Impacts of Seawater Rise on Seawater Intrusion in the Nile Delta Aquifer, Egypt

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Abstract:

Several investigations have recently considered the possible impacts of climate change and seawater level rise on seawater intrusion in coastal aquifers. All have revealed the severity of the problem and the significance of the landward movement of the dispersion zone under the condition of seawater level rise. Most of the studies did not consider the possible effects of the seawater rise on the inland movement of the shoreline and the associate changes in the boundary conditions at the seaside and the domain geometry. Such effects become more evident in flat, low land, coastal alluvial plans where large areas might be submerged with seawater under a relatively small increase in the seawater level. None of the studies combined the effect of increased groundwater pumping, due to the possible decline in precipitation and shortage in surface water resources, with the expected landward shift of the shore line. In this article, the possible effects of seawater level rise in the Mediterranean Sea on the seawater intrusion problem in the Nile Delta Aquifer are investigated using FEFLOW. The simulations are conducted in horizontal view while considering the effect of the shoreline landward shift using digital elevation models. In addition to the basic run (current conditions), six different scenarios are considered. Scenarios one, two, and three assume a 0.5m seawater rise while the total pumping is reduced by 50%, maintained as per the current conditions and doubled, respectively. Scenarios four, five, and six assume a 1.0m seawater rise and the total pumping is changed as in the first three scenarios. The shoreline is moved to account for the seawater rise and hence the study domain and the seaside boundary are modified accordingly. It is concluded that, large areas in the coastal zone of the Nile Delta will be submerged by seawater and the coast line will shift landward by several kilometers in the eastern and western sides of the Delta. Scenario six represents the worst case under which the volume of freshwater will be reduced to about 513 km3 (billionm3).

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