Uncertainty quantification with Polynomial chaos expansion in Ensemble based data assimilation framework

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In hydraulic simulations, water level calculations suffer from uncertainty in various physical and numerical parameters that translate into uncertainty in simulated water level. Usually, a classical Monte-Carlo method sampling is used to quantify uncertainty, but this approach is quite expensive as it requires a large number of the forward model integrations. This study aims at developing a cost-effective stochastic approach adapted to open-channel flows assuming that the uncertainty is mostly due to roughness coefficient and input discharge. We investigate the ability of a polynomial chaos expansion to evaluate the probabilistic features of the water level with the same accuracy as classical Monte Carlo methods but at significantly reduced cost with the 1D hydraulic model MASCARET. The convergence of the polynomial truncation and estimation of the polynomial coefficients with a quadrature method are investigated. The performance of the surrogate model is first assessed on an idealized rectangular channel case with uniform geometry as well as for a 50km reach over the Garonne River, in steady flow. As a perspective, this surrogate model will be used in place of the forward model in a data assimilation framework with an ensemble Kalman Filter algorithm in order to compute the model error statistics at low computational, thus meeting with real-time forecasting operational constraints.