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Air Pollution Modelling Using Spatial Analysis and Neural Networks

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In a huge number of applications, air pollution dispersion modelling using standard Gaussian methodologies is an excessively data-intensive process that requires considerable computing power. Land Use Regression (LUR) represents an alternative modelling methodology. LUR presumes that pollution concentration is determined by factors obtained via spatial analysis. These factors are chosen on the basis of their ability to describe air pollution variability. Most LUR models take into account factors of pollution sources and of land cover. The main disadvantage of the LUR model is the lower level of accuracy in comparison with Gaussian air pollution models. In the presented study, there were created datasets of factors of emission data and of Gaussian model results data.

Standard LUR models use linear regression for the estimation of concentrations. The coefficient of determination (R^2) of the standard LUR models reached 0.639 for emission data and 0.652 for Gaussian model results data. We assumed that linear regression did not sufficiently reflect generally non-linear phenomena. Therefore, linear regression in the LUR model was substituted by Artificial Neural Network (ANN)-based regression, which is able to capture non-linear behavior. The R^2 of the improved LUR models achieved 0.937 for the LUR model based on emission data and 0.938 for the model based on Gaussian model results. ANN-based non-linear regression LUR models provide a more accurate characterization of air pollution distribution than standard models.

Summary

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