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Finite difference methods for fractional advection dispersion equations

In recent years, fractional differential equation (FDE) models have been proposed in many fields such as fluid dynamics, geology, finance, biology and so on. Simultaneously reliable numerical methods for FDEs are in great demand and this talk is a contribution on this direction. We focus our attention on time fractional advection dispersion equations (TFADE) as potential tools for the prediction of the environmental consequences of groundwater contamination. For an initial boundary value problem for a linear two dimensional TFADE with variable coefficients, we consider a new implicit, consistent, unconditionally stable and convergent finite difference method of solution. Additionally, we develop a stable method of solution for an inverse problem based on a linear one dimensional TFADE. We offer illustrative numerical experiments and some insight on our current research on FDEs with time and/or space fractional derivatives.