新生氷への堆積物粒子取り込み過程のモデリング

松村義正[1]、伊藤優人[2]、大島慶一郎[1]
[1]*北海道大学 低温科学研究所*
[2]*北海道大学 環境科学院*

Modeling sediment entrainment into newly formed sea ice

Yoshimasa Matsumura[1], Masato Ito[2] and Kay I. Ohshima[1]
[1]*Institute of Low Temperature Science, Hokkaido Univ.*
[2]*Graduate School of Env. Science, Hokkaido Univ.*

In the Arctic ocean, highly sediment-laden sea ice is frequently observed (Eicken et al. 1997; Darby, 2003). The role of sediment-laden sea ice in ocean biogeochemistry has drawn attention recently, since it releases iron and other trace elements at the open ocean in the melting season and may trigger the spring bloom. While there are several possible sources for the sediment in sea ice, resuspension of bottom sediment induced by active thermal and/or brine-driven convection seems to be significant particularly at shallow coastal polynyas. If the ocean convection is strong enough to suspend the certain portion of bottom sediment up to the surface, these sediment particles will be captured at the time the surface grease ice layer consolidates into solid ice.

In the present study we performed idealized numerical simulation of this convection-induced sediment entrainment process by using a non-hydrostatic ocean model coupled with an online Lagrangian particle tracking system developed by Matsumura and Ohshima (2015). This model can comprehensively deal with both underwater frazil ice and suspended sediment as Lagrangian particles, and its results successfully represent the suspension of bottom sediment up to the surface coincide with the convective downward transport of underwater frazil ice down to ~20 m depths (Figure 1). The results of sensitivity experiments with different the sediment particle size are consistent with observational studies. Under the typical surface forcing corresponds to the wintertime Arctic coastal polynyas, while a certain portion of sediment particles of less than 10 μm diameter tend to rise to the surface and be captured in the grease ice layer, sediment particles of greater than 20 μm can hardly appear near the surface. Performing simulation with realistic settings and quantitative comparison with direct measurements are the next tasks.

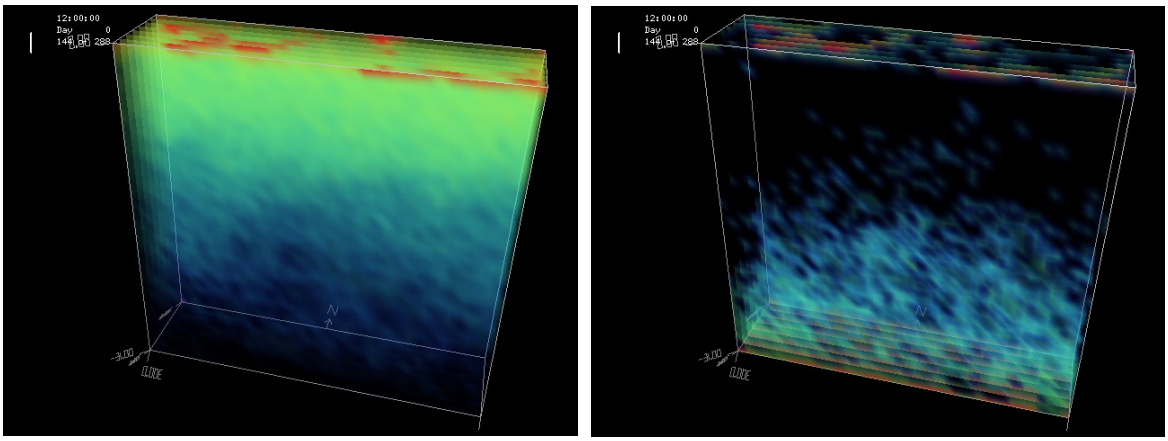

Figure 1. 3D volume rendering images of frazil ice distribution (left) and bottom sediment distribution (right).

References

Eicken, H. et al., Sea-ice processes in the Laptev Sea and their importance for sediment export, *Cont. Shelf Res.,* **17**, 205–233, 1997.

Darby, D. A., Sources of sediment found in sea ice from the western Arctic Ocean, new insights into processes of entrainment and drift patterns, *J. Geophys. Res.,* **C8**, 3257, 2003.

Matsumura, Y. and K. I. Ohshima, Lagrangian modelling of frazil ice in the ocean, *Ann. Glaciol.*, **56(69)**, 373-382, 2015.