Forcing mechanism controlling the variability of circulations and associated larval transport in the Seto Inland Sea, Japan

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Oceanic currents in the Seto Inland Sea (SIS), Japan, are mainly driven by tides, density and sea-surface wind. It has been reported that fluctuating Kuroshio path situated south of the SIS also plays a significant role in development of the mean circulation in the entire SIS. Hence dispersal patterns of material, such as larvae, nutrient and toxic substances, are substantially influenced by this overall circulation. Evaluation of effects of the circulation on material transport leads to further elucidation of the marine ecosystem and desirable marine environment in the SIS. In the present study, seasonal and interannual variability of larval dispersal in the entire SIS and effects of each forcing factor on the dispersal patterns are examined in detail with a multiple-year oceanic reanalysis based on a JCOPE2-ROMS double nested downscaling system along with a Lagrangian particle tracking submodel. The model results are compared with observations of temperature and salinity, tidal elevation and current in the SIS, and the Kuroshio path to demonstrate a good agreement.
Lagrangian PDFs are exploited to illustrate larval dispersal. In summer, the larvae in several regions are trapped by convergent cyclonic gyres locally-developed around dome-shaped bottom cold water mass, referred to as cold dome. In winter, southwestward Ekman transport have a prominent influence on dispersal of the larvae released from Iyo Sea, whereas the clockwise circulation associated with northwesterly monsoon rather than the transient Kuroshio path predominantly transports the larvae released from Harima Sea towards Kii Channel. However, the fluctuating Kuroshio is found to largely affect inter-annual variability of larval dispersal. When the Kuroshio path is located close to Cape Ashizuri, the clockwise mean circulation is enhanced in the entire SIS, promoting eastward transport of larvae in Harima Sea.

Keywords: Seto Inland Sea, Kuroshio-induced through flow, larval dispersal, JCOPE2-ROMS oceanic downscaling

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