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Using Stochastic Partial Differential Equation Models for Non-stationary Non- isotropic Spatial modelling. With a Case Study of Annual Precipitation in Southern Norway

Ingelin Steinsland (1), Rikke Ingebrigtsen (1), and Finn Lindgren (2)

(1) Department of Mathematical Sciences, Norwegian University of Science and Technology (NTNU), NorwayTrondheim, Norway (ingelins@math.ntnu.no, rikkei@math.ntnu.no), (2) Department of Mathematical Sciences, University of Bath, UK (finn.lindgren@gmail.com)

Based on experience from interpolation of precipitation of catchments relevant for Norwegian hydro-power production, we know that
interpolation of precipitation in complex terrain is an important, but challenging task. Traditional geostatistical methods of spatially phenomenons are modeled using stationary and isotropic spatial processes.
For precipitation over complex terrain it is known from the physics of the phenomena that the dependency structure is influenced by local characteristic such as temperature, elevation or slope.

It has been an interest in the literature to provide flexible and computationally efficient models and methods for non-isotropic, non-stationary phenomenons. In this work we demonstrate that the stochastic partial differential equation (SPDE) approach to spatial modeling provides a flexible class of non-stationary and non-isotropic models where explanatory variables easily can be included in the dependency structure. Further, because a SPDE approach is taken, the integrated nested Laplace approximation (INLA) methodology can be used for inference, which makes it computationally efficient to make inference, as well to preform simulation studies. The proposed method is used to model precipitation in Southern Norway using topological quantities as explanatory variables in the dependence structure. The goal of modeling is to do spatial reconstruction with a special focus on uncertainty quantification.