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Estimating submarine groundwater discharge in Obama Bay, Japan, using 222Rn mass balance model

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Recently, a number of studies have shown that submarine groundwater discharge (SGD) is even more important than surface runoffs in terms of nutrient transport and can drive primary production in coastal seas. Obama Bay is semi-enclosed bay in central Japan. In spring, phytoplankton blooms in the bottom layer around 2 km offshore from the river mouth. Aquifer distribution in the Obama plain and our previous observation of low salinity water around the bottom layer suggests that unconfined groundwater discharges induce this phytoplankton bloom. However, quantitative contribution of groundwater discharge to the coastal ecosystem has not been well evaluated in Obama Bay. In this study, we estimated the input of freshwater and nutrients via SGD into Obama Bay using mass balance model of radon (^{222}Rn) and salinity. As a result, the volume of SGD into the bay was estimated to be 0.05-0.80$\times 10^6$ m^3 d^{-1} during February 2013 to November 2013. Especially, the fraction of SGD in total freshwater flux in summer reached to 44%, because river water discharge decreased drastically. The nutrient fluxes from SGD were approximately 84%, 210% and 28% of riverine fluxes dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorous (DIP) and dissolved inorganic silicate (DSi), respectively.

Keywords: Submarine groundwater discharge, 222Rn mass balance, Obama Bay