

PHOTOGRAMMETRIC ANALYSIS OF COASTAL EROSION ALONG THE CHUKCHI COAST AT BARROW, ALASKA

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A variety of empirical and modeling approaches are being taken to assess the history and risk of erosion and flooding along the Chukchi Sea coast near Barrow, Alaska. Part of a broad assessment of climate impacts for the North Slope (nome.colorado.edu/HARC), this study utilizes softcopy photogrammetry and GIS to quantify coastal erosion over the last five decades.

We conducted a preliminary analysis of aerial photography for 1948 and 1997 (Fig. 1). The scanned photos were orthorectified and co-registered with PCI Geomatics to 0.5 m pixel resolution, using Ground Control Points (GCP's) previously acquired for this project with Differential GPS (instaar.colorado.edu/QGISL/barrow_gcp). The 1948 and 1997 shoreline and bluff-line positions were then digitized and overlaid. Locational accuracy is about 3.2 m for shorelines and 3.8 m for bluff lines, considering errors due to orthorectification, digitizing, and transient waterline shifts from tides and wave setup. Accuracy for corresponding erosion rates, averaged over the 49 year period, is thus 0.07 m/yr and 0.08 m/yr respectively.

Shoreline erosion is spatially variable, with 1948-to-1997 shoreline displacement averaging 20.7 m for the three areas shown in Fig. 2, equating with a time-averaged rate of 0.42 ± 0.07 m/yr. Net erosion rates reach 0.57 m/yr southwest of Barrow and 0.92 m/yr west of Barrow, with net progradation of about 0.1 m/yr for part of the Browerville shoreline (Fig. 2). Similarly, the nearshore bluff at Barrow has retreated on average 26.3 m over the intervening five decades, reaching a maximum retreat rate of 0.74 ± 0.08 m/yr. These erosion rates are approximately half those calculated for the ice-rich, peaty shorelines along Elson Lagoon, east of Barrow (Brown et al. 2003). They nonetheless are representative of the high rates of coastline erosion threatening many arctic settlements (cf. Hopkins and Hartz 1978; Reimnitz et al. 1988; Jorgenson et al. 2002; Smith 2002).

This analysis documents a significant hazard for the Barrow community. We plan to extend the analysis in space and time (SW of Barrow to Point Barrow, with additional photography for 1955, 1964, 1979, 1984, and 2002) to address such questions as: Which environmental factors control spatial variability in erosion? Is erosion accelerating due to climate change? Have mitigation efforts during the 1990's been effective at slowing erosion? Are the low-gradient gravel beaches northeast of Browerville experiencing progradation due to longshore drift of eroded materials? And with continued mitigation efforts, can we expect significant damage to buildings and infrastructure within the coming few decades?

References:

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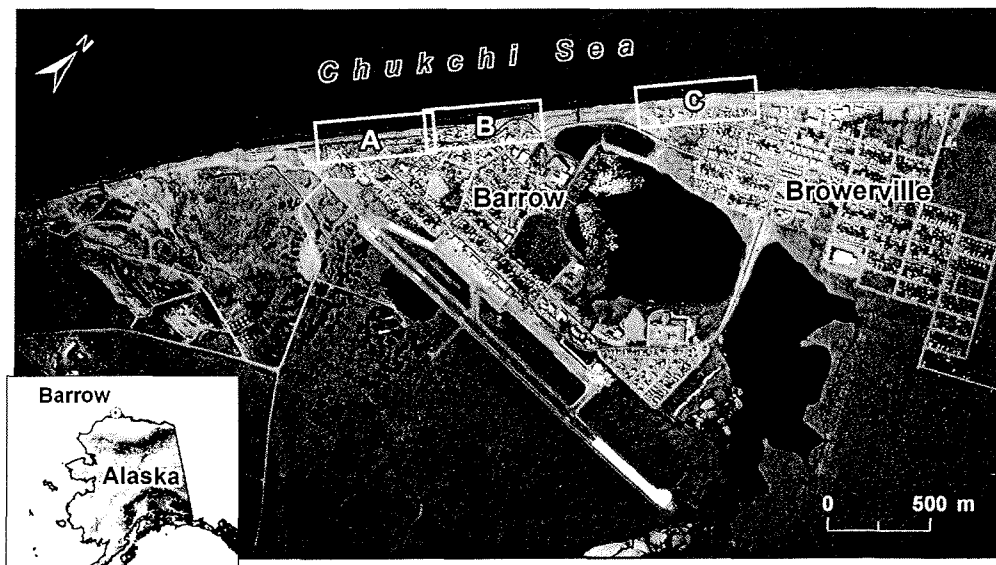


Figure 1. Orthorectified 1997 aerial photography of Barrow and Browerville, showing the 1948 shoreline position, as well as the location of close-up panels in Fig. 2.



Figure 2. Coastal strips of the 1997 orthophoto mosaic, showing the position of the 1948 shoreline and bluff line. Also shown are shoreline and bluff-line erosion rates for selected areas.