

Evaluation of submarine groundwater discharge in coastal aquifers at Osaka Bay, Japan

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In recent studies, it is recognized that the groundwater which contains nutrients can have a significant influence on coastal ecosystems. Submarine groundwater discharge (SGD) consists of terrestrial fresh groundwater and recirculated seawater which circulate across the aquifer-ocean interface. Recirculating seawater, which often constitutes a large portion of the total SGD, is an important component as it transports not only salt but also other chemicals from the ocean to the aquifer. Near the shore, seawater recirculation across the interface is driven primarily by tidal oscillations, waves and density variations between fresh groundwater and seawater. Recent numerical simulations show the formation of water circulations in the aquifers near the shoreline owing to the tidal oscillations. However, these calculation results do not compare with a field observation and are not necessarily an enough verification.

The objective of this study is to evaluate the SGD mechanism in the Omaehama, Osaka bay under the influence of tidal effects. The developed numerical model was verified by comparing the results with the observed SGD in the Osaka bay. The study area is located in the coast of Omaehama, Osaka, Bay, Nishinomiya city, Japan. The automated seepage meters with diameter of 500mm was installed to evaluate water dynamics below the beach slope. Electric resistivity and subsurface temperature were also observed to evaluate the terrestrial groundwater among SGD during one tidal cycle.

A model capable of multi-species transport with density-dependent flow is required to simulate the tidal influence on groundwater hydrodynamics, salt-water intrusion and chemical transport. SEAWAT-2000 (Langevin et al., 2003) was chosen to perform this simulation.

Numerical simulations with two difference changes of tidal fluctuations have been done to evaluate the characteristic of the SGD. The results shows that seawater recirculation induced by tide was occurred when the tidal fluctuations was large. This result qualitatively agree with the observation results, therefore the numerical model incorporating tidal effects is useful for evaluation of SGD including recirculated seawater.