

Understanding the Bering Glacier Hydrological System Proposed FY 04 Bering Glacier Field Program

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Introduction

The overall research goal of the Bering Glacier hydrological team (formerly the oceanography team) is to understand the dynamics of the Bering Glacier in respect to its effect on the Bering Glacier system hydrology. Specifically, a comprehensive sampling of the lakes, rivers, runoff, and glacier volumetric changes (ablations) is being conducted to understand how changes in the glacier affect the hydrological environment which in turn determines the individual habitat of the flora and fauna that defines the ecology of the region. An aspect of the hydrological investigation is the quantification of ocean water exchange with Vitus Lake. It is the changing ecosystem that most adversely impacts the long term BLM management of the Bering Glacier. Thus understanding the cause and effect relationship of glacier dynamics to the hydrologically dependent ecosystem is the major impetus for this investigation.

Background

The Bering Glacier hydrological team has systematically surveyed various pieces of the Bering Glacier hydrology during the last three field seasons. These measurements have included:

- 1) Completed bathymetric survey of Vitus and Berg Lakes.

- 2) Extensive CTD sampling of Vitus and Berg Lakes to characterize the water masses making up the lakes.
- 3) Measured ablation rates and glacier movement to ascertain changes in ice volume.
- 4) Utilized remote sensing data to observe glacier movement and terminus change of glacier as well as calculate water volume change in Vitus Lake.
- 5) Measured water quality parameters (pH, temp, DO, turbidity, salinity, conductivity, TDS, ORP) in Berg, Vitus and over 30 of the glacier lakes that are part of the Bering Glacier system.
- 6) Recorded water level at the Seal River and east end of Vitus Lake to quantify the tidal influence.
- 7) Using an ADCP, measured the flow rates of the Seal River as a function of tidal cycle and the Abandoned River discharge into Vitus Lake.
- 8) Collected water samples in Vitus Lake and the Abandoned River to quantify the effect of sediment loading on water column stability.

Specific FY 04 Summer Field Objectives

The primary objective for the hydrological investigation is to understand the hydrological balance of the Bering Glacier system, which is given by the summer hydrologic balance equation.

Seal River discharge = Abandoned River Vitus Lake inflow + glacier surface melt + iceberg melt + glacier sub surface flow + rainfall



To realize this overall objective the following specific measurements are planned during the FY 04 summer season.

- 1) In June, install water level gauges at Seal River and east Vitus to obtain long time series record.
- 2) Complete ADCP measurements of Seal River (all tidal cycles).
- 3) Also in June, instrument at two sites on the glacier the following automated one-hour recording system (lat/long location, temperature, barometric pressure, cloud cover, ablation rate, wind speed and direction, and rainfall). At four additional sites on the glacier we will record: latitude/longitude location, temperature, barometric

pressure, cloud cover, and ablation. The sites will start at the terminus and progress up to and include the snow equilibrium line.

- 4) Make some preliminary measurements (velocity, amount) of water transported by the glacier rivers on the upper part of the glacier.

The second overall objective for the hydrological team is to monitor and characterize the water quality parameters of the various water bodies that encompass the Bering Glacier system. The specific measurement planned for the FY 04 summer field season to support this objective include:



- 1) Return to the previous CTD sites at Vitus and re-measure to observe any annual changes. Deep (100m) profiles using a Horiba like device (pH, temp, DO, TDS, salinity, conductivity, ORP, and turbidity) will also be made at the CTD locations.

- 2) At Berg Lake we will conduct a comprehensive CTD/ Horiba survey to better characterize the water column. Selected water samples will be collected at 80m and the surface to further confirm the sediment loading hypothesis.

- 3) Complete the Horiba surface water survey of small kettle lakes that are part of the Bering Glacier system.

- 4) Utilize the ALWAS free floating buoys to characterize water quality and movement in Vitus and Berg Lakes,

and Seal River. The ALWAS buoys will measure location (latitude/longitude), speed, pH, DO, salinity, conductivity, water depth (up to 140 feet maximum), TDS, ORP, turbidity, and chlorides.

Role and Use of Remote Sensing Data

Remote sensing plays an important role in the hydrologic investigations. Satellite observations (RADARSAT, ERS-1/2, LANDSAT, and potentially MODIS and ICESAT) have been shown useful in providing information on glacier velocity, terminus location, iceberg amounts and calving rates, and frontal boundaries on Vitus Lake. Additionally, IFSAR techniques using repeat pass or shuttle TopoSAR produce elevations that provide glacier volumetric estimates. The ICESAT LIDAR will also provide elevation. In respect to remote sensing the following activities are underway.

- 1) Securing the 30m DEM TopoSAR data of Bering Glacier from JPL.
- 2) Put in a data collection request to obtain ICESAT laser data over the Bering Glacier.

- 3) Conducting an extensive archive search of the Alaska SAR facility to ascertain the amount and continuity of the microwave observations. The time history SAR data will be used to add to the terminus, iceberg and volumetric changes (glacier and Vitus Lake).
- 4) Continuing to collect all usable LANDSAT data.
- 5) Exploring use of MODIS to identify fronts and surface turbidity in Vitus Lake.
- 6) Tracking the progress being made by ASF and others (like the Utah group) on using IFSAR techniques to obtain meaningful volume estimates of Bering Glacier.
- 7) Utilizing LANDSAT data to estimate the number and average size of icebergs in Vitus Lake.

Logistical Needs

The non-BLM Bering Glacier team members will need to visit the field site in early June as well as the usual two weeks in early August. In June, a party of four to five plus BLM personnel will install the glacier site (six) and tide gauging stations. If time permits the group will also collect some ALWAS data in the Seal, Bering, and Abandoned rivers. The ADCP may also be used at that time if funding permits. During June a helo will be necessary for the glacier work while one of the boats can be used for the water work. In August, we will need a helicopter and boat support much the same as in 2003.



The hydro team, excluding the BLM folks, will consist of:

- (1) Meadows (2) plus student 3
- (2) USGS (3) Altarum