BEST-BSIERP
Bering Sea PROJECT
UNDERSTANDING ECOSYSTEM PROCESSES IN THE BERING SEA 2007–2013

What is the Crystal Ball Saying about the Bering Sea?

NOTHING, BUT CLIMATE MODELS ARE CALLING FOR VARYING AMOUNTS OF WARMING

It is a safe bet that the future will include a warmer Bering Sea. But it is uncertain exactly how climate change will be manifested, and in particular, how fast it will warm in summer versus winter, and in the north versus the south. Nevertheless, these details in the climate forcing are key in terms of their impacts on plankton community structure and distributions and, ultimately, the entire marine ecosystem. We addressed the formidable problem of how climate change is liable to impact lower-trophic levels, i.e., the base of the food web, using groundbreaking methods and massive computing resources.

How We Did It

Our approach featured high-resolution ocean model simulations using the Regional Ocean Modeling System (ROMS). This model includes interactions among physical water properties, nutrient concentrations, and the growth and consumption of groups of plankton crucial to fish, sea birds and marine mammals. The regional simulations were embedded in large-scale atmospheric and oceanic conditions from global climate model predictions. ROMS is much more realistic than the global models in representing smaller-scale effects of bottom topography on the currents and temperature (Figure 1).

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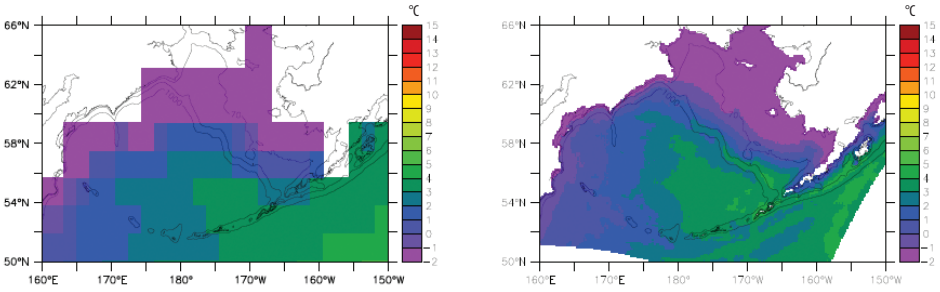
Euphausiids, also known as "krill."

The Big Picture

While global climate models provide consistent global-scale predictions over the next few decades, they differ significantly in their predictions on regional scales. By using an ensemble of such models to drive a coupled physical-ecosystem model for the Bering Sea region, we were able to achieve consistent estimates of how the euphausiid population, an important food source for commercial fish species, would change on those same time scales.

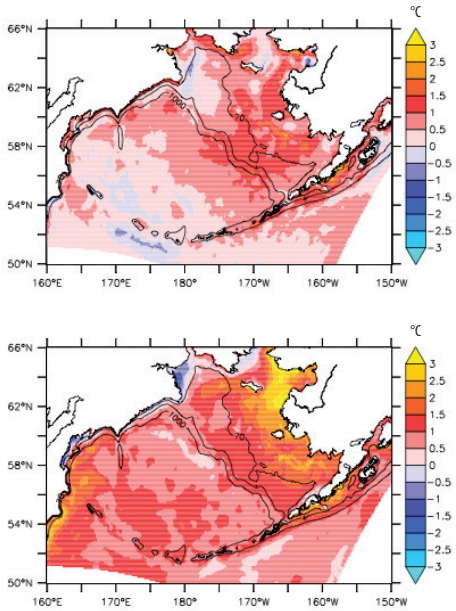
Fig. 1



Surface temperatures for the present climate during February from the Canadian Centre for Climate Modeling and Analysis (CCCMA) global climate model (left panel) and from ROMS (right panel) using the CCCMA for the large-scale atmospheric and oceanic forcing

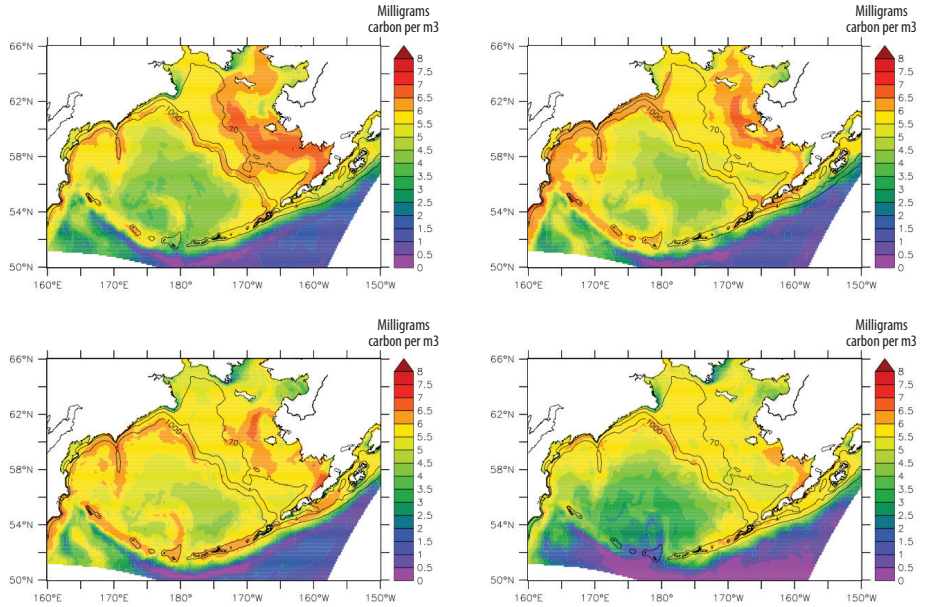
A component of the BEST-BSIERP Bering Sea Project, funded by the National Science Foundation and the North Pacific Research Board with in-kind support from participants.

Fig. 2



Surface temperature changes for August from the present climate to the 2030s from ROMS using the CCCMA (top panel) and Model for Interdisciplinary Research on Climate (MIROC) (bottom panel) global models for the climate forcing.

Fig. 3



Near surface concentrations of euphausiids in August from ROMS projections using the present climate forcing (upper left panel), and from ROMS using the climate forcing of the 2030s from the CCCMA climate model (upper right), ECHOG climate model (lower left) and MIROC climate model (lower right).

The climate model forecasts that have been carried out are mostly similar in terms of their projections of global means, but they predict different future climates from a regional perspective (Figure 2). There is little justification for selecting one of these models over others to specify the large-scale future climate forcing of the Bering Sea. It is therefore prudent to take a multiple-model approach, and focus on the range of probable outcomes.

An illustration of this range is provided by a set of ROMS projections of euphausiid distributions in August (Figure 3). Euphausiids represent key prey for a number of species, including young walleye pollock. There is consensus from the ROMS model projections that euphausiid populations are likely to decline on the eastern Bering Sea shelf. On the other hand, there is conflicting evidence from the model with respect to the sense of the expected changes in euphausiid populations over the deep basin of the Bering Sea.

Why We Did It

Our project represented an ambitious effort, and we have learned a lot along the way about the crucial interactions and chokepoints in the physical forcing of the Bering Sea ecosystem. While we may not be able to assert exactly how climate change will play out in the region, our research provides insights for effective monitoring of this system and towards the development of improved forecast models.

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The Bering Sea Project is a partnership between the North Pacific Research Board's Bering Sea Integrated Ecosystem Research Program and the National Science Foundation's Bering Ecosystem Study. **www.nprb.org/beringseaproject**

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