

ID: W2796478907

TITLE: The Arctic Coastal Erosion Problem

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ABSTRACT:

Permafrost-dominated coastlines in the Arctic are rapidly disappearing. Arctic coastal erosion rates in the United States have doubled since the middle of the twentieth century and appear to be accelerating. Positive erosion trends have been observed for highly-variable geomorphic conditions across the entire Arctic, suggesting a major (human-timescale) shift in coastal landscape evolution. Unfortunately, irreversible coastal land loss in this region poses a threat to native, industrial, scientific, and military communities. The Arctic coastline is vast, spanning more than 100,000 km across eight nations, ten percent of which is overseen by the United States. Much of area is inaccessible by all-season roads. People and infrastructure, therefore, are commonly located near the coast. The impact of the Arctic coastal erosion problem is widespread. Homes are being lost. Residents are being dispersed and their villages relocated. Shoreline fuel storage and delivery systems are at greater risk. The U.S. Department of Energy (DOE) and Sandia National Laboratories (SNL) operate research facilities along some of the most rapidly eroding sections of coast in the world. The U.S. Department of Defense (DOD) is struggling to fortify coastal radar sites, operated to ensure national sovereignty in the air, against the erosion problem. Rapid alterations to the Arctic coastline are facilitated by oceanographic and geomorphic perturbations associated with climate change. Sea ice extent is declining, sea level is rising, sea water temperature is increasing, and permafrost state is changing. The polar orientation of the Arctic exacerbates the magnitude and rate of the environmental forcings that facilitate coastal land area loss. The fundamental mechanics of these processes are understood; their non-linear combination poses an extreme hazard. Tools to accurately predict Arctic coastal erosion do not exist. To obtain an accurate predictive model, a coupling of the influences of evolving wave dynamics, thermodynamics, and sediment dynamics must be developed. The objective of this document is to present the state-of-the-science and outline the key steps for creation of a framework that will allow for improved prediction of Arctic coastal erosion rates. This is the first step towards the quantification of coastal hazards that will allow for sustainable planning and development of Arctic infrastructure.

SOURCE: None

PDF URL: None

CITED BY COUNT: 19

PUBLICATION YEAR: 2016

TYPE: report

CONCEPTS: ['Arctic', 'Coastal erosion', 'Permafrost', 'Shore', 'Erosion', 'Oceanography', 'Geography', 'Climate change', 'Physical geography', 'Environmental science', 'Geology', 'Geomorphology']