Revisiting the stream-aquifer flow problem with a flux-based Green element model

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Abstract

This revisit of the stream-aquifer problem is based on a recent flux-based Green element formulation which offers more accurate solutions than previous formulations presented in Taigbenu (2003). Its accuracy also surpasses those provided by finite element and finite difference methods using grids that are coarser. As in all Green element formulations, the current formulation is predicated on the singular boundary integral theory that is implemented in an element-by-element fashion. What is new in the current formulation is that it calculates the fluxes at all nodes and not only at external nodes. While this approach exhibits much improved accuracy, its drawback lies with handling an increased number of unknowns. This drawback is, however, compensated for by the fewer elements required to achieve accuracies comparable to other conventional numerical methods. In this paper, it is demonstrated that with between 20% and 30% of elements used in finite element and finite difference models, comparable accuracy is achieved with this formulation. The main significance of the current computational technique is that it preserves the flux calculations in a manner that is consistent with the stream-aquifer interaction problem.

Keywords: stream-aquifer interaction, The Green element method