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# Laboratory-scale investigations of Aquifer Storage Recovery (ASR) implementations with image analysis and numerical modeling

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Artificial Storage Recovery (ASR) is a widely used strategy for water resource management in coastal aquifers, the recovery efficiencies of which are determined by density-driven flow dynamics. Computer simulations of such flow dynamics are often limited by simplification of complex physics while field experiments are intensive in both time and resources. In this study, a physically scaled two dimensional coastal homogeneous aquifer is modeled by a 2 m x 1 m x 5 cm (L x H x W) sandbox with graded sand as aquifer material and saltwater tanks on the sides to represent seaside boundary conditions. A Nikon-D5000 camera was used to record the flow dynamics of freshwater and saltwater in response to different combinations of recharge wells and extraction wells in the sandbox. Freshwater and saltwater were colored with different dyes for visualization and subsequent image analysis. The images were corrected and analyzed to compute non-dimensional parameters related to freshwater growth, dispersion, saltwater intrusion, and consequent recovery efficiencies. The values obtained from the image analysis are compared with numerical models calibrated against salinity point measurements. They show good agreement and provide a basis for quantifying density-drive effects due to the ASR strategies. This can be an inexpensive approach to physically simulate ASR efficiency values and gain more insight into ASR performance in real world cases.