A model for spatio-temporally clustered disease rates

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Maps of estimated disease rates over multiple time periods are useful tools for gaining etiologic insights regarding potential exposures associated with specific locations and times. In this paper, we describe an extension of a model for spatial clustering proposed by Gangnon and Clayton (2001) to spatio-temporal data. As in the purely spatial model, a large set of circular regions of varying radii centered at observed locations are considered as potential clusters, e.g. subregions with a different pattern of risk than the remainder of the study region. Within the spatio-temporal model, no specific parametric form is imposed on the temporal pattern of risk within each cluster. In addition to the clusters, the proposed model incorporates spatial and spatio-temporal heterogeneity effects and can readily accomodate regional covariates. Inference is performed in a Bayesian framework using MCMC. Although formal inferences about the number of clusters could be obtained using a reversible jump MCMC algorithm, we use local Bayes factors from models with a fixed, but overly large, number of clusters to draw inferences about both the number and the locations of the clusters. We illustrate the approach with an application of the model to data on female breast cancer mortality in Japan.