Sixty-five years of Colville River dynamics and its impacts on present river navigability near Nuiqsut, North Slope of Alaska

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1. Introduction

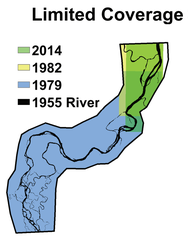
Climate-driven changes in river systems are challenging access to ecosystem services such as access to traditional hunting grounds and other subsistence food sources on the North Slope of Alaska. The Native village of Nuiqsut relies heavily on the Colville River for access to these resources, which serves as a vital transportation artery through the permafrost landscape. Recent reports from Nuiqsut residents indicate accelerated changes in the environment, limiting river travel and their ability to harvest subsistence food. This poster examines how river geomorphology changes over the past 65 years has affected river siltation. We focus on select areas of the Colville that have shown large changes in geomorphology as potential risk areas for river navigability. A field campaign conducted in August 2016 provides ground-truth for remote sensing analysis, as well as preliminary data on a ratio based multispectral approach to water depth retrieval along the river.

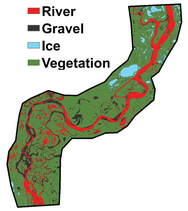
2. Mapping

Historical aerial and satellite imagery was collected for the study region in the timestamps outlined in the table below. Coverage of the Area of Interest (AOI) was less than ideal for some scenes, as shown in the inset on the left. Nonetheless, a Gaussian Maximum Likelihood Classification was run on each of the multispectral scenes in an effort to identify 1) River water, 2) Gravel/Developed land, and 3) Vegetation. The River was manually digitized for the 1955 scene, as there was not sufficient bit depth of the panchromatic scene to explore other classification methods, though there may be potential for a region growing classification technique.

Date	Imagery	Spectral	Resolution
1955	USGS	Panchromatic	4 m
1979	AHAP	Color Infrared	1.7 m
1982	AHAP	Clor Infrared	1.7 m
2010*	SPOT	RGBNIR	2.5
2014	WV02	Pansharpened RGB	1 m

* composite of multiple scenes from 2009, 2010, and 2011

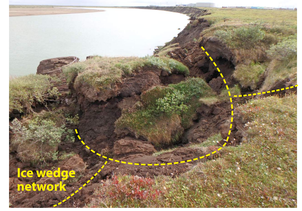


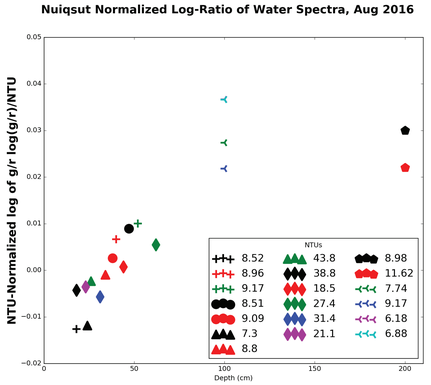


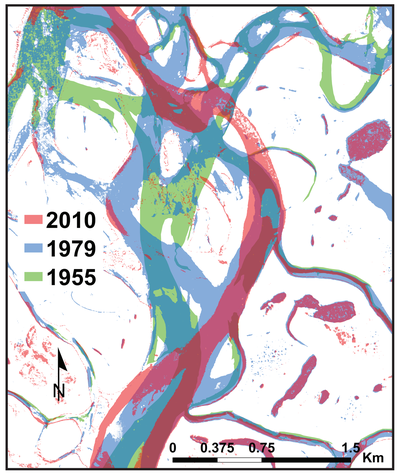
3. Field Spectra

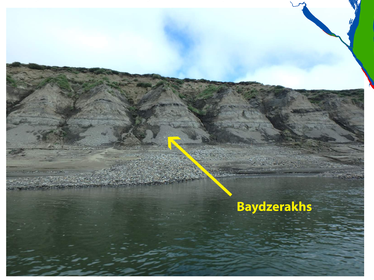
Spectra were collected in the field with a PSR+ Spectroradiometer to explore the possibility of mapping the Colville's water depth using optical remote sensing data. The spectra were taken at various depths in the shallows, as well as several times from a boat over deeper water. Coincident turbidity measurements in Nephelometric Turbidity Units (NTUs) were also recorded which were later used to normalize the spectra. A ratio-based processing of the spectra, similar to Legleiter's (2013) method, was employed using the red (Λ_{533}) and green (Λ_{685}) bands before normalization with the turbidity (NTU) measurements:

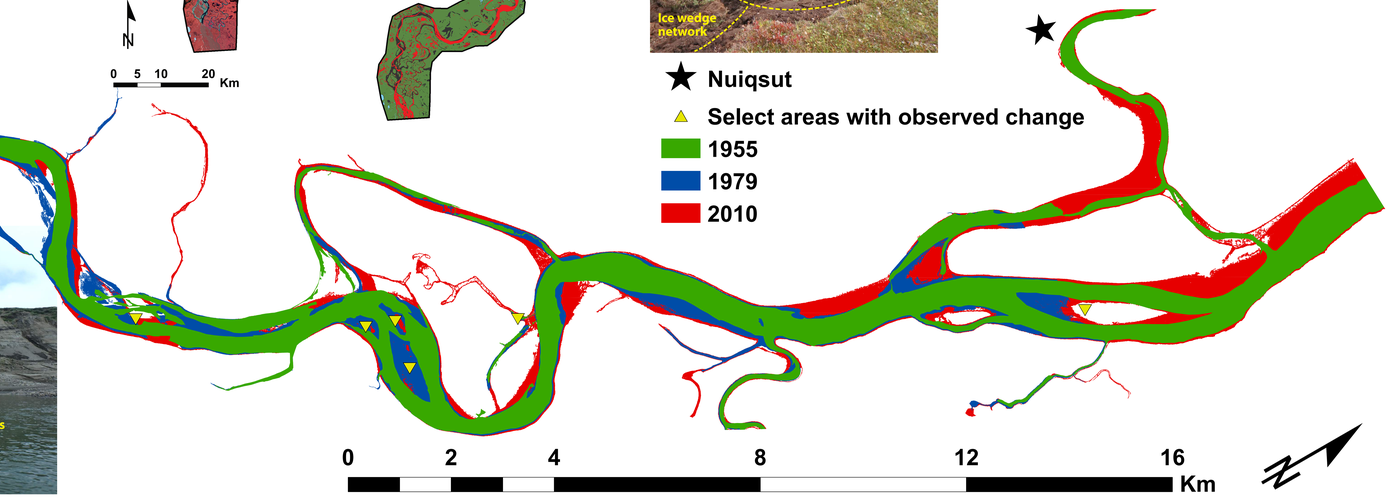
$$\chi = \frac{\ln\left(\frac{\Lambda_{533}}{\Lambda_{685}}\right)}{NTU}$$











4. Findings

Areas upriver from Nuiqsut are showing substantial change in river geomorphology. The inset map to the right shows the largest change detected in this study, where the river has migrated over 1.2 km since 1955. This large change in morphology can be attributed to the ice-rich yedoma complex in the area, and the exposure of ice wedges in the cut-bank of the river. There is potential to mapping water depth on the Colville using satellite or aerial imagery, but coincident turbidity measurements will be needed for normalizing different water conditions. There is also potential to scale up this process and provide predictive mapping services to boaters on the Colville.