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River mobility in a permafrost dominated floodplain

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Along arctic coastlines, recent studies have attributed dramatic increases in the rates of shoreline erosion to global climate change and permafrost degradation. While across much of the arctic, changes in the size and number of lakes have been interpreted as the result of permafrost degradation altering surface water dynamics. The potential influence of climate change and permafrost thawing on the mobility and form of arctic rivers, however, has been relatively unexplored to date. In rivers located within permafrost, some to potentially most, of the cohesive bank strength may be derived from frozen materials. It is likely that, as permafrost thaws, river bank erosion may increase, in turn influencing both migration rates and channel planform. Using automated feature extraction software (GeniePro), we quantified the of the mobility of a 200 km reach of the Yukon River through the Yukon Flats region located just north of Fairbanks, Alaska, USA. The Yukon Flats is an area of comprised of both continuous and discontinuous permafrost. Based on both changes in lake distributions and wintertime river base flows, it has been suggested that permafrost in this area has been experiencing recent thawing. In this reach, the Yukon River transitions from a 2 km wide braided channel to a multi-thread meandering channel where individual threads are approximately 1 km wide and the floodplain preserves prior meander cutoffs and oxbow lakes. Preliminary results from thirty years of LANDSAT imagery shows a surprising stability of channel location (at the image resolution of 30m/pixel) given the channel form. Within the braid-belt there is localized relocation of channel threads and mid-channel islands, though along much of the reach, the change in the location of channels banks is close to the resolution of the imagery. At the most active bends, bank migration rates range from 0.007 to 0.02 channel widths per year. These rates are comparable to system wide average rates observed on non-permafrost influenced rivers, suggesting significantly lower average migration rates occur along the Yukon River in this study reach. Ongoing technical challenges include quantification of the influence of river stage of the feature extraction of river banks, improved registration of images with limited ground control and identification of observable proxies for permafrost extent. Based on the preliminary results, our research will focus on quantifying system-wide rates to determine both spatial and temporal trends in river mobility. Using the spatial patterns in observed mobility, high resolution imagery of smaller areas will be used to refine estimates of the timing and rates of channel mobility and to help identify possible controls on bank erosion such as permafrost and vegetation distributions.