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Sensitivity analysis of hydrogeological parameters affecting groundwater storage change caused by sea level rise

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Sea level rise, which is one of the representative phenomena of climate changes caused by global warming, can affect groundwater system. The rising trend of the sea level caused by the global warming is reported to be about 3 mm/year for the most recent 10 year average (IPCC, 2007). The rate of sea level rise around the Korean peninsula is reported to be 2.30±2.22 mm/yr during the 1960-1999 period (Cho, 2002) and 2.16±1.77 mm/yr (Kim et al., 2009) during the 1968-2007 period. Both of these rates are faster than the 1.8±0.5 mm/yr global average for the similar 1961-2003 period (IPCC, 2007).
In this study, we analyzed changes in the groundwater environment affected by the sea level rise by using an analytical methodology. We tried to find the most effective parameters of groundwater amount change in order to estimate the change in fresh water amount in coastal groundwater. A hypothetical island model of a cylindrical shape in considered. The groundwater storage change is bi-directional as the sea level rises according to the natural and hydrogeological conditions.
Analysis of the computation results shows that topographic slope and hydraulic conductivity are the most sensitive factors. The contributions of the groundwater recharge rate and the thickness of aquifer below sea level are relatively less effective. In the island with steep seashore slopes larger than 1∼2 degrees or so, the storage amount of fresh water in a coastal area increases as sea level rises. On the other hand, when sea level drops, the storage amount decreases. This is because the groundwater level also rises with the rising sea level in steep seashores. For relatively flat seashores, where the slope is smaller than around 1-2 degrees, the storage amount of coastal fresh water decreases when the sea level rises because the area flooded by the rising sea water is increased. The volume of aquifer fresh water in this circumstance is greatly reduced in proportion to the flooded area with the sea level rising. Since relatively flat seashores where the slope is less than 1-2 degrees are much more common in Korea, it is expected that the quantity of fresh groundwater storage in most of the coastal region in Korea will be greatly reduced with sea level rise.

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