Geophysical Research Abstracts,
Vol. 11, EGU2009-1814-2, 2009
EGU General Assembly 2009

Ozone Concentration Prediction via Spatiotemporal Autoregressive Model With Exogenous Variables

W. Kamoun (1) and R. Senoussi (2)

(1) UR546 Biostatistique et processus spatiaux, INRA, F-84000 Avignon (kamoun_wassim@yahoo.fr), (2) UR546 Biostatistique et processus spatiaux, INRA, F-84000 Avignon (rachid.senoussi@avignon.inra.fr)

Forecast of environmental variables are nowadays of main concern for public health or agricultural management. In this context a large literature is devoted to spatio-temporal modelling of these variables using different statistical approaches. However, most of studies ignored the potential contribution of local (e.g. meteorological and/or geographical) covariables as well as the dynamical characteristics of observations. In this study, we present a spatiotemporal short term forecasting model for ozone concentration based on regularly observed covariables in predefined geographical sites. Our driving system simply combines a multidimensional second order autoregressive structured process with a linear regression model over influent exogenous factors and reads as follows:

$$Z(t) = A(\theta, D) \times [\sum_{i=1}^{2} \alpha_i Z(t-i)] + B(\theta, D) \times [\sum_{j=1}^{q} \beta_j X^j(t)] + \varepsilon(t)$$

$\mathbf{Z(t)=(Z_1(t),\ldots,Z_n(t))}$ represents the vector of ozone concentration at time **t** of the **n** geographical sites, whereas $\mathbf{X^j(t)=(X_1^j(t),\ldots,X_n^j(t))}$ denotes the $\mathbf{j}^{th}$ exogenous variable observed over these sites. The ***nxn*** matrix functions **A** and **B** account for the spatial relationships between sites through the inter site distance matrix **D** and a vector parameter θ. Multidimensional white noise ε is assumed to be Gaussian and spatially correlated but temporally independent. A covariance structure of **Z** that takes account of noise spatial dependences is deduced under a stationary hypothesis and then included in the likelihood function.

Statistical model and estimation procedure: Contrarily to the widely used choice of a **{0,1}**-valued neighbour matrix **A**, we put forward two more natural choices of exponential or power decay. Moreover, the model revealed enough stable to readily accommodate the crude observations without the usual tedious and somewhat arbitrarily variable transformations.

Data set and preliminary analysis: In our case, ozone variable represents here the daily maximum ozone concentration recorded in n=42 stations during the year 2005 within a south region in France, covering an area of approximately 10565 km^2. Meteorological covariates are the daily maxima of temperature, wind speed, daily maxima of humidity and atmospheric pressure. Actually, the meteorological factors are not recorded in ozone monitoring sites and thus preliminary interpolation techniques were used and compared subsequently (Gaussian conditional simulation, ordinary kriging or kriging with external drift).

Concluding remarks: From the statistical point of view, both simulation study and data analysis showed a fairly robust behaviour of estimation procedures. In both cases, the analysis of residuals proved a significant improvement of error prediction within this framework. From the environmental point of view, the ability of accounting for pertinent local and dynamical meteorological covariates clearly provided a useful tool in prediction methods.

Bib [1]: Pfeifer.P.E; Deutsh.S.J. (1980) “A Three-Stage Iterative Procedure for Space-Time Modelling.” Technometrics 22: 35-47.

Bib [2]: Raffaella Giacomini and Cliff W.J.Granger 2002 – 07 “Aggregation of Space-Time Process” Departement of Economics, University of California, San Diego.