Development of low trophic ecosystem model for land sea integral management in the Toyama Bay, Japan

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Japan Sea is concerned by the issues of water temperature increase with the global warming and of nutrient input increase from the East China Sea in the near future. We must understand how the coastal areas opening to the Japan Sea are affected by those changes and how we should manage the coastal areas to adapt those changes. Toyama Bay, one of the bays opening to Japan Sea, is constantly subjected to the influence of the Tsushima Warm Current. Meanwhile, influences from land areas through river discharge and submarine ground water (SGW) are also large. Therefore, in addition to the impact of environmental change in the Japan Sea in the Toyama Bay, the land and marine areas around the Toyama Bay should be managed integrally in consideration of changes in river discharge with global warming and the changes in groundwater use. We are developing a hydrodynamic based low trophic ecosystem model for the Toyama Bay in order to quantify the influence of environmental changes on the bay. In this study, we calculate the nutrient (DIN) supply by lateral and vertical advections of sea water to the bay from the model result and compared them with those from rivers and SGM.

The hydrodynamic model for the Toyama Bay is called DREAMS-T here, which is based on Data assimilation Research of the East Asian Marine System (DREAMS; Hirose et al., 2013). This model has a resolution of 1/60°×1/75° (approx. 1.5 km) in longitude and latitude directions, respectively, and has 36 layers in the vertical direction. The calculation period is 2006/3/1~2007/12/31. A NPZD type low trophic ecosystem model is combined with the DREAMS-T. Results of DREAMS-M are given as lateral conditions for the DREAMS-T and GPV-MSM data are used as air sea boundary conditions. Daily river discharges of major five rivers (Oyabe, Shou, Jintsu, Jyouganji, and Kurobe River) are added from the grids corresponding to the river mouths. Nutrient concentrations of river water are from Tsujimoto (2012). The effects of SGW is included by doubling the nutrient concentration of river waters in the model because the SGW discharge is little compared to the river discharges but the nutrient flux from SGW is at the same order as those from rivers.

Using model results, we carry out a budget calculation of DIN for the water shallower than 100 m depth in the Toyama Bay. The DIN fluxes by the lateral and vertical advections, especially vertical advection, is dominant in spring, autumn and winter. In summer (June - August), the DIN influx by the advections decreases while those by river discharge and SGW increase and becomes larger than the DIN influx by the advections. This indicates that the nutrients needed by primary production are supplied mainly by upwelling in spring, autumn, and winter, but mainly by river and SGW in summer. In the meeting, we will also report the influences of seasonal shift in river discharge (increasing of river discharge in winter and decreasing in summer) due to change in melting snow with global warming on the ecosystem in the Toyama Bay.

Keywords: Toyama Bay, low trophic ecosystem model, river discharge, submarine ground water, global warming

