Comparison of different approximation techniques for uncertain time series arising in ocean simulations

Pierre Sochala, Mohamed Iskandarani

Comparison of different approximation techniques for uncertain time series arising in ocean simulations.

The analysis of time series is a fundamental task in many flow simulations such as oceanic and atmospheric flows. A major challenge is the construction of a faithful and accurate time-dependent surrogate with a manageable number of samples. Several techniques have been tested to handle the time-dependent aspects of the surrogate including a direct approach, low-rank decomposition, auto-regressive model and global Bayesian emulators. These techniques rely on two popular methods for uncertainty quantification, namely Polynomial chaos expansion and Gaussian processes regression. The different techniques were tested and compared on the uncertain evolution of the sea surface height forecast at two location exhibiting different levels of variance. Two ensembles sizes were considered as well as two versions of polynomial chaos (ordinary least squares or ridge regression) and Gaussian processes (exponential or Matern covariance function) to assess their impact on the results. Our conclusions focus on the advantages and the drawbacks, in terms of accuracy, flexibility and computational costs of the different techniques.