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Distributions of Rn-222 activities in surface water and groundwater and determining groundwater discharge rate in Songji Lagoon, South Korea

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This study aims to quantitatively estimate the amount of groundwater discharge into Songji Lake the lagoonal environment by monitoring the radon isotope (Rn-222), a radioactive environmental tracer to understand the groundwater-surface water interaction characteristics.

Groundwater-surface water interaction and the groundwater level fluctuations due to climate change (heavy rainfall and drought) were assessed in Songji Lake of the study area since a large amount of freshwater enters the lake during the monsoon season, resulting in changes in salinity and water quality characteristics. Songji Lake is located in Goseong, Gangwon Province in South Korea, with the area of 0.54 km^2 and a maximum water depth of 5 m.

Sampling was conducted to analyze the chemical properties from surface waters (Songji Lake sample), groundwaters, stream and seawater in the study area. The electrical conductivity (EC) and the concentration of Rn-222 of the groundwater and stream inflowing into Songji Lake showed an EC range of 244-32,900 μS cm-1 for groundwater, with deep groundwater showing higher EC and shallow groundwater showing lower EC comparing to the EC of surface water. Rn-222 contents of groundwaters were in the range of 12.8-267 Bq L-1 approximately 100 times higher than those of surface water and seawater. The Rn-222 concentration of stream water was determined below the detection limit of LSC (0.22 Bq L-1).The concentration of Rn-222 of Songji Lake waters showed 9-19 Bq L-1 with an average of 14±3 Bq L-1 determined using RAD7. The seawater revealed relatively higher EC contents of 48.3 mS cm-1.

Groundwater discharge was estimated using the Rn-222 concentrations of groundwater and surface water in the vicinity of Songji Lake with assuming a simple box model and steady-state conditions. The estimated groundwater discharge was approximately (2.3±2.8)×103 m^3/day.

Overall, this study plays a major role to give valuable information on the mechanism of groundwater discharge into Songji Lak. The data determined will be very useful to understand the groundwater-surface water interaction and the groundwater level fluctuations due to climate change.