Spatial logistic Gaussian process for density field modelling: application to stochastic inverse problems

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Nowadays, stochastic simulators are extensively used to accurately model both natural and artificial systems. The variations of involved response distributions across parameter space can not only concern their mean and/or variance but also other features including for instance shape or uni-modality versus multi-modality. In this setting, one often relies on surrogate modelling of the response distribution to perform precise inference while accounting for the usually high computational cost of simulations.

We present a class of models for non-parametric estimation of the thereby induced fields of probability distributions based on scattered samples of heterogeneous sizes. The considered Spatial Logistic Gaussian Process (SLGP) models deliver probabilistic predictions of distributions at candidate points, hence allowing us to perform uncertainty quantification on our predictions.

We demonstrate applicability of such approach on stochastic inverse problems. In particular, we show that relying on SLGP models allows for speeding-up Approximate Bayesian Computation methods and we illustrate it on applications from natural sciences.