Effects of fluctuating Kuroshio path on larval dispersal in the Seto Inland Sea

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Abstract

Spatiotemporal variations of the Kuroshio drifting off the Shikoku Island, Japan, are recognized to influence on the estuarine circulation in the Seto Inland Sea (SIS, e.g., Uchiyama et al., 2012). In general, the ambient currents passively transport marine species particularly in their pelagic larval stage. Therefore the coastal dispersal of the larvae in the SIS is largely influenced by the transient impact from the Kuroshio through its seasonal and inter-annual variability. In the present study, we conduct a double-nested high-resolution SIS modeling based on ROMS for consecutive six years from 2008 and 2013. An offline Lagrangian particle tracking is then carried out with the ROMS reanalysis to emulate the pelagic larval dispersal in the SIS. Primary objectives are to investigate (1) correlation between the structure of the Kuroshio path and associated volume transport in the SIS, and (2) effects of the Kuroshio path on the larval dispersal analyzed with the Lagrangian probability density functions for the particles released in the entire SIS (e.g., Mitarai et al., 2009).

When the Kuroshio detaches far from (attaches to) the Cape Shionomisaki, the outgoing southward volume transport at the Kii Channel increases (decreases) due to the meridional pressure gradient force (Uchiyama et al., 2012). The volume transport in the SIS mostly occurs from the Bungo Channel to the Kii Channel to form the subtidal clockwise circulation with prominent seasonal variability. Apparent seasonality is also found in the modeled larval dispersal in the SIS. The fraction of the released particles arriving at the coastal areas after the advection time of 30 days is about 5% larger in summer than in winter. Substantially more particles remain in the released area in summer than in winter. For example, the fraction of the particles staying in the Harima Sea in summer is as 1.3 times much as that in winter. The persistent clockwise circulation is generally more energetic in winter to promote the eastward mean particle transport, inducing this seasonality. In addition, sub-regional cyclonic and anticyclonic circulations during summer result in formation of isolated water that enhances particles trapped in the circulations.