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The features of submarine groundwater discharge at the coastal area, Ise bay, Japan

Ikumi Tabata[1]; Kunihide Miyaoka[2]

[1] Graduate School of Education,Mie Univ; [2] Faculty of Education, Mie Univ.

Introduction

It is focused that submarine groundwater discharge (SGD) contributes the seawater quality and ecosystem at the coastal area. Taniguchi et al. (2006) showed the fresh water discharge volume from land to the ocean; 35,000-40,000km^3/y river water discharge to the ocean, and 2,600-6,300km^3/y groundwater discharge to the ocean. Whereas, according to many previous studies, groundwater-seawater interaction mechanism depends on many regional conditions, so we carefully should carried out in each study area, considering such conditions.

The purpose of this study is to estimate the volume of submarine groundwater discharge and its seasonal change, Ise bay, Japan.

Study area

The study area is the coastal plain located at the mouth of the Shitomo River. Two sandbars are distributed, and there are residential areas and agricultural fields. Two lagoons are present, and there are rice fields and wetlands. An alluvial plain is present on the western side of the inland sandbar. Steep slope is distributed at near shore line and about 200m offshore.

Method

A conductivity-temperature-depth (CTD) sensor was installed at under sea floor at depths of 30cm at four sites from the tidal zone through 54m offshore. CTD sensor was also installed in the depth of 5m, 10m, 20m observation wells at the tidal zone. Continuous measurements of electric conductivity, water temperature, and water level were made at 2-min intervals from low tide to next day low tide (24 hours). Manual seepage meter was installed at the same site as under the sea floor CTD sensor installed site. Seawater collected at 30-minutes each and measured discharge volume at 3-hour intervals. Hourly measurements of resistivity from onshore to offshore were made 3-hour intervals by using the Schlumberger method the same period as CTD censor measurement. These measurements were carried out on 21-22 March, 31 July- 1st August, and 13-14 August 2008.

Result and discussion

The groundwater level in March was higher than that in August at the land area, besides the electric conductivity in March was lower than in August. This tendency was remarkable at near the coastal zone. This shows that the SGD volume in March is larger than that in August. It is also corroborated by the result that SGD volume in the non irrigation period is larger than that in irrigation period and the cross-section of resistivity distributions resistivity survey.

The maximum SGD volume shows 0.0237m^3/m^2/h in March, and 0.0103m^3 /m^2/h in August at SGD site located at the nearest of coast line. Also, submarine fresh groundwater discharge (SFGD) volume is occupied 91.1% of the total SGD volume in March, and 97.4% in August. These show that when fresh water discharge volume is large, recirculated saline groundwater discharge (RSFGD) is also large. So, the pressure balances between groundwater flow and seawater intrusion control with SFGD-RSFGD mechanism.

The changes of PO ion concentration and electrical conductivity showed existence of submarine groundwater discharging period and seawater intruding period. The area of these element values are stable from low tide through high tide suggest that Submarine groundwater is always discharge. These tendencies depend on submarine topographic conditions.

The volume of SGD was estimated by the relation to submarine topographic condition.

The features of submarine groundwater discharge are controlled by the relation between groundwater flow conditions and tidal condition, and its seasonal change. The volume of submarine groundwater discharge shows large in the winter season and before and after high tide period in this study area.