Supplementary material

Sensitivity analysis scenario: Impact of applied hydraulic head difference

A centrally fractured numerical aquifer, identical with the one presented in the section 4.2.3, was employed in this section. Five distinct numerical setups were created in which the initial saline intrusion was triggered by hydraulic head differences (dH) that were equal to 4 mm (top aquifer), 5 mm, 6 mm, 7 mm and 8 mm (bottom aquifer) respectively. After the intruding saline wedges stabilized, freshwater was pumped out of the system, until well salinization was achieved. It has been long established that in head driven SWI, smaller values of applied dH result in longer intruding wedges. This is a basic principle applying to both homogeneous [27] and fractured coastal aquifers [46] alike. The results of the subsection 4.2.3 indicated that application of various abstraction rates from the area above the discontinuity had a limited impact on the saline wedges extent at the bottom of the system. The data presented in Figure S1c, showing a clear negative correlation between TL and dH, which agrees with those previous findings, and demonstrates the weak influence that the saltwater upcoing mechanism has on the TL values in these fractured aquifers. Moreover, the saline wedge in the first test aquifer, where dH = 4 mm was applied, had the largest TL value (29.73 cm) in all six sensitivity analysis scenarios of this study, indicating that out of the all the investigated aquifer characteristics, the applied hydraulic head difference has the most significant impact on the TL values in fractured coastal aquifers under critical pumping. Since the pre-pumping saltwater – freshwater interface was located further inwards, and thus closer to the well, for the lower dH cases, critical abstraction rates presented a linear positive correlation to the hydraulic head difference applied in the aquifer (Figure S1b). Boundary conditions aside, all other aquifer characteristics were the same for the five test cases. Because of that, the two remaining SWI variables, non-fresh and mixed concentration volume fractions, presented a correlation with the dH that was comparable to the aforementioned TL - dH relationship (Figures S1d and e).

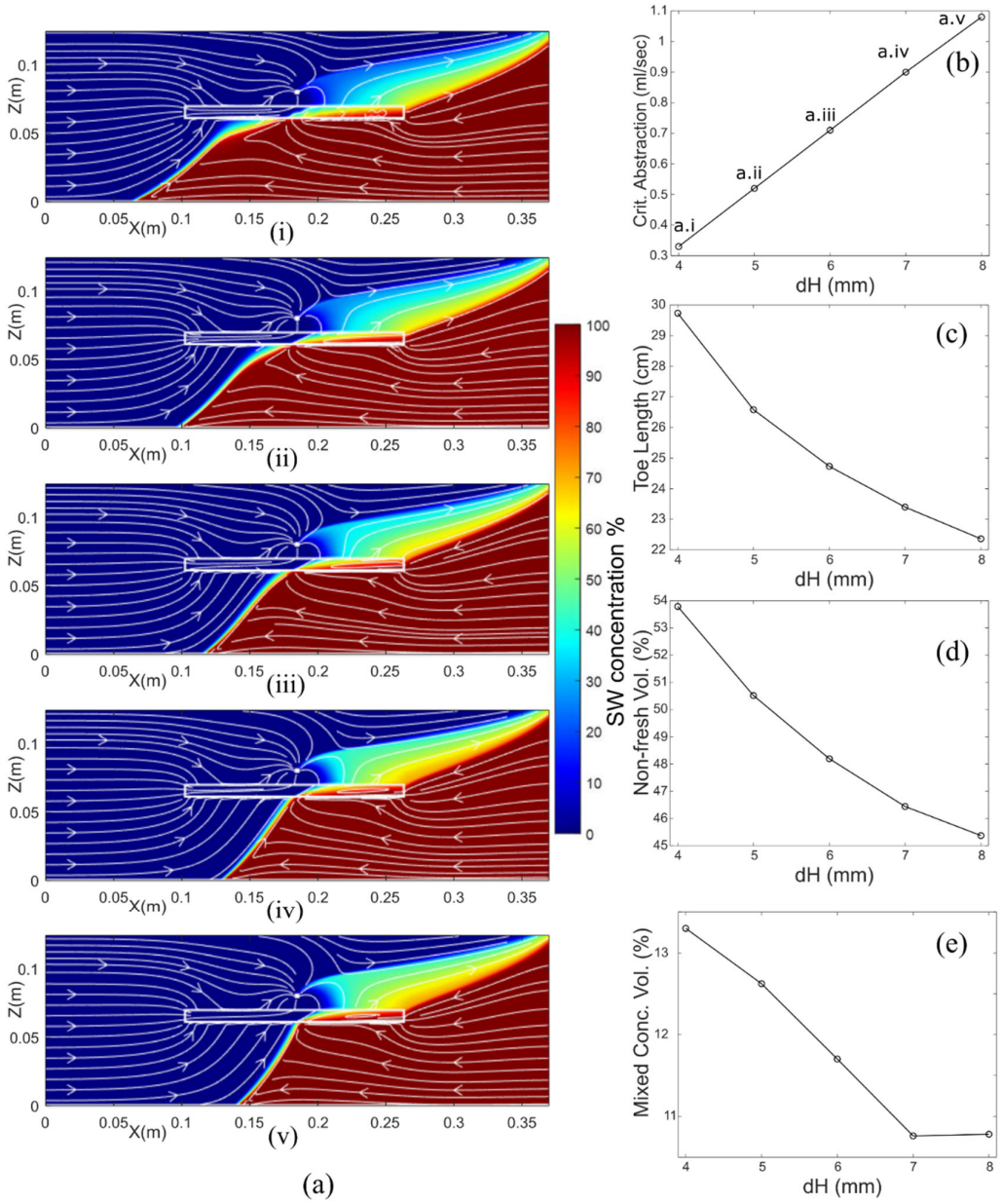

Figure S1. Simulated a) critical SW concentration fields alongside their corresponding values of b) critical abstraction rates, c) toe length, d) non-fresh and e) mixed-concentration volume fractions, demonstrating the impact of the applied hydraulic head difference on the saltwater upconing mechanism.