Localized/Shrinkage kriging-Prediction in a Bayesian, non-stationary Gaussian random field

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Assume that a set of exact observations from a regionalized variable is available. Focus is on spatial prediction in an unobserved location with associated prediction variance,i.e classical kriging prediction. Consider a classical, stationary traditional kriging model with spatially constant expectation and variance. Let the spatial correlation function be shift invariant and let it be known. This constitutes global ordinary kriging model, and global predictors are optimal. A more flexible and robust spatial predictor can be defined by applying the traditionalkriging predictor locally. This entails using only observations in a finite neighborhood around the location of the predictor. This robustfies the predictor with respect to devations from the assumptions of globally constant expectation and variance. The challenge in localized prediction is to make a bias/ variance trade-off in selection of the size of the neighborhood, i.e the number of observations involved in the predictor. Unwanted abrupt changes in the predicted regionalized variable and the associated prediction variance can appear.

The objective of the study is to improve on the flexibility and robustness of the spatial kriging predictors with respect to deviations from spatial stationarity assumptions. A predictor based on a non-stationary Gausian random field is defined. The model parameters are inferred in an empirical Bayesian setting, using observations in a local neighborhood and a prior model assessed from the global set of observations. The localized predictor appears with a shrinkage effect and is coined a localized/shrinkage kriging predictor.

The predictor is compared to global ordinary kriging predictors to traditional localized kriging predictors in a case study with observations of annual accumulated precipitation. A crossvalidation criterion is used in the comparision. The shrinkage predictor appears as clearly preferable to the traditional kriging predictors. A simulation study on prediction in non-stationary Gaussian random fields is conducted. The results from this study confirms that the shrinkage predictor is favorable to the traditional one. Moreover, the crossvalidation criterion is found to be suitable for selection of the predictor parameters like neighborhood. Lastly, the computational demands of localized predictors are very modest, hence the localized/ shrinkage predictors are suitable for large scale spatial prediction problems.

Keywords: Spatial statistics; Gaussian random fields; Bayesian inference; Conjugate models.