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Simulating ice-ocean downscaling characteristics in the Beaufort-Chukchi seas by an IARC Coupled Ice-Ocean Model (CIOM)

J. Wang, H. Hu, K. Mizobata

International Arctic Research Center, University of Alaska Fairbanks, Alaska USA;
jwang@iarc.uaf.edu; http://www.frontier.iarc.uaf.edu/∼jwang/amg/main.html

An IARC regional CIOM (Coupled Ice-Ocean Model) based on POM was used to simulate the downscaling ice and ocean processes with a 3.4-km resolution. The Beaufort Sea CIOM was nested to the CCSR/NIES/FRCGC high-resolution (1/6 x 1/4 degrees) global coupled atmosphere-sea ice-ocean-land model. Atmospheric forcing data were derived from the NCEP reanalysis. Simulation of seasonal cycle was conducted. In the Chukchi Sea, the Bering inflow separates into three branches: the first main branch flows along the Alaska's coast that is the Alaska Coastal Water (ACW); the second branch flows northward and turns to the right, joining the ACW along the Beaufort coast; and the third branch flows toward the Northwind Ridge. The Beaufort Gyre is well reproduced, superimposed by numerous mesoscale eddies, with anticyclones outnumbering cyclones. Downscaling sea ice dynamics was investigated, such as sea ice ridging, rafting, leads and landfast ice, which are not resolved in the previous coarse resolution model. This approach combining the global model for the 20th century climate simulation with the regional downscaling/nesting simulation helps understanding of both large-scale sea ice variability and small-scale sea ice dynamics. Sea ice breaks up offshore piece by piece with landfast ice untouched along the Beaufort Sea coast. Sea ice cracks from pack ice with irregular shapes due to 1) complex ocean circulation, coastal current, and mesoscale eddies, 2) multi-category sea ice dynamics, and 3) complex and high-resolution geometry and topography. Sea ice ridging, rafting, and openings/leads can be well reproduced in sea ice thickness and concentration. Model validation using in situ observations, satellite measurements, and historical datasets was also conducted.