

## **The Arctic Marine Pulses Model: Linking Contiguous Ecological Domains in the Pacific Arctic**

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### **ABSTRACT**

The Pacific Arctic marine ecosystem extends from the northern Bering Sea, across the Chukchi and into the East Siberian and Beaufort seas, encompassing territorial waters of three nations and international waters of interest to many nations. Implementing the ecosystem approach to management requires sustained environmental observations coupled with the development of models that portray the underlying complexity of the ecosystems. Food webs in Arctic marine ecosystems are short, a simplicity that belies the biophysical complexity underlying trophic linkages from primary production to humans. Existing biophysical models, such as pelagic-benthic coupling and advective processes, provide frameworks for connecting certain aspects of marine food webs, but do not offer a comprehensive approach. In the course of the Synthesis of Arctic Research (SOAR) project, a holistic Arctic Marine Pulses (AMP) model was developed that depicts seasonal biophysical 'pulses' across a latitudinal gradient by linking processes in four previously-described contiguous ecological domains, the: (i) Pacific-Arctic domain; (ii) Seasonal Ice Zone domain; (iii) Marginal domain; and (iv) Riverine Coastal domain. Some of the processes included in the model, such as pelagic-benthic coupling on the broad shelves of the northern Bering and Chukchi seas, and advection and upwelling of zooplankton along the western Beaufort shelf (i.e. the krill trap), have been the focus of long-term study. Other aspects, such as biophysical responses to shifts in seasonal sea ice phenology and variability in riverine outflow have received less attention. The AMP model provides a spatiotemporal framework to guide research on dynamic ecosystem processes during the current period of rapid biophysical changes in the Pacific Arctic. Further, the AMP model, with its focus on phenology of events, may facilitate communication between conventional science approaches to marine research and seasonal-cycle based indigenous knowledge of Arctic marine ecosystems. The AMP model could be enhanced by the application of visualization tools to provide a means to investigate how an annual cycle unfolds under various physical forcing conditions. The capability to track seasonal sea ice and current flow dynamics, and to evaluate the movement of nutrients, benthic and pelagic production, and habitats of upper-trophic species in space and time, would provide a strong foundation for the development of predictive human-inclusive ecosystem models for the Pacific Arctic domain in support of future development of an international pan-Arctic model.

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