Simulation of impact of present and future groundwater extraction from the non-replenished Nubian Sandstone Aquifer in southwest Egypt

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Abstract:

A numerical time-dependent groundwater model of the Nubian Sandstone Aquifer in Egypt is presented. A complete database of the hydrogeological and drilling information of 850 water wells drilled in the period 1960-2000 was evaluated and used for the model parameter input as well as for its calibration. A steady-state condition is rejected even for the pre-development time as the subsurface inflow across the Egyptian/Sudanese borders is lower than discharge, and the observed hydraulic gradient is residual gradient and not due to steady-state flow. The results of the long-period simulation (10,000 years) indicated that the Nubian Sandstone Aquifer is still under the influence of the past humid period and has been in an unsteady depleting process. Therefore, groundwater development plans should be based on this concept. The calibrated model was used to investigate the hydrodynamic impacts of the present and planned groundwater extraction on the potentiometry of the aquifer. The simulation results indicate that there is a real danger of groundwater depletion, particularly in the shallow aquifer in some areas. In fact, if the planned extraction of 1,200 million m³/year in East Oweinat area is imposed, drawdown after 100 years could be as much as 200 m relative to 1960s levels. By this time the cone of depression will extend to Dakhla and Kharga oases.

Keywords:

Groundwater flow modeling, Numerical modeling, Nubian sandstone Aquifer

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