Cartography

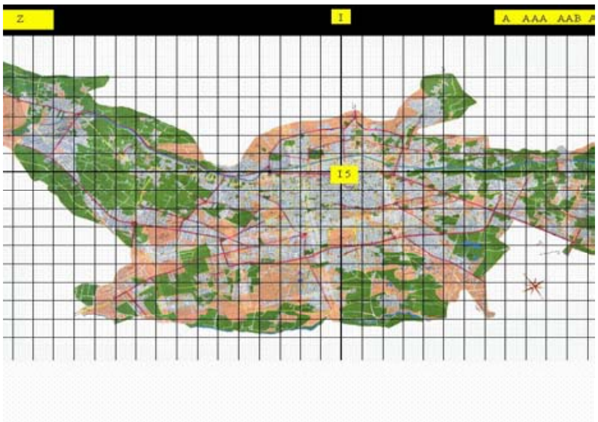
Presentation of air pollutant measurements

Results of air pollution measurements are recommended to be primarily produced in the form of maps with the following goals:

- Provision of accurate maps to the public.
- Quantification of risks e.g. exposure, threshold exceeded
- Classification of zones
- Representativeness of air quality monitoring stations

Procedure

The low cost and easy operation of the diffusive sampling technique makes it an ideal tool for large scale air pollution surveys with a high spatial resolution.



When applying this methodology in the case of a preliminary assessment, the following steps are proposed:

- Establish the location of the main emission sources from an assessment of emission sources.
- Construct a grid over the area under investigation (that surrounds the main area of interest) with a density of sampling sites defined according to emission sources.
- Select for each cell of the grid a location representative of the background pollution level in that cell, that is not directly influenced by local pollution sources
- If necessary, select additional sampling sites in the vicinity of important pollution sources (hot spots such as roads with heavy traffic, industrial sources).
- Install the samplers over the area and expose them over a representative time period.

Mapping methods

In order to map one pollutant, the data must be interpolated between monitoring sites on a regular grid that covers the studied area. To interpolate between monitoring sites means to set one estimated concentration at each point of the grid. At one specific grid node, the estimated concentration is a weighted average of the concentrations observed at the monitoring stations close to the grid node.
Yet there are several weighting algorithms, each one leading to a different estimated concentration and, therefore, to a different pollutant map.

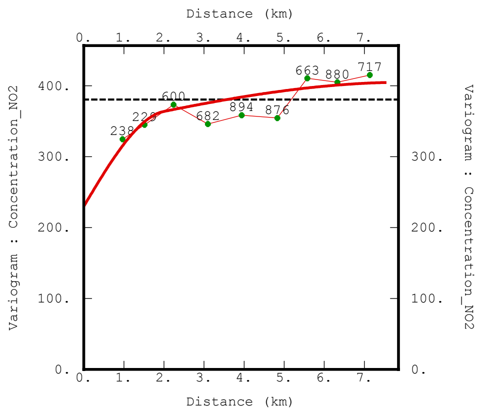
- The **polygon method** (nearest neighbour method
  implies that the datum closest to the node receives all the weight and the other data receive none
- The **moving average method** attributes the same weight to all the data neighbouring the node to be estimated.
- **Method of the inverse distances** squared, the weight assigned to the neighbouring data is proportional to the inverse of the distance between the node ant the datum under consideration

Choosing one algorithm depends on how consistently it combines the experimental measurements and on how it integrates other information – such as traffic density or meteorological conditions.

Geostatistical approach : kriging method

According to the geostatistical algorithm - called kriging -, the weighting rule and so the resulting map are directly determined by the spatial behaviour of the mapped pollutant. The variogram calculatedfrom the values observed at the monitoring sites makes it possible to quantify the pollutant's spatial continuity. A mathematical function is then fitted to the experimental variograms to get a model which characterizes the spatial variability for any distance and any direction in the two-dimensional plan.

The experimental variogram (thin discontinuous line) and the



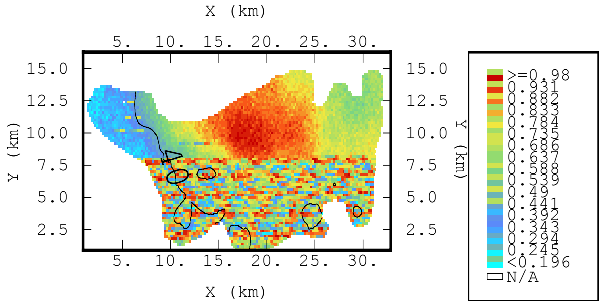
variogram models (thick line) for NO2 in Shiraz.

The variogram quantifies the variability between two measures of the same pollutant according to the distance between them. The variogram can be interpreted in terms of continuity or spatial correlation, if one graphically reverses the variogram to obtain a decreasing function : the higher the distance between two sites, the lower the correlation between the measures. The pollutant is no longer correlated beyond the distance where the variogram model becomes stabilized at a specific level, 3 km for for nitrogen dioxide in Shiraz.

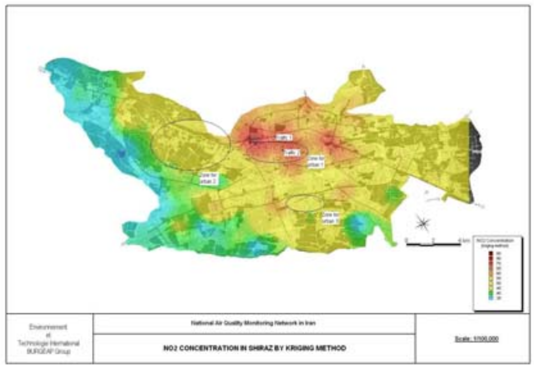
The variogram model that is specific to the pollutant is then used in a linear system of equations, the so-called kriging system, to calculate the optimal weight to be given to the data while interpolating. Doing so, a greater weight is given to the data that is better correlated with the concentration at the target grid point. At the same time, less weight is given to the data that is less correlated with the concentration. This means that geostatistical interpolation does not take into account the distance between monitoring sites and grid point, but the pollutant's spatial correlation between these sites and the concentration at the target grid point. By doing so, kriging adapts itself to the spatial features of the pollutant via the variogram model.

Mapping

The following figure shows the probability to exceed 40 µg/m3 (annual European objective for 2010) on a week with superimposition of kriging isoline 40 µg/m3



The next figure show the identification of zones for representative location of automatic stations under relevant correlation with population, ground occupation*...*



The color is linked to the pollution level. Red high concentration, then from yellow to blow decreasing level.

References

[1] IJST journal (Iranian Journal of Science and Technology)

[2] J. Deraisme, M. Bobbia: L'apport de la géostatisitque à l'etude des risque liés à la pollution atmosphericque

Cooperation

Mapping analysis are performed in cooperation with
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