COMPARING SPATIAL MODELS FOR DATA GIVEN ON DISPARATE SCALES: A STUDY RELATING CHILDHOOD LEUKAEMIA TO BENZENE EMISSIONS

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We analyze the relation of traffic-related benzene emissions and incidence of childhood leukaemia in Greater London. Benzene exposure data are given on a grid of 1km x 1km squares while incident cases of leukaemia are given on ward level.
The usual approach to model such data is to aggregate data and covariates to a common spatial scale leading to the problem of the ecological fallacy.
A random field generalization of Poisson–Gamma hierarchical models (Wolpert and Ickstadt, 1998) includes data and covariates on their original spatial scales. It was generalized by Best et al. (2000) for an application in epidemiology allowing for covariates to enter as multiplicative or additive risk factors leading to different interpretations.
Based on the real example of leukaemia cases we perform a simulation study to analyze the behavior of Poisson–Gamma random field models. Additionally, we compare the results to those of other spatial models, such as the CAR-model (Besag et al., 1991) and the clustering approach of Knorr-Held and Rasser(2000).
Compared to other spatial models, the simulation study identifies Poisson-Gamma models to be more flexible and easier to interpret for modelling different spatial patterns with and without latent risk sources. In all applications, multiplicative and additive modelling of covariates perform similar.