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QUANTIFICATION OF ANNUAL WILDFIRE RISK
A spatio-temporal point process approach

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ABSTRACT

Policy responses for local and global fire management depend heavily on the proper understanding of the fire extent as well as its spatio-temporal variation across any given study area. Data which we base our studies and findings are annual satellite imagery data, which consist of the location of observed fire scars in Portugal and their sizes (area burned). Ideally, such data can be assumed to be generated by a nonhomogeneous spatio-temporal marked point process, discrete in time and continuous in space, where points are the centroids of the fire scars and the marks are the sizes of the respective fire scars. The inference primarily targets the nonhomogeneous intensity function of this point process. We look at the first and second order properties of the empirical marked point processes which give us valuable information on the type of models that can be employed to represent the data. The empirical studies indicate dependence between the (random) points and the respective marks, complicating the structure of the resulting models. Thus, at first stage we fit a spatio-temporal log Gaussian Cox process to the spatial locations ignoring the marks. We follow the stochastic partial differential equation (SPDE) approach of Lindgren *et al* (2011), where certain SPDEs, whose stationary solutions are the Matérn fields are studied, and finite element method is used to approximate the solutions of these differential equations. These methods allow approximation of Matérn Gaussian fields by Gaussian Markov random fields defined over irregular discrete grids, which resolve many computational difficulties related to inference for spatio-temporal point patterns. These computational advances allow us to obtain the predictive distribution of the intensity function of such point patters for future years, permitting us to make probabilistic statements regarding the fire risk in space and time. The Method which we propose to model the spatial extend of wildfires in Portugal are improvement to the models considered in Turkman *et al* (2013).

Keywords: Wildfires, Spatial point processes, stochastic partial differential equations, Gaussian random fields, Gaussian Markov random fields

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