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A DiffeRential Evolution Adaptive Metropolis (DREAM) Particle Filter for Environmental Model Diagnostics

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Sequential Monte Carlo (SMC) approaches are increasingly being used in watershed hydrology to approximate the evolving posterior distribution of model parameters and states when new streamflow or other data are becoming available. The typical implementation of SMC requires the use of a set of particles to represent the posterior probability density function (pdf) of model parameters and states. These particles are propagated forward in time and/or space using the (nonlinear) model operator and updated when new observational data become available. Main difficulty in applying particle filters in practice is problems with ensemble degeneracy, in which an increasing number of particles is exploring unproductive parts of the posterior pdf and assigned a negligible weight. To ensure sufficient particle diversity at every stage during the simulation, I will present an efficient SMC scheme that combines particle filtering with importance resampling and DiffeRential Evolution Adaptive Metropolis (DREAM) sampling. Our method is based on the DREAM adaptive MCMC scheme presented in Vrugt et al. (2009), but implemented sequentially to facilitate posterior tracking of model parameters and states. Initial results using the Sacramento Soil Moisture Accounting (SAC-SMA) model have shown that our DREAM particle filter has the advantage of requiring far fewer particles than conventional SMC approaches. This significantly speeds up convergence to the evolving limiting distribution, and allows parameter and state inference in spatially distributed hydrologic models.