

Computationally Efficient Tools for Parameter Estimation and Uncertainty Analyses

Scientific Achievement

Developed a strategy to employ computationally efficient and practical framework for parameter estimation and prediction uncertainty analysis in complex subsurface flow and transport problems

Significance and Impact

Improved computational efficiency of both ensemble-based algorithms and calibration-constrained null-space Monte Carlo (NSMC) methods to provide a tool for model-based decision making and applied for an actual CO₂ pilot project, Cranfield, MI

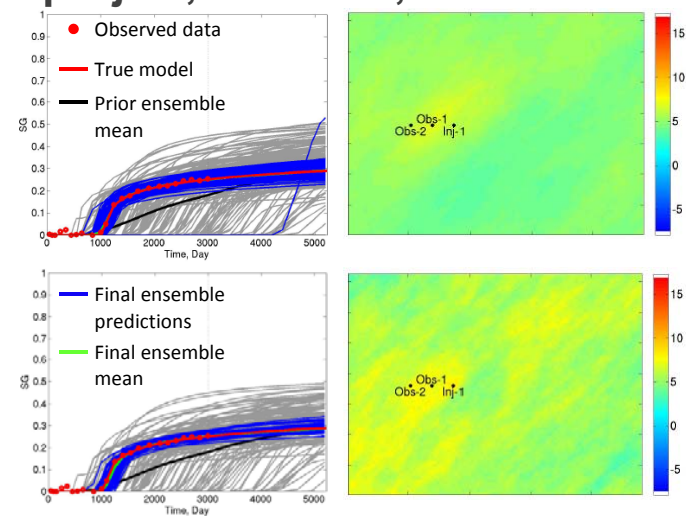
Publications

- Delshad, M., X. H. Kong, R. Tavakoli, S. A. Hosseini, and M. F. Wheeler (2013), Modeling and simulation of carbon sequestration at Cranfield incorporating new physical models, *International Journal of Greenhouse Gas Control*, 18, 463-473.
- Tavakoli, R., H. Yoon, M. Delshad, A. H. El Sheikh, M. F. Wheeler, and B. W. Arnold (2013), Comparison of ensemble filtering algorithms and null space Monte Carlo for parameter estimation and uncertainty quantification using CO₂ sequestration data, *Water Resources Research*, 49(10), 1 - 20.
- Tavakoli, R., G. Pencheva, M. F. Wheeler, and B. Ganis (2013), A parallel ensemble-based framework for reservoir history matching and uncertainty characterization, *Computational Geosciences*, 17(1), 83-97.
- Yoon, H., D. B. Hart, and S. A. McKenna (2013), Parameter estimation and predictive uncertainty in stochastic inverse modeling of groundwater flow: Comparing null-space Monte Carlo and multiple starting point methods, *Water Resources Research*, 49(1), 536-553.

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(Left) History matching and prediction of gas saturation profiles using ensemble smoother (ES4) (top) and NSMC (bottom). (Right) Final updated mean of horizontal ln(k) fields with ES4 (top) and single calibration-constrained NSMC (bottom). (Modified from Tavakoli et al. 2013)



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