

## GIS-based measurement of coastal change in the southeast Chukchi Sea, Alaska

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Coastal environments at high latitudes are experiencing rapid change. Coastal erosion threatens a variety of nearshore marine, terrestrial, and freshwater habitats, and may be accelerating with Arctic warming. To better understand impacts for national parks in northwestern Alaska, a collaborative study has begun to document coastal change in the southeast Chukchi Sea. The comprehensive geospatial study includes: creation of a high-resolution (0.6 m) orthophoto mosaic for 2003; rectification of historic aerial photography from ca. 1950 and ca. 1980; and quantitative analysis of coastline and bluff erosion. For Bering Land Bridge NP and Cape Krusenstern NM, the GIS analyses quantify complex spatial and temporal variability tied to environmental forcing, as well as a dynamic range of coastal morphologies and processes. The geospatial analysis documents that most of the ca. 400-km-long coast from Wales to Kivalina has experienced erosion in the past five decades, with long-term average rates of 0-3 m/yr. Direct impacts include beach and bluff retreat, overwash deposition, migration or closure of inlets and lagoons, capture of thaw-lake basins, and release of sediment and organic carbon to nearshore waters (see Figs. 1-3). Observations of shrub expansion and thermokarst degradation are also consistent with rapid change. Coastal ecosystems in the region appear to be sensitive to the frequency and intensity of storm events, increasing temperatures, permafrost melting, sea-level rise, and increasing length of the summer ice-free season.



Fig. 1. Flooding of Kiligmak Inlet, in Cape Krusenstern National Monument. The infra-red aerial photograph at left shows the creek, inlet, and surrounding tundra as they existed in 1980. The same area in 2003 is shown at right, after a storm moved sand and gravel across the inlet, forming a new lagoon, and flooding the tundra. The new lagoon is about 0.5 km wide.



Fig. 2. An eroding bluff in Cape Krusenstern National Monument. This high bluff – made of unconsolidated silt, peat, and ground ice – is rapidly slumping and eroding into the Chukchi Sea. Orthorectified aerial photography shows that the bluff eroded about 33 m from 1980 to 2003.



Fig. 3. An eroding bluff near Bering Land Bridge National Preserve that threatens archeological sites. The prehistoric remains of pit houses – with centuries-old artifacts – lie at the edge of the bluff in the background. Coastal erosion is causing the loss of cultural resources throughout the region.

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