NON-GAUSSIAN DATA ASSIMILATION WITH STOCHASTIC BOUSSINESQ EQUATIONS FOR COASTAL OCEAN DYNAMICS

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Uncertainty prediction and data assimilation schemes for coastal ocean flows and internal waves are discussed and illustrated within the context of stochastic partial differential equations (SPDEs). Dynamically Orthogonal (DO) field equations and their adaptive error subspaces provide prior probabilities for a semiparametric data assimilation framework using Gaussian mixture models, the Expectation-Maximization algorithm and the Bayesian Information Criterion. Bayes' Law is then efficiently carried out analytically within the evolving stochastic subspace. The use of this non-Gaussian data assimilation scheme is illustrated for adaptive sampling, i.e. for predicting the optimal sampling plans. For the uncertainty prediction, semi-implicit projection methods are used for the mean and for the DO modes, and time-marching schemes of first to fourth order are used for the stochastic coefficients. Conservative second-order finite-volumes are employed in physical space with Total Variation Diminishing schemes for the advection terms. Examples are provided using time-dependent two-dimensional Boussinesq flows including internal waves.
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