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Bayesian Generalized Linear Geostatistical Modelling for mapping subsoil ripening

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One of the first soil forming processes of marine and fluviatile clay is ripening: the irreversible change of physical and chemical soil properties under influence of air. Whether the soil is ripened or not has a large impact on soil hydrological properties and potential land use. We used Bayesian Generalized Linear Geostatistical Modelling (GLGM) to map the ripening stage of clay subsoils in a reclamation area in the west of the Netherlands. We consider the ripening stage as a binary variable (the subsoil is ripened or unripened) and spatially predicted it using the binomial logistic-linear GLGM. This model includes regression parameters and a spatial signal characterised by spatial structure parameters. Following the paradigms of Bayesian statistics, the GLGM was expanded into a Bayesian GLGM by treating all parameters as random variables and defining prior distributions for all. The Bayesian GLGM allows to include previously gained knowledge and incorporate parameter uncertainty in a flexible way. The use of prior information can especially be beneficial in case of a small number of observations. By combining prior knowledge with information contained in the observations, parameter probability distributions ('posteriors') were calculated using Markov Chain Monte Carlo simulation for the regression parameters and the spatial signal, and grid-wise calculations for the spatial structure parameters. We compared the mapping accuracy of Bayesian GLGMs for different priors and observation sample sizes. We also analysed whether the use of a complex Bayesian GLGM approach pays off by comparing the accuracy of the ripening map of the Bayesian GLGM with that of a ripening map obtained using conventional Bayesian logistic regression.