Development of the groundwater flow model to estimate submarine groundwater discharge in Ariake Bay, Japan

Jun Yasumoto[1]; Yoshifumi Nishiumi[2]; Mamoru Katsuki[3]; Hirotsugu Suemasu[4]; Yoshinari Hiroshiro[5]; Kenji Jinno[6]

[1] Engineering, Kyushu Univ.; [2] Urban and Environmental System,Kyushu Univ; [3] Environmental Engineering, Kyushu University; [4] Urban and Environment, Kyusyu Univ; [5] Environmental Systems, Kyushu Univ.; [6] Urban and Environmental Engineering, Kyushu Univ.

http://www.civil.kyushu-u.ac.jp/suiken/

During the part few decades, submarine groundwater discharge (SGD) has been recognized as an important factor of environmental and ecological impacts in the coastal regions. Although the field measurements using seepage meters are useful for a local characterization, it is difficult to extrapolate the observed values for the large scale. Furthermore, it is also difficult to estimate the SGD in a large basin having many rivers like Ariake bay in Kyushu Island, Japan. In this study it is attempted to develop a new method to estimate the SGD using the regional scale groundwater flow model.

The Ariake bay catchment extends over 8000km^2. In the numerical simulation model for groundwater flow and water budget estimation, one grid mesh with 500m$*$500m was used and the entire catchment was divided into 30612 cells. The information on land use and precipitation were assigned to all cells. The precipitation and river discharge data for the period from 2004 to 2006 were used. A quasi-three dimensional fresh-salt water groundwater flow model combined with groundwater recharge model was applied. In the groundwater recharge model, the land use was taken into consideration.

By applying this model, both groundwater flow and saltwater intrusion were simultaneously simulated. The groundwater recharge model used in the water budget estimation and the groundwater flow analysis functioned to separate rainfall into direct runoff component, evapotranspiration and groundwater recharge.

The result shows that annual river specific runoff and groundwater level agree with observed values reasonably. As a result, the annual SGD rate to Ariake Bay was 11% of total rainfall at the catchment. This figure accounted for 15% of total water discharge and remained within the range from 10 to 31% of total water flux which is reported by the literatures.