Proposed Project LAS 33509
Beavers as ecosystem engineers in the Arctic

Ken Tape, Ben Jones, Jason Clark, Ben Gaglioti
University of Alaska Fairbanks

Winter field campaigns will be used to characterize physical stream conditions along tundra stream segments punctuated by beaver activity. These campaigns in late-winter will coincide with what is expected to be the limiting time of year for beavers, as well as many other aquatic organisms. We hypothesize that there will be more unfrozen water in the vicinity of beaver ponds and downstream than elsewhere along the stream segment. UAV imaging and *in-situ* measurements will be used to measure stream physical attributes. We will acquire very high resolution (~5 cm) true color images, thermal images, and construct a snow-covered digital surface model using a UAV. Images will be acquired during winter field campaigns at focus stream segments punctuated by beaver activity. Key measurements will include ice thickness and water depth and temperature along streams during maximum end-of-winter ice conditions, which will also serve to validate the ice regime and unfrozen water availability determined from SAR imagery collected from space and in Obj. 1. The presence and magnitude of flowing water will be measured under ice (where ice in channels is not bedfast) using a velocity meter or dye dilution method depending on channel complexity. Because snow depth is a first order control on freshwater ice thickness, snow surveys will also be conducted along a matching longitudinal profile. Aboveground time-lapse and motion-detection cameras will be deployed near beaver ponds to monitor beaver activity, as well as a range of observable environmental conditions like snow extent, ice extent, and other wildlife. One-time point measurements of sediment temperature along many reaches will be made, for later comparison to annual temperature regimes at continuous sites, and eventually used to extrapolate thermal conditions to a wider range of channel locations. These beaver affected channel sites will typically include pool tails and downstream reaches from beaver ponds, where hyporheic upwelling could optimize conditions for enhanced productivity similar to a spring.

Summer field campaigns have the primary objective of characterizing stream hydrology, as well as vegetation structure, when stream and river systems are most accessible to fully quantify open-water extent, channel geometry and substrate, and make estimates of bankfull flows based on geomorphic indicators.

Arrays of 20 channel and riparian piezometers equipped with sensor to measure water level and temperature will illuminate how beaver activities are altering hydraulic gradients and connectivity. Piezometers are 3-inch pipe that are driven approximately 1m into the ground and covered with protective material where they protrude from the ground surface. Six temperature sensors will be embedded in the stream substrate along channel segments to be collected and downloaded in subsequent years. In-channel water levels sensors will be deployed to characterize hydrologic regimes coupled with lateral transects of shallow riparian wells to evaluate how the presence or absence of beaver works impact water table dynamics and thermal regimes. Locations for riparian monitoring wells and in-channel sensors will be selected using high resolution imagery and initial field surveys of bed sediment composition and zones of hyporheic exchange (using piezometer nests to measure vertical hydraulic gradients). Geomorphic, hydrologic, and thermal measurements collected in both the winter and summer at these sets of paired reaches will be used evaluate how beavers disrupt downstream gradients and modify basic stream physical conditions. Winter and summer field measurements, as well as landform, floodplain, and channel characterization, will be georeferenced onto high-resolution (+/- 10 cm) DSMs created using Structure-from-Motion (SfM) UAV imaging techniques. One or two game cameras will be installed at each site. One buoy with temperature sensors will be deployed in a beaver pond at each site.

Proposed Sites
Note: note all sites are located on State-owned lands
*indicates on state land

Site	Long	Lat	Meridian	Section, Township, Range
1	-164.943	64.461	Kateel River	S7 T12S R31W
*2	-163.966	64.73	Kateel River	S6 T9S R26W
*3	-164.856	65.157	Kateel River	S8 T4S R30W
4	-164.686	65.127	Kateel River	S19 T4S R29W
5	-164.804	65.169	Kateel River	S3 T4S R30W
6	-165.462	64.587	Kateel River	S27 T10S R34W
*7	-165.149	64.907	Kateel River	S4 T7S R32W
8	-165.239	64.734	Kateel River	S3 T9S R33W
*9	-164.652	65.03	Kateel River	S25 T5S R30W
*10	-164.657	65.044	Kateel River	S24 T5S R30W
11	-165.49	64.558	Kateel River	S4 T11S R34W
12	-165.674	64.593	Kateel River	S28 T10S R35W
13	-165.692	64.599	Kateel River	S28 T10S R35W
14	-165.205	64.559	Kateel River	S2 T11S R33W
15	-165.437	64.657	Kateel River	S3 T10S R34W
16	-165.404	64.697	Kateel River	S23 T9S R34W
17	-165.391	64.727	Kateel River	S12 T9S R34W
18	-165.207	64.816	Kateel River	S8 T8S R32W