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Florida’s Groundwater and Surface Water System Reliability in Terms of Climate Change and Sea-Level Rise

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Abstract : Florida is one of the most vulnerable states to natural disasters among the 50 states of the USA. The state exposed by tropical storms, hurricanes, storm surge, landslide, etc. Besides, the mentioned natural phenomena, global warming, sea-level rise, and other anthropogenic environmental changes make a very complicated and unpredictable system for decision-makers. In this study, we tried to highlight the effects of climate change and sea-level rise on surface water and groundwater systems for three different geographical locations in Florida; Main Canal of Jacksonville Beach (in the northeast of Florida adjacent to the Atlantic Ocean), Grace Lake in central Florida, far away from surrounded coastal line, and Mc Dill in Florida and adjacent to Tampa Bay and Mexican Gulf. An integrated hydrologic and hydraulic model was developed and simulated for all three cases, including surface water, groundwater, or a combination of both. For the case study of Main Canal-Jacksonville Beach, the investigation showed that a 76 cm sea-level rise in time horizon 2060 could increase the flow velocity of the tide cycle for the main canal's outlet and headwater. This case also revealed how the sea level rise could change the tide duration, potentially affecting the coastal ecosystem. As expected, sea-level rise can raise the groundwater level. Therefore, for the Mc Dill case, the effect of groundwater rise on soil storage and the performance of stormwater retention ponds is investigated. The study showed that sea-level rise increased the pond’s seasonal high water up to 40 cm by time horizon 2060. The reliability of the retention pond is dropped from 99% for the current condition to 54% for the future. The results also proved that the retention pond could not retain and infiltrate the designed treatment volume within 72 hours, which is a significant indication of increasing pollutants in the future. Grace Lake case study investigates the effects of climate change on groundwater recharge. This study showed that using the dynamically downscaled data of the groundwater recharge can decline up to 24% by the mid-21st century.

Keywords : groundwater, surface water, Florida, retention pond, tide, sea level rise
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