A modeling study of sea ice and plankton in the Bering and Chukchi Seas during 2007-2008

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Abstract
A nutrient (N), phytoplankton (P), zooplankton (Z), and detritus (D) ecosystem model (PhEcoM) coupled to an ice-ocean model (CDOM) was applied to the Bering and Chukchi Seas for 2007-2008 (Wang et al., 2013, JGR). The model reasonably reproduced the seasonal cycle of sea ice, phytoplankton, and zooplankton in the Bering-Chukchi Seas. The spatial variation of the phytoplankton bloom was predominantly controlled by the retreat of sea ice and the increased gradient of the water temperature from the south to the north. The model captured the basic structure of the measured nutrients and chl-a along the Bering shelf during July 4-23, 2008, and along the Chukchi shelf during August 5-12, 2007. In summer 2008, the Green Belt bloom was not observed by either the satellite measurements, or the model. The model-data comparison and analysis reveal the complexity of the lower trophic dynamics in the Bering and Chukchi Seas. The model is proven to be useful for understanding the ecological processes in these seas.

Models
The physical model used is the CDOM (Wang et al. 2002. 2003, 2005, 2008, 2009, JGR) and the Physical-Ecosystem Model (PhEcoM) with two improvements: a) water mixing effect and by forcing. Since the tidal current is strong in the Bering shelf sea, and the tidal energy is more than 80% of the total energy (Kuehl and Schumacher 1983, JGR). PhEcoM is the Physical-Ecosystem Model developed by Wang et al. (2003, 2005, 2009, JGR) that couples the nutrient transport and biological model to the ice-ocean model (CDOM) with the following features: a) an increase in air temperature by 2°C over the entire calculation period can result in a overall increase in phytoplankton by 15%.

Data
The temperature and salinity datasets used in this study are monthly mean PIB, Daily atmospheric forcings from NCEP reanalysis.

Conclusions
1) Sensitivity of ice, sea ice, ocean, circulation, and temperature in the Bering and Chukchi Seas are reasonably reproduced. Although 2007 and 2008 were not exact in the same years, the modeling results represented a normal ice year, with the ice edge being closer to the coastline. The simulated nutrient transport via the Bering Strait could reasonably supply all the observations. The seasonal cycle of the Bering and Chukchi Seas lower tropic level ecosystems was reasonably simulated using the simple NPB2 nutrient model. 2) Ice has an effect (i.e., the increase of water temperature) on the timing of the phytoplankton bloom in the south, giving the reason for the differences in bloom timing between the two regions. The chlorophyll a bloom in the Chukchi Sea started earlier than in the Bering Sea, which was due to the increased temperature of the south. 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