北極海航路利用のための海氷モデリング研究：短期予測に向けて

小野純 [1,2]、Liyanarachchi Waruna Arampath De Silva [1,2]、山口一 [2]
[1] *国立極地研究所北極観測センター*
[2] *東京大学大学院新領域創成科学研究科*

Modeling study of sea ice for the Northern Sea Route: toward the short-term prediction

Jun Ono[1,2], Liyanarachchi Waruna Arampath De Silva [1,2] and Hajime Yamaguchi[2]
[1]*National Institute of Polar Research*
[2]*Graduate School of Frontier Sciences, The University of Tokyo*

Recently, the Northern Sea Route (NSR) and Northwest Passage (NWP) have been opened to a greater extent due to sea-ice retreat in summer Arctic Ocean. This increases the possibility for the use of the NSR and NWP as a new Arctic sea route. Thus, a precise prediction system is vital for safe ship navigation in the NSR and NWP. To date, a lot of numerical studies have been carried out to forecast the overall Arctic sea ice for the climate change. With regards to the safe ship navigation, however, the accuracy and resolution in their model are still questionable. Our goal is to predict the ice edge up to 5 days ahead within an error of 10 km, using high-resolution (about 2.5 km) model. To date, an ice-ocean coupled model of the Arctic Ocean (De Silva, 2013) has been developed on the basis of the model. The ocean part is based on the Princeton Ocean Model (POM), a free surface, hydrostatic, primitive equation model (Blumberg and Mellor, 1987). The horizontal resolution is about 25 km and the vertical grid uses 33 sigma levels. The ice part consists of a dynamics model with the EVP rheology (Hunke, 2001) and floe-collision rheology (Sagawa, 2007) and 0-layer thermodynamic model (Semtner, 1979). The atmospheric forcing components are given by the ERA-Interim with 6-hourly interval. After spinup of 10 years with the forcing data in 2000, the model was integrated from 2001 to 2012. The model reproduces the seasonal and interannual variations in the sea-ice extent and sea-ice drift velocity to some extent. However, the model showed relatively poor reproducibility on the simulation of the sea-ice thickness. It was found that coarser resolution model can reproduce seasonal and interannual variations reasonably compared with observations but cannot be used to predict the short-term (1-2 weeks) variation as shown in Figure 1. Therefore, the high-resolution (about 2.5km) regional models were setup along the NSR to investigate the accuracy of short-term sea ice predictions. High-resolution model simulation was able to predict the sea ice extents reasonably with observations because of the improved expression of the ice-albedo feedback process and ice-eddy interaction process as shown in Figure 2.

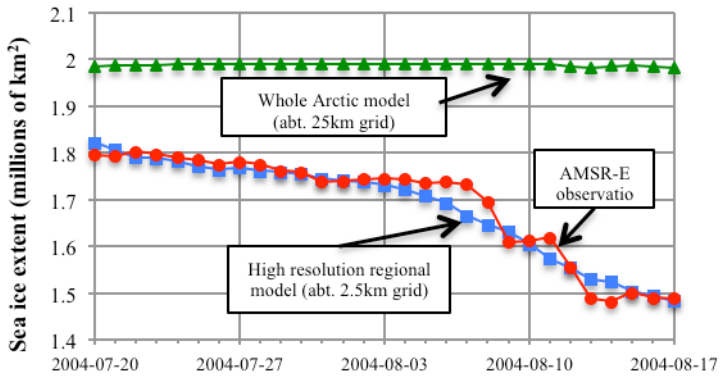

Figure 1. Comparison of sea ice extents by coarse model (green-triangle), fine regional model (blue-square), and satellite observation (red-circle), from 20 July to 17 August in 2004.

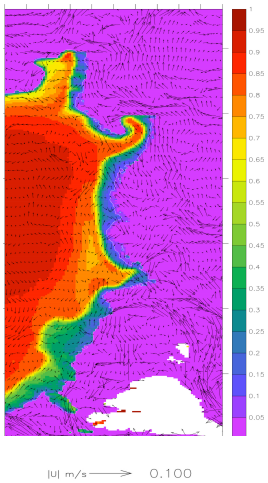

Figure 2. Snapshot (1 October, 2005) of ice-eddy interaction in the north of Sevelnaya Zemlya Islands. Color is sea ice concentration and Vectors are surface ocean current.