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EVALUATION OF PUBLIC RISKS CONNECTED TO EVASION OF DANGEROUS SUBSTANCES USING GIS

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Abstract: *This article is dealing with setting discrete values of individual risk in case of evasion of dangerous gas into GIS, data processing and their possible usage to state public risk.*
Key words: *Individual risk, public risk, GIS*

1 INTRODUCTION

This article is investigating risks connected with accident during transport of dangerous materials and case study of dangerous gas evasion on defined route.

Problem investigated in this article is processing data structure of calculated individual risk (IR), its displaying in geographical information system (GIS) and using of data in calculation of public risk.

2 INDIVIDUAL RISK

Individual risk is stated according to characteristics of evaded dangerous substances and environment conditions in surroundings of evasion place. These are given to the calculations using wind pointers for particular geographical coordinates. The calculation is done to the relative location of substance source.

Data structure of calculated individual risk has a shape of discrete IR values on intersections of homogenous square grid with defined dimension step. Data file has format X – coordinates, Y – coordinates of IR values in this point. Its dimensional location is relative; the origination of Cartesian coordination system is in the middle. The north is located in positive direction of Y axis and the east in positive direction of X axis.

3 DATA LOADING INTO GIS

The aim of evaluation is to state public risk, which contains individual risk and characteristic of environment, where the substance evaded, especially values threatened by this evasion. Therefore it is needed to locate created cloud into particular location. Next step is to create connected polygons from values of individual risk, which characterize IR value in any selected point. This will enable use GIS tools, for instance to state number of resident houses, threatened citizens, etc, which is public risk calculation.

This will help to geographically locate sources of evasion (on transport route it is possible to consider more sources) and wind pointer (for example from Czech hydromoterological institute in Prague) in chosen area. The geographical directions are known (positive part of X axis = east, positive part of Y axis = north) and it is needed to substitute relative coordinates X, Y in data file by absolute values of geographical coordinates. Geographical coordination system S-JTSK East-North will be chosen and original relative coordinates will be recalculated into this system. The output is database file, which contains data in X, Y format, with value IR in correct geographical coordinates.

4 DATA INTERPOLATION

It is very easy to load such database file into GIS. Up to this moment, the individual risk is stated in discontinuous point network. For stating public risk it is needed to connect these data.

This is possible by interpolation of known discrete values. The interpolation in GIS can be preceded by many ways, but the best one is method of kriging. This method uses chosen amount of known values with corresponding seriousness to find unknown values of investigated dimension, given by the distance from required value.

This method does not give optimal results in case of application on IR values. If we use more known values – global interpolation (look at figure. n. 1), the final lapse will be customized, what brings loss of information about high IR values in vicinity of substance source.

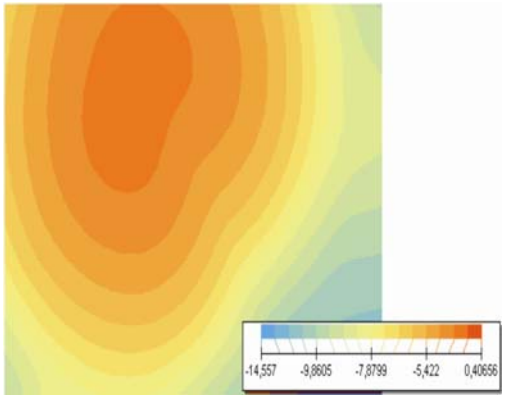

Figure n. 1: Kriging application - global interpolation.

If we use only small number of surrounding points, high values will be preserved, but on their edges are created buzzes which do not reflect real data (look at figure n. 2)

The size of dimension step in calculation discrete IR values has also very significant impact on result. If it is very high (100m), choosing of more surrounding points while using the kriging method causes the loss of these high IR values.

On the other hand, choosing too small dimension step (10 m and less) is in case of large tasks (in km) causing that data file is extremely big and interpolation method is processing these data very slowly or does not work at all.

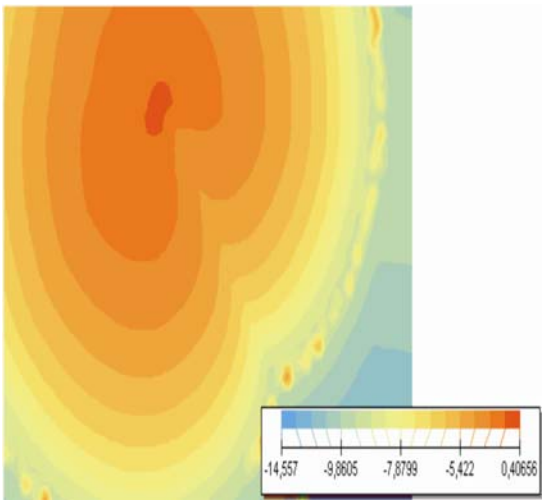

Figure n. 2: Kriging application – local interpolation.

The solution is to calculate data with dimension step 100m for whole area and than to edit much smaller area, which is close to substance source into dimension step 10m. This detailed set of values can be substituted into larger network (look at figure n. 3) and it is easy to precede such task. Area close to source is interpolated in higher resolution, data loss is prevented, number of points for kriging is big enough, and so there is no space for creating of inaccuracies, what is shown on figure n. 4.

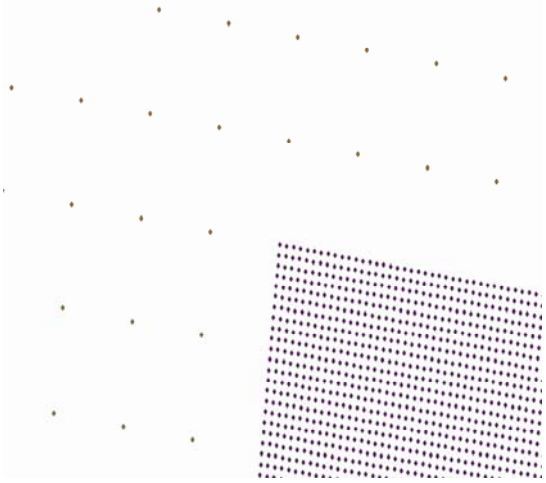

Figure n. 3: Refinement of discrete IR values of network.

5 USING OF CONNECTED IR DATA LAYER

The output is data layer in GIS, which contains evenly distributed connected IR values. IT is possible to combine this layer with layers of citizen distribution, places of high human density, etc. The final combination of data is public risk.

Other application is composing of calculated data close to the transport route, which enables to demonstrate and quantify public risk connected with possible accident and evasion of dangerous substance on defined transport route as wells as defining many places of evasion on transport path and their interpolation.

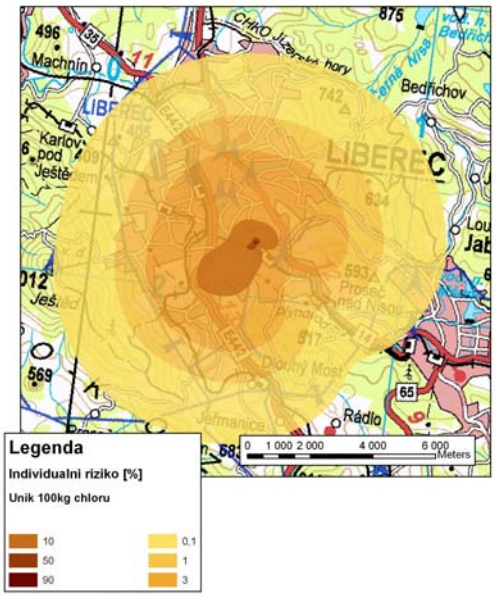

Figure n. 4: Individual risk in case of evasion of 100kg of chlorine in Liberec- Rochlice, when not protected persons are exposed to the evasion.

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ОЦЕНКА НА ОБЩЕСТВЕНИЯ РИСК, СВЪРЗАН С ИЗТИЧАНЕТО НА ОПАСНИ ВЕЩЕСТВА ПОСРЕДСТВОМ GIS

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СЛОВАКИЯ и ЧЕХИЯ

***Ключови думи**: Индидидуален риск, обществен риск, GIS*

***Анотация**: Статията разглежда установяването на дискретни стойности на индивидуалния риск при изтичането на опасен газ в GIS, обработката на данни и възможното им приложение при определянето на обществения риск.*