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RIO, an interpolation scheme for ambient ozone

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Ambient ozone concentrations are governed by two different mechanism, each acting on a different spatial scale. On the regional level, fluctuations in the ozone concentration pattern are mainly meteorological from origin. Beside this, ambient ozone can have a distinct local character due to air pollution. In Belgium, an increased nitrogen oxide (NO) level usually is accompanied by a reduced ozone concentration. The phenomenon is known as the "titration-effect" and is clearly noticeable in urban areas.

In Belgium ambient ozone concentrations are systematically sampled at more than 30 sites. The average distance between nearest measuring stations is about 25 km. In spite of this dense coverage it remains non-trivial to make an accurate spatial map from these values.

We describe an interpolation model, called RIO, that is developed to incorporate both the regional and local scale of the ozone phenomenon and that produces ozone estimates on a 5x5 km grid.

The interpolation model is based on the Kriging technique. An unbiased estimator is used and the RMS error is statistically minimized with respect to an estimated spatial covariance. In contrary to ordinary Kriging techniques, the availability of an ozone concentration time series is exploited for the estimation of the correlation function.

A requirement for the application of Kriging interpolation is spatial homogeneity. For the ozone phenomenon in Belgium, obviously this is not the case. In order to achieve this goal, the local differences in the sampling values are reduced: by assimilating the NO pollution, a spatial trend is estimated for the average ozone value. After removing this trend, all stations are transformed in rural sampling sites, suited for application in the Kriging-like interpolation scheme. At the end each interpolated value is corrected

with the appropriate trend value, corresponding to the NO pollution at the interpolation location.

In a first step, the population density is used as a measure for the NO pollution. For this parameter it is shown that a reasonable detrending of the ozone mean values can be obtained. In a next step, other GIS-based landuse information is used to refine the detrending procedure. After all, the quality of the detrending determines the success of the interpolation technique.

A comparison is made of the RIO scheme with a standard inverse distance weighting interpolation. From this, it becomes clear that RIO outperforms the standard techniques, especially in urbanized regions. Further, the results of RIO are compared to AURORA, an Eulerian chemical transport model. Good correspondence is achieved between both model results.