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EDITORIAL

Special Issue: Geostatistics Applied to Environmental Applications

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Dedicated to the application of geostatistics in environmental contexts, this special issue compiles a series of carefully selected papers originally presented at the 14th International Conference on Geostatistics for Environmental Applications (geoENV2022). The conference was hosted in Parma, Italy, at the University of Parma in June 2022. Since 1996 in Lisbon, this conference has been a venue for discussion among geostatistics experts on a broad spectrum of environmental applications, including ecology, natural resource management, environmental pollution and risk assessment, forestry, agriculture, advances in geostatistical theory, novel methodologies, health, epidemiology, ecotoxicology, inverse modeling, multiple-point geostatistics, remote sensing, soil applications, spatiotemporal processes, and surface and subsurface hydrology. Eight papers have been chosen for this special issue of Mathematical Geosciences, offering a glimpse into the most recent research in geostatistics. In the following, each of the papers in the special issue is introduced in alphabetical order and is briefly discussed.

The paper by Anello et al. introduces a statistical model designed to estimate soil water content based on weather data. The model performance was assessed using an extensive dataset from long-term field experiments conducted in northern Italy. Robust statistical techniques, including a combination of parametric and non-parametric models, were applied to analyze the data. The resulting statistical model, which accounts for seasonal trends in the field data, successfully captures and describes key features within the experimental dataset, demonstrating its effectiveness for predictive purposes.

Bossew examines geogenic and indoor radon data to understand the spatial properties of radon dispersion, focusing on the impact of mean radon levels and sampling density. Notable findings include the proportional effect in logarithmic scale on local

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exceedance probability estimation and the influence of estimation methods on outcomes such as the identification of radon priority areas. The work also involves the exploration of stochastic processes governing spatial dynamics.

Duarte et al. focus on creating an early warning system for predicting COVID-19 incidence anomalies at the municipal level in mainland Portugal. It employs a combination of stochastic sequential simulation and machine learning, specifically symbolic regression, to model the spatiotemporal evolution of the disease. The machine learning aspect captures 14-day COVID-19 incidence rate curves, while geostatistical simulation predicts their spatial distribution in the Lisbon metropolitan area. The study demonstrates the system's ability to predict and detect unusual high and low incidence rates during different phases of the pandemic.

Friedli and Linde focus on geophysical Bayesian inversion to estimate geological or hydrogeological parameters using geophysical data. They introduce a new method for approximating likelihood with Gaussian probability density through local linearization of the geophysical forward operator. This method is compared with the correlated pseudo-marginal approach, showing its effectiveness, particularly in scenarios of high petrophysical uncertainty.

The study by Li et al. investigates the near-surface structure of the Earth according to predictions of velocity from seismic refraction data. The uncertainty in these predictions arises from two sources: epistemic uncertainty in the inversion process and aleatoric variability in the data. The research investigates these uncertainties independently and combined. Results indicate that both sources affect the final uncertainty, but the initial model uncertainty has a more significant impact than picking errors on the velocity model uncertainty. Joint analysis shows that the uncertainty in the inverted model depends on various factors, including predicted velocity values, depths, velocity gradients, and ray coverages.

Ribeiro et al. report on a geostatistical tool developed to model the spatial distribution of COVID-19 risk, aimed at aiding decision-makers and policymakers. This model, based on a block direct sequential simulation algorithm, offers detailed disease risk estimates and associated spatial uncertainty. This paper provides a brief overview of the methodology and package functions for interacting with these tools. The application is demonstrated using real COVID-19 incidence rate data from mainland Portugal.

Riquelme and Ortiz present a novel clustering approach suitable for situations with multiple continuous variables and complex relationships. It assesses the local correlation matrix between variables in a neighborhood, using changes in these correlations to identify domains. By incorporating a manifold structure into the space of correlation matrices, matrices are clustered using an adapted K-means algorithm featuring Riemannian geometry tools. A real case study showcases the effectiveness of this methodology, even when complex nonlinear relationships exist in the attribute space.

Wieskotten et al. explore Bayesian kriging for estimating radionuclide quantities and their spatial distribution in nuclear facility decommissioning projects. The research demonstrates the effectiveness of Bayesian kriging compared with ordinary kriging, especially when dealing with limited data, a common scenario in decommissioning projects. The practical value of Bayesian kriging is further highlighted using real data from a decommissioning project in France.