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Coastal dispersal of the land-derived tracer in an estuary and a continental shelf margin

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Coastal marginal seas and estuaries are generally dumpsites for waster water from sewage and power plants (e.g., Uchiyama et al., 2014). Accidental leakage of toxic materials may result in serious hazardous incidents that should be predicted and assessed urgently upon the occurrence. We therefore develop an offline passive tracer model that computes 3D dispersal of arbitrary Eulerian tracers with a point source capability by exploiting 3D oceanic model reanalysis and prediction such as JCOPE2 (Miyazawa et al., 2009). The purposes of the present study are to investigate (1) reproducibility of the offline tracer dispersal against the online result, and (2) difference in spatiotemporal variability of the leaked tracers in a semi-enclosed estuary (viz., Seto Inland Sea, Japan; SIS) and in an open coast environment on the continental margin off Shizuoka Prefecture on the Pacific side of Japan.

For the first objective, we analyze with the double-nested JCOPE2-ROMS downscaling system for the entire SIS at the horizontal resolution of 600 m. The release site is chosen on the southern coast of the Iyo Sea. The tracer has been discharged for 11 days in 4 different seasons since the 1st day in Feb., May, Aug., and Nov., 2013, and tracked for 31 days after each release. Overall similarity in the dispersal pattern is obtained for both the online and offline cases, whereas some undesirable negative concentration arisen from a discrete advection scheme induces a slight deviation in the inventory of the released tracer between the two cases. Tidal oscillations enhance local dilution, while the month-long transport is dominated rather by inter-seasonal variability of the clockwise circulation of the SIS. The comparative offline tracer computation for the open coast off Shizuoka is conducted with another double-nested JCOPE2-ROMS downscaling model result for the Kuroshio region at the horizontal resolution of 1 km. The tracer release occurs near the Cape Omaezaki and is done in the same way as the SIS runs. The Kuroshio readily traps the released tracer in the offline open coast run, leading to immediate transport in the northeast direction. The seasonal difference of the tracer dispersal is apparent, depending on the locations of the Kuroshio axis.

Keywords: coastal dispersal, Eulerian passive tracer, offline tracer model, ROMS, downscaling ocean model, JCOPE2