost Hazards in Alaska: Research needs and opportunities.” The workshop was designed to provide a forum for scientists and managers to identify information and research needs of state agencies and other organizations working directly with the State of Alaska on issues that are potentially impacted by hazards associated with snow, ice and permafrost.

Over 35 participants included representatives from: Alaska Department of Environmental Conservation, Water Division; Alaska Department of Natural Resources, Division of Geological & Geophysical Survey; Alaska Department of Natural Resources, Division Oil and Gas; Alaska Department of Transportation and Public Facilities; Alaska State Pipeline Coordinator’s Office; Alyeska Pipeline Service Company; ASRC Energy Services Company; Bureau of Ocean Energy Management, Regulation and Enforcement; The Denali Commission; Institute of the North; NOAA-National Marine Fisheries Service; NOAA-National Weather Service & Alaska River Forecast Center; North Slope Science Initiative; University of Alaska Anchorage; University of Alaska Fairbanks; US Army Corps of Engineers; US Coast Guard; and the US Geological Survey.

As a result of the 2011 workshop and a follow up 2012 Cryosphere Hazards session at the Alaska Forum on the Environment, we invite you to contribute to “Changing Ice”, our bi-annual newsletter focused on cryosphere research in Alaska: glaciers, snow, floating ice (sea and river), lake ice, and permafrost. With this collaborative newsletter we aim to connect the cryosphere research and stakeholder community of practice in Alaska, encourage research cooperation, and exchange information among interested parties.

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