Flexible spatial models and their relevance in ecology

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Abstract:

Statistical models typically rely on a number of distributional assumptions, which might or not be met in practice - with all the implications on the validity of the conclusions drawn from the model. This is particularly relevant in ecology; however surprisingly few flexible methods are available that are directly linked to a standard model. The approach we discuss here explicitly incorporates deviation from a standard model into the modeling process. This is done within an extended family of models that has a basic standard model at is centre.

This family is constructed by introducing an additional flexibility parameter that controls the deviation from the basic model. Instead of parameterising the flexibility parameters directly, we base the distance between the base and the flexible model. Based on this distance we derive meaningful prior distributions for the flexibility parameters. These allow us to interpret the flexible model as a flexible version of the basic model. Shrinkage to the base model is warranted when supported by the data, but moderate deviations from the base model are properly captured if required.

Further, the approach can directly be integrated into the R-INLA software. Hence we are able to work with more flexible models without loosing the usual benefits of integrated nested Laplace approximation (INLA; Rue et al. 2009), i.e. short computation times and high accuracy. This extends the toolbox of models available in R-INLA and makes these models accessible to a wide audience of users. We illustrate the methodology with a number of relevant ecological examples.

References

Rue H., Martino S. and Chopin N. (2009) Approximate Bayesian Inference for Latent Gaussian Models Using Integrated Nested Laplace Approximations (with discussion). *Journal of the Royal Statistical Society, Series B*, 71: 319–392