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Study Regarding The Dispersion Modeling Of The Radioactive Pollutants And The Simulation In This Case

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***Abstract*—This study was realized during a graduation project of a student [1] under my direction and it had good ratings from the part of the exam Commission. In this project was presented a modelling of dispersion for the radioactive gas for a region from Galati, a Romanian town.**

A rail wagon of a train which carrying radioactive material, had leaking of gas radioactive in the train station Barbosi, on the outskirts of Galati town. For this situation, was made a simulation for a particular wind direction and for a specific speed, to make an analyze of the affected areas. In this paper was presented a model CFD (Computational Fluid Dynamics), considering a model 3D for the terrain , to find out the affected areas, for a speed of the wind by approximately 25 Km/h.

This monitoring is required. If it's happen such a disaster, it's necessary to know the results of this monitoring to know in what point/region it is necessary to evacuate the population. Population must know the measures to reduce and to eliminate this type of pollution, if it is possible.

Keywords—Modeling, Simulation, Dispersion, Radioactive pollutants.

I.INTRODUCTION.NOTIONS ABOUT THE RECONSTRUCTION 3D FOR A LAND

Surface modeling is the process through which is represented a graphically surface (a surface plot), natural or artificial, through one or more sub-surfaces modeled mathematically. To achieve the experimental program in a paper [1], was made a simulation for many directions and speeds for the wind. In this paper was presented a model for one value of the speed of the wind. For example, a rail wagon of a train which carrying radioactive material, had leaking radioactive pollutants as the gas form, in the train station Barbosi, on the outskirts of Galati town. For simulation were used the models CFD (Computational Fluid Dynamics) considering 3D terrain model, to find out the areas affected.

In figure 1 was presented the location of the station on the map. It is situated on the outskirts of Galati town [2].

Digital Elevation Model (CDM) is the starting point for calculating the morphometric elements of the relief, to realize the digital geomorphological map and for spatial analysis and modeling CFD. After that, it is possible to solve any practical problem in the dispersion modeling of the pollutants.

Digital elevation models (MDE) are required in almost any kind of analysis or modeling of 3D maps. Applications of mathematical modeling of the earth's surface and the digital models of the elevation were basic components within the Geographical Information Systems (GIS).

Modeling Earth's surface is a particular case of surface modeling, which must take into account the specific problems related to the representation of the maps in 3D topology to build a certain relief zone.

The terms:"a digital terrain model- MNT " was used by Miller and Laflamme. They defined it as " a statistical representation of a continuous land surface using a large number of points whose the horizontal coordinates (x, y) along the height (z) are known. This representation is achieved in a coordinate system arbitrarily. "The models mentioned above refers only to depictions of the land areas. There are numerical models of height from the ground surface objects (eg buildings) which are known as "Digital Surface Model (DSM) " or "Digital Feature Heigh Model (DFHM) ".

In figure 1 was presented an example of graphical representation for a land.

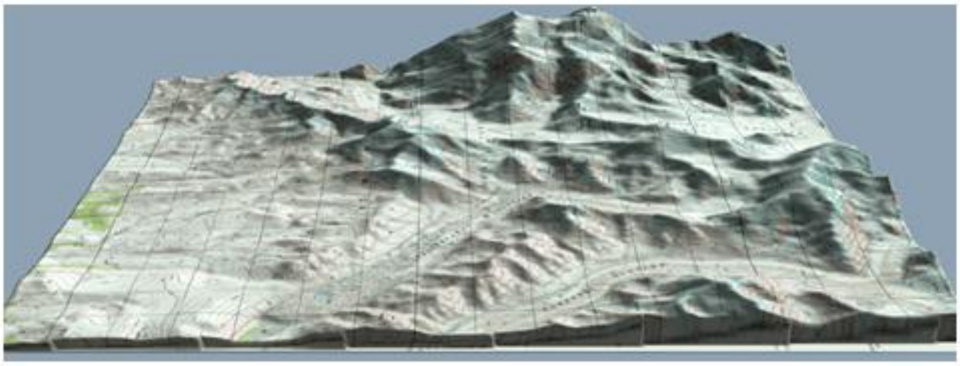

Fig. 1: *Graphical representation for a land surface*

Remote sensing and aero-photogrammetry tend to become the main ways of collecting data necessary to generate elevation MNT (digital terrain model).

These are data acquisition methods which attempts to minimize data collection effort, simultaneously with increase the accuracy of the results of the models. They have some characteristics:

a).- Uses satellite imagery and aero-photogramme;

This technique offers several advantages such as, for example, can eliminate redundant data when we have the acquisition of data. Their density can be adapted to the complexity of the relief zone.

b).- Passive sensors are used (photographic equipment or radiometers) and the images are obtained with active sensors such as RADAR systems: *Radio Detecting And Ranging* and LIDAR: *Light Detection And Ranging*.

II. CURRENT STATE FOR ESTABLISHMENT OF THE TERRAIN ELEVATION

There is the possibility that, on the basis of color, it can be determined the elevation of land. There are many approaches of the authors, in this case.

To avoid the distortion or the colour problem, Hedley [3] developed a method which uses information about colour and space.

Other authors [4] used a topographical map scanned, converted to CMYK space, where the value of channel K is used in the detection of the contour line. In [5], Lalonde and Li used L*a*b and a histogram which was amended to classify the pixels to obtain a binary-type image for lines of the contour.

A broken zone is solved through the looking the end of the line. Correspondent end point can be detected in a sector around the current direction. The interpolation techniques „*Thin Plate Spline*" are presented in [14].

D. Xin and others. [15] used a mathematical morphology to filter the binary image [16]. After

S. Salvatore [6] extracts one colour from the colour space HSV. The method implies a quantification of the HSV space, to reduce the difficulties in construction of the histogram of the pixels who follow in the chromatic region of the HSV cone. The pixels white or black are not considered.

Dupont and others [7] used an algorithm for separate in the RGB space to give a unique colour for the map for each pixel individually.

N. Ebi, B. Lauterbach, W. Anheier [8] and L. W. Kheng [9] isolates the various layers of the map, containing a dominant color by converting the RGB in the space of color L *u*v. Then, it determine the coordinates u*, v*, in the histogram, corresponding to each color group. Chen and others [10] work in grey levels and they obtained the contour line segments by extracting of all linear characteristics of the histogram analysis and from the controlled classification.

In the paper [11], lines are removed from the image, using an algorithm based on the quantification of the intensity of the image, followed by a equalization of the contrast histogram.

Appeared the following notions : processing of the binary image and the automatic reconstruction.

Many articles deals only with the problem of reconstruction, taking into account the contour lines which are already segmented and separated from the other layers.

Arrighi and Soille [12] use the morphological filters at the binary image, through the decrease of the sound intensity. Then they tried to make a reconnection of the contour lines before applying the decreasing procedure.

Their algorithm of reconnection use local informations: Euclidean distances between the extreme points of curves and their directions are combined.

L. Eikvril and others [13], reconect the conturs using a new technique for localization of the line.

thinning contour lines, they have been extracted a set of key points. The key points are introduced in the model GGVF (Generalized gradient vector flow) used for the extract of the curves.

Shimada [17] present a multy-agent system to solve the reconstruction problem for a contour line.

The aim of each factor analyzed, initialized by user, is to follow a specific contour.

The aim of the Surveillance Factor is to determine the route which must be followed, when appear the problems.

S. Spinello and P. Guitton [6] use a global topology at the topographic maps to extract and to rebuild the broken contour lines.

The reconstruction techniques are based on two geometric concepts: Voronoi Diagrams and Delauney triangulation. The method was inspire from [18] and [19] and focuses on the reconstruction of contour line. We talk about a method designed on the orientation change in a field of contours.

For each pair of points, was assigned a weight value according to the force which is necessary to move the potential curve reconstructed through the potential field. The solution is to find solving the problem of Perfect annexation issue. The solution is then found by solving a perfect splice problem.

III. EXPERIMENTAL RESULTS.

In this paper it were used information from [1] and Google Earth [20], with more slices and reformation in a CAD program.

Because it is impossible to find the elevation maps for Galati area, the reconstruction techniques were used as in the figure 2.

In the figure below, Barbosi station is located on the outskirts of Galati.

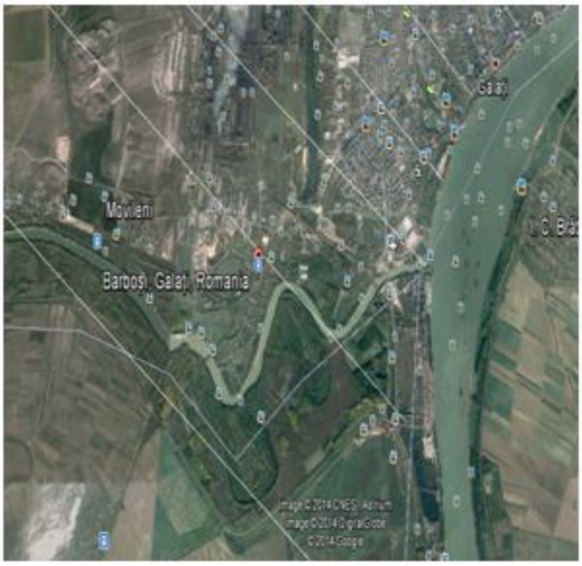

Fig. 2: *Map of the* ***Barbosi*** *station fom Galati area (drawing parallel lines) [20]*

For 3D reconstruction of the land, were respected the following consecutive steps, as shown in Figure 3. The contour of the elevation for each the parallel line was taken from Google Earth and was introduced in Solid Works. Was scaled the image and the distance between the successive plans on which had been situated the image of the elevation contours. It was rebuilt the surface using specific features for surfaces from Solid Works.

The reconstructed terrain (3D) was passed to simulation CFD (Computational Fluid Dynamics) taking into account the conditions realized by direction of the wind and the speed of the wind. Plus, using the functions "particle insertion", it was considered a generic gas called *fluid flow* (wind) passing over land.

It was considered the speed of the wind constantly, but the buildings were not considered, taking into account the fact that the dispersion takes places on large areas.

In figure 3 were presented the stages of the reconstruction 3D of the land.

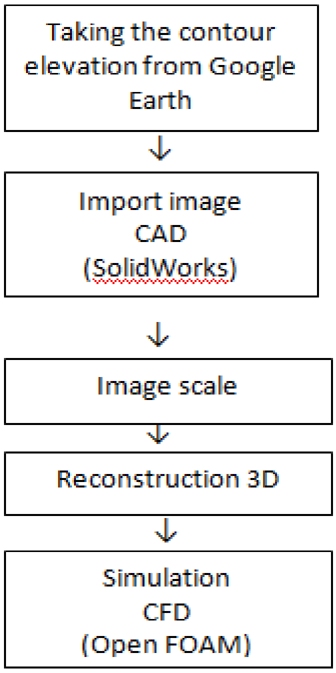

Fig. 3: *Stages of reconstruction 3D of the land*

The elevation contour images were used for 3D reconstruction of the land (see figure 4).

The built surface which was considered for the experimental program has 95 km^2 and has the urban buildings. [1].

In figure 4 is represented the elevation contour for the reconstruction 3D of the land.

In figure 5 is represented the reconstruction of the land using succesion plans with the elevation plans [1].

Fig. 4: *The elevation contour for the reconstruction 3D of the land*

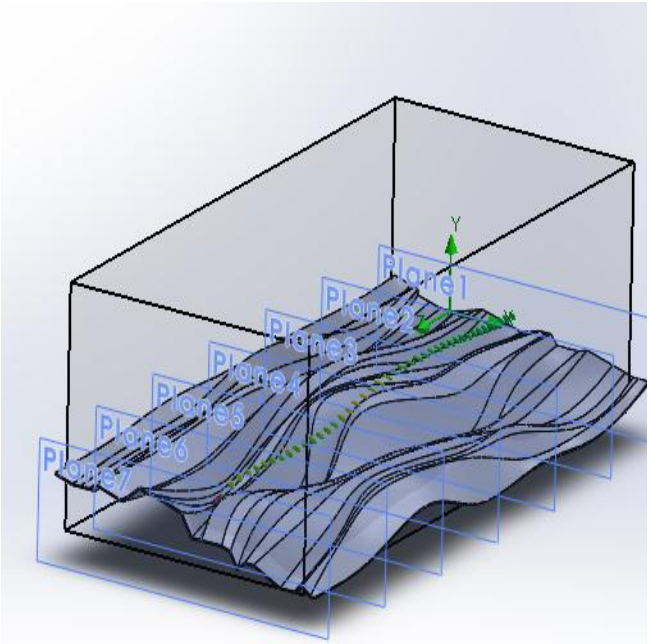

Fig. 5: *The reconstruction of the land - use succession plans with the elevation plans [1].*

In figures 6 and 7 are represented: the Top view of the point from which will appear radioactive fallout [20] respectively, the stationary train from which will be fallout the radioactive gas.

Fig. 6: *Top view of the point from which will appear radioactive fallout [20]*

For example, we considered the speed of the wind **v=25 km/h and the direction of the wind was SV-NE.** The emission of the gas was up to 10 kg/s from the rail of the train which transporte the radioactive pollutant.

Fig. 7: *The stationary train position*

It was considered the pressure of 760 mmHg. In this situation, the wind flow and the modeling 3D of the land are presented in figure 8 [1].

We noted that there are variations of the speed of air masses because of the terrain height variation, as shown in Figure 10.

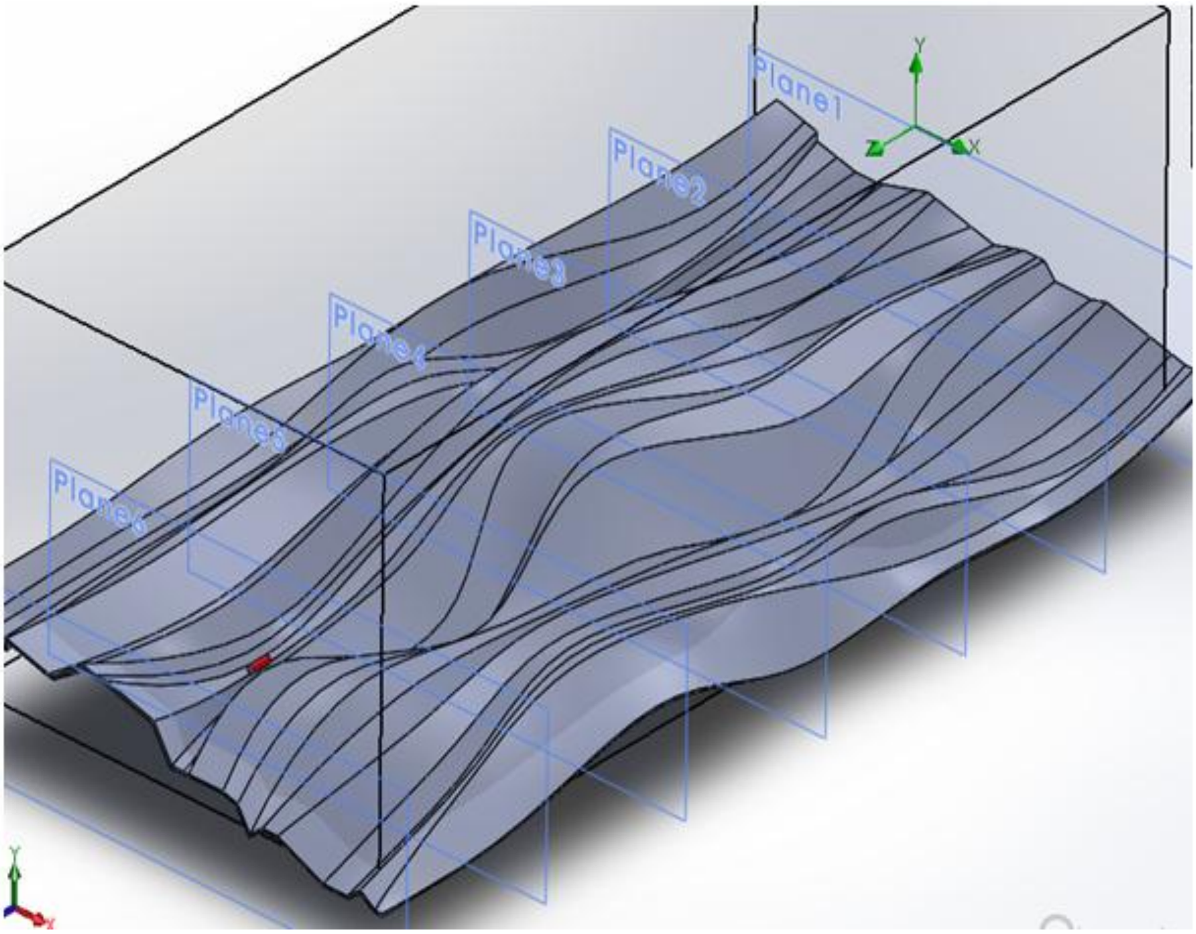

Fig. 8: *Modeling 3D of the land*

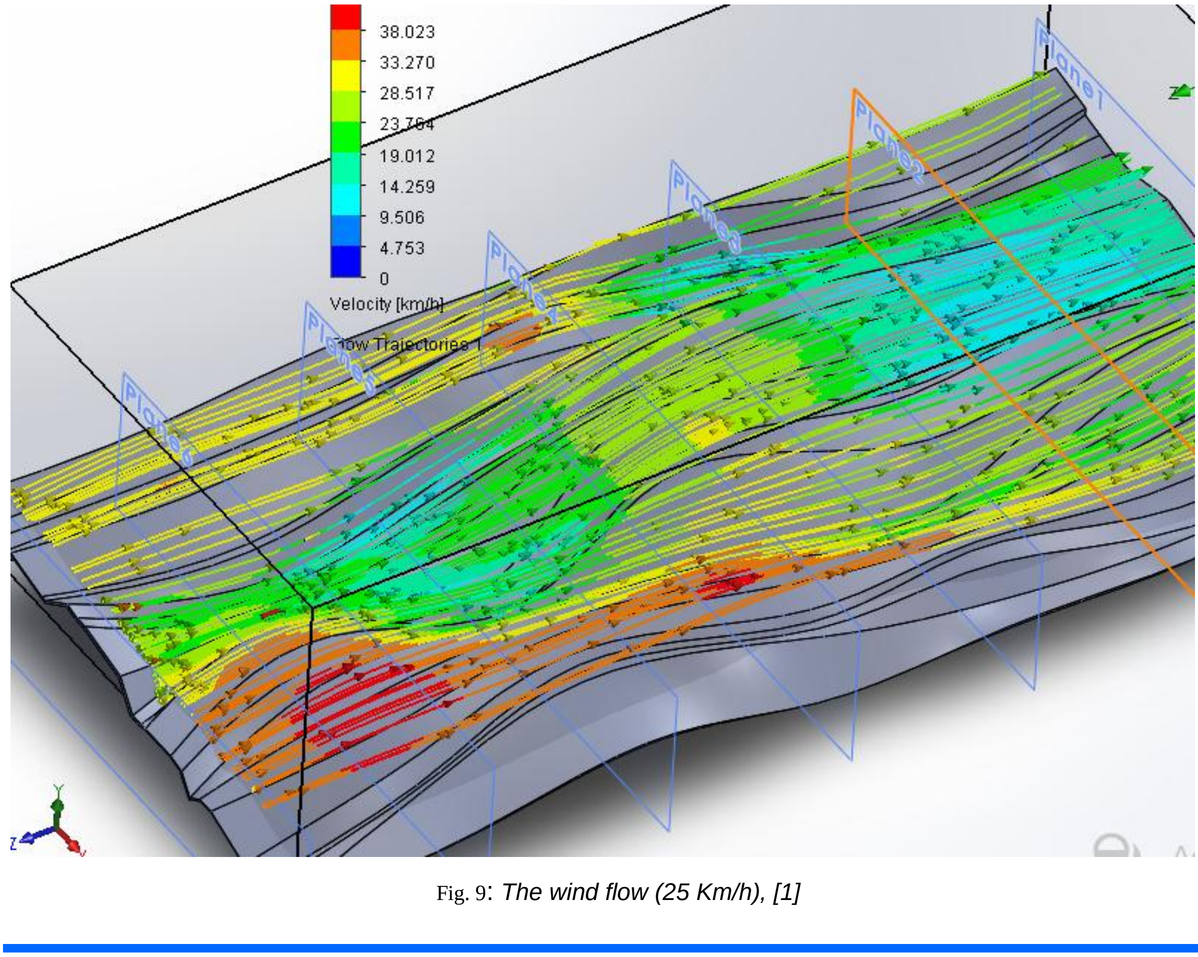

Fig. 9: *The wind flow (25 Km/h), [1]*

We can observe the variation of the speed of the wind around the train between 7 km/h until 30 km/h. These variations represent the fact that the dispersion of the pollutant can't be predicted without considering by the actual terrain on that is the phenomenon

In figure 10 is represented the geographical surface which was analyzed, taking into account 95 km^2 surface.

Figure 11 presents the variation of pressure in the perpendicular plan on the emission point (view 1).

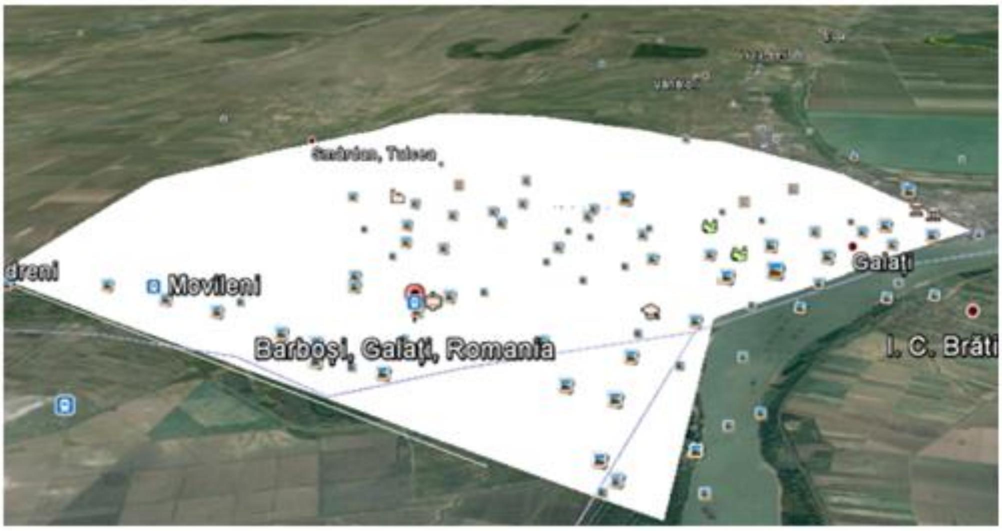

Fig. 10: *The geographical surface which was analyzed, taking into account 95 km^2 surface*

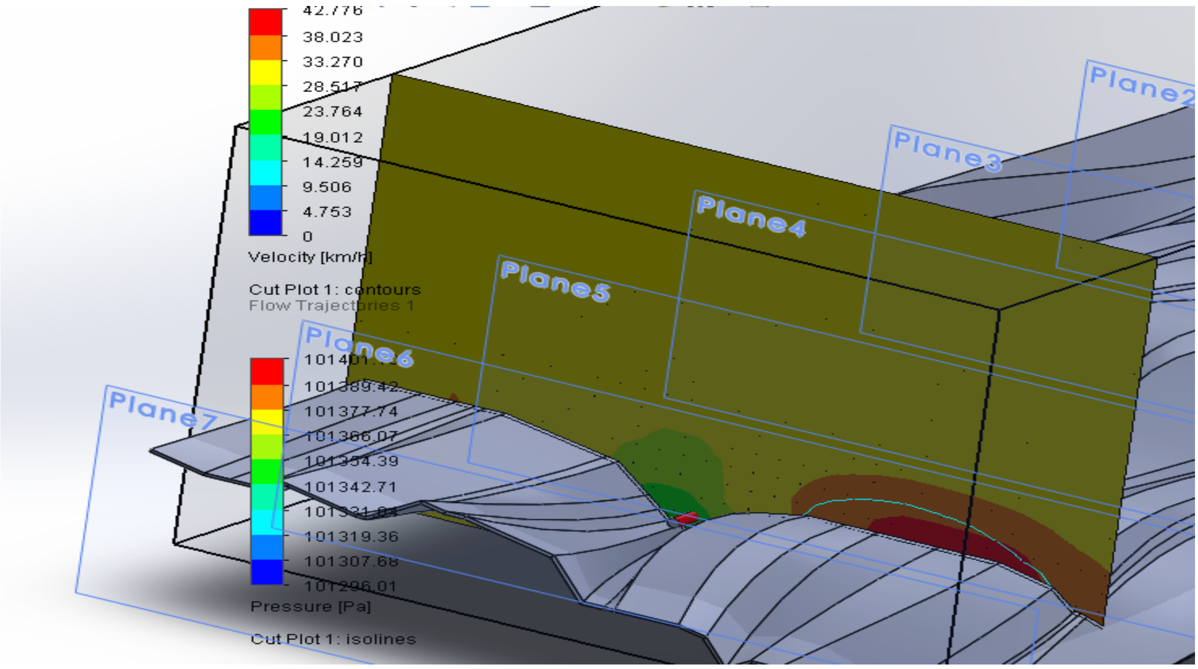

Fig. 11: *The variation of the pressure in the perpendicular plan on the emission point (image 1), [1].*

In particular we see a variation of the pressure depending on the land elevation, which leads to fact that the dispersion is not constantly and depend on the topology of the land.

For example, in figures 12, 13 was presented the variation of the pressure in perpendicular plan on the emission point, from other points of view.

In figures 14,…16 was presented the emanated gas trajectory (view 1, 2, or 3). .

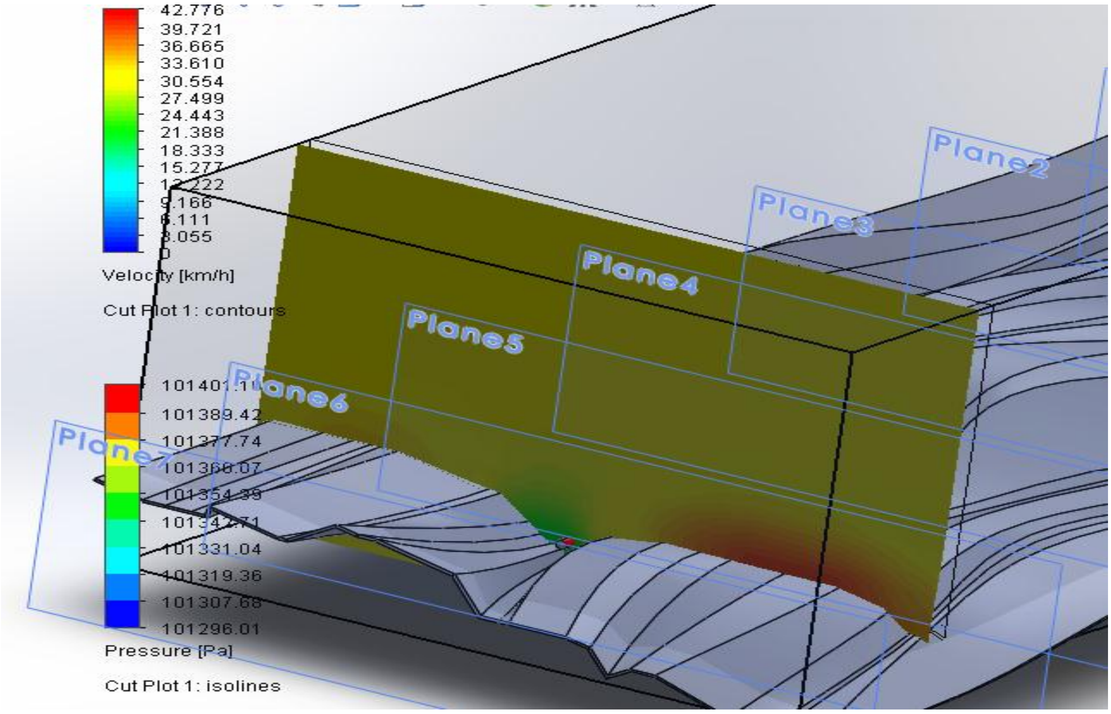

Fig. 12: *The variation of pressure in the perpendicular plan on the emission point (image 2), [1].*

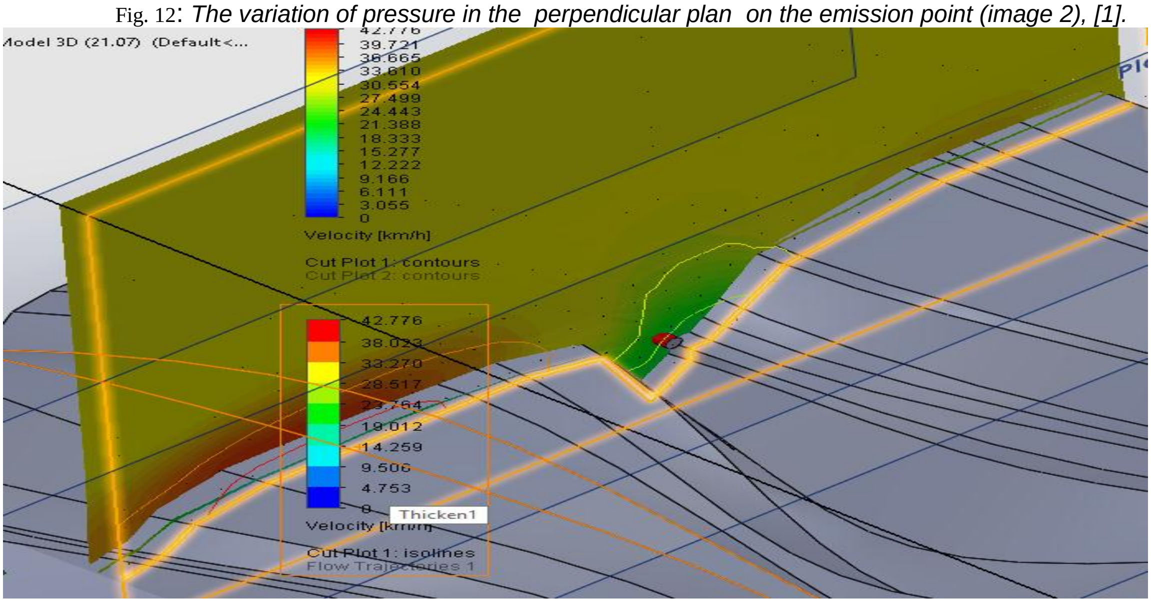

Fig. 13: *The variation of the pressure in perpendicular plan on the emission point (the second angle of view)*

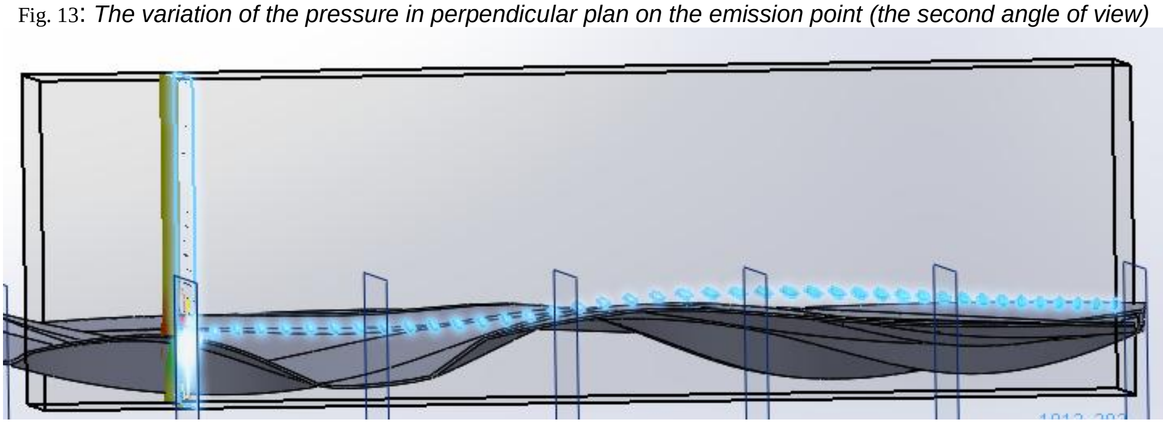

Fig. 14: *The trajectory of the gas emitted (image 1), [1].*

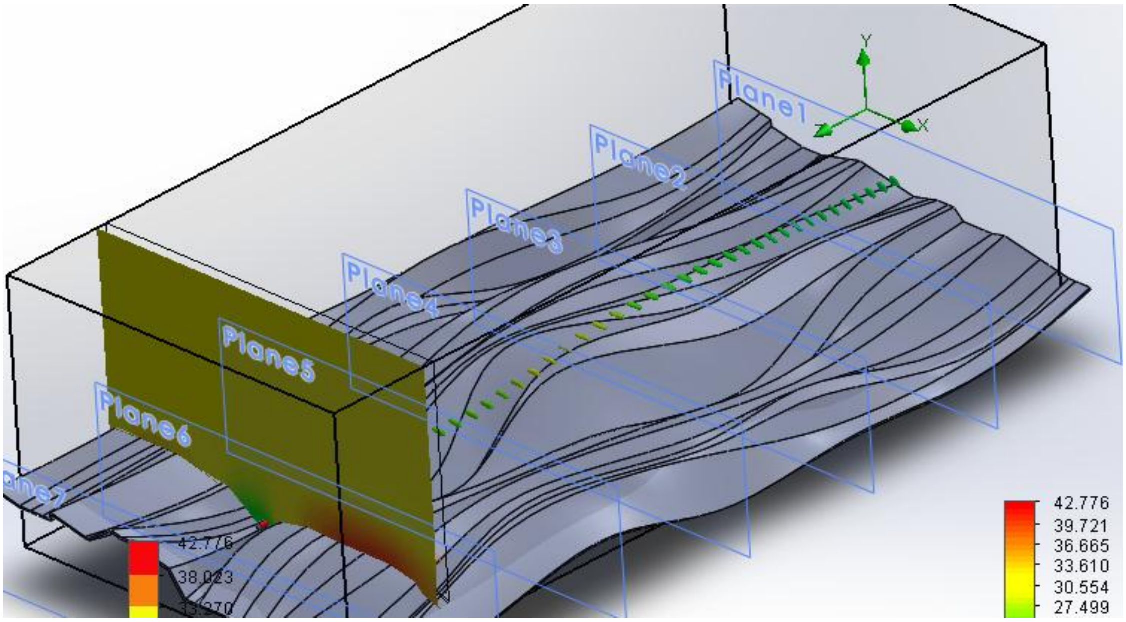

Fig. 15: *The trajectory of the gas emitted (the second angle of view), [1].*

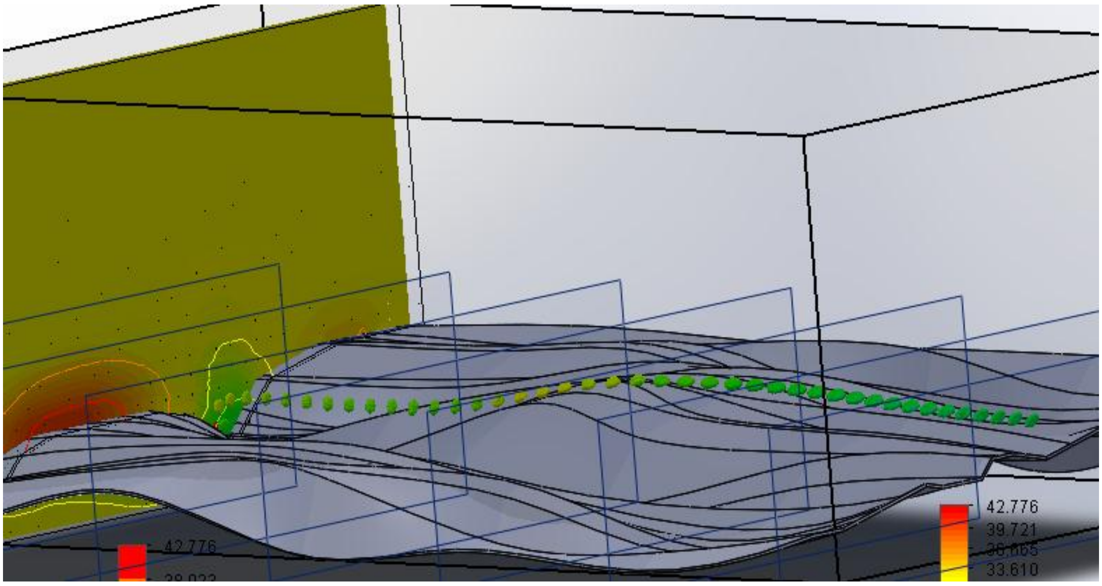

Fig. 16: *The trajectory of the gas emitted (the 3 rd angle of view), [1].*

Fig. 17: *Radioactively polluted area, in this case.*

CONCLUSIONS

As shown in Figure 17, the affected area will be around the gas dispersion path. For this area should be taken measures to prevent and mitigate the effects of disaster. Population from this area must be evacuated because the constant direction of the wind which is the same for all the time, during of the disaster. The evacuation must be made by authorities, avoiding the area indicated.

The simulations based on techniques CFD (Computational Fluid Dynamics) using the model 3D for the land are necessary for different accident scenarios. The aim of these simulations is to prevent and to decrease the intensity of the pollutants effects. It is necessary to create a special system available empowered authorities to allow rapid simulation in case of accidents.

REFERENCES

[1]. Bucur, A.-« Studii și cercetări privind monitorizarea și impactul radioactivității asupra mediului în regiunea Galați-Brăila», Lucrare de licență, Universitatea « Dunarea de Jos » din Galati, Coordonator ştiinţific: Dr.ing.ec. Papadatu Carmen, 2014;

[2]. http://apmgl.anpm.ro;

[3]. M. Hedley, H. Yan: "Segmentation of color images using spatial and color space information", Journal of Electron. Imaging, Vol. 1, pp. 374-380, 1992;

[4]. R. Q. Wu, X. R. Cheng, C. J. Yang: "Extracting contour lines from topographic maps based on cartography and graphics knowledge", Journal of Computer Science & Technology 9(2), pp. 58-64 (2009);

[5].M. Lalonde, Y Li: "Contour Line Extraction from Color Images of Scanned Maps", In Proceedings of the 9th international Conference on Image Analysis and Processing, Vol. I, Ed. Lecture Notes In Computer Science, vol. 1310, Springer-Verlag, London, pp. 111-118 (1997);

[6]. S. Spinello, P. Guitton:"Contour Lines Recognition from Scanned Topographic Maps", Journal of Winter School of Computer Graphics, Vol.12, No.1-3 (2004);

[7]. F. Dupont, M. Deseilligny, M. Gondran: "Terrain Reconstruction from Scanned Topographic Maps", Proceeding Third International Workshop Graphics Recognition, pp. 53-60 (1999);

[8]. N. Ebi, B. Lauterbach, W. Anheier:"An image- analysis system for automatic dat:-acquisition from colored scanned maps", Machine Vision and Applications, 7(3), pp. 148-164 (1994);

[9]. L. W. Kheng: "Color Spaces and Color-Difference Equations", Technical Report, Dept. of Computer Science, National University of Singapore (2002);

[10]. Y. Chen, Runsheng Wang, Jing Qian: "Extracting contour lines from common- conditioned topographic maps". Geoscience and Remote Sensing, IEEE Transactions on, 44(4), pp. 1048-1057 (2006);

[11]. A. Pezeshk, R. L. Tutwiler: "Contour Line Recognition & Extraction from Scanned Colour Maps Using Dual Quantization of the Intensity Image", Proceedings of the 2008 IEEE Southwest Symposium on Image Analysis and interpretation, pp. 173-176 (2008);

[12]. P. Arrighi, P. Soille: "From scanned topographic maps to digital elevation models", Geovision '99, International Symposium on Imaging Applications in Geology, pp. 1-4 (1999);

[13]. L. Eikvil, K. Aas, H. Koren: "Tools for interactive map conversion and vectorization", International Conference on Document Analysis and Recognition, Third International Conference on Document Analysis and Recognition, Vol. 2, pp. 927-930 (1995);

[14]. A. Soycan, M. Soycan: "*Digital Elevation Model Production from Scanned Topographic Contour MapsVia Thin Plate Spline Interpolation"*, The Arabian Journal for Science and Engineering Science, 34(1A), pp. 121-134 (2009);

[15]. D. Xin, X. Zhou, H. Zhenz: "Contour Line Extraction from Paper-based Topographic Maps", Journal of Information and Computing Science, 1(275-283) (2006);

[16]. J. Du, Y. Zhang: "Automatic extraction of contour lines from scanned topographic map", Geo-science and Remote Sensing Symposium, IGARSS '04, Proceedings, IEEE International, Vol. 5, pp. 2886-2888 (2004);

[17]. S. Shimada, K. Maruyama, A. Matsumoto and K. Hiraki: "Agent-based parallel recognition method of contour lines", In Proceedings of the Third international Conference on Document Analysis and Recognition, Vol. 1, IEEE Computer Society, Washington, DC, pp. 154 (1995);

[18]. N. Amenta, M. Bern, D. Eppstein: "The Crust and the Beta-Skeleton: Combinatorial Curve Reconstruction, Graphical models and image processing", 60(2), pp. 125-135 (1998);

[19]. J. Pouderoux, S. Spinello: "Global Contour Lines Reconstruction in Topographic Maps", In Proceedings of the Ninth international Conference on Document Analysis and Recognition, Vol. 02, ICDAR, IEEE Computer Society, Washington, DC, pp. 779-783 (2007);

[20]. https://earth.google.com