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# GROUNDWATER WITHDRAWAL AND SUBSIDENCE IN THE BASIN OF MEXICO

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## ABSTRACT

The groundwater pumping in Mexico City produces effects that have been linked to severe environmental impacts such as subsidence, inducement of bad quality groundwater and drying of springs. This work treats this problem and develops a mathematical model for the Mexico´s aquifer system, which corresponds to a leaky aquifer limited in its surface by a clayed aquitard. The aquifer is in a depressurization process due to the extraction of groundwater from the aquifer and the aquitard; its effects are: the drainage of the aquitard through the aquifer and its consolidation, and concomitantly the subsidence of the ground surface. Consequently, for an effective aquifer use it is necessary to study its behaviour. Subsidence is significant mainly because the storage capacity Mexico City's clays are quite big and therefore the integrodifferential equations approach to leaky aquifers was applied to model the aquitard performance.

The process of subsidence was evaluated by the following steps. The linear treatment of clays is incorporated by means of the aquitard integrodifferential formulation[1, 2]. The integrodifferencial equations were obtained when the behaviour of the aquitards separating aquifer formations was analyzed, mainly when the storage has an important role in the answer of a semi confined aquifer. Once established the boundary conditions and carried out the calibration of the model, a quantitative simulation of the potentiometric level changes with time was obtained.

A computational model for three dimensional flow simulations in study area (Fig 1) was developed[3]. Taking advantage of the possibilities a of a computational model available, the superficial aquitard is simulated incorporating injected water into the aquifer (Fig 4), whose magnitude is determined by the subroutines, and are inserted in the cells where aquitard is overlying the granular aquifer; taking into account the distribution of hydraulic conductivities. In general all water levels have a continuous drawdown (Fig 2), as a result of abstraction, which induces a negative evolution of the surface level (Fig 3).

There are complex coupled aspects of subsidence and flow in porous media: the injected water into the aquifer must be balanced applying the corresponding formulation of the hydraulic parameters, the specific storage coefficient and the hydraulic coefficient.


**Figure 1. Location of the study area in the endorheic basin of Mexico**

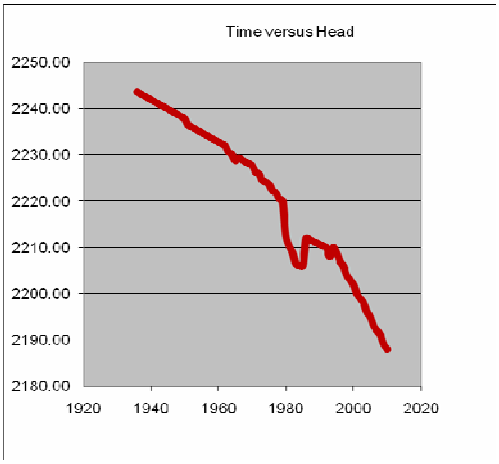


**Figure 2 piezometric level evolution, years versus meters**

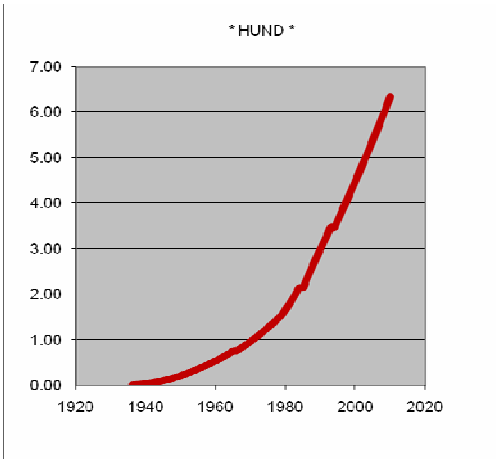


**Figure 3. subsidence evolution , years versus meters**

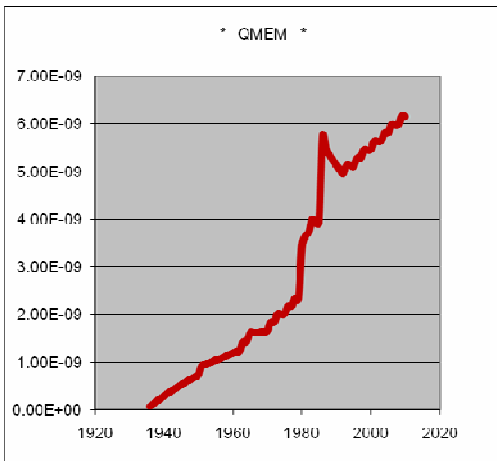


**Figure 4 evolution of discharge, years versus $m^3/s$**

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