

Make your own kind of sparse DAG; Fit your own special meshed Gaussian process. Methods, applications and software for Bayesian geostatistics

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Several fields of science are experiencing a massive growth in the complexity and size of data being collected. In forestry, ecology, and the environmental sciences, satellite images and remotely sensed data are increasingly being used to understand the impacts of climate change. Cheap, high frequency air quality monitors allow researchers to gain unprecedented access to hyperlocal data.

In these contexts, Gaussian processes can in principle help answer many scientific questions, especially when embedded in flexible Bayesian hierarchies. However, they perform poorly when challenged with massive datasets. To resolve these issues, I will introduce Meshed Gaussian processes (MGPs) and the associated Markov-chain Monte Carlo algorithms. MGPs are a class of spatial processes in which regions of a partitioned spatial domain are linked to a patterned directed acyclic graph (DAG).

These patterns, introduced by design, lead to computational advantages. I will consider hypercube DAGs for satellite imaging data and treed DAGs for multivariate misaligned data. Finally, I will introduce MCMC methods for more challenging non-Gaussian data types and R package 'meshed' for Bayesian geostatistics with multivariate multi-type spatial data.