Geophysical Institute Quarterly
Volume 28, No. 3, 2015

Measuring a New Height for Denali

Blaine Horner had a headache, was short of breath and was feeling nauseous as he trudged the sharp, snowy ridge towards Denali's summit. On his back was 25 lbs. of batteries, cables and a GPS unit.

Udi Karriere, packing an identical load, was on the rope with him. The weather was warm by the mountain's standards at 0° F, but the lack of oxygen at over 20,000 feet made the trek difficult that sunny June 24, 2015. Most climbers travel light on summit day.

But for these two climbers, summiting North America's highest peak was not the goal. Measuring Denali was.

"We had duplicates of everything," Horner said. "You have to carry it all. You don't want to be caught up there without something you need."

At the top, the pair got both units running. A day later the data was retrieved. In August, the U.S. Geological Survey announced Denali's new height of 20,310 feet, 10 feet less than the 1953 official elevation.

Tom Heinrichs, director of GI's Geographic Information Network of Alaska, was on the mountain too. Heinrichs and Horner, a surveyor and account executive for CompassData, had discussed the need for a resurvey of Denali using modern GPS techniques and developed the plan that took them to the mountain to climb to the top and survey it.

The USGS and the National Geodetic Survey awarded a grant to CompassData. In June four men set out: Heinrichs, Horner, Karriere and Rhett Foster.

Once they had the measurements, three different groups independently calculated the new height, including Jeff Freymueller, a geophysics professor at the UAF Geophysical Institute. The calculations were within centimeters of each other.

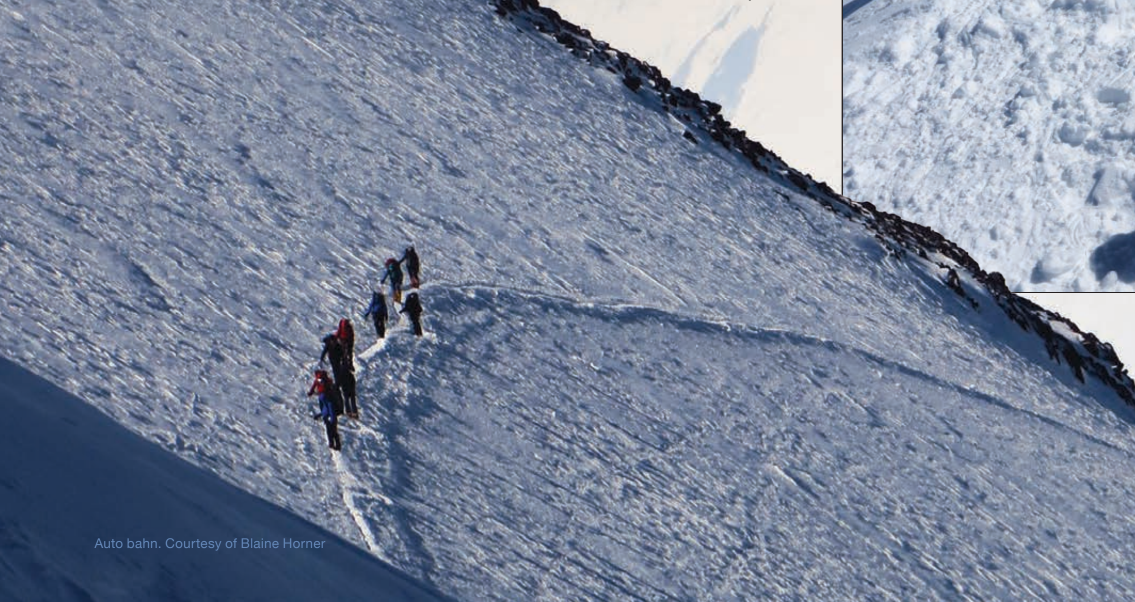
Finding the height of mountains requires defining a zero-elevation baseline. Elevations on topographic maps are measured from a surface called the geoid. GPS measures heights relative to the ellipsoid, a mathematical approximation to the geoid.

The sum of the two measurements – the distance between the geoid and the ellipsoid plus the distance between Denali's summit and the ellipsoid – is the true height.

At least for now, Freymueller said. As technology advances, a new height could be announced in 2022.

courtesy of Blaine Horner

SUMMIT–Udi Karriere checks the equipment on Denali's summit. Photo by Blaine Norner, CompassData.



Auto bahn. Courtesy of Blaine Horner

UAF UNIVERSITY OF ALASKA FAIRBANKS

MELTING ALASKA GLACIERS MAKE MAJOR CONTRIBUTIONS TO GLOBAL SEA LEVEL RISE

Alaska's melting glaciers are adding enough water to the Earth's oceans every seven years to cover the state of Alaska with a 1-foot thick layer of water.

"The Alaska region has long been considered a primary player in the global sea level budget, but the exact details on the drivers and mechanisms of Alaska glacier change have been stubbornly elusive," said Chris Larsen, a research professor with the Geophysical Institute at the University of Alaska Fairbanks. Larsen is lead author of a paper published in Geophysical Research Letters, a journal of the American Geophysical Union.

"This study gathered better, much more accurate data than anyone's ever had," said Matthew Sturm, leader of the GI's Snow, Ice and Permafrost research group. "The bottom line is, all those calving glaciers look dramatic but it's not that much ice when you compare what will melt from the land glaciers."

The research team from UAF and the U.S. Geological Survey analyzed studies of 116 glaciers across 19 years of data collection to estimate ice loss from melting and iceberg calving. The team collected airborne lidar altimetry data as part of NASA's Operation IceBridge and integrated the new information with pioneering lidar surveys collected by late GI scientist and pilot Keith Echelmeyer in the 1990s.

They combined the lidar observations with data from the newly completed Randolph Glacier Inventory, part of the Global Land Ice Measurements from Space, an analysis of the state and dynamics of the world's glaciers. As part of its global dataset, GLIMS characterizes the size, shape and mass of every glacier in the Alaska region, which includes the glaciers of Alaska, southwest Yukon Territory and coastal northern British Columbia.

The study used the airborne observations to compare the changes of two main types of glaciers: those that end on the land and those that end in lakes or the ocean, referred to as tidewater glaciers. Any glacier can lose mass through surface melting, but only those ending in water can lose ice through iceberg calving.

Mountain, or land-terminating, glaciers hold less than 1 percent of the Earth's glacial ice volume. The rest is held in ice sheets on Antarctica and Greenland. However, previous research has shown that the rapid shrinking of mountain glaciers causes nearly one third of current sea level rise.

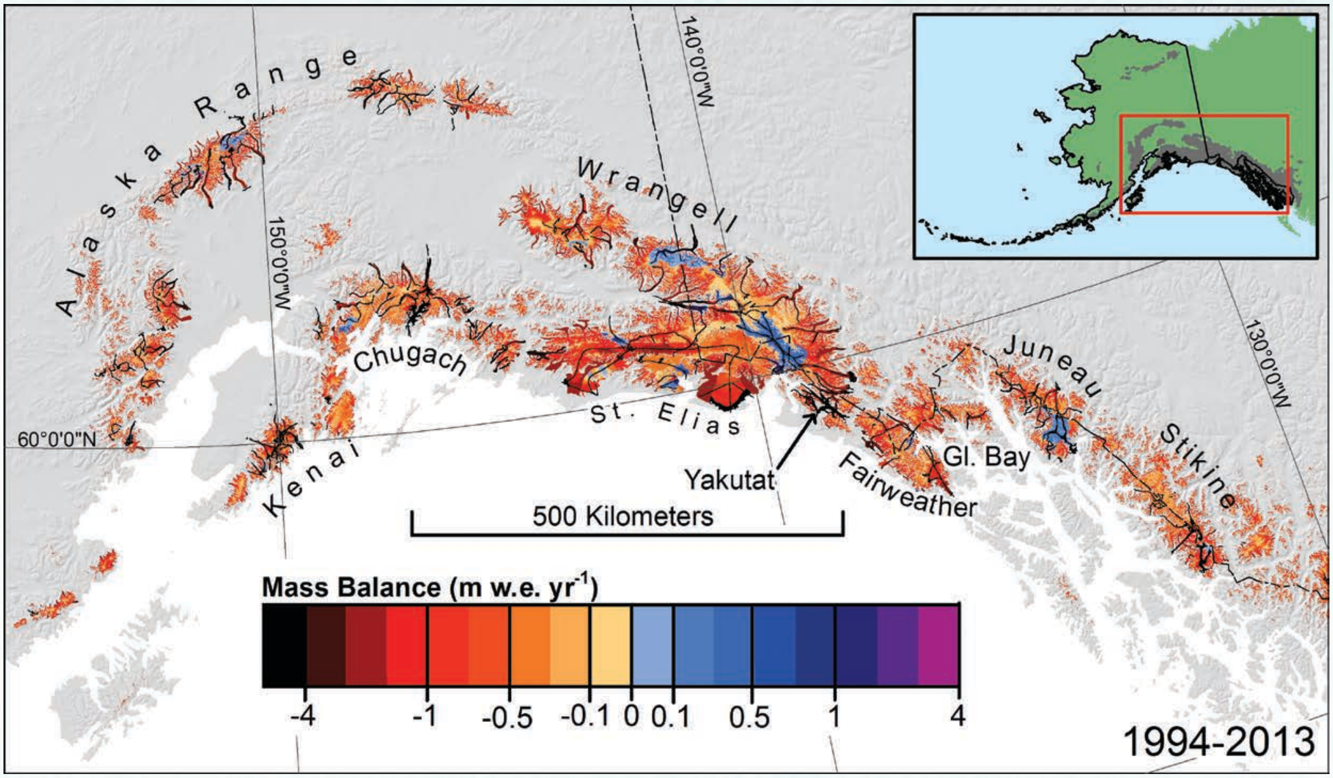


Figure from Larsen et al. 2015

ESTIMATED MASS BALANCE *(1994 – 2013) for surveyed and unsurveyed glaciers in the most densely glaciated subregion of Alaska. Black lines indicate survey flights.*

Unlike some other regions on Earth, Alaska has glaciers in many different climate zones that are significantly different. The smaller Arctic glaciers of the Brooks Range, a very cold and dry region with short, hot summers, contrast with the large glaciers found in the warm and wet coastal regions of Southeast and Southcentral Alaska. In between are the medium-sized iconic glaciers in the sub-Arctic Alaska Range, like those in Denali National Park.

Using the new ability to separate glaciers into different categories via the lidar data, the researchers made some surprising discoveries.

"Our results show the regional contribution of tidewater glaciers to sea level rise to be almost negligible," Larsen said. "Instead, glaciers ending on land are losing mass exceptionally fast, overshadowing mass changes due to iceberg calving and making climate-related melting the primary control on mountain glacier mass loss. This was somewhat expected, but the level of partitioning was a surprise."

"This work has important implications for global sea level projections. With improved understanding of the processes responsible for Alaska glacier changes, models of the future response of these glaciers to climate can be improved," Larsen said.

It means that rates of loss from Alaska are unlikely to decline, since surface melt is the predominant driver, and summer temperatures are expected to continue to increase. There is a lot of momentum in the system, and Alaska will continue to be a major driver of global sea level change in upcoming decades."

photo by Chris Larsen

PAUL CLAUS *with Operation Ice Bridge Alaska flies a lidar survey over the crevassed Tana Glacier in Southcentral Alaska.*

GEOPHYSICAL INSTITUTE
University of Alaska Fairbanks
903 Koyukuk Drive
P.O. Box 757320
Fairbanks, AK 99775-7320

The Geophysical Institute Quarterly is published as a public service by the UAF Geophysical Institute: **Sue Mitchell**, editor; **Andy Cummins**, designer; **Diana Campbell, Ned Rozell** and **Lea Gardine**, writers. Free subscriptions to the Quarterly are available by e-mail at info@gi.alaska.edu, by phone at (907) 474-7558; by fax at (907) 474-5882, from the address above, or online at http://www.gi.alaska.edu. UAF is an AA/EO employer and educational institution.

Address Service Requested

facebook.com/UAF.GI
twitter.com/UAFGI
youtube.com/user/GeophysInstitute
pinterest.com/UAFGeophysical/

Permafrost tunnel to hit the road

The nation's only research permafrost tunnel, located near Fox, Alaska, is the focus of a new outreach project about climate change. The U.S. Army Cold Regions Research and Engineering Laboratory has operated the tunnel since excavation began in 1963 for the study of permafrost, geology and ice.

"There is something about being in the tunnel that is really cool," said Laura Conner, UAF research assistant professor and co-investigator on the project. "You're using all of your senses. You can touch the bones, smell decay and see ice wedges up close."

Project members have already been sharing this sensory experience through a series of tabletop exhibitions and, surprisingly, an inflatable planetarium. The team visited seven rural Alaska communities this past winter, bringing with them hands-on permafrost demonstrations and activities. Inside the planetarium, they projected 360-degree images of the tunnel that made viewers feel like they were in the real tunnel. This coming winter they will continue to visit more communities. "People don't think about what's under their feet; the tunnel opens this up to them," Conner said.

Photo by Joyce McCombs

PROJECT OUTREACH INSTRUCTOR Santosh Panda simulating the effect that heating a home built on permafrost would have on the ground beneath it.