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Geostatistical modelling applied to epidemiologic studies: a contribution to the study of relationship between air quality and birth weight outcomes

PHD PROGRAM IN ENVIRONMENTAL ENGINEERING

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Introduction

Spatial epidemiology is a key element in health research, since it incorporates the description and analysis of the impact of space in health to better understand the etiology of diseases.

Geostatistics is the application of probabilistic methods to regionalized variables. The difference to conventional statistics is that geostatistics takes account that nearby locations have more often similar attributes than locations separated by longer distances.

Lichens are the most studied bioindicators and biomonitors of air pollution, because some are very sensible to variations in atmospheric pollution. They have only recently been used in health research for air quality assessment, and their wider use in health studies requires further research.

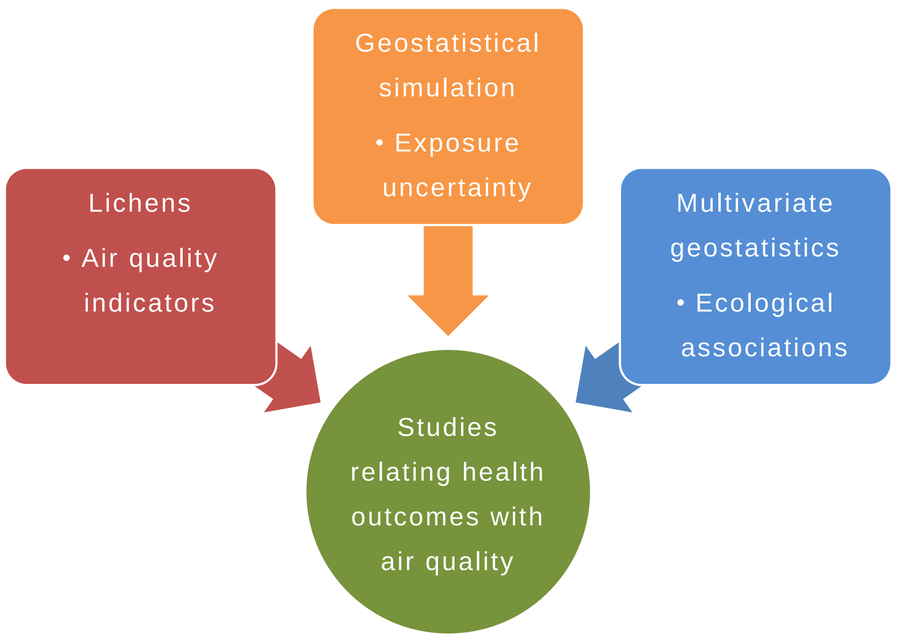

Figure 1: Scheme representing the contributions of this research for health studies relating birth weight outcomes with air quality.

The great potential for applying geostatistical methods in spatial epidemiology and for utilizing lichen ecological indicators for air quality assessment in health studies, motivates the search and development of novel methods and applications shown in this research work.

To address an epidemiological question related with the association between air quality and birth weight, the research presented here explores the development of novel approaches by 1) exploring the potential of lichen as air quality indicators in environmental health studies; 2) exploring the use of geostatistical simulation to assess uncertainty in air quality; 3) enhancing the exploratory analysis capabilities of multivariate geostatistics for analysis of spatially non-stationary processes underlying ecological associations in both environmental and epidemiological fields (Figure 1).

Results

The results showed that geostatistical methods combined with high-spatial-resolution lichen data allowed the production of air quality maps for posterior statistical analysis (Figure 2) and presented themselves as cost-effective and useful alternative ways of assessing spatial uncertainty of exposure to measure associations with the health outcome birth weight [1-3].

The Linear Model of Coregionalization (LMC) enriched the role of multivariate geostatistics to model the intensity and direction of spatially non-stationary processes underlying ecological associations in both environmental and epidemiological fields at multiple spatial scales [4-5].

Final remarks

Throughout this research novel methods and applications using geostatistics in health research studies have been developed. Together with high-spatial-resolution lichen data, new solutions were proposed to estimate air quality and to address spatial exposure uncertainty. These new methods can have a relevant role in studies correlating health outcomes with air quality, especially in areas where air-quality monitoring stations are scarce or nonexistent, and alternative ways of correlating human activities with the environment are needed to improve human well-being. The application of the LMC was expanded in both environmental and epidemiological fields, providing additional capabilities to address interpretation and hypothesis formulation over spatial processes underlying multivariate relations.

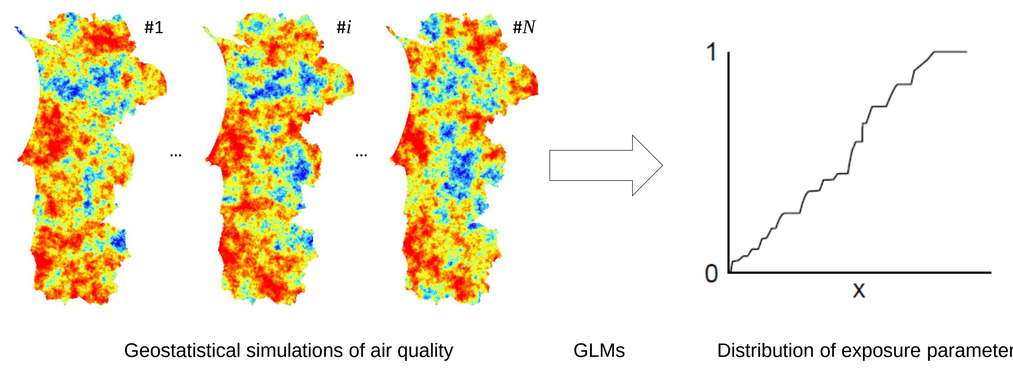

Figure 2: Geostatistical simulations of exposure for posterior analysis with Generalized Linear Models (GLMs). The distribution of exposure parameter drawn from GLMs reflects the results of geostatistical uncertainty.

References

[1] Ribeiro, M.C., Pereira, M.J., Soares, A., Branquinho, C., Augusto, S., Llop, E., Fonseca, S., Nave, J.G., Tavares, A.B., Dias, C.M., Silva, A., Selemane, I., de Toro, J., Santos, M.J., Santos, F., 2010. *A study protocol to evaluate the relationship between outdoor air pollution and pregnancy outcomes*. BMC Public Health 10, 613.

[2] Ribeiro, M.C., Pinho, P., Llop, E., Branquinho, C., Soares, A., Pereira, M.J., 2014. *Associations between outdoor air quality and birth weight: a geostatistical sequential simulation approach in Coastal Alentejo, Portugal*. Stochastic Environmental Research and Risk Assessment 28, 527–540.

[3] Ribeiro, M.C., Pinho, P., Llop, E., Branquinho, C., Pereira, M.J., 2016. *Geostatistical uncertainty of assessing air quality using high-spatial-resolution lichen data: A health study in the urban area of Sines, Portugal*. Science of the Total Environment. 562, 740–750.

[4] Ribeiro, M.C., Pinho, P., Llop, E., Branquinho, C., Sousa, A.J., Pereira, M.J., 2013. *Multivariate geostatistical methods for analysis of relationships between ecological indicators and environmental factors at multiple spatial scales*. Ecological Indicators 29, 339–347.

[5] Ribeiro, M.C., Sousa, A.J., Pereira, M.J., 2016. *A coregionalization model can assist specification of Geographically Weighted Poisson Regression : Application to an ecological study*. Spatial and Spatio-temporal Epidemiology 17, 1–13.

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