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STATISTICAL MODELING TO ESTIMATE SPATIAL DISTRIBUTION OF AIRBORNE FLUORIDE IN NATURAL VEGETATION AROUND AN INDUSTRIAL POINT EMISSION SOURCE

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ABSTRACT

Parametric and non-parametric statistical modeling techniques are applied to estimate fluoride concentrations in natural vegetation in the vicinity of an aluminum reduction plant as a function of the distance of the source, the predominating wind, the topography and the elevation of each sampling location. Linear correlation coefficients between concentration and environmental variables indicate a strong relationship only between fluoride concentration and distance. This implies that either the independent variables, except distance, have no effect on airborne fluoride concentration or that the effect is non-linear. The simple multiple linear regression model gives a rather good estimation of concentrations taking advantage of the relative strong linear correlation between concentration and distance. The other variables do not improve significantly the performance of this model. The hypothesis of nonlinear relationships of fluoride concentration to predictors is supported by the improvement of the results with the use of the non-linear statistical models that point out the importance of wind, topography and elevation in the spatial distribution of fluoride. Non-parametric models (Regression Tree Model, Generalized Additive Model, Multivariate Loess Model) clearly improve the model reliability; it remains, however, lower than that obtained by an artificial neural network model which can be considered particularly satisfactory since the correlation coefficient between model estimated and observed values is higher than 0.9.