

Predicting Missing Forest Inventory Data on a Lattice using the Stochastic EM-Algorithm and Spatially Varying Coefficients

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In Baden-Württemberg, a forest inventory is carried out periodically, where the nutrient concentrations in spruces and pines are intended to be observed on a regular lattice. At many points of this lattice the sampling requirements are not fulfilled and no values can be observed. The task is to get an impression, what values can be expected at these points, preferably as an interval, by making use of the spatial dependence structure in the data.

The data are modelled as a hierarchical Markov random field of an empirical Bayes type. The first level of the model consists of the observed nutrient concentrations, that are assumed to be normally distributed depending on an unobserved nutrient supply. This nutrient supply is considered to have a spatial dependence structure, which is modelled as a Markov random field. The coefficients of the model are not assumed to be fix, but are allowed to vary smoothly across the spatial coordinates.

These varying coefficients are estimated by a MCMC-version of the EM-algorithm. Given the estimates and the irregularly observed nutrient concentration, the posterior distribution of the unobserved nutrient supply is simulated by Gibbs-sampling. Prediction intervals are obtained from the simulation output by using a plug-in approach. Exploratory analysis gives evidence for the usefulness of this approach and the validity of the intervals.

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