FIELD MEASUREMENTS OF ICE DYNAMICS AND GLACIER MORPHOLOGY AT BERING GLACIER

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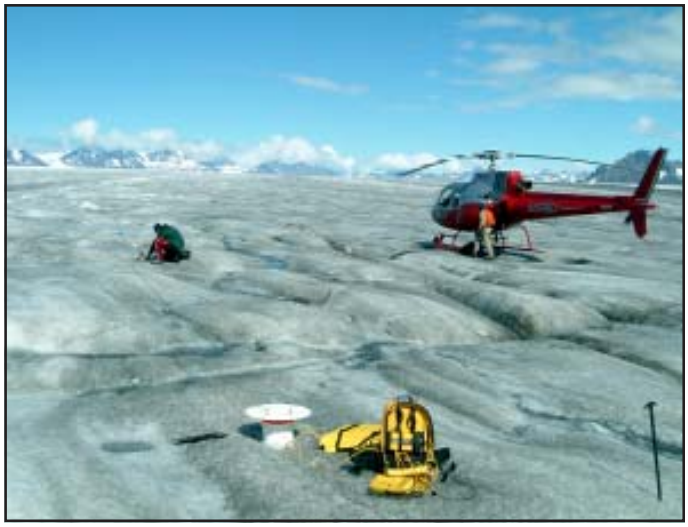
Introduction

We are studying the Bering Glacier using remote sensing and field measurements as part of a comprehensive investigation of the tectonics and glacial geodynamics of the Saint Elias orogen. Work to date has been funded by the NSF, NASA and with logistical support from BLM. We also collaborate with Dr. Terry Pavlis at the University of New Orleans who specializes in tectonics and structural geology.



Summer 2003 measurements

The field research was conducted by Ron Bruhn (Geology and Geophysics), Rick Forster and Andy Ford (Geography) of the University of Utah. We were based at the Bureau of Land Management (BLM) Bering Glacier research camp located on the south shore of Vitus Lake 5 km from the Bering terminus. The ASTER sensor onboard NASAPreliminary results of these measurements were presented in a poster "*Glaciological Field Measurements on the Bering Glacier, Alaska Summer 2003*"at the Fall 2003 AGU in San Francisco. A comparison of glacier elevations from the survey grade GPS measurements with those of a DEM derived from an ASTER stereo-pair acquired during the field measurements is the subject of a paper in preparation to be submitted to the International Journal of Remote Sensing (IJRS).

Proposed Summer 2004 measurements

The two main goals of the 2004 Bering Glacier field measurements are: 1) identifying sub glacial features related to tectonic structures and 2) continue baseline measurements of the quiescent phase of the surge cycle.

Specific objectives of the 2004 field campaign:

1) Determine if there are any changes in ice surface velocity and elevation from last year5) Estimate ice thickness variations for evidence of sub-ice tectonic features and ice flux calculations.

6) Compare field measurements of snowline position with those derived from SAR and ASTER.

Methods for accomplishing the objectives:

1) Repeat the 2003 velocity and surface elevation measurements along the three lateral transects. Each of the 19 sites will be occupied three times with differential GPS.

Comparisons of 2003 with 2004 ground based velocities can measure changes in short-term (daily to weekly) motion.
2) A 40 km longitudinal transect near the centerline of the Bering Glacier will be added to the three lateral transects. There will be 20 sites occupied three times each with the GPS. The sites will be spaced approximately every 1 km in the vicinity of the velocity decrease, which was found to be between the upper [C] and middle [B] transverse transects during 2003. The lower portion of the longitudinal transect will be sampled every 2-3 km.
3) To measure annual-scale velocity we will use feature tracking on repeated satellite images from SAR and ASTER. A long time series of SAR data exists beginning in 1992. We have already ordered this data from ASF and have begun to process it. ASTER scenes will once again be requested during the field campaign and used to map displacements since the acquisition of the 2003 scene.
4) Ablation stakes will be set in the ice at each of the GPS location sites along the transects with the ice surface measured at each visit.

5) Ice thickness will be measured directly at each site using a radio echo sounder (RES) and a gravity meter. The RES operates at 5 MHz and was purchased for the 2003 field measurements with funds from the previously mentioned NASA grant. Either a Worden or Scintrex CG-3M digital gravity meter will be used as an independent measure of ice thickness and to insure reliable readings in the deeper ice where the RES maybe limited due to potentially large amounts of englacial water and cavities. Additional RES measurements will be made in the vicinity of the suspected ice ridge to maps its orientation and depth below the ice. The gravity meter will be made available courtesy of the Dept. of Geology and Geophysics (University of Utah).
6) The position of the snowline on the Bering/Bagley Ice Valley will be measured with GPS. In 2003 this was done by flying along the snow/bare-ice boundary in a helicopter “tracing” the line with a hand-held GPS during the flight. The same procedure will be used in 2004 with the addition of two or three landing sites along the snowline. This will allow us to more accurately tie down the line with the geodetic GPS. We will also measure the snow depth along profiles approaching the snow/ice transition.

Expected results and future plans

The more detailed and comprehensive 2004 measurements when combined with the 2003 measurements will allow the main goals to be obtained; 1) identifying sub glacial features related to tectonic structures and 2) continue baseline measurements of the quiescent phase of the surge cycle.

An important and cost-effective method for continuation of the quiescent phase study of the Bering is the use of remote sensing data. SAR data of the Bering (regularly acquired and archived at ASF) is particularly useful owing to its operation in the presence of clouds and darkness that can be limit the temporal coverage of optical remote sensors. We will continue our multi-temporal SAR analysis of the Bering quiescent phase using ground observations and measurements made during the 2003 and 2004 field campaigns to compare velocity measurements, elevations and snowline positions and improve our knowledge of the Bering ice surface characteristics. We sill seek continued support for the study of the Bering quiescent phase through future funding opportunities.