

Modeling Tide-induced Groundwater Response in a Coastal Confined Aquifer Using the Spacetime Collocation Approach

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Abstract

This paper presents the modeling of tide-induced groundwater response using the spacetime collocation approach (SCA). The newly developed SCA begins with the consideration of Trefftz basis functions which are general solutions of the governing equation deriving from the separation of variables. The solution of the groundwater response in a coastal confined aquifer with an estuary boundary where the phase and amplitude of tide can vary with time and position is then approximated by the linear combination of Trefftz basis functions using the superposition theorem. The SCA is validated for several numerical examples with analytical solutions. The comparison of the results and accuracy for the SCA with the time-marching finite difference method is carried out. In addition, the SCA is adopted to examine the tidal and groundwater piezometer data at the Xing-Da port, Kaohsiung, Taiwan. The results demonstrate the SCA may obtain highly accurate result. Moreover, it shows the advantages of the SCA such that we only discretize by a set of points on the spacetime boundary without tedious mesh generation and thus significantly enhance the applicability.

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