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PROCEEDINGS

International Symposium on GeoInformatics for Spatial-Infrastructure Development in Earth and Allied Sciences

Hanoi, Vietnam, 4-6 December 2008

Conference Founders: Nghiem Vu Khai & Takashi Fujita

Conference Chairs: Tran Dinh Kien & Mamoru Shibayama

Editors: Venkatesh Raghavan, Nguyen Quang Luat, Truong Xuan Luan & Ho Dinh Duan

Japan-Vietnam Geoinformatics Consortium (JVGC)

Hanoi University of Mining and Geology (HUMG)

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APPLICATION OF GIS AND DISPERSION MODEL FOR AIR QUALITY EVALUATING FOR INDUSTRIAL ACTIVITIES IN THI VAI BASIN

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ABSTRACT

The Thi Vai river basin is in the Southern key economic region. The industrial growth speed of the surrounding area of Thi Vai river, together with the common development tendency of the region, is very fast. More and more industrial Zones are established along the basin. These bring about bad effects to the air quality here. Therefore, the assessment of air quality due to the industrial activities at the basin is very important. On the other hand, it is not easy to manage and control the air pollution problem because of its space unlimitedness in the atmosphere. For this reason, it is necessary to have an air quality model based on the modern information tool to support the management and control of air pollution.

Furthermore, the software of air pollution control, ENVIMAP, is designed by authors of this paper step by step is applied widely in Vietnam. The lastest version in 2008 for area source applied GIS enables the users to calculate the polluted emission from the area source which has non – point emission sources and is dispersed from the Industrial Zones. It will calculate automatically emissive parameters by adding input data that is quantity of fuel and retention period. As a result, the users have conception and preliminary assessment of air quantity through a model of air quantity given by ENVIMAP.

In the paper, the authors used ENVIMAP technology to set up the databases and serve in the air pollution monitoring and management. This software is also used to forecast the air quality due to industrial activities from the Industrial Zones which are the research subject.

1. INTRODUCTION

The Thi Vai river basin is in the Southern key economic region, emanates from Long Thanh district (Dong Nai province) – to Vung Tau city (Ba Ria Vung Tau province) and then flows into Ganh Rai bay. According to the planning of the Southern key economic region, the annual average of economic growth rate is 15% in 2010. Therein, the industrial growth rate attain 20 – 30%/year. Therefore, the industrial zones grow more and more at the Thi Vai river basin. The industry takes an important part in the growth of the economy. However, in the recent years, the environmental equality of the Thi Vai river basin is taking a complex turn. All of the problems such as the deverloping resources, the continuos growth of the industrial production and handicraft, the rapid rate of the municipalization, the density of the population, the considerable superaddition of means of transport... are the reasons of the exhaustion of resources and the environment polution, especially, the air polution due to the activity of the industrial production. Therefore, the accessment of the air quality at the Thi Vai river basin is the object research of the national and local research programs in many years.

In the recent years, in order to control the air quality in the basin objectively and scientifically, there have been many periodic mornitoring programs carried out. DONRE of

Ba Ria – Vung Tau and Dong Nai have moritored the air quality since 2004. However, there has not had an effective tool to control the air quality yet, such as:

- The periodic mornitoring data aren't managed systematically.
- Haven't had the reliable model of the pollution scatter to replace gradually the costly and effectless measure.
- Not apply GIS to display the mornitoring result as well as the calculation of model.

Therefore, researching into the mathematics - information model to control the air quality in the zones at The Thi Vai river basin is necessary. The goals of this model are:

- Gradually create data bank that has concern with the investigation of the mornitoring air positions at The Thi Vai river basin.
- Prepare the input data to access the air pollution according to the productional projects of this Industrial Zones.
- Help the managers to control the air polluted by dust and other toxic agents so that their concentrations dont't exceed the Vietnamese Environment Standard (VES).

The following section shows some initial results of applying ENVIMAP software to control the air quality at The Thi Vai river basin. This software is founded on the application of GIS technology, the database technology and the model of the air pollution scatter.

2. METHODOLOGY AND RESULT

The air pollution models are the mathematical displays of the access of the extraneous matter scatter, the chemiscal reactions, the emission rate, the specific emission of industrial sources and the meteorological data to forcast the concentration of the pollutant.

The studies during 70 years about this field show that to model the air pollution scatter exactly, modeling the meteorological parameters are necessary. Besides, it's important to note the element that concern with the character of the pollutants: the warm of the eshauted mater, the transformation from chemistrial reactions.

Before now, the studies of applying the model of the air pollution scatter primarily foccus model for point sources. In Viet Nam, two kinds of the point sources model used the most widely are Gaussian and Berlyand /[1]-[8]/.

Nowadays, there are many sources that are the same kind and dispose in regular area of some cities, industrial zones or inhabitations. It's difficult to define the emission data of each source, but we can define apporoximately the total of the emission quantity through the indirect data such as total of production, total of the used fuel .... In this case, it's necessary to build the method to assess the scatter of pollutants from such sources. The experiences of the world show that it's necessary to examine area source.

There are two vicinity methods to build model for area source. Project [7][8] express model ISC3 for area source in long term as well as short term. Short term is calcutating average in 1 hour. In the context of Viet Nam, to have the suitability between ISC3 and meteorological data monitored 4 obs/day: 1, 7, 13 and 19 o'clock, the dispersion parameters σ_y, σ_z need transforming the average coefficient in 6 hours. The transformative formula is shown in [7]. The examined area is splitted into squares that have Δx from 500 m to 10 000 m. (i,j) is the symbol of row i^{th} and colunm j^{th} of the cell (number: the headmost row is the first row, the first left colunm is the first colunm).

Basing on the input parameter, using specialist method to calculate the next parameters, they are: emission rate and emission quantity of each pollutant. The main idea of area source model: the area source is reduced to the supposed "stack" by spliting that area into small squares. Thence, define quantity M and rate V_{new} of each supposed "stack". Diameter of

supposed "stack" has the same size as small squares, H is mixing height, ΔT is the difference between stack gas and ambient temperature, chosing the average value, emission velocity is 1.

Software ENVIMAP, version 1.0 (ENVironmental Information Management and Air Pollution estimation) in 2003 was based on upgrading and modifying software CAP 2.5 by the group of Emvironment and Resources Institude. Software 1.0 was upgraded into the new version 2.0 in 11/2005. Version 3.0 of ENVIMAP was formed in 9/2006. Since 1/2008, ENVIMAP has had version in year and been upgraded regularly /source [2][3]/. Area source version of ENVIMAP was formed in 6/2008.

To imitate the research area exactly, the authors use the satellite image from website www.earth.google.com by taking a photograph of the Thi Vai river basin that contains the industrial zones researched with suitable dimention. 4 known co-ordinate points of the photograph scanned from www.earth.google.com are used as controling points. The co-ordinates of 4 points are: 10°46'12.01"N, 106°52'47.97"E; 10°46'11.59"N, 107°6'18.74"E; 10°30'35.27"N, 106°52'47.88"E; 10°30'35.67"N, 107°6'18.49"E.

The co-ordinates of the industrial zones and the sensitive points are defined in degree, minute, second by GPS; those co-ordinates are changed into decimal degree. Thence, the co-ordinates of those points are changed into meter by Mapinfo.

The co-ordinates of those points (meter) are intergrated in the information of software ENVIMAP 2008. Thence, the positions of those points are shown on map exactly. That is necessary for imitating the propagation of the pollutants from sources as well as calculating the concentration of the pollutant at the sensitive points.

The information of the sources, quantity of fuel of the industrial zones that belong to the research area are collected by defining the co-ordinate at the industrial zones in reality; fuel quantity data are supplied by DONRE of Dong Nai province.

The results are compared to VES 5937 – 2005 and expressed in charts as the figures 1 – 4.

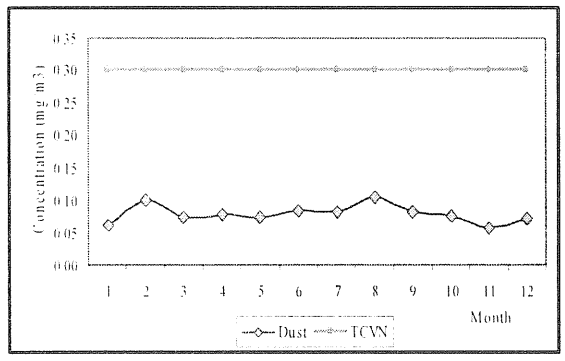

Figure1. The maximum of average concentration dust every month in 2007 compared to VES

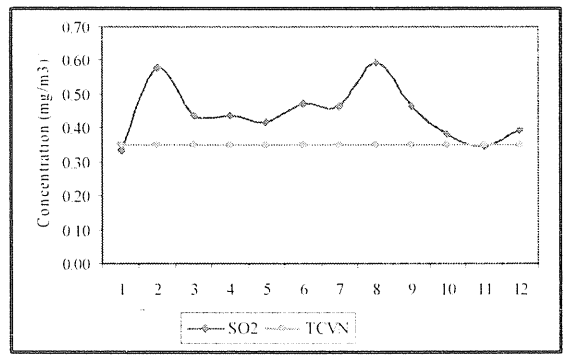

Figure 2. The maximum of average concentration SO_2 every month in 2007 compared to VES

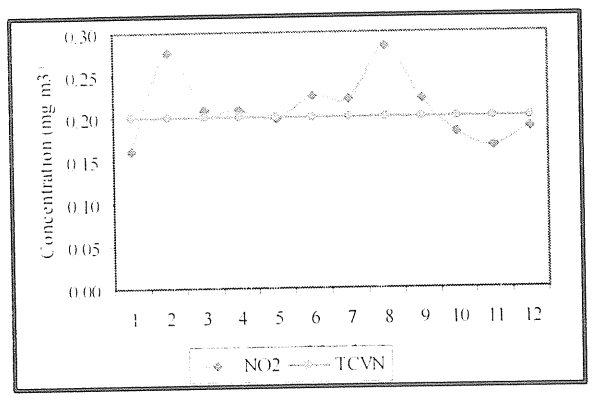

Figure 3. The maximum of average concentration NO_2 every month in 2007 compared to VES

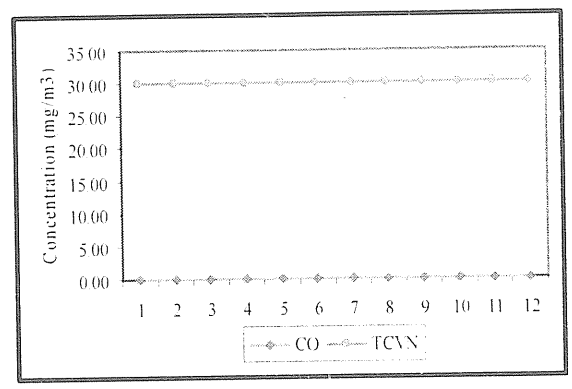

Figure 4. The maximum of average concentration CO every month in 2007 compared to VES

The concentrations of CO and Dust in 2007 are lower than VES 5937-2005.

February, june, august and september in 2007, average concentrations NO_2 are high and exceed TCVN 5937-2005. The average concentrations NO_2 in February and August are the highest value. They exceed VES 5937-2005 1.4 times.

According to the results, can see: for every month in 2007, average concentrations SO_2 are high. Almost them exceed VES 5937-2005. Especially, concentrations SO_2 in February and August exceed VES 5937-2005 twice.

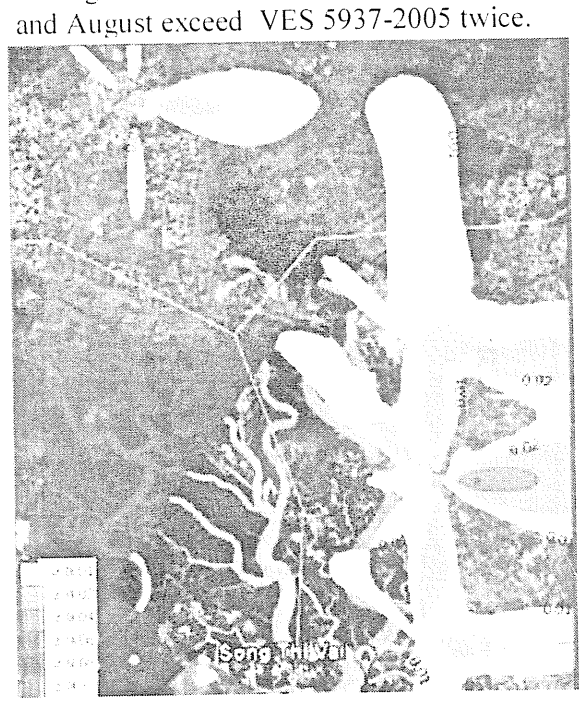

Figure 5. The average concentration of dust in 1/2007

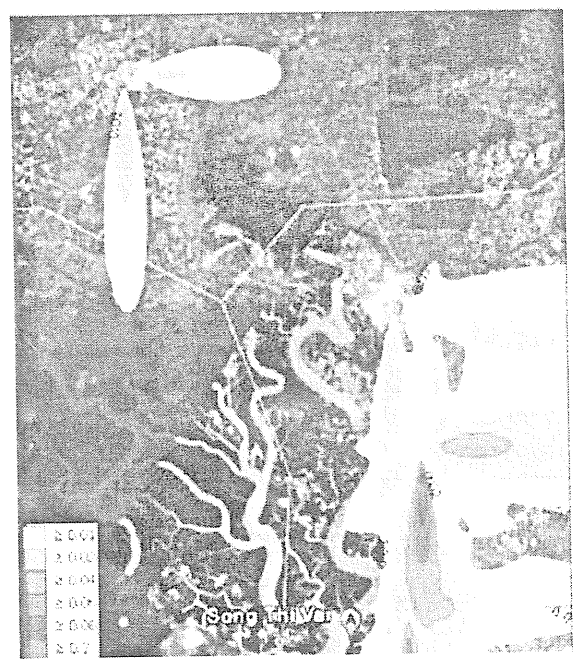

Figure 6. The average concentration of dust in 2/2007

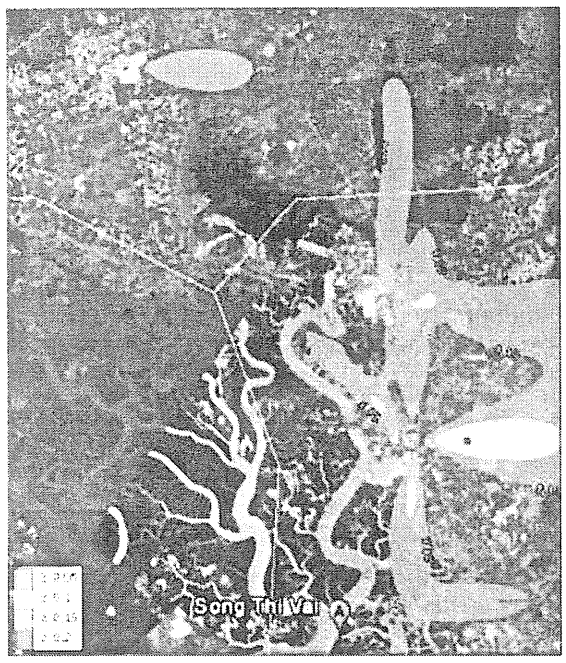

Figure 7. The average concentration of NO_2 in 1/2007

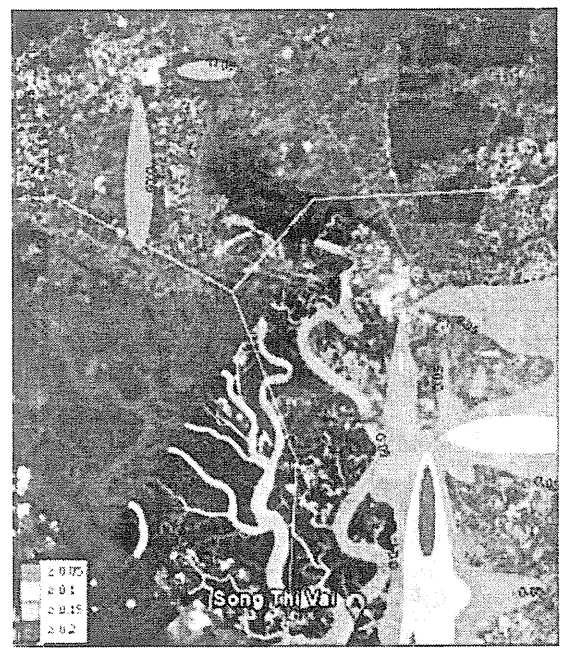

Figure 8. The average concentration of NO_2 in 2/2007

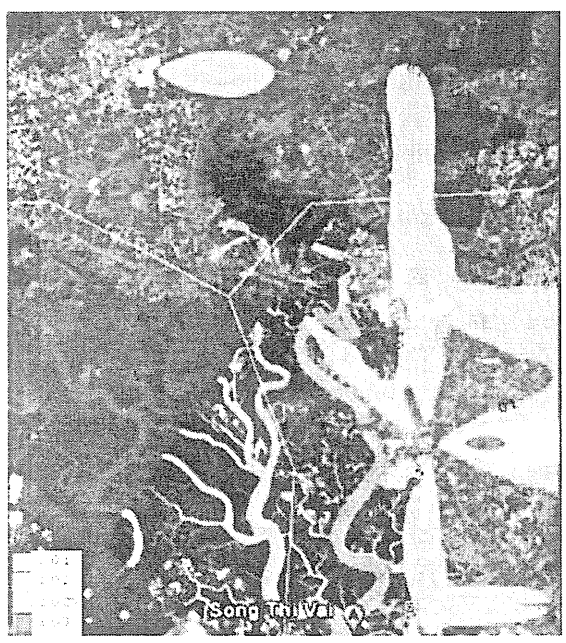

Figure 9. The average concentration of SO_2 in 1/2007

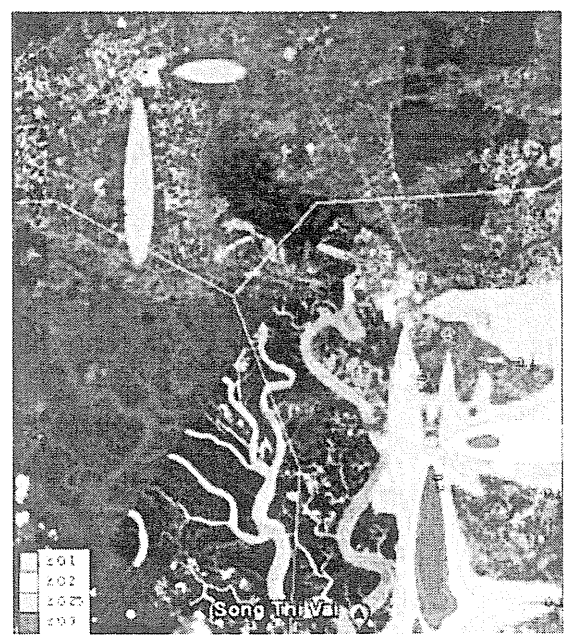

Figure 10. The average concentration of SO_2 in 2/2007

3. CONCLUSIONS

This paper declares the integrated model supporting us in managing and controling the air quality effected by the area sources, the Thi Vai river basin is an example of this study. The main results of this paper are:

- Integrate area source model for air dispersion, GIS data and the environmental databases, that becomes a tool to support in calculating air pollution (software ENVIMAP).
- Apply software ENVIMAP to simulate the air quality effected by the economic activities at the Thi Vai river basin.

The authors hope that we would receive the specialist's opinion to apply the studied product in reality to replace the expensive mesures.

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