Denali (Mount McKinley)

ELEVATION CAMPAIGN

On August 30, 2015, U.S. Secretary of the Interior Sally Jewell announced that the highest mountain in the United States and North America, formerly known as Mount McKinley, would be officially given the traditional Koyukon Athabascan name of Denali. This announcement was the culmination of an official request for a name change that had been pending for 40 years. "This name change recognizes the sacred status of Denali to many Alaska Natives," Secretary Jewell said. "The name Denali has been official for use by the State of Alaska since 1975, but even more importantly, the mountain has been known as Denali for generations. With our own sense of reverence for this place, we are officially renaming the mountain Denali in recognition of the traditions of Alaska Natives and the strong support of the people of Alaska."

Three days later, on September 2, the U.S. Geological Survey (USGS) announced that a new, official height for Denali had been GPS surveyed at 20,310 feet. This is 10 feet lower than the traditional elevation of 20,320 feet, which was established using differential leveling in 1953. Suzette Kimball, USGS acting director, stated: "No place draws more public attention to its exact elevation than the highest peak of a continent. Knowing the height of Denali is precisely 20,310 feet has important value to earth scientists, geographers, airplane pilots, mountaineers and the general public. It is inspiring to think we can measure this magnificent peak with such accuracy. This is a feeling everyone can share, whether you happen to be an armchair explorer or an experienced mountain climber."

» DAVID MAUNE AND BLAINE HORNER

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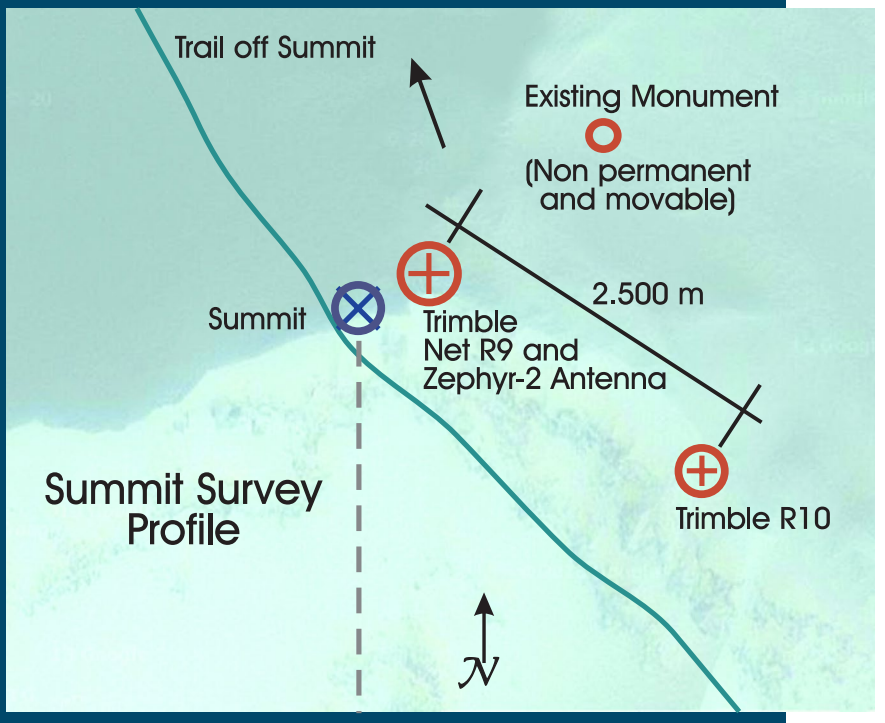
Seeking Denali's True Elevation

A 1989 GPS survey of Denali, headed by Ronald Cothren and Jeffrey Yates, had indicated the mountain was 20,306 feet high. Their eight-man expedition also had a major goal to collect gravity data needed for determining the deflection of the vertical and the local geoid model. Their GPS elevation of 20,306 feet was never adopted as official because of lingering doubts about the vertical datum and geoid model for Alaska, but their GPS survey achievements were truly pioneering.

Horner with two GPS antennas. In the foreground is a survey monument stuck in the snow in 1989 by Jeff Yates during his original GPS survey; it is not anchored in the ground as required for an official NGS monument.



Summit survey profile, showing the relative locations of the two GPS antennas that were leveled so as to survey the same height.

As a prime contractor to USGS under the Geospatial Products and Services Contract, Dr. Dave Maune of Dewberry had called for a new GPS survey of Denali since 2012. This was after interferometric synthetic aperture radar (ifsar), acquired in 2010, was processed and indicated that the elevation of Denali was 20,237 feet. This value is much lower than the traditional official elevation of 20,320 feet established by Dr. Bradford Washburn in 1953 using trigonometric leveling.

Maune had long recommended aerial ifsar for mid-accuracy statewide mapping in Alaska. Ifsar is the only remote sensing technology that maps through the clouds and fog that have long inhibited statewide mapping in Alaska. Ifsar was also the only technology that was affordable for vast remote areas and alone could deliver consistent data in a timely manner. Maune also recognized however, that ifsar, with its interferometric phenomenology and 5-meter post spacing, had the potential to smooth over the top of steep, narrow mountain peaks. Ifsar subcontractors could not guarantee 20-foot contour accuracy for slopes steeper than 20 degrees. The time lapse between the 2010 ifsar collection and the 1953 trigonometric measurement, the technology differences, and global warming debates made identifying the source of the elevation change difficult. With all the talk about global warming and changing annual snow depths, might it be possible that Denali's peak, covered with snow and ice of unknown depth, might actually be shrinking by a foot or more on average per year since 1953?

Following Maune's presentation at the Alaska Surveying and Mapping Conference on February 18, 2015, Blaine Horner of CompassData, Inc., and Tom Heinrichs of the University of Alaska, Fairbanks (UAF), developed a plan for a four-man team to survey Denali and attempt a determination of the depth of the snow and ice at its peak. On April 16, at a joint conference between the Management Association for Private Photogrammetric Surveyors (MAPPS) and the National Society of Professional Surveyors (NSPS), Hayden Howard and Blaine Horner of CompassData met with Maune to discuss their plan. Dewberry submitted a proposal for funding to the USGS and National Geodetic Survey (NGS) who agreed with the need to establish a more accurate height of Denali and provided funding for the effort. When

CompassData received Dewberry's task order on June 5th, CompassData obtained a National Park Service research permit and the climbing team was poised to execute their plan immediately. Permits were obtained with much help from Heinrichs of UAF and Britta Schroeder of the National Park Service.

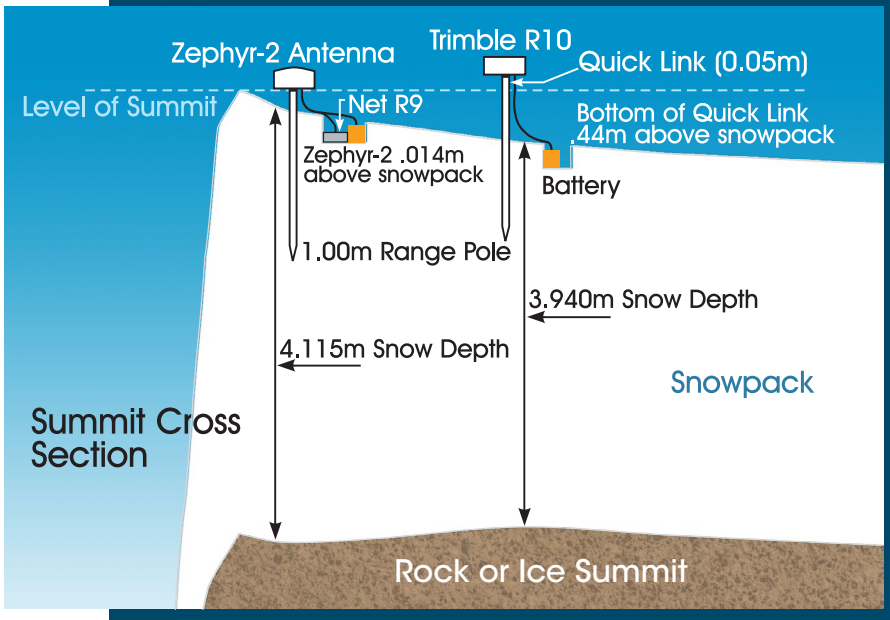
Maune was the project manager, and Horner served as the task manager who headed the survey team that overcame all technical, logistical, and environmental challenges and executed the GPS survey that resulted in the new elevation of 20,310 feet. Philipp Hummel of CompassData was the technical director for the GPS data collection and processing.

GPS Surveys

At Windy Corner (13,400 feet), the team used a Trimble R10 with a specialized bi-pod from UAF to survey a passive point for six days, logging at 30-second intervals. The summit collection occurred in the middle of these six days, providing a good overlap of data. The point was a black divot on a prominent stable rock that is rarely covered with snow. Because there is currently no good historical GPS data from the mountain, the team hopes to return and recollect this point in future years and possibly receive an NPS permit to install an actual survey disc, enabling the mapping community to better understand how the mountains in the Alaska Range are moving.

Upon reaching Denali's summit, Horner located the highest point for the Trimble Net R9 with Zephyr-2 antenna. He positioned a Trimble R10 2.5 meters away with its range pole leveled to the same height as the Zephyr-2 range pole. The observation time window was 4:01 p.m. on 6/24/15 to 9:45 a.m. on 6/25/15—a total of 17 hours and 44 minutes—collecting GPS data at one second intervals. The GPS data was processed independently by CompassData, UAF, and the NGS, using various CORS stations and processing methods. All results agreed within 3 cm. The elevation for the top of the snow was determined to be 20,310 feet, with the depth of the snow being measured to 4.155m (13.6 feet) before resistance was encountered at either rock or ice. Although a ground penetrating radar system had been carried as high as 17,000 feet, it never made it to the top before bad weather (high winds and snow) set in. Plans for measuring the ice thickness had to be abandoned for a future expedition.

The snow was probed and found to be 4.155 m (13.6 feet) deep prior to resistance at either rock or ice.



Summit cross section showing close proximity of the Net R9's Zephyr-2 GPS antenna to the steep cliff.

Complete details of the climbing expedition and GPS survey will soon be provided in a separate report being prepared by the USGS. Whether or not the mountain physically moves one iota, the official elevation of Denali is expected to change again in 2022 when NGS completes its GRAV-D project and releases its new Reference Frame (gravimetric vertical datum). ■

David Maune, PhD, CP, GS, PS, PSM, is senior project manager for Dewberry's IFSAR mapping of Alaska under its GPSC2 contract with USGS.

Blaine Horner is the task manager and survey party chief for CompassData's subcontract with Dewberry for the GPS survey of Denali.