Spatiotemporal modeling of count data

Diego Morales-Navarrete
Departamento de Estadística, Pontificia Universidad Católica de Chile

Moreno Bevilacqua
Departamento de Estadística, Universidad of Valparaíso

Mauricio Castro
Departamento de Estadística, Pontificia Universidad Católica de Chile

Christian Caamaño
Departamento de Estadística, Universidad del Bío-Bío

Abstract

Modeling spatial data is a challenging task in statistics. In many applications, the observed data can be modeled using Gaussian, skew-Gaussian or even restricted random field models. However, in several fields, such as population genetics, epidemiology and aquaculture, the data of interest are often count data, and therefore the mentioned models are not suitable for their analysis. Consequently, there is a need for spatial models that are able to properly describe data coming from counting processes. Commonly three approaches are used to model this type of data: GLMMs with gaussian random field (GRF) effects, hierarchical models, and copula models. Unfortunately, these approaches do not give an explicit characterization of the count random field like their q-dimensional distribution or correlation function. It is important to stress that GLMMs and hierarchical models induce a discontinuity in the path. Therefore, samples located nearby are more dissimilar in value than in the case when the correlation function is continuous at the origin. Moreover, there are cases in which the copula representation for discrete distributions is not unique, so it is unidentifiable. Hence to deal with this, we propose a novel approach to model spatial count data in an efficient and accurate manner. Briefly, starting from independent copies of a "parent" gaussian random field, a set of transformations can be applied, and the result is a non-Gaussian random field. This approach is based on the characterization of count random fields that inherit the well-known geometric properties from Gaussian random fields.