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Parametric Kalman filter : toward an alternative to the EnKF ?

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The ensemble Klaman filter (EnKF) has been designed as a practical implementation for the extended Kalman filter. In particular, EnKF is able to time propagate huge size covariance matrices thanks to the sampling of the initial distribution and its update during the analysis step. In this contribution we introduce and explore an alternative for the EnKF to implement the extended Kalman filter: the parametric Kalman filter (PKF). The basic idea is to approximate a covariance matrix by a parametric formulation (in place of the ensemble), then to design the evolution of these parameters along the tangent linear propagation and the analysis update. In the forecast step, the numerical cost of the PKF is equivalent to the cost of a single member of an EnKF. We present the formalism for the linear advection-diffusion equation with applications in chemical transport model, and then for the one-dimensional nonlinear advection-diffusion dynamics (Burgers equation). For these illustrations, the parametric model considered is the covariance model based on the diffusion equation, where the parametric Kalman filter describes the dynamics of the forecast error variance and of the local diffusion tensor.