Land use patterns and spatial interpolation of ambient air pollution

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Air pollution has become a major concern in highly urbanized regions such as Belgium. In order to assess ambient air quality a dens network of monitoring sites is developed. The real-time measurements of the telemetric network are used to inform the public, to trigger a warning mechanism in case of threshold exceedance and to feed short term forecast models. 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 point values. Rather than using a table of point values, such a map is of utmost importance to inform the general public.

Ambient air pollution concentrations such as ozone, NO_2 or PM_{10} are governed by two different mechanism, each acting on a different spatial scale. On the regional level, fluctuations in the concentration pattern are mainly meteorological from origin. Beside this, ambient air pollution can have a distinct local character due to local emission sources. In an urbanized region such as Belgium, the latter effects are significant. We describe an interpolation model, called RIO, that is developed to incorporate both the regional and local scale of the air pollution phenomenon and that produces concentration estimates on a high resolution grid.

The spatial interpolation is based on Kriging. A requirement for the application of Kriging is spatial homogeneity. For ambient air pollution in Belgium, obviously this is not the case. In order to arrive at this spatial homogeneity, spatial patterns of air pollution are taken into account to reduce the local differences in the sampling values. After removing the trends in the expectation value and the variance of the sampling values, all stations are transformed in uniform artificial sampling sites, suited for application in the Kriging scheme. At the end each interpolated grid value is retransformed with the appropriate trend shifts, corresponding to the spatial pattern of the interpolation location.

The spatial pattern of air pollution depends on the characteristics of the pollutant and is different for e.g. ozone and PM_{10}. For each of the pollutants a land use parametrization is defined based CORINE land cover maps. The parametrization is applied to assess a relation between land use and air pollution characteristics. This is the basis for the spatial pattern in the detrending of the measurement values.

Apart from a spatial map of interpolated air pollution concentrations, the RIO model assesses error estimates for the interpolated results. This quantity provides valuable information for environmental agencies to evaluate their sampling network. Regions with high interpolation errors are suited for the set up of additional measuring sites. Regions with low interpolation errors can be accurately described based on the results of adjacent monitoring sites.