Recently, there has been a growing interest in wireless sensor networks due to the advanced embedded network technology. Their applications include, but are not limited to, environment monitoring, building comfort control, traffic control, manufacturing and plant automation, and surveillance systems. The conventional inverse problem approach based on physical transport models is computationally prohibitive for resource-constrained, multi-agent systems. In contrast, Gaussian process and Gaussian Markov models have been widely used to draw statistical inference from geostatistical and environmental data. However, the statistical models need to be carefully tailored such that they can be practical and usable for mobile sensor networks with limited resources. In addition, reducing localization uncertainty in low-cost mobile sensors is very challenging. Thus, a fundamental problem in various applications is to correctly fuse the spatially collected data and estimate the process of interest under localization uncertainties. Motivated by the aforementioned issues, in this dissertation, we consider the problem of using mobile sensor networks to estimate and predict environmental fields modeled by spatio-temporal Gaussian processes and Gaussian Markov random fields. We derive the exact Bayesian solution to the problem of computing the predictive inference of the random field, taking into account observations, uncertain hyperparameters, measurement noise, and uncertain localization in a fully Bayesian point of view. The advantage of a fully Bayesian approach is the capability of incorporating various uncertainties in the model parameters and measurement processes in the prediction. We first show that the exact solution for uncertain localization is not scalable as the number of observations increases. To cope with this exponentially increasing complexity and to make it usable for mobile sensor networks with limited resources, we propose scalable approximations with a controllable tradeoff between approximation error and complexity to the exact solution. The effectiveness of the collection of the proposed algorithms is demonstrated by simulation and experimental results in many different scenarios.