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AIR POLLUTION MAPPING IN THE WILAYA OF ANNABA (NE OF ALGERIA)

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Abstract: Poor air quality can pose severe risks to human health and can also influence negatively on the natural environment. Annaba suffers from air pollution due to the industrial activities occurring in the province including, electricity generation, waste incineration, chemistry and other small additional industrial operations. However, mining, steel industry and metallurgy are considered among the most polluting activities. The aim of our research is to assess the risks of air pollution emissions with NO_2, SO_2, Toluene and Benzene as a result of industrial enterprises activities in Annaba province. The application of geographical information system (GIS) mapping based on automatic monitoring networks of air quality, allows us the assessment of air pollution risks in the studied area. Two zones of air pollution with $N0_2$ in the level of 1 MPC has been recorded near the blast furnaces and the steel shop, the second halo of NO_2 pollution was fixed over residential infrastructures. Moreover, revealed a tendency to higher content of nitrogen dioxide in the atmosphere of the bigger part of Annaba region. Corresponding to the data obtained from stationary monitoring networks, the annual average concentration of SO_2 was significantly lower than the MPC. Based on GIS maps there are two areas with SO_2 pollution inside the territory of El Hadjar metallurgical plant. A significant increase in concentrations of NO_2 in the atmosphere of the industrial areas was recorded in the first decade. On average during three years the highest content of technogenic dust was detected in El Bouni.

Keywords: Geographical information system, atmospheric pollution, industrial activities, risk assessment, Annaba.

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INTRODUCTION

Atmospheric pollution is one of the most important problems in urban environments (Fantozzi et al., 2013, Sawidis et al., 2011). Countries with low or medium socio-economic levels are now facing a deterioration of air quality due to the disorderly multiplication of human activities, aggravated by the population explosion and the impact of technologies not always mastered. In these countries, health data highlight the emergence of chronic cardiorespiratory pathologies recognized under the influence of environmental risk factors (Nejjari et al., 2003, Atek et al., 2005).

In Algeria, it is estimated that every year 10 to 12 million inhabitants consult for acute episodes of respiratory diseases. Their direct costs are estimated at 15,000,000 USD / year, or 0.04% of GDP. It can be assumed that the number of these episodes is directly related to exposure to air pollution (RNE, 2000). This leads to a higher overall rate of collective exposure to all of the resident population in the region (Nejjari et al., 2003).

The Wilaya of Annaba suffers from air pollution due to the industrial activities occurring in the province including, electricity generation, fossil fuel combustion, waste incineration, chemistry and other small additional industrial operations. However, mining, steel industry and metallurgy are considered among the most polluting activities.

The number of residents in the Annaba region is about 600.000 inhabitants. In this regard, it is necessary to monitor air quality in Annaba in order to assess the actual degree of urban and industrial pollution and implement a policy of protection of citizens' health (Benselhoub et al., 2015a, Benselhoub et al., 2015b, Benselhoub et al., 2015c). Every day are emitted in the atmosphere of industrial cities various types of pollutants such as CO, NO_x, O_3, SO_2, and Particulate matter. As a result, all these components can cause immediate health problems due to the increased anthropogenic impact (Semadi, 2010, Tlili et al. 2007). Particular attention should be given to identify the people’s exposure to pollution risks, especially in the workplace and in their place of residence (Karnaukh et al., 2008).

The aim of our research is to assess the risks of air pollution emissions with NO_2, SO_2, toluene and benzene as a result of industrial enterprises activities in the province of Annaba.

MATERIAL AND METHODS

To provide a depth environmental audit procedures in the industrial region of Annaba at the beginning of this century were installed four automatic meteo-posts in such districts as; El Bouni, Sidi Amar, and airport "Les Salines". In recent years, some

companies have installed additional posts automatically monitor the air pollution at the site and in the workplace.

According to WHO, the MPC (Maximum Permissible Concentration) for; NO_2 is 0.03 mg/m^3, SO_2 and man-made dusts is 0.05 mg/m^3, benzene and toluene is 0,005 mg/m^3.

These measures will have a positive impact on the health of workers. The main objectives of such measures at the el Hadjar steel plant in Annaba:

- Determining the current status of smelter emissions;
- Comparison of the data with established WHO maximum permissible concentration (MPC);
- Tracking trends in the long term.

Certainly, the implementation of the above objectives will be possible to identify industrial sectors that require immediate intervention with the introduction of environmentally friendly technologies.

It is necessary to create a database to assess risks not only for human health but also for environment from various industrial activities.

Monitoring networks of air pollution have been installed directly at the factory of El Hadjar Metallurgical Complex and neighboring areas by 19 stationary networks. Measurements were carried out for all seasons 10 times per year (Abedghers et al., 2002). Networks (S1-S16) are connected to the main process (S2- S6, S 9- 10, S15) and auxiliary production facilities (power supply, waste water treatment). Posts S17 - S19 are the objects of residential infrastructures (school in Sidi Amar and village in El Hadjar).

Mean, average monthly and average data monitoring toxic substances in the air according to posts on the network SAMASAFIA (Benselhoub et al., 2015d); are compared with the maximum permissible concentration (MPC).

A geographical information system GIS map software package was used ESRI Arcmap 9.3.1, ESRI ArcCatalog 9.3.1, and SAS.Planet versions 141212.8406.

RESULTS AND DISCUSSION

The data of air pollution with NO_2 and SO_2 in El Hadjar metallurgical plant of Annaba are shown in figures 1 and 2.

Nitrogen dioxide air pollution close to 1 MPC monitoring data recorded not only in several positions located near the blast furnaces and the steel shop. Focusing clouds high concentration of NO_2 over the surrounding residential areas (Sidi Amar and El Hadjar) is of particular concern.

According to the most fixed positions of observation posts the annual average concentration of SO_2 was significantly below the MPC. However, it was found a two-fold excess of MPC in the "hot" zone of the complex (agglomeration and melting iron

ore in the blast furnace). Noting that, dioxides of nitrogen and sulfur have the effect of summation (Atek et al., 2007). The resulting total torch actually distributed over the entire industrial agglomeration, when many distributed sources are imposing some emissions take place.

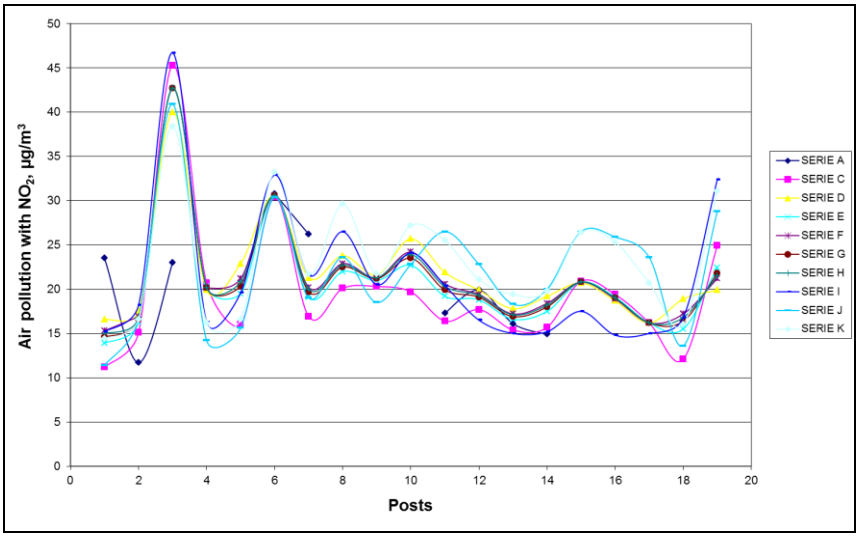

Fig 1.Air pollution with NO_2 in the metallurgical plant of El Hadjar

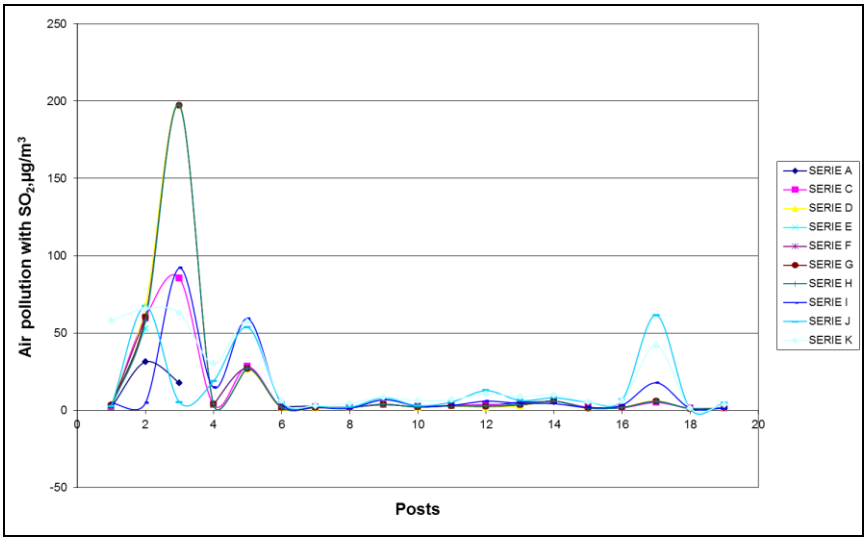

Fig 2.Air pollution with SO_2 in the metallurgical plant of El Hadjar

The GIS maps of air pollution with toluene and benzene in the area of the plant in the area of Al-Hadjar are shown in Fig 3.

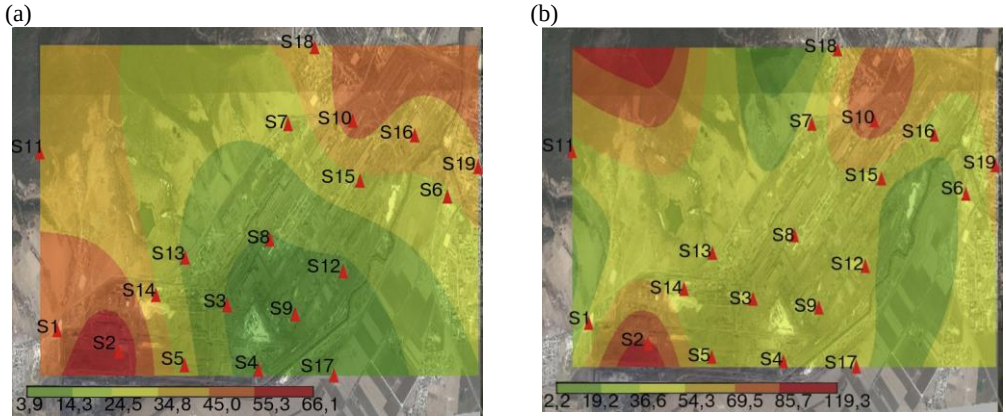

Fig. 3.GIS maps of air pollution in the area of El-Hadjar metallurgical plant;
a) with Toluene, b) with Benzene

The data of GIS mapping says about the danger of organic pollutants outside the metallurgical plant area. As a result of observations, the air pollution with NO_2 in four areas of Annaba region is shown in Fig 4.

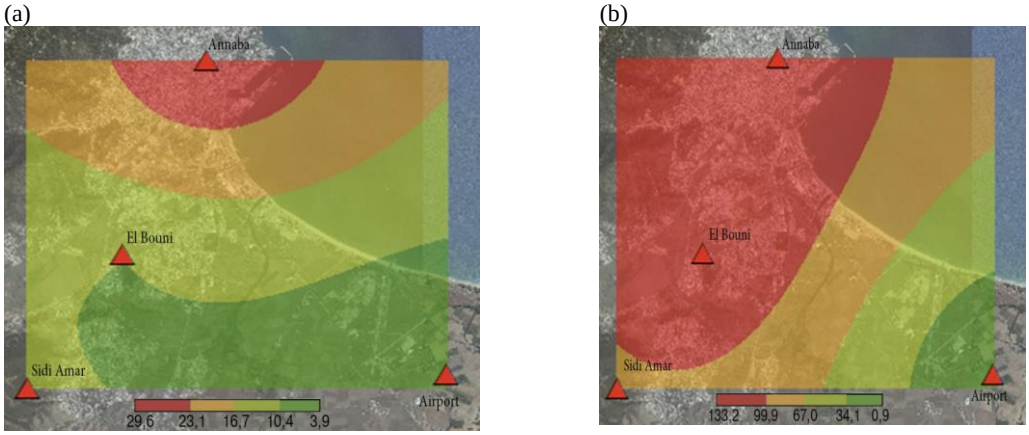

Fig. 4. Dynamic of air pollution with NO_2 in suburb districts of Annaba province for six years
a) in average for 2002-2006, b) for the year 2007

The data corresponding to the GIS maps of air pollution in residential areas of Annaba region shows that Steel Mill is not the major source of NO_2 pollution. However, at the end of the first decade was recorded a significant increase in the concentration of nitrogen dioxide in the atmosphere in the areas of Sidi Amar and El Bouni.

The GIS mapping of air pollution in the Annaba region of man-made dust for the period 2004-2007 is shown in Figure 5.

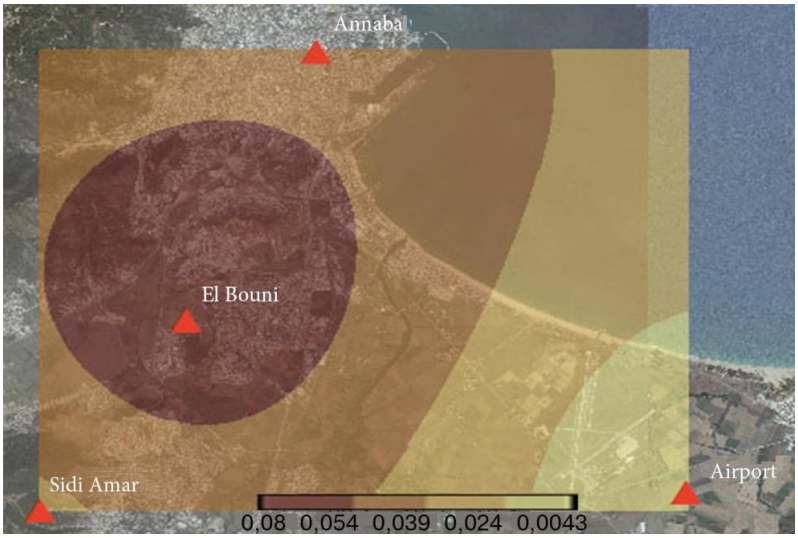

Fig. 5. GIS mapping of air pollution with technogenic dust

As it can be seen from the Fig 5, the area of El Bouni suffers from man-made air pollution with dust particles. A large part of the Annaba region is under the negative impact of stationary sources of pollution, except for the areas surrounding the airport.

CONCLUSION

According to GIS mapping the activities of the steel plant in the district of El Hadjar leads to the formation of halos of airborn technogenic pollution with NO_2, benzene and toluene, not only on-site, but also in the neighboring residential infrastructure. The trend towards a higher nitrogen dioxide content in the atmosphere of the Annaba region indicates the risk of acid rain falling not only in the city but in surrounding peri-urban areas.Further steps should be taken to establish a sufficient number of air pollution monitoring networks to reduce the risks of environmental degradation.

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