

## Functional kriging in air quality

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Functional data featured by a spatial dependence structure occur in many environmental sciences when curves are observed, for example, along time or along depth. Recently, some methods allowing for the prediction of a curve at an unmonitored site have been developed. However, the existing methods do not allow to include in a model exogenous variables that, for example, bring meteorology information in modeling air pollutant concentrations. In order to introduce exogenous variables, potentially observed as curves as well, we propose to extend the so-called kriging with external drift - or regression kriging - to the case of functional data by means of a three-step procedure involving functional modeling for the trend and spatial interpolation of functional residuals. A cross-validation analysis allows to choose smoothing parameters and a preferable kriging predictor for the functional residuals. Our case study considers daily  $PM_{10}$  concentrations measured from October 2005 to March 2006 by the monitoring network of Piemonte region (Italy), with the trend defined by meteorological time-varying covariates and orographical constant-in-time variables. The performance of the proposed methodology is evaluated by predicting  $PM_{10}$  concentration curves on 10 validation sites. In this application the proposed methodology represents an alternative to spatio-temporal modeling but it can be applied more generally to spatially dependent functional data whose domain is not a time interval.

**Key Words:** Functional data modeling, kriging with external drift, spatial dependence, particulate matter