Temporal Variation of Hydrology in the Alaskan Arctic

Douglas Kane, Larry Hinzman, Jim McNamara and Carl Benson

Field Activity Report 2001-2002

During the winter of 2001-2002, we continued our hydrological and meteorological monitoring program throughout the Kuparuk River basin. In April of 2002 we carried out our detailed snow survey for the entire Kuparuk River basin that included Imnavait Creek, Upper Kuparuk River and Putuligayuk River catchments. In the vicinity of Toolik Lake, we did most of the snow surveys from snow machines or skis. Our east-west transects at Happy Valley, Sagwon, Franklin Bluffs and the Putuligayuk River were done from helicopter. For Imnavait Creek, we do a 1 km transect across the watershed where we take one depth measurements ever 1 m and five water content measurements ever 100 m. For the remaining areas, we have designated locations that we take measurements at each year; 50 depth measurements and five water content measurements. The water content of the snowpack was about 20 % above normal. During this trip we installed all of the radiometers (long-wave, short wave and net) at our seven major remote meteorological sites.

On this same trip we sampled numerous springs on roughly an east-west transect from Toolik Lake. The purpose of sampling these springs is to test a hypothesis that where we see open water in the winter season, subpermafrost groundwater (at depths of 200 to 300 m approximately) is escaping through major geologic faults. We measured water temperatures, electrical conductivity and oxygen saturation in the field at each site and collected water samples for stable isotope, age dating and chemical analyses later. The analysis is not complete, but it appears that the springs to the east of SagavanirktokRiver are subpermafrost groundwater and most of the springs on the Toolik River, Upper Kuparuk River and to the west are suprapermafrost springs from taliks below the stream channel. The rationale for sampling at this time of year is that their would me no contamination from surface waters (snowmelt and rainfall generated runoff); unfortunately, some of this water flows for considerable distances underneath the snowpack.

The water content of the 2001-2002 snowpack was greater than average. For Imnavait Creek, the average water content was over 12 cm of water (average about 11 cm of water); the ablation was pretty normal, starting around the 10th of May and ending on the 23rd of May (after May 18 the melt progressed very rapidly). The interesting feature of the snowmelt was that melt took place over the entire Kuparuk River basin at the same time. Usually the melt is initiated in the foothills and then it proceeds southward into the Brooks Range and northward onto the coastal plain over a period of one to two weeks.

During the summer of 2002, we have been improving our data collection transmission capabilities at our various hydrological and meteorological sites. Our goal is to have real-time data available on the internet. For all of our Upper Kuparuk sites we transmit our data by radio technology to Toolik Lake through Slope Mountain. There are two

problems with this. First you cannot see (line of sight) Slope Mountain from Toolik Lake; this results in successful radio transmissions only during good during weather (no fog or low clouds). Toolik Lake camp is not operational continuously during the winter so we cannot transmit the at all. Shortly, we will start transmitting to the AK DOT&PF facility at Slope Mountain and from there to the internet through a Star Band Satellite connection. This should be operational soon. Next year we hope to transmit all of our northern sites, except the West Kuparuk Site, to a central site in Prudhoe Bay. The West Kuparuk Site is connected to the GOES satellite system. Past data can be found at http://www.uaf.edu/water/projects/NorthSlope/northslope.html. The most recent data can be found at http://www.uaf.edu/water/projects/near-real-time/all-current-raw.html.

During August 2002, a large rain on snow event occurred, primarily in the foothills. The Put River gauge worked fine, we do not have any reduced data yet and probably won't until mid-winter. Unfortunately, our two headwater gauges did not fare as well. For the Imnavait Creek flume, the flow exceeded the capacity of the flume and some damage was done to the flume itself. For the Upper Kuparuk River, the gauge was physically washed away 6 hours after the stage peaked (extensive erosion around the gauge). We were able to recover the data logger (memory module) and download it. Our first estimates of peak discharge is just below 100 m3/s or over 3 times greater than any measured snowmelt event (we had one summer event in 1999 of 84 m3/s). From the 10th of August until the 15th, it snowed off and on, with the greatest snowfall occurring on the 12th and 14th. Maximum depths of snow varied from 0.3 to 0.4 m with a water content of 30 to 40 mm. On the 16th of August, there was between 50 to 60 mm of rainfall in a 20-hour period. This intense rainfall on an already saturated watershed produced the large runoff response that resulted in the flood. We have spent considerable time on the North Slope since the flood doing indirect measurements of discharge, measurements related to sediment transport, etc. There was substantial sediment transport during this storm; we had numerous measurements with radio rocks, painted rocks, stream cross-sections, scour chains, etc. to document some of the sediment transport dynamics. The two gauging stations were rebuilt and are operational. The Upper Kuparuk stream gauge was moved downstream about 20 m from the old site.

In early September, we winterized all of our sites, programmed them to transmit data once daily (versus ever hour during the summer), removed all of the radiometers and performed some more measurements related to the flood.