Joint modelling of several diseases for high-dimensional spatial data using a multivariate scalable Bayesian approach

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Research on spatial multivariate disease mapping has received considerable attention in recent years, although the use of these models remains limited due to difficulties in their implementation and computational burden. These problems are accentuated when the number of small areas is very large. In this work, we introduce a scalable, order-free scalable Bayesian modelling approach to jointly smooth mortality or incidence risks of several diseases for high-dimensional areal count data. Our proposal partitions the spatial domain into smaller subregions, fits multivariate models in each subdivision and obtains posterior distribution of relative risks across the entire spatial domain. The modelling approach also provides local posterior estimates of between-disease correlations and variance parameters in each partition that are combined through a consensus Monte Carlo algorithm to obtain global estimates for the whole study region. We implement the proposal using integrated nested Laplace approximations (INLA) to reduce the computational burden through the `R` package `bigDM`, which also implements recent high-dimensional univariate scalable models for spatial and spatio-temporal count data.

Keywords: INLA, Non-stationary models, Spatial epidemiology.