Interactive effects between suspended sediment matter and physical processes induced by high riverine discharge on a microtidal open bay

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Rivers transport freshwater, suspended sediment matter (SSM), and nutrients from land to coastal seas. In coastal seas termed as regions of freshwater influence (ROFIs), SSM is not only passively transported but also changes density of ambient water and influences physical characteristics especially in flood events, when a lot of SSM and nutrients are supplied to ROFIs. Although the influence of SSM on physical fields in ROFIs would be significant, the interaction between SSM and physical processes such as river plumes and estuarine circulations has yet to be sufficiently investigated for hypopycnal plumes (i.e. the riverine sediment-freshwater is not denser than the seawater). In order to quantitatively estimate the interactive effects of SSM, we employ a non-hydrostatic ocean model with Lagrangian particles, which represents SSM and affects the density and buoyancy of ambient water. A simple lower-trophic-level marine ecosystem model is also incorporated with the model. We especially focus on the case of hypopycnal plume during the developing stage initiated by a flood on a microtidal open bay (Tango Bay), Japan. The width and length of Tango Bay opening to the Sea of Japan are ~18 km and ~21 km, respectively, which is wide enough for the Coriolis force to influence river plumes. The bay has only one river (the Yura River) dominating the freshwater supply to the bay. The model simulations demonstrate that a large amount of riverine SSM affects the physical field in ROFIs through the following process: 1) horizontal density differences between nearshore and offshore waters are reduced as apparent density is increased close to the river mouth by riverine SSM, 2) the strength of vertical estuarine circulation is weakened by the reduced horizontal density difference, and 3) vertical water exchange between the surface and the subsurface layers decreases. As a result, the physical process by large SSM could change the surface salinity, net primary production by the river plume, and sediment distribution on the seafloor near the river mouth.

