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SUTRA AND HST3D MODELING AND MANAGEMENT OF SALTWATER INTRUSION FROM BRACKISH CANALS IN SOUTHEAST FLORIDA.

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ABSTRACT

Salt water intrusion has been of concern in South Florida for quite some time. In addition to classical, horizontal sub-wedging oceanic intrusion, vertical infiltration of brackish sea water from the many open sea-canals has now become a major threat to the public water supply, particularly, since increasing water demands have lowered the groundwater table, destroying the sensible hydraulic balance between canal stage and surrounding aquifer head.

The phenomenon of vertical infiltration of saltwater into an aquifer is a density-driven instability problem and is governed by the dynamical interaction of the denser, saline water with the fresh surrounding groundwater. For the numerical solution of the problem we have extended earlier 2D SUTRA-model studies of the first author by 2D and 3D HST3D simulations, using a conceptual model that includes seasonal changes of the groundwater level, tidal variations of the canal stage, rainfall recharge, and a low permeability layer which mimics the canal bed.

As expected, whether salt water from the brackish water canal intrudes into the aquifer, depends on the adjacent groundwater table elevation: Lowering the latter during a dry season may initiate the seepage process which then becomes essentially irreversible. A significant influence of the short-term tidal fluctuations on the long-term dispersion of the vertical saltwater plume in the aquifer is found. A comparison of the outcomes of the SUTRA and HST3D models shows that minor differences exist but that the latter do not affect significantly the conclusions.

We have applied the models to simulate in more detail the possibility of brackish saltwater intrusion from the C-10 canal into the adjacent aquifer, where several drinking water pumping wells are in use, accentuating the problem further. This is especially the case for the large Hollywood well field. The models are used to simulate how future increased pumping rates could trigger a further advance of the present-day C-10 brackish intrusion front and what kind of management strategies could be taken to stop or even revert the intrusion. The results of the models suggest that to attain this objective, a sufficiently high groundwater table has to be created, especially during dry seasons. The effectiveness and practicality of two variants of such a “hydraulic barrier" are evaluated: (1) aquifer injection of reclaimed wastewater, proposed by Floridan agencies, which would create a permanent groundwater mound; (2) construction of a freshwater canal whose gage height would be maintained at an all-season sufficiently high level, with the effect of also raising the groundwater table. The numerical models suggest that because of the huge quantities of water needed for the injection, the first option is not viable, whereas the second one of a fresh water canal along the brackish water canal would serve its purpose.

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