

PROJECT SUMMARY

WAVE-ICE-OCEAN INTERACTIONS ALONG THE ARCTIC COAST

Overview

Arctic coastlines, and in particular the northern coast of Alaska, are eroding at rates of meters per year. Coastal flooding events are becoming more common, as reductions in seasonal sea ice create large fetches for autumn storms. The proposed work concerns the oceanographic factors associated with coastal erosion and flooding, which are distinct from the geologic controls. Key among these oceanographic factors is the previously demonstrated increasing trend in surface wave activity throughout the western Arctic.

Field observations will be collected and a coupled modeling system will be developed that together quantify the wave-ice-ocean interactions along the northern coast of Alaska. This new model will be applied, after calibration and validation with the field observations, to generate a 20-year hindcast. The hindcast will be used to investigate the climate signals in Arctic wave-ice-ocean coupling. The results will determine: 1) the significance of coastal protection via scattering and dissipation of waves by sea ice, 2) the thermodynamic and mechanical effects of increasing wave energy, and 3) the changes in coastal flooding and circulation associated with increasing wave momentum.

Intellectual Merit

The proposed work will connect a rapidly changing climatology and the physical processes that are fundamental to Arctic coastal ocean. This research topic is intrinsically multidimensional, with natural variability on a wide range of spatial and temporal scales. In order to make progress in this area, a modeling system capable of accommodating such variability is required, along with validation through detailed field observations. The work proposed here will synthesize recent progress in process-based modeling of coastal dynamics, especially in regards to the coupling of specific process models. The proposed work will fill a gap between the recent progress modeling wave-ice interactions in deep-water and existing programs studying erosion at the shoreline. Understanding wave-ice-ocean interactions along the Arctic coasts is essential to improving the skill of forecast and climate models to the region. These interactions continue to be a focal point for basic research, because of the complexities and possible non-linearities associated with these processes.

Broader Impacts

The proposed work will result in development of an open-source, process-based modeling system for Arctic coastal regions, including model grids and test cases for the north Alaska coastal zone. This capability will have impacts across basic research, public infrastructure planning, climate scenario assessment, and policy-making. The work will include outreach in the form of K-12 events and public seminars. Also, this work will involve the mentoring and training of a postdoctoral researcher. Finally, the proposed work will also generate a comprehensive set of field data and model results that will be publicly available to other researchers working to understand wave-ice-ocean interactions and Arctic coastal change.