Guest Editorial: Statistical models for environmental issues

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During April 30–May 1, 2011, the international workshop on “Digital Governance and Surveillance Hotspot GeoInformatics for Monitoring, Etiology, Early Warning, and Sustainable Development with Applications to Natural and Environmental Resources” was held at Middle East Technical University, Ankara, Turkey. From among the invited presentations, six papers were considered for publication and were peer reviewed. One of those papers got published earlier, in this journal in 2012, due to some technical problem. This Special Issue comprises of the accepted versions of the remaining five papers, which provide a good representation of the research work presented at the workshop. With the thrust on modeling, these papers reflect a panorama of recent methods based on frequentist and Bayesian paradigms, parametric and non-parametric, with linear and non-linear/directional data. Theoretical rigor, motivating real-life examples and finally, challenging data sets make this compilation an useful addition to the arena of environmental statistics. An overview of the papers is presented below.

Proper choice of a model for the underlying distribution, when it has to be based on censored data often due to measurement problems and instrumental restrictions, has been an important problem with environmental data. Surucu addresses this problem from the point of model validation in some location-scale family. A new bivariate goodness-of-fit test for censored data is proposed by combining ideas from Tiku’s test for the univariate case with concomitants of order statistics. A real-life example based on water quality evaluation, where left censoring arises naturally due to the limitation of the measuring instrument, exemplifies the use of the proposed test.

A new method of cross-ranking is introduced by Myers and Patil to reveal structures and dependences in multivariate data. The novelty lies in the simplicity of the method

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while its appeal is established by possible applications to data on intensity-incidence, spatial hotspot-abundance, etc. Complex probability models and intricate partial order theory are avoided in this development. R codes given in the paper make the method even more user-friendly. A convincing example based on ecological data enhances the proposed method for real-life applications.

Using directional statistics, SenGupta and Bhattacharya consider modeling relationships where the response is linear and the predictors could be both linear and circular. Further, it is argued that predictors could often be random variables themselves. Also, multimodality of the distribution of the circular predictor is envisaged. Bayesian analysis is performed, on both simulated and a real-life data set on air quality index derived from wind direction and temperature, to select between a symmetric and an asymmetric cylindrical regression model.

Yildirak and Kestel consider, in a broad sense, the problem of model selection through non-parametric classification method where the models are visualized as drought classes. First, a new crop-specific drought index, DI, is formulated. It is then used to produce thresholds for calibration of the classes. The model selection problem is formulated as that of a multi-objective optimization, under multiple threshold constraints, of the weighted sum of area under ROC and the misclassification error rate as measured by cross-validation performance of CART algorithm. For implementation, non-availability of crop specific data and as well as that of other subsidiary data pose non-trivial challenge. Required input data were estimated by exploiting AgroMetShell (AMS), a software developed by FAO. The method was motivated and illustrated by real-life data on wheat from rainfed agricultural terrain in Central Anatolia of Turkey.

Spatio-temporal, crop and location specific, fixed and mixed effects models are developed by Yildirak, Kalaylioglu and Mermer for estimation of crop yields during droughts in arid areas. A modified drought index, to better capture water-related agricultural parameters and drought properties of the related farms, is also introduced as a predictor in this model. Most of the input data for this study were estimated using AMS of FAO. Model selection, validation, estimation and predictive abilities of the proposed Bayesian model are studied in some details. The model is illustrated through a real-life data set on wheat yields spanning 16 years and 11 agricultural stations from the arid terrains located mostly in Central Anatolia of Turkey.

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