DEVELOPING FLEXIBLE SPATIAL MODELS FOR THE REAL WORLD – A MULTI-DISCIPLINARY SYMBIOSIS

Janine B Illian

University of St Andrews, St Andrews, UK and NTNU Trondheim, Norway

E-mail: jbi@st-andrews.ac.uk

In the spatial modelling literature, substantial advances have been made in the development of statistical methods for modelling spatial trend and correlation in the context of spatial point process models, for instance in the context of log Gaussian Cox processes. Until very recently, fitting realistically complex models from this class was computationally prohibitive for any but the smallest of datasets, largely preventing them from being used in practice. This is because fitting them involves time-consuming repeated solving of large, dense linear systems of equations.

However, the recent development of efficient and very accurate approximation methods for fitting models based on spatial random fields has made it possible to fit more flexible and realistically complex spatial models without prohibitive computational cost (Rue et al. 2009; Lindgren et al. 2011, Illian et al. 2012a and b). These approaches are based on integrated nested Laplace approximation (INLA), which, like Markov chain Monte Carlo (MCMC) methods, is a Bayesian estimation method, but is much faster (Rue et al. 2009). A key ingredient is the use of Markov random field models to replace the dense systems of equations with sparse alternatives. The R library R-INLA has been instrumental in making these methods available to non-specialist users.

This talk outlines the mutual benefits of developing both methodology and software as part of a continuing dialogue between method developers and ecologists. Highlights of this symbiosis and recent developments resulting from it are presented. We illustrate these with a number of applications from ecology and beyond.