Remote Sensing of the Bering Glacier Region

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Remote sensing has played an active and critical role in studying the dynamics of the Bering Glacier System. Given the vast expanse of the glacier (an area of 5200 square km and length of over 190 km) the use of electro-optical and radar satellite sensors provides a synoptic record of the glacier's changing landscape. Landsat images (30 m multispectral and 15 m panchromatic resolution) collected during cloud-free days in the fall from 1996 to the present have been used to map the location of the glacier terminus. The terminus locations obtained from geometrically rectified Landsat images have been combined in a geographic information system (GIS) with bathymetry of Vitus and Berg outflow lakes to estimate the area and rate of glacier retreat and amount of new water formation. The Landsat images have also been used as GIS base maps to show where data collection has occurred during each field season, which has proven extremely useful in planning future investigations. Work continues using the Landsat images to estimate the number of icebergs in the ice marginal lakes as well as the location of the snow line on the glacier.

In the summer of 2005, high resolution (60 cm) QuickBird electro-optical satellite images of Vitus Lake and Seal River were acquired to test the utility of higher resolution imagery. These fine-detailed images clearly show the field base camp as well as sediment discharge from the Abandoned River into Vitus Lake. The grounded icebergs near the Seal River are clearly discernible, however the extensive Harbor Seal population that outhauls on the icebergs are not visible at this resolution.

A set of synthetic aperture radar (SAR) fall satellite images of the Bering Glacier acquired from 1995 to the present, show the details of the dramatic retreat of Bering Glacier since the last surge. The SAR images have a resolution of 25 meters and are acquired independent of cloud, rain, and snow; hence they are particularly useful for

determining the ice edge location, mapping the iceberg field and snow line which becomes the equilibrium line at the end of the ablation season. Time series SAR images show a migration in increasing altitude on an annual basis.

In summary, the fusion of synoptic electro-optical satellite imagery, such as Landsat and QuickBird, and SAR data can be used to map glacier features and their subsequent changes. When remotely sensed data are combined with bathymetry and other in situ field measurements in a GIS, useful information can be extracted to help understand the dynamics of the rapidly changing system. In this paper, we present analyses of several remote sensing data sets used in the study of the Bering Glacier and surrounding landscape and waters.