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Data assimilation in density-driven subsurface flows through a localized Iterative Ensemble Kalman Smoother

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We apply a lag-one localization scheme for the Iterative Ensemble Kalman Smoother (LIEnKSlag-one) to jointly update system parameters and state variables in a variable-density groundwater flow setting. We consider a seawater intrusion scenario corresponding to a variant of the Henry problem under the action of pumping. Equivalent freshwater head, hf, and salinity, Sa, are taken as state variables and hydraulic conductivity, K, as system parameter. The performance of LIEnKSlag-one is assessed in terms of its ability to cope with different observation types and quantity, magnitude of measurement error, and temporal frequency of data assimilation. We find that LIEnKSlag-one performs generally well when only hf data are assimilated. Our results show that hf data are more informative than Sa under the conditions examined. The most informative hf data are those which are collected in the proximity of the transition region between fresh and salt water and close to the pumping well. Our results suggest that implementing the Iterative Ensemble Kalman Smoother through a lag-one localization scheme is a viable and efficient strategy to enable data assimilation in density-driven subsurface flow.